The Eco ISLAND

El Hierro, an island in the North Atlantic, is about to give up fossil fuels. **Jennifer Carpenter** investigates if the British Isles could follow suit

ALAMY

The UK's energy prices are soaring. As gas and oil reserves run dry, the cost of energy will continue to climb. But what if we could wean ourselves off fossil fuels and make the jump to clean, renewable energy?

This is exactly what a small island off the coast of Africa plans to do. With a population of 11,000 people, El Hierro is building a solution to its mounting energy costs. As the most remote Canary Island, it struggles to meet the high price of shipping oil from the mainland. But what the island lacks in fossil fuels it makes up for in wind – over 3,000 hours a year of gusts blowing fast enough to propel windmills and generate electricity. And on the rare windless day, El Hierro hopes to bridge the gaps in its electricity supply with the ultimate energy cache: a 500,000m³ reservoir some 700m up inside the island's dormant volcano. When the power supply dwindles, the reservoir can be drained downhill through turbines to generate electricity.

Energy on tap

Pumped storage, as this technology is known, has been around for decades. The UK has four such pumped storage stations. The largest, Dinorwig in Snowdonia, ▶

Construction begins on the tunnel that will carry the water down from the upper reservoir

has been on the grid since 1984 and has a storage capacity of around 9GWh, or enough energy to run the whole country for 15 minutes. That doesn't sound very long, but Dinorwig was largely designed to help the UK balance its energy demand, not to deliver energy outright.

Just like the storage facility on El Hierro, Dinorwig works by pumping water from a reservoir uphill when energy demand is low to a second reservoir higher up. This is then released at times of high demand, like when the country collectively turns the kettle on during an ad break in a crucial World Cup match.

It's a system that's flexible and can react quickly, says Tobi Kellner from the UK's Centre for Alternative Technology (CAT). "Dinorwig can be brought to full generating capacity in 16 seconds," he adds, "and can play a major role in balancing supply and demand". This balancing act can help a nation like the UK to smooth out the spikes and troughs in demand on a grid that's mostly fed by fossil fuels and nuclear energy, which can be slow to match changes in demand.

But can pumped storage be relied upon to meet a grid's entire energy needs? This is what the residents of El Hierro are about to find out.

Powering up

Harnessing El Hierro's wind has meant two decades of planning for the islanders. Tomás Padrón, the island's president, started measuring wind speed in the 1980s in the hope of solving his island's energy problems.

The project became a reality when a €35m (£31m) grant from the Spanish government was secured, which the island matched with funds from its own government, the Canary Institute of Technology, and Endesa – Spain's largest electric utility company.

The construction so far has entailed the digging of a sea-level reservoir, the installation of three desalination tanks and hydroturbines, and a thorough testing of the volcanic crater to ensure that it won't collapse under the weight of the vast quantities of water planned for it.

The island now awaits delivery of its five windmills. Once installed they will allow the island to begin testing its new power project. The aim is to generate as much as 11.5 megawatts of electricity per year: that's two and a half times the island's current energy demands. And as a backup to this wind power, the island will rely on its giant water-filled crater, which will release desalinated seawater – pumped uphill on windy days – to run downhill through turbines.

The island could keep going for between two and 2.5 days even with no wind at all

John Loughhead, the executive director of The UK Energy Research Centre, estimates that if the crater is full, based on their current energy requirements, El Hierro could keep going for between two and 2.5 days even with no wind at all.

"If we [in the UK] could have more pumped storage we would," says Loughhead. But the trouble with this technology, he explains, is that it's very expensive. And there's little scope for building more storage capacity because suitable locations in the UK are limited. "We could have a lot of wind turbines out at sea, and we could take over a quarter of Scotland and fill it full of lakes, and it would work, [but] it's quite a big civil ▶

With just 11,000 residents, El Hierro's fuel demands are modest – making renewable energy a viable option

MARCO ANSALONI/LIGHT MEDIATION AGENCY. ILLUSTRATION BY PAUL WOOTTON

TRICKLE-DOWN THEORY

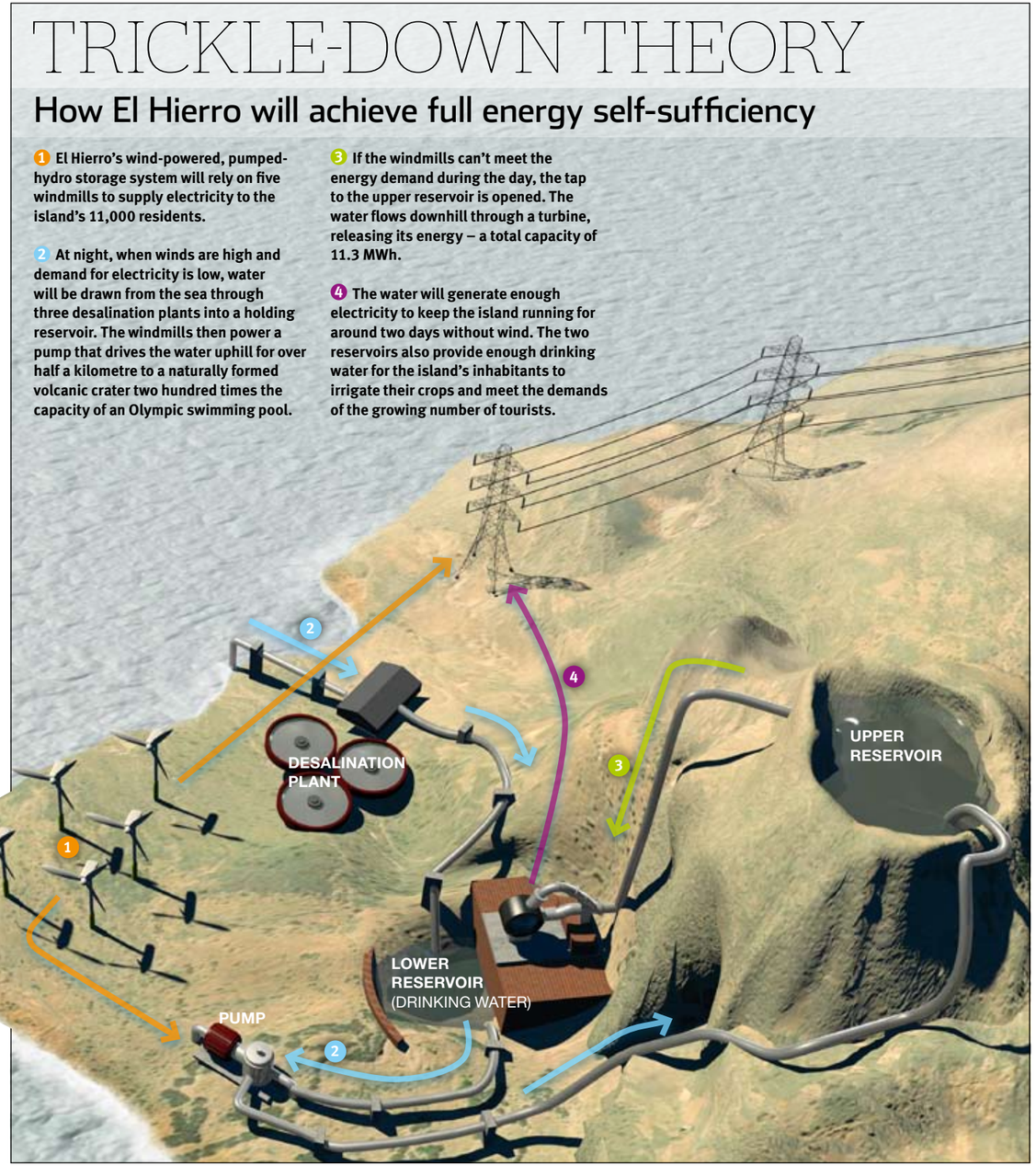
How El Hierro will achieve full energy self-sufficiency

1 El Hierro's wind-powered, pumped-hydro storage system will rely on five windmills to supply electricity to the island's 11,000 residents.

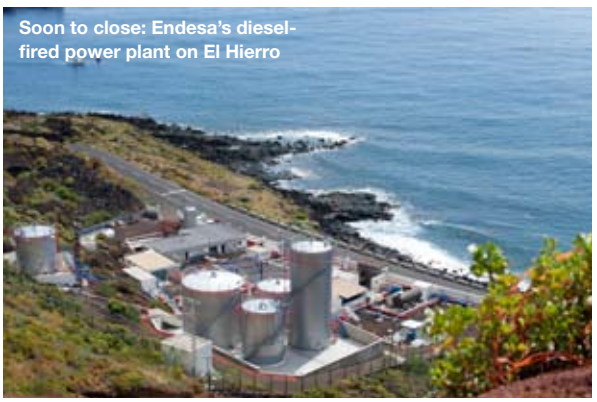
2 At night, when winds are high and demand for electricity is low, water will be drawn from the sea through three desalination plants into a holding reservoir. The windmills then power a pump that drives the water uphill for over half a kilometre to a naturally formed volcanic crater two hundred times the capacity of an Olympic swimming pool.

3 If the windmills can't meet the energy demand during the day, the tap to the upper reservoir is opened. The water flows downhill through a turbine, releasing its energy – a total capacity of 11.3 MWh.

4 The water will generate enough electricity to keep the island running for around two days without wind. The two reservoirs also provide enough drinking water for the island's inhabitants to irrigate their crops and meet the demands of the growing number of tourists.



The upper (and larger) of the two hilltop reservoirs that will power El Hierro's pumped storage facility



Soon to close: Endesa's diesel-fired power plant on El Hierro

The UK's largest pumped storage facility, Dinorwig

DINORWIG, MARCO ANSALONI/LIGHT MEDIATION AGENCY X 2

▶ engineering project," he explains. But even if the formidable task of building these elevated lakes was realised, could they contribute substantially to the UK's energy grid? Currently the UK's four pumped storage stations have a total capacity of around 30GWh. In 2009, the UK grid consumed around 40GW in one hour. In other words, the total pumped storage capacity of the UK is enough for a bit less than one hour of average electricity consumption.

El Hierro, on the other hand, has a smaller population and lower energy demands. Crucially, it also has little choice in how it will meet those demands. "This looks like a very sensible thing to do," says Loughhead.

The road to progress

Every year the El Hierro project will generate around €7m (£6m) worth of energy, saving the island 40,000 barrels of oil, which would cost €2m (£1.7m) at current oil prices. The two reservoirs will also provide residents with enough water to irrigate their crops, fill their glasses and meet the demands of holidaymakers.

"If you have water, and you have energy, you can have food," says Javier Morales, El Hierro's vice president. For him, a source of energy that can sustain the population and economy of an island the size of El Hierro, with little impact on the island's delicate environment, is the paragon of self-sufficiency.

This autumn the island will flick the switch on its new energy project, and although Mr Morales predicts the energy solution might need some tweaking, he hopes to boil his own kettle with clean, island energy by early next year at the very latest. But his ultimate ambition is that El Hierro's success will inspire other islands to follow suit. ■

Jennifer Carpenter is a science and environment reporter for BBC News

WHAT DO YOU THINK?

Should the UK get more of its electricity from renewable sources?

post@sciencefocus.com