

# LCN Fund Full Submission

## Supplementary Answer Form

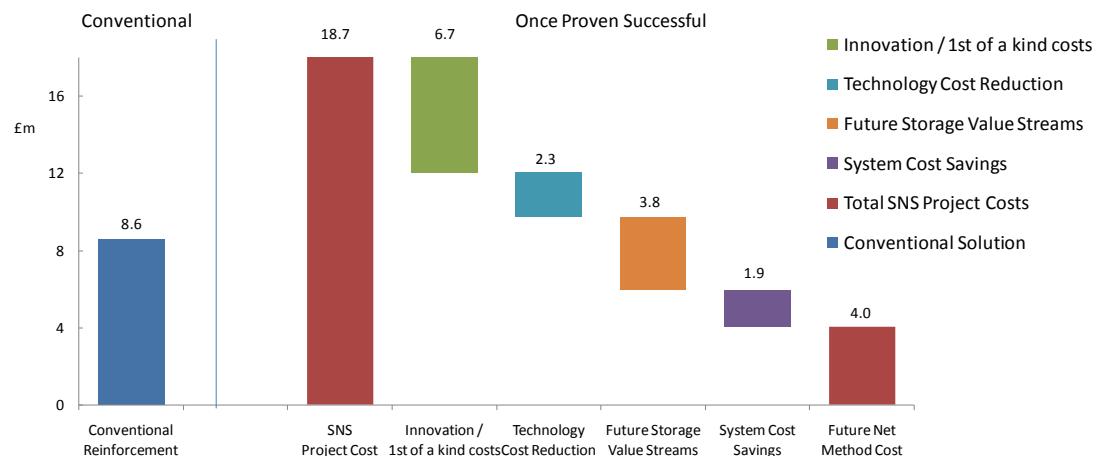
Tick if this answer is Confidential:

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Project code:	SNS		Question Number	UKPN033																						
Question date	27 September 2012		Answer date	02 October 2012																						
Submission section question relates to	Section 3																									
Topic	Project Business Case																									
Question	What conditions might be necessary for this Method to become commercially viable and how likely are they?																									
Notes on question																										
Answer	<p>The Expert Panel asked in particular what our starting assumptions were for building the business case, in terms of prices we expected we might bid at, and the size of the markets that we were bidding into for the 'Future Storage Value Streams' element. These starting assumptions are tabulated below:</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th>Service</th> <th>Current Market Size</th> <th>Forecast Market Size</th> <th>Eventual Market Share</th> <th>Current Pricing</th> <th>Initial Pricing Assumed</th> <th>Usage</th> </tr> </thead> <tbody> <tr> <td>Frequency Response (Commercial)</td> <td>2.04 GW<sup>(1)</sup></td> <td>3 GW by 2025</td> <td>202MW by 2020 (7%) (600 – 800 MW by 2040)</td> <td>Holding: c£26/MW/h Energy: c£1.1/MWh</td> <td>£21.5/MWh £1.26/MWh</td> <td>Availability: 2600 hours per annum  Utilisation: 10 – 20 hours per annum</td> </tr> <tr> <td>STOR</td> <td>4.352 GW<sup>(2)</sup></td> <td>7 – 8 GW by 2040</td> <td>600 – 800 MW by 2040 (8%–11%)</td> <td>Availability: £8/MW/h Utilisation: £210/MWh</td> <td>£9/MW/h £220/MWh</td> <td>Availability: 1000 - 1600 hours per annum  Utilisation: 10 – 20 hours per annum</td> </tr> </tbody> </table> <p>The result of £3,800k (present value) over 10 years comprised a total of £520k revenue from STOR and £3,300k from Frequency response and equates to approximately £400-500k per annum for the installation. Overall, we believe these figures reflect:</p> <ul style="list-style-type: none"> <li>• Conservative pricing and growth estimates</li> <li>• Conservative utilisation levels across a limited period of 10 years only</li> </ul>					Service	Current Market Size	Forecast Market Size	Eventual Market Share	Current Pricing	Initial Pricing Assumed	Usage	Frequency Response (Commercial)	2.04 GW <sup>(1)</sup>	3 GW by 2025	202MW by 2020 (7%) (600 – 800 MW by 2040)	Holding: c£26/MW/h Energy: c£1.1/MWh	£21.5/MWh £1.26/MWh	Availability: 2600 hours per annum  Utilisation: 10 – 20 hours per annum	STOR	4.352 GW <sup>(2)</sup>	7 – 8 GW by 2040	600 – 800 MW by 2040 (8%–11%)	Availability: £8/MW/h Utilisation: £210/MWh	£9/MW/h £220/MWh	Availability: 1000 - 1600 hours per annum  Utilisation: 10 – 20 hours per annum
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- (lifetime of the installation is expected to be nearer 15)
- A small and justifiable market share of the requirements now and in the future
  - A reasonable estimate due to the additional value that might be gained from a fast acting service that can be held in dispatch for longer periods

The remainder of the answer elaborates on the conditions necessary to become commercially viable over and above these starting assumptions, along with why we believe these are likely and realistic.



### **1. An uplift in the value of flexibility on the system**

In estimating the potential income of the storage ('Future Storage Value Streams'), we used only two existing balancing services (namely STOR and commercial Frequency Response) as the basis of our calculations. Further background on these balancing services is provided in Section B.1 of the attached Appendix if required.

The initial pricing assumption for STOR was based on an average for the period Aug 2010- July 2011. Frequency Response holding payments of £21.5/MW/h was based on an average position over the period June 2011 - May 2012. The energy payment of £1.26/MWh was similarly based on an average over this period. A projected growth of 30% was assumed in both STOR and FR prices through to 2035, reflecting a number of drivers set to increase the requirements significantly. Further detail and explanations of market sizes and pricing relating to these current markets is provided in Section A of the Appendix for clarity.

#### Comparison with international experience

The Expert Panel expressed an interest in the level of revenues from ancillary services from international installations. Whilst these are very different markets to the unique GB system, and vary across the USA they serve to provide some benchmark to the value of flexibility on electricity systems, although here are further complications because of different nomenclature.

In 2009, Beacon Power Corporation stated publicly (4) that frequency regulation was currently valued at \$50 / MW / h and on this basis, each MW of storage would be in receipt of an annual income of over \$400,000. Regulation prices have fallen since that date. However regulation is procured on the basis of "mileage" that is actual MWh delivered as regulating energy at the Regulation

Market Clearing Price, plus a lost opportunity cost to the generator of providing the service (5).

According to the web-site of PJM, a US-based system-operator, the revenue per MW for just frequency regulation over the past 12 months would have been approximately \$130K. This is significantly less than what such a system would have made as little as 3 years ago (more than double) due to the very low price of natural gas in the US, which has depressed the price of regulation service. For a 6MW installation, this translates to around £480k pa.

A useful comparison is also provided by EPRI (6), who give a present value of the regulation income for storage to be between \$255 - \$426 kW / h, and Sandia National Laboratory which quotes \$785 - \$2010 kW / h. The prices show a spread across the different markets in the USA.

Assessing the market and value of energy storage is highly dependent upon factors including the market environment, storage technology and the energy system in which it will operate. It should be noted that there is a significant amount of uncertainty impacting upon the likely makeup of balancing services in the future. For example EMR, European Regulation, Electricity Balancing SCR (cash out) and the general development of generation and demand to name a few. The upshot of this is that, although the balancing services themselves, structurally, together with the providers is subject to change, there will still be a System Operator function required to procure response and reserves. Whilst the nature of balancing services may be uncertain, however, what is certain is the volumes required to meet these requirements (be it the same services or different ones) will increase in the future.

## **2. Proven methods for shared use of flexibility, and the ability to harness multiple value streams**

Energy storage technologies are currently not economically competitive when considered for just network support alone, nor when considered for the provision of ancillary services or energy arbitrage alone. To quote the ERP's report entitled the 'Future Role Energy Storage in the UK', "*Commercial deployment of energy storage technologies is likely to rely on revenue from several streams, though business models are yet to be proven. These will include arbitraging across hours to peak-shave / load-shift, providing back-up capacity during low wind periods, and ensuring power supply quality. Policy-makers, regulators and potential users of energy storage should be aware of this, and not take a narrow view of what the technology can offer.*"

We therefore believe that in order to achieve least-cost decarbonisation it will be necessary to make most efficient use of flexible assets on the networks, across the full electricity system. For energy storage to play a role in the future UK electricity system, we believe that the innovation proposed in SNS on the methods, commercial arrangements and smart IT to achieve this is required to address these issues, as no other trials in the UK are currently tackling these specific challenges.

## **3. Technology Cost reductions for energy storage technologies**

The technology cost reductions, and expected first-of-a-kind costs associated

with undertaking the SNS project are described in the answer to question UKPN025 for 6MW/15MWh of storage.

There were three core components, which are re-summarised below but incorporating the latest cost movements as presented in the final Expert Panel meeting on 26 September, reflecting a 6MW/10MWh device.

The three core components calculated to derive the 'once proven' deployment costs of storage of an equivalent size were:

**a) Installed costs of the actual storage device, including housing, cells, power conversion system and all other auxiliary equipment.**

A saving was assumed, reflecting the expected downwards pressure on storage technology as a result of increased deployment volumes and electric vehicle research investment.

Based on a 6MW/10MWh device, the total installed cost within the project totals approximately £12.1m (excluding contingency). Following the same methodology described in UKPN025, the range of cost-reduction curves predicted a possible range of future costs of £5.7m - £9.1m by 2022.

Taking the upper-most conservative cost-projection, this equated to an installed cost of approximately £9.1m for 6MW/10MWh of storage technology in the once-proven successful scenario.

**b) Ongoing inspection, operational and maintenance costs and;**

**c) Ongoing IT and software costs to fully integrate and automate the optimisation and scheduling of storage.**

Added to the above installed cost was the £730k present value of assumed costs for IT/software and operation/maintenance components of the solution, as described in UKPN025.

The resulting total costs of replicating the solution once proven successful were therefore calculated as  $9.1 + 0.730 = £9.83\text{m}$ . This then equates to an overall 'technology cost reduction' amount of  $£12.1 - £9.83 = £2.3\text{m}$ .

**Innovation / First-of-a-kind costs**

In constructing the business case, the 'innovation / 1<sup>st</sup> of a kind costs' reflect the costs incurred in the SNS project that would not be expected to be repeated or required in future deployments of optimised, integrated storage. These have been revised below, to reflect the latest cost movements introduced at the final expert panel session on 26 September:

Description	Cost (£k)
Initial Design and Development costs for the Smart Optimisation & Control system, including development of Forecasting & Optimisation algorithms, which will then be available for other DNOs to purchase at license fee cost only	2,331
Design, planning and execution of series of trials to prove multi-purpose operation, the income streams and results of which will be documented and disseminated	368
Design and development of contractual arrangements to underpin storage services, which will be made available as	239

model contracts	
Studies and modelling into the regulatory and market barriers, and value of storage, which will be disseminated	793
Costs of learning capture and dissemination, LCNF project management/delivery	2,263
Contingency	695
Total first of a kind cost	6,689

Further detail on the first row, relating to the Smart Optimisation & Control System are provided in answer UKPN035 relating to the IP arrangements for this aspect.

#### **4. Supportive Regulatory & Market Frameworks**

For the SNS solution to be adopted into BaU, a number of regulatory and market barriers should be addressed.

In particular, the contribution of flexibility such as demand-side response and storage needs to be incorporated into network security standards, such as revisions of ERP P2/6 and/or ETR 130, to allow DNOs to freely use such solutions to confidently provide enhanced security of supply to customers.

Reviews of these standards are in the pipeline, and as such we see this as a likely outcome, however real operational data relating to the contribution (especially when used for shared/multipurpose use) is lacking, and is the rationale for specific studies within the SNS project by Imperial College on these aspects.

Secondly, revised services for supporting balancing of the system, be it for the transmission system operator, or distribution system operators, are required in order to fully capture the potential benefits that can be offered by smaller, alternative but flexible providers such as storage and DSR operators. Existing product suites, such as STOR and FR have been designed for a market of only generators and therefore do not suit well the characteristics of more flexible, alternative providers. We will be working with National Grid throughout the project, and in particular during the final optimised operational phase to explore such products, the learning from which will inform future market frameworks.

#### **5. Confidence in the business models relevant to the GB market**

The final area we believe is necessary for the solution to become commercially viable is an improved level of confidence in the business models and economics of storage installations, when used for multiple purposes by multiple entities – SNS is the only project to be demonstrating this.

The learning from the SNS project will provide credible data that will serve to demonstrate the potential value that can be realised from energy storage, and validate the potential business models around storage flexibility, whether led by third-party operators, DNOs, aggregators or suppliers.

#### References:

- (1) [http://www.nationalgrid.com/NR/rdonlyres/55610D9A-C53A-4E28-88C6-29AE5DF72EF2/42697/Future\\_Balancing\\_Services\\_Requirements\\_Reserve1.pdf](http://www.nationalgrid.com/NR/rdonlyres/55610D9A-C53A-4E28-88C6-29AE5DF72EF2/42697/Future_Balancing_Services_Requirements_Reserve1.pdf)

	<p>(2) Primary, Secondary and High services:  <a href="http://www.nationalgrid.com/NR/rdonlyres/0F82BB0B-98E9-4B02-A514-3C87A85E60D8/42696/Future_Balancing_Services_Requirements_Response1.pdf">http://www.nationalgrid.com/NR/rdonlyres/0F82BB0B-98E9-4B02-A514-3C87A85E60D8/42696/Future_Balancing_Services_Requirements_Response1.pdf</a></p> <p>(3) Table 2-5, pg 62, Electricity Energy Storage Technology Options - A White Paper Primer on Applications, Costs, and Benefits, EPRI, Dec 2010</p> <p>(4) Presentation to the ESA by Beacon Power Corporation, 2009</p> <p>(5) DOE / NREL 2008-1330</p> <p>(6) Table 2-5, EPRI White Paper TR 102676 December 2010</p>
Attachments	 Appendix to Question UKPN033 v1
Verbal Clarifications  (Consultants )	