energy technology partnership

Grid, Power Systems & Networks

Scotland's enormous green energy potential is evident from its ambitious targets to generate the equivalent of 100% of electricity demand from renewables by 2020. Integrating a variety of renewable energy sources, including wind, tidal and wave into the electricity power system, represents a considerable challenge.

The focus of the utilities sector, in Scotland, the UK and internationally, is on building an electrical transmission and distribution networks capable of incorporating a high penetration of highly-distributed renewables. And while conventional coal or gas-fired and nuclear power stations generate extremely stable power supplies, the integration of renewable sources of electricity generates a diverse range of technical and economic issues.

A 'smart' grid capable of managing the widespread adoption of all renewables will need to be more intelligent and controllable, capable of being actively managed and operating without costly network reinforcements (e.g. overhead lines, cables). Changing patterns of demand and generation – from plugging in electric vehicles to heat pumps and the intermittency of wind – also radically changes what is required of an electricity transmission network.

The industry challenges ahead mesh traditional power engineering, advanced electronics, monitoring and control technologies, software, as well as information and communications technology. The Energy Technology Partnership is well-placed to support the development, demonstration and deployment of these next-generation grid and related systems technologies.

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Summary of Grid, Power Systems and Networks expertise in ETP

Distributed generation

Increasing the penetration of renewables introduces a wide range of technical challenges which require innovation to generate novel approaches and technologies. From maximising the capacity of distribution networks with hardware and software solutions to intelligently managing and controlling distributed generation ('smart grid') and demand-side management, to centralised communications and network security, ETP members are tackling these issues through desktop research, laboratory work and field studies.

Power systems

The detailed modeling of systems under various scenarios is critical to research efforts. Whether it involves power systems modelling, simulation and analysis, or detailed models of new load categories focused on next generation of high-efficiency electronic loads (e.g. plug-in chargers for electric vehicles, LEDs and high-intensity discharge lighting sources), the ETP has the expertise in modeling and analysis to help resolve critical interconnection, operation, control and protection issues.

Power electronics

A power system with distributed renewable energy sources requires more complex control and safety systems with advanced power electronics. ETP research into novel converters, DC /DC conversion, High Voltage DC (HVDC), inverter-connected generation and control, as well as power electronics components and materials, supports the development and deployment of next-generation transmission and distribution systems.

Digital communications

Communications is a critical element in power systems and many evolving smart grid technologies. This raises new issues of communication and network types, data speed, security and analysis. ETP research areas include signal processing; communications systems, human interface factors and data analytics.

Electrical Machines

Research into electrical machines (incorporating power electronics) is focused on the design of novel machines for use in renewable energy systems (e.g. direct drive wave, wind and tidal current systems/ generators) and the hardware/ software developments required in electrical motor and generator control and testing. Power electronic converters are also being developed for interfacing these renewable energy systems to the grid and for control purposes to optimise performance. In addition, there is also research into electronic power supplies.

Monitoring and diagnostics

Asset management is a key area of innovation for utilities faced with investing in networks to support new distributed generation. Research into new methods of asset condition monitoring, maintenance, repair, refurbishment and replacement of HV equipment and electrical energy systems, as well as data communication systems, are all core ETP activities.

The Scottish Energy Laboratory (SEL)

A key facility in the Scottish Energy Laboratory (SEL) is the Power Networks Demonstration Centre (PNDC) – due to open in 2013. A collaborative venture involving the University of Strathclyde, Scottish Enterprise and an industrial membership that includes ScottishPower and SSE, the PNDC is a purpose-built platform for researching and developing state-of-the-art electrical transmission, distribution and generation innovation. The facility will be focused on accelerating the adoption of new technologies, from advanced power grids to electric cars and household appliances.

For more details visit www.scottishenergylaboratory.com
www.strath.ac.uk/pndc

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