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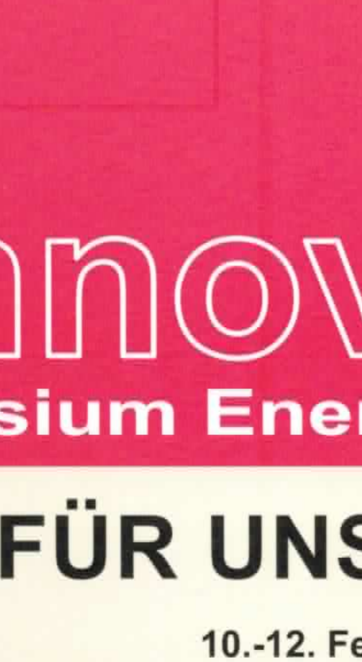

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A COST ALLOCATION METHODOLOGY IN HYBRID ENERGY SYSTEMS

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Motivation

The key question of planning energy infrastructure is which kind of technology provides the most advantages in terms of economic, environmental and security of supply issues. So far, energy infrastructure e.g. electricity, natural gas and heat grids are planned and operated usually independently from each other. This is not least due to the implementation of unbundling rules in competitive energy markets, where market participants maximize their individual benefits and profits. Therefore, synergies as long as they are compatible with the implemented regulations and market rules, are envisaged in this paper.

Nowadays investments in decentralized generation units (e.g. photovoltaic) increase the competition among grid connected energy carriers, because demand is reduced. On the other hand, decentralized technologies are used to satisfy both, electric and heat demand. Due to this reason, competition of between energy carriers continues on the end-customer level (e.g. locally produced electricity can be used to satisfy heat demand too). This paper investigates the effect of decentralized investments, if they are realized in an economic way. For this reason this paper's analysis focuses on the framework development and evaluation of an optimal energy system from the end-user's perspective.

Methodology

The methodology of this work is an optimization model minimizing the energy system's total costs. The method uses a steady-state power flow model and considers all costs of the predefined technologies (investment, fuel, operation and maintenance costs). It is based on a multi-energy-grid approach and the modelling of energy hubs according to (Schulze 2010; Kienzle 2011; Geidl 2007).

In this work, the hybrid-energy approach is used to model the end user's perspective with an economic model with technical restrictions (techno-economic model). It consists of decentralized energy conversion (e.g. µCHP and boilers) and production units (e.g. solarthermal and photovoltaic system) as well as grid connection (for energy consumption and feed-in). From an economic perspective each asset is characterized by investment, operational, and maintenance costs. Since electricity can be used for satisfying the electrical demand (e.g. light) as well as the heat demand, power flows of each asset have to be split up as shown in Figure 1, to calculate the end customer's levelized costs of electricity and heat. With this method investment, operational and maintenance costs can be allocated in a proper way.

Results

The expected results of the investigated cases shall indicate optimal investment strategies differentiated by technology, energy carrier and supply/demand pattern. It also determines the optimal technology portfolio subject to fuel costs scenarios as well as the optimal dispatch of assets over a predefined planning horizon. Energy prices are used, among others, as sensitivity parameters. E.g. it will be shown that a high dynamic in energy prices usually decrease the risk of investing in decentralized generation. Additionally by equipping end customers with decentralized storages, flexibility is increased.

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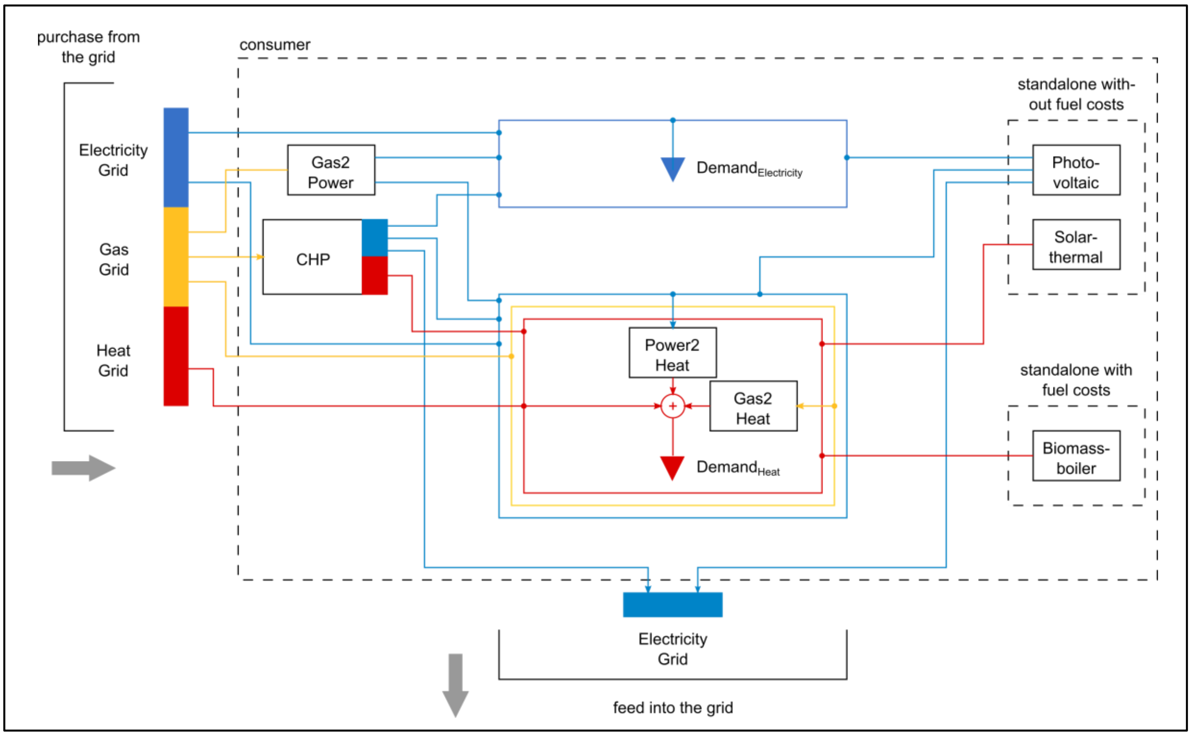

Figure 1: Graphical representation of the methodology.

Literature

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