A Two-Step Planning Case Study for Urban Integrated Energy Systems

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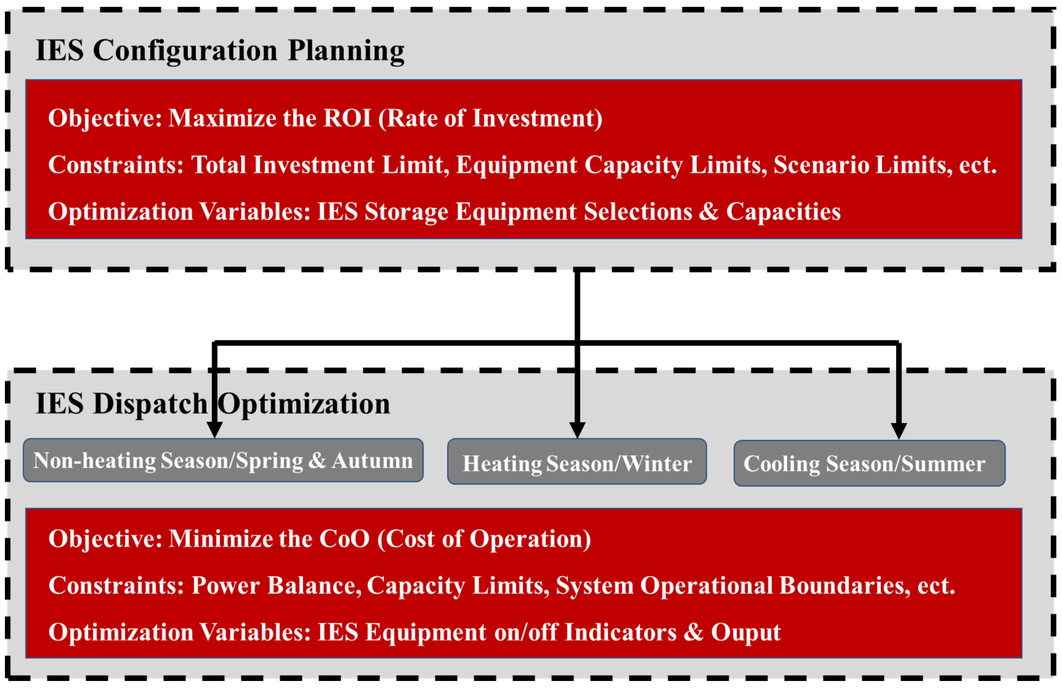
Introduction

This paper proposed a two-step IES planning approach to optimally determine the equipment combination and installed capacities of various equipment of IES, including electric boiler, water chiller, gas boiler, heat pumps, CCHP and energy storages. A case study is presented using the proposed approach based on an actual integrated energy project in China. The results recommend system developers with initial configuration and scenario design for integrated energy system, as well as detailed economic index for potential project investment.

Methods of your work

The methodology of the proposed IES planning contains two steps: IES configuration planning and IES dispatch optimization. The figure indicates the two-step methodology of configuration planning and dispatch optimization of IES planning.



In the first step, IES configuration planning mainly optimizes the types and quantities of energy supply & storage equipment.

In the second step, IES dispatch optimization mainly optimizes the operations of energy equipment in IES.

Results of your work

The proposed planning methodology is applied on a case studies based on an actual urban IES project in China. The heating, cooling and electricity supply and energy flow is further described in figure below:

The results indicate that the optimal scenario suggests applying ice storage system together with duplex status chiller units to purchase electricity from the main grid for cold storage during electricity troughs in the night, and then release cold during peak demand for cold in summer. This suggests that the energy storage can significantly reduce the cost of energy by allowing the peak demand shifting and fully utilizing the cheap electricity at nights. Also, the economic benefits of CCHP using gas turbines (or engines) depend on the price and availability of natural gas on site.

Conclusions of your work

This paper proposed a two-step IES planning approach: 1) firstly, simulate the hourly economic operation of IES on the typical day of each season; 2) secondly, the operational results from typical day simulation, such as the profits, costs, fuel usage, renewable penetration, together with additional factors, such as investment costs, CO2 emission, governmental subsidization, are utilized to calculate the return on investment (ROI) of the proposed IES within its whole life cycle.