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Decentralized optimization of coordinated electrical and thermal generations in hierarchical integrated energy systems considering competitive individuals

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Abstract

Along with the popularity of distributed energy generations and hybrid energy appliances, the optimization of integrated energy system combining various kinds of energy has drawn more and more attention. In this paper, we establish a hierarchical model of integrated energy system, which composes of fundamental units such as energy converters, supply networks, and consumers. The fundamental units are modeled as individuals which operate independently and interact with others through mutual information. The fundamental units constitute low-level systems and the combinations of low-level systems make up high-level systems. In order to protect the information privacy of each individual and make full use of the limited mutual information, a decentralized optimization method is presented to optimize the operation strategy of the hierarchical system considering competitive activities between individuals. The individuals participate in an iterative process, interacting with others through an energy pricing mechanism until the system equilibrium achieved. Simulation studies are conducted on several integrated energy systems to investigate the performance of the proposed hierarchical model and decentralized optimization of coordinated electrical and thermal generations. Furthermore, the proposed method is applied to a practical case of Guangzhou Higher Education Mega Center, and the daily operation strategy of the energy supplier is optimized.

Keywords: integrated energy system, hierarchical model, decentralized optimization, competitive individual.

1. Nomenclature

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