District heating enables systemic change to renewable energy system

Heli Antila
Our current geographical presence

**Nordic countries**
- Power generation: 45.4 TWh
- Heat sales: 5.0 TWh
- Electricity customers: 2.4 million

**Poland**
- Power generation: 0.5 TWh
- Heat sales: 3.7 TWh

**Baltic countries**
- Power generation: 0.7 TWh
- Heat sales: 1.4 TWh

**Russia**
- PAO Fortum
- Power generation: 26.3 TWh
- Heat sales: 19.8 TWh

**India**
- Power generation: 0.3 TWh

**Key figures 2017**
- Sales: EUR 4.5 bn
- Comparable operating profit: EUR 0.8 bn
- Balance sheet: EUR 22 bn
- Personnel: 8,800
City Solutions CHP assets and district heating operations
Current focus in Nordics, Poland and Baltic rim

Fortum’s European heat production 16.6 TWh* in 2017

- Biomass 28%
- Oil 1%
- Peat 2%
- Natural gas 4%
- Heat pumps, electricity 16%

*Production capacity 6,513 MW*

- Waste 27%

- Coal 22%

- Woodchips, peat + pyrolysis plant
- Czestochowa
- New unit ready 2018: coal, waste

- Woodchips, horse manure & SRF
- Järvenpää

- Woodchips
- Jelgava

- Woodchips
- Pärnu

- Woodchips, peat
- Tartu

- Woodchips
- Värtan KVV8, Brista 1

- Wood pellets
- Hässelby

- Woodchips
- Naantali

- MSW, RDF, woodchips
- Klemetsrud**

- MSW, RDF, woodchips
- Klaipėda

- MSW, ICW, RDF
- Högdalen

- Coal, natural gas
- Espoo

- Coal
- Bytom

- Hazardous waste
- Nyborg

- Hazardous waste
- Riihimäki

- Hazardous waste ICW + MSW
- Kumla

- Coal/gas-CHP

- Associated companies
- Värtan, old units

- Coal, oil
- Brista 2

- Co-owned and consolidated companies
- MSW, RDF, woodchips
- Klaipėda

- MSW, ICW, RDF
- Högdalen

- Hazardous waste ICW + MSW
- Kumla

- New unit ready 2018: coal, waste
- Järvenpää

- Waste-CHP

- Waste CHP
- Multifuel-CHP

- Woodchips
- Pärnu

- Woodchips
- Tartu

- Coal, woodchips
- Naantali

- Coal, natural gas
- Espoo

- Coal
- Bytom

- Waste
- Järvenpää

- Waste
- Espoo

- CHP plant locations today
- Associated companies’ CHP plants
- District heat supply/networks w/o own production

- Coal/gas-CHP

- Fortum’s total heat production 36.6 TWh in 2017

Note: Fortum’s total heat production 36.6 TWh in 2017
Waste-to-energy plant belonging to Fortum Oslo Värme, which is owned together with City of Oslo since August 2017. Fortum is responsible for operating the joint venture.

Heat production incl. Fortum’s associated company Stockholm Exergi; heat production 8.0 TWh (capacity 3,842 MW).
Fortum – For a cleaner world

**Megatrends**
- Climate change and resource efficiency
- Urbanisation
- Active customers
- Digitalisation, new technologies

**Vision**
For a cleaner world

**Mission**
We engage our customers and society to drive the change towards a cleaner world. Our role is to accelerate this change by reshaping the energy system, improving resource efficiency and providing smart solutions. This way we deliver excellent shareholder value.

**Strategy**
- Drive productivity and industry transformation
- Grow in solar and wind
- Create solutions for sustainable cities
- Build new energy ventures
IPCC: Staying below 1.5°C requires “rapid and far-reaching transition” – Fortum calls for an ambitious EU climate strategy

- We need to reach global carbon neutrality by 2050
- The power sector should reduce emissions by 100% well before 2050
- 70-85% of electricity should come from renewables and nuclear will play a bigger role
- We believe electrification will be an enabler for decarbonisation
- We ask for a stable, visionary, and long-term political framework
- Carbon pricing should be the key for reaching carbon neutrality and market mechanisms developed to reward CO₂ removal
Transition towards Solar Economy is ongoing
Wind capacity scenario forecasts compared over time

Cumulative installed capacity

Net capacity additions per year

Solar capacity scenario forecasts compared over time

Cumulative installed capacity

Net capacity additions per year

Onshore wind and solar PV have become competitive among new power plants in most regions across the World

Recently announced long-term Power Purchase Agreement contract prices / tariff levels

Sources: announcements by the investing companies and IEA report “Renewable Energy Medium-Term Market Report 2015” for US, Brazil, South Africa, Australia and Jordan. Values reported in nominal euros. United States values calculated excluding tax credits. Typical contract lengths are 15-25 years. The prices indicate levels with which investors have been willing to invest, however, they may not describe the actual comparable costs as the bid prices may be reduced by preferential land prices, site exploration cost, targeted low-cost loans etc.

For Sweden the price level at which investors can hedge their renewable production for the next 4 years: average of 2017-2020 electricity (LUL) + elcertificate futures with 29.8.2016 closing prices. In Spain, wind and solar built on market prices with only downside protection mechanisms in case of significant drop in market price. Germany and Netherland have had merchant bids in offshore were grid connection is provided by TSO.
Renewables demands a new way to look at the energy system

- Energy is a limited resource
- Focus on how much energy is used
- Minimize usage of energy
- Fixed tax
- Support for renewable generation
- Focus on the electricity system
- Focus on national solutions
- Solar PV important in the solar belt
- Baseload will secure the future
- DH is old-fashioned and fossil based

- Energy is an infinite resource
- Focus on when energy is used
- Optimize production capacity
- Variable tax
- Support for flexible generation
- Focus on the energy system
- Focus on regional solutions
- Wind and hydro important in the Nordics
- Baseload looses importance
- DH is smart, sustainable and a complement to renewables
The electric system is supported by the heat, gas and transport sectors as well as by the customer.
The energy system is becoming more interlinked – and more complex – with electrification and decarbonisation as key drivers.
Integration of district heating and electricity systems
Size of Nordic power and CHP systems

Nordic power system:
• 400 TWh annual consumption
• 72 GW peak demand

Nordic CHP sector:
• 55 TWh annual consumption
• 16.5 GW installed capacity

If all DH networks would be replaced by electrical heating (heat pumps and boilers), the energy and capacity demand would grow by 20% and 50% respectively.
Centralised heating enables more intermittent wind and solar production

Finnish electricity and heat demand

- Electricity demand without district heating and CHP
- Electricity demand without district heating*
- Electricity demand
- District heat demand

*Heat demand produced with heat pump increase electricity demand with 1/3 of the heat demand
Integration of district heating and electricity systems
DH alleviates supply and demand imbalances in the electricity system

In the future the DH system support to the power system is accentuated with the build up of additional wind power capacity.
District heating – enabler of energy recycling

A DH network can reuse excess heat from e.g. the following sources:

- Industrial processes
  - Refineries and chemical industry
  - Pulp and paper industry
  - Metal smelters and workshops

- Waste water treatment plants

- DH’s own customers
  - Exhaust air heat pumps
  - Ground heat pumps
  - Cooling equipments (shopping centers, cooling storages, hospitals etc.)
District heating – enabler of energy recycling

- Waste heat from e.g.:
  - Industrial processes
  - Waste water treatment plants
  - Excess heat from customers

- Non-recyclable side-products and waste

- Heat generated from renewable fuels
  - Forest industry and agricultural residues
  - Biogas
  - Bio oils

- Heat generated from fossil fuels
  - Coal, Natural gas, Peat, Fossil oils

Modern district heating system enables capturing otherwise lost energy; storing, up-grading and re-using in space heating
SmartLiving – end-customer experience

1. Steady indoor climate
2. Decreasing heating costs
3. Shared goals for increasing living comfort

Weather information and forecast
Ecologically optimized production
Building owners and residents
Machine intelligence

Powered by Leanheat
Thank you

Join the change!