Mehran Khodadadi and Alireza Askarzadeh, 2025, A techno-enviro-economic framework for optimal operation of a battery-driven hybrid energy system with biomass: A risk-averse approach, *Energy*, available online 25 February 2025,
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Highlights

- Risk-averse optimal operation of a grid-connected battery-driven PV/biomass HES.
- Developing a techno-enviro-economic framework considering load demand uncertainty.
- Using IGDT technique to model RAS.
- Comparison of techno-economic and techno-enviro-economic optimization frameworks.
- Evaluation of different approaches to tune awareness probability of CSA.

Abstract In power system, optimal operation of grid-connected hybrid energy systems (HESs) is a challenging issue which should be considered from technical, economic and environmental aspects. Load uncertainty is a key parameter which can significantly affect the result of the operation problem and from the operator's point of view, it is necessary to evaluate the operation risk and make the system robust against the increase of the load demand. This paper proposes a risk-averse-based framework for techno-enviro-economic operation of a grid-connected HES composed of photovoltaic (PV), biomass (as a dispatchable renewable resource) and battery (as a storage device). In the PV/biomass/battery HES, load uncertainty is modelled by information gap decision theory (IGDT) and a robust IGDT model is developed to identify the highest level of the uncertainty radius. In order to efficiently solve the operation problem, crow search algorithm (CSA) is utilized and since the performance of CSA is greatly influenced by a parameter, named awareness probability, the impact of using various patterns (constant, linear and nonlinear) is investigated on the operation results. Over the case study, it is observed that when there is no risk and emission cost is included in the objective function, the value of CO2 emission decreases around 19.6%. Furthermore, with respect to the deviation factors of 0.1, 0.15 and 0.2, maximum value of the uncertainty radius is obtained 6.84%, 10% and 13.76%, respectively.