Use of treated wastewater - demonstration cases from WIDER UPTAKE

Klimatilpasningsdsagene 2022

Website: www.wider-uptake.eu

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Outline

- Introduction about WIDER UPTAKE
- Demonstration cases for use of water and resources in wastewater
- Assessment methods
- Conclusions

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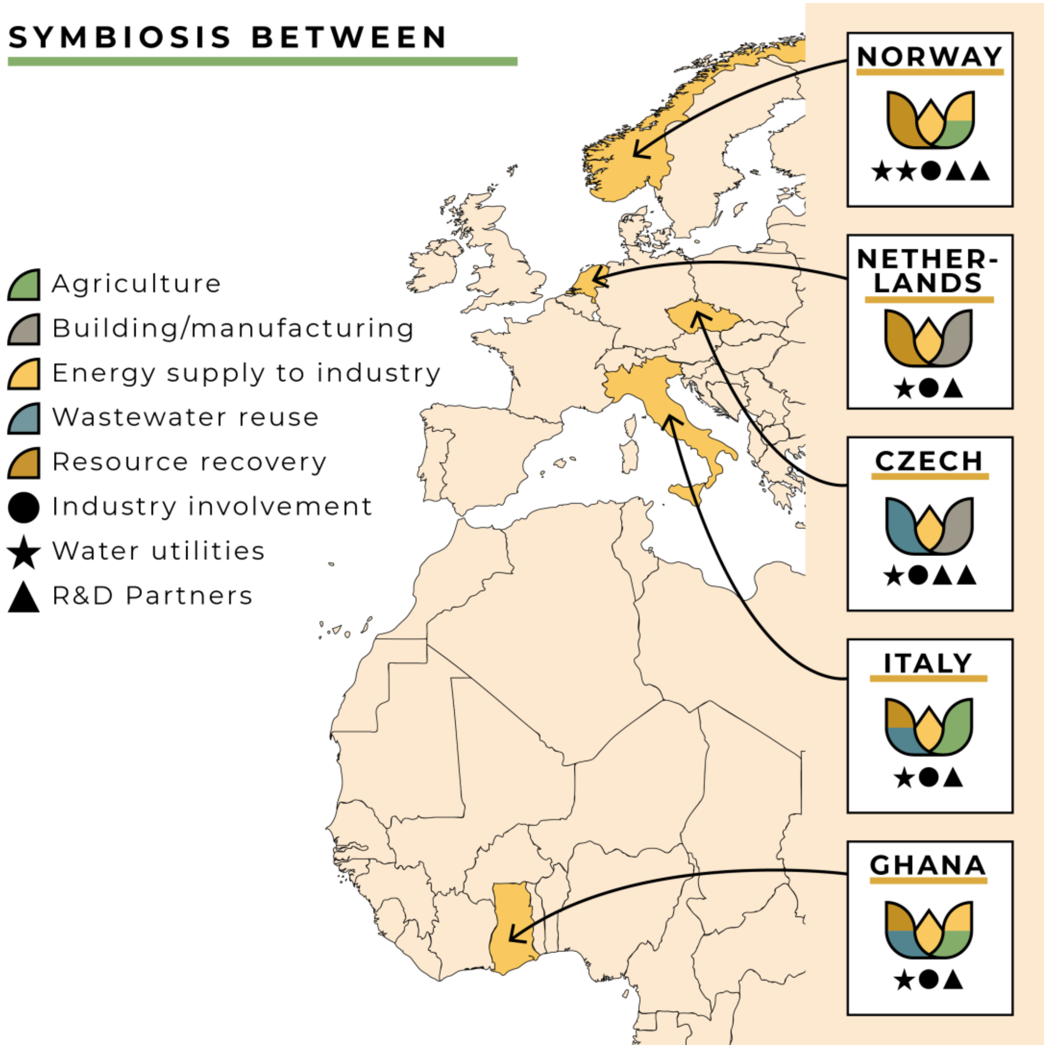
WIDER UPTAKE – partners and key facts

- Partners
- 11 water utilities and industries:
  - SSGL, AMAP S.p.A., PVS, Storm Aqua, WATNL, NPSP BV, Hias IKS, HIAS How2O AS, Sirkula, IVAR IKS and HØST,
- 7 research institutes or universities:
  - SINTEF, NTNU, TU Delft, CVUT, VSCHT, UNIPA, CSIR-GH
- 5 countries:
  - Norway, Netherlands, Czech Republic, Italy, Ghana



Key facts

- Horizon 2020 Framework Programme; Call: H2020-SC5-2019-2
- CE-SC5-04-2019 — Building a water-smart economy and society
- Innovation action
- Project: 869283
- Duration 2020 – 2024
- EU contribution: 11 606 479.88 EUR
- Coordinator: SINTEF, Herman Helness, herman.helness@sintef.no

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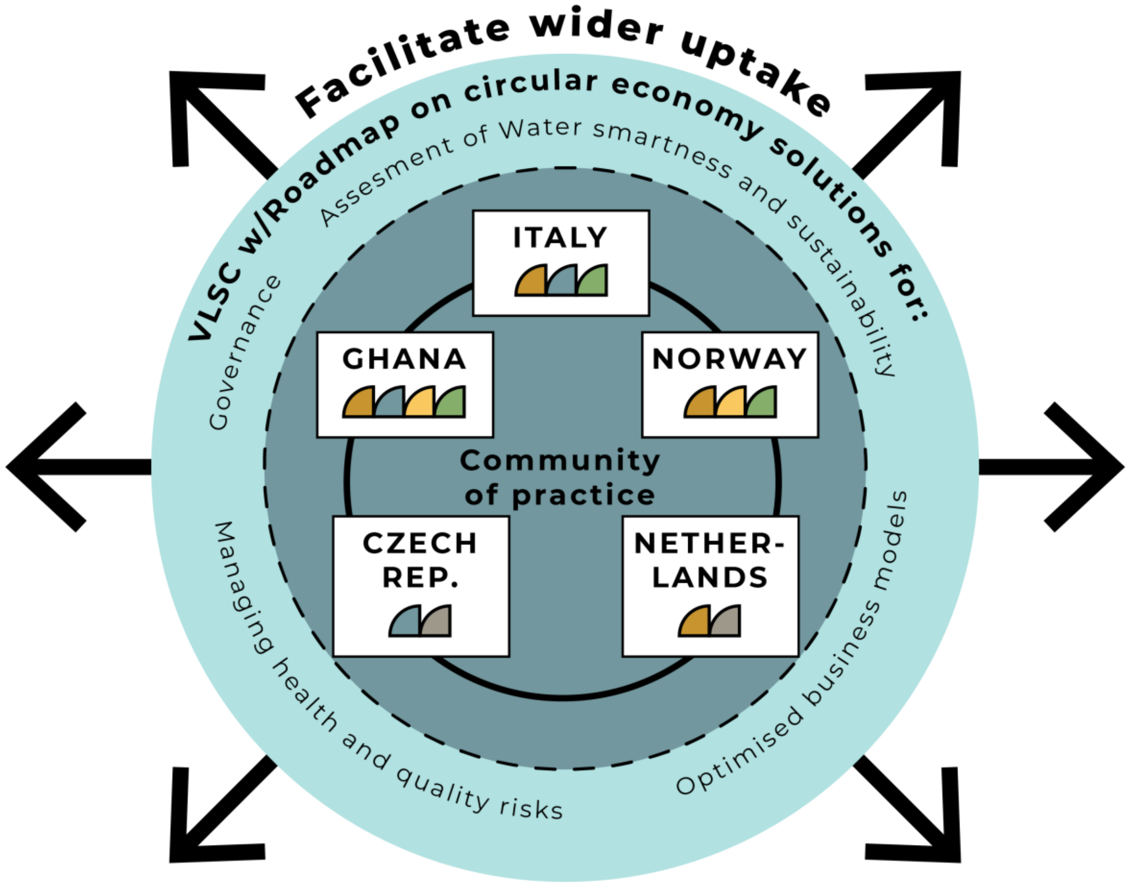
WIDER UPTAKE of smart water solutions – overview



SYMBIOSIS BETWEEN

Agriculture · Building/ manufacturing · Energy supply to industry · Wastewater reuse · Resource recovery

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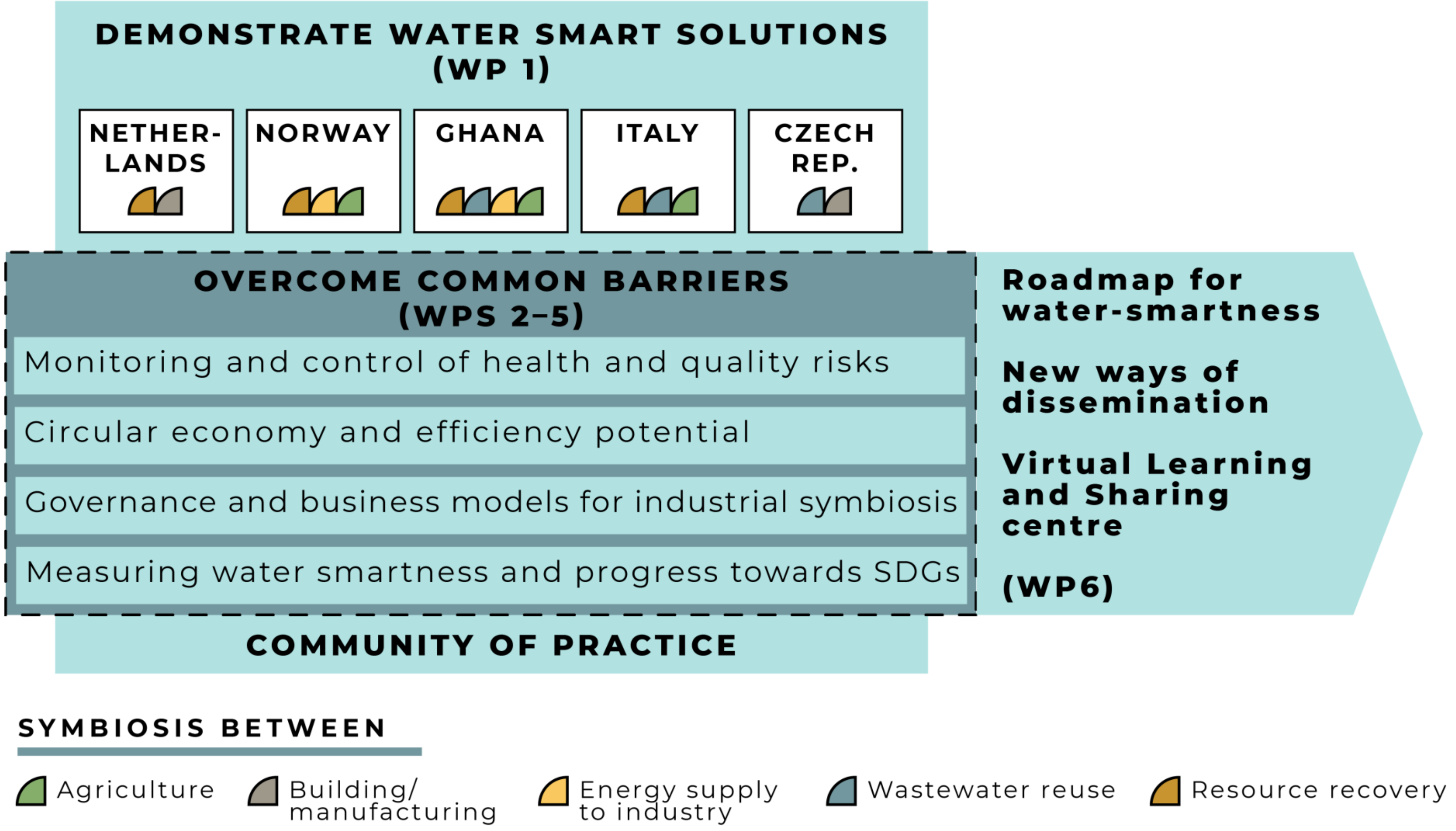
WIDER UPTAKE – work packages



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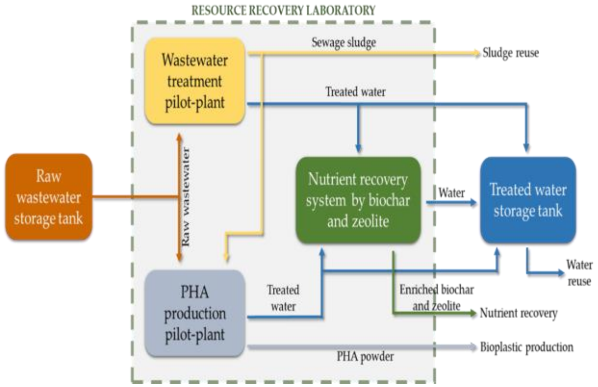
Italian demonstration cases

1. Palermo University: bioplastic, water reuse, fertilizers production; sewage sludge reuse (composting)

2. Marineo WWTP – PhA production/extraction for bioplastic production – deviation line

3. Corleone WWTP: water reuse; sewage sludge reduction and minimization



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Ghana: Treated wastewater for irrigation in urban agriculture

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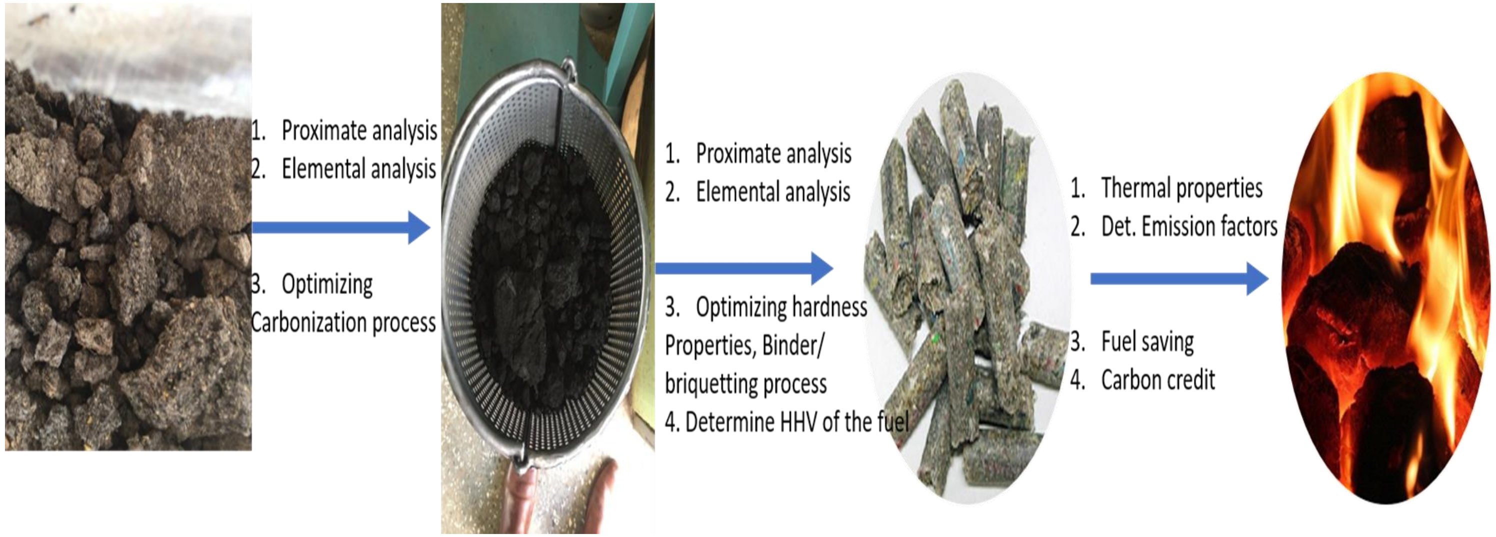
Ghana: Biochar as wood fuel substitute

- Full scale at SSGL's WWTP in Accra
- Laboratory testing and business development at CSIR
- To establish parameters for the optimization of carbonization and activation processes in the valorisation of sewage sludge



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Norway at Hamar: Phosphorus recovery as struvite

- Phosphorus and soil products from wastewater treatment sludge
  - Retrofitting WWTP with new biological wastewater treatment process from Hias How2O at Hias
  - Phosphorus recovery process under construction
  - Develop products, markets and value chains for struvite and high quality biosolids Hias and Sirkula

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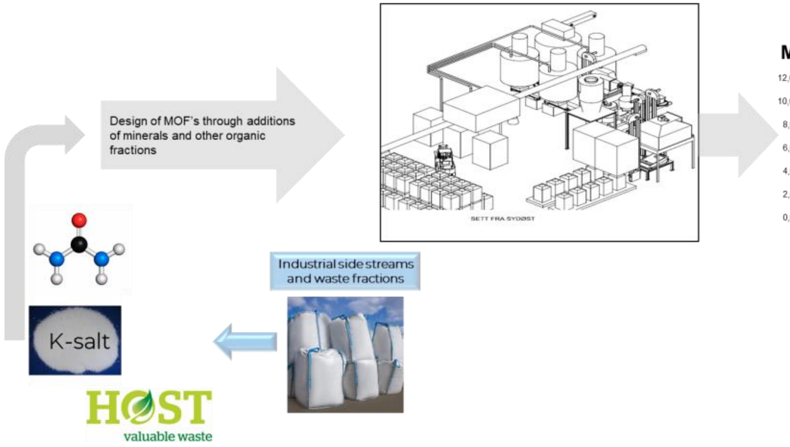
Norway in Stavanger: Wastewater & sludge treatment for fertilizer and biogas production

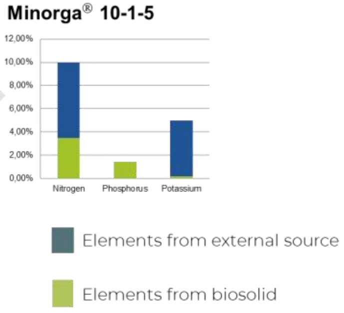
Focus Composition
Nutrients
Hygienic issues
Pollution issues
Regulating issues

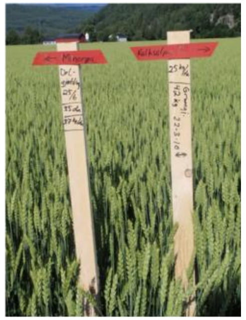
Focus: Application
Spreading technology competitiveness

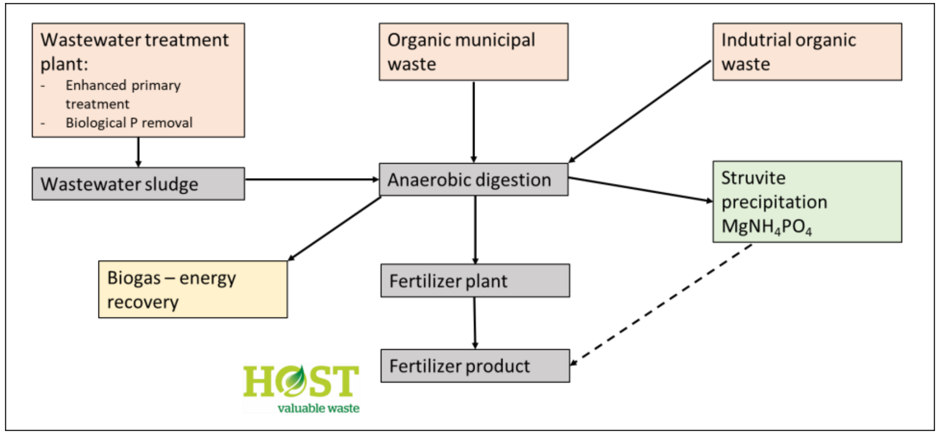
Focus: Pellet solubility
Demands on dissolution

Focus: Fertilizing effects
Fertilizing plans
Business case and SDG









- Also: Biogas from the digestion of wastewater sludge is upgraded and supplied to a regional distribution system for natural gas

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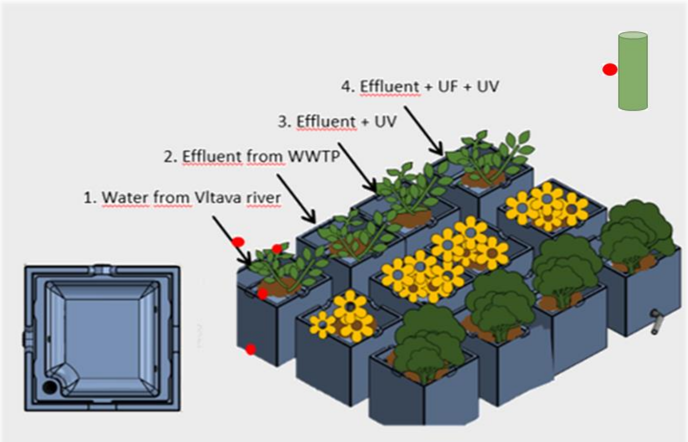
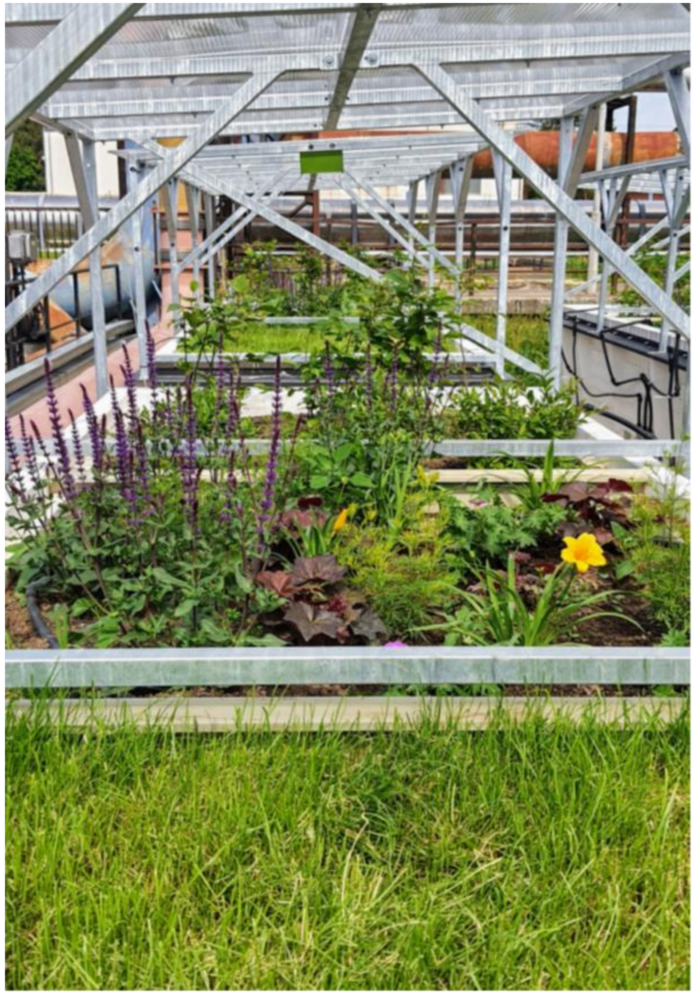
Czech republic: Treated wastewater for irrigation of urban green areas

- 4 demonstration units consisting of 3 parts
- 4 types of water
  1. River
  2. WWTP effluent
  3. WWTP effl.+ UF
  4. WWTP effl. + UF & UV
- 3 types of plants
- Several sampling points





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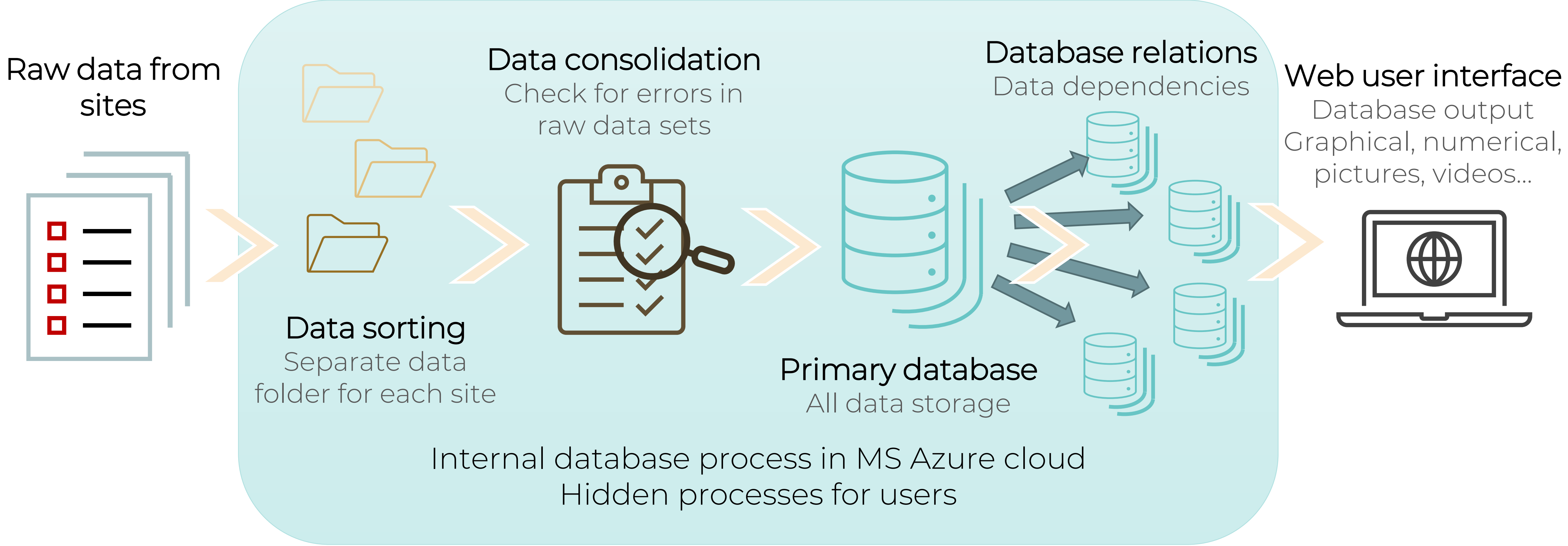
Database processes organization

database.wider-uptake.eu



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Netherlands: Next generation bio-composites from waste-based resources and materials

- The key outcome will be an optimized, functional, safe and sustainable new bio-composite material ready for mass production.

- Demonstration of the bio-composite

https://theexplodedview.com/nl/materialbb/nabasco-8010-2/

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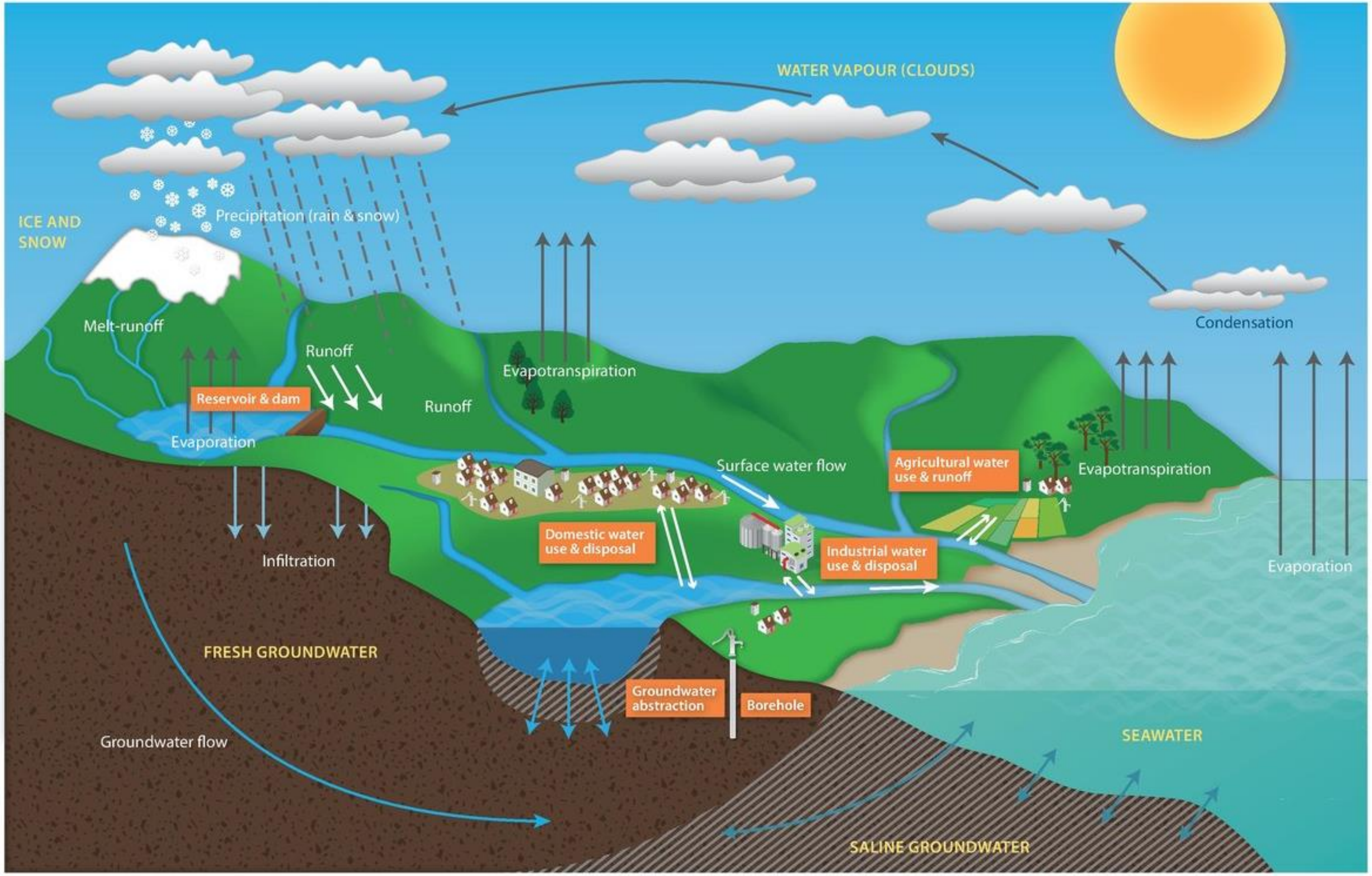
The natural water cycle and some human activities that influence it



University of Oxford 2018 (https://upgro.files.wordpress.com/2018/03/water-module-student-resource-web.pdf

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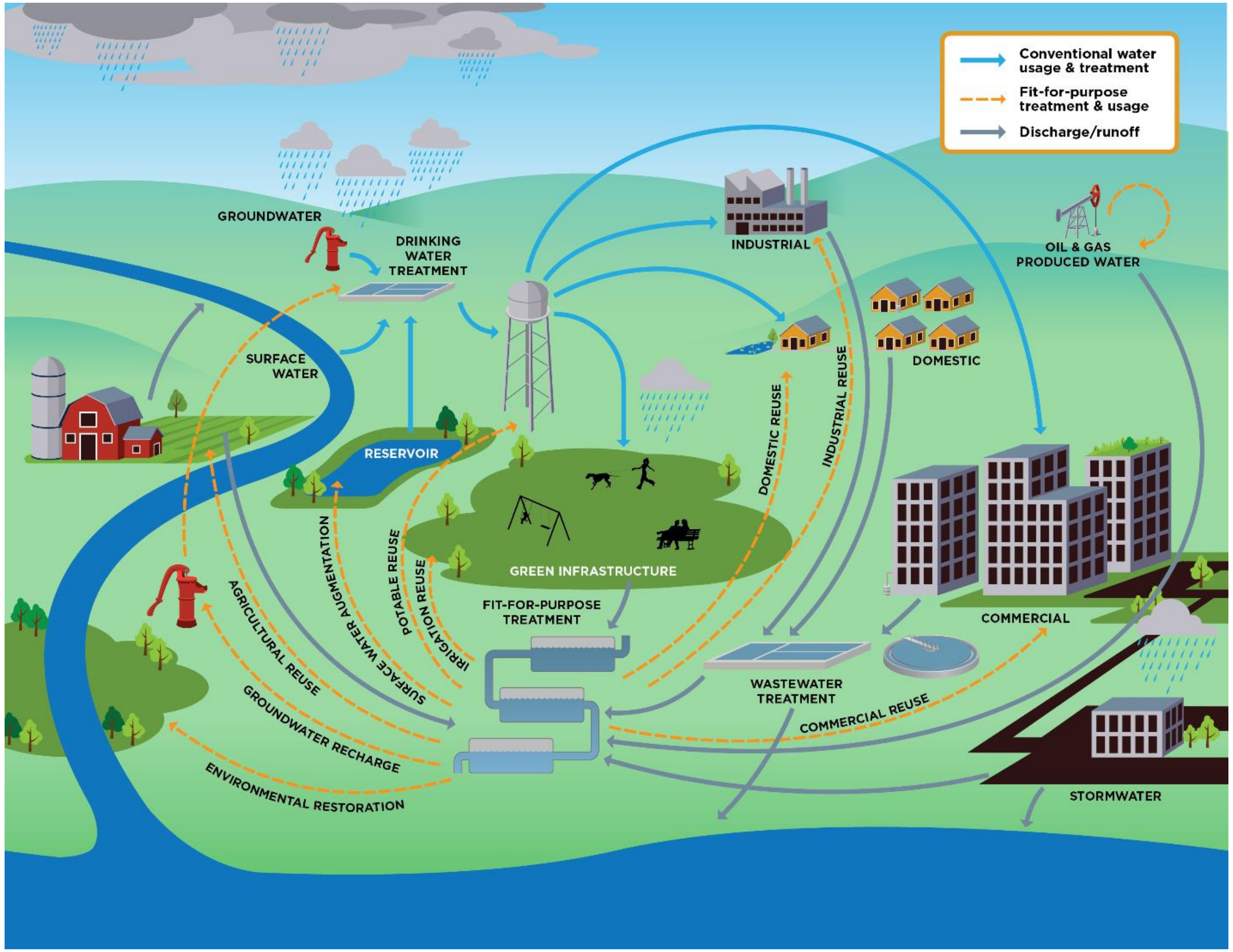
Man made circular additions to the water cycle



US EPA

- Circular economy through recovery and reuse of:
  - Water
  - Nutrients
  - Other materials
  - Energy
- To realise the value <u>of</u> and <u>in</u> water one should target the most valuable resource in a given case
- Solutions exist but implementation slow
- Common barriers
  1. Health and quality risks
  2. Circularity and resource efficiency
  3. Governance and business models
  4. Water smartness

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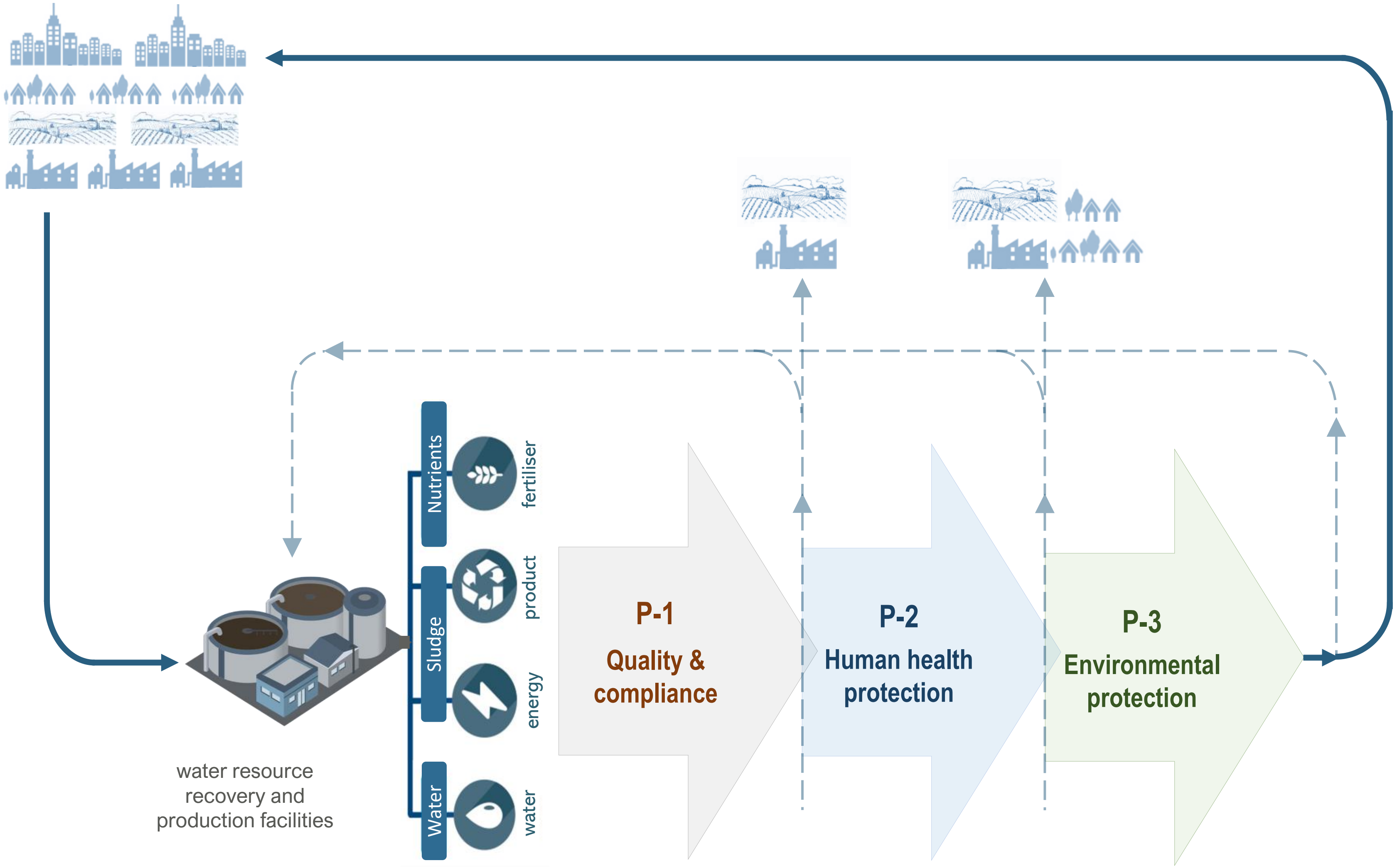
1. Health and quality risks: General monitoring framework

1st innovative aspect

Combining 3-pillar evaluations to address the first main barriers in bringing a new product to the market



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General monitoring framework

2nd innovative aspect

Dividing the scope between recovered resources and final products.

3rd innovative aspect

Explicit classification of the recovery cases.

1: To account for **multi actor contributions**

2: To simplify the **variety of cases** by grouping

3: To simplify identification of the applied **regulations**

RECOVERED RESOURCES		FINAL PRODUCTS
Water Recovery		
WWTP effluent	→	Reclaimed water for agriculture
WWTP effluent	→	Reclaimed water for park irrigation
Fertilizer Recovery		
WWTP (dewatered)digestate	→	Biopellet soil improver
WWTP (reject-water)digestate	→	Organo-mineral fertilizer/Struvite
WWTP effluent	→	Nutrient-embedded biochar
Energy Recovery		
WWTP (dewatered)sludge	→	Biochar fuel (briquettes)
WWTP biogas	→	Heat & electricity, biogas fuel
Intermediate Product Recovery		
WWTP recovered cellulose, and DWTP recovered lime pellets	→	Bio-composite
WWTP recovered PHA	→	PHA biopolymer pellets

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- Circularity assessment to be based on Material Circularity Index (MCI) method
  - Substance Flow Models for simulating flow of elements (N,P,C, etc.).
  - Linear Flow Index as percentage of flows originating from virgin extraction and/or ending as unrecovered waste.
  - MCI = 1-LFI
  - To be calculated separately for Abiotics, Biotics, Nutrients (N,P) and Water.

- Solutions to be assessed with MCDA

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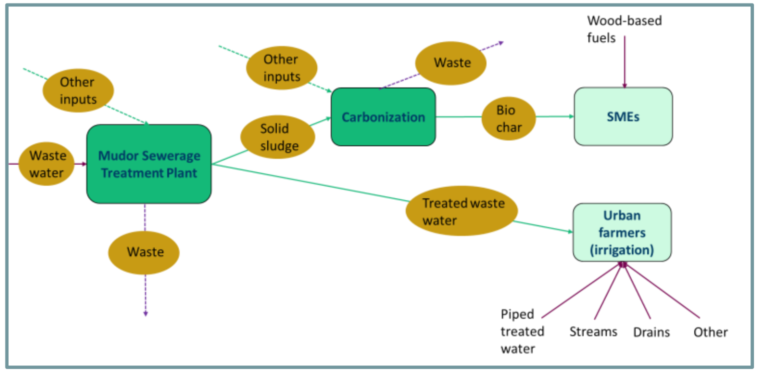
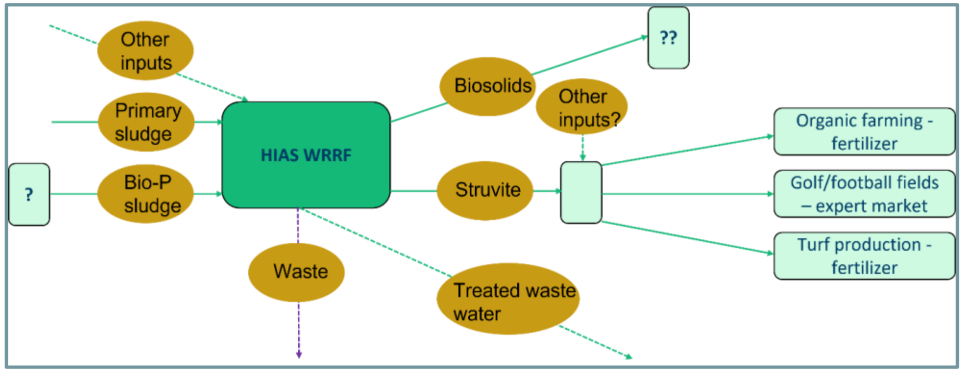
Optimisation of Symbiotic Circular Economy Solutions (SCES)

- Focus on value chain:
  - Relevant actors/entities
  - Relations between actors/entities
    → symbiotic solutions
    (WP 4: at least 3 entities, at least 2 resources exchanged)
- System boundaries – we consider only part of a circular system
- Sketched out possible value chains for Ghana and Norway cases





(to be discussed and refined)

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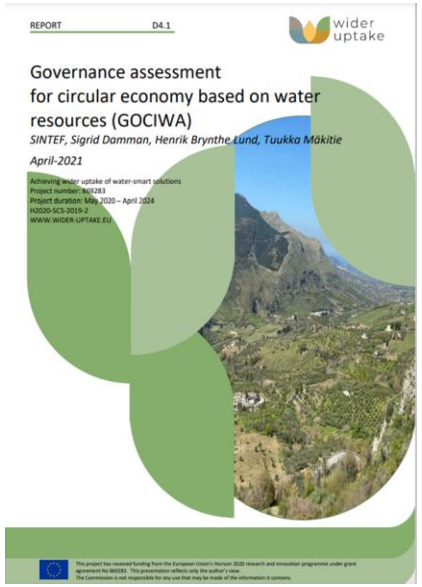
3. Governance and business models

- Tool for systematic assessment of the conditions, drivers and barriers to circular economy based on water-smart solutions in different governance contexts.
  - Not evaluation of what policy measures or instruments that are more or less apt - this will follow in subsequent tasks
  - For researchers and consultants, as well as public and private decision-makers who want to get an overview or make a "diagnosis"



- Case definition
  - Focal action situations, resources, actors, governance systems
- Wider Contexts (desk study)
  - Demography, environment, political, economic, socio-cultural context
- Structural context (interviews, desk study, workshops)
  - Levels and scales
  - Strategies and instruments
  - Actor networks
  - Perspectives and goals
  - Responsibilities and resources
  - Pre-existing technologies and procedures
- Case-specific context (interviews, desk study)
  - Previous decisions, context-specific circumstances, process (history of collaboration, agreements, struggles, etc.)

Summary scorecard

Context level	Dimension	Conducive factors	Nom. rank	Unconducive factors	Nom. rank	Development trend
Wider contexts	Demographic					
	Environmental					↑
	Political					
	Economic					↓
	Socio-cultural					↔
Structural context	Levels and scales					
	Strategies and instruments					
	Actors and networks					
	Perspectives and goal					
	Responsibilities and resources					
	Prevailing technologies					
Specific context	Synergies, strategic fit					
	Location and facilities					
	Capabilities and practices					
	User acceptance					
	Entrepreneurial initiative					

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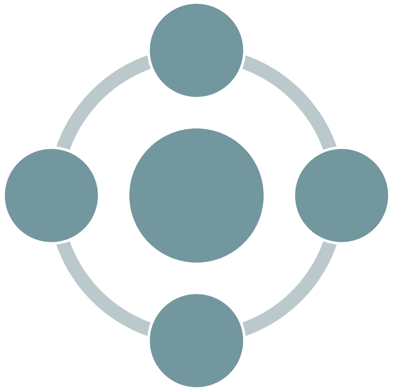
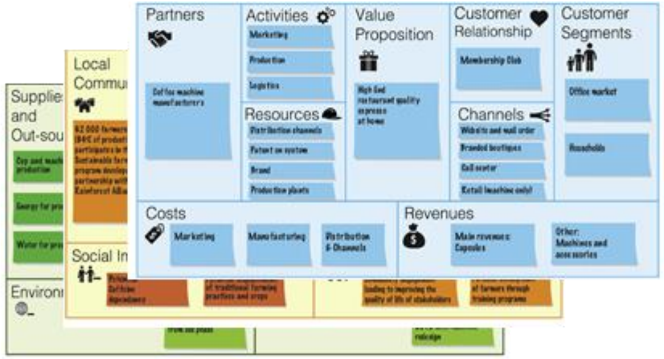
Further work

- Network and industrial symbiosis development
  - Set up and execute a plan for industrial network development
  - Action research and results from T4.1 will be applied



- Business model development
  - Triple-layered business model canvas
  - Aspects that need special attention; social and geographical proximity, input/output matching, stakeholder relationships, material flows, stores etc.
  - Identify potential for collaborative models, based on existing frameworks and capabilities of the solutions



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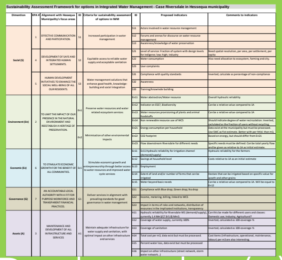
4. Water smartness: Assessment method development

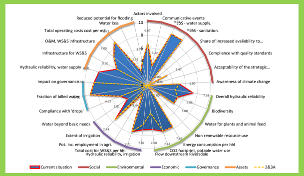
⇒ How do SCES contribute to achieving the properties that characterise a water-smart society and to progress towards SDGs?

- Holistic approach – technical performance, environment impact, societal aspects, economy, governance
- Build on previous projects on integrated water management with integrated sustainability assessments (ISA)
  - ISA framework structure based on EU-project TRUST – further developed by several, e.g., as in: Helness, H., Damman, S., de Clercq, W. P., and Elema, N. M. (2017). A Framework for Integrated Sustainability Assessment of Water Cycle Services. *European Journal of Sustainable Development*, *6*(4), 1-12. https://doi.org/10.14207/ejsd.2017.v6n4p1
  - Integration of assessment criteria and ranking of alternatives based on PCA as in: Helness, H., Damman, S., Sivertsen, E., and Ugarelli, R. (2019). Principal component analysis for decision support in integrated water management. *Water Supply*, 19(8), 2256-2262. https://doi.org/10.2166/ws.2019.106
- Interaction with WP2, WP3 and WP4 for input from their domains
  - Health & quality risks, circularity & resource efficiency and business models & governance, respectively
- Involve stakeholders for co-development, local adaptation and weighing of criteria

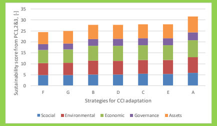
ISA matrix

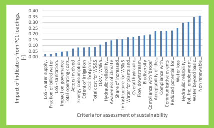


Radar plot(s)



Sustainability score:





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Approach to assess water smartness – main steps

1) Define *system* to be evaluated
2) Define *objectives* to be achieved to be *water smart*
3) Define *criteria* and *indicators* to assess achievement
4) Organise in similar manner as ISA frameworks
5) Develop/define alternative assessment *scenarios*
6) Compare alternatives (solutions and/or scenarios) with MVA

Steps 1–3: Co-developed with stakeholders

Steps 5–6: Involve stakeholders for local adaptation and weighing of criteria

- Iterative procedure

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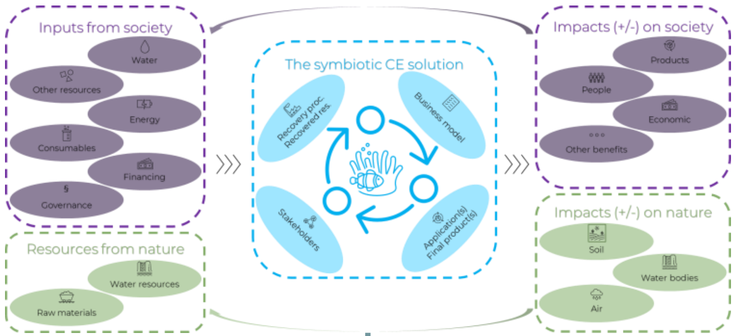
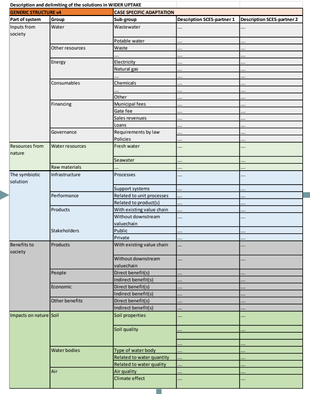
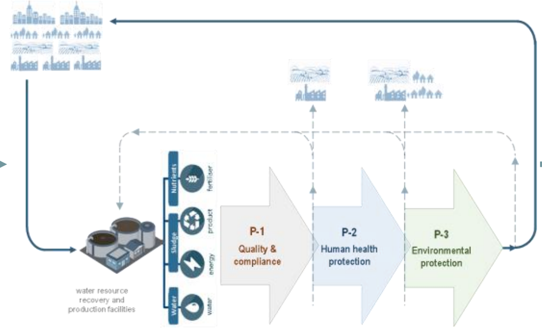
Aim to have common use of information



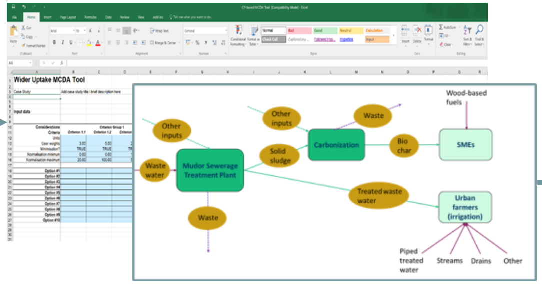
Information about the solutions demonstrated in WP1 to be used in the assessments



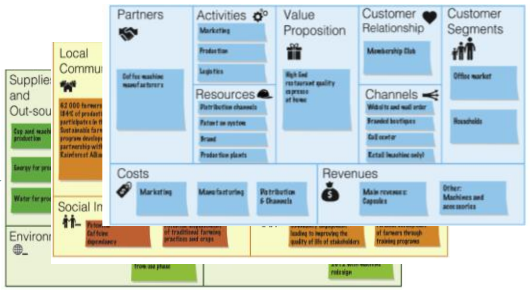
WP2



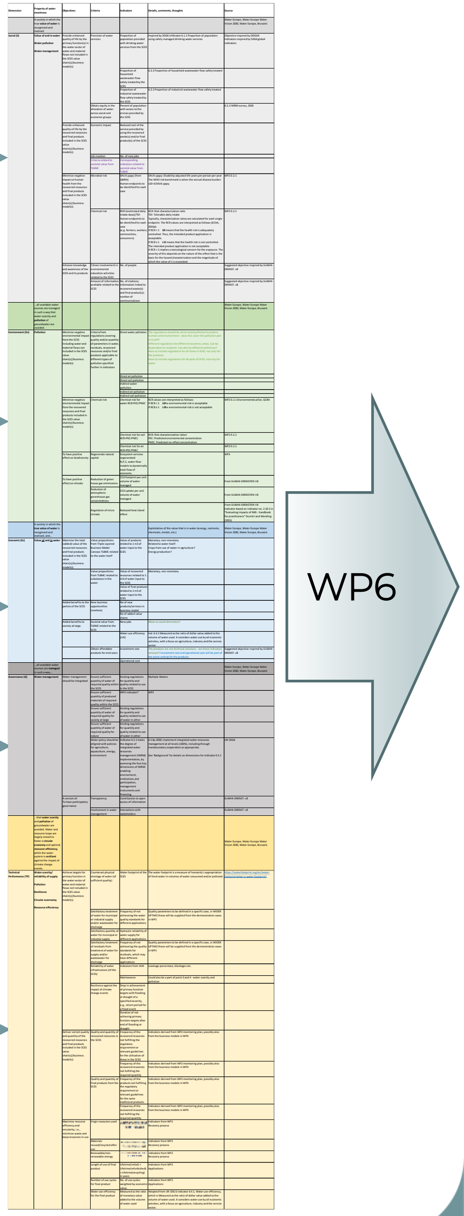
WP3



WP4



WP5 eventual additional info.



WP6

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Conclusions

- Use of treated wastewater should consider both the water itself and resources in the wastewater
- To realise the value of and in water one should target the most valuable resource in a given case
- "Water smart" use of treated wastewater and resources in it, requires assessment of:
  - Governance and regulations; health and quality; circularity and resource efficiency; sustainability of the solutions
- In Norway examples are (so far) on utilisation of carbon (bigas and soil) and phosphorus (struvite)

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wider uptake

www.wider-uptake.eu

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