5th International Conference on Smart Energy Systems
Copenhagen, 10-11 September 2019
#SESAAU2019

The Scale of District Heating Based on Excess and Geothermal Heat in Europe

Bernd Möller[a,b]
Eva Wiechers[a]
Urban Persson[c]
Younes Noorollahib[b,d]
Steffen Nielsen[b]
a)Europa-Universität Flensburg
b) Aalborg University
c) Halmstad University
d) Technische Universität Wien

sEEnergies GA no. 846463

Heat Roadmap Europe

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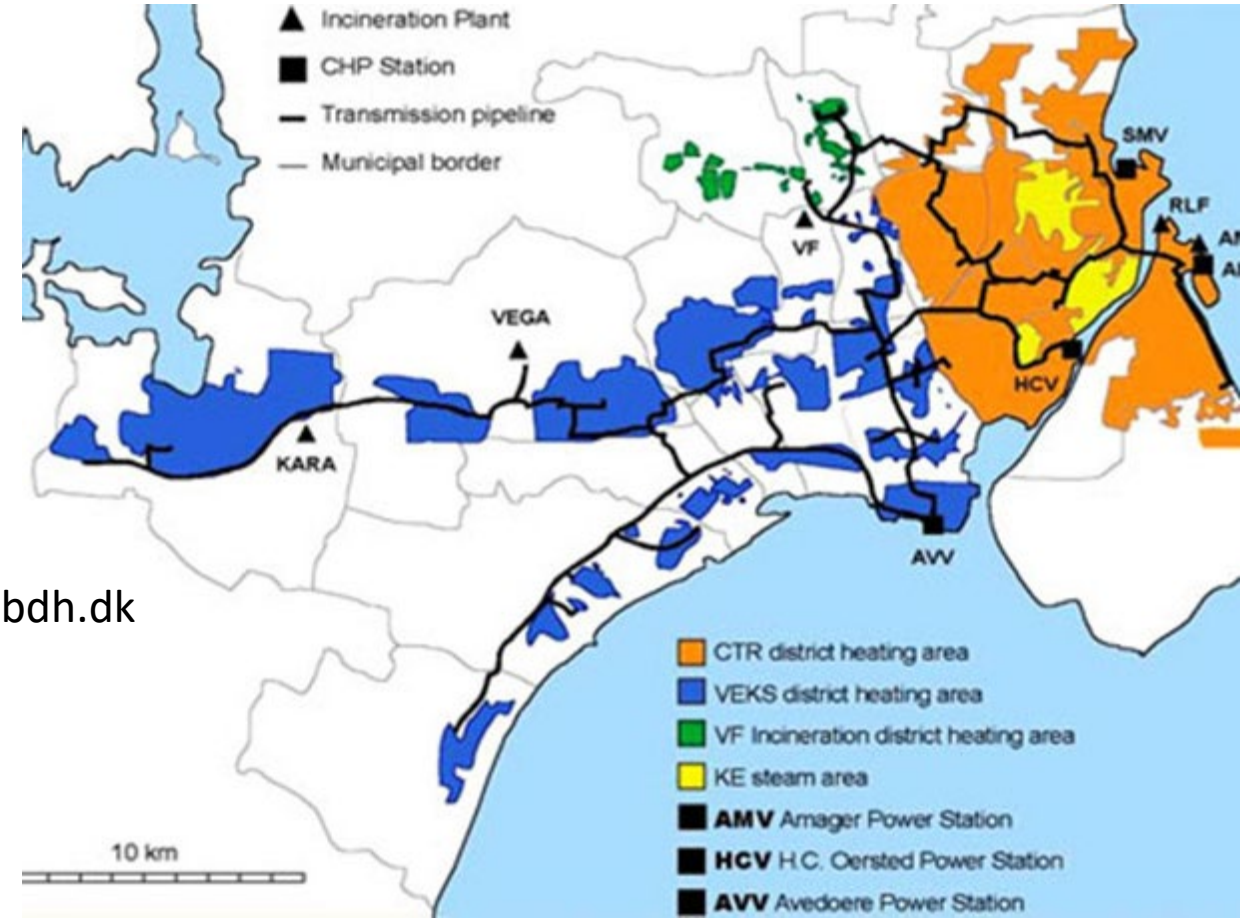
Research Motivation

- Structural energy efficiency by means of DH is underdeveloped:
  - Reliance on fossil fuel remains high
  - Large-scale, low enthalpy heat sources remain unutilised
  - Smart energy system potentials remain low.
- A reason for low DH coverage is the reluctance or inability to plan at greater scale.



Source: dbdh.dk

The greater Copenhagen DH transmission network

Heat Roadmap Europe 4

- Has quantified how to decarbonise the heating and cooling sector for 14 EU countries
- Described low-carbon pathways for heating and cooling by 2050
- Resulted in Peta 4, a comprehensive spatial model of European heat demand and supply.

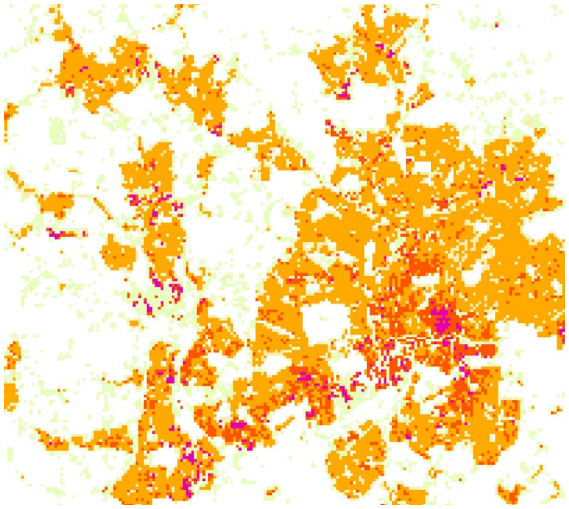
Advantage of Scaled-Up DH Systems

- Greater DH coverage: 30 – 70% access to economies of scale in supply
- Greater choice of complementary heat supplies: excess heat, geothermal, solar etc.
- Greater flexibility in terms of smart energy systems: heat storage, heat pumps, system integration of industrial processes.

Methods in Peta

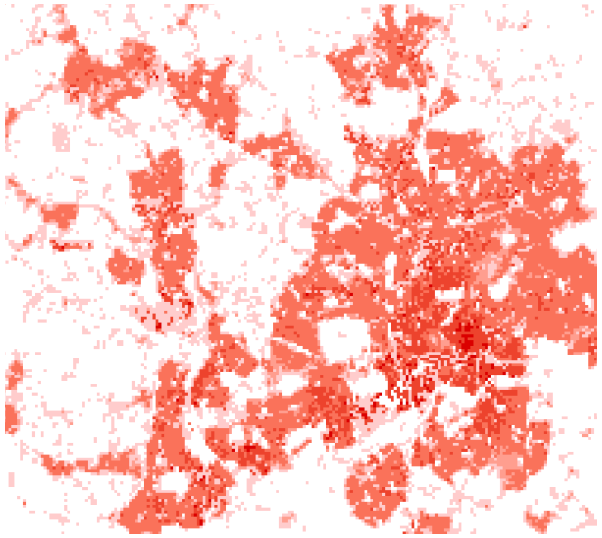
- Spatially explicit modelling of distributed resources and their association to elements of energy systems
  - Spatial disaggregation: mapping uncharted demands
  - Cost-supply modelling: identifying economic potentials
  - Spatial allocation: matching supply and demand locally
- In Peta, this is done in a consistent spatial model.

Demand, Costs and Supply Zoning



Modelling heat demand densities (HDD) to determine technical and economic potentials.

Zoning of coherent and contiguous prospective supply districts (PSD).



Calculation of DH distribution network investment costs.

Cost-Supply Relations of DH Infrastructure

U. Persson et al. / Energy 176 (2019) 604–622

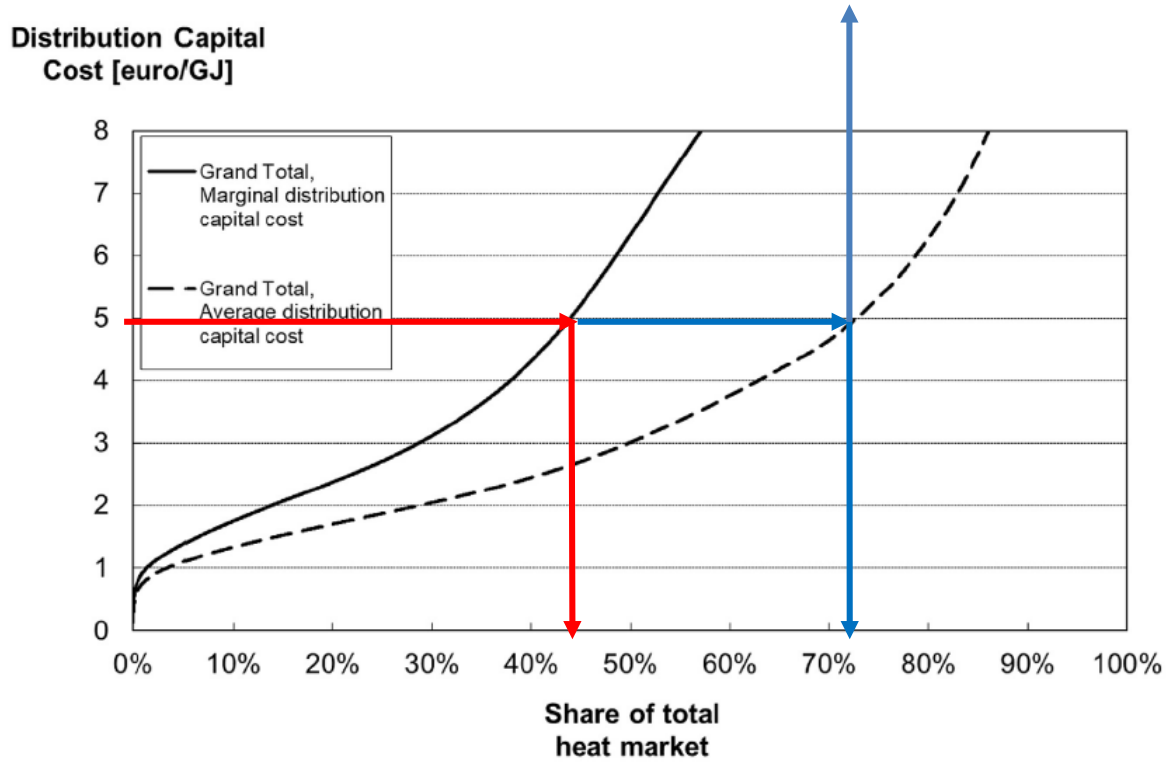


Fig. 5. Current distribution capital cost levels and the corresponding district heat market shares in EU28 on average.

DH Potential by Marginal vs. Average Cost

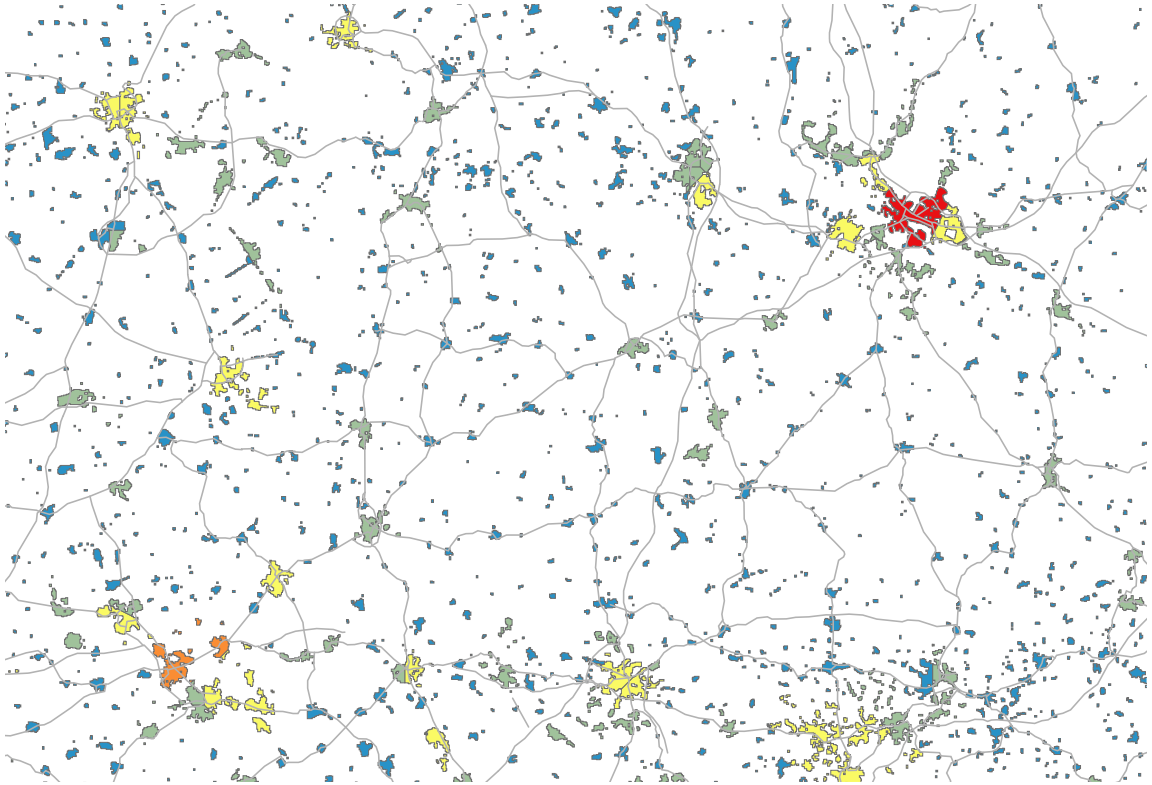
Potential DH at annualised **marginal** distribution capital costs < 5€/GJ

Potential DH at annualised **average** distribution capital costs < 5€/GJ

Example: Hamburg

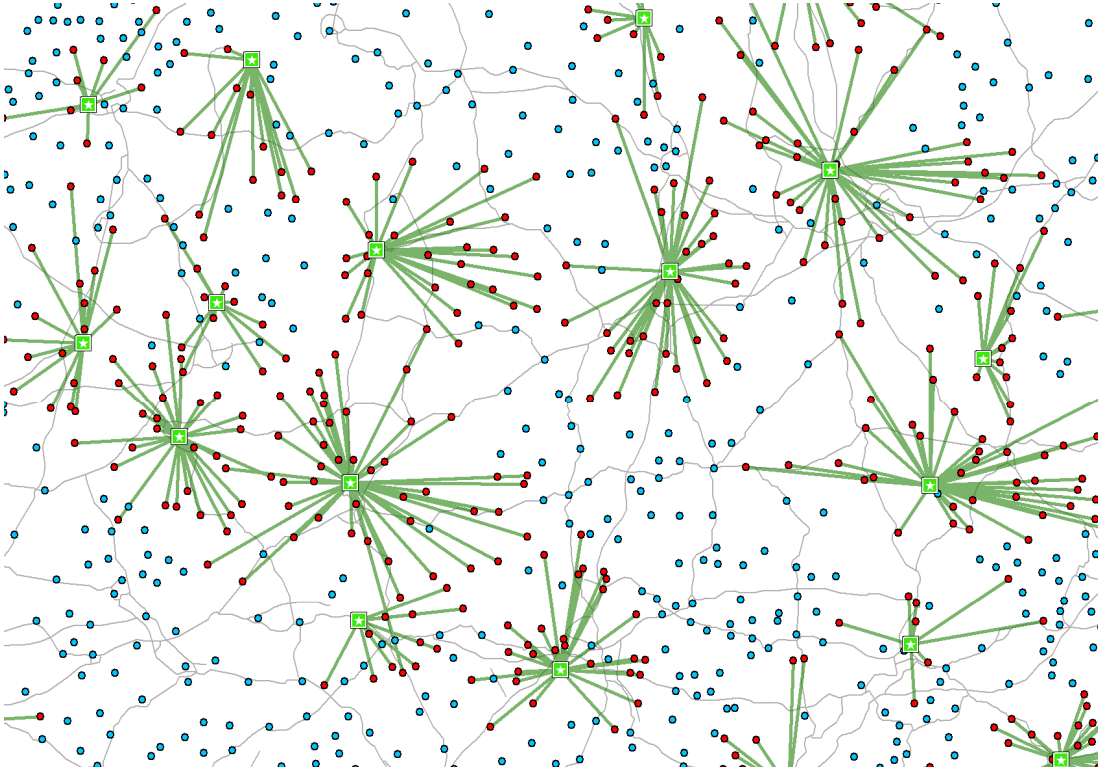
8 €/GJ
annual heat
supplied

Identification of Economic DH Potentials



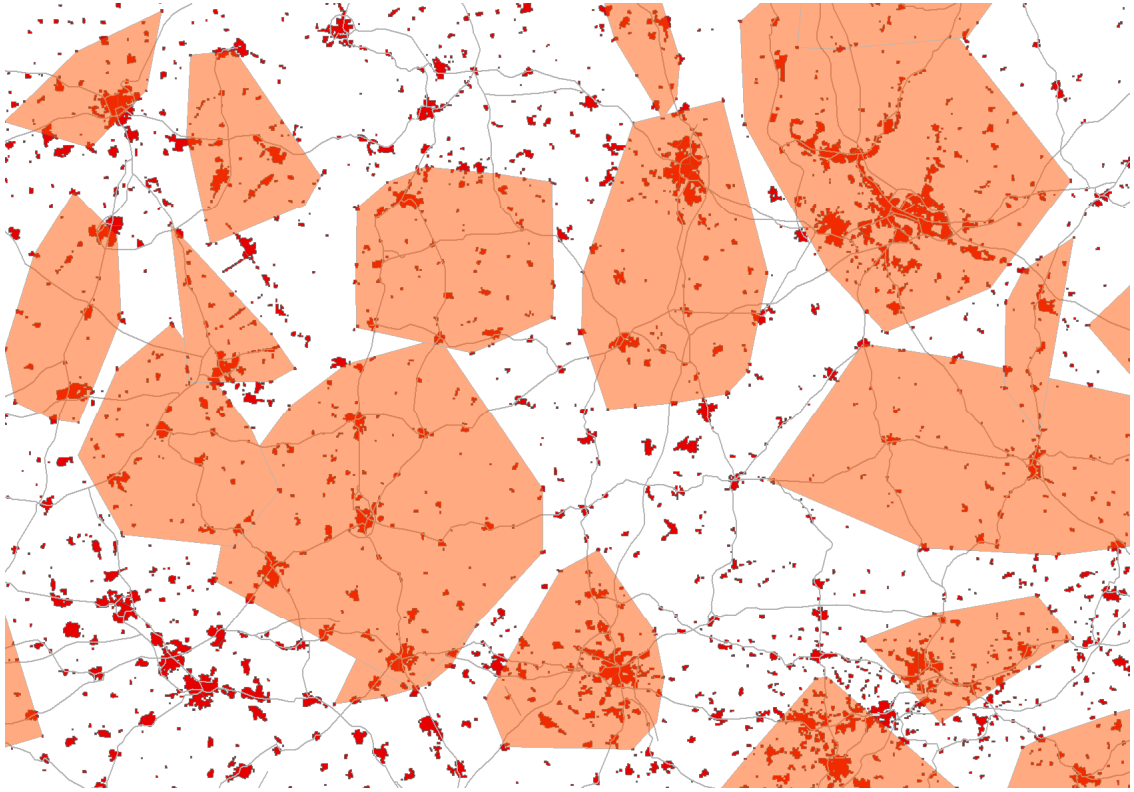
For each PSD, gross DH potentials are summarised by increasing average heat distribution capital costs.

Least Cost Allocation of Excess Heat



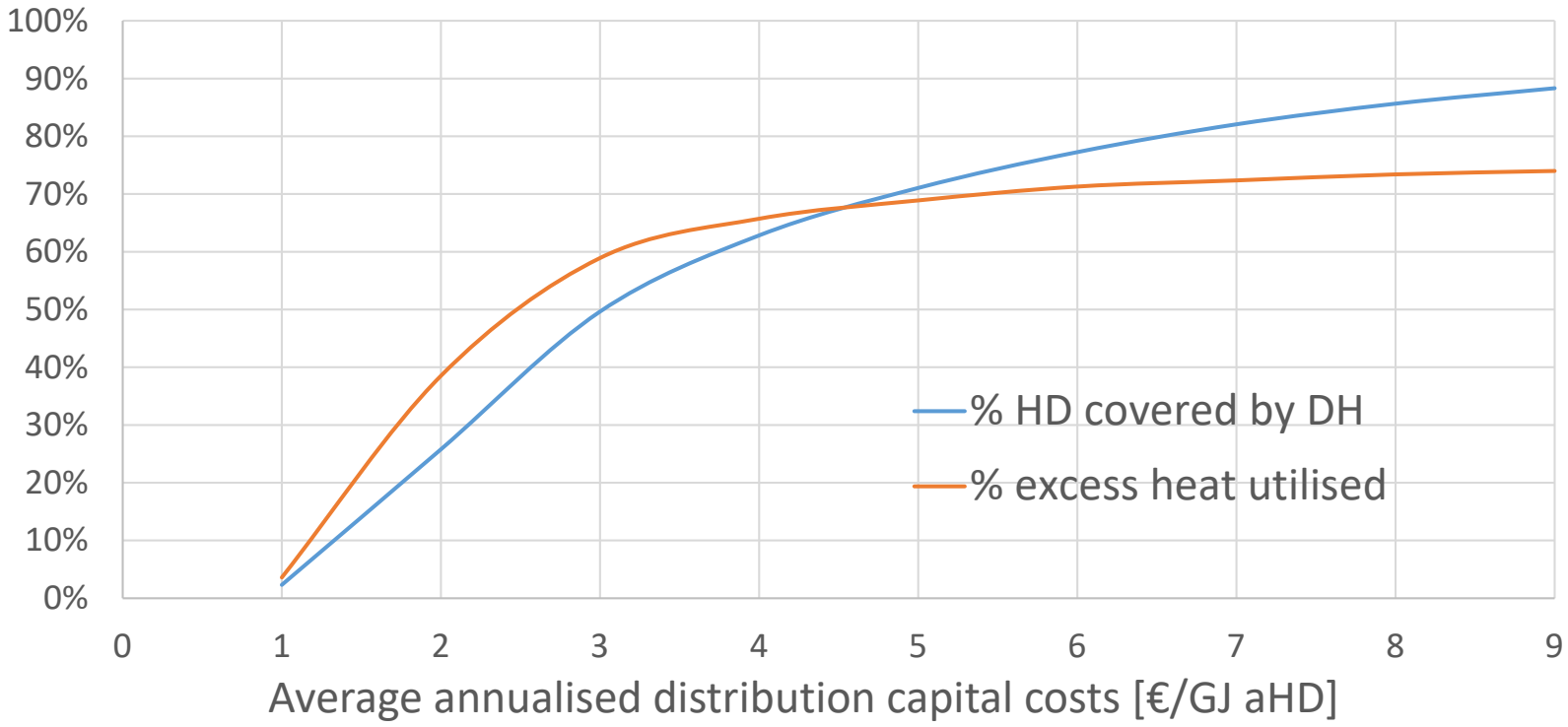
Excess heat is allocated to PSD with economic DH potentials by means of locate-allocate network algorithms. The green lines indicate a demand-supply relationship.

Identification of DH Clusters



Synergetic clusters are mapped, within which potentials for nearby low-cost excess heat can be quantified by cumulative DH potentials.

Economies of Scale for Excess Heat

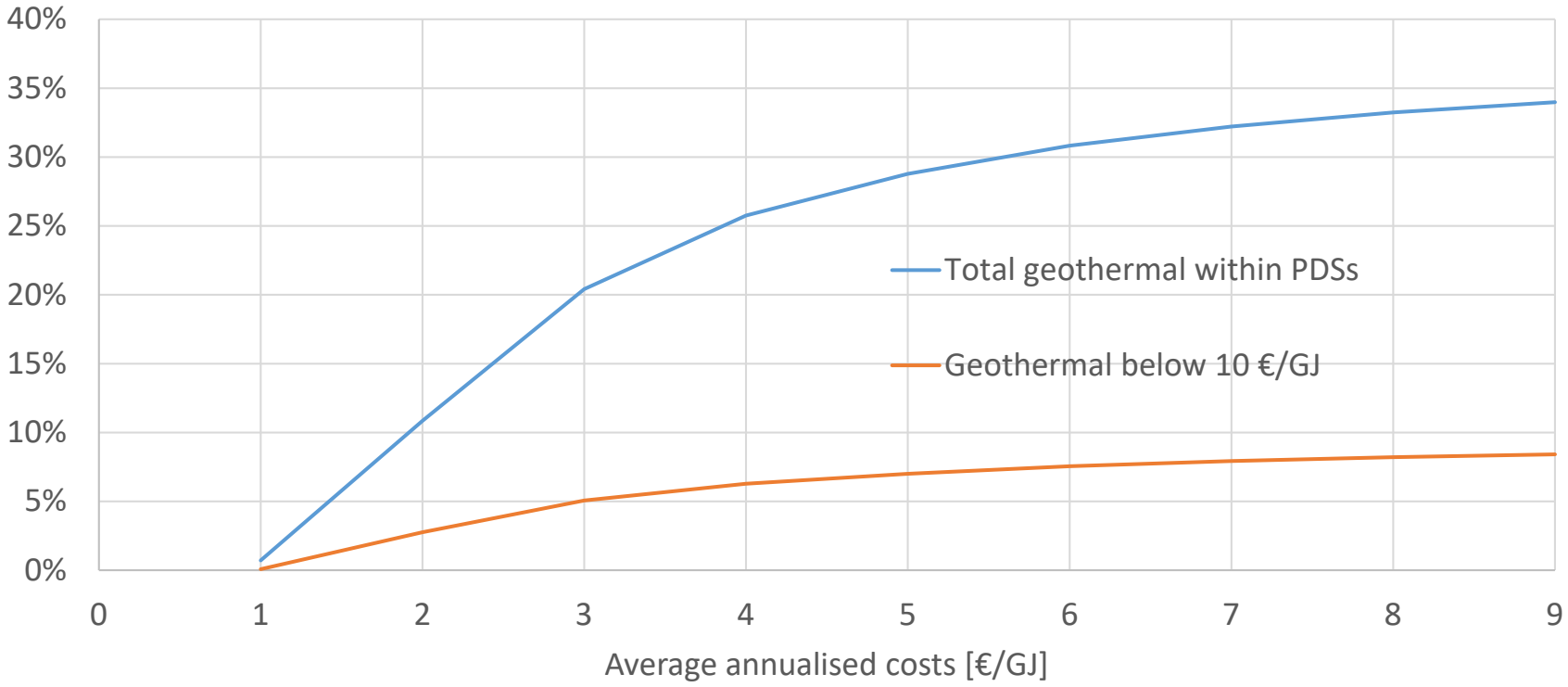


Above average heat distribution capital costs of 5€/GJ, the uptake of excess heat is limited by geography.
1,500 PJ of excess heat from industry and waste incineration may cover 15% of all heat demand.

A Large-Scale Technology: Deep Geothermal

Geothermal heat supply costs were mapped using geothermal parameters and mapping from the GeoDH project.

Economic DH Potential in DH



Until about 5-6 € / GJ annualised infrastructure investment costs, geothermal heat at costs below 10€/GJ may cover 7% of heat demands in settlements, 5% of all heat demand in HRE-countries.

Conclusions

- A consistent model of demand and supply by cost allows for identification of economies of scale
- For the first time, geographically determined DH infrastructures and sources can be linked by location and costs
- At levels of about 5 €/GJ annualised average investment costs, DH distribution grids allow for the uptake of excess heat and geothermal heat, which may cover about 20% of all heat demands.