

44 years of wind energy research at RAL

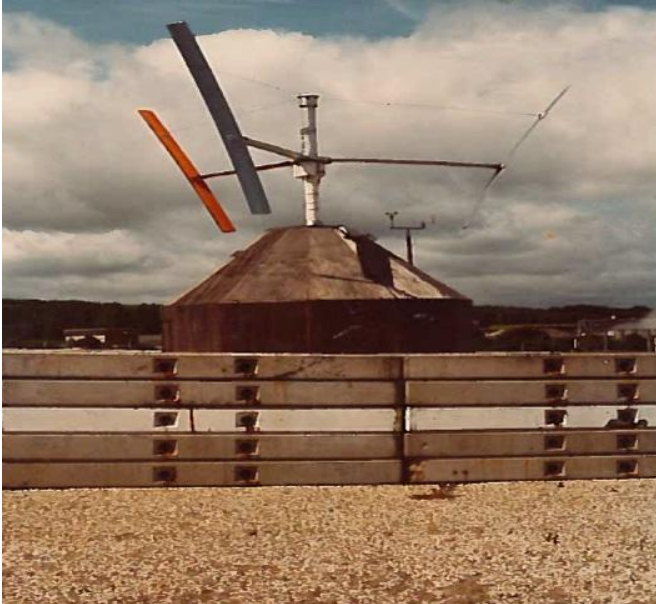
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Tuesday 22 February 2022 marked the fourth anniversary of STFC Rutherford Appleton Laboratory's current wind turbine and its installation on the Energy Research Unit (ERU) test site.

The test site, which was founded in 1978, is available to energy researchers and students to investigate new and renewable energy exploitation. It is notable for its involvement in innovative wind energy research in the 1980s and 90s in areas such as aeronautics, electrical engineering, meteorology and mechanical engineering. In 1978, ERU staff members were involved in the creation, and subsequent running, of the **British Wind Energy Association**, which later became the trade association **RenewableUK**. Over its lifetime the ERU has been the home to a variety of wind turbines, each of which added another facet to RAL's history in pioneering energy research.

The first wind turbine installed on the site was a **Vertical-axis Wind Turbine (VAWT)**. It was originally built for a sustainable building in Cambridge but, after a change of heart, it came to RAL in 1978. The VAWT was one of the first post-1960s experimental wind turbines in the UK and provided vital input into the debate of whether turbines should have a vertical or horizontal axis. The turbine was removed in 1999 to make way for the **Building Integrated Wind Turbine's (BUWT)** concentrator.

In 1983, five years after the installation of the VAWT, a second wind turbine was added to the site – the American-built **North Wind L-916 turbine**. The new 14kW turbine was used in wind/diesel experiments and also provided data for projects modelling dynamically active turbines. It is interesting to note that the turbine's maintenance logs recorded a repeated issue of jackdaws making nests in the turbine cover! The equipment was finally dismantled in 2005 (having been rebuilt in 1996) and was taken to the University of Leicester for use in undergraduate projects.



VAWT installed at RAL in 1978.



North Wind Turbine in 1986.

Fast forward to 1990, the **Windharvester** was installed. This 45kW turbine featured a 17m rotor diameter, three blades and a 15m high tower. It was designed for high wind speed locations, a similar machine provided power on Fair Isle in the Shetlands for many years. The turbine was refurbished in 2000-2001 and raised again in July 2002.



Windharvester installation in 1990.

In October 2016, the Windharvester was lowered for a final time to make room for two new ISIS buildings (R105 and R106). While the turbine generated 549,305 kWh over 23 years, it had spent a significant amount of time being instrumented during various research campaigns.

In its later years, the Windharvester's role was used solely to generate power into the RAL grid and to be a large exhibit for Public Engagement purposes. It was lovingly maintained for many years by Technology Department staff members Peter Anthony and Alan Ruddell.

The test site has also hosted two turbines designed by Imperial College. The first – a 5kW, 6.5m diameter, two-bladed, upwind, variable pitch and speed device on a 10m tower – was erected in 1987. The turbine was used in various PhD projects until it was dismantled in 1997 and taken to Loughborough University. The second Imperial College turbine – the **Sail Wing turbine** – was much smaller. It was rated at 4kW and featured three cloth sail blades.

The Sail Wing turbine was built to explore a modern replacement of the traditional turbines used on the Lasithi Plateau in Crete and developing countries. It was installed at RAL in 1994, tested for three years and then taken to Crete.



Sail Wing turbine in 1994.

In 1999 the **Building Integrated Wind Turbine (BUWT)** was hosted by the ERU for an EU-funded project led by Imperial College. The structure was made to accommodate very small vertical and horizontal axis wind turbines and was installed to evaluate the optimum design for integrating wind turbines into buildings. In 2016, when the ERU test site was moved, the BUWT was dismantled. This move occurred due to building work and provided the ERU team with a new control room and weather station but resulted in the loss of the Windharvester and the BUWT.



The old ERU test side (in red), the new site (green) and the site of the Green Ammonia Experiment (purple).



Green Ammonia Demonstrator.

On 22 February 2018 the site's latest wind turbine was installed as a part of the Siemens-led £2 million InnovateUK project involving Cardiff University, the University of Oxford and the Energy Research Unit. As part of the project, STFC had committed to providing the **Green Ammonia** demonstration plant with a supply of renewable electricity from a wind turbine.

After some initial research, the ERU team realised it would be cheaper to install a new wind turbine than to install the foundations and ducts required by the existing Windharvester (which was later sold to a farmer in Scotland). A specification was

drawn up for the purchase and installation of the new Britwind 12kW turbine, a three-bladed upwind turbine optimised for low wind speed.

During the four years the Britwind has been at RAL it has generated over 80,000 kWh. It starts generating at low wind speeds (3 to 4 m/s) until the rated wind speed (about 12 m/s) when it generates its maximum power of 12kW. Above the cut-out wind speed (about 14 m/s) the wind turbine starts to be shut down for safety and to avoid excessive stress as happened during Storm Eunice.



Installing the new wind turbine in February 2018.



Britwind in operation in 2018...



...and still operating this winter.

Today, the UK has nearly 11,000 operational wind turbines (on land and offshore) with a capacity of 24,629 MW and in 2020 24 percent of the UK's electricity was generated by wind power.

If you are interested in finding out more about new and renewable energy research at RAL, please visit the Energy Research Unit's website: <https://www.eru.rl.ac.uk/>

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