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CENTRE FOR
BIOENGINEERING &
BIOMEDICAL TECHNOLOGIES



Co-Director of the Centre for Bioengineering and Biomedical technologies

BACTERY

Co-founder and Director of Bactery Ltd



Research interests and expertise:

- **Bioelectrochemical systems (BES)** for sustainable solutions in energy harvesting and bioremediation of water and soil
- **Biosensors** for water quality monitoring and point-of-care soil diagnostics
- **Self-powered implantable and wearable bioelectronics** for the management of chronic conditions
- **Participatory design and co-development** to embed bottom-up perspectives in the research agenda

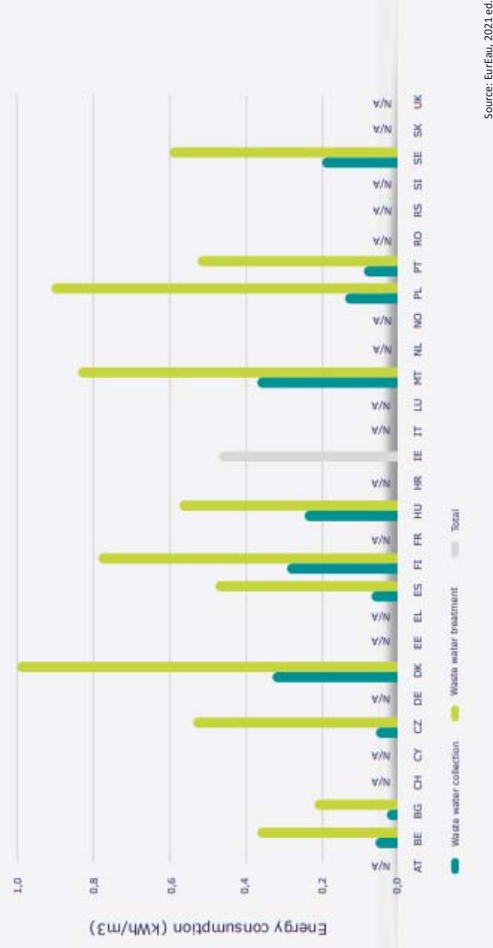


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Waste as a resource

Energy consumption for the collection and treatment of wastewater



OPPORTUNITIES:

- Recovery of electricity,
- Recovery of bioresources,
- H₂ generation
- Sequestration of carbon dioxide

FACTS:

- Every day **131 million m³** of wastewater is produced per day;
- Around **70-80%** of this wastewater is treated requiring up to **1%** of the daily consumption of energy (**25-30 kWh per capita** annually);
- Wastewater contains **40-60 %** of organic matter (in terms of COD).

Source: European Environmental Agency, UN

Energy production by water operators



Heat energy: incineration of sludge, heat recovery from sewers.

Electricity: hydropower from drinking water networks and reservoirs or wastewater networks, wind turbines and solar panels installed in water works

Decentralisation versus Centralisation

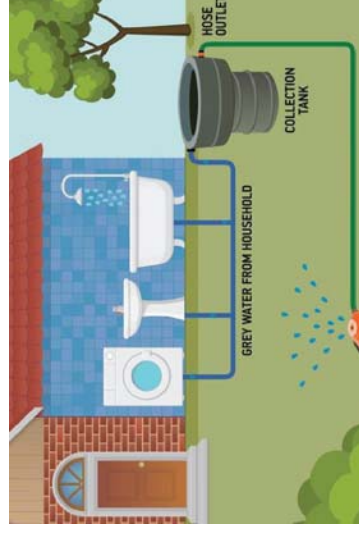
'Most of the UK has a combined sewerage system dating from the 19th century. This system carries rain and wastewater in the same pipes to sewage treatment plants. However, these become overwhelmed during heavy rainfall. To avoid the inundation of treatment plants, homes, and roads, water companies are allowed to discharge wastewater into our rivers and sea, which is known as combined sewer overflows.'

Source: Thames21, 9th April 2024

Aging infrastructure in wastewater treatment are responsible for:

- ~**20—30%** of water leakage
- **Billions of euros** lost annually (faulty pipelines can cost up to **€100 per meter**)
- up to **30% of contamination** of drinking water

Source: European Environmental Agency



VS



Benefits of Decentralisation

- **Lower capital costs** by up to **50%** in rural and peri-urban areas, where centralized systems are often not feasible
- **More resilient to climate-related impacts**, such as flooding or drought. In urban settings, decentralized systems help mitigate overloads on centralized infrastructure during extreme weather events, offering greater environmental sustainability
- Opportunity for better integration of **resource recovery** technologies, enabling the extraction of nutrients (like phosphorus and nitrogen), biogas, and reclaimed water, contributing to a circular economy approach
- Can incorporate **energy-efficient processes**, lowering the overall operational cost and reducing the carbon footprint