

Europe Clean-energy solutions

Island pioneers future

Isolated communities can show the world how to create the green power grids our planet needs, writes **Darius Snieckus** in Berlin

The Portuguese island of Graciosa, a 10km-long volcanic outcrop in the Azores, has for many centuries been known as the white island, for its sea-bleached rocky southern coast. But with the development there of what is expected to become the world's first bona fide stand-alone renewable-energy network, "green" might become the new "white".

Berlin-based Younicos, a spin-off from German solar module manufacturing giant Solon, is managing a landmark project that will wire together 7MW of wind turbines, a 1MW PV solar farm and a six-unit 3MW storage facility made up of several sodium sulphur (NaS) batteries to supply the island's 4,600 residents, starting in 2012.

It is currently finalising a power-purchase agreement (PPA) with local utility Electricidade dos Açores (EDA) to switch Graciosa away from electricity generated at its 4.2MW diesel power plant, which needs up to four million litres of fuel imported by tanker each year.

To begin with, the plan is to shift the energy production balance so that 75% comes from renewable-energy installations, while the remaining output continues to be supplied by the

diesel generator. Eventually, however, as technology improves and the price of energy storage drops, and the price of fossil fuels and CO₂ emissions climb, it is hoped the island will go 100% renewable.

"Everybody involved really wants to move forward with this project and we are in the final stages of negotiating the PPA, which will really get us out of the starting blocks," Younicos spokesman Philip Alexander Hiersemenzel tells *Recharge*.

"The Portuguese are very actively taking up renewables and the Azores even more so — they want to get 75% renewable-energy production by 2018," he adds. "[Graciosa] is the first project on the way towards this."

"The island had thought to use renewable energy in the past as backup but they had never thought of using wind and solar power and large-scale battery storage to make a grid that is autonomous with renewables."

Project engineer Elena Franzen notes: "Graciosa was ideal because it is in a region where energy prices are already high, so we could set out to build a system that is competitive much more easily than on the European mainland."

Despite the enthusiasm to



REASON TO CHANGE:

Graciosa uses up to four million litres of diesel a year to fuel its only power plant

make Graciosa self-sufficient as soon as possible, the local authorities nonetheless had questions about the economic viability of the project that could

not be satisfactorily answered by computer modelling.

So Younicos spent €10m (\$13.1m) setting up an "island test core" plant behind its headquarters in Berlin, where it could simulate delivery of 14GWh per year on a 100% renewable-energy-based grid using wind, solar and load measurements "from any location", complete with one-third scale NaS storage batteries, PV plant and small diesel generator.

"Even if the Graciosa project looks good economically on paper — not least given the state of the price of fuel nowadays — no-one wanted to be the first to implement such a new approach," says Franzen. "So we decided to build a test site where we could simulate the entire energy control system over its lifetime."

At the test site, an actual 200kW Solon integrated PV plant, a pair of 500kW NGK Insulator NaS batteries and a 1MW diesel generator are connected to the control system via medium-voltage cabling, with 1MW wind- and solar-power plant simulators feeding in

"virtual" streams of data that are making it possible for Younicos to build up a body of knowledge about operating the batteries as part of a grid-linked energy management system.

"Producers and consumers are this way simulated in real time using high-resolution measurement data from the island: wind speed, solar radiation and load curves," says Franzen.

"We could have modelled this set-up, of course, but it will always be true that reality functions a little bit different from what you have simulated on the computer — and it is also important that we have a place where potential clients can get a 'hands-on' feeling for how the system would operate."

The five-metre-tall NaS batteries, which are 10 metres wide and 2.5 metres deep, could each supply 500 homes with electricity for six hours.

Their chief selling point is longevity: the 47-tonne NGK unit, which uses technology that has been developed and field-proven over the past 20 years, is designed to last 15 years or 4,500 "full-cycles" — the time



TEST SITE: The PV plant at Younicos headquarters is helping to simulate conditions on Graciosa

Darius Snieckus

Life without fossil fuels



Jose Luis de Silveira

developed in-house. “The idea is to have control of the system within the microsecond range, relying on the intelligence of the components themselves, but we do still have a stand-alone communication system set up to feed and filter data back to us,” says Franzen.

Sitting in the corner of Yunicos’ test site, the diesel generator holds an ironic pride of place, insofar as it has been built to show that it will – ultimately – not be needed, according to Franzen.

“We spent a couple of million euros so that we could push a button and shut down the diesel generator to show that we can supply electricity at the same quality as a conventional power plant with distributed, fluctuating sources, and batteries,” she says.

Graciosa enjoys plentiful renewable-energy resources, with long hours of sunlight and high winds. The island sees an average of 3.75kWh of sunlight per square metre, per day, while winds reach eight to nine metres per second.

Still, by Yunicos’ calculations, an optimised system that could be started up on the island inside two years would need to bolt together 75% renewables and 25% diesel.

Electricity generated by the Yunicos development will be largely for domestic use – the island has three main villages and a dispersed rural population – while 20% of demand will come from two major industrial customers – a stone mill and a dairy manufacturer.

“The Azores are so remote that they will have to burn diesel to



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OPPORTUNITY: The Graciosa project engineer, Elena Franzen

the end of all days; or they have to come up with other solutions. Graciosa is large enough that the project will have an impact and small enough that a company

“Energy prices are already high [in Graciosa], so we could set out to build a system that is competitive”

ELENA FRANZEN

our size can handle it,” states Franzen.

For Yunicos, Graciosa provides the “ideal platform” on which to design and construct a

network that mirrors the European grid in miniature, complete with the supply intermittency “instabilities” linked to renewables. The company will retain control of the installation and machinery, while EDA will own and operate the grid.

The company envisages the wind/solar/battery hybrid as the first in a two-phase scheme. A follow-on project looking at ways to hit the 100% renewables target is being brainstormed, says Hiersemenzel, with ideas ranging from installing energy-efficient household appliances in every home to setting up a pricing tariff that would encourage inhabitants to use energy “when it is there”, rather than drawing down the battery “as and when”.

it takes to charge up and run down.

Yunicos has been experimenting with a range of intelligent inverters that will be connected

to the system to control the rate at which the batteries charge and discharge, in line with the rates of wind- or solar-energy production, using software

Nations big and small unite to develop clean technologies

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The US, New Zealand and Iceland are pressing ahead with a series of pilot projects under the aegis of the Energy Development in Island Nations (Edin) partnership, which was set up in 2008 with the aim to help island nations develop clean-energy technologies, policies and financing mechanisms.

In three pilot schemes, policy advisers, technical experts and financial specialists from the three mentor countries will team up with organisations in the US Virgin Islands (USVI), Dominica and the Pacific island nations to devise clean-energy initiatives.

“Island nations and territories are especially vulnerable to energy price volatility and dependence on foreign oil,” says the Edin secretariat’s Mary Werner. “Islands often have abundant renewable resources, including solar, geothermal, wind and ocean energy.”

“Through this collaboration, our countries can help their island economies across the globe to develop clean energy, while increasing their energy security and addressing the climate crisis.”

The US is partnering the USVI to move the residential islands – comprising St Croix, St John, St Thomas and Water Island – away from their 100%

dependency on fossil fuels for electricity and transport. Energy costs on the USVI run at nearly three times the mainland US average.

In November, a conference of the members of the USVI Energy Action Team was held in St Croix to fine-tune strategies for reaching a 60% reduction in fossil-fuel consumption by 2025, with a focus on clean-energy policies.

A three-year study of the area’s wind resource was launched last year in St Thomas.

Iceland and Dominica are working together to develop the latter’s geothermal resource using the energy transition model devised by

Iceland during the oil crisis of the 1970s, when it shifted away from a fossil-fuel-dependent economy to one rooted in clean-energy production.

As part of the pilot project, Iceland’s UN University Geothermal Training Programme opened its curriculum of short courses to qualified candidates from Dominica.

New Zealand’s pilot project, Geothermal Potential in the Pacific, will take stock of the potential for electricity generation in a number of Pacific island nations, including US territories. The scheme will concentrate on harnessing the potential of geothermal resources to

provide baseload electricity at a lower cost than that sourced from diesel generation.

Some 18 countries will be considered under the report, which will include detailed surveys for islands that have high geothermal potential, together with an assessment of their grid capacity and load factors to flesh out the suitability of tying geothermal power production into the existing grid infrastructure.

The pilot projects are expected to clear the way for “quick action and testing of proposed Edin methodologies; provide valuable lessons; and establish procedures that can be replicated across other projects”, according to Edin.