COMMERCIAL INTEGRATION OF STORAGE AND RESPONSIVE DEMAND TO FACILITATE WIND ENERGY ON THE SHETLAND ISLANDS

Authors & organisations F= First author **P**= Presenter

Graeme Hawker (1) **F P** Laura Kane (1) Simon Gill (1) Ivana Kockar (1) Keith Bell (1)

(1) University of Strathclyde Glasgow United Kingdom

Track: Hardware technology
Topic: Storage and Grid Integration

Abstract title
COMMERCIAL INTEGRATION OF STORAGE AND RESPONSIVE DEMAND TO FACILITATE WIND ENERGY ON THE SHETLAND ISLANDS

Introduction
The Northern Isles New Energy Solutions (NINES) project seeks to implement Active Network Management (ANM) on the Shetland Islands in a manner which reduces customersâ€™ energy consumption, lowers peak demand and facilitates an increase in the proportion of electricity from wind, in order to take advantage of the unique wind resource of the islands. This presentation focuses on the commercial frameworks and trading arrangements necessary to permit additional wind capacity onto the islanded network through the active use of storage and responsive demand technologies.
Approach
The network is modelled using a Dynamic Optimal Power Flow (DOPF) framework, which allows the unit scheduling of different combinations of generation, storage and demand to be optimised according to different optimisation goals. This is used as a foundation to explore the value of wind energy and storage in meeting the long-term goals of the network, the forms of trading and markets which may be used to contract services, and the potential for responsive demand to facilitate different forms of connection agreements and curtailment strategies for new wind farms.
Main body of abstract
In modelling the Shetland network using Dynamic Optimal Power Flow (DOPF), the optimum unit commitment schedule is determined across a daily horizon for different network topologies, including variable levels of wind generation, storage and demand-side response - primarily storage heaters and water tanks controllable by the Distribution System Operator via Active Network Management. This informs the level of wind generation which may be accepted onto the network, and allows the creation and testing of commercial agreements both for wind generators keen to utilise the unique resource of the islands, as well as allowing third-party operation of storage, and reducing the peak energy demand of domestic consumers. This allows a greater level of demand to be supplied by non-thermal sources through the time-shifting of demand against the availability of the wind resource. Support of the grid through reserve and response is considered in the context of maintaining system stability, with the aim of procuring services through third-party contractual arrangements. Data collected from the operational history of the islands and technology trials demonstrate the feasibility of these approaches and their potential applicability to other constrained distribution networks with the potential for high levels of wind generation.
Conclusion
The data from trials of domestic storage equipment and modelling of wind curtailment demonstrate quantitatively the ways in which commercial integration of modern storage and responsive demand can be used to increase the utilisation of wind energy on islanded networks, which may often have increased renewable resources but limited grid capacity. It is shown that there are a number of trading and connection agreements which can be used to contract for generation and ancillary services to meet these goals.