

The winds of change

風向轉變時,有人築牆,有人造風車

‘When the wind of change blows, some build walls, while others build windmills.’ So says the ancient Chinese proverb. In other words, change is inevitable; some will try to resist it, whilst others, the pioneers and visionaries, see change as opportunity and embrace it.

The world of energy is changing in such a way. The ever-growing demand for goods and services, for petrol, for electricity, has been driven for the last 150 years by fossil fuels. A resource that is finite, that can and will run out. Even if it was not, the science tells us the perils of continuing to burn fossil fuels at the rate we are. But the Stone Age did not end because we ran out of stone, so why should the age of fossil fuels end because we run out of fossils? Alternative, renewable forms of energy are out there, ones that will last for as long as our sun does.

In places like Northern Ireland, there is a huge wind resource, one that will last as long as the sun does, that will generate electricity without emissions. The Northern Ireland Assembly has been one such country to embrace opportunity, and has set a pioneering target for 40% of its electricity to be produced from renewables by 2020.

But with all these wind turbines popping up, both onshore and offshore, new challenges emerge. That’s the difficulty with pioneering. You have to be first to confront difficult challenges.

The wind doesn’t always blow consistently all the time, yet the amount of electricity at any one moment has to be balanced with demand from one second to the next by the operator of the electricity system. The rate at which wind output can change, and what to do when there is too much to be practically used, are both yet to be effectively addressed with such an imagined level of wind.

This is something I set out on a mission to shed light on. Specifically, in the fossil fuel based power system of today, what would the impact of variability of the wind be in 2020? Would it be manageable? And if not, realistically what could be done to make sure it is?

These are a bunch of important questions, given the small and aging mix of fossil fuel generation that will be required to balance the wind in Northern Ireland. Other electricity systems around the world will be observing with interest, looking for assurances that such targets are indeed possible.

I identified that wind curtailment (having to turn wind turbines off because there’s more power than can be used by the grid) will be a growing concern; up to around 7-7.5% of an average year’s wind generation in 2020 if nothing is done. Similarly, whilst the majority of the time changes in wind output are manageable, there will be times where the drop off or increase in electricity from wind generation (‘ramping’) will be too fast for the fossil fuel power plants on the system to balance. Something needs to be done.

The solution? Well, that’s a little complicated. Answers to the wind curtailment and wind ramping problem pull in different directions. To reduce wind curtailment, we have to make more room for wind on the system. This involves minimising the amount of ‘baseload’ fossil fuel power plants running on the grid for power quality purposes. On the other hand, to improve the system’s ability

to respond to ramps in wind generation, we need increased ramping capability from the same power plants. Quite the paradox.

So how do we resolve needing more and fewer conventional power plants on the system at the same time? There are three ways my research identifies: one is to encourage conventional generation to be more flexible, the second is to increase interconnection (the ability to import and export electricity to other systems) and the third is battery storage which can provide the flexibility of a power plant without the carbon intensive minimum generation.

The research has helped to inform dialogue between the conventional fossil fuel generators, the system operators and policymakers. It has also been a starting point for informing new solutions to these challenges, such as a \$20m energy storage bid to support grid operations in Ireland. It has also allowed me to advise the Parliamentary Office of Science and Technology and Strategic Investment Board on policy implications, to help ensure our future energy system is fit for purpose.

So although the issues are complex, there are ways of managing them with a bit of innovative thinking. The winds of change are blowing; some will build walls, whilst others will build windmills.