Project: Evaluation of Co-Located Wind and Battery Storage Projects in the Light of a Battery Sizing Algorithm for Maximum Return of Investment

Key focus: co-location of wind and battery, stacking of multiple revenue streams, size optimisation

Researcher: Fulin Fan **Supervisor: John Nwobu / Ander Madariaga**

Background

Given increasing integration of low-carbon technologies such as offshore wind power into the UK grid and their associated implications on the grid reliability and stability, the incorporation of battery energy storage systems (BESS) with renewable energy sources has been a topic of interest. The BESS co-located with offshore wind not only can enable the time shift of wind generation and capacity firming, but also has the potential of improving system operation in terms of security of supply, provision of ancillary services and deferral of grid reinforcement. However, the high cost of the investment on BESS and a lack of technical maturity for the offshore wind + BESS project have slow-paced the development of a successful business case of the co-location of offshore wind farms and BESS. Given that the expenditure of some BESS technologies is reduced with their improved maturity, the application of BESS with offshore wind farms is re-evaluated in this research.

Project description

The research project conducted in University of Strathclyde / ORE Catapult's Electrical Infrastructure Research Hub simulates the operation of offshore wind farm in conjunction with BESS under a number of scenarios where the primary role of BESS is to provide enhanced frequency response or dynamic firm frequency response driven by frequency deviations from the nominal 50Hz. Furthermore, in the scenarios where a back-to-back converter is installed, the BESS is additionally modelled to manage the imbalance risk of offshore wind farm given a bidding strategy or sell the surplus energy from the frequency response service as wind energy via the wind farm meter.

Based on the developed simulation model, the research employs a particle swarm optimisation algorithm to find the optimum size of the co-located BESS in terms of power (MW) and energy (MWh) that maximises the return of investment, considering the stacking of multiple revenue streams and capital and operational costs of the BESS. Furthermore, the sizing algorithm having high flexibility can be adapted to other operational strategies of wind + BESS projects and include additional revenue streams and subsidies.

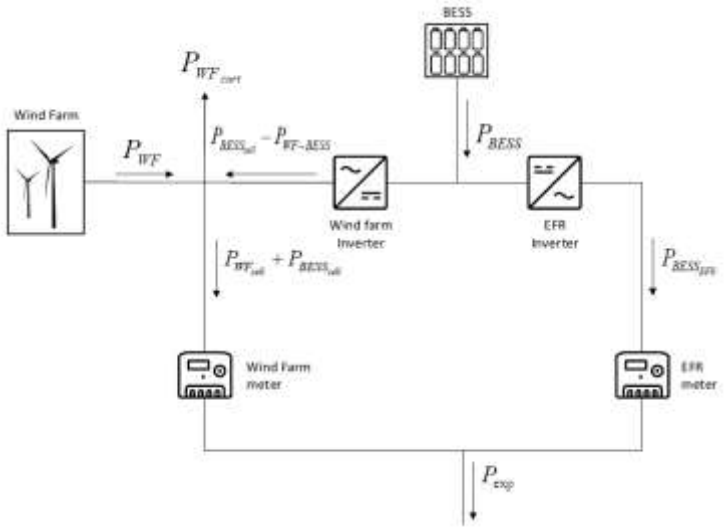

Figure 1. Schematic diagram of the model for the co-location of offshore wind farm and BESS.

Research outcomes/impact

The outcomes of the on-going research will inform the industry on economic benefits and challenges for the co-location of offshore wind farms and BESS in the UK. In addition, the research can help the offshore wind industry make suitable operational strategies for offshore wind farms in conjunction with BESS, and determine the best size of the BESS for the maximum return of investment.

Project Sponsorship:

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