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Comprehensive Assessment of the Potential for the Application of High-efficiency Cogeneration and Efficient District Heating and Cooling

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Space heating and cooling accounts for almost one third of the final energy use in Austria and plays a central role in achieving energy efficiency targets. As part of the EU Energy Efficiency Directive (2012/27/EU) all Member States have to develop a comprehensive assessment of the potential for the use of high-efficient combined heat and power (CHP) and efficient district heating and cooling by the end of 2015. In a first step relevant heating and cooling demand regions exceeding certain consumption or production thresholds listed in the directive have to be identified and the potential of renewable energy and efficient technologies should be determined for each region. For these regions an economic cost-benefit analysis has to be performed in a second step. In this paper the Austrian approach and methodology for this comprehensive assessment is described.
To determine relevant demand regions for district heating the actual demand for heating and cooling is identified and two scenarios for the year 2025 are developed using the techno-economic bottom-up model INVERT/EE-Lab. This model calculates the building related demand for space heating, cooling and hot water on a highly disaggregated level of a 250x250 m resolution. Then the current state of supply in terms of existing plants and district heating networks is investigated to include relevant infrastructure into the cost benefit analysis. Regional technical potentials for high efficient technologies are determined by using technical approaches like the suitable roof area for solar thermal collectors, the availability of natural gas within a certain distance or existing waste capacities for incineration plants. Based on these steps a cost benefit analysis is conducted for the relevant regions. To calculate the economic capacities and the full load hours of the CHP plants hourly electricity prices, hourly heat demand and the opportunity costs of covering the load by a central gas boiler are considered but no dynamic interdependency between the electricity market and the CHP output were taken into consideration. The load-dependent heat generation cost for each technology includes investment costs, O&M costs, fuel and emission certificates costs. For the technologies connected to a district heating network additional costs for transmission and distribution pipes depending on the distance from the supply technology to the network and the heat

density within the network are considered. Therefore every region was divided into sub-regions with different heat densities using the results given by the INVERT/EE-Lab model. The network costs are calculated for a model network with fixed parameters for size, layout and temperature level. Furthermore the costs for a peak load gas boiler that covers 10 % of the peak energy demand are included. According to these costs a technological merit order is established for every region. Starting from the sub-regions with the highest density and with existing net infrastructure the cheapest technology in the merit order is used to cover the demand until the potentials or a maximal connection rate is reached.

Using the INVERT/EE-Lab model to determine the relevant demand regions showed that the in the EED suggested plot ratio of 0.3 was achieved only in very few areas in Austria. This is why a modified approach using a combination of plot ratio, heat density and heat demand is used to.

These criteria lead to 38 main regions suitable for district heating representing 40 % of the energy demand for space conditioning and hot water in Austria. The remaining regions, which do not fulfill the adapted criteria, are classified into 30 types of regions according to similar characteristics. For both the main regions as well as the remaining regions the cost benefit analysis is conducted.