MODELLING THE PRIVATE HOUSEHOLDS SECTOR AND THE IMPACT ON THE ENERGY SYSTEM

Jochen Conrad, Forschungsstelle für Energiewirtschaft e. V., +49 89 158121-54, jconrad@ffe.de
Simon Greif, Forschungsstelle für Energiewirtschaft e. V., +49 89 158121-58, sgreif@ffe.de

Overview

As part of the project *Dynamis* (Dynamic and Intersectoral Evaluation of Measures for the cost-efficient Decarbonisation of the Energy System) [1] the *Forschungsstelle für Energiewirtschaft* develops a model of the German energy system which couples its energy supply optimisation models *ISAaR* and *MInGa* with four energy application submodels for the industry, the commerce, trade and service, the transport and the private households sector. The target of this paper is to introduce a methodology of modelling measures to reduce CO_2 Emissions in the private households sector taking into account the requirements of the ever changing energy system. The focus of this paper lies on the heating of households because of its high share of total emissions [2]. In this regard an overview of the methodology explains the dependencies between the different models. The exemplary results show the reduction costs for a demand side measure. Finally the conclusions are given describing the characteristics of the private households sector.

Methods

The main objective of Dynamis is to determine the CO_2 abatement costs for different measures considering the specific characteristic of the sectors. Modelling the energy system in a dynamic way also means to link the models mentioned above. The sector-inherent costs and emissions of the demand side are calculated by the private households sector model whereas the supply side and therefore the energy carrier related costs and emissions are simulated by ISAaR (electricity generation) and MInGa (gas market). The analysis is being carried out from 2015 to 2050 in steps of five years.

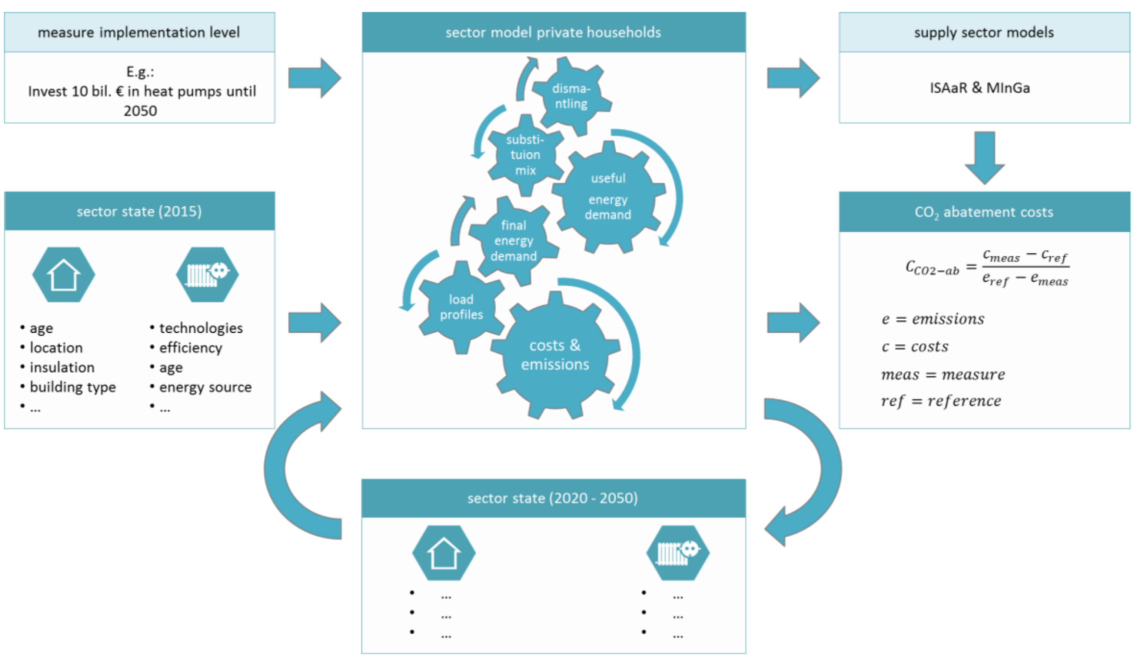

Fig. 1: methodology of the sector model private households

The sector model consists of two main parts (centre in fig. 1): the sector state and the sector modelling. The sector state on the one hand includes detailed parameter sets of buildings, white goods and heating systems such as building categories [3], energy efficiency, age and energy demand. On the other hand the model combines the information of the sector state and the measure implementation level to calculate a new sector state (5 years later). In order to do so it has to perform several tasks:

- The *dismantling-rate* of technologies and buildings is used to estimate the yearly potential for new technologies and buildings.
- The implementation of CO_2 reduction measures leads to a *substitution* of reference technologies. Different strategies can be applied here, such as the substitution of the oldest, the most expensive or the most inefficient technologies.
- The *useful energy demand* (kWh/a) is calculated with the parameter set of the buildings.
- The *final energy demand* can be derived from the useful energy demand and the efficiency of each technology.
- *Load profiles* are applied in order to get a time series from the annual value.
- *Costs and emissions* for two scenarios (reference and measure) are calculated.

Results

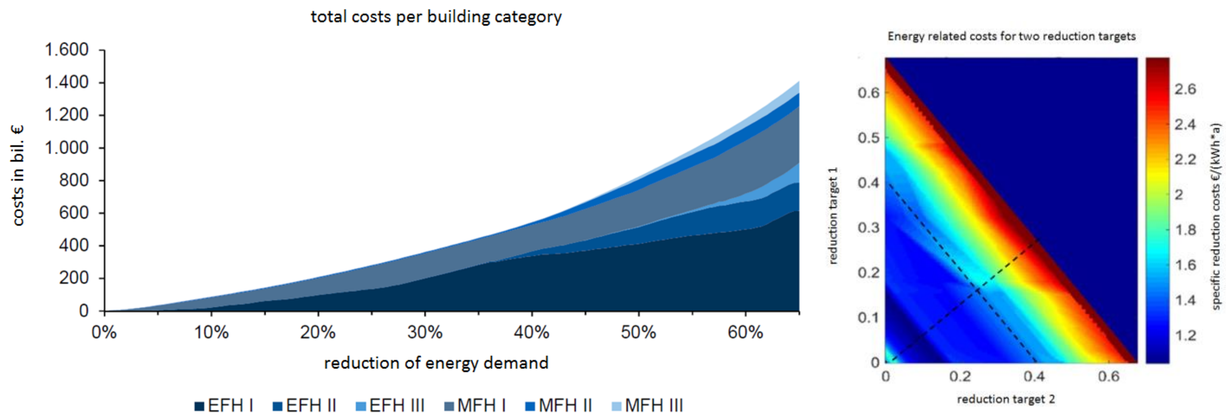

Fig. 2: Total costs of energetic renovation for building categories (left) and energy related costs for two reduction targets (right).

As an exemplary result Fig. 2 shows the total costs of energetic renovation per building category. Old multi-family houses (MFH) should be renovated first considering cost efficiency. This can mainly be explained by a good ratio of their area to their volume. Also old one-family houses (EFH) are represented by a large area in the chart. This is primarily due to the high amount of buildings and the generally low insulation standard. Other building categories play a minor role. But when it comes to reaching the ambitious reduction targets, even those expensive measures have to be realized. The maximum reduction of energy by energetic renovation is 66 %. Reasons are the protection of historical buildings and an economic maximum in insulation depth. More results from the simulation will be described in the final paper.

Conclusions

Due to a relatively long life span of buildings and technologies the sector private households is characterized by very limited transformation rates. In order to meet the climate targets by 2050 it is therefore necessary to start the transformation of the sector towards energy efficiency and low-carbon heat generation technologies as soon as possible. As shown in fig.2 (right) aiming for several distinct targets (e.g. on for 2030 and one for 2050) can result in cost inefficiencies. Therefore the focus should be on the main climate target in 2050. The decarbonization of the sector private households can be achieved by efficiency-measures and technologies using renewable energies. Results have shown that improving efficiency first often leads to the implementation of smaller scaled technologies, hence lower costs.

References

[1] Conrad, Jochen; Fattler, Steffen, Regett Anika: Laufendes Projekt: Verbundprojekt Dynamis - Dynamische und intersektorale Maßnahmenbewertung zur kosteneffizienten Dekarbonisierung des Energiesystems in: https://www.ffe.de/ dynamis (Abruf: 09.01.2017) München: Forschungsstelle für Energiewirtschaft e.V., 2016

[2] Rasch, M.; Regett, A.; Pichlmaier, S.; Conrad, J.; Greif, S.; Guminski, A.; Rouyrre, E.; Orthofer, C.; Zipperle, T.: Eine anwendungsorientierte Emissionsbilanz - Kosteneffiziente und sektorenübergreifende Dekarbonisierung des Energiesystems in: BWK Ausgabe 03/2017, S. 38-42. Düsseldorf: Verein Deutscher Ingenieure (VDI), 2017

[3] Diefenbach, Nikolaus Dr.; Cischinsky, Holger Dr.; Rodenfels, Markus: Datenbasis Gebäudebestand - Datenerhebung zur energetischen Qualität und zu den Modernisierungstrends im deutschen Wohngebäudebestand. Darmstadt: Institut Wohnen und Umwelt GmbH (IWU), 2010