Cold Water District Heating and Cooling Systems as Flexible Energy Exchange Systems – a Promising Concept for the Future?

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Linn Laurberg Jensen, Dadi Sveinbjörnsson

Agenda

FLEXYNETS
PlanEnergi

- ∞ Introduction to the Flexynets project
- ∞ Network design and layout
- ∞ Network and storage

- ∞ Project partners

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Learn more: http://www.flexynets.eu

FLEXYNETS

- Fifth Generation, Low Temperature, High Exergy Heating and Cooling Network
- FLEXYNETS will develop, demonstrate and deploy a new generation of intelligent DHC networks that reduce energy transportation losses by working at “neutral” (i.e. 10-25 °C) temperature levels
- Reversible heat pumps will be used to exchange heat with the DHC network on the demand side, providing the necessary cooling and heating for the buildings
- High potential for use of excess heat

FLEXYNETS – Pros and Cons

- Neutral temperatures → Reduce energy losses
- Lower investments in pipes
- Contemporary heating and cooling supply
- Integrate multiple energy (generation) sources
- Flexibility

- Larger mass flow
- Larger pipes
- Complicated control

FLEXYNETS – Considerations

- Hydraulic consequences → It is relevant to look into the consequences for different temperature levels:
  - Flow rate
  - Required diameter
  - Pumping energy
  - Insulation materials and thicknesses
- Investments
- Energy effectivity (exergy)

FLEXYNETS - Network Design and Layout

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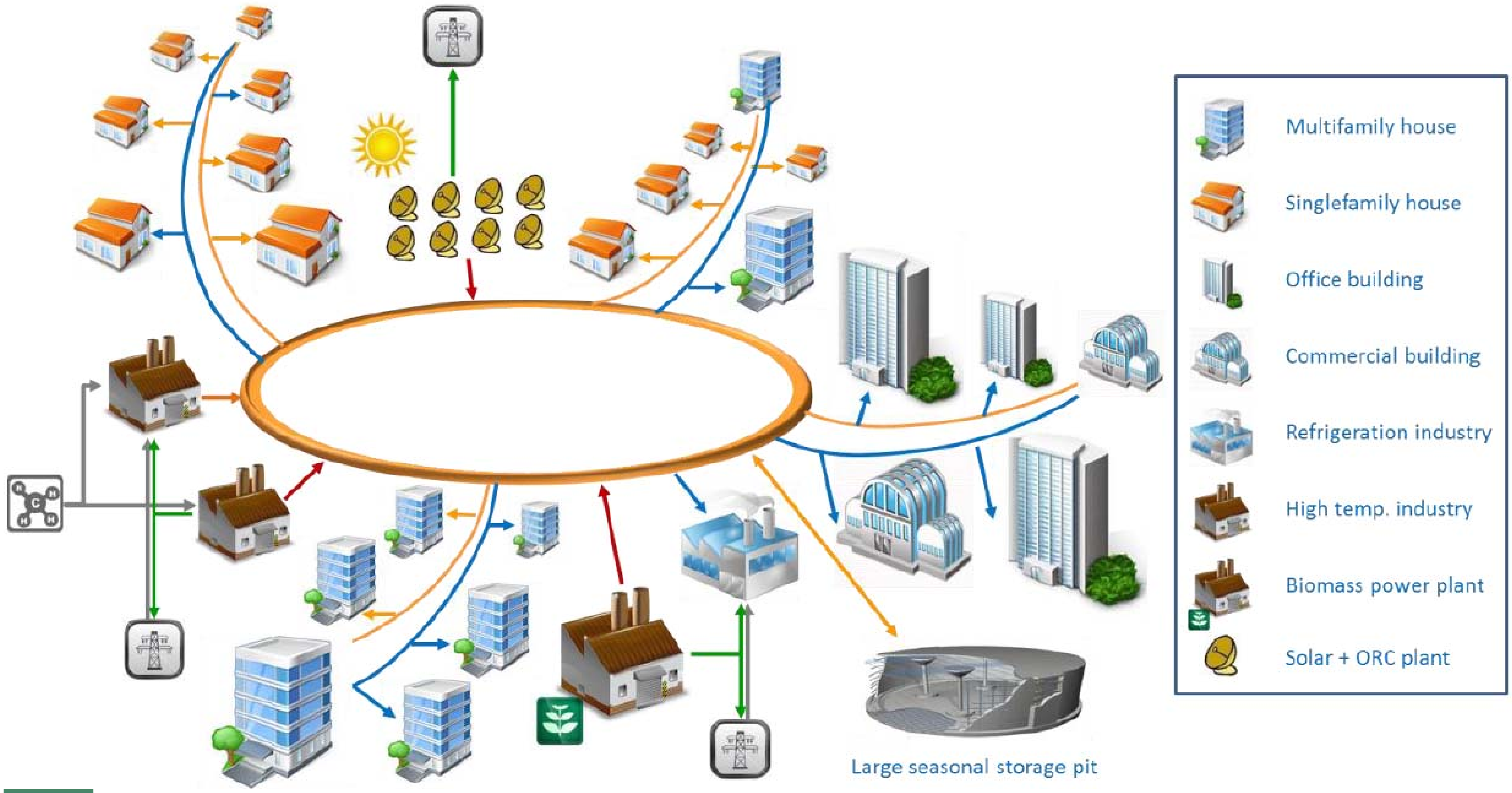
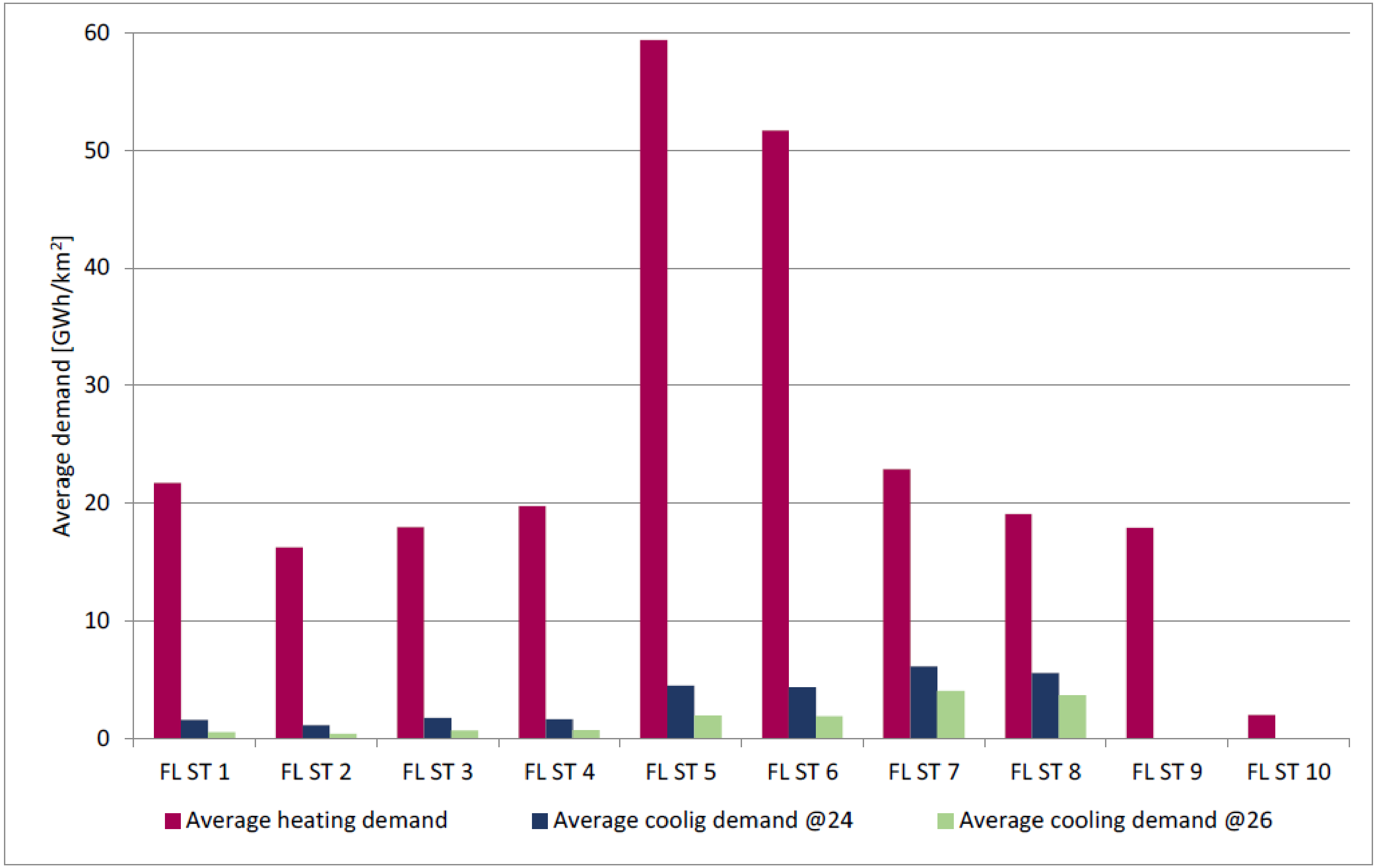
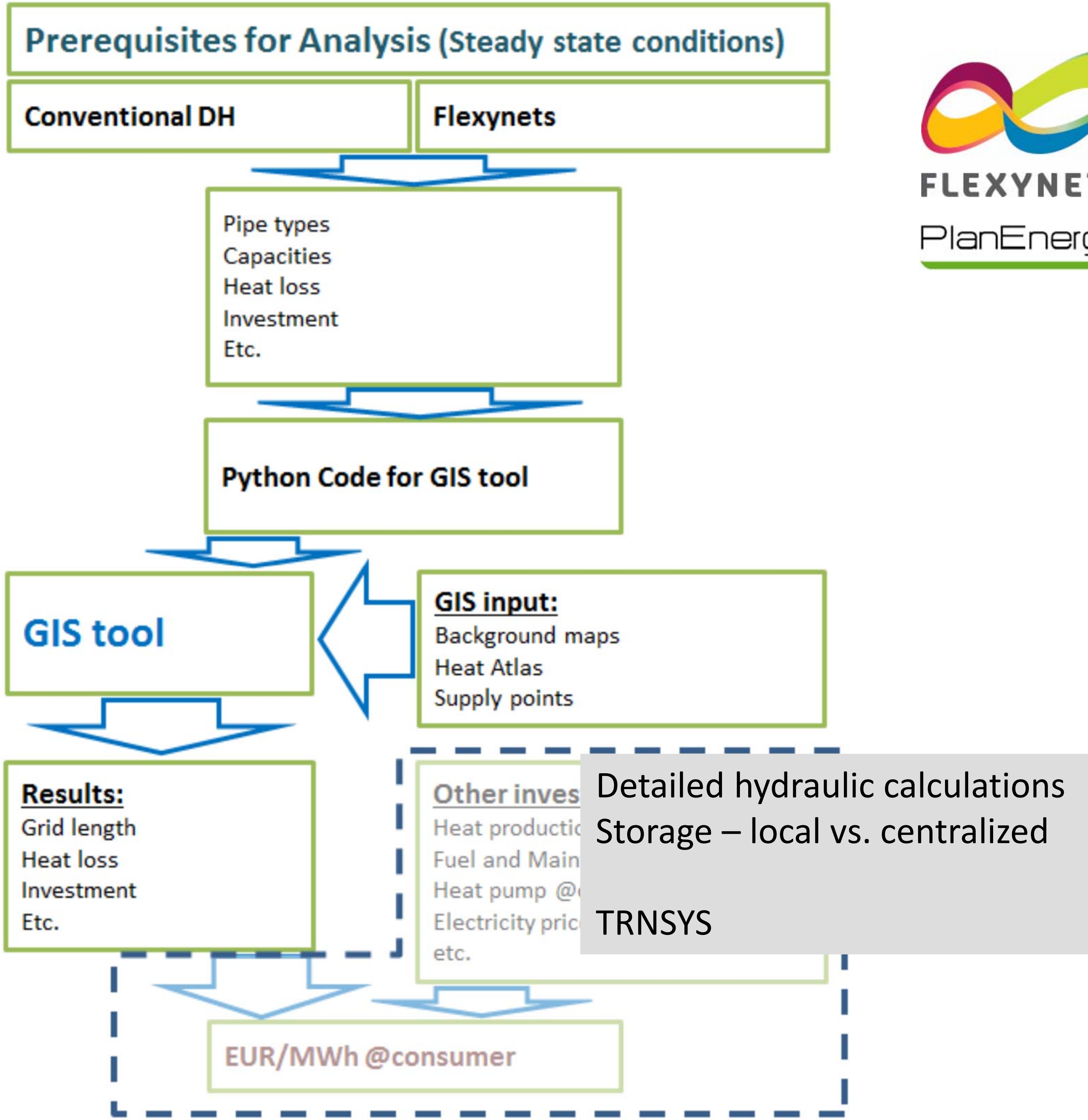


Network Design and Layout

∞ U




Prerequisites for Analysis (Steady state conditions)
Conventional DH
Flexynets
Pipe types
Capacities
Heat loss
Investment
Etc.
Python Code for GIS tool
GIS tool
GIS input:
Background maps
Heat Atlas
Supply points
Results:
Grid length
Heat loss
Investment
Etc.
Other inves
Heat productic
Fuel and Main
Heat pump @
Electricity pric
etc.
EUR/MWh @consumer
Detailed hydraulic calculations
Storage – local vs. centralized
TRNSYS

Network Design and Layout

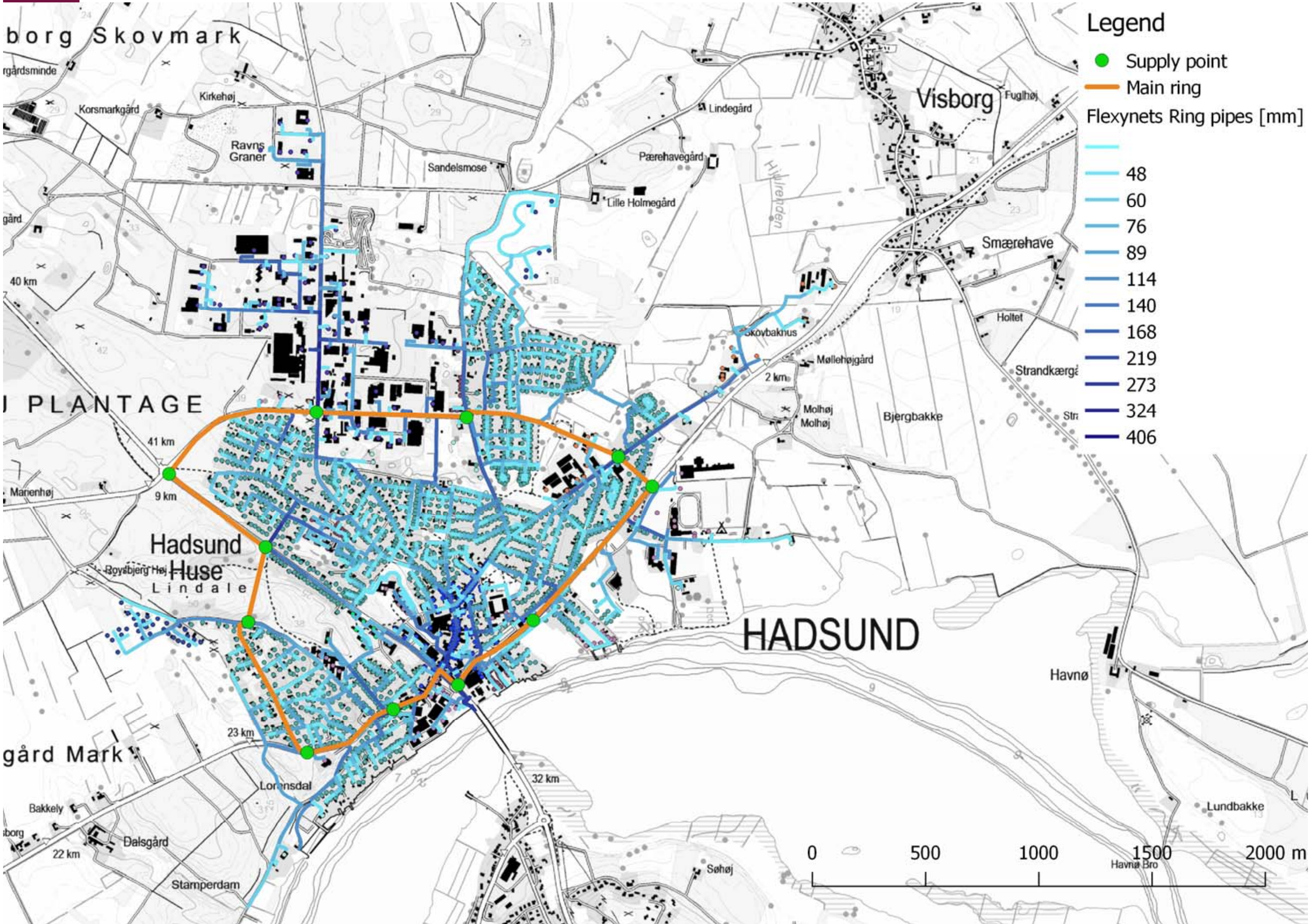
∞ Model inputs→ Design conditions

The analysis is based on the two following main assumptions setting the base for the analysis:

∞ Conventional DH	Series 3 pipes	78/41 °C*
∞ FLEXYNETS	Series 1 pipes	25/10 °C

∞ Ground temperature of 8 °C

*) For traditional DH this corresponds to average values for Denmark, Benchmarking 2011/12.

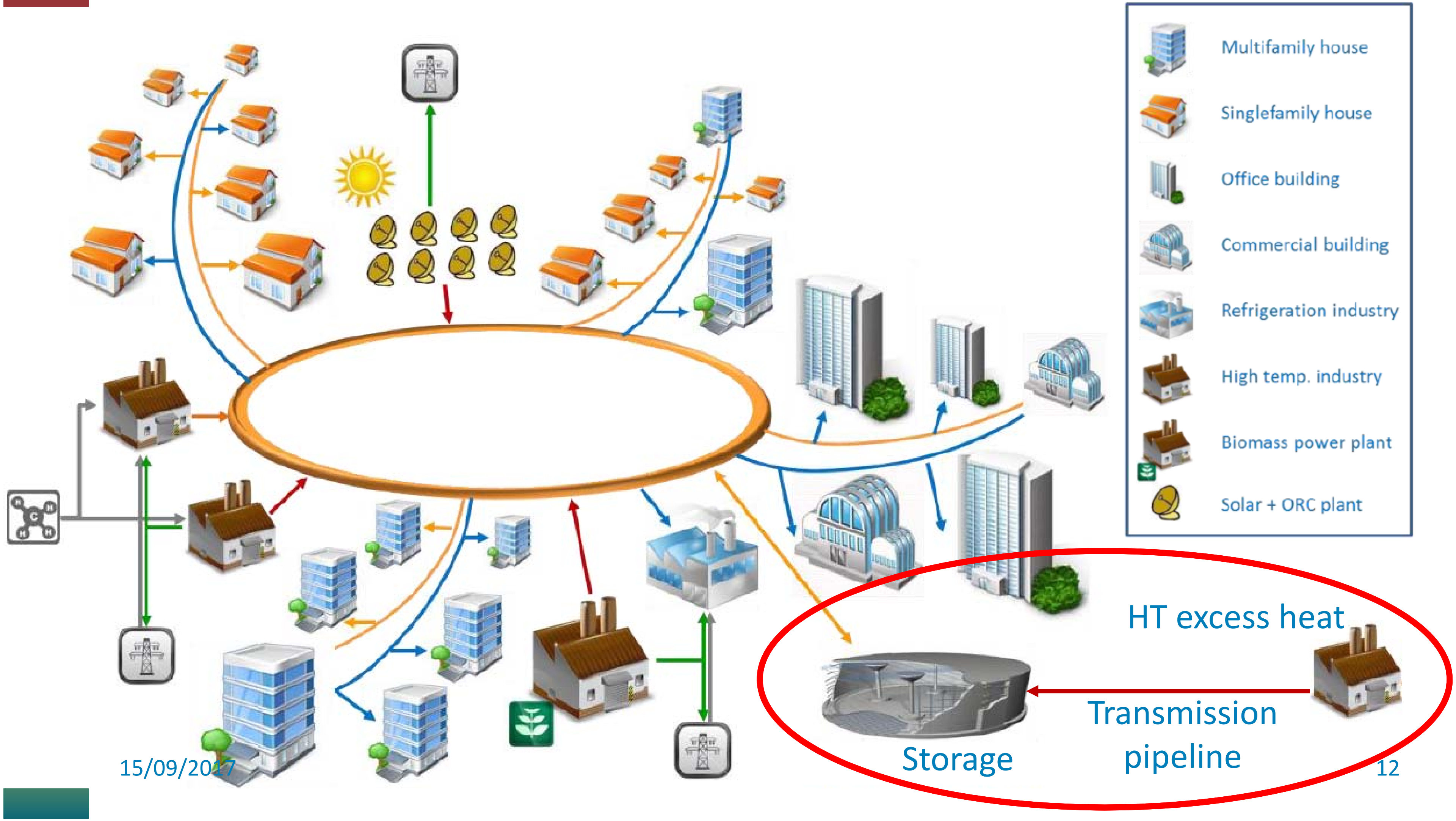

Legend
Supply point
Main ring
Flexynets Ring pipes [mm]
48
60
76
89
114
140
168
219
273
324
406
0
500
1000
1500
2000 m
HADSUND
Hadsund Huse
Visborg
PLANTAGE
Lindale
Skovmark
Korsmarkgård
Kirkehøj
Ravns Graner
Sandelsmose
Lindegård
Pærehavegård
Lille Holmegård
Smærehave
Holtet
Skovbakhus
Møllehøjgård
Strandkærgå
Molhøj
Bjergbakke
Mariehøj
Royibjerg Høj
Lorensdal
Bakkely
Dalsgård
Stamperdam
Søhøj
Havnø
Havnø Bro
Lundbakke
Fuglhøj
40 km
41 km
9 km
2 km
23 km
22 km
32 km

Network Design and Layout – Conclusions so far

- Heating demand as governing demand for this analysis (DK)
- Ring structure can be suitable and feasible
  - Several heat sources
  - Cover a larger fraction by excess heat
- Significantly reduced heat losses (-75 %)
- Higher use of pumping energy and electricity for local heat pumps
- High dependence on local conditions

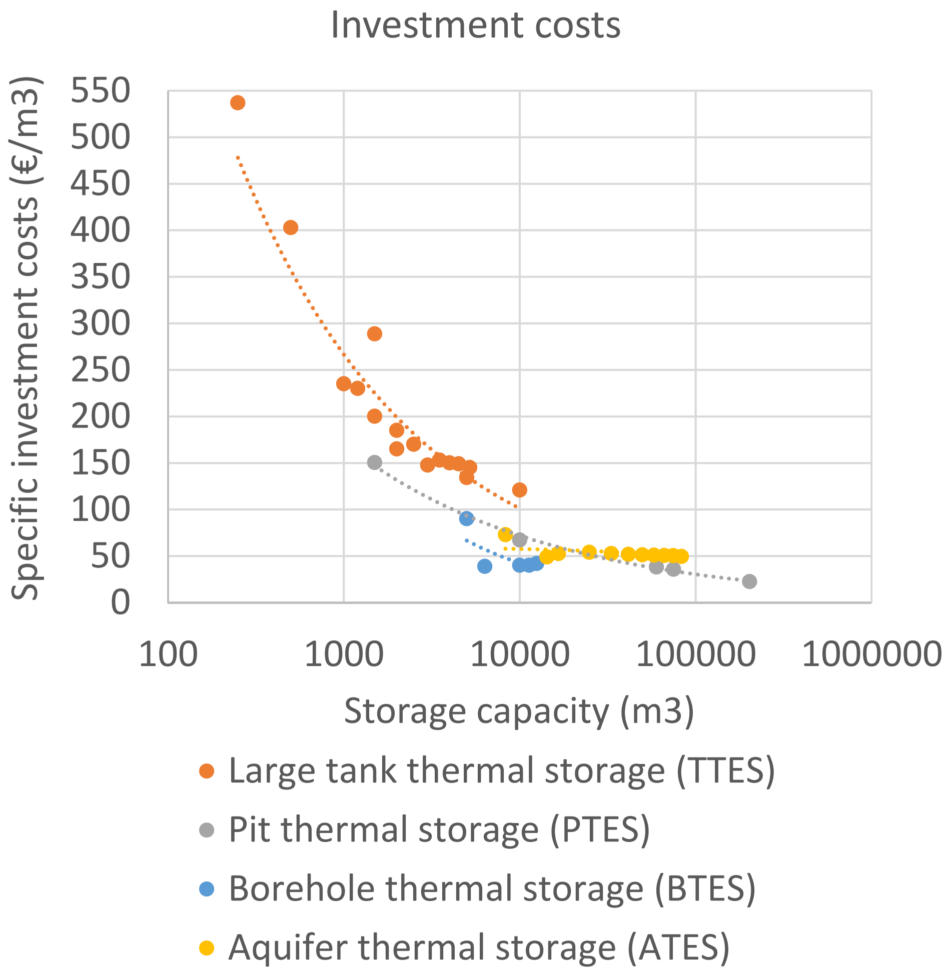
- Further analysis → Network and storage

Excess Heat and Large-scale Storages



Large-scale thermal energy storages

- ∞ Considered storage types:
  - ∞ Tank storage (TTES)
  - ∞ Pit storage (PTES)
  - ∞ Borehole storage (BTES)
  - ∞ Aquifer storage (ATES)

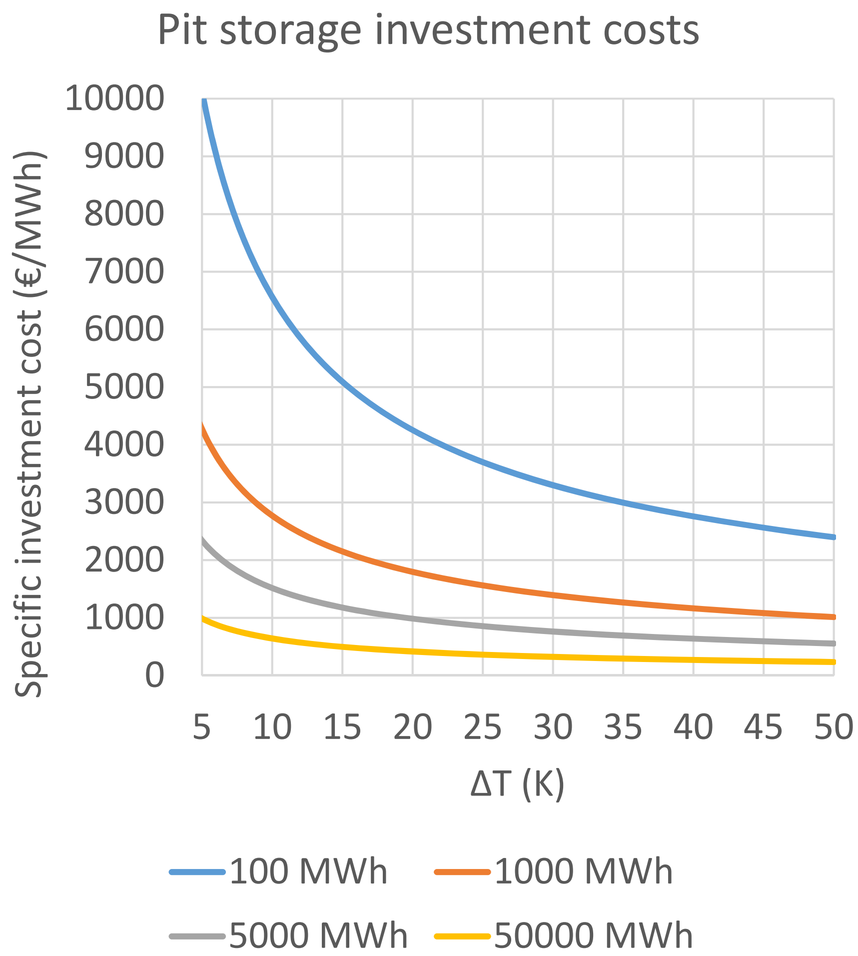


Temperature levels and investment costs

- Low ΔT in the FLEXYNETS network (5-15 K)
  →Low storage density.

- In case high temperature excess heat is available:
  - Thermal storage can balance heat supply and demand.
  - Heat storage at high temperatures is more economical.

- Direct HT heat transmission pipes from heat sources to storages could be feasible.



How far away from the network can excess heat be sourced?

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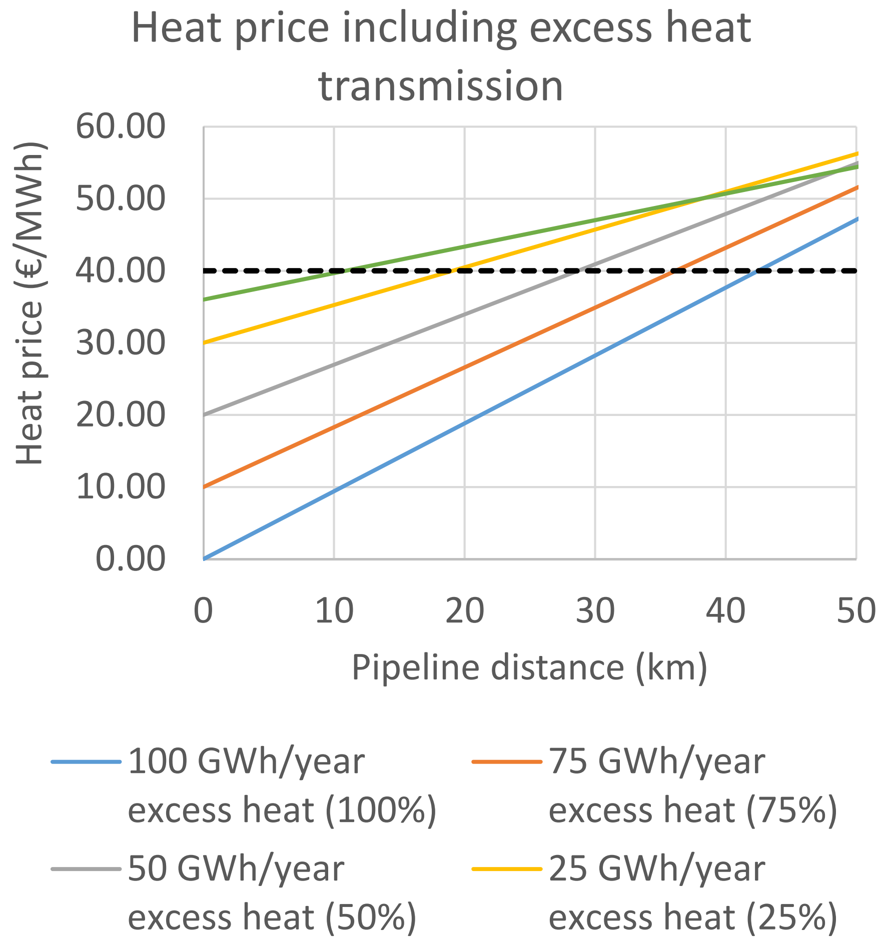
- Assumptions:
  - 100 GWh/year heat demand.
  - 40 €/MWh avg. network heat price.
  - Free 80°C excess heat from industry.

→ Transmission up to approx. 40 km could be economical.

- TRNSYS modelling of excess heat, transmission and storages is part of further work.



Conclusions

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- Ring structure can be suitable and feasible when several heat sources are available and/or a large fraction of the demand can be covered by excess heat
- Significantly reduced heat losses (-75 %), but need of higher use of pumping energy and electricity for local heat pumps
- In case industrial excess heat is available, long transmission pipelines and centralized heat storages can be economical.
- High dependence on local conditions

FOR MORE INFORMATION

WWW.FLEXYNETS.EU
WWW.PLANENERGI.EU

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