Jamie Cox *is an undergraduate economics student at the University of Strathclyde, about to start his fourth year, and has a summer internship in the Fraser of Allander Institute supported by the Research Interns@Strathclyde scheme. This blog summarises some of Jamie's research into how electricity charges vary geographically. Following on from his earlier blog last week on transmission charges in the UK (TNUoS), in this blog he explores variation between tariffs for different generator types, with a focus on intermittent generators.*

Transmission Tariff Model

To analyse transmission charges, we built a model that approximates the charges levied by National Grid: both on methodology, and in monetary amounts. Using sub-national electricity consumption statistics and generation statistics (from the Department for Business, Energy & Industrial Strategy) we approximate electricity flows, and thereby estimate TNUoS tariffs. An example of the output of our model and how it matches up with actual charges levied by National Grid can be seen in the second figure of previous blog.

In this blog, we discuss how tariffs depend on generator type, in particular: whether the generator is conventional or intermittent.

Conventional v Intermittent

Conventional and intermittent power stations use the transmission system differently. A conventional plant, e.g. Longannet type coal-fired power plant, can switch generation on and off when needed, potentially minimising the use of the transmission network.

Intermittent generators e.g. wind, face varying levels of input, and so produce varying levels of output electricity. On a windless day, when demand for electricity is high in that region, energy will have to be transmitted to that region to make up the difference. Likewise, on a windy day, a wind farm is producing lots of electricity that is potentially not needed locally, and so surplus energy will need to be exported (or stored). These activities use the transmission system and National Grid's charging structure consequently charges intermittent generation a higher TNUoS tariff than it does conventional generators.

The analysis then of the previous blog can be extended therefore: although Longannet's closure will lower transmission charges in Scotland; Longannet's replacement with wind

generation of equivalent capacity will raise transmission charges in Scotland further, especially for other intermittent generators.

	With Longannet	Longannet closed	Replaced with intermittent
Tariff faced by Conventional (£/kW)	5.109	2.014	9.015
Tariff faced by Intermittent (£/kW)	7.404	6.068	9.407

The table above gives estimated tariffs from the model for the Longannet area. It shows them as they would have been had Longannet not closed (1st column), after it did so (2nd column), and the tariffs caused by the simulated addition of 5GW[1] of intermittent generation in Longannet's place (3rd column).

The tariff impact of Longannet's closure

The conventional tariff decreases by over 60% when Longannet is closed. The less conventional generation installed, the lower the charges faced by conventional generators. This makes sense as a way of encouraging a balance of generator types.

When Longannet closes the intermittent tariff decreases as well. This decrease though is less than that for conventional. So the closure of Longannet does provide some economic incentives to build new generation in Scotland, but these extra incentives are weighted towards new conventional rather than new intermittent generation.

The tariff impact of new renewables in Scotland

Replacing Longannet with equivalent intermittent generation causes an increase in both tariffs, as expected. Again, as expected, the intermittent tariff rises to a higher level than the conventional tariff.

There are two ways in which additional intermittent generation increases the tariffs levied by National Grid. Firstly, and very obviously, additional generation means that the zone transmits more energy across the system. This is the same as how an increase in conventional generation would increase tariffs.

The second mechanism that National Grid use to increase the intermittent tariff is through a

"Boundary Sharing Factor" (BSF). This works to reflect the fact that intermittency increases the variability of supply in a zone so that sometimes it exports a lot, but other times, even if it normally exports electricity, it can actually require imports.

As the proportion of intermittent generation to total generation increases, the BSF decreases linearly. Intermittent tariffs are inversely related to the BSF, so, as intermittent generation increases, so too does the tariffs for those generators.

The tariffs charged by National Grid is now higher for intermittent generators than conventional generators. This matches the conclusion in the previous section.

Overall effects

The overall effect is that the more of a certain type of generator you have, the higher the TNUoS tariffs will be for that type of generator. This charging structure has a certain rationale (though as in our previous blog, we make no claim as to its optimality or otherwise) in that it penalises excessive reliance upon one type of source. Together with other features of electricity market design (like the capacity market) this is meant to promote a resilient electricity supply network. As the generation mix in the UK shifts from conventional to low carbon generation – much of which is intermittent – the charging mechanism used by National Grid will need to continue to promote a resilient network, which will include much more energy storage infrastructure than at present.

[1] Longannet had a capacity of 2.4GW. We assume that this is replaced with wind generation of capacity 5GW. This is approximately the same supply averaged over a year, assuming a capacity factor of roughly 35-40% for intermittent, and 80% for conventional.