TURKU REGION WASTEWATER TREATMENT PLANT LTD.

ENERGY RECOVERY AND CARBON FOOTPRINT OF KAKOLANMÄKI WWTP

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Jarkko Laanti, Quality and Environmental Manager

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AT THE TOP OF MUNICIPAL WATER MANAGEMENT

https://www.youtube.com/watch?v=0fmZhRHH1BM

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TURKU REGION WASTEWATER TREATMENT LTD

- Wholesale company owned by 14 municipalities in Turku region in South-Western Finland
- Centralized wastewater treatment in the area
- Turku Region Wastewater Treatment Ltd (TSP) mission is to produce good quality and cost-effective wastewater treatment services to its owner municipalities by operating Kakolanmäki WWTP

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KAKOLANMÄKI WWTP

- WWTP is located in the solid rock of Kakolanmäki hill in the middle of Turku city
- Started in 2009
- WWTP treats 300.000 resident's wastewater and industrial wastewater of the area
- Average inflow is 90 000 m3/d
- The treated wastewater is discharged into the harbor basin

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OPERATING MODEL

Own personnel focuses on providing efficient and high-quality wastewater treatment

- Manages, operates and develops the WWTP (14 employees)
- Expertise in centralized regional wastewater treatment
- Strategy:
  - Best possible cleaning results cost-effectively
  - Optimizing the energy efficiency and carbon footprint
  - Preparing for the climate change and exceptional situations
  - Active partner in research and development projects

Support services are outsourced to reliable partners

- Sludge treatment (Gasum Oy)
- Maintenance services (Caverion Suomi Oy)
- Laboratory and reporting services (Lounais-Suomen vesi- ja ympäristötutkimus Oy)
- Cleaning, maintenance of automation systems, financial management services...

We work in accordance with the UN's Sustainable Development Goals

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RESULTS OF PURIFICATION

AMOUNT OF WASTEWATER	**2017***	**2018***	**2019***	**2020***	**2021***	
m^3/d	84 400	74 100	93 300	89 000	83 600	
m^3/a	30 800 000	27 000 000	34 100 000	32 600 000	30 500 000	
CONCENTRATION [mg/l]	**2017***	**2018***	**2019***	**2020***	**2021***	**ENIVIRONMENTAL PERMIT***
COD_{Cr}	38	35	27	24	20	≤ 60
BOD_{7ATU}	3,8	2,8	4,0	2,4	2,2	≤ 10
Phosphorus	0,17	0,12	0,11	0,099	0,13	≤ 0,3
Nitrogen	10	11	7,9	7,2	7,2	-
Suspended solids	3,6	2,2	2,6	1,2	1,6	≤ 15
CLEANING EFFICIENCY [%]	**2017***	**2018***	**2019***	**2020***	**2021***	**ENVIRONMENTAL PERMIT***
COD_{Cr}	95	96	96	96	97	≥ 90
BOD_{7ATU}	99	99	99	99	99	≥ 95
Phosphorus	98	99	99	99	98	≥ 95
Nitrogen	84	86	84	86	86	≥ 75
Suspended solids	99	99	99	100	100	≥ 95

* Including the sewage network overflows

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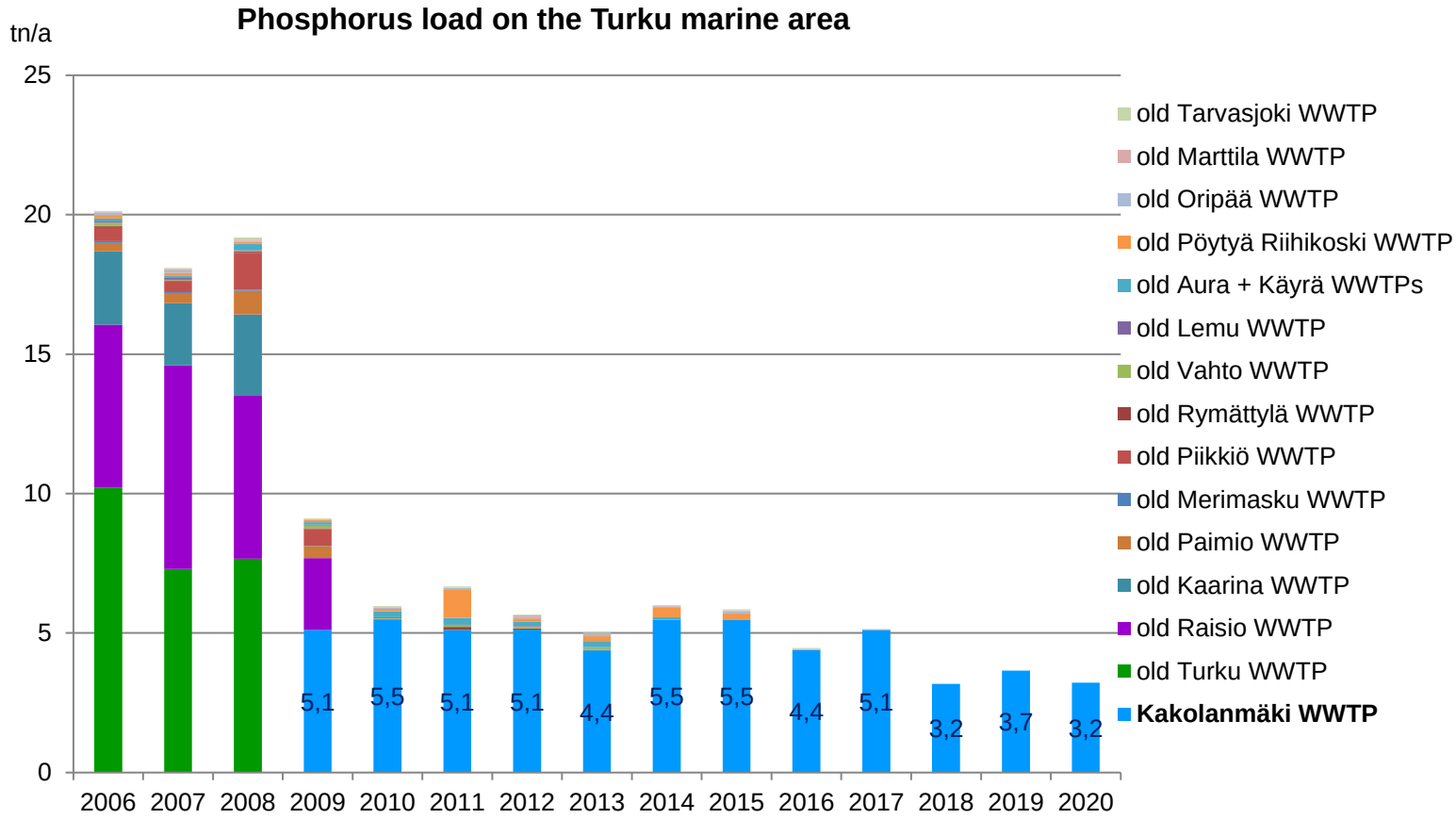
LOADS ON THE MARINE AREA



Phosphorus load on the Turku marine area has decreased approximately **83** percent or 16 t/a (2020 vs. 2006-2008)
BOD_{7ATU}-load on the Turku marine area has decreased approximately **79** percent or 280 t/a (2020 vs. 2006-2008)
Nitrogen load on the Turku marine area has decreased approximately **60** percent or 300 t/a (2020 vs. 2006-2008)
Suspended solids load on the Turku marine area has decreased approximately **94 %** or 610 tn/a (2020 vs. 2006-2008)

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COOPERATION

Energy efficiency by optimizing and developing energy consumption

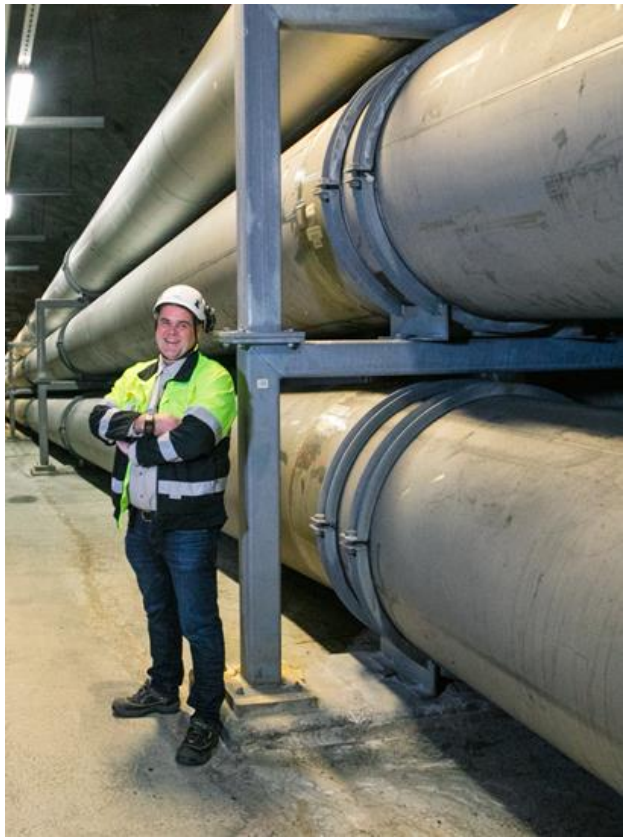
- Cooperation with local energy companies on heat recovery from wastewater
  - Heat for 15 000 households and almost all district cooling in Turku region
- Cooperation with Gasum on sludge recovery
  - Biogas, nutrients and heat

Own power generation

- Heat recovery from ventilation and compressors
  - Equivalent to 300 household's energy consumption
- Solar panels
- Heat Recovery to produce warm process water
- Future Energy Efficiency Measures
  - Turbine before the Outlet Pipe
  - Enhanced heat recovery from the aeration compressors

Commitment for the better Baltic Sea

- The Baltic Sea Challenge (http://www.itamerihaaste.net/en)



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HEAT PUMP STATION

- The heat of treated wastewater is used as renewable energy
- Energy company is producing district heating and district cooling from the wastewater
- The energy output is 200 GWh / year district heating and 20 GWh / year district cooling
  - That means 14 % of all district heating and almost all district cooling in Turku region
- Turku region carbon emissions are 80 000 tons lower per year because of the use of the heat pump station (vs. the situation in 2009)

Efficiency is good: One unit of electrical energy produces three units of district heating and two units of district cooling

TSE Turun Seudun Energiantuotanto Oy

TURKU ENERGIA

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SLUDGE TREATMENT

- Gasum Oy owns and operates the biogas station
  - 40 000 tn/a sludge from Kakolanmäki WWTP
- Mesophilic Process + Post hygienization (THP removal)
  - **Liquefied Biogas production for traffic**
- Reject Waters treated on site (Evapo-Stripping) (Low loading to WWTP)
  - High quality liquid Nitrogen-product (**with End of Waste -status**)
- The nutrients produced by the community are recycled for utilization (nutrient products for industry and recycling nutrients for landscaping and agriculture)
  - Solid fertilized compost for soil production + Biochar production -piloting

Gasum

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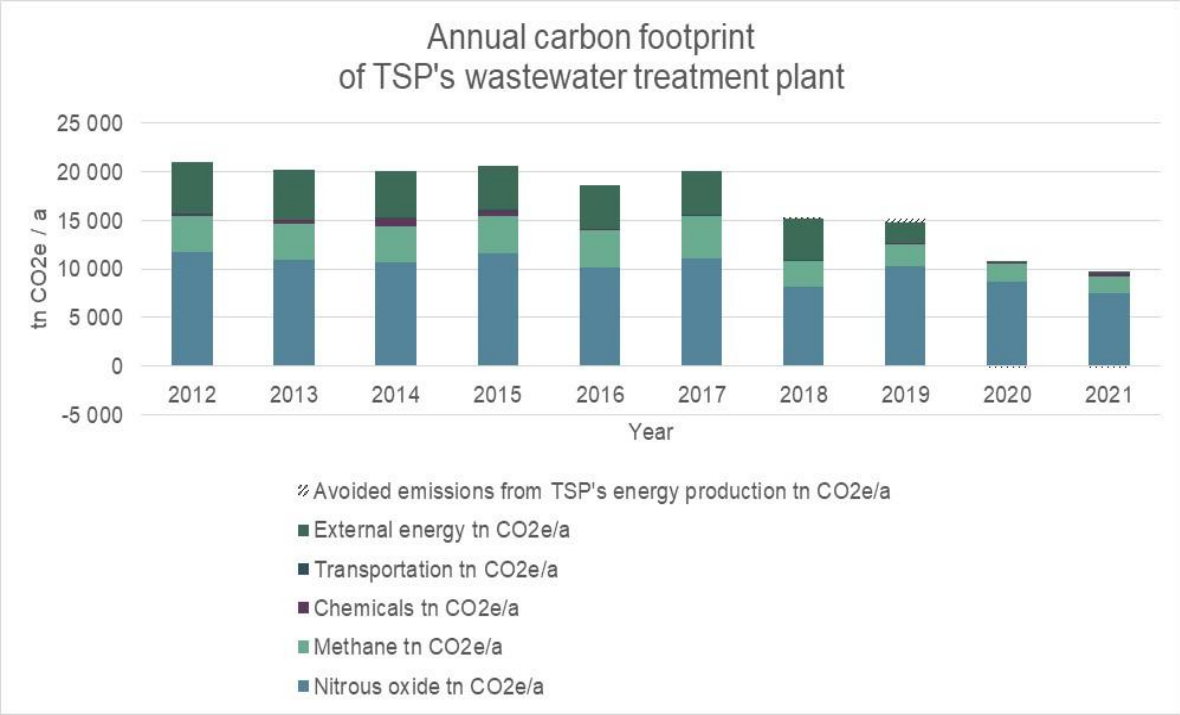
ANNUAL CARBON FOOTPRINT

Measures which have reduced the carbon footprint

- Energy consumption of the WWTP has been reduced
- Starting from the year 2019 the WWTP will move step by step to zero-emission electricity
- By changing the alkalisation chemical in 2016 reduction in emissions was achieved
- Variation in the WWTP inflow and loading causes changes in the evaluation of direct emissions



6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
11 SUSTAINABLE CITIES AND COMMUNITIES
13 CLIMATE ACTION
14 LIFE BELOW WATER

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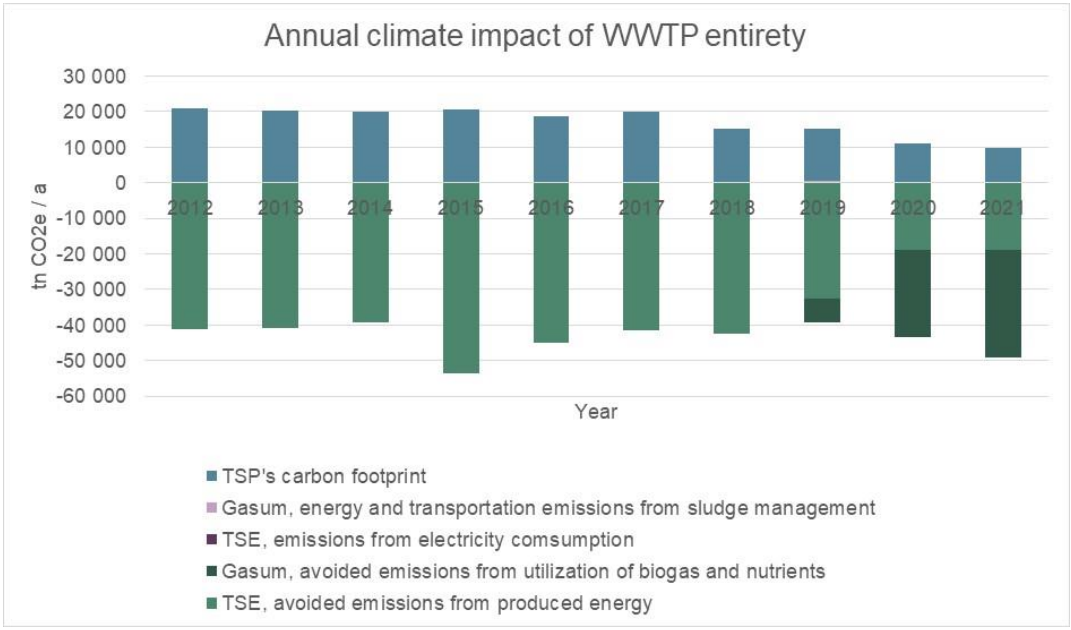
CLIMATE IMPACT OF WWTP AS ENTIRETY

- In the chart emissions of the WWTP operation and the emissions and avoided emissions from operations affiliated with it are presented
  - WWTP operation
  - Sludge treatment at Gasum's biogas plant
  - Waste heat utilization at TSE's heat pumping plant
- Operation enables bio-based energy production in external entities which makes it possible to avoid using fossil energy sources



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ENERGY BALANCE 2021

ENERGY CONSUMPTION OF WWTP AND NETWORK		
• TSP	15 908	MWh/a
• TSP, pumping stations	7 000	MWh/a
TOTAL ENERGY CONSUMPTION	**22 908**	**MWh/a**
ENERGY PRODUCTION OF WWTP AS ENTIRETY		
• TSP, solar panels (+ turbine)	35	MWh/a
• TSP, heat recovery	2 300	MWh/a
• TSP, process water heat exchanger	549	MWh/a
• TSE, heat pumping plant, district heat production (net)	24 558	MWh/a
• TSE, heat pumping plant, district cooling production (net)	174 704	MWh/a
• Gasum, biogas plant, sludge treatment (TSP's share, net)	5 889	MWh/a
TOTAL ENERGY PRODUCTION	**208 034**	**MWh/a**

WWTP operations produce nearly ten times as much energy as they consume

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FOR THE BETTER FUTURE FOR ALL

- WWTP’s operations are based on excellent know-how and optimized operating models. This knowledge can be utilized all over the world.
- Interest in the wastewater expertise has already been considerable, and there are thousands of visitors every year from all over the world.
- The whole process is a great example of the functionality of a circular economy.

Taking into account all factors, the end result is the world's best wastewater treatment.

SUSTAINABLE DEVELOPMENT GOALS

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THANK YOU!
Only the sun may go down to the Baltic Sea without purification.
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