TAMWORTH BATTERY ENERGY STORAGE SYSTEM
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The Energy Storage Conundrum - Briefing 61 - GWPF - Francis Menton

"The unsolved, and potentially unsolvable, challenges of energy storage in a grid predominantly supplied by intermittent generation are quite obvious. One does not need to be a highly credentialed scientist or engineer to understand the magnitude of these issues, or to see that solutions are critical if such a grid is to be made to work without fossil fuel backup. And yet politicians across the world have committed their peoples to achieving full decarbonisation without any demonstration project to show that the target can be met in practice, let alone at reasonable cost.

Historically, major innovations in provision of energy have begun with demonstration projects or prototypes to establish the feasibility and cost, before any attempt at widespread commercialisation. In the 1880s, when Thomas Edison wanted to start building power plants to supply electricity for his new devices, such as incandescent lightbulbs, he began by building a prototype facility in London under the Holborn Viaduct, and followed that with a larger demonstration plant on Pearl Street in Lower Manhattan, which supplied electricity to only a few square blocks. Only after those had been demonstrated as successful did a larger build-out begin. Similarly, the provision of nuclear power began with small government-funded prototypes in the late 1940s and early 1950s, followed by larger demonstration projects in the late 1950s and early 1960s. Only in the late 1960s, twenty years into the effort and after feasibility and cost had been demonstrated, were the first large-scale commercial reactors built.

But somehow our politicians have now become so filled with hubris that they think they can just order up a functioning wind and solar electricity system and assume that backup energy storage devices will magically be invented, that it will all work fine, that it will not be financially ruinous, and that all this will be achieved by some arbitrarily-imposed date in the 2030s.

There is today no such functioning electricity system based on wind or solar or a combination of the two that is free of fossil fuels and fully backed up by energy storage. There have only been two half-hearted attempts at delivering such a thing, both of which have been, and continue to be, abject failures, only serving to demonstrate how unlikely the whole Net Zero endeavour is ever to come to fruition.

The most significant of the two is a facility called Gorona del Viento on the Spanish island of El Hierro, one of the Canary Islands. El Hierro is a mountainous volcanic island with a population of about 10,000. The Gorona del Viento project consists of five large wind turbines and a pumped storage system to provide the backup. The wind turbines have sufficient capacity to fulfill 100% of the electricity demand of the island when the wind blows at full strength – the nameplate capacity is 11.5 MW, versus an average demand of 5.1 MW and a peak of 7.6 MW. When the wind blows and demand is low, the electricity can be used to pump water from a lower reservoir to an upper storage reservoir built in an extinct volcanic crater. The water then can be released through turbines to provide electricity at other times when the wind is not blowing.

The concept of the planners of the El Hierro project was that they would demonstrate how to do a 100% renewables/storage electricity system. The project launched in 2014, and on August 20, 2015 the Spanish daily El Pais reported that the island ‘aspires to energy self-sufficiency to provide light

and water from 100%-renewable sources'. However, apparently nobody bothered to do the simple arithmetic to be sure there was enough wind capacity and storage to make it work. The project has consistently fallen far short of its goal, as anyone who had done the arithmetic could have easily shown before they started. Fortunately, the island retains a secondary backup system, based on diesel generators, with a capacity of 11.2 MW, and which is therefore capable of exceeding peak demand on its own.

The most important shortfall of the Gorona del Viento system is that it has only a small fraction of the storage capacity needed to get through frequent daily and seasonal wind droughts. Roger Andrews calculated that the storage capacity would have to be 40 times bigger to see the island through a full year without the diesel backup. Unfortunately, the existing reservoir is the only suitable site on the island for pumped storage, and it cannot be made bigger. Even if a suitable site did exist, it would be of little to no relevance to the rest of the world, where sites for pumped storage on the scale required are essentially non-existent.

A second problem is that, although El Hierro has wind turbine capacity to supply average electricity demand more than twice over when the wind blows at full strength, the wind does not often do so, and therefore the installed wind turbines are insufficient to keep even the existing pumped storage reservoir full for when it is needed.

Gorona del Viento publishes monthly data on how much of the electricity for the island came from the wind/storage system and how much from the diesel generators.21 The most recent data are from September 2021. These make clear how very seasonal the wind power is, with far more in the summer than the winter. Data for earlier years show that the Gorona del Viento system has produced somewhat more than 50% of the electricity for El Hierro in some years of operation, but then fallen back well below half in other years, depending on the weather.

The bottom line is that El Hierro has wind turbines for more than double average demand, pumped storage for more than double average demand, and also diesel generators for more than double average demand – three separate and redundant systems, all of which must be paid for, yet they struggle to get half of their electricity from the wind/storage system, averaged over the year. So the island must retain 100% diesel backup, fully maintained and ready to go, for the regular times, even in the windiest months, when the wind fails to blow. Estimates of the cost of the electricity produced by the Gorona del Viento system put it at around 80 euro cents per kilowatt hour, although most of that is subsidised by the Spanish government or the EU and thus hidden from the El Hierro ratepayer.

In summary, the El Hierro model, in return for electricity costs around four times the European average and seven times the US average, is not remotely capable of achieving Net Zero. It is a disaster that no other jurisdiction can or should attempt to follow.

After El Hierro, the next closest thing in the world to a Net Zero demonstration project is on King Island, part of the state of Tasmania, Australia. King Island is much smaller than even El Hierro, with a population of only about 1500 people. In fact, it never claimed that it was attempting to get all the way to Net Zero, but it did build substantial wind, solar, and battery storage facilities to attempt to get at least a large part of its electricity from these sources. However, like El Hierro, King Island retains 100% backup in the shape of a diesel generator system as well.

Roger Andrews did a detailed study of the results of the King Island system in a post on October 16, 2018.22 He concluded that King Island did not provide sufficient data to enable a precise calculation of how much of its electricity comes from renewables and storage, and how much from the diesel backup. However, he made an estimate of about 60% from the wind, solar and batteries over the

course of a year. He also calculated that to attempt to get to all the way to Net Zero without the diesel generators for a whole year, the island would need at least 100 times more storage, in addition to more wind and solar capacity.

Thus, as a model for how to get to Net Zero emissions from the generation of electricity, King Island must also be rated a total failure. All that it has shown is that you can't get much beyond 50% of electricity from renewables without vastly more energy storage capacity than anyone can afford.

Politicians throughout the developed world, urged on by environmental activists, talk with utmost earnestness about their plans for Net Zero, and have committed and are further committing their citizens and taxpayers to tens and hundreds of billions of dollars of spending to achieve this goal. Yet from their heads-in-the-sand approach to the energy storage conundrum, one would have to conclude that the entire effort is either wholly unserious or breathtakingly incompetent.

It is abundantly clear that no jurisdiction can get anywhere near Net Zero on the current path of just building more wind and solar generators and paying little to no attention to the problem of energy storage. Down that path one quickly comes to the current predicament of Germany, which has plenty of wind and solar generation capacity to supply its needs on a windy and sunny day, but almost no storage for when the night comes and the wind stops blowing. Germany has thus made itself dependent on fossil fuel backup, mostly in the form of Russian natural gas. And now, with the Ukraine war and the shutdown of the Nord Stream 1 and 2 pipelines, it has hit the Net Zero wall. With winter approaching, there is no time to acquire batteries to serve as backup, even if any existed that could technically do the job. Moreover, fully replacing natural gas backup with battery storage is a multi-trillion-dollar project, likely costing a multiple of the country's GDP, and thus completely infeasible. Realistically, Germany will never build any amount of storage that is meaningful relative to the scope of its problem. It is only a question of time until it gives up its Net Zero quest, with the other fantasist countries shortly to follow."