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THE CHALLENGE IN DEPLOYING ENERGY STORAGE AT SCALE

Introduction

The National Infrastructure Commission published a report on 4 March 2016 called Smart Power. It reported on key aspects of the electricity industry. It contained this statement: "Crucially, storage technology will not need subsidies to be attractive to investors – businesses are already queuing up to invest." In this note, we examine whether this assessment is correct.

Storage is a hot topic. The challenge of decarbonising our electricity system at the same time as ensuring secure and affordable electricity is getting harder, not easier. Addressing the so-called 'trilemma' of decarbonisation, security of supply and affordability has been the challenge at the heart of Government policy for years. Meeting two of the objectives is easy enough but meeting all three is becoming more challenging every year.

The dilemma at the heart of the trilemma

The essential problem is that renewables (at least the established technologies) decarbonise supply and are affordable but not secure. Nuclear decarbonises supply and is secure (subject to breakdown of course) but less affordable. Gas fired power is affordable and secure, and if it replaces coal, it reduces CO2 emissions. But if it replaces nuclear, it increases CO2 emissions. The added problem is that renewables are variable and nuclear is not despatchable (it needs to operate on a constant basis) and therefore nuclear is unable to provide additional power at times when renewable generation is low.

Three conclusions

We draw three conclusions:

- based on current technologies, our power supply cannot be decarbonised without renewables
- renewable generation requires despatchable – not baseload – power to balance the system
- therefore, to decarbonise our power supply, we must develop despatchable low carbon technologies

How do we reach those conclusions?

If nuclear could provide all our electricity supply safely, we would be able to rely solely on nuclear – this was the dream back in the 1950s when indeed it was forecast that the cost of producing power would be so cheap it wouldn't be worth metering. It's clearly not going to do that - £92.50 per MWh is the agreed price for Hinkley Point, somewhere between two and three times the current market price. Even at these prices, nuclear could not provide all our power. The only conclusion we can draw is that renewable generation is required if we are to decarbonise our power supply.

The second conclusion is that despatchable technologies must be used to complement the deployment of renewables. The UK Government's answer to that conclusion appears to be the deployment of new gas fired power stations. Technologically gas fired power is despatchable, but as we noted above, if it replaces nuclear, it has the effect of increasing CO2 emissions. The UK, particularly Scotland, has a nuclear fleet reaching the end of its life. EDF recently extended the lives of its nuclear plants to 2030 but this cannot continue indefinitely. So the use of gas fired power stations is not an ideal solution.

The third and unavoidable conclusion is that the only way we can decarbonise our power supply is if we can develop low carbon technologies which are despatchable. Biomass CHP could be one, and it could be important, but it cannot alone provide the solution. Tidal, hydro possibly, but again they do not have the potential capacity to provide a total solution. Carbon capture was once all the rage but the UK Government has withdrawn support and it does not look as if it will be an effective technology for some time, if ever. All of which leaves storage as the only technology we currently know of, which could potentially be deployed at scale, could be low carbon and could be despatchable.

Storage – the answer?

Reports on storage are released at an ever increasing frequency. We will mention only two. First, the Carbon Trust release a report this year stating that energy storage could save up to £2.4bn per year by 2030. The second report was also released this year by the National Infrastructure Commission. It is called Smart Power and contained this statement: "Crucially, storage technology will not need subsidies to be attractive to investors – businesses are already queuing up to invest."

A rosy picture indeed, and one which would answer the prayers of policymakers worldwide. Can it really be the case? If, by investing in storage solutions, investors are able to unlock and capture those forecast savings of £2.4bn per annum, a large amount of storage could indeed be deployed and paid for by private investors. So why isn't this happening now? The Smart Power report did identify the current regulatory regime as a barrier to investment in storage, the implication being that, if this barrier is removed, investment will flow into storage projects.

Regulatory barriers

It is certainly correct that the current regulatory structure is not conducive to the deployment of storage. This is particularly so for stand-alone storage projects, which draw their power from the network. They must pay use of system charges for both the import and export of electricity – it is true of course that they make two uses of the system, but it is unlikely that the double exposure to use of system charges is cost reflective of the costs a storage unit imposes on the system. Accordingly, the development of a more cost reflective charging structure for storage projects is a necessary condition for the development of commercially viable stand-alone storage projects.

This of course will not affect energy storage located generation side. In this case, the regulatory clarifications which are required relate to the impact on a generator's entitlement to RO or FIT support[1].

The Smart Power Report implies that if the regulatory barriers are removed, that of itself will be sufficient to unlock investment. Is this assessment correct?

The economics of storage

Storage technologies are many, old and new, and can be deployed at many points on the network: demand side (eg. your home), generation side (eg at a windfarm) and stand-alone on the network (eg hydro pumped storage). There is no doubt that demand side installations will have an effect on the demand curve, and over time potentially, a profound effect upon the elasticity of demand. Yet, even if we imagine a world where demand side storage is common and plentiful, the system operator will still need to be able to call upon despatchable generation to balance supply and demand. The only question is how much. We say "only", but of course this is an extremely difficult question to answer.

The point though is whether, if we make changes to our regulatory regime to remove investment barriers for storage, this will of itself lead to storage deployment, or whether additional support measures will be require to encourage deployment. There are a number of additional revenue streams which a storage project installed generation side or stand-alone on the network could potentially source:

- if installed generation side, additional power sales revenue from delaying the time of export of power to a time when demand is high or supply is scarce[2]
- if installed stand-alone on the network, power sales revenues exceeding the power purchase costs by importing at time of low demand and exporting at times of high demand (arbitrage revenues)
- fees for providing frequency response or reactive power under an ancillary services contract
- availability fee for providing back-up power capacity under a reserve contract
- availability fee for providing back up power capacity under a capacity market contract

[1] The same is true of CfD, in the few situations where it might make sense to deploy storage with a CfD project eg. where storage addresses a grid constraint and therefore increases the overall volume of electricity exported.

[2] It is possible that storage could increase the overall volume of exported electricity where there is a grid constraint and storage is used at a time when the wind farm would otherwise be curtailed. See Sarah-Jane McArthur's note on Grid constraint: options for project development on 13 April 2016

How investible are these revenue streams?

The primary difficulty for an investor is forecasting whether the amount of additional or arbitrage revenue will be sufficient to provide a return on the investment in the storage facility. Price volatility helps of course, but the nature of price volatility means that the value of the additional and arbitrage revenue is inherently unpredictable. We should not forget that, if a generator has entered into a fixed price PPA or have a CfD then there will be no scope for additional revenues. This source of revenue is therefore only available to stand-alone projects and generation projects which are RO-backed and have a market price PPA.

A second source of revenue can come from the provision of balancing or 'ancillary' services. There are a range of balancing services which are required, from service to maintain power quality, to provide power at short notice – or 'reserve' – to maintain system balance, and system restart – or 'black start' –services. Many storage facilities could provide more than one service but in general they would be designed to provide a limit number of balancing services. For example, batteries are good at providing automated frequency response services while hydro pumped storage is able to provide fast reserve and black start services. In general, fees for ancillary services are paid on an 'as utilised' basis, while some back-up capacity is contracted on an availability fee basis.

However, currently, the contracts available for such services are short term contracts allocated by National Grid in tender competitions. Given their short tenors and pay only on an 'as utilised' basis, investors have little visibility on either the long-term need for their service or the price it will command. Therefore, no new storage capacity is likely to be built solely on the strength of the ancillary services market.

As a result, all of the contracts for the provision of system services are awarded to generators with existing capacity, rather than operators seeking to develop new facilities.

The final possibility is a capacity market contract. The capacity market is the UK Government's response to the risk that there may be insufficient capacity available to meet peak demand. Successful generators are paid an availability fee per MW of installed capacity. Contracts of different durations up to 15 years are awarded by auction and it is open to all forms of generation. The key obligation is that the contracted generator is able to provide an agreed quantity of power on 4 hours' notice, and therefore is designed to provide contracted flexible generation capacity.

However, it has not resulted in the deployment of new generating capacity, other than new diesel generation capacity. In particular, not a single new build energy storage project was awarded a capacity market contract in the latest auction at the end of 2015.

To sum up, we don't think the removal of regulatory barriers will of itself lead to the deployment of storage projects. The current potential revenue streams are either unpredictable (arbitrage revenues), short term (ancillary services) or inaccessible (capacity market). Ultimately, it comes down to Amber Rudd's comment back in November 2015 that no new generating capacity is built without government intervention. The economics of storage are not sufficiently differentiated from generating projects to come to the view that they can be built without government intervention. Storage projects are after all, as yet, unproven with uncertain economics. We conclude therefore that some form of support will be required if storage projects are to be deployed at scale on the GB system.

Financeability of energy storage revenues

The table below considers the revenues which could be available to the operator of a storage unit at a windfarm developed by an independent developer under the RO with a floor price PPA.

Revenue type	Financeability
Additional power sales revenue from delaying the time of export	• Inherently unpredictable • Dependent on high price volatility
Arbitrage revenues	• Inherently unpredictable • Dependent on high price volatility
Fees for providing frequency response or reactive power	• Short term contracts • No security of volume
Availability fee for providing back-up power capacity	• Short term contracts • No security of volume
Availability fee under a capacity market contract	• Statutory mechanic to be tested • Inaccessible under current rules

Supporting the deployment of storage

If government intervention is required, what form could that take? There are three possibilities:

- a new bespoke storage support mechanism
- a reformed ancillary services market
- a reformed capacity market

Bespoke storage mechanism. As we described earlier, the development of low carbon flexible generation capacity will be essential if our power system is to be decarbonised. The policy context therefore for storage is that (broadly speaking) it can be carbon neutral and can therefore contribute to the development of a low carbon flexible generation policy. Would it be possible therefore to design a support mechanism which supports low carbon flexible generation?

Since storage facilities provide services which are by their nature used on an 'as required' basis, the fee structure must include an additional component to use of service fees in order to be investible. In principle, this could be either a flat availability fee or a 'take or pay' clause. In either case, it will be essential for generators to remain exposed to market prices, since one of the objectives is to help match supply to demand. Therefore, a storage operator would source revenues from an availability fee plus power sales revenues, or solely from power sales subject to a take or pay clause. The introduction of such a mechanism would require wide industry consultation and a new state aid approval – you can almost hear the enthusiasm waning before the pixels appear on the screen.

Reformed ancillary services market. In theory, this sounds simple – extend ancillary service contracts to 15 years and include a take or pay clause. The difficulty is that a minimum take up obligation would expose National Grid to the risk that total amount of contracted services would exceed the total services required at some point during the 15 years – a level of risk its investors would not associate with a regulated investment. National Grid would no doubt resist taking this level of risk.

Reformed capacity market. The most obvious policy tool to support the deployment of energy storage is the capacity market. The aim of the capacity market is to provide contracted flexible generation capacity to help balance supply and demand, a partial overlap with the ancillary services market. However, the capacity market does offer contracts of up to 15 years and in theory therefore is open to new generation capacity. As we noted above though very little new generation capacity has been awarded capacity market contracts – currently new build cannot effectively compete with existing capacity.

Capacity market reform

Recognising this situation is unsustainable in the long run, DECC has launched a consultation on a review of the operation of the capacity market. The primary purpose of the review appears to be to facilitate the construction of new gas fired power stations. Given the current state of technological development in flexible generation, some gas fired generation capacity is probably essential. However, to promote only gas fired generation in this review would overlook the longer term need to develop low carbon flexible generation capacity.

The capacity mechanism is (rightly) designed to achieve the low cost to the consumer. However, this only looks to the immediate financial impact on the consumer. The design of the capacity market could conceivably take a longer term view. For example, it could make adjustments for carbon costs. It could include a minimum allocation to new generation capacity. It could include a minimum allocation to low carbon generation. Contract allocations could be conditional on technologies meeting certain cost targets. These mechanisms could be used to promote the development of new capacity in both the gas fired and low carbon sectors at a limited and controllable financial cost. This cost may well mitigate future liabilities which are being stored up by the lack of deployment of any new flexible generation capacity.

The capacity market is operated under a state aid decision from the EU Commission, which was in turn made under the EU Environmental and State Guidelines issued in 2014. It is not widely discussed, but the Guidelines require EU capacity markets to “give preference” to low carbon generators. The Commission Decision (whose primary objective in EU law is “environmental protection”) concluded that the UK capacity market would give preference to low carbon generators by virtue of the UK carbon price floor policy.

It is not clear however that the carbon price floor has had a material impact on the operation of the capacity market. First, it is clear from the results of the first two auctions that the advantage (to the extent there is an advantage at all) is insufficient to bridge the gap to fossil fuel technologies. There is therefore a strong case that the current review process should consider measures to promote participation by low carbon generators in the capacity market. Second, the capacity market cannot currently be used to promote storage being deployed generation side. Projects which have a CfD or RO support are excluded from participating in the auction under the no double subsidy principle.

We understand the no double subsidy principle. Yet, the effect of the application of this principle in its current form has the effect of preventing the deployment of generation side storage capacity. Wind farms and solar parks could in theory only compete once the CfD or RO has expired, but who would install new storage facilities at a 15 or 20 year old windfarm? Even if that becomes feasible, that would delay deployment for years. We believe the no double subsidy principle can be refined so that capacity market fees could not be used to cross-subsidise the primary low carbon generation capacity eg the wind farm itself. The result would be that

the primary generation technology would be entitled to CfD support and the storage technology would be entitled to capacity market support – to our minds this would not contravene the no double subsidy principle.

Conclusion

Where does all this leave storage? It is one of the most promising technologies capable of complementing the deployment of renewables, which itself is an essential technology if our power system is to be decarbonised. It is difficult to see how storage can be deployed at scale without some form of support. A re-vamped capacity market, re-designed to meet the objectives of the EU Environmental and Energy Guidelines, would be the most viable policy tool to achieve the deployment of new flexible low carbon generation capacity. It will not be easy to deliver, but finding a means is a key to designing the power system of the future.

If you have any questions or would like to discuss this topic further please get in touch with Keith Patterson, Kirsty Macpherson or your usual Brodies contact.

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