Building Energy Exergy: From Analysis to Applications Aalto University

Waste heat utilization in Espoo’s district heating network

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Espoo – the 2nd largest city in Finland

- 280,000 residents
- Awarded as the Most Sustainable City in Europe
- Aims to be carbon-neutral in 2030
- **900 km of district heating network**
- **Total 250,000 end users**
- **Heat production capacity 1380 MW**
- Total annual heat production 2,200 GWh, power generation nearly 600 GWh
- 230 MW of coal-fired heat units in base load use, accounting for 50% of production

Espoo Clean Heat

Carbon neutral district heating in Espoo in the 2020s

Fortum and the City of Espoo have committed to carbon-neutral district heating in the district heating network operating in the Espoo, Kauniainen and Kirkkonummi regions in the 2020s. Now the development work is being accelerated with a new intermediate goal to discontinue the use of coal in 2025.

The accelerated project for carbon-neutrality in 2020's is called Espoo Clean Heat. It is the most significant climate action in Espoo.

The new generation of district heating is based on replacing fossil fuels with smart and flexible solutions, e.g. by utilising waste heat, renewable electricity, geothermal energy, and bioenergy. Artificial intelligence optimises the district heating system’s operations. www.espoocleanheat.com

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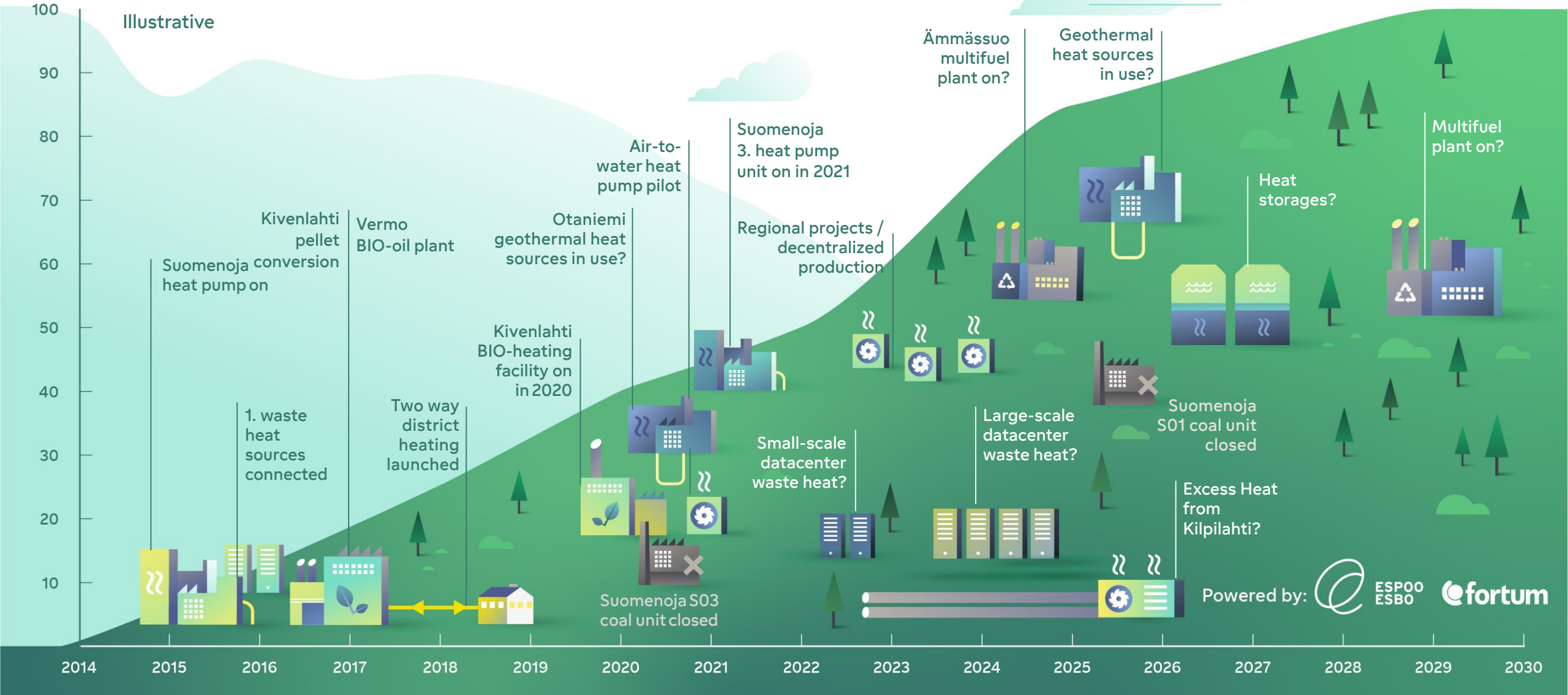
Espoo district heating transformation journey 2014–2029

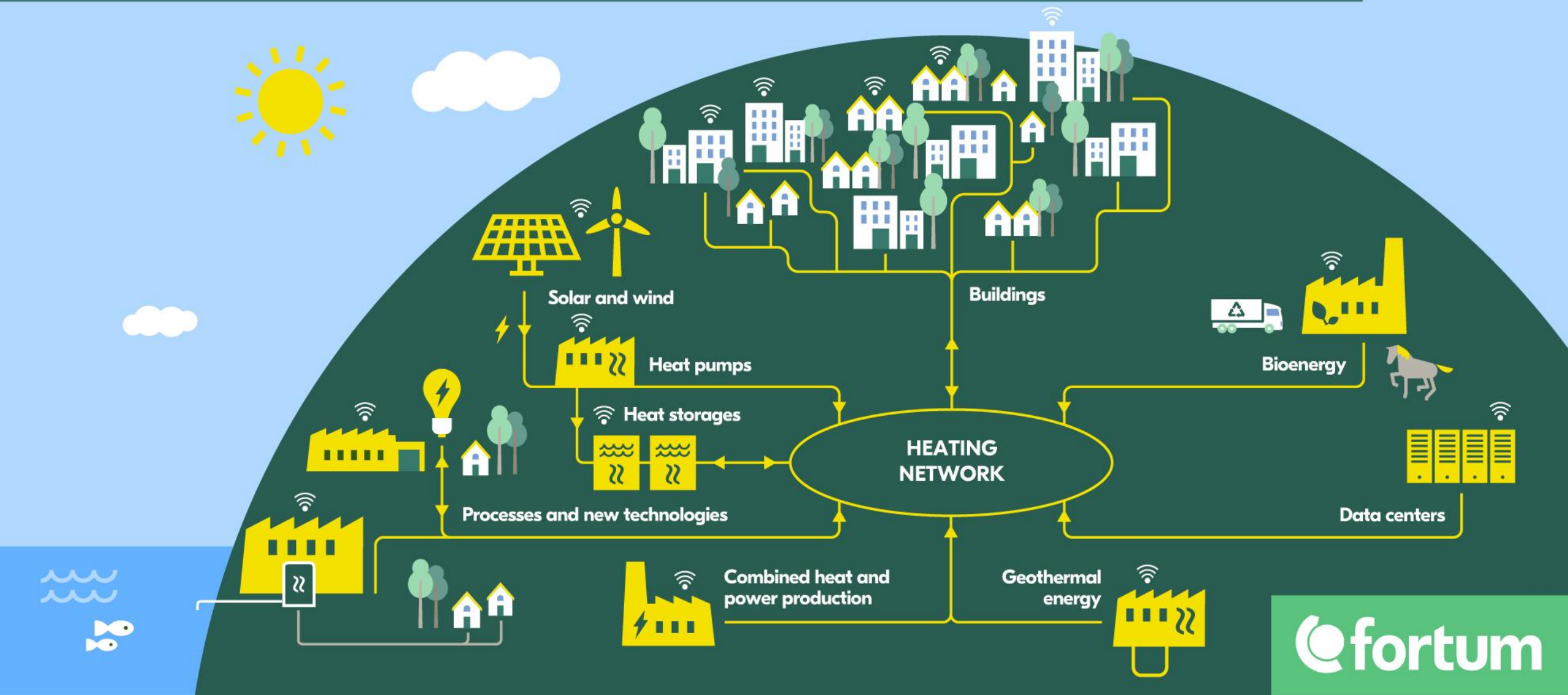
Espoo Clean Heat

% CO_2 emissions in relation to 2014 level

% share of carbon neutral production



Flexible, smart and two way district heating network — enabler of carbon neutral energy system



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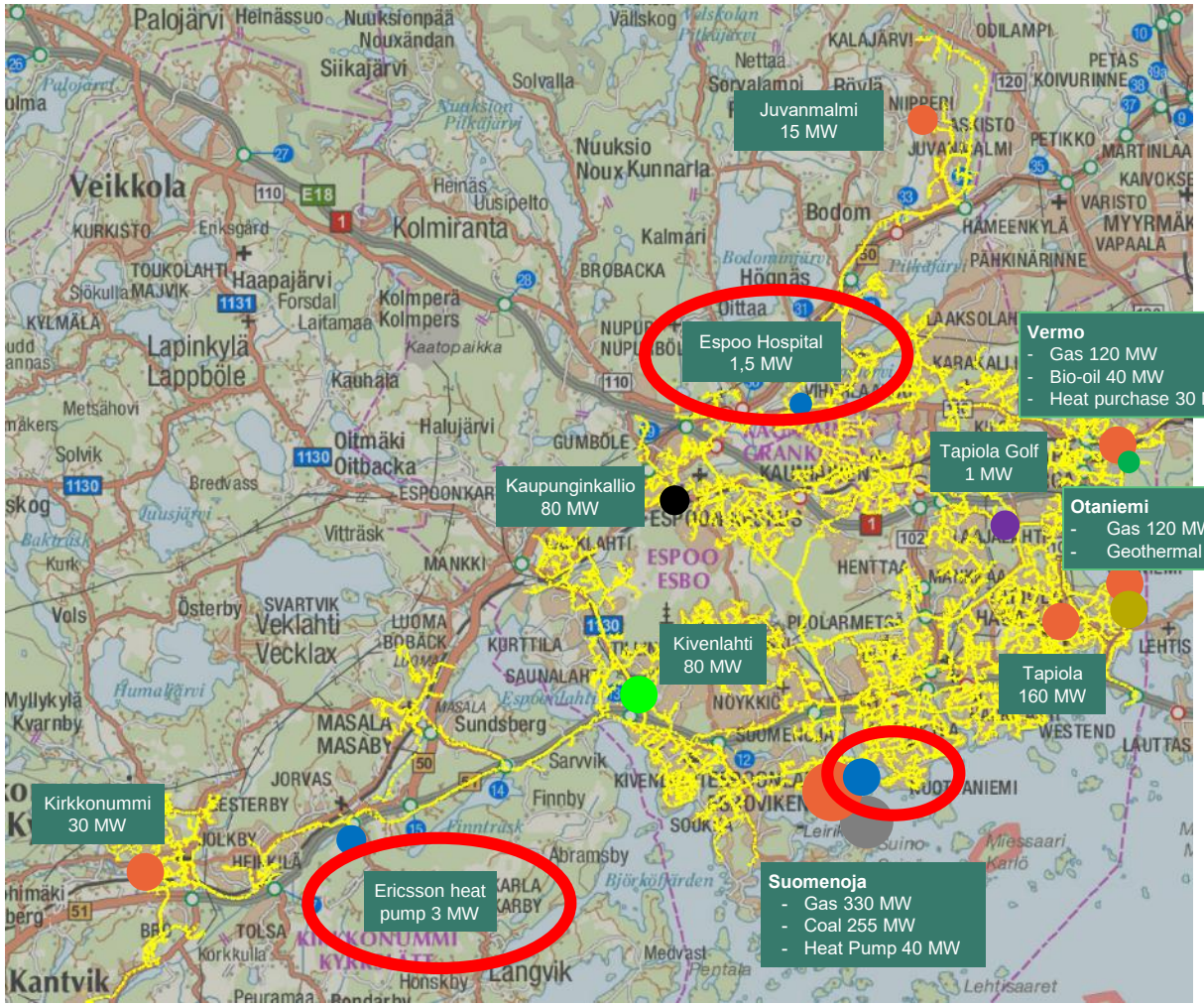
Espoo’s district heating network



Suomenoja Power Plant

- Electricity 350 MW
- Heat 620 MW

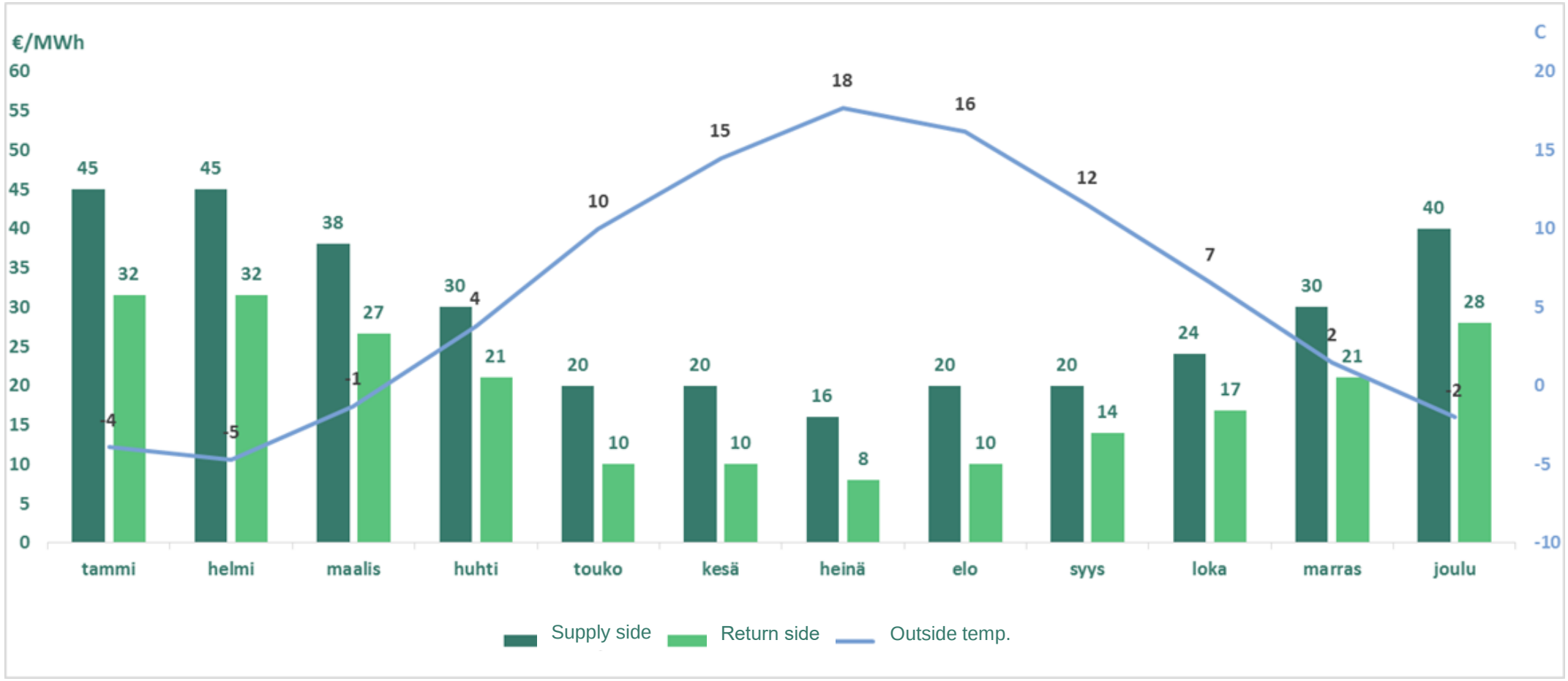
Heat only boilers 760 MW

- Tapiola 160 MW
- Otaniemi 120 MW
- Kivenlahti 90 MW
- Vermo 172 MW
- Vermo (h.e.) 70 MW
- Kaupunginkallio 80 MW
- Juvanmalmi 16 MW
- Kirkkonummi 31 MW
- Masala 18 MW
- Kalajärvi 5 MW

- Natural gas
- Light-fuel oil
- Coal
- Heat pump
- Geothermal
- Pellet
- Bio-oil (pyrolysis)
- Bio/Multi-fuel
- Biogas

Open district heating

Purchasing prices for excess heat



- Prices are valid up to 5 MW when customer invest for equipments https://www.fortum.fi/yrityksille-ja-yhteisoille/lammitys-ja-jaahdytys/kaukolampo/avoin-kaukolampo/avoin-kaukolampo-ostohinnat

Existing applications

- Suomenoja sewage water heat pums 40 MW (+20 MW 2021)
- Elisa and Tieto datacenters
- Ericsson datacenter 2,8 MW
- Espoo Hospital 1,5 MW

- Lidl distribution centre in Järvenpää produce about 700 MWh annually

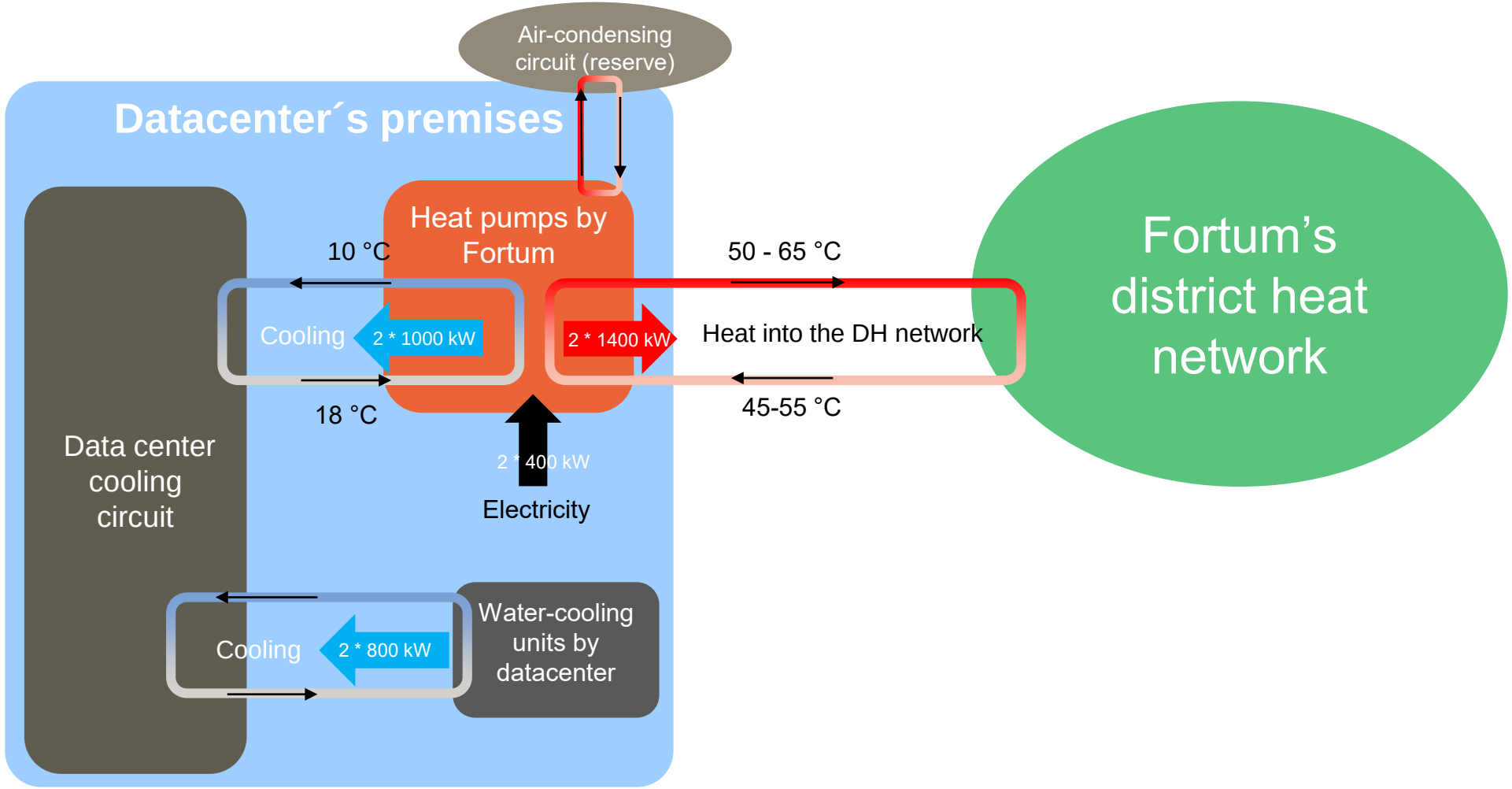
Kymmenen jalkapallokenttää - Lidl avaa hiilineutraalin jakelukeskuksen Järvenpäässä

23.10.2018 17:16 KAUPPA LOGISTIIKKA YMPÄRISTÖ

Havainnekuva Lidlin Järvenpään jakelukeskuksesta. KUVA: LIDL

Excess heat recovery from data centers

Heat pump based cooling enables heat recovery into the district heat network



Identified potential sources and challenges of execution

Potential

- App. 20 - 40 MW in Espoo
- Mostly datacenters, from 0,5 MW and up
- A few indutrial sites
- Negotiations ongoing with 5 waste heat producer
- Open DH –prices to activate customers?
  - helps waste heat producers to estime the profitability

Challenges

- Many parties involved
  - Producer, solution provider, Fortum, real estate manager, owner / landlord
  - Future of rental agreement uncertain
- Future location of production uncertain
- Temperatures in DH network (70 – 115 ℃)
  - Hight temperature heat pumps prices
- Investement for DH piping
- Mismatch of heating and cooling demand
  - Local and DH level (network “full” in summer)

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Thoughts

- Waste heat has a role in (future) DH
- Future temp. of DH -network?
  - Lower temp. → more efficient waste heat use
- Local block level networks with a lower temp.
  - e.g. Aalto Works
- Demand for cooling is rising?
  - More condensation heat available?

Kiitos!

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