**SE21.1 Energy Cadastres as Planning Tools for Sector Coupling (S)**

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In order to implement the energy transition (German Energiewende), sector coupling – thus the connection of the energy sectors electricity, heat and traffic [Sterner et al., 2017] – is crucial. Flexibility options within energy sectors, but also between the sectors, are becoming increasingly important. In this context, decentralized energy supply systems play a special role. They allow flexibility in a small scope, e.g. by maximizing self-consumption of individual users. This reduces the compensation necessities for the larger scope [Bauknecht and Vogel, 2015]. Decentralized energy supply systems are designed to cover the energy demands of locally connected consumers (such as a residential building, a housing block or a municipal area). In order to be able to define the local potential of the decentralized energy supply system to support sector coupling, the local heat and power demands (energy demands) must be known. In addition, local energy demands are crucial to using the proper technological measures for decentralized, cross-sectoral energy supply.
However, the complete analysis of a building is complex and is hardly affordable for the entire building stock of municipalities. This is where the energy cadastre applies. The energy demands of a building are determined in a simplified way by linking existing information [ebök, Planung und Entwicklung GmbH, 2007]. The object-related energy demands are then presented in a local context. Energy cadastres can identify characteristic factors and prioritize the implementation of energy efficiency measures [Förtsch and Meinholz, 2011].
In this contribution, we present outcomes and experiences from two large-scale projects involving geo-located energy demands and present solutions to common problems.
An accepted approach to access local heat demands is by multiplication of the heated area with the specific heat demand per area, and the local electricity demand by multiplication of the number of inhabitants with the specific power consumption per person. Decisive for the quality of the results is the choice of the specific demand values. However, the energy demands calculated with specific demand values for residential buildings and non-residential buildings given from literature [IWU, 2015; German Government, 2015], show great differences compared to the climate-adjusted consumption values of the buildings. On the one hand, this results from the fact that the age of the buildings has a strong influence on the specific heat demand values, but in most of the cadastral offices, construction years and, above all, renovation measures are not available digitally. On the other hand, the behaviour of consumers in the specific demands cannot be sufficiently taken into account. As a result, many municipal energy cadastres establish their own demand values using available consumption values or surveys (in Germany, e.g. Freiburg, Nürnberg, or smaller municipalities like Bergheim near Cologne.)
Another problem with creating municipal energy cadastres is the amount of data to be processed from different databases. Formats must be adapted to each other. Missing or incorrect information cannot be searched or fixed manually. If the municipal energy cadastre is not only set up statically for a moment, data processing and evaluation must inevitably be automated as far as possible.
The ongoing project KWK-Inno.Net Krefeld examines energy demands of 11 German municipalities of various sizes (Cologne, Dusseldorf, Arnsberg, Herdecke, Hagen, Kerpen, Ludenscheid, Moenchengladbach, Troisdorf, Grevenbroich and Marsberg) for the available combined heat and power (CHP) expansion potential. For this purpose, the available information about the building and resident structure is used. It becomes apparent that the specific heat demand values from literature can at best be used for an initial assessment.
In a second project, a dynamic energy cadastre for the city of Krefeld has been developed. Here, the measured heat consumption is compared with the required values calculated on the basis of specific literature values, resulting in a mean absolute percentage error (MAPE) of over 50%. Subsequently, a so-called Krefeld indicator is calculated, using building information from the land registry office and existing heat consumption data from the local energy supplier. The Krefeld indicator has an improved MAPE of about 30%. To determine the indicator, the buildings are categorized according to their type of use. For each user group, an indicator is calculated by determining the mean heat demand from the climate-adjusted heat consumption. This value is applied to the buildings of the respective user group for the forecast. In addition to the mentioned outcomes and experiences from the projects, we explicate in details how the Krefeld indicator is calculated and how it can be further optimised.
If a municipal energy cadastre is based on reliable specific demand values, not only the required amounts of energy of the consumers are known, but also the locality of the demand and the required demand. With this knowledge, energy supply systems can be optimally adapted to local energy demands.