Mostafa Kafaei, Davoud Sedighizadeh, Mostafa Sedighizadeh, Alireza Sheikhi Fini, 2021, A two-stage IGDT/TPEM model for optimal operation of a smart building: A case study of Gheshm Island, Iran, *Thermal Science and Engineering Progress,* Volume 24, 1 August 2021, 100955.

Highlights

- Proposing an EH based on a CCHP-ORC equipped with an SWD.
- Assessing the effects of installation of WST on optimal operation of EH.
- Formulating a two-stage model for modelling uncertainties in PV, WT, and gas price.
- Considering risk-averse and risk seeker strategies for optimal day-ahead operation.
- Considering two objective functions, i.e. operation cost and emission, simultaneously.

Abstract Using poly-generation schemes based on energy hub (EH) concepts is one of the new ways to efficiently supply energy (electrical/thermal/cooling/water) demanded by smart buildings equipped with building energy management system (BEMS). Regarding severe uncertainties pertaining to renewable generation and demands, BEMS is faced with challenges to optimally operate EH during day-ahead. The present study proposes a stochastic day-ahead optimization model for BEMS to minimize the operation costs and emissions under a number of techno-economic constraints considering extreme uncertainties related to generations, demands, and prices. The proposed grid-connected EH includes combined cooling, heat, power (CCHP) system as dispatchable generation, and wind turbine (WT) and photovoltaic (PV) as non-dispatchable generations. To enhance the reliability of energy and water supply, two energy storage systems (ESSs), namely battery energy storage (BESS) and thermal energy storage systems (TESS) and one water storage tank (WST) have been installed in EH. Moreover, to improve flexibility of the proposed EH, it utilizes a seawater desalination (SWD) with reverse osmosis (RO) technology as an active load and an organic Rankine cycle (ORC) as a new technology for generating electrical power by means of thermal power. Also, it considers a demand response program as time of use (TOU) to enhance the flexibility of the operation. The proposed stochastic model is solved by a two-stage algorithm. The first stage formulates the uncertainties of the demands and renewable generations by two-point estimate method (TPEM) while the second stage models the extreme uncertainty of the gas price by information gap decision theory (IGDT) method as well as economically dispatching the generations and storages with risk-averse and risk-seeker strategies. The efficacy of the proposed model is evaluated on a smart commercial building in Gheshm located not far away from the southern coast of Iran in Persian Gulf. It is seen that the total cost of the EH equipped with a WST reduced by 16.55% compared to the one without a WST.

Keywords Energy hub (EH), Flexible load, Gas pricing policy, Information gap decision theory (IGDT), Seawater desalination (SWD), Two-point estimation (TPE) method.

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