

Losses Discretionary Reward – Tranche 1 Submission

Reducing Network Energy Losses & Greenhouse Gas Emissions

January 2016

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1 Foreword

Network loss reduction is a key area where we can add value for our customers and for the widest possible stakeholder group. At SP Energy Networks we are committed to deliver cost effective loss reduction activities that reduce customer energy bills, reduce carbon pollution and help reduce the pace of climate change.

In September 2015 we published our Losses Strategy which is based upon a high level vision that we will **“Consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers”**.

Our processes will continue to evolve to ensure we establish a culture of considering network losses in every major investment decision we undertake. In line with EU regulations we will install lower loss transformers where we are replacing end of life assets. Further, specifically as a result of our losses strategy, we will accelerate replacement of more than 1,000 higher loss transformers that would have normally been replaced between 2023 and 2039.

We anticipate that the actions included within our Losses Strategy will lead to carbon savings of 23,835 tCO_{2e} and 44,977 tCO_{2e} in SP Distribution and SP Manweb respectively, and reduce the cost of network losses to energy suppliers, and ultimately customers, by around £8m during the RIIO-ED1 period.

Losses on electricity distribution networks are currently complex and difficult to quantify. Energy loss inevitably arises from the action of transferring energy across today’s distribution networks, as proscribed by the laws of physics. Our existing distribution networks are extensive, would cost more than £17bn to replace like-for-like, and take several decades to replace with lower loss alternatives.

SP Energy Networks is committed to better understanding and managing our network losses despite these significant challenges. A key activity for us is to undertake ongoing studies and develop tools, data processing systems and trials to consider the value of loss reduction schemes. The future availability of Smart Meter Data has a key role in improving our understanding of the level and location of losses.

The amount of energy that customers use and the timing of this have a direct impact on network losses. This provides exciting opportunities for both losses and demand reduction by working closely with our customers to identify initiatives that deliver shared benefits. Within this submission we have included specific actions aimed at developing administrative, commercial and technical infrastructure to enable and encourage customers to participate in loss reduction and capacity enhancement initiatives.

The actions set out in our Losses Strategy and Losses Discretionary Reward application have been developed to improve our understanding and management of network losses. They are designed to ensure effective engagement and sharing of best practice with stakeholders, and will demonstrate the actions we are taking to incorporate innovative approaches into business as usual activities.

Scott Mathieson
Network Planning & Regulation Director

2 Introduction

2.1 Objective

The objective of this submission is to present a number of initiatives which we consider will add long term value for customers, the energy industry and the widest possible group of stakeholders and thus seek funding for these initiatives under the Losses Discretionary Reward (LDR) mechanism.

This submission is additional to, but develops enablers for, meeting Licence condition 49 (as set out in our Losses Strategy¹). The Licence condition requires us to “publish a strategy showing how we will ensure that Distribution Losses from our system are as low as reasonably practical” and to “maintain and act in accordance with our Distribution Losses Strategy”. The test for “reasonably practical” is an economic cost/benefit analysis. Our Losses Strategy sets out our overall intention for loss reduction, given what is reasonably practicable. This is based on our current knowledge and ability to manage network losses. We include in Appendix 2 the main activities included within our Losses Strategy. Our LDR initiatives are designed to extend the boundary of what is reasonably practicable and can be considered as enablers to improving the management of network losses.

Network loss reduction is only one element of electrical energy waste. By increasing load efficiency and timing, the efficiency of our network is also increased. A cost/benefit analysis, as presently performed, values the DNO cost but does not value the total social and environmental benefits of motivating such improvement. Proactively managing users of the distribution system should offer significant losses and capacity benefits.

Against this background, Ofgem has challenged the DNOs to consider whether they are able to go beyond the licence requirement. In forming their submissions, Ofgem has essentially invited the DNOs to consider whether:

- there are additional actions which they could take and are outside the reasonableness test set down as a licence requirement;
- any actions which they have already defined within their Losses Strategy document fall beyond the reasonableness test.

The LDR is managed in three tranches within ED1 (detailed within Appendix 7). Tranche 1 is concerned with “processes and methods which DNOs are exploring and implementing to understand and ultimately better manage losses on their networks”. Tranche 1 initiatives will be assessed against the stated criteria of: understanding of losses; effective engagement and sharing of best practice with stakeholders on processes to manage losses; and innovative approaches to losses management and actions taken to incorporate these approaches into business as usual activities.

We believe that:

- where there is a long term losses benefit from a particular approach (even if coupled with other benefits), but
- where the resulting projects cannot be tested by a cost benefit analysis,

that approach should be a strong candidate for LDR work / funding and this submission has been developed with that principle in mind. Losses initiatives which did not meet the cost benefit analysis test were in general not eligible for funding under the normal RIIO-ED1 mechanism and therefore cannot proceed without alternative funding.

¹ http://www.spenergynetworks.co.uk/userfiles/file/SPEN_Revised_Losses_Strategy_Final_Issue_1.pdf

We will confirm priorities and the depth of investigation when we understand the level of the reward and which initiatives might be shared between DNOs. It is our intention to invest the full amount awarded in loss reduction incentives.

2.2 The Origin, Level and Value of Losses

The two types of losses are explained in full within our Losses Strategy document. In summary:

- **technical losses** represent energy lost to the environment with no gain to anyone; and
- **non-technical losses** arise where energy is used but not billed. Reducing non-technical losses increases revenue and reduces customer bills but does not (at least directly) reduce CO₂ emissions.

The total level of losses on the UK distribution networks is about 6%. As losses cannot be completely eliminated; the task is to better understand the origin of losses with an aim of loss reduction.

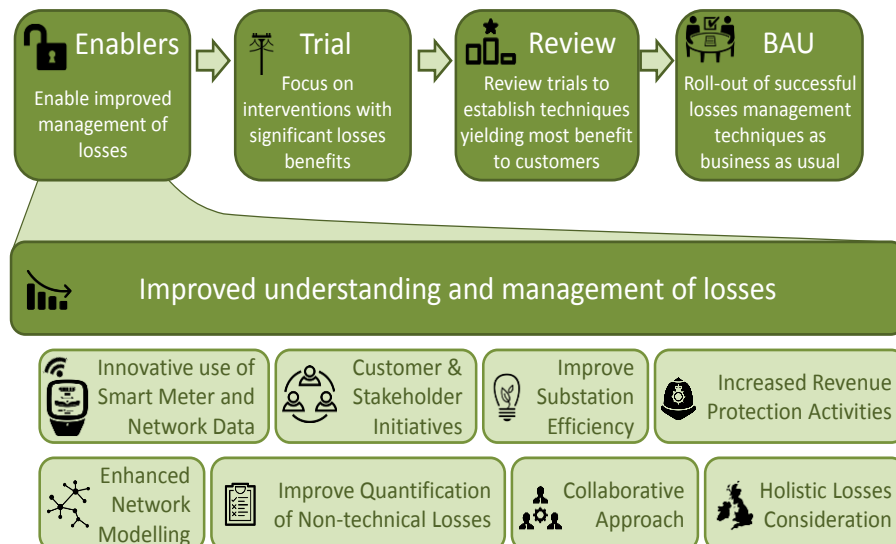
The geographic separation of generation from load lengthens network flows and increases losses. Network losses increase steeply at periods of high load. The closer the generation is located to load and the more even the load is throughout the day, the lower the total losses will be. Where embedded generation exceeds local load, losses increase as current flows in the reverse direction on the network. DNOs faced with applications for generation capacity then have conflicting drivers.

Throughout RIIO-ED1, a collaborative aim between the distribution and transmission network operators and Ofgem should be to agree an economically efficient target reduction in total GB losses to be achieved in successive periods. The target quantity may need to be adjusted year-on-year due to the dependence of load (and hence losses) on ambient temperature. The carbon value of losses depends upon the degree of decarbonisation of the generation base. It is for consideration whether a single GB-wide value is appropriate, or whether increased network losses caused by decarbonisation action should be treated, to reduce conflicting drivers.

2.3 Our Portfolio of Initiatives

Building on the work undertaken to develop our Losses Strategy, a dedicated working group considered the challenges faced, taking account of national and international learnings and industry developments. From this analysis a portfolio of initiatives, additional to our licence requirement and focusing on the LDR criteria, have been identified and assessed as suitable candidates for long term losses benefit. These initiatives address eight key themes and fit into the long term context of loss reduction as follows:

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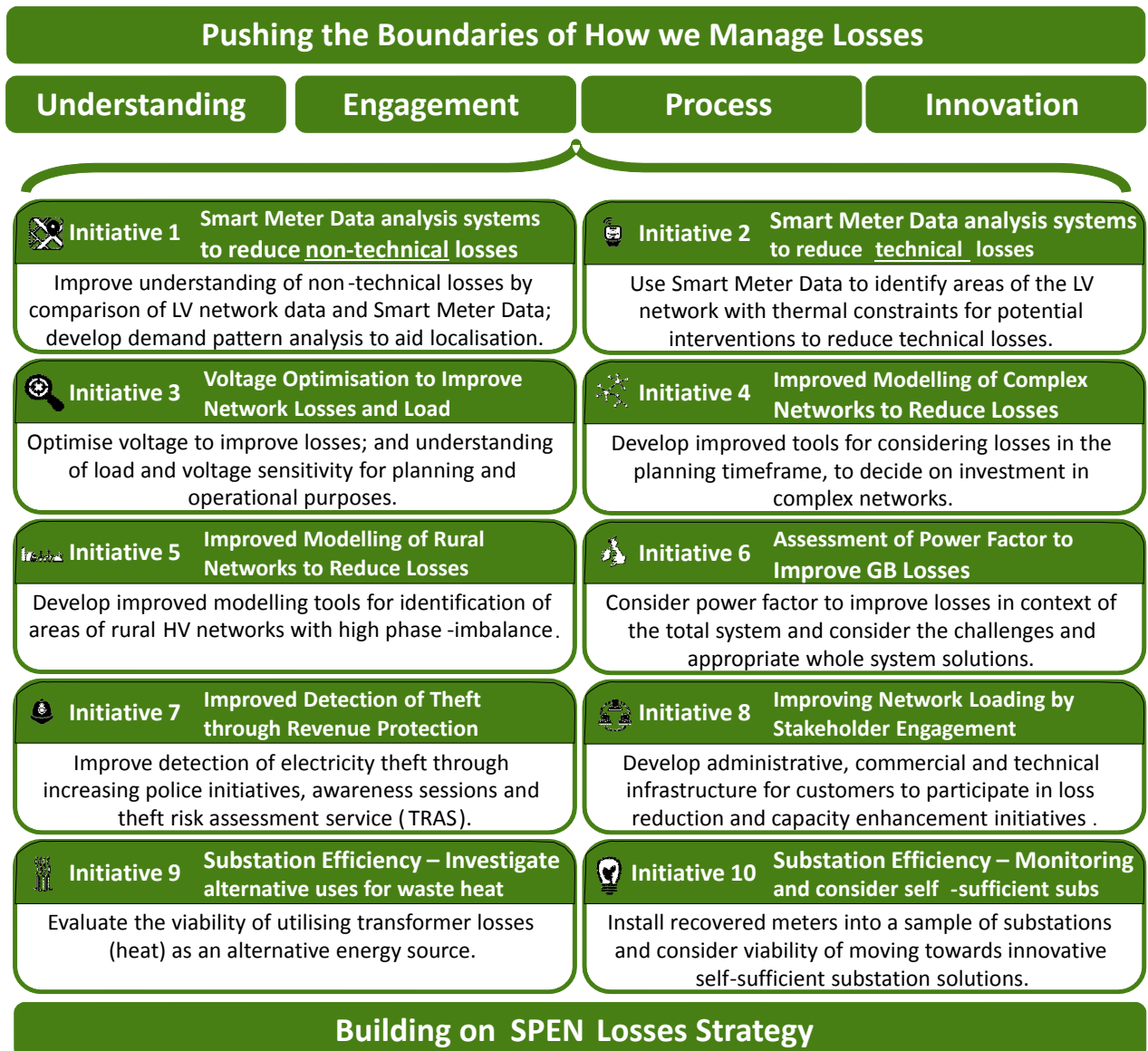


3 Pushing the Boundaries of How We Manage Losses – Our Initiatives

In compiling our portfolio of LDR initiatives we have considered Ofgem's guidance, DNO's published Losses Strategies, information from industry experts, best practice from our parent company along with the needs of our network and processes.

We have identified and assessed ten initiatives as suitable candidates for long term losses benefit. They meet Ofgem's four criteria of understanding losses, effective engagement and sharing of best practice with stakeholders, processes to manage losses, innovative approaches to losses management and actions taken to incorporate these approaches into business as usual activities. Whilst each initiative contributes more or less to each criteria, taken together the portfolio of initiatives achieve a good balance against the four areas. We would point out that the stakeholders for the development phase (Tranche 1) are not necessarily the same stakeholders who would have interest in Tranche 2 and 3 of the LDR. This is because, out of necessity, Tranche 1 is heavily weighted to development of tools, techniques, analysis and processes.

The following gives an overview of the proposed initiatives which contribute to a balanced achievement of the criteria (full details of each initiative are included in Section 4 with linkage to LDR criteria in Section 5):



Initiatives 1 to 5 relate to better understanding and providing a strong platform for improving network losses, including incorporating the use of Smart Meter Data. Initiative 6 develops processes aimed at holistic working and we have already entered discussions about the requirements for work in this area with other DNOs. Initiative 7 provides for revenue protection services to further address non-technical loss reduction and includes extending a trial already underway thus giving a lengthy reporting period for the Tranche 3 review. This trial is in excess to our Licence condition.

The nature of customers demand and generation is the single largest variable factor affecting network losses. Initiative 8 looks to develop administrative, commercial and technical infrastructure for customers to participate in active network management. This type of initiative could not be funded within the Losses Strategy because the cost benefit analysis, as presently performed, values the DNO cost but not the total social benefits of motivating such improvement. Typical activities needed are:

- assessing whether international best practices could be deployed by users as well as DNOs;
- incentivise better power flow profiles by involving stakeholders in the design of incentives;
- assess total value of encouragement of customers to improve their overall efficiency of energy use, which also reduces network losses and improves capacity.

This initiative also considers how the DUoS tariff and other motivators can influence stakeholders (customers, councils and devolved government) to create reduced and smoothed demand patterns to avoid the network peak. Lowering demand and smoothing the use pattern of energy significantly reduces losses. On average, energy consumed at peak loading time in winter creates 3 to 6 times the variable losses compared with energy consumed at the minimum time in winter.

Initiatives 9 and 10 are aimed at reducing substation losses by seeking to convert transformer heat to useful energy and by monitoring substation house load with a view to reducing our waste and moving toward self-sufficient substations. Initiative 9 improves accountable losses by removal of certain transformer losses from the count (because they would be producing useful energy). Initiative 10 uses innovation to create a good housekeeping example for our system users. We will be including a public expert event open to (and seeking contributions from) EU energy managers, customers, academics, other DNOs, our regulator and DECC. We intend our parent company Iberdrola to contribute their wider experience of loss reduction activity and we expect to extend knowledge on all aspects of loss reduction - from approaches to regulation through to more technical aspects such as development of Smart Meter Data analysis systems, transformer waste heat applications and low energy use substations.

3.1 Linkage with Losses Strategy

The initiatives included within this application build on our Losses Strategy, the linkage between the two is provided in Appendix 3.

3.2 Resource and Action Plan


We recognise that this work requires both internal and specialist resources and once the awarded level of LDR is known, the initiatives will be prioritised according to the following principles:


- list the deliverables, their linkages and resource requirements for each initiative;
- determine the opportunities for initiative sharing with other DNOs; and
- prioritise according to the level of award and the initiative sharing opportunities.


If early investigation of a project demonstrates that later deliverables are likely to be of little value, our proposed set of initiatives have the flexibility to adapt focus to outputs which are more likely to add value.


Where possible, we would seek to form collaborative arrangements with other DNOs to improve the efficiency of LDR work (aligning with Ofgem's focus on wider stakeholder involvement and funding efficiency). For some initiatives the progress will depend upon DNO's agreeing to share resources. Where there are opportunities to share resources we would follow the process set out in Appendix 4.

4 Details of LDR Initiatives (Tranche 1)


 Initiative 1 - Smart Meter Data analysis systems to reduce <u>non-technical</u> losses		
Challenge	<p>The granularity of data presently available to us limits our ability to quantify the level, location and variance of non-technical losses across our networks.</p> <p>This initiative will improve our understanding of non-technical losses by:</p> <ul style="list-style-type: none"> • comparison of LV network data and Smart Meter Data; and • developing demand pattern analysis to aid localisation of differences. 	
Background	<p>Non-technical losses arise where energy is used but not properly recorded or advised to the supplier, or because of theft. The level of such losses is difficult to quantify. The roll out of Smart Meters across the UK offers an opportunity to develop systems to identify and quantify non-technical losses so that these can be more effectively targeted / managed.</p>	
SPEN Activities	<ul style="list-style-type: none"> • Automate comparison of LV network monitoring data with Smart Metering Data. • Quantify difference in energy supplied versus energy billed. • Use network construction and topology data to disaggregate technical and non-technical losses. • Apply (and build on) fraud detection algorithms being successfully employed by Iberdrola in Spain to develop prototype analysis tools. • Develop multi-factorial pattern-detection algorithms to identify suspicious profiles. • Establish initiative evaluation criteria and report. 	
Target Outcomes	<ul style="list-style-type: none"> • Clarifies the benefits of co-joining information from network monitoring and metering data in identifying customers with exceptional trends / detecting fraud. • Facilitates more targeted investigation. • Identifies whether there is non-technical loss reduction value in widespread network monitoring and if so, what level this monitoring needs to be set at. 	
Future benefits	<ul style="list-style-type: none"> • Adds additional network monitoring where this brings benefit to customers. • Progressively improves the accuracy of the method during Smart Meter roll out. 	
LDR Justification	<p>Separates technical and non-technical losses. Creates interim improvement in losses including targeting fraud. Develops tools ahead of Smart Meter roll out.</p>	
Assessment Criteria	Understanding	<ul style="list-style-type: none"> • Improved quantification of non-technical losses.
	Stakeholder	<ul style="list-style-type: none"> • Supports a “no hiding place” approach. • Results and practice will be shared. • Active engagement with the industry (e.g. Meter operators) and customers.
	Process	<ul style="list-style-type: none"> • Smart Meter Data to develop processes. • Learning from approach of parent company (Iberdrola).
	Innovation	<ul style="list-style-type: none"> • New methods of detection. • New data management and modelling systems.


 Initiative 2 - Smart Meter Data analysis systems to reduce <u>technical</u> losses									
Challenge	<p>With the data presently available to us, we are limited in our ability to identify specific areas of LV network incurring high-losses.</p> <p>This initiative will use Smart Meter Data to identify areas of the LV network with thermal constraints and potential for interventions to reduce technical losses.</p>								
Background	<p>Work by ourselves and other DNOs indicates that the majority of distribution network losses (with exception of very rural networks) are likely to occur in the HV/LV transformers and the LV network feeders. The variance in network assets, topology, demand patterns etc. dictates that to adequately assess losses each network requires separate and detailed modelling.</p> <p>We have already invested in a vectorised GIS which provides much connectivity detail of the LV network. This project will add a specific losses related application using that data coupled with Smart Meter Data. In the longer term, Smart Meters will be installed across our networks and can be utilised to facilitate better understanding and therefore management of losses and capacity in our networks.</p>								
SPEN Activities	<ul style="list-style-type: none"> • Develop a model which identifies high losses in HV/LV substations and LV feeders including validation of the accuracy of modelled losses. • Determine how Smart Meter Data may be integrated into business as usual model runs when data becomes available. • Identify (with other DNOs, suppliers and meter operators) how to complete data sets and/or generate accurate synthetic data. 								
Target Outcomes	<p>Use Smart Meter Data to improve losses understanding and decision making for the LV networks by:</p> <ul style="list-style-type: none"> • providing a tool for identifying areas of rapid demand growth, e.g. LCT clusters, without requiring additional network monitors to be installed. • enabling consideration of how losses & capacity would be affected by network reinforcements or stakeholder co-operation to shift or reduce loads • as electric vehicle technology is rolled out, enabling consideration of how network usage may be incentivised for maximum capacity and minimum losses 								
Future benefits	<ul style="list-style-type: none"> • Tranche 2 should be a period of evaluation and continuous improvement in modelling accuracy, to give confidence in the accuracy of predicted savings. This is important as LV networks are the highest losses area. • Model extended to deal with a wide area or generalised for a range of networks. • Certain “losses hotspot areas” targeted for improvement by showing the cost and value of phase rebalancing, load flattening and stakeholder co-operation. 								
LDR Justification	Creates interim improvement in loss reduction decision making and develops tools ahead of Smart Meter roll out.								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #e8f5e9;">Understanding</td> <td> <ul style="list-style-type: none"> • Significantly increased understanding and visibility of HV/LV and LV network losses. </td> </tr> <tr> <td style="background-color: #e8f5e9;">Stakeholder</td> <td> <ul style="list-style-type: none"> • Active engagement with the industry (e.g. Meter operator). • Sharing of learning and approach. </td> </tr> <tr> <td style="background-color: #e8f5e9;">Process</td> <td> <ul style="list-style-type: none"> • Takes account of earlier customer funded work. • Researches how others have approached this. • Uses Smart Meter Data to develop appropriate processes. </td> </tr> <tr> <td style="background-color: #e8f5e9;">Innovation</td> <td> <ul style="list-style-type: none"> • New methods and processes. • New data management and modelling systems. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Significantly increased understanding and visibility of HV/LV and LV network losses. 	Stakeholder	<ul style="list-style-type: none"> • Active engagement with the industry (e.g. Meter operator). • Sharing of learning and approach. 	Process	<ul style="list-style-type: none"> • Takes account of earlier customer funded work. • Researches how others have approached this. • Uses Smart Meter Data to develop appropriate processes. 	Innovation	<ul style="list-style-type: none"> • New methods and processes. • New data management and modelling systems.
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Innovation	<ul style="list-style-type: none"> • New methods and processes. • New data management and modelling systems. 								


 Initiative 3 - Voltage Optimisation to Improve Network Losses and Load									
Challenge	<p>Historically our voltage control strategies have been designed with standardised settings, primarily focusing on capacity. The losses/capacity impact, through all voltage levels, of applying different voltage control strategies requires further study in order to optimise our control strategies.</p> <p>This initiative seeks to optimise voltage to improve losses; and improve understanding of load / voltage sensitivity for planning and operational purposes.</p>								
Background	<p>Our trials in Flexible Networks and other DNOs work through LCNF projects have demonstrated a reduction in demand when HV tap-changer target voltage levels are reduced. We wish to consider the potential losses benefits (at all levels of our system) of applying different voltage control strategies.</p>								
SPEN Activities	<ul style="list-style-type: none"> • Determine selection criteria and select network sections for trials. • Building on LCNF projects already undertaken; determine impact on losses and capacity of a range of target voltage strategies ensuring adequate network and system user monitoring and control is in place. • Prepare and publish a report showing the methodology, synthesis of information acquired, benefits of the trial and recommended actions. • Undertake trials incorporating DNO-initiated HV voltage reduction to determine load characteristics for sudden and permanent voltage shifts (to be undertaken with a University and other stakeholders e.g. NGET). 								
Target Outcomes	<ul style="list-style-type: none"> • Improved understanding of the losses impacts of optimising network voltage in a range of our networks. 								
Future benefits	<ul style="list-style-type: none"> • Routine assessment of potential losses savings and capacity benefits due to reduced demand on the network. • Improved understanding and characterisation of load behaviour, and load/voltage relationships. This understanding will improve all subsequent estimates of losses benefits and facilitate active network management. 								
LDR Justification	<p>This is a knowledge improvement project where the potential losses and capacity benefits would be calculated as part of the initiative.</p>								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; padding: 5px;">Understanding</td> <td style="padding: 5px;"> <ul style="list-style-type: none"> • Improved understanding of voltage → losses relationship. </td> </tr> <tr> <td style="padding: 5px;">Stakeholder</td> <td style="padding: 5px;"> <ul style="list-style-type: none"> • Engagement with other DNOs to share best practice. </td> </tr> <tr> <td style="padding: 5px;">Process</td> <td style="padding: 5px;"> <ul style="list-style-type: none"> • Takes account of work done by others. • Informs policy and facilitates the move towards DSO. • Knowledge sharing. </td> </tr> <tr> <td style="padding: 5px;">Innovation</td> <td style="padding: 5px;"> <ul style="list-style-type: none"> • There is considerable academic literature which indicates capacity benefits from voltage management, but much less on losses benefits. • Optimisation of voltage for losses benefits is not presently BAU. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding of voltage → losses relationship. 	Stakeholder	<ul style="list-style-type: none"> • Engagement with other DNOs to share best practice. 	Process	<ul style="list-style-type: none"> • Takes account of work done by others. • Informs policy and facilitates the move towards DSO. • Knowledge sharing. 	Innovation	<ul style="list-style-type: none"> • There is considerable academic literature which indicates capacity benefits from voltage management, but much less on losses benefits. • Optimisation of voltage for losses benefits is not presently BAU.
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Innovation	<ul style="list-style-type: none"> • There is considerable academic literature which indicates capacity benefits from voltage management, but much less on losses benefits. • Optimisation of voltage for losses benefits is not presently BAU. 								


 Initiative 4 - Improved Modelling of Complex Networks (HV) to Reduce Losses									
Challenge	<p>Our existing losses assessment tools are limited in their ability to accurately assess the technical losses in more interactive / complicated areas of our networks.</p> <p>This work will develop improved tools for considering losses in the planning timeframe. This will enhance our ability to make losses related investment decisions.</p>								
Background	<p>In some areas of network, technical (I^2R) losses can be complex, stochastic, time varying relationships which can be sensitive to assessment methods. More work is required to develop improved tools to more accurately assess losses and any business cases of network interventions in these areas. It is part of the scope of this work to determine the industry experience of developing and using such tools.</p>								
SPEN Activities	<ul style="list-style-type: none"> • Undertake literature review and methodology assessments for: <ul style="list-style-type: none"> ○ stochastic determination of quantities and evaluation of losses and capacity in radial and interconnected HV networks; and ○ application of losses optimisation principles in real-time active network management either in widespread or local Smart applications. • Determine the real-time data / meter-data links and data gap assumptions regarding demand, embedded generation, load pattern and economic aspects to be used for life-cycle modelling. • Develop and take wide views on model principles and architecture. • Assess/provide guidance on conditions where all half-hour periods should be assessed independently versus a method of banding hours at flow-levels. • Code, document and validate the model. • Consider applicability of approaches to real-time active network management. 								
Target Outcomes	<ul style="list-style-type: none"> • Improve knowledge regarding losses / capacity impacts for load related and asset replacement decision making, enabling us to hold a more accurate view on: <ul style="list-style-type: none"> ○ the long term losses impacts of HV network development strategies; and ○ losses minimised settings for planned innovative network components e.g. Phase Shifting Transformers and STATCOMs. • Enable holistic assessments with TSOs regarding overall losses optimisation. 								
Future benefits	<ul style="list-style-type: none"> • Enables development of holistic loss reduction processes (e.g. time co-ordinated studies with NGET and SPT) to assess the losses and capacity impacts of: <ul style="list-style-type: none"> ○ Master-plan development options; ○ the time phasing of 5-7 year plans; and ○ individual large projects. • Enables development of any derivative operational tools. 								
LDR Justification	<p>This is an enabler project which will allow us to better quantify losses and business cases of interventions. Our Losses Strategy sets out this project in general terms; LDR funding is sought to develop these tools, possibly in combination with other DNOs.</p>								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Understanding</td> <td> <ul style="list-style-type: none"> • Improved understanding and quantification of technical losses. </td> </tr> <tr> <td>Stakeholder</td> <td> <ul style="list-style-type: none"> • Enabler for engagement with customers and other utilities including NGET. </td> </tr> <tr> <td>Process</td> <td> <ul style="list-style-type: none"> • Literature review enables existing experience to be captured. • Model principles and performance will be published. </td> </tr> <tr> <td>Innovation</td> <td> <ul style="list-style-type: none"> • Improves existing tools. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding and quantification of technical losses. 	Stakeholder	<ul style="list-style-type: none"> • Enabler for engagement with customers and other utilities including NGET. 	Process	<ul style="list-style-type: none"> • Literature review enables existing experience to be captured. • Model principles and performance will be published. 	Innovation	<ul style="list-style-type: none"> • Improves existing tools.
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Initiative 5 - Improved Modelling of HV Rural Networks to Reduce Losses									
Challenge	<p>At present we rarely assess the imbalance arising due to single-phase HV spur lines.</p> <p>This work will develop and validate improved modelling tools for identification of areas of rural HV networks with high phase-imbalance.</p>								
Background	<p>We have many long rural HV circuits, especially within our SP Distribution licence area. There may be high levels of load imbalance on parts of these circuits due to heavily loaded single-phase spur-lines. We confirm the following findings from WPD, UKPN, Sohn and Imperial College:</p> <ul style="list-style-type: none"> • rural HV networks form the majority of losses in supplying HV customers; • imbalance losses costs rise steeply when imbalance exceeds a few percent; and • imbalance losses costs increase in severity with circuit length, <p>and wish to consider, in more detail, the losses due to imbalance on these long HV circuits</p>								
SPEN Activities	<ul style="list-style-type: none"> • Take wider views from interested UK DNOs on parameters likely to be convenient determinants of significant imbalance on HV feeders. • Formulate a parametric model based on readily available network data, establishing appropriate weightings for each criteria to indicate the likelihood of phase imbalance. • Use any applicable pre-existing data collected during LCNF Tier 2 Flexible Networks to refine/improve the parametric model. • Carry out small scale measurement trials to determine which parameters and network characteristics are indicative of worst cases. Trials involve measurement at various line locations and comparison with predicted flows. • Use results of these trials to inform locations for more detailed modelling / study. • Report to stakeholders on: <ul style="list-style-type: none"> ○ the usefulness of this problem identification phase; ○ the methodology and predicted losses /capacity benefits of options; and ○ the accuracy of those predictions in cases where actions are undertaken. • Report on any modelled improvements in generation connection capacity achieved by the options. 								
Target Outcomes	<ul style="list-style-type: none"> • Improve understanding of the losses (and capacity) impacts of phase-imbalance on HV rural networks using a validated process. • Clarify the economic and technical basis for approval of intervention actions. 								
Future benefits	<p>Helps prioritise interventions (including phase re-balancing, ANM) on rural HV networks. This is likely to involve imbalance correction by re-phase-locating customers (or entire spur-lines), spur line splitting, or conductor change. Potentially informs asset replacement policy.</p>								
LDR Justification	<p>This is an enabler project which aims to improve our understanding and systems of identifying areas of HV network with high losses due to phase imbalance.</p>								
Assessment Criteria	<table border="1"> <tr> <td style="vertical-align: top;">Understanding</td> <td> <ul style="list-style-type: none"> • Improved understanding of phase-imbalance → losses relationship. </td> </tr> <tr> <td style="vertical-align: top;">Stakeholder</td> <td> <ul style="list-style-type: none"> • Liaison with DNOs to ensure replicability. • Share findings. </td> </tr> <tr> <td style="vertical-align: top;">Process</td> <td> <ul style="list-style-type: none"> • Wide peer review at each stage. • Potential DNO shared project and results sharing. </td> </tr> <tr> <td style="vertical-align: top;">Innovation</td> <td> <ul style="list-style-type: none"> • Development of new tools and methods including useful indicators. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding of phase-imbalance → losses relationship. 	Stakeholder	<ul style="list-style-type: none"> • Liaison with DNOs to ensure replicability. • Share findings. 	Process	<ul style="list-style-type: none"> • Wide peer review at each stage. • Potential DNO shared project and results sharing. 	Innovation	<ul style="list-style-type: none"> • Development of new tools and methods including useful indicators.
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Innovation	<ul style="list-style-type: none"> • Development of new tools and methods including useful indicators. 								

 Initiative 6 - Assessment of Power Factor to Improve GB Losses									
Challenge	A long term, whole-system view should be taken to understand and optimise the efficiency of the overall GB electricity systems. This work will develop / test a system of holistic working with stakeholders by considering power factor to improve losses, in context of the total system. <i>(NGET have indicated a move towards maintaining a lagging power factor at each interface.)</i> This will consider the challenges and appropriate whole system solutions.								
Background	<ul style="list-style-type: none"> • NGET have indicated that they are asking DNOs to maintain a lagging power factor at each interface. We intend to study the losses impact on our networks and share this information. • As part of the DSO role, we would want to understand the issues faced by, for example, NGET and then respond with a solution that has been developed to take account of all parties. • Entered discussions on requirement for structured assessment with other DNOs. 								
SPEN Activities	<ul style="list-style-type: none"> • Undertake an investigation of how power factor at each transmission interface changes naturally both hourly/seasonally. • Agree with all NGET and all key stakeholders of how the total system impacts of proposals would be assessed. • Agree a range of alternative options to achieve equivalent stability measures and how these options would be valued. • Consider impact on own system and on Transmission/Distribution and inter-DNO boundary flows / losses to facilitate assessment of whole-system. • Quantify the increased cost (losses and capacity) associated with maintaining a range of agreed lagging power factor values at each NGET and DNO interface. • Produce an interim report on the methodology and assumptions and invite comment from stakeholders. • Produce final report incorporating stakeholder views. 								
Target Outcomes	<ul style="list-style-type: none"> • Supports a process for consideration of total system impacts of planning and operational initiatives however and wherever arising. • Stress tests the process by linking it to a real system issue. • Establishes a mechanism for deriving and critiquing costs (including losses and opportunistic capacity values) to be used for cross-utility option assessments. 								
Future benefits	The development of principles and processes will lead to a framework for joint consideration of many matters and better facilitates the development and joint working on all technical and economic matters affecting active distribution networks.								
LDR Justification	This is an initiative aimed at developing/proving methods and processes for holistic working.								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Understanding</td> <td> <ul style="list-style-type: none"> • Improved understanding of power-factor → losses relationship. • Enabler for GB wide investment appraisals. </td> </tr> <tr> <td>Stakeholder</td> <td> <ul style="list-style-type: none"> • Active engagement with industry, in particular TOs and DNOs. </td> </tr> <tr> <td>Process</td> <td> <ul style="list-style-type: none"> • Informs / shapes industry wide common methods and practices. • Seeks co-operation with other DNOs. • Shares learning. </td> </tr> <tr> <td>Innovation</td> <td> <ul style="list-style-type: none"> • New working arrangements. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding of power-factor → losses relationship. • Enabler for GB wide investment appraisals. 	Stakeholder	<ul style="list-style-type: none"> • Active engagement with industry, in particular TOs and DNOs. 	Process	<ul style="list-style-type: none"> • Informs / shapes industry wide common methods and practices. • Seeks co-operation with other DNOs. • Shares learning. 	Innovation	<ul style="list-style-type: none"> • New working arrangements.
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Innovation	<ul style="list-style-type: none"> • New working arrangements. 								

 Initiative 7 - Improved Detection of Theft through Revenue Protection									
Challenge	Electricity theft continues to be an issue faced by the industry; this work seeks to improve detection of such theft.								
Background	<p>Police Initiatives</p> <ul style="list-style-type: none"> • Allocates 1 full time member of staff to Merseyside Police Cannabis Dismantling Team (has already resulted in some high profile detections leading to the identification of electricity theft). • Work with Police Scotland to set up Information Sharing Agreement and Memorandum of Understanding to allow both parties to work closely together for mutual benefit. <p>Awareness Sessions</p> <p>By reaching out and informing managed housing associations we (and Electricity Suppliers) can take advantage of the volume of statutory visits made to tenants by those associations. We have already set up working protocols with Liverpool Housing Trust and the Glasgow Housing Temporary Accommodation Unit and we have a view to rolling out to other appropriate partners for this work. Training in awareness of theft and the safety aspects is part of the programme. The Emergency Services can also provide useful information and similar training is undertaken with them.</p> <p>Theft Risk Assessment Service (TRAS)</p> <ul style="list-style-type: none"> • Respond to the introduction of TRAS by actively engaging with all industry parties to contribute to the increased quality of leads which will result in increased volumes of detections. • Increase support and field staff FTE significantly. 								
SPEN Activities	<ul style="list-style-type: none"> • Devise and deliver training, both for external parties (e.g. police) and new /current SPEN staff to gain appropriate authorisation and accreditation. • Develop fast response where meter interference is suspected, accompanying staff on site. • Formulate awareness sessions (part of the “Weed It Out” campaign) and participate in delivery of this and similar initiatives. 								
Target Outcomes	<ul style="list-style-type: none"> • Reduce present instances of significant theft. • Assist the police to discourage future theft. 								
Future benefits	<ul style="list-style-type: none"> • Improved understanding of consequences and societal impact. • Enables a longer reporting period for future Tranche 3 review. 								
LDR Justification	These elements of our revenue protection service lie outside of our licence requirement. We wish to continue and expand these activities, sharing the scale of costs and benefits with other DNOs and licensed Suppliers.								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #D9EAD3;">Understanding</td> <td> <ul style="list-style-type: none"> • Improved understanding of mechanisms and likelihood of theft. </td> </tr> <tr> <td style="background-color: #D9EAD3;">Stakeholder</td> <td> <ul style="list-style-type: none"> • Proactive engagement with police, Suppliers, offenders. </td> </tr> <tr> <td style="background-color: #D9EAD3;">Process</td> <td> <ul style="list-style-type: none"> • Builds upon historic experience and learning. • Improved processes through improved understanding. • Share experiences at meter protection forums. </td> </tr> <tr> <td style="background-color: #D9EAD3;">Innovation</td> <td> <ul style="list-style-type: none"> • Developing new approaches. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding of mechanisms and likelihood of theft. 	Stakeholder	<ul style="list-style-type: none"> • Proactive engagement with police, Suppliers, offenders. 	Process	<ul style="list-style-type: none"> • Builds upon historic experience and learning. • Improved processes through improved understanding. • Share experiences at meter protection forums. 	Innovation	<ul style="list-style-type: none"> • Developing new approaches.
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Innovation	<ul style="list-style-type: none"> • Developing new approaches. 								

 Initiative 8 - Improving Network Loading by Active Stakeholder Engagement									
Challenge	<p>The losses incurred in our networks are dominated by the way our customers use energy. This work will develop administrative, commercial and technical infrastructure for customers to participate in loss reduction and capacity enhancement initiatives.</p> <p>It will encourage user and influencer participation in development of processes and in overall value determination and DUoS banding.</p>								
Background	<p>DNOs are charged with making more intense and yet lower loss use of system assets. Load reduction, load shifting, active DSM and local generation control are enablers. To manage these, we seek to establish an active management (DSO) role and to facilitate that by administrative, commercial and technical developments.</p>								
SPEN Activities	<ul style="list-style-type: none"> • Identify/target parts of networks likely to benefit at an early stage from user load reduction or active management initiatives. • Work with customers individually and/or in focus groups, influential bodies and suppliers to maximise the efficiency of energy use in order to reduce network demand loading and losses including whether DUoS tariffs modify behaviour. • Develop with users, flexible arrangements for the target networks by agreeing the form of administrative and commercial arrangements needed. • Enable active networks to use flexible arrangements with demand customers and other network users by agreeing suitable monitoring, communication, control and network safety measures. • Report on key learning, obstacles and recommended solutions for user participation in network loss reduction and capacity enhancement. 								
Target Outcomes	<ul style="list-style-type: none"> • Investigate and report on the main factors to be considered to encourage users to participate in active network management. • Develop key enablers of active network management, including undertaking a national and international assessment. • Provide a platform for a number of network zones suitable for active network management trials and enthuse key users to participate in trials. • Develop mutually beneficial arrangements with customers willing to participate in demand reduction schemes. 								
Future benefits	<ul style="list-style-type: none"> • Trial appropriate schemes and arrangements. • Determine how real-time losses benefits of active management are to be assessed and aggregated on a wide-area basis. • Develop key network risk indicators to determine when network development intervention must be carried out in actively managed networks. • Consult on and determine/recommend how participating users should be dealt with following network development interventions. • In combination with other activities, contribute to reporting on how local losses and capacity benefits will feed into NGET processes and generation capacity adequacy. 								
LDR Justification	<p>The development of such administrative, legal and technical tools is an enabler toward ANM with the potential for significant losses benefits in the long term.</p>								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Understanding</td> <td> <ul style="list-style-type: none"> • Improved understanding of customer drivers and customer behaviour → losses relationship. </td> </tr> <tr> <td>Stakeholder</td> <td> <ul style="list-style-type: none"> • Proactive engagement with customers and suppliers to pro-actively control network demand. </td> </tr> <tr> <td>Process</td> <td> <ul style="list-style-type: none"> • Moves towards active management and DSO role. • National / international experience considered. • Shared learning /partnership approach welcome. </td> </tr> <tr> <td>Innovation</td> <td> <ul style="list-style-type: none"> • Innovative commercial incentives and admin processes. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding of customer drivers and customer behaviour → losses relationship. 	Stakeholder	<ul style="list-style-type: none"> • Proactive engagement with customers and suppliers to pro-actively control network demand. 	Process	<ul style="list-style-type: none"> • Moves towards active management and DSO role. • National / international experience considered. • Shared learning /partnership approach welcome. 	Innovation	<ul style="list-style-type: none"> • Innovative commercial incentives and admin processes.
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Innovation	<ul style="list-style-type: none"> • Innovative commercial incentives and admin processes. 								

 Initiative 9 - Substation Efficiency - Investigate alternative uses for waste heat									
Challenge	<p>Reducing wasted energy reduces carbon pollution and slows climate change.</p> <p>This work will evaluate the viability of using transformer waste heat as an energy source.</p> <p>Prioritise cases based upon economic cost/benefit and technical applicability, applying a range of values for unit of heat to determine cases worth pursuing.</p>								
Background	<ul style="list-style-type: none"> • The following are projects, cited by Sohn associates, which are re-using waste heat: <ul style="list-style-type: none"> ○ NGET installed heat pumps at Hurst substation. In 18 months this has recovered 64.2 GWh of heat with payback of <9yrs; ○ the Tate Modern is embarking on a scheme to recover heat from 6 adjacent UKPN transformers. Estimated 1MW heat output (forecast payback of < 4yrs); and ○ Vattenfall is systematically rolling out heat recovery solutions in its substations in Sweden to supply office heating. • City centre networks with substations embedded in buildings may offer opportunities. • Waste heat is low grade (not high temperature / pressure) - may be of limited value. 								
SPEN Activities	<ul style="list-style-type: none"> • Understand from existing projects which cases met/failed an economic test. • Understand the range of technical challenge and feasibility of retro-fitting heat exchangers to existing equipment. • If viable, plan trials within the Tranche 1 period. • Share plans, collect and evaluate comments to develop programme for continuation of work throughout the entire LDR period. • Quantify to what degree active heat recovery from a transformer can be used to enhance the thermal rating and release transformer capacity. This builds on key findings from Flexible Networks Tier 2 LCNF project. • Host an industry conference on loss reduction and include a main session on substation heat recovery as part of the information gathering / sharing phase. 								
Target Outcomes	<ul style="list-style-type: none"> • Quantifies the benefits and obstacles to distribution level substation heat recovery projects and may identify specific projects worth developing. • The oil / gas price is low at present and projects may be less economically viable, however the initiative will show the type of projects likely to fall into the frame for re-consideration as the price of a BThU varies. • If projects are marginal, the initiative serves to direct Ofgem to consider whether value can be attributed by holistically considering that turning waste heat into useful energy also supports UK targets in decarbonising heat. <i>It is recognised that there could be cross-subsidy issues in this and mechanisms might need to be considered.</i> 								
Future benefits	<p>If projects can be justified within the economic and technical assessments during Tranche 1, a case will be developed for Tranche 2 action. Otherwise, case types will be actively monitored against heat prices to determine when cases can be justified.</p>								
LDR Justification	<p>This is a knowledge improvement project where the technical and economic implications of converting transformer losses into useful heat are explored.</p>								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Understanding</td> <td> <ul style="list-style-type: none"> • Economics and practicalities of heat recovery/re-use. </td> </tr> <tr> <td>Stakeholder</td> <td> <ul style="list-style-type: none"> • Hosting an industry conference. </td> </tr> <tr> <td>Process</td> <td> <ul style="list-style-type: none"> • Uses learning from others (national and international). • Shares learning with others. </td> </tr> <tr> <td>Innovation</td> <td> <ul style="list-style-type: none"> • Innovative heat recovery design consideration. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Economics and practicalities of heat recovery/re-use. 	Stakeholder	<ul style="list-style-type: none"> • Hosting an industry conference. 	Process	<ul style="list-style-type: none"> • Uses learning from others (national and international). • Shares learning with others. 	Innovation	<ul style="list-style-type: none"> • Innovative heat recovery design consideration.
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Innovation	<ul style="list-style-type: none"> • Innovative heat recovery design consideration. 								

 Initiative 10 - Substation Efficiency – Monitoring & consider self-sufficient subs									
Challenge	<p>We currently have no facility to accurately record the energy required to operate our substations. The energy is not large for individual substations, collectively it is substantial.</p> <p>This work seeks to improve substation efficiency by:</p> <ul style="list-style-type: none"> • determining the level and pattern of substation in-house load; • reducing load by efficiency measures; and • considering whether substations can be engineered to be self-sufficient and propose trials. 								
Background	<p>Energy meters will become available as part of the Smart Meter conversion. Traditionally many substations have not been constructed with efficiency in mind.</p> <p>There are administrative obstacles to e.g. generating rooftop solar energy or using energy storage in the substation and if these systems seem sensible we will discuss these with Ofgem.</p> <p>Such approaches may better suit the scale of transmission substations, but the large number of distribution substations in UK provides a case for investigation.</p>								
SPEN Activities	<p>Monitor substation load</p> <ul style="list-style-type: none"> • Identify a sample of typical substations (in both SPD and SPM network areas). • Install meters which perform to standard but are recovered as part of other programmes. • Analyse data to estimate load and load pattern at all substations. <p>Determine Suitable Efficiency Measures</p> <ul style="list-style-type: none"> • Carry out further analysis to determine cost effective measures to reduce heating and lighting load. Take account of international experience. • Report on recommended actions and scope of substations to be improved in the first stage action plan. <p>Develop substation self-sufficiency plans</p> <ul style="list-style-type: none"> • Either linked to Initiative 9 (or otherwise), develop and cost plans to make a selected substation(s) self-sufficient against the monitored use of energy (<i>above</i>). • Publish the findings and show whether it is recommended to implement a self-sufficiency substation project as part of Tranche 2 activity. 								
Target Outcomes	<ul style="list-style-type: none"> • Better understanding of load consumed by substation equipment. • Sets the example to our customers regarding adopting a scientific approach to energy reduction and efficiency • Provides a well-researched action plan • Researches how to create a self-sufficient substation. Develops and costs this and reports openly. 								
Future benefits	<ul style="list-style-type: none"> • Follow the action plan to reduce substation in-house load and report on achievement. • Implement any recommendation regarding self-sufficient substation projects either as future design policy or conversion of existing substations. • Amend design / operational policies. 								
LDR Justification	<p>Under our Losses Strategy we are already considering our civil substation specifications. This initiative extends the Strategy work by an innovative project to ascertain whether self-sustaining substations are viable.</p>								
Assessment Criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Understanding</td> <td> <ul style="list-style-type: none"> • Improved understanding of in- house consumption. </td> </tr> <tr> <td>Stakeholder</td> <td> <ul style="list-style-type: none"> • Strong engagement with supply chain. </td> </tr> <tr> <td>Process</td> <td> <ul style="list-style-type: none"> • Takes account of international experience. • We would seek partners to share cost and learning. </td> </tr> <tr> <td>Innovation</td> <td> <ul style="list-style-type: none"> • Considers innovative techniques to reduce in-house demand. </td> </tr> </table>	Understanding	<ul style="list-style-type: none"> • Improved understanding of in- house consumption. 	Stakeholder	<ul style="list-style-type: none"> • Strong engagement with supply chain. 	Process	<ul style="list-style-type: none"> • Takes account of international experience. • We would seek partners to share cost and learning. 	Innovation	<ul style="list-style-type: none"> • Considers innovative techniques to reduce in-house demand.
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5 Assessment of LDR Initiatives (Tranche 1)

This section outlines how the initiatives meet each of the criteria and sub-criteria stated by Ofgem in their LDR guidance document. They will be regularly reviewed to ensure ongoing compliance.

UNDERSTANDING
<p>Are companies able to demonstrate how they are improving their understanding of the current level and sources of losses on their networks (including through the use of Smart Meter Data)?</p> <p>In line with the forward looking aim of Tranche 1 to improve understanding, our portfolio of projects has a strong emphasis on more accurate quantification of existing levels and better understanding of the sources of losses on our networks. This is followed by improved tools to better understand the impact and economies of managing/reducing losses. All initiatives included in our LDR submission contribute toward this objective.</p> <p>We will make innovative use of Smart Meter Data to help quantify the level of non-technical losses, to detect energy theft and, coupled with increased revenue protection activities, to aid our understanding of the sources of non-technical losses in our networks. (Initiative 1, supported by Initiative 7)</p> <p>We intend to design and implement prototype systems to use Smart Meter Data to indicate areas of LV network where loadings give rise to high losses. This will increase visibility and understanding of losses at HV/LV and LV. (Initiative 2)</p> <p>We plan to expand our losses modelling capability by the development of improved tools. These will serve to better quantify the technical losses in areas of network with complex (stochastic) power flow patterns, e.g. mixed embedded generation and demand, or areas of heavily interconnected network. (Initiative 4). We intend to improve assessment of rural HV networks to ascertain indicators of high levels of phase-imbalance. (Initiative 5). These tools will be useful when assessing the business cases for mitigation and also in enabling informed holistic assessments.</p> <p>We intend to improve understanding and characterisation of load behaviour and voltage/load relationships to be able to better assess losses potential from voltage reduction activities. (Initiative.3) Characterisation of power-factor / losses relationship across our networks is improved to inform holistic optimisation of power-factor management. (Initiative 6)</p> <p>We intend to facilitate an active management (DSO) role by administrative, commercial and technical enablers. We will progress our understanding of customer drivers through customer engagement and determine the relationships between altered customer behaviours and losses. (Initiative 8)</p> <p>We also include two initiatives relating to substation efficiency. We currently have no facility to accurately record the energy required to operate our substations. Although the energy is not large for individual substations, collectively it is substantial. We intend to meter substation energy use and explore opportunities to: reduce substation energy use, re-use waste heat; and establish whether self-sufficient substations would be viable. (Initiatives 9 and 10)</p>
<p>Are companies considering the network in a holistic manner and making efforts to understand how losses on their network affect others e.g., those on the transmission and/or other distribution networks?</p> <p>We recognise that a long term, whole-system view should be taken to understand and optimise the efficiency of the overall GB electricity systems in the context of UK energy and carbon policies. We envisage that industry wide collaboration will be required to accurately achieve this, and standardisation in systems of working and reporting will need to be agreed.</p> <p>Initiative 6 is fundamentally a whole-system network investigation whereby systems of holistic working with stakeholders are tested by taking an example (management of power factor) and collaboratively considering whole system solutions. Improved tools for quantification of losses and carbon benefits will also support this activity (Initiative 4).</p> <p>All loss reduction activities which reduce the energy flowing through the upstream network will be reported separately from those activities where the energy remains un-altered (i.e. non-technical losses where only the remuneration to the Supplier is affected).</p> <p>We will quantify the upstream losses benefits of loss reduction in lower voltage networks.</p>

ENGAGEMENT

How are companies planning to utilise stakeholder engagement to inform their losses management actions and allow them to understand their impact?

We plan to hold discussions with any interested parties at the inception of the LDR initiative work (**All initiatives**). With relevant stakeholders we would carry out tailored engagement, collect and analyse feedback, develop and adapt actions based on the feedback and then report progress back to stakeholders.

It is our intention to publish an LDR programme/plan document at the inception of the project and then, at a suitable stage, one (or more) interim report documents which will be used to seek views.

We have already demonstrated the value of engagement with community organisations (police, housing association, emergency services) in relation to non-technical losses (**Initiative 7**) and we seek to extend this trial. **Initiative 9** engages stakeholders regarding alternative uses for heat.

We plan to develop a forum on losses and seek to involve stakeholders at all levels (**Initiative 9**).

How are/will companies engage with stakeholders (e.g. suppliers, distributed generators, the TSO, TOs etc.) to develop relevant partnerships which may help to manage losses (e.g. opportunities to use DSR)? This could include initiating a joint project where a reduction in losses is the primary driver or identifying opportunities within existing projects.

In many cases the initiatives in Tranche1 are about better modelling of losses on the network and validating those models through measurement and essential engagement with other utility organisations and their modelling agents. In some initiatives we see significant value in University level input (**Initiatives 3, 4, 5**) into optimising the initiative and we will form appropriate arrangements. Where there are innovative hardware implications (**Initiatives 9 and 10**) we intend to form partnerships with appropriate manufacturers / suppliers to better understand the opportunities.

Initiatives 1, 2 and 7 will seek input from the Meter Operator (and suppliers), **Initiatives 3, 6 and 8** involve TOs.

Network users are heavily involved in **Initiative 8** and focus groups e.g. energy managers and housing associations in **Initiative 4** (but at a later stage). We see a wide stakeholder steering or monitoring group in **Initiative 8**.

Are companies able to demonstrate that they have processes in place to share their own best practice with relevant stakeholders? This could include engaging with one another, the Transmission System Operator (TSO) and the Transmission Owner (TO) to facilitate a holistic and co-ordinated approach to losses management.

We plan to engage in continuous knowledge and shared learning by open access reporting and seminars at the inception stage, interim stages and in concluding Tranche 1. (**All initiatives**)

Initiative 6 is a whole-system network investigation whereby systems of holistic working with stakeholders are tested (or proposed). We have been discussing the requirement for a more structured, collaborative approach with other DNOs (see Appendix 6). Improved tools will support this activity (**Initiative 4**).

We plan to develop a forum on losses and seek to involve a wide range of stakeholders at all levels (**Initiative 9**).

We remain open to shared initiatives with other DNOs and will facilitate where appropriate. We intend to chair the Technical Losses Working Group within the ENA Electricity Networks and Futures Group. A key focus of this group will be to ensure that all UK DNOs co-ordinate our approach and collectively share our findings - not only regarding what works, but also about challenges faced.

PROCESSES

Have companies looked at best practice, both nationally and internationally, when considering processes and methods to manage losses on their networks?

In compiling our portfolio of LDR initiatives we considered Ofgem's guidance, DNOs published Losses Strategies, information from industry experts, and best practice from our parent company. **All Initiatives** have literature or other forms of review embedded into them. We will continue to use contacts through CIGRE and CIRED and make use of information available through our parent company Iberdrola. **Initiative 9** includes a public expert event and seeks contributions from stakeholders all across the industry. **Initiatives 1 and 7** build and act upon fraud detection algorithms developed by Iberdrola, Spain.

For **All Initiatives** we will review prior work undertaken by ourselves², other DNOs³ and the wider industry⁴ and determine if updates are required to progress the initiative. Where we identify that insufficient information is available to provide confidence we have suggested peer review of the approaches.

How are companies preparing to effectively use Smart Meter Data to develop specific actions to manage losses?

Several **Initiatives (1, 2, 7 and 8)** are directly linked to developing processes and analysis suitable to be used ahead of Smart Meter Data but also form the basis of large Smart Data analysis applications.

INNOVATION

How are companies planning to use innovative approaches to manage losses (including through the use of Smart Meter Data) outside of projects funded through the RII0-ED1 price control and the innovation stimulus mechanisms?

Initiatives 1, 2 and 8 require new data management and modelling systems.

Initiative 3 extends existing work by ENW into other networks/network types. **Initiative 4** builds new tools for complex network loss analysis. **Initiative 5** develops indicators of severity for imbalance on rural networks. **Initiative 6** develops new approaches to holistic working and paves the way for inter-utility communication as active network management is considered. **Initiative 8** develops enablers for active network management. **Initiative 9** develops methods to use transformer waste heat and **Initiative 10** seeks to develop a self-sufficient or at least low energy usage pattern for substations.

How will companies incorporate these approaches into “business as usual” activities?

Tools and learning (**Initiatives 1, 2, 3, 4, 5**) will generally be used first in the planning time frame. Experience and improvement gained in this “off-line” environment should give confidence that the basic approaches and algorithms are suitable for control applications. In the off-line application, as soon as validated, the tools will be utilised in improving the losses elements of decision making.

Analysis tools to use Smart Meter Data (**Initiatives 1 and 2**) will be progressively part of BAU as Smart Meters are rolled out. Interim arrangements for working with part-synthesised data will be developed.

In **Initiative 6** processes developed for the basis of on-going communication between transmission and distribution operators, so that holistic assessment becomes an embedded practice.

Processes developed under **Initiative 8** will form part of the commercial, legal and technical basis for the roll out of user involvement in active system management.

Substation efficiency/heat recovery (**Initiatives 9 and 10**) may be rolled out depending upon economics.

During the development of the LDR initiatives we have confirmed and validated that none of the activities would be rewarded under other funding mechanisms. Confirmation is included within Appendix 5.

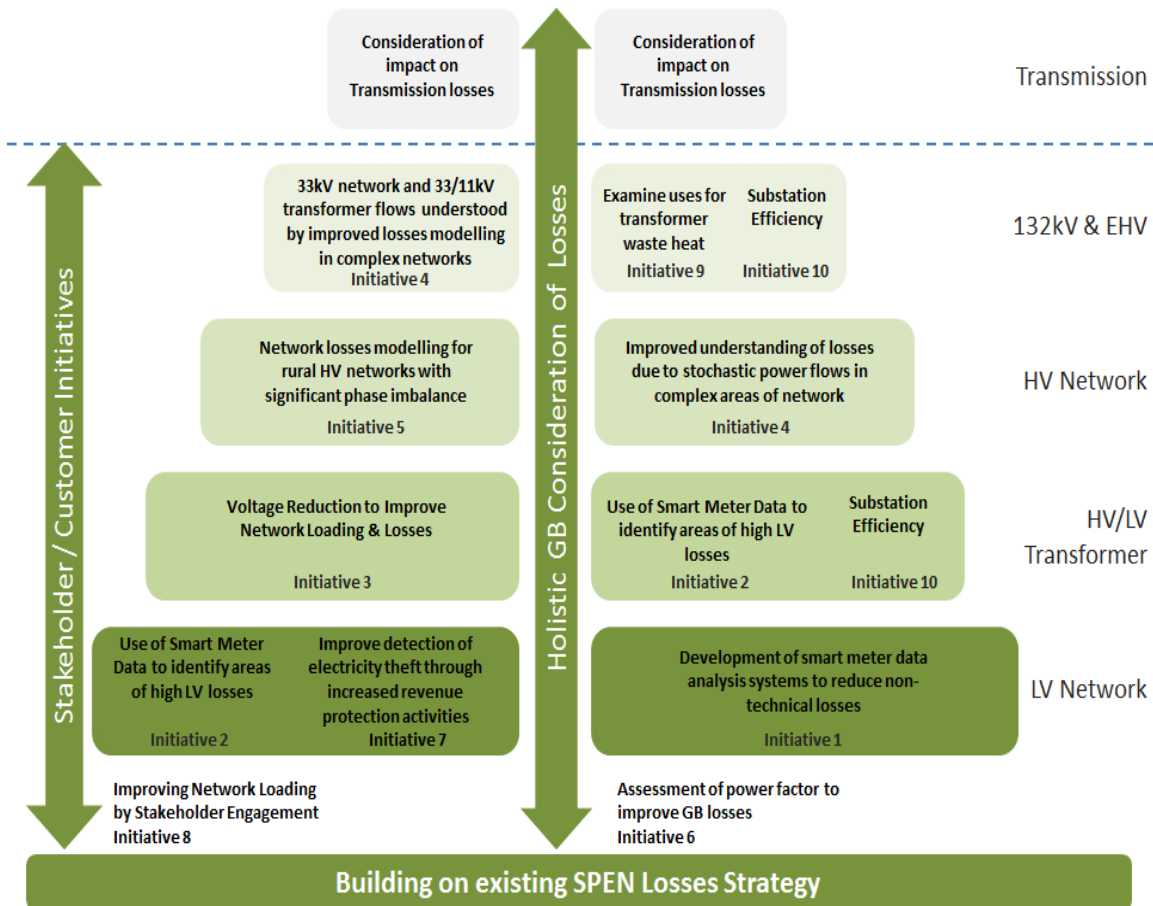
² Flexible Networks LCNF Tier 2 project

³ Other DNO LCNF / IFI projects (in particular SSE LEAN, ENW Smart Street, NPG CLNR, WPD Lincolnshire Low Carbon Hub, Falcon, UKPN Fun LV, Sohn Associates & Imperial College Losses IFI)

⁴ ENA STP, CIGRE, CIRED and wider academic documentation

6 Conclusion

The portfolio of projects included in this application is balanced to match our overall needs and networks, recognising that a stakeholder and holistic approach is required when analysing and managing losses to achieve the maximum benefit. This approach, considering all voltage levels, network interfaces and stakeholder and customer engagement is summarised in the following diagram:



These initiatives have been identified to:

- improve losses knowledge over our entire network, geographically and with regard to voltage;
- build upon work carried out within the UK and capture international experience from our parent company and others;
- develop tools to use Smart Meter Data and network information ahead of the widespread roll out of the Smart Meter equipment, dealing with partial data availability;
- ensure the interests of stakeholders are recognised in designing the way forward;
- share the learning widely and encourage collaborative working;
- develop enablers for the DSO role of Active Network Management, as a way of reducing losses and facilitating capacity; and
- develop holistic working within the industry and its stakeholders.

Furthermore, we have been actively investigating working with other DNOs to achieve the maximum efficiency and breadth of coverage of the initiatives. In some cases industry-wide management of initiatives might be appropriate.

Appendix 1 - Glossary

ANM	Active Network Management
BAU	Business as Usual
CBA	Cost Benefit Analysis
BThU	British Thermal Unit
DECC	Department of Energy and Climate Change
DNO	Distribution Network Operator
DSM	Demand Side Management
DSO	Distribution System Operator
DSR	Demand Side Response
DUoS	Distribution Use of System
EHV	Extra High Voltage (33kV and above)
EMS	Energy Management System
ENA	Electricity Networks Association
GIS	Geographical Information System
GWh	Gigawatt Hour
HV	High Voltage (11kV and 6.6kV)
IFI	Innovation Funding Incentive
kV	Kilovolt
LCNF	Low Carbon Network Fund
LCT	Low Carbon Technologies
LDR	Losses Discretionary Reward
LV	Low Voltage (< 1kV usually 415V)
MDI	Maximum Demand Indicator
NGET	National Grid plc
RIIO-ED1	Revenue = Incentives + Innovation + Outputs – Electricity Distribution ¹ 2015/16-2022/23
SPD	SP Distribution plc
SPEN	Scottish Power Energy Networks
SPM	SP Manweb plc
STATCOM	Static Synchronous Compensator
TO	Transmission Owner

Appendix 2 - Loss Reduction Strategy

A2.1 Technical Loss Reduction

The following extract from our Losses Strategy sets out the main Technical Loss reduction activities to be achieved in RIIO-ED1 under Licence Condition 49.

Equipment Improvements

- Opportunistic replacement of Grid and Primary transformers.
- Proactive replacement of older ground mounted transformers and opportunistic replacement of pole mounted transformers.
- Proactive move toward minimum size of 100mm² HV overhead main line;.
- Project specific consideration of larger cable sizes but on-going review of policy.
- Review of policy on LV service cable sizes.
- Consideration of energy efficiency of substation buildings.

We also identified within the Losses Strategy the need for the following unquantifiable improvements.

Enablers for Development in RIIO-ED1

- Roll out HV and LV monitoring and Smart MDIs on parts of the network to improve knowledge and decision making for loss reduction and efficient network utilisation. We consider this project as Business As Usual (BAU). There are related analysis projects in LDR.
- Use Smart Meter Data together with network measurement to prioritise loss reduction. The use of that data is BAU however we believe that we should now develop reasonable and consistent dummy data sets to plug data gaps and advance the development of application tools ahead of Smart Meter roll out and treat that advancement work as LDR.
- Study and improve the optimal network configuration first as a static improvement, then as real-time optimal configuration. We believe that the static case is BAU. We would welcome the opportunity to also focus now on development of the enablers for real-time active network management for losses as part of LDR.
- Enhanced network modelling for losses by development of a stochastic network modelling tool. We think that this is a better fit with LDR Tranche 1 because it closely links with, and is of the same character as, other LDR projects. It is not possible to justify with a traditional reasonableness test.
- Advanced network solutions by information and control systems. We see development of equipment and controllers for these advanced network solutions as BAU, but the project links closely with several LDR initiatives related to Stakeholder involvement and active network enabling.
- Power factor and power quality actions are dependent upon information from network monitoring and Smart Metering projects. We would seek to advance a specific project under LDR to consider the total system losses impact of a National Grid distribution power factor initiative.

Stakeholder Engagement actions

- Seek to develop DSM, tariffs and smoother network loading via tariff and automation – use Smart Meter Data to identify opportunities. We consider the roll out of this project to be BAU but we consider that there is an opportunity for tactics to be informed by ideas and stakeholder interactions generated within LDR initiatives. We expect this to generate more robust and acceptable solutions.

- Continue to seek ways to connect new generation to our network which de-carbonises the overall system. This is BAU, but again the LDR stakeholder forums will provide more robust and acceptable approaches.

A2.2 Non-technical Loss Reduction

The following extract from our Losses Strategy sets out the main Non-technical Loss reduction activities to be achieved in RIIO-ED1 under Licence Condition 49.

- Revenue protection - we will be increasing staff and will continue to work closely with police and other stakeholders and to share best practice. There are related projects under the LDR.
- Transactional theft - additional visits we consider as BAU. We intend to use Smart Meter Data and network data to detect transactional theft. We would seek to advance the development of software in Tranche 1 ahead of the widespread availability of Smart Meter Data, by using dummy data and inserting unusual consumption patterns.
- Unmetered supplies - improve records accuracy; audits, reasonable ways to improve unmetered supply inventories. We consider these as BAU.
- Smart Meter Data to target areas. There are related projects under LDR.

We believe these elements of our revenue protection service lie outside our Licence requirement but we wish to continue to develop these activities.

Appendix 3 - Specific Explanation of Items linked with Losses Strategy

The following table discusses any association between these LDR initiatives and our Losses Strategy.

LDR No.	LDR Initiative	Closest Strategy Initiative	Comment
1	Development of Smart Meter Data analysis systems to reduce <u>non-technical</u> losses	9.2.1 Smart Meters reducing non-technical losses	<p>The Losses Strategy promises to examine ideas and create the linkage with network data and substation data.</p> <p>This LDR initiative additionally:</p> <ul style="list-style-type: none"> • Builds on advanced fraud detection algorithms being employed successfully by Iberdrola in Spain; • Uses synthesised data to develop / test software ahead of Smart Meter roll out; • Develops multi-factorial demand pattern analysis approaches.
2	Development of Smart Meter Data analysis systems to reduce <u>technical</u> losses	7.5.3 Substation and LV Network Monitoring - Project 2 To consider methods of reconciling Smart Meter Data with substation monitor data.	<p>The Losses Strategy promises to examine ideas and create the linkage with network data and substation data.</p> <p>This LDR initiative additionally:</p> <ul style="list-style-type: none"> • considers that Smart Meters should be useful in technical losses decision making without co-joining the data with network monitoring; and • develops models and uses both real and synthesised data to develop and test realistic losses based decision making algorithms ahead of Smart Meter roll out.
3	Voltage Optimisation to Improve Network Losses and Load	7.5.1 Voltage reduction and Optimisation	The Losses Strategy references long rural networks whereas the LDR has a wider target of candidate networks to be considered for voltage optimisation.
4	Improved Modelling of Complex Networks to Reduce Losses	7.5.5 Development of Enhanced SPM modelling tools	This is an enabler project which will allow us to better quantify losses and business cases of interventions. The Losses Strategy sets out this project in general terms, under LDR funding is sought to develop tools, possibly in combination with other DNOs.
5	Improved Modelling of HV Rural Networks to Reduce Losses	In Section 7.5 we refer to phase imbalance locations and here are considering the urban environment.	The LDR initiative is aimed at identifying rural environments where phase imbalance may lead to excess losses and should facilitate developing the CBA approach for these situations.

6	Assessment of Power Factor to Improve GB Losses	None	The Losses Strategy refers to quantifying the benefits of improved power factor whereas the NGET initiative is aimed at maintaining a lagging power factor at distribution level. The LDR tests the total system implications of NGET's approach and develops processes of holistic assessment.
7	Improved Detection of Theft through Revenue Protection	8.1.2 Revenue Protection Services We highlight work with Merseyside Police and with housing associations and emergency services.	We believe these elements of our revenue protection service lie outside our Licence requirement but we wish to continue to develop the activity. We are happy to share the scale of costs and benefits throughout the seven year period for the learning of other DNOs and Licensed Suppliers.
8	Improving Network Loading by Stakeholder Engagement	None	The LDR seeks to develop the administrative, legal and technical tools to enable active distribution network management.
9	Substation Efficiency – investigate alternative uses of waste heat	None	The LDR seeks to investigate the technical and economic implications of converting transformer losses into useful heat.
10	Substation Efficiency - monitoring & consider self-sufficient substations	7.5.6 Improvement of our house load. In this section we intend to look at our civil substation specifications to ensure low energy use.	In LDR we plan to study substation load patterns with a view to designing self-sufficient or close to self-sufficient substations. There could be linkage with initiative 9 above.

Appendix 4 - Working with Partners

Throughout this LDR initiatives paper, we have indicated that we are keen to share cost and activity with other DNOs and will pursue where appropriate.

There are three sharing processes likely to be useful, depending upon the initiative under consideration. There are common elements in each process.

Management Process Tasks	
Common	Review the opportunities for sharing. List potential partners. Organise discussions and appoint an Initiative Management Task Forces and a convenor. Determine the management / review / reporting structure and budget / resource contributions.
Process 1	Minimal Sharing / Peer Review Parties are asked to commit to certain actions of insignificant value. The timetables and responsibilities are set out and agreed. The process is managed by the Initiative Management Task Force.
Process 2	High Sharing (externally managed) The initiative is managed by an external agent. The Initiative Management Task Force drives the scope, any variations, cost and resource sharing. The Initiative Management Task Force drives the arrangements, timetable, quality and costs.
Process 3	High Sharing (SPEN managed) (This approach may be more appropriate where there is a higher level of data confidentiality or network contact.) The initiative is managed directly by the companies involved. The Initiative Management Task Force drives the scope, any variations, cost and resource. sharing The Initiative Management Task Force drives the arrangements, timetable, quality and costs. The Initiative Management Task Force drives the co-ordination of activity by DNOs.
Common	The Initiative Management Task Force reviews the findings and the interim and final reporting and controls public information.

Common - means common to all processes.

Appendix 5 - Statement on other Sources of Funding

The initiatives included within this submission have been developed specifically to further understand and manage network losses. The work to be undertaken has not been submitted for funding under existing reward mechanisms.

We submitted a business case for funding to support the achievement of Smart Meter benefits as part of our ED1 RIIO submission. This covered both financial and customer related benefits over the course of ED1. However no losses related incentive was included in these plans as it was understood that losses matters would be dealt with separately.

Collaborative and stakeholder engagement actions identified within the LDR initiatives are not included within our Stakeholder Engagement Work Plans.

Appendix 6 - DNO Collaboration Regarding Holistic Consideration

Whilst, historically, DNO licence areas operate independently we are keen to work with Ofgem and other DNOs to discuss how the design of initiatives and rewards systems can promote a culture of collaborative working.

Generally interconnection between distribution licence areas is limited to the geographic fringes of the network. Throughout UK DNO networks, there are sites at or near the geographical boundaries where either ownership is shared, or supplies are taken from the adjacent network operator.

Because of these geographical boundaries, there is potential within the existing arrangements for there to be inefficiency which cannot be quantified by any single party. This leads to a requirement for a common, consolidated and collaborative approach to work more closely together as network operators. This is to ensure that the most efficient solutions are provided for the benefit of our customers.

Toward this goal we have entered discussions relating to an Inter-Network Engagement working group. This forum recognises that a collective approach could lead to a number of customer benefits and is committed to exploring both the potential benefits and methods of working. This working group is still in the process of being established, however to date this group has received expressions of interest from:

- Scottish Power Energy Networks;
- Scottish and Southern Energy Power Distribution;
- UK Power Networks;
- Western Power Distribution; and
- Scottish Power Transmission.

There has been agreement to hold working level meetings in 2016 to explore the potential benefits of a more structured approach and to lay out a process to define the principles required to improve DNO interaction.

Some areas of interest relate to:

- methods of determining the most efficient Point of Connection (PoC) for future customers (regardless of geographical network boundaries);
- consideration of the level of transfer capacity between DNO areas which may be used to meet P2/6 compliance under N-1 conditions; and
- holistic assessment of network configuration and voltage settings for optimising network efficiency.

The process will detail how to access/share key information required to inform network analysis outside of the DNO patch and will support holistic inter-DNO analysis to ensure losses are considered as a whole network, as opposed to DNO licence area level.

Specifically in relation to losses, we intend to chair the Technical Losses Working Group within the ENA Electricity Networks and Futures Group. A key focus of this group will be to ensure that DNOs co-ordinate approaches and collectively share findings.

Appendix 7 - The LDR Award Process

The discretionary reward is worth up to £32m across all DNOs and available in three tranches over the eight year RIIO-ED1 price control. The focus of the Tranches is set out below:

Tranche 1	Assessment of the processes DNOs are exploring and implementing to significantly shift expectations of what they are capable of doing to reduce losses.
Tranche 2	Focus on the specific outputs produced and actions undertaken by DNOs to manage losses and shift expectations, and the concurrent improvements in understanding.
Tranche 3	A predominantly backward looking assessment of losses management achievements and preparations for RIIO-ED2.

Ofgem have set out four criteria for assessing initiatives proposed under Tranche 1, and DNOs must demonstrate they are shifting the expectations of their capability to reduce losses by:

Understanding	<ul style="list-style-type: none"> - Improvement of understanding of the current level / sources of losses - Consideration of the network in a holistic manner and efforts to understand how losses on own network affect other transmission/distribution networks.
Engagement	<ul style="list-style-type: none"> - Use of stakeholder engagement to inform of losses management actions and expected impact. - Engagement with stakeholders to develop relevant partnerships which may help manage losses (e.g. Demand Side Response). - Demonstration of processes to share own best practice with relevant stakeholders. - Verify that any stakeholder engagement actions are not already rewarded.
Processes	<ul style="list-style-type: none"> - Consideration of national and international best practices to manage losses. - Preparing to effectively use Smart Meter Data to develop specific actions to manage losses.
Innovation	<ul style="list-style-type: none"> - How are DNOs planning to use innovative approaches to manage losses (outside of projects funded by ED1 innovation stimulus mechanisms). - How will companies incorporate approaches into 'business as usual'. - DNOs must verify that innovation activities are not funded under any other ED1 financial initiatives.