

## **Market Perspectives of Innovative Distributed Technologies: the case of combined heat and power generation**

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### **Abstract**

The optimization program *deeco* — dynamic energy, emissions, and cost optimization — was developed by Dr. Thomas Bruckner at the University of Würzburg, Germany and released in 1996. *deeco* is a generalized energy systems modeling environment, aimed at the analysis of regionally integrated energy systems in terms of their technical capabilities, financial costs, and environmental impacts. Models built using *deeco* can also be used to assess proposed [tracks] for energy sector policy development in cases where sustainability directives need to be fulfilled.

This study modeled an energy system providing electricity and heat under a range of technical scenarios. Using one-minute demand data, it is possible to replicate, in detail, the economic and environmental impacts of distributive technologies. In this instance, the focus was on combined heat and power generation systems, such as fuel cells, small cogeneration plants, and micro-gas-turbines. The purpose of this work is to determine the kinds of niche market requirements under which small-scale cogeneration units — selected as being representative of existent decentralized energy technologies — can be successfully introduced.

Germany is used as a case study to examine the diffusion of such technologies. The project utilized environmental data from Würzburg, demand data from residential buildings in North Rhine Westphalia, and actual costs and technical information from a new cogeneration product from Germany.

This study describes how the characteristics of apartments and their inhabitants define the energy demand of a building and how this, in turn, can influence the economic and environmental advantages of a given technology in relation to its (selected) operational mode. Moreover, it was shown that, in spite of normally having good environmental benefits, a small-scale engine-based cogeneration plant was only economically attractive for certain types of building and households, namely, large buildings with high living densities.