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National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

Evidence for the Electricity Interconnection and Storage Study for the National Infrastructure Commission

Dear Sir/Madam,

Please find below our evidence for the Electricity Interconnection and Storage Study for the National Infrastructure Commission.

To give some background, EnAppSys is an energy consultancy and energy data and analysis provider. We specialise in the development of tools and analysis that allow market participants to optimise their positions in the energy market and in particular in the short term, intraday and balancing market. We are currently supporting developers of energy storage projects and new entrant peaker plants which are both gas and diesel fueled. This support includes valuing opportunities in the balancing market, forecasting future prices and system requirements and supporting developers in raising finance and equity.

Our feedback for the consultation below is derived from the ongoing analysis and realtime monitoring of the GB market. We would have liked to provide detailed quantitative analysis to support some of the points we have made below but analysis of the GB Market is complex and time consuming and we need to manage our resources carefully. If you would like us to expand further on any of the points made please contact us.

Please find below responses to the questions you raised.

1. **What changes may need to be made to the electricity market to ensure that supply and demand are balanced, whilst minimising cost to consumers, over the long-term?**
   a. **What role can changes to the market framework play to incentivise this outcome:**

Changes to the market framework for managing supply and demand in the GB system has a significant ability to drive reduction of balancing costs and deliver the energy infrastructure that is required to keep the lights on, reduce environmental impact and keep costs affordable.

We believe that at a high level changes should be implemented to reduce the System Operator's intervention in balancing supply and demand and move the onus to the market where it is able to deliver more efficient solutions.

Ultimately it is suppliers who should bear the responsibility for ensuring that their customer's security of supply is ensured. Customers of suppliers sign a contract and within a market based approach it is necessary that any suppliers unable to ensure stability of supply must be sufficiently penalised to encourage compliance.

The changes implemented on the 5th November, 2015 to move to Single System Pricing were a step in the right direction and Imbalance Pricing is an ideal means to ensure that supply and demand match up, however the new system pricing calculation mechanism that offsets high price 'offer' actions by the lowest price 'bid' actions has resulted in more benign system prices than we believe was the intention.

The result is that GB imbalance prices may not send sufficient market signals for suppliers to balance and developers and traders to deliver technology and products that enables suppliers to better achieve balance.

Higher system prices result in a strong commercial driver to avoid imbalance and provide high payments to the system that ultimately results in a higher excess imbalance charge which through the recycling provisions (RCRC) rewards those parties that are better at managing imbalance. This is an effective mechanism but its effect is diminished if the penalties and returns are low.

An argument in the market is made that extreme system prices create an unacceptable risk that cannot be reasonably managed. One of the reasons of this is that the GB market 1 hour gate closure period prevents market participants being able to trade out imbalances just prior to the delivery period. This is a valid point and any changes to deliver higher system prices for imbalance should be part of an overall mechanism that enables market participants to trade their way out of imbalance closer to delivery time or else hold and operate their own or contracted standby generation assets. Short gate closure periods are used on the Continent and we understand these result in more self-balancing.

Higher potential imbalance prices and the ability for market participants to buy and sell power closer to the delivery period should result in increased intraday market volume and prices that provides a larger and more liquid market for flexible demand side reduction and generators to participate in. These strong market signals should encourage the building of assets the system needs.

We believe that moving the onus on balancing from the system operator to the market will ultimately result in lower cost of balancing and create more demand from market participants to build and/or own and/or contract flexible assets. Overall inefficiency in the system will be reduced, resulting in lower bills.

b. Is there a need for an independent system operator (SO)? How could the incentives faced by the SO be set to minimise long-run balancing costs?

We do believe that there is merit in the System Operator being fully independent. There is the potential that a System Operator who also operates the network sees network and transmission infrastructure as the solution to the challenges we face. Even if this is not the case it is hard for market participants to not perceive that the System Operator will have a bias against non-network solutions to system operation problems.

An example of this that is relevant to the other aspects of the consultation is that the solution being implemented to deal with constraints in Scotland is increased transmission. It is not clear if an economic evaluation of the option of large grid connected energy storage as an alternative was looked at.

How could the incentives faced by the SO be set to minimise long-run balancing costs?

We would suggest that incentives set for the SO are based on a levelised cost calculation using a forecast model to predict balancing costs forward based on past performance with a reward for beating the model year on year.

c. Is there a need to further reform the "balancing market" and which market participants are responsible for imbalances?

The balancing market(s) as a whole seems to be functioning well but it is over complicated. There is a tension between what is deemed by observers to be "acceptable costs" of balancing and the prices required to justify a power station to be available to meet the intermittent needs of the system for power.

Due to its very high level of transparency high prices achieved in the balancing mechanism are used as examples of gaming and become politically sensitive. In our view as long as those high prices are borne by the party causing the imbalance then it is positive. It drives those imbalancing parties to avoid imbalance by better forecasting, building flexible generation or else improved asset reliability and encourages those assets that can bridge the gap between supply and demand to do so as the rewards are there.

When the capacity mechanism comes into effect in 2018 it will be interesting to see how the cost of balancing is impacted. Also the introduction of the TERRE replacement reserves market in 2017 may also impact the cost of balancing. It would be unwise to undertake a change to the balancing market before the impact of these other changes has been understood.

It is also useful to understand that the cost of the "balancing mechanism" is only around a third of the overall cost of balancing services. Sometimes there are interactions between different balancing services that result in undesirable consequences. For example moving assets from STOR to the balancing mechanism, to Firm Frequency Response or to SBR. National Grid has many different balancing markets which compete with each other for limited resources.

There are also asymmetries in information between different balancing tools used by the System Operator with some having exceptional visibility (the balancing mechanism) and others being very opaque (some of the non-tendered services). This means that market signals are obscured leading to inefficiencies for existing players and are a disincentive to new entrants.

a. To what extent can demand-side management measures and embedded generation be used to increase the flexibility of the electricity system?

Demand-side management is going to be a necessary part of decarbonising the electricity grid. However, for demand-side management to occur on a larger-scale the connection between wholesale power prices and consumer's power prices needs to be made. Regulatory interventions to reduce the number of tariffs provided to consumers are not helpful if a supplier wants to come up with more sophisticated time of use tariffs. Smart metering may help connect the engaged consumer to the variable cost of power.

Currently the system is heavily oversupplied during periods of high wind overnight resulting in the loss of low carbon power and very low power prices. However, since consumers are paid on a static rate they are unable to benefit from these periods resulting in a net cost upon the system as wind farms are paid not to generate and as low carbon power is not able to be used by the system.

If a connection can be restored between wholesale and consumer power price on an hourly or half-hourly basis, this opens up opportunities for businesses to provide consumers with solutions that allow them to benefit from generation surpluses and provide large scale-demand response.

On a smaller scale demand-side management gives an extra option in managing the system, but needs to be scaled to be truly effective.

Embedded generation can be effective in reducing the requirements for transmission to be built and should be rewarded for doing so, but only in cases where generators are providing real transmission cost savings. Otherwise embedded generation should be treated like transmission connected assets.

2. What are the barriers to the deployment of energy storage capacity?

a. Are there specific market failures/barriers that prevent investment in energy storage that are not faced by other 'balancing' technologies? How might these be overcome?

Storage assets typically have high capital costs that will be recovered by operating in the market at a premium. These assets have a high probability of recouping their costs as their risk of not being able to be profitable in the market is particularly low since they are almost certain to be able to buy cheap power and sell it later at higher prices.

However, these assets can have difficulty proving that they will be able to secure sufficient revenues in the market to justify investment since with higher capital expenditure, payback is longer and hence regulatory change risk is greater.

These storage assets therefore benefit from regulatory certainty and we would argue should be somehow incorporated into low carbon incentive mechanisms. This will promote the construction of new build as the ability to timeshift renewable generation and the speed of response of energy storage allows zero carbon power to be used to balance the system as opposed to being lost due to constraints.

Storage assets also allow transmission costs to be reduced as they can time shift renewable generation. The large build outs of onshore wind in Scotland are constrained in generation by the size of the transmission network. The current solution is to build more wires. Perhaps investing in storage may be a more cost effective means of smoothing renewable generation output. The saved cost on transmission is not recovered by the current market structures.

b. What is the most appropriate scale for future energy storage technologies in the UK? (i.e. transmission network scale, the distributed network or the domestic scale.)

There are numerous benefits of storage at distribution network scale in areas with high levels of renewables, such as regions with large solar farms that at peak output might oversupply the grid yet leave it undersupplied overnight. Such installations will reduce transmission costs.

However, building at distribution network level imposes restrictions on size that may encourage projects that rather than being the best projects are simply the most optimal for the current regulatory framework.

A better outcome may be achieved by treating storage as a whole as a unique asset with unique benefits for a grid beyond those rewarded by a market system through valuing the deferred transmission costs.

c. What level of electricity interconnection is likely to be in the best interests of consumers?

At a high level we believe that in the current market system the more GB interconnection is built the lower the average wholesale price will be due to the overall excess of generation capacity across a connected Europe reducing margins and prices. There is evidence of this in the UK market as interconnection has come on line.

The negative side of this is that the cost of the capacity mechanisms of each European country will rise as the revenue needed to keep capacity available to keep the lights on at times of system stress will increasingly come from these mechanisms. If the European Union does not centrally manage reserve capacity then the schemes will compete to attract capacity to be located in their country. The countries that lose this competition could see significant risk of power outages as country interests and capacity mechanism rules prevent electricity flowing to the area of highest price and hence highest demand.

Interconnectors allow the pooling of markets. The current situation in the GB market means that transmission costs are asymmetric with those on the continent meaning that energy flows into GB reducing the options for GB generators. Prices in the SEM in Ireland are typically higher than those in GB encouraging flows of power into the SEM providing opportunities for GB generators.

Taking the above considerations into account the level of interconnection can be allowed to find its own commercial level if there is a level energy market playing field across Europe with the premise that electricity flows will follow market price. Different regulatory regimes in different markets will result in interconnector investment being driven by regulatory asymmetries.

Modelling of UK electricity supply stability using probabilistic simulation of the loss of interconnectors either due to failure or system stress events in mainland Europe versus projected scenarios of UK installed capacity and reserve capacity will be required to ensure that we benefit from possible lower wholesale energy costs whilst keeping the lights on.

d. Is there a case for building interconnection out to a greater capacity or more rapidly than the current 'cap and floor' regime would allow beyond 2020? If so, why do you think the current arrangements are not sufficient to incentivise this investment?

See above.

e. **Are there specific market failures/barriers that prevent investment in electricity interconnection that are not faced by other 'balancing' technologies? How might these be overcome?**

Interconnectors currently do not operate as balancing assets, but instead provide power via trading in the day-ahead market or via the purchase of capacity along interconnectors. There is a regulatory trajectory from Brussels to move more of the interconnection capacity to day ahead markets and then within day markets and finally balancing based on the principle of net social welfare. The TERRE market currently being finalised will provide for dispatch of replacement reserves balancing services across the interconnectors.

The technology used in the interconnections to the GB, CSC HVDC, is currently not suited to participating close to realtime in short term balancing services such as frequency response or short term balancing. Newer VSC HVDC technology provides more opportunities for provision of ancillary services but as this is new technology to the GB market it will take some time to understand how this technology will work in practice.

3. What can the UK learn from international best practice in terms of dealing with changes in energy technology when planning to balance supply and demand?

The technology landscape is moving too fast for regulatory regimes and large utilities to keep up. Falling solar and onshore wind costs along with battery storage costs decreasing rapidly mean that designing markets to "pick winners" is dangerous.

The best international practice is technology agnostic, procuring the required services rather than the technology.

If the selection criteria for procuring balancing services is drafted to not pick technology winners, then the best solutions will come forward and the industry will be incentivised to find and deliver these solutions and not second guess what technology the UK government will support or want.

R&D support and competitions can ensure early support for new technologies to ensure innovation is nurtured to produce the next generation solutions.

Regards,

Phil Hewitt