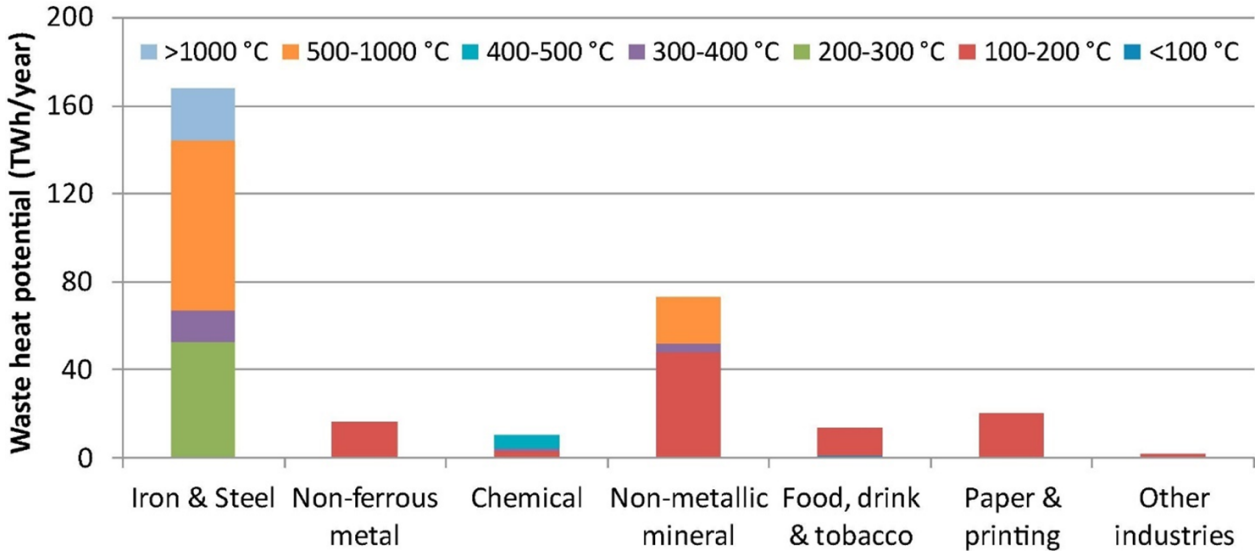
STORM District Energy Controller

Johan Van Bael, Application Area Leader DHC, EnergyVille/VITO

Why district heating networks?

- Large amount of untapped residual heat
- USA:
  - 167-435 GW of residual heat
    [US Department of Energy: waste heat recovery]
- Europe - Industry
  - 10,800 MW of low temperature (<230°) waste heat [Venkatramani, 2018]
  - 304.13 TWh/year of waste heat which is 16.7% of the industrial energy use for process heating [Papapetrou, 2018]
    - Potential at 100-200° is about 100 TWh/year
    - Potential at 200-500° is about 78 TWh/year



Waste heat potential per industrial sector for EU, Papapetrou et all, 2018

Why district heating networks?

- Overview of available and accessible excess heat within 2 km of urban areas in EU [H2020 project ReUseHeat – Accessible Urban Waste heat]
  - 340 TWh/year to recover from data centres, metro stations, service sector building and waste water treatment plants.
  - More than 10% of the EU's total energy demand for heating

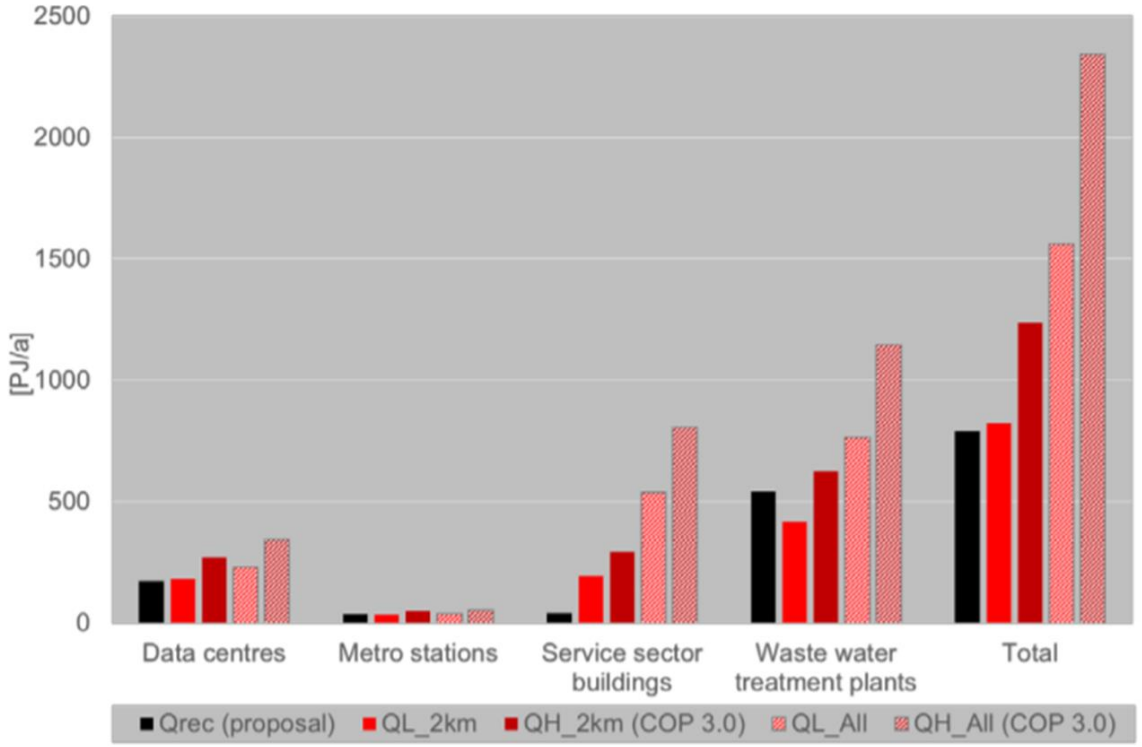


Figure 26. Summary overview of modelled available and accessible excess heat total volumes inside or within 2 kilometres of urban district heating areas (2km) vs. volumes unrestricted by local conditions (all), by source category and with comparison to recoverable excess heat volumes (Q_{rec}), as anticipated in the project proposal.

Why district heating networks?

- A large potential for district heating networks in Europe

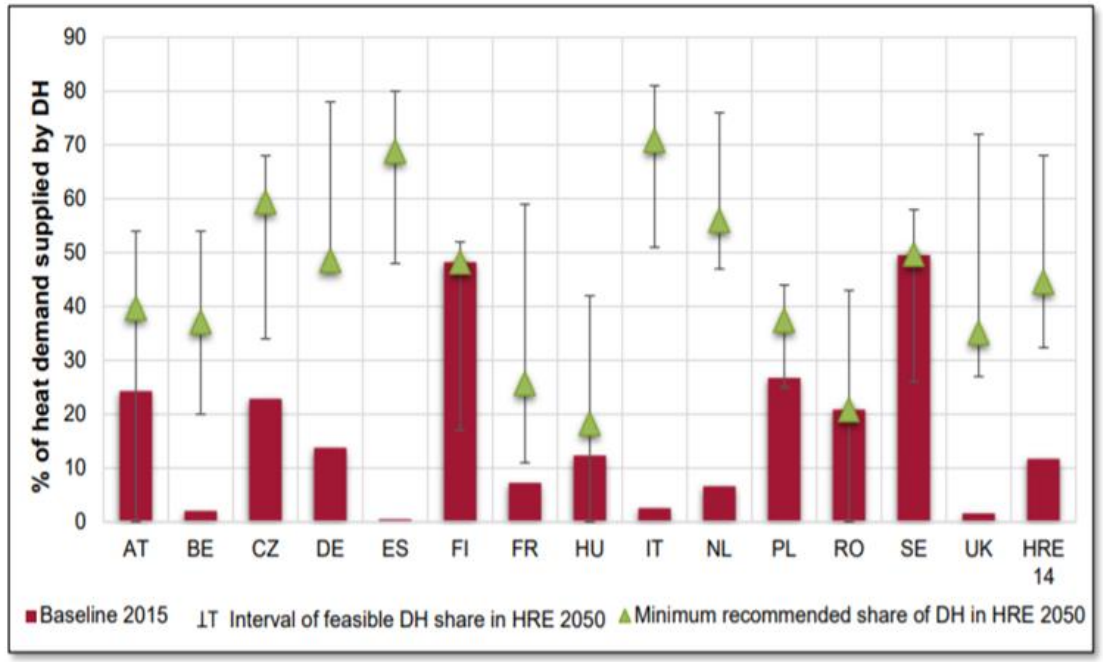
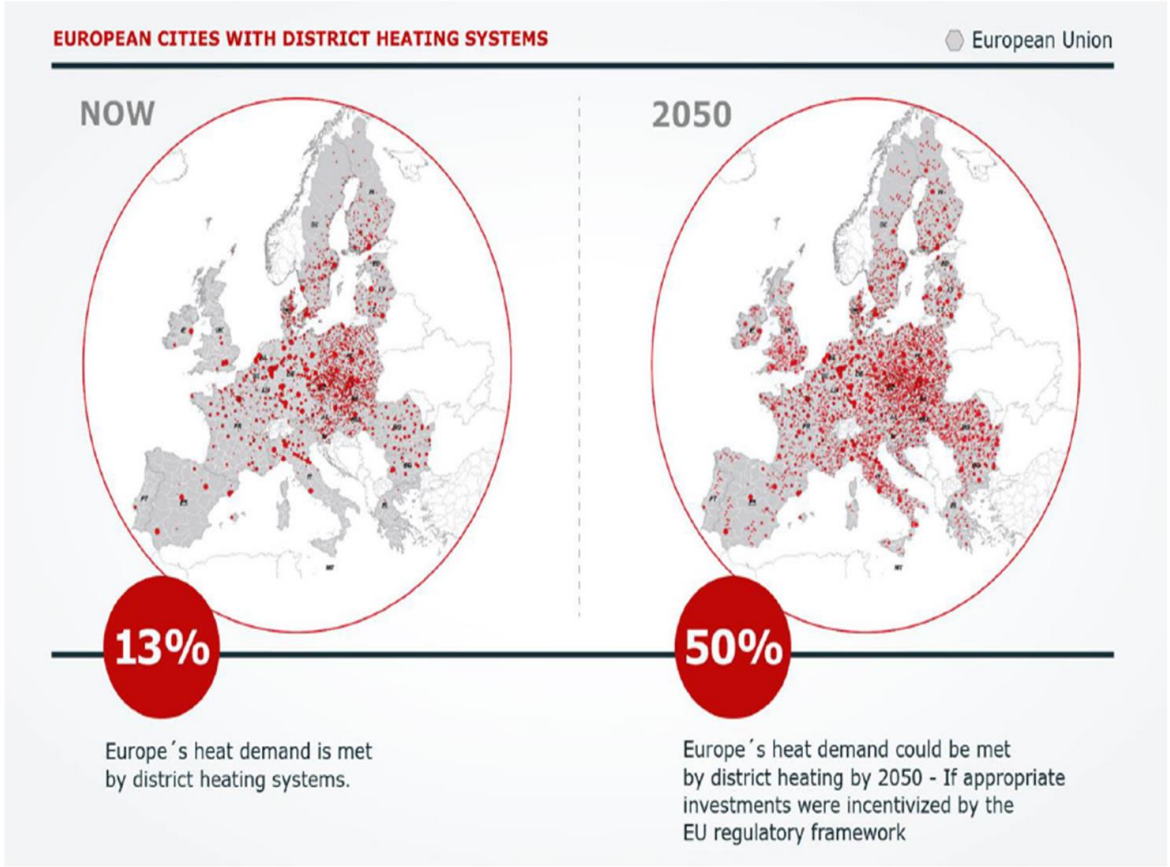


Figure 6. Baseline share of district heating in 2015 and the minimum recommended level of district heating share in HRE4. The range bars represent the amount of district heating that is economically feasible within a 0,5% total annual energy system cost change sensitivity. The recommended minimum levels take into account cost efficient levels and current level of district heating. Going beyond this level can generally increase energy efficiency.

[Heat Roadmap Europe – A low-carbon heating and cooling strategy by Aalborg University]



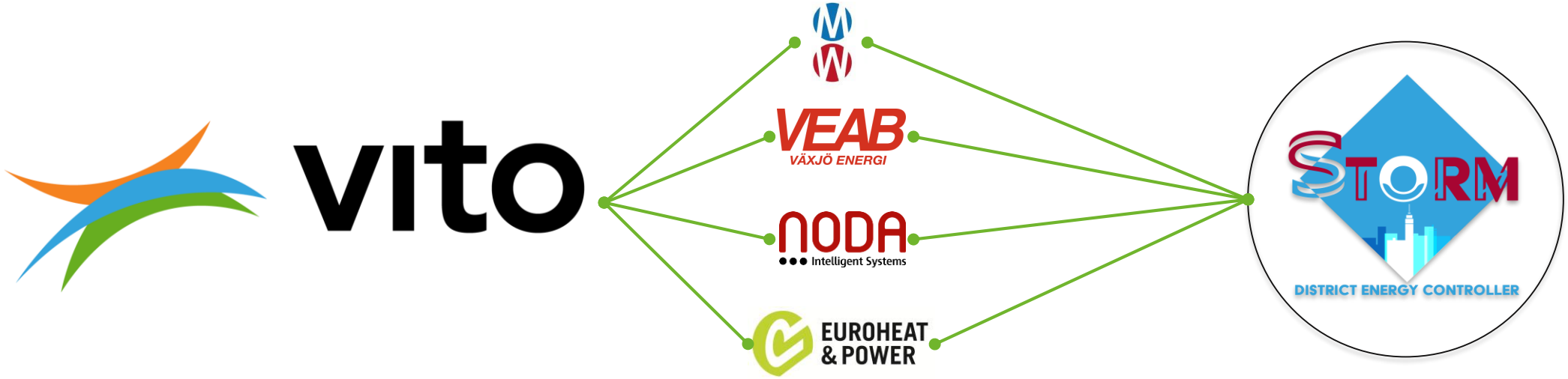
Digitalization in district heating networks

- Digital heat roadmap

- To offer insights on how digitalization impacts the DHC industry
- State-of-art in digitalisation
- Objectives, targets and recommendations
- Chapters:
  - Production level
  - Distribution level
  - Buildings level
  - Consumption level
  - Design & planning
  - Sector Coupling & integration of multiple sources
- https://www.euroheat.org/publications/digital-roadmap-district-heating-cooling/

Storm District Energy Controller

- The Storm District Energy Controller has been developed by VITO/EnergyVille as a part of a H2020-project.



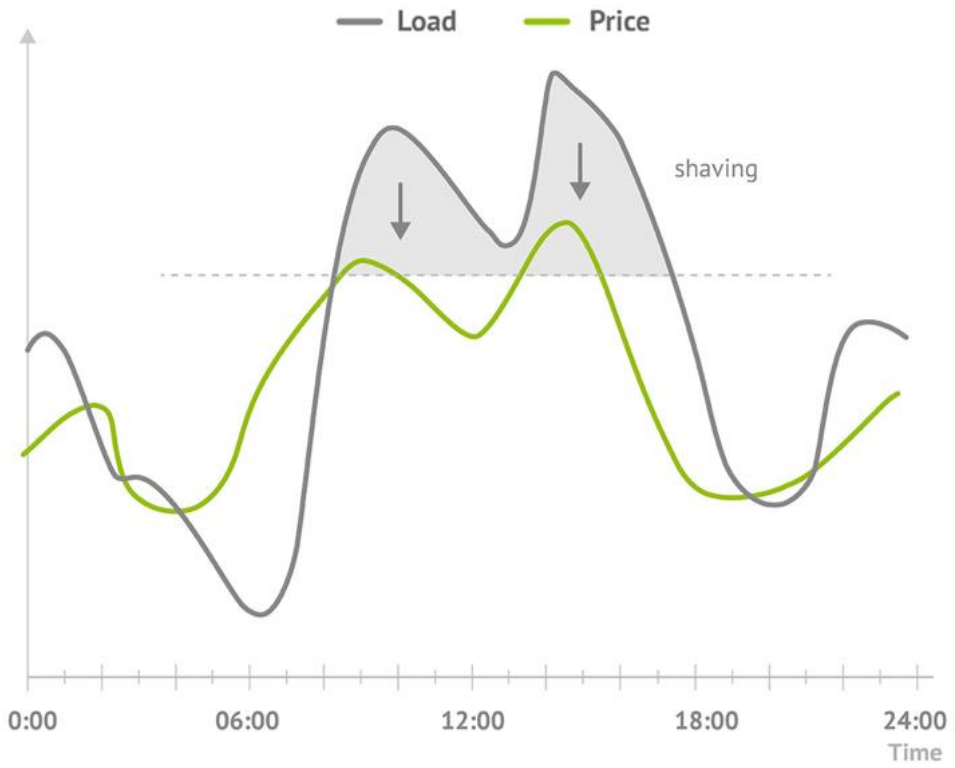
What is Storm District Energy Controller?

- An artificial intelligence based smart controller for district heating network operators to optimize operations through active demand side management.

Operational Optimization Potential

- Base load (Cheap): Residual heat, Biomass, Renewables, CHP

- Peak load (Expensive): Oil, Gas



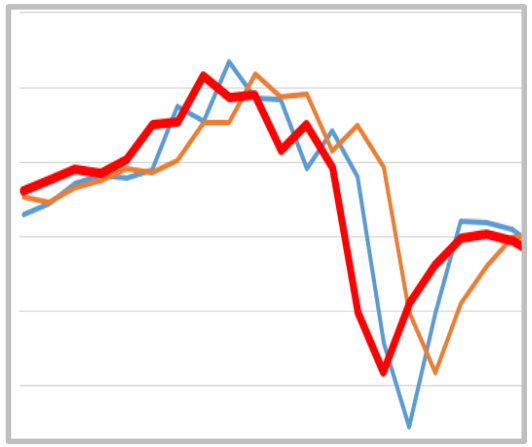
Basic operational principle

- Active demand side management utilizing flexibility offered by the buildings' thermal mass without loss in quality of service.

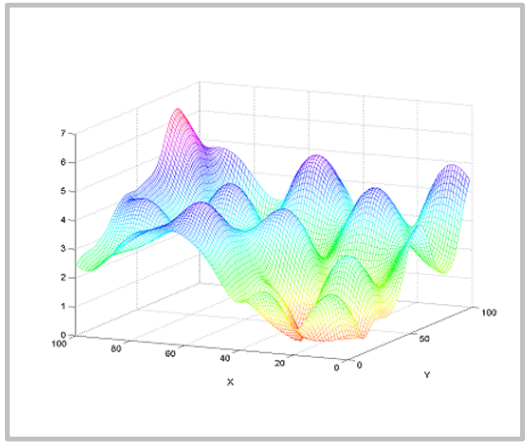
Duration	Potential reduction in heat demand (%)
Short-term [1-3h]	40-50%
Medium-term [3-5h]	20-30%
Long-term [>5h]	10-12%

1. **Without loss in thermal comfort ($\Delta T_{indoor} \approx 0.1^{o}C$ Order of magnitude)**
2. **Regardless of outdoor temperature (ODT)**

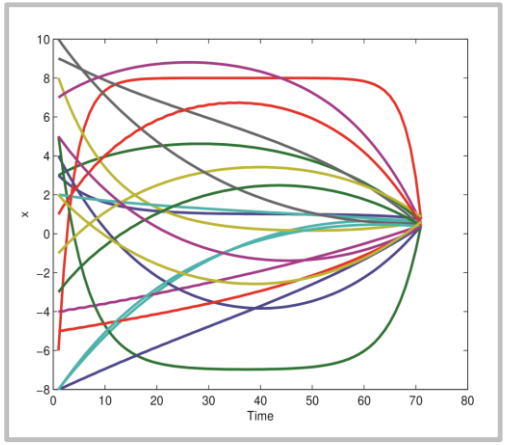
Technical details



FORECASTING (AI)



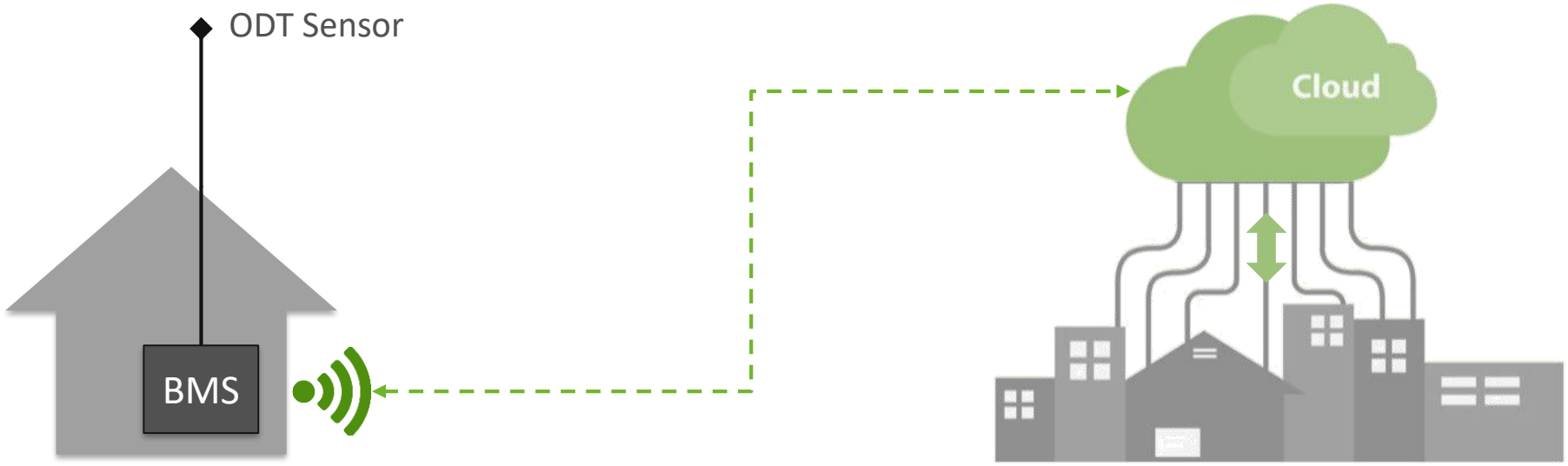
DAY-AHEAD SCHEDULING & OPTIMIZATION



REAL TIME TRACKING & OPTIMIZATION

WIRELESS COMMUNICATION OF CONTROL SIGNALS

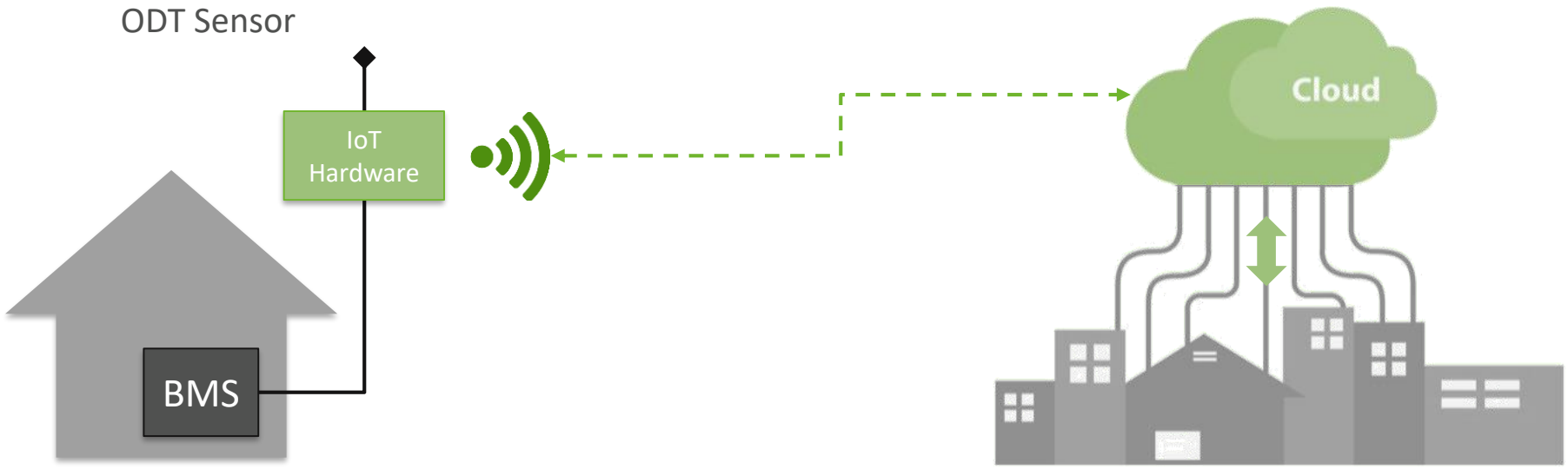
On site implementation 1



DIRECT BMS CONNECTION WITH THE CLOUD

CLOUD BASED DATA PROCESSING AND VISUALIZATION PLATFORM

On site implementation 2



INDIRECT BMS CONNECTION VIA OUTDOOR TEMPERATURE OVERRIDE

CLOUD BASED DATA PROCESSING AND VISUALIZATION PLATFORM

Demonstrated technology

3GDH in Rottne, SE

5GDH in Heerlen, NL

3GDH in Eindhoven, NL

3GDH in Mol, BE

5GDH in Paris, Fr

Past projects

Current projects

Benefits in numbers

Reduction in peak heat demand
17.3%

Reduction in CO_2 emissions
11.2 kilo Tonnes/year

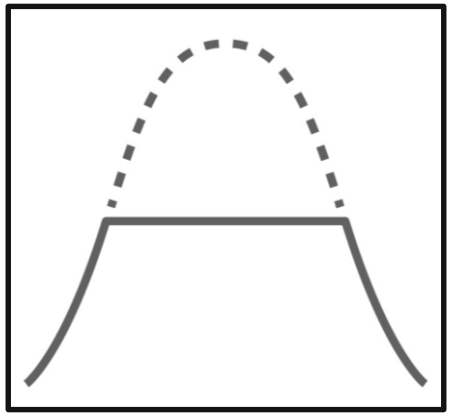
Potential increase in capacity of
42.1% enabling **48.000** additional homes

Reduction in peak heat demand
12.7%

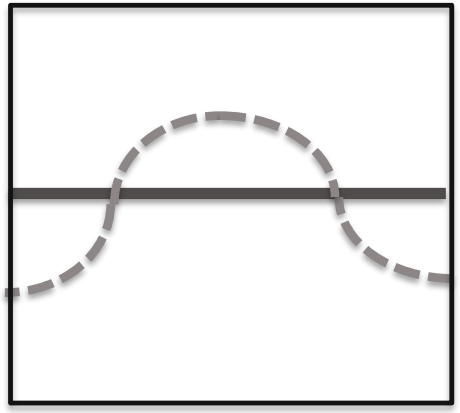
Reduction in CO_2 emissions
10.8 kilo Tonnes/year

Reduction in power procurement costs of **6%**

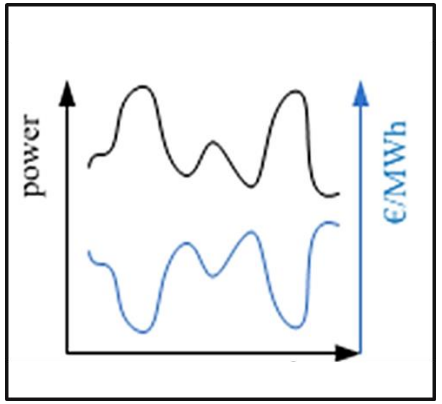
Storm Technology Roadmap



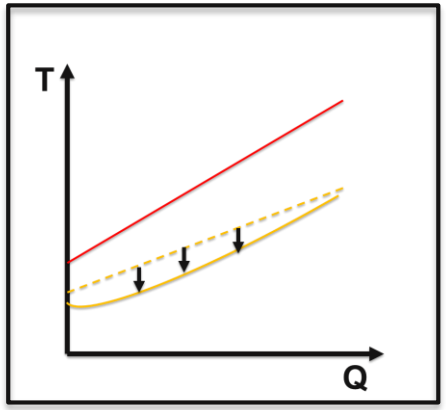
Peak shaving



Load curve flattening



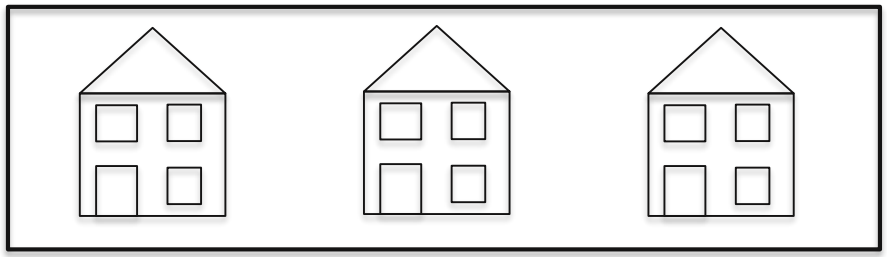
Electricity Market Interaction



Return temperature reduction

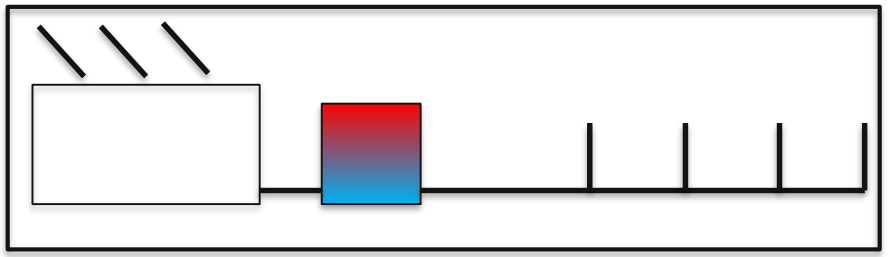
Commercially available

Storm Technology Roadmap

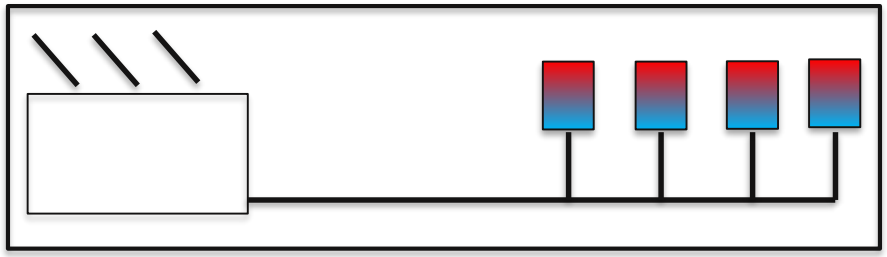


Building mass

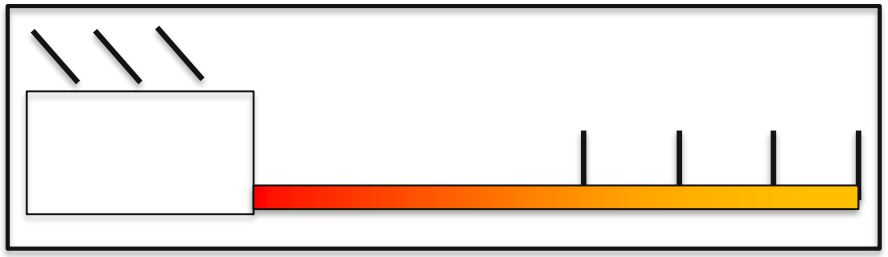
Commercially available



Centralised storage



Decentralised storage



Storage in the network piping

Some application benefits for DHN operators/owners

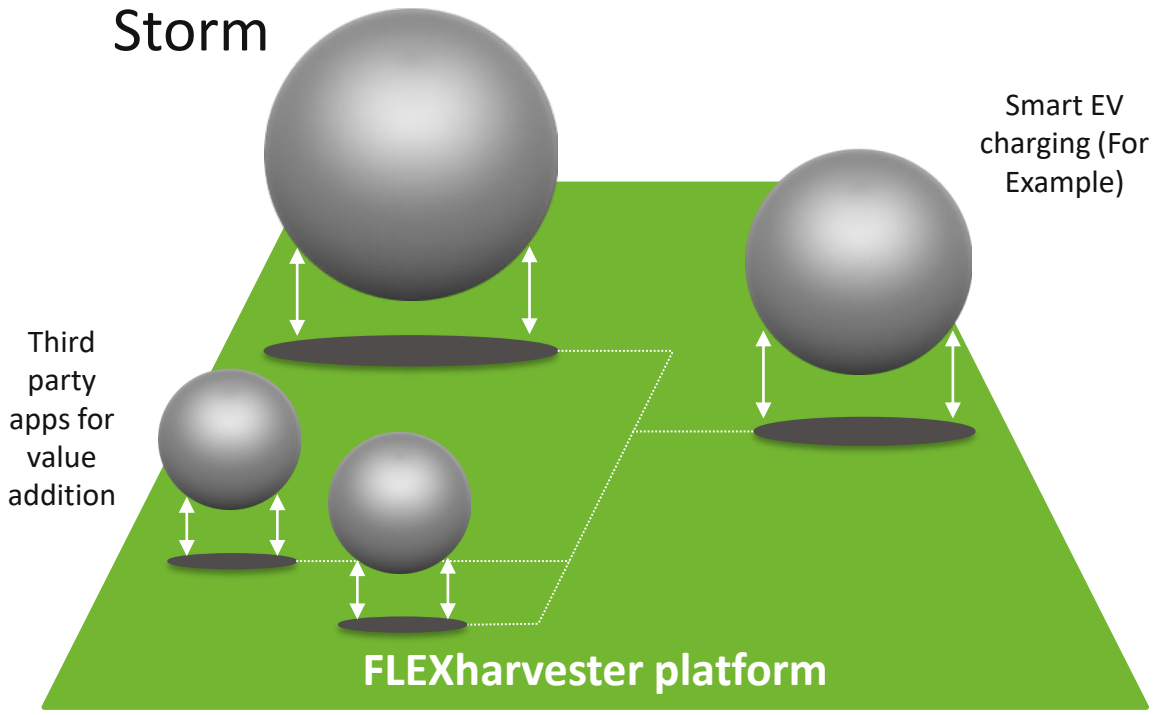
- Production mix optimization (peak vs base)
- Increased efficiency of the production installation by reduced network return temperature

- Increased revenue of CHP/HP via market interaction optimization
- More connections of heat consumers to the network infrastructure

- Improved integration of renewable energy sources
- Reduction of the CO_2-emissions

Storm running on FLEXharvester

- Storm is the first among the applications supported by the FLEXharvester platform



Further Information @ energyville.be/en/storm-controller

Johan.vanbael@energyville.be - Application Area Leader District Heating and Cooling Networks

Erik.deschutter@energyville.be - Business Developer

Somil.Miglani@energyville.be - Product Owner STORM District Energy Controller

Energy Ville

KU LEUVEN vito imec UHASSELT