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# DEVELOPMENTS IN ENERGY TECHNOLOGY AND POLICY RESEARCH

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In recent years the main research activities of the Electricity Research Centre (ERC) have been in the area of grid integration of renewable energy and the operational challenges of island power systems. It is anticipated that the ERC will present on some salient results of our current research under the headings 'Energy Distribution' and 'Public Policy and Economics'.

## Energy Distribution

- **Distributed Generation:** Many energy resources, both for supply or demand of electricity, are intended for connection to the low voltage electricity distribution network and are collectively known as distributed energy resources (DER). This project addresses the unique technical and economic challenges of integrating DER for the planning and operation of distribution networks.
- **Transmission Networks:** Integrating the variable nature of wind energy to transmission system planning requires study in the probabilistic domain. Current research is focused on optimally allocating 'firm' wind connection capacity to minimise cost while guaranteeing transmission system security.
- **Network Topology:** This project investigates the impact of electricity grid topology changes on the long term average size of blackouts and examines if increasing the number of line cutsets increases reliability.

## Public Policy and Economics

- **Electricity Storage:** This project investigates the effect of electricity storage on the operation of the electricity system and determines the optimal size of different storage solutions based on their costs and revenues. Further work will investigate the emissions savings and system security benefits and possible support mechanisms.
- **Electricity Markets:** This project involves addressing the market design implications of ultra high wind energy penetrations in isolated markets.
- **Generator Cycling Costs:** Cycling may be defined as the ramping and switching on and off of conventional units and results in both physical and chemical damage being inflicted to generator components. This project investigates the impact of wind on the extent of this damage on different types of generating units and the additional costs

incurred. Recommendations will be made on the optimal operating strategy of the electricity system to reduce stresses on the generators in order to maximize the life span of the existing units and reduce system cycling costs.

Other current and recent research projects:

- Stochastic unit commitment with wind
- Reserve requirement with wind
- Impact of wind and tidal on system operation
- Optimal power plant portfolios
- Inertial response and dynamic modelling of wind turbines
- Frequency control characteristics of CCGTs
- Costs and benefits of increased wind