Wastewater Treatment Update

FINLAND

Mari Heinonen
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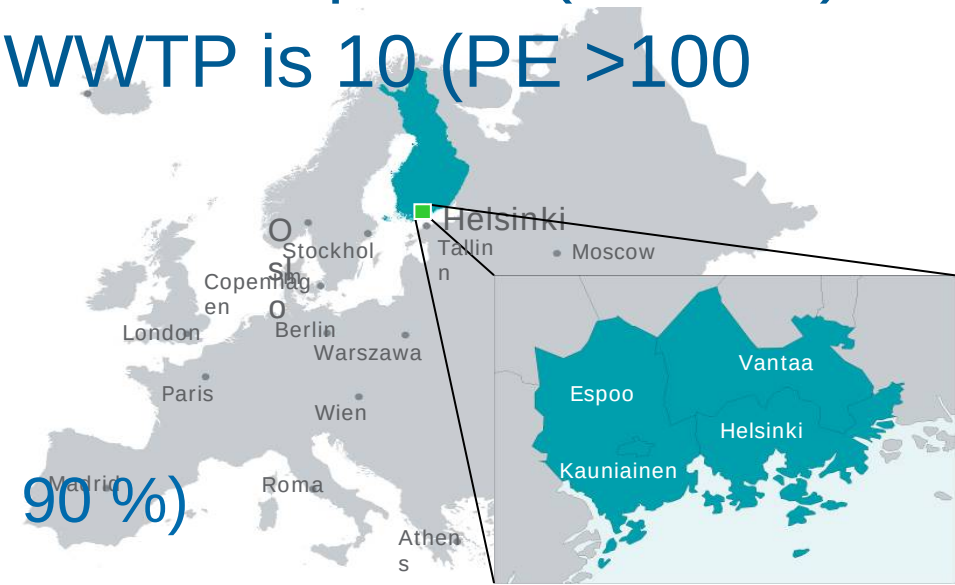
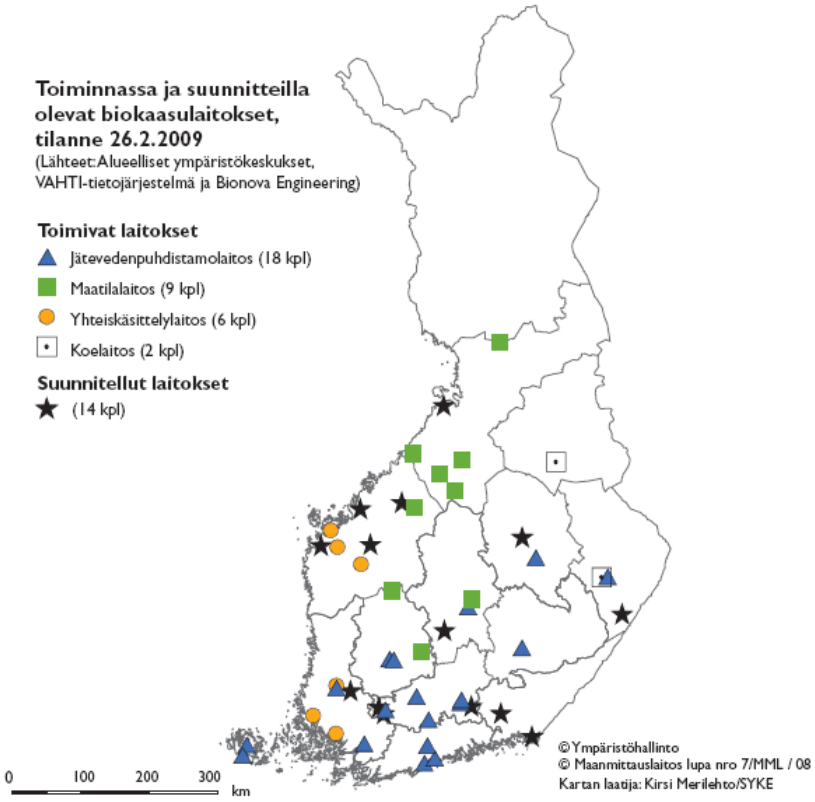
Wastewater Treatment in Finland

- 80 % population is connected to municipal wastewater treatment plants
  - Treatment process is typically combined biological organic material and N removal + chemical precipitation of P
- 540 wastewater treatment plants (PE >50)
- Number of large WWTP is 10 (PE >100 000)
- Reduction level
  - BOD 97 %
  - P 96 %
  - N 56 % (Helsinki 90 %)



Methane Reduction, Recovery, and Use Initiatives in Finnish WWTP

- Municipal WWTP + digesters 18 pcs.
- Municipal sludge + biowaste combined digesters 8 pcs.
- Industrial WWTP 4 pcs.



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Biogas production

- Biogas production at 60 % of WWTP (PE > 10 000)
- Annual biogas production 24 Mm3/a
- 20,5 Mm3/a was utilised
- El prduction 27 GWh
- Heat production 80 GWh

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Biogas production

WWTP	Year	Material	Reactor capacity m3	Biogas production (Mm3/a)	Utilization
Espoo / HSY	1981	Sewage sludge	2*6 000	2,9	CHP
Helsinki / HSY	1994	Sewage sludge	4*10 000	10,0	CHP
Forssa	1999	Sewage sludge	1 475	0,3	CHP
Hämeenlinnan seutu HS	1988	Sewage sludge	3 000	0,75	CHP
Joensuu	1987	Sewage sludge	2*2 000	0,8	CHP
Jyväskylän seutu JS	1987	Sewage sludge	2*2 750	1,6	CHP
Kuopio	1987	Sewage sludge	2* 3 000	1,1	CHP
Lahti Aqua1	1976	Sewage sludge	2*2 000	0,6	Heat
Lahti Aqua 2	1981	Sewage sludge	2*4 000	1,2	Heat
Maarianhamina	1979	Sewage sludge	2 000	0,3	CHP
Mikkeli	1962	Sewage sludge	2 000	0,4	Heat
Riihimäki	1974, 2005	Sewage sludge	1500 +800	0,7	CHP
Salo	1982	Sewage sludge	2 000	0,3	Heat
Tampere 1	1962	Sewage sludge	2*1 500	0,8	Heat
Tampere 2	1985	Sewage sludge	2*3 500	1,8	CHP
Klaukkala	2005	Sewage sludge		0,1	Heat

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Barriers/Challenges to Methane Reduction, Recovery, and Use

- Size of the units is rather small
  - Large number of WWTP units which PE < 10 000
- Strong pressure to combined digesters (bio waste)
  - Increase the digestion unit dimensions and make it economically attractive
  - Negative influence to water process of WWTP (concentrated reject water)
  - 2 new combi plants had start up 2012 (Kouvola, Kokkola)
- Production subsidiary mechanism for new biogas production units started in 2010
- Support mechanism for investments which will increase energy efficiency (20-30 %)

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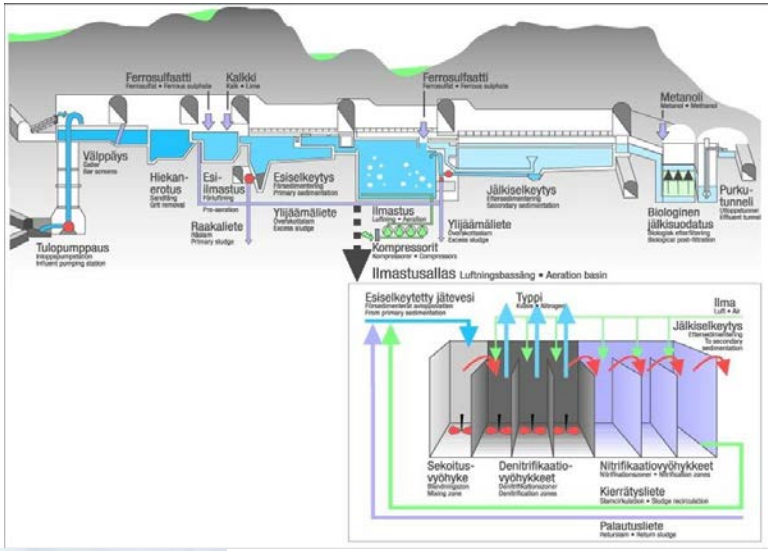
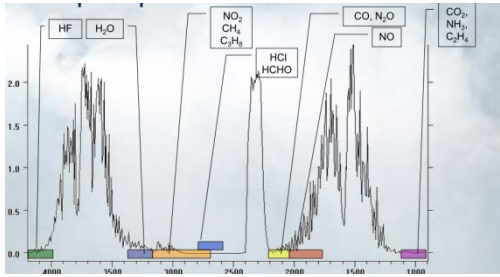
New step for process emission control

- On line measurement of process gases was implemented in June 2012 at Viikinmäki WWTP
- Online measurement of methane, CO2, N2O etc.
- New and continuous information of process gases and correlations by Gasmet CEMII FTIR





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Centralised Wastewater Treatment examples

- Wastewater treatment is centralized into two plants in Helsinki metropolitan area:
  - **Viikinmäki WWTP and Suomenoja WWTP**
- Biological treatment is combined with chemical treatment
  - Phosphorus is removed by chemical precipitation with ferrous sulphate
  - Nitrogen is removed biologically by nitrification denitrification process
- Side products are **sludge and biogas**.
- **Biogas is used as a source of energy (CHP) in Viikinmäki**
- **Suomenoja bio gas is utilized as vehicle fuel by GASUM Ltd.**
- Sludge is composted to the soil products

Viikinmäki WWTP

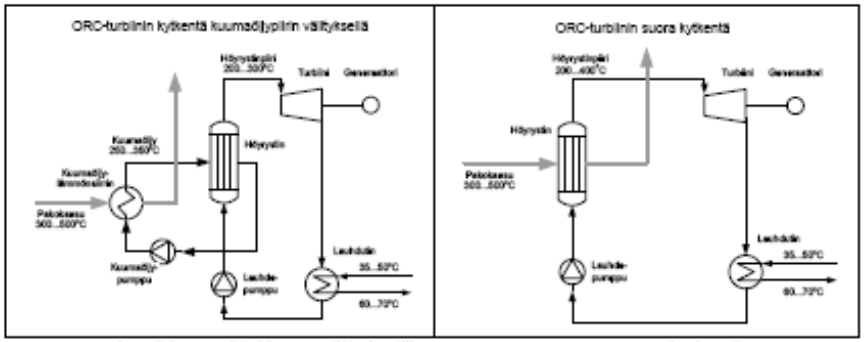
Suomenoja WWTP

Case Viikinmäki WWTP

- 3 original 1994 gas motors (3*0.7 MW) , 1 motor (1 MW) 2010, 1 motor (1,5 MW) 2012
- Biogas production 12 Mm3/a (5 % wasted by flaming)
- Annual power production 23 GWh + heat 27,5GWh (+4 GWh by heat recovery of effluent water)
- Original old gas motors will be replaced step by step – next unit in 2014 (1,5 MW)
- App. 20 % increase in energy efficiency
- New engines will be equipped with gas cleaning system (active carbon)

Case Viikinmäki WWTP – ORC

- New gas motor (2012) will be combined with ORC tecnology
- ORC (Organic Ranking Cyckle) is under purchase process at the moment
- Investment will be supported by TEM (Ministry of employment and energy)
  - Support max level 24 % of the investment
- Implementation Q4/2013
- Designed for 1,5 MW gas motor exhaust gas heat potential
  - 165 kW max power
  - 120 kW effective power generation



1. Kytkentä kuumaöljykierron välityksellä
2. Suora kytkentä

Case Suomenoja WWTP

- Biogas has been sold out for vehicle fuel (Gasum Ltd.) from 11/2012
- 1 original gas motor (0,6 MW) – lack of operational saftety
  - Used in case of operational breaks
- Biogas production 3,5 Mm3/a
- Annual power production 5 GWh