Socioeconomic potential for deploying large district heating networks using heat from nuclear plants in Europe

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Keywords: District heating, cost benefit analysis, urban area, nuclear, cogeneration, Europe

District heating (DH) has the potential to support the decarbonisation of the heating sector of the European Union (EU) by taking advantage of a variety of heat sources. Recovering industrial excess heat and distributing the recovered heat to dwellings through DH networks is encouraged by the EU and its member states. Nuclear plants generate a large amount of excess heat that could safely be used for DH, and yet this alternative is rarely considered by policy makers.
This article evaluates the socioeconomic potential of theoretical DH networks using nuclear combined heat and power plants (NCHP) for base loads. The work follows the methodology described by Leurent et al. [2017], where a systematic approach is proposed for investigating the socioeconomic potential of DH+NCHP systems in terms of primary energy consumption, greenhouse gases (GHG) emissions and heating cost. The heart of the data is based on STRATEGO [2015. Peta, the Pan-European Thermal Atlas], accounting for land area with heat density greater than 100 $\mathrm{TJ/km^2}$. This is above the threshold for DH feasibility commonly identified in the literature. Data for the 2015 heat demand are extrapolated to 2030, taking into account the potential decrease in demand due to improved energy efficiency of buildings
The method is applied to 16 nuclear sites located less than 100km from large cities. Despite of significant capital costs, heat transportation over long distances has been shown to be technically feasible (with heat losses below 2%) and potentially profitable in the long run [Hirsch et al., 2016]. There are 22 cities concerned, over 8 European countries: Czech Republic, Finland, France, Hungary, Poland, Slovenia, Switzerland and the United Kingdom. All these countries use or consider using nuclear energy, and have shown interest in DH+NCHP systems [NEA, 2015]. The studied cities are at different stage of deploying DH networks. However this is not an issue since the methodology used accounts for the total cost of DH networks, including investment costs of new equipment. Considering all costs allows a comprehensive comparison of DH+NCHP systems with local electric and gas boilers servicing a single building or potentially a group of buildings.
Simulations will provide at least two key results:

- The potential heat density of modelled DH networks in cities where no large DH exists in 2017;
- For each DH+NCHP project, the associated GHG emissions, primary energy consumption and heating cost. By comparison with the actual heat sources used in those cities, the environmental and economic potential of DH+NCHP projects will be assessed on a case by case.

References

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Czech Republic (**)	France	Finland	Hungary (**)	Poland (***)	Slovenia	Switzerland (**)	United Kingdom
Temelin - České Budějovice (25km)	Dunkerque – Gravelines (15km)	Helsinki – Loviisa (80km)	Paks – Szekszard (30km)	Zarnowiec – Wejherowo (18km)	Krško - Krško (2,3km)	Gosgen – Berne (60km)	Oldbury – Bristol (20km)
Dukovany – Brno (35km)	Lyon – Le Bugey (30km)			Zarnowiec – W. + Gdynia (40km)	Krško – Brezice (7km)	Beznau – Zurich (40km)	Hartlepool – Newcastle (40km)
	Paris – Nogent-Sur-Seine (90km)			Zarnowiec – W. + Gdy. + Gdansk (85km)	Krško – Zagreb (40km)		Bradwell – London (70km)

Interest from policy makers

Interest from both policy makers and nuclear operators

Interest from nuclear operators

Interest from academiciancs

(**) Countries with one or several industrial experience of DH supplied with NCHPP

(***) Poland does not have nuclear plants today but two nuclear sites are under investigation (and construction could start by 2028)