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Das Energiesystem nach Corona: Irreversible Strukturänderungen - Wie?

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Perspectives of district heating and the role of heat mapping and spatial heat planning

Integrierte Netze der Zukunft
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Motivation and Aims

According to Art. 14 of the Energy Efficiency Directive (Europäisches Parlament und Rat der Europäischen Union, 2012), Member States are required to submit a "comprehensive assessment of the potential for efficient heating and cooling". The main objectives of the comprehensive assessment is (1) the presentation of the current heating and cooling supply and future scenarios, (2) the calculation of the economic potential of efficient heating supply and (3) the presentation of results on a map.

This paper presents the methods, analyses and insights gained related to objective (2) of the comprehensive assessment in the context of the target to achieve full climate neutrality of the Austrian energy system until 2040 in line with the current government programme and the European Green Deal. Moreover, it discusses the role of heat mapping and spatial planning on the future role of District heating.

Method

In order to assess the economic potential of district heating in the light of full decarbonisation in the coming decades, we carried out the following steps:

- Survey of the status quo of the Austrian heating sector (heat demand and distribution, existing supply infrastructure, technologies and energy sources used) and analysis of the potential of industrial waste heat for feeding into district heating networks (for the case of industrial sites under the European Emission Trading System) and of RES-H potentials based on previous studies
- Deriving heat demand maps on a hectar level for 2030 and 2050
- Identification of regions potentially suitable for district heating: Taking the heat demand maps as a starting point, we calculate heat distribution costs and identify those regions below a certain threshold of heat distribution costs (30, 40 or 50€/MWh).
- Clustering of regions with similar characteristics (size, resources and existing infrastructure)
- Calculation of costs for heat supply: First, we defined three typical portfolios for each regional cluster and subsequently applied an hourly dispatch model to assess the levelized costs of heat (LCOH) for each of the portfolios. For each cluster, we chose the least cost portfolio. The sum of LCOH and heat distribution costs for each potential district heating region results represents the total costs of district heating supply in a certain region.
- Identification of the economic potential for efficient heat supply: Here we compare costs for district heating and object-related, decentral heat supply. In case that the costs for district heating are lower than the object related, decentral costs, the corresponding district heating potential is assumed to be economic feasible.
- Finally, we discuss the impact of different approaches of heat mapping and spatial energy planning on the results.

The basic assumption of the study is that the goal of (net) climate neutrality in Austria will be achieved between 2030 and 2050. This means that fossil energy sources still play a role in determining the economic potential for 2030, but no longer for 2050. For 2050, it is therefore assumed, among other things, that any demand for gas will be provided from renewable sources.

Results and Discussion

Figure 1 shows the results for the economic district heating potential. The results are shown for two energy demand scenarios: The scenario “transition” represents a reduction of energy demand of about 50% by 2050 and the scenario “WEM – with existing measures” a reduction of energy demand of about one third by 2050. We carried out a parameter variation for the case of energy prices (high vs low prices), the connection rate (the share of heat which is provided by district heating within each district heating area) and the maximum achievable district heating distribution costs.

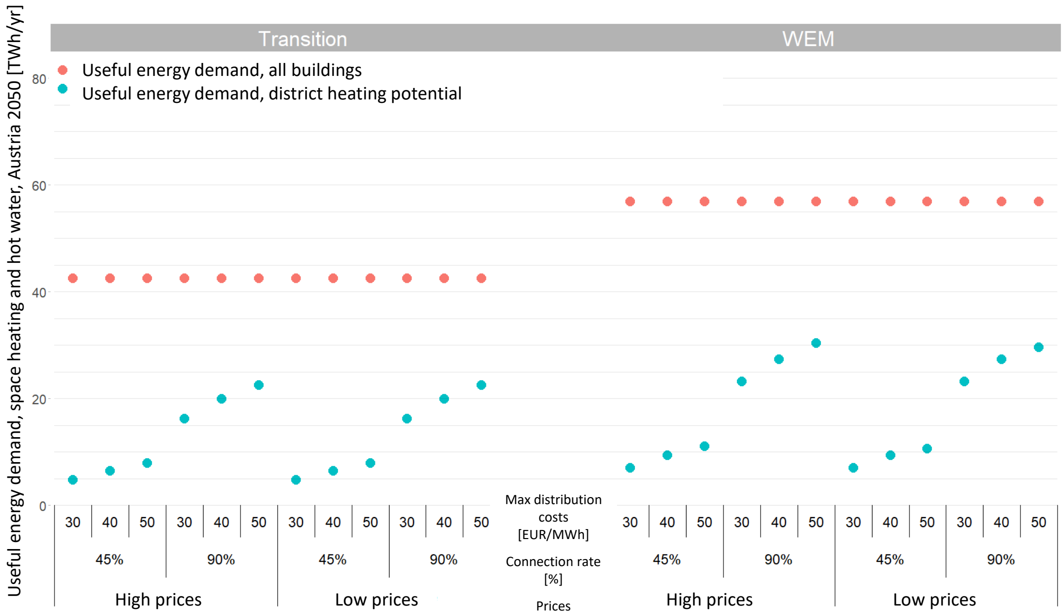

Figure 1. Useful energy demand space heating and hot water and related district heating potentials, Austria 2050 in two demand scenarios (Transition, WEM) for variations on max district heating distribution costs, connection rate and energy price levels.

The full contribution to the conference will also include detailed results on the technology mix of district heating, i.e. the resulting cost-effective district heating supply portfolios:

- Under our assumptions renewable gas is not a cost-effective option for decarbonising the sector.
- Biomass continues to represent a significant share of the renewable heat supply. In the scenarios with low efficiency increases the pressure on the use of biomass resources would increase.
- Heat pumps play an essential role not only in decentral systems, but also in district heating.
- By 2050, our analyses shows that gas-fired CHP plants will only be used with relatively low full load hours.
- Large solar thermal plants can be an economically viable option, although there is a strong dependence on the overall structure of the generation portfolio on the one hand, and on the achievable cost reductions on the other - these in turn scale strongly with the size of the plants.
- The use of large thermal storage systems is shown to contribute significantly to the economic viability of heating networks. At the same time, there are significant uncertainties regarding the associated costs, which depend not least on the exact location.

Conclusions

The decarbonisation of the heating and cooling supply in Austria is possible, but only under some framework conditions, such as extensive efforts to renovate buildings, parallel decarbonisation of electricity generation and the integration of industrial waste heat. The share of district heating depends above all on the connection rate which in turn is strongly related to stringency of spatial energy planning. This again requires further enhancemenets in heat mapping as a robust basis for policy decisions. Depending on the achievable connection rate, an economic potential for district heating is calculated from about 10% to over 50% of useful energy demand. Uncertainteis and limitations of the study result from the possible cost development (including the locally existing site-specific conditions, which can lead to deviations in terms of costs), especially regarding large-scale thermal storage and solar thermal energy and the costs for land required for them, as well as deep geothermal (and the associated risks in the development). On the other hand, there are also uncertainties regarding technological developments and the efficiencies and corresponding technology characteristics to be expected in the future, in particular regarding 4-5th generation district heating. The expected heat demand is in turn strongly dependent on the measures concerning building renovation as well as on the achievable connection rates. Since these factors cannot be predicted in the long term, a continuously adapting planning process is required, both on the part of the heating network operators and on the part of policymakers.