THE POTENTIAL ROLE OF GRID CONNECTED SOLAR THERMAL HEAT IN AUSTRIA

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Overview

District heating currently supplies more than 20% of the Austrian delivered energy for space heating and domestic hot water purposes. The share has been rising steeply for the past 10-15 years and it is expected that this trend will continue in the next years or decades. Heat from solar thermal collectors represents a carbon-free energy source which can be utilized in district heating networks. While combining district heating and solar thermal collectors is well-established in Denmark, this combination serves only a niche-market in Austria.
This paper aims to estimate resonable, long term upper boundaries for heat from grid connected solar thermal collectors for Austria. We achieve this opjective by deriving dynamic shares for the possible market pentration of district heating and a subsequently performed analysis about the potential to which solar thermal collectors could be used to provide the required energy.

Methods

The economics of DH (district heating) are strongly influenced by the ratio of the annual sold energy and the required length of the DH pipelines (linear energy density). To estimate the future upper economic market penetration of DH in Austria, we calculate the energy density for space heating and domestic hot water production nation-wide. Based on the results we identify possible DH areas and calculate the infrastructure costs using an approach developed by Persson and Werner (2011). To derive the potential techno-economic market penetration of solar thermal energy in DH networks, we deploy a cluster of three models, namely Invert/EE-Lab, TRNSYS und SIMPLEX, and calculate the relation between the solar thermal collector efficiency (solar yield) and the energy fraction supplied by solar thermal energy.

Results

Our results indicate that under current conditions, about 40 TWh of energy for space heating and domestic hot water production could be served by district heating with grid costs of less than 20 €/MWh. If we consider a future reduction of the energy needs for space heating and domestic hot water (DHW) of 50%, this potential shrinks by about 65%. In addition, about 80% of the remaining potential is demanded in 9 Austrian cities. If we neglect competing low-cost production technologies during the summer season, in such a scenario, about 2.5 – 3 TWh/a could be supplied by solar thermal collectors with an energy yield of more than 400 kWh/m². Based on current investment costs, we derive heat generation costs in the range of 60 to 80 €/MWh.

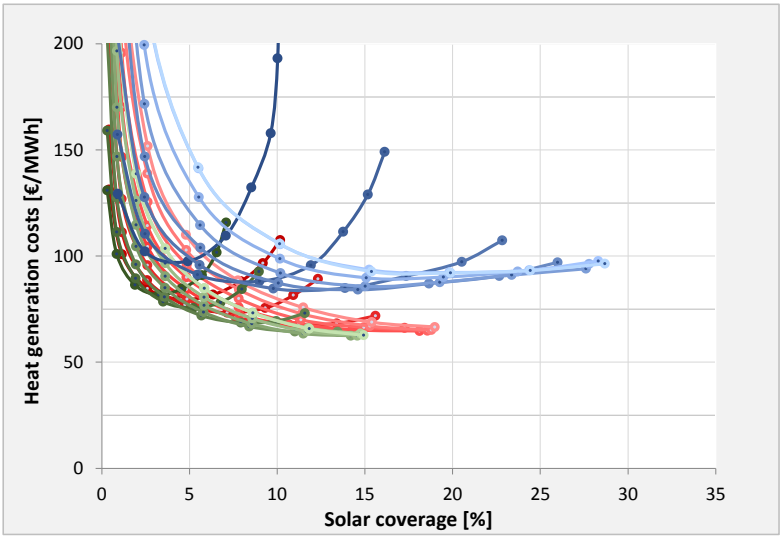

Fig. 1 Heat generation costs for different types of district heating networks (green, red and blue) and different heat storage capacities.

Conclusions

According to our calculations, district heating could provide about 14 TWh (out of 45 TWh) of energy for space heating and DHW production, considering a reduction of those energy needs by 50%. Under these settings, heat from grid connected solar thermal collectors could provide about 2.5-3 TWh with a solar yields of more than 400 kWh/m². This potential, however, is quite sensitive to the assumptions on low-cost waste heat. If the waste incineration in Vienna will be operated year-round, the estimated potential is reduced by about 50%.

References

Persson, U. und Werner, S., 2011. Heat distribution and the future competitiveness of district heating, Applied Energy, Volume 88, Issue 3, March 2011, Pages 568–576.