

Flexibility Solutions & Barriers in the Danish Power Markets

NEOGRID
TECHNOLOGIES

DG-STORE

webinar "Power Markets & Regulation on Flexibility"

26th october 2022



Interreg
Deutschland - Danmark



Agenda

- Heat pump connection
- Heat pump business models
- Flexibility
- Control Strategies
- Barriers and Neogrids business strategies

Neogrid Technologies ApS

Founded in 2009 in Aalborg, today 18 people

Focus areas:

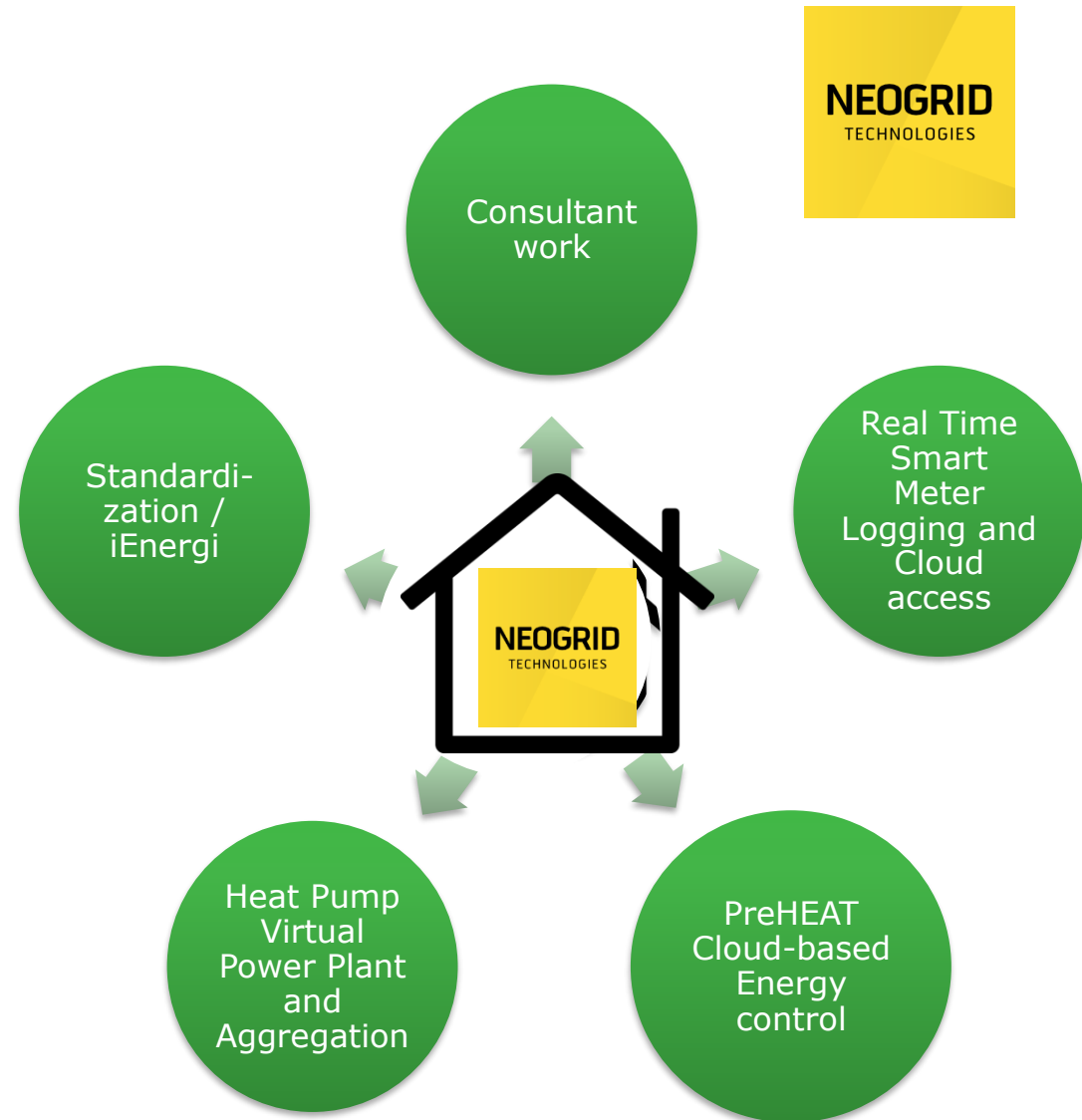
- ✓ 24/7 control and monitoring of energy installations
- ✓ Model- og prognosis based MPC controllers for heat/ventilation/cooling
- ✓ Advanced online data analysis on buildings
- ✓ Platform for data collection and visualisation
- ✓ Smart Meters, IOT sensors, BMS systems, heat pumps etc.
- ✓ Aggregator services, i.e. pool control of heat pumps

Collaboration-oriented

Experienced in research and demonstration (+20 projects until now)

PreHEAT solution:

- ✓ Active since 2016 in Denmark.
- ✓ Currently 24/7 on +400 apartment blocks
- ✓ +50 houses and +5 schools, office buildings etc.



Background

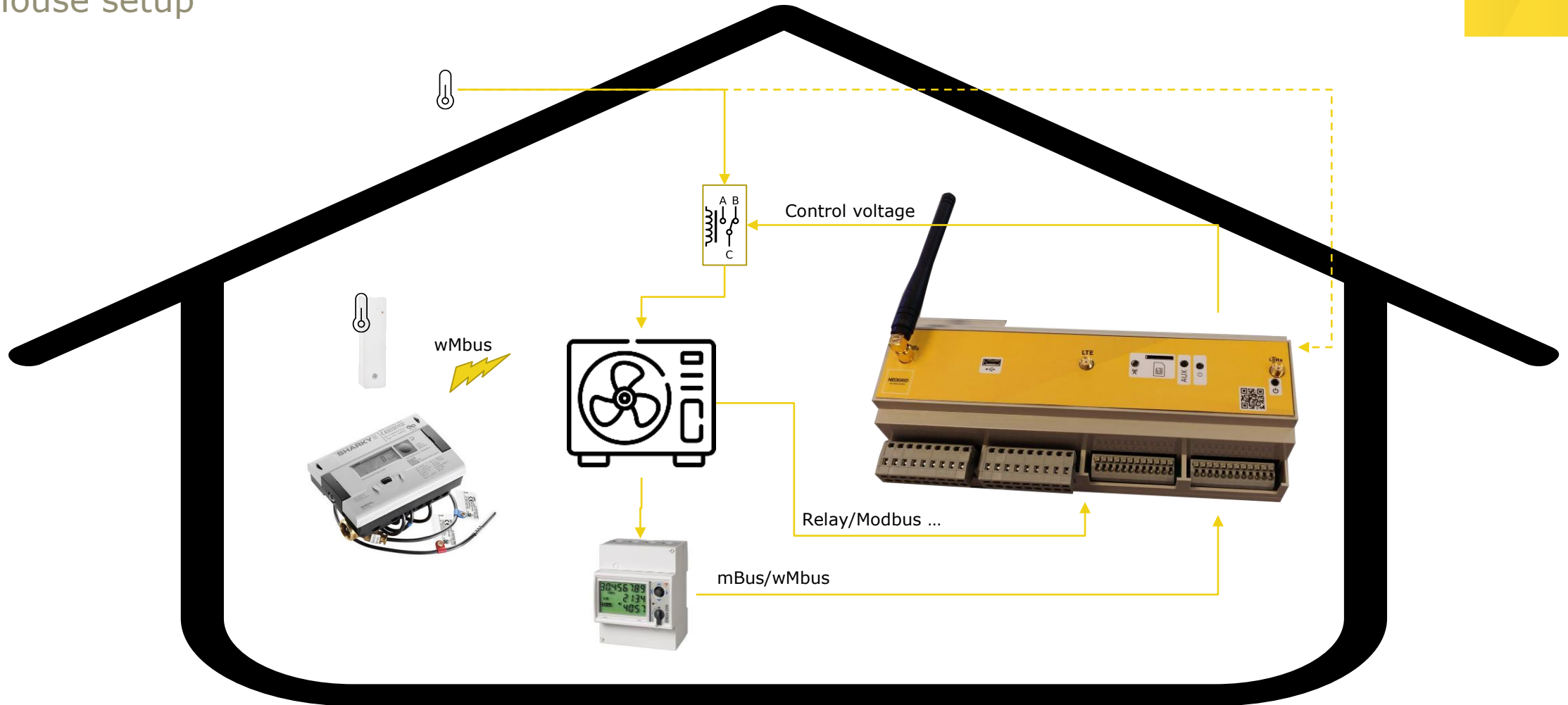
Many research projects regarding control of heat pumps

- SDVP1 – StyrDinVarmepumpe1 – “controlyourheatpump” (2011-2013)
 - Retrofit and individual control of 300 ground source and air source heat pumps
- Smart Summer houses (2011-2013)
 - Control and monitoring of existing air source heat pumps
- Ready (2012-2014)
 - Pool control of heat pumps from StyrDinVarmepumpe
- SDVP2 – StyrDinVarmepumpe2 (2013-2015)
 - SDVP1 + SOAP/XML for online XMPP Communications
- StyrDinVarmepumpe Connect
 - Standardisation work
- HPCOM (2014-2017)
 - Development of a HP-hub, standardisation of heat pump interfaces
- TotalFlex (2012-2016)
 - Description of flexibility by flex-offers
 - Demonstration of a market place for flexibility with the actors:
house owner – DSO - BRP
- SmartCE2H (2019-): (booster) heatpump to energy communities
- OPSYS2 (2019-): Integration of heat pumps with a floor heating controller in a building

Heat pump - connection

HW Setup for legacy Heatpump

House setup



Heat pump – business opportunities

Heat pump

Neogrid is offering 3 categories of services

- Avoid hours with high spot prices and high tariffs
- Monitoring and alarm

- PreHEAT optimised operation (reduced energy consumption, improved comfort)
- Optimised consumption of own or location power consumption

- Services towards electricity markets - Pool control of heat pumps

- Services to DSO (reduce bottlenecks in LV/MV grid)

Flexibility – an important parameter

Building characteristics

What determines flexibility?

Flexibility, the capability for a heat pump to shift its operation and still keep comfort in the building

Important Building characteristics

- ↑ Accumulation tank
- ↑ Domestic Hot Water tank
- ↑ Frequency controlled heat pump
- ↑ Ground source vs air-air heat pump

- ↑ Building heat capacity
- ↑ Dimensioning temperature of heat pump
- ↑ Building time constant
- ↓ Tight comfort limits in building

- ↓ Limiting thermostats
- ↓ Limiting thermostats
- ↑ Floor heating

Flexibility

Two examples (New/old and over-/under dimensioned)

(newer)

- **Key data**

- Consumption heat 2020: 9,4 MWh
- Degrees days: 2390
- Heat loss $\approx 0,16$ kW/°C
- Time constant ≈ 90 timer
- Heat capacity ≈ 14 kWh/°C
- HP ≈ 6 kW heat
- $T_{i\text{dim}} \approx -17$ °C (@ $T_i = 20$ °C)

- **Flexibility calculation, example**

- $T_{\text{out}} = 5$ °C og comfort window = -1 °C
- HP operation ≈ 10 hours/day
- $t_{\Delta T} \approx 6$ hours

(older)

- **Key data**

- Consumption heat 2020: 19,2 MWh
- Degrees days: 2390
- Heat loss $\approx 0,33$ kW/°C
- Time constant ≈ 45 timer
- Heat capacity ≈ 15 kWh/°C
- HP ≈ 6 kW heat
- $T_{i\text{dim}} \approx 2$ °C (@ $T_i = 20$ °C)

- **Flexibility calculation, example**

- $T_{\text{out}} = 5$ °C og comfort window = -1 °C
- HP operation ≈ 20 hours/day
- $t_{\Delta T} \approx 3$ hours

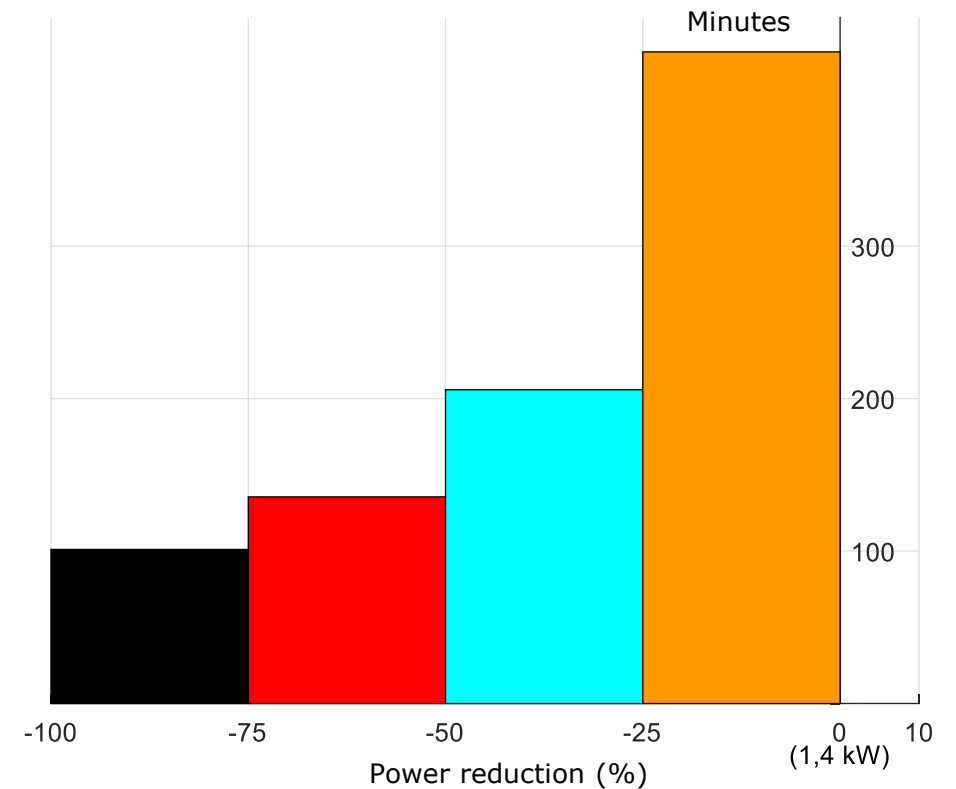
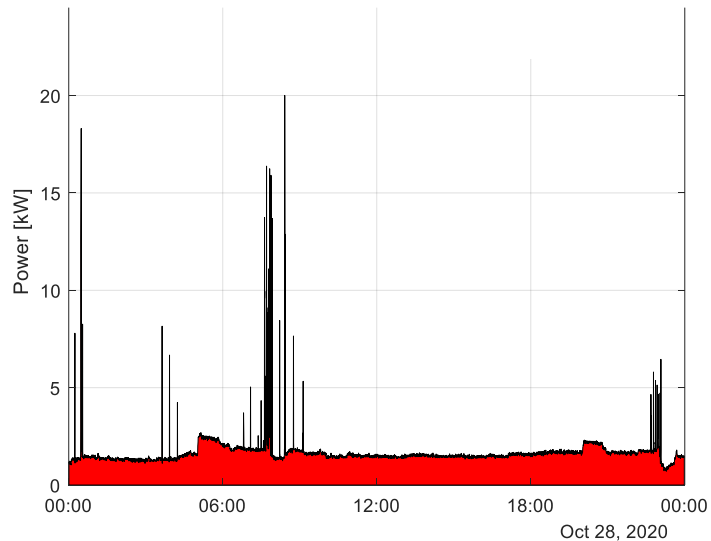
Accumulation tank

- 400 l water, 10 degrees dynamic $\approx 4,7$ kWh
- 400 l salt storage, 10 degrees dynamic $\approx 4*4,7$ kWh

Flexibility

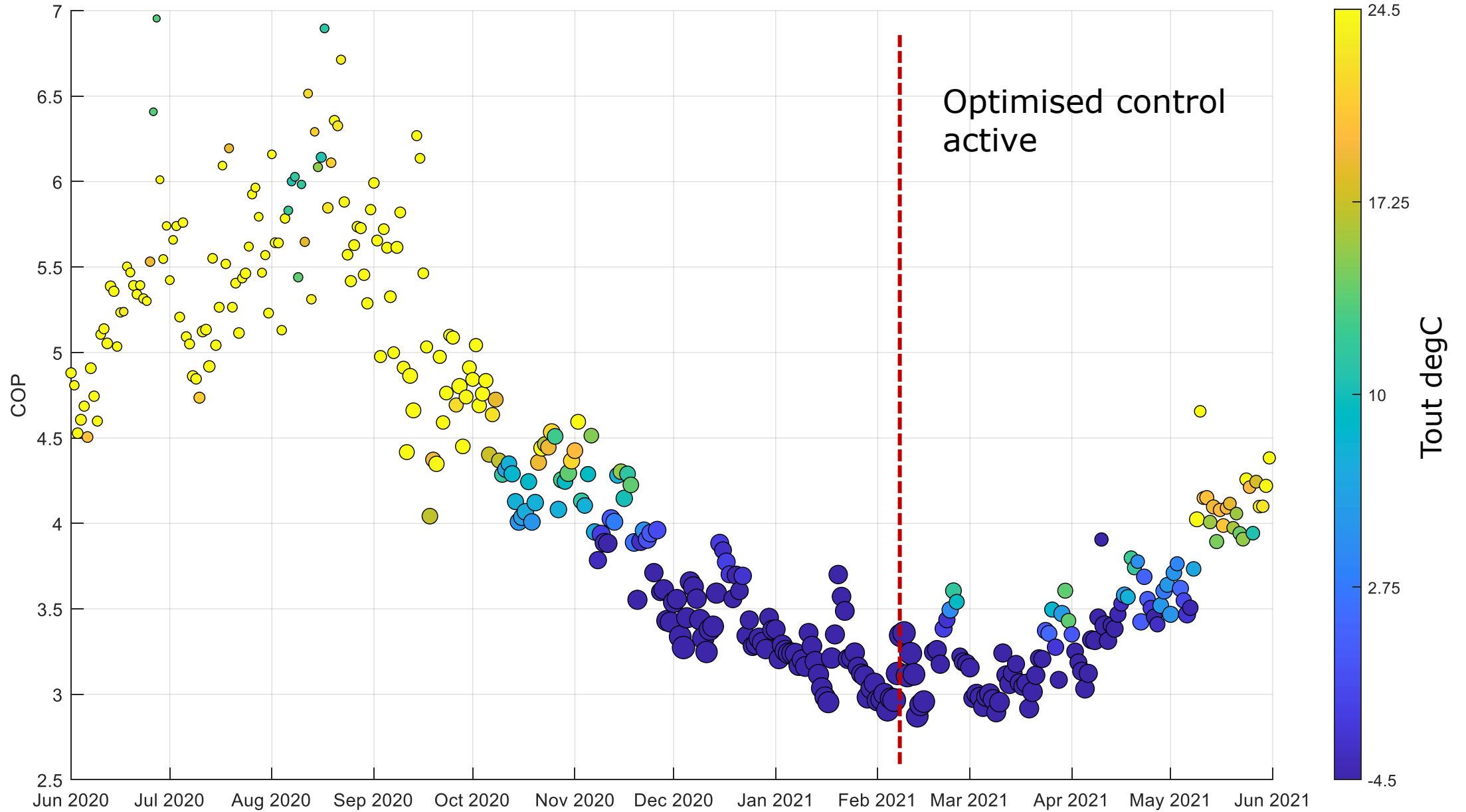
Description

- Duration curve a typical day in october
 - How long can a service be delivered?
- Other important parameters
 - Response time
 - How fast can a service be delivered?
 - Rebound effect
 - How does the heat pump catch up



Services – Daily COP

Daily COP

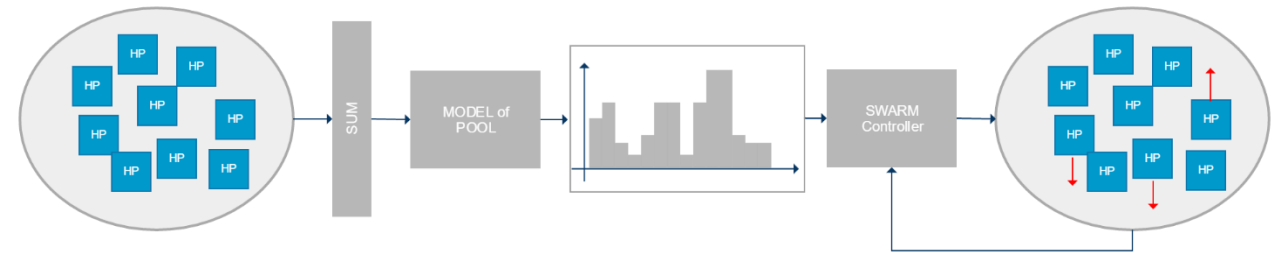


Control strategy

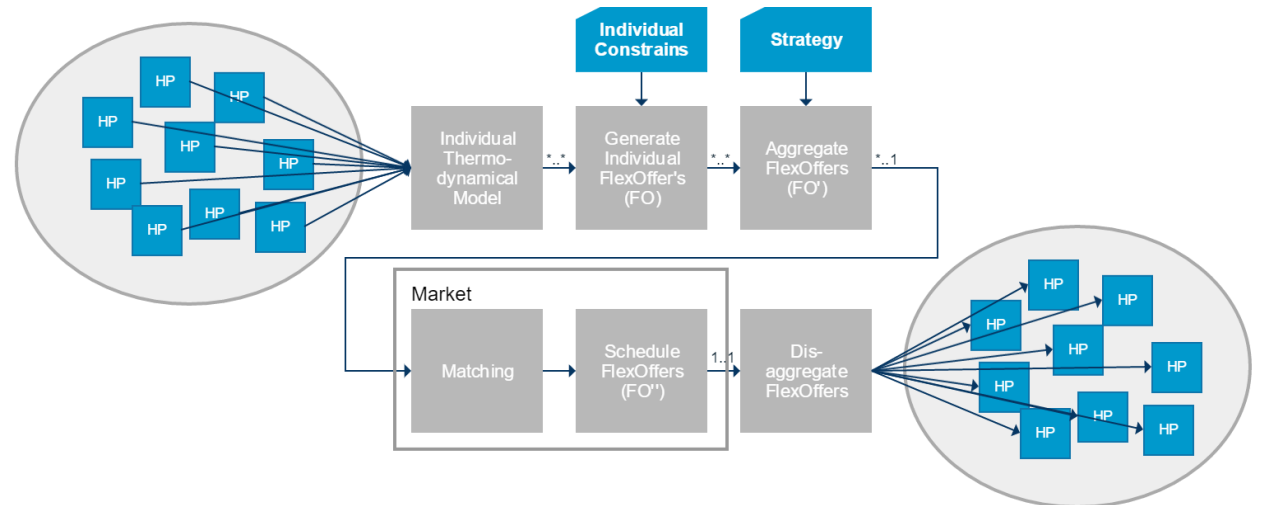
Control of a Pool of heat pumps

2 principles are supported

- Neogrid has direct connection to each heat pump
 - No indirect control via price signal
 - Rebound effect are fully controllable



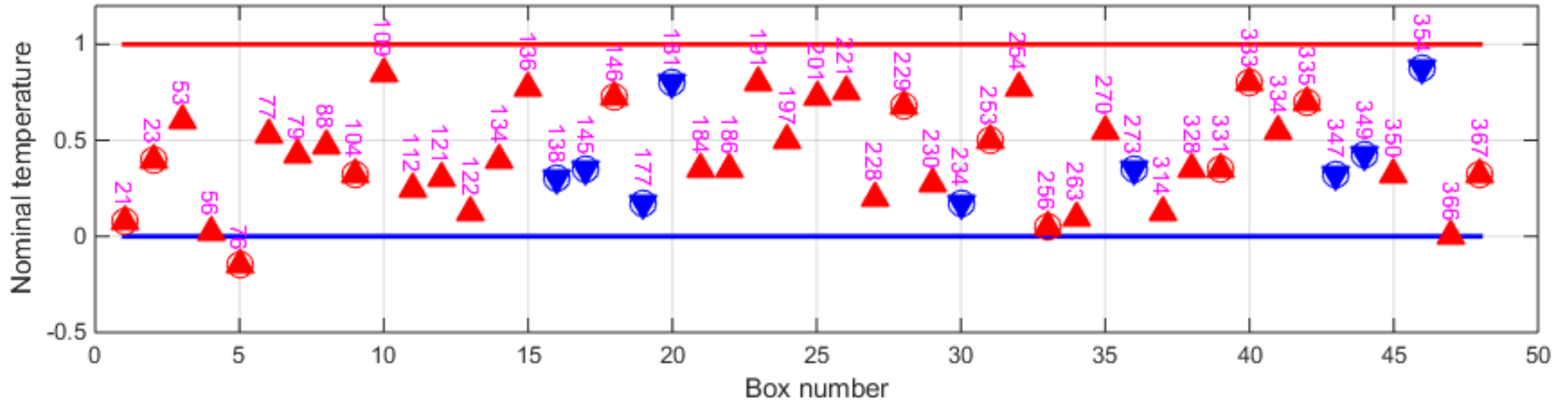
- Control Methods
 - Control a SWARM
 - Control via FlexOffers



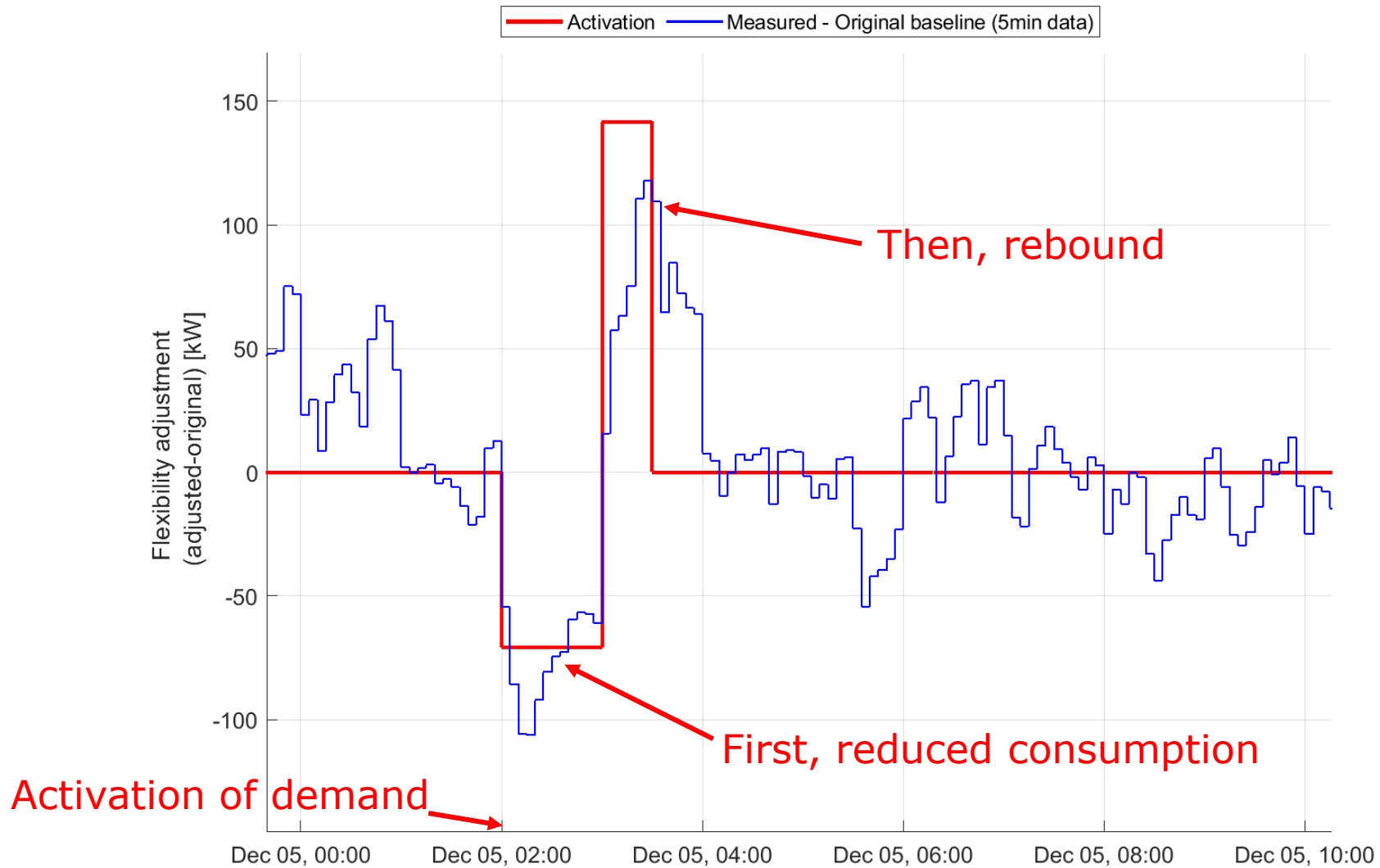
- Flexibility available
 - Not symmetrical
 - Depending on weather
 - Sometimes 25% og peak power

Swarm controller

Practical example



Fleksibilitet 'in the real world'



Barriers and strategy

Aggregator business

Challenges

- Getting heat pumps on board
 - Cheap and easy access to heat pump complicated, missing standardization
- Delivering services to electricity market requires many heat pumps
- Delivering primary reserves from a pool of heat pumps is complicated
- Complicated business model, a long value chain
 - BRP – Aggregator – heat pump owner
 - Separate measurement of power and price settlement for the house owner
 - For house owner pool participation should always be better than Neogrids local optimized operation
- Limited markets
 - Only balancing market with regulating power exist today
 - Need close interaction with BRP so heat pumps can be pooled with other flexible devices to secure bid size
 - DSO markets not really existing

Aggregator business

Neogrid status now



NEOGRID
TECHNOLOGIES

- Goal
 - Having a pool of heat pumps prequalified at Energinet to deliver services to the electricity system
- Various heat pumps are being connected and tested
 - Owners with cloud connected heat pump
 - Importer of heat pump
 - Producer of heat pump
 - Complex setups: heat pumps + PV + EV + battery

Neogrid Technologies ApS

www.neogrid.dk

NEOGRID
TECHNOLOGIES



Further information at:

Per D Pedersen

Niels Jernes Vej 10

9220 Aalborg Ø

pdp@neogrid.dk

+45 3065 4710