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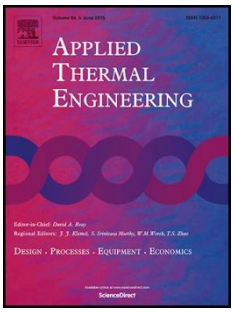

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Design optimization of smart poly-generation energy districts through a model based approach

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Highlights

- A tool for hierarchical thermo-economic optimization for energy systems is presented
- Performance curves and costs of real machines installed in the district are considered
- Two co-generative and two tri-generative configurations are investigated
- Optimal sizes and management for each plant lay-out are determined
- The energetic and economic results are compared to determine the best configuration

Abstract

This paper proposes a time-dependent, thermo-economic hierarchical approach for the analysis of energy districts and smart poly-generation microgrids, in order to determine the optimal size of different prime movers, required to meet the energy demand of a generic user. This approach allows for determining the optimal size for each component of the energy district, as well as defining its most efficient operation management for the entire year, taking into proper account the time-dependent nature of the electrical, thermal and cooling demands, which are the main constraints of the optimization problem. Additionally, the proposed method takes into consideration both energy performance and operation costs.

A specific case study is developed around the smart poly-generation microgrid at the University of Genoa, Savona Campus (Italy), which has been operational since 2013. In the original design, the microgrid includes different co-generative prime movers, renewable generators and a thermal storage system. In a second design an absorption chiller is included to supply the campus' energy cooling demand.

Obtained results allowed identifying the best operation configuration, from a thermo-economic standpoint, for the considered scenario. The proposed method can be easily replicated in different applications and configurations of different smart poly-generative grids.

Keywords:

Distributed generation, thermo-economic analysis, smart poly-generation grids, energy districts optimization.