

EcoIslands shown the Wight way to go green with smart grid and hydrogen energy

By Steve Barrett – Editor

EcoIsland is a wide-ranging initiative under which the Isle of Wight – a mainly tourist-oriented island off the English south coast – plans to become a net energy exporter by 2020, while halving its residents' energy bills, eliminating waste going to landfill, and creating a significant number of green-tech jobs. EcoIsland – the largest single sustainability project in the UK – will also see hydrogen vehicles on the roads and in the water around the Island, as well as providing a demonstration of smart grid technologies in tandem with the use of hydrogen for both vehicle refuelling and energy storage.

Islands are different

Like many islands, the Isle of Wight (IOW) is particularly vulnerable in terms of meeting its energy, fuel, food, water, and waste disposal needs, and in particular it wants to improve its energy security. The Island benefits from some of the best natural resources in the UK, with great solar, wind and tidal power potential, as well as promising geothermal resources just 2 km below the surface.

EcoIsland aims to make the Isle of Wight energy self-sufficient and carbon-neutral by 2020, through technological innovation and by promoting and providing incentives for social change. The EcoIsland concept is the brainchild of a charismatic local man, David Green, who has worked with a wide range of local people and international companies to bring it to fruition.

There are already quite a few solar PV installations on the Island, to the point that at some times (e.g. Sunday mornings) the IOW is actually a net exporter of energy. Plans are in hand for a £25 million (US\$40 million) project to install rooftop solar panels on much of the social housing across the Island, with small and medium-scale wind turbines also being encouraged for the wider community and small businesses. The IOW Council is also looking at utilising energy-from-waste technologies, given the very limited space available for landfill disposal.

Furthermore, EcoIsland is investigating possible tidal power installations at Hurst Narrows in the west and/or St Catherine's Point at the southern tip. 'The tidal project

is one of the most highly evolved,' says Green. 'We have 15 companies interested in demonstrating their technology as part of the first phase of this project, and feasibility studies have been completed.'

Community Interest Company

David Green is co-founder and CEO of the EcoIsland Community Interest Company (CIC), which was launched in 2011 to provide a formal entity with the broad goal of improving the resilience of, and promoting and achieving sustainability in the Isle of Wight.

'The tidal project is one of the most highly evolved'

The CIC is a newly constituted regulatory framework in the UK that is specially designed to accommodate social enterprise initiatives. The CIC is allowed to buy, sell, borrow, lend, own assets, and employ without the typical constraints of a charity. The key principle is that all of its assets are locked into the community it serves. The EcoIsland CIC is also backed by the financial and technical resources of global partners Toshiba, IBM, Cable&Wireless Worldwide, and Silver Spring Networks, and national partners Toyota, SSE, ITM Power, Gloucester Composites, and Southern Water, as well as some 60 other partners and organisations.

Local and national energy approaches

Within the EcoIsland CIC sits the EcoIsland Energy Service Company (EESCo), which will also act as an energy aggregator to enable the trading of generation and demand assets for the Island on the UK's energy markets. A smart grid infrastructure will be deployed to support the special projects, allowing the EESCo to integrate both generation assets and demand-side resources from the Island's small and medium enterprises (SMEs) and domestic consumers.

This smart grid balancing system, with significant demand-side management capabilities, will enable loads to be curtailed where advantageous market conditions prevail. The minimal latency of the system will enable the aggregated system output to be traded on the balancing mechanism and provide fast demand response for the National Grid.

Energy storage is the 'holy grail' of the aspirant smart grid, and the EcoIsland partners are involved with a number of trials of battery and hydrogen storage to supplement the energy system. This extra layer of fast response enhances the flexibility of the aggregated load available for trading. By managing the smart infrastructure and ensuring the stability of the grid, the EESCo will reduce the need for expensive network reinforcement.

The Isle of Wight network is already one of the most advanced, self-healing networks in the UK at the 11 kV level, which is optimal for smart grid operations. The system will be monitored and managed centrally, and will be optimised to ensure benefits for Island residents while maximising the tradable value of the energy generated and stored.

Much of the generation will be committed to power purchase agreements, and benefit from subsidies such as Feed-In Tariffs (FITs), Renewable Obligation Certificates (ROCs), and Renewable Heat Incentives (RHI), with

a proportion of the energy output being held outside of this mechanism to enable trades on the Short Term Operating Reserve (STOR) and bilateral markets.

The heart is smart

At the heart of the EcoIsland project is a smart grid infrastructure developed in collaboration with global partners Cable&Wireless Worldwide, Silver Spring Networks, Toshiba, and IBM.

Cable&Wireless and Silver Spring Networks are providing technology for the IPv6 communications platform, that is a combination C&WW network and radiofrequency wireless mesh that connects houses, SMEs, and the component parts of the Virtual Power Plant (VPP) resources. The communications platform provides two-way control, and data can be sent back to the central hub for processing. The platform is resilient, self-healing, and capable of remote upgrades to ensure that it is future-proof.

The asset and telemetry data are routed to the EcoHUB data centre for processing. Initially this is likely to be a small server application at St Cross Business Park in Newport, but as the need for larger-scale data processing emerges, there are plans to establish a larger, 'green' data centre. The proximity of the processing systems to the generation and demand-side assets is critical, as this reduces

latency and ensures maximum responsiveness and security of the system. The wireless mesh platform has one of the most sophisticated authentication and encryption systems available.

The control systems need to monitor the performance and outputs of the generation assets, and provide real-time assessments of the demand side of the market, with links to the houses and SMEs and the loads being managed by the utility SSE, as the Distribution Network Operator. The systems also need to provide a level of forecasting for assets, and reflect an accurate profile of the energy market by assimilating the patterns of the trades that are undertaken. Finally, they need to provide a control mechanism for curtailment events, and a feedback loop to the plant and machinery across the Island.

As a by-product of this, the systems provide very accurate output information and alarms. The data will be accessible via central control screens in the main trading centre, but there will also be the option of displaying summary data in a real-time dashboard format on public display.

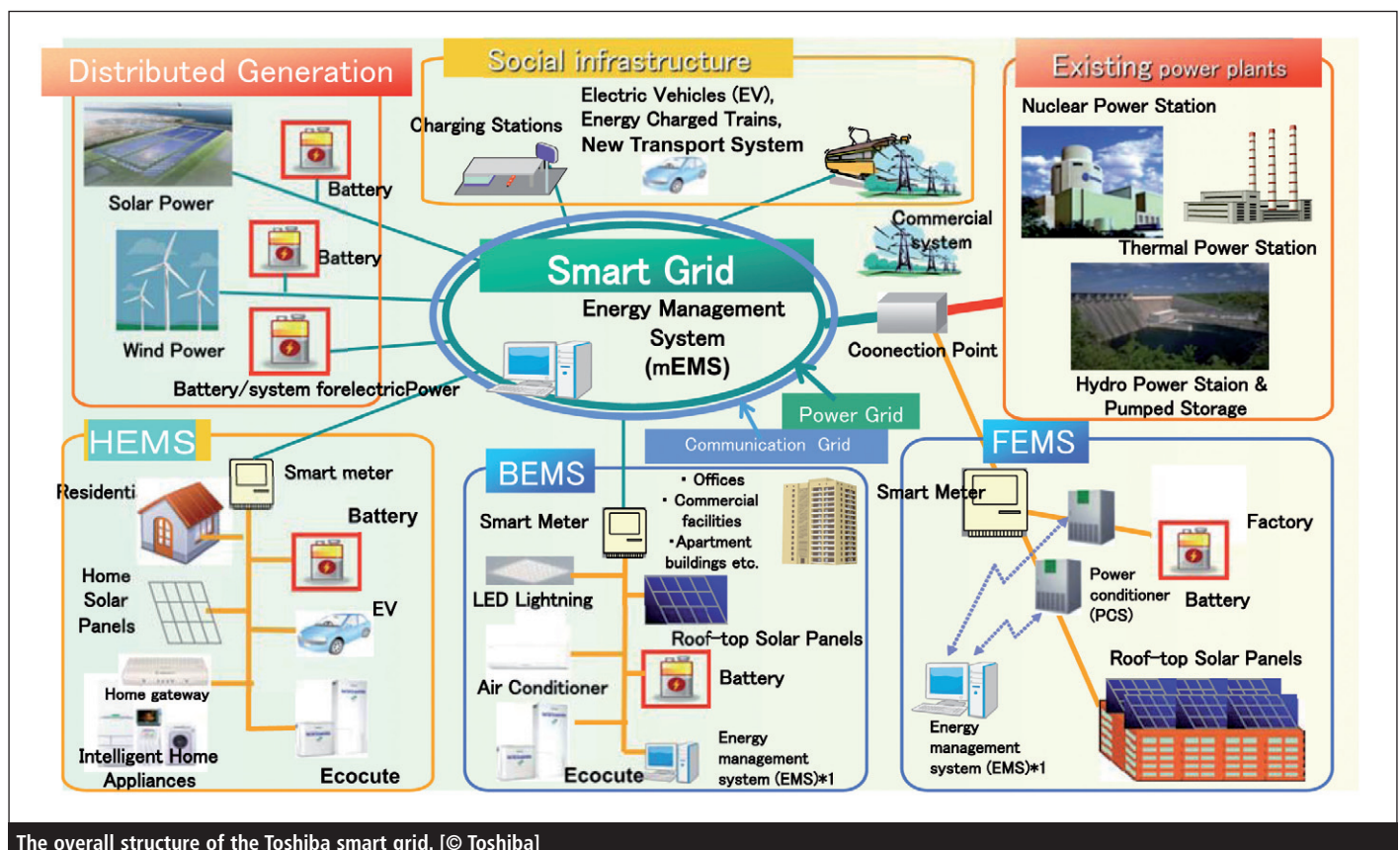
One of the hidden benefits of this system will be to provide SSE with a fully integrated load management system, that can interface with its existing system to help balance the load and provide frequency response for the mix of generation assets.

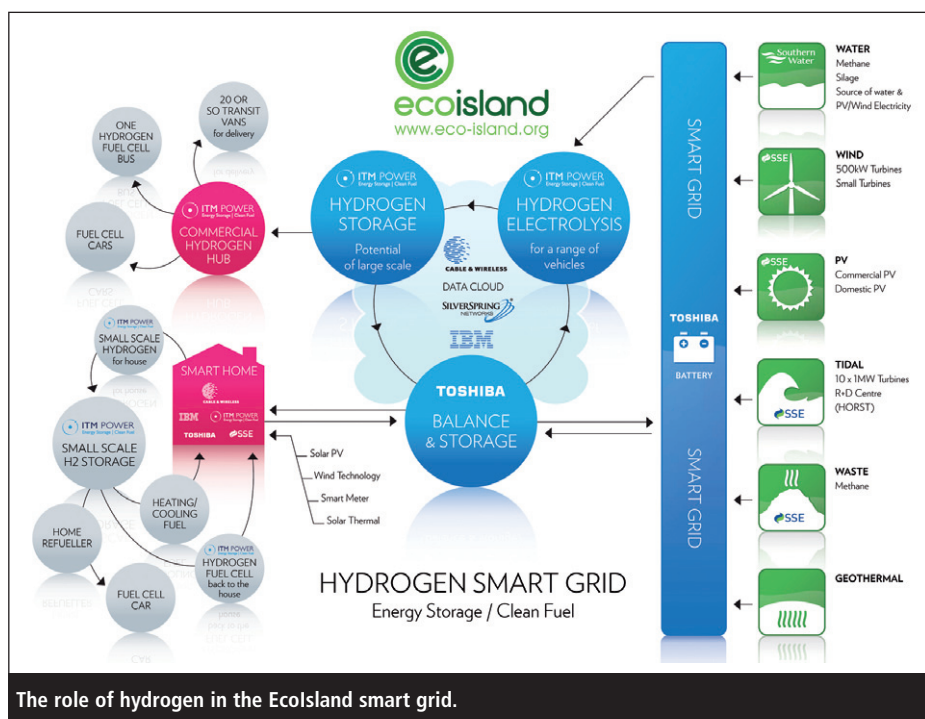
Solar and wind are intermittent resources, with a lot of energy when the sun is shining or the wind is blowing, and little or nothing when they are not. Total oversight of this generation capacity will provide a mechanism for balancing the loads using storage and demand-side management, thus reducing the need for 'spinning reserve' and avoiding costly re-enforcement issues. The active management of loads and generators connected to the grid can also help alleviate issues such as voltage, frequency, and reactive power control during faults.

The net result of all the smart grid technology will mean a more stable and balanced grid network, with less of the generated capacity needing to be constrained by the network operator, and thereby maximising the value of generation from assets and producing a higher output per MW installed. In addition, it should help migrate home and SME demands away from peak times which, following the introduction of time-sensitive tariffs, will result in reduced energy bills.

Hydrogen energy

EcoIsland will also use renewably produced hydrogen for transportation fuelling and as energy storage. In the summer the Technology Strategy Board, which acts as the UK government's innovation agency,





The role of hydrogen in the Ecoland smart grid.

awarded a grant to fund a £4.66 million (\$7.5 million) project that will build and integrate a hydrogen energy storage and vehicle refuelling system into the power system in the Isle of Wight [FCB, July 2012, p1].

The project will be led by Sheffield-based ITM Power in collaboration with SSE, Toshiba, IBM, Cable&Wireless Worldwide, the National Physical Laboratory, Cheetah Marine, Arcola Energy, the EcoIsland CIC, and the Universities of Glamorgan and Nottingham. ITM Power will receive £1.3 million (\$2.1 million) of grant funding directly, with a further £1 million going to the collaboration partners who are integrating their equipment with ITM Power's refuelling technology. [See the feature on ITM Power's hydrogen refuelling technology in FCB, January 2012.]

The project focuses on the integration of an electrolyser-based hydrogen refueller with the Island's renewable energy sources. This allows the electrolyser to act as a demand-side management (DSM) mechanism to manage the variable load of the renewables, storing excess energy as zero-carbon hydrogen fuel for vehicular use.

There is also the potential in the future to sell excess hydrogen to the natural gas network, which can take up to 15% hydrogen, decarbonising the gas supply without any changes required to existing appliances. ITM Power is participating in a separate feasibility study, called GridGas, to look at injecting hydrogen generated using electrolysis fed by excess renewables into the UK's gas networks [FCB, April 2012, p1, and September 2012, p8].

The hydrogen project will design, build, install, and operate two grid-connected hydrogen refuelling platforms in the Isle of Wight, with both offering dual 350 and 700 bar refuelling capability. A 15 kg/day refueller will be used in a marine application located on the south coast of the Island, and a larger 100–125 kg/day unit will be installed at a centrally located business park for the operation of a fleet of hydrogen vehicles, including vehicles from Hyundai, Microcab, and Riversimple. The vehicles showcased will include fuel cell electric vehicle (FCEV) cars, hydrogen internal combustion engine (HICE) vans, and a HICE boat.

'We are delighted that the Technology Strategy Board is backing this key element to our plans'

The system includes integrated power control systems to allow the electrolyzers to operate as a DSM load under a variable load factor, and a highly accurate metering and monitoring system for hydrogen delivery. The project participants have the following roles:

- ITM Power will design and build two hydrogen refuellers, and take a key role in the system integration.
- SSE is providing the grid connection to utilise the Island's renewable energy sources, and will use the refueller and vehicles in the final year of demonstration.
- Toshiba will ensure compatibility of the hydrogen system with its Energy

Management System and the Distribution Network Operator (DNO) networks, which will enable it to actively participate in the energy balancing of the distribution network in future.

- IBM will develop a user interface to allow smart card payment facilities to the refuellers, in order to meter and monitor the provision of hydrogen.
- Cable&Wireless Worldwide will provide communications to allow remote monitoring of both the refuellers and the vehicles, and allow data collection and data 'cloud' integration.
- The National Physical Laboratory will develop hydrogen purity tests to ensure compliance with FCEV requirements (ISO14687-2).
- The EcoIsland CIC will assist with site surveying, planning applications, and will operate the hydrogen car club, which counts wind energy company Vestas and Southern Water among its members. With Arcola Energy the CIC will organise and run an FCEV road show with ride & drive opportunities.
- Arcola Energy will develop an educational and dissemination package, and will provide public and commercial engagement activities.
- Cheetah Marine will build a hydrogen catamaran in conjunction with ITM Power, and operate it in validation trials.
- The Universities of Nottingham and Glamorgan will evaluate the performance and operating characteristics of the hydrogen refuelling stations, and use their own ITM Power electrolyser-fed refuelling stations to devise refuelling strategies to optimise the efficiency of operation.

Project management and reporting will include a high-level steering group, meeting twice a year, that is made up of consortium executives, key industry and other stakeholders, and representatives from automotive OEMs including Toyota Europe and Hyundai.

'We are delighted that the Technology Strategy Board is backing this key element to our plans,' says David Green. 'We will be the model for the future smart grid, and the Isle of Wight will become a global centre for energy technology. The team we have pulled together for this project has the potential to lead the world in smart grid systems.'

Hydrogen mobility

The Isle of Wight hosted one of the initial hydrogen vehicle and fuelling

demonstrations in ITM Power's Hydrogen On-Site Trials (HOST) programme, with Vestas Wind Systems. The Danish wind turbine manufacturer has a research and development centre in Newport, which under HOST operated two Ford Transit vans with hydrogen internal combustion engines converted by Revolve Technologies. (There also a small number of charging points for battery electric vehicles.)

As well as the hydrogen road vehicles, ITM Power is also providing refuelling for a hydrogen powered catamaran in a project with boat builder Cheetah Marine in Ventnor [FCB, January 2012, p8]. The companies will work to optimise existing gasoline outboard motors to run on hydrogen, reducing both emissions and fuel costs. The resulting vessel will be taken through the approvals process, to be marketed as a product alongside ITM Power's refuelling equipment.

'Hydrogen is a realistic fuel substitute for marine applications, and will play a vital role in reducing emissions while helping to protect the sensitive inshore environment,' says Sean Strevens, Managing Director of Cheetah Marine.

Island energy systems are one of the key entry markets for onsite hydrogen fuel production, since islands have high fuel prices and difficult fuel logistics. Most island systems utilise significant numbers of marine vehicles, which represent a sizable global market for outboard engines. Emissions are an important focus for the industry, owing to restrictive use in the sensitive environment around the shore.

EcoIslands Global Summit

With the Isle of Wight's EcoIsland project now under way, the idea is being pushed out to other communities around the world that also want to be self-sufficient in renewable energy and achieve sustainability in their land space. This is open to regions and cities as well as islands, since the emphasis is on community ownership.

To this end, the first EcoIslands Global Summit took place in Cowes, Isle of Wight in mid-October, with speakers and participants from numerous other island and regional communities. As well as workshops for discussion of the many aspects of the EcoIsland concept, the summit included a number of presentations on the various technologies in hand or under consideration.

The keynote speech was given by the UK's energy minister, John Hayes, in a clear signal that the national government sees



A Revolve Technologies HICE van, the ITM Power transportable hydrogen refuelling station, and a Hyundai ix35 Fuel Cell vehicle being demonstrated at the recent EcoIslands Global Summit.

this initiative as a significant step towards communities taking responsibility for their own energy needs and local environmental sustainability.

'What we're doing with EcoIslands is hugely ambitious, but it's also practical, scientifically sound, measurable, and verifiable'

'What we see here today is the embodiment of the kind of approach which is close to my heart in developing another new paradigm, the new paradigm of local ownership of energy,' says Hayes. 'It is central to the EcoIsland approach, which is about local people taking control of their own futures by making the ambitious commitment to living within their means – giving themselves securer supplies of energy and lowering their energy bills.'

Another key element of the summit was discussions and negotiations to encourage signatories to the EcoIslands Accord. This aims to unite island and regional communities around the world in a public commitment to the ambitious targets of becoming renewable energy self-sufficient by 2020, and sustainable by 2030. The latter is taken as the community's 'ecological footprint' – a broader measure of sustainability than the widely discussed carbon footprint – being no larger than the actual land area it occupies. By way of example, Oxford-based sustainability consultants Best Foot Forward have calculated the IOW's ecological footprint, which has been estimated as nearly three islands' worth of land – which clearly is not sustainable. EcoIsland and other IOW initiatives are expected to be already making progress in bringing this down.

The EcoIslands Accord signatories so far include Bornholm in Denmark, Winchester Action on Climate Change (representing the Hampshire city/region), and proxy signatures by the Scottish Islands Federation (15 in total) as well as Eigg and Cumbrae, and the US state of Hawaii, with other communities needing more time and discussions back home before formally signing the Accord.

'What we're doing with EcoIslands is hugely ambitious, but it's also practical, scientifically sound, measurable, and verifiable,' says David Green. 'Often it's the smallest places that can demonstrate the greatest change, and what we are doing on our small islands is providing an example of what countries and continents can do around the world.'

The Summit closed with a live video link to the first EcoIslands Ambassador, reggae artist and sustainability advocate Derek Sandy on the Caribbean island of Tobago, who gave the first play of his specially written reggae song as an anthem for the EcoIsland movement.

The next Global Summit will take place next year on the Baltic island of Bornholm, with a further announcement once the initial arrangements have been made.

Further information

EcoIsland: www.eco-island.org

ITM Power: www.itm-power.com

Cable&Wireless Worldwide, Utilities:
www.cw.com/services/industry/utilities

IBM, Smart Grid:
www.ibm.com/smarterplanet/us/en/smart_grid/ideas

Silver Spring Networks, Smart Metering:
www.silverspringnet.com/products/metering-devices.html

Toshiba, Smart Community:
www.toshiba-smartcommunity.com/EN