ASSESSMENT OF FUTURE HEAT DEMAND AND SUPPLY WITH THE HOTMAPS TOOLBOX: CASE STUDIES FOR THREE CITIES IN EUROPE

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Introduction

The way we organise heating and cooling demand and supply has a high impact on the energy demand and related CO_2 emissions of a country, region or city. Furthermore, heating and cooling together currently account for around half of the energy demand and the related CO_2 emissions in the EU. Therefore, heating and cooling systems have to change radically in the near future in order to reach low carbon energy systems by 2050.

In order to assist public authorities, planners and consultants in the analysis and strategic planning of low carbon heating and cooling systems the open source planning software Hotmaps has been developed. The Hotmaps project hereby has set up a default database containing heat and cold related data for all EU28 regions, various calculation modules to analyse different parts of the heating and cooling demand and supply systems and a platform where both components can be used. In addition, the Hotmaps database and toolbox is demonstrated in course of the project. For this, heating strategies for several pilot areas around Europe were developed using the database and toolbox.

The aim of the heat strategies in the pilot areas is to identify economically feasible future heat demand and supply systems in the cities with low CO_2 emissions. In this contribution, we describe the starting situation, the analyses performed and the recommendations derived for three pilot areas of the project: Bistrita (RO), Frankfurt (DE) and San Sebastian (ES).

Methodology

The first step in the analysis was to collect necessary input data. This consisted of data on existing buildings and related heat demand, the current heat supply technologies and energy carriers used and potentials for renewable energy and excess heat in the regions. This also included technical and economic data on renovation measures in buildings, on heat supply technologies and on energy carriers. Hereby we used as much data as possible provided by the local authorities of the cities. If no local data was available we used default data contained in the Hotmaps database and discussed it with the local authorities.

In a second step we developed a toolchain for using the different calculation modules (CMs) contained in the Hotmaps toolbox (see figure 1). The goal was to use the CMs for a) analysing the sensitivity of costs and emissions in the different parts of the heat demand and supply side, and b) generating scenarios for the cities. The toolchain hereby consists of the following steps:

1) Calculate the costs and effects of heat savings in the buildings of the city for pre-defined overall saving targets using a cost curve approach. 2) Calculate the costs and zones of district heating in the different heat saving scenarios in dependence of various influencing factors like share of buildings connected in the zones and maximum allowed distribution costs for single buildings. 3) Calculate the costs and emissions of decentral heat supply in the different types of buildings under the different heat saving scenarios, and 4) calculate the costs and emissions of heat supply to the district heating systems using various different supply portfolios using a dispatch model.

From the calculations for the different parts of the heat demand and supply systems described before combinations of calculations are selected in order to form scenarios of heat demand and supply for the entire cities. For these scenarios, we calculate the overall energy demand, the share of renewable

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energy sources, the overall costs and emissions as well as the heat supply costs. Based on these indicators we derive recommendations for future heat demand and supply in the cities.

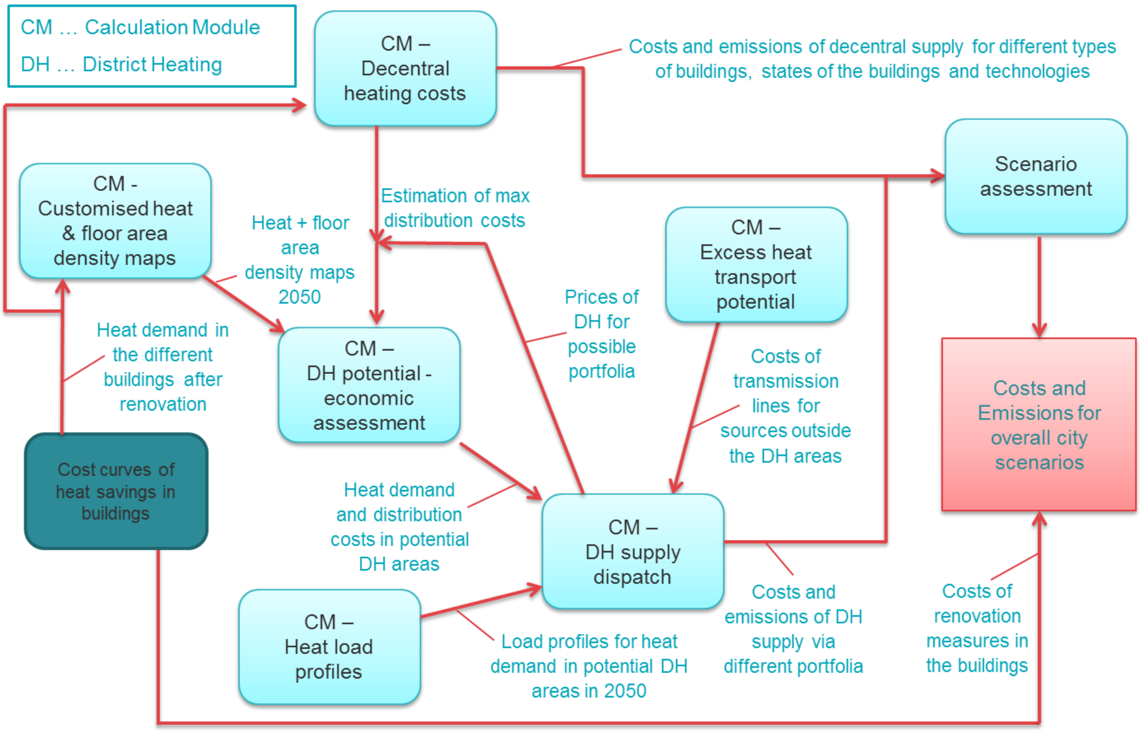

Figure 1: Hotmaps toolchain for calculating scenarios of future heating demand and supply for the case study cities

Results

We find that the results for the three cities differ largely: first, the economically interesting level of heat savings is very different. Heat savings in Bistrita are cheaper compared to heat supply than in the other cities. This makes it cost effective to save higher shares of current heat demand in Bistrita than in the other cities. Also, the results show that the level of heat savings that should be aimed for not only depends on the costs of savings vs. the costs of supply. It also depends on the amount of heat that could be supplied by available resources. Like for heat savings the results also differ remarkably regarding interesting future shares of district heating. Although having high investment costs for the construction of district heating networks in Frankfurt, the overall heat distribution costs are remarkably lower for many places in the city than in the other case study cities. Thus, higher shares of district heating should be aimed for in Frankfurt.

In the long version of the paper we are going to present quantitative results of the analyses and draw further conclusions for future heat demand and supply in the three cities. Also, we are going to discuss the possibilities of the Hotmaps toolbox for performing such analyses including a collection of research questions that can be answered with the tool and that cannot be answered with the tool in its current state.