UK Power Networks

Business plan (2015 to 2023)

Annex 22: Asset Plan Production Process

March 2014

“A reliable... an innovative... and the lowest price electricity distribution group.”

UK Power Networks
Delivering your electricity

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Document History

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1 Executive summary

This document explains the overarching process and principles used to derive the Network Asset Management Plan (NAMP) that defines our direct spend for RIIO ED1 period.

The NAMP consists of all of the investment streams that directly relate to expenditure on our network – i.e. direct costs. We assess the need for investment by applying appropriate and proportionate approaches depending on the materiality of the investment stream.

Our industry leading modelling techniques and analytical frameworks provide us with objective analysis upon which to build our investment plans. We enhance this analysis with rigorous expert assessment that incorporates a broad range of considerations (stakeholder input, history, local knowledge, innovation insights), all working within our asset management strategy and policies.

This human enhancement of modelled output allows us to develop robust and justified sets of investment need cases – that can see either increases or decreases in the volume of activity compared to the raw modelled output. These adjustments seek to ensure that we plan to undertake activities based on the fullest possible consideration of the information available.

We translate each of the need cases into engineering options through a robust process that consists of: considering potential solutions, short-listing and finally identifying the scheme that delivers the greatest long term value for customers while meeting our obligations. Taken together these individual decisions on work are brought together to form a complete efficient investment stream to deliver the required outputs, e.g. non-load related (NLRE), load related (LRE) or quality of supply (QoS).

The individual investment streams are aggregated into the NAMP through an optimisation process that seeks to ensure that the interactions between streams are recognised and the objectives and outputs appropriately balanced.

We then test the full NAMP to ensure that it is consistent, well-justified and robust within the bounds of uncertainty, deliverability and financeability.

2 NAMP development process

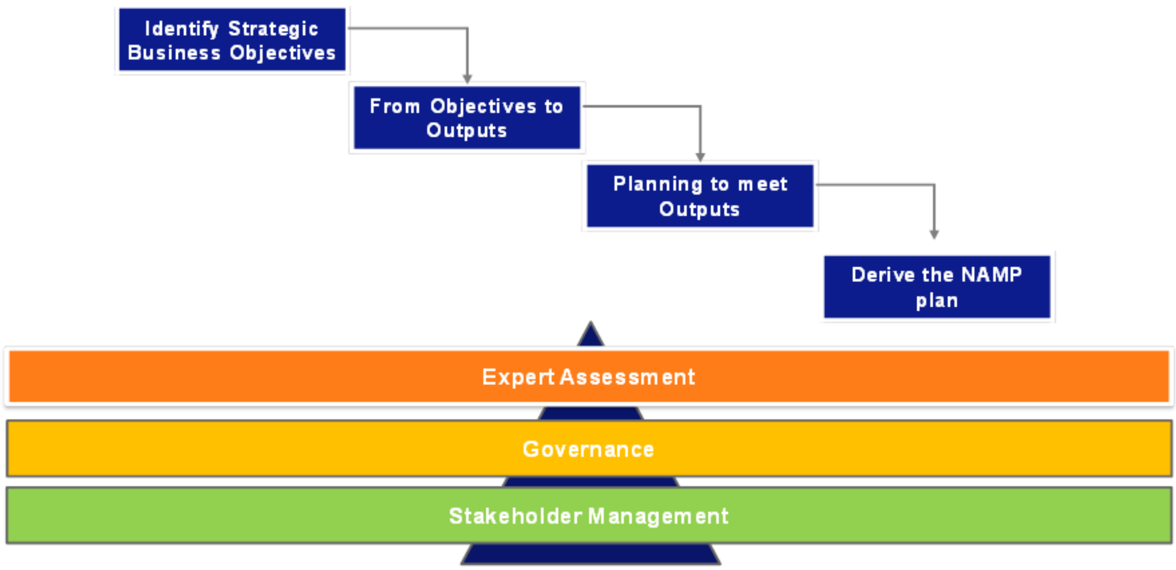
The Network Asset Management Plan (NAMP) contains the company's best view of investment needed in each of our networks to meet outputs and commitments during the RIIO ED1 period (from April 2015 to end of March 2023). The investment projections incorporated in the NAMP relate to all of the expenditure on our network – i.e. what is termed our direct capital and direct operating costs.

2.1 Overarching process

The NAMP is produced on a rolling basis, updated annually and feeds directly into the production plan used by our delivery functions.

We follow a robust process that links the business' direct expenditure to the objectives and the outputs we have committed to deliver. Figure 1 provides an overview of the steps taken to develop the NAMP.

Figure 1 NAMP development framework



The NAMP development process consists of:

1. Identifying strategic business objectives aligned to our stakeholders views and committed outcomes
2. Translating the high level objectives to the outputs we have committed to deliver
3. Developing detailed planning analysis to meet our objectives and outputs
4. Deriving the efficient volume and cost NAMP

Throughout the process we apply expert assessment and work with internal and external stakeholders to enhance and test our plans (e.g. seeking input on the balance of competing objectives, ensuring compliance, assessing economic efficiency and resilience to uncertainty).

The NAMP development process is subject to strict governance procedures. These define the approval authorities, roles, responsibilities and procedures that need to be adhered to when adding or changing the expenditure for investment projects included in the NAMP. In addition to that, we expose some key inputs and outputs to thorough scrutiny by our stakeholders (see chapter 7 for more details).

3 Identify strategic business objectives

The first step in the development of the NAMP is the identification of overarching strategic business objectives. These were developed within a process encompassing the whole business and signed-off by the Executive Management Team (EMT). The EMT has established these business plan objectives within the framework of our overarching corporate objectives (i.e. Employer of Choice, Respected Corporate Citizen and Sustainably Cost Efficient).

Below are (in no particular order) relevant strategic objectives that have been used to guide the NAMP development process;

- Invest (opex and capex) at the lowest long-term cost to manage the health and risk of the network thus avoiding detrimental impact on the outputs that are important to our stakeholders
- Invest at the lowest long-term cost to support the anticipated needs of a future carbon conscious network through the delivery of outputs that our customers value Operate our customer processes to deliver sustained customer satisfaction and performance
- Inform the regulatory outputs to recognise our approach to long-term improvements in safety
- Respond to society's existing and evolving expectations of social obligations to deliver value to the business

The application of these strategic objectives is discussed further in the context of Asset Management in our "Meeting Business Objectives" document.

3.1 From objectives to outputs

Our strategic objectives have been translated to specific commitments and outputs for the RIIO-ED1 period.

We have used extensive stakeholder engagement to develop our strategic objectives into the outputs and commitments. You can find more on our engagement programme in our Process Overview document that forms part of our Business Plan[1].

The decision on the outputs and commitments falls to our Executive team. They take into account a full range of expert assessment and information from stakeholder feedback, our networks' performance, in-progress innovations and our vision to be in the top third performance amongst our peers.

Table 1 below reports the overarching business objectives and their respective outputs where relevant to the NAMP development process.

Table 1 Output category mapping

Output category	Primary Output	Secondary deliverable
Reliability and	• Customer interruptions (CI) - planned	• Health Index (HI)

[1] UK Power Networks, 2015 to 2023 Business Plan Update, Incorporating stakeholder feedback, April 2013

Output category	Primary Output	Secondary deliverable
availability	• Customer interruptions (CI) - unplanned • Customer Minutes Lost (CML) – planned • Customer Minutes Lost (CML) - unplanned	• HI Criticality and Risk Index (RI) • Load Index (LI) • Resilience • Worst served customers (WSC) • Guaranteed Standards of Performance (GSoP)
Customer Service	• Customer Satisfaction Survey • Complaints Metric	
Connections	• Time to connect • Major Connections Stakeholder Engagement	
Environment	• Business Carbon Footprint (BCF) • Innovation Funding	• SF6 and oil leakage • Undergrounding in Areas of Outstanding Natural Beauty (AONB)
Safety	• Compliance with HSE (Health & Safety Executive) legislation and directives	• Asset Health, Criticality and Risk Index – see Network Reliability. This provides a framework for managing risk including safety • Number of fatal major and lost time contractor accidents • Number of public injuries (resulting from our activities)
Social	• Zero Harm • Public safety awareness	• Provision of PS (Priority Service) Register • Fuel poverty

4 Planning to meet objectives

Our investment planning process is based on a series of workstreams. These provide the analysis to support the investments we consider are required to meet our business objectives and deliver the output measures we have committed under RIIO ED1.

The key investment streams are:

- Load Related Expenditure (LRE)
- Non Load Related Expenditure (NLRE)
- Quality of Supply (QoS)

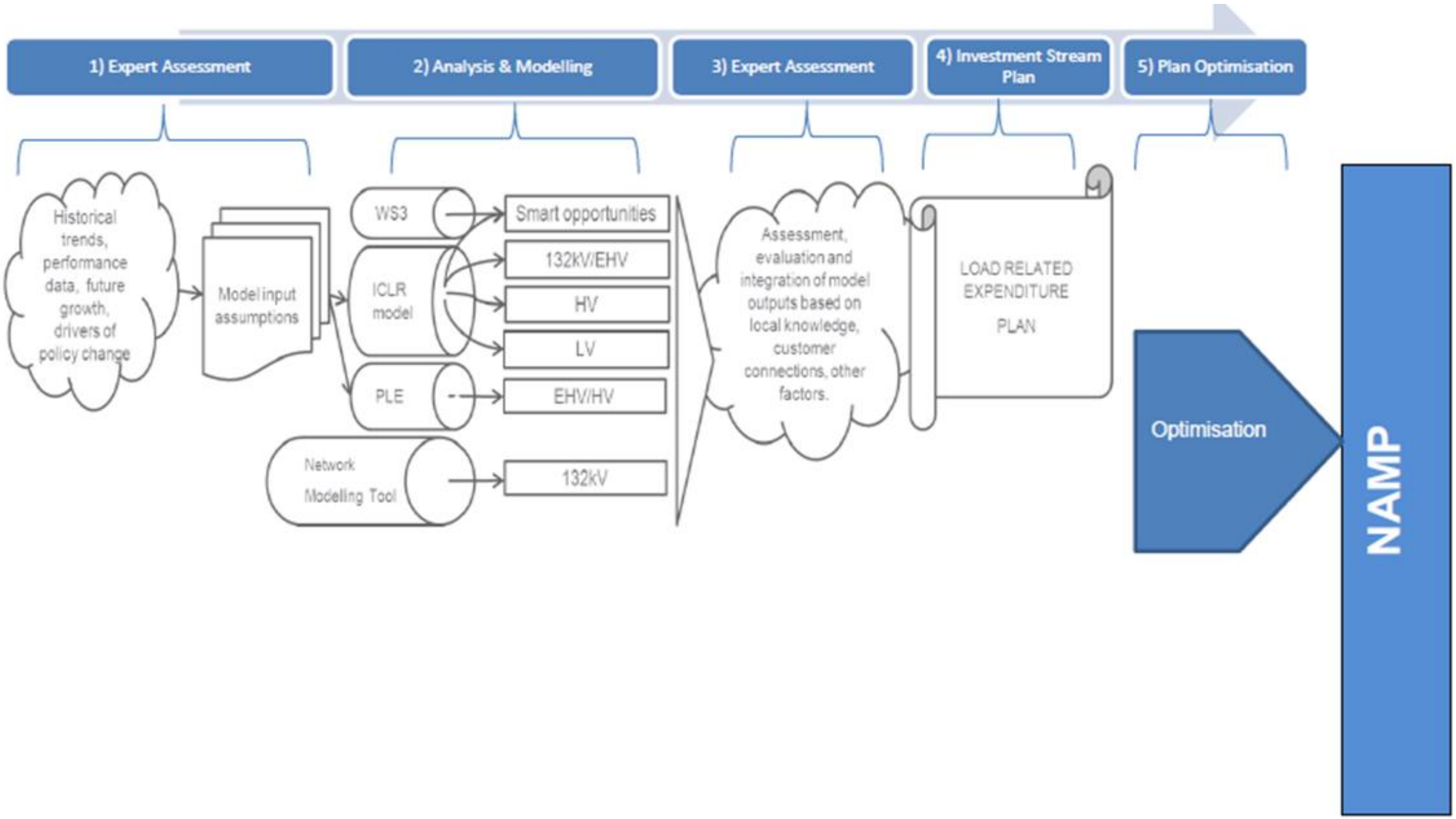
Within each investment stream, our approach to asset management and our use of industry leading modelling techniques provides a deep understanding of the issues and robust evaluation of the investment drivers. Together they form the basis of our business case and robust justification for each efficient investment project in each stream to ensure we can efficiently deliver our commitments and outputs.

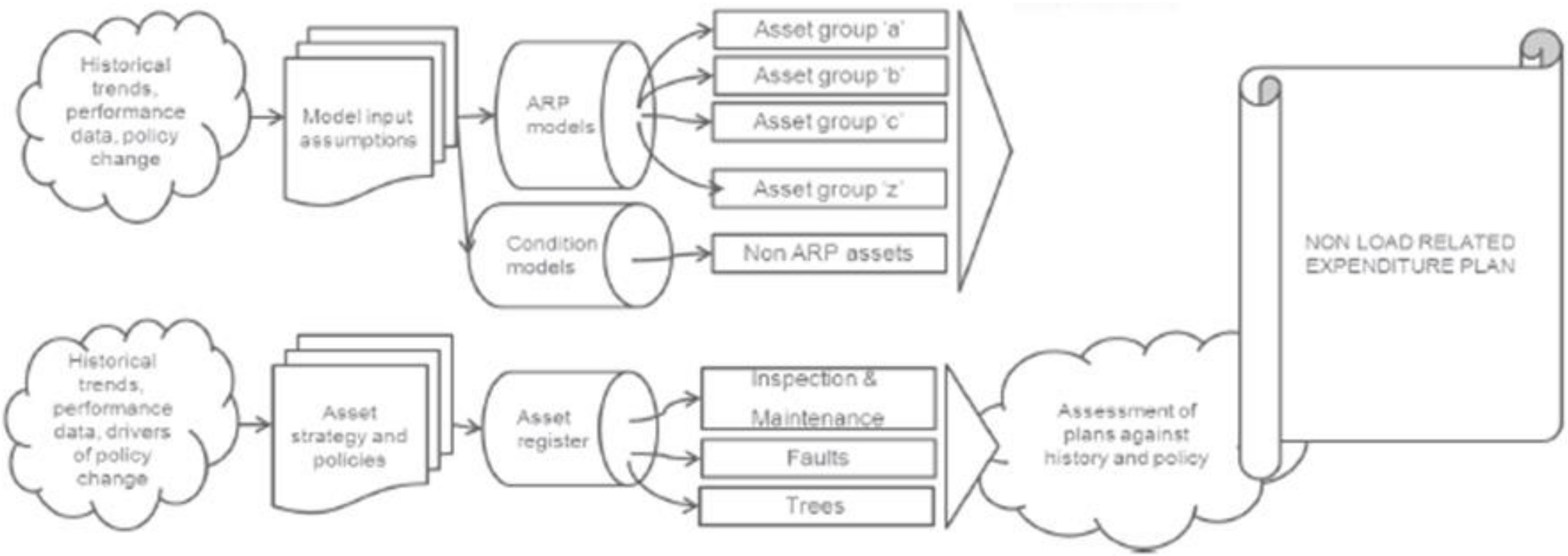
Figure 2 illustrates the overarching analytical framework used to derive the individual investment stream plans, and each of the stages is described in more detail below.

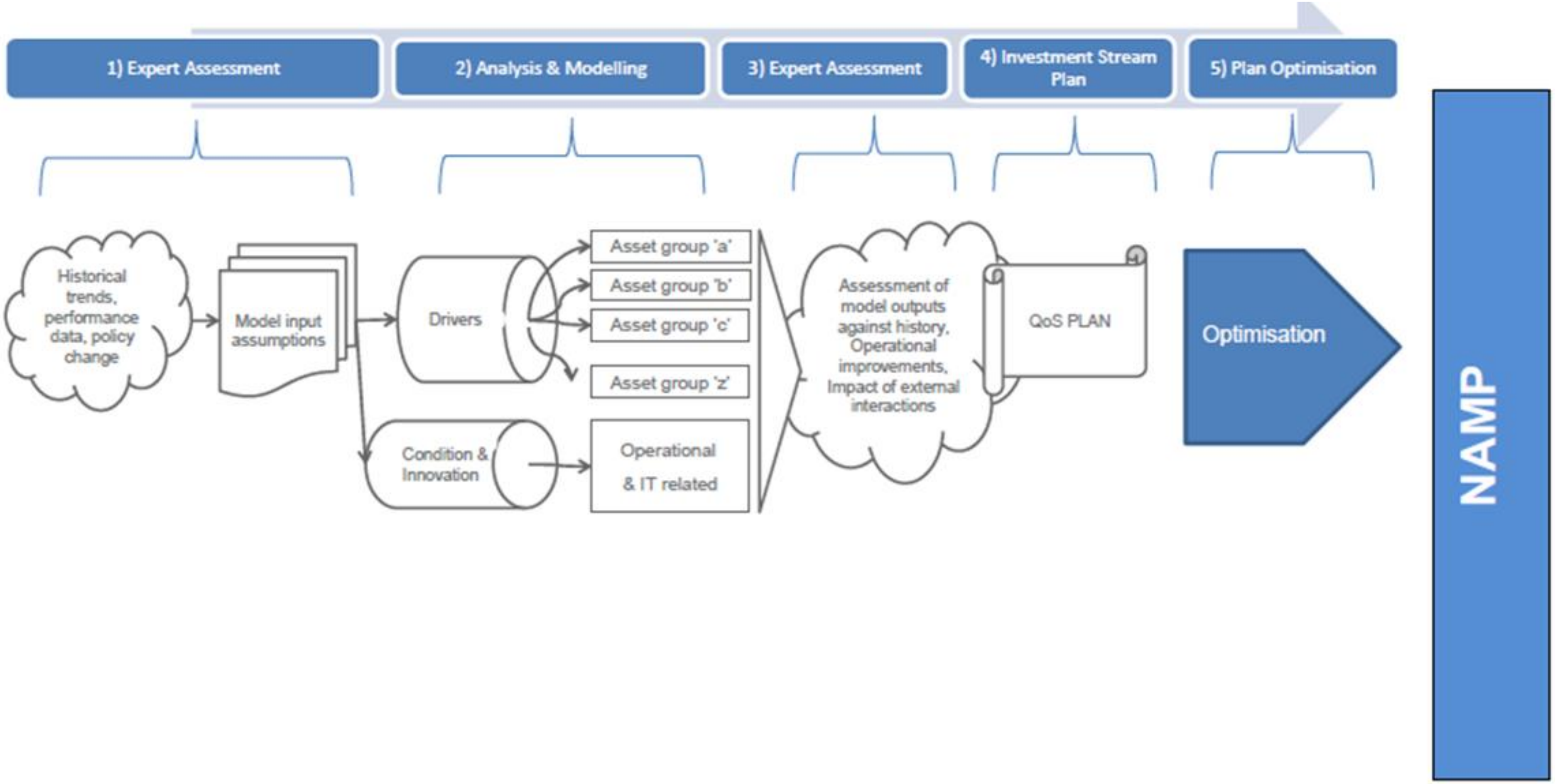
Expert assessment (step 1) inference from stakeholder engagement, historical trends, performance data etc, is used to derive the relevant **input assumptions** to the models and analysis. These are then used within the investment stream **specific analysis and model frameworks** (step 2). For example, for the asset replacement plans within the NLRE the tools used are the Asset Risk Prioritisation (ARP) models. These models are tailored to provide accurate forecasting of health and criticality indices to each asset group categories (e.g. substations, switchgear, etc.).

Expert assessment (step 3) is then rigorously applied to the model outputs in order to test the proposed investment programmes against factors such as historical trends, regional factors, site specific knowledge and the requirements of our asset policies. The refined outputs (i.e. the investment programmes) (4) are subsequently integrated into our Network Asset Management Plan (NAMP).

Figure 2 Modelling analytical framework




Historical trends, performance data, policy change
Model input assumptions
ARP models
Condition models
Asset group 'a'
Asset group 'b'
Asset group 'c'
Asset group 'z'
Non ARP assets
NON LOAD RELATED EXPENDITURE PLAN
Historical trends, performance data, drivers of policy change
Asset strategy and policies
Asset register
Inspection & Maintenance
Faults
Trees
Assessment of plans against history and policy


1) Expert Assessment
2) Analysis & Modelling
3) Expert Assessment
4) Investment Stream Plan
5) Plan Optimisation
Historical trends, performance data, policy change
Model input assumptions
Drivers
Condition & Innovation
Asset group 'a'
Asset group 'b'
Asset group 'c'
Asset group 'z'
Operational & IT related
Assessment of model outputs against history, Operational improvements, Impact of external interactions
QoS PLAN
Optimisation
NAMP

4.1 Planning investment streams

As previously discussed the NAMP has three key investment streams. Table 2 provides an overview of the three investment streams and the significant subcomponents.

Table 2 Planning Investment streams

Investment stream	Subcomponents
Load Related Expenditure (LRE)	• General Reinforcement • Diversions • National Grid related expenditure • Connections related expenditure
Non Load Related Expenditure (NLRE)	• Capex: – Asset Replacement – Asset Refurbishment – ESQCR (Electricity Supply, Quality & Continuity Regulations) – Civil Works • Opex: – Inspection & Maintenance – Faults – Trees
Quality of Supply (QoS)	• Quality of Supply investments • Operational IT (Information Technology) & Telecoms

Below we describe the individual investment streams. For each, we focus on highlighting the objectives, modelling techniques used, expert assessment applied and relevant interactions with other streams.

4.1.1 Load Related Expenditure (LRE)

The Load Related Expenditure Objective for RIIO ED1 is to maintain the overall network risk, based on assessment of utilisation - as indicated by our Load Index (LI) categories 1 to 5.

We assess the utilisation of our networks and seek to maintain the number of sites in our LI 4/5 categories (using our existing categorisation) broadly the same over time. The change of definition of LI, will mean LI4/5 is no longer an indicator of the need for intervention. However, we will continue to assess the need case for investment on the expected utilisation of assets, evaluating the opportunities for operating above the firm site capacity e.g. using smart technologies and our expertise in running our assets efficiently, while employing innovation and smart interventions to mitigate uncertainty around future load growth.

To achieve the LI objective we use the following models in order to predict the future demand growth on our networks and inform our investment decisions, e.g. around application and benefits of smart technologies:

- [Element Energy (EE)] Demand forecasting tool
- Planning Load Estimates (PLE)
- The Imperial College developed Load Related model (ICLR)
- Smart Grid Forum Work Stream 3 (WS3) Transform model
- Table 3 provides an overview of the four different models.

Table 3 LRE models

LRE Models / Frameworks	Overview
Element Energy	• Load growth model projecting future demand trends • Based on economic and technology factors[2]
Planning Load Estimates[3]	• Site specific investment model that supports decisions around the need for investment at HV and EHV substations, highlights constraining factor (which may include in/out bound circuits). • Ensures P2/6 compliance • Provides key outputs to meet the full range of statutory and licence requirements • Supported by Regional Development plans that record specific site by site drivers of demand growth • Uses Element Energy model output for load growth assumptions
Imperial College Load Related	• Innovative system level model • Models total system demand at all voltage levels (LV, HV, EHV and 132kV) • Flags constraints on all assets (circuits, substations, switchgear etc.), for a range of conditions, thermal, voltage, fault-level • Provides longer term view and allows alternative scenarios to be modelled to aid the understanding of the impact of Low Carbon technologies on the network • Uses Element Energy model for load growth assumptions
Transform (Smart Grid Forum, Work stream three -WS3)	• Models generic network types nationally to provide an indication of what and how smart could be deployed and indicative financial benefits • Our own models and expert analysis provide specific opportunities for smart based on a full understanding of our network topology and operating constraints that demonstrate how our plans fit within the envelope smart benefits suggested by the Transform model

The models described in the table above provide complementary perspectives regarding future LRE network requirements and we use the outputs of these models through the application of expert assessment. For example, the ICLR and PLE models are used:

- Individually when the results are not comparable in terms of outputs modelled (e.g. the PLE provides a site specific view whilst the ICLR also provides outputs relating to the system as a whole) or in terms of network modelled (e.g. the PLE does not provide a view on Low Voltage investment requirements; whilst the ICLR does)
- Jointly when their output is comparable, but complementary perspectives to the same problem are required (e.g. the PLE model is more likely to better identify constraints earlier than the ICLR as the former is a site specific model whilst the latter is a system maximum one)

The result of the modelling exercise provides a range of outputs and information that we use to develop our investment plan. In doing so, a complex set of factors and expert assessment will be taken into account to obtain the best engineering solutions that meet the committed objectives. This includes:

- Examining the opportunity of adopting non network related solutions to address the issue
- Estimating the impact on Quality of Supply of the alternative solutions

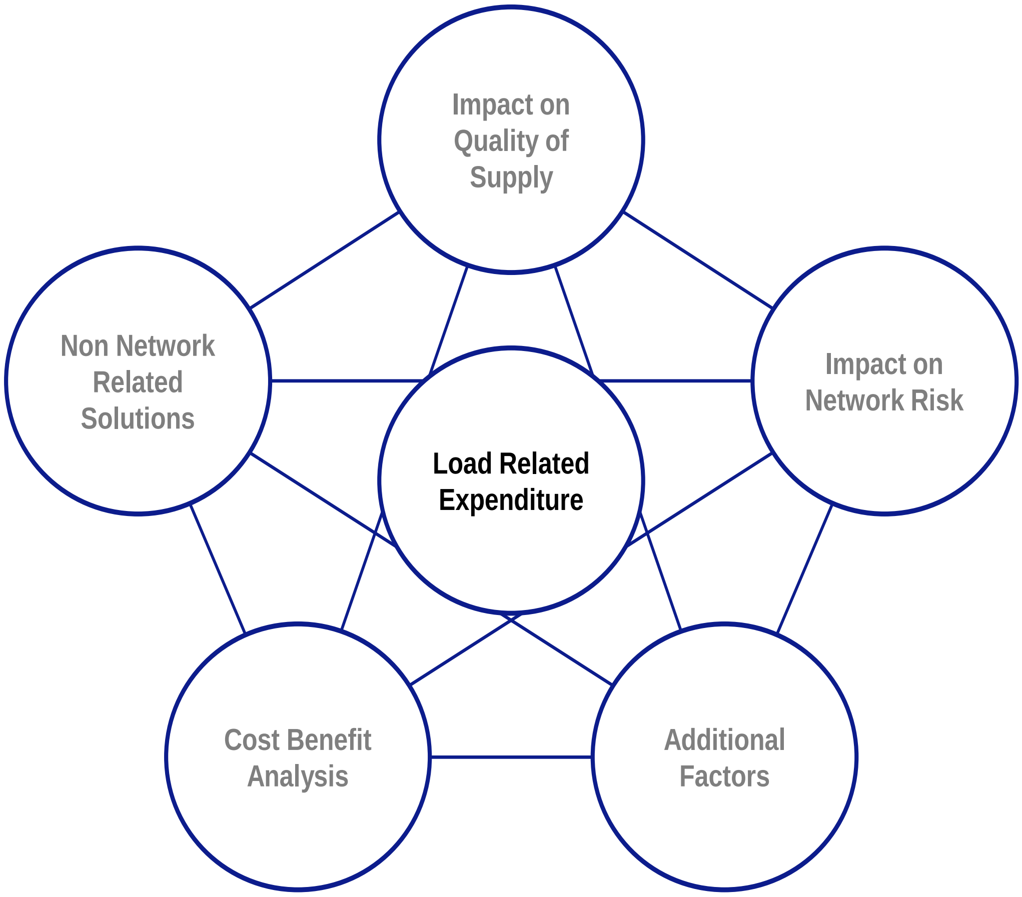
[2] Examples of economic growth factors include population growth and domestic thermal efficiency whilst technology factors include heat pumps uptake and onshore wind generation plans.

[3] A comprehensive description of the Planning Load Estimator model can be found in EDP 08-106

- Assessing the impact on network risk of alternative solutions
- Considering the impact of additional factors on the model outputs (e.g. the impact of distributed generation)
- Undertaking a cost benefit assessments of alternative options

Figure 3 provides an overview of the factors taken into account

Figure 3 Load Related Expenditure factors



These are discussed in detail in Table 4.

Table 4 LRE Investment Plan Development factors

LRE investment plan development factors	Description
Non Network Solutions	• Assess the alternative options of adopting Demand Side Response (DSR) solutions • Assess the alternative options of increase capacity by operational measures • Assess other relevant non-network asset options
Impact on Quality of Supply	• Assess the benefit (risk) of investment (deferred investment) on QoS • Assess mitigation actions if non-investment decision is taken
Impact on Network Risk	• Assess long term impact on overall network risk • Assess the risk of increased probability asset degradation as a consequence of deferred investment • Assess the increase in regional network risk e.g. from increasing load transfers against a scenario of uncertain load growth forecasts • Assess mitigation actions if necessary

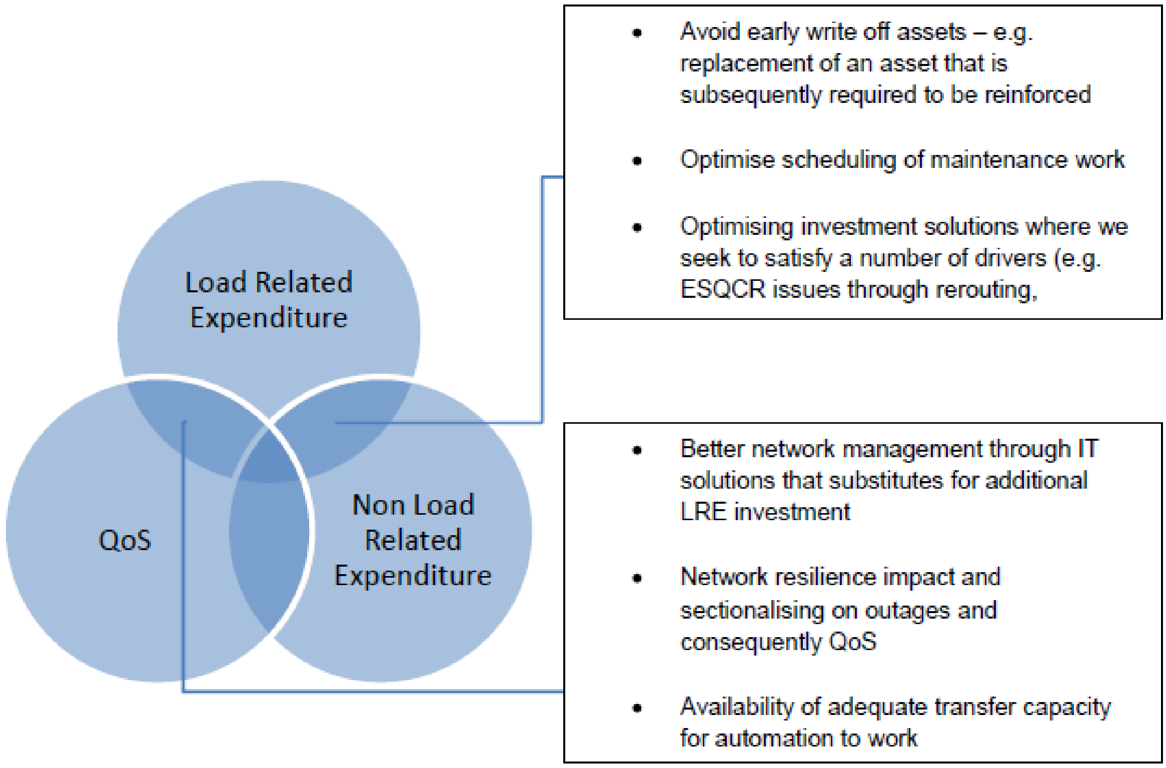
LRE investment plan development factors	Description
Additional Factors	• Assess the potential for innovative solutions • Assess the impact of Connection applications • Assess the impact of Low Carbon technologies • Assess the impact of broader network development considerations (e.g. National Grid connections) • Assess the impact of distributed generation • Use Local knowledge of the assets • Assess the impact of future local authorities development plans • Assess the impact of future Network Rail development plans • Assess the impact on interlinked and sequenced projects (e.g. there may be dependencies such that adding capacity at a site is dependent on capacity being built available elsewhere first) • Assess other site specific factors
Cost Benefit Analysis	• Consider the long-term cost/benefit analysis of alternative options • Assess the alternative options e.g. capacity vs load transfers vs auto-reconfiguring the network • Assess on a regional basis to ensure an appropriate portfolio of solutions to maintain flexibility and avoiding lock-in to particular strategies

By taking into account the factors and expert assessment illustrated above, the Asset Management teams establish the most effective solution to meet the committed outputs for RIIO ED1. Senior managers within the Asset Management function provide rigorous challenge to their respective teams by exploring the considerations described above before a final endorsement by the Director of Asset Management.

In particular the balance of types of projects (e.g. interconnection, capacity addition or demand side response etc.) within the plan would be scrutinised to reflect expectations from past experience and uncertainties of future load growth. This is particularly relevant as small increases in capacity are not always the most economical solution for the long-term flexibility for a region. In producing the overarching Load Related Expenditure investment plan, we apply additional expert assessment as detailed in chapter 5.

It is also important to note that the Load Related Expenditure investment plan interacts with the other streams as detailed in Figure 4 below.

Figure 4 LRE investment plan interaction with other streams



4.1.2 Non Load Related Expenditure (NLRE)

The Non Load Related Expenditure Objectives for RIIO ED1 are:

- Achieve compliance and minimise the risk to the members of the public and employees
- Maintain the networks' asset health risk broadly constant over the period. This is measured by the Health Index (HI) categories 1- 5 and the Criticality Index (C) categories 1 – 4
- Achieve our forecast CI targets and improve processes and target inspection and maintenance interventions (I&M) at those assets and features that are recognised (e.g. type of failures) or believed to be the most problematic, unless replacement is the more appropriate option
- Achieve a resilient network by maintaining compliance with the ENA Technical Specification 43-8 on tree cutting (ETR132)

In order to achieve the above mentioned objectives we seek to maintain the number of assets with HI4/5 categories between the start and end of RIIO ED1 period broadly constant.

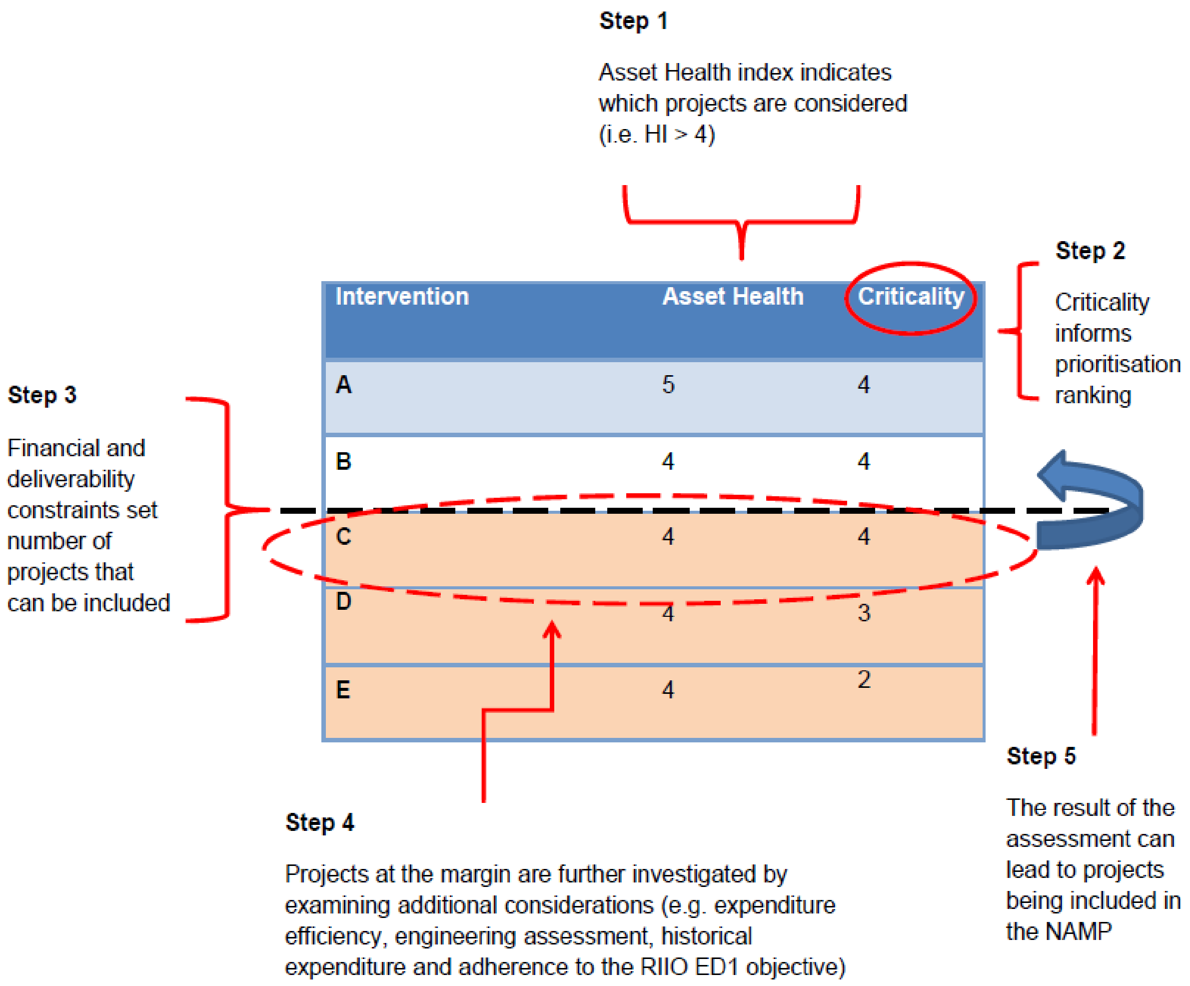
The first step in this process estimates the number of HI4 / HI5 categories at the beginning and end of RIIO ED1 by asset classes. This provides a provisional number of interventions that need to be included in the investment plan based on the deterioration profiles for our assets.

In establishing which intervention should be prioritised, we look at asset criticality. This measure considers the consequences of failure of an asset in each of the following categories: network, safety, environmental and financial risks as a result of failure.

Given our finite financial and delivery capacity, we prioritise the interventions to those that deliver the greater risk reduction per pound spend. There will be projects that are clearly high priority and those that are clearly low priority. Where we draw a line across our prioritised list we apply additional expert scrutiny to ensure the right projects are included in the plan considering the full range of information, risks and efficiency opportunities to best meet our objectives.

Senior managers within the Asset Management function use this assessment to challenging their respective teams on the broadest range of considerations like expenditure efficiency, engineering assessment (e.g. acceptable levels of risk), historical expenditure and adherence to the RIIO ED1 objective. The result of this challenges the priority of the projects around the margin to ensure the best balance of the asset management objectives.

Figure 5 NLRE Project Assessment process



To identify the future Asset Health and interventions' Criticality across our asset base we apply the following models:

- Asset Health models (e.g. Asset Risk and Prioritisation – ARP - models, Civil Asset Health models, etc.);
- Criticality models (e.g. Criticality models relating to Asset Health, Criticality models relating to ESQCR interventions, etc.).

Table 5 below provides an overview of the different models used.

Table 5 NLRE models

NLRE Models / Frameworks	Overview
Asset Health (ARP) [4]	• Provides a numeric representation of the condition of each asset, known as Health Index (HI) • Uses condition information (e.g. age, location, inspection data, etc.) to derive the HI (Health Index) • Provides comparable measures of condition for individual assets in terms of proximity to end of-life (EOL) and probability of failure (POF) • Makes predictions on the change of HI over time, future failure rates, and how these

[4] Further information on ARP models can be found in Annex 22: Asset Plan Production Process

NLRE Models / Frameworks	Overview
	might be affected by different intervention strategies over specified lengths of time • Provides information on the appropriate window for replacement / refurbishment reflecting our asset management strategy and individual policies
Asset Health (Civil) [5]	• Provides a numeric representation of the condition of each asset, known as Health Index (HI) • Uses condition information to derive the HI (1 to 4) • Provides a trigger for intervention (improve the condition of asset categories 3 and 4 into asset categories 1 and 2)
Asset Health (Other)	• Stocks & Flows / SARM
Criticality (ARP)	• Provides a relative comparison of the consequences of failure within the Health index categories by assigning a criticality score (1 to 4) • The criticality score is based on the consequences of failure from a network performance, safety, environmental and financial perspective
Criticality (ESQCR)	• Assigns a severity score indicating the deadline within which issues needs to be resolved • The severity score is based on the following defect categories: Regulatory Risk, Safety Risk, Environmental Risk, Quality of Supply Risk, Financial Risk • The results feed into the Criticality (ARP) model

The application of the models mentioned above, and ARP in particular, allows us to better look across a range of asset types to ensure that we are managing asset risk consistently across our network assets. This, combined with the information derived from criticality models and expert review, provides a holistic view of our asset replacement programme.

The results of the modelling exercise allow us to forecast the future health condition of our network, compare it with its status at the beginning of RIIO ED1 and identify the number of interventions needed to keep the health risk broadly equivalent between the start and the end of the regulatory period. The criticality outputs inform our decision of which assets should be prioritised when undertaking the planned interventions.

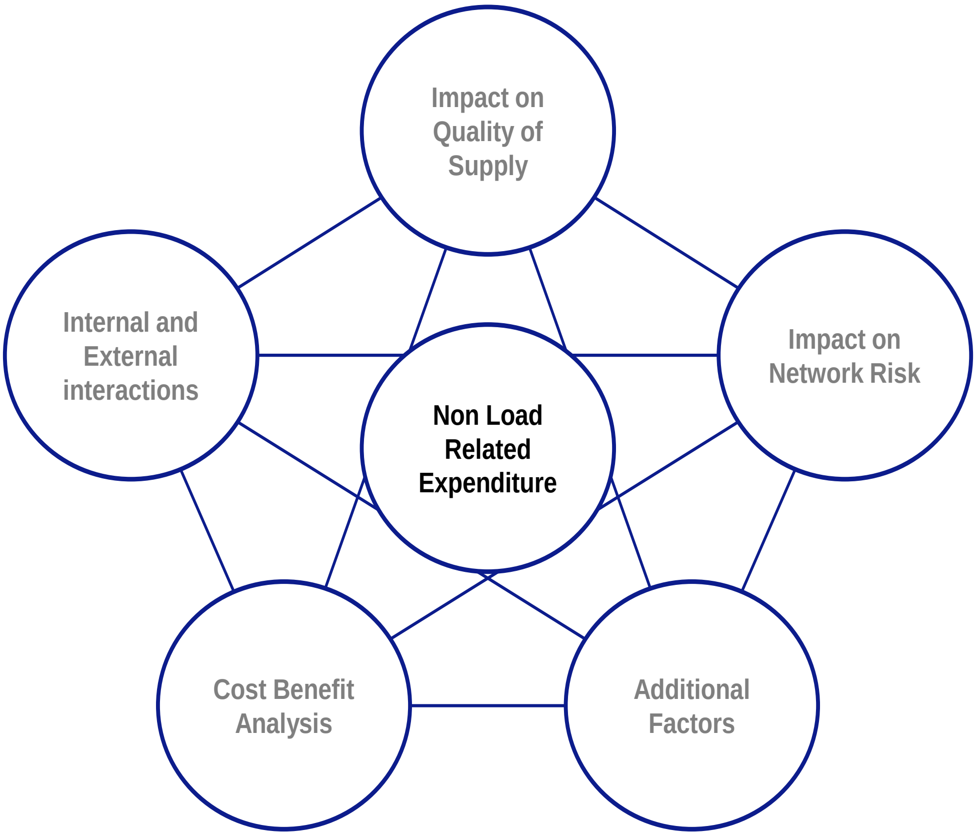
A set of additional considerations and expert assessment is taken into account when developing the NLRE investment plan. This includes:

- Understanding and managing the interactions within and external to the NLRE stream
- Considering any impacts on Quality of Supply of the alternative solutions
- Assessing the impact on network risk of alternative solutions
- Considering the impact of additional factors on the model outputs
- Undertaking a cost benefit assessment of alternative options

Figure 6 provides an overview of the factors taken into account.

[5] Further information on the Civil Works modelling can be found in Document 10, Asset Category – Civils (Capex & Opex)

Figure 6 NLRE investment plan development



These are discussed in detail in Table 6.

Table 6 NLRE Investment Plan Development factors

NLRE investment plan development factors	Description
Internal and External Interactions	• Manage and address interactions within non-load stream (see below) • Manage and address interactions across investment streams(see below)
Impact on Quality of Supply	• Assess the benefit (risk) of intervention (non-intervention) on QoS • Assess mitigation actions if non-intervention decision is taken
Impact on Network Risk	• Assess long term impact on overall network risk • Adopt mitigation actions if necessary
Additional Factors	• Assess the potential for innovative solutions • Industry best practice • Knowledge of our assets and the operational performance • Knowledge of local circumstances • Asset strategy and policy • Previous forecasted activity • Actual historical performance • External climate and natural events (e.g. flooding) • Impact on faults of adopting new technologies early (e.g. in the case of polymeric cables)
Cost Benefit Analysis	• Whole Life Cost analysis of alternative options • Understand the different economic benefits and trades off of replacement / refurbishment / maintenance

By taking into account the factors and expert assessment mentioned above, the Asset Management teams establish the most effective solution to meet the committed outputs for RIIO ED1. Ultimately, in producing the overarching NAMP, we apply additional expert assessment checks as detailed in chapter 5.

As detailed in Table 7 the NLRE internal interactions are particularly important in determining optimal intervention strategies and consequently the overall investment stream plan.

Table 7 below provides an overview of these internal interactions.

Table 7 NLRE internal interactions

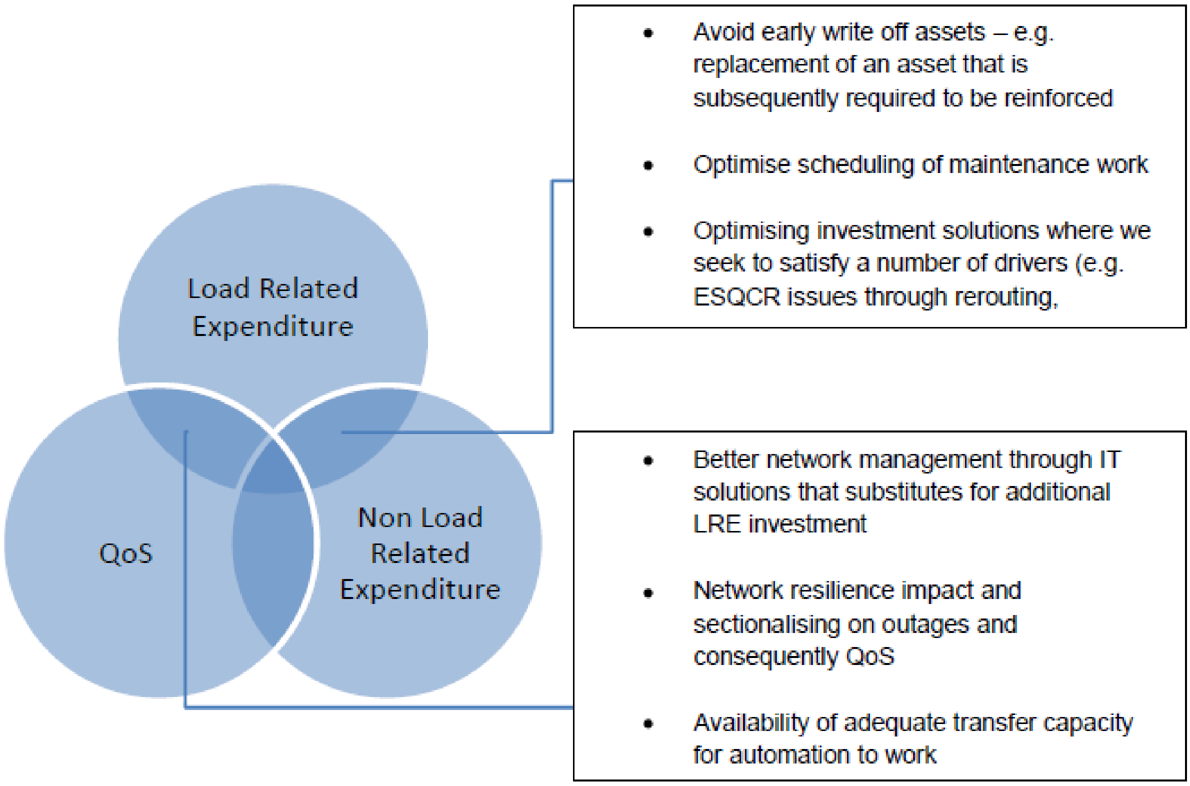
Investment sub-stream	Interaction with…	Interaction description
Refurbishment Replacement	ESQCR	• ESQCR enhancing intervention
	Civil Works	• Optimisation of scheduled maintenance
	Inspection and Maintenance	• Asset records • Number of visits • Ease of fix • Intervention scheduling optimisation
	Faults	• Historical trend analysis
	Trees	• Intervention on OHL (overhead lines)
ESQCR	Refurbishment	• ESQCR enhancing intervention
	Civil Works	• ESQCR enhancing intervention • Land owner consent
	Inspection & Maintenance	• Asset Records
	Faults	• Historical trend analysis
	Trees	• Land owner consent
Civil Works	Refurbishment / Replacement	• Optimisation of scheduled maintenance
	ESQCR	• ESQCR enhancing interventions
	Inspection & Maintenance	• Asset records
	Faults	• Historical trend analysis
	Trees	• Vegetation clearance
Inspection & Maintenance	Refurbishment / Replacement	• Asset records • Number of visits • Ease of fix • Intervention scheduling optimisation
	ESQCR	• Asset records • Number of visits
	Civil Works	• Asset records • Number of visits
	Faults	• Historical trend analysis • Asset records • Number of visits
	Trees	• Asset records • Number of visits
Faults	Refurbishment / Replacement	• Historical trend analysis

Investment sub-stream	Interaction with…	Interaction description
	ESQCR	• Historical trend analysis • Detection of issues
Faults	Civil Works	• Historical trend analysis • Enhance Flood protection
	Inspection & Maintenance	• Historical trend analysis • Asset records (Defects)
	Trees	• Historical trend analysis • Fault numbers
Trees	Refurbishment / Replacement	• Intervention type on OHL
	ESQCR	• Land owner consent
	Civil Works	• Vegetation clearance
	Inspection & Maintenance	• Asset records
	Faults	• Historical trend analysis • Fault numbers

When assessing alternative options the Asset Management teams also take into account NLRE interactions with the other investment streams.

Figure 7 provides an overview of these interactions.

Figure 7 NLRE Investment determination considerations



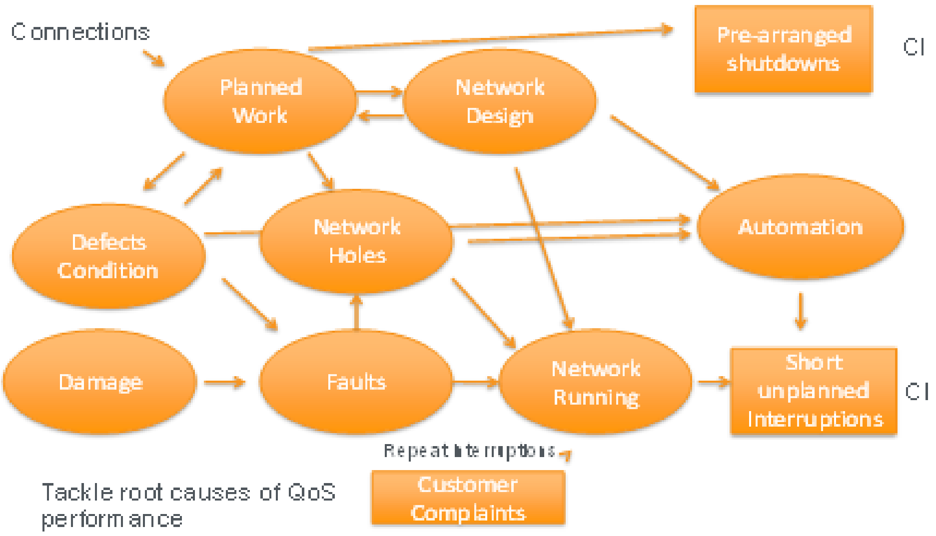
4.2 Quality of Supply (QoS)

The Quality of Supply objectives for RIIO ED1 are:

- Improve quality of supply in all three licence areas so that their CI and CML performance during ED1 is in the top third compared to other DNOs (Distribution Network Operators)
- Improve on the number of restorations within 12 hours by 30%
- Optimise cost benefit from the ED1 Interruptions Incentive Scheme and other Customer Service Incentives
- Maintain the existing SCADA (Supervisory Control and Data Acquisition) capabilities to support any future smart grid innovation that will enable the network to run more effectively

In order to achieve this objective, we take a holistic view of QoS performance drivers, as illustrated in Figure 8, and track performance through industry reporting and benchmarking. We would also take into account historical trends and technology developments to inform our analysis.

Figure 8 QoS drivers



In addition to that analysis, a complex set of additional considerations and expert assessment is also taken into account when developing the QoS strategy (see Annex 6: Quality of Supply Strategy)

Figure 9 QoS investment plan development

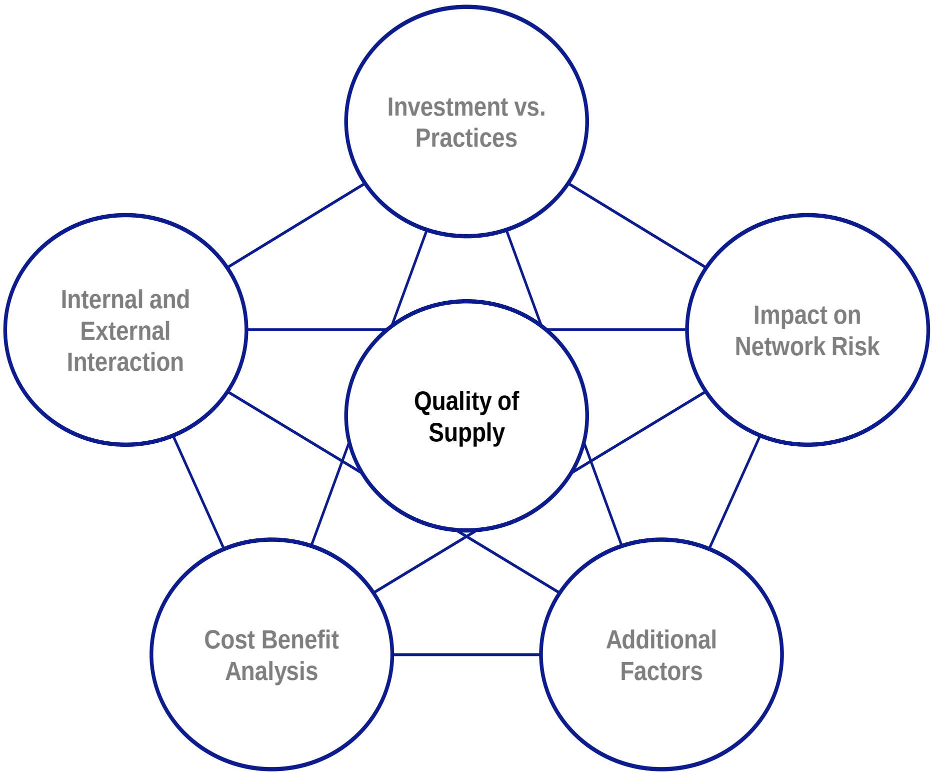


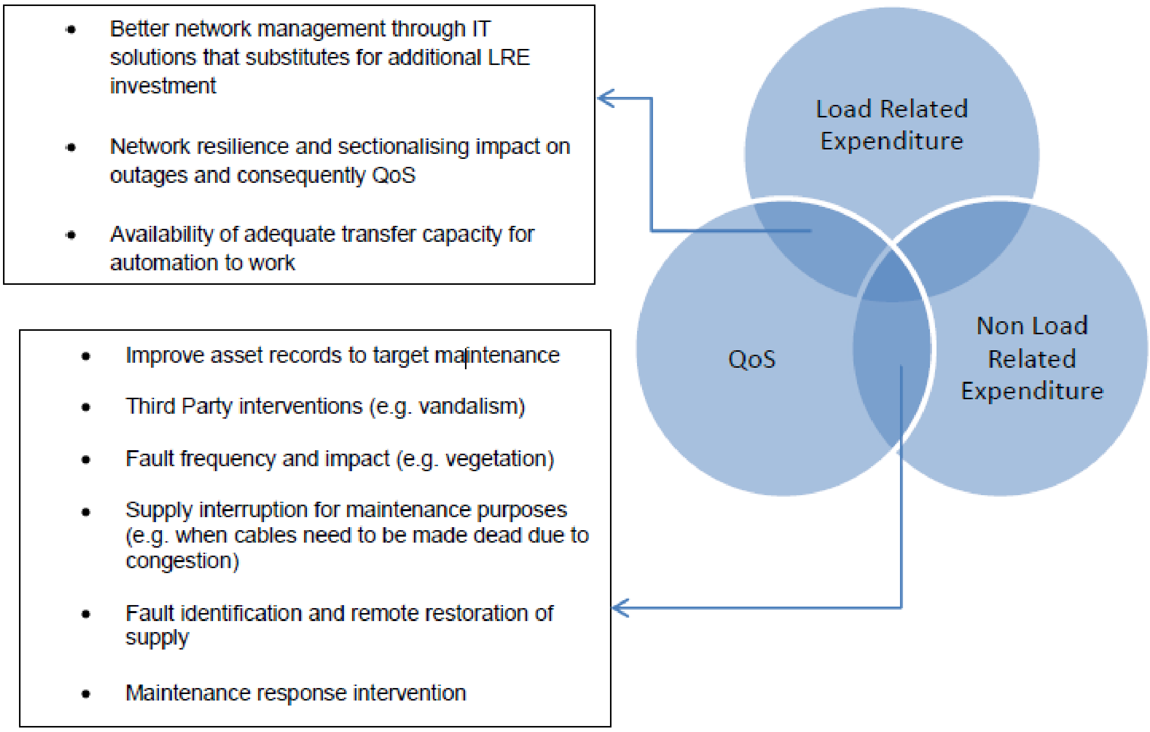
Table 8 Quality of Supply Investment Plan Development factors

QoS investment plan development factors	Description
Internal and External Interaction	• Impact of Telecoms and IT on automation and automatic restoration of supply (internal) • Manage external interactions (see below)
Investment vs. Operational measures	• Impact of improvements from operational measures versus investment in network assets or other hardware/technology
Impact on Network Risk	• Assess the risk of outages as a consequence of deferred intervention • Assess the risk of increased probability of faults as a consequence of non-intervention • Assess mitigation actions if necessary
Additional Factors	• Suitability of Asset Health condition models in fast developing technology environment (e.g. SCADA) • Future technology serviceability • Impact of smart meters on data availability
Cost Benefit Analysis	• Whole Life Cost analysis • Incentive payments vs. investment cost

The result of the analysis above ensures that we expect to maintain or improve QoS in each of our networks and that we undertake the necessary interventions to meet our RIIO ED1 commitments.

As for the other investment streams, the development of QoS plans need to take into account the interactions with other plans.

Figure 10 QoS investment plan interaction with other streams



5 Deriving NAMP through application of expert assessment

5.1 Our investment management team

Our Investment Management team is responsible for ensuring that the individual investment stream projects are coherently aggregated into our complete NAMP.

Further expert assessment and challenge is applied at this stage. This involves the application of sensitivity analyses, additional testing for deliverability and financeability constraints. This process ensures that the NAMP is thoroughly scrutinised and is resilient to known risks and the range of uncertainties that the network is exposed to (i.e. reflecting the uncertainty mechanisms in the regulatory framework).

As briefly touched upon in the previous chapters, expert assessment is applied throughout the NAMP development process in order to weigh up the range of competing drivers, objectives, and trade-offs of the options available to us.

Expert assessment ensures that the overall NAMP is:

- Compliant with the statutory obligations
- Efficient in delivering long-term value for money
- Robust when tested against different scenarios and risks
- Deliverable in terms of resources required
- Financeable

At NAMP level this translates into a number of optimisation goals as illustrated in Figure 11.

Figure 11 Optimisation goals under expert assessment

Table 9 Optimisation goals description

Optimisation goals	Description
Targeting optimum totex spend	• Ensuring the overall NAMP is in totality the efficiency sum of opex and capex (i.e. totex) that delivers the objectives and outputs, while recognising the long-term view and a need for flexibility to adapt to change
Smoothing for deliverability	• Reducing peaks and troughs in work programmes • Maintaining a smooth profile of work to avoid overstressing our workforce and supply chain • Aligning work packages from different streams into a coherent programme for the asset in question
Smoothing for financeability	• Reducing peaks in spend that would overstretch our financial standing
Aligning with our asset strategy and policy	• Ensuring the assumptions and modelled outcomes are aligned to our strategy and policy goals
Ensuring coherence with historical performance	• Achieving a plan that is based on assumptions inferred from the past and whose overall result is stress tested against experience
Addressing overlapping interventions	• Eliminating overlapping drivers or interventions from different investment streams • Optimising scheduled maintenance and other planned interventions

The approach to applying each of the optimisation goals is described below.

5.2 Alignment with our asset strategy and policy

Throughout the process we ensure that the optimised options chosen by our planners are consistent with the outcome committed in RIIO ED1 for each investment stream and at aggregate level.

Our asset strategy and policy frameworks provide some constraints on how discretion is applied in our expert assessment is made. This promotes consistency across the decision making process and ensures that discretion is exercised within specific boundaries. This alignment is ensured by our governance process and by the degree of challenge that takes place during the NAMP development process.

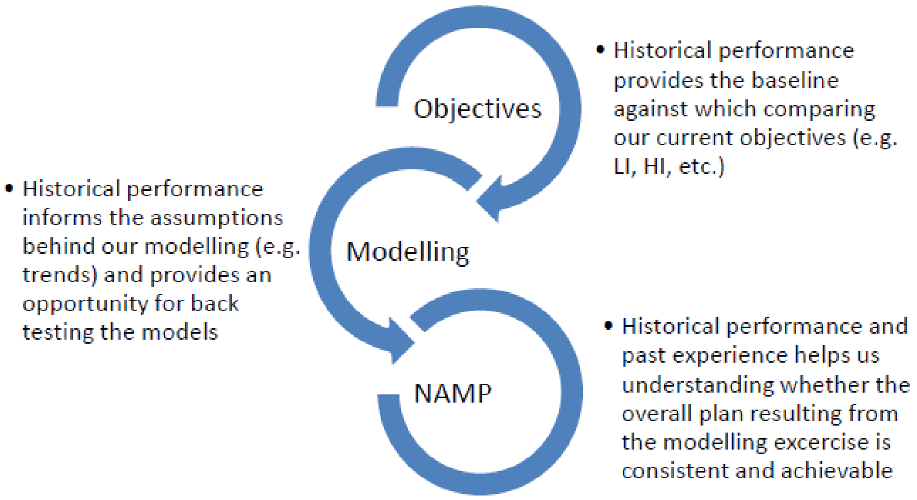
Further details on our overarching asset management policy can be found in AST 00 001 (Asset Management Policy). Individual lifecycle strategy documents outline instead the specific policy details for each asset class.

5.3 Ensuring coherence with historical performance

Throughout the process historical performance trends are used not only to derive model assumptions, but also to cross check the overall output of the NAMP to identify inconsistencies or step changes that emerge.

Figure 12 below illustrates how the assessment of historical performance is used in the NAMP development process.

Figure 12 Ensuring coherence with history in the NAMP development process



5.4 Addressing overlapping drivers of intervention

Overlapping needs for investment are a potential risk of the developing investment plans aligned to the drivers. These are most likely and significant in the following streams:

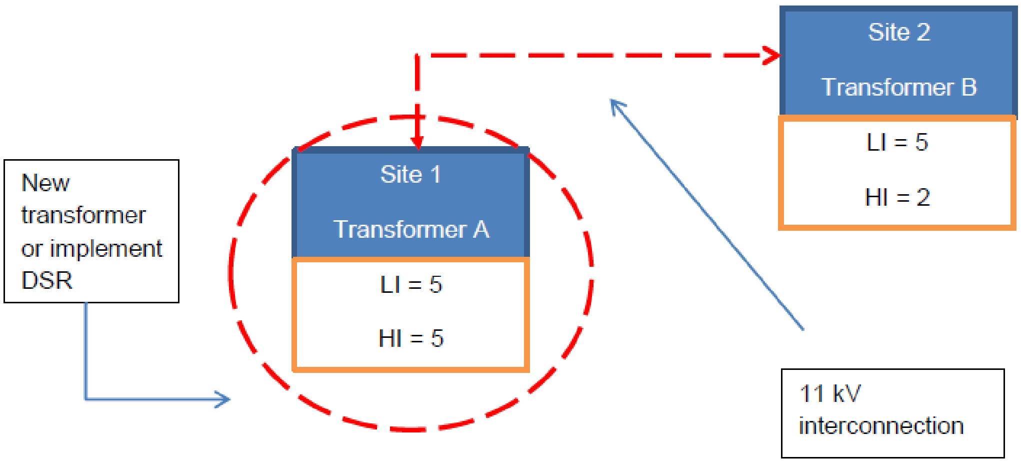
- Load Related Expenditure vs. Non Load Related Expenditure. Asset replacement models accurately indicate when a particular piece of equipment should be replaced / refurbished due to condition. On the other hand, local demand conditions or compliance requirements may indicate the need for the same asset to be upgraded to new standards or reinforced.

  This is illustrated below through a stylised example.

  Transformers A and B are closely located although they belong to two different circuits. Both transformers are rated as LI 5 categories and need reinforcement due to forecasted demand growth in 2018. In addition to that Transformer A is scheduled to be replaced / refurbished in 2015 as it is currently rated as an HI 5 asset.

  The first possible solution to the problem would be to refurbish transformer A in 2015 and increase the capacity of both transformers in 2018. On the other hand, savings could be achieved by moving forward the LRE investment for transformer A to 2015. In addition to that, planners would consider whether the expenditure for transformer B due in 2018, could be avoided by creating an 11 kV interconnection between the two circuits or by applying DSR measures until the HI of asset B increases to 4 / 5.

Figure 13 Addressing LRE vs. NLRE overlapping drivers



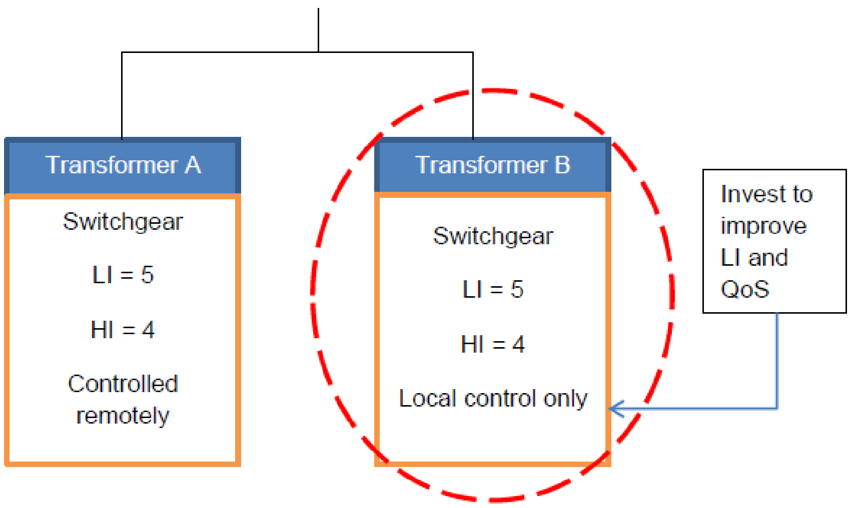
The teams in charge of Load Related Expenditure and Non-Load Related Expenditure investment streams are regularly in contact to ensure the plan is correctly optimised and to avoid duplications in the NAMP, both informally (e.g. through management) or formally through the Governance process (see chapters 6 and 76 & 7 for further details).

- Load Related vs. Quality of Supply. Automation will be a significant driver in improving the Quality of Supply performance of the network. On the other hand, a lack of load transfer capabilities imposes a limit to the benefits of such an option. The teams in charge of Quality of Supply and Load Related Expenditure ensure consistency between these two mutually dependent interventions.

  This is illustrated in Figure 14 below through a stylised example.

  Transformers A and B belong to the same circuit. Both Transformer switchgear assets have LI 5 (switchgear limited) and HI 4 indexes. At present only Transformer A switchgear can be controlled remotely. Presented with the choice of being able to replace only one asset, we would prefer to intervene on Transformer B switchgear as the project would have increased benefits to customers from the increased ability to reconnect customers quickly as the new switchgear would have remote control capability.

Figure 14 Addressing LRE vs. QoS overlapping drivers



The teams in charge of Load Related Expenditure and Quality of Supply Expenditure investment streams are regularly in contact to ensure the plan is correctly optimised and to avoid duplications in the NAMP, both informally (e.g. through management) or formally through the Governance process (see chapters 6 and 7 for further details).

- Load Related Expenditure vs. National Grid plans. Our models provide view of future reinforcement requirements for its Grid Supply Points. This forward-looking information is shared with National Grid (NG) through the "Week 28" submission and discussed in liaison meetings with NG. In developing the NAMP we seek to align future projects with the developments proposed by NG. This may lead to us or NGC rescheduling of our investments away from the optimised plan, which may in the case of a deferral require mitigating actions. This may lead to a less efficient plan for us, but an overall benefit (from lower transmission costs) to customers who pay both transmission and distribution charges.

The following is a real example of managing duplications:

The replacement of the Barking to Brunswick Wharf 132kV gas cable circuit in the London Power Networks with a solid cable is an example where expert assessment was used to test divergent modelling outputs.

The above mentioned cable circuit requires replacement due to condition but also reinforcement for P2/6 compliance purposes.

Whilst it was desirable to schedule the replacement of the circuit later in the middle of ED1 from a condition and smoother NAMP perspective, P2/6 compliance considerations led the planners to shift the intervention earlier in the regulatory period.

The decisions discussed above and supporting information is recorded in our Regional Development Plans.

5.5 Targeting optimum totex spend

Expert assessment is applied to ensure that the NAMP is consistent with efficient capex / opex trade-offs. These trade-offs are particularly important as they influence how the cost of operating the network is apportioned between current and future customers.

For instance, Load Related Expenditure (Reinforcement) vs. Non Load Related Expenditure (Demand Side Response) decisions are subject to different capex and opex expenditures which in turn produce different level of totex expenditure profiles over time. In deciding the right option for customers, we look at minimising the costs to customers of our plans by using Whole Life Cost models and examining the profile expenditure over time to minimise volatility.

The NAMP development process is designed to ensure that the overall totex expenditure is optimal and delivers our strategic objectives, outputs, in the interests of both current and future customers - recognising the future is uncertain.

The NAMP is a key input to our business' financial health. The impact of the NAMP is tested by Strategy and Regulation / Business planning as part of the overall testing of our plans for financeability. For more information on how the plan is developed with input and challenge with internal stakeholders please refer to chapter 7.

Ensuring optimum totex

UK Power Networks has a constrained substation in the East London area; Whiston Road 11 kV. The Whiston Road 11 kV substation needs to be upgraded to accommodate the load growth in the area. Unfortunately there is not enough space at the substation for the upgrade to take place and therefore a new substation will need to be built and the load transferred. The new substation is proposed to be built in nearby Hoxton.

Demand Side Response (DSR) solutions have been investigated at the site. Using DSR will enable UK Power Networks to defer the build of the new Hoxton substation out of RIIO ED1 and help manage the network constraint at Whiston Road 11 kV substation. Contracting 5 MVA DSR between 2021 and 2025 (inclusive) will defer the new Hoxton substation thus creating considerable benefits.

5.6 Smoothing for deliverability

The delivery of the NAMP requires a strategy that does not to overstretch the finite resources available (e.g. skilled contractors) and to ensure minimum service disruption.

Smoothing for deliverability is therefore one of our optimisation goals. This is routinely undertaken for each individual investment stream. The most frequent types of actions undertaken are:

- Stagger or reschedule investment. Specific asset conditions (for instance age profile) could lead to a significant volume of work at discrete points in time. In turn, this could create deliverability pressures (for instance on the supply chain). The teams within each individual asset streams, apply expert assessment to stagger or delay specific type of investments / interventions. This type of decisions is taken based on industry best practice or experience of dealing with specific assets and it is constantly reviewed and challenged by senior management to ensure that the overall network risk remains broadly constant
- Long-term view. We look at the portfolio of projects that are proposed for a region and consider whether mix of solutions provide suitable flexibility. Flexibility will be considered around issues including system access, potential variation from the core scenario view and operational complexity. For example, sequencing of projects in a region could lead to complicated and multiple outages for customers to allow new capacity to absorbing delivery resources and slowing the provision of new capacity
- Contract additional resources. In certain instances contracting additional resources is the only option available when a significant and prolonged type of intervention is required. The teams within individual asset streams and Delivery functions proactively look into future requirements to assess the adequacy of the available resources

The NAMP is further tested for deliverability. This process occurs within the specific process and Governance measures described in chapter 6.

5.7 Smoothing for financeability

Investment plans have a significant impact on our financial performance due to their size and profile. This in turn impacts our overall financeability.

We work with the business planning team to review the individual and aggregate NAMP streams of expenditure to ensure it allows us to work within our financial constraints. Adjustments are made by seeking to staggering investments whenever feasible or by ensuring maximum alignment between investment plans and the available financial capacity.

Under ESQCR Risk mitigation programme, the planning for structural mitigation could be expensive as possible mitigations include diversion/undergrounding. This type of work has been staggered by smoothing the expenditure and work over the next 10 years. This has reduced the increased expenditure requirement in the initial years and have smoothened the expenditure profile over the ED1 period.

6 Governance

Each step of the process described above is undertaken within strict governance rules and processes. This ensures that the NAMP is:

- Challenged by the relevant decision makers
- Change controlled
- Rigorously risk assessed
- Appropriately documented
- Properly communicated
- Effectively implemented

Specifically, the individual NAMP projects are scrutinised at:

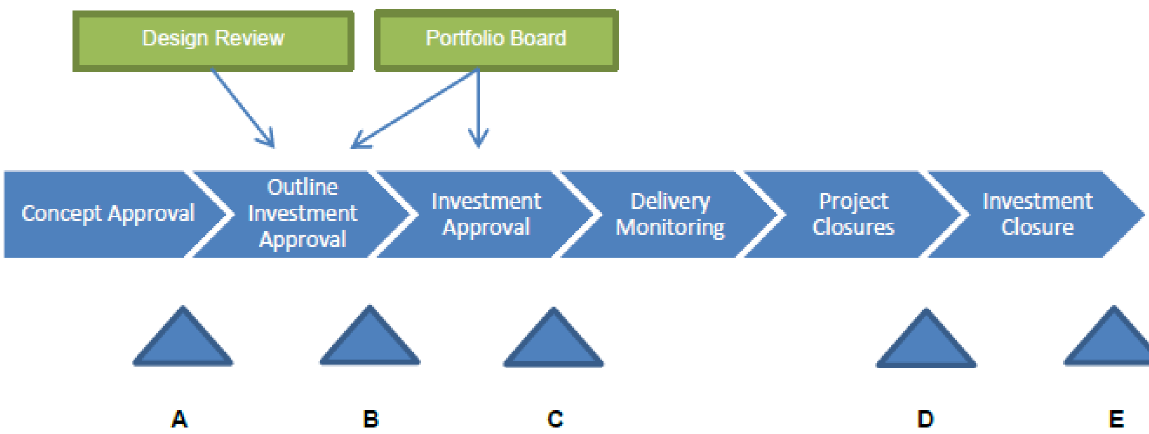
- Design Review.
  This consists of fortnightly weekly meetings chaired by a senior manager within the Asset Management function during which the initial project concept is scrutinised from an engineering perspective. Attendees include representatives from Connections, Capital Programme Delivery, Capital Programme & Procurement and Network Operations (Control).
- Investment Portfolio Board.
  This consists of weekly meetings, chaired by the Director of Asset Management (or his delegated deputy) to review plans, relevant documentation and commercial decisions where approval for capital expenditure greater than £1m is sought.

Each of the NAMP investment projects that require capital expenditure is subject to the "Regulated Project Approval Process" (EDP 08-0801). The framework details the approval authorities, roles, responsibilities and procedures that need to be adhered to when approving capital expenditure for regulated projects.

Project approval occurs twice within the overall "Regulated Project Approval Process", first at the Outline Investment Approval stage and second at the Investment Approval Stage.

Figure 15 provides an overview of the "Regulated Project Approval Process" with relative Gateways (A to E).

Figure 15 Project Investment Gateway process



Each Stage / Gate within the process is further described in Table 10 below.

Table 10 Regulated Project Approval Process stage / gate description

Stage	Gate	Description
Concept Approval	A	This is the point at which an opportunity or business need is first identified, and approval of the concept in principal is sought prior to proceeding to the next Gate.
Outline Investment Approval	B	This is the point at which approval of the preferred option is sought prior to proceeding to the next Gate. Generally for Major NAMP projects this is the point where all the options have been considered and the Planners hand over their preferred solution to the Delivery Team for development into the full investment form.
Investment Approval	C	This is the point at which the preferred solution is identified in detail. Also, this is when the capital expenditure values for NAMP Projects are approved.
Delivery Monitoring		This is the stage in which the project is monitored to ensure efficient delivery.
Project Closures	D	This is the point at which the project is complete and a review is carried out to assess its success in order to identify best practice and capture the lessons learned and closing out SAP.
Investment Closure	E	This is the point at which the Investment is closed and the benefits, if any, stated in the Investment form, are measured.

Further details on the overall NAMP development roles and responsibilities can be found in Document EDP 08-0300 (NAMP Development Process Overview), whilst document EDP 08-0301 deals with the overall NAMP Change Control Process.

7 Stakeholder management

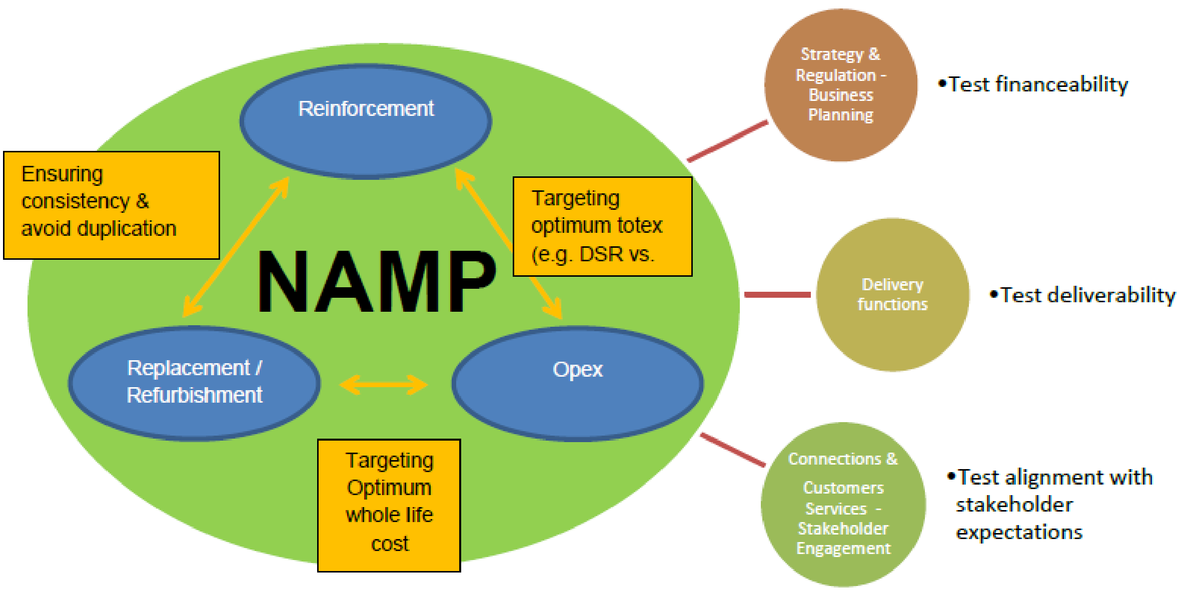
Each step of the process described above has also been informed by extensive stakeholder engagement both internally and externally.

Figure 16 below provides a schematic diagram of how the stakeholder engagement has influenced the development of the NAMP:

The key actors that constantly interact to deliver the NAMP are:

- The Asset Management teams (e.g. Asset Management, Investment Management, Asset Strategy, System Development, etc.)
- The Strategy and Regulation / Business Planning teams
- The Delivery functions – Network Operations and Capital Programme and Procurement
- Connections
- Customer Services, external Stakeholder Engagement teams

Figure 16 Stakeholder engagement for the NAMP development process



The Asset Management teams are responsible for developing the NAMP. In particular, they ensure that the interactions between the key investment streams of reinforcement projects, replacement interventions and direct operating costs are fully understood and addressed.

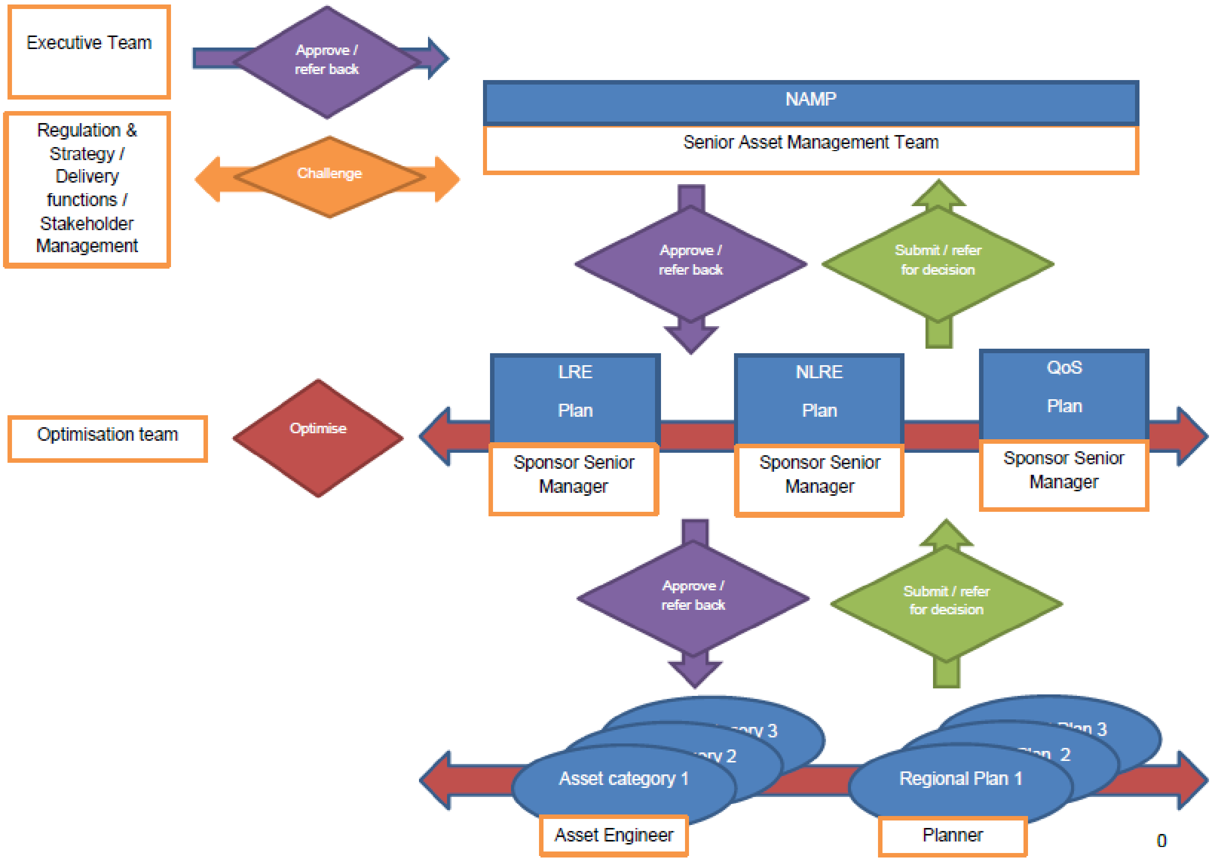
They work to reflect our customers' desired outcomes, based on the work by our Customer Services - Stakeholders Engagement team in collecting these insights, fulfilling the businesses broader objectives and remaining with the finite resources available.

The process is run dynamically, recognising that new information and delivery challenges may impact on the delivery of the plan and change priorities. This means that there is continuous process of dialogue where the Asset Management teams interact with each other and other internal stakeholders on a regular basis. This occurs formally as a part of the Governance framework (e.g. Portfolio Boards, Gateway process, etc.) and through informal basis of good management practice (e.g. managerial approval, meetings with interested parties outside the scope of the Governance framework) as illustrated in Figure 17.

A key internal stakeholder, are the Delivery functions. They are continuously involved in assessing the profile of future interventions on the network so to ensure that the NAMP can be realised within any existing resource and delivery constraints (e.g. skilled resources, supply chain, etc.).

The overall alignment with the business objectives, ED1 commitments and stakeholder feedback is carried out as part of the wider business plan process that delivers a well-justified plan.

Figure 17 Building the NAMP dynamically



8 Conclusion

UK Power Networks development of the Network Asset Management Plan is based on a robust process as summarised in this document.

In-depth descriptions of our Stakeholder engagement process used to inform, shape and scrutinise the plans is available.

A review of our leading industry modelling techniques is provided in detail in other Annex documents.

You can find more detail around our planning processes in the following documents:

Table 11

Document number	Title
AST 00 001	Asset Management Policy
EDP 08-0106	Production of Annual Planning Load Estimates (PLE)
EDP 08-0300	NAMP Development Process
EDP 08-0301	NAMP Change Control Process
EDP 08-0600	Network Design Review
EDP 08-0801	Regulated Project Approval Process

Finally, the output of the NAMP development process for our direct expenditure for each investment stream and asset class for each network is described in the annex documents within the Business Plan submission.

Figure 18 Main features of the NAMP development process