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, and in particular, how the closure of the Longannet coal fired power station in Fife in 2016 may affect the economics of renewable energy in Scotland.*

In late March 2016, Longannet power station closed after providing energy for nearly half a century. The station's closure brought about the loss of 236 jobs, with an estimated 800 indirect supply jobs also affected (figures from the Longannet Task Force Report, March 2017).

So while the closure of a coal-fired power station may be viewed as positive environmental news, on the face of it, this was negative economic news. This blog describes some research conducted at the Fraser of Allander Institute, which investigates whether there is an economic as well as environmental upside to Longannet's closure.

The mechanism by which Longannet's closure could have positive economic effects, is via its impact upon transmission charges.

What are Transmission Charges?

Transmission charges are payments, paid to National Grid by electricity generators, in order to use the large and expensive capital intensive asset that is the transmission network: the system of cables, pylons and transformers that transports electricity from generators to consumers.

This asset needs to be paid for: building and maintaining the transmission network is a real cost. However, the payments faced by particular generators and consumers is a feature of the design chosen for the payments system to cover this cost – alternative systems are possible. In this blog we will discuss only how the current system operates: we make no comment here on the optimality or otherwise of this system.

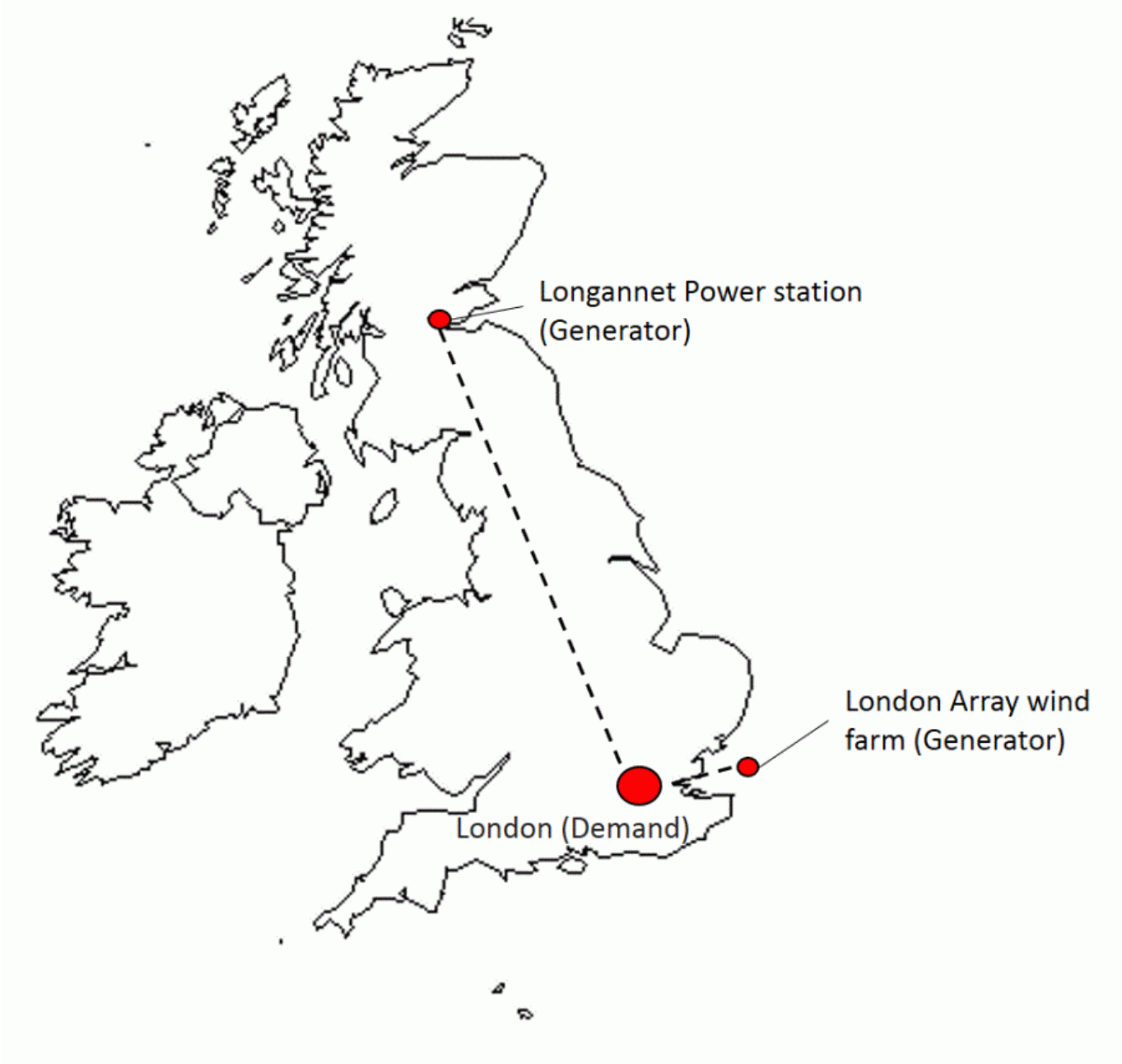
Broadly, the payments system could be structured in the following ways:

- it could take supply as given and charge consumers for the use of the grid: the further demand is located from supply, the higher the charges;

- it could take demand as given and charge generators for the use of the grid: the further supply is located from demand, the higher the charges;
- it could be a hybrid of (1) and (2);
- or it could be unrelated to geography (fixed charge per unit supplied or consumed).

The current system is of form (3), a hybrid system charging both generators and consumers[1] for their distances from effective demand and supply respectively. However, the large majority of the locational charges fall upon generators – so the current system is much closer to (2) than it is to (1).

Generation landscape of UK



If a generator is near a large centre of demand then they will pay less because they are using the transmission system less. Whereas generators in locations with excess supply will pay more because they use the transmission system more.

Scotland is a net exporter of electricity to the rest of the UK, so Longannet's output was partly exported and had to use the transmission system to access demand in the rest of the UK, with associated high transmission charges. On the other hand, the London Array wind

farm for example, has a shorter distance to transmit, with associated lower charges.

Longannet faced a generation tariff of £18.02/kW in 2014/15, whereas London Array's tariff was £1.43/kW.

Longannet's closure

Longannet was an old (relatively inefficient), coal-fired (exposed to the same challenging economics facing all coal-fired plants), and Scottish located (hence facing high transmission charges) generator. As a result of these high operating costs, it closed in 2016 when it failed to win a contract from National Grid.

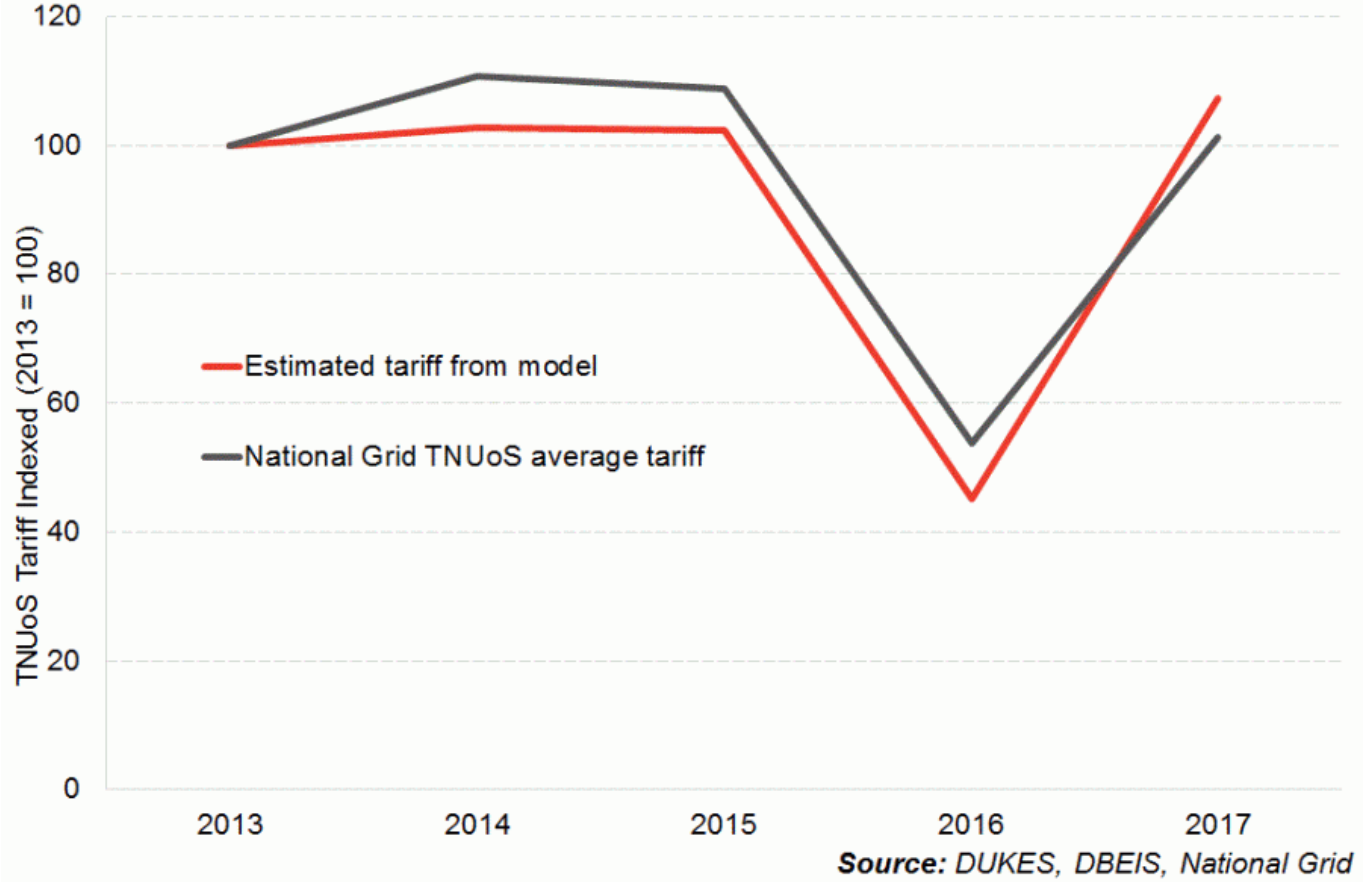
But these same transmission charges which contributed to Longannet's high cost base and hence to its closure, are a function of Scotland's net exports of electricity, which are reduced by Longannet's closure.

Did Longannet's closure cause charges in Scotland to be lower as less excess energy had to be transmitted south?

Calculating the effect of Longannet's closure

National Grid calculates the distance that energy is transmitted from generators in a "zone", and uses this to form a tariff via the annualised cost of the line being used. The effect is that all generators in a zone face the same tariff.

Using a simple model, we can simulate the closure of a station like Longannet, decreasing the distance that energy is transmitted. Longannet's closure should have caused downward pressure on generation tariffs in Stirlingshire and Fife area, but also on overall charges in Scotland. As generation as a whole decreases in Scotland, all tariffs in Scotland should go down.



This above chart shows the tariffs from our model against the actual tariffs given by National Grid for zones around and including Longannet's zone, indexed to 2013.

What does this mean?

Scotland has large renewable potential with scope for wind, hydro and tidal generation. However, these must be located where the wind or water is, not where demand is. The high transmission charges faced by such generators – as a result of Scotland's net export of electricity – add to the costs of developing this renewable potential, and so, at the margin, must deter some investment.

Closing existing conventional non-renewable generators like Longannet, by lowering transmission charges in Scotland, boosts incentives to build new generators. This mitigates the job loss numbers mentioned in the introduction. Further, the new generators can be low carbon sources, helping to reach the Scottish Government's climate change target.

Next steps

National Grid use different tariffs depending on generator type – especially relevant to intermittent renewables. Taking the project forward will involve exploring the effect of these different charges and simulating how new renewable generators will face transmission costs as they replace older conventional generation.

[1] For example, the transmission component of a customer's electricity bill in North Scotland – where there is lots of generation – is £21 per year, whereas in London and South England it is £37 per year (2015 prices).