ENA Smart Metering System Use Cases

For: ENA

April 2010

Engage Consulting Limited

Document Ref: ENA-CR007-002 -1.1

Restriction: ENA authorised parties only
Document Control

Authorities

<table>
<thead>
<tr>
<th>Version</th>
<th>Issue Date</th>
<th>Author</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>18th March 2010</td>
<td>James Boraston</td>
<td>Initial draft to confirm structure</td>
</tr>
<tr>
<td>0.2</td>
<td>19th-31st March 2010</td>
<td>James Boraston &amp; Alastair Manson</td>
<td>Various additions to report</td>
</tr>
<tr>
<td>1.1</td>
<td>6th April 2010</td>
<td>James Boraston</td>
<td>Incorporate ENA comments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version</th>
<th>Issue Date</th>
<th>Reviewer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>31st March 2010</td>
<td>Tom Hainey &amp; Alastair Manson</td>
<td>Engage review</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version</th>
<th>Issue Date</th>
<th>Authorisation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2nd April 2010</td>
<td>Dave Openshaw, Ralph Reekie</td>
<td>ENA member review</td>
</tr>
</tbody>
</table>

Related Documents

<table>
<thead>
<tr>
<th>Reference 1</th>
<th>ENA Smart Metering Project Initiation Document (ENACR004-001-1.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference 2</td>
<td>ENA Smart Metering Requirements Update (ENACR006-002-1.0)</td>
</tr>
<tr>
<td>Reference 3</td>
<td>DECC – “Towards a smarter future: Government response to the Consultation on Electricity and Gas Metering”.</td>
</tr>
</tbody>
</table>

Distribution

Recipient 1 – Alan Claxton (ENA) / Dave Openshaw (edf)

Recipient 2 – ENA members
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Document Control</strong></td>
<td>2</td>
</tr>
<tr>
<td>Authorities</td>
<td>2</td>
</tr>
<tr>
<td>Related Documents</td>
<td>2</td>
</tr>
<tr>
<td>Distribution</td>
<td>2</td>
</tr>
<tr>
<td><strong>Table of Contents</strong></td>
<td>3</td>
</tr>
<tr>
<td>1 Introduction</td>
<td>4</td>
</tr>
<tr>
<td>1.1 Background</td>
<td>4</td>
</tr>
<tr>
<td>1.2 Purpose</td>
<td>4</td>
</tr>
<tr>
<td>1.3 Scope</td>
<td>5</td>
</tr>
<tr>
<td>1.4 Copyright and Disclaimer</td>
<td>5</td>
</tr>
<tr>
<td>2 Introduction to Use Cases</td>
<td>6</td>
</tr>
<tr>
<td>2.1 What Use Cases are</td>
<td>6</td>
</tr>
<tr>
<td>2.2 The benefits and use of use cases</td>
<td>7</td>
</tr>
<tr>
<td>2.3 Use case sets and use case diagrams</td>
<td>8</td>
</tr>
<tr>
<td>2.4 Use of the documentation</td>
<td>8</td>
</tr>
<tr>
<td>2.5 Explanation of the template</td>
<td>8</td>
</tr>
<tr>
<td>3 Overall approach</td>
<td>11</td>
</tr>
<tr>
<td>3.1 Process</td>
<td>11</td>
</tr>
<tr>
<td>3.2 The use case levels</td>
<td>11</td>
</tr>
<tr>
<td>3.3 The workshops</td>
<td>11</td>
</tr>
<tr>
<td>3.4 Review process</td>
<td>11</td>
</tr>
<tr>
<td>4 Scope of the Smart Metering System</td>
<td>12</td>
</tr>
<tr>
<td>4.1 Introduction</td>
<td>12</td>
</tr>
<tr>
<td>4.2 Statement of System Scope</td>
<td>12</td>
</tr>
<tr>
<td>4.3 Out of Scope</td>
<td>15</td>
</tr>
<tr>
<td>5 Use Cases in Context</td>
<td>16</td>
</tr>
<tr>
<td>6 Electricity Use Cases</td>
<td>17</td>
</tr>
<tr>
<td>6.1 Use Case Actors</td>
<td>18</td>
</tr>
<tr>
<td>6.2 Assess Network Performance</td>
<td>19</td>
</tr>
<tr>
<td>6.3 Actively manage networks</td>
<td>41</td>
</tr>
<tr>
<td>6.4 System Balancing</td>
<td>62</td>
</tr>
<tr>
<td>6.5 Actively manage network – planned and unplanned outages</td>
<td>74</td>
</tr>
<tr>
<td>6.6 Manage safety issues</td>
<td>97</td>
</tr>
<tr>
<td>6.7 Support network activities</td>
<td>105</td>
</tr>
<tr>
<td>7 Gas Use Cases</td>
<td>109</td>
</tr>
<tr>
<td>7.1 Use Case Actors</td>
<td>109</td>
</tr>
<tr>
<td>7.2 Gas network activities</td>
<td>109</td>
</tr>
<tr>
<td>8 Uses Outside of System</td>
<td>121</td>
</tr>
<tr>
<td>8.1 Electricity</td>
<td>121</td>
</tr>
<tr>
<td>8.2 Gas</td>
<td>121</td>
</tr>
</tbody>
</table>
## 1 Introduction

Since their production of an initial set of ENA Requirements for Smart Metering which formed part of their response to the DECC consultation on smart metering, the ENA and its member companies have recognised the importance of further developing their original functional specification in order to fully support the objectives of the ENSG Smart Grid Vision and Route map, and in recognition of the importance that DECC has placed on the development of Smart Grids. In order to achieve this objective, ENA has commissioned Engage Consulting Limited (Engage) to undertake a project (PID – Reference 1) to address 4 key areas of work as follows:

- **Workstream 1 – ENA Smart Metering System Requirements:** Update and enhance key network requirements needed to support current network businesses and the future needs of Smart Grids;

- **Workstream 2 - Development of Appropriate Use Cases:** To fully articulate the key aspects of the ENA requirements it is intended that specific Use Cases will be developed for critical areas related to energy network businesses and smart grids.

- **Workstream 3 – Performance Standards & Communication Requirements:** This workstream will develop appropriate scenarios for each Use Case and undertake a data traffic analysis to assess the impact this will have on the smart metering communications infrastructure.

- **Workstream 4 - Privacy & Security Considerations** - This activity will provide an overview of the scope, principles and concepts that need to be considered when developing a secure smart metering system solution to take account of the Energy Networks additional requirements.

This report provides the output of Workstream 2.

### 1.1 Background

The Government’s response to the DECC smart metering consultation process (Reference 3) included a number of statements emphasising the importance of developing a smart grid in Great Britain and of ensuring that Network businesses were able to contribute by specifying the functional requirements of a smart metering system that would be required to support that objective.

It is therefore imperative that the correct level of factual and detailed information is fed into Ofgem E-Serve’s Phase 1 work. This will ensure that in developing the smart meter functionality and communications infrastructure requirements, full account can be taken of the short, medium and long term needs of network operators such that the key functionalities can be incorporated in an appropriate manner and within the relevant timescales.

### 1.2 Purpose

The purpose of this report is to:

- Document the ENA smart metering functional requirements using the Use Case methodology
1.3 Scope

This project is focused on ensuring that the requirements of energy networks – in respect of the short, medium and longer term functionality required of smart metering, and associated communication infrastructure - are clearly defined and aligned with work being undertaken by the DECC/Ofgem E-Serve Smart Metering Implementation Project. This particular report is focused on the clear and precise articulation of the business need and benefits that Smart Metering functionality will fulfil for the ENA members in a format that can be fully understood by Ofgem E-Serve and DECC and factored into the scoping work currently being undertaken.

1.4 Copyright and Disclaimer

The copyright and other intellectual property rights in this document are vested in ENA. Engage Consulting Limited has an unlimited licence to use any techniques or know-how developed by it under this Agreement on its future work.

No representation, warranty or guarantee is made that the information in this document is accurate or complete. While care is taken in the collection and provision of this information, Engage Consulting Limited shall not be liable for any errors, omissions, misstatements or mistakes in any information or damages resulting from the use of this information or action taken in reliance on it.
2 \textbf{Introduction to Use Cases}

This section describes the methodology that is known as Use Cases.

2.1 \textbf{What Use Cases are}

The main purpose of use cases is to articulate simply and clearly the functional requirements of a system.

Use cases describe how a system behaves to provide functionality of benefit (goals) to “actors” which may be people, systems or organisations. Each use case identifies a goal and how that goal is achieved for an actor.

As much as possible, this should be done avoiding the use of specialist or technical terminology. Use cases use natural language and put the requirements in context to allow the requirements to be easily comprehensible to a wide audience including the non technical and allow a common understanding between people with different interests and experience. This has benefits of bridging the gap between various stakeholders – the people who understand the problem, and people who are sponsoring or building the solution.

Use cases may be written at different levels for different purposes. High level or summary use cases may collect a number of more detailed uses and are useful to give an overview of requirements or more strategic goals. More detailed user level use cases describe an individual use of a system to achieve a more immediate goal. Very low level sub use cases can be written to detail programming level requirements.

In documenting a use case it is helpful to address further information that supports the understanding of the goal and how it is achieved as follows:

- **Scope** - identifies the system (the boundaries of the system) being described.
- **Use case (Goal)** - the objective of the system that gives benefit to an actor.
- **Actor** - anyone outside the system that interacts with the system to achieve the goal.
- **Primary actor** - usually the actor that initiates the use case.
- ** Preconditions and Post conditions** - what must be true before and after the use case runs (note: preconditions almost invariably point to the existence of another use case where the condition is established).
- **Basic Flow** - the main success scenario and a description of the steps in a straightforward case where the goal is achieved.
- **Alternative flows** - other ways in which the flow may happen.

A reasonably full use case would contain the information above.

Use cases can capture other useful information such as:

- The key information involved in an interaction;
- Relationships with other use cases;
- Business rules;
• Frequency and performance requirements;
• Assumptions;
• Outstanding issues.

By documenting the functional requirements as use cases it is possible to avoid the technical solution, or particular perception of it, driving the requirements. Often the perception of the solution is difficult to resist so assumptions of the solution may be recorded in a notes section of a use case allowing later assessment but these should not become central to the documentation.

2.2 The benefits and use of use cases

Use cases provide some very clear benefits to the Analysis Phase. One important benefit of use case driven analysis is that it helps manage complexity, since it focuses on one specific usage aspect at a time. Use cases start from the very simple viewpoint that a system is built first and foremost for its users.

2.2.1 Avoiding early solution design constraint

Use case modelling is a proven method to effectively describe the required behaviour of a system. Functional requirements should be central to the understanding of a system and should largely drive development of that system. An early focus on the functional requirements of a system can avoid technical solutions leading and constraining their use.

2.2.2 Cost benefit analysis

Since use cases describe the benefit of a system, and the solution provides the cost they are a vital part of cost benefit analysis.

2.2.3 Uncovering further expectations

Use cases may be used in an iterative process:
• as understanding of the uses of a system is gained more uses may be revealed;
• as understanding of costs and benefits is gained – the set of use cases may be refined.

Since early use cases may be expected to be discarded they should be written only to an appropriate level of detail.

2.2.4 Uncovering misaligned expectations

Use cases describe expected uses of a system. Different stakeholders may have assumed this use and prior to the production of clear documentation the different stakeholders may also assume the same requirements. Simple documentation of the requirements often uncovers where different stakeholders have different expectations and allows early reconciliation of these differences in the eventual solution.

2.2.5 Providing a central point for other requirements

Use cases are not all the requirements of a system. They do not capture, non functional requirements, data formats, user interface requirements and so on. Use cases are, however, central to the requirements and can be used to connect other requirement details. Use case development is a good way to capture
information relating to other requirements; for example although data formats would be part of the technical solution, use cases can be used to capture the key information involved in an interaction and drive the requirements for information exchanges and analysis of data traffic.

Use cases describe achieving a goal. These requirements are testable and use cases can be mapped to requirements for testing the most important part of a system to test whether it delivers the functional requirements.

2.3 Use case sets and use case diagrams

Use cases can be gathered into sets for different purposes – a set of summary use cases summarises the high level expectations of a system.

Sets of more detailed use cases can show how each of the summary objectives are achieved.

Use cases may be gathered into sets to illustrate other groupings such as phasing of delivery or other prioritisation.

Use case diagrams are a useful way to depict sets of use cases and the simple relationships with actors. Use case diagrams do not substitute for the use cases themselves but provide a useful summary of requirements or sets of requirements.

Actors are shown as stickmen with the name of the actor written underneath and use cases are shown as ellipses with the name of the use case written inside. The system boundary is a rectangle enclosing the use cases.

2.4 Use of the documentation

Although the use cases and use case diagrams are gathered into a single document here, both each use case and each diagram should be able to be used reasonably independently depending on what is to be illustrated.

2.5 Explanation of the template

There is no single template for use case documentation, indeed, projects should be encouraged to create a template that suits their purpose. There is, however, much agreement on the key information to be captured for a use case, although it is important to capture information appropriate to the level addressed.

For example a summary use case would not present much, or any, information to depict a flow of interaction – simply a summary level use case, although perfectly valid, is not started and completed by a series of interactions but might be carried out by the employment of more detailed use cases.

The elements of the template that are used here will be familiar to anyone experienced with use cases. The elements used are as follows:
2.5.1 Use case name, level and ID
Unique identification of the use case and indication of its use and relationship.

2.5.2 Description
Identifies the goal – and how the system delivers that goal.

2.5.3 Actors
Identification of the Actors involved:
- the primary actor is usually the actor that starts the use case and or gains benefit;
- Secondary actors – are other actors involved in the fulfilment of the use case.

2.5.4 Scenarios
Provide an illustration of the achievement of the goal and contain the following sections:

2.5.4.1 Pre conditions
These are conditions that must be true before the use case starts.

2.5.4.2 Post conditions
These are conditions that are true when the use case is completed – note that these should cover the successful completion and unsuccessful completion of a use case.

2.5.4.3 Trigger
The reason for the use case starting.

2.5.4.4 Basic Flow
A sequence of interactions that achieves the successful completion of the use case.

Note here these are frequently illustrative rather than definitive.

2.5.4.5 Alternative flows
Descriptions of other paths the use case may take.

2.5.5 Additional Information
Used to capture additional pertinent information not already noted.

2.5.5.1 Related Information
Used to detail other information, such as other use cases, that relate to the current use case.

2.5.5.2 Notes and Issues
Used to capture other information or issues not already captured. Also can be used to capture questions or areas the author is unsure of and requires further
clarity. This section is often extensively used in collaborative production of use cases.
3 Overall approach

The Use Case workstream ran in parallel (with a slight lag) to the Requirements workstream.

3.1 Process

The ENA Smart Metering requirements as provided to DECC were taken and the functional reasons for their inclusion were assessed in an iterative process. The requirements were distilled into some initial high level summary use cases that attempted to capture the high level Network activities – planning, actively managing the network, and ensuring network safety and security – these were expanded as further uses were discovered.

3.2 The use case levels

Use Cases may start at high summary levels that all stakeholders can agree on, and then drill down to more detailed levels as required. For this analysis we have provided high level summary use cases and then a more detailed system level set of use cases that fulfil the summary level. Production of further more detailed levels is possible but would be spurious at this point.

3.3 The workshops

Use Cases were introduced to the ENA members at the first Requirements workshop, which was then followed by a full day workshop on Use Cases. Draft detailed Use Case names and brief descriptions were then drafted and issued to the members for review. The detailed Use Cases were then developed based on these and comments received. A further workshop was held on 22nd March where the detailed draft Use Cases were discussed and developed further.

3.4 Review process

The Use Cases included a full internal review by Engage staff and then a subsequent review by a network expert Engage associate. The documents were then issued to the ENA members for review.

Various iterations of the use cases were produced from the review cycle, including new use cases written by the ENA members themselves.
4 Scope of the Smart Metering System

4.1 Introduction

The purpose of this exercise is to describe the functional requirements of networks businesses involving smart metering in the context of a mandated roll out of that metering and in the expectation that this metering may facilitate the operation of smart grids. The intention is not to describe smart grids themselves (although this may be a useful exercise later).

Network businesses are already expected to operate efficiently and provide a reliable service. There is the expectation that there will be new challenges to providing this service and that this will result in new demands being placed on Network businesses to maintain, improve and demonstrate this efficiency and reliability.

The challenges and the opportunities to make use of smart metering may be more obvious for electricity than gas; however the major business objectives of planning the efficient and reliable use of the network apply to electricity and gas so both are considered.

Use cases describe the functional requirements that Actors have of a system. It is critical that the scope of that system is clearly understood.

4.2 Statement of System Scope

The scope of the system under discussion is as follows:

A set of smart metering systems and the associated communications infrastructure each of which provide:

- measurement of the supply (and export where applicable) of Gas or Electricity at their metering points;
- remote interaction with the smart metering systems; and
- interaction with particular devices installed at consumers’ premises.

The next two figures provide a diagrammatic representation of the system scope for electricity and gas.
The focus of this analysis is the requirements that energy networks businesses may have of that system.

The Government’s approach to smart metering for GB is set out in the document published by DECC on 2nd December 2009: TOWARDS A SMARTER FUTURE: GOVERNMENT RESPONSE TO THE CONSULTATION ON ELECTRICITY AND GAS SMART METERING. This analysis considers only the smart metering for Domestic and Small and Medium Enterprise businesses under a roll out as set out in that document and assumes that the approach DECC outlined is followed. It considers potential use of smart metering and not the transitional arrangements that may be needed to achieve that use.
The communications to the smart meters are to be provided as a central service. This central service means that some additional communications services are possible but the breadth of other central services are currently unknown. Networks will need to interact, with singular, groups, or sample populations of supply points, which may involve utilising the central communications service, or additional currently undefined communications services. This work does not assume additional smart functionality external to the supply point metering system will be required to support this interaction. For the purpose of the use case analysis the system under discussion is treated as a “black box”.

No assumptions are made within this analysis as to how the various Smart Metering functionalities will be delivered. For example, a complete system may be composed of a number of components within the same “box” or in a number of interoperating “boxes”. The components may be dedicated to the Smart Metering System or could be shared with other systems.

Any single Smart Metering System will be in place to measure aspects of the import and, where relevant, the export of Electricity or Gas in GB.

Any network operator is responsible for a discrete part of a Gas or Electricity network, so each will have a set of meter points relevant to them.

The Smart Metering System has further functionality in addition to the measurement of the commodity:

- Interfaces - three levels of interface are available providing:
  - two way remote communication – the ability to communicate with parties remote from the Smart Metering System;
  - local communication – the ability to communicate with devices local to the metering system, generally within the same premises; and
  - a human interface - allowing an amount of data to be provided displayed and input or selected.

- Hardware which may include some of the following:
  - additional sensors;
  - means to control the delivery (or export where relevant) of the commodity; and
  - the meter has its own clock and a source of power which might be taken from an external source or provided by batteries.

- Software, firmware and memory required to operate the metrology and other hardware and to perform required processes and calculations.

The scope of the system under discussion does not include the following:

- The network businesses own internal systems e.g. Asset Management System, GPRS System etc.;
- Devices local to the metering system with which the metering system can interact, such as a display, home appliances, domestic generation or storage devices.

These are actors that interact with the system but are not within the system. As actors they may be relevant to the analysis, but are not part of the system.
It is recognised that new requirements may be determined during the roll out that lead to a new generation of smart metering. Any rollout superseding that described in the DECC smart metering consultation response is not specifically included in the scope of this analysis. However, use cases can be captured as required for later fulfilment.

This analysis is not concerned with the timing of roll out although some functions may only be relevant given a particular number or concentration of smart meters and this may be considered in the timing of the realisation of any functional requirement.

4.3 Out of Scope

The following items are outside the scope of this analysis:

- I&C customers;
- Within grid metering;
- Unmetered supply;
- Other remote parties – such as suppliers, meter operators and their use of smart metering;
- The roll out of smart meters or any other transitional arrangements.
5 Use Cases in Context

The future smart grid is expected to involve Network Operators taking data from various sources, including from metering installed at premises, to inform actions to be taken at points on the network; or using smart metering as a gateway to effect demand side management.

For the interactions with the smart metering to take place the Network Operators will need to have the smart meters mapped to the network within their systems, and to run network models for planning and operational purposes. They will need to identify individual meters and groups for configuration, data retrieval and action.

Generally, the activities that are taken through, or at, the smart metering as described in this document will have corresponding functions within the Network systems. Although these systems will need to be developed to make the most effective use of smart metering, any such analysis is out of scope of this exercise.
Electricity Use Cases

This section includes the documented functional requirements captured from our discussions with the electricity ENA members. The detailed Use Cases are grouped under several high level summary Use Cases:

- Assess network performance;
- Actively manage network;
- System balancing;
- Actively manage network – planned and unplanned outages;
- Manage safety issues; and
- Support network activities.

The following diagram displays the relationship that the primary actors have with the high level use cases.

**Figure 3 - Use Case diagram summary of network activities**
6.1 Use Case Actors

Each Use Case refers to participants who are referred to as ‘Actors’. The ‘Actors’ referenced in the Detailed Use Cases are described in Figure 4 - Use Case Actors and descriptions. Figure 4 below.

**Figure 4 - Use Case Actors and descriptions**

<table>
<thead>
<tr>
<th>Actor Name</th>
<th>Actor Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Organisation responsible for managing the distribution network that delivers electricity to the premises.</td>
</tr>
<tr>
<td>Network Operator</td>
<td>Organisation responsible for carrying out actions to manage load on the network. Note: This role is used for convenience and these actions may actually be carried out by NETSO, a Distribution Network Operator, a Supplier, an Aggregator, or any other party providing a Demand Response to Networks Businesses</td>
</tr>
<tr>
<td>Micro-generation</td>
<td>Sources of power from domestic properties or small-to-medium enterprises that are attached to the Smart Metering System, such as PV, micro-wind turbines or micro-CHP.</td>
</tr>
<tr>
<td>Consumer</td>
<td>Organisation, or person, consuming or generating the electricity at the premises. The Consumer may also be the organisation or person contracted with the Supplier for the provision of energy.</td>
</tr>
<tr>
<td>In Home Display</td>
<td>A display provided to Consumers to enable them to monitor their energy usage and the charges levied for that energy under a tariff.</td>
</tr>
<tr>
<td>Energy Management System</td>
<td>A device which uses information taken from the smart meter (including energy prices and signals) and other monitoring devices (such as thermostats) to manage the usage of appliances or generation at a premises.</td>
</tr>
<tr>
<td>Interference Responsible Entity</td>
<td>A party that attempts to interfere with and/or defraud the Metering System and/or illegally abstract energy at the point of supply.</td>
</tr>
</tbody>
</table>
6.2 Assess Network Performance

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>ANP</th>
<th>Level</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role</td>
<td>Electricity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use Case Name: Assess Network Performance

Description

Distribution Network Operators have a requirement to use data from Smart Metering Systems to aid in monitoring their networks.

Once they have the location of the Smart Metering Systems mapped to their networks, Distribution Network Operators will be able to check the capacity and voltage headroom of specific parts of their network.

This assessment will identify needs for future reinforcement and active management. The information will also facilitate assessment of the impact of additional demand / generation, or new network connections, calculation of latent demand and improvement of the effectiveness of customer profiles used in network forecasting.

Smart Metering functionality will also monitor voltage quality, logging voltage events that breach a set threshold. The information will enable DNOs to improve the reliability of power quality delivered to end users.
Figure 5 - Assess Network Performance Use Case diagram

Assess Network Performance

- Monitor current flows and voltage levels to identify thermal capacity and voltage headroom
- Determine network impact of proposed new demand / generation connections
- Determine network impact of proposed increases in demand / generation at existing connection points
- Monitor demand and generation profiles for network load forecasting
- Determine latent demand due to embedded generation
- Identify voltage quality issues
6.2.1 Monitor power flows and voltage levels to identify thermal capacity and voltage headroom

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td></td>
<td>Electricity</td>
</tr>
</tbody>
</table>

Use Case Name
Monitor Power Flows and Voltage Levels to Identify Thermal Capacity and Voltage Headroom

**Description**

**Business Need**

Distribution Network Operators have a requirement to use data from Smart Metering Systems to aid in proactively monitoring their networks. Once they have the location of the Smart Metering Systems mapped to their networks, Distribution Network Operators will be able to check the capacity and voltage headroom of specific parts of their network, i.e.:

- That the thermal duty imposed on plant and equipment is within its rating
- That the High Voltage (HV) network in particular, complies with the redundant capacity requirements of Engineering Recommendation P2/6
- All customers are supplied within statutory voltage limits.

This assessment will identify the need for future reinforcement or some other form of intervention. The information will also be required to assess the impact of requests for additional demand / generation or new network connections and to test future load growth scenarios to ascertain the critical timing and potential quantum of future reinforcement actions or interventions.

Low Voltage (LV) networks, and to some extent High Voltage (HV) radial networks, have traditionally been designed as ‘tapered’ networks to match capacity to the lower level of loading experienced further from the source of supply. In future, new loads associated with electric vehicles, heat pumps, and micro-generation have the potential to give rise to either loads exceeding the rating of smaller capacity conductors or result in voltages at customers premises rising above / falling below statutory limits. Given the very sparse nature of loading and voltage information currently available at distribution substations and especially LV networks, there will be an increasing risk of undetected thermal capacity or voltage transgressions.

As the uptake of electric vehicles, heat pumps, and micro-generation increases, the daily load shape will change and the overall energy distributed by the networks will increase – giving rise to a need for greater granularity of voltage and loading information. Data available from Smart Metering Systems has the potential to meet that need and will allow Distribution Network Operators to optimise the use of existing network capacity (thereby
avoiding or delaying infrastructure costs or targeted infrastructure investment) and make more informed planning decisions.

For Distribution Network Operators to gain the maximum benefit from the additional planning data available from Smart Metering Systems the meters must provide:

- Real and reactive / import and export power flow data (in terms of half-hourly averaged values)
- Real and reactive / generation power flow data (in terms of half-hourly averaged values)
- Voltage data (in terms of half-hourly averaged values)
- Phase connectivity information

Note that where potentially exporting generation is installed, both import and export power flow measurements need to be recorded separately in order to assess the direction of (real/reactive) power flow and hence allow aggregated (half-hourly average) feeder power flows to be derived. Reactive as well as real power flow measurements are required so that the impact of new non-linear loads such as heat pumps, air cooling compressors, compact fluorescent lamps, and some types of generation on reactive power flows can be measured and the power factor calculated. This is important since correcting adverse power factor will generally be a more cost effective solution to a voltage or thermal capacity problem than simple reinforcement.

To permit aggregated power flows on the network to be derived and monitored it will be important for every Smart Metering System to provide the required data. For voltage profile monitoring, it will be generally sufficient to derive information from meters close to the substation and at the far end of LV feeders. However, where micro-generation is installed which might export at certain times of the day (e.g. potentially Photo-Voltaic cells (PVs) during the working day when houses may be unoccupied), additional strategic measurements of voltage may be necessary to detect potential statutory voltage transgressions other than at the extremities of LV feeders. It is therefore important that the Distribution Network Operators are able to configure specific Smart Metering Systems to provide the required measurements. The configuration will ideally include the ability for DNOs to refine the need to transmit meter data through the Smart Meter System to meet the requirements of the network.

The Distribution Network Operators may require up to two or three years of power flow and voltage data tagged by MPAN with an acceptable lag time of three months after the date the last data item was recorded. It is envisaged that archive data storage requirements beyond the three months of data stored in the smart meter will be addressed through Distribution Network Operators’ own systems. This data will then be used with other network planning data (e.g. from substations and SCADA) to inform planning decisions.

**Business Benefit**

- Higher utilisation / more efficient use of existing networks
- More informed, efficient and timely network investment
- Faster better informed responses to requests for additional demand / generation and new connections
- Earlier identification of potential network stresses – enabling mitigating interventions before thermal loading or statutory voltage transgressions occur
- Improved forecasting of future reinforcement need

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Distribution Network Operator</td>
</tr>
<tr>
<td>Micro-generation</td>
</tr>
</tbody>
</table>

Scenario 1 – Data is sent periodically from the Smart Metering System

**Scenario Descriptions**

**Pre Conditions**

Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator

The Distribution Network Operator’s system maintains information relating to the location (including the phase to which it is connected) of the Smart Meter and can position it on a network connectivity model (e.g. to permit aggregation of data to drive total feeder / substation loading)

The Smart Metering System has an accurate internal clock (and will receive a periodic synchronisation signal to ensure continued accuracy)

Smart Metering Systems have been configured to measure, record and store half-hourly power flow and voltage data

Smart Metering Systems are able to collect generation data where micro-generation is installed

Distribution Network Operators have available sufficient archive data storage configured to download information held in smart meter data stores at a maximum frequency of three month intervals

**Post Conditions**

The Distribution Network Operator is able to extract Smart Metering System data from archive stores for monitoring network power flows and voltage levels.

**Trigger**

The configured time period to send data has been reached

**Basic Flow**

*Note this flow will be repeated across all required Smart Metering Systems within a Distribution Network*
1. The Smart Metering System determines that the DNO configured time period that has been set to send data has been reached and sends the half-hourly data to the Distribution Network Operator

2. The Distribution Network Operator receives the data and loads it into its system to use in monitoring power flows and voltage levels

3. The Smart Metering System continues to make available data to the DNO at the predetermined interval until the DNO configures it to stop

Alternative Flow

2. At Basic Flow step 2
   
2a1 The Distribution Network Operator does not receive the data

2a2 The Distribution Network Operator checks and takes steps to ensure that the Smart Metering System has been configured correctly and is working properly

2a3 Go back to Basic Flow step 1

Scenario 2 – DNO requests data

<table>
<thead>
<tr>
<th>Scenario Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Conditions</td>
</tr>
<tr>
<td>Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator</td>
</tr>
<tr>
<td>Smart Metering Systems are installed and configured to permit data extraction by Distribution Network Operators</td>
</tr>
<tr>
<td>The Distribution Network Operator’s system maintains information relating to the location of the Smart Metering System and its electrical connectivity to their network</td>
</tr>
<tr>
<td>Smart Metering Systems have been configured to measure, record and store half-hourly power flow and voltage data</td>
</tr>
<tr>
<td>Smart Metering Systems are able to collect generation data where micro-generation is installed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Distribution Network Operator has Smart Metering System data available for monitoring power flows and voltage levels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Distribution Network Operator has a requirement to gather Smart Metering System data to use in monitoring power flows and voltage levels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note this flow will be repeated across all required Smart Metering Systems within a Distribution Network</td>
</tr>
</tbody>
</table>

1. The Distribution Network Operator sends a message to the Smart Metering System requesting the stored half-hourly power flow (including that of any generation data) and
### ENA Smart Metering System Use Cases – ENA authorised parties only

<table>
<thead>
<tr>
<th>Voltage Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. The Smart Metering System receives the message and validates it</td>
</tr>
<tr>
<td>3. The Smart Metering System retrieves the stored half-hourly power flow (including that of any generation data), and voltage data</td>
</tr>
<tr>
<td>4. The Smart Metering System sends the data to the Distribution Network Operator</td>
</tr>
<tr>
<td>5. The Distribution Network Operator receives the data and loads it into its system to use in monitoring power flows and voltage levels</td>
</tr>
</tbody>
</table>

#### Alternative Flow

<table>
<thead>
<tr>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a1 The Smart Metering System rejects the message as invalid</td>
</tr>
<tr>
<td>2a2 The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp</td>
</tr>
<tr>
<td>2a3 The Distribution Network Operator receives the message and takes the required steps to resolve the error</td>
</tr>
<tr>
<td>2a4 Once error is resolved go back to Basic Flow step 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a1 The Smart Metering System does not have any measured data stored</td>
</tr>
<tr>
<td>3a2 The Smart Metering System sends a no data found message to the Distribution Network Operator</td>
</tr>
<tr>
<td>3a3 The Distribution Network Operator checks and takes steps to ensure that the Smart Metering System has been configured correctly and is working properly</td>
</tr>
<tr>
<td>3a4 End flow</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 5:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5a1 The Distribution Network Operator does not receive the data from the Smart Metering System</td>
</tr>
<tr>
<td>5a2 The Distribution Network Operator checks and takes steps to ensure that the Smart Metering System has been configured correctly and is working properly</td>
</tr>
<tr>
<td>5a3 Go back to Basic Flow step 1</td>
</tr>
</tbody>
</table>

#### Additional Information

#### Related Information

#### Notes and Issues

The scope of the Smart Metering System incorporates comms and the potential for some central data services. It may be that these services store the required data and packages it to be sent to the DNO rather than the meter itself.
It has been noted that the meters may be configured to send data periodically or on request for this use case; either may be valid depending on circumstances pertaining to the network concerned.

6.2.2 Determine network impact of proposed new demand / generation connections

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine network impact of proposed new demand / generation connections</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

Distribution Network Operators (DNOs) have a requirement to use Smart Metering System data to determine the network impact of requests for new connections. The new connection may comprise demand only, generation only or a mixture of demand and generation at the new premises. The new load may include demand from new technologies, such as Electric Vehicles (EV) or heat pumps, or generation from micro-generation. As take up of these technologies increases, the load profile of networks will alter and may become less predictable. The Distribution Network Operator needs to be able to determine whether the existing distribution network has sufficient capacity headroom to cope with the additional demand / generation, whether infrastructure reinforcement is required, or whether a form of active network management will be sufficiently effective to cater for the extra demand / generation.

The Distribution Network Operators can use measurements of exported and imported electricity from smart metering in the same area of the network as the proposed new connection (two - three years worth of half-hourly real and reactive power flow and voltage data is suggested as suitable to give confident assessment). This data will be used alongside the knowledge of the proposed new connection and data from the Distribution Network Operator’s Supervisory Control And Data Acquisition (SCADA) system to assess the requirements of the new connection. The data should be available to the Distribution Network Operator at the latest a week after the data is requested.

Where the power flow and voltage data is not transmitted and stored routinely, or where more up to date information is required, the Distribution Network Operator will need to be able to choose the specific Smart Metering Systems from which they require information, based on their location on the network. In this event Distribution Network Operators will only be able to configure the specified Smart Metering Systems when they have received...
the request for the new connection. Data from a high proportion of Smart Metering Systems in the relevant area will be required for this analysis.

**Business Benefit**

- The information enables DNOs to comply with Guaranteed Standards of Performance timescales for provision of LV connections
- Enables DNOs to accurately determine the reinforcement or active network management requirements, together with the associated costs, to allow the proposed new demand / generation connections to be provided (costs will include those funded by the user and the DNO)
- Avoidance of unnecessary reinforcement or active network management costs due to enhanced assessment of capacity headroom
- Enables DNOs to accurately determine the reinforcement or active network management requirements, together with the associated costs, to allow the proposed new connection to be connected to the network (costs will include those funded by the user and the DNO)
- Enhance the customer experience of new connections

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
<tr>
<td>Micro-generation</td>
<td>Secondary</td>
<td>Sources of power from domestic properties or small-to-medium enterprises that are attached to the Smart Metering System, such as PV, micro-wind turbines or micro-CHP.</td>
</tr>
</tbody>
</table>

**Note:** the following scenario could equally be met by the Distribution Network Operator using extracted smart metering power and voltage data residing in a DNO archive storage system where this information is considered to be sufficiently up to date.

**Scenario Descriptions**

**Pre Conditions**

- Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator
- The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model
- The Smart Metering System has been measuring, recording and storing half-hourly average power flow and voltage data for a predetermined period of time and the Distribution Network Operator has received confirmation of this
- The Smart Metering System is able to collect generation data where micro-generation is installed

**Post Conditions**
The Distribution Network Operator can use Smart Metering System data to determine available network capacity

**Trigger**

The Distribution Network Operator receives a request for a new connection on their network and targets specific Smart Metering Systems on that network to extract half-hourly average power flow and voltage data

**Basic Flow**

Note this flow will be repeated across all required Smart Metering Systems within a Distribution Network

1. The Distribution Network Operator sends a message to the Smart Metering System requesting the stored half-hourly power flow and voltage data (and micro-generation data where available)
2. The Smart Metering System receives the message and validates it
3. The Smart Metering System retrieves the stored half-hourly power flow and voltage data
4. The Smart Metering System sends the data to the Distribution Network Operator
5. The Distribution Network Operator receives the data and loads it into its system / procedure for determining network capacity

**Alternative Flow**

5. At Basic Flow step 5

   5a1 The Distribution Network Operator does not receive the data
   5a2 The Distribution Network Operator checks and takes steps to ensure that the Smart Metering System has been configured correctly and is working properly
   5a3 Go back to Basic Flow step 1

**Additional Information**

**Related Information**

**Notes and issues**

The Smart Metering System incorporates comms devices while there are other Comms Services that may be provided centrally. It may be that these central services store the required data and packages it to be sent to the DNO rather than the meter itself.
6.2.3 Determine network impact of proposed increases in demand / generation at existing connection points

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Use Case Name**
Determine network impact of proposed increases in demand / generation at existing connection points

**Description**

**Business Need**

Distribution Network Operators have a requirement to use Smart Metering System data to determine the impact on their network of increased levels of demand or generation at existing connection points. The new load may be increased demand from new technologies, such as Electric Vehicles (EV) or heat pumps, or generation from micro-generation. As take up of these technologies increases, the load profile of networks will alter and may become less predictable.

Distribution Network Operators can use Smart Metering System data to create load profiles that can then be used to model the impact of increased levels of demand or generation at existing connections.

The Distribution Network Operator then needs to be able to determine whether the existing distribution network has sufficient capacity headroom to cope with the additional demand / generation, whether infrastructure improvement is needed, or whether a form of active network management will be sufficiently effective to cater for the extra demand / generation. To calculate this, the Distribution Network Operators require two to three years worth of half-hourly real and reactive power flow and voltage data. This data will be used alongside the knowledge of the proposed new connection and data from the Distribution Network Operator’s Supervisory Control and Data Acquisition (SCADA) system to assess the requirements of the new connection. The data should be available to the Distribution Network Operator at the latest a week after the date the last data item has been recorded.

Where the power flow and voltage data is not transmitted and stored routinely, or where more up to date information is required, the Distribution Network Operator will need to be able to choose the specific Smart Metering Systems from which they require information, based on their location on the network. In this event Distribution Network Operators will only be able to configure the specified Smart Metering Systems when they have received the request for the new connection. Data from a high proportion of Smart Metering Systems in the relevant area will be required for this analysis.

**Business Benefit**
- The information enables DNOs to comply with Guaranteed Standards of Performance timescales for dealing with additional demand / generation enquiries
- Enables DNOs to accurately determine the reinforcement or active network management requirements, together with the associated costs, to allow the proposed demand / generation to be connected to the network (costs will include those funded by the user and the DNO)
- Avoidance of unnecessary reinforcement or active network management costs due to enhanced assessment of capacity headroom
- Enhanced data from the Smart Metering System permits higher levels of demand / generation to be connected to the network
- Enhance the customer experience of adding new equipment

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Distribution Network Operator</td>
</tr>
<tr>
<td>Micro-generation</td>
</tr>
</tbody>
</table>

**Note:** the following scenario could equally be met by the Distribution Network Operator using extracted smart metering power and voltage data residing in a DNO archive storage system where this information is considered to be sufficiently up to date.

**Scenario Descriptions**

**Pre Conditions**
- Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator
- The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model
- The Smart Metering System has been measuring, recording and storing half-hourly average power flow and voltage data for a predetermined period of time and the Distribution Network Operator has received confirmation of this
- The Smart Metering System is able to collect generation data where micro-generation is installed

**Post Conditions**
- The Distribution Network Operator can use Smart Metering System data to determine the network impact of new loads on existing connections

**Trigger**
- The Distribution Network Operator receives a request for a proposed increase in demand / generation
at an existing connection on their network and targets specific Smart Metering Systems on that network to extract half-hourly average power flow and voltage data

**Basic Flow**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The Distribution Network Operator sends a message to the Smart Metering System requesting the stored half-hourly power flow and voltage data (and micro-generation data where available)</td>
</tr>
<tr>
<td>2.</td>
<td>The Smart Metering System receives the message and validates it</td>
</tr>
<tr>
<td>3.</td>
<td>The Smart Metering System retrieves the stored half-hourly power flow and voltage data</td>
</tr>
<tr>
<td>4.</td>
<td>The Smart Metering System sends the data to the Distribution Network Operator</td>
</tr>
<tr>
<td>5.</td>
<td>The Distribution Network Operator receives the data and loads it into its system / procedure for determining network capacity</td>
</tr>
</tbody>
</table>

**Alternative Flow**

5. At Basic Flow step 5

5a1 The Distribution Network Operator does not receive the data

5a2 The Distribution Network Operator checks and takes steps to ensure that the Smart Metering System has been configured correctly and is working properly

5a3 Go back to Basic Flow step 1

**Additional Information**

**Related Information**

**Notes and issues**

It may be that some central services store the required data and packages it to be sent to the DNO rather than the meter itself.
6.2.4 Monitor demand and generation profiles for network load forecasting

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

Use Case Name

Monitor demand and generation profiles for network load forecasting

Description

**Business Need**

The uptake of new technologies such as electric vehicles, heat pumps, compact fluorescent lights and domestic air cooling units, will change the currently observed diversity of demand – affecting total energy distributed, power factor, voltage levels, peak demands, and the overall shape of the daily and seasonal cyclic demand profile.

The increased installation of micro-generation in domestic properties, such as photo-voltaic cells, micro-wind turbines, micro-Combined Heat and Power, etc. will lead to increased generation diversity and bi-directional flows of electricity.

These developments present a new set of challenges to Distribution Network Operators, who will need to forecast their effect on the network in order to take timely action to maintain system integrity (with regard to thermal ratings, statutory voltage limits and ER P2/6 requirements for redundant capacity). These actions could include network reinforcement or actively managing networks to make better use of existing capacity by encouraging demand reduction at forecast times of peak load.

Distribution Network Operators use generic profiles to model the effects of new connections and changes in the type and quantity generation and demand on the networks. By using smart metering data it will be possible to assess the accuracy of these generic profiles, their adequacy for use and create new ones for emerging demand and generation technologies. It is likely that with the advent of new demand and new generation technologies a much greater number of these profiles will be needed to effectively model the network.

Smart metering data can be used to measure changes in existing profiles at a granular level (for example individual distribution substations and LV feeders) thereby increasing the accuracy of forecasting and helping to maintain system integrity through timely planned interventions.

As part of the routine load forecasting procedure, Distribution Network Operators will require to be notified of proposed significant future demand or generation connections in order to identify whether the historic power and voltage profile data stored in their archived data stores can be used for forecasting if or the Smart Metering Systems needs be configured to begin recording the half-hourly real and reactive power flow, generation export profiles and voltage profiles.
Business Benefit

- Improved network load forecasting capability
- Informed network investment / intervention decisions resulting in reduced capital costs
- Enables DNOs to accurately determine the reinforcement or active network management requirements, together with the associated costs, associated with the increase in demand / generation at an existing connection point based on a sound understanding of the diversity between the new demand / generation and the existing network power flows, and hence the impact of the superimposed new demand / generation on the existing load cycle.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
<tr>
<td>Micro-generation</td>
<td>Secondary</td>
<td>Sources of power from domestic properties or small-to-medium enterprises that are attached to the Smart Metering System, such as PV, micro-wind turbines or micro-CHP.</td>
</tr>
</tbody>
</table>

Note: the following scenario could equally be met by the Distribution Network Operator using extracted smart metering power and voltage data residing in a DNO archive storage system where this information is considered to be sufficiently up to date.

Scenario Descriptions

Pre Conditions

Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator.

The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model.

The Distribution Network Operator is aware of the proposed significant future loads or generation connections to be installed on the network and the premises at which the Smart Metering System data needs to be accessed to determine the aggregate impact of the new and existing load on the network.

The Smart Metering System has been measuring, recording and storing half-hourly power flow and voltage data for a predetermined period of time and The Distribution Network Operator has received confirmation of this.

The Smart Metering System is able to collect generation data where micro-generation is installed.

Post Conditions

The Distribution Network Operator has Smart Metering System data available for use in creating generic profiles.
### Trigger

The Distribution Network Operator wants to use accurate generic profiles in network load forecasting

### Basic Flow

**Note**: this flow will be repeated for every Smart Metering System meeting the DNO criteria

1. At the defined interval the Smart Metering System collects the data and sends it to the Distribution Network Operator
2. The Distribution Network Operator receives the data and loads it into their systems

### Alternative Flow

2. At Basic Flow step 2
   2a1 The Distribution Network Operator does not receive the data from the Smart Metering System
   2a2 The Distribution Network Operator checks and takes steps to ensure the Smart Metering System is configured correctly and had data to send
   2a3 The Distribution Network Operator requests the Smart Metering System resends the data
   2a4 The Smart Metering System resends the data
   2a5 Back to Basic Flow step 2

### Additional Information

**Related Information**

**Notes and issues**
6.2.5 Determine Latent Demand due to Embedded Generation

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Electricity</td>
</tr>
<tr>
<td>Use Case Name</td>
<td>Determine Latent Demand due to Embedded Generation</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

One of the emerging challenges for Distribution Network Operators is to obtain a true view of the potential peak demand on their network with increased micro-generation and distributed generation. Dependent on local conditions network load will be greatly affected by distributed generation. This will vary depending on the various technologies e.g. Photo Voltaic cells (PVs) are unlikely to affect the system peak whereas micro Combined Heat and Power (CHP) and potentially micro wind turbines are likely to reduce the measured system peak. It is feasible that the true peak demand may never be directly measureable under normal conditions. This provides a challenge for Distribution Network Operators, as they will need to assess whether their network has sufficient spare capacity to cope with the theoretical maximum demand that would be presented should all the distributed generation connected to a given section of network cease generating (for example due to a network fault resulting in operation of its ‘loss-of-mains’ protection). The decision then for Distribution Network Operators is whether to reinforce their network to cope with a theoretical peak load that is unlikely to occur when the network is operating normally or plan on the basis of a lower peak load and put in place contingency plans to cater for post fault scenarios when the actual load is higher.

When a distribution circuit is re-energised after a prolonged outage the initial load can be greater than previously observed, this is known as ‘cold load pickup’ and arises from appliances such as refrigeration and heating plant simultaneously drawing power as soon as supplies are restored (i.e. because normal diversity of demand has been temporarily lost). This issue will be exacerbated where there is distributed generation connected to the network and as the penetration of electricity based heat pumps increases. During outages it is expected that all distributed generation will cease to operate – this is a requirement of the present connection standards (and in any case is likely to happen due to the almost inevitable mismatch between generation capacity and network demand). The Distribution Network Operator will then need to be aware of the gross network demand that will be presented when power is restored in order to ensure that the network has sufficient capacity to meet this demand until such time that generation is able to recommence. The demand effectively ‘hidden’ by the presence of distributed generation is termed ‘latent demand’. While ‘cold load pick up’ demand can generally be estimated in the absence of generation, ‘latent demand’ is less easy to identify as assessment depends on knowing the aggregate output from all generators connected to the section of network concerned.
Distribution Network Operators could use the Smart Metering System data to obtain a better estimate of both the potential ‘cold load pickup’ and especially the ‘latent demand’ due to any generation present. To do this they will need to determine the latent demand at each connected Smart Metering System that has micro-generation installed, as well as the normal connected demand. This can be calculated by obtaining, from the Smart Metering System, the half hourly average real and reactive power flow from each individual premises, and the half hourly generation output from the generation meter if fitted (i.e. the Feed-in Tariff or ‘FIT’ meter).

Where the power flow and voltage data is not transmitted and stored routinely, or where more up to date information is required, the Distribution Network Operator will need to be able to choose the specific Smart Metering Systems from which they require information, based on their location on the network and configure the Smart Meter System accordingly. They must also be able to request the information on an ad-hoc basis whenever it is required.

Once the Distribution Network Operators have determined the ‘latent demand’ and/or the normal ‘cold load pickup’ they can determine the network capacity required. If sufficient network capacity is not available there may be a need to perform a ‘rolling restoration’ of customer supplies so that the return of demand is staggered allowing generation plant time to pick up production to meet some of the demand. In order to do this there may be a need to disconnect individual premises so that not all supplies are restored when the network is restored; these customer supplies would be restored soon afterwards once micro-generation connected on the network had recommenced electricity generation. It should be noted however that this will not always be practical; for example auto-reclose operations will result in all the disconnected demand and latent demand being presented at the moment the network is re-energised.

**Network Benefit**

The benefit of this approach is that the DNO will be able to better understand and manage the risks associated with latent demand. If the latent demand is not understood, then in certain network conditions there will be a risk of overloading the circuits resulting in interruptions to customer supplies and potentially damaged assets.

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Distribution Network Operator</td>
</tr>
<tr>
<td>Micro-generation</td>
</tr>
</tbody>
</table>
**Note:** the following scenario could equally be met by the Distribution Network Operator using extracted smart metering power and voltage data residing in a DNO archive storage system where this information is considered to be sufficiently up to date.

<table>
<thead>
<tr>
<th>Scenario Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre Conditions</strong></td>
</tr>
<tr>
<td>Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator</td>
</tr>
<tr>
<td>The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model</td>
</tr>
<tr>
<td>The FIT meter (generator output) data is accessible through the Smart Metering System in the form of half-hourly average power readings</td>
</tr>
<tr>
<td>The Distribution Network Operator is aware of micro-generation installed at the Smart Metering System premises (either through notification or through information received from the FIT meter via the Smart Metering System)</td>
</tr>
<tr>
<td>The Distribution Network Operator identifies the premises and Smart Metering System it wishes to obtain data from</td>
</tr>
<tr>
<td>The Smart Metering System has been measuring, recording and storing half-hourly power flow, voltage data for a predetermined period of time and the Distribution Network Operator has received confirmation of this</td>
</tr>
<tr>
<td><strong>Post Conditions</strong></td>
</tr>
<tr>
<td>The Distribution Network Operator has Smart Metering System data available for use in determining latent demand</td>
</tr>
</tbody>
</table>

| **Trigger** |
| The Distribution Network Operator wants to determine latent demand |

| **Basic Flow** |
| Note: this flow will be repeated for every Smart Metering System meeting the DNO criteria |

1. At the defined interval the Smart Metering System sends the data to the Distribution Network Operator
2. The Distribution Network Operator receives the data and loads it into their systems

| **Alternative Flow** |
| 2. At Basic Flow step 2 |
| 2a1 The Distribution Network Operator does not receive the data from the Smart Metering System |
| 2a2 The Distribution Network Operator checks and takes steps to ensure the Smart Metering System is configured correctly and had data to send |
| 2a3 The Distribution Network Operator requests the Smart Metering System resends the data |
| 2a4 The Smart Metering System resends the data |
2a5 Back to Basic Flow step 2

### Additional Information

### Related Information

### Notes and issues

It is assumed that the maintenance of the Micro-generation meter will be the Consumer’s responsibility and that the DNO will not be able to communicate directly with the Consumer if the DNO detects a fault with it.

‘Rolling restoration’ of supplies will require the facility for DNOs to prevent some customers from having their supplies restored immediately upon supply restoration. Such customers would need their Smart Meter configured during the outage period. Following the initial supply restoration information on network demand would need to be collected in short timescales (5 minutes) to detect the re synchronisation of generation that would permit commands to be issues to restore the remaining customer supplies.

### 6.2.6 Identify Voltage Quality Issues

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>06</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify Voltage Quality Issues</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

### Description

#### Business Need

As part of the day to day operation of distribution and transmission networks there is a requirement to ensure that voltage quality is maintained to an acceptable level (as set out in BS EN 50160:2000 (Voltage characteristics of electricity supplied by public distribution systems)). To ensure that the connection of new demand and generation does not result in degradation of voltage quality to the extent that it breaches prescribed limits of acceptability there are Distribution Code requirements that need to be complied with when new equipment is connected to the network. The key aspects of voltage quality are Harmonic Distortion and Voltage Flicker. Engineering Recommendations G5/4 and P28 respectively provide guidance on acceptable emissions from demand / generation connected to networks.
With the anticipated increases in LV connected non-linear loads (such as heat pumps equipped with motor soft-start mechanisms, Compact Fluorescent Lights, and DC/AC converters associated with Photo Voltaic micro-generation and in the future Vehicle-to-Grid (V2G)) and potentially disturbing loads (such as heat pumps equipped with direct-on-line starting mechanisms) it will be particularly important to monitor power quality on the low voltage network.

Smart meters will provide the opportunity to record voltage fluctuations and date / time stamp such events so that Distribution Network Operators will be able to identify any parts of their networks where poor voltage quality is a recurring issue. Threshold limits for recording of events will be specified.

Distribution Network Operators will use the Smart Metering System information to monitor voltage sags and swells and, in the event of excessive activity, initiate root cause investigations, and take appropriate corrective actions to keep the networks operating within the prescribed limits.

While it is also feasible for smart meters to monitor Harmonic Distortion, typically measured as Total Harmonic Distortion (THD), it is anticipated that THD might be more economically monitored at distribution substation level where regularly occurring excessive levels of THD would trigger further root cause investigations.

Once corrective actions have been taken, Distribution Network Operators will continue to monitor the Smart Metering System to confirm that the corrective actions have been effective.

**Business Benefits**

The benefits of using these actions include the following:

- The presence of excessive voltage fluctuations determined at an early stage improving the chances of identifying the root cause (for example a recent installation or change of use) and securing agreement by the customer to rectify the issue
- Early identification and resolution of the issue would provide affected customers with earlier relief from the nuisance of voltage flicker
- Early identification of any general increase in voltage quality issues that might require a change in the process surrounding connections of disturbing loads and/or to the standards governing equipment (such as heat pumps) so that the issue is designed-out.

Actions might include one or more of the following:

**Actions on DNO Assets**

- Actions to reduce source impedance (for example install a lower impedance transformer) to increase fault level and reduce the depth of the voltage sag.

**Actions within Customers premises**

- Advise customers to carry out remedial actions to eliminate the issue at the point of connection.
- In the event of refusal, invoke powers under the ESQC Regulations to disconnect
supply until the issue had been resolved.

Other Actions
- Engagement with manufacturers (or their trade associations - e.g. BEAMA) and/or authorities governing standards for electrical equipment to agree any necessary changes.

<table>
<thead>
<tr>
<th>Actors</th>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for carrying out actions to manage voltage quality on the distribution network</td>
</tr>
</tbody>
</table>

Scenario Description

Pre Conditions
A Smart Metering System is installed and configured to identify voltage quality transgressions in respect of threshold limits prescribed by the Distribution Network Operator that are broadly consistent with BS EN 50160\(^1\).

The Smart Meter has the capacity to record the voltage quality events (defined as transgressions beyond configurable thresholds) occurring over a period of 3 months and is configured to transmit that data to the Distribution Network Operator at defined intervals.

The Distribution Network Operator is aware of the location of the Smart Meter and can 'position' it on a network connectivity model.

The Smart Meter can be configured to record the time and date of voltage quality events that exceed the prescribed thresholds.

The Distribution Network Operator is able to access the Smart Metering System to identify the recorded events.

Post Conditions
The Distribution Network Operator interrogates the data from the Smart Metering System to identify any voltage quality events (and from other electrically adjacent Smart Meters) to determine the geographic extent of the voltage quality issue and to help isolate the locality of the root cause.

In receiving the data from the Smart Metering System the Distribution Network Operator identifies an excessive (limits to be determined by the Distribution Network Operator) number of voltage quality events.

Trigger

---

\(^1\) note: ER P28 sets out the permissible voltage fluctuation requirements from equipment to be connected to the distribution network and it is not anticipated that the meter would have the capability to undertake a P28 compliance test; the intention is that the meter would time and date stamp events that might indicate non-compliance.
The voltage quality of the electricity supplied to the premises varies outside of the prescribed thresholds resulting in voltage quality events

Basic Flow

1. The Smart Metering System accumulates time and date stamped voltage quality events
2. The Smart Metering System stores the recorded events for a period of three months (after which time the meter continues to record events but overwrites the most historic events)
3. The Distribution Network Operator receives the information from the Smart Metering System at the intervals required
4. The information is analysed to determine if further follow-up investigation is required.

Alternative Flow

Additional Information

Related Information

Notes and issues

The voltage quality issue having been resolved, the Distribution Network Operator is able to access the Smart Metering System to confirm that recorded voltage quality events have been eliminated or fallen to an acceptable level.

6.3 Actively manage networks

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use Case Name: Actively Manage Networks

Description

As part of the day to day operation of distribution networks there is a need to ensure that they are managed so that power flows and voltages are maintained within prescribed operating limits at all times. Smart Metering Systems will enable DNOs to monitor network conditions in near-real time enabling rapid identification and rectification of issues.

The range of actions a DNO may take are varied, incorporating changing DNO assets,
Demand Side Management or changing the settings of demand or generation equipment. The scale and amount of control involved in the intervention will vary dependent on the situation. Some actions may be taken with a long term view and looking for a proportional behavioural response, such as load shifting tariffs, while short term actions may be quite controlling looking for more certain / immediate response, such as initiating maximum threshold cut-off settings on the meters.

In each case it will be important to understand the location on the network that the response is wanted, and the amount, immediacy and reliability of response. It will be important to measure the effectiveness of actions to feed into future planning.

**Figure 6 - Actively Manage Network / System Balancing Use Case diagram**
6.3.1 Collect data for active network management

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Electricity</td>
</tr>
<tr>
<td>Use Case Name</td>
<td>Collect data for active network management</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

As part of the day to day operation of distribution networks there is a need to ensure that they are managed so that power flows and voltages are maintained within prescribed operating limits at all times. Distribution networks are managed by Distribution Network Operators, and are currently not managed as proactively or in real time, as transmission networks are, however there is an expectation that this will change in the near future.

The Distribution Network Operators will face a variety of challenges in the future. Increasing quantities of generation will be connected to the distribution networks and there will be new types of demand, such as electric vehicles, heat pumps and domestic air cooling units, which will change the characteristics of consumer demand. It is expected that there will be a need to build on the present systems for managing power flows and voltages on distribution networks.

Distribution Network Operators will use Smart Metering System information to monitor real and reactive power flow and voltages within their network to identify, or predict, where actions are required to keep the networks operating within the prescribed limits. Implementing active network management techniques as an alternative, or to supplement, network reinforcement is expected to be used increasingly in the future. The information required will be similar to that in Use Case 01, but the information will be required with a much lower latency.

The same monitoring systems will be used to check that the rectifying actions have been successful.

**Business Benefits**

This use case allows Distribution Network Operators to identify parts of the network where rectifying actions are needed in real time to maintain appropriate power flows and network voltages.

The use of Smart Metering Systems allows increased monitoring so that the requirement for real time interventions can be identified. Potential benefits include:
• Increased efficiency of network operation
• Reduced need for network reinforcement
• Improved reliability and quality of supply.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
</tbody>
</table>

Scenario Descriptions
Pre Conditions
Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator
The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model
Strategically located Smart Metering Systems have been identified configured to measure, record and provide the power flow and voltage data at high granularity

Post Conditions
The Distribution Network Operator has Smart Metering System data available that will help identify locations where active network management is needed.

Trigger
This use case may be running continually

Basic Flow
This use case is carried out at each selected Smart Metering System

1. The Smart Metering System measures real and reactive power flow and voltage data
2. The Smart Metering System sends the data to the Distribution Network Operator
3. The Distribution Network Operator receives the data and loads it into its system along with data from sensors within networks and other information to identify whether actions are needed or actions that have been carried out have been successful.

Alternative Flow
At Basic Flow step 2:

2a1 The Smart Metering System fails to send the message
2a2 The Distribution Network Operator’s systems identify the missing data, the Distribution Network Operator, investigates the cause of the failure and may
reconfigure the meter

2a3 The use case returns to Basic Flow step 1.

Additional Information

Related Information

Use Case 08 – Active management of network voltage
Use Case 09 – Perform active management of network power flow

Notes and issues

6.3.2 Active management of network voltage

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td></td>
<td>Electricity</td>
</tr>
</tbody>
</table>

Use Case Name
Active Management of Network Voltage

Description

Business Need

As part of the day to day operation of distribution networks there is a need to ensure that they are managed such that power flows, voltages and frequency are maintained within prescribed operating limits at all times. Distribution networks are managed by Distribution Network Operators, however they are currently not managed proactively, in real time. There is however an expectation that this will change in the near future.

The Distribution Network Operators will be facing a variety of challenges to undertake both these responsibilities in the future. Increasing quantities of generation will be connected to the distribution networks and there will be new types of demand, such as electric vehicles, heat pumps and domestic air cooling units, which will change the characteristics of consumer demand. It is expected that there will be a need to build on the present systems for managing network voltages on distribution networks.

Distribution Network Operators will use Smart Metering System information to monitor voltages within their network enabling them to identify, or predict, where actions are required to keep the networks operating within the prescribed limits.

Rectifying actions would be implemented by the Distribution Network Operator and systems would be developed to check that the rectifying actions have been successful.
Actions may be taken directly on assets owned and operated by the Distribution Network Operator e.g. operation of:

- primary or distribution transformer tap changing equipment
- HV or LV voltage regulators
- Capacitor / Distribution Static Compensator (DStatcom)

Alternatively, or in addition, actions may be requested on equipment within the consumer’s premises e.g. initiating control actions to:

- change the load on the network by decreasing or increasing demand
- change the operation of in-premises generation

These actions are expected to be used in various combinations to resolve the observed voltage issues on distribution networks. A further description of these actions is provided below. It should be noted that although actions on DNO equipment are outside the Smart Metering System Scope, there may be a need for communications from the Smart Meter System to the DNO equipment to initiate action and confirm its effectiveness.

**Business Benefits**

The benefits of using these actions include the following:

- efficiently ensuring that voltages on the distribution network are maintained at all times within the prescribed limits
- helping to avoid or defer investment in reinforcement of the network

**Actions on DNO Assets**

Examples of actions carried out directly on DNO assets include:

**A Transformer tap changers**

The Distribution Network Operator currently effects a change in network voltage by real time voltage control via tap changers at primary substations. In the future, in addition to this, it is likely that voltage adjustments will be necessary at lower levels of the network hierarchy, for example at distribution substation transformers or via voltage regulators or capacitors. These latter actions may only be required to cover relatively long periods (e.g. each morning / evening or at the start of the summer / winter), however operation of the tap changer at the primary substation transformer would, as at present, need to continue to be controlled in real time.

**B Power factor control**

Due to the non-linear load characteristics of certain types of appliances (for example: heat pumps, air cooling compressors, some types of generation, and Compact Fluorescent Lamps (CFLs)) it is anticipated that there will be a general degrading of power factor as these appliances become increasingly popular. Poor power factor leads to higher currents on distribution systems than are necessary to supply the real power required (hence reducing thermal rating capacity headroom) and especially gives rise to poor voltage regulation due to the high reactance component of HV overhead lines and (especially) transformer
impedance. Correcting power factor by switched capacitors or DStatcoms can be a far more cost effective means of increasing capacity and improving voltage control than reinforcement; it will also beneficially reduce losses. Voltage sourced converters (VSCs) associated with battery storage also have the ability to correct PF.

**Actions within Customers premises**

On the demand side, actions will normally be with the agreement of Consumers. There are three key approaches:

A. **Increase or decrease network voltages by decreasing or increasing consumer demand.**

The mechanisms for changing customer demand may range from “softer” controls intended to gain a behavioural response such as by Time of Use, Critical Peak Price (CPP) or dynamic Tariffs, through direct control of appliances but allowing Consumer override, to “firm control” such as direct control of use without Consumer override. Tariff signals could be given to encourage consumers to either increase or decrease demand.

Actions may be effected at any of the following groups:

- Electric vehicles
- Domestic appliances, especially ‘wet’ appliances
- Immersion heaters
- Air cooling units
- Heat pumps and/or back-up electric heating systems
- Specific circuits within premises
- Home area networks

The “control” may be via combinations of pricing mechanisms or other incentives. Pricing mechanisms include:

- Time of Use Pricing
- Critical Peak Pricing
- Real Time Pricing (dynamic)

These may be used in conjunction with control of consumption by appliances including frequency response appliances (such as refrigerators), smart appliances that communicate with the Smart Metering System or an energy management system, or by control of circuits or the whole premises. The mechanisms may include allowing the Consumer to override the control or not.

These mechanisms would need to be widely adopted over populations of equipment and premises supplied via defined parts of a distribution network in order to have sufficient effect.

B. **Increase or decrease network voltages by increasing or decreasing generation / storage**

In addition to demand response mechanisms, there may be corresponding mechanisms to incentivise or curtail export power from micro-generation or returned from storage. Again,

---

2 Examples of ‘wet’ appliances are dishwashers, washing machines, etc.
this may be influenced by pricing measures at different granularity or by direct control allowing or prohibiting input under particular conditions. Again these actions would be carried out within contracts with Consumers.

C. Change the operating parameters of generation / storage plant

In addition to influencing the export from micro-generation, there may be mechanisms to change their operating parameters e.g. to increase the reactive power exported to help support network voltages. Again, this may be influenced by pricing measures at different granularity or by direct control allowing or prohibiting input under particular conditions. Again these actions would be carried out within contracts with Consumers.

Different types of mechanism will produce responses of different latency and predictability. For example a Time of Use tariff might be useful for reducing traditional peaks (but will be ineffective for providing response to short term stress) whereas, depending on the commercial arrangements, direct control of demand or generation can be used to provide immediate response to stress.

In addition, it should be noted that the effect of any action may be masked or enhanced by other actions and commercial arrangements (at the same premises or in the same part of the network) or by external factors such as the weather or television schedules.

Although some of the examples above may require changes of Customer behaviour and an acceptance of greater external intervention into their use of electricity, they have the potential to avoid major investment in network reinforcement and hence potentially significant increases in Use of System prices. Hence they should all be considered as legitimate mechanisms that may increasingly be used to balance networks and should therefore be supported by the functional specification of the Smart Metering System.

Note

Given that the focus here is on the management of voltages on the distribution network the commercial arrangements for the demand management options could be directly between the Distribution Network Operator and the Consumer. However, in practice, for domestic sized metering it may be more likely that the Distribution Network Operator would offer products to Suppliers or Aggregators in order that these parties could then provide the demand management service for them. If this were the case, the actual interaction with the Smart Metering System would be by another party and therefore requirements to interact with the Smart Metering Systems would belong to those other parties. The use case would then strictly be reduced to using voltage information from smart meters to determine trigger points for the interaction to commence, however there would be a corresponding Use Case for these other parties.

The mechanisms that could be used are virtually limitless and exhaustive documentation is beyond the scope of this Use Case. However the following scenarios are provided to illustrate a range of mechanisms and actions from the longer term pricing mechanisms, through short term pricing, to direct control of appliances or generation.

Further analysis could develop the use cases included in this summary use case depending on which mechanisms the parties genuinely expect to use or are interested in exploring. For this same reason alternative flows are not explored.
### Actors

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
<tr>
<td>Consumer</td>
<td>Secondary</td>
<td>Organisation, or person, consuming or generating the electricity at the premises. The Consumer may also be the organisation or person contracted with the Supplier for the provision of energy.</td>
</tr>
<tr>
<td>In Home Display</td>
<td>Secondary</td>
<td>A display provided to Consumers to enable them to monitor their energy usage and the charges levied for that energy under a tariff.</td>
</tr>
<tr>
<td>Energy Management System</td>
<td>Secondary</td>
<td>A device which uses information taken from the smart meter (including energy prices and signals) and other monitoring devices (such as thermostats) to manage the usage of appliances or generation at a premises.</td>
</tr>
</tbody>
</table>

### Scenario 1

#### Operation of (Distribution Use of System) Time of Use Tariff

Note this use case would be carried out at a number of premises

Note for this scenario it is assumed that the prices are also relayed to a display in the premises

#### Pre Conditions

A Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator

The Distribution Network Operator is aware of the location of the Smart Meter and can ‘position’ it on a network connectivity model

The Distribution Network Operator has systems that can generate the appropriate Time of Use tariffs and bill the Supplier accordingly

The Distribution Network Operator has a contract with the Consumer including the operation of a Time of Use tariff for all, or part, of the consumption at the premises

The Smart Metering System has been configured with the Time of Use tariff

The Smart Metering System has been configured to provide register readings according to the Time of Use tariff at set periods

#### Post Conditions
The Time of Use Tariff is operational; load has been influenced and changed according to the Consumer’s response

The Supplier can be billed according to the Customer’s usage and Time of Use tariff

**Trigger**

This use case is continuous throughout the life of the contractual arrangement

The Consumer uses power influenced by the Time of Use tariff

**Basic Flow**

1. The Smart Metering System accumulates readings for registers according to the Time of Use tariff
2. The Smart Metering System periodically (according to the schedule) provides readings for the registers associated with the Time of Use tariff to the Distribution Network Operator
3. The Distribution Network Operator receives the readings and loads them into their system

**Alternative Flow**

**Scenario 2**  
Operation of (Distribution Use of System) Real Time Pricing

Note for this scenario it is assumed that the prices are also relayed to a display in the premises

**Pre Conditions**

A Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator

The Distribution Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model

The Distribution Network Operator has systems that can generate the appropriate Real Time Use of System (UoS) tariffs and bill the Supplier accordingly

The Distribution Network Operator has a contract with the Consumer including the operation of a Real Time UoS Pricing tariff for all or part of the consumption at the premises

The Smart Metering System has been configured to accept regular price updates some time in advance of their being in effect

The Smart Metering System has been configured to provide register readings according to every price period

**Post Conditions**

The Real Time UoS Pricing Tariff is operational, load has been influenced and changed according to the Consumer’s response
The Consumer can be billed according to their usage and the prices used

Trigger

This use case is continuous throughout the life of the contractual arrangement

The Consumer uses power influenced by the Real Time Price regime

Basic Flow

1. The Distribution Network Operator periodically sends prices to the Smart Metering System
2. The Smart Metering System validates the prices and forwards them to the In Home Display (or other display device)
3. The Consumer uses the information on their In Home Display to influence their consumption behaviour either directly or via an Energy Management System
4. The Smart Metering System periodically sends consumption readings to the Distribution Network Operator
5. The Distribution Network Operator receives the consumption readings and loads them into their system

Alternative Flow

Scenario 3
Power Sharing by Maximum Power Thresholds
Note thresholds could be used to limit supply or export in a variety of ways for example there could be a maximum in a period, a maximum instantaneous consumption with cut offs where thresholds are exceeded.
For this illustration a maximum instantaneous power consumption is used

Pre Conditions

A Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator
The Distribution Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
The Distribution Network Operator has a contract with the Consumer including the operation of maximum thresholds for power use
The Smart Metering System is configured with a maximum power consumption threshold

Post Conditions

Power is returned to a premises

Trigger

The consumption through a Smart Metering System reaches the maximum power threshold

Basic Flow
1. The Smart Metering System recognises that power consumption has reached the threshold configured in the meter

2. The Smart Metering System sends a message to the In Home Display advising of excessive power use and warning that the supply will be interrupted unless consumption is reduced

3. The In Home display receives and displays the message

4. The Consumer notes the message and turns off some appliances

5. The Smart Metering System recognises that power consumption has dropped below the threshold configured in the meter

6. The Smart Metering System sends a command to the In Home Display to replace the previous message with one stating consumption has reduced below threshold

7. The Consumer notes the message and acknowledges it at the In Home Display

### Alternative Flow

At Basic Flow step 4:

4a1 The Consumer does not turn off some appliances

4a2 After a predetermined time the Smart Metering System cuts supply and logs the event

4a3 The Smart Metering System sends a message to the In Home Display stating supply has been interrupted due to excessive power use

4a4 The Consumer notes the message and acknowledges it at the In Home Display

4a5 The Consumer turns off some appliances

4a6 The Consumer restarts supply with an action at the meter (such as pressing a button)

4a7 The Smart Metering System restarts supply and logs the event

### Scenario 4

**Direct Control, by DNOs, of appliances or micro-generation**

This scenario assumes that the direct control is carried out by event messages sent through the Smart Metering System and that there is an Energy Management System in the premises.

It is assumed that the events are of predetermined duration

### Pre Conditions

A Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator

The Distribution Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model

The Distribution Network Operator has a contract with the Consumer including the operation of a Direct Control tariff
### Post Conditions
Direct control events have happened and load or generation has changed

### Trigger
A control event is recognised as required by the Distribution Network Operator

### Basic Flow
1. The Distribution Network Operator sends a message to the Smart Metering System of an event requiring greater or less demand or greater or less generation for a known duration
2. The Smart Metering System validates the message
3. The Smart Metering System acknowledges to the Distribution Network Operator that the event has been received
4. The Smart Metering System forwards the message to the Energy Management System which co-ordinates the change to demand event
5. The Energy Management System recognises the end of the change to demand event and allows consumption or generation to return to unfettered use.

### Alternative Flow

### Additional Information

### Related Information
This use case includes a variety of actions that may be performed to actively manage networks; they will not be performed in isolation. Some of the mechanisms are quite direct and may have immediately observable responses whereas others are long term and the response is less directly measurable by the state of the network. Although some measures may be continuously in force it may be considered as preceded and followed by “07 Collect data for active management”.

This use case identifies that actions are needed and checks the effect on the network.

Particularly where actions do not directly control load but rely on a proportion of response from a population it will be important to gauge the amount of response achieved, this will be done by using the “11 Check effectiveness of network management / system balancing”.

### Notes and issues
6.3.3 Perform active management of network power flow

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use Case Name
Perform Active Management of Network Power Flow

Description

**Business Need**

As part of the day to day operation of distribution and transmission networks there is a need to ensure that they are managed such that power flows and voltages are maintained within prescribed operating limits at all times. Distribution networks are managed by Distribution Network Operators, however they are currently not managed as proactively in real time, as transmission networks. There is however an expectation that this will change in the near future.

The Distribution Network Operators will be facing a variety of challenges to undertake these responsibilities in the future. Increasing quantities of generation will be connected to the distribution networks and there will be new types of demand, such as electric vehicles, heat pumps and domestic air cooling units which will change the characteristics of consumer demand. It is expected that there will be a need to build on the present systems for managing network voltages on distribution networks.

Distribution Network Operators will use Smart Metering System information to monitor real and reactive power flows on their network to identify or predict where actions are required to keep the networks assets, and potentially those in the transmission network, operating within their capability.

Rectifying actions would be implemented by the Distribution Network Operator or the National Electricity Transmission System Operator (NETSO) in the case of managing power flows at the interface between the transmission and distribution networks, and systems would be developed to check that the rectifying actions have been successful.

Actions may be taken directly on assets owned and operated by the Distribution Network Operator e.g. operation of

- storage device
- capacitors / Distribution Static compensator (DStatcom)

Alternatively, or in addition, actions may be requested on equipment within the consumers premises e.g. initiating control actions to:

- change the load on the network by decreasing or increasing demand
change the operation of in premises generation

These actions are expected to be used in various combinations to resolve the observed power flow issues on distribution networks. A further description of these actions is provided below. It should be noted that although actions on DNO equipment are outside the Smart Metering System Scope, there may be a need for communications from the Smart Meter System to the DNO equipment to initiate action and confirm its effectiveness.

**Business Benefits**

The benefits of using these actions include the following:

- efficiently ensuring that power flows on the distribution network are maintained at all times within the prescribed limits
- helping to avoid or defer investment in reinforcement of the network

**Actions on DNO Assets**

The Distribution Network Operator effects a change in power flow, e.g. using capacitors. These actions may only be required to cover relatively long periods (e.g. each morning / evening or at the start of the summer / winter), however the use of DStatcoms and storage devices would need to be controlled in real time. Correcting network power factors using switched capacitors or DStatcoms can be a far more cost effective means of increasing capacity and improving voltage control than reinforcement; it will also beneficially reduce losses. Voltage sourced converters associated with battery storage also have the ability to correct PF.

**Actions within Customers premises**

On the demand side, actions will normally be with the agreement of Consumers. There are two key approaches:

A Increase or decrease network power flows by changing consumer demand.

The mechanisms for changing customer demand may range from “softer” controls intended to gain a behavioural response such as by Time of Use, Critical Peak Price (CPP) or dynamic Tariffs, through control of appliances but allowing Consumer override, to “firm control” such as direct control of use without Consumer override. Tariff signals could be given to encourage consumers to either increase or decreased demand.

Actions may be effected at any of the following groups:

- Electric vehicles
- Domestic appliances, especially ‘wet’ appliances
- Immersion heaters
- Air cooling units
- Heat pumps and/or back-up electric heating systems
- Specific circuits within premises
- Home area networks
The “control” may be via combinations of pricing mechanisms or other incentives. Pricing mechanisms include:

- Time of Use Pricing
- Critical Peak Pricing
- Real Time Pricing

These may be used in conjunction with control of consumption by appliances including frequency response appliances (such as refrigerators), smart appliances that communicate with the Smart Metering System or an energy management system, or by control of circuits or the whole premises. The mechanisms may include allowing the Consumer to override the control or not.

These mechanisms would need to be widely adopted over populations of equipment and premises supplied via defined parts of a distribution network in order to have sufficient effect.

### B Increase or decrease network power flows by changing generation / storage

In addition to demand response mechanisms, there may be corresponding mechanisms to incentivise or curtail export power from micro-generation or returned from storage. Again, this may be influenced by pricing measures at different granularity or by direct control allowing or prohibiting input under particular conditions. Again these actions would be carried out within contracts with Consumers.

Different types of mechanism will produce responses of different latency and predictability. For example a Time of Use tariff might be useful for reducing traditional peaks but is not good for providing response to short term stress, whereas, depending on the commercial arrangements, direct control of demand or generation can be used to respond to immediate stress.

In addition, it should be noted that the effect of any action may be masked or enhanced by other actions and commercial arrangements (at the same premises or in the same part of the network) or by external factors such as the weather or television schedules.

Although some of the examples above may prove inoperable or ineffective in reality, currently they should all be considered as possible mechanisms that may be used to balance networks. Hence the Smart Metering System is expected to cater for all examples.

### Note

It is possible that the commercial arrangements for these actions could be directly between the Transmission or Distribution Network Operator and the Consumer. For domestic sized metering it may be more likely that the Network Operator would offer products to Suppliers or Aggregators in order that these parties provide the service for them. If this were the case, the actual interaction with the Smart Metering System would be by another party and therefore requirements to interact with the Smart Metering Systems would belong to those other parties. The use case would then be reduced to strictly using demand information from smart meters to determine trigger points for the interaction to commence.
Simply for the purpose of describing the actions to a useful level, this analysis uses the generic title Network Operator as the party that has a contract with the Consumer and carries out the actions. In practice this actor may actually be the Transmission Network Operator, the Distribution Network Operator, the Supplier or an agent such as an aggregator.

The mechanisms that could be used are virtually limitless and exhaustive documentation is beyond the scope of this Use Case. However the following scenarios are provided to illustrate a range of mechanisms and actions from the longer term pricing mechanisms, through short term pricing, to direct control of appliances or generation.

Further analysis could develop the use cases included in this summary use case depending on which mechanisms the parties genuinely expect to use or are interested in exploring. For this same reason alternative flows are not explored.

<table>
<thead>
<tr>
<th>Actors</th>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for carrying out actions to manage load on the network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> This role is used for convenience and these actions may actually be</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>carried out by NETSO, a Distribution Network Operator, a Supplier, an Aggregator,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>or any other party providing a Demand Response to Networks Businesses</td>
</tr>
<tr>
<td></td>
<td>Consumer</td>
<td>Secondary</td>
<td>Organisation, or person, consuming or generating the electricity at the premises.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The Consumer may also be the organisation or person contracted with the Supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>for the provision of energy.</td>
</tr>
<tr>
<td></td>
<td>In Home Display</td>
<td>Secondary</td>
<td>A display provided to Consumers to enable them to monitor their energy usage and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the charges levied for that energy under a tariff.</td>
</tr>
<tr>
<td></td>
<td>Energy Management</td>
<td>Secondary</td>
<td>A device which uses information taken from the smart meter (including energy prices</td>
</tr>
<tr>
<td></td>
<td>System</td>
<td></td>
<td>and signals) and other monitoring devices (such as thermostats) to manage the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>usage of appliances or generation at a premises.</td>
</tr>
</tbody>
</table>

**Scenario 1**

**Operation of (Distribution Use of System) Time of Use Tariff**

Note this use case would be carried out at a number of premises

Note for this scenario it is assumed that the prices are also relayed to a display in the
### ENA Smart Metering System Use Cases – ENA authorised parties only

<table>
<thead>
<tr>
<th>premises</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre Conditions</strong></td>
</tr>
<tr>
<td>A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator</td>
</tr>
<tr>
<td>The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model</td>
</tr>
<tr>
<td>The Network Operator has systems that can generate the appropriate Time of Use tariffs and bill the Supplier accordingly</td>
</tr>
<tr>
<td>The Network Operator has a contract with the Consumer including the operation of a Time of Use tariff for all, or part, of the consumption at the premises</td>
</tr>
<tr>
<td>The Smart Metering System has been configured with the Time of Use tariff</td>
</tr>
<tr>
<td>The Smart Metering System has been configured to provide register readings according to the Time of Use tariff at set periods</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Time of Use Tariff is operational, load has been influenced and changed according to the Consumer’s response</td>
</tr>
<tr>
<td>The Supplier can be billed according to their usage and the Time of Use tariff</td>
</tr>
</tbody>
</table>

### Trigger

This use case is continuous throughout the life of the contractual arrangement

The Consumer uses power influenced by the Time of Use tariff

### Basic Flow

1. The Smart Metering System accumulates readings for registers according to the Time of Use tariff
2. The Smart Metering System periodically (according to the schedule) provides readings for the registers associated with the Time of Use tariff to the Network Operator
3. The Network Operator receives the readings and loads them into their system

### Alternative Flow

---

### Scenario 2

**Operation of Real Time Pricing**

Note for this scenario it is assumed that the prices are also relayed to a display in the premises

<table>
<thead>
<tr>
<th>Pre Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator</td>
</tr>
<tr>
<td>The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model</td>
</tr>
<tr>
<td>The Network Operator has systems that can generate the appropriate Time of Use tariffs and bill the Supplier accordingly</td>
</tr>
<tr>
<td>The Network Operator has a contract with the Consumer including the operation of a Time of Use tariff for all, or part, of the consumption at the premises</td>
</tr>
<tr>
<td>The Smart Metering System has been configured with the Time of Use tariff</td>
</tr>
<tr>
<td>The Smart Metering System has been configured to provide register readings according to the Time of Use tariff at set periods</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Time of Use Tariff is operational, load has been influenced and changed according to the Consumer’s response</td>
</tr>
<tr>
<td>The Supplier can be billed according to their usage and the Time of Use tariff</td>
</tr>
</tbody>
</table>

### Trigger

This use case is continuous throughout the life of the contractual arrangement

The Consumer uses power influenced by the Time of Use tariff

### Basic Flow

1. The Smart Metering System accumulates readings for registers according to the Time of Use tariff
2. The Smart Metering System periodically (according to the schedule) provides readings for the registers associated with the Time of Use tariff to the Network Operator
3. The Network Operator receives the readings and loads them into their system

### Alternative Flow

---
network connectivity model

The Network Operator has systems that can generate the appropriate Real Time tariffs and bill the Supplier accordingly

The Network Operator has a contract with the Consumer including the operation of a Real Time Pricing tariff for all or part of the consumption at the premises

The Smart Metering System has been configured to accept regular price updates some time in advance of their being in effect

The Smart Metering System has been configured to provide register readings according to every price period

**Post Conditions**

The Real Time Pricing Tariff is operational, load has been influenced and changed according to the Consumer’s response

The Consumer can be billed according to their usage and the prices used

**Trigger**

This use case is continuous throughout the life of the contractual arrangement

The Consumer uses power influenced by the Real Time Price regime

**Basic Flow**

1. The Network Operator periodically sends prices to the Smart Metering System
2. The Smart Metering System validates the prices and forwards them to the In Home Display (or other display device)
3. The Consumer uses the information on their In Home Display to influence their consumption behaviour either directly or via an Energy Management System
4. The Smart Metering System periodically sends consumption readings to the Network Operator
5. The Network Operator receives the consumption readings and loads them into their system

**Alternative Flow**

---

**Scenario 3**

**Power Sharing by Maximum Power Thresholds**

Note thresholds could be used to limit supply or export in a variety of ways for example there could be a maximum in a period, a maximum instantaneous consumption with cut offs where thresholds are exceeded.

For this illustration a maximum instantaneous power consumption is used

**Pre Conditions**

A Smart Metering System is installed and configured to receive and respond to messages
from the Network Operator
The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
The Network Operator has a contract with the Consumer including the operation of maximum thresholds for power use
The Smart Metering System is configured with a maximum power consumption threshold

**Post Conditions**
Power is returned to a premises

**Trigger**
The consumption through a Smart Metering System reaches the maximum power threshold

**Basic Flow**

1. The Smart Metering System recognises that power consumption has reached the threshold configured in the meter
2. The Smart Metering System sends a message to the In Home Display advising of excessive power use and warning the supply will be interrupted unless consumption is reduced
3. The In Home display receives and displays the message
4. The Consumer notes the message and turns off some appliances
5. The Smart Metering System recognises that power consumption has dropped below the threshold configured in the meter
6. The Smart Metering System sends a command to the In Home Display to replace the previous message with one stating consumption has reduced below threshold
7. The Consumer notes the message and acknowledges it at the In Home Display

**Alternative Flow**
At Basic Flow step 4:

4a1 The Consumer does not turn off some appliances
4a2 After a predetermined time the Smart Metering System cuts supply and logs the event
4a3 The Smart Metering System sends a message to the In Home Display stating supply has been interrupted due to excessive power use
4a4 The Consumer notes the message and acknowledges it at the In Home Display
4a5 The Consumer turns off some appliances
4a6 The Consumer restarts supply with an action at the meter (such as pressing a button)
4a7 The Smart Metering System restarts supply and logs the event
Scenario 4
Direct Control of appliances or micro-generation
This scenario assumes that the direct control is carried out by event messages sent through the Smart Metering System and that there is an Energy Management System in the premises.
It is assumed that the events are of predetermined duration.

Pre Conditions
A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator.
The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model.
The Network Operator has a contract with the Consumer including the operation of a Direct Control tariff.

Post Conditions
Direct control events have happened and load or generation has changed.

Trigger
A control event is recognised as required by the Network Operator.

Basic Flow
1. The Network Operator sends a message to the Smart Metering System of an event requiring greater or less demand or greater or less generation for a known duration.
2. The Smart Metering System validates the message.
3. The Smart Metering System acknowledges to the Network Operator that the event has been received.
4. The Smart Metering System forwards the message to the Energy Management System which co-ordinates the change to demand event.
5. The Energy Management System recognises the end of the change to demand event and allows consumption or generation to return to unfettered use.

Alternative Flow

Additional Information
Related Information
This use case includes a variety of actions that may be performed to actively manage network power flows, they will not be performed in isolation. Some of the mechanisms are quite direct and may have immediately observable responses whereas others are long term and the response is less directly measurable by the state of the network. Although some measures may be continuously in force it may be considered as preceded and followed by “07 Collect data for active management”.
This use case identifies that actions are needed and checks the effect on the network.
Particularly where actions do not directly control load but rely on a proportion of response from a population it will be important to gauge the amount of response achieved, this will be done by using the “11 Check effectiveness of network management”.

### Notes and issues

#### 6.4 System Balancing

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role</th>
<th>Electricity</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th>System Balancing</th>
</tr>
</thead>
</table>

**Description**

The National Electricity Transmission System Operator (NETSO) is responsible for ensuring that power supply balances the demand in real time whilst maintaining the system frequency within statutory limits for Great Britain.

The NETSO could use Smart Metering System information relating to export from generation in consumers premises together with information from larger generators to manage the changing future risks in generation capacity associated with inflexible base load and intermittent generation.

The balancing actions the NETSO makes may be direct demand side management via smart metering, or carried out by other parties (Distribution Network Operators, Generators or Aggregators) on their behalf. These Use Cases describe the NETSO’s potential interaction with the Smart Metering Systems.
6.4.1 Perform system balancing

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Electricity</td>
</tr>
<tr>
<td>Use Case Name</td>
<td>Perform System Balancing</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

As part of the day to day operation of distribution and transmission networks there is a need to ensure that they are managed such that power flows, voltages and frequency are maintained within prescribed operating limits at all times.

In addition, there is a need to balance the amount of electricity generated with the customer demand. The National Electricity Transmission System Operator (NETSO) currently performs this residual balancing role for Great Britain and is responsible for ensuring power supply balances the demand in real time whilst maintaining the system frequency within statutory limits. It uses a range of balancing services, including demand side management, to maintain frequency and cater for a number of contingency arrangements.

The Distribution Network Operators and NETSO, (referred to generically as Network Operators) will be facing a variety of challenges to undertake both these responsibilities in the future. Increasing quantities of generation will be connected to the distribution networks, there will be greater quantities of intermittent generation connected to transmission and distribution networks and there will be new types of demand, such as electric vehicles, heat pumps and domestic air cooling units, which will change the characteristics of consumer demand. It is expected that there will be a need to build on the present systems for managing power flows and voltages on both transmission and distribution networks and also those used to balance energy across the total system.

The NETSO could use Smart Metering System information relating to export from generation in consumers premises together with information from larger generators to manage the changing risks in generation capacity associated with inflexible base load and intermittent generation. In the future there is the possibility that the Distribution Network Operator will be increasingly involved in energy balancing if parts of the distribution networks are operated as Virtual Power Plants (VPP).

These balancing actions could be implemented solely by the Distribution Network Operator, the NETSO or a combination of co-ordinated approaches.

The same monitoring systems will be used to check that the rectifying actions have been successful.
Actions may be taken directly on assets owned and operated by the Distribution Network Operator e.g. operation of energy storage devices. Alternatively, or in addition, actions may be requested on equipment within the consumers premises e.g. initiating control actions to:

- change the load on the network by decreasing or increasing demand
- change the operation of in premises generation

These actions are expected to be used in various combinations to address forecast energy imbalance issues in ‘operational planning timescales’ however provided that control signals could be sent sufficiently quickly and in sufficient volume, the above actions could be used to help balance the system in real time. A further description of these actions is provided below. It is worth identifying that although actions on DNO equipment are outside the Smart Metering System Scope, there may be a need for communications from the Smart Metering System to the DNO equipment to initiate action and confirm its effectiveness.

Business Benefits

The benefits of using these actions include the following:

- Providing alternative balancing actions and sources of short term operating reserve, which are expected to increase with the growth of intermittent generation and connection of larger transmission connected generation, e.g. 1,800 MW units

Actions on DNO Assets

The Distribution Network Operator effects a change in energy flowing onto the system by the use of storage devices. Such equipment would need to be controlled in real time.

Actions within Customers premises

On the demand side, actions will normally be with the agreement of Consumers. There are two key approaches:

A. Increase or decrease network power flows by changing consumer demand.

The mechanisms for changing customer demand in ‘operational planning timescales’ may range from “softer” controls intended to gain a behavioural response such as by Time of Use Tariffs, through control of appliances but allowing Consumer override. Tariff signals could be given to encourage consumers to either increase or decreased demand. Increasing or decreasing customer demand to balance the system in real time would require rapid “firm control” such as direct control of use without Consumer override.

Actions may be effected at any of the following groups:

- Electric vehicles
- Domestic appliances, especially ‘wet’ appliances
- Immersion heaters
- Air cooling units
• Heat pumps and/or back-up electric heating systems
• Specific circuits within premises
• Home area networks

The “soft control” may be via combinations of pricing mechanisms or other incentives. Pricing mechanisms include:
• Time of Use Pricing
• Critical Peak Pricing
• Real Time Pricing

The “hard control” would require direct communication to customer’s equipment.

These actions may be used in conjunction with control of consumption by appliances including frequency response appliances (such as refrigerators), smart appliances that communicate with the Smart Metering System or an energy management system, or by control of circuits or the whole premises. The mechanisms may include allowing the Consumer to override the control or not.

These mechanisms would need to be widely adopted over populations of equipment and premises supplied via defined parts of a distribution network in order to have sufficient effect.

B Increase or decrease network power flows by changing generation / storage

In addition to demand response mechanisms, there may be corresponding mechanisms to incentivise or curtail export power from micro-generation or returned from storage. Again, this may be influenced by pricing measures at different granularity or by direct control allowing or prohibiting input under particular conditions. Again these actions would be carried out within contracts with Consumers.

Different types of mechanism will produce responses of different latency and predictability. For example a Time of Use tariff might be useful for energy balancing in ‘operational planning timescales’ but is less effective in contributing to real time system balancing. In contrast, depending on the commercial arrangements, direct control of demand or generation could be more effective in contributing to real time balancing.

In addition, it should be noted that the effect of any action may be masked or enhanced by other actions and commercial arrangements (at the same premises or in the same part of the network) or by external factors such as the weather or television schedules.

Although some of the examples above may prove inoperable or ineffective in reality, currently they should all be considered as possible mechanisms that may be used to balance networks. Hence the Smart Metering System is expected to cater for all examples.

Note

It is possible that the commercial arrangements for these actions could be directly between the NETSO or Distribution Network Operator and the Consumer. For domestic
sized metering it may be more likely that the Network Operator would offer products to Suppliers or Aggregators in order that these parties provide the service for them. If this were the case, the actual interaction with the Smart Metering System would be by another party and therefore requirements to interact with the Smart Metering Systems would belong to those other parties. The use case would then be reduced to strictly using demand information from smart meters to determine trigger points for the interaction to commence.

Simply for the purpose of describing the actions to a useful level, this analysis uses the generic title Network Operator as the party that has a contract with the Consumer and carries out the actions. In practice this actor may actually be the NETSO, the Distribution Network Operator, the Supplier or an agent such as an aggregator.

It should be noted that different parties may actually carry out activities for different reasons which means that they will not always complement the requirements of the network.

The mechanisms that could be used are virtually limitless and exhaustive documentation of them are beyond the scope of this work.

However the following scenarios are provided to illustrate a range of mechanisms and actions from the longer term pricing mechanisms, through short term pricing, to direct control of appliances or generation.

Further analysis could develop the use cases included in this summary use case depending on which mechanisms the parties genuinely expect to use or are interested in exploring. For this same reason alternative flows are not explored.

<table>
<thead>
<tr>
<th>Actors</th>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for carrying out actions to manage load on the network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> This role is used for convenience and these actions may actually be carried out by NETSO, a Distribution Network Operator, a Supplier, an Aggregator, or any other party providing a Demand Response to Networks Businesses</td>
</tr>
<tr>
<td></td>
<td>Consumer</td>
<td>Secondary</td>
<td>Organisation, or person, consuming or generating the electricity at the premises. The Consumer may also be the organisation or person contracted with the Supplier for the provision of energy.</td>
</tr>
<tr>
<td></td>
<td>In Home Display</td>
<td>Secondary</td>
<td>A display provided to Consumers to enable them to monitor their energy usage and the charges levied for that energy under a tariff.</td>
</tr>
</tbody>
</table>
**Actors**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Management System</td>
<td>Secondary</td>
<td>A device which uses information taken from the smart meter (including energy prices and signals) and other monitoring devices (such as thermostats) to manage the usage of appliances or generation at a premises.</td>
</tr>
</tbody>
</table>

**Scenario 1**

**Operation of (Distribution Use of System) Time of Use Tariff**

*Note this use case would be carried out at a number of premises*

*Note for this scenario it is assumed that the prices are also relayed to a display in the premises*

**Pre Conditions**

- A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator
- The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
- The Network Operator has systems that can generate the appropriate Time of Use tariffs and bill the Supplier accordingly
- The Network Operator has a contract with the Consumer including the operation of a Time of Use tariff for all, or part, of the consumption at the premises
- The Smart Metering System has been configured with the Time of Use tariff
- The Smart Metering System has been configured to provide register readings according to the Time of Use tariff at set periods

**Post Conditions**

- The Time of Use Tariff is operational, load has been influenced and changed according to the Consumer’s response
- The Consumer can be billed according to their usage and the Time of Use tariff

**Trigger**

This use case is continuous throughout the life of the contractual arrangement

The Consumer uses power influenced by the Time of Use tariff

**Basic Flow**

1. The Smart Metering System accumulates readings for registers according to the Time of Use tariff
2. The Smart Metering System periodically (according to the schedule) provides readings for the registers associated with the Time of Use tariff to the Network Operator
3. The Network Operator receives the readings and loads them into their system

### Alternative Flow

### Scenario 2
**Operation of Real Time Pricing**

Note for this scenario it is assumed that the prices are also relayed to a display in the premises

#### Pre Conditions

- A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator
- The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
- The Network Operator has systems that can generate the appropriate Real Time tariffs and bill the Supplier accordingly
- The Network Operator has a contract with the Consumer including the operation of a Real Time Pricing tariff for all or part of the consumption at the premises
- The Smart Metering System has been configured to accept regular price updates some time in advance of their being in effect
- The Smart Metering System has been configured to provide register readings according to each price period

#### Post Conditions

- The Real Time Pricing Tariff is operational, load has been influenced and changed according to the Consumer’s response
- The Consumer can be billed according to their usage and the prices used

#### Trigger

- This use case is continuous throughout the life of the contractual arrangement
- The Consumer uses power influenced by the Real Time Price regime

#### Basic Flow

1. The Network Operator periodically sends prices to the Smart Metering System
2. The Smart Metering System validates the prices and forwards them to the In Home Display (or other display device)
3. The Consumer uses the information on their In Home Display to influence their consumption behaviour either directly or via an Energy Management System
4. The Smart Metering System periodically sends consumption readings to the Network Operator
5. The Network Operator receives the consumption readings and loads them into their system
Alternative Flow

### Scenario 3
**Power Sharing by Maximum Power Thresholds**

Note thresholds could be used to limit supply or export in a variety of ways for example there could be a maximum in a period, a maximum instantaneous consumption with cut offs where thresholds are exceeded.

For this illustration a maximum instantaneous power consumption is used

**Pre Conditions**

- A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator
- The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
- The Network Operator has a contract with the Consumer including the operation of maximum thresholds for power use
- The Smart Metering System is configured with a maximum power consumption threshold

**Post Conditions**

- Power is returned to a premises

**Trigger**

- The consumption through a Smart Metering System reaches the maximum power threshold

**Basic Flow**

1. The Smart Metering System recognises that power consumption has reached the threshold configured in the meter
2. The Smart Metering System sends a message to the In Home Display advising of excessive power use and warning the supply will be interrupted unless consumption is reduced
3. The In Home display receives and displays the message
4. The Consumer notes the message and turns off some appliances
5. The Smart Metering System recognises that power consumption has dropped below the threshold configured in the meter
6. The Smart Metering System sends a command to the In Home Display to replace the previous message with one stating consumption has reduced below threshold
7. The Consumer notes the message and acknowledges it at the In Home Display

**Alternative Flow**

At Basic Flow step 4:
4a1  The Consumer does not turn off some appliances
4a2  After a predetermined time the Smart Metering System cuts supply and logs the event
4a3  The Smart Metering System sends a message to the In Home Display stating supply has been interrupted due to excessive power use
4a4  The Consumer notes the message and acknowledges it at the In Home Display
4a5  The Consumer turns off some appliances
4a6  The Consumer restarts supply with an action at the meter (such as pressing a button)
4a7  The Smart Metering System restarts supply and logs the event

Scenario 4
Direct Control of appliances or micro-generation
This scenario assumes that the direct control is carried out by event messages sent through the Smart Metering System and that there is an Energy Management System in the premises. It is assumed that the events are of predetermined duration

Pre Conditions
A Smart Metering System is installed and configured to receive and respond to messages from the Network Operator
The Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
The Network Operator has a contract with the Consumer including the operation of a Direct Control tariff

Post Conditions
Direct control events have happened and load or generation has changed

Trigger
A control event is recognised as required by the Network Operator

Basic Flow
1. The Network Operator sends a message to the Smart Metering System of an event requiring greater or less demand or greater or less generation for a known duration
2. The Smart Metering System validates the message
3. The Smart Metering System acknowledges to the Network Operator that the event has been received
4. The Smart Metering System forwards the message to the Energy Management System which co-ordinates the change to demand event
5. The Energy Management System recognises the end of the change to demand event and allows consumption or generation to return to unfettered use.
### Alternative Flow

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th>Check effectiveness of active network management / system balancing measures</th>
</tr>
</thead>
</table>

### Additional Information

**Related Information**

This use case includes a variety of actions that may be performed to undertake system balancing. Some of the mechanisms are quite direct and may have immediately observable responses whereas others are long term and the response is less directly measurable by the state of the network.

Particularly where actions do not directly control load but rely on a proportion of response from a population it will be important to gauge the amount of response achieved, this will be done by using the “11 Check effectiveness of network management”.

### Notes and issues

#### 6.4.2 Check effectiveness of active network management / system balancing measures

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Detailed</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

There are a range of measures that may be operated to manage power flow, maintain voltages or undertake system balancing. Although some measures may actually control power used or generated to a known amount, many measures are dependent on local conditions, external forces and particularly on consumer response to a signal. In all of these cases it is necessary to check the effectiveness of the mechanism. Where a near/real-time response is expected, the NETSO or Distribution Network Operator needs to be able to check the efficacy of the action by retrieving power flow and voltage data from the Smart Metering System.

In addition, a network management or system balancing measure may need to be altered for it to achieve the desired response. For example the effectiveness of a pricing incentive
such as a time of use tariff may depend on:

- the attractiveness of the tariff – determining its up take by Consumers
- the level of the peak price – affecting the extent of response

It will be important to measure and compare the response from Consumers with the mechanism to similar Consumers without the mechanism. Different mechanisms need data over different periods and granularity – for example where a direct control event is operated there may be a need for data covering shortly before, during and shortly after the period and may be delivered in a single batch. Whereas a time of use tariff may need data covering a much longer period delivered periodically.

**Business Benefits**

This use case allows Network Operators to identify the effectiveness of active network management or system balancing measures and thus to be able to tailor them to gain suitable responses.

<table>
<thead>
<tr>
<th>Actors</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Operator</td>
<td>Organisation responsible for carrying out actions to manage load on the network</td>
</tr>
<tr>
<td>Primary</td>
<td>Note: This role is used for convenience and these actions may actually be carried out by NETSO, a Distribution Network Operator, a Supplier, an Aggregator, or any other party providing a Demand Response to Networks Businesses</td>
</tr>
</tbody>
</table>

**Scenario Descriptions**

**Pre Conditions**

Smart Metering Systems are installed and configured to receive and respond to messages from the Network Operator

The Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model

The Network Operator has identified samples of Smart Meters where a particular mechanism is used and a sample of meters in similar conditions but where the mechanism does not operate

The Smart Metering Systems within these samples have been configured to collect and deliver data appropriate to the mechanism in place

**Post Conditions**

The Network Operator has Smart Metering System data available to help identify the
effectiveness of mechanisms used for active network management and be able to refine the mechanisms so that their effectiveness can be better predicted in the future.

**Trigger**

The process is triggered by a network’s periodic assessment of active management / system balancing techniques.

This may vary depending on the mechanism.

**Basic Flow**

This use case is carried out at each selected Smart Metering System of a sample.

There will be samples of meters where a load management mechanism is used and similar sites where it is not used.

1. The Smart Metering System measures power flow and voltage data
2. The Smart Metering System sends the data to the Network Operator
3. The Network Operator receives the data and loads it into its system to analyse the effectiveness of load management mechanisms.

**Alternative Flow**

At Basic Flow step 2:

2a1 The Smart Metering System fails to send the message
2a1 The Network Operator’s systems identify the missing data, the Network Operator, investigates the cause of the failure and may reconfigure the meter
2a2 The flow returns to step 1.
6.5 Actively manage network – planned and unplanned outages

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>AMN-P&amp;UO</th>
<th>Level</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Case Name</td>
<td>Actively Manage Networks – planned and unplanned outages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description**

Users connected to electricity networks experience power outages – either planned when the Distribution Network Operator (DNO) needs to conduct work on the network, or unplanned for example as a result of extreme weather conditions or equipment failure.

Smart Metering Systems provide an opportunity for DNOs to increase their visibility of outage occurrences resulting in increased network efficiency in their resolution. The increased granularity of outage information will enable the DNOs to analyse outage occurrence and improve their regulatory reporting processes.

DNOs will also be able to maintain supplies by using Smart Metering data and functionality to reroute power through alternative routes.

The customer experience can also be improved by the DNO sending outage related information to the Smart Meter, In Home Display and other associated devices.
Figure 7 - Actively manage network outages Use Case diagram

Actively manage network - Planned & unplanned outages

- Notify consumer of planned outage
- Ensure meter energisation status to determine outage source and location
- Send alert to DNO during network outage
- Restore and maintain supply during outages
- Verify restoration of supplies after outage
6.5.1 Notify consumer of planned outage

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th></th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role</td>
<td></td>
<td>Role</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

| Use Case Name | Notify consumer of planned outage |

**Description**

**Business Need**

Distribution Network Operators have an obligation to inform customers of planned outages under both the Electricity Safety, Quality and Continuity Regulations and the Electricity (Standards of Performance) Regulations 2005. This is presently achieved by posting cards through Consumer’s doors with a governance process for confirming delivery. If the Smart Metering System is configured to receive messages from the DNO then they will be able to transmit the notification of planned outages to the smart meter and receive confirmation that it has been delivered. The message could be displayed on the Smart Meter display or on the In House Display, or on an alternative presentation device.

In addition to their statutory obligations, DNOs are subject to Guaranteed Standards of Service to deliver notification to Consumers, with penalties applied for failures. Functionality within the Smart Metering System will improve the current process potentially both reducing the cost of notifying planned outages, and allowing for more accurate notification.

As an added service to the Consumer, DNOs could send a reminder message on the day of the outage.

A further use for the functionality could be to inform Consumers of an emergency outage. From time to time DNOs need to interrupt supplies to customers with healthy supplies during fault restoration works. This need arises to isolate a section of the network (and hence switch off supplies) beyond that immediately affected by a fault in order to enable the fault to be repaired safely. The ability to advise Consumers of a pending emergency outage will offer a significant improvement in customer services from that currently provided. This could be achieved by sending an “immediate” notice of outage to the Smart Metering System.

**Business Benefit**

- Reduced cost to serve by moving away from letters
- More auditable
• Allows checking of the premises that have received the notification
• Allows immediate notification during emergencies
• Enhanced Customer Service

### Actors

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
<tr>
<td>Consumer</td>
<td>Secondary</td>
<td>Organisation, or person, consuming or generating the electricity at the premises. The Consumer may also be the organisation or person contracted with the Supplier for the provision of energy.</td>
</tr>
</tbody>
</table>

### Scenario 1 – Consumer notification of planned / emergency outage

#### Scenario Descriptions

**Pre Conditions**

- The Smart Metering System is installed and configured to accept, display, and respond to, messages from the Distribution Network Operator
- Distribution Network Operator has the right to display messages on the Smart Metering System (e.g. the meter, the In House Display, or an alternative display)
- Either a modification to, or approved relaxation of, the current ESQC Regulation would be required as this presently requires ‘written’ notification

**Post Conditions**

- The Smart Metering System confirms to the Distribution Network Operator that a message that is meaningful to the Consumer has been delivered and displayed
- The Distribution Network Operator is aware when a failure has occurred

**Trigger**

- The Distribution Network Operator has a requirement to send a notification of planned / emergency outage message to the Consumer

**Basic Flow**

1. The Distribution Network Operator sends an instruction to the Smart Metering System to display notification of planned / emergency outage message for the Consumer
2. The Smart Metering System validates the request
3. The Smart Metering System forwards the message to an In Home Display (or...
4. The message is displayed until the Consumer acknowledges it, or it expires

5. The Smart Metering System sends a delivery receipt and message displayed message to the Distribution Network Operator

**Alternative Flow**

2. At Basic Flow step 2

   2a1 The Smart Metering System deems the request invalid

   2a2 The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp

   2a3 The Distribution Network Operator takes the required steps to resolve the error

   2a4 Once the error is resolved back to Basic Flow step 1

5. At Basic Flow step 5

   5a1 The Distribution Network Operator does not receive the delivery receipt message from the Smart Metering System

   5a2 The Distribution Network Operator is aware that a failure has occurred

   5a3 The Distribution Network Operator arranges for a card notifying of the planned outage to be delivered to the Consumer’s address

**Scenario 2 – Consumer notified that outage is over**

<table>
<thead>
<tr>
<th>Scenario Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre Conditions</strong></td>
</tr>
<tr>
<td>The Smart Metering System is installed and configured to accept, display, and respond to, messages from the Distribution Network Operator</td>
</tr>
<tr>
<td>Distribution Network Operator has the right to display messages on the Smart Metering System (e.g. the meter, the In House Display, or an alternative display)</td>
</tr>
<tr>
<td>The planned/emergency outage has been resolved</td>
</tr>
</tbody>
</table>

| **Post Conditions**    |
| The Smart Metering System confirms to the Distribution Network Operator that a message that is meaningful to the Consumer has been delivered and displayed |
| The Distribution Network Operator is aware when a failure has occurred |

| **Trigger**            |
| The Distribution Network Operator has a requirement to send a notification of planned / emergency outage over message to the Consumer |

| **Basic Flow**         |
| 1. The Distribution Network Operator sends an instruction to the Smart Metering System to display notification that the planned / emergency outage is over message for the Consumer. This could include a reminder to reset clocks / check |
2. The Smart Metering System validates the request

3. The Smart Metering System forwards the message to an In Home Display (or alternative display device)

4. The message is displayed until the Consumer acknowledges it, or it expires

5. The Smart Metering System sends a delivery receipt and message displayed to the Distribution Network Operator

### Alternative Flow

2. At Basic Flow step 2

   - **2a1** The Smart Metering System deems the request invalid
   - **2a2** The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp
   - **2a3** The Distribution Network Operator takes the required steps to resolve the error
   - **2a4** Once the error is resolved back to Basic Flow step 1

5. At Basic Flow step 5

   - **5a1** The Distribution Network Operator does not receive the delivery receipt message from the Smart Metering System
   - **5a2** The Distribution Network Operator is aware that a failure has occurred
   - **5a3** The Distribution Network Operator arranges for an alternative contact method to be used to notify the Consumer that the planned / emergency outage is over

### Additional Information

#### Related Information

**Notes and issues**

It would need to be established that the delivery and display of a message on the Smart Metering System (either on the meter or a separate display device) fulfils the DNO’s obligation to inform the Consumer. This would require either a change to or automatic derogation from the ESQC Regulation. Issues would be how valuable this message is in a partial population of smart meters, until full roll out is reached or where the In Home Display may not always be used. The materiality of this latter concern will be influenced by the degree of engagement that Customers have with the overall Smart Meter package.

It may be that this would have to be used in combination with current notification methods until full roll out is reached.

The process may be appropriate as a reminder in addition to a notification.

If this process were to be used it may well be appropriate to require the message to be acknowledged confirming that the Consumer has read it.
How long the message should stay on display unacknowledged is a matter to be determined. Other questions to be determined include: if the message expires (because the outage completion time had passed) is the DNO’s obligation fulfilled? and should the message on display be unable to be replaced by a newer message until the outage message has been acknowledged or expired?

6.5.2 Query meter energisation status to determine outage source and location

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Electricity</td>
</tr>
<tr>
<td>Use Case Name</td>
<td>Query meter energisation status to determine outage source and location</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

This use case describes how the Distribution Network Operators will use information from, and take actions through, the smart metering population, to identify the reason for an outage and enhance the location of network faults.

Once the Distribution Network Operator has been notified (i.e. through a telephone call from a Consumer) or suspect the existence of, an unplanned power outage, they can use the ability to query individual Smart Metering Systems to check their energisation status, allied with information from Supervisory Control And Data Acquisition (SCADA) network metering to improve the fault location / supply restoration process.

There are broadly three types of scenario where a Consumer may experience a loss of supply:

- A loss of power supplied from the network side;
- Meter conditions preventing power flowing from the network into the premises (e.g. pre-payment meter running out of credit, Supplier intervention, or as a safety feature); or
- Operation of a protective device on the customer’s side of the meter.

It is assumed that the Local or Wide Area Network (LAN or WAN) communications system for the meter will receive power in such a way that they will still operate during metering conditions (or customer installation protective devices) that prevent the premises being energised. The power may come from the network side of the meter or from the Supplier side but before the ‘on/off contactor’. During a network power outage it is assumed that the LAN/WAN communication gateway at the meter will be without power.
even if meter battery capacity is available as battery capacity will be conserved for critical meter functionality.

Distribution Network Operators will then deduce that where multiple Smart Meters fail to respond to queries it indicates a network outage (or communications failure) requiring further investigation.

Where the Smart Metering System does respond it is indicative of network power being provided to the meter enabling either a redirection of the query to the Supplier (or Meter Operator) or further interrogation depending on DNO preference.

Querying the energisation status of multiple Smart Metering Systems that have been mapped onto a network connectivity model will enable faster fault location and awareness of the extent of the fault affected area.

This facility would be particularly beneficial to DNOs during adverse weather conditions (such as storms, heavy snow, flooding, lightning, etc.) where multiple faults can occur which DNOs may be unaware of (especially nested LV faults masked by upstream HV faults). The benefit of this method over outage alarms automatically generated by the Smart Meter System is that it prevents the risk of potentially many thousands of alarm messages swamping the communications network and DNO internal systems during adverse weather conditions. It also avoids the use of meter battery power and the cost of providing ‘last gasp’ capability.

**Business Benefits**

The DNO can use this information to determine the appropriate number of engineers required to be dispatched to the location to resolve the fault (if a site visit is required), thereby reducing the time taken to locate and repair the fault and so:

- Make more effective use of the DNO’s workforce, thereby reducing the cost to serve
- Improve fault identification and location times thus reducing outage durations and hence enhancing the customer experience
- Rapidly and proactively identifying outages affecting vulnerable customers (e.g. those reliant on artificial ventilators or dialysis machines)

---

<table>
<thead>
<tr>
<th>Actors</th>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Consumer                    | Secondary Organisation, or person, consuming or generating the electricity at the premises. The Consumer may also be the organisation or person contracted with the Supplier for the provision of energy.
Scenario 1 - False Outage Report

**Scenario Descriptions**

**Pre Conditions**

Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator.

There is an apparent power outage at the site of the Smart Metering System (which may be either on the network or customer side).

The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model.

**Post Conditions**

Distribution Network Operator has verified the nature of the reported outage.

**Trigger**

Distribution Network Operator wishes to verify a suspected outage.

**Basic Flow**

1. Consumer telephones Distribution Network Operator informing them that they are experiencing a power outage.
2. The Distribution Network Operator identifies the relevant meter(s) and sends an energisation status request message to the Smart Metering System.
3. The Smart Metering System receives and validates the message.
4. The Smart Metering System checks the power supply from the network and finds it is supplied.
5. The Smart Metering System sends a date and time stamped network power available message to the Distribution Network Operator.
6. The Distribution Network Operator requests the status of the contact / or switch that may be used under a Supplier’s contract to control supply.
7. The Smart Metering System reports the status of the switch.
8. The Distribution Network Operator receives the message and explains to the customer the nature of the supply problem – the network operator may offer advice that the customer would need to contact the Supplier or an electrical contractor.

**Alternative Flow**

3. At Basic Flow step 3
   3a1 The Smart Metering System rejects the message as invalid.
   3a2 The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp.
5. At Basic Flow step 5
   5a1 The Distribution Network Operator does not receive the message.
Scenario 2 – Confirmed network outage

Scenario Descriptions

Pre Conditions

Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator

The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model

The Distribution Network Operator has a system for identifying a population of Smart Metering Systems to query to check the energisation status in any given suspected fault affected area

Enhanced Distribution Network Operator systems to send, receive and analyse the query messages

Post Conditions

The Distribution Network Operator has information of outages from Customer calls, the Smart Metering Systems, or their own internal SCADA monitoring systems that they use to determine the extent and location of an unplanned power outage

Trigger

Distribution Network Operator suspects that an outage has occurred and wishes to confirm its extent

Basic Flow

1. The Distribution Network Operator knows / identifies which meter(s) are to be queried
2. The Distribution Network Operator sends an energisation status query message to the Smart Metering System
3. The Smart Metering System is not receiving power from the network so the communications system is not in operation
4. The Distribution Network Operator receives no confirmation that the message has been received by the Smart Metering System
5. After a defined period of time (based on the normal time a response is received in scenario 1 above) the Distribution Network Operator deduces that the Smart Metering System is either experiencing a network outage or a communications failure
6. The Distribution Network Operator queries the energisation status of further Smart Metering Systems to determine the extent of the network outages/communications failures
7. The Distribution Network Operator instigates their network fault management
Use Case 12 – notify consumer of unplanned outage

Notes and issues

The DNO should be able to send energisation status queries to 1,000 meters in 15 minutes for routine fault management, or 100,000 meters in 1 hour in the example of an extreme weather related event.

This Use Case makes the assumption that Consumers will continue to telephone the DNO in the event of a power outage rather than assume that post the Smart Meter roll out, the DNO will be automatically aware of power outages.

If DNOs wish to use this facility while Consumer’s are on the telephone with them then the response time from the Smart Metering System must be quick (seconds rather than minutes)

The process described here could also be used as an alternative to “use case 15 – verify restoration of supplies after outage”. It may be a cheaper alternative to a “network restored” message.

The process described also may be beneficial as it precludes the need for (and cost of) batteries / capacitors within the Smart Metering System or support last gasp outage alarms.

It is difficult for the DNO to differentiate between a genuine network outage and a communications failure at the Smart Metering System. It could be assumed that several Smart Metering Systems clustered in an area not responding is more likely to indicate a network outage than a widespread communications failure. The DNO would need to understand the topology of the communications infrastructure to assist in this decision making process.
6.5.3 Send alarm to DNO during network outage

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Detailed</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

Use Case Name: Send alarm to DNO during network outage

**Description**

**Business Need**

This use case describes how the Distribution Network Operators will use information from, and take actions through, the smart metering population, in identifying unplanned power outages.

Distribution Network Operators wish to know when and where unplanned power outages occur, and how many sites are affected. Analysis of the outage information will mean that the Distribution Network Operators are better placed to more accurately identify the location of the fault and hence dispatch adequate staff to restore customer supplies efficiently.

When Consumers currently experience a power outage they may telephone the Distribution Network Operator who then determines the relevant details about the outage from the caller. The effectiveness of this process relies on the number of customers that call and the time between the start of the outage and the customer’s call. Faults occurring at night and during the working day are often not reported by Customers resulting in the DNO having restricted information on which to make its initial assessment of the fault location.

The Smart Metering System will be configured to send a power outage alarm to DNOs that will enable them to more accurately assess which customers have lost power and quickly identify the likely location and extent of the outage. This facility would be particularly beneficial to DNOs in identifying LV faults (including open-circuit faults), HV faults on spurs protected by HV fuses / sectionalisers, and HV faults downstream of protective devices beyond auto-reclosers.

The Smart Metering System could also be configured to send a message to the In Home Display to inform the Consumer that an outage is in progress and an alarm has been sent to the Distribution Network Operator.

**Business Benefits**

The DNO will immediately be aware of a network fault, and the extent of the fault, enabling the correct action to be determined immediately. It will also avoid the despatch of the wrong type of operator due to an incorrect assessment as to the extent of the fault. The information will be used to determine the requisite number of staff to be
dispatched to the appropriate location to resolve the fault (if a site visit is required), thereby reducing the time taken to locate and repair the fault and so:

- Make more effective use of the DNO’s workforce, thereby reducing the cost to serve
- Avoid costs of abortive visits by inappropriate staff being unable to resolve the problem because the nature of the fault has not been correctly established before they are dispatched
- Improve fault identification and location times thus reducing outage durations and hence enhancing the customer experience
- Rapidly and proactively identifying outages affecting vulnerable customers (e.g. those reliant on artificial ventilators or dialysis machines)
- DNOs are rapidly informed of outages – often before the Consumer notices
- Unlike in Use Case 13 the DNO is sure that an outage is occurring rather than it potentially being a communications failure.

There is an assumption that the Smart Metering System will only send an outage alarm when it detects a loss of power on the network side of the meter. This will prevent the meter from sending outage alarms when pre-payment customers run out of emergency credit, for Supplier instigated disconnections or for meter failures.

The alarms from the Smart Meter System will need to be delayed so as not to send alarms for loss of supplies that are restored automatically by equipment (auto reclosers) on the DNO network.

The DNO will need to develop systems outside the Smart Metering System to manage the potential high alarm volumes under fault conditions.

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Distribution Network Operator</td>
</tr>
<tr>
<td>Consumer</td>
</tr>
</tbody>
</table>

Scenario Descriptions
Pre Conditions
Smart Metering System is installed and configured to send outage alarms to the
### Distribution Network Operator

The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position this Smart Meter on a network connectivity model.

Each Smart Metering System is configured to send an outage alarm when it detects a loss of power from the network.

The comms element of the Smart Metering System retains sufficient power to send and receive messages during a power outage.

Enhancements to Distribution Network Operator systems and processes to identify the location of the fault and send suitably equipped/qualified technicians.

### Post Conditions

The Distribution Network Operator has information of outages from the Smart Metering Systems that they may use to determine the extent and location of an unplanned power outage.

The Distribution Network Operator is aware when a failure has occurred.

### Trigger

A network outage occurs.

### Basic Flow

1. The Smart Metering System detects a loss of power from the network and sends a date and time stamped outage alarm to the Distribution Network Operator.

2. The Distribution Network Operator receives the message.

3. The flow is repeated by other meters in the outage affected area.

### Alternative Flow

1. At Basic Flow step 1

   1a1 A Smart Metering System is unable to send the outage alarm message, e.g. due to insufficient battery power remaining – however it is assumed that at least one Smart Metering System in the affected area will succeed in sending the outage message, or a Consumer will ring the Distribution Network Operator to notify of the outage.

   1a2 The flow is continued by other meters in the outage affected area.

1. At alternative flow step 1a1

   1a1a Distribution Network Operator receives neither an outage alarm nor a telephone call from a Consumer informing them of an outage.

   1a1b Through monitoring their network Distribution Network Operator detects conditions suggesting an outage has occurred.

   1a1c Go to Use Case 13.
Use Case 13 – query meter energisation status to determine outage source and location

Notes and issues

When a meter has a power outage there are a number of functions that need to continue to run via the internal battery. Transmitting the outage notification may present challenges to that battery power and hence increase the costs of the Smart Metering System.

A potential risk to the usefulness of outage alarms may be that the volume of them sent during a significant outage (such as a storm or other extreme weather condition) could swamp the communications network. DNOs currently have SCADA systems that manage an avalanche of alarms by grouping and interpreting alarms in such a scenario. It is envisaged that a similar system would be incorporated into a centralised communications service.

A cut down version of this use case where the outage alarm is only configured for vulnerably customers, e.g. those using dialysis equipment, could be used.

### 6.5.4 Verify restoration of supplies after outage

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify restoration of supplies after outage</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

### Description

**Business Need**

This use case describes how the Distribution Network Operators will use information from the smart metering population to verify power supply restoration using Smart Metering Systems.

Once a Smart Metering System detects power has been restored at the network side of the meter it will send a power restored message to the DNO. DNOs can use the receipt of these messages to monitor the efficacy of their fault repair work and identify previously unknown network faults that were being masked by known ones. Fault masking is common during extreme weather conditions where multiple faults can occur on the network.

DNO engineers on site would be able to receive restored power reports sent from the Smart Metering Systems using hand held devices and use this information to be assured they have restored supplies to all Customers affected by the fault or to identify further
fault locations to redeploy to. This will lead to better directed, more efficient, and more assured treatment of outages as the engineers are made aware of additional faults whilst “on site”.

Operatives can be more effectively deployed and they can be assured when a restoration job has been completed hence leave site with confidence that the faults they have resolved have restored power to customers as they expect.

In certain outage situations DNOs may be able to re-route power through a neighbouring LV feeder to restore supply to some premises. The power restored message would then inform the DNO how many premises have been restored and how many require further action.

This will require DNO systems to be able to receive and process messages from multiple Smart Metering Systems (unless the messages are aggregated by a central communications service provider) within short timescales (e.g. within 5 minutes).

**Business Benefits**

- Allows identification and resolution of fault masking
- Reducing outage durations, thereby enhancing the customer experience
- Positive confirmation of supply restoration, enhancing the customer experience
- Better management of Customer Interruption (CI) and Duration (Customer Minutes Lost (CML)) performance through earlier identification of masked faults
- Reduce exposure to Guaranteed Standards of Performance failures (e.g. supply restoration exceeding 18 hrs)
- Reduced cost to serve through more efficient usage and deployment of field staff
- Enhanced customer experience as DNOs will be confident that supplies have been restored without disturbing customers

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Distribution Network Operator</td>
</tr>
</tbody>
</table>

**Scenario Descriptions**

**Pre Conditions**

Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator

An outage has occurred and has been noted by the Distribution Network Operator

Smart Metering System is configured to record the date and time of a power outage (i.e. date and time of loss of supply)
Smart Metering System is configured to send a date and time stamped power restored message when it detects restoration of power.

The Distribution Network Operator’s system maintains information relating to the location of the Smart Meter and can position it on a network connectivity model.

Enhancements to Distribution Network Operator systems and processes to initiate, receive and analyse restoration reports and send summary output to operatives on site.

### Post Conditions
- Distribution Network Operator has verified power restoration
- Distribution Network Operator has identified faulty Smart Metering Systems

### Trigger
Restoration activities have taken place

### Basic Flow
**Note this flow will occur for each Smart Metering System as power is restored**

1. The Smart Metering System detects restoration of power supplied from the network
2. The Smart Metering System sends a date and time stamped power restored message to the Distribution Network Operator
3. The Distribution Network Operator receives the message

### Alternative Flow
1. At Basic Flow step 1
   1a1 Although power has been restored to the premises due to an internal fault the Smart Metering System fails to detect this
   1a2 The Distribution Network Operator will receive power restored messages from Smart Metering Systems connected to the part of the network affected by the fault
   1a3 The Distribution Network Operator will send an operative to the site to determine whether power has been restored or whether the meter is faulty. The operative will deal with any network fault if the smart metering system is not faulty.
   1a4 On identifying that the Smart Metering System is faulty the Distribution Network Operator will initiate their faulty meter detected procedure

3. At Basic Flow step 3
   3a1 The Distribution Network Operator does not receive the message
   3a2 The Distribution Network Operator is aware a failure has occurred
   3a3 Go to alternative flow step 1a3 above

### Additional Information
Related Information

Notes and issues

Would DNOs want a power restoration message to be initiated automatically as power is restored or at DNO request?

DNOs systems will need to aggregate the power restored messages by circuit and compare against meter location to identify meters for which they have not received a power restored message. An exception report will then be provided to restoration engineers to determine follow up actions.

6.5.5 Regulatory reporting of outages

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Detailed</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

Use Case Name: Regulatory Reporting of Outages

Description

Business Need

Distribution Network Operators have licence obligations requiring them to report to Ofgem interruptions in the supply of electricity to customers. The ability of Smart Metering Systems to provide Distribution Network Operators with date and time stamped outage information would significantly improve the quality, accuracy and audit ability of outage information. Distribution Network Operators have a requirement to be able to retrieve stored outage and restoration information from the Smart Metering Systems (data stored by the Smart Meter and made available to the DNO within three months’ worth would be sufficient for DNOs to extract the information and capture it within their own reporting systems).

Business Benefit

With this information stored within the Smart Metering System, Distribution Network Operators can retrieve it whenever they need to create a report or conduct analysis of network quality of supply performance, e.g. the number of interruptions, customer minutes lost, Guaranteed Standard of Service failures, etc.

The information could also ultimately be used to set up an automated payment system to automatically deliver Guaranteed Standard of Service payments to eligible Consumers. However, to be fully effective this will require phase connectivity of each Smart Meter to...
be identified, either during installation or as an inherent facility provided by the LAN (for example PLC would enable Smart Meter phase connectivity to be positively identified at the Data Concentrator).

It will also enable Distribution Network Operators to analyse the time it takes to resolve outages and develop strategies to improve their performance.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
</tbody>
</table>

Note that this scenario requires a virtually complete roll out of Smart Meters to be effective

### Scenario Descriptions

**Pre Conditions**
- Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator
- Smart Metering Systems are configured to store date and time stamped power outage and restoration messages
- Enhancements to Distribution Network Operator systems and processes to initiate, receive and process outage reports and make Guaranteed Standards of Service payments

**Post Conditions**
- Distribution Network Operators have gathered the required outage information from Smart Metering Systems

**Trigger**
The Distribution Network Operator has a requirement to extract outage failure information from the Smart Metering System

**Basic Flow**

Note this process is replicated for all Smart Metering Systems within a Distribution Network area

1. The Distribution Network Operator sends a message to the Smart Metering System requesting stored outage information
2. The Smart Metering System receives the message and validates it
3. The Smart Metering System extracts the required information from internal storage, packages it, and sends it to the Distribution Network Operator
4. The Distribution Network Operator receives the information and loads it into its systems
5. The Distribution Network Operator analyses the information and compares it to
its own outage records to build a complete picture of outage incidents and periods of supply interruption

### Alternative Flow

2. At Basic Flow step 2
   - 2a1 The Smart Metering System rejects the message as invalid
   - 2a2 The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp
   - 2a3 The Distribution Network Operator receives the message and takes the required steps to resolve the error
   - 2a4 Once error is resolved go back to Basic Flow step 1

3. At Basic Flow step 3
   - 3a1 The Smart Metering System does not have any of the requested information stored
   - 3a2 The Smart Metering System sends a message to the Distribution Network Operator stating “no records found” (or similar)
   - 3a3 Distribution Network Operator receives the message and loads it into its systems
   - 3a4 End of flow

4. At Basic Flow step 4
   - 4a1 The Distribution Network Operator does not receive the information from the Smart Metering System
   - 4a2 The Distribution Network Operator performs a communication test with the Smart Metering System
   - 4a3 The communication test fails indicating a problem with the Smart Metering System
   - 4a4 The Distribution Network Operator informs the Smart Metering System owner of the fault with the Smart Metering System
   - 4a5 End of flow

### Additional Information

**Related Information**

Although some of this use could be fulfilled as a by-product of Use Cases 13-15 this requirement highlights the need for a complete set of information to be used for reporting and analysis which may not be completely satisfied by Use Cases 13-15

**Notes and issues**

The information may be retrieved periodically to match reporting requirements, or configured to be sent automatically according to a configurable schedule. This will avoid overly burdening the meter with expensive storage
## 6.5.6 Restore and maintain supply during outages

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Detailed</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

### Use Case Name
Restore and maintain supply during outages

### Description

**Business Need**

In the envisaged future scenario where it is anticipated that networks will be operated to much higher levels of utilisation using a ‘smart’ control paradigm in order to avoid extensive reinforcement to cope with increased demand from electric vehicles and heat pumps, it will be important to develop a capability to assess real-time capacity headroom. This will be required to ensure that both thermal ratings of equipment are not exceeded in system intact conditions and also in system depleted conditions during planned and unplanned network outage conditions.

Under network planned or unplanned network outage conditions the capability of the network to meet customer requirements is depleted. The extent and materiality of the depletion will depend on several factors including:

- The assets affected by the outage
- Their location on the network
- The time of year of the outage
- The duration of the outage
- The expected demand and generation that would normally be supplied via the affected assets
- The expected demand and generation on those assets used to restore supplies

A better understanding of the capability of the assets unaffected at the time of the outage, and the expected load on those assets, will enable the DNO to make a more informed decision as to whether there is sufficient network capacity to maintain supplies during a planned outage (by pre-outage transfer), or to restore supplies by rerouting (in the case of an unplanned outage) and that the ERP2/6 requirements for redundant capacity available under network depleted conditions are satisfied.

Better planning timescale information provided by Use Case 01 and real time information provided by Use Case 06 will enable the DNO to model the capability of healthy parts of the network to carry additional (better defined and understood) load at the time of the outage thus maximising the number of customers who’s supply can be maintained under a planned outage scenario or restored under an unplanned outage scenario.
If the additional information available confirmed that the DNO was unable to maintain/restore supplies to all customers, Active Network Management of DNO owned assets and Demand Side Management (DSM), as described in Use Cases 07-10 will provide the opportunity for the DNO to further increase the number of customers whose supply can be maintained under a planned outage scenario or restored under an unplanned outage scenario. An example of this would be to limit the load that could be drawn by customers on the healthy part of the network so as to be able to restore partial supplies to customers directly affected by the fault, i.e. equitably sharing the capacity of the depleted network.

This capability will also be beneficial in refining emergency load reduction / disconnection arrangements (i.e. due to unexpected shortfalls in generation or transmission capacity) in that the need for (or extent of) rota disconnections might be reduced if real-time capacity is better understood and selective disconnection of non-essential demand (rather than total disconnection) can be initiated.

**Business Benefit**

- Fewer customers affected by planned outages
- Improved restoration times for customers affected by unplanned outages
- Improved customer experience
- Improved overall quality of supply performance
- More refined emergency load reduction / disconnection functionality

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Distribution Network Operator</td>
</tr>
</tbody>
</table>

**Note:** The system intact scenario that may be used to limit demand on the neighbouring circuits unaffected by the outage is described in Use Case 09

**Scenario Descriptions**

**Pre Conditions**

- A Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator
- The Distribution Network Operator is aware of the location of the Smart Meter and can position it on a network connectivity model
- The Distribution Network Operator has a contract with the Consumer including the operation of maximum thresholds for power use
- The Smart Metering System is configured to record and send real-time data to the Distribution Network Operator
- A network fault affecting supplies has occurred
The Distribution Network Operator has determined that power can be re-routed through alternative supply circuits

<table>
<thead>
<tr>
<th>Post Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A limited continuous supply of power is provided to the outage affected area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Distribution Network Operator has re-routed power through alternative supply circuits to restore supply</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note this flow is repeated for all Smart Metering Systems in the outage affected area</td>
</tr>
<tr>
<td>1. Power is restored to the Smart Metering System</td>
</tr>
<tr>
<td>2. The Smart Metering System sends a date and time stamped power restored message to the Distribution Network Operator</td>
</tr>
<tr>
<td>3. The Distribution Network Operator receives the message and sends a message to the Smart Metering System activating the maximum power consumption threshold</td>
</tr>
<tr>
<td>4. The Smart Metering System receives the message and validates it</td>
</tr>
<tr>
<td>5. The Smart Metering System activates the maximum power consumption threshold and sends a confirmation response to the Distribution Network Operator</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. At Basic Flow step 3:</td>
</tr>
<tr>
<td>3a1 The Distribution Network Operator does not receive the power restored message</td>
</tr>
<tr>
<td>3a2 The Distribution Network Operator checks that the Smart Metering System is configured and working correctly, and that communications are working</td>
</tr>
<tr>
<td>3a3 The Distribution Network Operator is aware that power has been restored so sends a message to the Smart Metering System activating the maximum power consumption threshold</td>
</tr>
<tr>
<td>3a4 Back to Basic Flow step 4</td>
</tr>
<tr>
<td>4. At Basic Flow step 4:</td>
</tr>
<tr>
<td>4a1 The Smart Metering System deems the request invalid</td>
</tr>
<tr>
<td>4a2 The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp</td>
</tr>
<tr>
<td>4a3 The Distribution Network Operator takes the required steps to resolve the error</td>
</tr>
<tr>
<td>4a4 Back to Basic Flow step 3</td>
</tr>
<tr>
<td>5. At Basic Flow step 5:</td>
</tr>
<tr>
<td>5a1 The Distribution Network Operator does not receive the confirmation response</td>
</tr>
<tr>
<td>5a2 The Distribution Network Operator checks that the Smart Metering System is</td>
</tr>
</tbody>
</table>
configured and working correctly, and that communications are working

5a3 The Distribution Network Operator sends a message to the Smart Metering System checking whether the maximum power consumption threshold has been activated

5a4 End of flow

### Additional Information

**Related Information**

Scenario 3 in Use Case 09 describes how the maximum power consumption threshold works

**Notes and issues**

The maximum power consumption threshold may need to be activated at the Smart Metering Systems on the alternative supply circuits to ensure sufficient capacity is available.

### 6.6 Manage safety issues

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>MSI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Electricity</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Use Case Name**

Manage safety issues

**Description**

Smart Metering functionality will enable the meter to detect changing conditions at the meter that may present safety concerns, such as extremes in voltage, meter tampering, etc. On detection of these conditions the meter will produce an alarm to send to the relevant party, including Distribution Network Operators, and potentially automatically disconnect from the network.

This increases the safety of the end user and the speed with which the situation is identified and resolved.
6.6.1 Manage meter safety alarm

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Electricity</td>
</tr>
</tbody>
</table>

| Use Case Name | Manage meter safety alarm |

**Description**

**Business Need**

Distribution Network Operators will benefit from Smart Metering Systems being able to detect tampering and identify unsafe conditions. The distribution losses incentive imposed on Distribution Network Operators by Ofgem provides financial incentives to reduce losses. As theft forms a potentially significant part of non-technical losses any functionality within the Smart Metering System that reduces theft will have a potentially positive effect on their reported distribution losses insofar as Suppliers will then be able to enter those currently unbilled units into the settlements system.

Distribution Network Operators are currently required to attend premises where the electricity supply conditions before the meter present a potential danger to life. Smart Metering System functionality that identifies early signs of meter tampering or distress to the equipment at the service termination will reduce the safety related risks to Distribution Network Operators, Suppliers, Meter Operators and Customers.

The Smart Metering System will include diagnostic functionality to detect tampering (including for example terminal cover removal).

The Smart Metering System will detect other unsafe conditions at the meter, such as crossed polarity and thermal distress. Different conditions will result in different messages, the exact recipients of which have yet to be determined. It is reasonable to assume that conditions that require intervention by the Distribution Network Operator will
necessitate relevant messages being sent by the Smart Metering System to them.

Conditions that may be detected include:

- That the terminal cover has been removed
- That the contact/switch has been bridged
- Interruption to the neutral supply of the meter
- Detection of crossed polarity at the meter
- The presence of a magnetic field stronger than 200 mT
- The detection of excessive heat (parameters to be determined)

Detection of such conditions will result in messages being sent to the DNO, Supplier, Meter Operator or other stakeholder as appropriate.

On the detection of certain conditions the Distribution Network Operator may wish to configure the Smart Metering System to automatically disconnect. An example of this would be the detection of crossed-polarity at the meter.

**Business Benefit**

- Reduced non-technical losses
- Enhanced safety at the customers premises
- Reduce DNO call-outs to attend premises due to dangerous conditions
- Automatic cut-off on detection of dangerous conditions prevents risk to Consumers

### Actors

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity to the premises.</td>
</tr>
<tr>
<td>Interference Responsible Entity</td>
<td>Secondary</td>
<td>A party that attempts to interfere with and/or defraud the Metering System and/or illegally abstract energy at the point of supply.</td>
</tr>
</tbody>
</table>

### Scenario Descriptions

**Pre Conditions**

- Smart Metering Systems are installed and configured to receive and respond to messages from the Distribution Network Operator
- Smart Metering Systems have an accurate internal clock and calendar
- Smart Metering Systems are configured to send alarm messages to relevant authorised market participants
Smart Metering Systems are configured to know which alarms to send to Distribution Network Operators

The Distribution Network Operator is authorised to remotely activate the cut-off switch

### Post Conditions

Distribution Network Operator is aware of conditions at the Smart Metering System requiring DNO intervention

### Trigger

Conditions at the Smart Metering System change to be unsafe/require DNO intervention

### Basic Flow

**Note** – although the Smart Metering System will issue alarms to other participants this flow only concentrates on the conditions that will result in alarms being sent to Distribution Network Operators

1. Interference Responsible Entity changes conditions at the Smart Metering System to render it unsafe and requiring Distribution Network Operator intervention
2. The Smart Metering System detects the change in condition and sends a date and time stamped alarm to the Distribution Network Operator
3. The Distribution Network Operator receives the alarm and analyses the content
4. The Distribution Network Operator dispatches a crew to investigate the conditions at the meter
5. If the Distribution Network Operator deems the conditions to be dangerous enough they will send a message to the Smart Metering System supply switch to remotely disconnect the meter until an on-site investigation has been undertaken by skilled DNO staff
6. The Smart Metering System receives the disconnect message and validates it
7. The Smart Metering System activates the supply switch and sends a date and time stamped confirmation message to the Distribution Network Operator
8. The Distribution Network Operator receives the message and updates their system in case an outage query is received

### Alternative Flow

2. At Basic Flow step 2
   
   2a1 The Smart Metering System fails to detect the change in conditions
   2a2 The Distribution Network Operator is unaware of the change in conditions at the meter
   2a3 The change in conditions is detected during the next routine meter inspection
   2a4 The Supplier informs the DNO of any DNO required intervention
   2a5 Flow ends

3. At Basic Flow step 3
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3a1</strong></td>
<td>The Distribution Network Operator fails to receive the alarm from the Smart Metering System</td>
</tr>
<tr>
<td><strong>3a2</strong></td>
<td>Go to alternative flow step 2 above</td>
</tr>
</tbody>
</table>

### 6. At Basic Flow step 6

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6a1</strong></td>
<td>The Smart Metering System rejects the message as invalid</td>
</tr>
<tr>
<td><strong>6a2</strong></td>
<td>The Smart Metering System sends notification to the Distribution Network Operator detailing error type along with date/time stamp</td>
</tr>
<tr>
<td><strong>6a3</strong></td>
<td>The Distribution Network Operator receives the message and takes the required steps to resolve the error</td>
</tr>
<tr>
<td><strong>6a4</strong></td>
<td>Once error is resolved go back to Basic Flow step 5</td>
</tr>
</tbody>
</table>

### 8. At Basic Flow step 8

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8a1</strong></td>
<td>The Distribution Network Operator does not receive confirmation of the supply switch activating to cut-off supply</td>
</tr>
<tr>
<td><strong>8a2</strong></td>
<td>The Distribution Network Operator informs the dispatched crew that the Smart Metering System may not have been disconnected so to test on arrival</td>
</tr>
<tr>
<td><strong>8a3</strong></td>
<td>Flow ends</td>
</tr>
</tbody>
</table>

### Additional Information

### Related Information

### Notes and issues

The actual process and the various parties that are notified of the various alarms are yet to be confirmed.

The Smart Metering System will maintain a register of alarm types that should be sent to the DNO (as well as others that will sent to other parties).
### 6.6.2 Manage extreme voltage at meter

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Role</td>
<td>Electricity</td>
</tr>
<tr>
<td></td>
<td>Use Case Name</td>
<td>Manage extreme voltage at meter</td>
</tr>
</tbody>
</table>

#### Description

**Business Need**

Some network faults, e.g. open-circuit neutral conductor faults and failures of automatic voltage control equipment, can result in potentially damaging extremes of voltage (either high or low) at the service termination. These extremes of voltage could damage equipment within, or attached to, the premises, or in extreme circumstances, give rise to a fire hazard.

To guard against this, there is the opportunity to incorporate a safety feature within the Smart Metering System to monitor voltage levels at the meter and send an alarm to the Distribution Network Operator when specified tolerances are breached – either above or below the configurable voltage levels. The alarm message to the Distribution Network Operator will alert them to the requirement to investigate and resolve the cause of the extreme in voltage.

Alternatively (or additionally) at the discretion of the DNO, the extreme voltage event will cause the smart meter to automatically isolate the supply via its integral cut-off switch thereby immediately removing the risk of damage to the consumer’s appliances.

**Business Benefit**

- Automatic DNO notification of extremes of voltage
- Auto-disconnection to make safe at meter
- Reduced safety related risk to Consumer and premises
- Potentially reduced claims for damage to appliances
- Avoided bad publicity associated with damage to appliances

#### Actors

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides electricity</td>
</tr>
</tbody>
</table>
### Scenario Descriptions

#### Pre Conditions
- Smart Metering System is installed and configured to receive and respond to messages from the Distribution Network Operator
- Smart Metering System is fitted with a configurable and controllable cut-off switch to enable auto-disconnection
- The Distribution Network Operator has configured the high and low voltage tolerance levels within the Smart Metering System

#### Post Conditions
- Distribution Network Operator is aware of the dangerous extreme voltage level at the Smart Metering System and whether the Smart Metering System has auto-disconnected

#### Trigger
- A change in network conditions, e.g. neutral cable fault, create a dangerous extreme voltage level at the Smart Metering System

#### Basic Flow
1. The Smart Metering System detects a voltage level outside its configured tolerance levels
2. The Smart Metering System sends a date and time stamped extreme voltage level alarm detailing the voltage level detected to the Distribution Network Operator
3. (Optionally) the Smart Metering System auto-disconnects itself from the network supply of electricity sending confirmation of disconnection to the Distribution Network Operator
4. The Distribution Network Operator receives the extreme voltage level alarm and uses the information to determine the corrective action to be taken to resolve the extreme voltage level
5. The Distribution Network Operator receives the confirmation of disconnection due to extreme voltage detected and loads it into its systems to use for any outage queries

#### Alternative Flow
1. At Basic Flow step 1
   1a1 The Smart Metering System fails to detect the extreme voltage level
   1a2 The extreme voltage level impairs equipment within/attached to the premises
   1a3 The Consumer contacts the Distribution Network Operator to complain
   1a4 The Distribution Network Operator investigates the cause of the extreme voltage and compensates the Consumer (where appropriate)
2. At Basic Flow step 2

2a1 The Smart Metering System fails to send the extreme voltage alarm
2a2 The Distribution Network Operator receives the confirmation of auto-disconnection due to extreme voltage but no alarm
2a3 The Distribution Network Operator dispatches a crew to investigate the conditions on site and determine the corrective action required
2a4 End of flow

3. At Basic Flow step 3

3a1 The Smart Metering System fails to auto-disconnect
3a2 The Smart Metering System sends a date and time stamped extreme voltage level alarm detailing the voltage level detected to the Distribution Network Operator
3a3 The Distribution Network Operator receives the extreme voltage alarm but no confirmation of auto-disconnection
3a4 The Distribution Network Operator uses the information from the voltage alarm to determine the corrective action required to resolve the extreme voltage level
3a5 End of flow

2. At Basic Flow step 2 & 3

2b1 or 3b1 The Smart Metering System fails to auto-disconnect or send the extreme voltage alarm
2b2 or 3b2 Go to step 2a1 of the first alternative flow
6.7 Support network activities

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Role</td>
<td>Electricity</td>
</tr>
<tr>
<td></td>
<td>Use Case Name</td>
<td>Support network activities</td>
</tr>
</tbody>
</table>

**Description**

It will be necessary to configure Smart Metering Systems to set meters to perform functions according to parameters or cease to perform functions.

This use case describes how Smart Metering Systems may be configured in this way – this use case enables the other Networks’ use cases to take place.

*Figure 9 - Support network activities Use Case diagram*
6.7.1 Configure Smart Metering System

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td>Electricity</td>
</tr>
</tbody>
</table>

Use Case Name: Configure Smart Metering System

Description

**Business Need**

The set of functions and calculations that will be enabled at the initial installation of the Smart Metering System are to be defined, however there is a requirement that Distribution Network Operators (DNOs) will need to change those configurations over the life of the meter. Examples of potential changes that might need to be made are:

- Initiating functionality to gather network planning data (assuming it is not configured on, or before, installation)
  - Half-hourly real and reactive import and export power flow
  - Half-hourly real and reactive generation power flow data
  - Half-hourly voltage data
- Initiating / disabling functionality to transmit data
- Introduction of new DNO tariff structures, such as Time of Use and Critical Peak Price use of system charges (which should be reflected in the Suppliers tariff prices)
- Amendments to parameters for alarms and corrective actions, such as trigger levels for high/low voltage alarms and automatic load disconnection
- Synchronisation of the meter’s internal clock to ensure accurate time stamping of information, such as load profile data and outage duration.

**Business Benefit**

- Enables other described use cases to occur

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Network</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides</td>
</tr>
</tbody>
</table>
### Scenario Descriptions

**Pre Conditions**

Smart Metering System is operational, or ready to be operational

**Post Conditions**

Smart Metering Systems are configured to deliver Distribution Network Operator functionality

**Trigger**

Distribution Network Operator has a requirement to change Smart Metering System functionality

**Basic Flow**

Note – this use case is carried out for each Smart Metering System

1. The Distribution Network Operator sends a message to configure the Smart Metering System to perform (or cease performing) a set functionality according to supplied parameters
2. The Smart Metering System receives the message and validates it
3. The Smart Metering System activates the requested functionality and sends a date and time stamped confirmation response to the Distribution Network Operator
4. The Distribution Network Operator receives the confirmation response

**Alternative Flow**

3. At Basic Flow step 3
   3a1 The Smart Metering System rejects the message as invalid
   3a2 The Smart Metering System sends a date and time stamped notification to the Distribution Network Operator detailing the error type
   3a3 The Distribution Network Operator receives the message and takes the required steps to resolve the error
   3a4 Once error is resolved go back to Basic Flow step 1

4. At Basic Flow step 4
   4a1 The Distribution Network Operator does not receive a confirmation response
   4a2 The Distribution Network Operator checks the current configuration of the Smart Metering System and takes steps to ensure that it is working properly
   4a3 Back to Basic Flow step 1
## Notes and issues

It is expected that most configuration would be carried out remotely, this does not preclude that configuration may be carried out locally.
7 Gas Use Cases

This section contains the output from our discussions with the gas ENA members on their uses of gas smart metering functionality.

7.1 Use Case Actors

Each Use Case refers to participants who are referred to as ‘Actors’. The ‘Actors’ referenced in the Detailed Use Cases are described in Figure 4 - Use Case Actors and descriptions Figure 10 below.

**Figure 10 - Gas Use Case Actors**

<table>
<thead>
<tr>
<th>Actor Name</th>
<th>Actor Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Distribution Network Operator</td>
<td>Organisation responsible for managing the distribution network that provides gas to the premises.</td>
</tr>
<tr>
<td>Competent Person</td>
<td>An individual, either a Consumer, Network employee, or other individual deemed competent (by the Supplier) to identify when it is safe to restart a gas supply after interruption</td>
</tr>
<tr>
<td>Consumer</td>
<td>Organisation, or person, consuming the gas at the premises. The Consumer may also be the organisation, or person, contracted with the Supplier for the provision of gas.</td>
</tr>
</tbody>
</table>

7.2 Gas network activities

The primary use Gas Network Operators will make of smart metering data is to supplement existing planning data taken from Industry Design Standards and very limited data loggers installed at sample sites. The increase in data will allow for more detailed modelling of networks. The meter also provides the opportunity for the Gas Network Operators to communicate directly with end users; and if a robust valve is included within the meter, to potentially improve the safe operation of the network during gas emergencies by enabling remote disablement of supply.

The following diagram provides a summary of the gas Use Cases and the actors interacting with the system.
### 7.2.1 Gather information for planning

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Gas</td>
</tr>
<tr>
<td>Use Case Name</td>
<td>Gather information for planning</td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

Gas Distribution Network Operators currently use Standard Industry Planning algorithms to design and evaluate capacity within the Networks. This is supplemented by populations of data loggers attached to specific points within the pipe system to gather data used for a number of purposes\(^3\) including planning of the network infrastructure and for the development of data for estimation and demand modelling.

\(^3\) One of those purposes is to measure pre-regulator pressure, if the smart metering system cannot do this and the data loggers are no longer used an alternative method to measure the pressure will be required.
Smart meters could be configured to provide demand data measurements to Gas Distribution Network Operators. This can allow the Gas Distribution Network Operators to allow for the development of consumer type and geographically specific algorithms using larger or more targeted samples – leading to more accurate or representative data and hence better output from models.

The demand data recorded, the interval of the data, and delivery of data would be configured remotely by the Gas Distribution Network Operators. The data may be required over a yearly, monthly or daily frequency dependent on the specific network requirement or the optimum method of providing the data. For example, the Network Operators may only want data from specific Smart Metering Systems during defined winter and summer months, or during specific times of the day, such as morning and evening peaks, or minimum consumption over night. Once the period of Network use finishes the meters would be configured to cease providing this data. Over the life of the meter it is expected that it will be configured to collect network planning data on multiple occasions.

The data can be used for planning network infrastructure such as assessing capacity for new connections or whether a local network can cope with the input of gas (such as biogas, coal-bed methane and Liquid Natural Gas) during periods of low demand. This will inform investment decisions and allow more efficient use of the network, including the potential to avoid networks being over engineered for capacity. Additionally, the smaller pipes will result in lower pressure needed to move the gas and so reduce system leakage that Gas Distribution Network Owners are incentivised over.

**Business Benefit**

- Improved Optimisation of Network
- Better data will lead to better modelling which will lead to better investments resulting in more efficient investment and greater security of supply
- Remove cost involved in identifying and establishing specific demand sites and obtaining and recording demand data

<table>
<thead>
<tr>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Gas Distribution Network Operator</td>
</tr>
</tbody>
</table>

**Scenario Descriptions**

**Pre Conditions**

- Smart Metering Systems are installed at premises and configured to receive and respond to messages from the Gas Distribution Network Operator
- The Smart Metering System has been configured by the Gas Distribution Network Operator to measure gas demand at the required level of granularity
Post Conditions
The Gas Distribution Network Operator has received the gas demand data

Trigger
The Smart Metering System detects the pre-determined time has arrived to send the collected data

Basic Flow

1. The Smart Metering System sends the recorded gas demand data to the Gas Distribution Network Operator
2. The Gas Distribution Network Operator receives the data and loads it into their system

Alternative Flow

2. At Basic Flow step 2
   2a1 The Gas Distribution Network Operator does not receive the correct data or it is corrupt.
   2a2 Back to Basic Flow step 1

Additional Information

Related Information
This use case is linked to 02_configure smart metering system which describes that the Smart Metering System must be able to be remotely configured to activate and deactivate functionality.

Notes and issues
Although it is presumed that signals from the GDNO will pass through a Central Communications Provider to reach the Smart Metering Signal this is not mentioned within the use cases.

The level of granularity required, the number of meters involved in samples, the targeting and period of sampling will be determined based on cost benefit analysis. The functionality would need to be included so that the Smart Metering System can be configured to record at whatever interval the GDNO requires.

Current gas industry processes concentrate on creating views of the annual consumption and peak daily demand for gas consumers, and then profiling them into a daily value for use in the allocation of daily balanced volumes. The availability of detailed demand data for every meter point on the network could lead to a complete overhaul of this process, or more accurate data items to feed into the existing process leading to a more representative allocation of costs.

Note, the data required does not need to be sent as recorded and can be stored and sent by the meter at the most economic intervals based on data storage and transmission constraints.
7.2.2 Configure gas smart metering system

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configure Gas Smart Metering System</td>
<td></td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

The set of functions and calculations that will be enabled at installation are to be defined, however there is a requirement that Gas Distribution Network Operators will need to change those configurations over the life of the meter. Examples of potential changes that might need to be made are:

- Initiating functionality to gather network planning data
- Initiating data capture interval (6 min; half hour, etc) and delivery period (daily; weekly)

**Business Benefit**

- Ability to update Smart Metering System with different parameters to meet future requirements and supports the provision of data under Use Case 01.

A non direct benefit is that this is the enabler that allows the other benefits to be achieved.

**Actors**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides gas to the premises.</td>
</tr>
</tbody>
</table>

**Scenario Descriptions**

**Pre Conditions**

Smart Metering System is operational, or ready to be operational

**Post Conditions**

Smart Metering Systems are configured to deliver Gas Distribution Network Operator
**ENA Smart Metering System Use Cases – ENA authorised parties only**

**functionality**

**Trigger**

Gas Distribution Network Operator has a requirement to initiate Smart Metering System functionality

**Basic Flow**

Note – this use case is carried out for each Smart Metering System

1. The Gas Distribution Network Operator sends a message to configure the Smart Metering System to perform (or cease performing) a set functionality according to supplied parameters

2. The Smart Metering System receives the message and validates it

3. The Smart Metering System activates/updates the requested functionality and sends a date and time stamped confirmation response to the Gas Distribution Network Operator

4. The Gas Distribution Network Operator receives the confirmation response

**Alternative Flow**

3. At Basic Flow step 3

   3a1 The Smart Metering System rejects the message as invalid

   3a2 The Smart Metering System sends a date and time stamped notification to the Distribution Network Operator detailing the error type

   3a3 The Distribution Network Operator receives the message and takes the required steps to resolve the error

   3a4 Once error is resolved go back to Basic Flow step 1

4. At Basic Flow step 4

   4a1 The Distribution Network Operator does not receive a confirmation response

   4a2 The Distribution Network Operator checks the current configuration of the Smart Metering System and takes steps to ensure that it is working properly

   4a3 Back to Basic Flow step 1

**Additional Information**

**Related Information**

**Notes and issues**

It is expected that most configuration would be carried out remotely, this does not preclude that configuration may be carried out locally.
### 7.2.3 Disable supply of gas by GDN

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Detailed</td>
</tr>
<tr>
<td>Role</td>
<td>Gas</td>
</tr>
<tr>
<td>Use Case Name</td>
<td>Disable supply of gas by GDN</td>
</tr>
</tbody>
</table>

#### Description

**Business Need**

This Use Case is on the assumption that the gas smart meter incorporates a valve within the final meter functional specification.

A use could be made of the gas valve by a Gas Distribution Network to prevent gas being offtaken from the network in the following circumstances;

- Temporary isolation - following public reported emergency, such as a smell of gas in the premises or suspected Carbon Monoxide (CO) report by consumer.
- Temporary isolation by GDN for poor pressure - Where the GDN has identified effected premises and wishes to reduce risk to consumers by temporarily isolating the supplies.
- Temporary isolation to reduce demand following damage to distribution mains or temporary reduction in gas availability - Possible prevention measure where consumers (whether a percentage or all for a particular Gas Supply Emergency) are isolated to ensure the overall pressure is maintained in the mains and services.
- Temporary isolation for Water Ingress - Isolate to protect consumers from poor pressure and some protection to consumer’s appliances from water ingress.

These scenarios potentially provide, once identified, an almost immediate response to a potential issue and allow the GDN to take some action prior to the visit by a competent person to site under the normal attendance policies and safety case requirements.

There are likely to be a limited number of incidents each year where this provides benefit. Robust procedures would be required to ensure that these processes operate safely.

**Business Benefit**

- Ability to assist the emergency process to add further protection to the consumer
- Enables quicker restoration of gas supply after gas supply emergencies

Note: For a reported gas escape and / or CO report, security measures would need to be in place to confirm links of reporter to address.
### Actors

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides gas to the premises.</td>
</tr>
<tr>
<td>Competent Person</td>
<td>Secondary</td>
<td>An individual, either a Consumer, Network employee, or other individual deemed competent (by the Supplier) to identify when it is safe to restart a gas supply after interruption</td>
</tr>
<tr>
<td>Consumer</td>
<td>Secondary</td>
<td>Organisation, or person, consuming the gas at the premises. The Consumer may also be the organisation, or person, contracted with the Supplier for the provision of gas.</td>
</tr>
</tbody>
</table>

### Scenario Descriptions

#### Pre Conditions

- The Smart Metering Systems are operational and incorporates a reliable gas valve
- The Gas Distribution Network Operator has the Smart Meter location mapped onto a network model
- The Gas Distribution Network Operator is authorised to remotely trigger the activation of the gas valve
- The Gas Distribution Network Operator is able to target specific Smart Metering Systems in the required area

#### Post Conditions

- The Consumer has been successfully prevented from offtaking gas for a period of time by the Gas Distribution Network Operator while network issues are resolved.

#### Trigger

- The Gas Distribution Network Operator has a requirement to temporarily isolate the Smart Metering System from the network and can confirm the required customer security questions (if applicable)

#### Basic Flow

Note – this use case is carried out for each Smart Metering System in the targeted area

1. The Gas Distribution Network sends a message to the Smart Metering System to operate the valve
2. The Smart Metering System receives the message and validates it
3. The Smart Metering System activates the gas valve and sends a confirmation response message to the Gas Distribution Network Operator
4. The Gas Distribution Network Operator receives the confirmation response that the gas valve has operated

5. On completion of works, a Competent Person would open gas valve on site following necessary safety checks and soundness testing.

### Alternative Flow

2. At Basic Flow step 2
   - **2a1** The Smart Metering System rejects the message as invalid
   - **2a2** The Smart Metering System sends notification to the Gas Distribution Network Operator detailing the error type along with a date/time stamp
   - **2a3** The Gas Distribution Network Operator resolves the issue and goes back to Basic Flow step 1

4. At Basic Flow step 4
   - **4a1** The Gas Distribution Network Operator does not receive the confirmation response
   - **4a2** The Gas Distribution Network Operator ensures that the Smart Metering System is configured and working correctly
   - **4a3** The Gas Distribution Network Operator remotely checks the status of the gas valve
   - **4a4** Go back to Basic Flow step 4

### Additional Information

### Related Information

### Notes and issues
This functionality is only applicable should the meter functionality include a gas valve.
7.2.4 Display messages from GDN

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>Level</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>Detailed</td>
<td>Gas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Case Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Messages from GDN</td>
<td></td>
</tr>
</tbody>
</table>

**Description**

**Business Need**

The use case describes how the Gas Distribution Networks (GDNs) will communicate with consumers through the smart metering population to notify them of key works, issues or progress updates on specific incidents.

Currently when consumers find themselves affected by gas supply emergencies, such as water ingress, the current processes requires the GDN to visit each customer or allow the customer to contact the local GDN or enquiry lines to find out specific progress on incidents. In addition, when the GDN wishes to undertake works in the near future at the customers address to interrupt the supply for maintenance purposes (mains and service replacement) this relies on sending letters to consumers, which are usually addressed to the occupier and can be perceived as unwanted or ‘Junk’ mail.

The smart metering system would be configured to allow the GDN to issue notifications to consumers who have In Home Displays (IHD) or other information receipt devices in order to provide specific updates.

**Business Benefit**

- Ability to communicate key information to consumers in addition to existing processes
- Ensure alignment between gas and electricity smart metering systems on the assumption that consumers would expect comparable benefits from any smart meter installation whether gas or electric.

**Actors**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Role Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Distribution Network Operator</td>
<td>Primary</td>
<td>Organisation responsible for managing the distribution network that provides gas to</td>
</tr>
</tbody>
</table>
Scenario Descriptions

Pre Conditions

Smart Metering Systems are installed and configured to accept, display and respond to messages from Gas Distribution Network Operators

The Gas Distribution Network Operator has the right to display messages on the Smart Metering System (e.g. the meter, the In House Display, or an alternative display)

Post Conditions

The Smart Metering System confirms the Distribution Network Operator that a message that is meaningful to the Consumer has been delivered and displayed

The Gas Distribution Network Operator is aware when a failure has occurred

Trigger

The Gas Distribution Network Operator has a requirement to send a message to be displayed to the Consumer via the Smart Metering System

Basic Flow

Note – this use case is carried out for each Smart Metering System

1. The Gas Distribution Network Operator sends a message to the Smart Metering System
2. The Smart Metering System receives the message, validates it and displays it
3. The Smart Metering System sends a message displayed confirmation to the Gas Distribution Network Operator
4. The Gas Distribution Network Operator can send updates to the message.
5. The Gas Distribution Network Operator sends a message to update the message, i.e. clear message or send situation resolved message.

Alternative Flow

2. At Basic Flow step 2
   2a1 The Smart Metering System rejects the message as invalid
   2a2 The Smart Metering System sends notification to the Gas Distribution Network Operator detailing the error type along with a date/time stamp
   2a3 The Gas Distribution Network Operator resolves the issue and goes back to Basic Flow step 1

Additional Information

Related Information
<table>
<thead>
<tr>
<th>Notes and issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>This requirement assumes a web based access facility via the CCP to allow GDNs to send messages to specific meters or group of addresses as required.</td>
</tr>
</tbody>
</table>

Message could be limited to ‘Gas Supply Incident contact tel. Xxx xxxxxxxx or visit web site’;
8 Uses Outside of System

ENA member functional and non-functional requirements were discussed and raised during the course of this analysis that may not have any interaction with the Smart Metering System or benefit for the Network Operator. This section discusses these.

8.1 Electricity

The following electricity use case pre-conditions suggest use cases that have not been documented within this analysis.

8.1.1 Location of the Smart Metering System

A common electricity pre-condition is that the Distribution Network Operator’s has the Smart Meter location mapped onto a network model implies the existence of procedures in installation.

The DNO needs to have and maintain a model of their network, and the Smart Metering System needs to be mapped to that model as a result of installation - this may be carried out by capturing the location of the meter at the time of installation and by communications using the smart metering infrastructure or separate procedures.

8.1.2 Collection of generation data

A further critical pre-condition is that the Smart Metering System will be able to gather generation data from the Feed In Tariff (FIT) meters connected to installed micro-generation. Smart meters have been defined by DECC as being able to receive, store and communicate the total generation for billing although how this is done and whether this is adequate for Networks purposes is to be determined.

8.2 Gas

The following functional requirement may not have any gas network operator interaction with the Smart Metering System and derives no benefit to the network operator hence has been included here rather than in the use case section.

8.2.1 Measure and store Calorific Value (CV)

The Gas Distribution Network Operators have identified that for UK security of supply purposes the input of a range of gas qualities from Europe (including LNG), Bio Methane and coal bed methane into the gas networks may mean that the current regime for collecting and providing CV data becomes less appropriate. In addition, this may apply equally to the National Transmission System.
Currently the Calorific Value (CV) of gas is measured at strategically placed points at the Transmission / Distribution system interface. The CV is measured daily at the Local Distribution Zone (LDZ) level and an estimate is provided to Shippers on the day and the actual CV provided on the day plus 1.

These values are used to weight usage for settlement and to weight the amount that Supplier’s customers are billed. Current meters use a generic Flow Weighted average CV to calculate the amount of Energy consumed for the billing period. The billing CV is subject to a ‘cap’ and ‘collar’ mechanism, and if the lowest CV measured during a day is below a trigger level, this is the value used for billing purposes. Current CVs vary very little and the current regime is considered to be effective.

The obligations for Gas Distribution Network Operators to measure CVs and for Suppliers to use them to weight bills for their customers shall continue.

Bio Methane (and other sources such as coal bed methane, coal mine methane, shale gas and LNG) is anticipated to be introduced as a source of gas into the networks at a local level within the near future. The CV of this gas is understood to be much more variable and could cause the current CV ‘collar’ to be experienced more often than at present. In addition, various sources of gas across Europe may require the UK to accept a wider range of gas qualities for future security of supply although still within the requirements of the Gas Safety Management Regulations.

If there is no change to the current regime, Shippers and Suppliers and consumers may be charged according to CVs that are less representative than currently.

There are possible solutions whereby more granular areas are distinguished, Gas Distribution Network Operators measure the CV at many more locations than currently and these are provided to Shippers or the Smart Metering System directly. This will ensure that the gas values displayed on the In Home Display corresponds with their bill.

Alternatively each Smart Metering System includes the functionality to measure the CV to the accuracy required by the Gas Calculation of Thermal Energy Regulations. The CV is then used regularly to bill the customers and determine energy use within the premises. This CV could be used to provide the energy consumption for non smart metering nearby although the issues raised by this would need resolving. In this arrangement consumers would be billed for a more representative energy use rather than the current estimation.

Such a change would mean changes to systems across the industry.

**Business Benefit**

The solution whereby CV was measured at each smart meter would fulfil the GDNOs obligation to measure CVs. The largest benefit is that billing would be equitable for all consumers.
This will also support security of supply by enabling the greatest range of gas qualities (within regulatory limits) to be injected without the need for expensive treatment processes.

8.2.2 Location of the Smart Metering System

The gas pre-condition that the Gas Distribution Network Operator (GDN) has the Smart Meter location mapped onto a network model implies the existence of procedures in installation.

The GDN needs to create and maintain a model of their network, and the Smart Metering System needs to be mapped to that model as a result of installation - this may be carried out by capturing the location of the meter at the time of installation and by communications using the smart metering infrastructure or separate procedures.