

# Distribution networks enable the energy transition

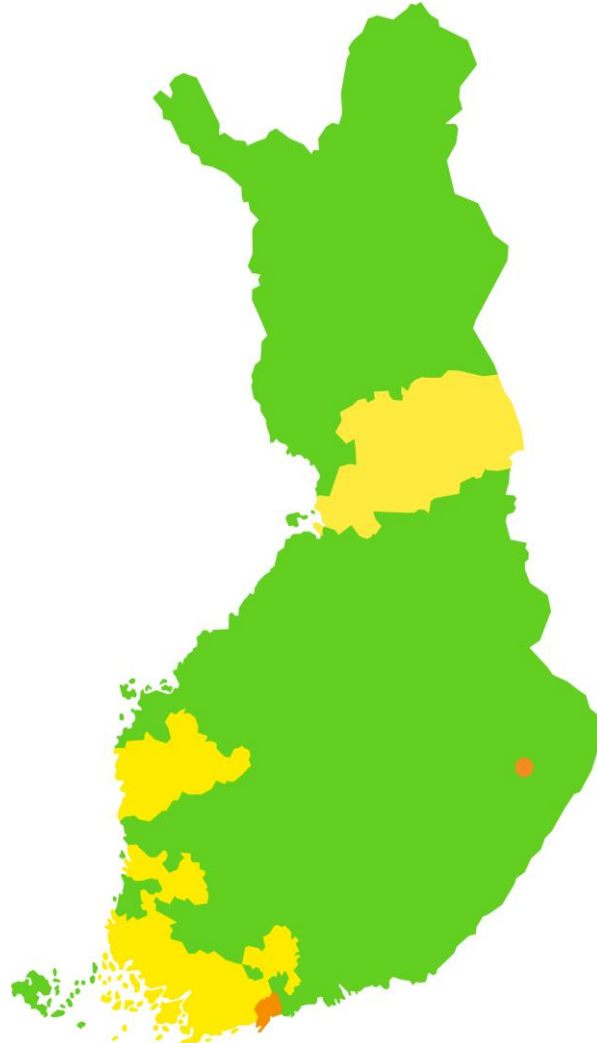
Elina Lehtomäki 8.11.2022



# Market Share ~ 20% of the Electricity Distribution in Finland

## Caruna Oy

- + Central Uusimaa, Koillismaa, Western Uusimaa, Southwest Finland, Pohjanmaa, Satakunta
- + Customers 484,000
- + Electricity network 80,000 km
  - 165 m / customer
- + Cabling rate 60%
- + Investments 104.6 meur
  - 216 € / customer



## Caruna Espoo Oy

- + Espoo, Joensuu, Kauniainen, Kirkkonummi
- + Customers 230,000
- + Electricity network 8,100 km
  - 35 m / customer
- + Cabling rate 81%
- + Investments 35.5 meur
  - 154 € / customer



# Customers

- + 713,000 customers in low-voltage network, 800 customers in the medium-voltage network, 60 in the high-voltage network
- + 166 MVA small-scale solar (~19 000 producers)
- + 460 MVA wind power (800 MVA in the end of the year)

# Employees

- + ~300 professionals
- + 37% Master's degree
- + Great Place to Work -certified™ organisation



# Electricity networks are a key enabler of the energy transition

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- + Finland is undergoing an unprecedented energy transition.
- + EUR 40 billion will be invested in the energy system over the next few decades.
- + Fossil fuels used by heating, transport and industry are the easiest and most cost-effective to replace with technology based on clean electricity.
- + The role of reliable electricity networks increases in a society that is increasingly dependent on electricity
- + Finland has excellent opportunities to be a model country for carbon-neutral solutions

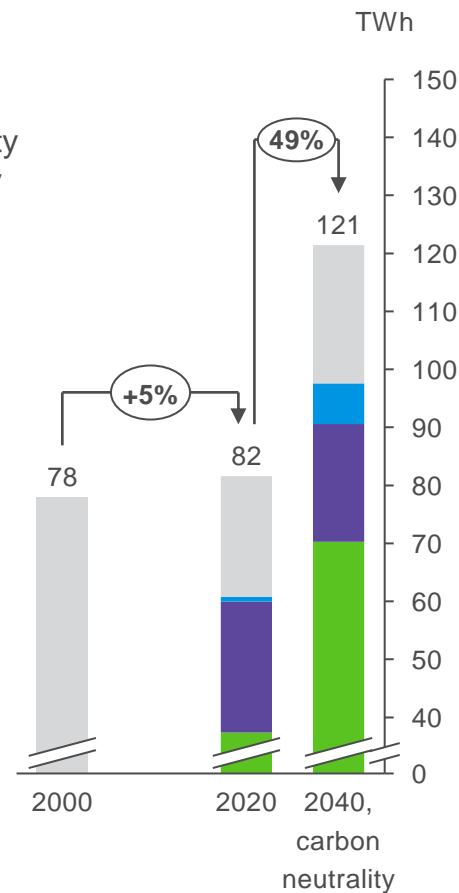


# Society will become even more dependent on electricity as emissions are reduced and digitalisation progresses

Electricity consumption is estimated to increase by up to 50% by the year 2040 and the production capacity by 100%.

Whereas in the past, electricity was mainly produced in individual large power plants in cities, in the future, electricity will be produced in thousands of small power plants, mainly in rural areas. In the past, electricity production could be adjusted to meet consumption needs; in the future, the majority of production will vary according to the weather.

Electrical energy consumption increases (TWh)



## Megatrends affecting the energy system

### CLIMATE CHANGE

Every effort must be made to slow down global warming, but we must also adapt to its inevitable consequences.

### SECURITY OF SUPPLY

National energy security, cybersecurity and resilience of the physical infrastructure must be improved

### DIGITALISATION AND TECHNOLOGY

New technologies and digitalisation shape the energy system and society, creating new business opportunities.

### URBANISATION

Energy consumption concentrates in cities and electricity production in rural areas. An efficient electricity network is increasingly important.



The electricity system faces new risks.

**Climate change increases extreme weather phenomena, which challenges the operation of electricity networks and weather-dependent electricity production.**

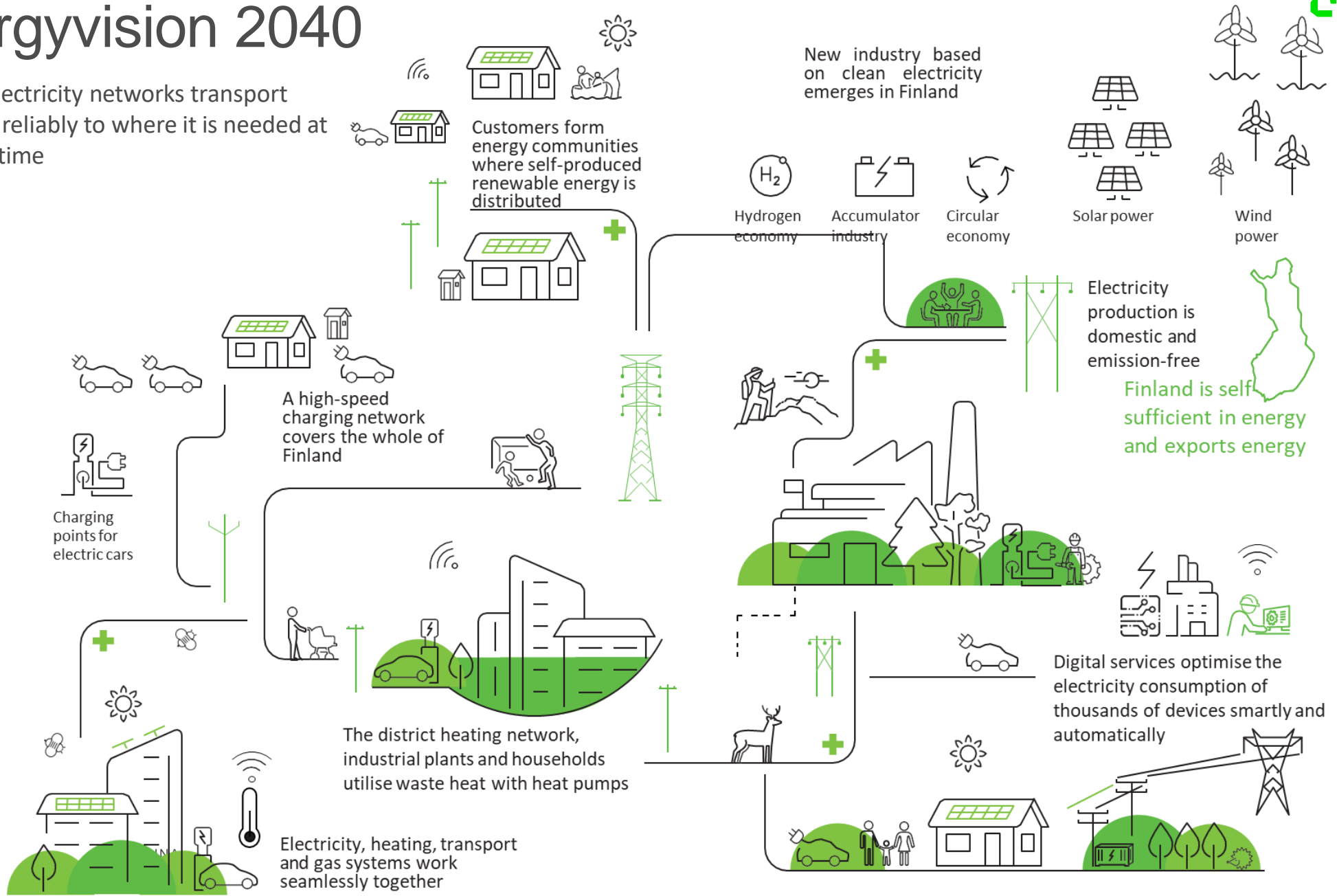
**Changes in energy production, transmission and consumption are unprecedented, both in size and schedule.**

- Others
- Transportation
- Households
- Industrial customers



# Energyvision 2040

Reliable electricity networks transport electricity reliably to where it is needed at any given time

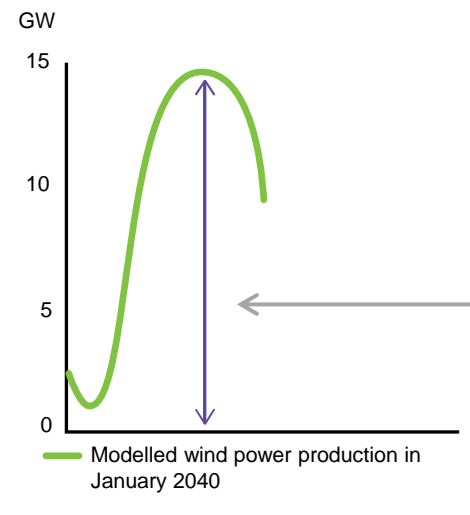


Electricity, heating, transport and gas systems work seamlessly together

# The growing demand for electricity will be generated by renewable energy, requiring huge investments in the electricity system

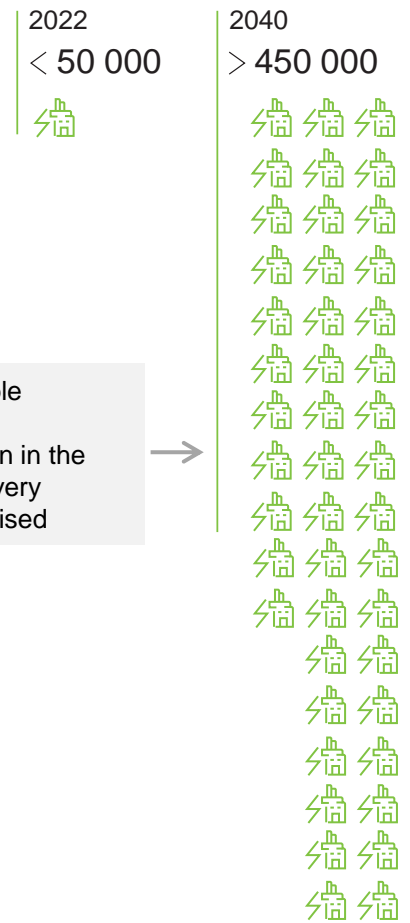
- + Due to growing demand, electricity production will need to increase strongly in the coming years, and electricity production capacity must more than double compared to today. Finland has an excellent opportunity to build clean electricity production, especially wind and solar power.
- + **The electricity production of the future will be very different from today. Whereas in the past, electricity was mainly produced in individual large power plants in cities, in the future, electricity will be produced in thousands of small power plants, mainly in rural areas.**
- + Both the national electricity transmission grid and local distribution networks are critical to enabling the energy transition. Large wind farms and electrifying heavy industry are connected to the transmission grid. Distribution networks enable bi-directional transmission and the connection of all new technologies, such as hundreds of thousands of electric cars and solar panels, to the electricity system.

Fluctuations in electricity production will increase (GW)



Predicting wind power is difficult. Production can increase 15-fold in less than 30 hours. In the situation of the 2040s, the fluctuation may be as high as the current peak consumption in Finland.

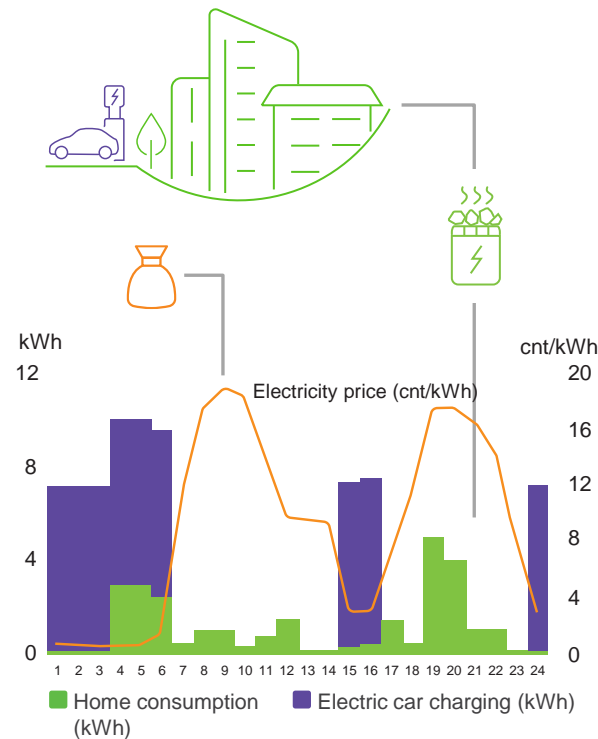
The number of electricity production sites will multiply



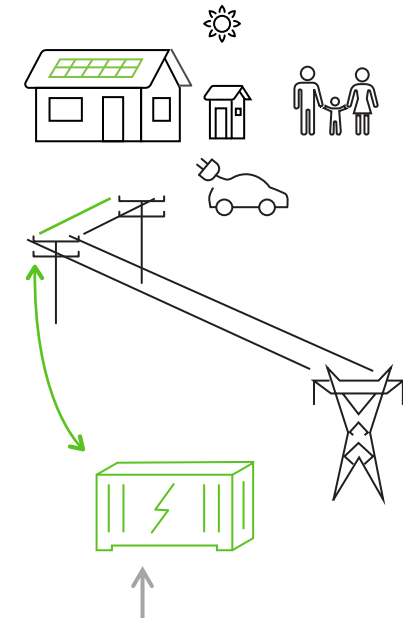
# Electricity cannot be stored in large quantities, which is why the electricity market is in great need of flexibility – the customer can participate

- + The energy transition and digitalisation create new opportunities for customers to participate in the electricity market.
- + **With the growth of variable electricity production, a lot of demand response is needed in the electricity market in order to keep the electricity system balanced and reliable.** There is a lot of potential for demand response in an electrifying society.
- + As decentralised electricity production increases, the impact on the distribution network must also be taken into account. For example, in rural areas, a larger solar power station in a field can produce more electricity on a sunny summer day than the owner consumes, so the power plant feeds electricity into the network. This may cause voltage problems in the electricity network and the distribution network company must decide how to meet the technical requirements for the electricity system.

Charging an electric car changes the electricity consumption of your home



The production of solar panels can be stored in electricity storages



An electricity storage can be used for the needs of the distribution network and can balance fluctuations in the production and consumption of the entire electricity system.



# Smart charging of electric cars brings savings to consumers and balances the electricity system

## CHEAP HOURS SHOULD BE USED FOR

**CHARGING.** Optimising the charging of an electric car according to the electricity price brings energy cost savings of up to 40-50% compared to uncontrolled charging.

**CHARGING ENERGY SUFFICES ON AN ANNUAL BASIS, MOMENTARY RESTRICTIONS MAY OCCUR.** For the electricity system, instantaneous charging power can become a problem if electricity is simply not available when electric car drivers want it. For the local distribution network, high instantaneous charging power can generate problems and power passed on to customers create local bottlenecks

**SMART CHARGING IS THE KEY TO NETWORK OPTIMIZATION.** Electricity networks are sized to meet likely peak consumption. If peak consumption increases with the charging of electric cars, electricity networks must be reinforced. Reinforcement can mean ordering a larger transformer, for example, even if the previous transformer has decades of service life left.

## Various electric powers

Current charging powers

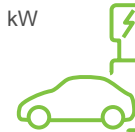
car heater 0,8 kW

electric sauna 7 kW

home charging point 7-11 kW

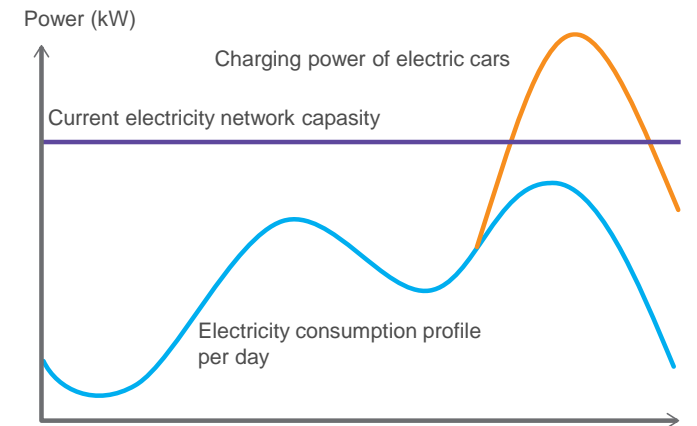
business premises charging points 11-22 kW

high-power chargers 100-300 kW



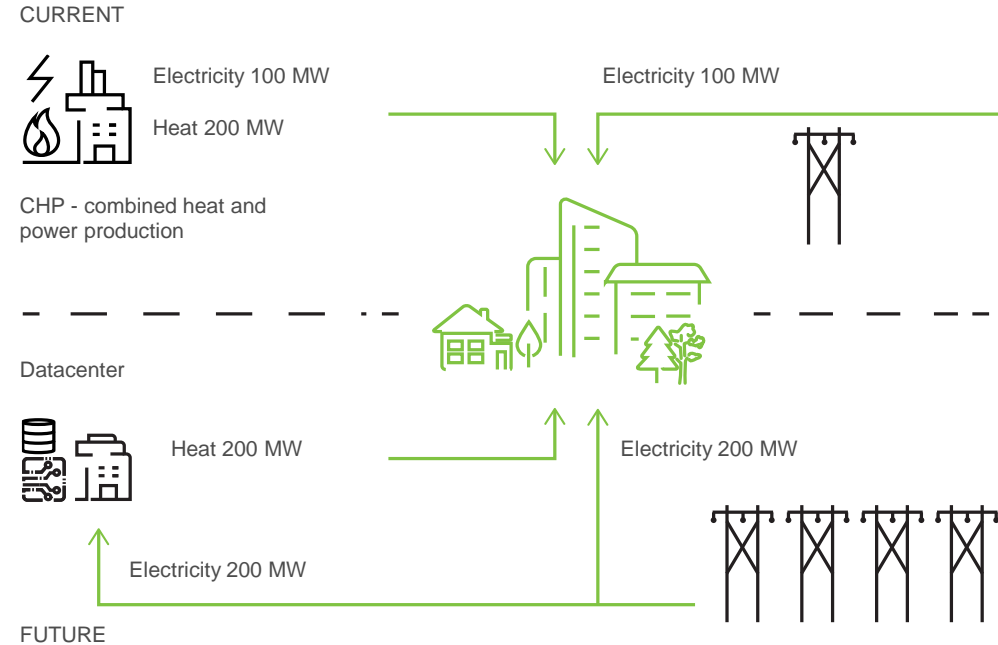
Electric car charging points can increase connection power by as much as 60% in housing companies

Due to the charging power of electric cars, the distribution network must be reinforced



# The electrification of heating is accelerating – this requires investments in distribution networks

- + **Climate targets drive energy companies to give up district heating produced by combustion.**
- + **The electrification of district heating challenges the durability of the urban network.** District heat is increasingly produced by various waste and ambient heat, data centre heat and, during cheap hours, even by electric boilers. The local impacts can be significant. Cities are losing electricity production, which will be replaced by large consumption sites. This change is taking place at a rapid pace, and the transmission capacity of the high-voltage distribution network must be strengthened.



# How it looks like right now?

CURRENT MARKET OUTLOOK EMPHASIZES RENEWABLE ELECTRICITY GENERATION, REDUCED DEPENDENCY ON NATURAL GAS AND VERY STRONG ELECTRICITY DEMAND ON URBAN AREAS

## Market outlook and topical subjects

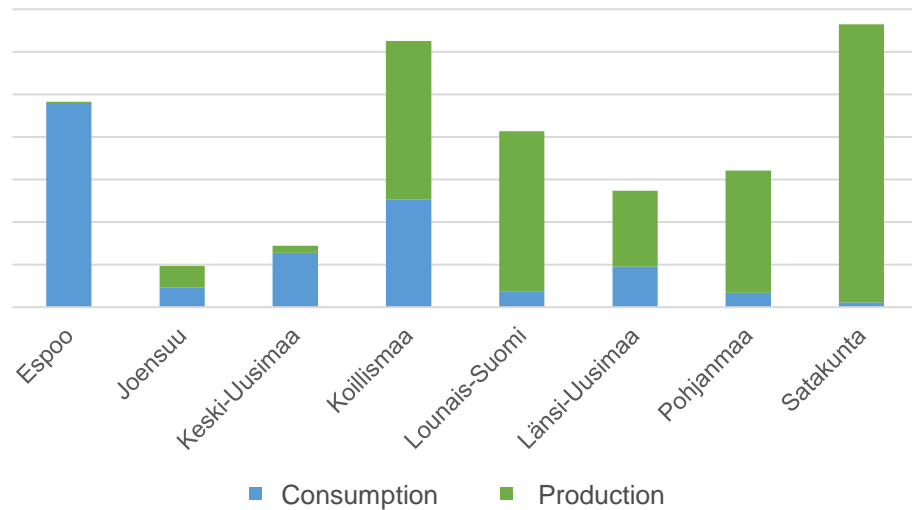
- + Very high amount of customer requests concerning **industrial-sized solar power (PV) plants**, both mid- and large-scale projects.
- + **A lot of active wind park projects still in pipeline** but available network capacity and stability causing challenges.
- + Current **European energy crisis is accelerating the electrification of industrial process** which are currently dependent e.g. on natural gas.
- + Electrification trend and **strong development of urban areas result in high demand for new electricity consumption connections:**
  - + For instance, the electrification needs of district heat production in Espoo are massive and timely critical.
  - + Electrification of traffic solutions visible in railways, public transport (buses) as well as logistics and EV charging solutions.
- + **Active project development regarding data centers** especially in Southern Finland. However, majority of the projects are in early stage and thus uncertain.
- + **Couple of P2X / hydrogen projects** under development.

## Implications on DSOs

- + **Short term:** increased amount of new medium voltage (20 kV) connections, already realized.
- + **Longer term:** increased amount of new high voltage (110 kV) connections appx. around mid 2020s.
- + Sufficient network capacity to be developed (vs. security of supply criteria).
- + New large-scale development projects require holistic approach and wide competencies:
  - + Case example: P2X + district heat (CHP + heat pumps) + solar plant + electricity connections -> all within the same site.

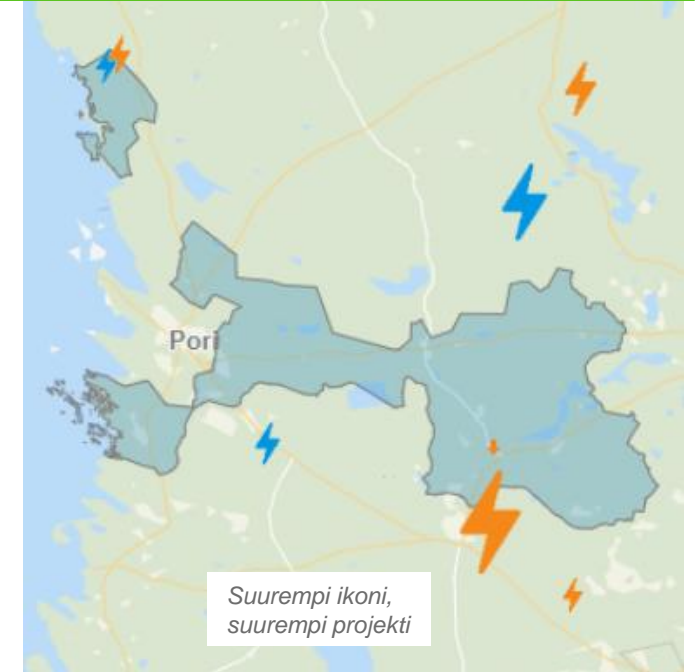
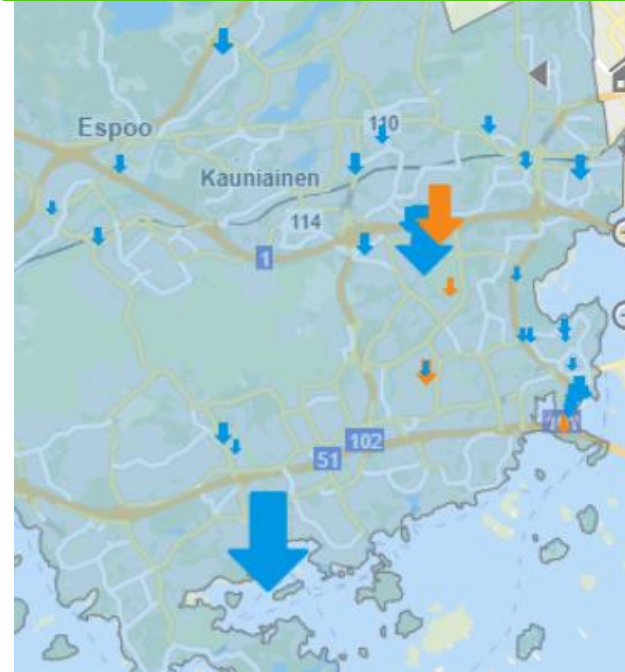
# More consumption to the South and production to the North

Sales potential in MV and HV network by area (MVA)



~150 active projects  
~3000 MVA new capacity

Customer potential in Espoo & Ostrobothnia



Suurempi ikoni, suurempi projekti

- Preliminary potential, consumption
- Ongoing project, consumption
- Preliminary potential, production
- Ongoing project, production



**We help our customers and the society  
in the energy transition**