Amirhossein Khazali, Yazan Al-Wreikat, Ewan J. Fraser, Mobin Naderi, Matthew J. Smith, Suleiman M. Sharkh, Richard G. Wills, Daniel T. Gladwin, David A. Stone and Andrew J. Cruden, 2024, Sizing a Renewable-Based Microgrid to Supply an Electric Vehicle Charging Station: A Design and Modelling Approach, *World Electric Vehicle Journal*, 15, 363. https://doi.org/10.3390/wevj15080363.

Abstract In this paper, an optimisation framework is presented for planning a standalone microgrid for supplying EV charging (EVC) stations as a design and modelling approach for the FEVER (future electric vehicle energy networks supporting renewables) project. The main problem of the microgrid capacity sizing is making a compromise between the planning cost and providing the EV charging load with a renewable generation-based system. Hence, obtaining the optimal capacity for the microgrid components in order to acquire the desired level of reliability at minimum cost can be challenging. The proposed planning scheme specifies the size of the renewable generation and battery energy storage systems not only to maintain the generation–load balance but also to minimise the capital cost (CAPEX) and operational expenditures (OPEX). To study the impact of renewable generation and EV charging uncertainties, the information gap decision theory (IGDT) is used to include risk-averse (RA) and opportunity-seeking (OS) strategies in the planning optimisation framework. The simulations indicate that the planning scheme can acquire the global optimal solution for the capacity of each element and for a certain level of reliability or obtain the global optimal level of reliability in addition to the capacities to maximise the net present value (NPV) of the system. The total planning cost changes in the range of GBP 79,773 to GBP 131,428 when the expected energy not supplied (EENS) changes in the interval of 10 to 1%. The optimiser plans PV generation systems in the interval of 50 to 63 kW and battery energy storage system in the interval of 130 to 280 kWh and with trivial capacities of wind turbine generation. The results also show that by increasing the total cost according to an uncertainty budget, the uncertainties caused by EV charging load and PV generation can be managed according to a robustness radius. Furthermore, by adopting an opportunity-seeking strategy, the total planning cost can be decreased proportional to the variations in these uncertain parameters within an opportuneness radius.

Keywords microgrid; renewable energy; battery energy storage system; optimisation; information gap decision theory (IGDT)

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