QUB and NIE Networks collaborate on feasibility study for incorporating storage devices in Northern Ireland distribution networks

SPIRE 2
Storage Platform for the Integration of Renewable Energy

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THE CHALLENGE

Increased penetration and uncontrolled operation of low carbon technologies (LCT), e.g., PV panels, wind turbines, electric vehicles (EV) and heat pumps, can adversely affect distribution network security and reliability. Considering the environmental benefits of incorporating LCTs, the challenge is to devise a cost-effective solution (incorporating storage devices as opposed to more expensive network reinforcement options) that can facilitate the increased adoption of these technologies while ensuring satisfaction of network security constraints.

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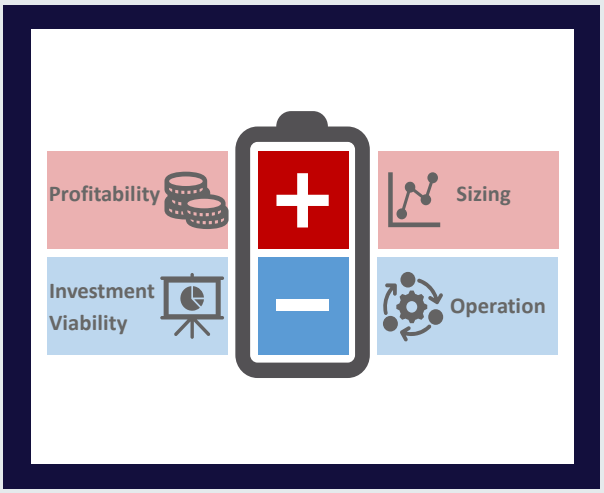
THE RESEARCH

Using real-life medium and low voltage (MV/LV) distribution network models along with associated substation data obtained from Northern Ireland Electricity (NIE) Networks, QUB SPIRE 2 researchers are conducting simulations for identifying potential network security violations arising from increased adoption of LCTs. Optimal siting and sizing of battery energy storage systems (BESS) have been determined for removing identified violations. Optimal operating schedules for BESS and EV charging have also been investigated for offering a variety of network services (e.g., renewable curtailment minimization, congestion management and voltage regulation) while opening up additional revenue streams for their owners.

THE CONCEPT



While ancillary service markets (e.g., frequency regulation and reserve) at the transmission level are already well defined in Ireland, those at the distribution network level are not. The central theme of this project is to determine optimal siting, sizing and operating schedules of BESS for exploring their service provision capabilities in MV/LV distribution networks while facilitating the increased uptake of LCTs. By quantifying the revenue generation potential of BESS (through the provision of network services), the project also aims to investigate the economic viability of investing in these devices by performing appropriate cost-benefit analyses.

THE IMPACT

Simulations performed under high LCT growth scenarios have revealed that several downstream feeder sections in the MV/LV distribution network test beds under consideration experience congestion and/or voltage problems. The economic viability of investing in BESS technologies (e.g., Pb-acid and Li-ion), as opposed to implementing more expensive network control measures, has been investigated. It has been shown how optimal scheduling of EV charging can accelerate the BESS payback period. It has also been demonstrated that Pb-acid and Li-ion batteries can potentially recover an average of 12.92% and 15.64% (respectively) of their investment and operation and maintenance costs through the provision of just two network services: renewable curtailment minimization and peak shaving. These findings by QUB SPIRE 2 researchers can significantly help NIE Networks in planning for a more sustainable distribution network in Northern Ireland while facilitating the increased uptake of LCTs.

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