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Smart Energy Systems and 4th Generation District Heating

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ABSTRACT

Energy systems are becoming increasingly complex, integrating across traditionally separate sectors such as transportation, heating, cooling and electricity. Integration through the use of district heating is the main topic of this editorial introducing volume 10 of the *International Journal of Sustainable Energy Planning and Management*. The editorial and the volume presents work on district heating system scenarios in Austria, grid optimisation using genetic algorithms and finally design of energy scenarios for the Italian Alpine town Bressanone-Brixen from a smart energy approach.

Keywords:

Renewable energy;
Smart energy systems;
District heating and cooling;
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1. Introduction

Smart energy systems [1–3] expand on the sector-specific approach of the smart grid approach by tackling the entire energy system more holistically and designing and optimising the entire system across traditional energy sectors with a view to harvesting synergies and flexibility at the lowest costs. Such an approach can pave the way for 100% renewable energy systems [3–5], and in this, district heating is a major enabler for cost-effective transitions to renewable energy [6–8].

This volume present work from the *International Conference on Smart Energy Systems and 4th Generation District Heating* held in Copenhagen, Denmark, August 2015 where the key-focus was on the integration of district heating systems into smart energy systems from the 4th generation district heating approach [9]. This approach includes low-temperature district heating (see e.g. how low-temperature district heating stands against individual solutions [10]); a production system characterised by integration with renewable energy supply and the organisation and design of specific public regulation measures including ownership, tariffs, reforms to assist the implementation and integration of district heating (see e.g. [11] on the integration between wind power and heating systems from an organizational perspective).

2. District heating optimisation

In this volume, Büchele et al. [12] investigate the potential for district heating and cooling in Austria using the bottom-up model *Invert/EE-Lab*. They determine significant potentials in Austria, with an economically feasible potential of 67% of the Austrian heat demand. The also determine that while e.g. heat from waste incineration and geothermal sources are cost competitive, cogeneration of heat and power cannot compete against natural gas boilers.

Razani and Weidlich [13] investigate how genetic algorithms may be applied for analysing three scenarios for district heating networks – district heating with centralized heat storage, semi-decentralized heat storage and decentralized heat storage. They find that the central storage exhibits the best economy of the three – however also the largest energy losses. Decentralised heat

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storages, according to their findings, are the most expensive however also the most efficient in terms of minimising heat production ab works.

3. Smart energy systems at urban level

Prina et al. [14] investigate smart energy systems with a case from the municipality of Bressanone-Brixen in Italy. Based on both a deterministic approach using the EnergyPLAN model [15] and an approach where EnergyPLAN simulations are combined with a metaheuristic approach, the authors design scenarios for the energy system in an approach similar to that presented by Mahbub et al. [16].

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