Review of Low Carbon Network Fund proposals

Report to Expert Panel

Scottish & Southern Energy

SSET2001: Northern Isles New Energy Solutions

8th October 2010

Report prepared by TNEI and Arthur D. Little
for project commissioned by Ofgem

Report Context

This report has been prepared for the Expert Panel with the aim of supporting them in their funding allocation decisions for the Low Carbon Network Fund.

Having reviewed the submission pro-forma and all of the supporting material, as well as answers to clarification questions we have put to the DNO, this report is intended to serve two purposes:

- it sets out any factual clarifications that we believe would be helpful to the expert panel when considering the submissions, based on information or data that is not immediately apparent or available in the pro-forma or Appendices A-E; and
- it highlights any concerns we have in any particular areas from, for example, either a technical, commercial or deliverability perspective, that the Expert Panel may wish to explore further with the DNO.

Consequently, the Expert Panel can assume that the factual content of the submission pro-forma to be sound unless noted otherwise in this report.

In writing the report we have avoided merely reproducing large parts of the submission, which stands on its own merits for the Expert Panels' consideration.

This report does not seek to assess the quality of this submission or rank it against any others. In particular, it does not provide any opinion as to whether the proposal should be funded. This is the role of the Expert Panel.

This report is not intended to be read in isolation and should be reviewed alongside the pro-forma and compulsory appendices.

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Project: Northern Isles New Energy Solutions

Description of Project (summarised from pro-forma Box 1)

Scottish Islands

Scottish & Southern Energy is proposing to develop sophisticated networks on Orkney & Shetland. The project submitted is the first phase and focuses on Shetland. It considers 20%-30% renewable generation by 2014 and includes actively manage heating demand, involving Industrial & Commercial customers in demand control, and thermal and chemical storage.

Problem

The Low Carbon Transition Plan demonstrates a clear trajectory of the UK's renewable energy use to 2020. With 7% renewable energy usage in 2010, Shetland's non-connected grid system represents the stage at which the UK is anticipated to be in 2015. Shetland is the only place in the UK which is currently experiencing both frequency and stability constraints in addition to thermal and voltage constraints across the island. These constraints are as a direct result of the high penetration of renewable generation. This means that in an area recognised as having the richest renewable energy resource in Europe: no new generation can connect to the network, new development is obstructed by restrictions on new electrical connections, and communities cannot benefit from feed in tariffs or other similar initiatives. Similar problems lie ahead for the UK grid as the country moves towards its 2020 targets for renewable generation. Such a situation would seriously jeopardise the achievement of deriving 15% of energy from renewable sources.

Solution

The project in Shetland's controlled electricity environment will contribute to resolving problems on a much wider scale. New knowledge will be developed and the learning captured from this work and facilitate application to the UK system. The project will deploy proven technologies in ways they have never been used before, specifically to allow more renewable generation to be connected to the system, manage existing demand to keep the system balanced, develop more flexible connection arrangements, reward communities for helping us balance the system and reduce reliance on fossil fuel consumption at the islands' main generation sources. The project involves a broad spectrum of customers including large scale generation, a 1MW battery at Lerwick power station, small community scale generation, industrial customers and up to 1,000 domestic customers, which represents around 12% of households in Shetland. To put this in context, an equivalent trial on the GB system would need to involve around 1.6m households. By undertaking a large scale project on Shetland's dedicated network, clear and statistically valid findings can be confidently used to inform decisions at both distribution and transmission level on a national scale.

Method

With partners Shetland Heat Energy and Power (SHEAP), SSE Renewables, Shetland Islands Council and Hjaltland Housing Association, the project team has identified potential for a new large controllable demand. This will allow the expansion of the existing Lerwick District Heating Scheme by combining a new 7MW wind farm with a 4MW boiler. The project includes new storage heaters that have greater storage capacity and crucially provide frequency responsive capability. An active network management system will be implemented to allow the integrated operation of these controllable components to optimise the costs, electrical losses and carbon intensity of the network.

Project

The project comprises of two phases, the proposal relates to the first phase. It includes installation of domestic demand side response in up to 1,000 homes, a demand controlled boiler, up to 10MW of new renewable generation, new commercial arrangements for generators, developing network modelling and forecasting, deployment of an active network management system, continued training, education and engagement and exploring the practicalities of a hybrid power station as part of the repowering project.

Key Project Figures

Project

Funding requested:	**£24.2M**
Total Project value:	**£51.6M**
Direct Benefit:	**£0.0**

Roll-out	**Proposal**
Total Carbon Benefit (discounted):	**£28.2B**
Total Other Benefits (discounted):	**£0.0**
Total Costs :	**£0.0**
Net Benefit :	**£26.2B**
Carbon Saved (undiscounted):	**682 million tonnes**

TOTAL WITHOUT CONTINGENCY	51,505,548
Percentages of total cost	
Contingency	0.2%
IT	3.9%
Equipment	52.1%
Staff	38%
Internal	*22%*
Contractors	*15%*
Payments to consumers	6%
Decommissioning	0.2%
Other	0%

EXPLICIT PROJECT MANAGEMENT LABOUR	
Project Working Days	1199
Labour Days	19550
Full Time Equivalents	19.3
Project Management	£11,547,000
Relative to Project Cost	22%

Key Items	**Total Cost**	**FUNDING PROPORTION OF TOTAL ITEM COSTS**			
		External	**LCNF**	**DNO**	
				Compulsory	**Extra**
Labour	11,546,341	4%	87%	10%	0%
Equipment	26,819,771	79%	19%	2%	0%
Contractors	7,962,708	24%	69%	8%	0%
IT	2,000,948	0%	90%	10%	0%
IPR Costs	-	-	-	-	-
Travel & Expenses	162,874	0%	90%	10%	0%
Payments to users	2,908,239	0%	90%	10%	0%
Contingency	104,667	0%	90%	10%	0%
Decommissioning	104,667	0%	90%	10%	0%
Other	-	-	-	-	-
Total	**51,610,215**	**45%**	**49%**	**5%**	**0%**

Summary of independent analysis

General View:
The project brings together network control solutions, storage technologies, and commercial and domestic demand-side response both through direct control and incentive mechanisms to manage a network with high levels of renewable energy.

This project has been well developed to this point and is in conjunction with a number of other parallel activities. There is a genuine need case and the Project represents an effective approach to test and demonstrate the proposed Method.

Significant Issues:
There are no significant issues with this project.

Specific Issues:
- We note that SSE believes that the NINES project reflects the future of the UK's electricity system. We broadly agree with that assertion, and merely invite the panel to consider the timeframe over which to assess the relevance. Please refer to Appendix B4 and optional Appendix 6 for further details.

- The confirmation of the ERDF grant will be critical to the success of the project; with evidence provided to date there is a reasonable level of confidence this will be approved in early December.

- Contingency is included without detailed breakdown. There is no detailed assessment of impact of risks on cost/benefit items or on project schedule.

- Given project involves engaging with customers to flex/ shift demand patterns, the underlying commercial arrangements are not clear (esp. the relationship with SHEAP)

- We believe the carbon benefits are overstated as they are based on a more rapid increase in renewable generation in Shetland than is likely to occur in the rest of GB.

- No benefits have been claimed in addition to carbon benefits, though the SSE recognises that there are a range of non-carbon benefits that the project will deliver.

- The GB-wide benefits are calculated on the basis of avoided carbon, specifically from 100% of the displaced MWh of grid electricity by up to 37 TWh of renewable electricity. No costs feature in this calculation. As a result we believe in the GB-wide roll-out carbon benefits are gross rather than net benefits.

- There is considerable benefit being derived from "wider" aspects such as fuel saving and Operation & Maintenance cost reductions rather than strict network benefits.

1. Accelerates the development of a low carbon energy sector

Summary:
The project brings together network control solutions, storage technologies, and commercial and domestic demand-side response both through direct control and incentive mechanisms to manage a network with high levels of renewable energy. The project will trial a range of technological and commercial initiatives to allow for greater interaction between the demand side and intermittent renewable generation.

We note that the GB-wide benefits are calculated on the basis of avoided carbon, specifically from 100% of the displaced MWh of grid electricity by up to 37 TWh of renewable electricity. No costs feature in this calculation. As a result we believe the GB-wide roll-out carbon benefits are gross rather than net benefits.

We note that SSE believes that the NINES project reflects the future of the UK's electricity system. We broadly agree with that assertion, and merely invite the panel to consider the timeframe over which to assess the relevance.

1.1. The proposal is closely aligned to priorities outlined in the current Low Carbon Transition Plan	The trials aim for better control of the system as well as enabling greater and quicker penetration of renewable generation on a constrained network.
1.2. The calculations for carbon savings are robust (audit of calculations only)	The calculations of carbon savings appear robust.
1.3. The carbon benefits of the project are credible	The net carbon savings for a GB-wide rollout are based on claiming 100% of the credit for up to 37 TWh of additional renewable generation. We note that the GB-wide benefits are calculated on the basis of avoided carbon, specifically from displaced MWh of grid electricity by renewable electricity. No costs for rolling out the solution feature in this calculation. As a result we believe the GB-wide roll-out carbon benefits are gross rather than net benefits. The GB carbon savings are based extrapolating the Shetland carbon savings based on the relative size of the generation portfolios between Shetland and the GB network (response to question SSE013). This is based on an assumption of scaling factor from Shetland to GB systems of 1000 (Appendix B(iv), University of Strathclyde report). We further note that the assumed growth in UK renewables is lagged by 5 years compared to the growth in Shetland renewables to account for the fact that the Shetlands is considerably ahead of the UK. This results in GB reaching its maximum carbon benefit (representing the avoidance of and additional 39 TWh of grid electricity) by 2022. We also note that the carbon intensity of the GB system is assumed to be 0.529 kg CO2/kWh (DNO comment: *taken from the SAP 2009 dated March 2010*),, rather than the DECC assumption of 0.4795 kg CO2/kWh.

	The carbon benefits are valued using DECC Traded Carbon Prices.
1.4. Extrapolation for roll-out is both statistically and technically sound, reliable and/or verifiable.	See the discussion above on the extrapolation.
1.5. Total energy system consideration as well as for DNO	There are no other specific assumptions on behalf of other industry players.
1.6. Assessment of Method's credibility	The Method is credible. It should deliver carbon benefits through demand-side response, allowing more renewables to connect to the system quicker, and by managing the interaction between the demand side and intermittent generation profiles, including controlling generation. We note that while the principles are transferrable to many other DNOs, we believe that the level of network complexity is not as high as other networks throughout mainland GB.
1.7. Significance of the Deliverable	The project allows for the complex interactions between "choppy" energy demand and intermittent renewable generation, and brings together a range of initiatives both commercial and technical, which will be relevant to other DNOs. While we accept that this represents a potential future for the UK's electricity system, we question the direct, or near-term, applicability of the findings to the wider GB network as it is not clear to us that the demand/supply characteristics of Shetlands and GB are sufficiently similar for direct learnings to be transferrable in the short-term. We note that the University of Strathclyde report sets out where it believes there are significant learnings that the NINES project can generate for a UK system however we still have are still some background concerns, set out below: The demand on Shetland is much 'lumpier' than the UK, and in particular has a strong dependence on a single large industrial load (a fish factory). We also note that the demand on the island is considerably "peakier" (when comparing load duration curves than for GB. We note that the average Shetland wind capacity factor is 50% compared with a European (and closer to GB) average of 20% meaning wind characteristics are likely to be very different to the rest of GB. Though we do acknowledge SSE's point that it is the intermittency rather than absolute capacity factor that is the issue.

	We also note that National Grid has identified up to 40 learnings that will be applicable to GB's future electricity system. We note that SSE believes, for exactly the reasons set and many others, that the NINES project reflects the future of the UK's electricity system. We broadly agree with that assertion, and merely invite the panel to consider the timeframe over which to assess the relevance.
Re-estimation of carbon benefits on the basis of "correcting for erroneous assumptions" or re-baselining	

2. Has the potential to deliver net benefits to existing and/or future customers

Summary:
The proposal has the potential to deliver benefits to existing and future customers.

No benefits have been claimed in addition to carbon benefits, though the SSE recognises that there are a range of non-carbon benefits that the project will deliver.

No costs are assumed in the GB-wide roll-out meaning the benefits are gross rather than net benefits.

2.1. The calculations for net benefits are robust	The calculations appear to be robust
2.2. The benefits claimed are credible	There are no benefits claimed in addition to the carbon benefits above, though the SSE recognises that there are a range of non-carbon benefits that the project will deliver.
2.3. The costs are credible	As discussed above, no costs are assumed in the GB-wide roll-out meaning the benefits are gross rather than net benefits.
Re-estimation of net benefits on the basis of "correcting for erroneous assumptions" or re-baselining	

3. Has a Direct Impact on the operation of the distribution system

Summary:
This project is targeting an existing known problem in terms of frequency control and stability on Shetland. At present no new generation can connect without additional measures. With measures in place, additional generation can be brought onto the system, the required measures include demand side response.

The applicability and implications of dynamic load response will be common to other DNOs. The learnings on active network management will be common although the Shetland network characteristics may not be representative of the wider GB system

The Shetland system is somewhat unique in the UK context as it is an island system that requires vertically integrated considerations. As such for efficient and cost effective design, the network and generation operation cannot be separated in the same way as for the interconnected mainland systems.
(DNO comment: The reality of this system is that there are a hierarchy of constraints that need to be addressed. With increasing volumes of embedded generation and changing demand profiles, in many ways Shetland is representative of a DNO of the future)

The operational philosophy is around using demand flexibility in a real-time mode to provide frequency response as well as peak management and active network management.

3.1. Directly contributes to the planning, development and operation of an efficient distribution system.	This is phase 1 of phase 2 and similar developments stated to follow for Orkney. No other DNOs have the same requirements as with Shetland, although it is recognised that there are direct parallels with the requirements for the GB system at a system balancing level.
3.2. The size of benefits that can be attributed to the Distribution System, taking into account the level of funding requested.	There is considerable benefit being derived from "wider" aspects such as fuel saving and Operation & Maintenance cost reductions rather than strict network benefits. There are additional elements to this project such as the hybrid power station and balancing that are not directly applicable to most DNO settings.

4. Generates new knowledge that can be shared amongst all DNOs

Summary:
Box 17 includes a clear statement on the new learning that is being sought and these are appropriate in the context of the project and the wider industry requirements. The directly applicable learnings will be secure operation of networks with high levels of renewables, economic impact on stakeholders of low carbon networks, impact on domestic and industrial customers and customer engagement and interaction

The quality of knowledge is likely to be high given that this is based around physical deployment onto a system with an existing as well as forecast problem. A good range of activities are proposed and information will be made available at a technical and non-technical level. Includes site visits for DNOs, websites, academic publications and via professional bodies.

There are a number of discrete but inter-related activities taking place as part of this project and as such, there will be a good range of knowledge generated from this project.

The volume of dissemination is relatively low for a project of this size.
(DNO clarification: the dissemination plans were perhaps over-summarised to minimise additional appendices, a more informative paper on this aspect is being prepared)

Learning Chain Summary:
The project will create data (but not the key focus) as well as information, but the main focus is on the development of knowledge and learning that result from a physical deployment to resolve a known and forecast continuing problem.

4.1. Robust methodology to capture the results from the Project	Shetland is a remote location and may be difficult for many people to get to due to distance and travel constraints. The Glasgow Science Centre element may help with the non-technical engagement and dissemination.
4.2. Applicability of the new learning to the other DNOs.	Not clear if only the academic study learning is being made available, or if all learning will be disseminated.
4.3. Effective plans to disseminate learning from the Project	Quality of knowledge for transfer will be dependent on the learning capture and dissemination
4.4. Knowledge generated is novel including innovative plans, tools and techniques which will be shared openly and easily with DNOs.	No information is shown on dissemination of learning from ANM deployment, or the final benefits of the full demand response implementation.

4.5. Effective treatment of IPR. (Where a DNO wishes to deviate from the default requirement for IPR)	Default conditions and no new IP generation anticipated as based on existing technologies

5. Involvement of other partners and external funding

Summary:
Key parties involved in the project are summarised below. Organisations with an asterisk represent organisations which could have been categorised as collaborators

	Equipment providers	***Transmission Network Operator***	***Energy retailers***	***Academic organis-ations***	***Project managers/ consultants/ advisors***	***Public sector players***
Collaborators	Glen Dimplex Smarter Gird Solutions (SGS)	National Grid	Shetland Heat Energy & Power Limited (SHEAP) SSE Renewables Developments (UK) Ltd	University of Reading University of Strathclyde	KEMA	Shetland Islands Council – Housing Service Hjaltland Housing Association Ltd
Partners						Higlands and Islands Enterprise Scottish Government The Shetland Community Community Energy Scotland
Others mentioned						

Collaborators
All collaborators are independent from Scottish and Southern Power Distribution; the exception is for Smarter Grid Solutions (where SSE has a minority share).

Key areas of technical experience are covered (though it is noted that several key collaborators are only listed in the Appendices and not the main proposal). The role/contribution of each partner appears to be clear.

Collaborators are making a significant investment in the project; rationale for provision of funds appears proportionate to benefits.

Significant effort appears to have been made to ensure appropriate collaborators and partners are involved in the project with indications of success to date.

Contractual arrangements have not been finalised. This will depend on the confirmation of the ERDF grant conditions.

Partners
Partners correctly classified; collaborators are all providing funds appropriate to benefits.

External Funding
Funding provided is not clearly differentiated between funds contributing to ERDF proposal and this project

Project dependent on ERDF and DECC funding; While the DECC funding is confirmed, the ERDF has not been announced. Further details provided under the clarification questions include:
"Two applications for ERDF funding were submitted by Shetland Islands Council on the 13th August 2010. We expect decisions to be formally announced in early December 2010. Whilst we cannot pre-empt the ERDF decision making process, we are reasonably confident of success as the Highlands and Islands ERDF programme has a strong focus on supporting renewable energy development in the region. The Highlands and Islands ERDF programme also has a clear objective of supporting sustainable growth in fragile and peripheral areas in the Highlands"

6. Relevance and timing

Summary:
The project is timely in terms of resolving a known problem on the wider Shetland network. It is fore-sighting problems and solutions for the wider GB network. The benefits of using active networks and demand response to manage increased levels of renewable generation are appropriate.

The project will be trialling active network management, the learnings from which will feed into wider network deployments.

The project focus is on improved methods for balancing systems with high levels of renewable generation

The project is likely to be delivering results within a practically rapid timeframe. Firm plans for the Shetland Repowering must be produced by December 2013.

6.1. The timing of the project is appropriate	Most of the stated value appears to be system balancing rather than network related. It is recognised that for the system balancing to use demand, the distribution network must be capable of managing this dynamic demand response.
6.2. Use of solution as part of their future business planning and how it would impact on its business plan submissions in future price control reviews, including DPCR6.	No explicit mention has been made of DCPR6 activities.
6.3. Focus on developments associated with a move to a low carbon economy that are more likely to happen.	The project focus on developments moving to decarbonisation of the electricity sector are appropriate.
6.4. Time to tangible results	The project will be achieving early results but it is not clear whether these will be disseminated at this same stage, or whether the release of these learnings will not be until at a later date.

7. Demonstration of a robust methodology and that the Project is ready to implement

Summary:
The project involves engaging with customers to flex/ shift demand patterns (incl. Domestic customers to actively manage their heating demand) involving careful consideration of underlying commercial arrangements.

The technology is in general low volume, large capacity proven existing technology applied to networks with the exception being 1,000 Demand Side Response (DSR)/frequency response heaters. Domestic customers are not actively involved but the scheme makes use of 1,000 customer DSR/frequency response heaters.

The project plan outlines critical pathways, linkages to external activities and identifies key links. Key organisations are in place and appear to have been involved in proposal preparation. Further activities prior to project launch include establishing commercial arrangements, and finalising negotiations with Ofgem

Risks to the project such as securing additional external funding are identified and alternatives discussed; similar risks of cost increase are discussed. Procedures are in place and risks have been identified and mitigated against.

The delivery criteria align with the project work areas. Dates for delivery are included.

7.1. Detailed Project plan, with responsibilities clearly established and inter-dependencies identified.	The plan is provided in reasonable detail and key interdependencies between work packages have been attempted. The organisation chart includes named individuals and identifies the role of specific collaborators within the diagram.
7.2. Resources to deliver the Project are of a sufficient size and quality to be reasonably expected to ensure its delivery.	Appropriate organisations have been identified and are clearly identified on the organagram. Most of the resources appear to be of a sufficient size and quality for the project. For SGS, if they were part of several successful LCN projects could find significant proportion of resources used by these projects. *(Clarification stated that the NINES project will represent approximately 20% of SGS total anticipated revenues in 2010)* *(DNO Clarification: There are a number of reasons why SSE do not see this as a major cause for concern:* - *The likelihood that SGS is involved in all successful projects is small.* - *SHEPD has a long established working relationship with SGS extending back to the company's inception… this established relationship puts us in a good position going forward.* - *Through the work we have done to date with SGS, we are confident that SGS will be adequately resourced to take on any work that it commits to.* - *….Our other LCNF project uses a different provider to take on the lead technical role)*
7.3. Demonstration that the Project can be started in a timely manner.	Subject to finalising commercial arrangements and finalising negotiations with Ofgem, the project appears able to start according to schedule. The commercial arrangements are pending confirmation of ERDF grant which is due in early December (see topic 5 above).

7.4. Risks to costs and benefits of the Project have been reasonably estimated.	Contingency is included without detailed breakdown. There is no detailed assessment of impact of risks on cost/benefit items or on project schedule. Elements of the project which may need to be revised in terms of risks to costs and benefits are identified (market conditions and customer reaction).
7.5. Assessment of proposed cost overrun percentage (if non-default?)	Default requested.
7.6. Assessment of Direct Benefit protection (if non-default?)	No Direct Benefits in the project are identified
7.7. Identification of appropriate risk mitigation processes	Procedures are in place and risks have been identified and mitigated against. Contingency has not been identified.
7.8. Direct Impact on Distribution Networks on roll-out has been correctly identified	Though the Shetland network is quite unique within the UK the knowledge gained both in network operation and equipment installed will be transferable to other networks.
7.9. Immediate Project impacts on the proposer's network have been correctly identified	Real life, full scale, smart grid with active network management The scheme involves the connection of both additional storage and generation onto the network to allow the DNO to maintain system stability, by balancing generation and demand, both actively and through new commercial arrangements and variable tariffs.
7.10. Customer Impact and change required have been correctly identified	Domestic customers are not actively involved but the scheme makes use of 1,000 customer DSR/frequency response heaters which can be both automatically controlled based on system frequency or actively controlled based on demand. Commercial incentives and tariffs will be used for I&C customers to provide demand response both generation and load
7.11. Technology Viability	Technical low risk due to the relatively low number of components being employed and technology applied. The technology is in general low volume, large capacity proven existing technology applied to networks with the exception being 1,000 DSR/frequency response heaters. The scheme requires active network management but not on the same scale,

	in terms of device numbers, as other smart grid projects. Risk of individual component failure is low but the impact is high. However the fall back position is business as usual
7.12.Successful Delivery Criteria	Revised successful delivery criteria align with project milestones and timescales provided.
7.13. Contractual proposals	Given project involves engaging with customers to flex/ shift demand patterns, the underlying commercial arrangements are not clear (esp. the relationship with SHEAP) *(DNO clarification: we will seek to maintain the existing contractual arrangements that customers have with suppliers (via supply contracts) and where appropriate with SHEPD via connection agreements…… We are in ongoing discussions with all of participant groups to finalise these arrangements for commencement of the project. The long term intention is to use the learnings from the NINES project to inform the development of new charging and reward mechanisms for customers who participate in demand side management schemes)*
7.14 Derogations and exemptions	