Having 25 percent of Europe’s wind resource Scotland is an ideal location for wind power projects. With 7.4 GW of onshore wind energy and 10 GW of offshore wind energy planned or under construction, Scotland has the capacity to produce huge amounts of sustainable, clean energy.

As well as excellent natural resources, Scotland offers cutting-edge technology and a skilled workforce. Scotland’s key wind power industry strengths include:

- A strong and developing supply chain
- An investment environment that takes advantage of Scotland’s oil and gas experience and success
- Funding and support for diversification into wind energy activity
- Skilled labour workforce
- Expertise in manufacturing large steel structures which is transferable to the wind sector

The Energy Technology Partnership (ETP) adds to these strengths by forging strong and effective links between the wind power industry and Scotland’s world leading universities.
Wind Energy

Summary of Wind Energy expertise in ETP

**Operations & Maintenance**
Reducing O&M costs is crucial to enabling and accelerating the deployment of off-shore wind. Several research groups are investigating novel approaches to Asset Management and Condition Monitoring, through detailed analysis of SCADA data.

**Control systems design**
Modern, large turbines use active pitch control, both to improve energy efficiency and to minimise stresses on the turbine. The optimisation of pitch control is an active research topic, and has led to at least one spin-out company – MLS Ltd.

**Composite materials research**
Large wind turbines rely heavily on composite materials for their blades and other components. Better performance from these composites can lead to bigger blades, longer lifetime and lower LCOE. Research is being undertaken on topics across this field, from the chemistry of sizing, through modelling of debonding and other failure modes, right through to end-of-life recycling of reinforcing fibres.

**LIDAR and SODAR technologies**
LIDAR and SODAR are increasingly being used to improve the understanding of wind resources. Reducing the uncertainty of energy yield makes financing cheaper, but still needs validation against conventional MetMast measurements to be accepted as bankable. These techniques are also used by ETP for analysing the complex interaction between turbines in a wind farm, allowing wake effects and turbulence to be taken into account when choosing the optimal separation and positioning of turbines.

**Power electronics and converters**
Movement towards the use of lower-speed, direct-drive generators, and the use of variable-speed turbines to increase reliability and efficiency, all have the effect of making the power electronics and power conversion requirements increasingly important. Scotland has world-class research capabilities in these areas. There has also been a recent resurgence of interest in HVDC networks, seen as necessary to reduce power losses in intra-farm connections. There are a number of ongoing research projects in this area, investigating both system control and power converter topologies.

**Wind Modelling and Resource Assessment**
In wind farms, a key factor is the wake effect that one turbine has on others downstream. Researchers are using sophisticated Computational Fluid Dynamics (CFD) programs to investigate these effects, so that wind farm operators can site turbines with optimal spacing. CFD can be used to determine likely energy yields for particular turbine sites, and statistical and numerical approaches are being used to enhance the accuracy and usability of wind resource databases.

**Turbine Foundations**
Scotland has a strong history in Civil Engineering, and research into new foundation designs for offshore turbines will be a key driver in cost reduction. Wave tank resources are used to study novel floating turbines as well as conventional, gravity-based foundations that need to be towed into position. In addition, research into novel, “green” concrete promises more environmentally sustainable foundations.

**Scour and Geotechnics**
For offshore turbines, gravity-based foundations look increasingly attractive, but issues such as scour need to be better understood. A number of researchers are looking at scour modelling and monitoring technologies. Other foundation types, such as suction caissons, require a clear understanding of the response from the sea bed to the cyclic loads a turbine imposes, an area of active research within ETP universities.

The Scottish Energy Laboratory (SEL)
Energy sector test facilities have been brought together under the Scottish Energy Laboratory (SEL) umbrella. Facilities of particular relevance to the wind energy sector include:
- Myers Hill – Onshore Wind Turbine Testing
- University of Glasgow - Wind Tunnel Test Facilities
- Deep-water Offshore Wind Demonstrator
- European Offshore Wind Deployment Centre
- Integrated Marine Test Facility - Wind Tunnel
- Marine Test Tanks
- Energy Technology Centre - component test facilities

For more details visit www.scottishenergylaboratory.com

For further information please email: wind@etp-scotland.ac.uk

Energy Technology Partnership