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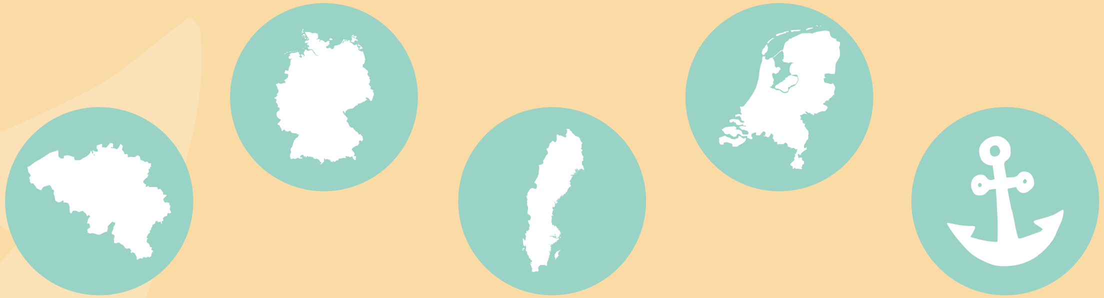
ANCHOR Blackwater



3rd Anchor Lunch Talk

September 23rd 2024

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provincie Oost-Vlaanderen

vito

DuCoop

HAMBURG WASSER

Bauhaus-Universität Weimar

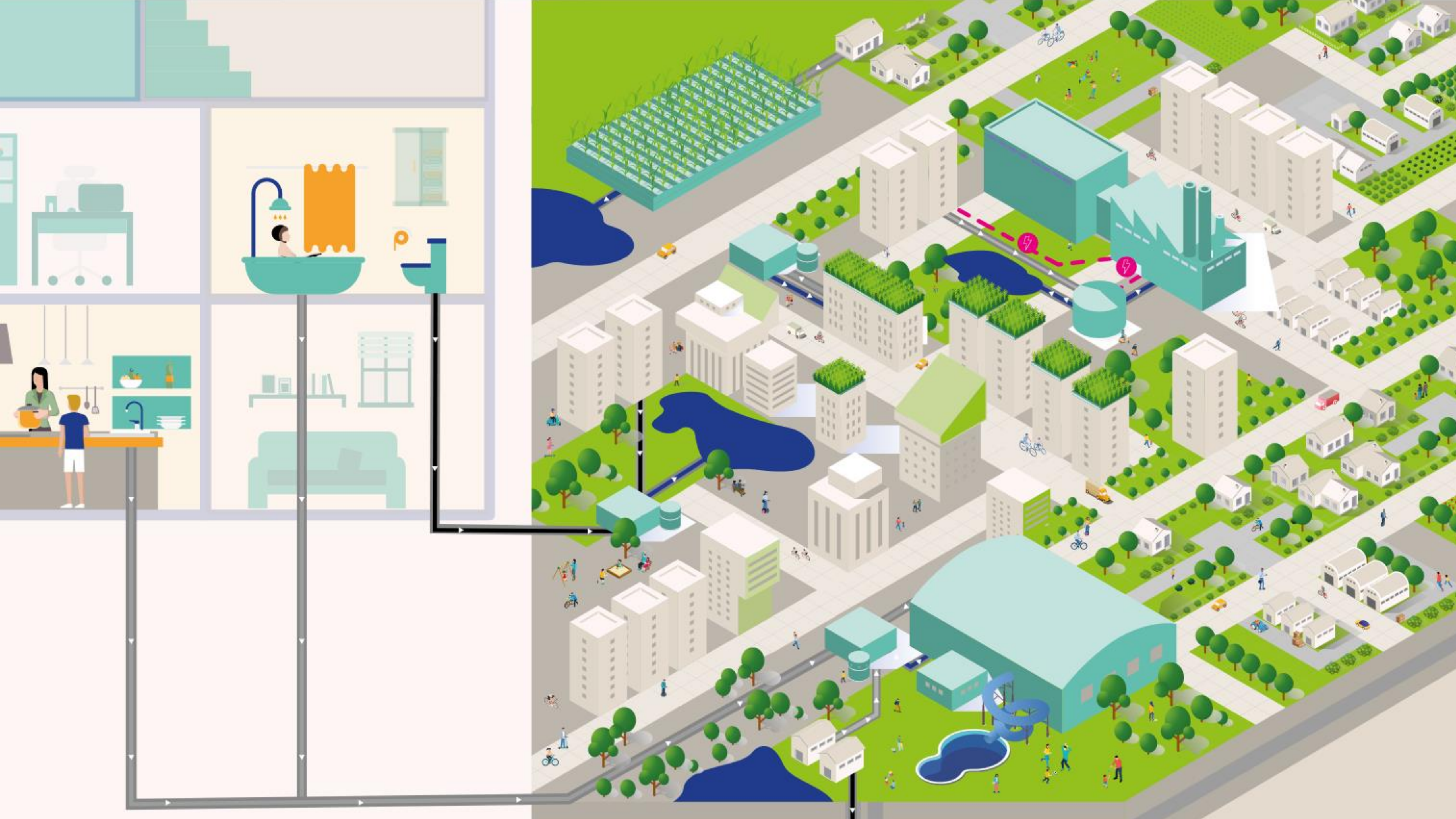
waternet
waterschap amstel gooi en vecht
gemeente amsterdam

KWR

Stockholms stad

NSVA
NORDVÄSTRA SKÅNES VATTEN OCH AVLOPP

Let’s fuel the transition towards **water wise neighbourhoods**



HOW?

- By gathering experiences from a **unique EU demo network** in Belgium, the Netherlands, Germany and Sweden with **source separation technology**, and expanding it with **new pilots**
- By mapping the impacts of **decentralized water systems** in urban areas
- By closely **engaging with stakeholders**
- By delivering **practical tools and transition knowledge**

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WHO?

vito

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Anchor Lunch Talks

AGENDA

- Why should one collect blackwater separately from greywater? (Prof. Jörg Londong)
- How do we treat blackwater for resource recovery (Hamse Kjerstadius)
- Where is the economy in source-separating wastewater systems? (Dries Seuntjens)
- Discussion

Why should one collect blackwater separately from greywater?

Prof. Dr.-Ing. Jörg Londong

Bauhaus-Institute for Infrastructure Solutions (b.is)

5 Take home messages

- Blackwater is wastewater from toilets. It contains urine, faeces and flush water.
- Blackwater contains valuables:
  - Nutrients such as nitrogen and phosphorus
  - Energy in form of organic matter
- Blackwater contains hazardous matter:
  - Pathogens such as bacteria, viruses, and parasites
  - Antibiotic resistant bacteria and genes
  - Chemicals and pharmaceuticals
- The conventional system of urban drainage does not have sufficient barriers against emission of hazardous matter.
- Source separation can provide barriers, energy and nutrient recovery.

TUHH
Technische Universität Hamburg-Harburg

Volume stream		Grey water 25,000 – 100,000 l/(p*a)	Urine ~ 500 l/(p*a)	Faeces ~ 50 l/(p*a)
N	~ 4-5 kg/(p*a)	~ 3 %	~ 87 %	~ 10 %
P	~ 0,75 kg/(p*a)	~ 10 %	~50 %	~ 40 %
K	~ 1,8 kg/(p*a)	~ 34 %	~ 54 %	~ 12 %
COD	~ 30 kg/(p*a)	~ 41 %	~ 12 %	~ 47 %

Based on:
Niederste-Hollenberg, J., Otterpohl, R. (2000). Innovative Entwässerungskonzepte, wwt wasserwirtschaft wassertechnik, S.23, Heft 2

Volume stream		Grey water 25,000 – 100,000 l/(p*a)	Urine ~ 500 l/(p*a)	Fa… ~ 50
N	~ 4-5 kg/(p*a)		~	
P	~ 0,75 kg/(p*a)			
K	~ 1,8 kg/(p*a)	~ 34 %		
COD	~ 30 kg/(p*a)	~ 41 %	%	

water

nutrients

Pathogens and Antibiotic Resistance

Based on:

Niederste-Hollenberg, J., Otterpohl, R. (2000). Innovative Entwässerungskonzepte, wwt wasserwirtschaft wassertechnik, S.23, Heft 2

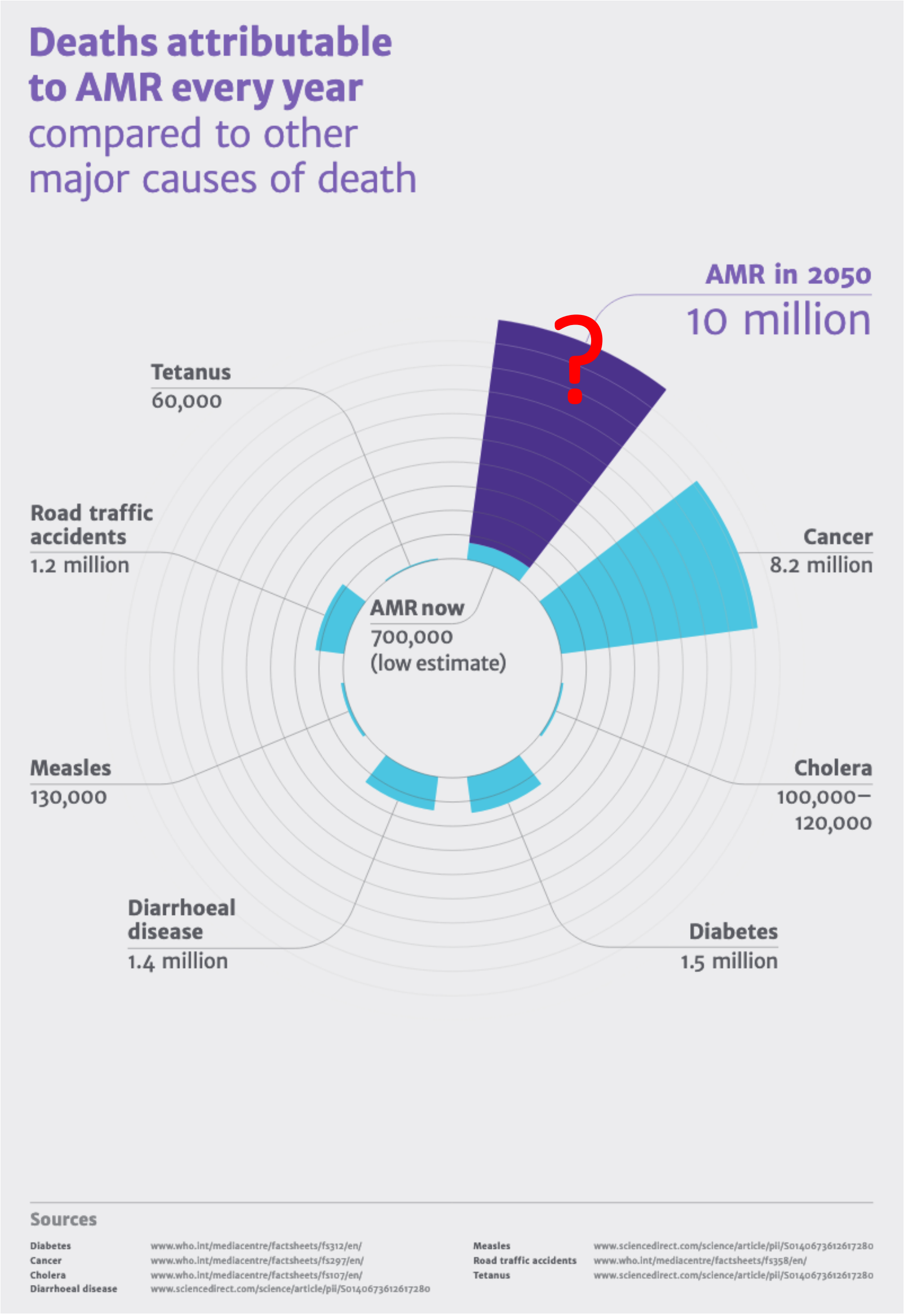
Review on Antimicrobial Resistance

Tackling drug-resistant infections globally

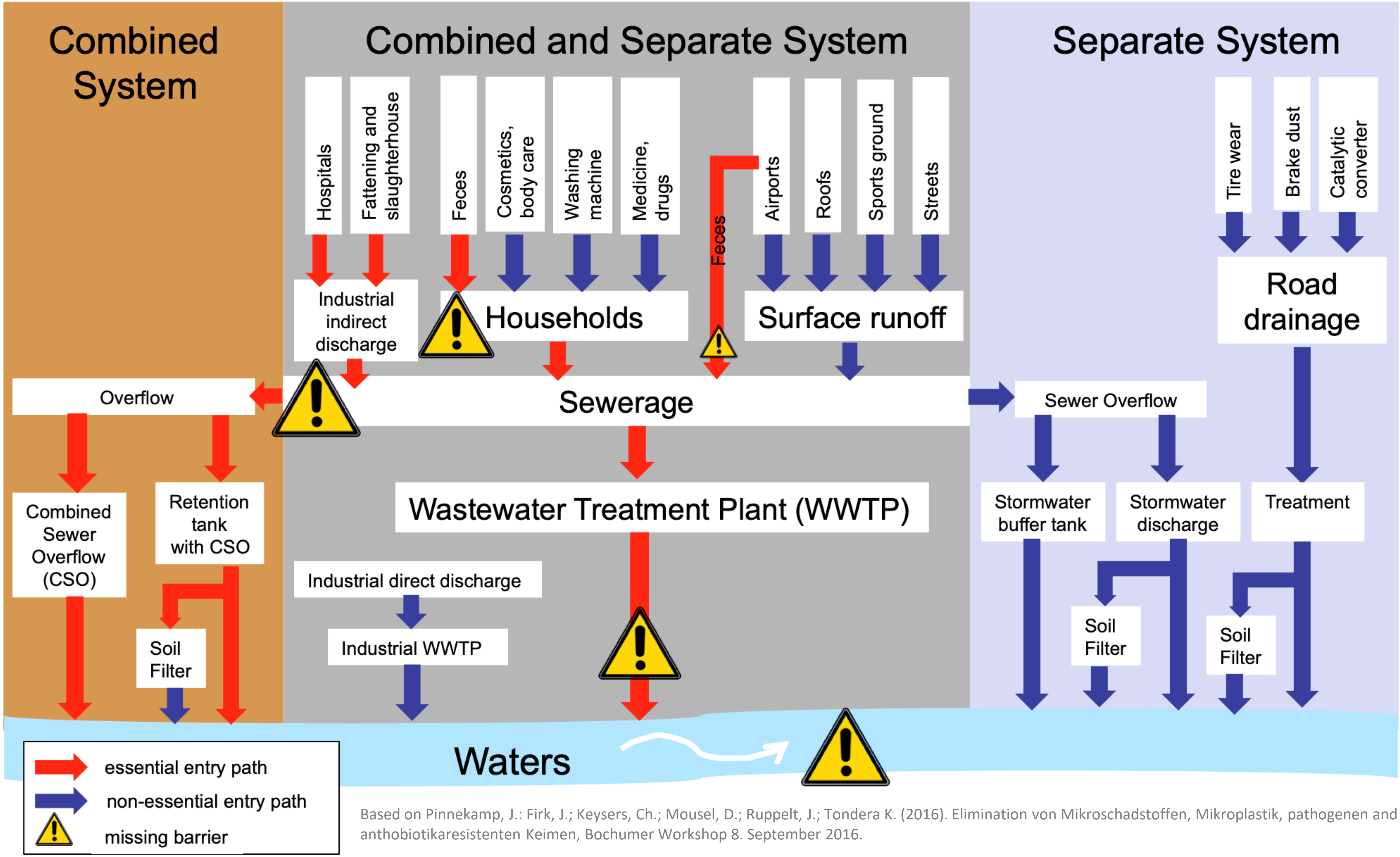
Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations

The Review on Antimicrobial Resistance
Chaired by Jim O'Neill
December 2014

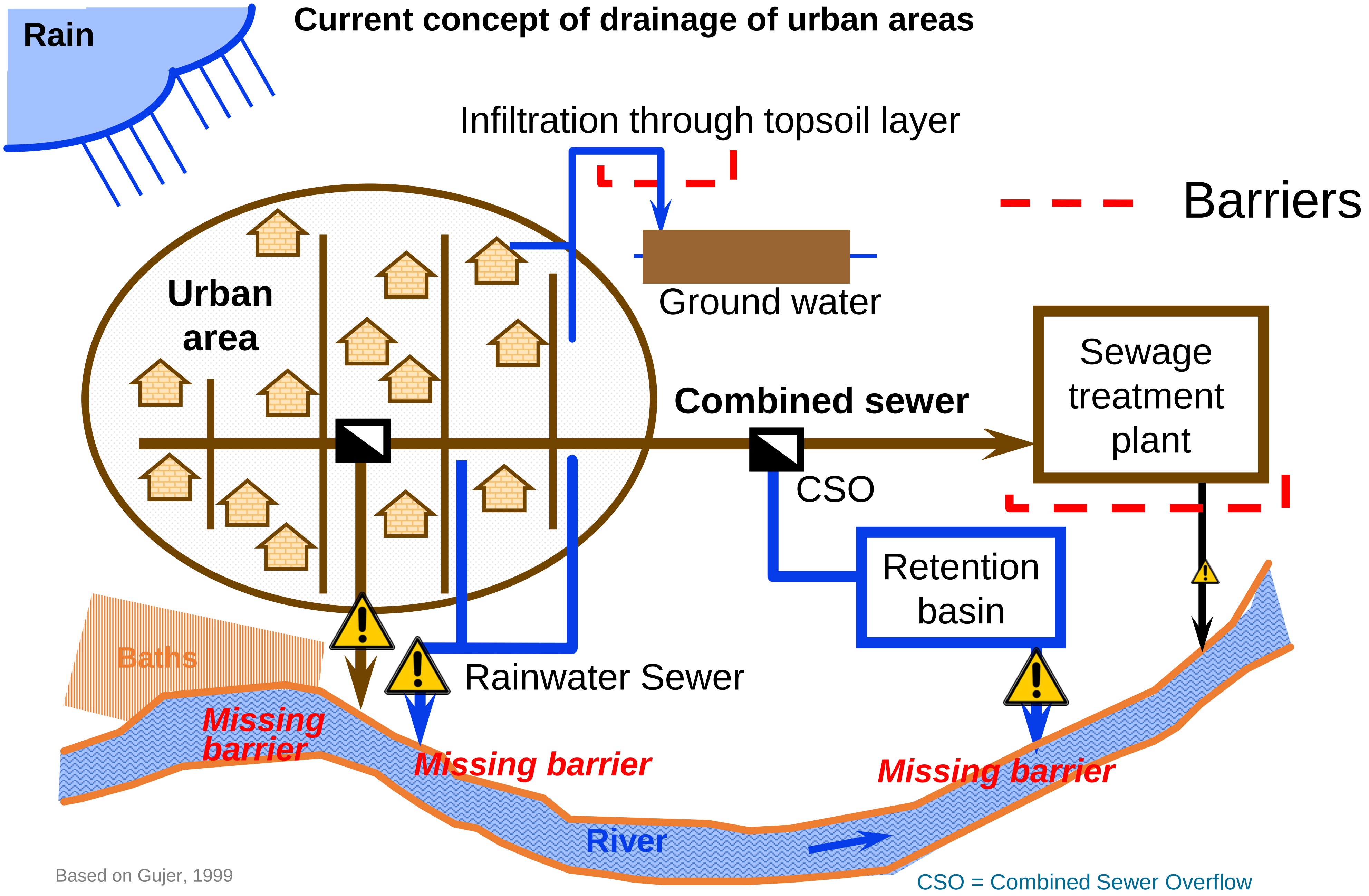
Source: https://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf



Relevant entry paths for antibiotic resistance

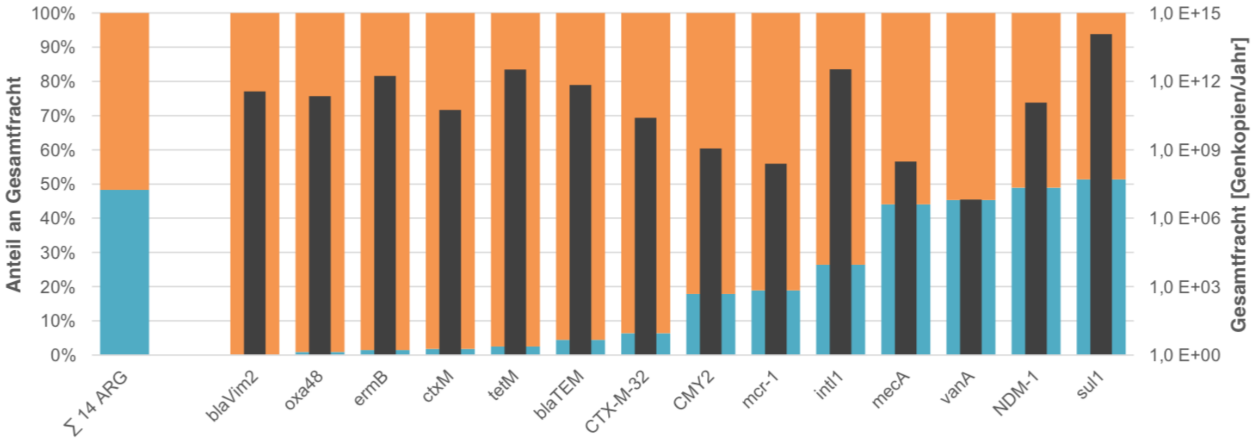


Based on Pinnekamp, J.: Firk, J.; Keysers, Ch.; Mousel, D.; Ruppelt, J.; Tondera K. (2016). Elimination von Mikroschadstoffen, Mikroplastik, pathogenen and anthobiotikaresistenten Keimen, Bochumer Workshop 8. September 2016.

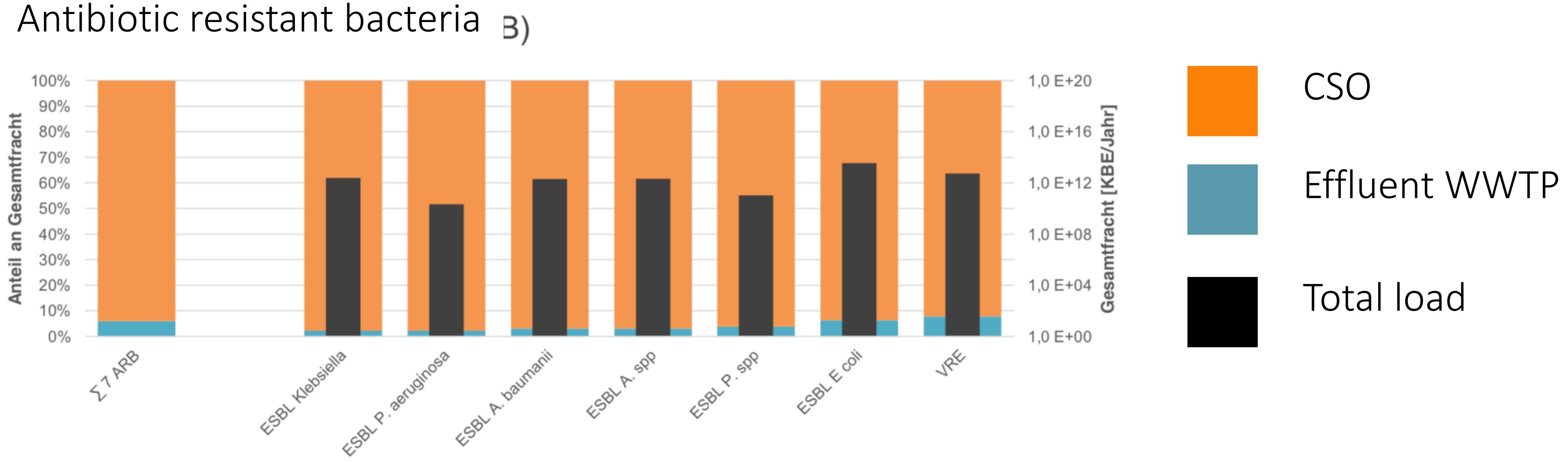


Rain
Current concept of drainage of urban areas
Infiltration through topsoil layer
Barriers
Urban area
Ground water
Sewage treatment plant
Combined sewer
CSO
Retention basin
Baths
Rainwater Sewer
Missing barrier
Missing barrier
Missing barrier
River
Based on Gujer, 1999
CSO = Combined Sewer Overflow

Antibiotic resistance genes

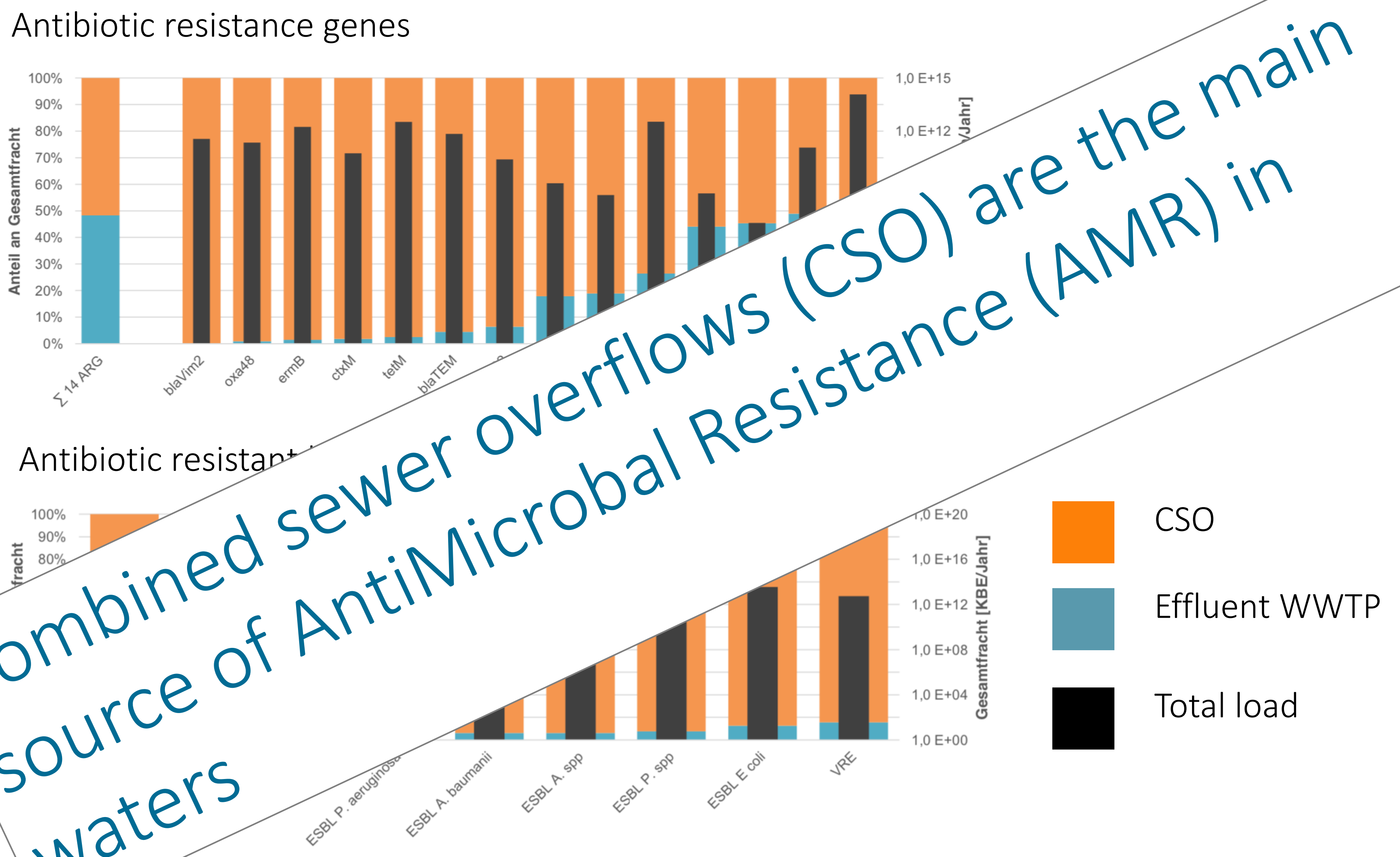


Antibiotic resistant bacteria

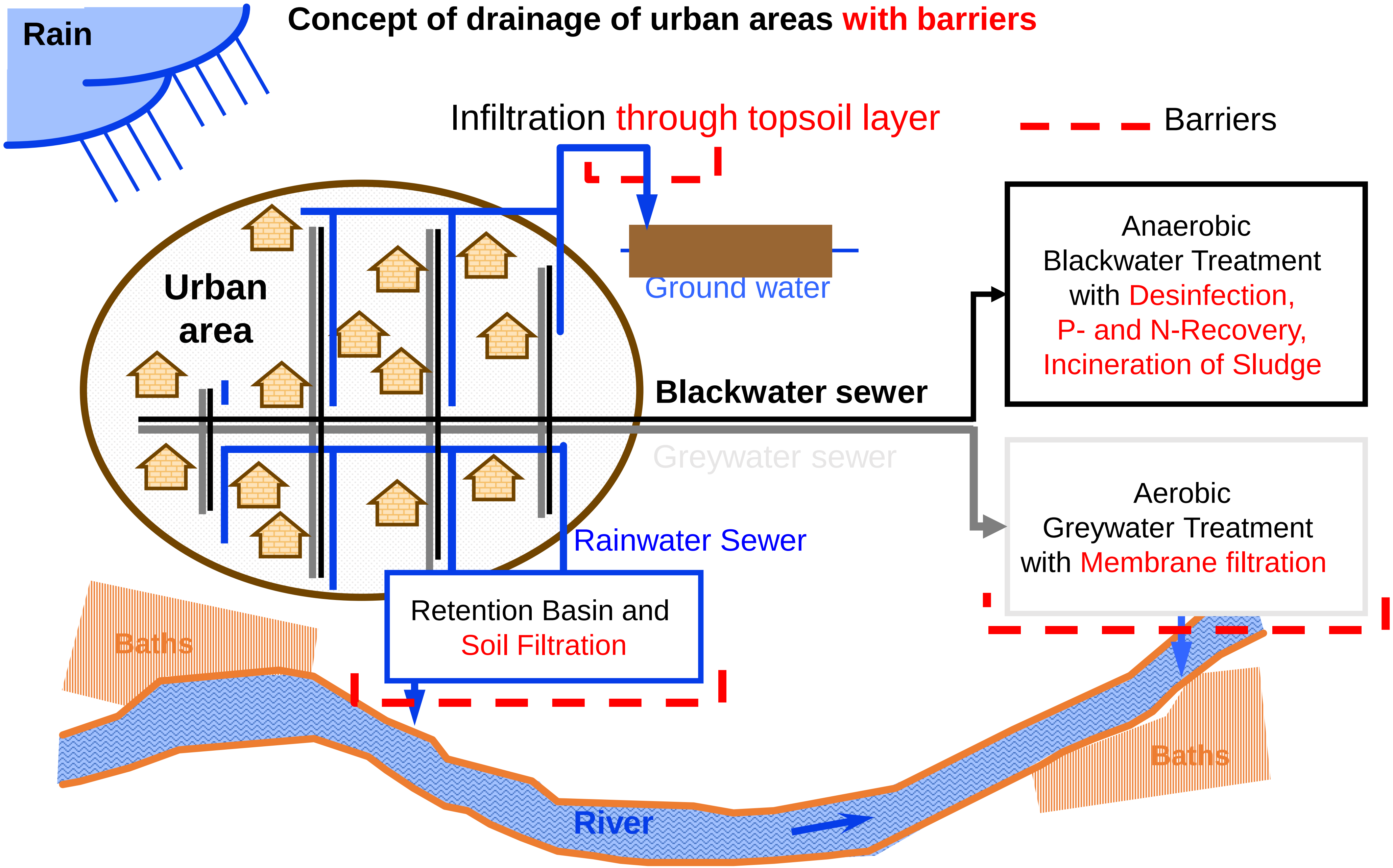


Source: Pinnekamp, J.; Firk, J.; Schleiffer, P. (2019) Bewertung der urbanen Gewässereinträge und Möglichkeiten der Eintragsminderung, Abschlussveranstaltung des BMBF-Forschungsvorhabens zu Antibiotikaresistenzen im Wasserkreislauf (HyReKA), April 2019 (http://www.hyreka.net/uploads/2019_5_Präsentationen%20HyReKA-Abschluss_Homepage.zip)

Combined sewer overflows (CSO) are the main source of AntiMicrobal Resistance (AMR) in waters



Source: ...amp, J.; Firk, J.; Schleiffer, P. (2019) Bewertung der urbanen Gewässereinträge und Möglichkeiten der Eintragsminderung, Abschlussveranstaltung des BMBF-Forschungsvorhabens zu Antibiotikaresistenzen im Wasserkreislauf (HyReKA), April 2019 (http://www.hyreka.net/uploads/2019_5_Präsentationen%20HyReKA-Abschluss_Homepage.zip)


Rain
Concept of drainage of urban areas with barriers
Infiltration through topsoil layer
Barriers
Ground water
Urban area
Anaerobic Blackwater Treatment with Desinfection, P- and N-Recovery, Incineration of Sludge
Blackwater sewer
Greywater sewer
Aerobic Greywater Treatment with Membrane filtration
Rainwater Sewer
Retention Basin and Soil Filtration
Baths
River
Baths

End of my presentation

How do we treat blackwater for resource recovery

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Hamse Kjerstadius, NSVA
HELSINGBORG - SWEDEN

NSVA
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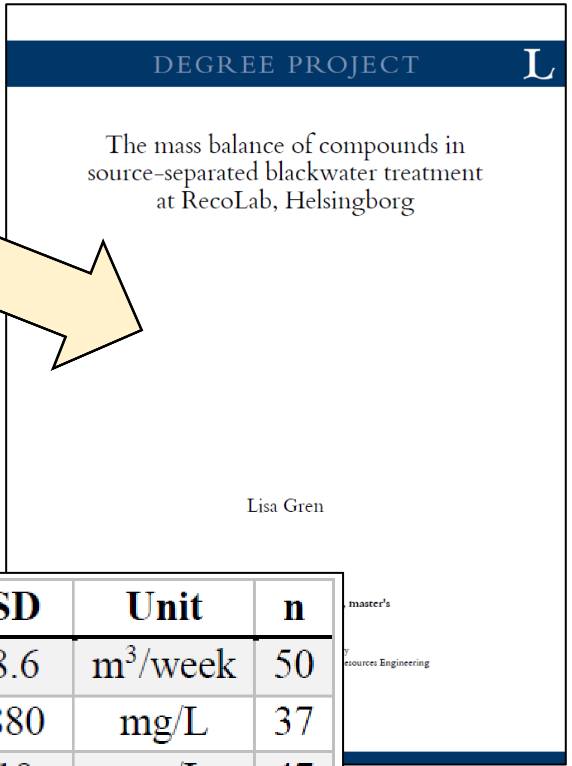
Hamse.kjerstadius@nsva.se

Blackwater – a smooth wastewater! Massbalance for 2023 in Helsingborg


DEGREE PROJECT

The mass balance of compounds in source-separated blackwater treatment at RecoLab, Helsingborg

Lisa Gren

Even flow rate all weeks of the year

Blackwater flow rates in Helsingborg were 64 ± 9 m3 per week, which gives 13% standard deviation.
This is even with a large commercial area connected + a hotel.

Stable concentrations

Around 8 700 mgCOD/L, 120 mgP/L and 1300 mgN/L.

Concentrations are stable for Total solids (22% STDEV), phosphorus, nitrogen and COD (<20% STDEV).

Parameter	Mean	SD	Unit	n
Flow	64	8.6	m^3/week	50
TS	4 108	880	mg/L	37
TP	123	19	mg/L	47
TN	1311	112	mg/L	90
COD	8757	1526	mg/L	47
Cd	1.0	0.11	µg/L	11
Cu	174	28	µg/L	11
Ni	38	9.5	µg/L	11
Pb	2.3	0.32	µg/L	11
Zn	1175	130	µg/L	11
Hg	0.14	0.12	µg/L	11
Cr	31	12	µg/L	11

Clean stuff

The influent BW has a cadmium to phosphorus ratio of 8 mg Cd/kg P. (normal sewage sludge 20-25 mg Cd/kg P).

NB! High Zink and Cu concentrations likely due to wear of metal parts in process equipment (sinking concentration trend seen in struvite).

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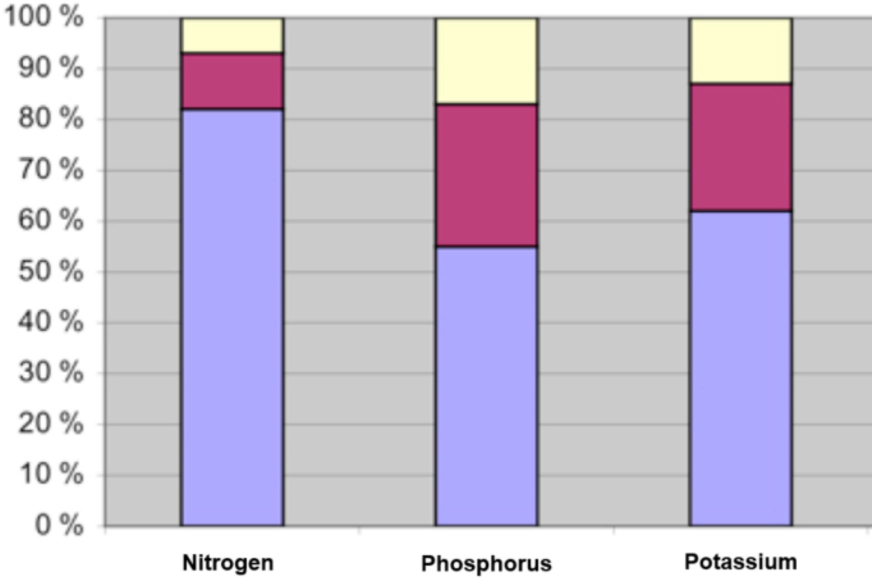
Blackwater treatment chain

Anaerobic digestion as core process

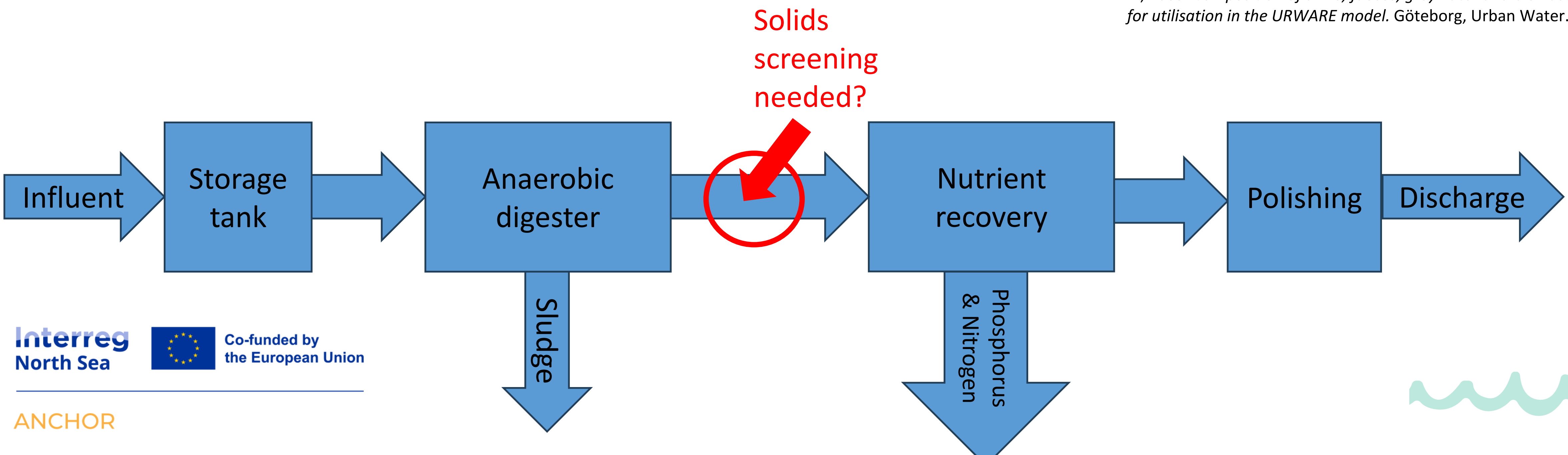
The concentration of COD in the blackwater is high enough for immediate anaerobic digestion…. Beneficial for increased recovery of primary energy as methane.

Digestate liquid with reasonable concentration of nutrients

With concentrations of approx. 120 mg P-tot/L and 1 200 mg N-tot/L the digestated blackwater has a composition similar to reject water at normal WWTPs. But much more of the macro and micro-nutrients are found in the blackwater*!



* Jönsson, H., Baky, A., Jeppson, U., Hellström, D. and Kärrman, E., 2005. *Composition of urine, faeces, greywater and biowaste for utilisation in the URWARE model.* Göteborg, Urban Water.



Suitable for anaerobic digestion

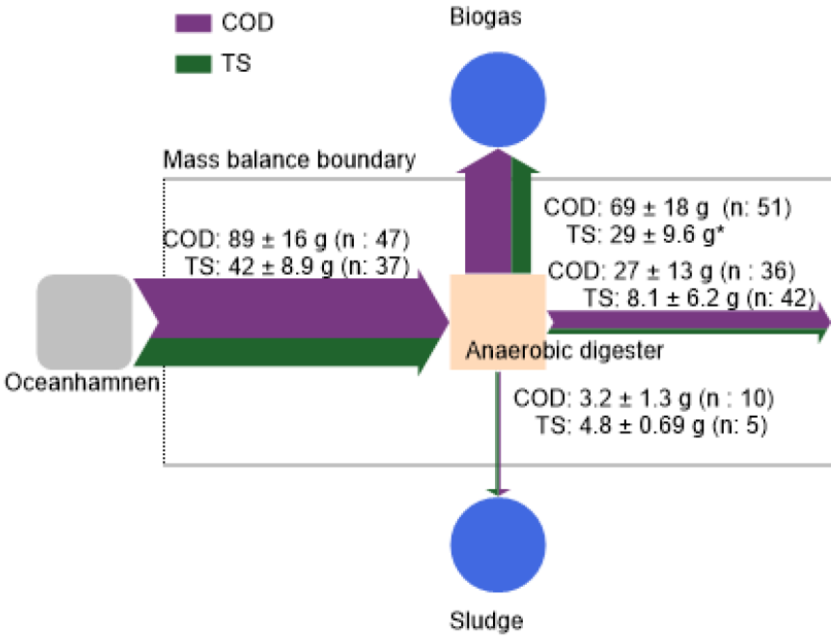
More organic material converted to methane

The concentration of COD in the blackwater is high enough for immediate anaerobic digestion…. if you use sludge separation systems like UASB!

- Approx. 3m^3 biogas per m^3 blackwater.
- 22 NL CH_4/pe/day → 65% more biogas per connected person*

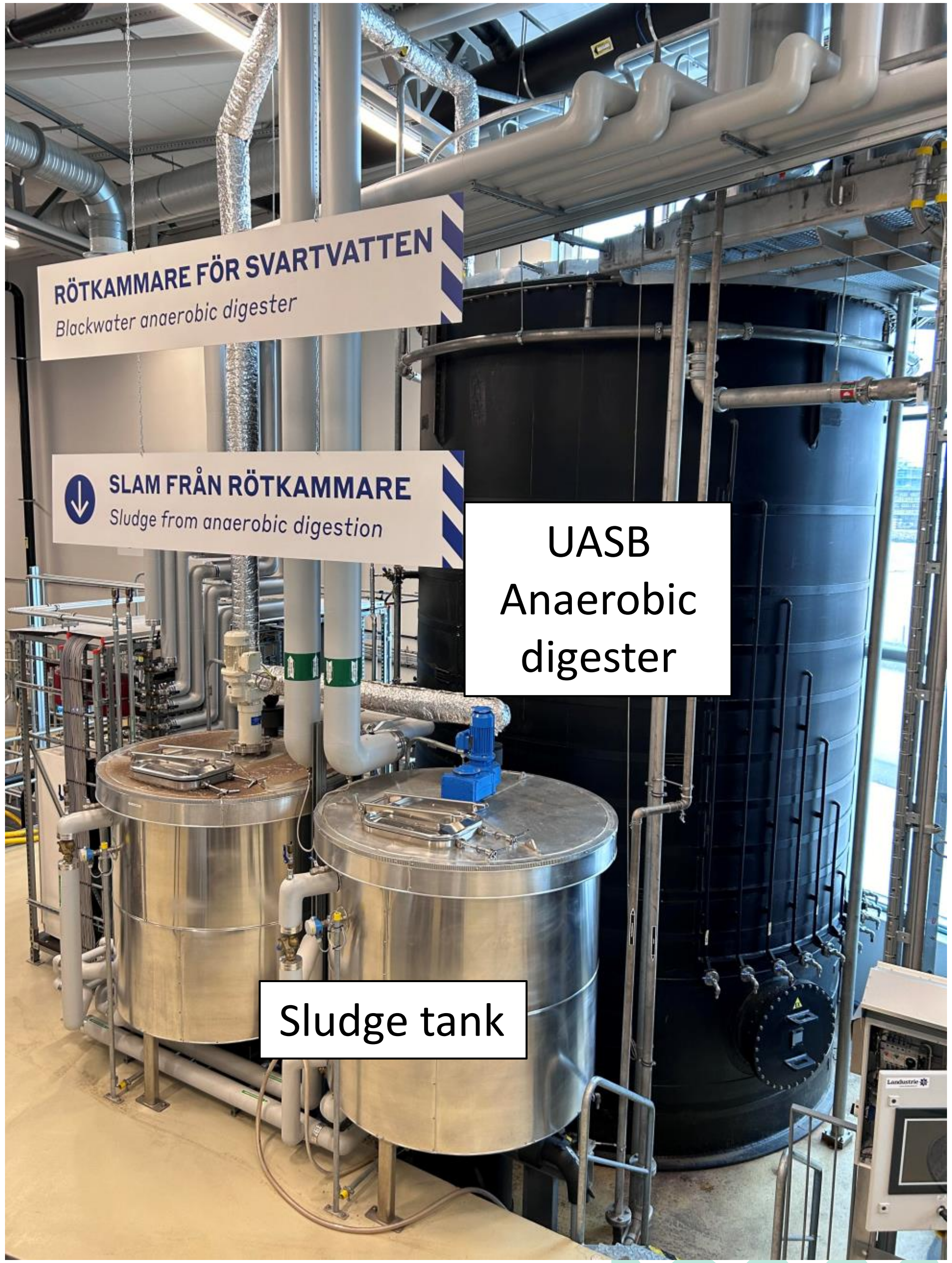
Removes solids from the water

Around 80% TS and 70% COD is removed during anaerobic digestion



Low sludge production

The sludge flow is 2% of the total liquid flow, before dewatering.



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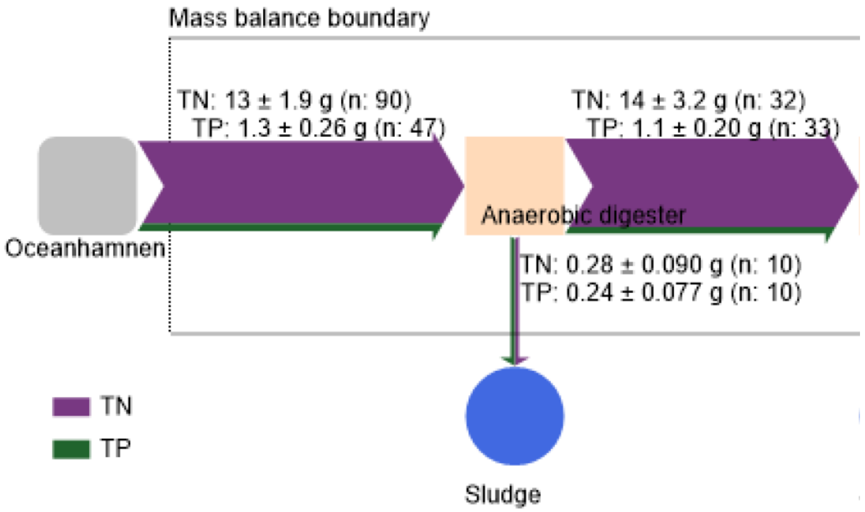
* As compared to the biogas production from municipal wastewater: https://doi.org/10.1016/j.jenvman.2017.03.094

Effluent water quality

The digester decanted effluent usually has a nice orange-brown colour

High degree of nutrients in effluent in mineralized form (free for extraction)

- 98% nitrogen in effluent (1 200 mg NH_4-N/L)
- 85% phosphorus in effluent (90 mg PO_4-P/L)
- Sufficient for struvite precipitation and ammonia stripping



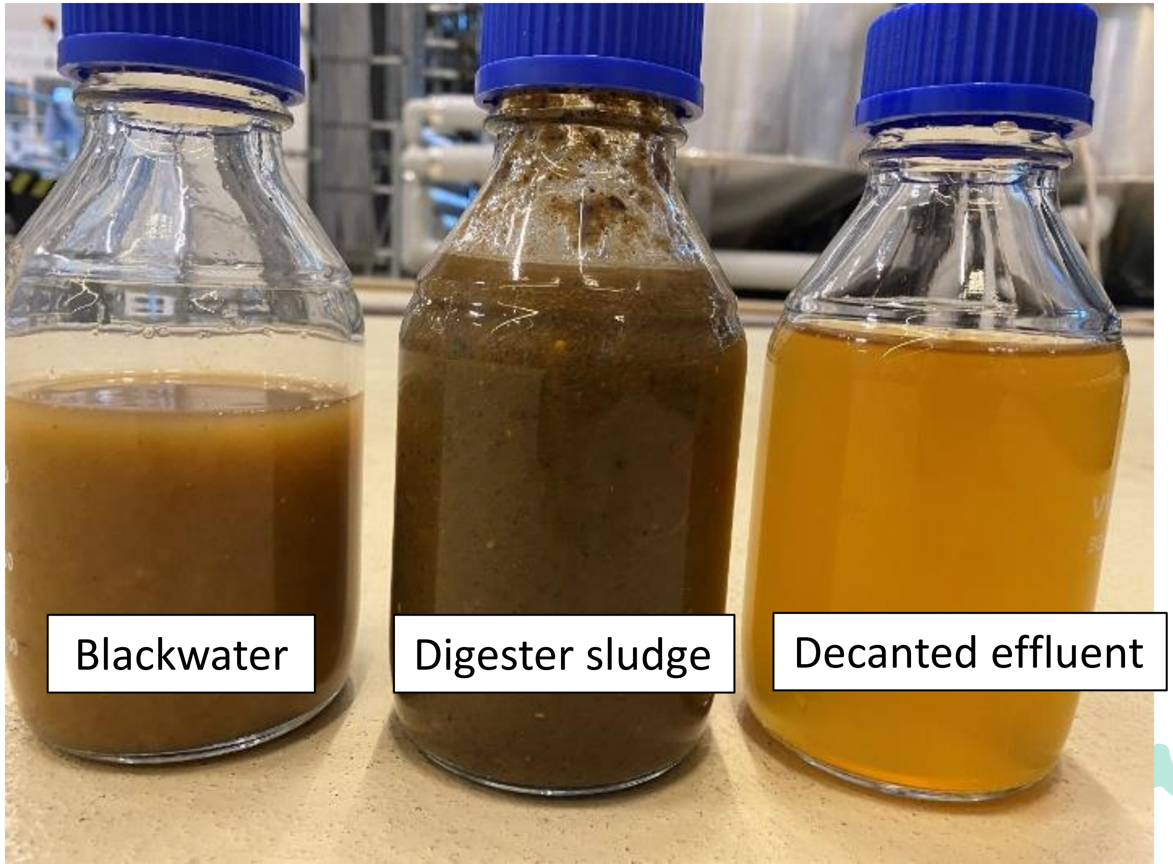
But sometimes also solids washout….

Solids concentration can jump from 250 mg SS/L up to 2 000 mg SS/L!

We do not fully understand the causes yet.

…which can be solved with mechanical filtration

Next slide.



Solids removal with drumfilter or micro filtration?

Drum filter with 40 um screen

9 months good operation.
>500 mg SS/L → 100 mg SS/L.

Ceramic microfilter 0.1 um screen

Pilot tests by PhD student*
>500 mg SS/L → <10 mg SS/L.

Conclusion: Drum filter is enough!

Protects the effluent quality while being very easy to operate.

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* *Academic paper by Saida on it is way =)*

Recovery of nutrients

Liquid fraction recovery (Not ANCHOR-project)

- Wet composting with urea addition.
- Concentrate recovery using distillation (tested in Helsingborg, SE) or freeze concentration (tested by Brightwater tools, USA).

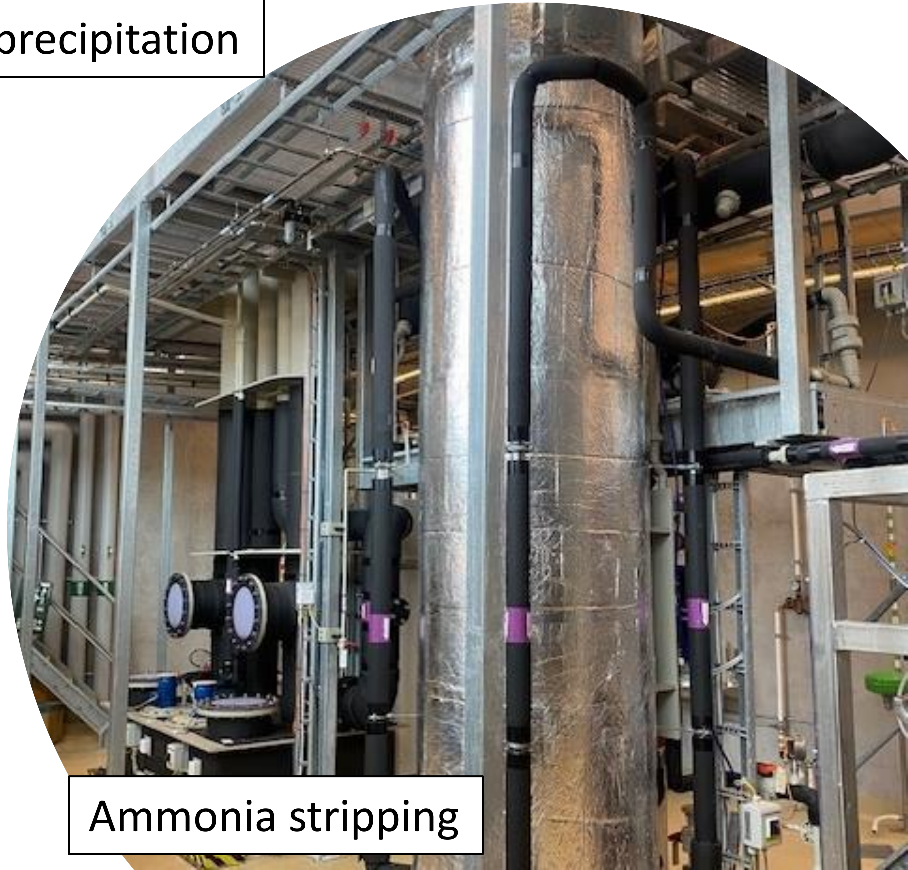
Anaerobic sludge reuse (monitored in ANCHOR-project)

- Sludge quality evaluation (Ghent, Helsingborg & Hamburg)
- Produced volumes at demo sites are too small for any practical reuse (2m^3 per week before dewatering).

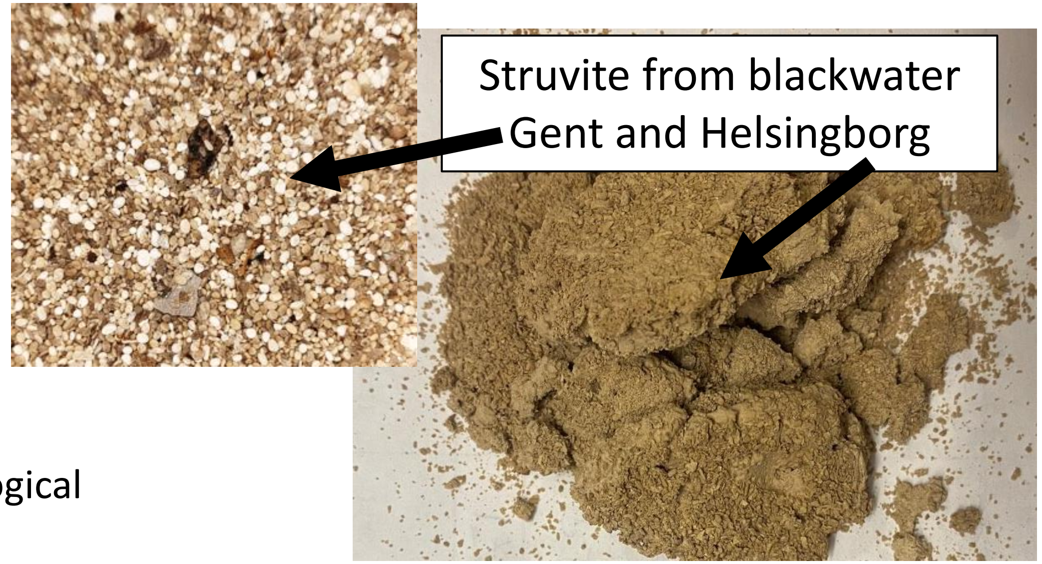
Extracted nutrients (within ANCHOR-project)

- Struvite precipitation (Ghent & Helsingborg)
- Ammonia stripping (Helsingborg)


Struvite precipitation


Ammonia stripping

Struvite precipitation for phosphorus recovery



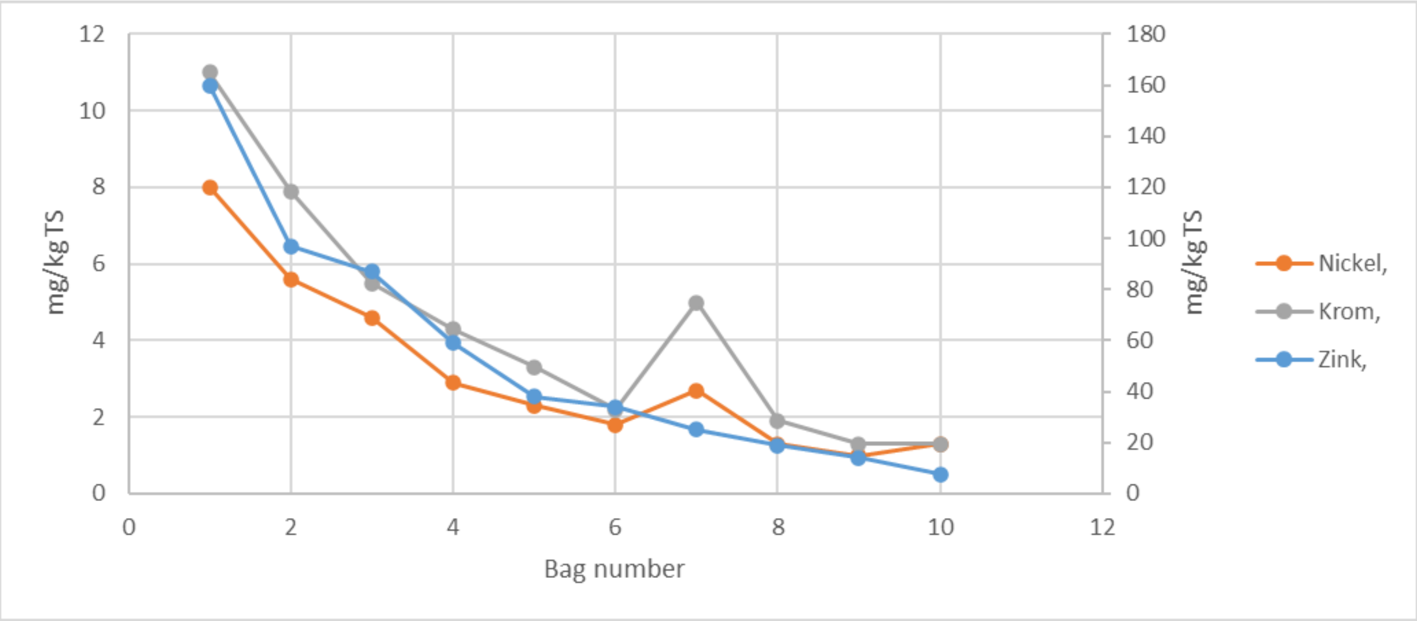
A solid fertilizer material with low metal content

Struvite precipitation is low cost and low chemical need.

- Liquid magnesium chloride used for precipitation.
- Performed in Helsingborg, Ghent and a few places in the Netherlands.
- Struvite on the EU fertilizer (2019/1009) list of products. End of waste & ecological farming possibility.
- Nice and clean product already now (Cd/P = less than 1)!
  But we also noticed heavily dropping trends of Nickel, Zink and Cromium
  (wear from the process equipment!)

Element	RecoLab sludge	RecoLab struvite	Sewage sludge
Cd	0.57	0.14	0.606
Cu	98	8.1	334
Ni	24	3.55	16.8
Pb	< 2	2.3	13.72
Zn	614	61	470
Hg	0.24	0.060	0.341
Cr	20	5.0	19.78
TN	58 000	72 000	49 510
TP	49 000	210 000	28 672

Object	mg Cd/kg P
RecoLab influent	8.1
RecoLab sludge	13
RecoLab struvite	0.68
SPCR178 certification	17
Revaq certification	22



Ammonia stripping for nitrogen recovery

A solid fertilizer material with low metal content

Ammonia stripping is a proven technology, but high in chemical usage and operational cost.

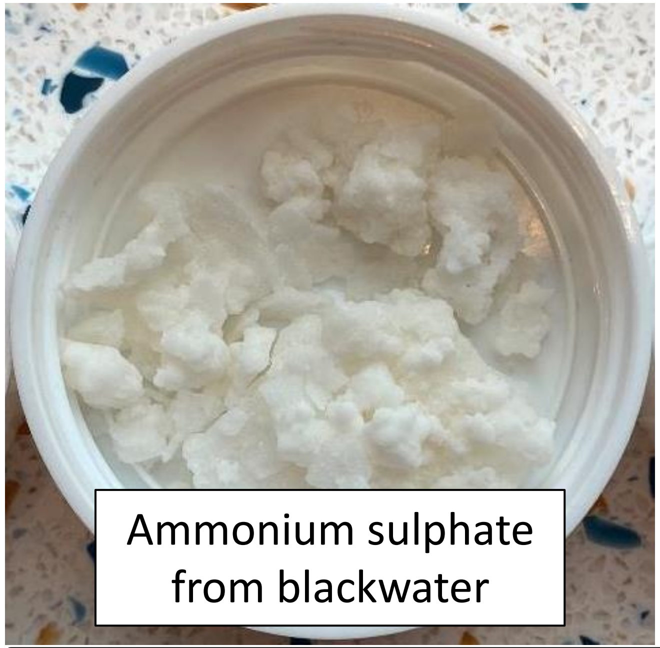
- Uses NaOH, sulphuric acid and heat.
  Still a climate positive effect compared to the fossil nitrogen cycle*.

- Performed in Helsingborg and a few places in municipal WWTPs (like Oslo, NO).

- Due to the gas separation of ammonia, the extracted ammonium sulphate is a pure salt near free from pollutants.

- Ammonium sulphate on the EU fertilizer (2019/1009) list of products.
  End of waste possibility.

- More efficient N-recovery methods being develop (for example membrane stripping)**



Ammonium sulphate from blackwater

Fertilizer NPK pellet produced from recovered struvite / ammoniumsulphate and digester sludge gave good results in 3 year farm trials***.

* https://doi.org/10.1016/j.jenvman.2017.03.094
** https://doi.org/10.1016/j.jclepro.2023.137227
***projekt.nsva.se/wp-content/uploads/sites/3/slutrapport-kretslopp-fran-stad-till-land_2024-02-21.pdf

Polishing or pharmaceutical removal

Polishing of the remaining phosphorus and nitrogen

- 20 mg tot-P/L and 200 mg N-tot/L needs to be decreased (not economically realistic to recover).
- In Ghent the blackwater effluent is mixed with the greywater influent for nutrient polishing in activated sludge system (plus colour removal).
- In Helsingborg and Hamburg polishing is not part of the demo site process (effluent discharged to sewer/WWTP)

Removal of pharmaceutical residues (not handled in ANCHOR-project, LIFE application on this topic submitted!)

- Wet composting or mesophilic digestion has some (40-60% of selected compounds) removal. *
- Thermophilic digestion has similar or higher degree of removal, but still not complete. **

Based on what we know so far, a dedicated process step is likely needed for a high removal of organic micro pollutants.

- For example carbonfilters ***

Colour of effluent water before and after activated carbon at Ghent demosite.

* https://doi.org/10.1016/j.scitotenv.2019.135530
** https://doi.org/10.1016/j.jece.2022.107340
*** http://dx.doi.org/10.2166/wst.2017.640

Outlook

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Blackwater treatment is moving from university to municipal operation:

- Blackwater has a smooth flow rate and stable concentrations.
  It is a really nice wastewater.
- Anaerobic digestion is a central process for both recovery of energy but also for removal of solids and COD from the blackwater prior to nutrient recovery.
- Full scale biogas production proven to equal university results.
- Digestor sludge washout events solved by drumfilter.
- Struvite and ammonium sulphate proven clean products and fit in EU 2019/1009 (end of waste expected in 2025).
- Still lack of full-scale application of organic micro pollutant removal from blackwater (not in ANCHOR).

”Blackwater is the wastewater of my dreams”

Coming later on in ANCHOR-project:

- Mass balances off treatment systems at ANCHOR demo site.
- Assessment of removal of antibiotic resistant genes from separate blackwater treatment.

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ANCHOR LUNCH TALK

Where is the economy in source-separating systems?

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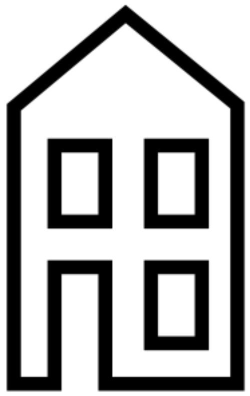
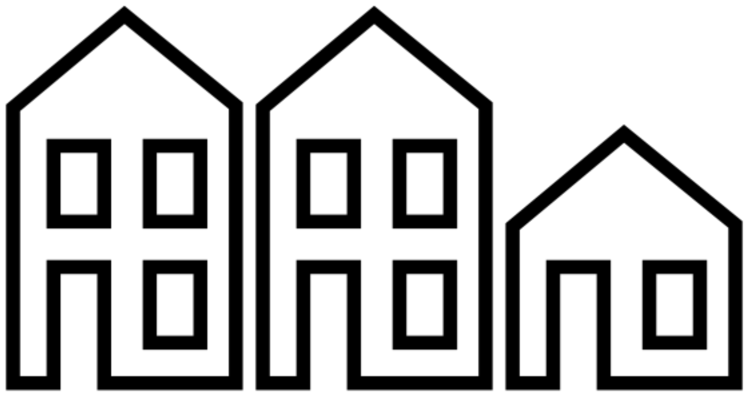
Definitions

Where is the **economy** in **source-separating systems**?

Where : what has value and why?
Economy: is there a market for this value?
Source-seperating systems: What is the benefit created by separating wastewater at source and treating it with decentralized/ on-site water treatment?

Where is the economy? Part 1 : Location

	Individual house	Flat(s)	District/City/ Country
Economy	Individual	Semi-collective	Society
Responsibility	Individual	Collective house owners Or utility (private or public)	Local utility
Financing	private (Government support)	private (Government support)	public Private (rarely) with government support

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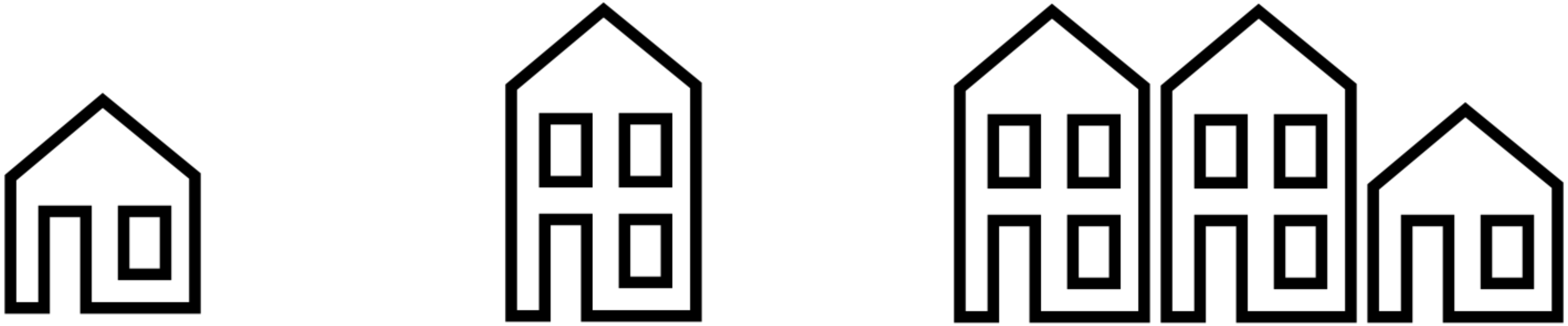
Where is the economy? Part 2: Markets



	Individual house	Flat(s)	District/City/Country
Water	x	x	x
Energy	x	x	x
Nutrients			x
Current infrastructure			x
Sewer capacity			x
Drinking water production			x
Climate change adaptation			x
Health and environment			x
Micropollutants			x
Pathogens			x
Heat-island/urban greenery	x	x	x
Eutrophication			x

What drives the markets?

Scarcity

- **Water** : Areas like South Europa, San-Francisco, South-Africa, Singapore, ..
- **(Sustainable) Energy**: Climate and geographical dependent drivers

Environmental regulation

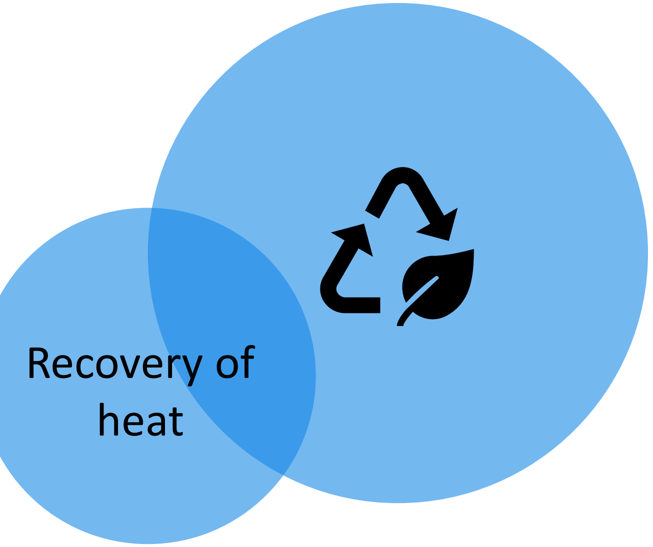
- **Eutrophication**: Obliged sewer connections to reduce nutrient emissions, more stringend emission limits
- **Micropollutants**: PFAS, pharmaceuticals, microplastics,..
- **Pathogens :** sewer overflow storm events.
- **Energy production:** Clean and local energy production
- **Climate adaptation strategies** : Adaptation Extreme weather events
- **…**

Europe: >> New Urban WasteWater Treatment Directive (UWWTD) creates opportunities for local water treatment plants

City development

- Current and planned infrastructure (Water, Energy, greenery,..)
- Real estate valuation
- Well-being of citizens

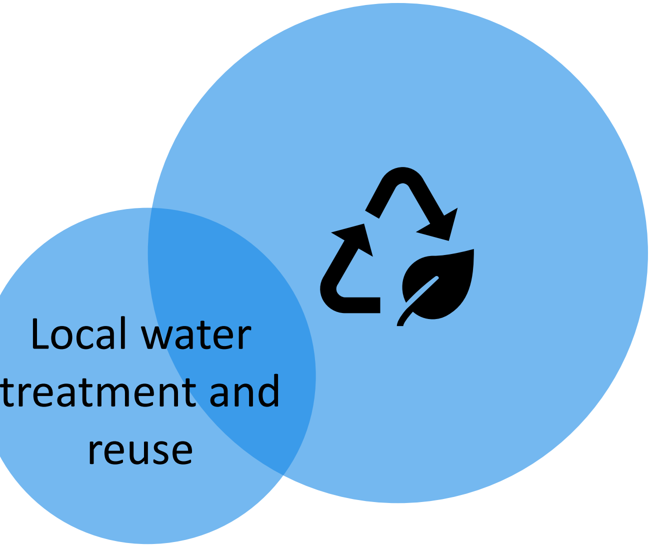
Circular Economy: Energy Service Company or ESCO



After treatment of our wastewater, the heat is recovered in the district heating system

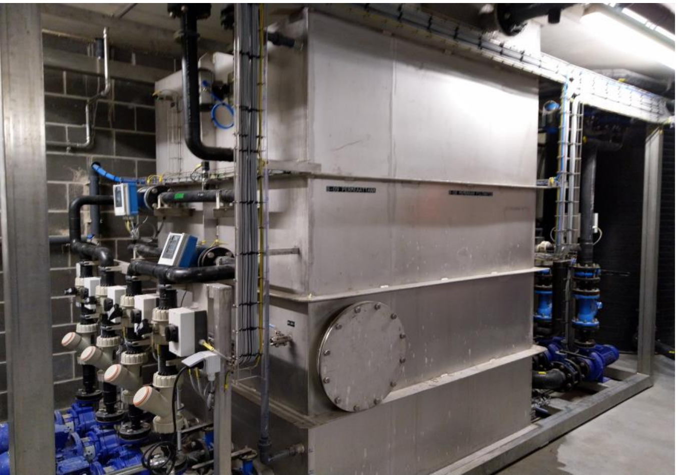
- Effluent temperatures 17-31°C: on average 5°C higher than central sewer systems (in Ghent, Belgium)
- Up to 25% of local yearly heating demand can be covered by heat recovery from grey water
- Heat is used in the district heating and sold to clients as an **Energy as a service (ESCO)** concept.
- The whole district is an energy community with local solar production, battery, Electrical Vehicles and a energy management system

Circular Economy: Water Service Company or WASCO

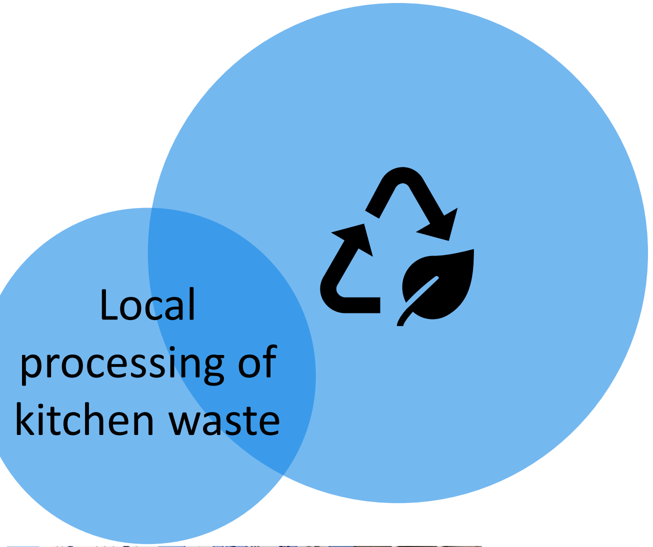


Black water, kitchen waste and grey water are treated on-site. Water is reused by the nearby soap factory Christeyns.

- Inhabitants in the district pay the same for drinking water and water treatment as somewhere else in the city
- Levies on the drinking water bill for treatment and transport are used for DuCoop to manage the water treatment plant and collection systems.
- Extra revenues are generated by the sale of purified water to the nearby soap factory Christeyns.



Circular Economy: Waste Service Company



kitchen waste is is collected in a communal shredder and treated together with black and grey water

- Inhabitants in the district pay the same for kitchen waste treatment as somewhere else in the city.
- Levies on kitchen waste are used for DuCoop to manage the water treatment plant and collection systems.
- Extra revenues are generated by the production of biogas out of the kitchen waste.
- Separate collection of other waste streams like frying oil occurs in the district

Health and environment: urban heat island effect

Local Water communities linked with <u>local greenery</u>:

- Water quality produced by De Nieuwe Dokken water treatment plant is sufficient in quality for irrigation
- Potential revenues on city/country level
  - Reduce heat related health problems
  - (The climate crisis is also a health crisis, Lancet, 2023, Climate health report)
  - Increased happiness and productivity
  - Real estate valuation

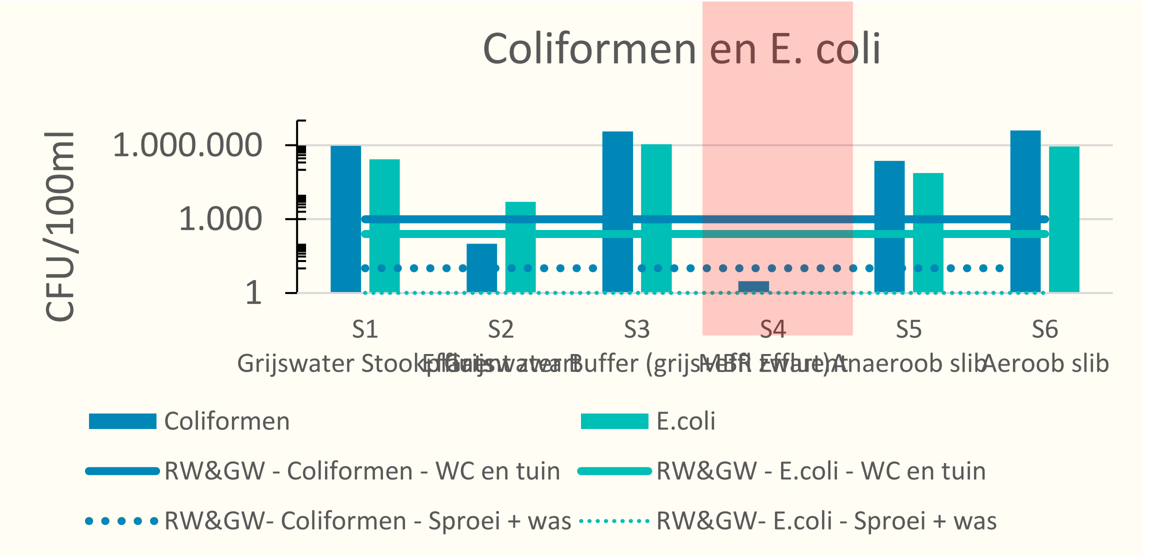
Reuse of water in city greenery

Higher quality of life

Reduce heat-island effects

No enterococci, staphylococci or Legionellae measured in MBR effluent

Buildwise



Current infrastructure: reduce sewer overflows

Less problems at combined sewer overflows

Comply to legislation

Local recovery may reduce sewer overflows by increasing connection capacity of Local Water Infrastructure

- Robust treatment : last 4 years : very limited use of central sewer connection (emergency connection)
- Potential revenues on city level
    - Adaptation of current Wastewater/ drinking water infrastructure to legislation/climate change

Seine River in Paris still too polluted for Olympic events as opening ceremony looms

Rebecca Rommen

22 jun 2024

Nature.com 01/2024 / Antibiotic resistance is a growing threat — is climate change making it worse?

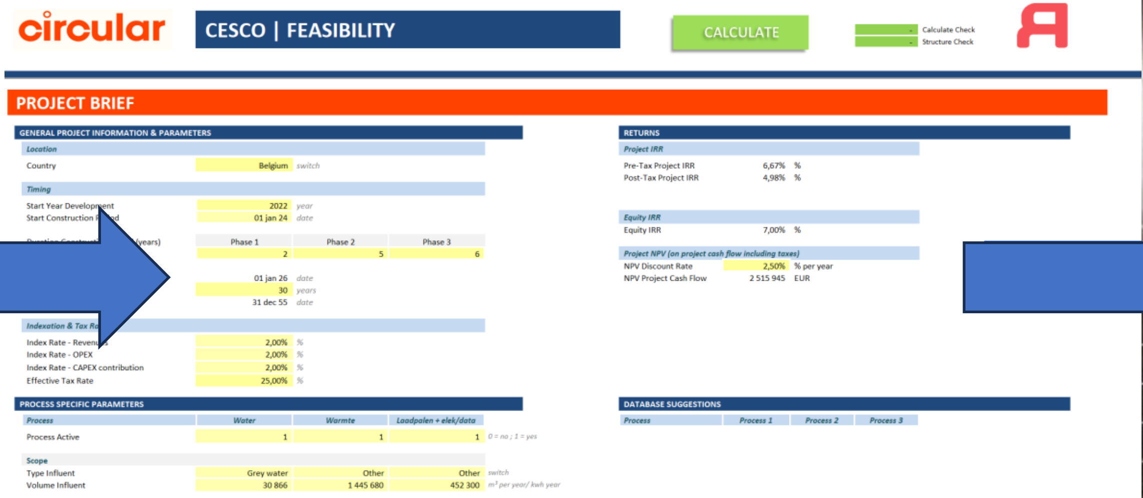
Current infrastructure: new city developments

Allow development where it is not possible today

Local recovery may increase connection capacity of Local Water Infrastructure

- Current sewer infrastructure for new city development is running on it's limits in Stockholm and Helsingborg, SE
- Potential revenues on city level
    - Avoid change of current wastewater/drinking water infrastructure

Business case calculations
From a concept to implementation?



circular | CESCO | FEASIBILITY | CALCULATE | Calculate Check | Structure Check

PROJECT BRIEF

GENERAL PROJECT INFORMATION & PARAMETERS

Location				
Country	Belgium			*switch*
Timing				
Start Year Development	2022			*year*
Start Construction P[illegible]d	01 jan 24			*date*
[illegible] (years)	Phase 1	Phase 2	Phase 3	
	2	5	6	
	01 jan 26			*date*
	30			*years*
	31 dec 55			*date*
Indexation & Tax Ra[illegible]				
Index Rate - Revenu[illegible]s	2,00%			%
Index Rate - OPEX	2,00%			%
Index Rate - CAPEX contribution	2,00%			%
Effective Tax Rate	25,00%			%

PROCESS SPECIFIC PARAMETERS

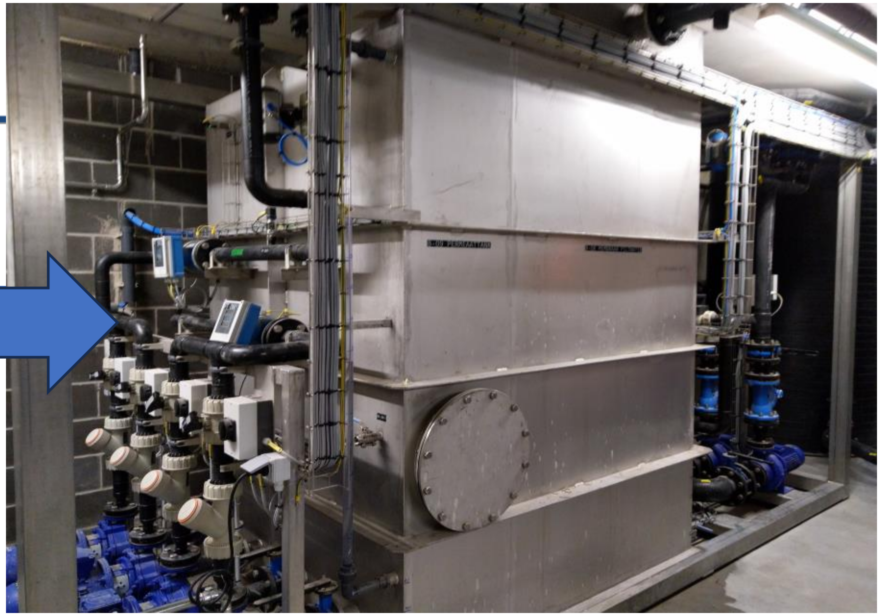
Process	*Water*	*Warmte*	*Laadpalen + elek/data*	
Process Active	1	1	1	*0 = no ; 1 = yes*
Scope				
Type Influent	Grey water	Other	Other	*switch*
Volume Influent	30 866	1 445 680	452 300	*m³ per year/ kwh year*

RETURNS

Project IRR		
Pre-Tax Project IRR	6,67%	%
Post-Tax Project IRR	4,98%	%
Equity IRR		
Equity IRR	7,00%	%
Project NPV (on project cash flow including taxes)		
NPV Discount Rate	2,50%	% per year
NPV Project Cash Flow	2 515 945	EUR

DATABASE SUGGESTIONS

Process	*Process 1*	*Process 2*	*Process 3*



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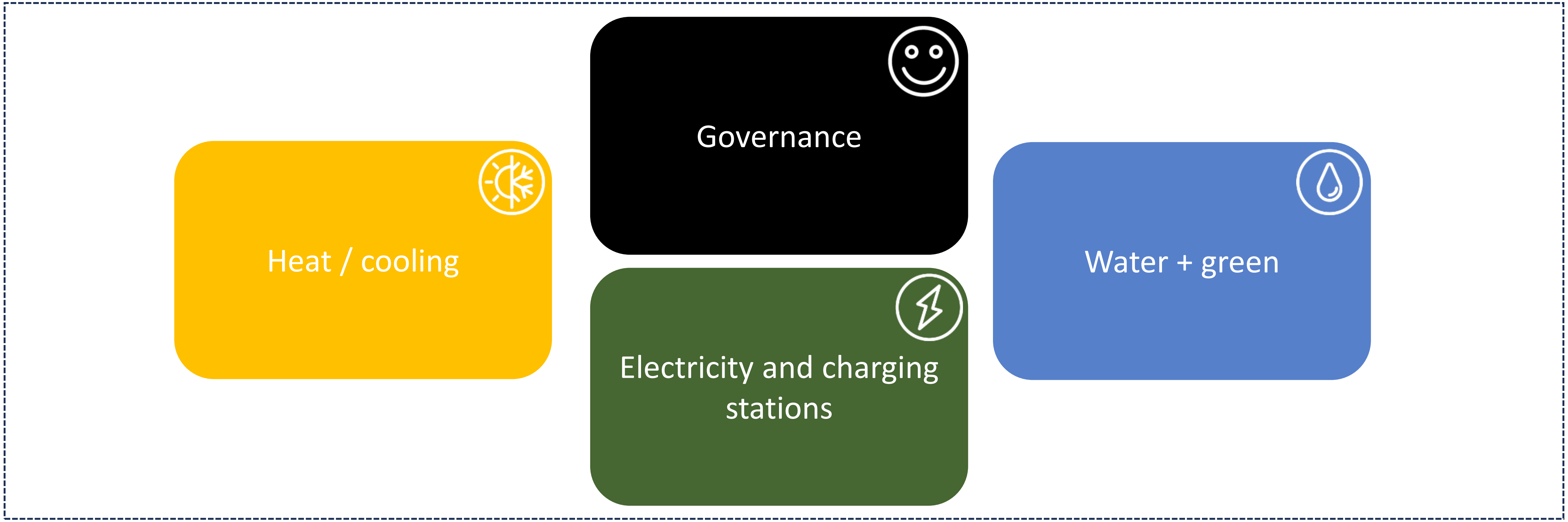
Financial modelling of new districts

Financial model



CAPEX: Cost database Circular: ∑ (known prices + market survey + experience in construction), Index: ABEX
OPEX: Reinvestment (5-15-20 years) + OPEX (Standards + practical experience prices external services); Index: CIP
Revenues: Volume profiles: practical experience (DND data translated into models: build-up of occupancy, adoption rate, … + Peer reviewed open source models), rates: Continuous market study, Index CIP
Financing: private equity, government support, revenues, banks, ..

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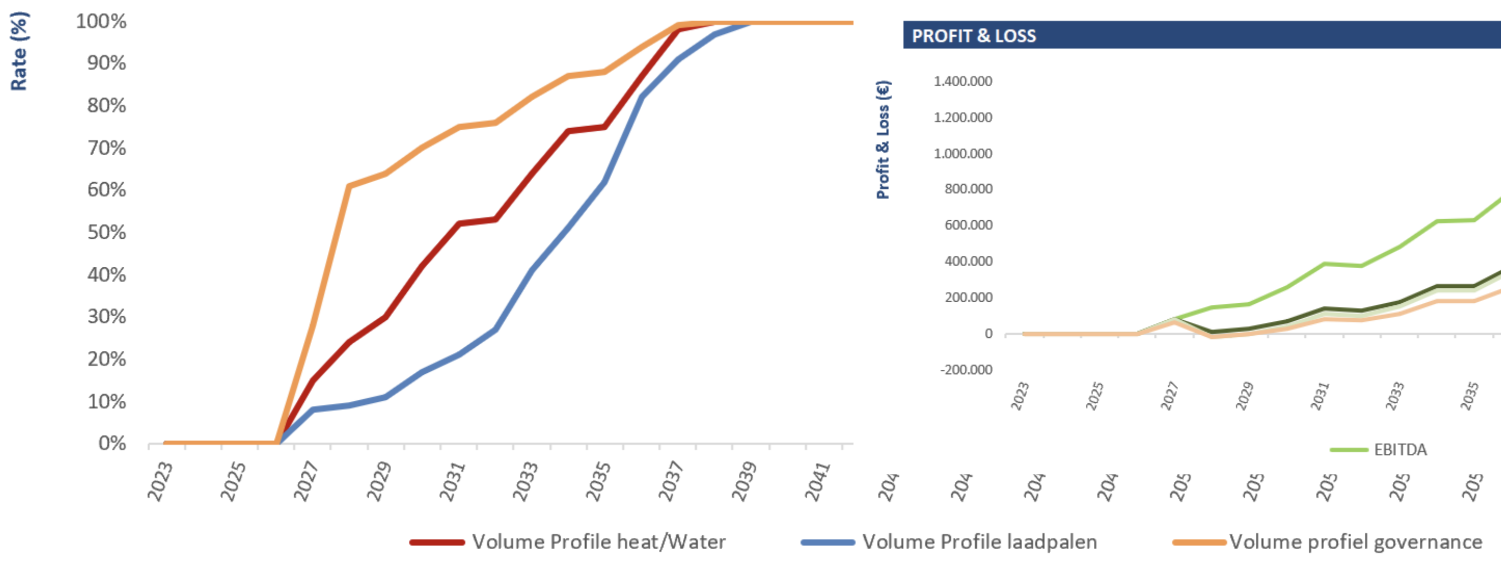
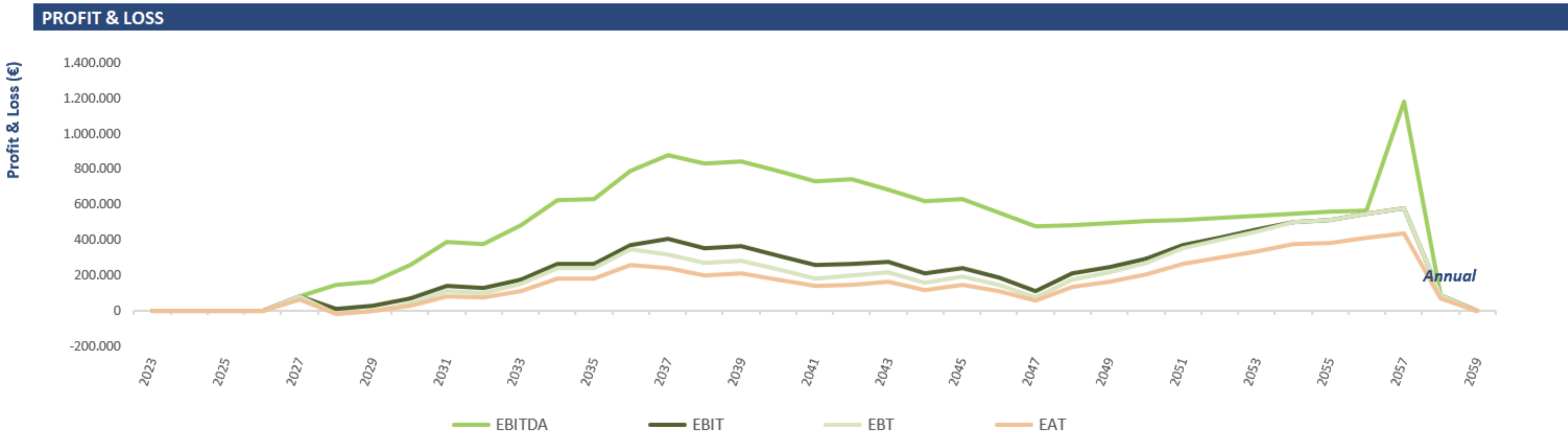
Results

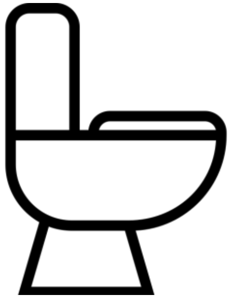
VOLUME PROFILE





Process 1 - Revenues Accrued & Received	PL & CF	EUR	1.895.879	-	-	-	-	-	-	12.528	15.973	22.810	28.806	29.947	36.886	43.502	44.972	53.211	61.137	63.633	64.905	66.203	67.527	68.878	70.256	71.661	73.094	74.556
Process 2 - Revenues Accrued & Received	PL & CF	EUR	22.482.204	-	-	-	-	-	-	136.646	186.143	263.989	335.890	354.041	430.807	509.574	531.899	623.158	717.452	752.211	768.466	783.836	799.512	815.502	831.813	848.449	865.418	882.726
Process 3 - Revenues Accrued & Received	PL & CF	EUR	6.467.969	-	-	-	-	-	-	16.989	21.180	33.388	42.068	55.170	85.452	108.420	134.440	181.364	205.296	223.208	234.714	239.408	244.196	249.080	254.062	259.143	264.326	269.612
Other Revenues Accrued & Received	PL & CF	EUR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAPEX Contributions Recognized	PL	EUR	5.994.959	-	-	-	-	-	79.897	162.991	162.991	224.779	289.039	289.039	356.015	426.984	426.984	512.273	519.598	436.505	436.505	374.717	310.457	310.457	243.481	172.512	172.512	87.223
Revenues from Sale Remaining Asset Value	PL & CF	EUR	600.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Revenues		EUR	**37.441.011**		-	-	-	-	**79.897**	**329.155**	**386.288**	**544.966**	**695.803**	**728.197**	**909.160**	**1.088.480**	**1.138.295**	**1.370.007**	**1.503.484**	**1.475.557**	**1.504.590**	**1.464.164**	**1.421.693**	**1.443.918**	**1.399.611**	**1.351.764**	**1.375.349**	**1.314.117**
Process 1 - Operational Costs Accrued & Paid	PL & CF	EUR	(1.901.942)	-	-	-	-	-	-	(22.868)	(23.748)	(38.326)	(39.825)	(40.697)	(51.717)	(53.529)	(54.679)	(56.744)	(58.787)	(60.131)	(61.334)	(62.560)	(63.811)	(65.088)	(66.389)	(67.717)	(69.072)	(70.453)
Process 2 - Operational Costs Accrued & Paid	PL & CF	EUR	(9.682.535)	-	-	-	-	-	-	(80.672)	(109.387)	(142.121)	(153.133)	(182.770)	(222.030)	(235.141)	(257.538)	(292.802)	(308.779)	(316.831)	(323.168)	(329.631)	(336.224)	(342.948)	(349.807)	(356.803)	(363.939)	(371.218)
Process 3 - Operational Costs Accrued & Paid	PL & CF	EUR	(3.601.457)	-	-	-	-	-	-	(9.460)	(11.793)	(18.591)	(23.424)	(30.719)	(47.581)	(60.370)	(74.858)	(100.986)	(114.311)	(124.285)	(130.692)	(133.306)	(135.972)	(138.691)	(141.465)	(144.294)	(147.180)	(150.124)
Other Operational Costs Accrued & Paid	PL & CF	EUR	(4.559.920)	-	-	-	-	-	-	(72.420)	(77.502)	(86.463)	(94.491)	(97.666)	(107.484)	(116.319)	(120.009)	(130.755)	(140.465)	(144.721)	(147.616)	(150.568)	(153.579)	(156.651)	(159.784)	(162.980)	(166.239)	(169.564)
Total OPEX		EUR	**(19.745.853)**		-	-	-	-	-	**(185.420)**	**(222.430)**	**(285.500)**	**(310.874)**	**(351.852)**	**(428.812)**	**(465.358)**	**(507.084)**	**(581.288)**	**(622.342)**	**(645.969)**	**(662.809)**	**(676.065)**	**(689.586)**	**(703.378)**	**(717.446)**	**(731.795)**	**(746.430)**	**(761.359)**
EBITDA		EUR	**17.695.157**		-	-	-	-	**79.897**	**143.735**	**163.858**	**259.466**	**384.929**	**376.345**	**480.348**	**623.122**	**631.211**	**788.719**	**881.142**	**829.588**	**841.781**	**788.099**	**732.107**	**740.540**	**682.165**	**619.970**	**628.919**	**552.758**
Depreciations Investments Accrued	PL	EUR	(8.548.117)	-	-	-	-	-	-	(143.585)	(143.585)	(198.440)	(253.822)	(257.301)	(313.539)	(369.882)	(377.239)	(430.692)	(484.463)	(484.463)	(484.463)	(484.463)	(484.463)	(484.463)	(416.066)	(416.066)	(395.791)	(375.431)
Settlement Balances at End of Project	PL	EUR	(600.000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amortization Capital Subsidies	PL	EUR	187.000	-	-	-	-	-	-	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350	9.350
EBIT		EUR	**8.734.041**		-	-	-	-	**79.897**	**9.499**	**29.622**	**70.376**	**140.457**	**128.394**	**176.159**	**262.590**	**263.322**	**367.378**	**406.029**	**354.475**	**366.668**	**312.986**	**256.994**	**265.427**	**275.450**	**213.254**	**242.478**	**186.676**
TLF A - Financing Cost post Drawdown Period	PL & CF	EUR	(343.207)	-	-	-	-	-	-	(31.232)	(31.232)	(31.232)	(29.839)	(28.368)	(26.817)	(25.180)	(23.454)	(21.632)	(19.710)	(17.683)	(15.544)	(13.287)	(10.906)	(8.395)	(5.745)	(2.949)	-	-
TLF B - Financing Cost post Drawdown Period	PL & CF	EUR	(761.286)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(69.278)	(69.278)	(69.278)	(66.187)	(62.925)	(59.484)	(55.854)	(52.024)	(47.983)	(43.721)
TLF C - Financing Cost post Drawdown Period	PL & CF	EUR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EBT		EUR	**7.629.547**		-	-	-	-	**79.897**	**(21.733)**	**(1.610)**	**39.144**	**110.619**	**100.026**	**149.342**	**237.409**	**239.869**	**345.746**	**317.040**	**267.514**	**281.846**	**233.512**	**183.162**	**197.548**	**213.851**	**158.281**	**194.495**	**142.956**
Corporate Tax Paid	PL & CF	EUR	(1.913.223)	-	-	-	-	-	(19.974)	-	-	(9.786)	(27.655)	(25.006)	(37.335)	(59.352)	(59.967)	(86.436)	(79.260)	(66.879)	(70.462)	(58.378)	(45.790)	(49.387)	(53.463)	(39.570)	(48.624)	(35.739)
EAT		EUR	**5.716.325**		-	-	-	-	**59.923**	**(21.733)**	**(1.610)**	**29.358**	**82.964**	**75.019**	**112.006**	**178.057**	**179.901**	**259.309**	**237.780**	**200.636**	**211.385**	**175.134**	**137.371**	**148.161**	**160.388**	**118.711**	**145.871**	**107.217**
Dividends Declared & Paid	PL & CF	EUR	(5.650.177)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(543.049)	(200.353)	(152.752)	(172.941)	(193.796)	(198.633)	(203.159)	(225.825)	(282.294)	(304.307)
Net Result		EUR	**66.147**		-	-	-	-	**59.923**	**(21.733)**	**(1.610)**	**29.358**	**82.964**	**75.019**	**112.006**	**178.057**	**179.901**	**259.309**	**(305.268)**	**283**	**58.633**	**2.193**	**(56.425)**	**(50.472)**	**(42.770)**	**(107.114)**	**(136.423)**	**(197.090)**
Retained Earnings																												
Retained Earnings BEG		EUR			-	-	-	-	-	59.923	38.190	36.580	65.938	148.902	223.921	335.927	513.984	693.885	953.195	647.926	648.209	706.842	709.034	652.610	602.138	559.367	452.253	315.830

Replication potential local water community (based on numbers case study DuCoop)



Black water treatment and recovery

- > 1000 housing units
- Biogas digestion coupled with other resources:
  - Kitchen waste
  - SWILL streams (e.g. Jenfelder au, Hamburg Wasser)

Grey water treatment and recovery

- > 200 housing units WHEN coupled with heat recovery
- Context driven:
  - density of urban environment
  - Scarcity of water and renewable heat
  - Re-use potential water

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Thank you

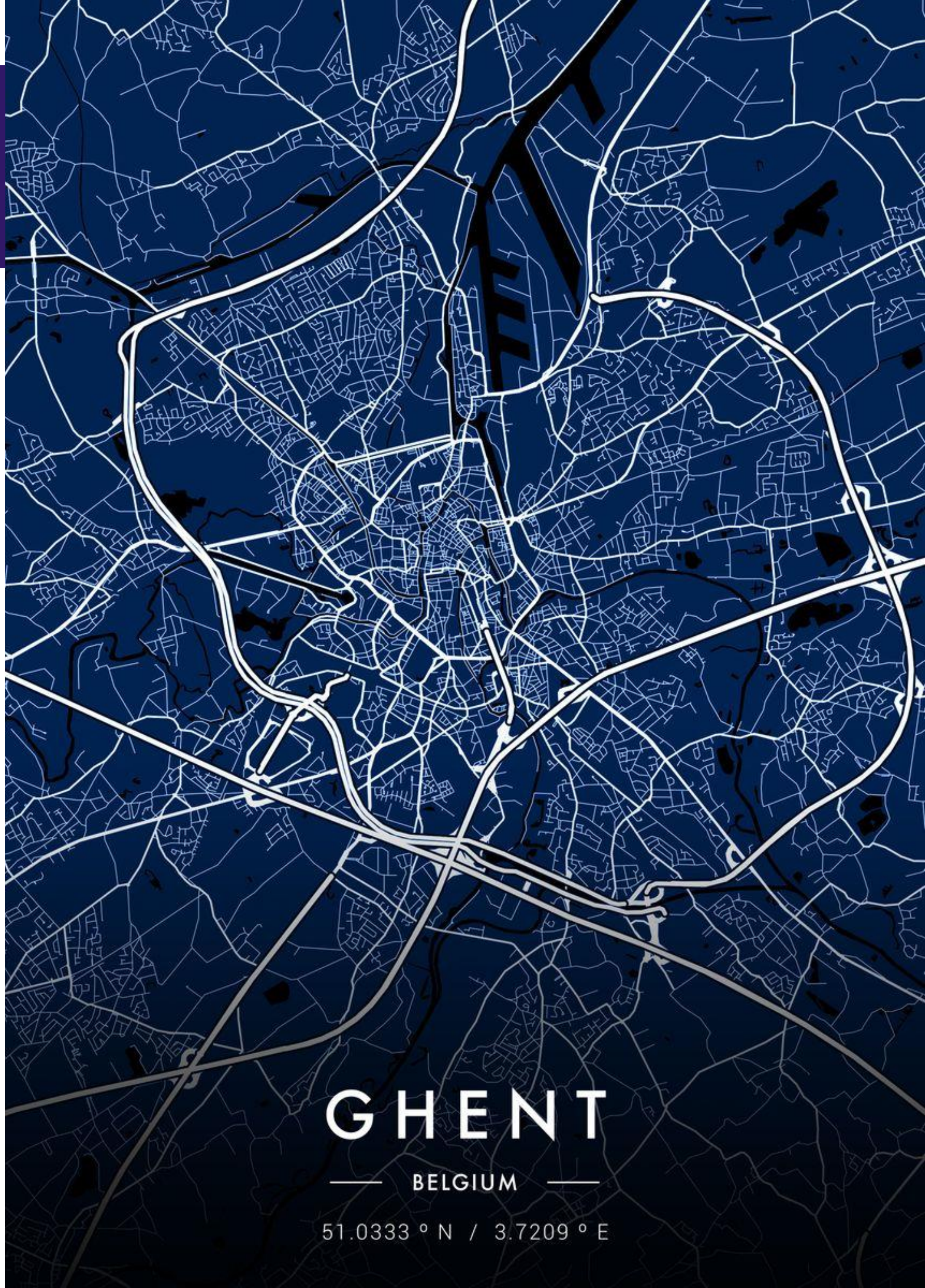
DuCoop circular

provincie Oost-Vlaanderen

Dries.seuntjens@circular-living.be

Implementing future proof districts with Local Water Community requires:

- Early urban planning and support by local authorities – part of city blue print
- Modular planning of infrastructure and investments
- Different financing structures: Added value is not always created on the project level



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Anchor Lunch Talks

Next Lunch Meeting

- ⚓ When: December 2nd
- ⚓ Topic: Greywater

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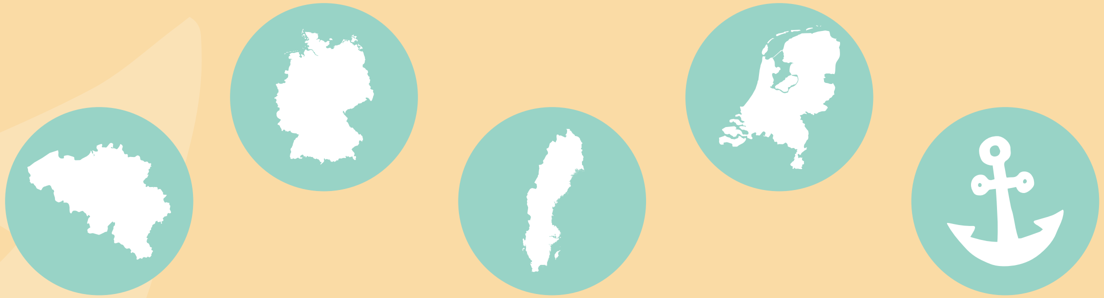
Thank you for attending!



Interreg ANCHOR project

www.interregnorthsea.eu/anchor

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