



Cross-system optimisation from a building perspective

Learnings from HEAT 4.0

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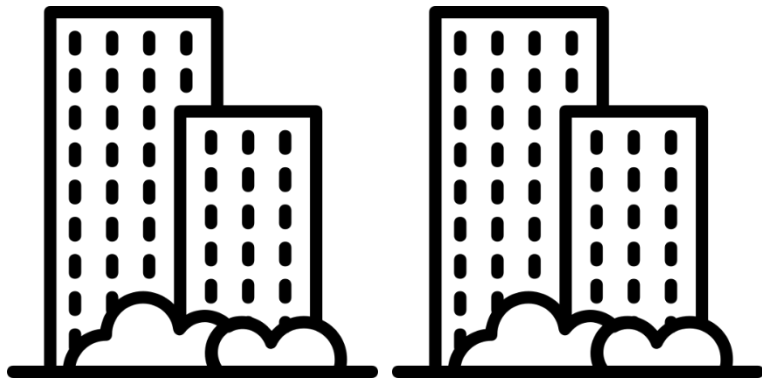
Monthly meeting @ Online - 06/07/2022

Outline

- 1 - Buildings as active players in district heating systems
- 2 - Challenges of cross-system optimisation from a building perspective
- 3 - Concrete results on the building side within HEAT 4.0
- 4 - Conclusion

*Buildings as active players
in
district heating systems*

Buildings within the HEAT 4.0 project

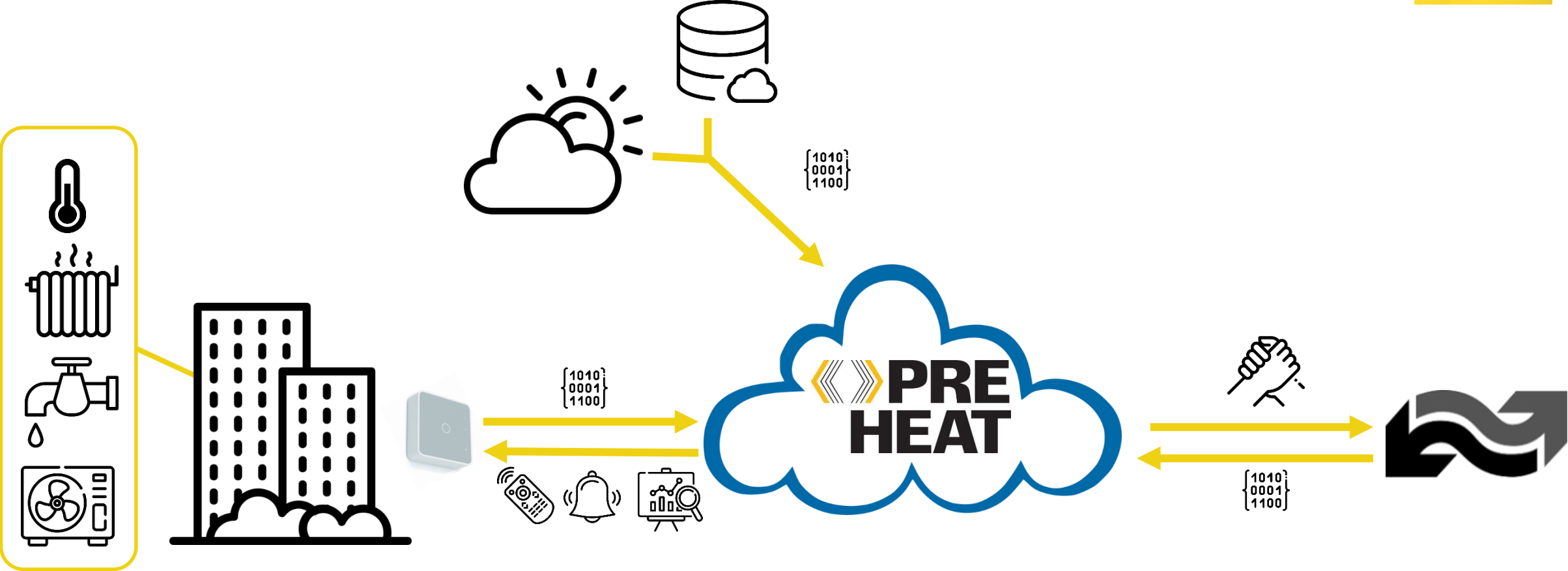


Leanheat
(Trefor, Hillerød)



Neogrid Technologies
(Brønderslev, Hillerød)

Cloud platforms enable smarter operation of building systems



Buildings can actively support the district heating system

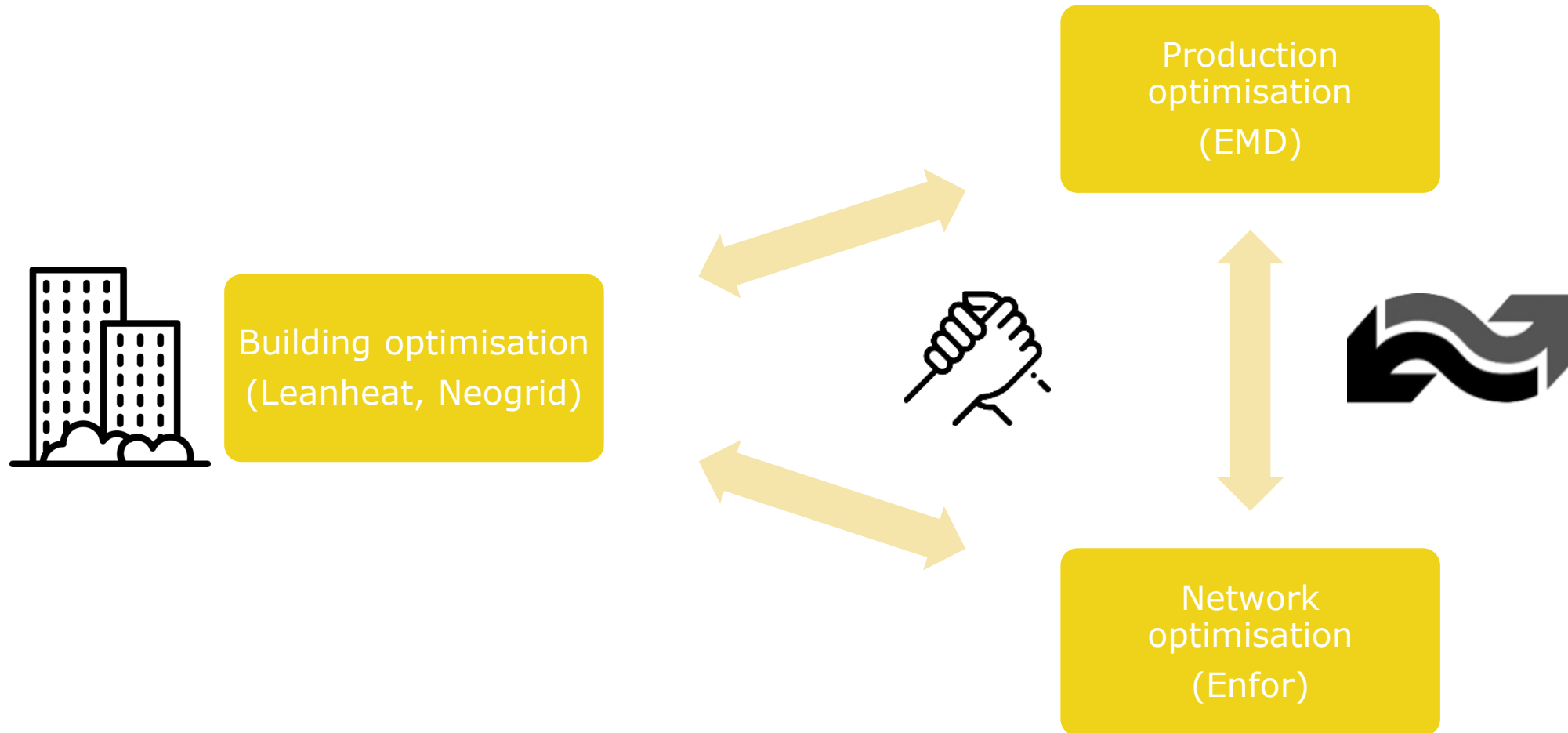
Efficiency-focused contribution

- Supply temperature requirements:
 - communicating explicitly requirements to reduce unnecessary margin
 - tolerating lower temperatures without loss of comfort via adequate fault-detection
- Cooling:
 - improving their cooling of the district heating water

Load-focused dynamic contribution

- Buildings can:
 - reduce their contribution to the system peak load
 - shift their energy demand in time on request
- Aggregates of buildings can:
 - coordinate to reduce their total peak load

HEAT 4.0 brought buildings, network and production together in cross-system optimisation



*Challenges of
cross-system optimisation
from a building perspective*

The building level has its specific interests and challenges

Building owners and operators focus on:

- **Comfort**
- Operational costs
- ROI of the solution (ideally based upon solid documentation of potential)
- Green profile

Privacy is a key concern (especially at household level where GDPR-complexity is unavoidable)

The building sector has a broad variety of customer segments and decision-making processes

Human-related factors often matter at least as much as technical solutions

Digitalisation is still in its infancy in the sector, where the culture is still very “deliver and forget”-oriented

Recruitment of the buildings is the main challenge

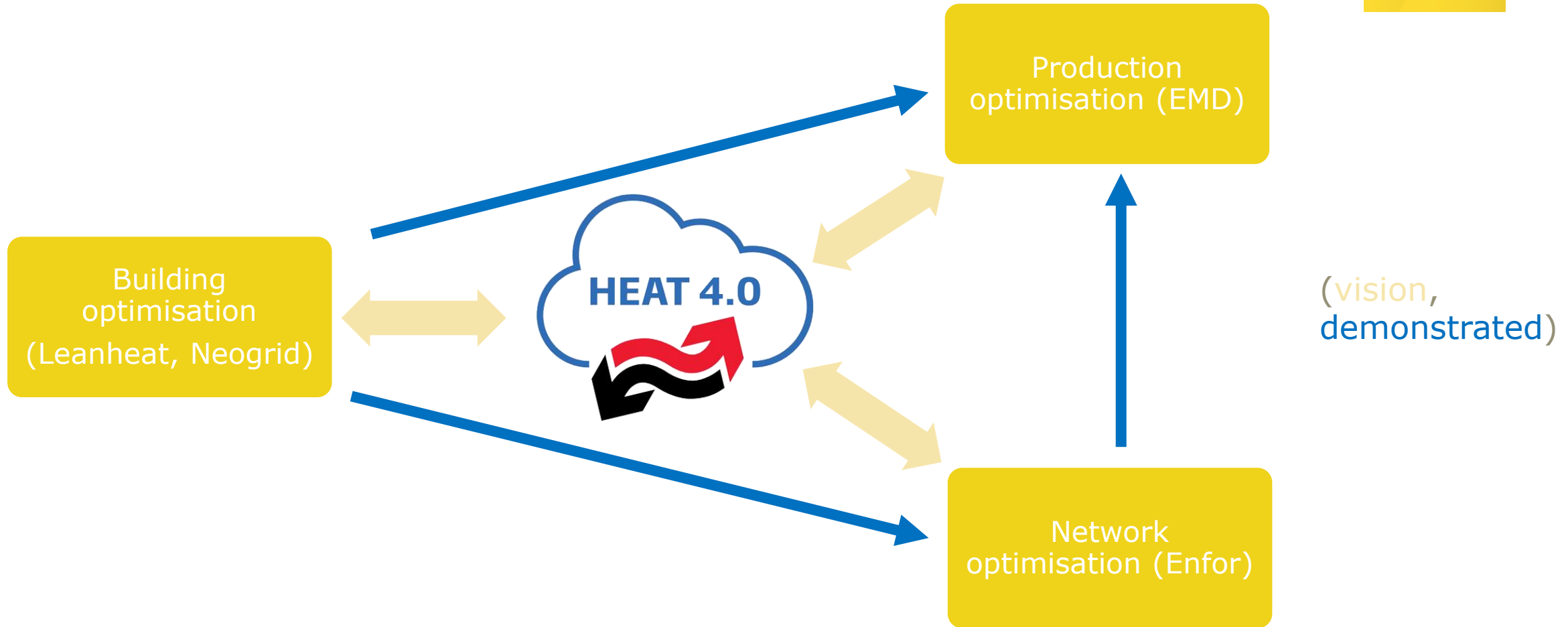
Volume and coverage matter:

- Large activatable capacity is required for meaningful building involvement (either few very large buildings, or many smaller ones)
- For temperature optimization, critical buildings need to be covered
- We did not reach sufficient coverage in our demonstrations, while ending up over-spending resources on recruitment of the buildings we managed to get into.

Onboarding of buildings:

- Every new customer is a demanding task (so best with larger organisations, with a large capacity)
- Better **business models** are required to onboard buildings faster (together with DH operators?)

P2C2P has been a challenging path



*Concrete results on the building side
within HEAT 4.0*

A building to network/production REST interface was developed

Request URL

```
https://analytics-api.neogrid.dk/HEATman/v0/zone/demo_subnet
```

Server response

Code	Details
200	<p>Response body</p> <pre>area_identfier;production_datetime;start_datetime;minimum_supply_temperature_c;expected_return_temperature_c;expected_energy_demand_kwh demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T12:00:00+00:00;55.0;35.0;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T13:00:00+00:00;55.01;35.01;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T14:00:00+00:00;55.02;35.02;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T15:00:00+00:00;55.03;35.03;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T16:00:00+00:00;55.04;35.04;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T17:00:00+00:00;55.05;35.05;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T18:00:00+00:00;55.06;35.06;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T19:00:00+00:00;55.07;35.07;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T20:00:00+00:00;55.08;35.08;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T21:00:00+00:00;55.09;35.09;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T22:00:00+00:00;55.1;35.1;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-06T23:00:00+00:00;55.11;35.11;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T00:00:00+00:00;55.12;35.12;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T01:00:00+00:00;55.13;35.13;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T02:00:00+00:00;55.14;35.14;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T03:00:00+00:00;55.15;35.15;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T04:00:00+00:00;55.16;35.16;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T05:00:00+00:00;55.17;35.17;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T06:00:00+00:00;55.18;35.18;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T07:00:00+00:00;55.19;35.19;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T08:00:00+00:00;55.2;35.2;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T09:00:00+00:00;55.21;35.21;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T10:00:00+00:00;55.22;35.22;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T11:00:00+00:00;55.23;35.23;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T12:00:00+00:00;55.24;35.24;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T13:00:00+00:00;55.25;35.25;20.0 demo_subnet;2022-06-06T11:00:00+00:00;2022-06-07T14:00:00+00:00;55.26;35.26;20.0</pre>

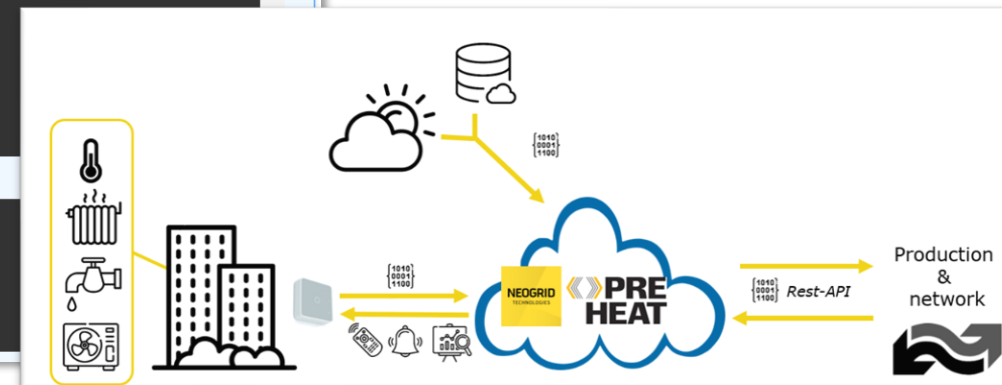
Response headers

```
connection: Keep-Alive
content-length: 13711
content-type: text/csv; charset=utf-8
date: Mon, 06 Jun 2022 11:53:15 GMT
keep-alive: timeout=15,max=100
server: uvicorn
```

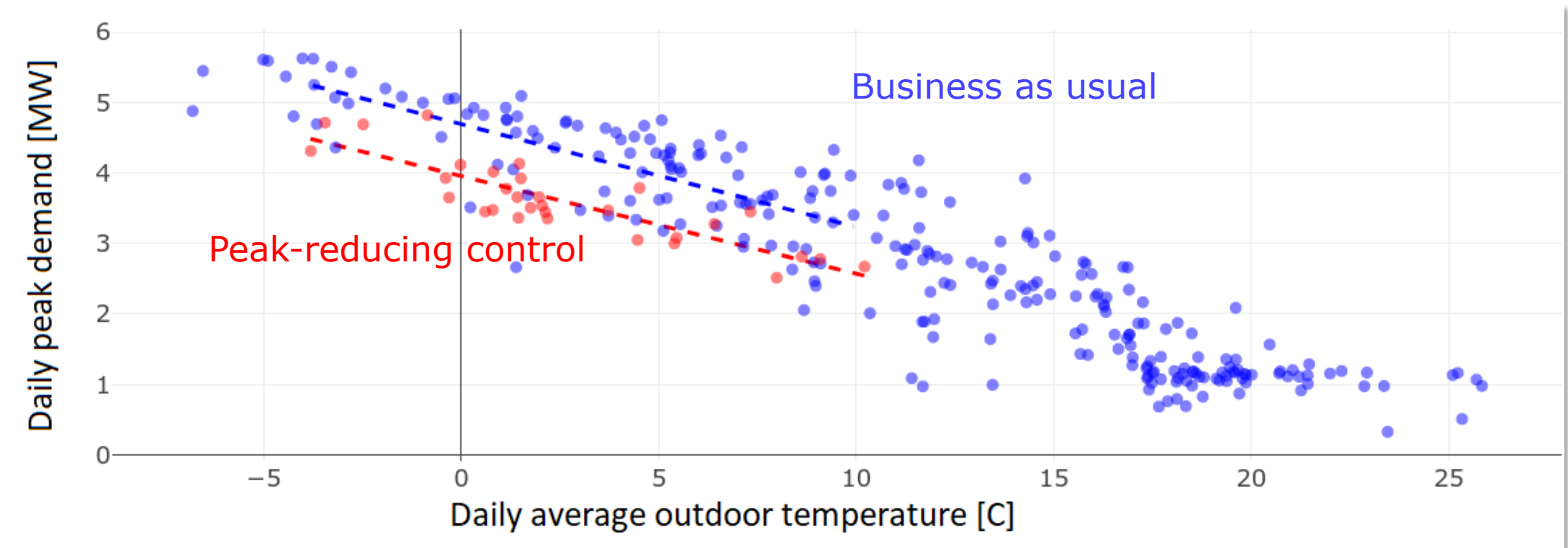
Encrypted REST API with authentication

For an aggregate of buildings, 7 days ahead forecast of hourly:

- Minimum supply temperature
- Expected return temperature
- Expected energy demand

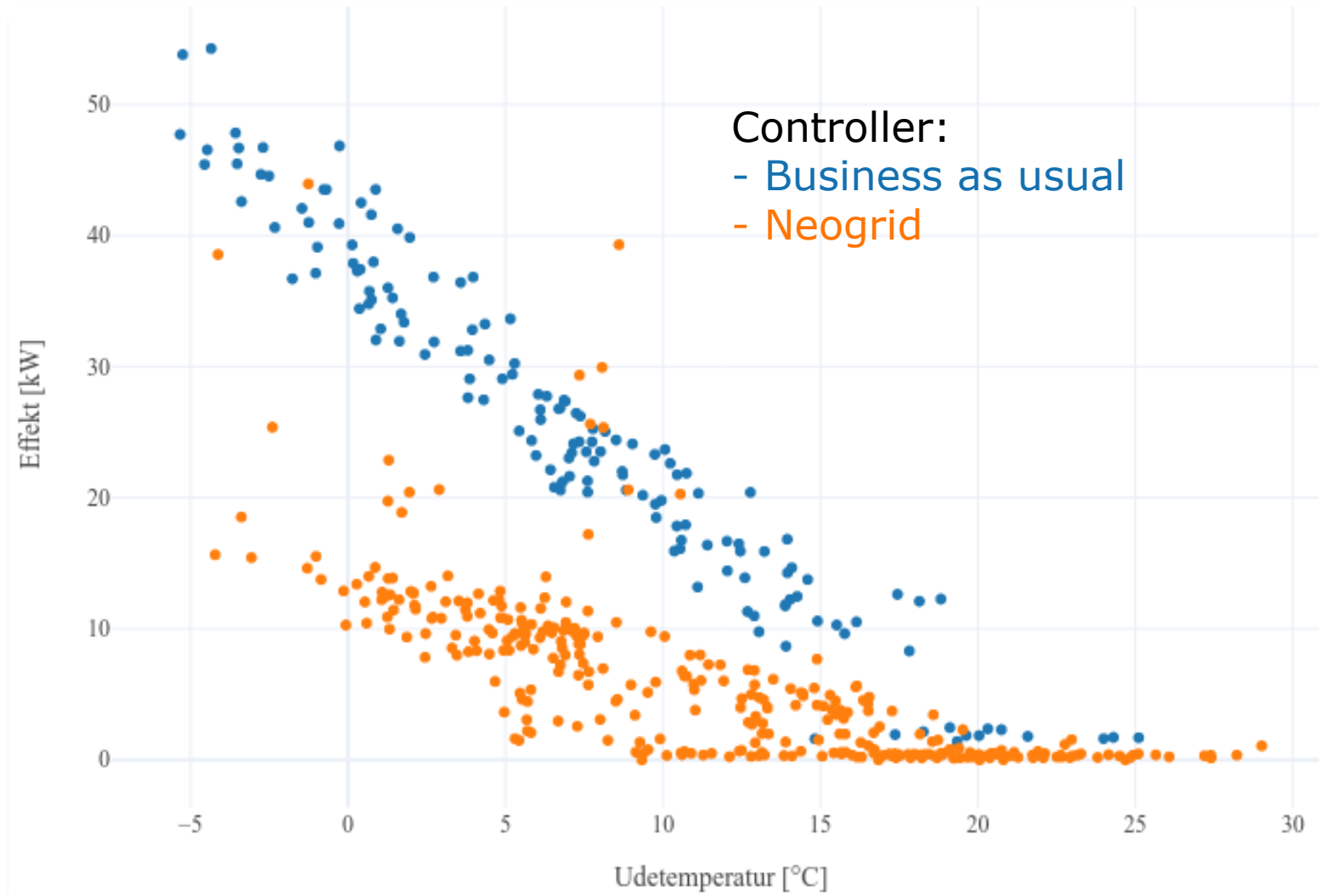


Peak demand reduction for an aggregate of buildings



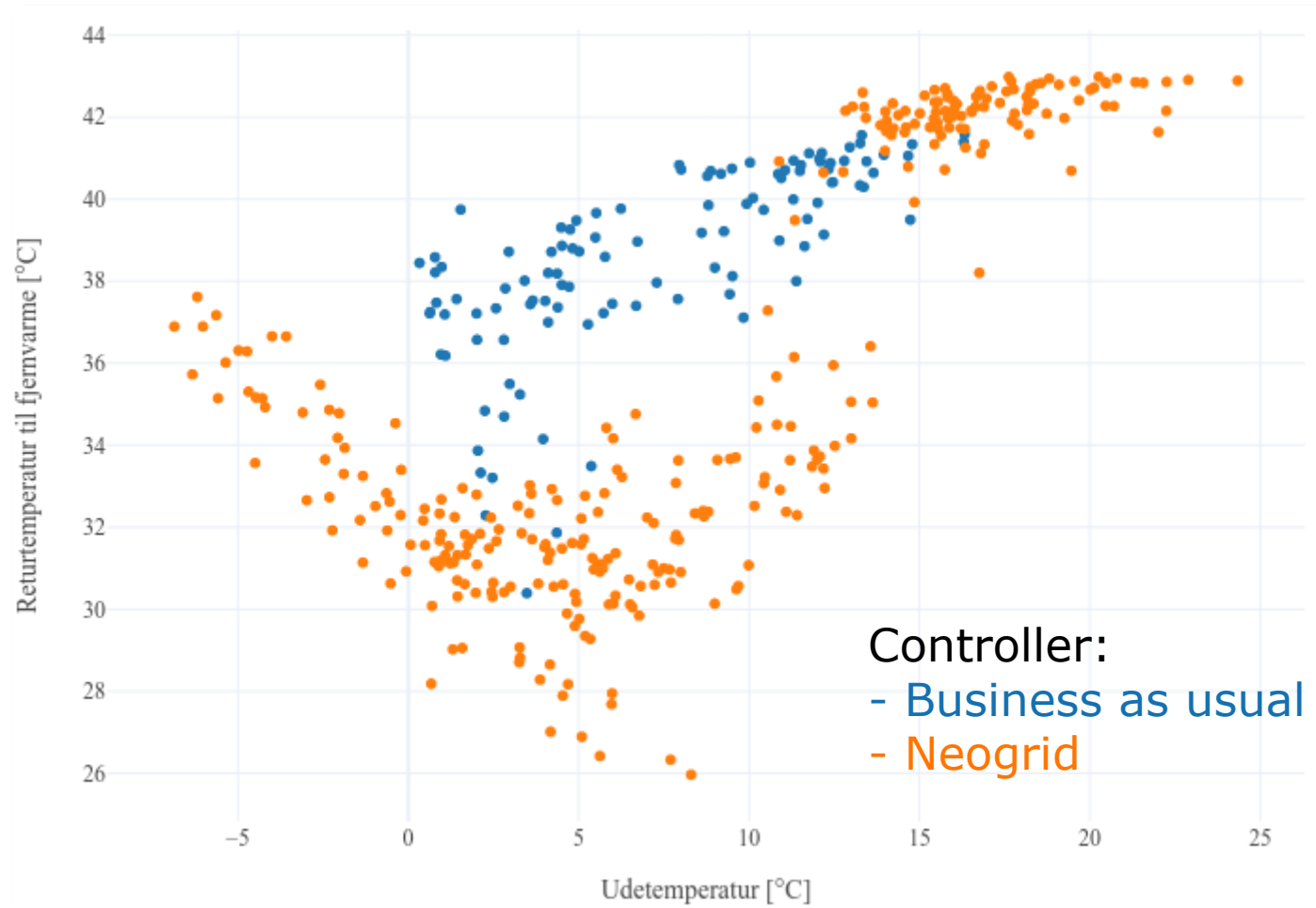
Result of a winter trial for a group of 36 apartment blocks (from Neogrid's commercial pool)

Reduction of contribution to system evening peak



Reduction of the average demand of an institution building during the evening peak times (16:30-18:30) for an institutional building in Brønderslev

Reduction of return temperature for a single family house



Result on a low energy house in Brønderslev

Conclusion

Activation of buildings in district heating networks is underway

Neogrid and Leanheat can enable buildings to play an active role via cross-system-optimization (CSO)

In HEAT 4.0, we achieved:

- Methodology to identify supply temperature limits in local areas, to help achieving reduction
- Reduction of peak loads (at aggregate and system level)
- Communication interface to integrate building operation in network and production optimisation

Remaining work for the future:

- Activating demand response from the buildings with a 2-way optimisation flow in CSO
- Demonstrating the scheme in an area (with sufficient coverage)
- Peer-to-cloud-to-peer operation of CSO

Accessing enough buildings is a hard and costly task, which needs to be made easier/more effective

Appropriate business models and incentives are key to ensure uptake and viability of the solution



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