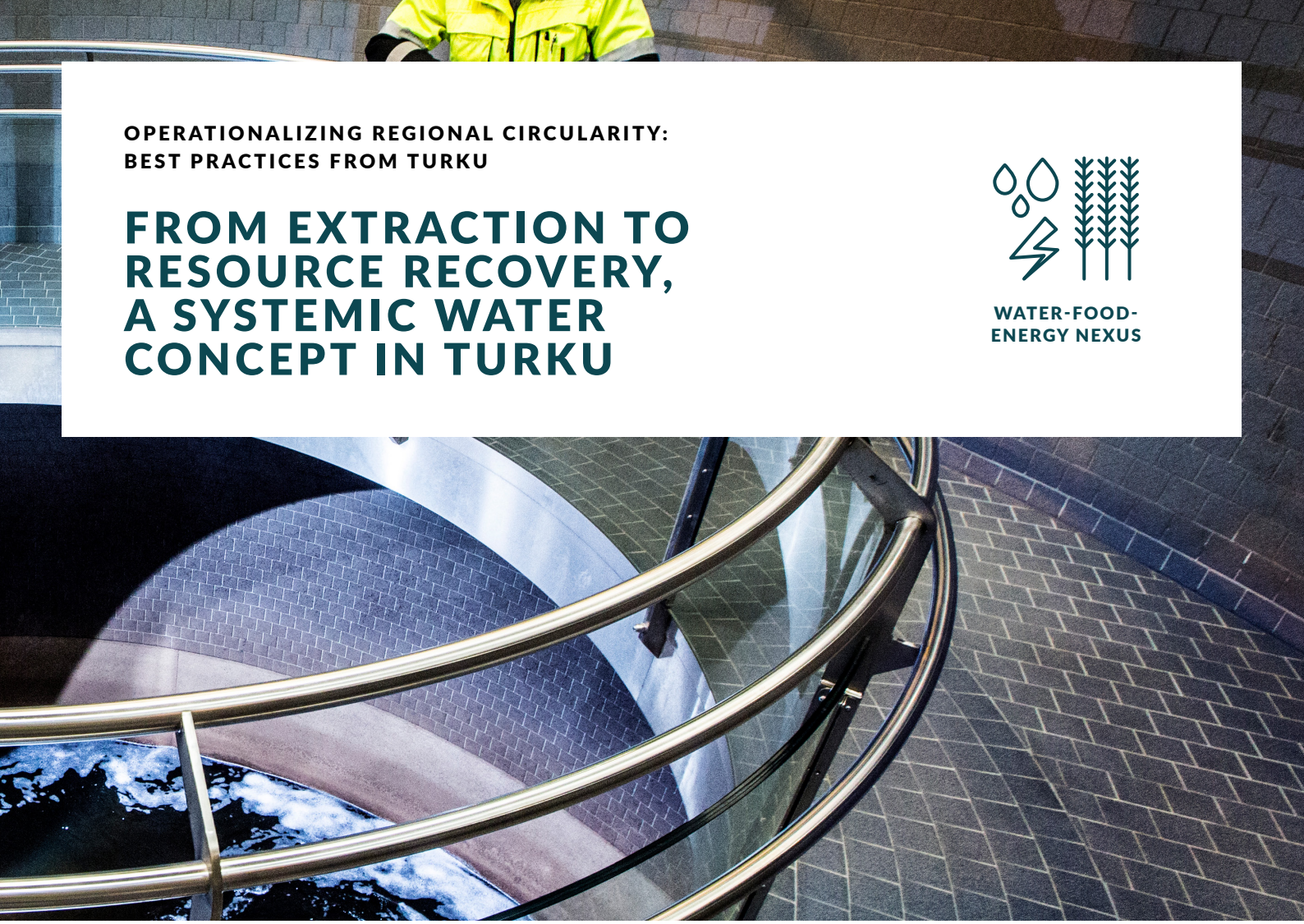

OPERATIONALIZING REGIONAL CIRCULARITY:
BEST PRACTICES FROM TURKU

FROM EXTRACTION TO RESOURCE RECOVERY, A SYSTEMIC WATER CONCEPT IN TURKU

WATER-FOOD-ENERGY NEXUS

Led by Turku's City Council, municipalities in the Turku region collaborated to design a systemic solution to water management in the area. From groundwater protection to energy positive treatment and nutrients recovery, the water concept developed in the Turku region offers a systemic circular economy solution to efficiently manage water, nutrients and energy at the local level.

CONTEXT

Until 2009, wastewater was collected separately by fourteen municipalities in the Turku region. Nutrients capture wasn't maximized which was causing the Turku marine area to be substantially polluted with phosphorus and nitrogen.

As for drinking water, it used to be produced by separate water production facilities using either groundwater or surface water obtained from small rivers nearby Turku. The quality and quantity of the river water was not sufficient. As a result, drinking water in the Turku area suffered from a bad reputation.

Turku acknowledged the need to reinvent water management in the region to both improve the water quality and protect local ecosystems.

KEY ACTORS

Two main actors are responsible for water management in the Turku region.

Turun Seudun Vesi Oy (Turku Region Water Ltd.) is a wholesale water company owned by seven municipalities in the Turku region. The company is responsible for planning and developing water production and distribution in the Turku region.

Turun seudun puhdistamo Oy (Turku Region Wastewater Treatment Plant Ltd.) is a wastewater treatment service provider that is owned by fourteen municipalities and a subsidiary of the city of Turku. The company is responsible for the operation and treatment of the Kakolanmäki wastewater treatment plant (WWTP), where most of the wastewater produced in the Turku region is directed.

The heat pump station located in the plant tunnels is operated by Turku Energia Oy (Turku Energy Ltd.), which is also owned by the city of Turku. Support services such as sludge treatment and maintenance services are outsourced to regional companies, with carbon neutral criteria integrated in tenders.

ACTION

Turku Region Water Ltd. and Turku Region Wastewater Treatment Plant Ltd. have developed innovative water management techniques to improve the sustainability of water networks in the Turku region, from water extraction to resource recovery at the other end of the pipe. Throughout the chain, the focus is placed on resource efficient and energy neutral processes and continuous improvement through research and development.

Groundwater protection

To protect the condition of groundwater aquifers and water availability, municipalities in the Turku region have been collaborating through Turku Region Water Ltd. to implement innovative managed aquifer recharge techniques. River water is sustainably collected, pre-treated and pumped to Virttaankangas Esker, one of the largest groundwater areas in Southern Finland. There, natural infiltration processes are used to convert pretreated river water to artificially infiltrated groundwater.

This technique offers a natural means of producing high quality water and increases the yields of the aquifer. The artificially infiltrated groundwater is then piped gravitationally to underground reservoirs where an electric turbine slows down the water movement at the end of the pipe and generates most of the energy required for water pumping, making it an energy-efficient process. The water is distributed to the 300.000 inhabitants, businesses and industrial sites of the Turku region.

Efficient wastewater management

Located in the solid rock of Kakolanmäki hill in the middle of Turku city, the Kakolanmäki WWTP processes the wastewater of residents in the Turku region.

The wastewater treatment plant uses mechanical, chemical and biological treatment processes. This combination makes the purification process very efficient: the plant removes up to 99 percent of organic matter and phosphorous and over 80 percent of nitrogen from the wastewater, far above the regulatory requirements.

Energy recovery

The Kakolanmäki WWTP also features a heat pumping station. Turku Energy Ltd. uses the station to extract some of the thermal energy from the wastewater to produce heat for district heating purposes (160 GWh / year) of 15.000 households. The water that is cooled down by the pumping station is also used for district cooling (30 GWh / year, or almost all of the need in Turku city).

Investments in research and development have allowed making the heat recovery system particularly efficient: one unit of electrical energy used at the station produces three units of district heating and two units of district cooling.

Sludge treatment

Sludge treatment has been outsourced to the state-own company Gasum Oy, which owns a biogas plant at the Topinoja waste treatment center in Turku. There, the sludge transported from Kakolanmäki is processed using anaerobic digestion. The plant processes 50.000 tons of sludge from Kakolanmäki WWTP per year, producing 30 GWh / year used in various regional transport needs.

One third of the nutrients from the digestate are used as fertilizers in agriculture and two thirds in landscaping. Nitrogen products produced from the sludge and sold to chemical industries.

SUCCESS FACTORS

- **Regional collaboration** between municipalities allowed them to pool resources to face the upfront costs of a very innovative wastewater treatment plant.
- **Focusing on continuous improvement and innovation** through collaboration with local universities and researchers has allowed the WWTP to continuously optimize its processes.
- **Incorporating circular criteria in the procurement of outsourced services**, such as sludge treatment and energy recovery services, which had to demonstrate carbon neutral processes, enabled the WWTP to focus on its core activities while ensuring circular economy side-activities were sustainable.

IMPACTS

Biodiversity protection: Centralizing all municipal wastewater treatment plants in one location at Kakolanmäki has decreased nutrient pollution in the surrounding marine area. Nutrients recovery practices have led to an 83 percent decrease in phosphorus load in the Turku marine area, which has had a positive effect on the water quality of the Baltic Sea.

Carbon savings: The various wastewater activities linked to Kakolanmäki produce 10 times more energy than they consume. It is estimated that carbon emissions in the Turku region are 80.000 tons lower per year because of the use of the heat pump station. As for the sludge treatment process, it is CO2 negative and energy positive.

Water security: The quality and supply of water has become extremely stable thanks to the use of managed aquifer recharge techniques and efficient wastewater treatment. Today, water in Turku benefits from a very good reputation.

NEXT STEPS

Looking into the future, Turku Region WWTP Ltd. is investing into adaptation to climate change. The period 2018-2023 will see the construction of a new wastewater removal channel at the Kakolanmäki WWTP. The new channel will separate the wastewater and stormwater discharge systems, enabling the WWTP to utilize its full wastewater treatment capacity during extreme weather conditions, which are expected to increase substantially in the future as a result of climate change.

Protecting the Archipelago and the surrounding marine area is a key concern for the city of Turku. Regional actors are working together to ensure the innovative water solutions already developed are continuously improved and adapted to changing weather patterns.

TURKU ÅBO

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