REWARDHeat

Decarbonised Heat Conference

16th June 2022, Helsingborg, Sweden

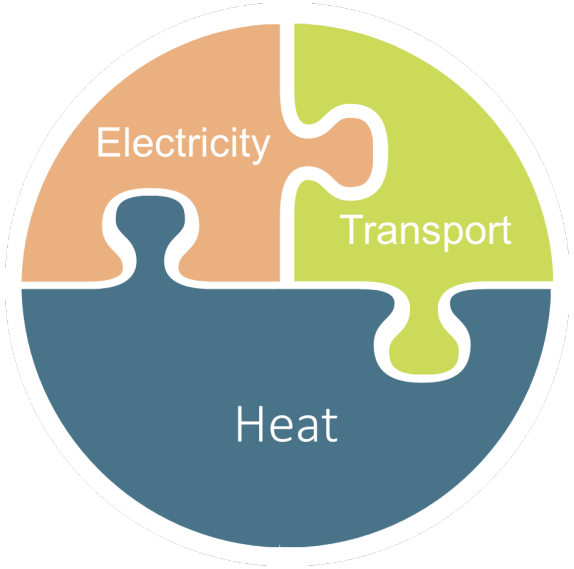
Jack Corscadden, Euroheat & Power

jc@euroheat.org

No Energy Transition without Sustainable Heating and Cooling

Heating & **Cooling** represents

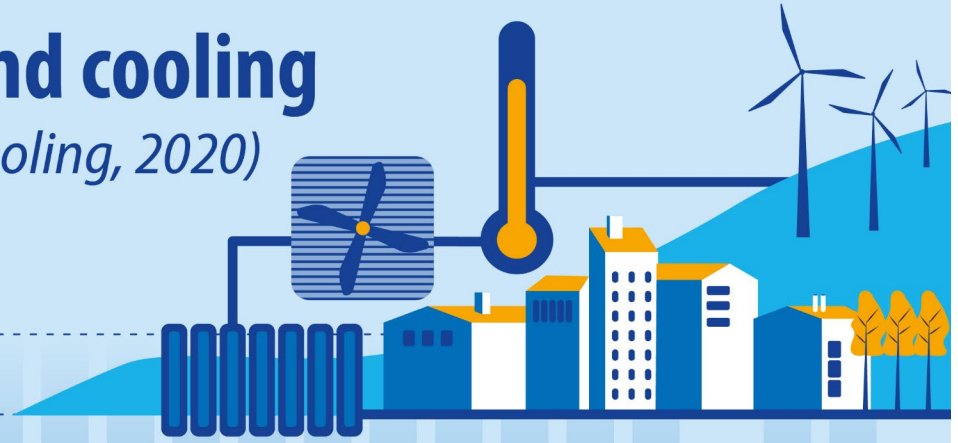
50% of the EU total annual energy consumption

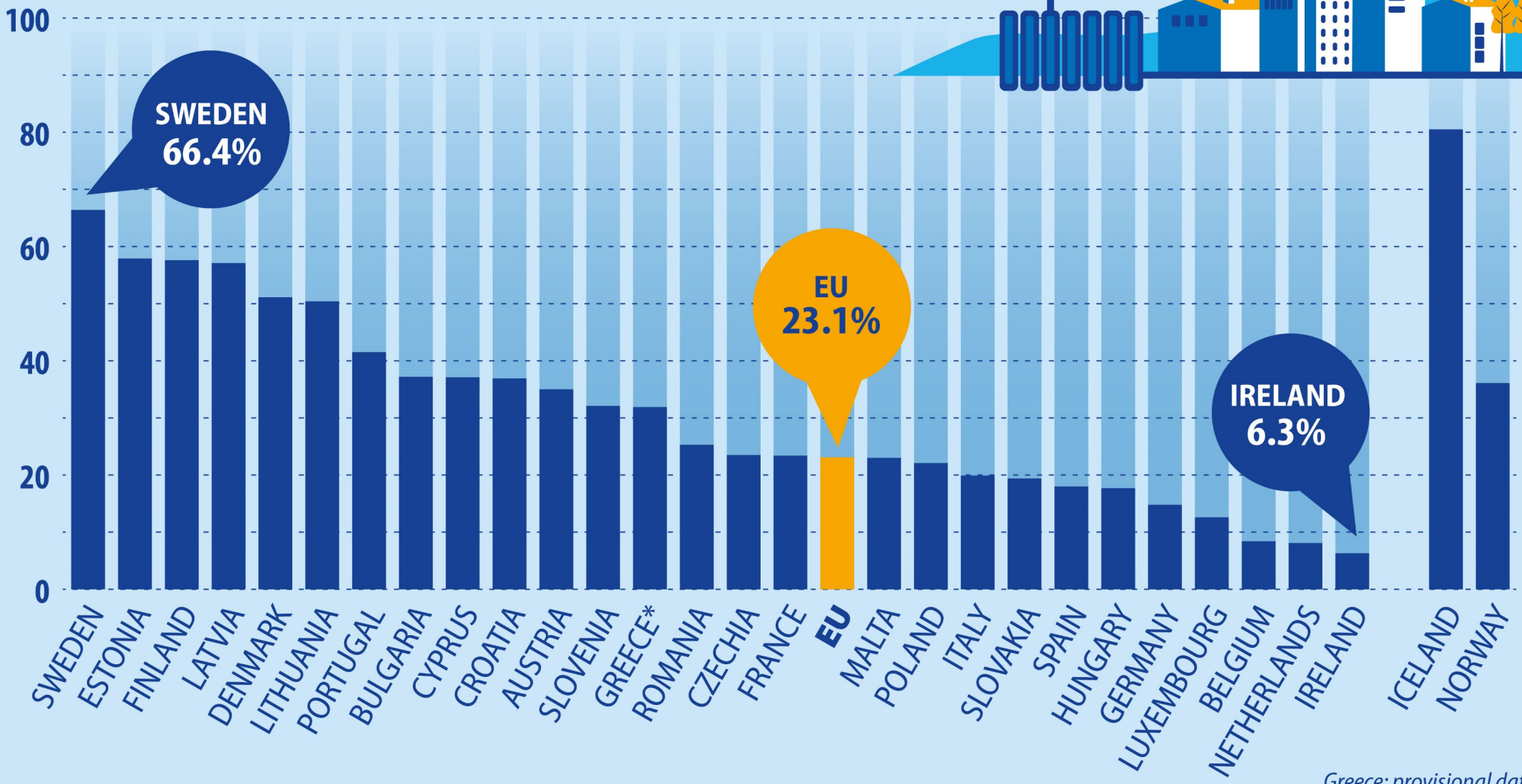


75% of EU citizens will live in urban areas in 2022, with an increase to **84%** by 2050

Renewable energy used for heating and cooling

(% of gross final energy consumption for heating and cooling, 2020)





Greece: provisional data

The Vision

REWARDHeat

- Demonstrate DHC networks, which are able to recover renewable and waste heat available at low temperature, i.e. lower than 40°C
  - Reduce supply temperatures
  - Focus is on the exploitation of the energy sources available within the urban context

Welcome to Helsingborg Öresundskraft

Our district heating, a key for a sustainable region:

Regional DH partnership and Optimization

- Fredrik Hörberg, Production Planning

Smart asset management, using IoT

- Magnus Ohlsson, Senior Specialist

Carbon Capture and Storage year 2026

- Jesper Baring, Project Manager

The Helsingborg Energy System

Agenda

0905 **Welcome to Helsingborg and Öresundskraft**
Anna Sundberg, Strategy & Innovation

0915 **Our district heating - a key for a sustainable region**
Jesper Baaring, Project Manager

0920 **Regional DH Partnership and Optimization**
Fredrik Hörberg, Energy systems engineer

0925 **Smart asset management, using IoT**
Magnus Ohlsson, Technical Manager DH Network

0930 **Carbon Capture & Storage 2027**
Jesper Baaring, Project Manager

0935 **Questions**

Helsingborg & Öresundskraft

HELSINGBORG

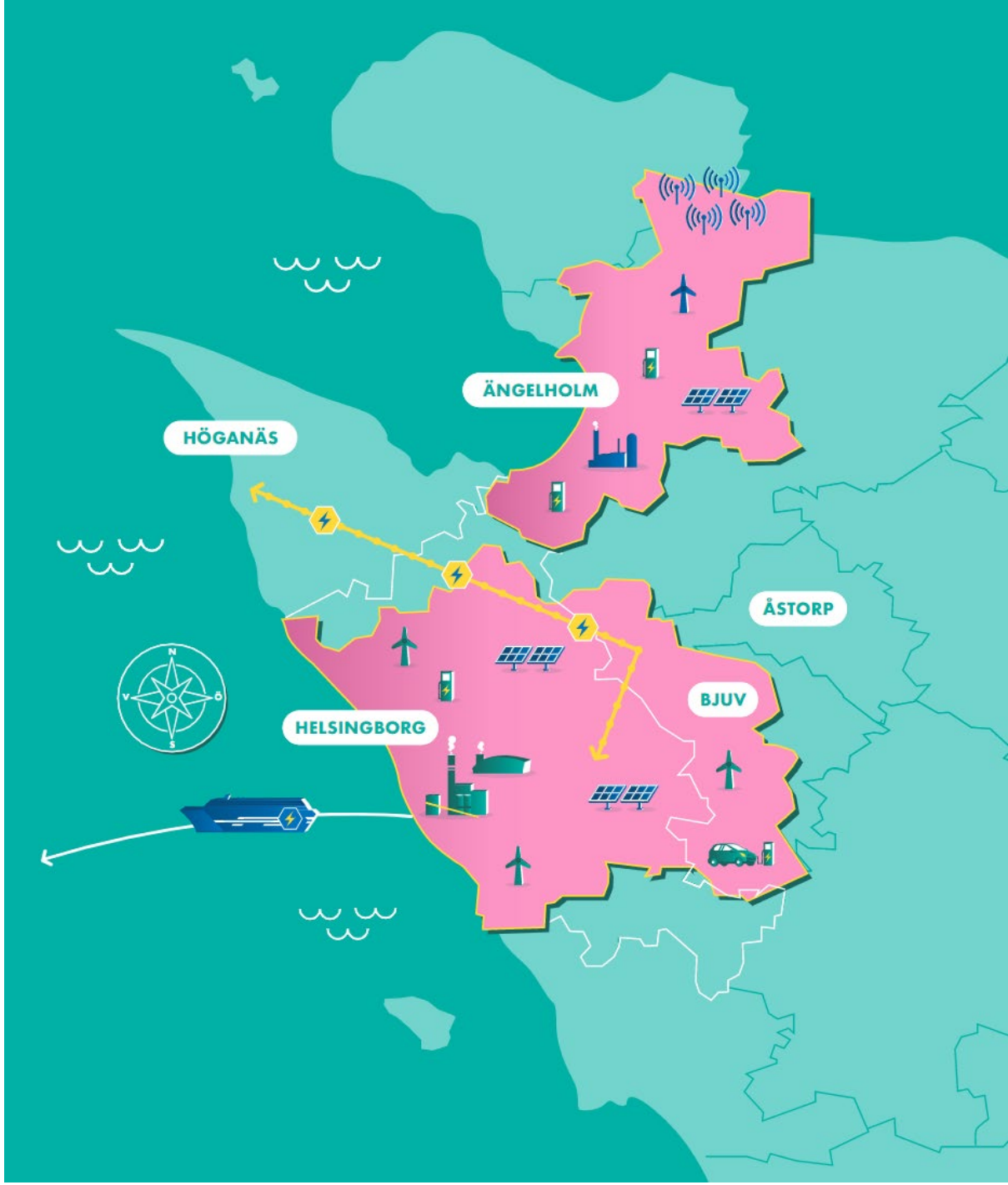
City of Helsingborg

- 150 109 citizens
- Fast growing, 190 000 by 2050
- Net Zero CO_2 2030

ÖRESUNDS KRAFT

Öresundskraft

- Regional Energy Company
- 100 % owned by City of Helsingborg
- 240 M€ Turnover
- 400 employees

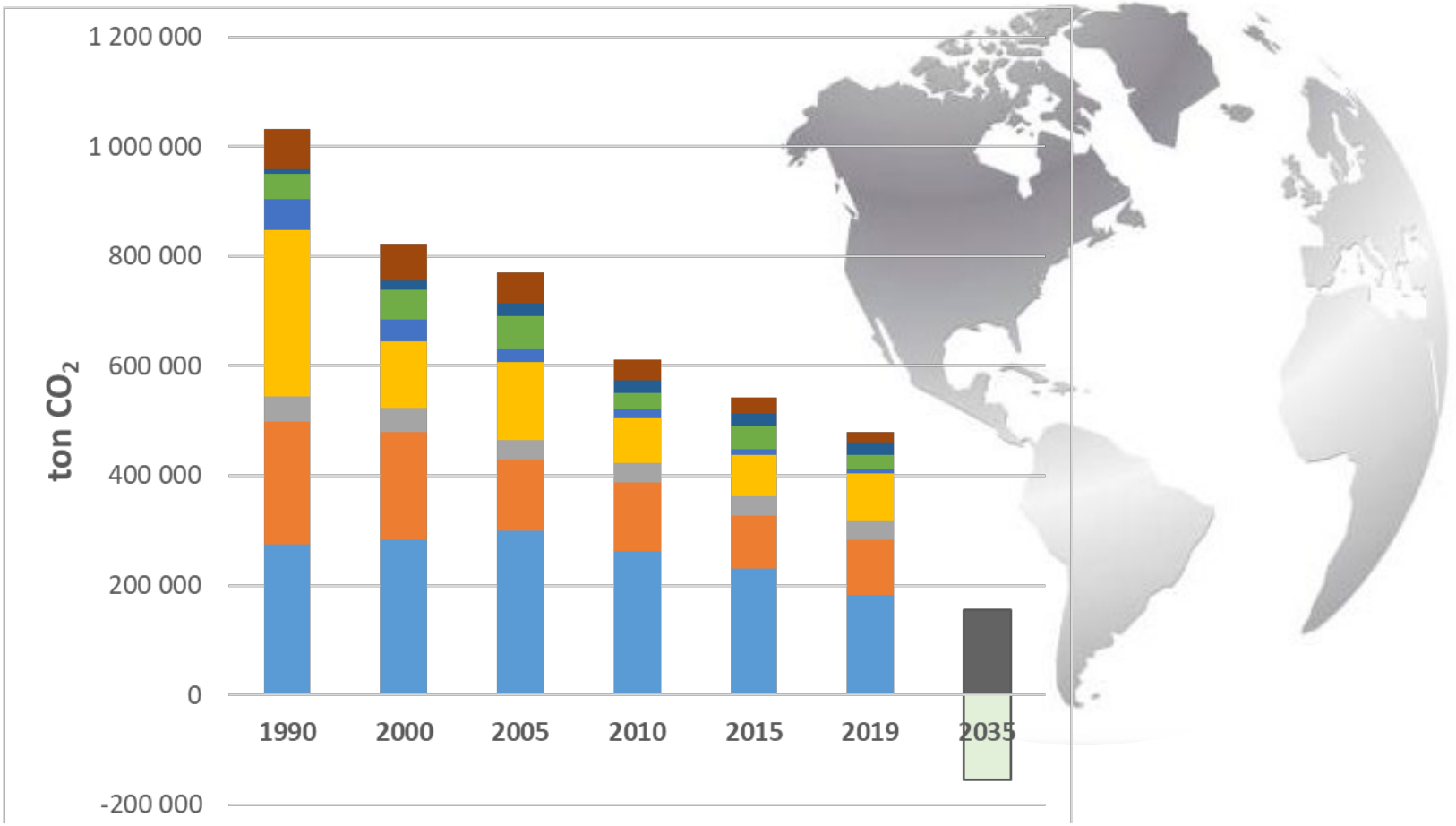


ÖRESUNDS KRAFT

Helsingborg Net Zero CO_2 2030

ÖRESUNDS KRAFT

Mission 479 992 t CO_2

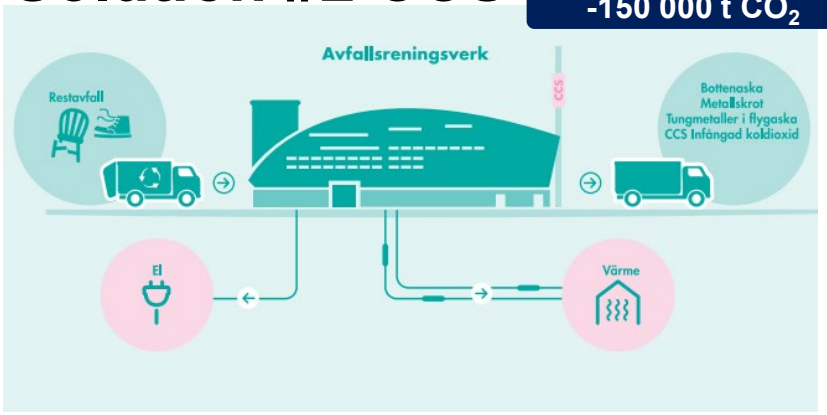


Solution #1 Electric Power

-150 000 t CO_2

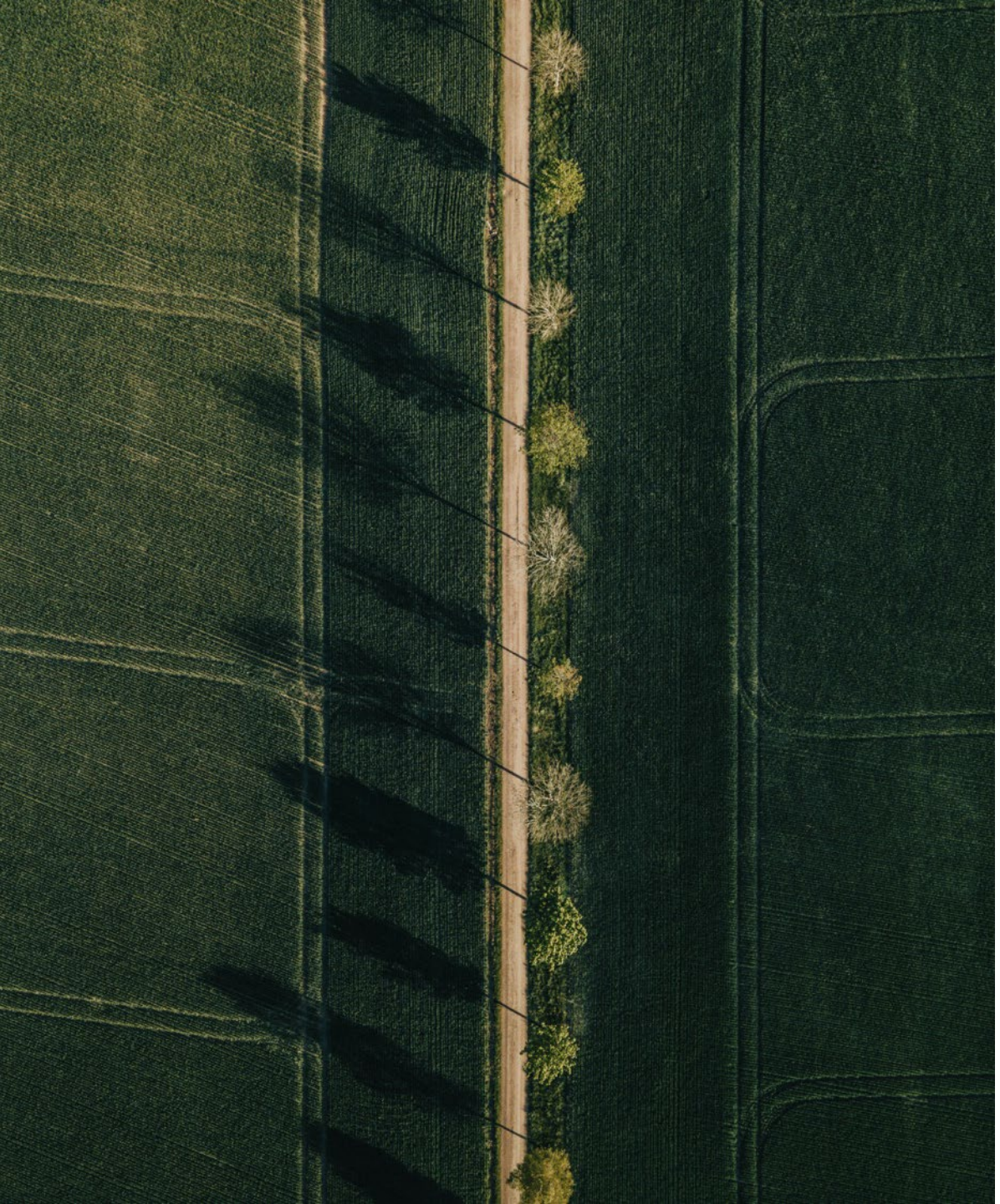
Solution #2 CCS

-150 000 t CO_2



Our district heating, a key for a sustainable region

Patrik Hermansson
Strategy & Innovation



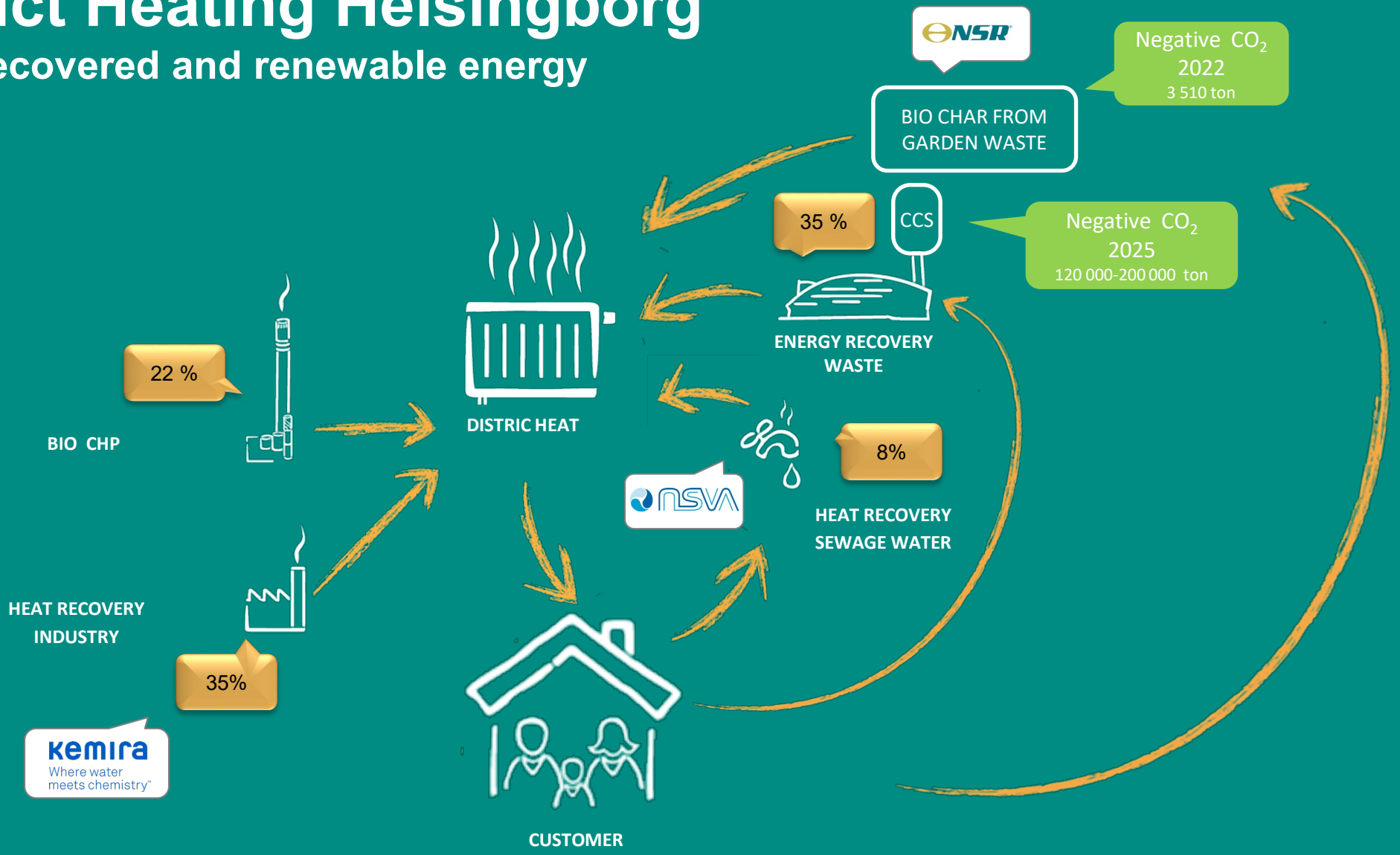
ÖRESUNDS KRAFT

Short facts DH

- Fossil fuel free
- 80 % Market Share
- 100 M€ Turn Over
- 12 000 B2C (detached houses)
- 1 400 B2B (apartment buildings, offices, public service, industry)
- Strong growth

District Heating Helsingborg

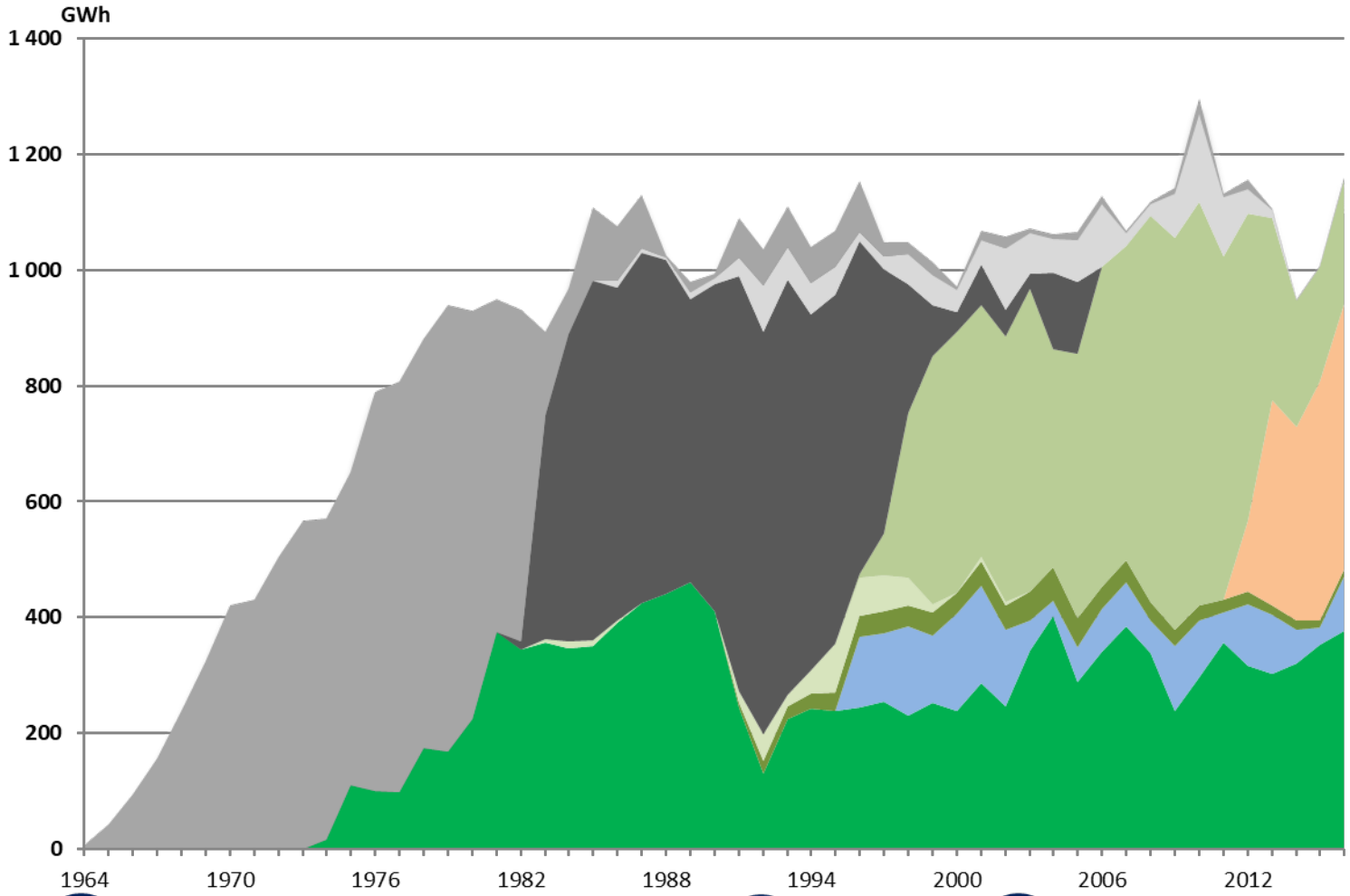
99,8% recovered and renewable energy



ÖRESUNDS KRAFT

DH system adresses societal challenges

ÖRESUNDS KRAFT



Bio CHP (75-130MW)
(Nov-Mar)

Energy from Waste (70 MW)

Sewage Heat (30 MW)

Industry (50 MW)

99,8% Fossil Fuel Free

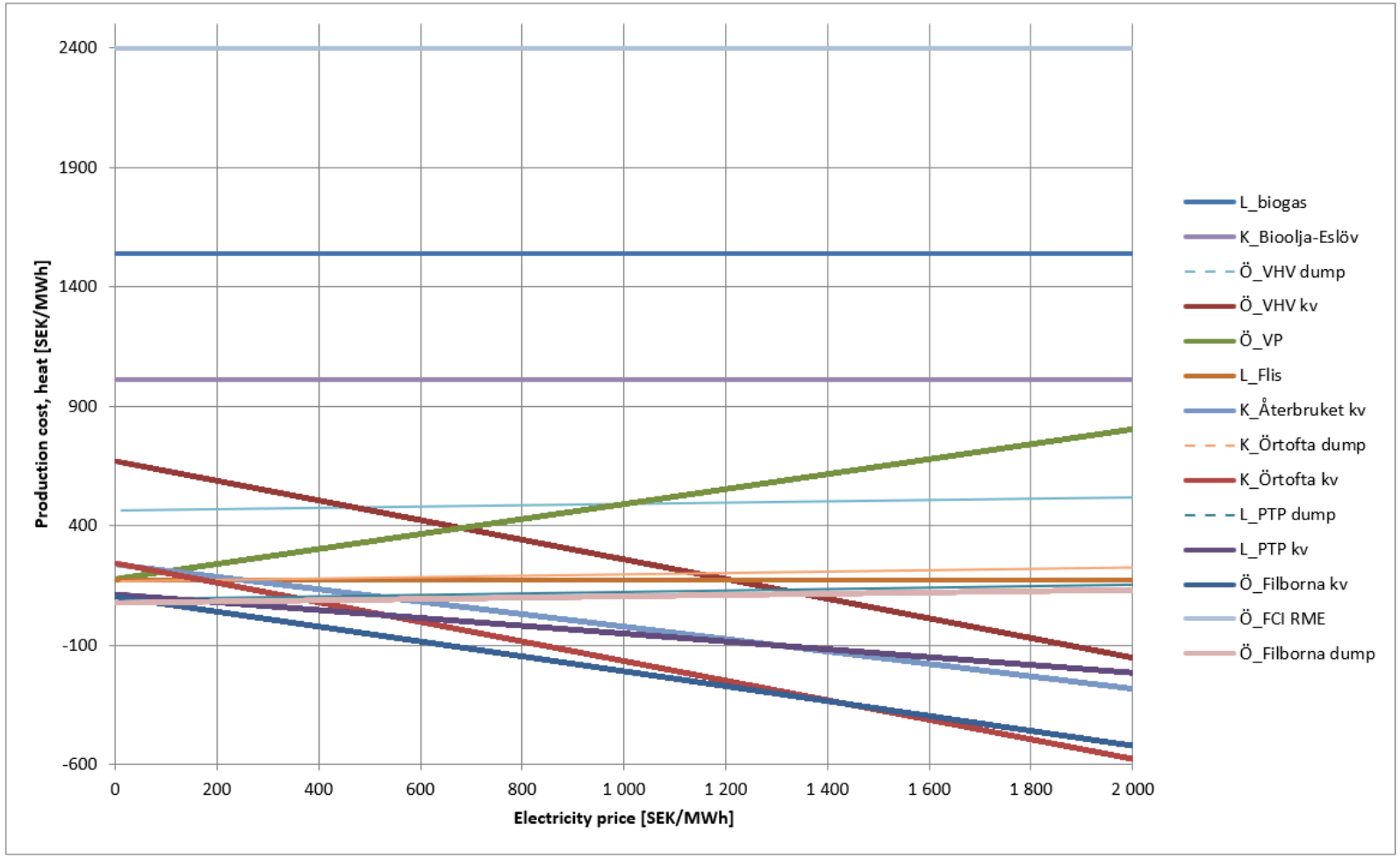
Regional DH partnership and Optimization

Fredrik Hörberg
Energy Systems Engineer

Our district heating grid

- 2,3 TWh
- Hydraulic separation Örtofta
- HBG/LKR 45 MW
- LKR/LUND 60 MW
- Approx 40 different heat/power plants

Production cost



Financial settlement

- Settled monthly by joint evalution of the actual result and the simulated, hypotectical ”disconnected” outcome

Production costs (monthly)	Connected (outcome)	Disconnected (simulated)	Operational advantage
Öresundskraft	30 000 000	29 000 000	-1 000 000
Landskrona	3 000 000	5 000 000	2 000 000
Kraftringen	25 000 000	30 000 000	5 000 000
Sum:	**58 000 000**	**64 000 000**	**6 000 000**

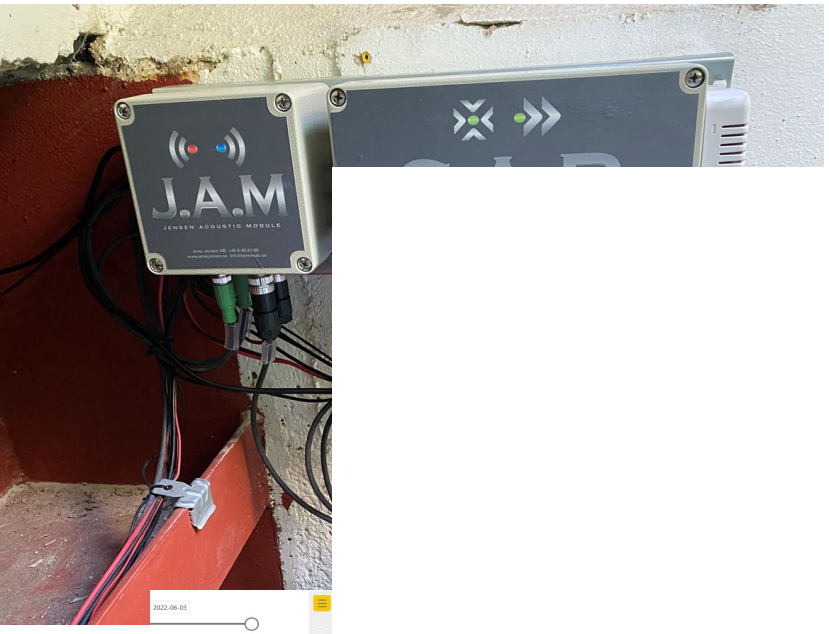
Financial settlement	ÖKAB	LKR	KR
Profit share	1 800 000	1 200 000	3 000 000
Individual advantage	-1 000 000	2 000 000	5 000 000
Total [SEK]	**2 800 000**	**-800 000**	**-2 000 000**

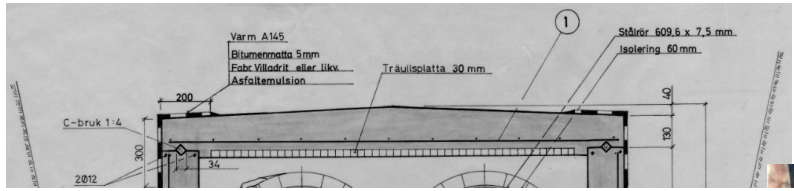
- Compares individual gains to overall result and divides gains evenly

- Ensures a fair and an accepted division of the achieved result

Smart asset heat network management using IOT

Magnus Ohlsson
Technical Manager DH Network

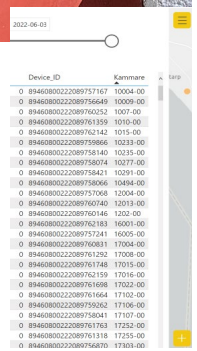


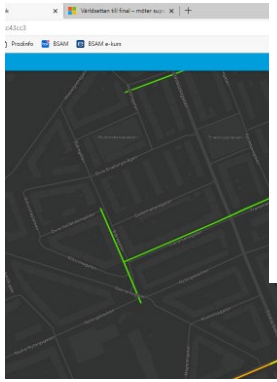


ÖRESUNDS KRAFT

11 km

66 000 000





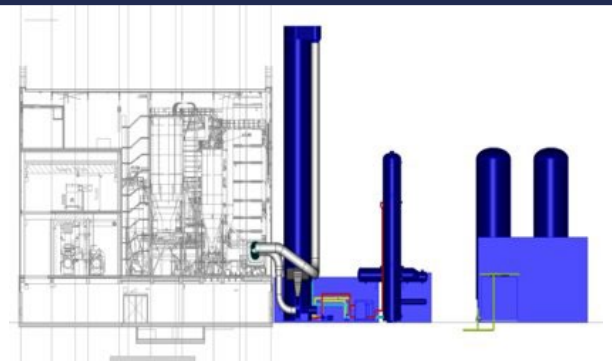
Carbon Capture and Storage 2027

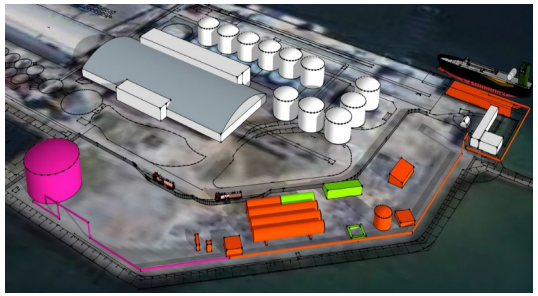
Jesper Baaring
Senior Projekt Manager

Objectives for the HICAS project
(Helsingborg Innovative Carbon capture And Storage)

- Help the City of Helsingborg to become carbon neutral and offer the market Carbon Removal Certificates (CRC)
- Strengthen the value proposition of District heating to become carbon neutral.
- From Filbornaverket (Energy from Waste plant)
  Capture 85.000 tonnes of fossil CO2 and 125.000 tonnes of biogenic CO2, by 2027

Carbon Capture and Storage, chain





Thank you for your attention!

Panel Discussion

REWARDHeat

- How do we optimize the capture and storage of low-quality heat sources and the flexible use and supply of electric power to mitigate peak power demand?
    - Point of departure: City of Helsingborg – Electric Power Plan 2022 – 2026

- Anna Sundberg, Öresundskraft
- Paul Westin, Sweden Energy Agency
- Håkan Knutsson, Indepro and SweHeat

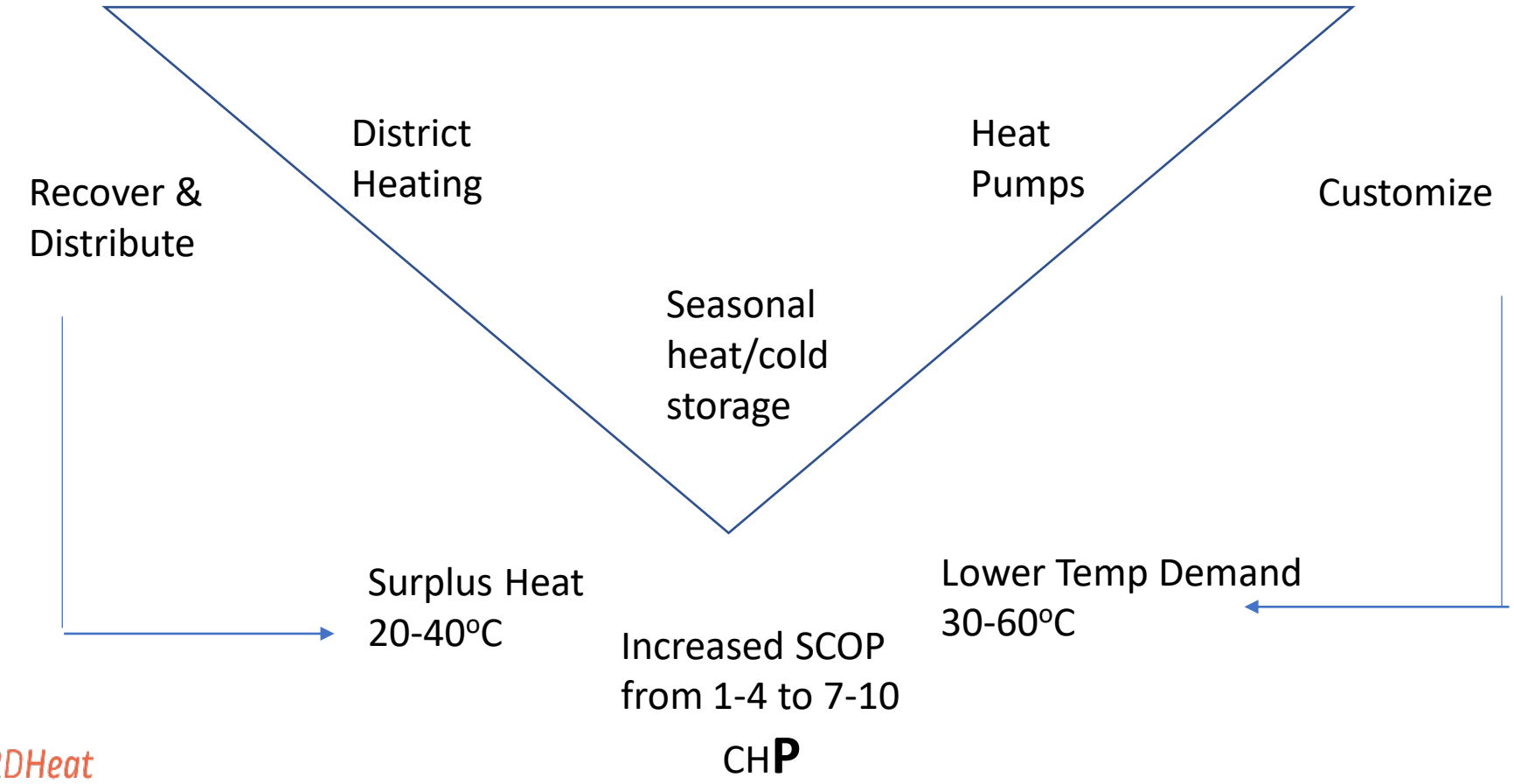
REWARDHeat
Panel Discussion June 16

Europe – phase out fossil fuels
Heating and electric power demand

Background Information – Swedish experience

Anna Sundberg, Öresundskraft
Paul Westin, Sweden Energy Agency
Håkan Knutsson, Indepro and SweHeat

Replace gas-driven heating with Electric-driven heating – circular sources



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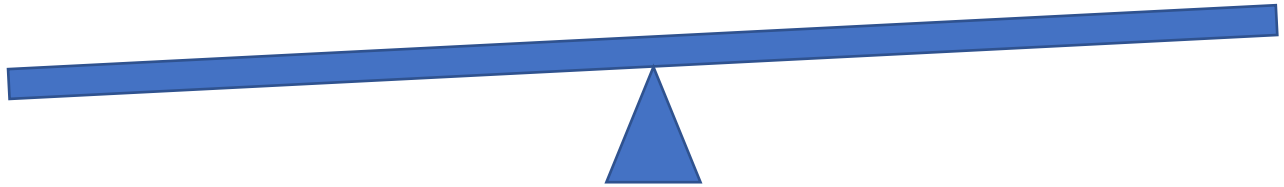
Electric energy
DH Pipe lines

Amount of heat to recover



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Proposed agenda – discussion with audience

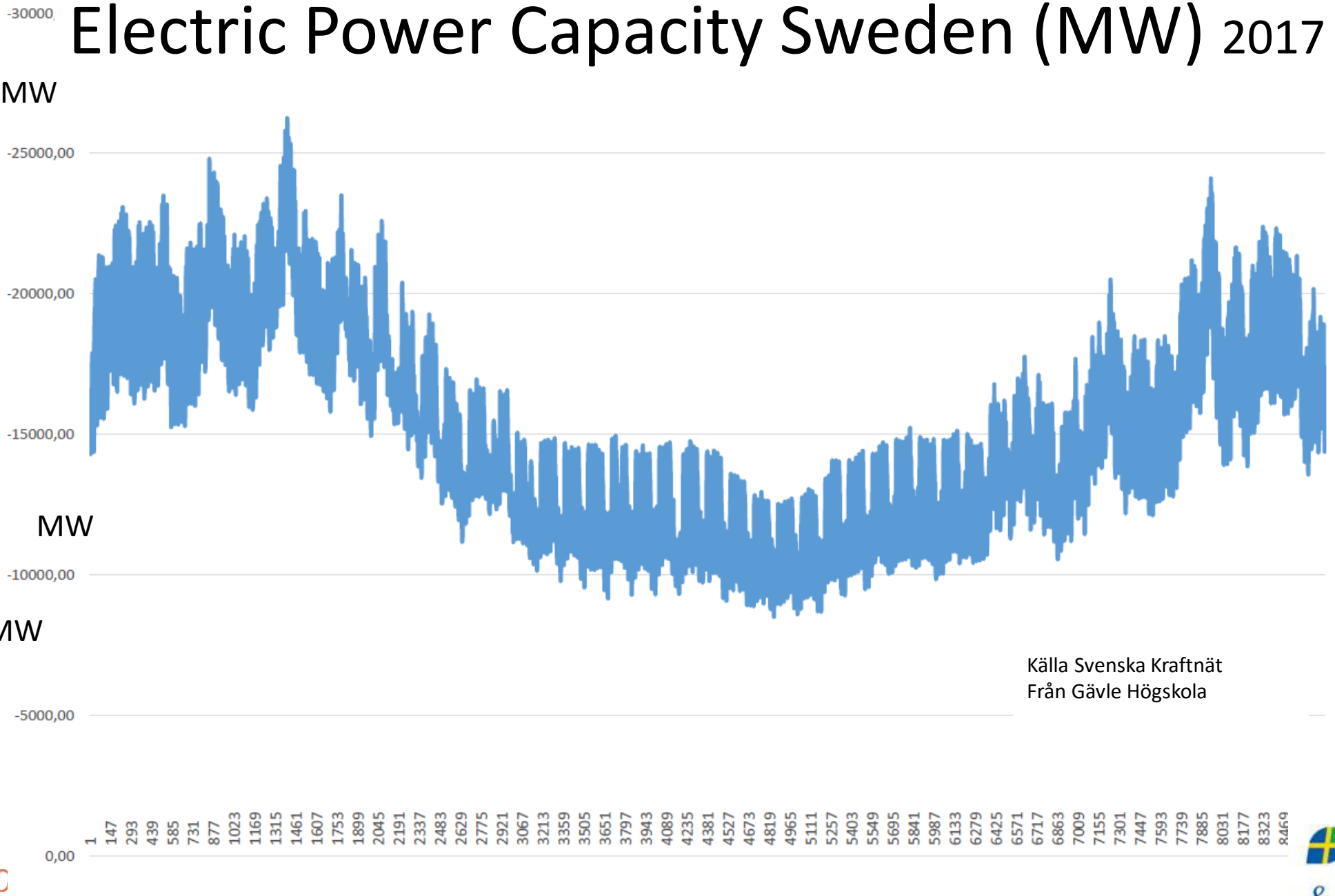
1. Sweden quick review: Heating and Electricity
2. Zoom in at Helsingborg: Power constraints and City Plan
3. Briefly Sweden Electricity Strategy in relation to IEA
4. The way forward in Europe….?

Electric Power Capacity Sweden (MW) 2017

Compare Northstream

Max at 28 000 MW

150 TWh
Stable since 1990



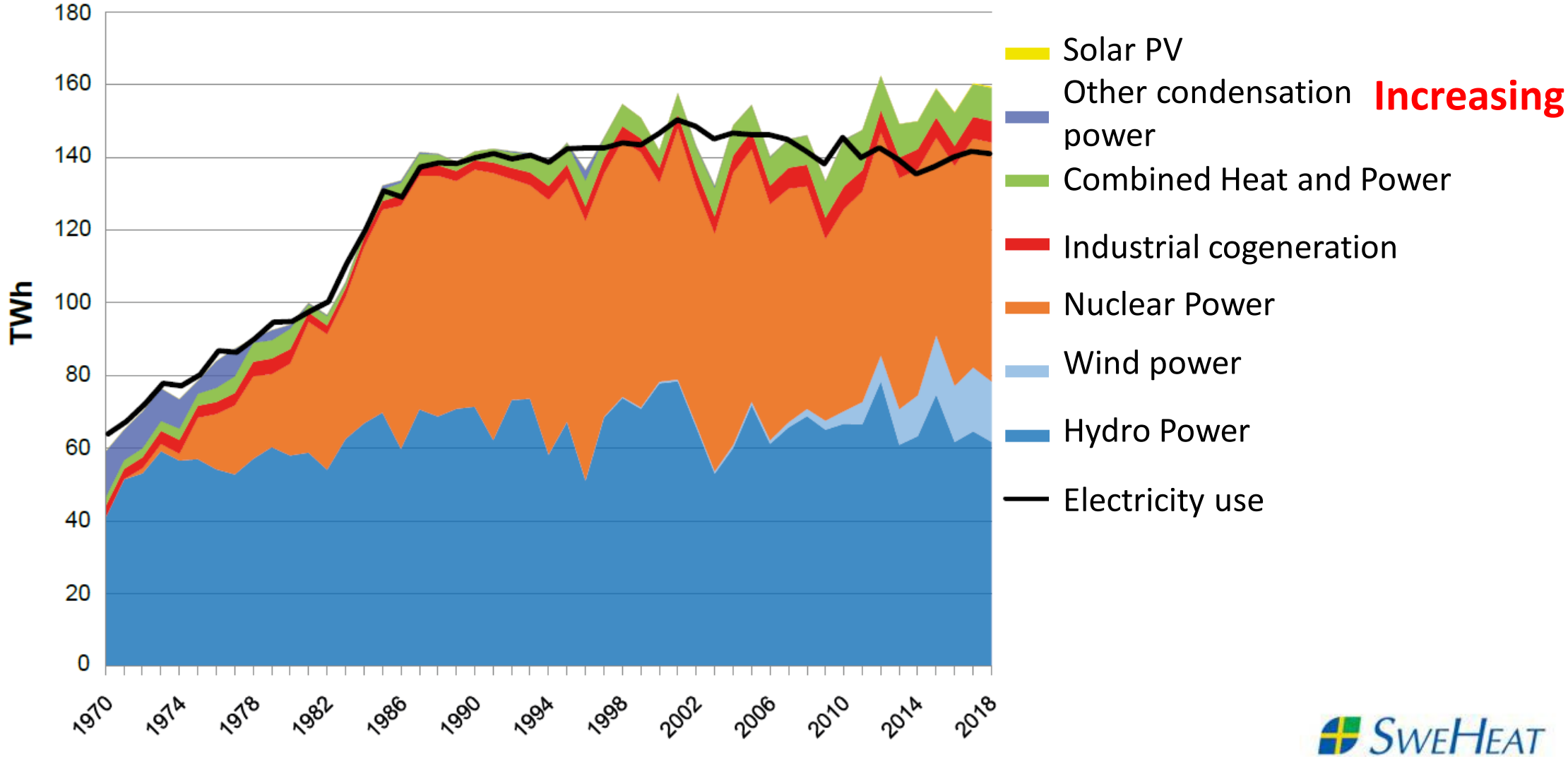
Min at 8 000 MW

Källa Svenska Kraftnät
Från Gävle Högskola

REWARD

SWEHEAT & COOLING

Electricity Supply in Sweden

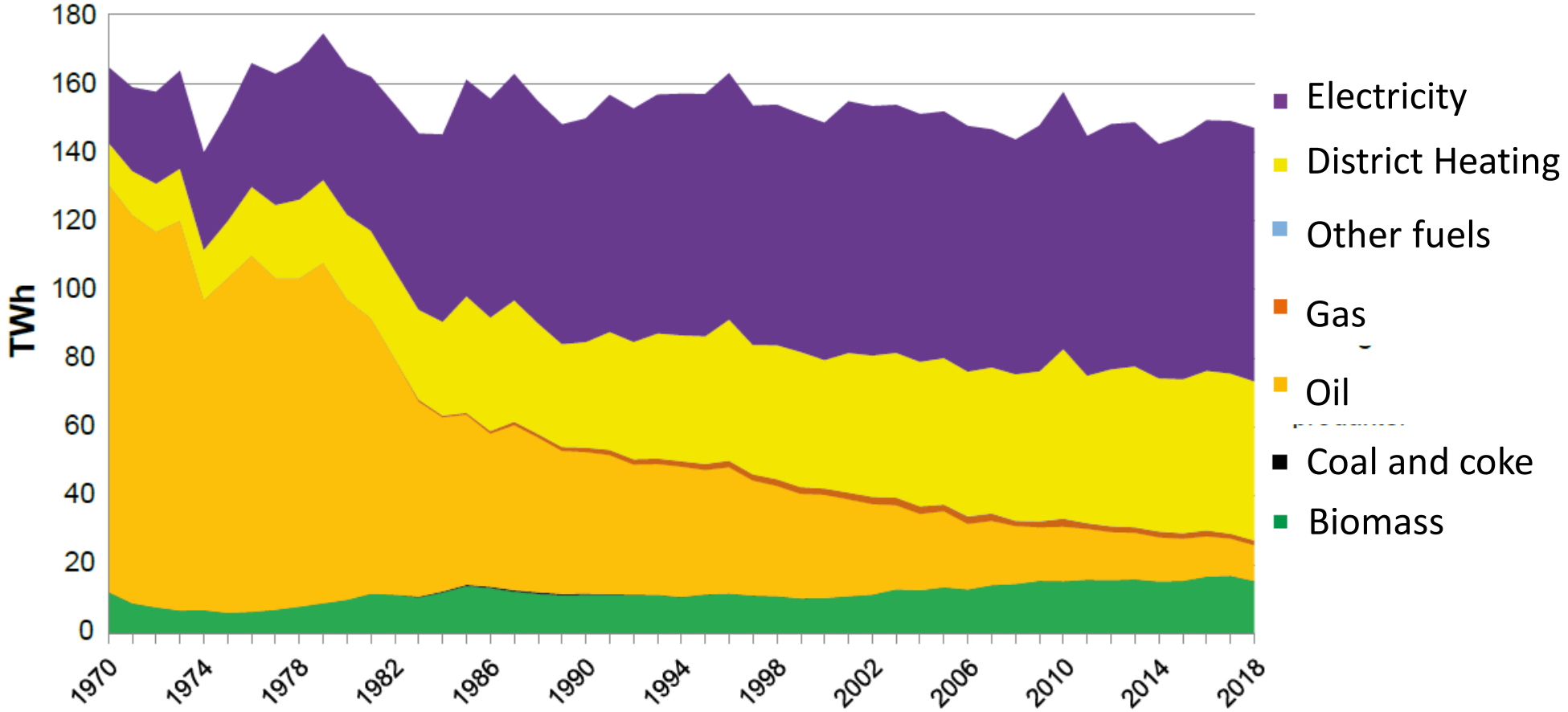


Source: Sweden Energy Agency

REWARDHeat

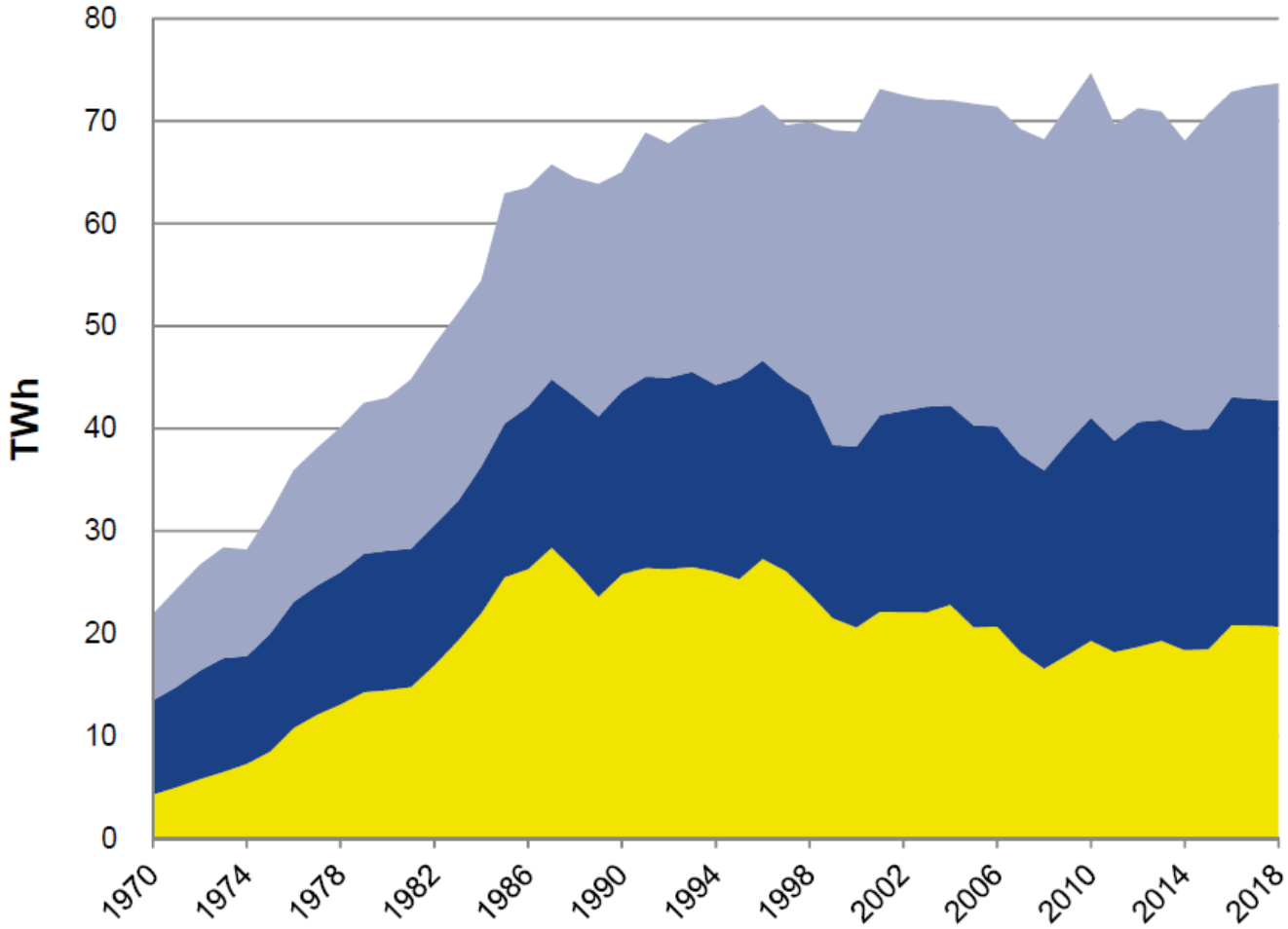
SweHeat & Cooling

Energy use in the building and service sector



Source: Sweden Energy Agency

Use of electricity in the building and service sector

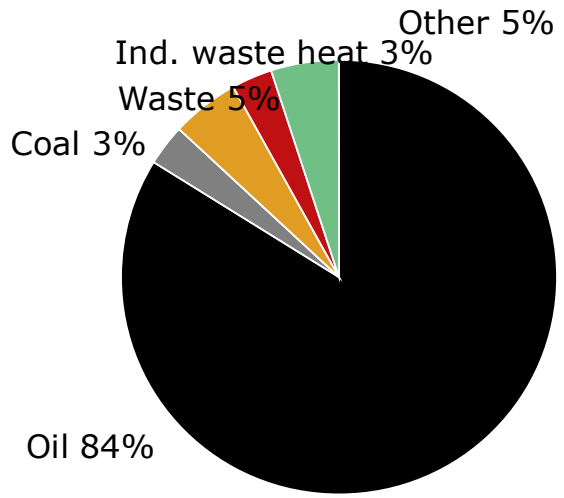


28% heating

Source: Sweden Energy Agency

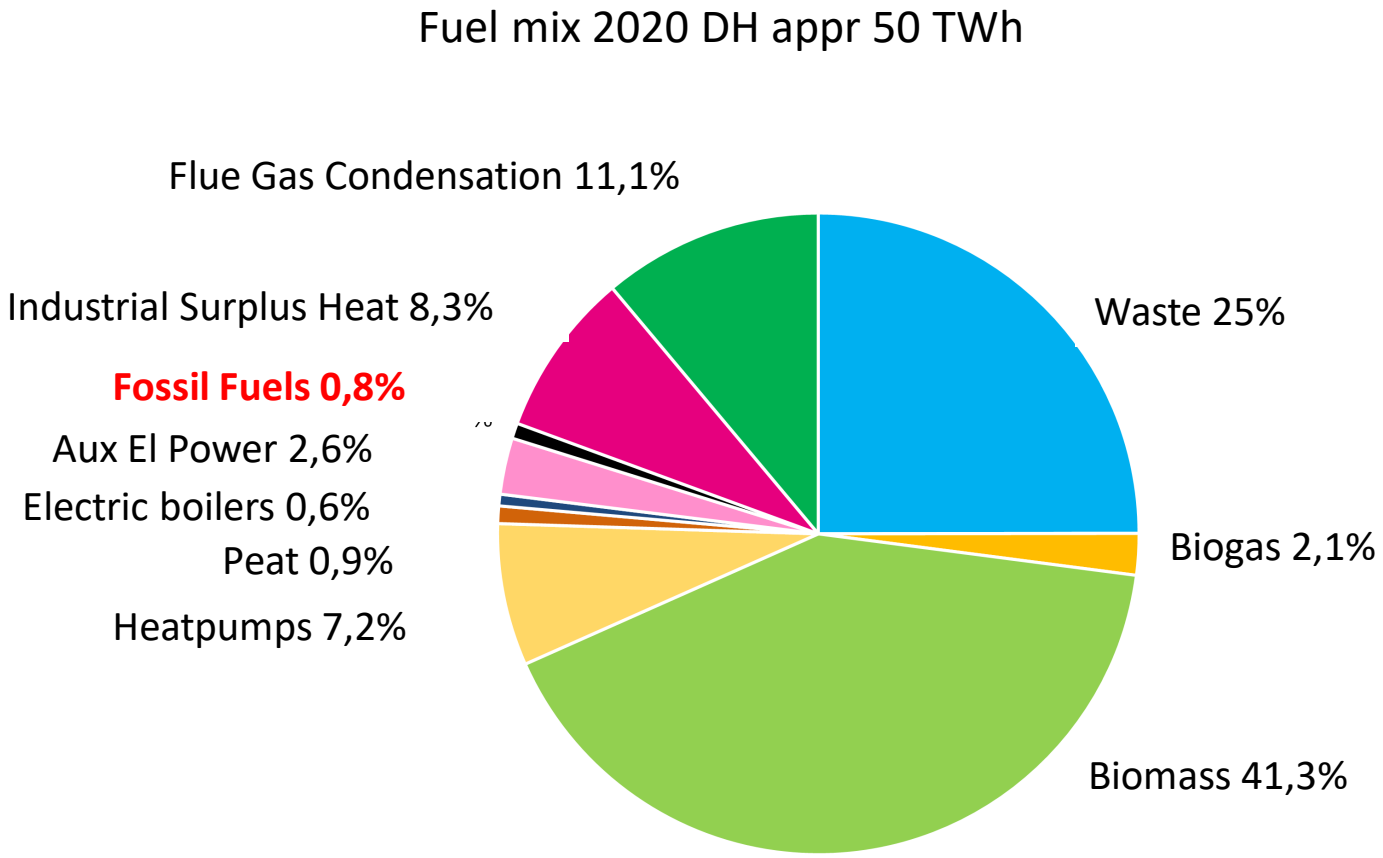
District heating heat sources 1981

Total production: 27 TWh



Source: Sweden Energy Agency

District heating heat sources 2020



Deregulated market and ownership

Source: Sweden Energy Agency

The electrification of our society

Cars

Hydrogen and E-fuels

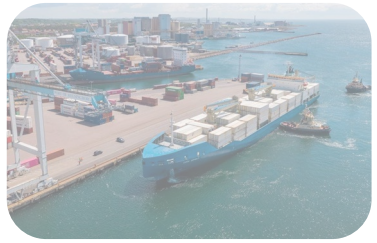
Industry

Public transport

Data Centres

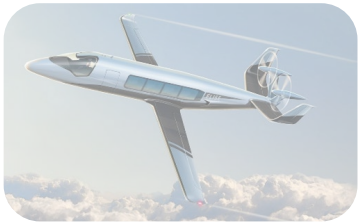
EL

Heavy transport



Harbours

Ferries



Aircrafts

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Electric power shortage

Helsingborg local conditions:
Local electric power is produced from two CHP plants as well as being distributed from the regional electricity network

National conditions:
Nuclear power is shut down in the south of Sweden

Wind power is primarily built in the north

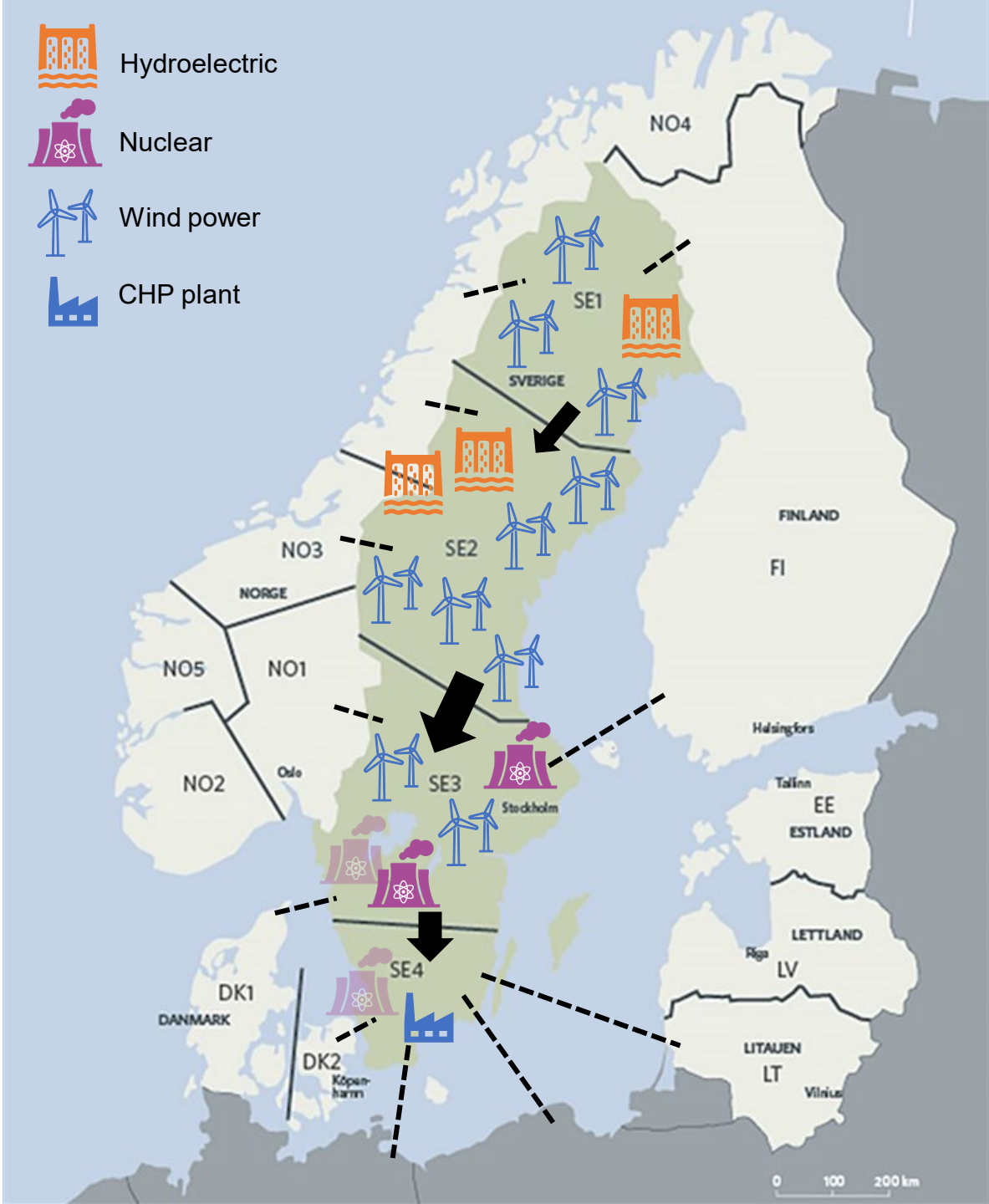
→ More electricity needs to be transported down to Scania in the south (SE4)

Capacity problems in the national electricity grid network causes transmission issues

Reimbursements are in progress but takes time

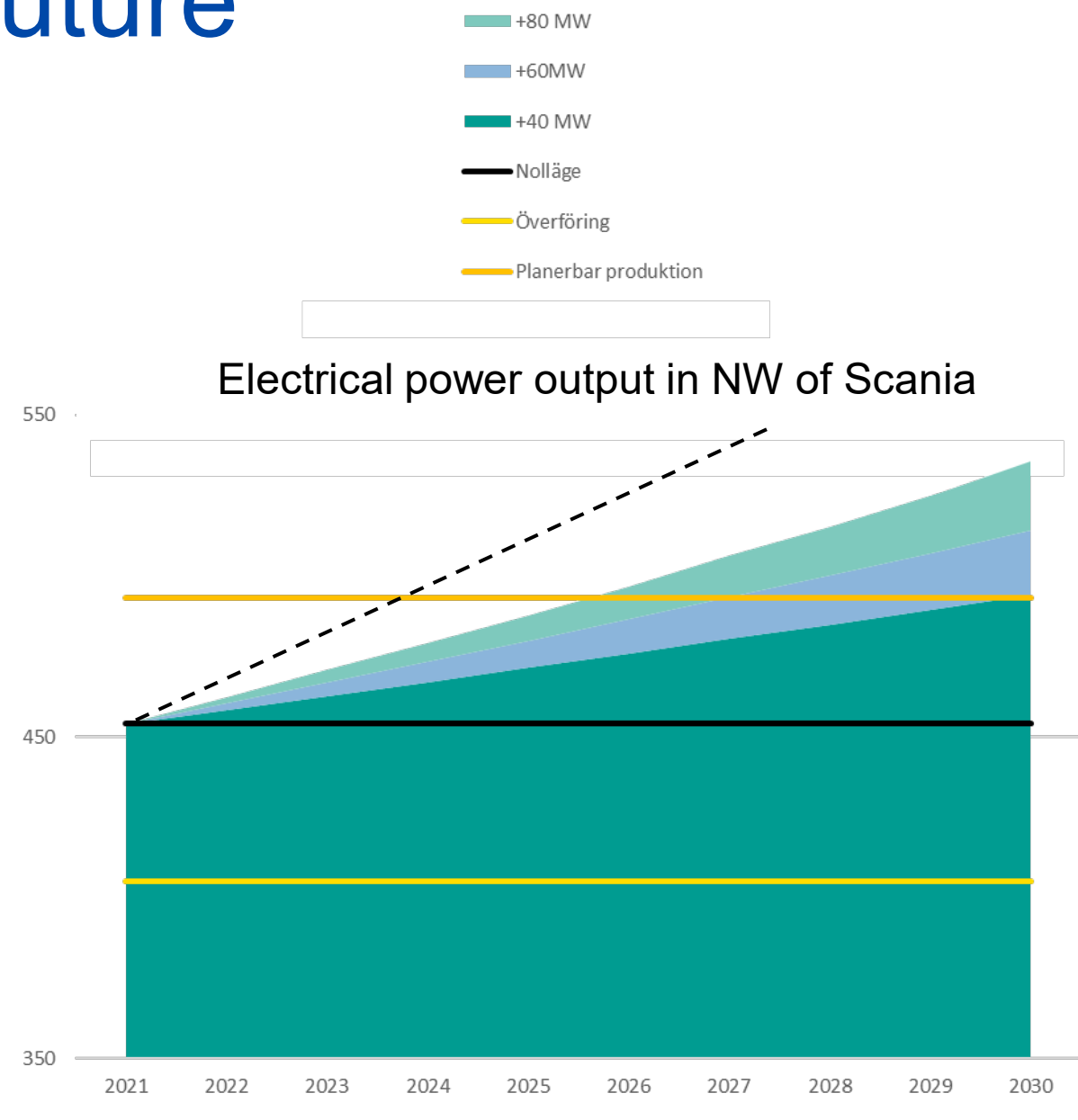
→ Result – shortage of available electric power in Northwest of Scania until 2026

REWARDHeat



Current situation and future

- The electrical power demand in Helsingborg is a part of the one in the whole Northwest of Scania, where the city of Helsingborg represent half of the total demand
- Maximal power output during the winter 2021/2022 was around 450 MW for the Northwest of Scania
- Industry, transport and the increasing population are influencing the power usage, as well as the choices we make in the community planning of the city
- If we don't use the electrical power in a smart way our margin will be reduced drastically, which already can be seen as a sneaking load increase
- The development is preceding faster than all scenarios expected; without taking action the maximal level of power output will be reached already in 2023/2024



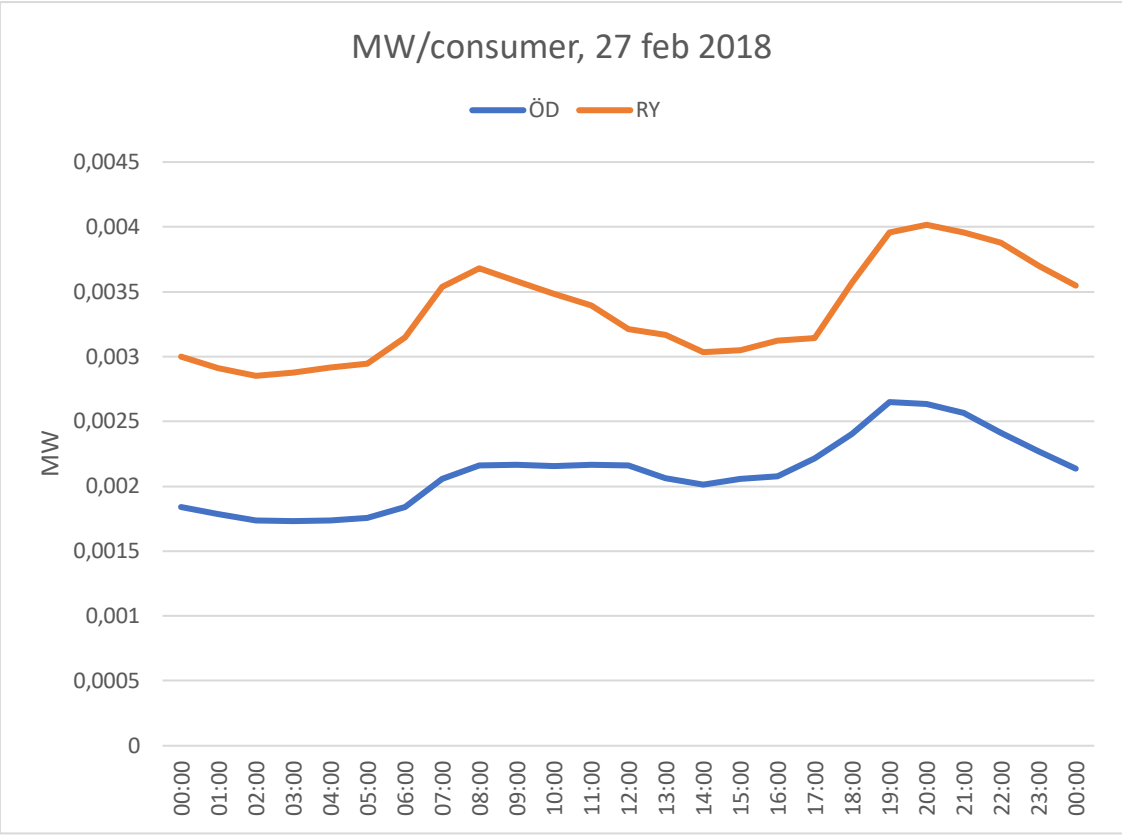
REWARDHeat

Helsingborg Electrical Power Plan

- The city of Helsingborg in cooperation with the local energy utility Öresundskraft have created a plan for the electrical power between 2022-2026.
- The goal is to take a holistic approach in the area if electrical power, both through increased knowledge but also by proposing a number of activities securing a robust, sustainable and efficient electrical power usage.
- The plan consists of three areas of focus:
  - *Develop the community planning from an electrical power perspective,*
  - *Develop methods of flexible electrical energy usage,*
  - *Strengthen the local renewable electrical power production*

REWARDHeat

The heating sector has a key role to play



- Electricity should be used in sectors where there are no other energy carrier options
- District heating releases electrical power to be used were it is most needed; such as personal transport, lighting etc.
- CHP plants produces local electrical power at the same time as heat is produced – get two for one!
- When comparing two equal city districts, Ödåkra which is heated with DH and Rydebäck which is primarily heated with heat pumps, you can see that the electrical power output differs very much
- During the electrical power peak day in 2018 the power output differed more than 50% between the two districts

REWARDHeat

Power Capacity: Constraints and Flexibility

Time Resolution

- ✓ Seconds, Minutes
- ✓ Hours
- ➢ **Days**
- ➢ **Weeks and months**

HP SCOP: from 1-4 to 7-10
Capture Heat
Seasonal Storage

Location of contraints

Power Supply (Generation)
Transmission Network and interconnections
Regional Network
Local Network

REWARDHeat

Technologies to empower a new generation of DHC networks and modernise existing ones

REWARDHeat

Demand side management and remote fault detection of individual heat pumps

- Per Ola Persson - CEO, Easyserv

Demand side management, optimization and sector coupling of DH and power

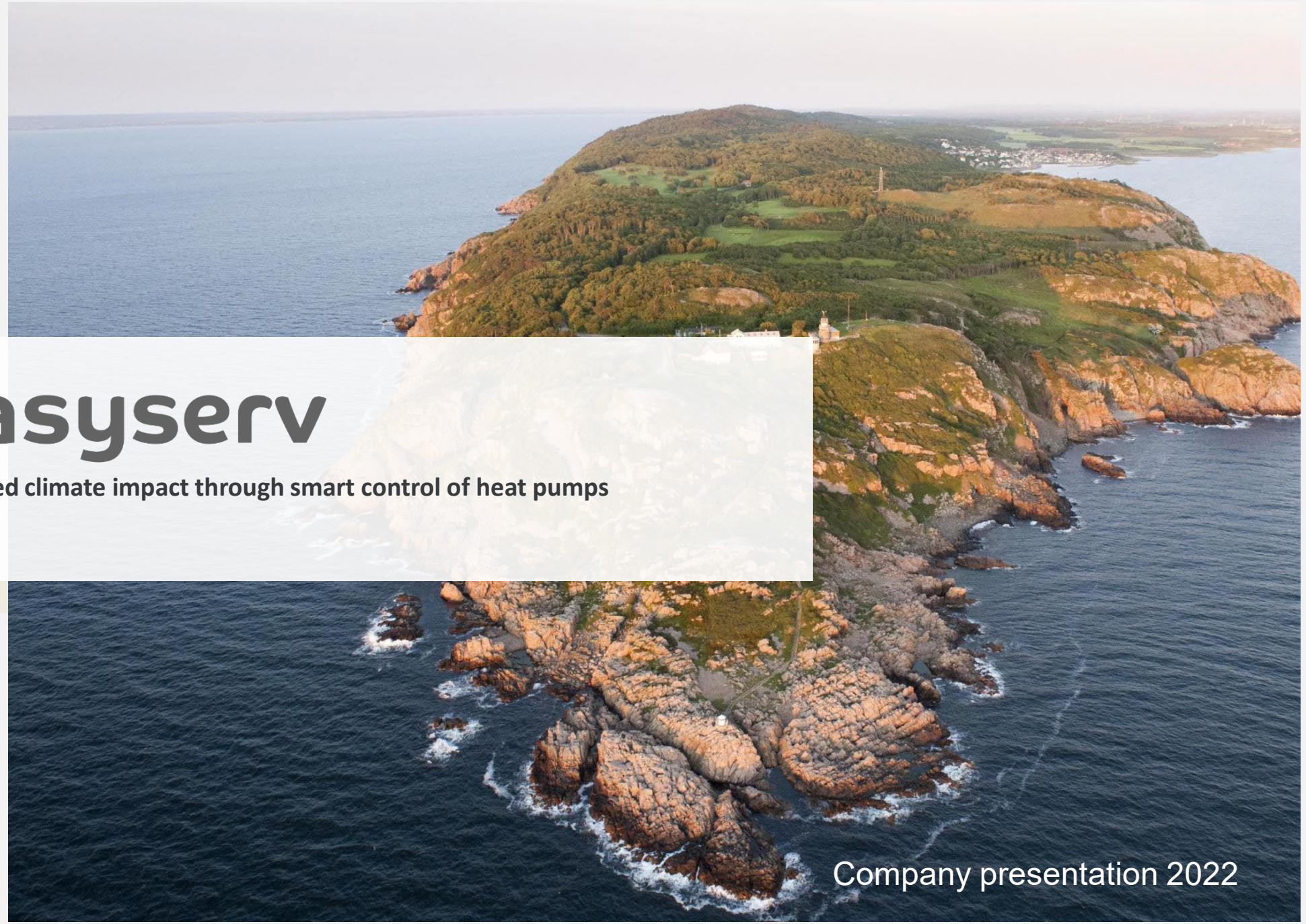
- Moa Dahlman-Truesdale – CFO and Bjorn Malstrom – CTO, Energy-Opticon
- Christian Johansson – CEO, Noda Intelligent System

Preservation of existing network assets by relining with carbon fibre composites

- Andreas Martsman – VP Business Development, CarboSeal

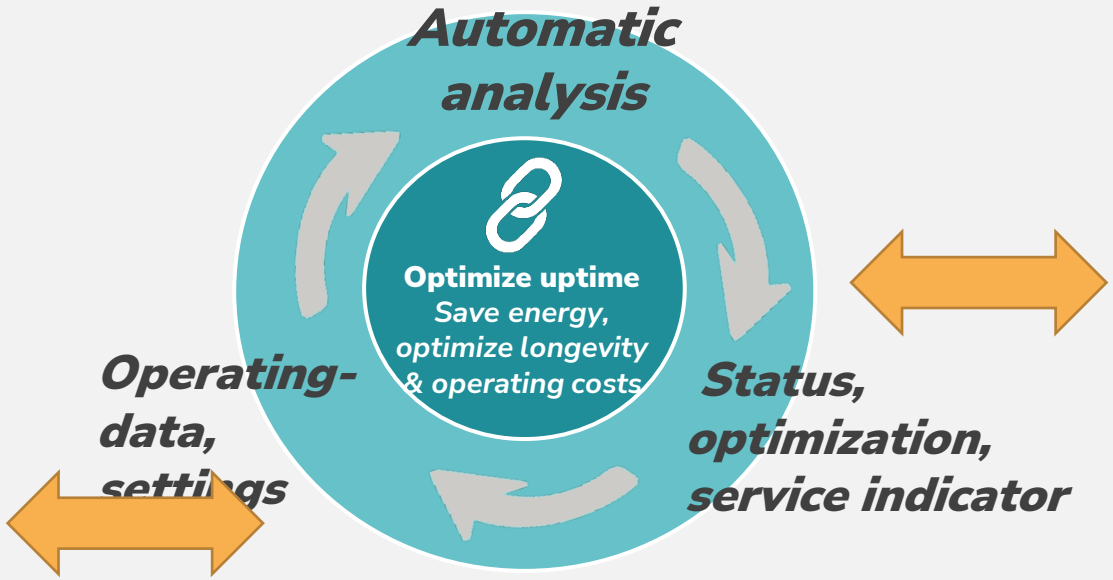
easyserv

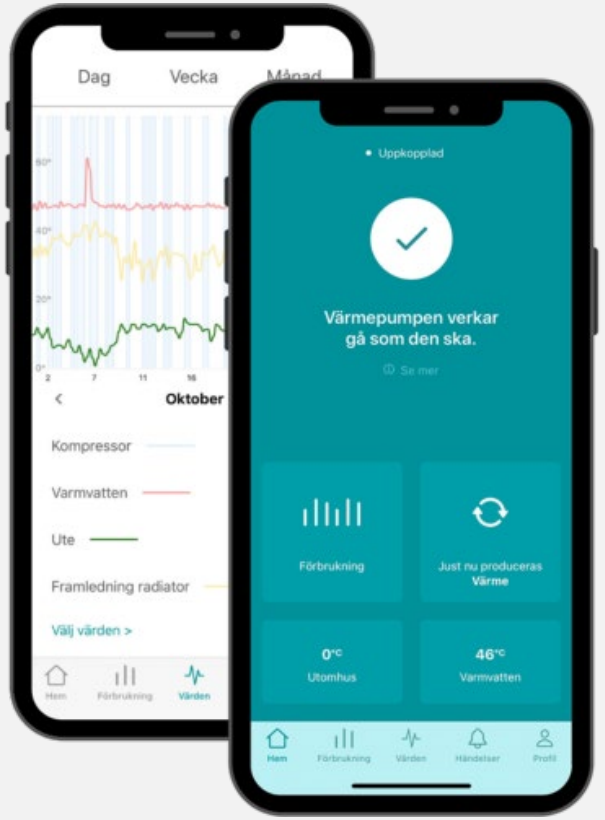
Reduced climate impact through smart control of heat pumps



Company presentation 2022

Summary, history



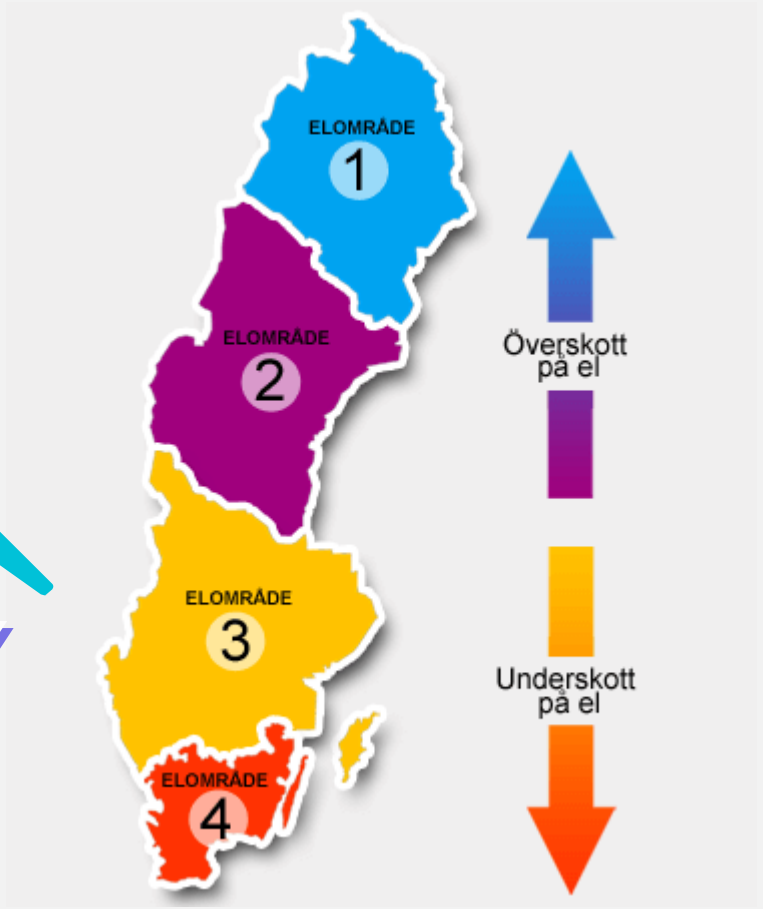


First product: service indicator, operating status

easyserv

New product / service

The energy conversion fundamentally **changes** the electricity system - requires **power balancing** in a new way



Elområde 1: Norrbottens län samt delar av Västerbottens län. **Elområde 2:** Jämtlands län, Västernorrlands län samt delar av Dalarnas län, Gävleborgs län och Västerbottens län. **Elområde 3:** Gotlands län, Stockholms län, Södermanlands län, Uppsala län, Värmlands län, Västmanlands län, Örebro län, Östergötlands län samt delar av Jönköpings län, Hallands län, Kalmar län, Västra Götalands län , Gävleborgs län och Dalarnas län. **Elområde 4:** Skåne län, Blekinge län, Kronobergs län, samt delar av Kalmar län, Hallands län, Jönköpings län och Västra Götalands län.

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Heat pumps a possibility

- ➔ **1.25 m heat pumps** in Sweden
- ➔ **12 m HP** installed in 2020 in Europe
- ➔ Forecast doubles to 2024-2025
- ➔ Sweden 800,000 water-based heat pumps

Effect capacity 8-10 GW!

Uppvärmning med el (värmepumpar) i **villahushåll** är ca **15 TWh/år**

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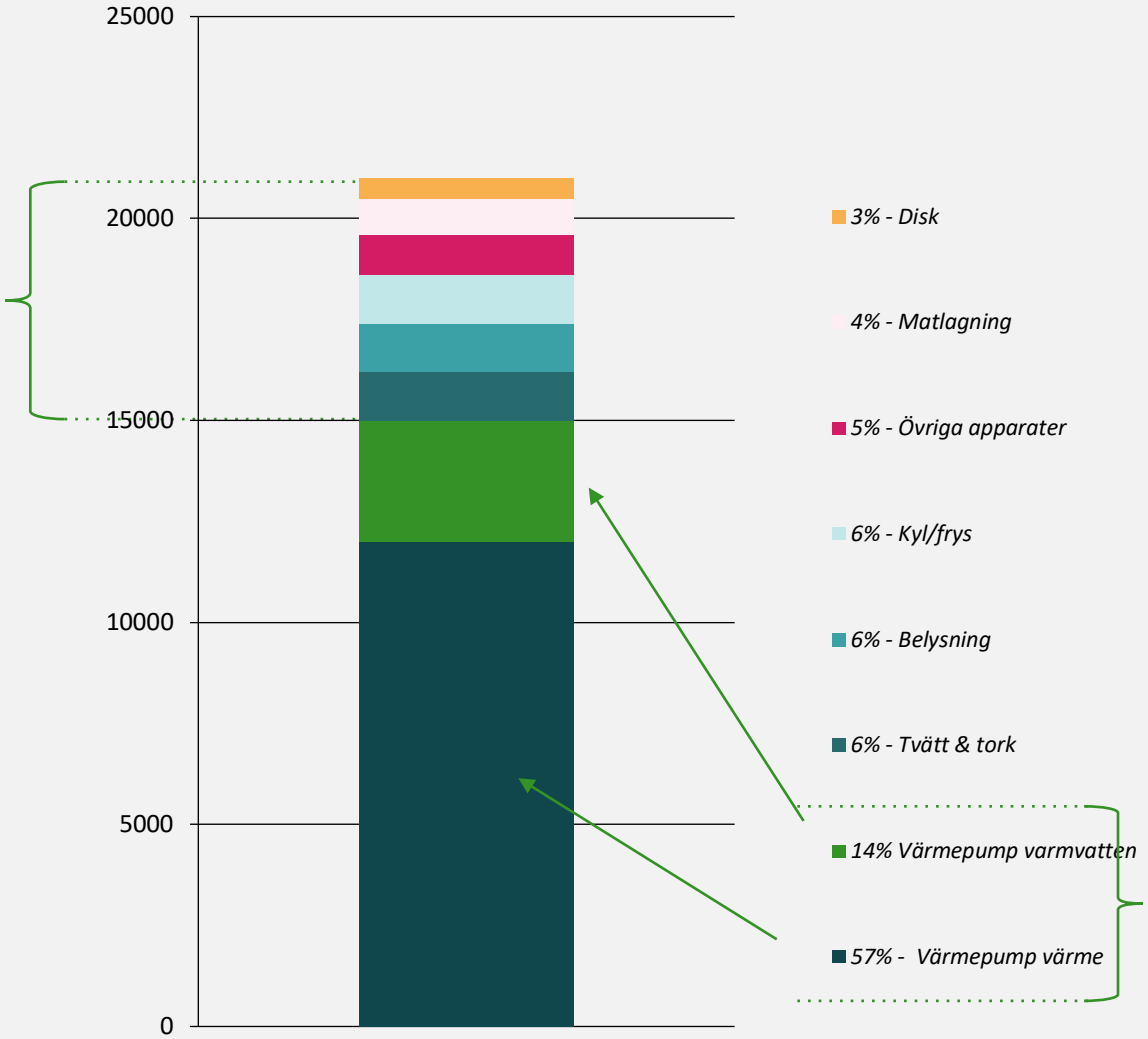
The heat pump is the largest electricity consumer in the residence

Energiförbrukning normalvilla
totalt 21 000 kWh/år

ca: **20-30 %**
är hushållsel



ca: **65-80 %**
av elkostnad är
värme & varmvatten

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Principle - the house an energy stock

- The house has stored heat energy
- "Free" energy storage

Heat / hot water production can be paused / moved, and thus this flexibility can be used

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OM OSS

Power optimization local area network + consumption flexibility

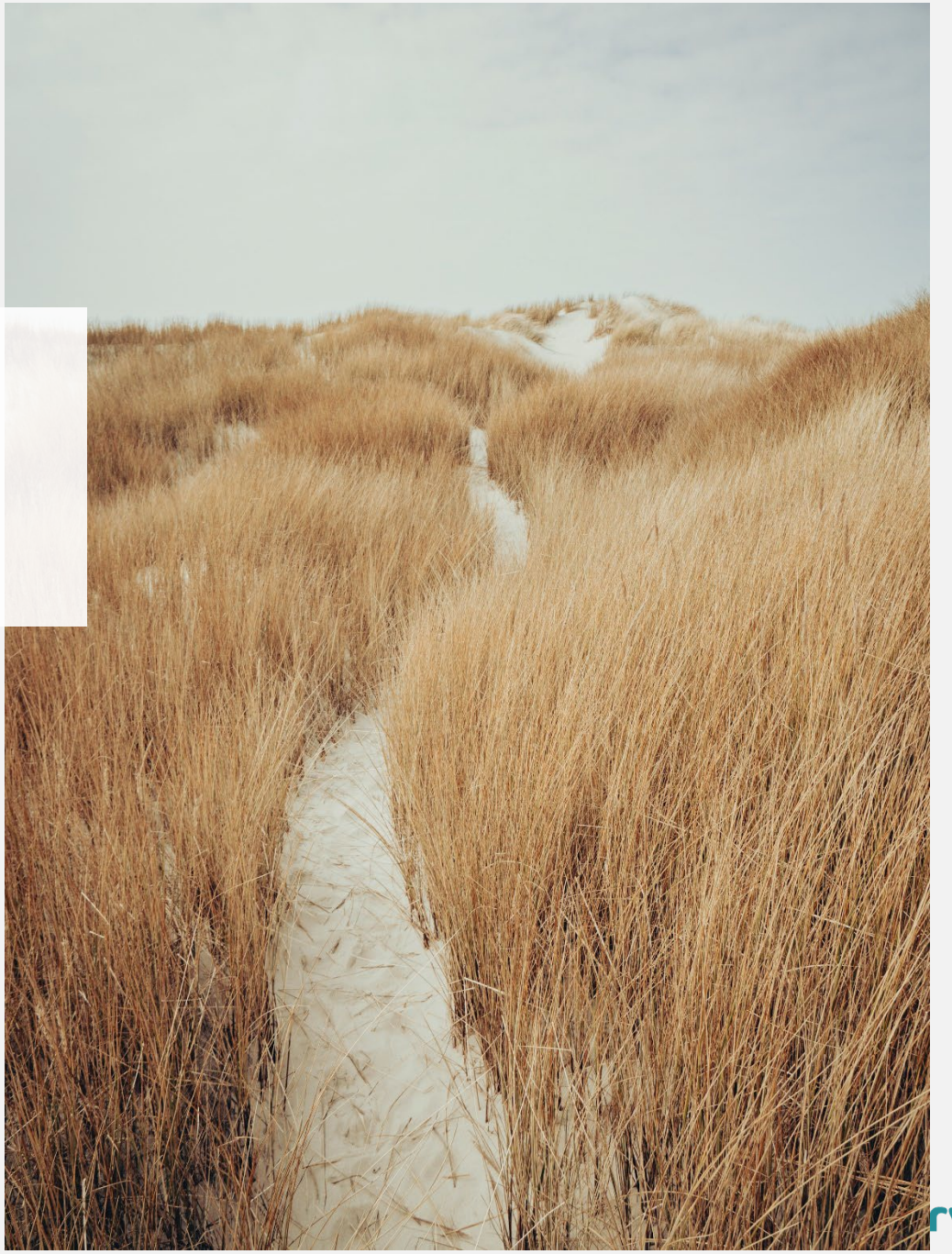
Weather forecast control

&

Trading Balance Energy Market

Optimization heat pump

Power optimization residence



BALANCE

Local balancing - summary

Capacity 1000 heat pumps

- Top load hours 2021: approx. 5.0 MW
- Average: winter: 3-5 MW, spring/autumn: 2-3 MW
- Quick stop / dimmer function: 10-60 sec
- Grouping in several levels
- Decentralized power balancing

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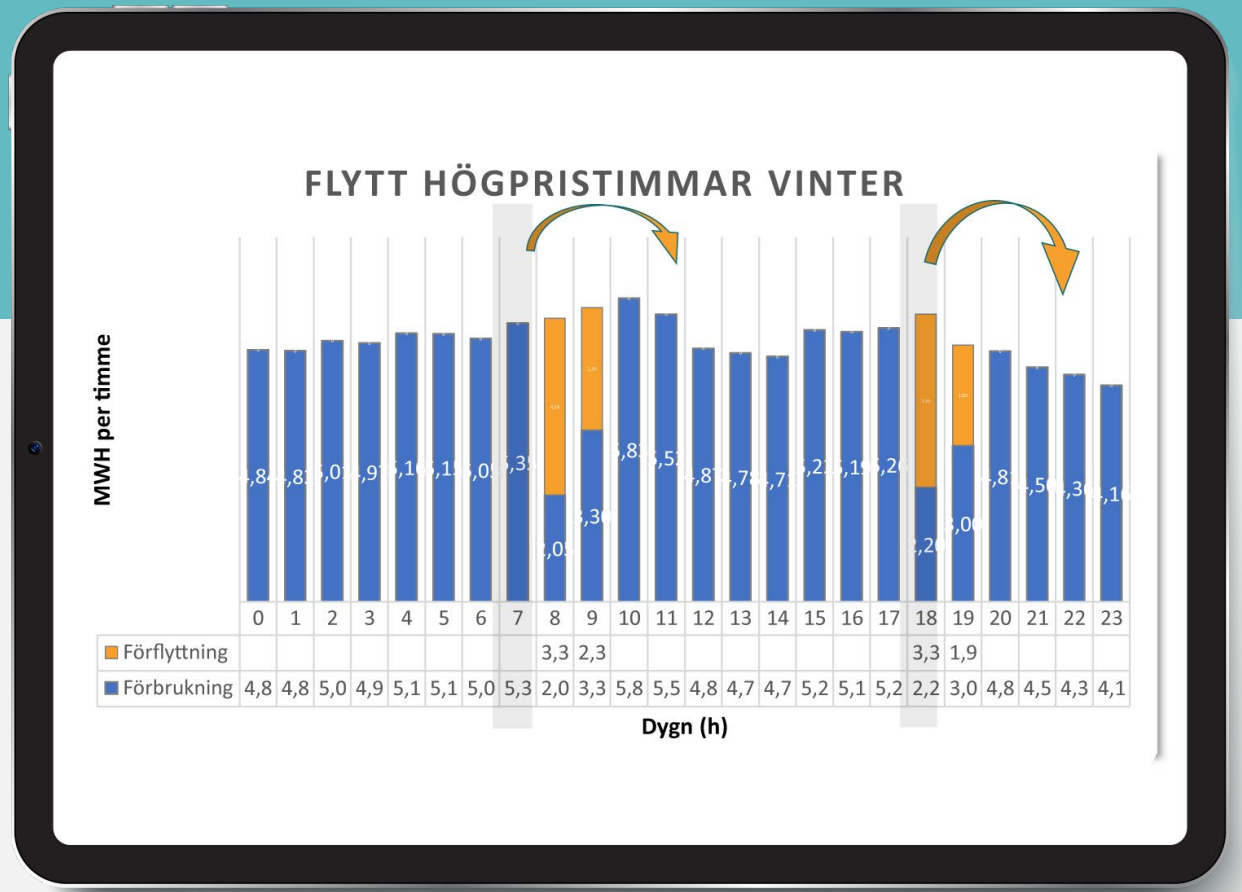


SAVE

consumption flexibility - summary

Capacity 1000 heat pumps

- Move consumption to low-cost hours
- 150-450 SEK / month depending on price-difference, consumption and outdoor climate
- Customer value SEK 1,000-3,000 SEK
- Good tool for hourly rate agreements
- Contributes to power stability

easyserv

Pilot customers rating?

- Customer survey conducted in April
- 80 % did not notice any difference from before
- 95 % would like to continue
- 85 % can imagine hourly price agreements

PRODUKT

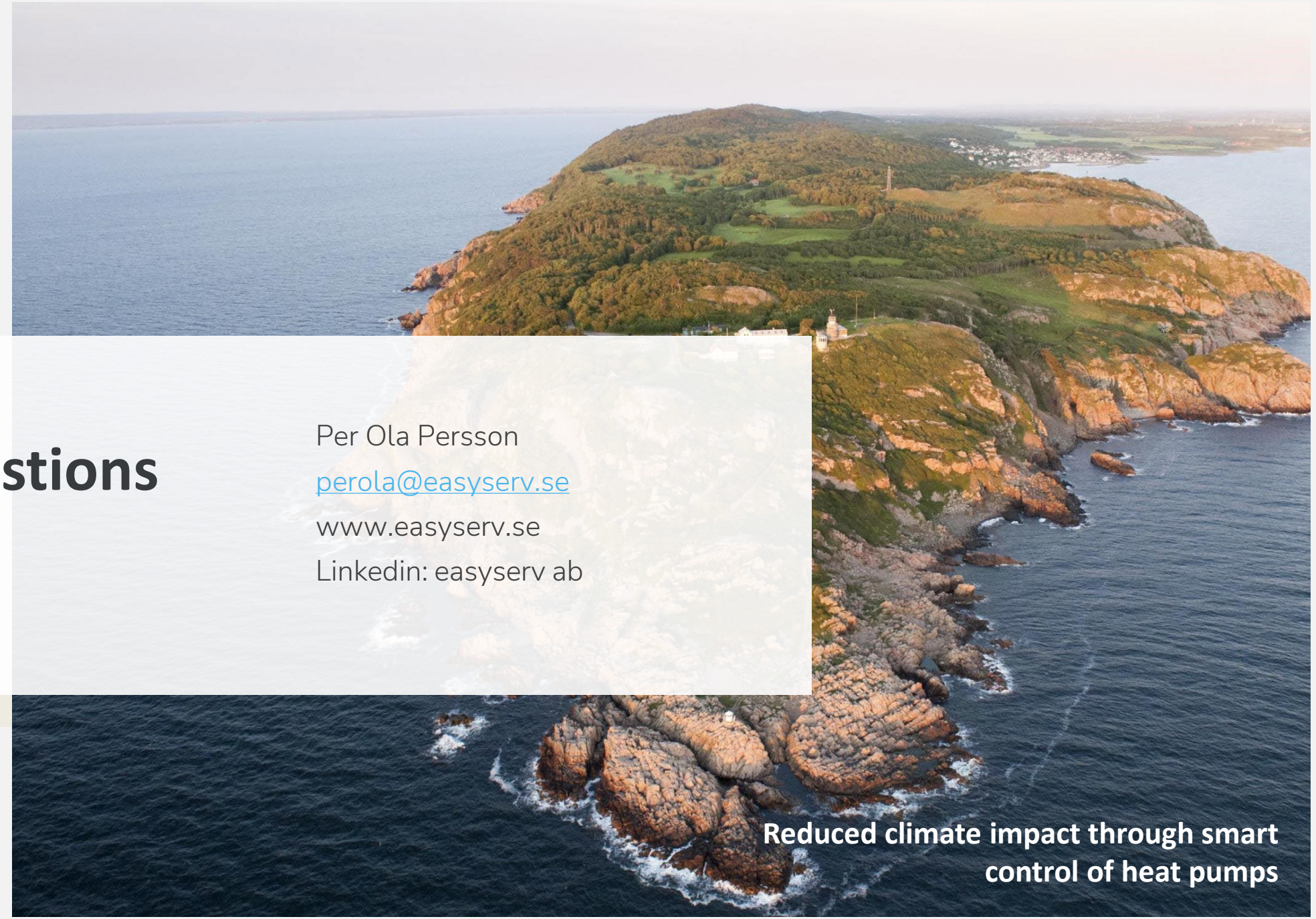
New version - Summary

- Prototype pilot test performed Q1 2022
- New hardware: Tests begin June
- Cloud service for validation / test Q3-Q4
- Delivery zero series 200-500 pcs: Q4 2022

easyserv

Easyserv Summary (+/-)

+ Flex in both power and energy
+ Scattered and local in the network
+ Opportunity to group at different levels
+ Flex in both directions (increase / decrease)
+ Low investment cost
+ Quick way to create flexibility
- Capacity depending on the season
- Indoor climate can limit capacity
- Certain reaction time (10-60 sec)



FRÅGOR?

Questions

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Demand Side Management and Optimization

of Sector Coupling of District Energy and Power

Moa D. Truesdale, CFO
Björn Malmström, CTO

Energy Opticon

Christian Johansson, CEO

NODA
Intelligent Systems

Synergies between energy companies and facility owners

What is Demand Side Management?

- Harnessing the flexibility of the thermal mass within buildings to connect supply and demand
- About 10% of energy used in a building is flexible on average long-term
- Short term flexibility is normally upwards 40-50 % while ensuring quality of service

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Synergies between energy companies and facility owners

Benefits

- **Demand profile**
  - Shaving demand peaks to reducing fossil
  - Reduction of the heat produced by heat-only boilers
  - Control demand in a demand-driven system
- **System temperatures**
  - Reducing return temperatures
  - Making the building less sensitive to lowered supply temperatures
- **Increase capacity and reduce risk**
  - Better exploitation of renewable energy sources – reduce CO_2 emissions
  - Increase incomes from electricity trading
  - Connect additional buildings to the network without installing new supply capacity

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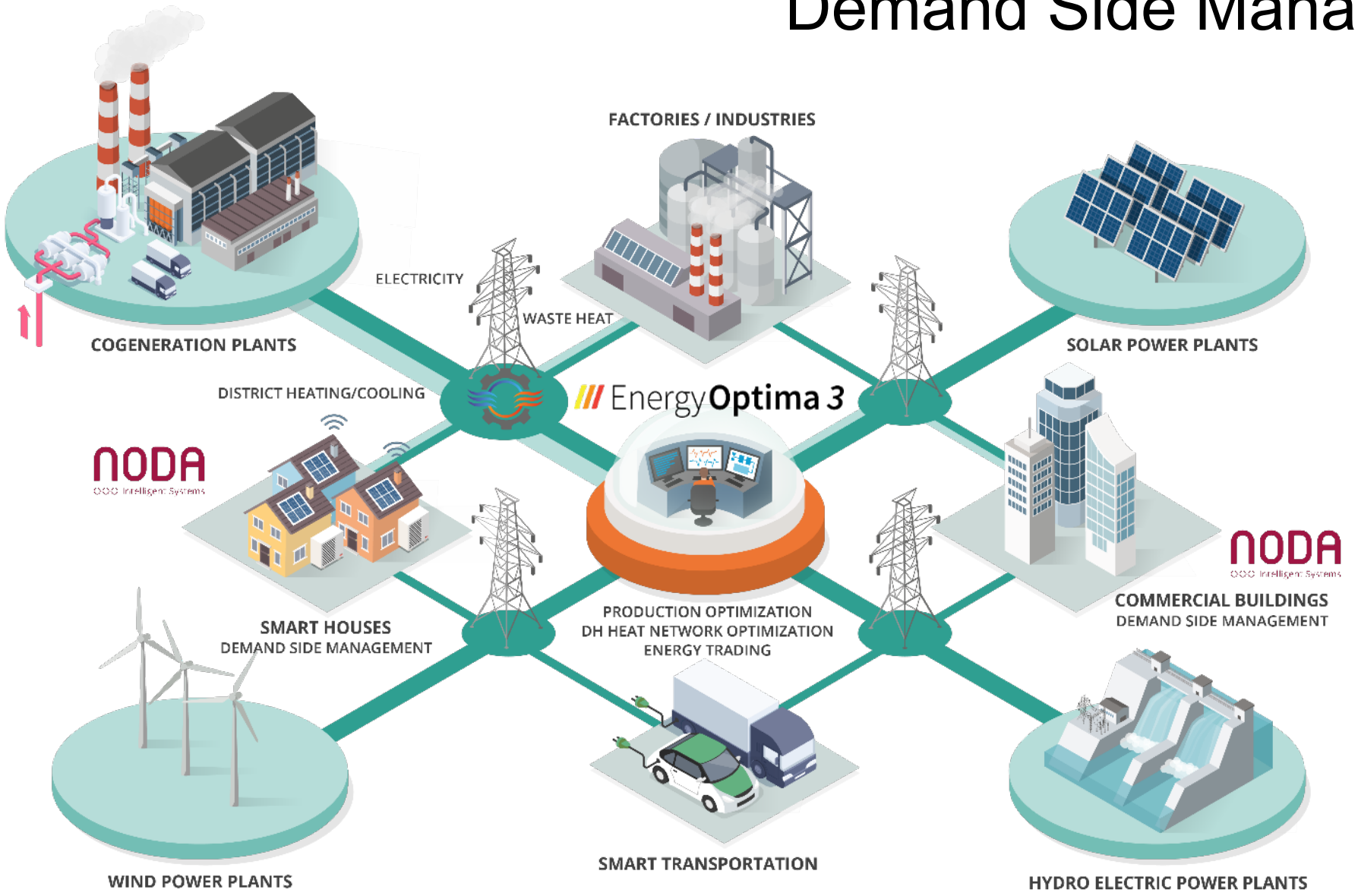
Demand Side Management



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EnergyOptima 3

Economic Total Optimization of Energy Production

Moa Dahlman Truesdale, CFO
Björn Malmström, CTO

Energy Opticon

Facts about the company

- Founded in 1989 – Know-how since more than 30 years
- Delivers software with newest technology for energy companies
- Large base of satisfied customers (more than 50 in Europe)
- Big international partners for deliveries and local service, like:

Valmet SIEMENS energy

- 25 specialists in Lund, Sweden
- Dedicated, competent service, single-point-of-contact

- ISO 9001:2015 certified, 40% R&D

What we do

EnergyOptima 3

Economic production optimization (short- and long-term)

Cloud
EnergyOptima 3

Optimization of the forward temperature in district heating networks

Accurate load and price forecasts

Advanced BI reporting

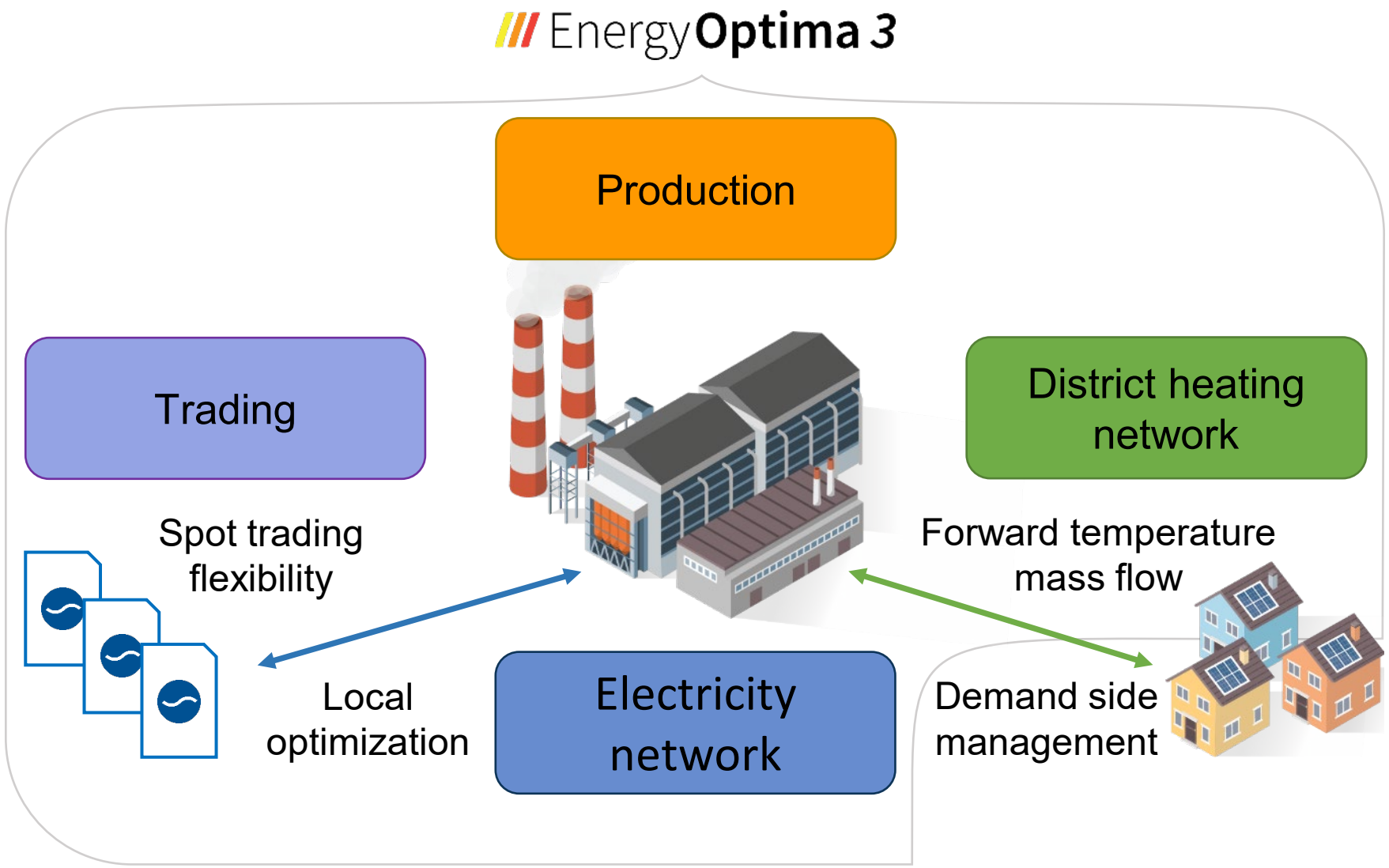
Optimization of local electricity networks

Support for energy trading

Measurements handling and validation

Energy Opticon

What we do



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Challenges for energy companies

In a changing energy market, energy companies need to **reduce their costs for energy production** and **increase their revenues** in order to **stay competitive**.

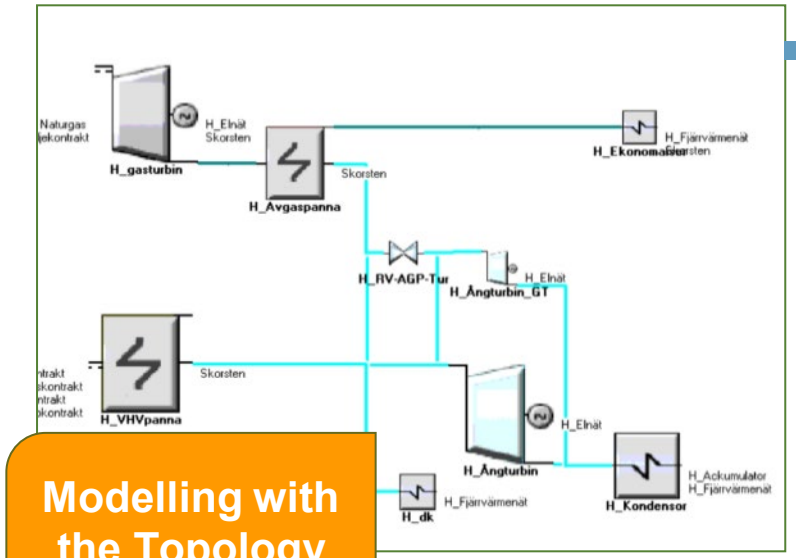
But how?

Avoid **start** and **stops** of units	Cheapest choice of **fuel**	Use units with the highest **efficiency**	Planning **maintenance** to optimal periods
Reduce **production costs**	Increase the revenues from **energy trading**	Lower **CO_2 Emissions**	Common **planning tool** for the **shift team**

Energy Opticon

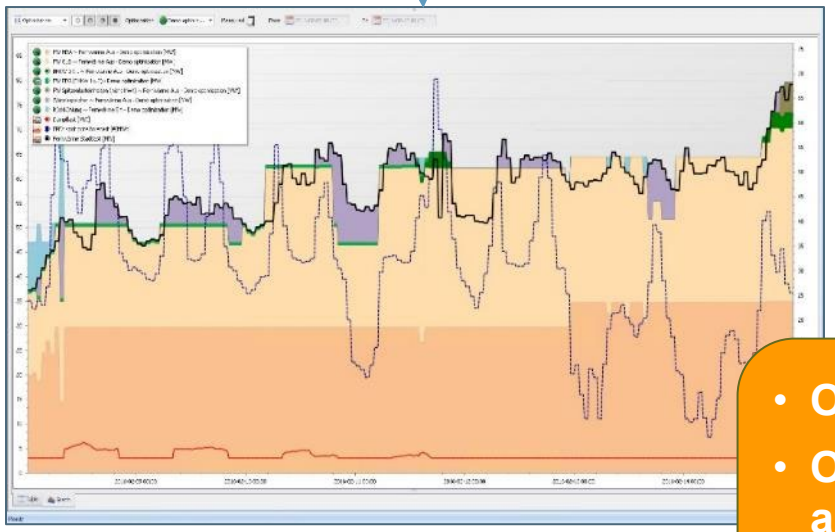
Optimized production plans

Technical/economic data



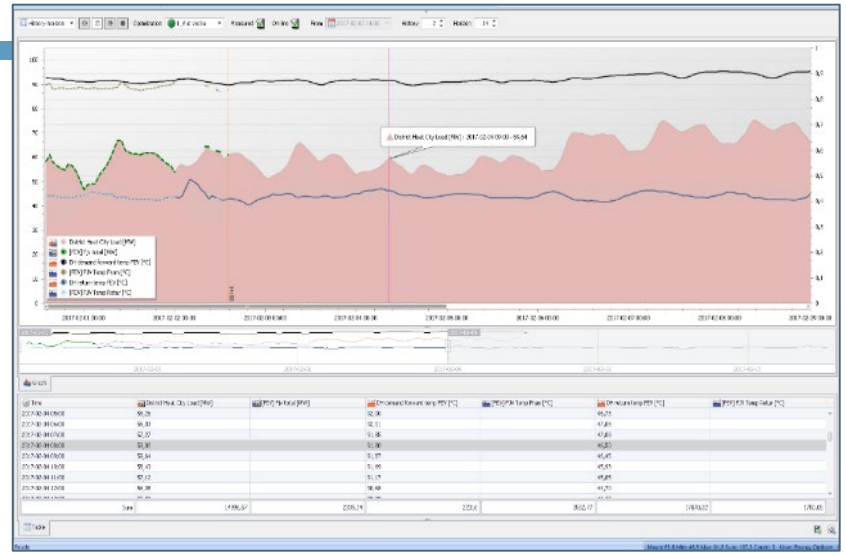
Modelling with the Topology editor

Optimization



Optimized production plans

Load and price forecasts



- **Optimal load**
- **Optimal time for start and stop of units**
- **Optimal forward temperature**

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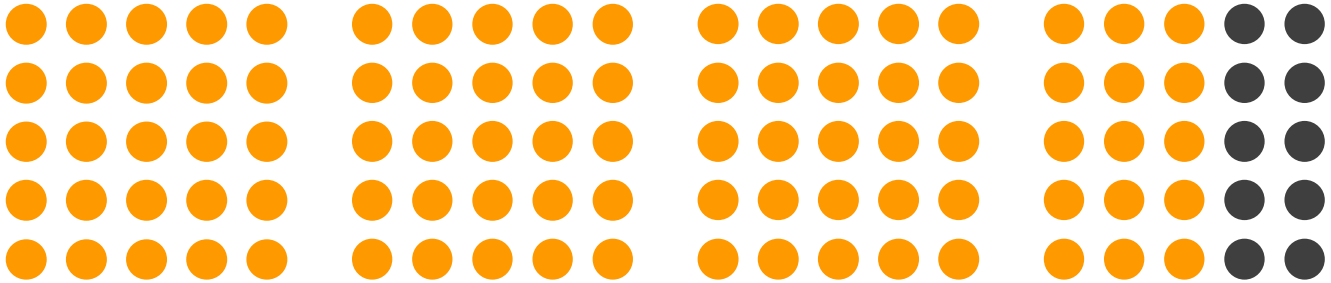
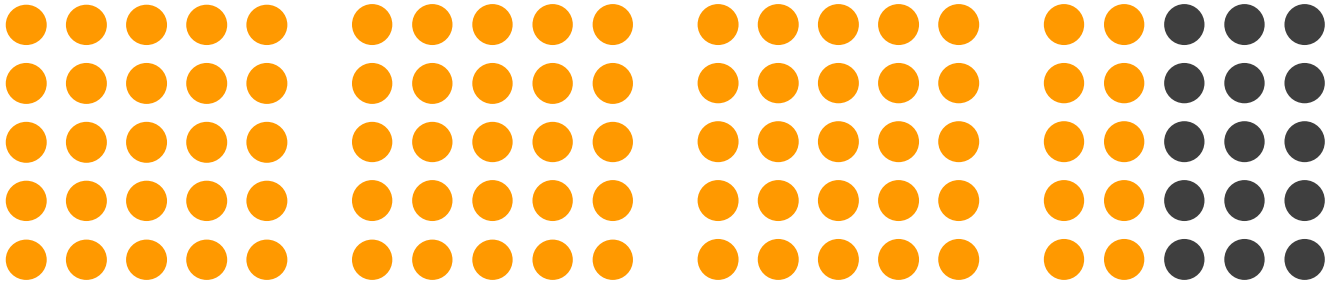
Possible reduction of variable production costs



Economic Production Optimization

12%

Each year



Economic Production Optimization

+ Smart Optima Heat Network

15%

Also large CO_2 savings.

Future savings?

Energy **Opticon**

Case study: Kraftringen, Sweden

"During the two first months (with SOHN) in operation, the forward temperature was in average lowered with 2 degrees and with an achieved savings of about 20,000 Euros."

David Edsbäcker, Project Leader for Smart Cities Accelerator, Kraftringen

The Challenges

- Decrease **production costs**
- Lower the **forward temperature** in the DH network
- **Co-optimization** of the Evita DH pipeline **between 3 cities**
- Reduce dependency of **fossil fuels**

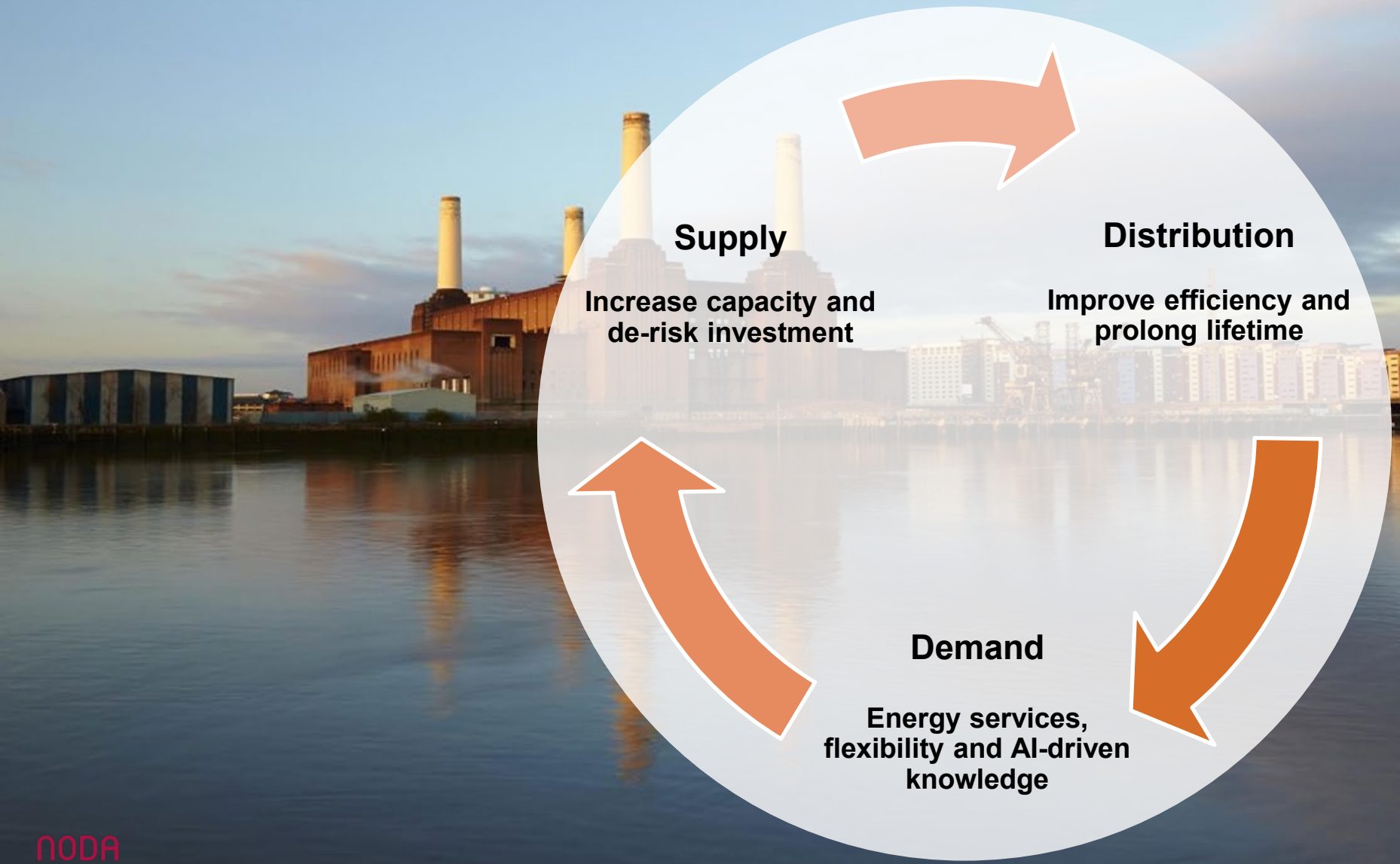
The System

- **Production sites:** 4.
- **DH grid length:** 1050 km
- **Biofuels**, heat produced with bio-oil, wood pellet and **geothermal** energy
- **Heat production/year:** 1,100 GWh
- **Electricity production/year:** 200 GWh

Energy Opticon


NODA
Intelligent Systems
A world where sustainable energy is available when, where and how it is needed
NODA

Creating best-in-class digital thermal AI since 2005



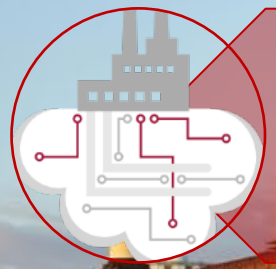
NODA
Intelligent Systems

Building better energy

Based in Sweden with partners globally

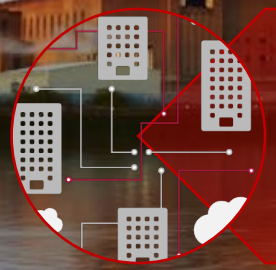
Customers in Europe, North America and Asia

NODA solution portfolio, delivered by cloud, tech transfer & knowledge



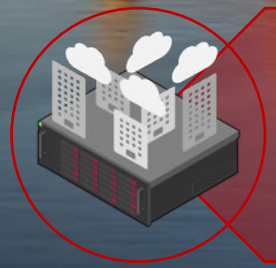
NODA Heat Network

Balance supply and demand to maximise business value



NODA Building

Active energy services to save cost and improve indoor climate



NODA Co-create

Innovation as a service to scale business and technology

NODA
Intelligent Systems

RUNA 瑞纳智能 SMART EQUIPMENT

- **Case**: peak load management
- **Scenario**: two city areas connected through network stations
- **Results**: 27 % and 23 % peak load reductions with 11 % energy savings

WWW.MIJNWATER.COM

- **Case**: geothermal capacity increase
- **Scenario**: two city clusters controlled in relation to the backbone system
- **Results**: more than 40 % of increase in extraction from the geothermal well

kraftringen

- **Case**: active energy services and demand response
- **Scenario**: many connected buildings throughout the main city and most large ones in a nearby city
- **Results**: savings of on average 12-15 % and flexibility capacity for narrow sections

ENGIE

- **Case**: virtual storage expansion
- **Scenario**: about half of the demand connected in a smaller city network
- **Results**: Reduced primary fuel usage of 13.7 %

e-Flex

Digital plattform för handel och styrning av energi

Moa D. Truesdale,
Energy Opticon

RewardHeat

Development of digital platform for trading and control of energy

16 June, 2022

Partnership

kraftringen

Region Skåne

Energy Opticon

Lunds Universitet

Sustainable Business Hub

RI.SE

Reference group

Akademiska Hus

Lunds Kommun

LKF

Tetra Pak®

eslövs bostads ab

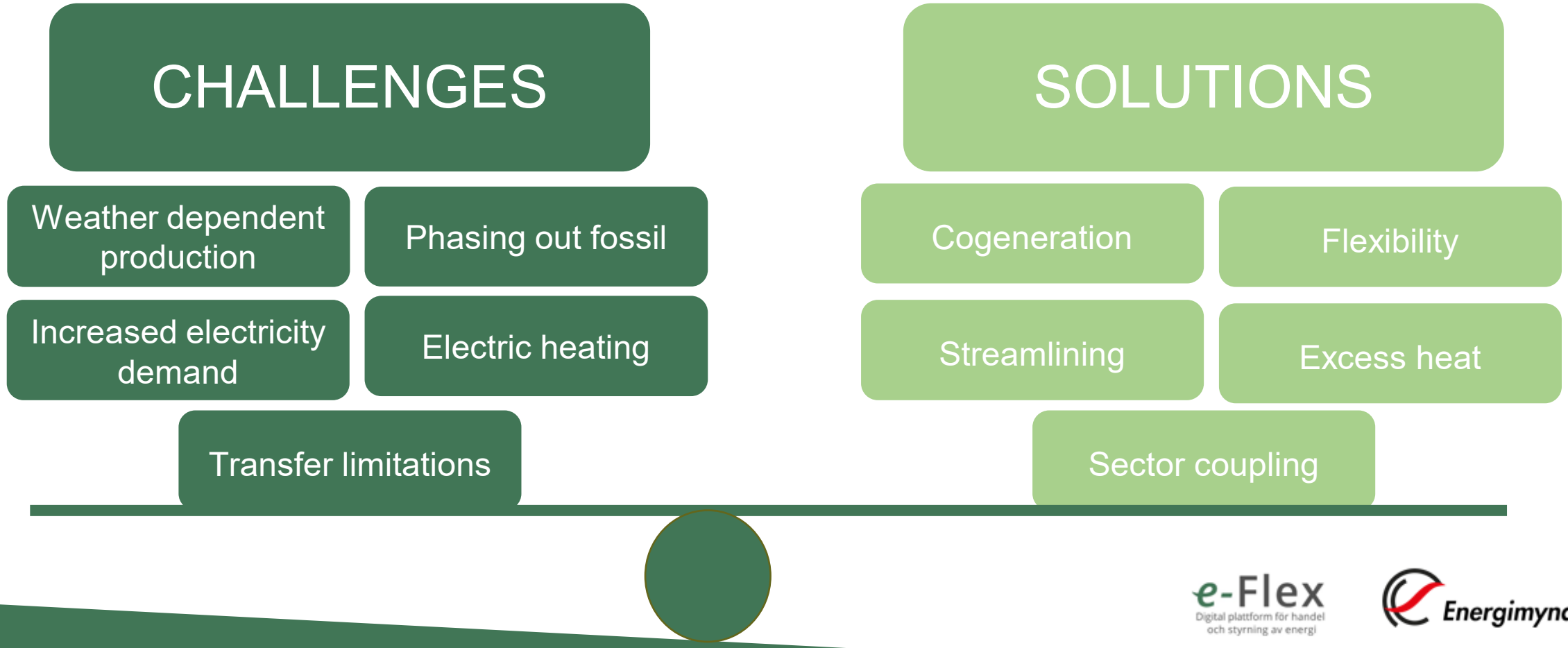
Wihlborgs

GENOVA

The project is funded by participating partners and the Swedish Energy Agency.

e-Flex
Digital plattform för handel och styrning av energi

The energy system of the future



e-Flex
Digital plattform för handel och styrning av energi

Energimyndigheten

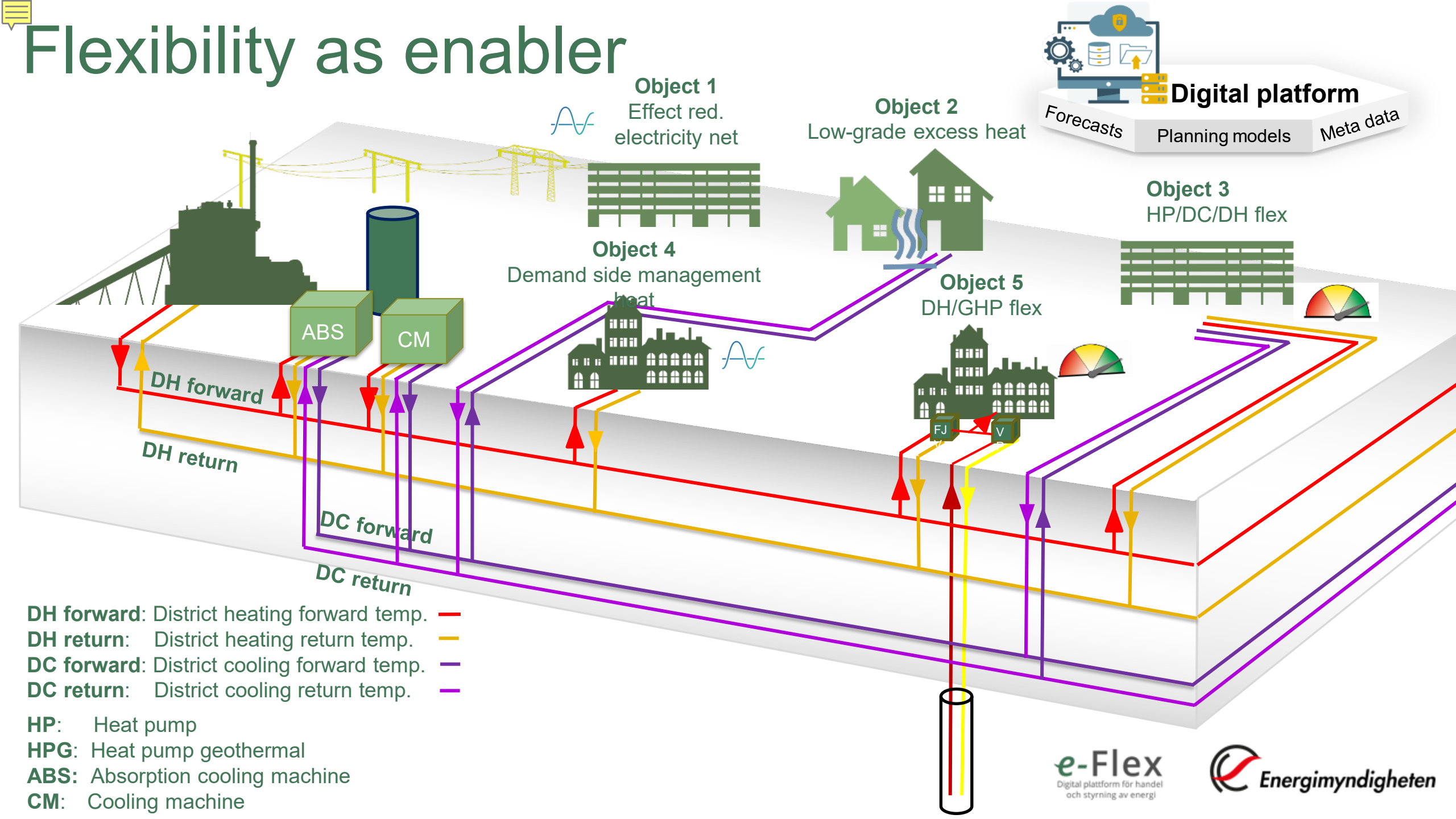
Project

- Digital platform where energy is bought and sold
  - District heating, district cooling, waste heat, electrical power
- Create a more robust, environmentally friendly and economically optimized energy system
- Replicable solution to be shared
- Developed and tested on several objects in Lund's hospital area

e-Flex
Digital plattform för handel och styrning av energi

Energimyndigheten

Flexibility as enabler



DH forward: District heating forward temp.
DH return: District heating return temp.
DC forward: District cooling forward temp.
DC return: District cooling return temp.

HP: Heat pump
HPG: Heat pump geothermal
ABS: Absorption cooling machine
CM: Cooling machine

e-Flex
Digital plattform för handel och styrning av energi

Energimyndigheten

Conclusions

- Flexibility Potential for large parts of the year, especially during spring / autumn
  - Enables reduced load on the electricity grid
- Increased potential with a more variable electricity price
- Cost and environmentally optimized energy delivery

e-Flex
Digital plattform för handel och styrning av energi

Energimyndigheten

Thanks for listening!

- Sector Coupling of District Energy and Power
- Optimize Production – Distribution – Demand
- Flexible Energy Systems

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Energy Opticon

CarboSeal

Relining for District Heating

Andreas Martsman – CarboSeal® by PPR

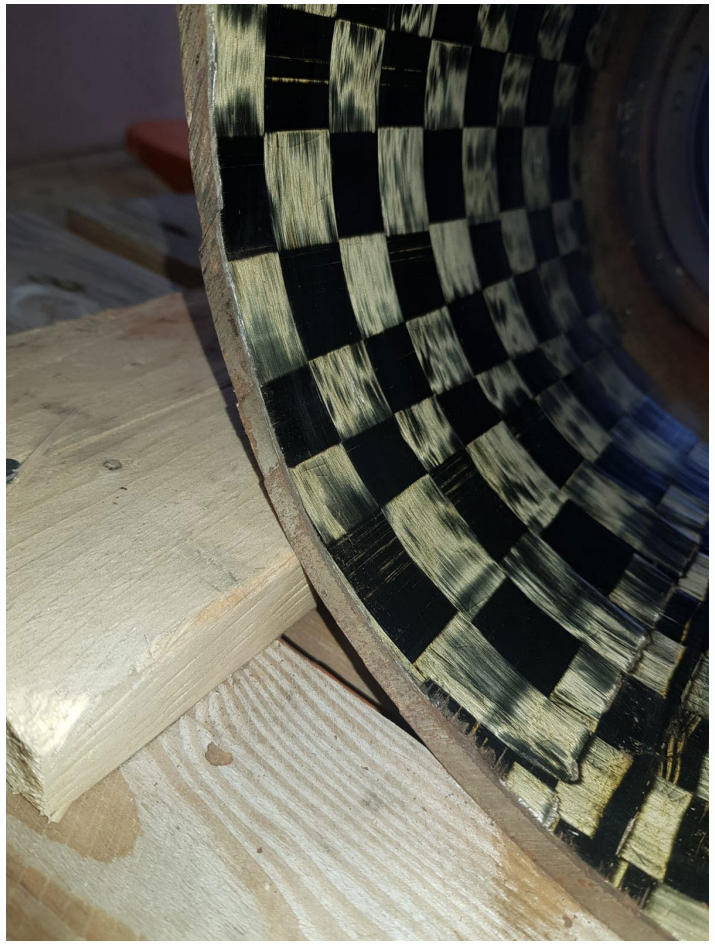

TeXtreme


SCUDERIA FERRARI
ALFA ROMEO
XCDS brembo NGK


BELL


PUMA
TAG HEUER
17
ORACLE TEAM USA


KING
cobra



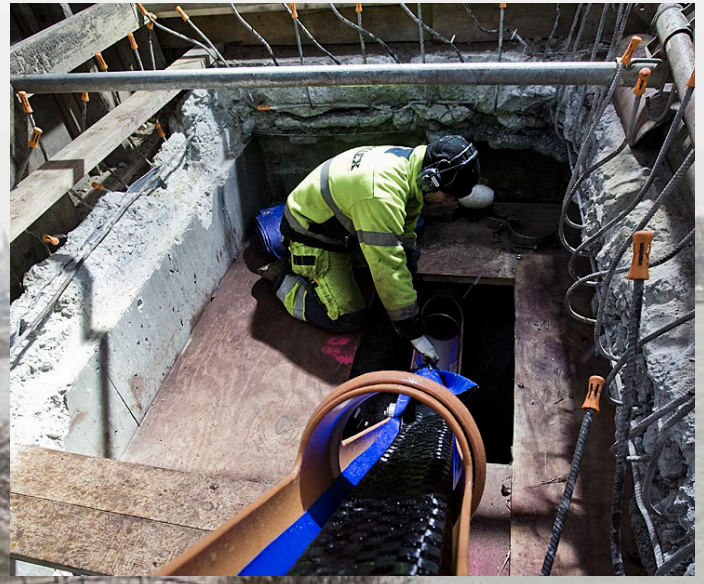
PPR
Relining for District Heating


THIS
OR
THAT
CarboSeal
Relining for District Heating

- No/heavily reduced impact on society, traffic, other networks
- Faster/simpler permit process as existing network is used to build the new pipe
- Heavily reduced carbon footprint – about 80% reduction compared to dig and replace

HOFOR, Copenhagen
1x170 meter DN200

HOFOR

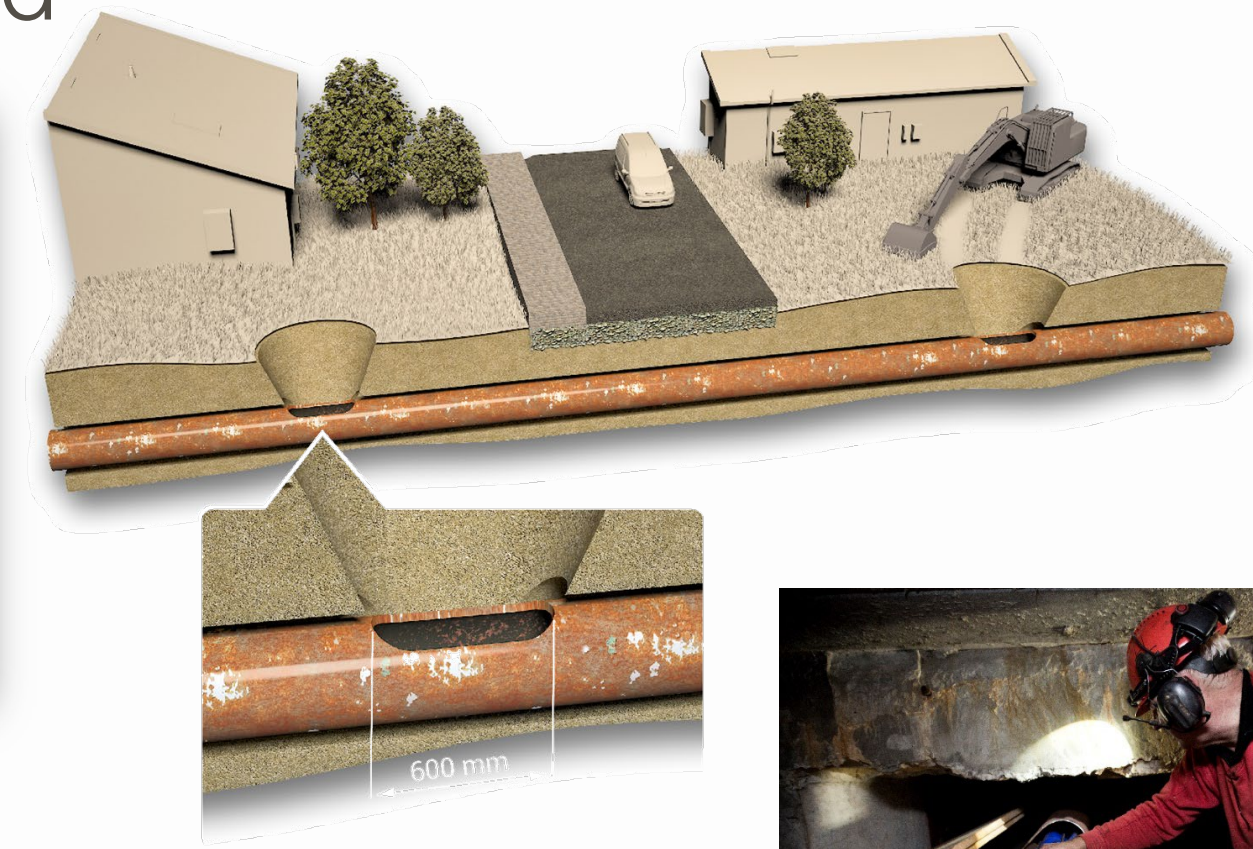


Norrenergi, Stockholm
2 x 50m DN300 (in DN400)


AGFW/Stadtwerke Neumünster
1 x 50m DN200 (Test site)

KDHC, Seoul
1 x 30m DN200 (Test site)

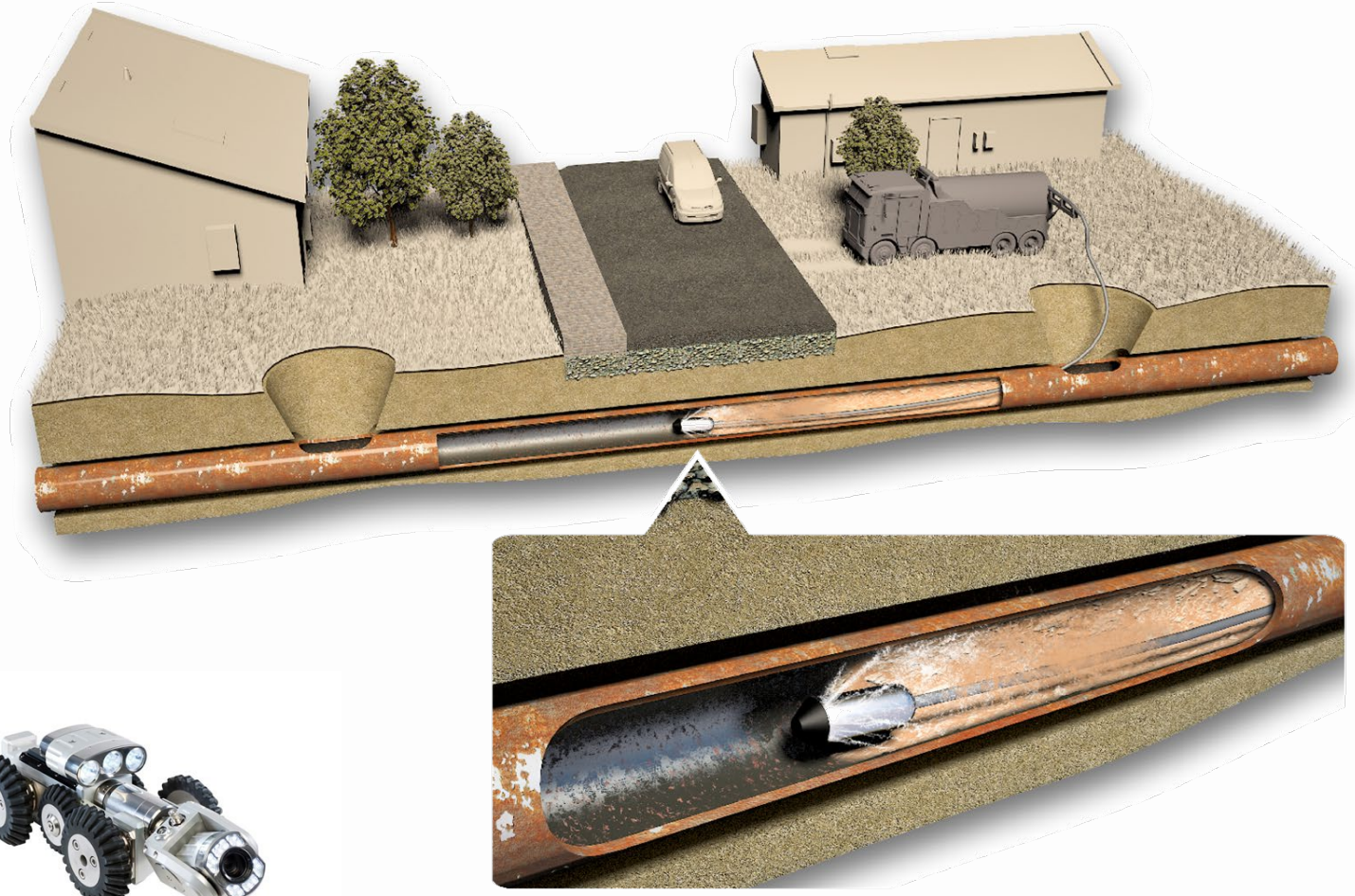
Installation Method



Access through manholes or small controlled trenches.

No need for full axial cut, only 600 mm openings are made to allow for cleaning and entry.

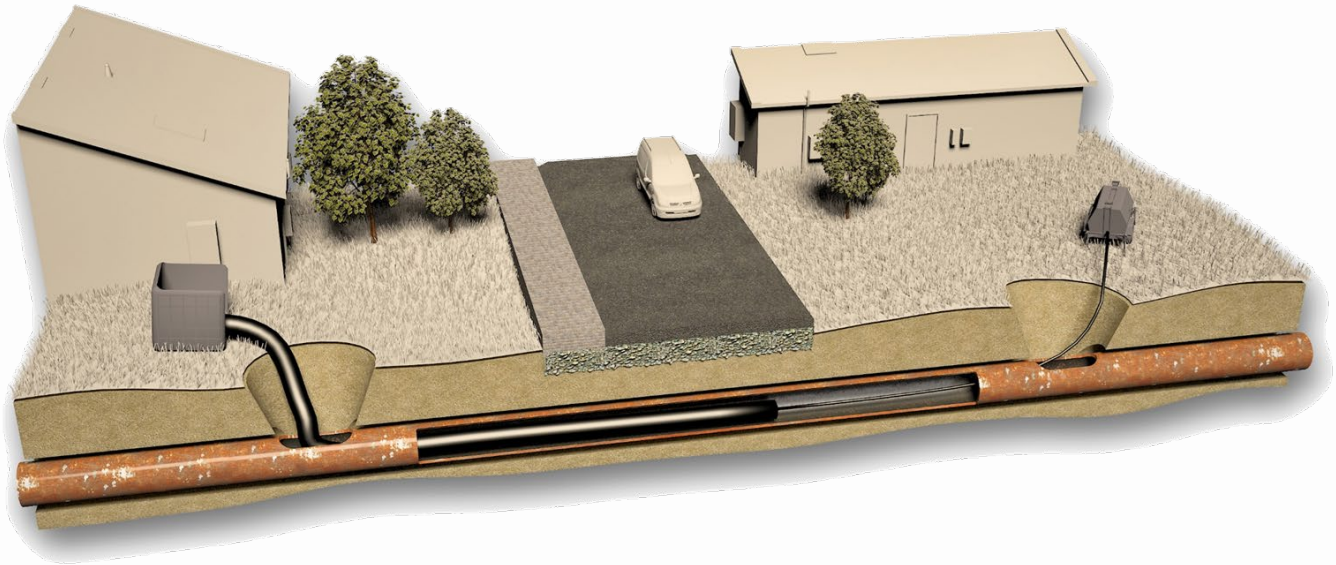
Installation Method

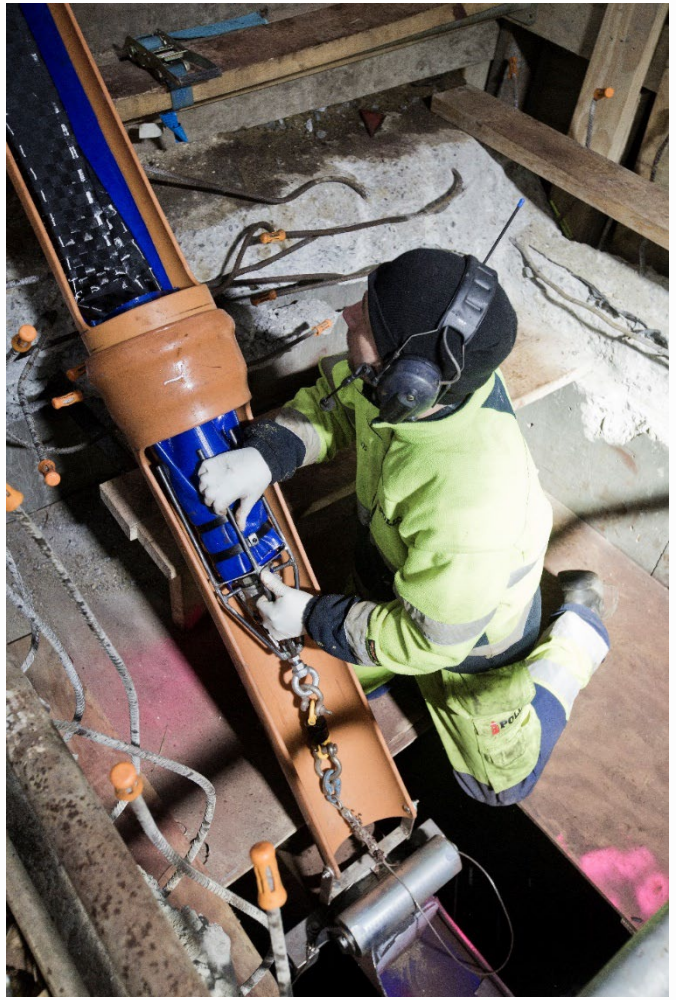


Cleaning the pipe by high pressure water flush and/or poly pig and perform inspection

PPR
Relining for District Heating

Installation Method

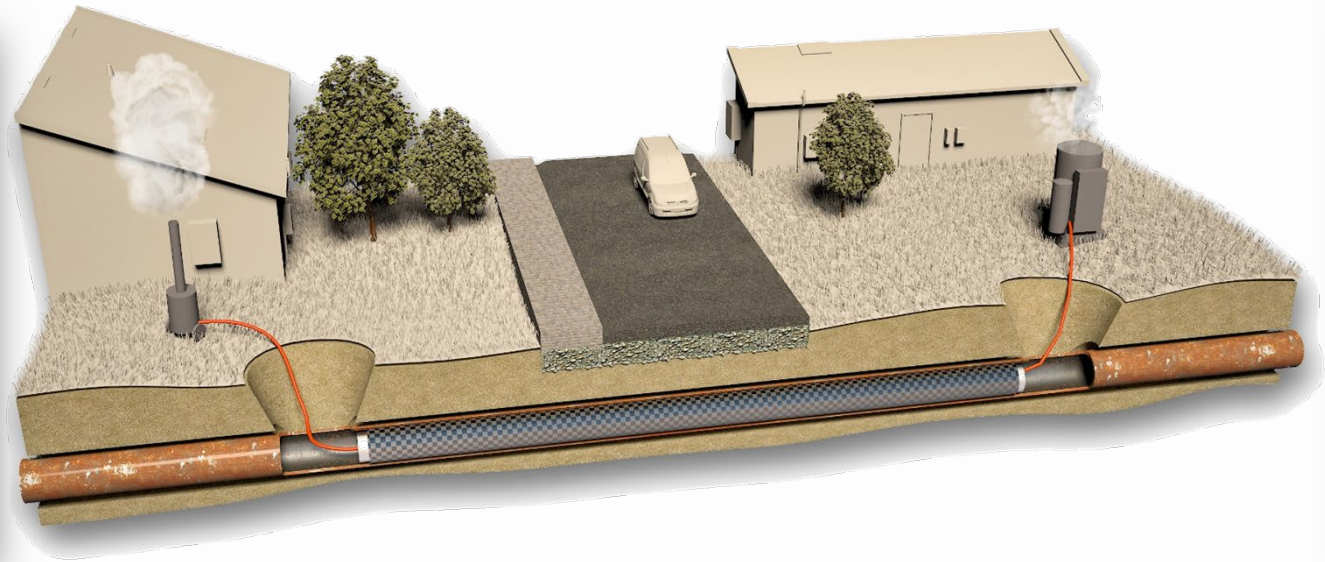


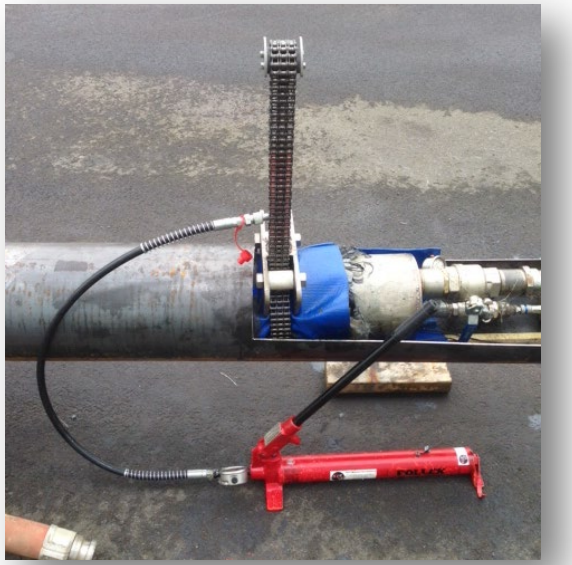


The liner is winched into place

To ease the winching a friction reduction foil can be used.

Installation Method





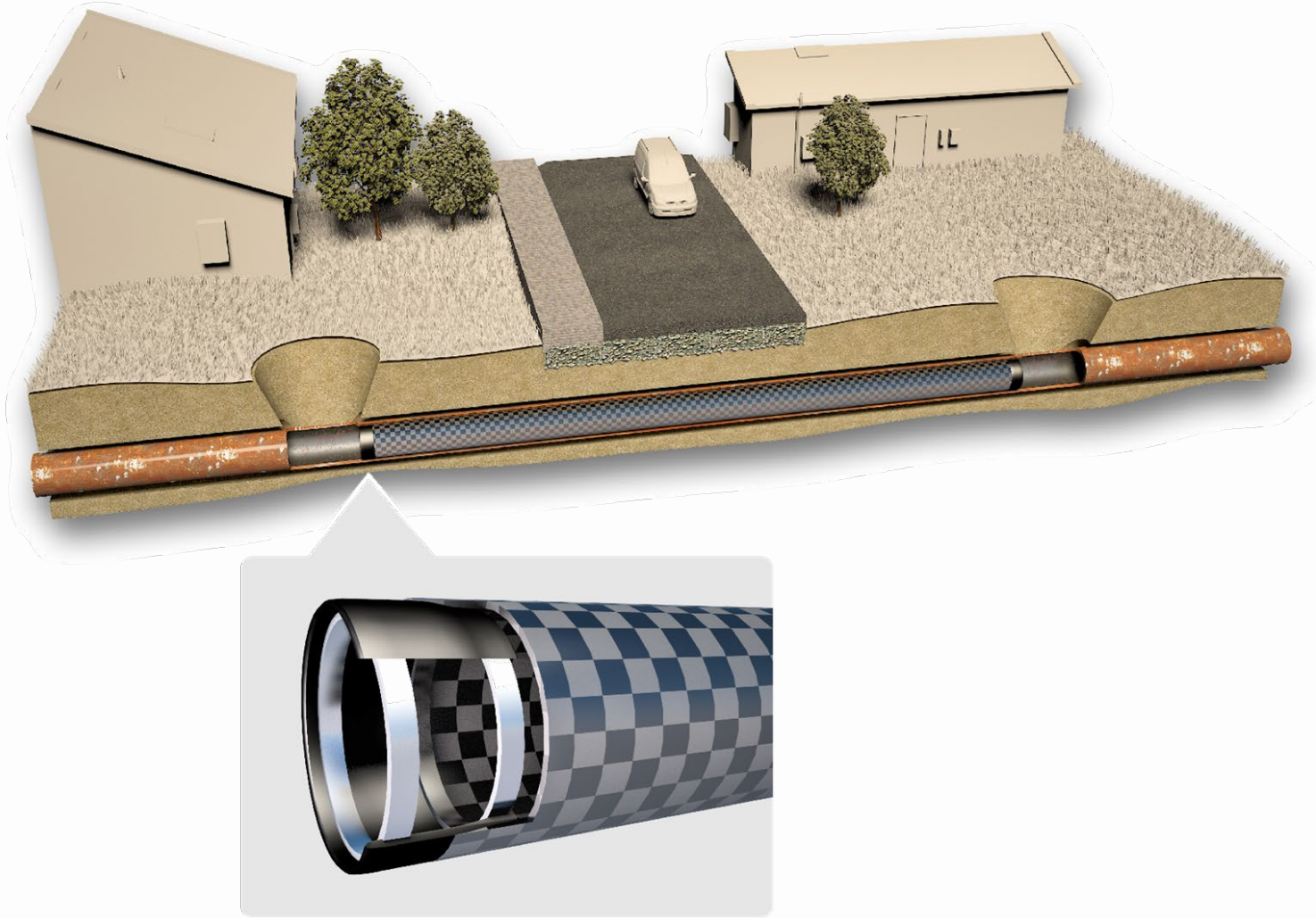
Curing the liner with controlled high temperature steam

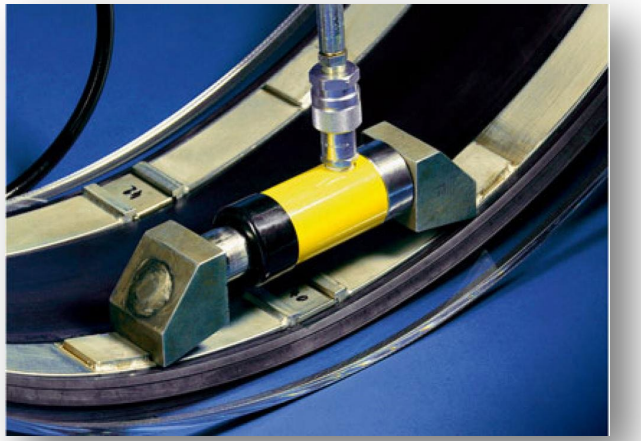
Require about 3 bars pressure to reach cure temp

PPR
Relining for District Heating

Installation Method

Closing off the finished carbon fiber liner with seal and locking rings





Carbon fiber liner

- High temperature epoxy resin + carbon fiber = no hydrolysis
- Designed for DN100-DN800
- Current offering typically DN100 - DN450
- Can sustain water at 130°C
- Designed for 16Bar pressure, higher can be achieved by different design
- Delivered ready for installation -> no impregnation at the work site.

CarboSeal

Relining for District Heating

www.carboseal.com

info@carboseal.com

andreas.martsman@carboseal.com

Video links

[Installation in Stockholm]

[Installation in Copenhagen]

[Installation in Neumünster]

PPR

Relining for District Heating

REWARDHeat

Thank you

www.rewardheat.eu

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