Technology Strategy Board
Driving Innovation

Innovation **results**

AN R&D CASE STUDY #045

Renewable energy storage cuts carbon emissions

Storing surplus renewable energy and then releasing it back to the grid at times of high demand improves the efficiency and economics of renewables generation and reduces reliance on polluting power stations.

The need

Increasingly, renewable energy technologies are being used to cut carbon emissions by reducing the need for electricity from fossil-fuelled power stations. As renewable technologies rely on natural sources of energy (eg wind, sunlight), supply is intermittent and unpredictable. During periods of high demand or when there is insufficient renewable energy being generated, fossil-fuelled stations generate electricity to balance supply and demand. To reduce this requirement, one option is to develop large-scale energy storage systems that store surplus renewable energy when supply exceeds demand and release it when demand increases.

The results

There has been limited development in large-scale energy storage system technology. For many applications, conventional lead-acid batteries are used, but they are an expensive and inefficient option because of performance limitations and the need for frequent replacement.

In this collaborative project, Camco Advisory Services (CAS) Ltd – now Renewable Energy Dynamics Technology (REDT) Ltd – led a consortium that successfully designed, developed, constructed and tested a prototype 5 kW energy storage system based on vanadium redox flow battery (VRFB) technology.

The principal advantage of VFRB is that, unlike conventional batteries, it separates the power delivery module (known as the stack) from the energy storage medium (electrolyte) and can be charged as quickly as it was discharged. Energy can be stored for days and returned to the grid when required.

The challenge for this project was to develop a unit with a production cost of £700/kW for 2-hour storage and an 80% efficiency. Conventional soluble lead-acid battery technology has a cost of about £1,200/kW. The innovative aspects of the prototype battery are injection moulded frames and shunt current reduction techniques (which are the subject of a new patent application), low impedance cells and high energy density electrolyte.

The 5 kW system has met all expectations and the next stage will be to develop methods of connecting individual units together to make commercially attractive units capable of storing several hundred kW of renewable energy.

Market potential

The main markets for energy storage are:

- Distributed conventional generation.
- Renewable power generation.
- Grid support.

According to the lead partner, these markets have an estimated global value of USD20 billion. Increasing world energy consumption, use of renewable energy and the rising cost of fuel mean that these markets are growing rapidly. The VRFB also has a pivotal position in terms of the development of the 'smart grid' as it enables multiple generation sources to be managed simultaneously.

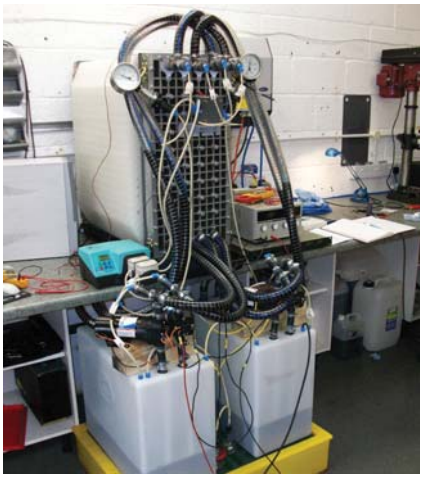
Identified market applications/customers

- Renewable power generation – reducing intermittency in supply from wind and photovoltaic sources in remote locations.
- On/off grid mobile telecommunications base stations – for use in conjunction with renewable power generation sources.
- Water utilities – improved efficiency of diesel generating sets and renewable power generation sources.
- Concentrated solar power generation – for night-time power availability.
- Domestic solar power installations – back-up energy storage to match household demand.
- Small and medium-sized enterprises with high energy demand (eg bakeries, data centres, factories, supermarkets) – to enable off-grid function in conjunction with renewable generation sources.
- Major power generators and distributors/utilities – grid/network support (from 2013/14 when development work on a larger, utility scale system has been completed).

Next steps

As a direct result of the success of this project, additional funding is being sought to finance and undertake:

- The development of a plant to extract vanadium from fly ash and heavy oil.
- The establishment of a plant to process vanadium pentoxide powder tor electrolyte production.
- The setting up of a high-volume electrolyte production facility.
- The design, development, construction and proving of a larger stack system suitable for the utility market.



Laboratory trials of the 5 kW energy storage system

'Technology Strategy Board funding has enabled us to prove a new form of energy storage technology. We are now ready to scale up the technology for world markets.'

GARY SIMMONDS, RENEWABLE ENERGY DYNAMICS TECHNOLOGY LTD (REDT)

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Project partners
University of Southampton (Research Institute for Industry)
Swanbarton Ltd

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£490,854

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£965,567

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