Sustainable Urban Energy – Challenges and Opportunities, case Helsinki

Systems Thinking for Sustainable Living Environment

Pirjo Jantunen, Business Development Manager
@mojri

Agenda

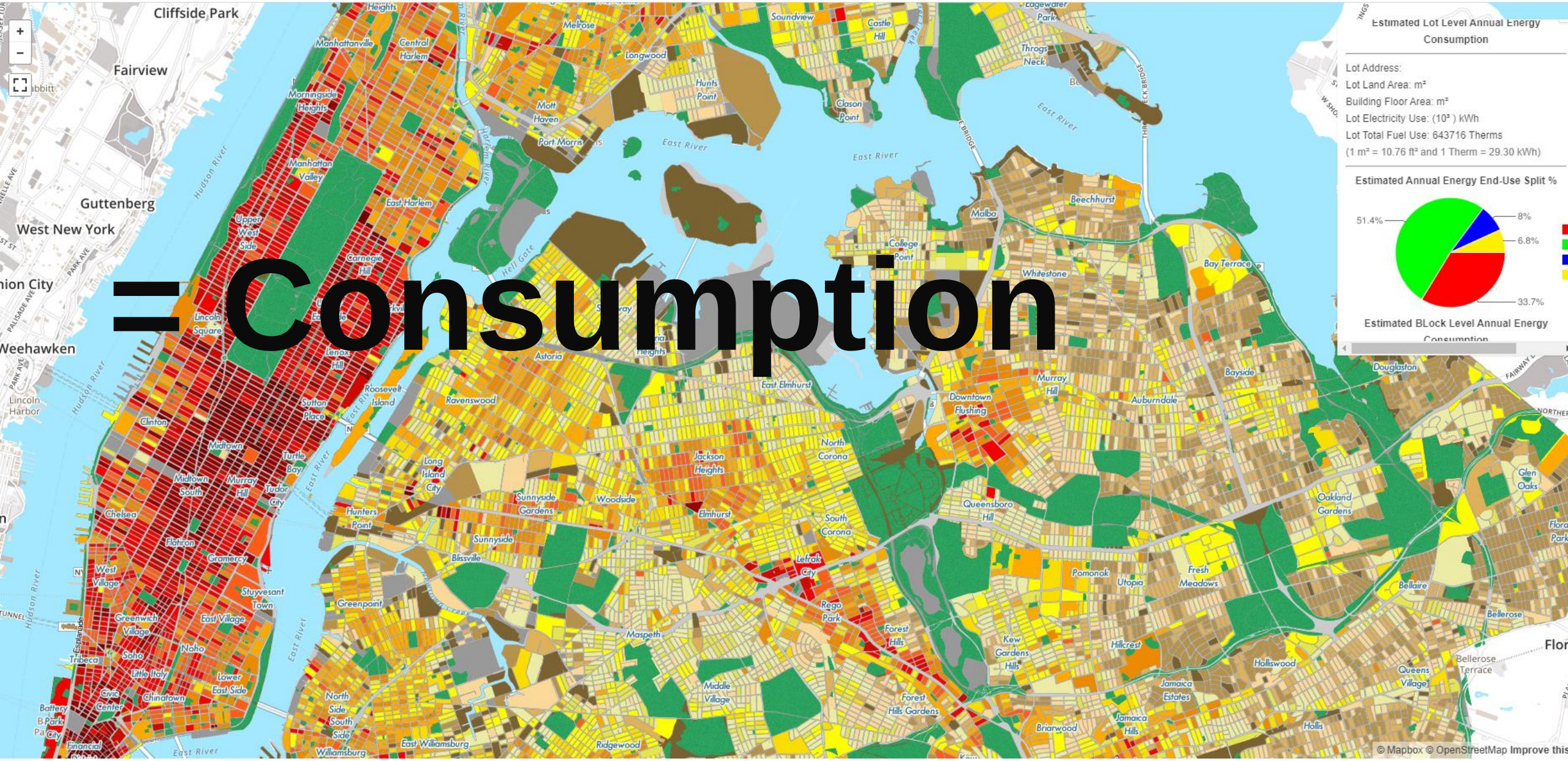
Challenges in the City

Urban Energy in Helsinki

Urban Energy Solutions by Helen

Challenges in the City


People



http://qsel.columbia.edu/nycenergy/

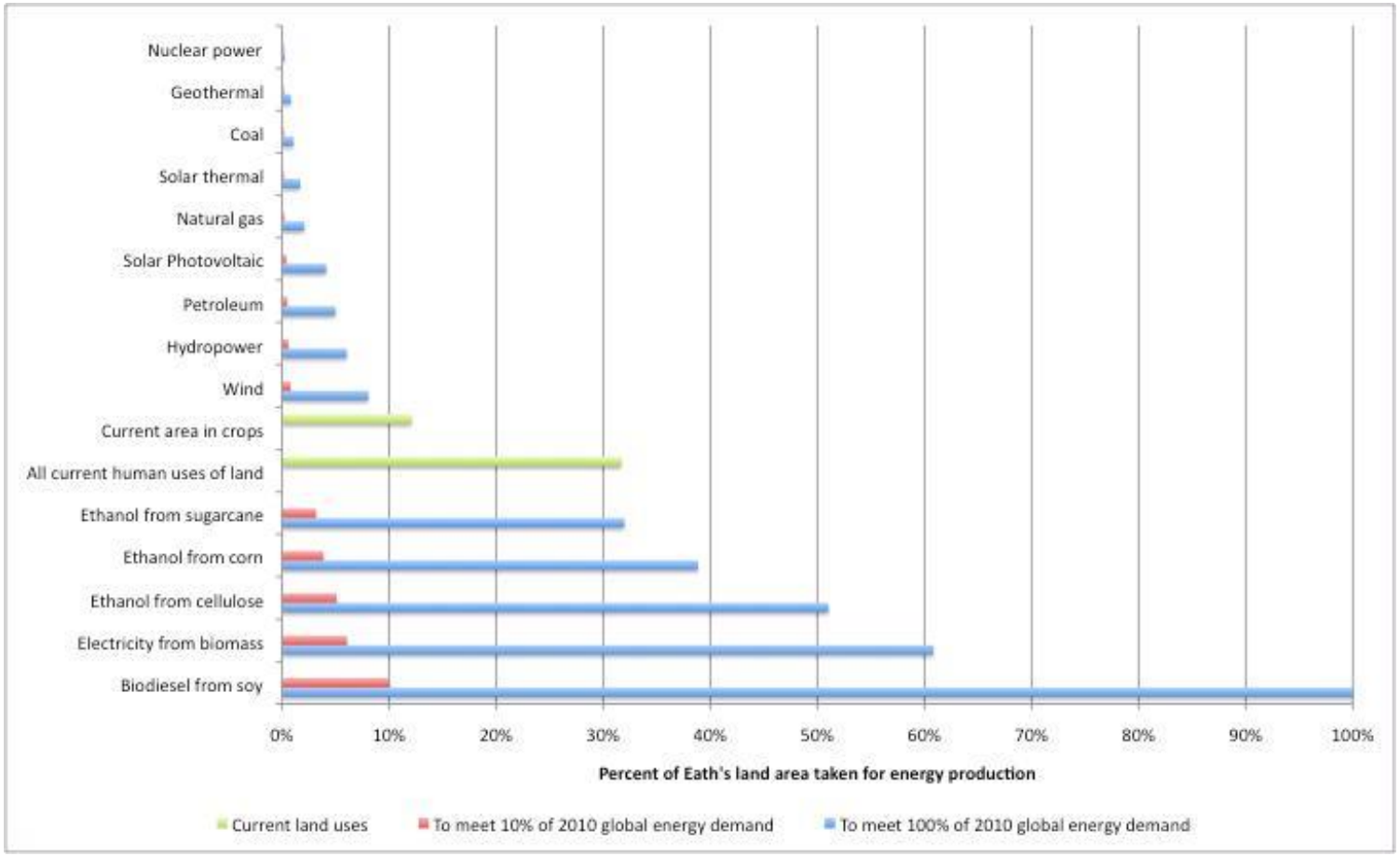
Source: Ed Hawkins
#showyourstripes


People


= No
space

Energy production requires space

Land required for each energy source to supply 10% and 100% of the world's current energy demand

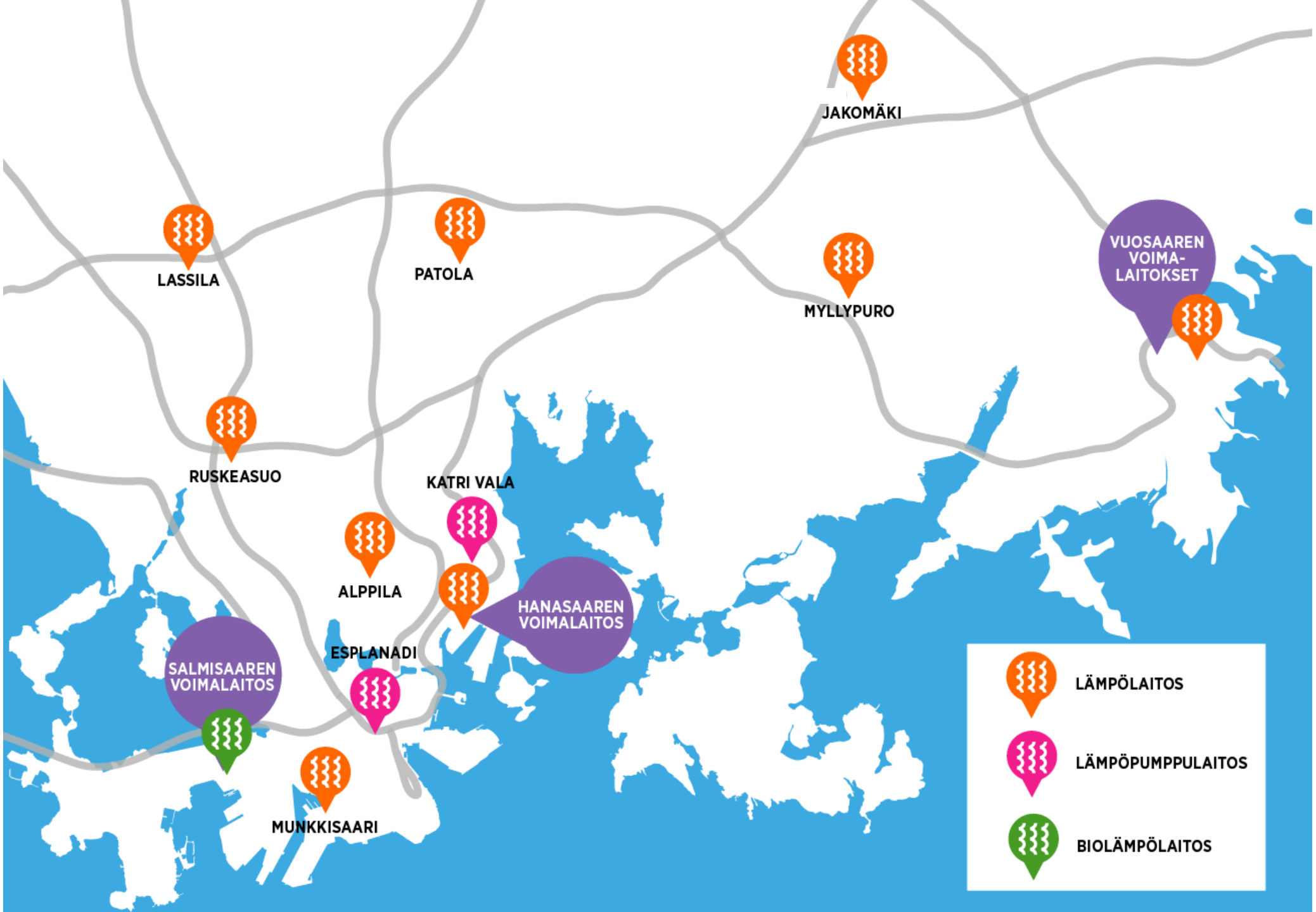


Source: Andrews et al., McDonald et al., Melillo et al., EIA.

Challenges to be solved: Emissions & Space

Urban Energy in Helsinki

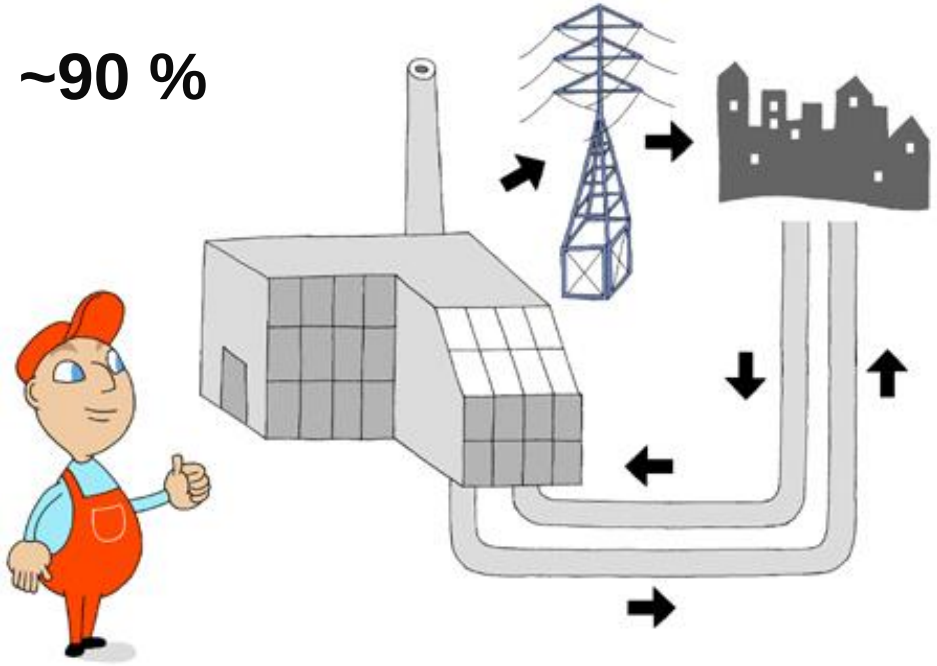

HELEN


JAKOMÄKI
LASSILA
PATOLA
MYLLYPURO
VUOSAAREN VOIMA-LAITOKSET
RUSKEASUO
KATRI VALA
ALPPILA
HANASAAREN VOIMALAITOS
ESPLANADI
SALMISAAREN VOIMALAITOS
MUNKKISAARI
LÄMPÖLAITOS
LÄMPÖPUMPPULAITOS
BIOLÄMPÖLAITOS

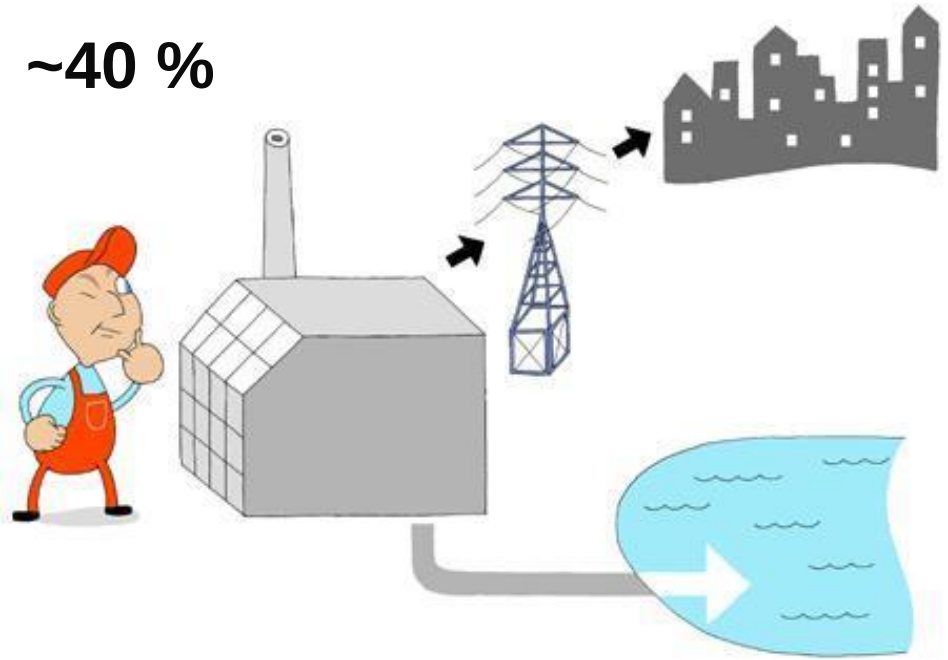
District heating has been increasing efficiency

Combined heat and power production vs. condensing power plant

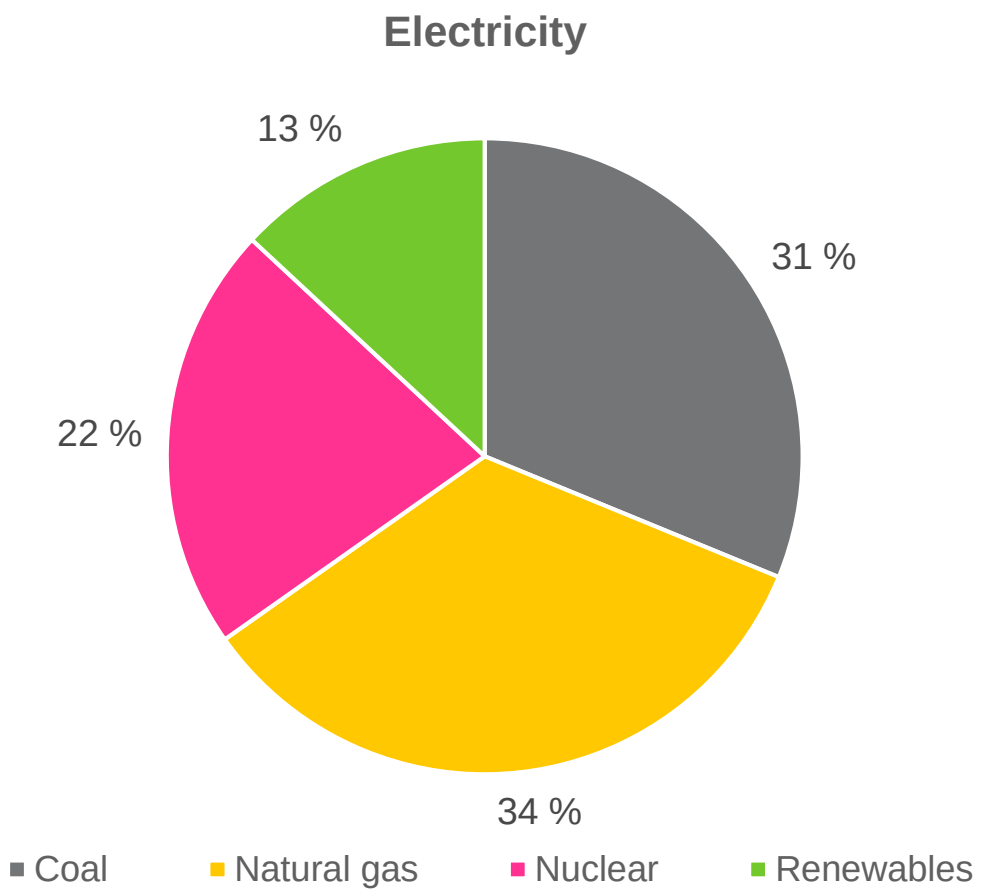
~90 %

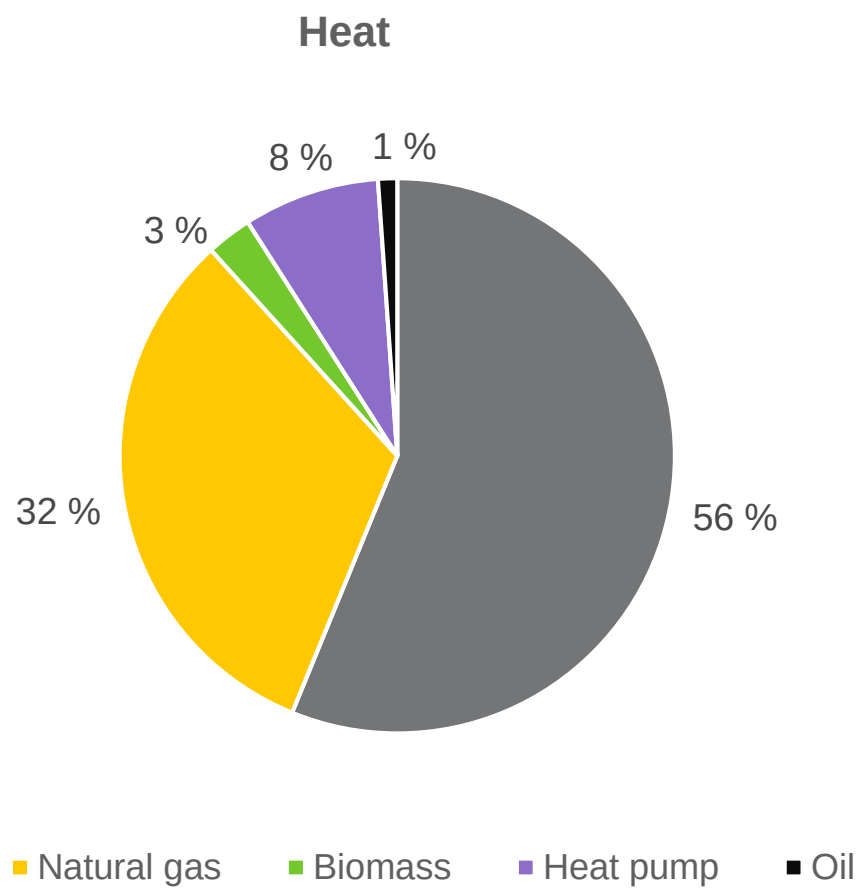


~40 %

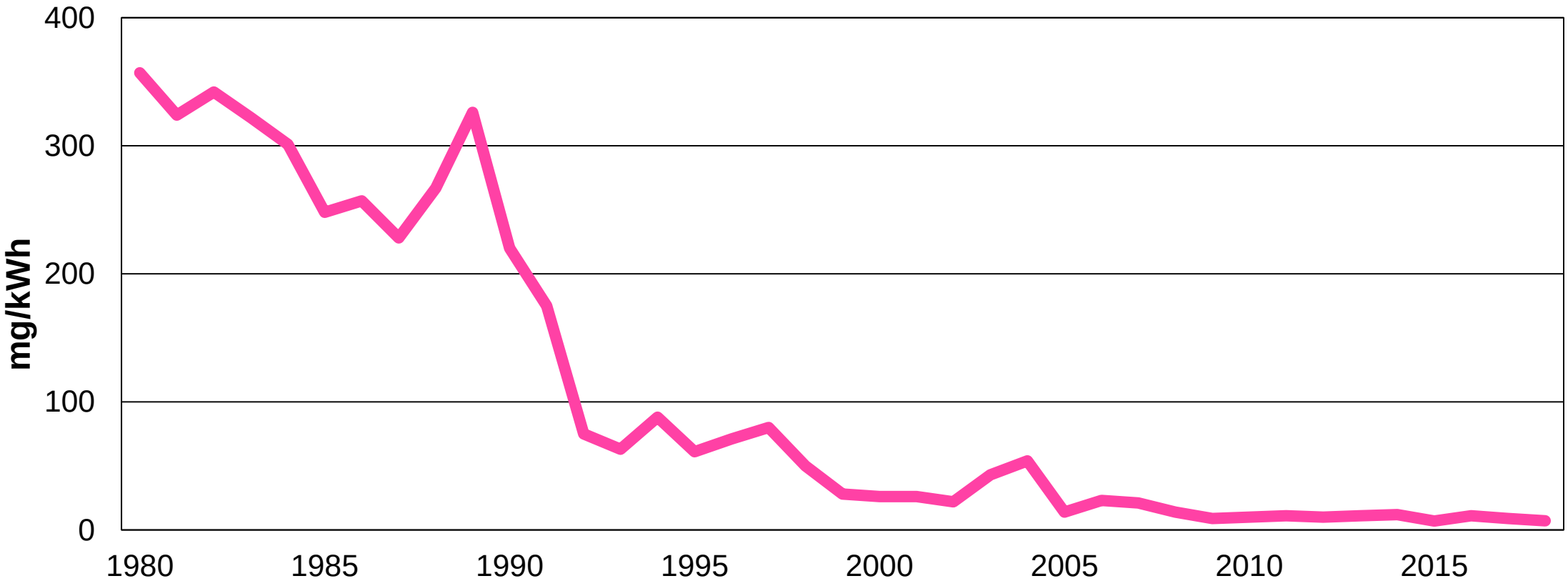


Energy sources 2019

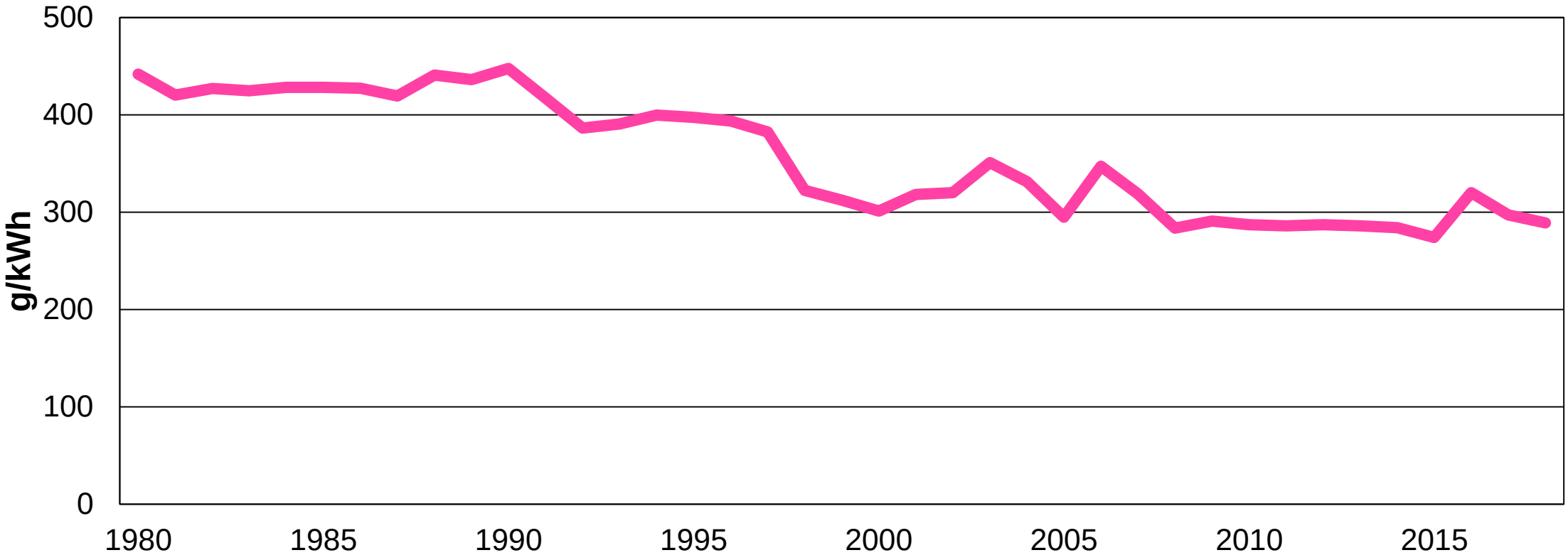




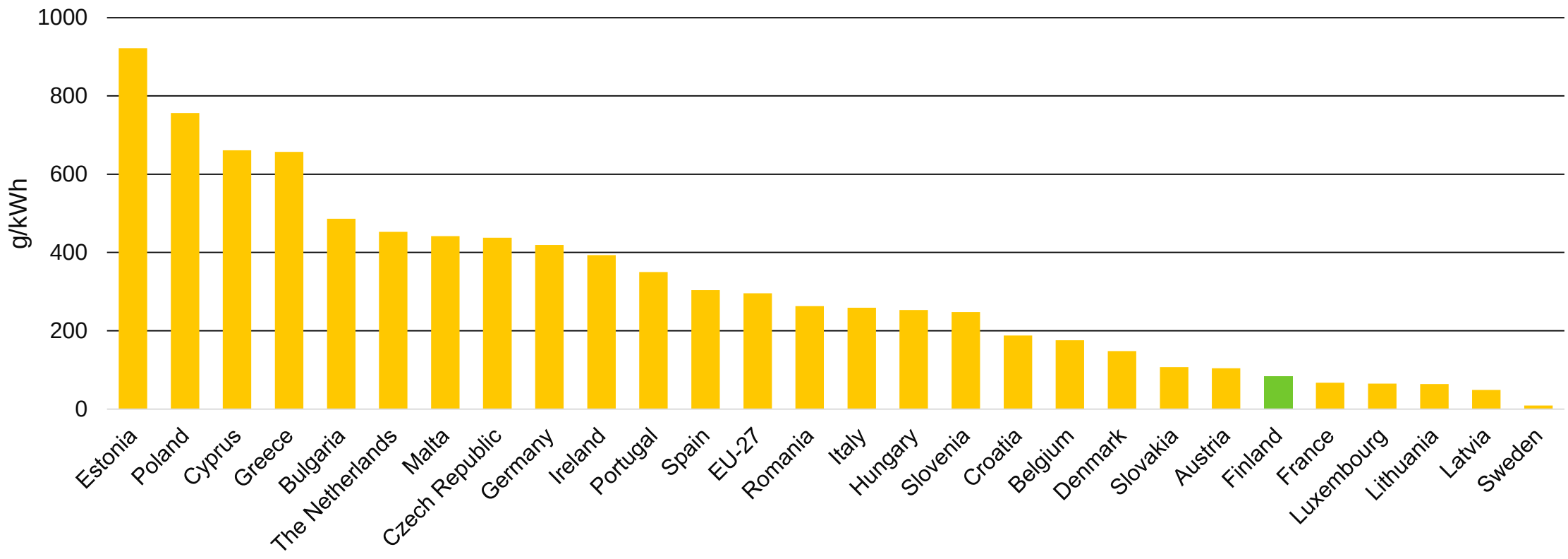
Particulate matters

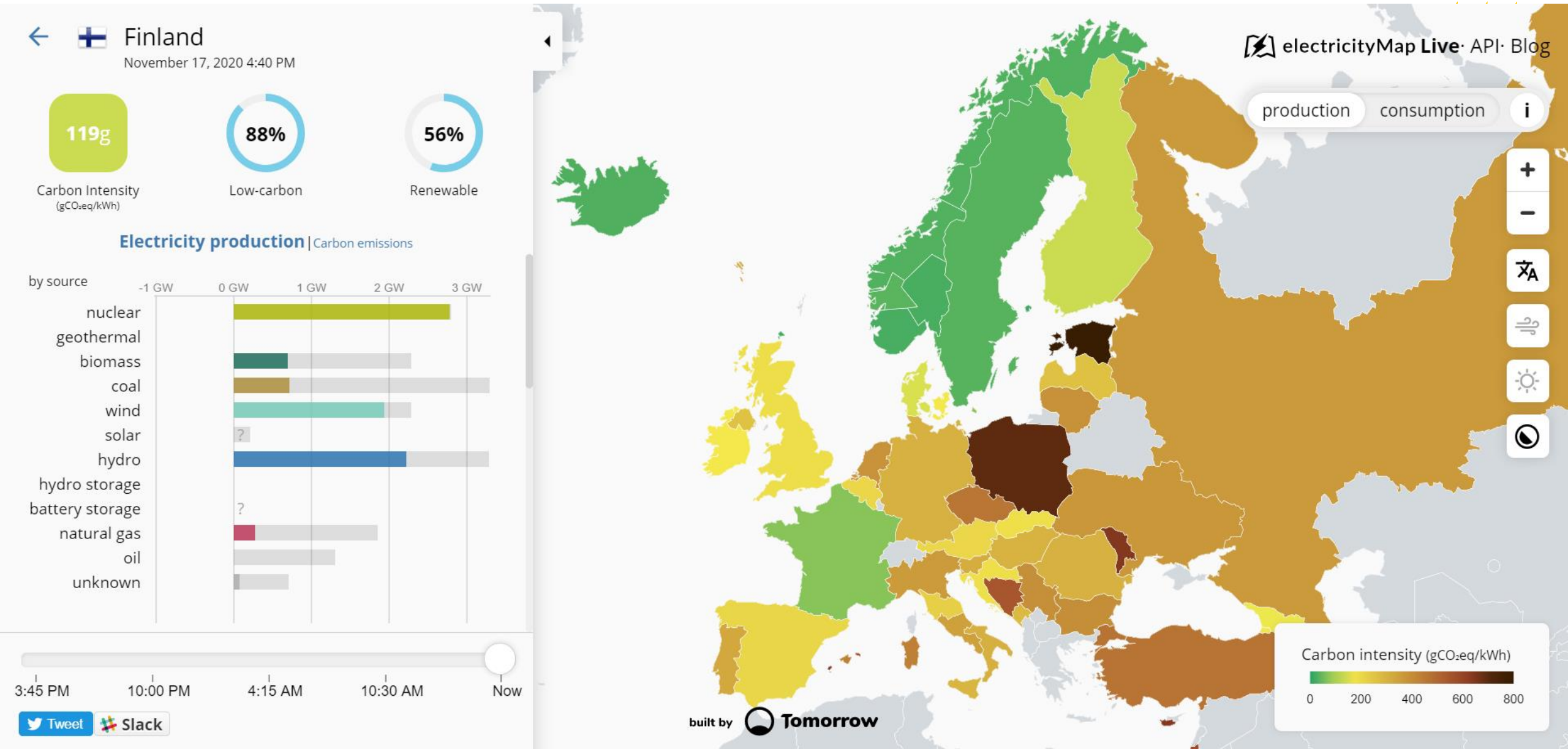


Carbon dioxide, specific emissions in Helsinki



Specific CO_2 emissions, electricity EU-27 2017

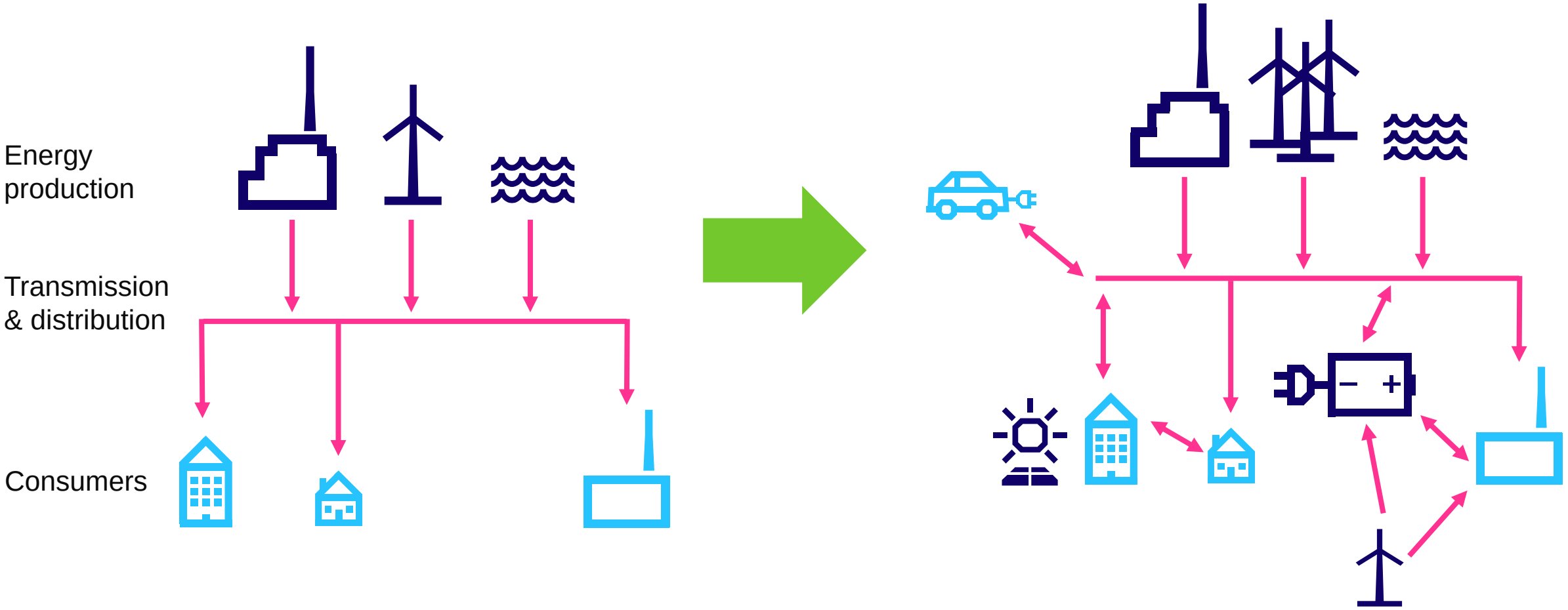



Finland
November 17, 2020 4:40 PM
119g
Carbon Intensity
(gCO₂eq/kWh)
88%
Low-carbon
56%
Renewable
Electricity production | Carbon emissions
by source
-1 GW
0 GW
1 GW
2 GW
3 GW
nuclear
geothermal
biomass
coal
wind
solar
hydro
hydro storage
battery storage
natural gas
oil
unknown
3:45 PM
10:00 PM
4:15 AM
10:30 AM
Now
Tweet
Slack
electricityMap Live · API · Blog
production
consumption
Carbon intensity (gCO₂eq/kWh)
0
200
400
600
800
built by
Tomorrow

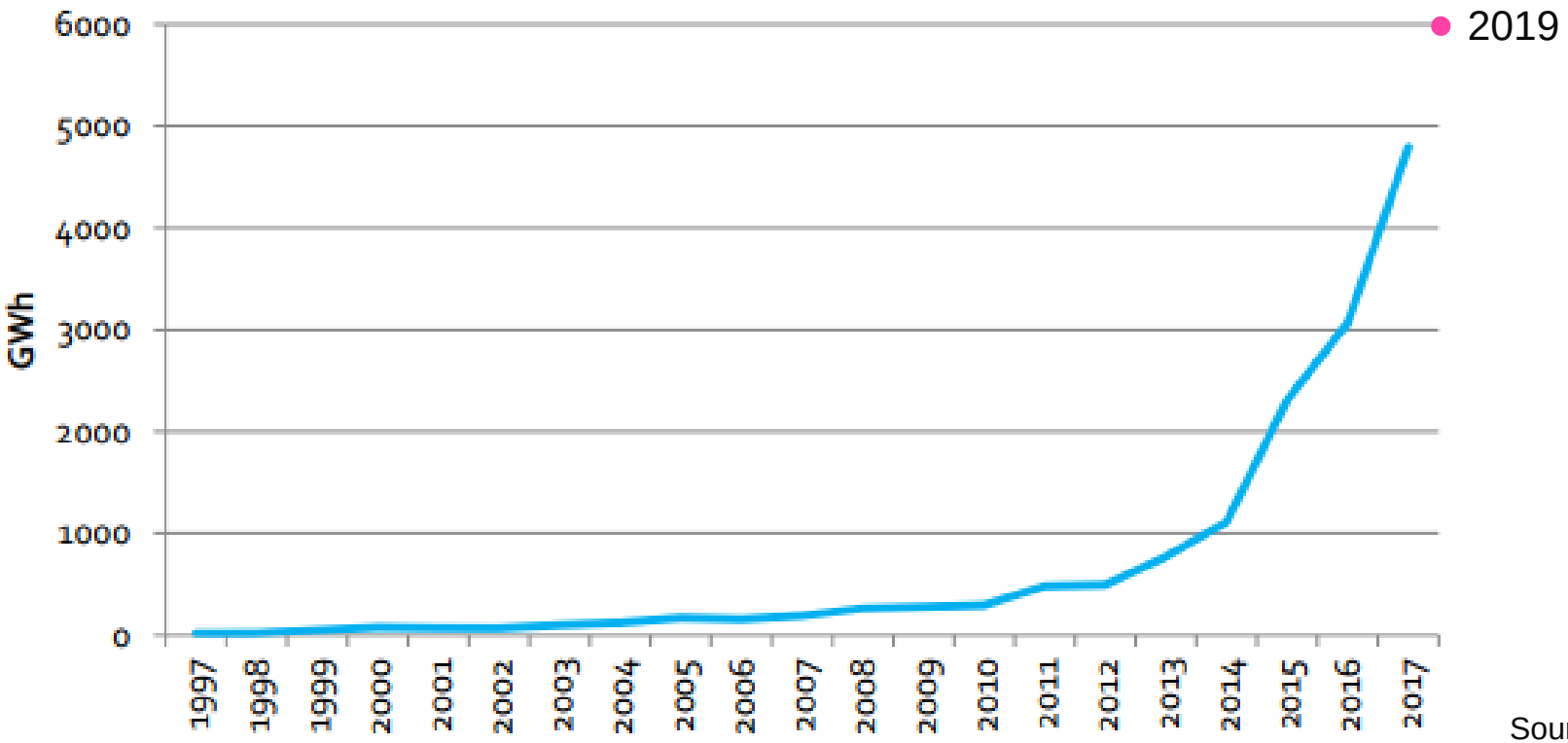
Urban Energy System in Transition

Megatrends shaping the future

Energy system is in transition

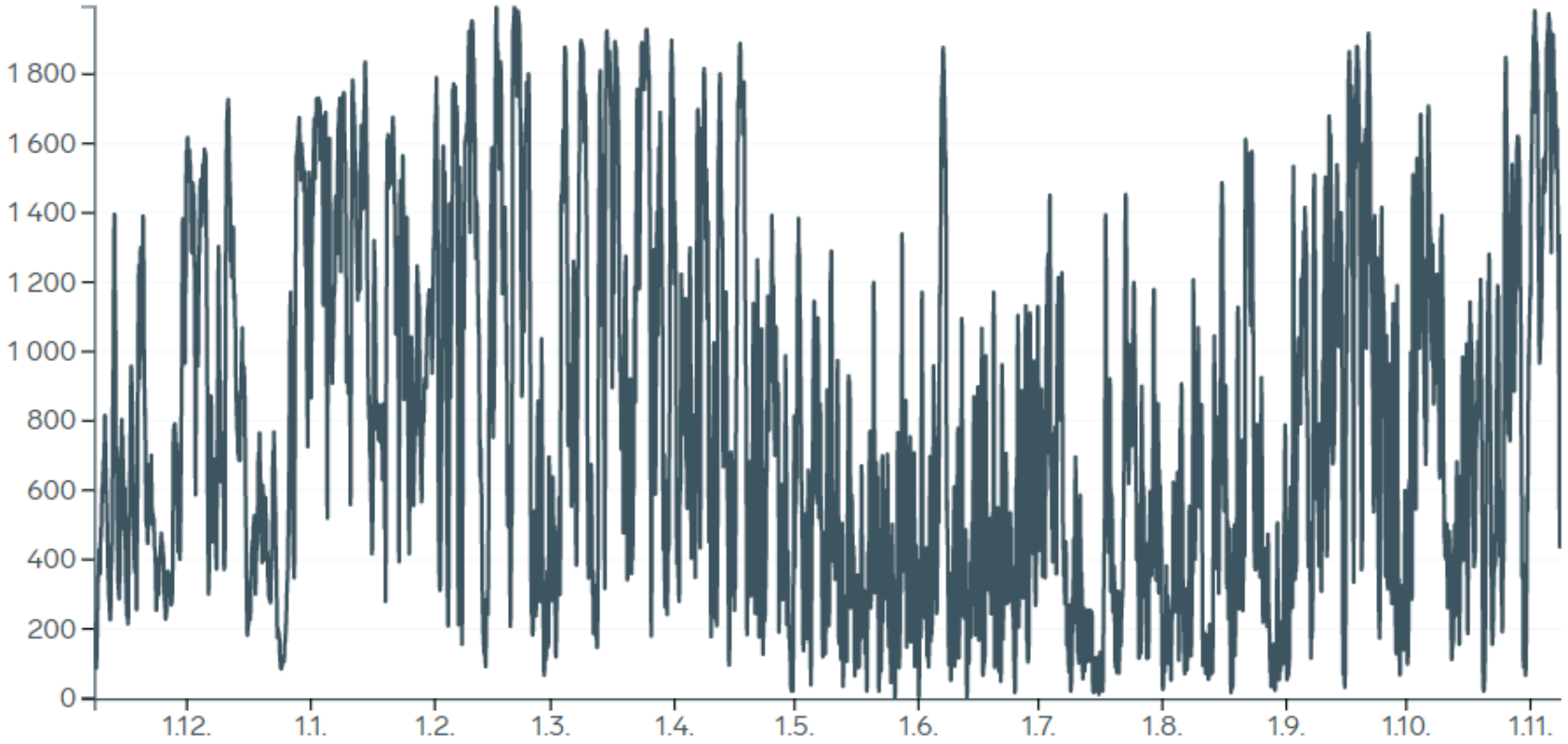


Annual wind power production in Finland



Source:
Tuulivoimayhdistys

Wind power production in Finland, year to date



Source: Fingrid

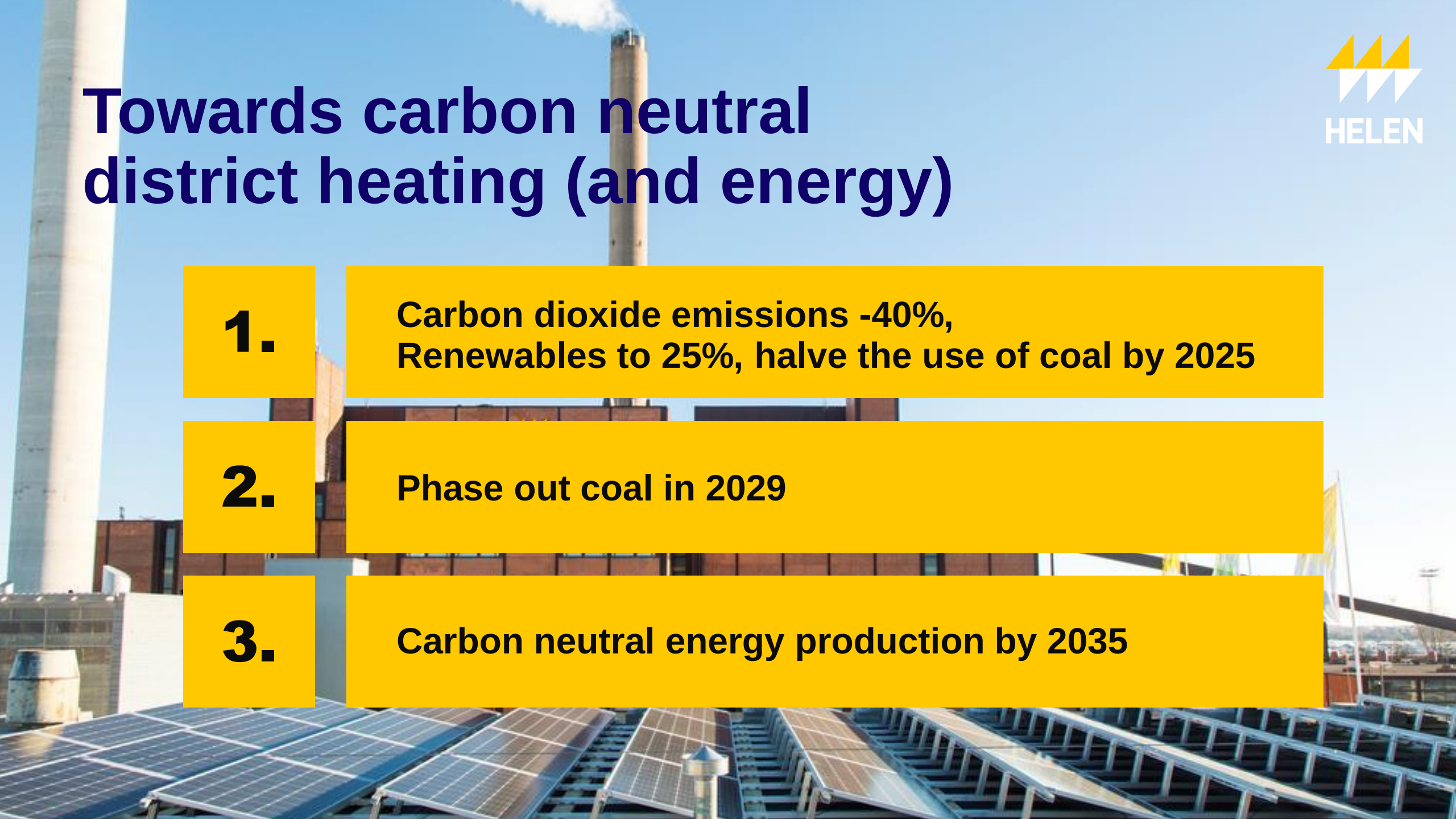
Challenges to be solved: Emissions & Space & Intermittency

Urban Solutions by Helen

Urban Solutions by Helen

- Production

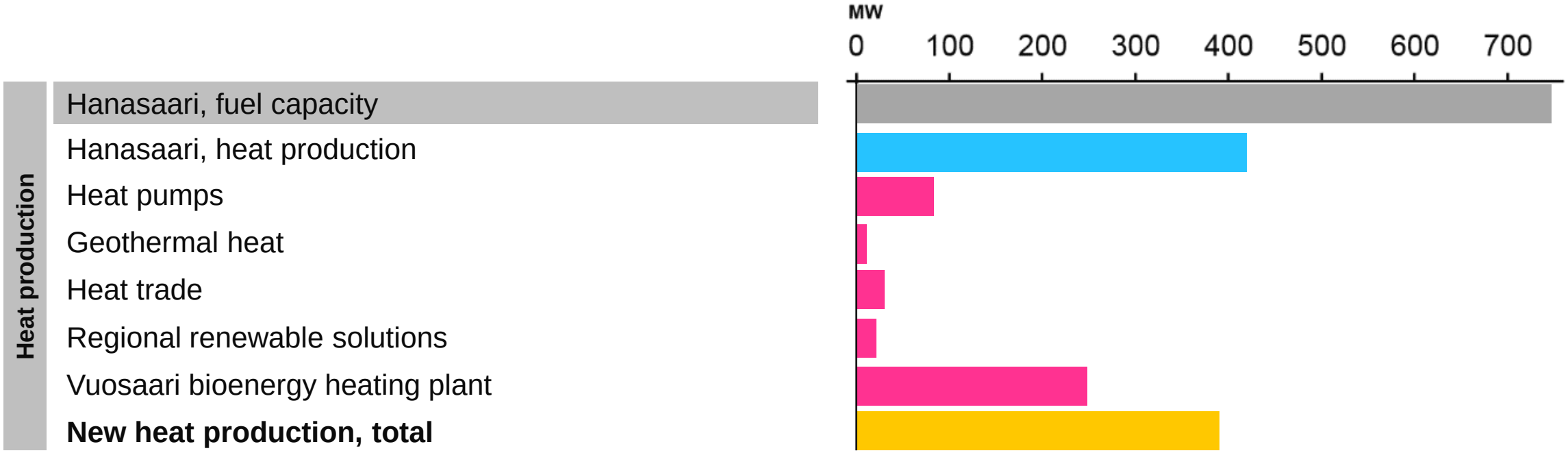
Carbon Neutral by 2035



Towards carbon neutral district heating (and energy)

1. Carbon dioxide emissions -40%,
   Renewables to 25%, halve the use of coal by 2025
2. Phase out coal in 2029
3. Carbon neutral energy production by 2035

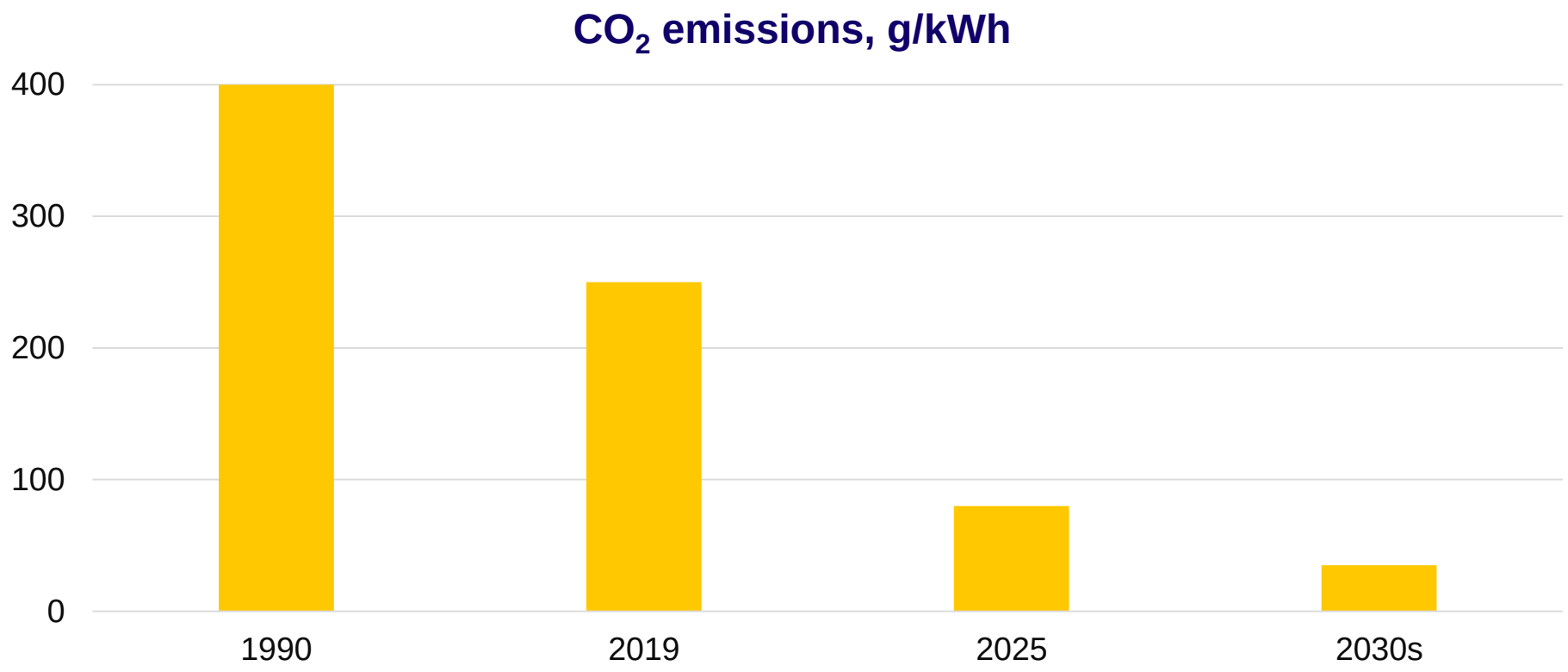
Phase I: Hanasaari power plant will be replaced by biomass and heat pumps



Phase II: Coal will be replaced with wide variety of solutions

- **Energy efficiency** in production and consumption
- **Heat pumps with various heat sources**
  - Data centers and other industrial waste heat streams
  - Sea water heat pumps
  - Customer solutions, e.g. ground source and exhaust air heat pumps
- **Geothermal heat**
- **Heat produced by third parties**
  - Excess heat from Kilpilahti Oil Refinery
  - Collaboration with other energy utilities
- **Biomass** as a source of flexibility
- **New techologies,** e.g. small and modular nuclear reactors

Towards carbon neutrality



Urban Solutions by Helen

- Consumption

Solutions supporting customer’s carbon neutrality

New solutions decrease consumption, cut demand peaks and decrease emissions.

- Energy efficiency
- Demand management
- Solar energy
- Services for electric mobility

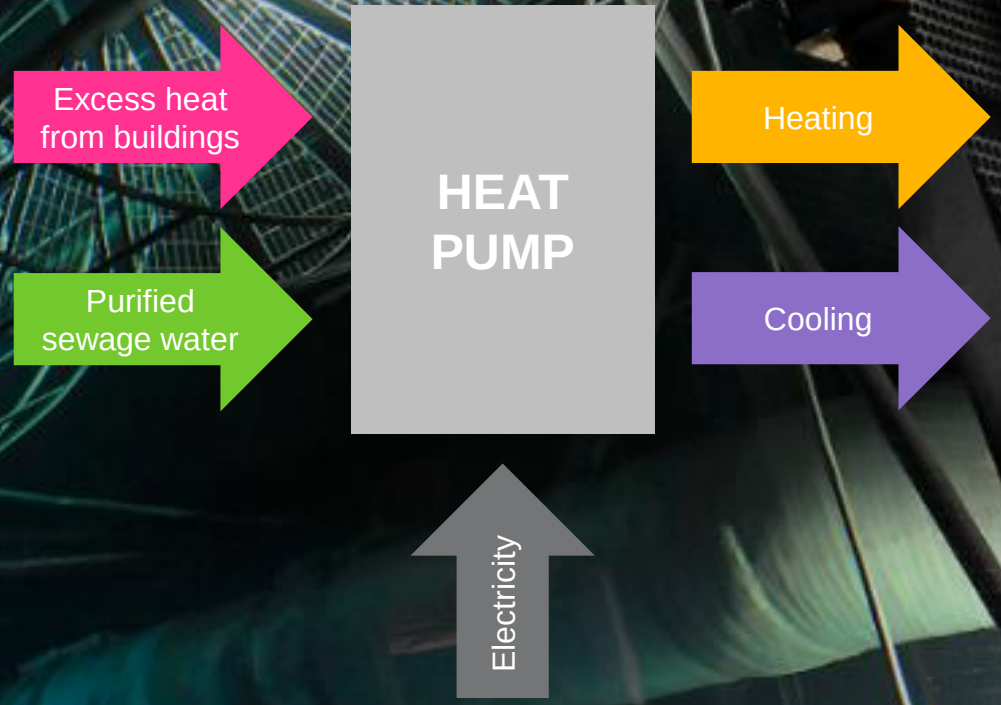
How urban planning can impact consumption?

Urban Solutions by Helen

- Space

Circulating energy: District heat from excess heat

- Already 8% of city's heating need covered by excess heat, e.g. from purified waste water, data centers, buildings
  - Excess heat from properties recovered with district cooling
- Based on energy sources that would be left unutilized
- Will increase in the future, many projects ongoing



How to reserve space for energy production in urban areas?

Urban Solutions by Helen

- Intermittency

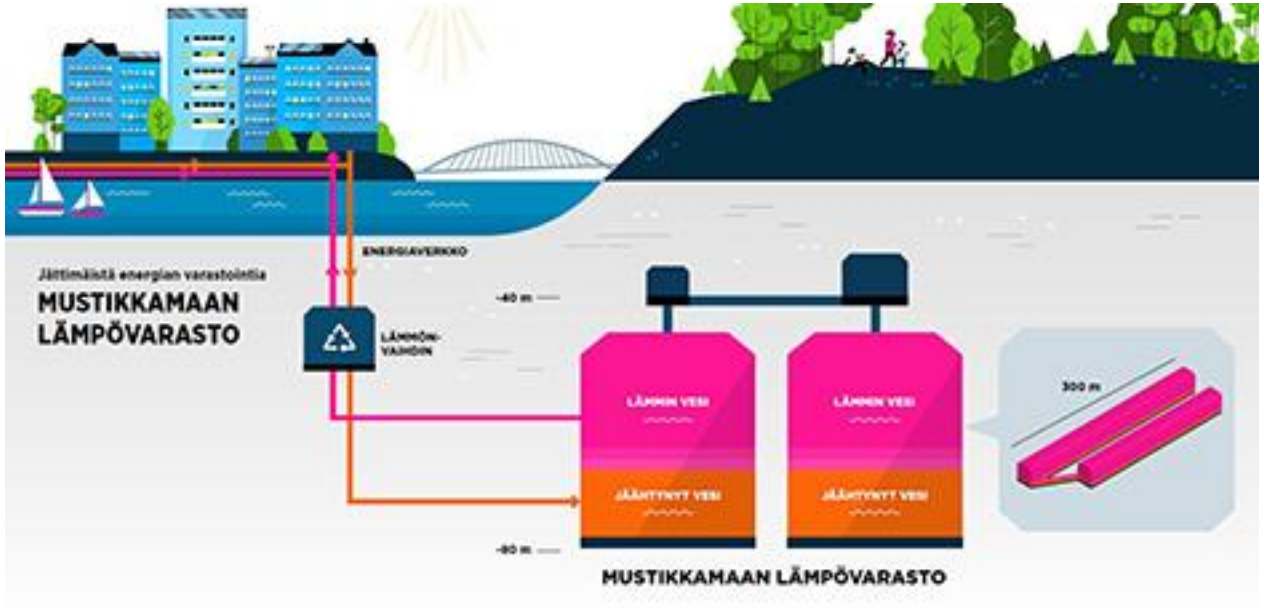
Flexibility from multiple sources

Sector integration: power, heat, mobility, hydrogen

Storages: heat, cooling, power

Demand response

Production: CHP, hydro



Take-away

Utilise local resources
Focus on life cycle impacts
Plan & optimize