

# District Heating in Sweden

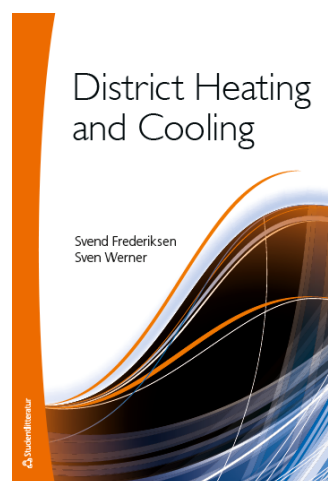
Sven Werner  
Professor at Halmstad University

2018-10-15

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## Who is Sven Werner?

- Professor in energy technology at Halmstad University 2007-2017.
- Been active with district heating research since 1978. PhD in 1984 with "The heat loads in district heating systems".
- Have coordinated and participated in various projects concerning the future for district heating in Europe.
- Co-author of textbooks about district heating and cooling in 1993 and 2014 (Swedish versions), 2013 (English version), and 2017 (Korean version).
- Retired on Dec 31, 2017.



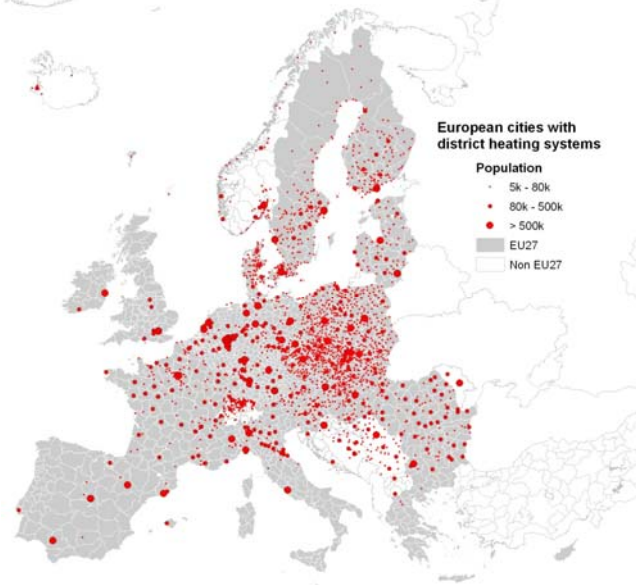
27/08/2018

DHC+ Summer School, Ljubljana 2018

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## District Heating

Figure. Map showing district heating systems in Europe in 2011. Systems have identified in 2779 cities and towns having more than 5000 inhabitants. Further 1395 district heating systems have been found in smaller towns and villages, mostly in Denmark, Sweden, Switzerland, Austria, the Czech Republic, and the Slovak Republic. According to national statistics, further about 1500 systems are in operation. Source: The European DHC database at Halmstad University (Urban Persson).

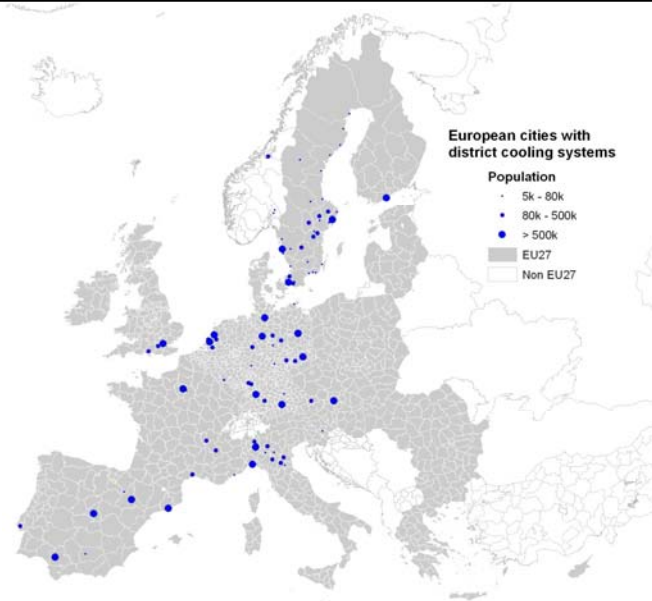


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## District Cooling

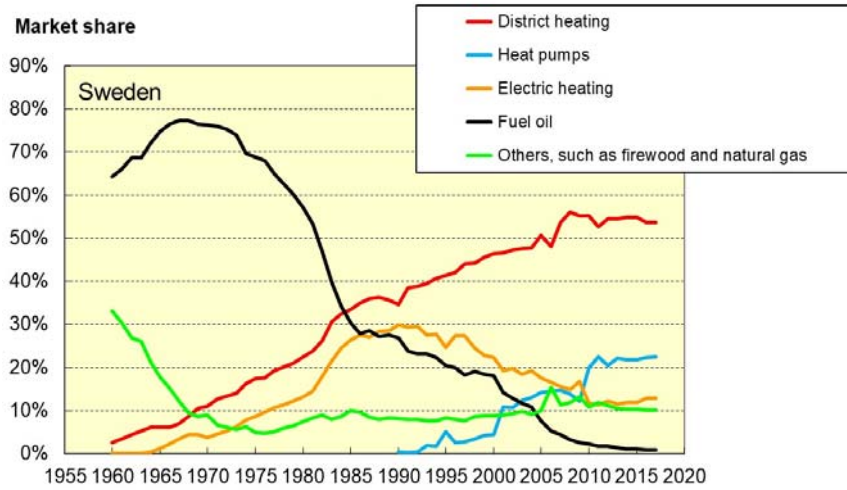
Figure. Map showing European district cooling systems in 2011. Source: The European DHC database at Halmstad University (Urban Persson).



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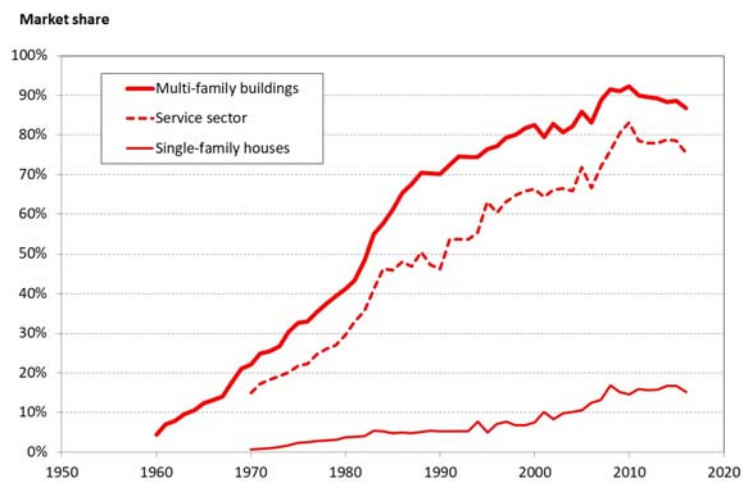
## Heat supply to Swedish buildings



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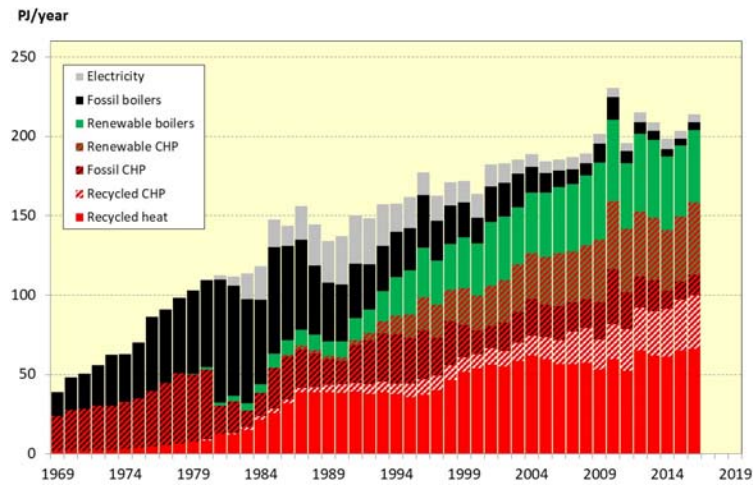
## District heating market shares for different customer groups



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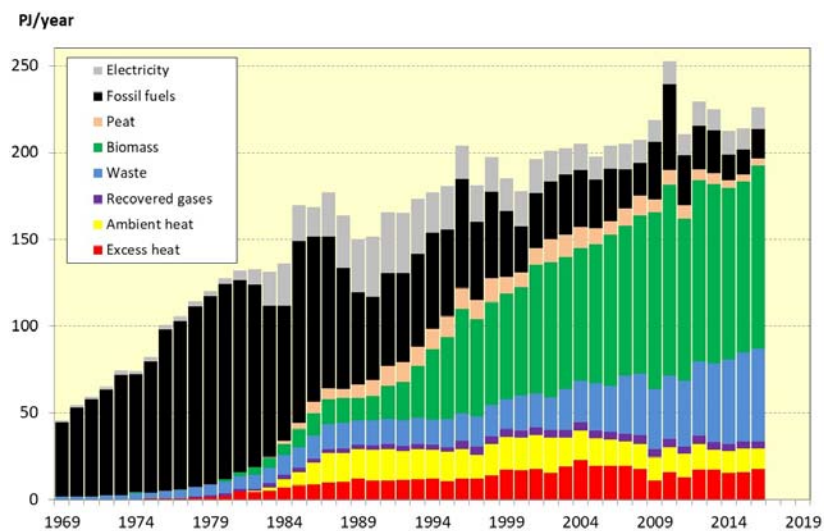
## Heat supply in Swedish district heating systems



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## Energy origin for the heat supply to Swedish district heating systems



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## Some biomass-fueled steam CHP plants in Sweden



Lund: 38 MW<sub>el</sub> and  
88 MW<sub>heat</sub>, including 16 MW  
flue gas condensation



Stockholm: 130 MW<sub>el</sub> and  
280 MW<sub>heat</sub>, including 80 MW  
flue gas condensation

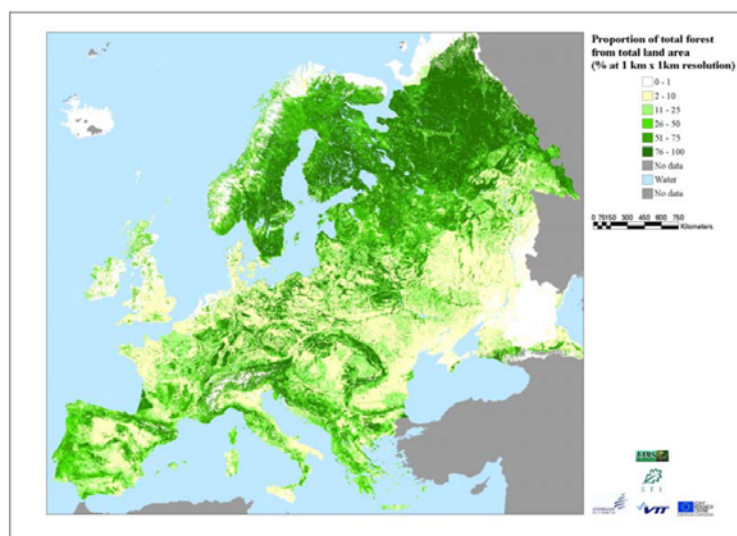
Södertälje: 85 MW<sub>el</sub> and  
200 MW<sub>heat</sub>, including 56 MW  
flue gas condensation



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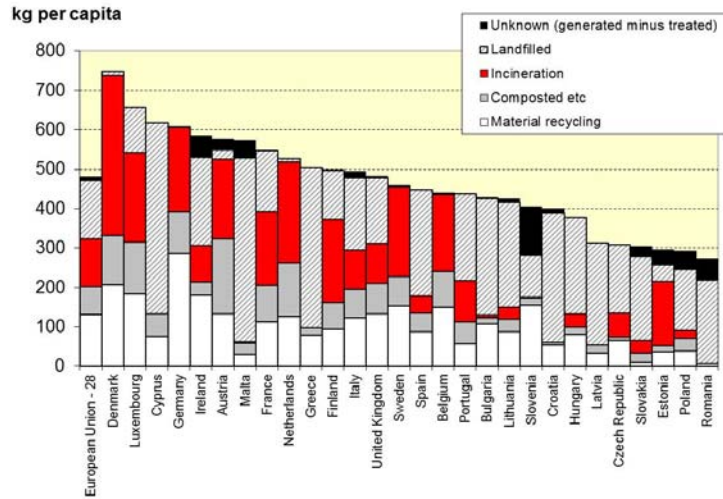
## Forest biomass availability



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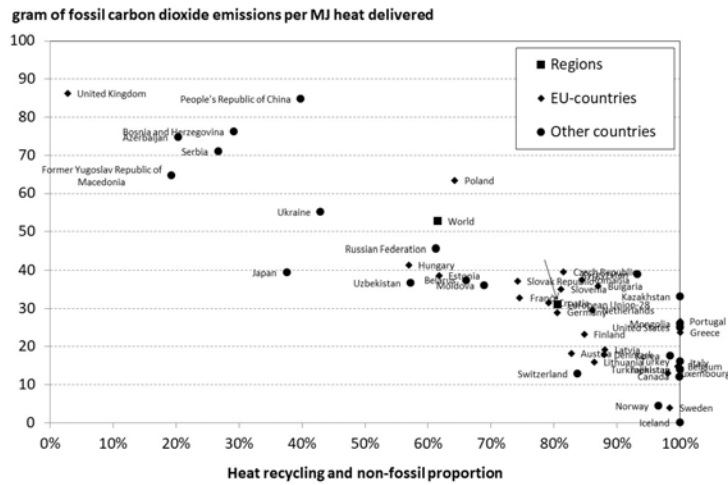
## EU – municipal waste management



Current Waste Management for Municipal Waste during 2013 in the EU28 countries. Source: Eurostat online database.

## Carbon dioxide emissions

Estimated specific carbon dioxide emissions during 2014 from all district heating systems in 24 EU-countries, and 23 other countries.



## More information about district heating in Sweden

District heating and cooling in Sweden

<http://www.sciencedirect.com/science/article/pii/S0360544217304140>

Large heat pumps in Swedish district heating systems

<http://www.sciencedirect.com/science/article/pii/S1364032117307839>

The introduction and expansion of biomass  
in Swedish district heating systems

<http://www.sciencedirect.com/science/article/pii/S0961953416302793>

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## District Heating Research @ Halmstad University

Sven Werner

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## Two major research directions

### Future district heating technology

- 4th generation of district heating technology (4GDH)
- New future market conditions concerning lower heat demands and no use of fossil fuels

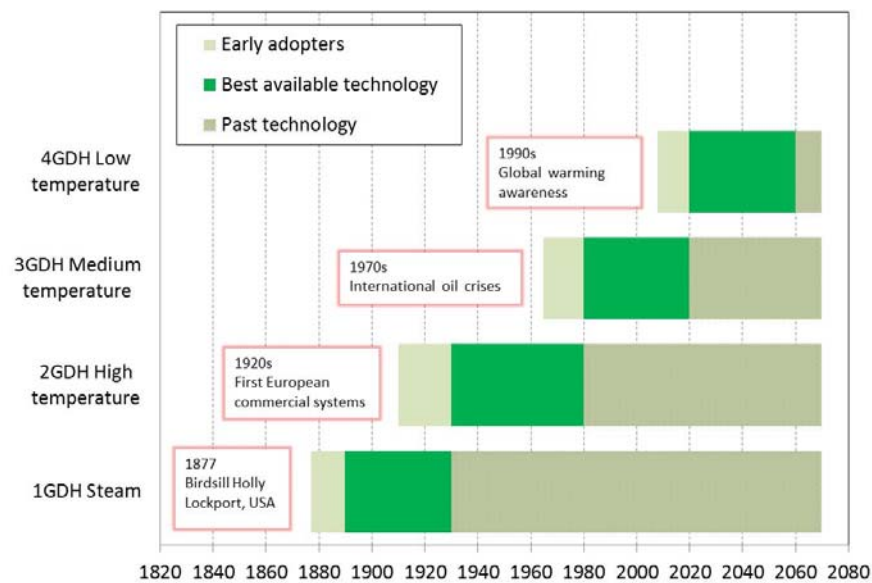
### Future possibilities for district heating within the European Union

- Heat Roadmap Europe in four steps: two prestudies and two European projects

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The four generations of district heating technologies



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## 4GDH, definition paper

Energy 68 (2014) 1–11

Contents lists available at [ScienceDirect](#)

**Energy**

journal homepage: [www.elsevier.com/locate/energy](http://www.elsevier.com/locate/energy)


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Review

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

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<sup>c</sup>Building Research Establishment (BRE), Bucknalls Lane, WD25 9XX Watford, UK  
<sup>d</sup>Department of Civil Engineering, Technical University of Denmark, Brovej, Building 118, DK-2800 Kgs. Lyngby, Denmark  
<sup>e</sup>Danfoss District Energy, DK-6430 Nordborg, Denmark  
<sup>f</sup>Department of Development and Planning, Aalborg University, A.C. Meyers Vænge 15, DK-2450 Copenhagen SV, Denmark

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## The five abilities of 4GDH

1. Ability to supply low-temperature district heating for space heating and hot water
2. Ability to distribute heat in networks with low grid losses
3. Ability to utilise renewable heat and recycled heat from low temperature sources
4. Ability to be an integrated part of smart energy systems
5. Ability to ensure suitable planning, cost and motivation structures

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## Heat Roadmap Europe projects

- 1st Heat Roadmap Europe pre-study 2012 about the future conditions for district heating in a business-as-usual scenario. Benefit of lower costs with 14 billion EUR in 2050.
- 2nd Heat Roadmap Europe pre-study 2013 about the future conditions for district heating in a strong energy efficiency scenario. Benefit of lower costs with 100 billion EUR in 2050.
- Stratego – HRE3, European project between 2014 and 2016 with several partners. Detailed studies of five European countries.
- Heat Roadmap Europe 4, European project between 2016 and 2018 with several partners. Detailed studies of further ten European countries.
- Outputs and corresponding maps are available at <https://hre.aau.dk/>

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## Main results from Heat Roadmap Europe

- A. Forecast:** District heating will be suitable in dense urban areas, while local heat pumps and biomass boilers will be suitable in other areas.
- B. News:** First ever estimation of the district heating benefits in the future European energy system.
- C. Less costly:** We can avoid the most expensive end use energy efficiency measures in buildings by using district heating as an energy efficiency tool.
- D. Paradox:** District heating will have a higher competitiveness in a future more energy efficient Europe.

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# Heat Roadmap Europe methodology

We sliced EU into about 1300 pieces (NUTS3 regions), and estimated what was possible in each region.

Other energy modellers just cut EU into 27 pieces (the national energy balances)

Figure 11: The NUTS3 regions of Europe, of which 1289 are located within the EU27 European territory and 14 are located overseas. (from the second pre-study)



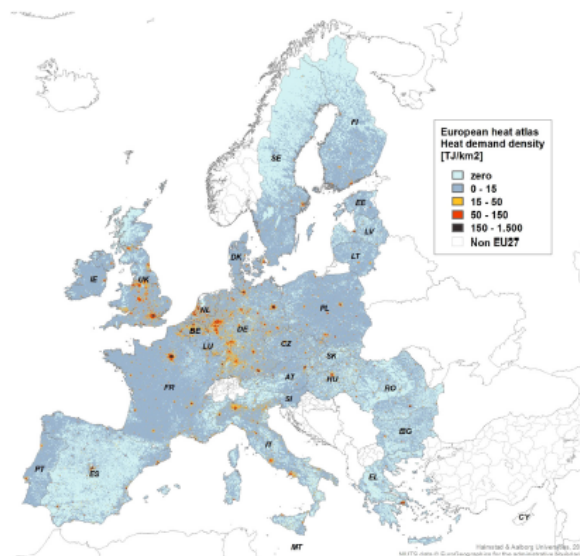
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# The European heat density map

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D. Connolly et al. / Energy Policy 65 (2014) 475–489



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Fig. 6. European Heat Atlas by heat demand density classes based on the GEOSTAT 2006 1 km<sup>2</sup> population grid.

The End: Thank you for your attention!

DHC in the world:

<http://www.sciencedirect.com/science/article/pii/S036054421730614X>

Heat Roadmap Europe:

<https://hre.aau.dk/>

The 4DH research centre:

<http://www.4dh.dk/>

The 4GDH definition paper by Henrik Lund et al:

<http://www.sciencedirect.com/science/article/pii/S0360544214002369>

Novel low temperature heat distribution technology:

<http://www.sciencedirect.com/science/article/pii/S0360544217322004>