Untapped opportunities of the Water-Sludge-Energy nexus

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PLATFORM BSR WATER

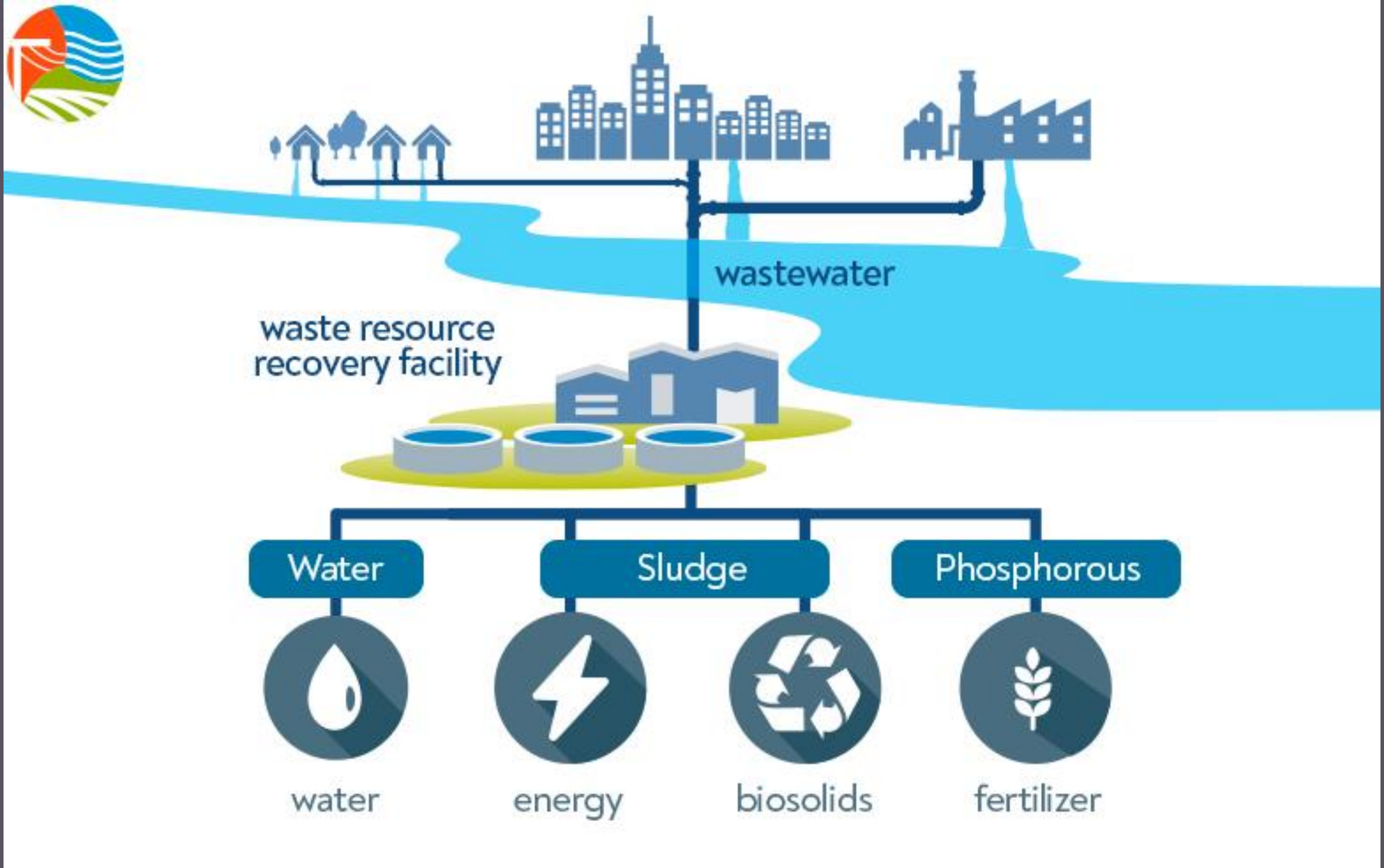
Interreg Baltic Sea Region

EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND

Major shift in paradigm

WWTPs around the world are currently going through a major change, driven by climate change, circular economy and advancements in technology:

- From energy consumers to energy or biofuel providers to municipality
- Producers of valuable substrates, such as fertilisers
- Treated wastewater is seen as a resource and considered for reuse (“Water reclamation facility”)
- WWTP is a place where public health can be monitored by continuous analysis of specific biomarkers



Source: The World Bank, "Wastewater? From Waste to Resource", www.worldbank.org/wastetoresource

WP4

Facilitation of the regional policy dialog on sustainable water management

Aim:

to elaborate policy tools, based on the outcomes of regional projects and HELCOM workgroups, and to facilitate regional dialog on promotion of sustainable solutions in waste- and storm water management to enhance utilization of nutrients and other valuable components

Activities:

- Developing regional policy recommendations on **nutrient recycling**
- Developing recommendation on **hazardous substances**
- Constructing **integrated model for Water-Sludge-Energy** cooperation
- Developing policy recommendations for implementing **sustainable urban storm water management**

GoA 4.3

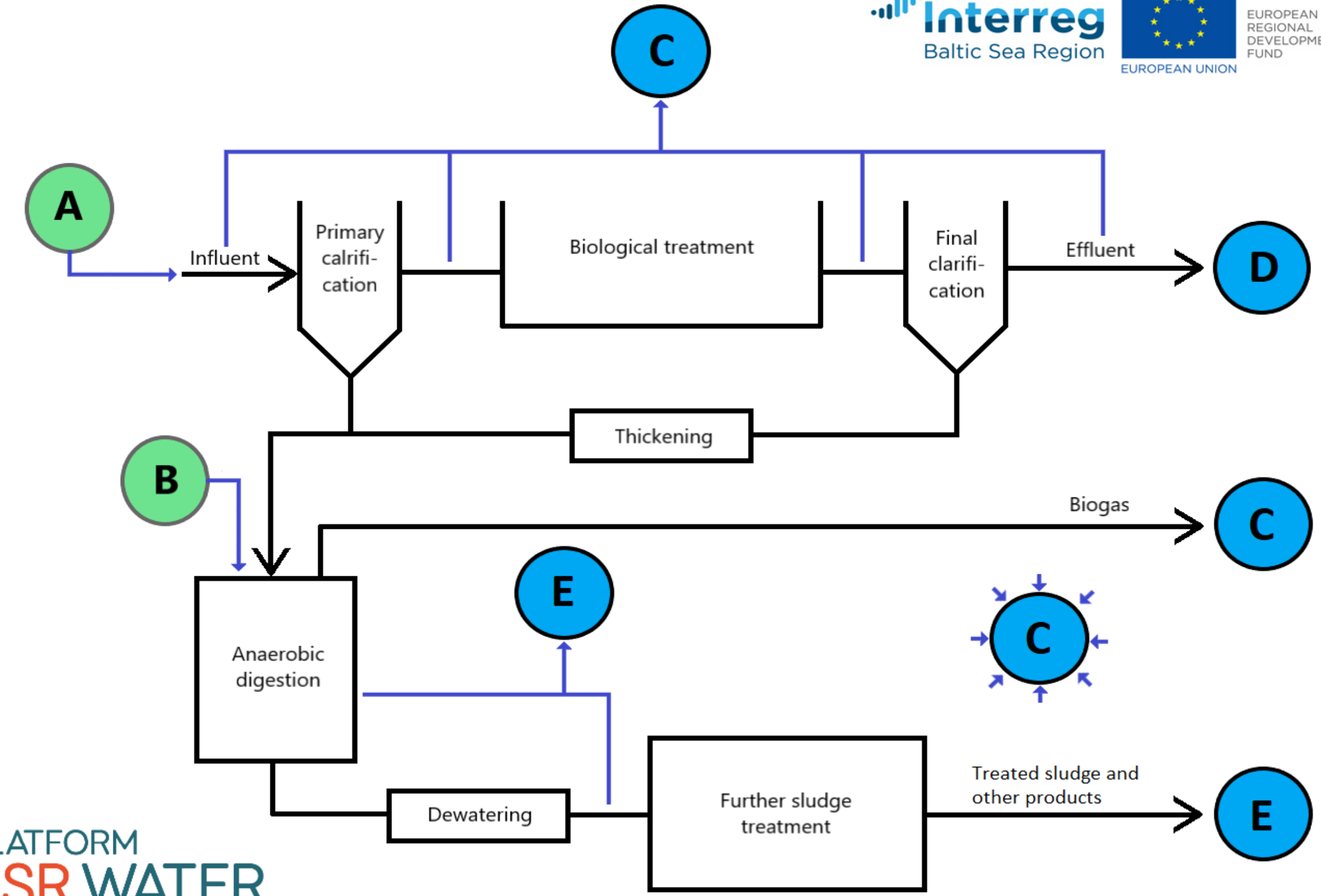
Water-Sludge-Energy Cooperation Model

Aim:

Consider necessary pre-dispositions and factors influencing successful cooperation model to establish sustainable circular economy linkages related to wastewater treatment. **Will be based on cases collected to the HUB**.

Layout:

Each point of cooperation will have specific recommendations, with specific descriptions, parameters and potential effects, financial feasibility and for most recommendations an **example case.**



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Points of Cooperation:

A – influent

B – biodegradable material to digester

C – energy and fuel produced

D – effluent for reuse

E – treated sludge, fertilisers or other materials

Incoming streams – example recommendations

Point A – influent to the WWTP

- Recommendation A.1 – Accepting wastewater with high easily degradable organic content from industrial sources (food industry)
- Recommendation A.2 – Accepting controlled pumping of liquid streams from septic tanks, pit latrines and other onsite sanitation system streams without significant chemical addition
- Recommendation A.3 – Separating stormwater and municipal wastewater sewer systems
- Recommendation A.4 – Accepting industrial wastewater with higher concentrations of hazardous substances for advanced treatment

Outgoing streams – example recommendations

Point C – Energy produced in the WWTP

- Recommendation C.1 – Increasing electricity production with new co-generation engines
- Recommendation C.2 – Selling surplus energy to the network
- Recommendation C.3 – Equipping the WWTP with heat exchangers to extract heat from sewage, sidestream or effluent
- Recommendation C.4 – Equipping the WWTP with solar panels
- Recommendation C.5 – Equip the WWTP with wind generators
- Recommendation C.6 – Producing hydropower from wastewater

Incoming points of cooperation

A – Influent to the WWTP

Recommendation A.1 – Accepting wastewater with high easily degradable organic content from industrial sources (food industry)

Recommended for:

- WWTP with anaerobic digestion or anaerobic treatment of wastewater;
- Smaller WWTPs struggling with biological nitrogen treatment due to low organic carbon content in the influent.

Description:

For a WWTP with biogas production, higher incoming easily degradable carbon can directly result in higher biogas production, in turn making energy neutral or even energy positive wastewater treatment plant operation a possibility. Food residues might however increase the maintenance needs of some of the equipment and therefore indirectly increase maintenance costs.

Accepting easily biodegradable carbon sources could also be feasible for smaller WWTPs with low BOD concentrations in their influent and additional methanol dosing for denitrification. In this case, small industries with lower flow rates are especially good, as too high incoming BOD can result in high secondary sludge production and create problems in sludge treatment.

Important parameters and potential effects:

- BOD and the BOD/COD ration describing biodegradability
  - Higher biogas production – with higher incoming BOD, both more primary and secondary sludge can be produced, increasing sludge mass transported to digestion and therefore biogas production as well.
  - For WWTP with too low organic carbon in the influent, accepting industrial high BOD influent can reduce or eliminate the need for external organic carbon addition via methanol dosing. This can also increase the efficiency of biological phosphorus and nitrogen removal and result in a cleaner effluent.
- Volume and redundancy of digesters
  - Accepting more organics means higher sludge production, therefore digesters need to have spare volume that can be used. In longer terms, building additional digesters could be feasible, while the stable industrial inflow and long-term agreements might be needed in case of new investments.
- Concentration of nutrients (nitrogen, phosphorus)
  - High additional N concentration can increase the aeration energy and potentially methanol dosing (depends on how much organics is taken out with primary sludge), resulting in higher expenses.
  - High additional P concentration can increase the need for chemical phosphorus precipitation, increasing expenses to precipitation chemicals such as $FeSO_4$ and $Al_2(SO_4)_3$.
- Hazardous components, such as heavy metals, different organic pollutants, pharmaceutical residues etc
  - can deem the treated sludge unusable, create environmental harm, bring the need for tertiary treatment in order to get the effluent clean,
  - can cause inhibitions to biological treatment or digestion, lower the efficiency and increasing financial costs. In very bad cases, severe inhibition can destroy biological treatment and result in very high effluent nutrient concentrations, bringing forth high environmental fees and potential fines.

Financial feasibility:

Financial feasibility will mainly come from increased biogas and energy production and from lower electricity bills. Additional influent will of course increase the costs of treatment and influent from the food industry can also significantly increase maintenance costs of equipment. In most cases, the practice is very cost-beneficent and should result in fast financial feasibility, with no high return times on investment. Some additional information should be considered:

- Financial feasibility of higher biogas production depends greatly on the biogas utilisation. Using CHPs with high electricity production ratios can increase the feasibility greatly, as smaller amounts of electricity need to be bought from the network or could even be sold back if the circuit is developed to accept electricity from distributed generation.
- While upgrading biogas to biomethane still in most calculations loses money compared to electricity production; gas-powered public transportation can be supplied with the biomethane. This is often a political decision (EU green transportation goals), while with good financial compensation measures in place, can also bring positive financial effect to the WWTP.

Example – Grevesmühlen WWTP in Germany

Thank you!

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