Island Power: Renewables for Diesel-Powered Utilities

Wind in the Aegean Sea

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HOMER MICROGRID AND HYBRID POWER | 9TH ANNUAL INTERNATIONAL

EWT is the world's leading localised wind turbine company

Best turbine in its class 250kw-1MW range	Localised energy generation	Proven in challenging environment	International operation and presence

Long-term focus on distributed energy with microgrids as a key market segment

Distributed energy:
Generation close to point-of-use, to save on local energy costs and generate local income

Market drivers:
Global efforts to improve access to electricity in remote locations
High cost of diesel-based power
Necessity to decarbonate the power sector

FIT projects:
Generate electricity for subsidised tariffs with local small-scale projects

Repowering:
Replace older turbines at sites with height, logistical and other challenges

Self-consumption:
Replace costly grid electricity with energy from EWT turbines at industrial sites

Microgrid:
Reduce fuel costs and improve security of electricity supply at remote locations

Island power is often fossil based, utilities started to integrate renewables

47 million people around the world rely on +19.000 microgrids. Nearly half of them are powered by diesel generators.

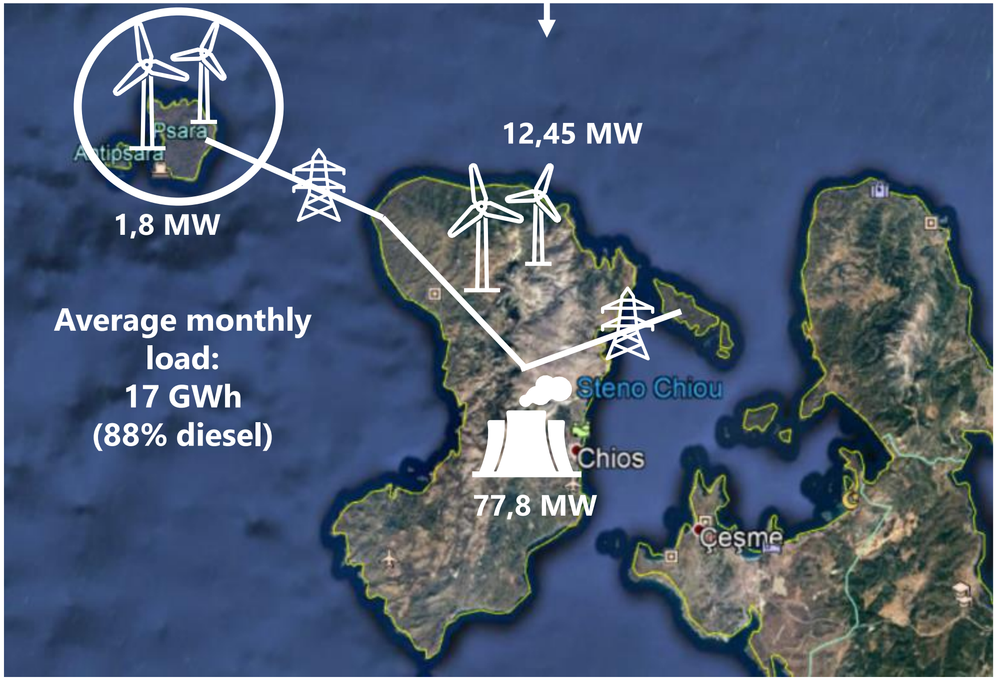
Diesel power is both expensive and a high GHG emitter: utilities have started to phase out these generators and to integrate RE.

Greece aims for carbon neutrality by 2050. It has 61 non-interconnected electrical systems on islands with a combined capacity of 1,8 GW, which rely on expensive and polluting diesel generators. They represent nearly 10% of the electricity consumption in Greece.

There is a clear ambition to phase-out diesel generators: interconnection and integration of RE. There is currently around 500 MW of RE installed in these islands, supplying 20% of the electricity. All this deployment is managed by the national utility, PPCR.

Given its high wind resource, Greece is integrating many wind turbines to these diesel-powered grids: 60% of the RE installed in the islands is wind. EWT has supplied 22 turbines to date in 10 different Greek islands.

Microgrid in Chios is a typical example of the challenge to integrate a high level of renewables



The archipelago (Chios, Psara , Inousses) has a microgrid with a connection between the main island Chios and the much smaller island of Psara that only has 500 inhabitants.

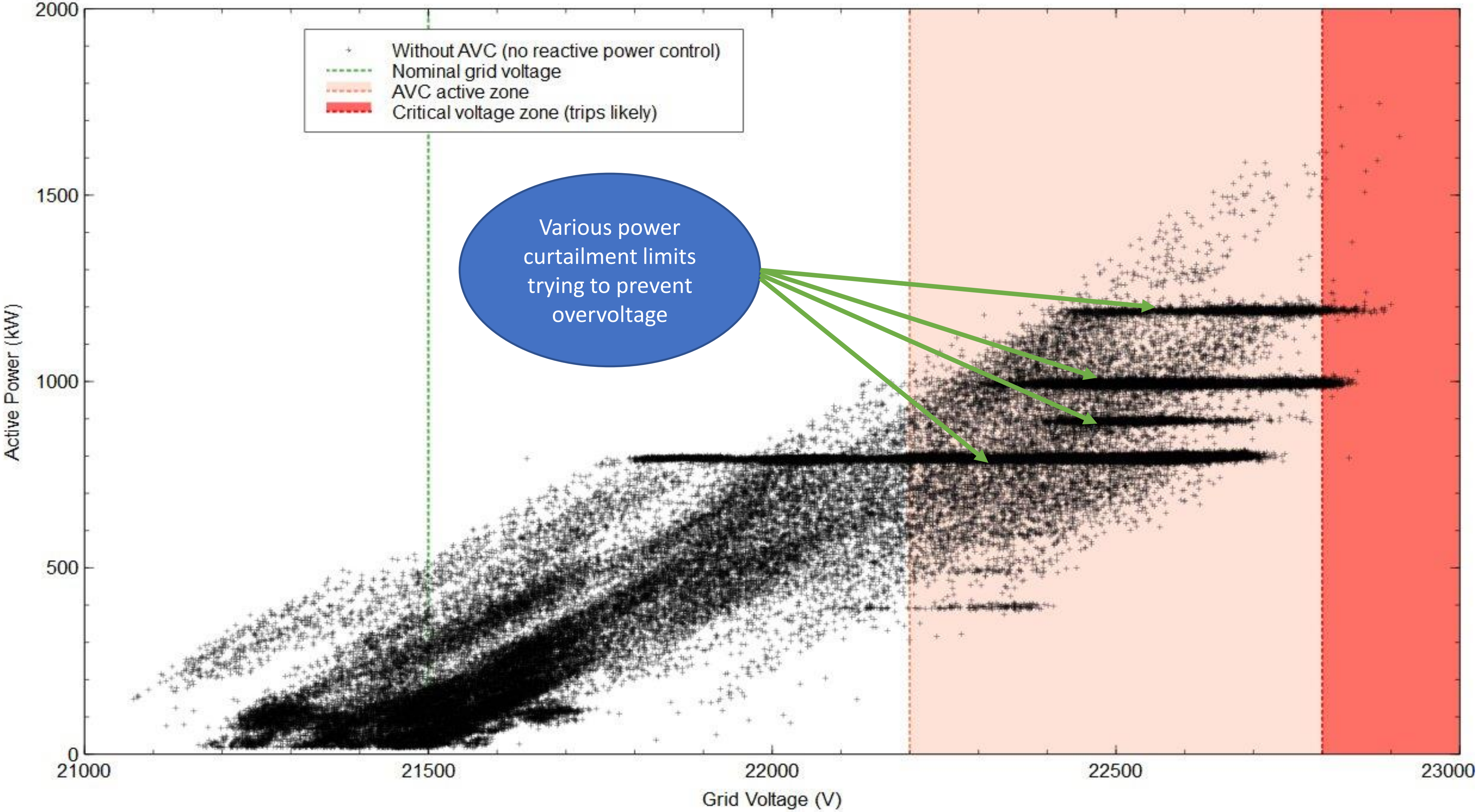
Electricity cost is 80% higher than on the interconnected grid (92€ / MWh) and 88% of the energy is generated using diesel.

Several wind parks have been installed on Chios Island to lower diesel power plant production. To date, EWT has installed 8 turbines on the archipelago.

EWT has helped PPCR to develop a 1,8MW wind park on the island of Psara. The wind park has 2 DW52-900kW turbines and exports most of its production to Chios through an underwater cable.

Challenge: the amount of power that Psara could export was limited by the impedance of the sea cable that caused overvoltage trip of the park before the rated 1.8MW export capacity was reached.

The overvoltage could only be solved by curtailing the output



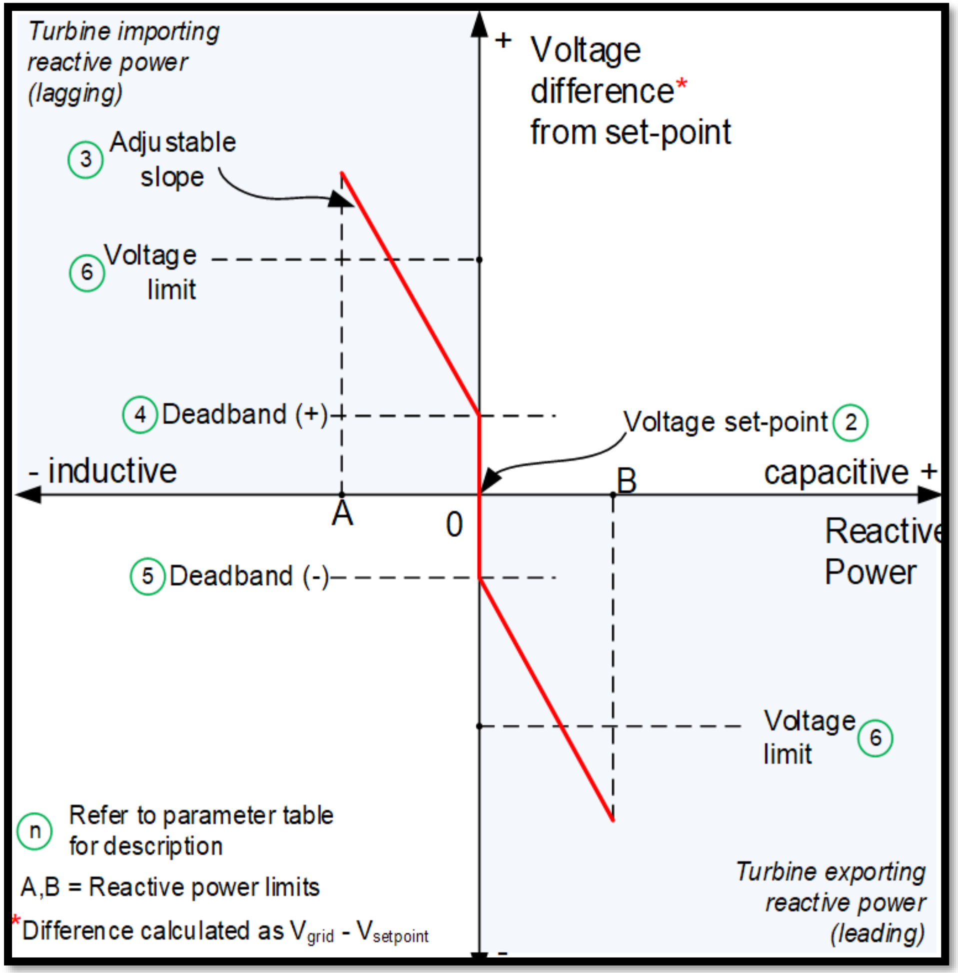
Technical description of the AVC solution

Controlling the wind park's terminal voltage involves changing the reactive power imported or exported by the park. Importing reactive power lowers the terminal voltage while exporting reactive power increases it.

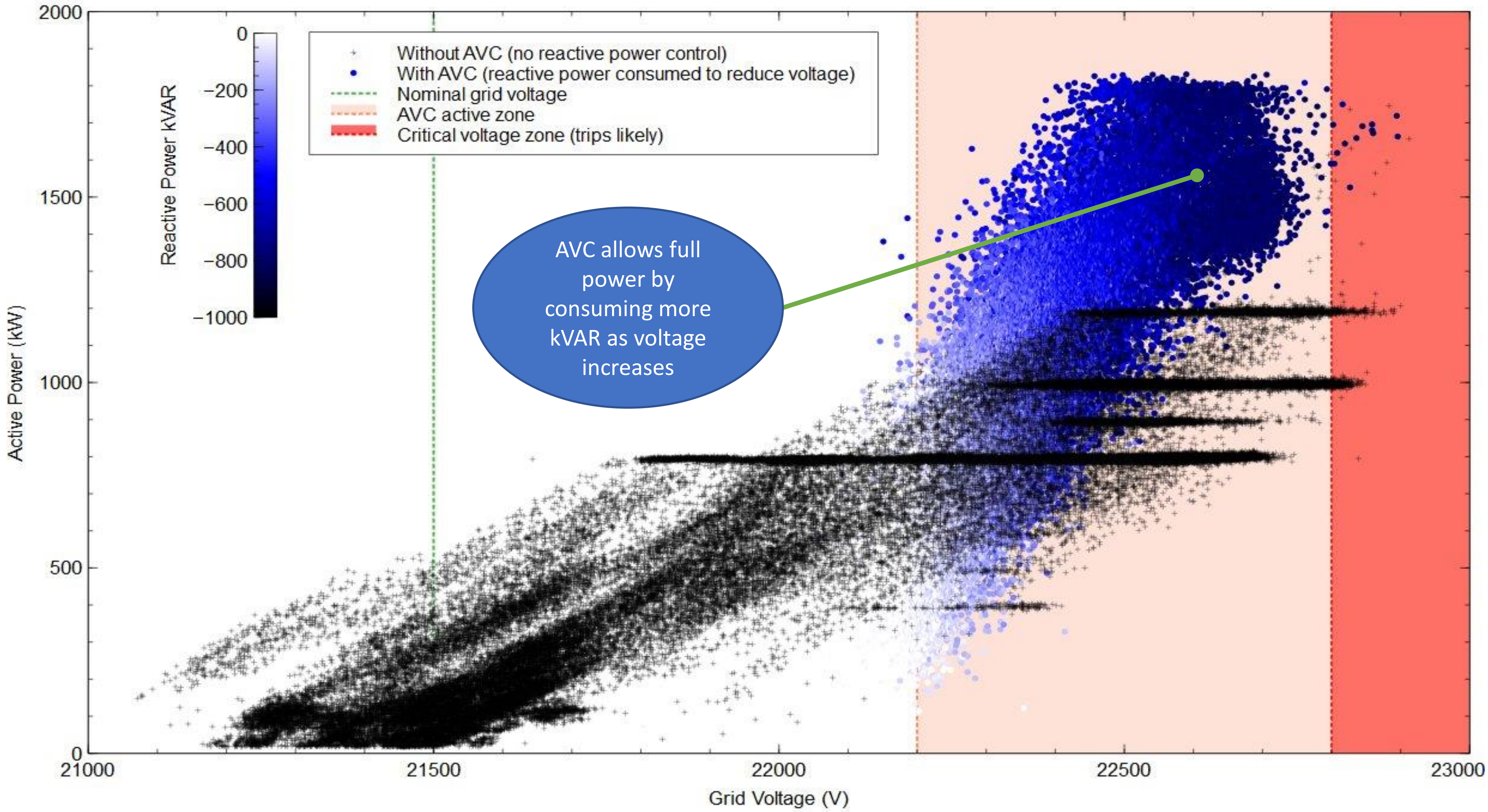
During AVC the Park Controller measures the terminal voltage and adjusts the reactive power setpoint to the turbines proportionally. The power converters in the turbines control the reactive power at each turbine by adjusting the phase angle. The reactive power measured at the wind park terminals is the result of all the turbines following the reactive power setpoint received from the park controller.

If voltage continues to increase when reactive power has reached its limits, the park controller will begin to curtail active power (if configured to do so) so as not to exceed the voltage limit, thus keeping the park within the operational limits of the equipment and the braker

The control parameters are adjustable by the client in real time by remote control, or statically set by EWT at commissioning using the parameters. Limits can be set for reactive power, power factor and active power reduction.



AVC allows full power operation by consuming reactive power



Key learnings / Sum-up

- Reactive power consumption reduces terminal voltage
- EWT wind parks can operate at full active power capacity on weak grids by employing AVC
- EWT's AVC can also automatically reduce active power if necessary to ensure voltage limit not exceeded
- This solution has allowed to greatly improve the wind penetration and further reduced diesel consumption
- PPCR requested this software to be deployed to other locations

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