

## DEVELOPING A SMART GRID TRIAL SITE IN THE UK

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### ABSTRACT

The Smart Grid is referenced as the solution to meeting the future demands on electricity networks without incurring the significant costs of wholesale infrastructure renewal, yet how the Smart Grid is created and what actual benefits arise are still the subject of speculation. The paper describes the design of a Smart Grid trial intended to help understand, by demonstration, the actual and potential benefits that could be derived. The key players, their roles and the funding requirements are defined thus creating a 'how to' guide for those seeking to establish Smart Grid trials in their area.

### INTRODUCTION

Prior to the emergence of the UK Regulator's Low Carbon Network Funding (LCNF) mechanism, a group of Distribution Network Operators (DNOs) from Britain and Ireland collaborated on a Strategic Technology Programme (STP) project to design and implement a Smart Grid Trial. The objective was to extract common learning about the costs, risks and benefits of the Smart Grid and to identify solutions that could be cost-effectively implemented on new and existing networks in response to stresses expected on electricity distribution networks in the transition to a low carbon economy.

The project identified the elements felt essential for the viability of a trial. A number of potential trial sites were measured against the availability of these essential elements. Once a suitable trial site had been selected, a specification and implementation plan was drawn up.

### ESSENTIAL ELEMENTS

The definition of a Smart Grid used in this project aligns with the 'Key Elements of a UK Smart Grid' as expressed by UK's Department of Energy and Climate Change (DECC) in the Low Carbon Transition Plan [1].

- *Improved information for electricity consumers, notably through smart meters, to allow them to manage their energy use (and hence energy bills) more effectively.*
- *Facilitating demand management, providing data to technologies in homes and buildings that can regulate electricity use (e.g. encouraging electric cars to recharge when there is "surplus electricity" available on the system).*

- *Enabling individuals and businesses to sell electricity into the network as well as buying from it, through microgeneration and on-site technologies.*
- *Enhanced monitoring and information flows for network operators, allowing them to make more efficient decisions about where energy flows across the network on a real time basis.*
- *More optimal usage of the whole network in meeting demand, which could limit the need for more reinforcement of the grid.*

The three essential ingredients for a Smart Grid trial site, aligning with the DECC definition, were identified as:

- Available, deployable, smart elements
- Support of major stakeholders
- Suitable sources of funding.

Each of the above are considered essential prerequisites for a successful Smart Grid trial.

### Smart Elements

The term 'smart elements' has been coined to identify those items of equipment or systems that could feature in a Smart Grid. Examples are:

- Smart metering
- Small-scale distributed generation
- Network automation
- Energy storage
- Electric vehicles
- Demand-side management
- Smart software and communication infrastructure
- Network monitoring and control.

Rather than research the individual performance of the elements still in development, the Smart Grid trial was required to demonstrate the actual and potential benefits which could be derived from the application of currently available Smart Grid systems and technologies.

### Major Stakeholder Support

The UK regulatory landscape is somewhat different than in other countries around the world. The present separation of electricity supply businesses from distribution businesses means that DNOs have limited access behind the customer's point of connection and meter. The support of other stakeholders in a Smart Grid trial is therefore an essential element.

### **Sources of Funding**

A number of sources of high value and relevant funding were identified from both UK and EU sources. However, no single source of funding was identified which was capable of supporting all the elements of a Smart Grid trial. The Low Carbon Network Fund, launched during the execution of this project, was particularly suitable for the network elements. The absence of a comparative mechanism to fund elements on the customer (non-network) side of the meter added significant risk to the establishment of the trial. Partnering with other stakeholders, including those used to accessing funding for domestic and commercial property improvements, was determined to be a key factor in mitigating this risk.

### **TRIAL DESIGN**

A generic Smart Grid trial specification was not possible. The host DNO, equipment to be deployed, other stakeholders and sources of funding could only be determined once the area in which the trial would take place was selected.

#### **Site selection**

Discussions with the UK Department for Communities and Local Government (DCLG), DECC and various local councils led to a short-list of three potential trial sites being identified:

- A proposed Eco-Town
- A new build extension to an existing housing development
- A retrofit option in an existing area undergoing urban regeneration.

Each site was measured-up against the essential ingredients for a Smart Grid trial and a selection made of the site offering the best opportunity for success in establishing a trial site and producing relevant learning.

The retrofit option was selected in particular because:

- The host DNO and local council (and associated agencies) showed a high level of support for the trial
- The retrofit application meant that the learning points had greatest utility for other DNO networks
- There was no reliance on building works thus allowing a timely delivery; regeneration works targeted for the area would continue with or without the Smart Grid trial.

#### **Selection of Smart Elements**

Based on the publicity surrounding Smart Grids and the enthusiasm shown by the leading manufacturers in establishing Smart Grid departments, it was assumed that identifying commercially available smart elements would be relatively straight forward, however the reality was somewhat different. It was found that whilst many manufacturers had high level presentations on Smart Grids, commercially available equipment was sparse.

Availability and funding of smart meters suffered from the absence, in 2010, of the final UK smart meter specification.

Of the seven smart meters that were listed as approved for use in the UK on the National Measurement Office web site in March 2010, only two met more than half of the requirements proposed by the ENA (energy networks association) in their response to DECC's smart meter specification consultation.

Of the small-scale distributed generation elements, solar PV was assessed to be the most suitable for the trial area with a number of properties in a concentrated area having south facing roofs. Currently available Domestic Combined Heat and Power boilers were deemed unsuitable for the small terraced houses and rooftop wind generators were also discounted in this dense urban environment.

Some centralised points for the installation of public electric vehicle charging points were identified.

The relatively small amount of generation expected to be connected within the trial area did not warrant expensive energy storage.

In comparison with other elements, network monitoring equipment, complete with near real-time communications back to the host DNO operations centre, was widely available. Equipment capable of monitoring power quality and power flows within the Smart Grid trial area was specified for the trial.

#### **Major Stakeholders**

One of the expected outcomes of the Smart Grid trial is a net reduction in energy use and/or a flattening of the demand curve by virtue of managing network demand. Customer participation in the trial is therefore assessed as a vital requirement in achieving benefits from a smart grid. The issue for UK DNOs is that they have neither direct access to the meter or to the customer's themselves. In order to bridge this gap, any meaningful Smart Grid trial requires collaboration between the host DNO, one or more energy supply companies and the residents and businesses in the trial area. For the Smart Grid trial, a project group was proposed comprising of key stakeholders with overlapping responsibilities for developing, funding, implementing and operating the various elements that make up the Smart Grid trial. The resulting multi-partner project group requires a high degree of project management that must be factored into the trial design.

One attraction of the selected trial area was the presence of a Social Landlord that owned approximately half of the 1200 properties in the selected trial area. They are actively engaged in regeneration works on their properties and have a much stronger community identity than either DNOs or Energy Supply Companies. As such they presented an ideal partner in encouraging customer participation.

The proposed composition of the Smart Grid trial project group is shown in Table 1. Manufacturers are conspicuously absent but this would not preclude their inclusion later in the trial.

**Table 1 Proposed Project Group Composition**

Partner	Role
Project Leader	Experienced manager of multi-partner projects Manages the expectations of each partner
DNO	Technical expert for networks Provider of monitoring data Investor in network Local knowledge
Local Authority / Business Representative	Links to businesses Provider of information on regional Low Carbon Agenda Links to Government Media interface
Proxy Customer / Provider of Customers	Customer-liaison Represent customer views Access to customers
Technical Expert	Provides legislative environment and energy expertise Ability to monitor Smart Grid Trial design and analysis
Energy Supplier	Access to energy efficiency funding Access to Smart Meters Access to Customer billing methods

### **Funding**

Responsibility for equipment funding was divided between the eventual asset owners.

The UK Regulator's Low Carbon Network Funding mechanism effectively covered the network elements of the trial including project management and monitoring, analysis and learning dissemination.

Smart meters are mandated to be installed in all UK properties by 2020. Discussions with the dominant energy supply company in the trial area indicated their willingness to install smart meters in the area but only once the specification was finalised.

In terms of encouraging customers to manage demand, Electronic Display Devices (EDDs) were assessed to provide the required functionality at relatively low cost. The absence of a funding mechanism similar to the Low Carbon Network Fund but for items on the customers premises caused problems for the procurement of EDDs and microgeneration.. Feed-in-tariffs for microgeneration introduced in March 2010 essentially prevent access to grant funding for these items.

Though they were felt to be a key element in the smart grid trial, non-capital works such as customer engagement and education also proved tricky to fund.

The large energy supply companies in the UK are incentivised to provide energy savings and energy efficiency measures under the Supplier Obligations such as the Carbon Emissions Reduction Target (CERT) Programme. As such, the

involvement of a large energy supplier on the project group and as an active partner in planning and delivering the trial was assessed to be key in delivering learning from non-network smart elements.

### **THE FIVE STAGE PROCESS**

It is envisaged that the early Smart Grids will be the result of DNOs proactively conducting trials rather than any natural development of the network. A generic five stage process to develop a Smart Grid trial is proposed:

- Site Identification
  - Use of the three essential ingredients for a Smart Grid site
  - Geographic boundaries and number and type of customer of sufficient size to ensure relevant learning at manageable cost
- Project group
  - Project group composition as Table 1
  - Responsible for project direction and pace
  - Forum for identifying and resolving issues
  - Coordinated and consistent communication
  - A partner with existing good customer relationships is key
  - A proactive energy supply partner is required for access to smart meters and customer-side equipment funding
  - The project group composition is expected to change over time
- Initial plans
  - Selection of smart elements and determination of budget costs and funding
  - Funding and expected contributions from each stakeholder need to be confirmed at this stage
  - Expected project duration
- Specification and project plan
  - Composition of Smart Grid trial and how it is to be delivered
  - Including communications plan
  - Including risk register
  - Design of trial into test cells (experimental structure) and time lines
- Project delivery
  - Execution of the project plan
  - Steered by the project group
  - Ongoing risk management
  - Procurement and installation of smart elements
  - Structured monitoring and engagement
  - Analysis and learning
  - Project close out and learning dissemination

The above describes a gated approach to the development of the smart grid trial. The opportunity exists at any of the transitions (gates) between stages for the project group to decide whether to move on to the next stage or not.

## CONCLUSIONS

The first UK Smart Grids are likely to be trial sites. This paper describes a project undertaken with a group of DNOs from the Britain and Ireland and explores the initial steps taken in setting up a trial.

During the course of the project it has become apparent that any meaningful Smart Grid trial aligned with UK Government's Low Carbon Transition Plan requires engagement with the end users (customers) of electrical energy. Where the regulatory environment separates energy distribution and supply, in the UK for example, this creates some barriers as DNOs do not have direct customer access and have therefore lost some community identity. The formation of a project group comprising customer's representatives and energy supply companies as well as the host DNO was used to overcome these problems.

Predictably, the lack of a clear funding mechanism for non-network elements has been the key issue along with doubts surrounding the final specification for smart meters prior to their full-scale roll-out. Feed-in tariffs as funding mechanisms for trial smart elements presuppose that customers or the organisations supporting them have access to spare capital, which they may not, and that a payback time well beyond the duration of the trial is acceptable, which it may not be. Capital free roof rental schemes for PV generation impose long term roof access restrictions for Social Landlords which are unattractive when balanced against the relatively small benefits for their customers.

A generic five stage approach to developing a Smart Grid trial is proposed allowing the opportunity at the interface between stages to reassess the project against the ultimate goals.

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## REFERENCES

- [1] DECC, 2009, *The UK Low Carbon Transition Plan*, Crown Copyright, UK, 70-71