ELECTRICITY DEMAND FROM HEATING AND COOLING IN EUROPE UNTIL 2030

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Overview

For various planning and policy issues the estimation of future development of heating and cooling demand is of great importance. Within the project *Mapping and analyses for the current and future (2020 - 2030) heating/cooling fuel development*. (See Fleiter, T.; Steinbach, J.; Ragwitz et.al.) scenarios for the development of heating and cooling demand and supply within Europe have been developed. Within this article we focus the analyse the results of this project with respect to the development of electricity demand from heating and cooling purpouses. First we analyse potential developments of annual electricity demand until 2030 for the end use categories space heating, hot water and space cooling for a current policy scenario. Second we discuss the most important parameters that could influence the development of electricity demand from heating and cooling in other pathways. Finally we estimate resulting load profiles on country level and discuss the influence on the electricity system with a focus on maximum loads and electricity prices.

Methods

We start with the development of scenarios for energy demand in buildings and related heating system choice including the development of electrically driven heating systems such as direct electric heaters and heat pumps.
We use the model INVERT/EE-Lab[1] to simulate the development of demand and supply for heating and cooling in the European building sector. It is a dynamic bottom-up simulation tool that evaluates the effects of different economic and regulatory conditions in scenarios up to 2020, 2030, 2050 (or beyond) based on the total energy demand, energy carrier mix, CO_2 reductions and costs for space heating, cooling, hot water preparation and lighting in buildings. More information is available on www.invert.at or, for example, in Müller (2015). Invert/EE-Lab covers residential and non-residential buildings. The residential building stock is distinguished according to different size of building (i.e. single family houses, apartment bufforildings etc.), construction period and state of thermal renovation. The levels of detail or the number of construction periods etc. depend on the data availability and structure of national statistics. Moreover, a set of about 30 heating and hot water technologies is considered in the description of the building stock, taking into account different energy carriers and technologies (e.g. local stoves or condensing boilers). In total, this leads to about 500-4500 reference building segments per country. For the analyses within this paper the focus is on the electrictal heating systems consisting of direct electric heaters for space heating and hot water as well as ground and air source heat pumps. Additionally to heating systems also cooling appliances are included in the analyses.

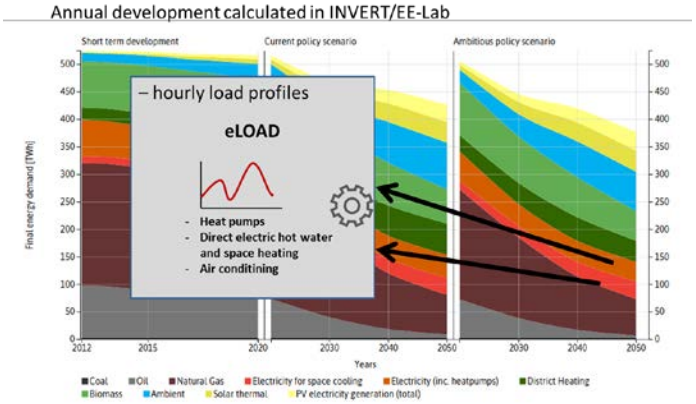

Figure 1: Linking annual heating and cooling demand with load profiles

[1] www.invert.at

Results from current policy scenario runs show that electricity demand from heating and cooling demand is going to slightly decline until 2030 compared to the base year 2012. Total final electricity demand from heating and cooling appliances in the residential and tertiary (services) building stock are expected to decrease from 384 TWh in 2012 to 352 TWh in 2030. This is mainly due to the following effects:

- decrease of heat demand in buildings with electric heating systems through thermal renovation
- decrease of heat demand in buildings with electric heating systems through climate change
- substitution of direct electric heaters with heat pumps

The decrease of electricity needs for heating is expected to outweigh additional needs for space coolings due to warmer climate conditions and expected diffusion of air conditioning systems. However as shown in Figure 2 the development is different in the residential sector vs. the tertiary sector where cooling needs account for a much larger share of final energy demand and consequently also of electricity needs for heating and cooling of buildings. In total electricity needs for heating and cooling in the tertiary sector are expected to increase from 128 TWh in 2012 to 173 TWh in 2030. Results for the developments of load profiles will be shown in the full paper version.

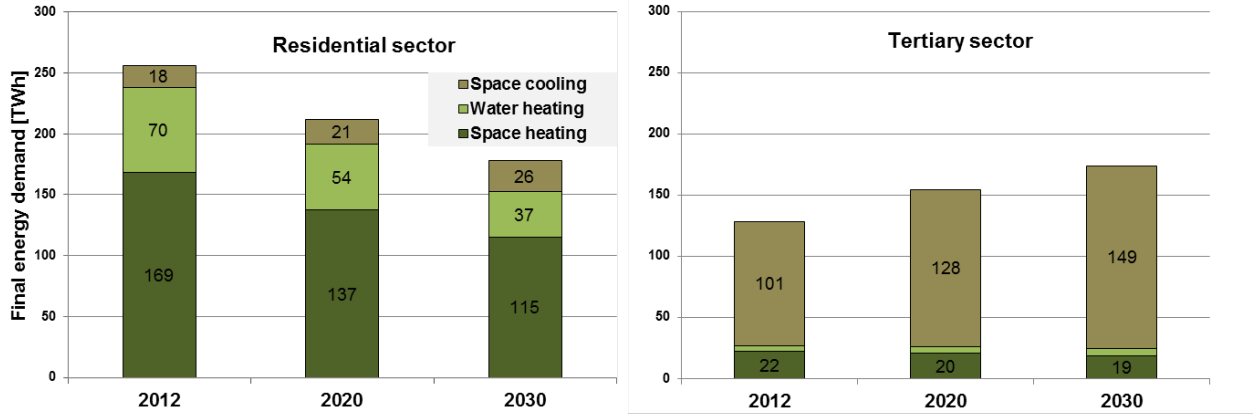

Figure 2: Electricity demand from heating and cooling in the residential and tertiary sector EU 28.

Conclusions

Despite current trends towards heat pumps in the heating system market and increasing cooling needs due to climate change the total electricity demand for heating and cooling purposes in the European building stock are not expected to increase dramatically. Decreasing heating needs in the residential sector and substitution effects of heat pumps instead of direct electric heaters are expected to make up for the increases in cooling needs until 2030. A policy strategy which focuses on the use of heat pumps is therefore expected not to put substantial additional pressue on the European electricity systems. Scenarios with high CO_2 mitigation targets cleary show a substantial role for heat pumps. The main issue to look at are peak loads resulting from heat pumps which can be mitigated by flexible heat pumps and corresponding incentives for consumers to shift the use of heat pumps away from peak load hours. Similar conclusions can be drawn for electricity demand for space cooling. The moderate demand increase until 2030 can be covered by existing electricity supply especially when considering the increase of electricity generation from PV. However demand peaks in summer are expected to increase significantly which could put pressure on the electricity system in some European regions.

References

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Müller, A., 2015. Energy Demand Assessment for Space Conditioning and Domestic Hot Water: A Case Study for the Austrian Building Stock (PhD-Thesis). Technische Universität Wien, Wien.

Invert/EE-Lab [Model website], URL http://invert.at/ (accessed 4.4.17).