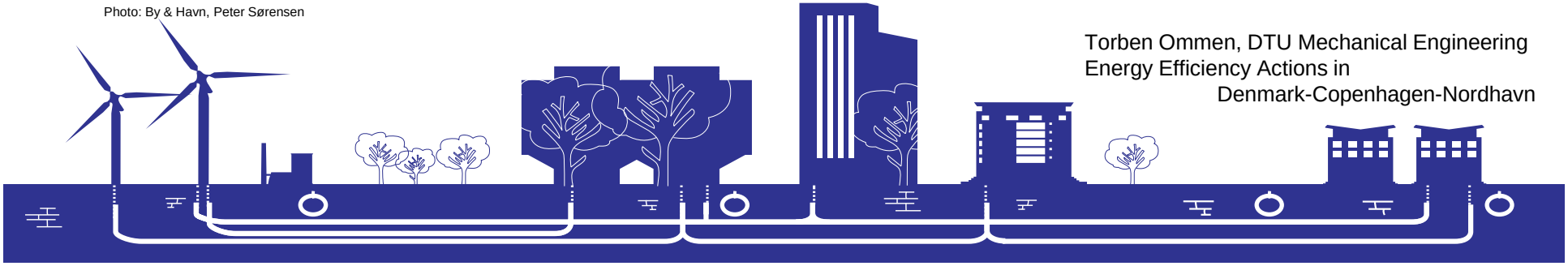
EnergyLab Nordhavn

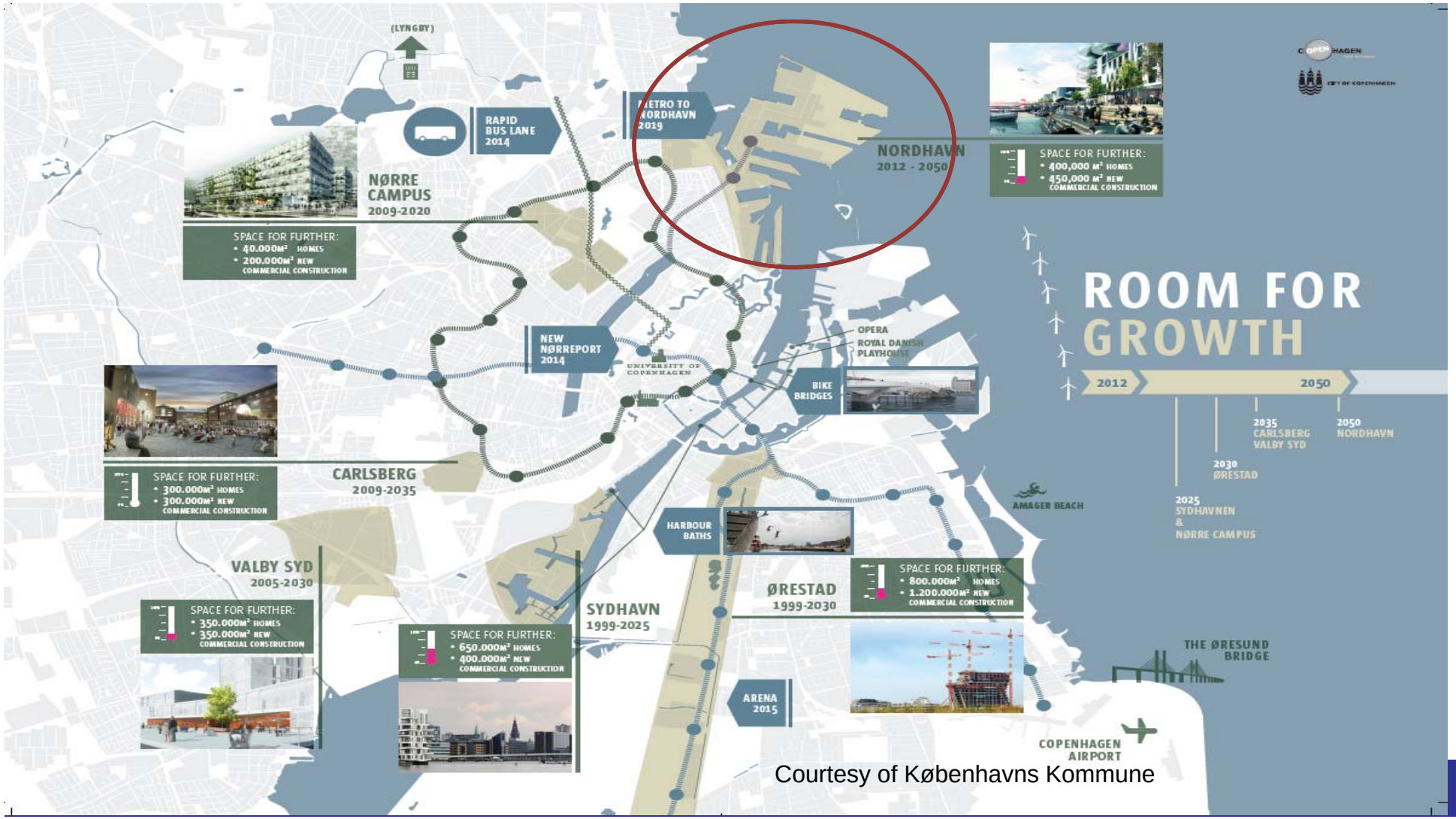
Integrated Energy Infrastructures and Smart Components

Photo: By & Havn, Peter Sørensen



Torben Ommen, DTU Mechanical Engineering

Energy Efficiency Actions in
Denmark-Copenhagen-Nordhavn



Courtesy of Københavns Kommune

Nordhavn – sustainable energy and transport

- Over the next 50 years, Nordhavn will develop into a **new district** with 40,000 residents and 40,000 jobs.
- The ambition is to become an **example of a future sustainable city**, while also contributing to the City of Copenhagen's goal of becoming **carbon-neutral** by 2025.
- This requires **innovation** in urban design - not least of energy infrastructure.
- DGNB Certification at district level - Result : 81,4 % = **platin**

Objective

To develop

new methods and solutions

for design and operation of the future

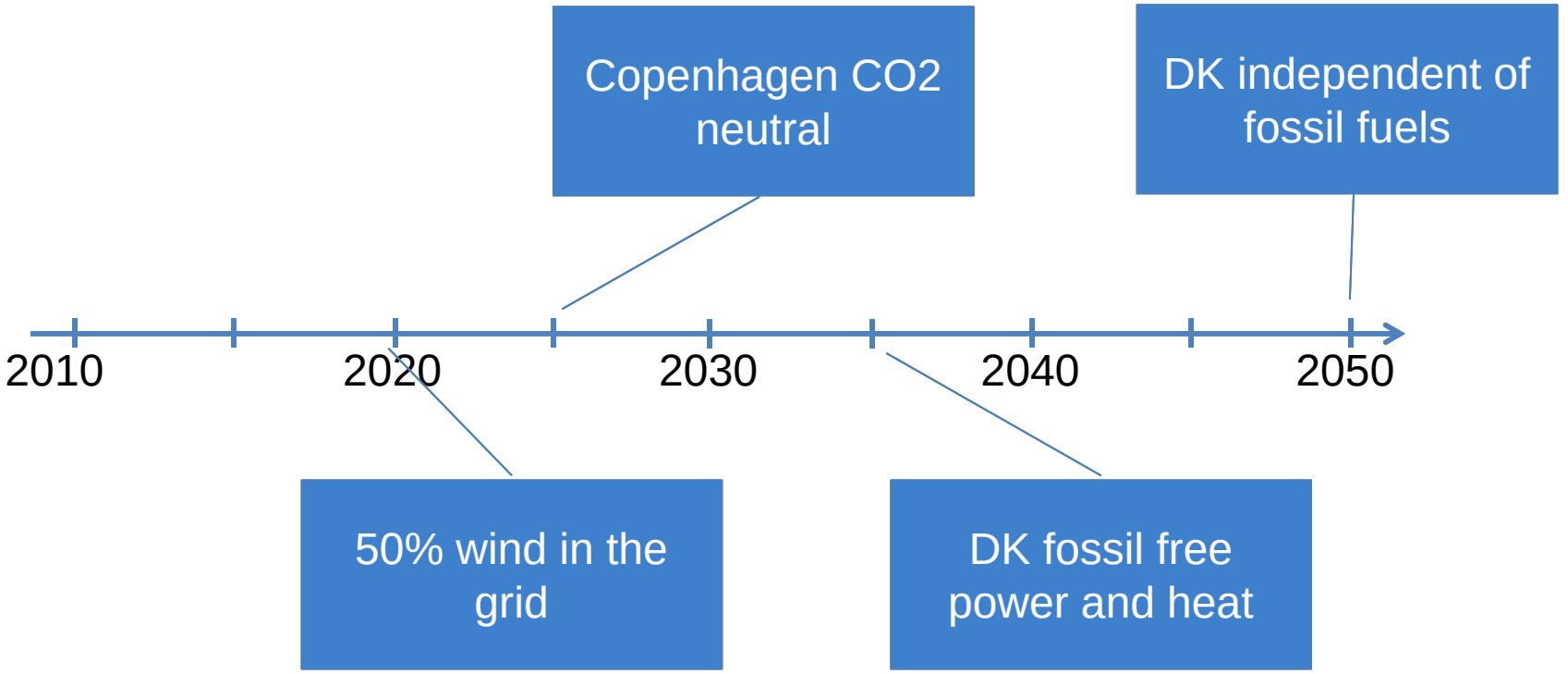
cost-effective integrated energy system

based on Nordhavn as a

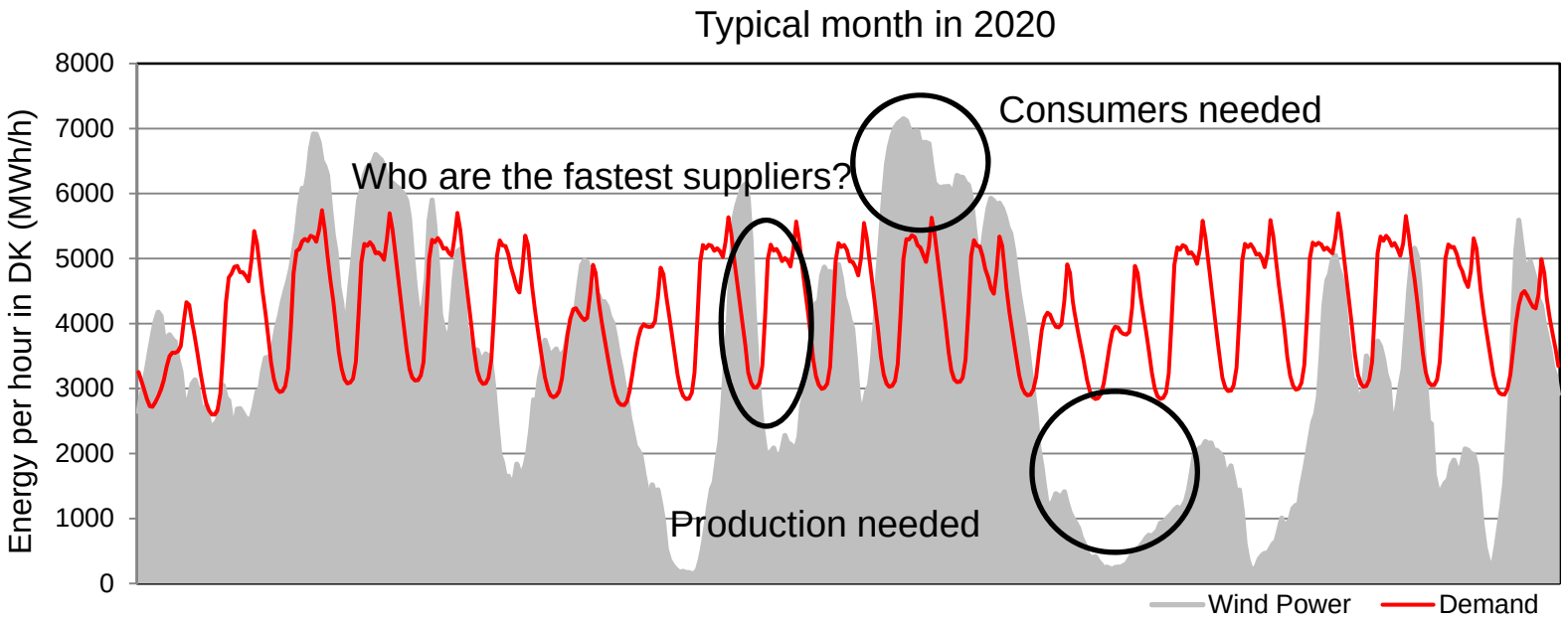
globally visible real-life laboratory.

Photo: Kontraframe

Long term goals supported



50% wind already in 2020



Partners from multiple sectors

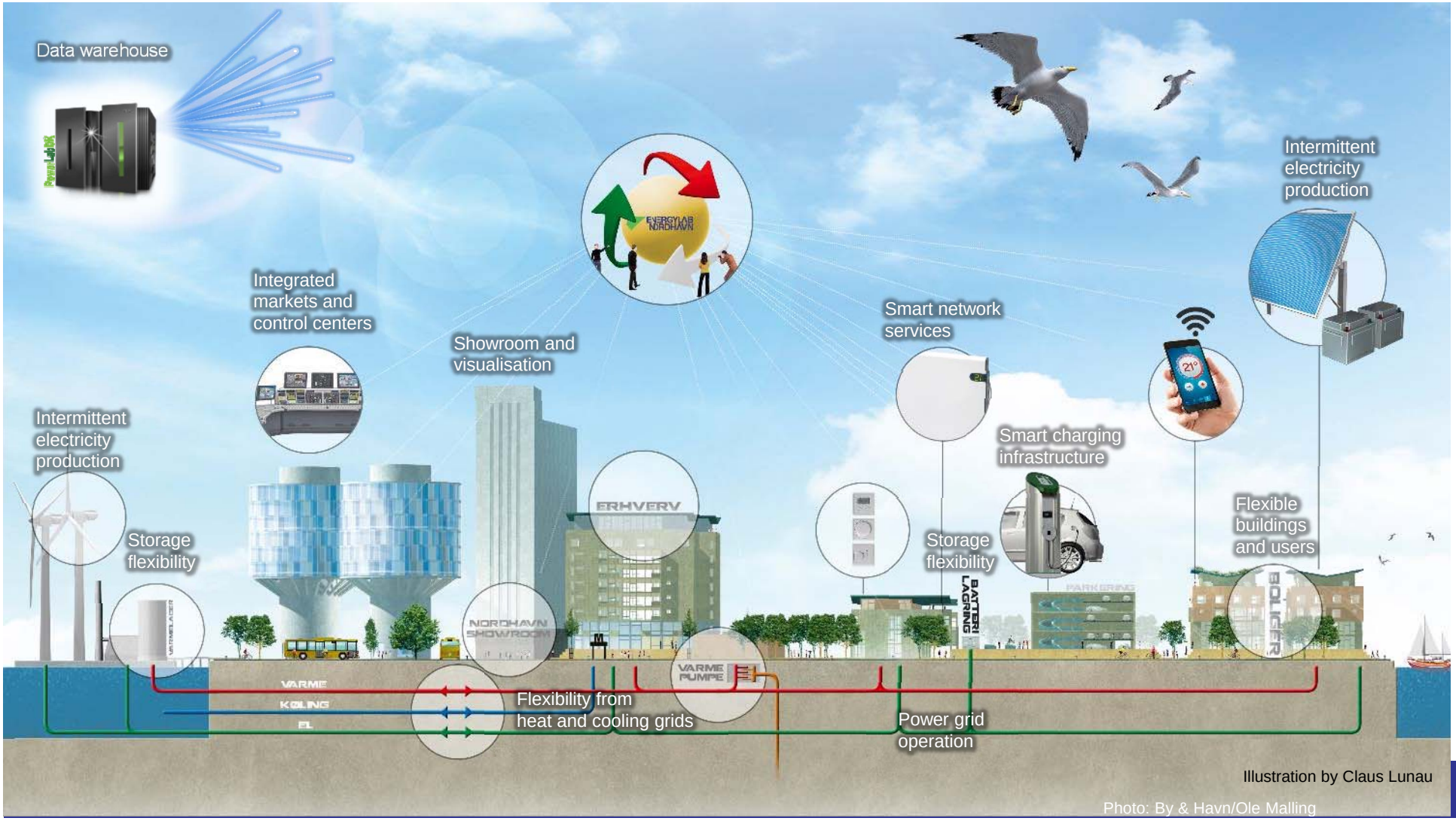
Authority and city development

Energy Infrastructure

Industry and consulting engineers

University and data infrastructure

2015-2019, Budget 19 M€, Public funding 11 M€ from EUDP


Data warehouse
Integrated markets and control centers
Showroom and visualisation
Smart network services
Intermittent electricity production
Intermittent electricity production
Storage flexibility
Smart charging infrastructure
Storage flexibility
Flexible buildings and users
ERHVERV
NORDHAVN SHOWROOM
VARME
KØLING
EL
VARME PUMPE
Flexibility from heat and cooling grids
Power grid operation
BATTERI LAGRING
BOLIGER
Illustration by Claus Lunau
Photo: By & Havn/Ole Malling

Frihavnstårnet

- 12 appartments with building automation
- Q4 2016
- Remote controlled heating, appliances, light, indoor climate

Havnehuset

- Demonstration of flexible district heating and low temperature district heating
- Q4 2016

Terra Nova

- 10 appartments with smart control of heating systems
- Measuring of thermal capacity in four apparments
- Q4 2016

Photos: By & Havn, ABB, DTU

CIS

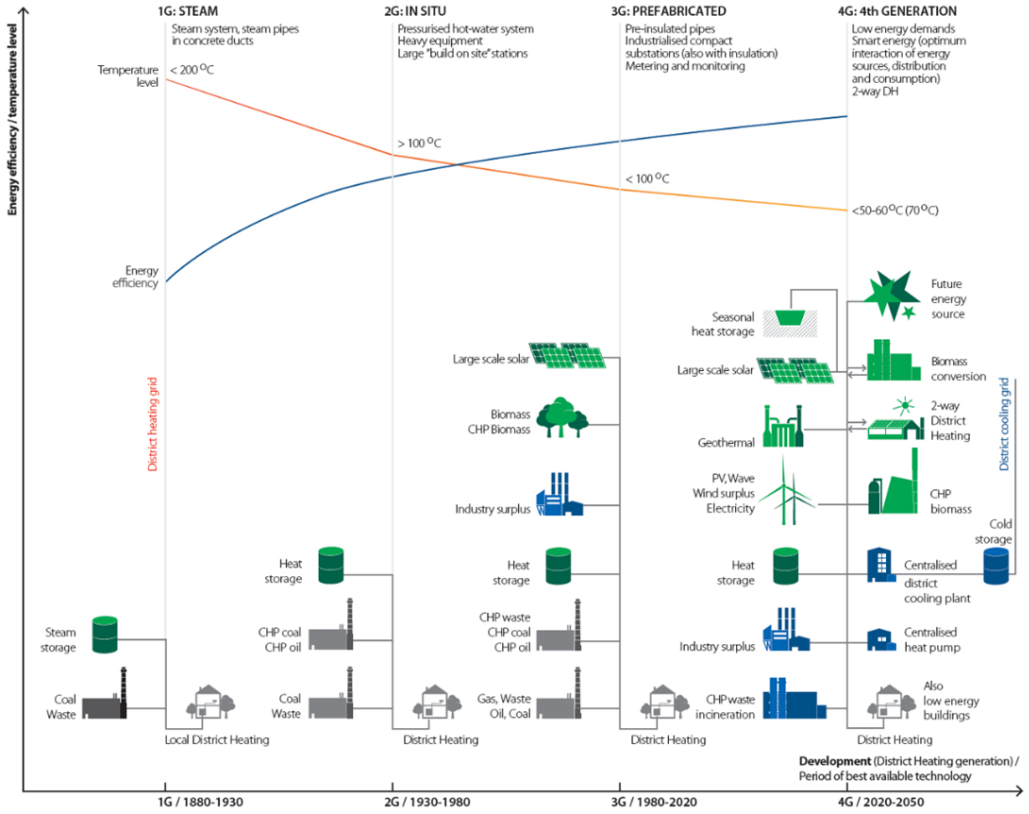
- Integration and smart building management

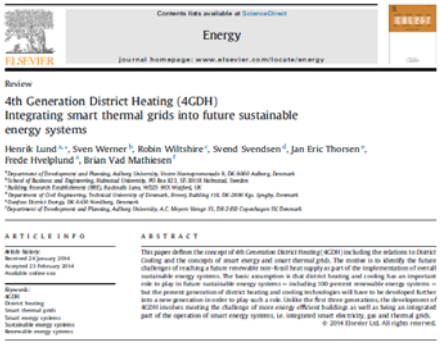
P-hus Lüders

- Grid connected Li-ion battery
- 460 kWh (60 homes for one day)
- Integrated with 10 kV grid
- Technology: ABB
- Operation: Radius
- Q1 2017

Cruise terminals and UNICEF building

District Heating, past, present and future




Contents lists available at ScienceDirect

Energy

journal homepage: www.elsevier.com/locate/energy

Review

4th Generation District Heating (4GDH)
Integrating smart thermal grids into future sustainable energy systems

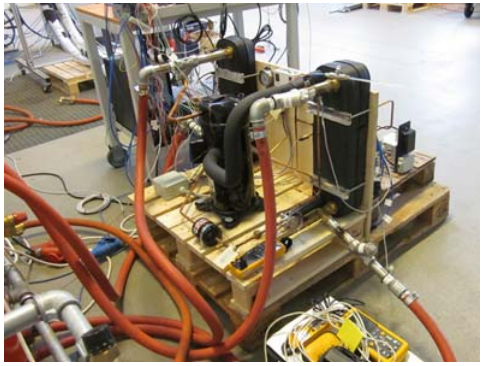
Henrik Lund, Sven Werner, Robin Wiltshire, Svend Svendsen, Jan Eric Thorsen, Frede Hvelplund, Brian Vad Mathiesen

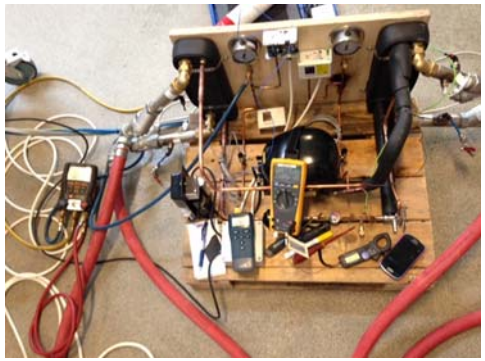
ARTICLE INFO

ABSTRACT

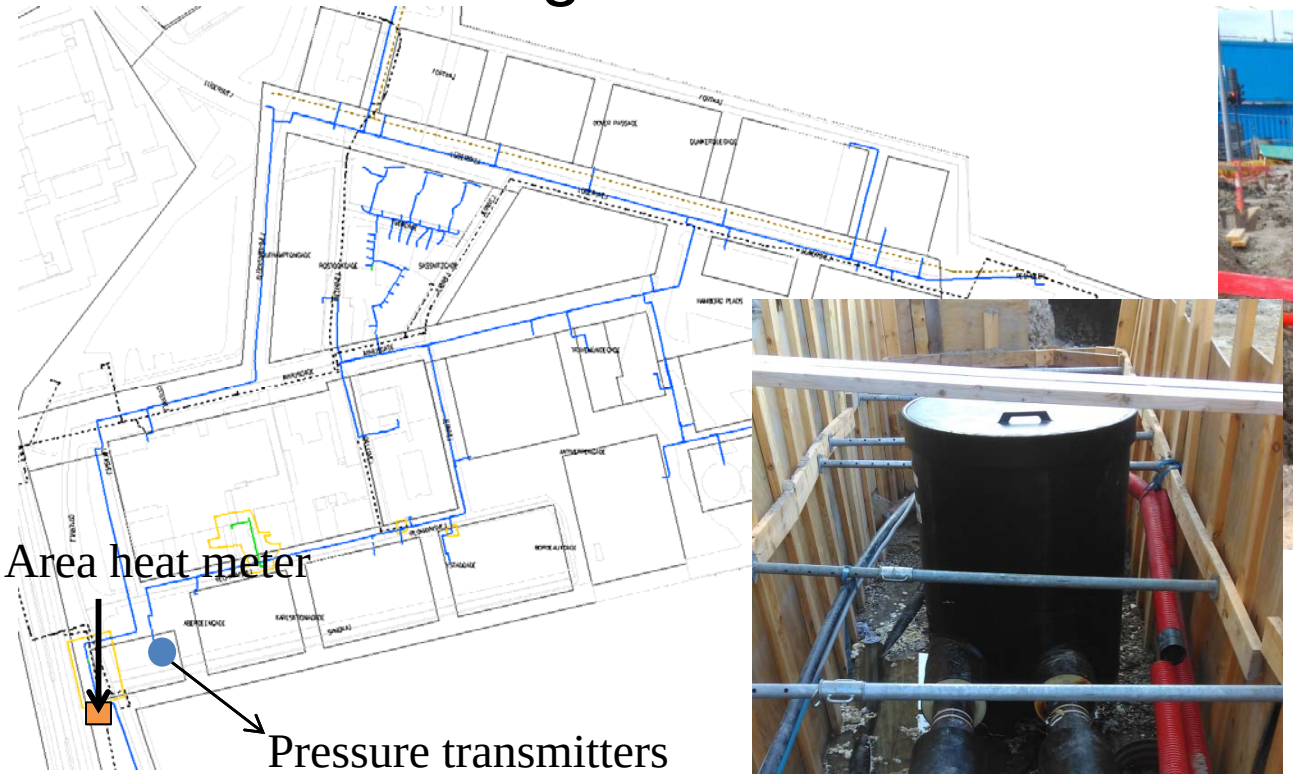
Illustration by Claus Lunau

Developed prototype of Heat Booster Substation



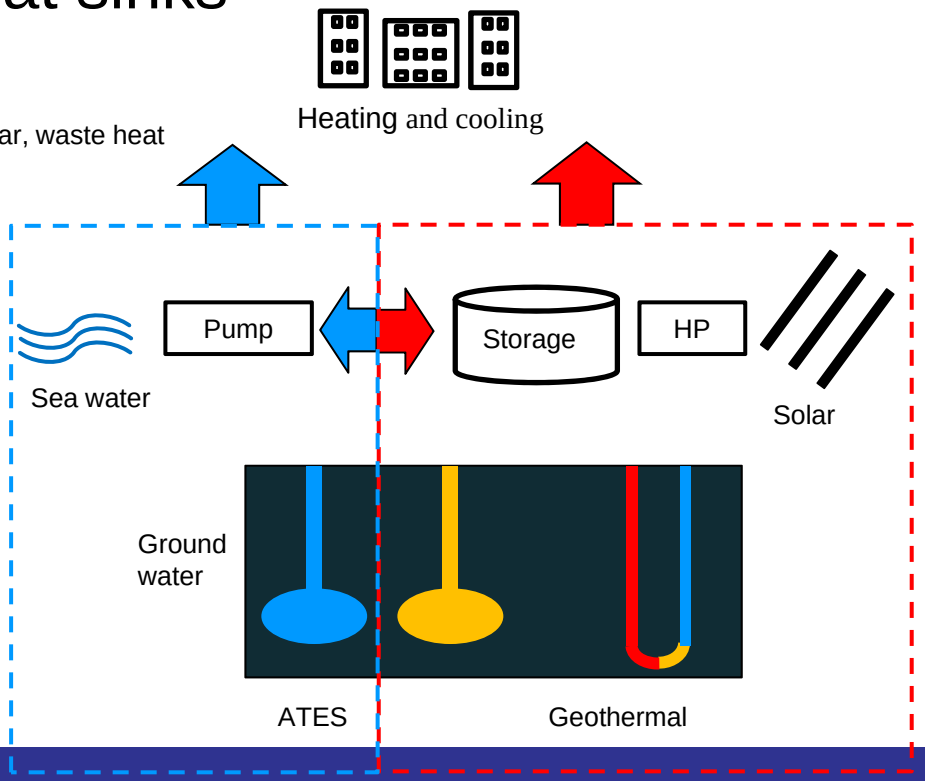


District Heating Performance



Optimal integration of district heating, district cooling, heat sources and heat sinks

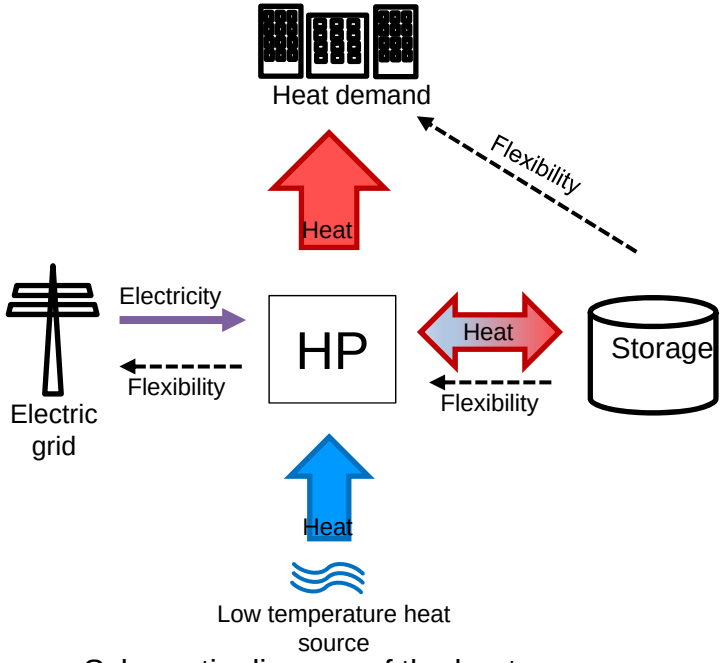
- Develop model for optimal integration of heat sources and heat sinks in district heating and cooling systems
  - Air, geothermal, groundwater, seawater, sewage water, solar, waste heat
  - Thermal energy storage
  - Heat pumps
- Develop system design for optimal integration
  - Low temperature district heating
  - Ultra-low temperature district heating
  - District energy networks (heating and cooling)
  - Island solutions (separated from DH network)
  - Smart district energy networks
  - Ring systems



Heat pump solutions for integration with district heating in a renewable energy system

- Heat pumps within DH systems
  - Description of different integration scenarios
  - Large central heat pumps + decentral booster heat pumps
  - Dynamic behaviour of heat pumps within DH systems
  - Cycle design, working fluid
  - Mapping of performance of potential configurations

- Heat pumps as integration technology
  - Flexibility of integrated energy systems
  - Interaction with other components (such as storage, el-boiler)



Schematic diagram of the heat pump within an integrated energy system

Take aways

- Learning by doing
- Show it.
- Physical demonstration > provoke thought – also on regulation
- Dissolve traditional divides

[From www.tvindkraft.dk]

Torben Ommen (PD researcher), tsom@mek.dtu.dk, +4545254037
Christoffer Greisen (Project manager), cgre@elektro.dtu.dk, +4541390347
www.energylabnordhavn.dk,

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