Annex 3A: Load Related Expenditure

Investment Plan – Part A

December 2021

CONTENTS

EXECUTIVE SUMMARY

Greater use of electricity will be required to meet the UK Government's commitment to achieve Net Zero carbon emissions by 2050 and address the global issue of climate change. Part of the urgent action that society must take includes the electrification of more transport, heating and industry, increasing the loading on electrical distribution networks.

Load related expenditure is required to develop our network so that it can continue to meet the evolving needs of our customers, enabling them to connect low carbon technologies without barriers and reach more ambitious regional Net Zero targets. Network development must satisfy the need for capacity according to the quantity, timing and location of power used by and produced by our customers.

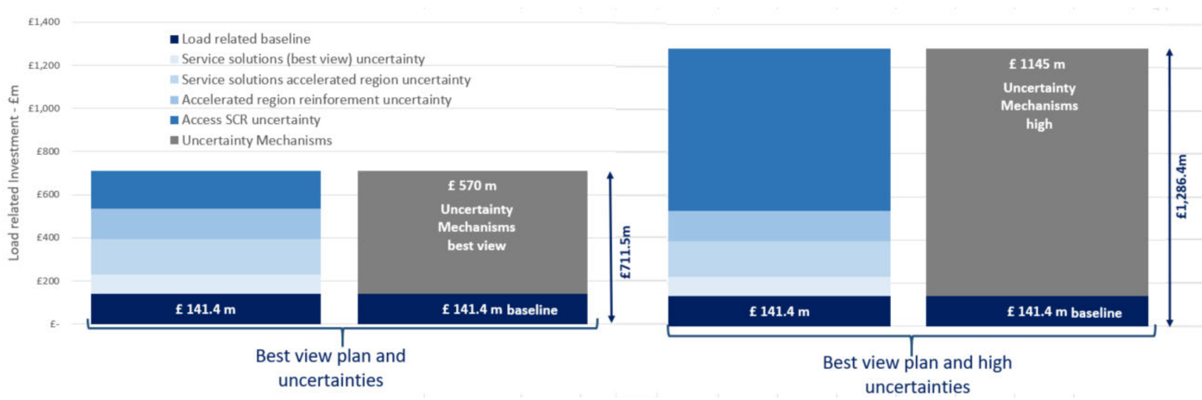
This Annex is the first of our three load related expenditure Annexes (Annex 3A) which describes our RIIO-ED2 load related investment plan. Annex 3B describes the methodology that underpins our load related investment plan, starting with our unique bottom up forecasting methodology. In Annex 3C we present the results of our review of the potential impacts of Ofgem's minded-to position on the Access SCR.

The baseline (ex-ante) allowance of our proposed RIIO-ED2 load investment plan consists of the "best view" solutions that are informed by our highest certainty and RIIO-ED2 guidance compliant Central Outlook scenario. The total baseline allowance cost of our proposed RIIO-ED2 load "best view" plan is £141.4 milion, with £53.9 and £108.2 million spend required for primary and secondary networks respectively. This value includes the proposed service unlooping programme that has a baseline allowance cost of £20.1 million but excludes the proposed £20.6 million programme for permanent asymmetrical LV monitoring equipment reported in BPDT CV11. A baseline allowance of £1.6 million for other service solutions sometimes required to accommodate our customers LCTs, such as replacement of fuses or cut-outs, is included within our secondary network reinforcement value.

Load related investment area	Baseline (ex-ante) value £m
Primary (132kV and 33kV)	£28.0
Secondary (11kV, 6.6kV and LV)	£61.1
Primary and secondary fault level reinforcement	£32.2
NTCC	£0
Unlooping	£20.1
LV monitoring	£20.6
Total	£162m **£141.4m excluding LV monitoring**

The load related investment included in our baseline business plan allowance is based upon network needs corresponding to our Central Outlook scenario and is built up from high certainty, low regret actions. The most cost efficient network solutions have been identified through our comprehensive optioneering process and have been selected for our baseline load related investment plan. Costs in our RIIO-ED2 load investment plan have been developed for the preferred solutions based on our projected view of unit costs and consistent with future efficiency assumptions and the use of Flexibility First (for further information see Section 4.4 of the DSO Transition Plan, Annex 2). Overlap with the asset replacement programme was reviewed and duplicated units removed from one or the other programme to avoid double counting.

To estimate uncertainty in RIIO-ED2 load related budgets, we have produced and costed network investment plans for all other DFES scenarios (both RIIO-ED2 Business Plan Guidance compliant and non-compliant), corresponding accelerated decarbonisation versions and considered the impact of Access SCR reforms. Together, these potential influences lead to a significant uncertainty and highlight the importance of a fast acting and agile uncertainty mechanism. Our best view based on the simple addition of uncertainties is that Uncertainty Mechanisms could be between £570 million and £1.145 billion above baseline at the high extreme.



Our load related expenditure plan corresponding to accelerated decarbonisation of our region is £139 million higher than the baseline cost. This excludes the allowance for service solutions (unlooping/fuse replacement/cut-out changes/service uprates) required to accommodate LCTs and their associated uncertainties based on accelerated decarbonisation of the region.

Three types of uncertainties on our provision of service solutions have been considered and correspond to an overall £244.8 million investment above the baseline plan. The split of these three uncertainty elements is as follows:

- £89 million corresponding to best view uncertainty around customer behaviour
- £22.3 million corresponding to best view uncertainty around using only full unlooping interventions, and
- £142.5 million corresponding to the accelerated decarbonisation scenario.

Implementation of elements of Ofgem's Access SCR minded to position is expected to have impacts on the need for further load related investments and closely related indirect costs to be reflected in DNO business plans. Our estimates of the value of the impact cover a large range, from £177 million to £752 million, reflecting the uncertainty in predicting customer behaviour. The Access SCR minded to position may evolve further, incorporating feedback from the consultation which closed in August 2021 and the final decision may be different. Unknown details mean that the impacts of the Access SCR on network investments cannot be fully evaluated with great certainty at this stage. Lack of specifics and time means that for the final plan it is not feasible to conduct the thorough bottom up analysis that underpins the forecasting and evaluation of the load related investment needs based on existing charges included in our load related plan. It is probable that initial impact assessments will be superseded as changes in the final decision on charging will need to be incorporated.

We consider our proposal of utilising a Load Related Re-opener to manage variations in load related investment is flexible enough to accommodate any further changes which arise due to Access SCR decisions. Our proposed approach is suitable irrespective of whether the driver for additional load related expenditure is because of economic growth, change in pace of decarbonisation or coming from changing behaviour due to Access SCR outcomes.

In addition to our load related uncertainty mechanism solution, we are also proposing a Regulatory-Driven Changes Reopener for RIIO-ED2 as described in our Uncertainty Mechanism Annex 29. The Regulatory-Driven Changes Reopener is designed to ensure that DNOs are funded for costs efficiently incurred as a consequence of regulatory or policy change, that have not been included in baseline allowances. Further details of both our proposal for Load Related Re-opener and Regulatory Driven Changes Re-opener can be found within our Managing Uncertainty Annex (Annex 29).

We have enhanced our deliverability plan to ensure that we can ramp up from our current level of investment to the greater level required in RIIO-ED2. Early engagement with suppliers and contractors has started to ensure priority outputs and provide greater foresight of our needs. Additional investment in our training facility will ensure that we provide the necessary education to increase the skills of our existing and new workforce (further information is provided in our Workforce Resilience Annex 27). This approach of providing development opportunities helps with staff retention and also protects us from market volatility for specialist skills.

1 INTRODUCTION

In this first of our three load related expenditure Annexes (Annex 3A) we present our load related investment plan as summarised in section 6.1 of our business plan submission.

Load related expenditure is required to develop our network so that it can continue to meet the evolving needs of our customers, enabling them to connect Low Carbon Technologies (LCTs) and reach Net Zero targets. Network development must satisfy the need for capacity according to the quantity, timing and location of power used by and produced by our customers. Our load related expenditure plan also includes network developments to manage the increasing system fault levels also driven by customer connections and changes in fault level due to modifications to our network or the transmission network.

The objective of this document is to provide transparency and a deeper understanding of how our load related investment is built and justified.

This Annex covers some of the requirements explained in Appendix 7 – "LRE strategy Guidance" of Ofgem's Business Plan Guidance September 2021, in particular:

- Strategic Vision and how we achieve its outcomes through our approach to reinforcement,
- summary of our baseline load related investment plan, broken down across the voltage levels with named schemes for our primary network (132kV & 33kV) and programmes of work for secondary networks (11kV, 6.6kV & LV),
- the potential magnitude of load related expenditure funding that may be required through uncertainty mechanisms within the RIIO-ED2 period, and
- deliverability of the load related plan.

The other requirements of Appendix 7 to explain the forecasting, network impact assessment and optioneering methodologies that underpin our load investment plan are covered in our complementary Load Related Expenditure Methodology (Annex 3B).

1.1 Annex 3A in relation to other parts of our RIIO-ED2 submission

1.1.1 Main plan

This Annex provides detail and supporting evidence for section 6.1 of our main business plan submission. Costs outlined in this Annex are consistent with the main body of our business plan.

1.1.2 Load Related Expenditure Annexes

Our baseline funding request has a high degree of confidence including only those interventions that are reasonably likely to be required under our Net Zero DFES scenarios, based on a robust forecasting and impact analysis approach. There are also less certain drivers for additional load related investment, such as charging reforms expected from Ofgem's Access Significant Code Review. For clarity and readability, our load related plan, methodology and the impacts of the Access SCR are described in three separate, but highly linked parts of our load Annex as shown in Fig. 1.

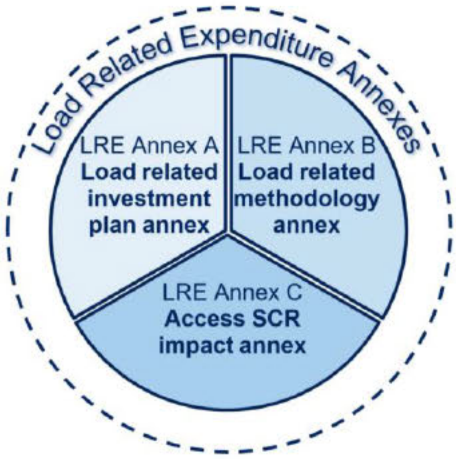


Fig. 1. Load related expenditure Annexes

1.1.3 Related Business Plan Data Tables

The load investment plan described in this Annex relates to the following business plan data and memo tables and their corresponding commentaries:

- C2 – Customer funded reinforcement
- CV1 - Primary reinforcement
- CV2 - Secondary reinforcement
- CV3 - Fault level reinforcement
- CV11 – IT equipment
- M14 – Drivers
- M19 – DSO
- M20 - LCT
- M30 – Access SCR impacts
- LRE Appendix-DNO 1

1.1.4 Other Related Documents

The load related investment plan described in this Annex is justified through detailed assessments and analysis. Project costs have been estimated based on summated costs per meter of cable and cost per unit (e.g. transformer) for each load intervention identified using power system studies of our network subject to forecast conditions and following our comprehensive optioneering processes. Engineering Justification Papers (EJP) have been created to support the investment for projects anticipated to cost more than £2 million. This Annex should be read in association with the Engineering Justification Papers and CBA results listed in Table 1.

Table 1: Summary of load investment EJPs and CBAs

Scheme name	CBA reference	EJP reference
Little Hulton	LRE CBA 1	LRE EJP 1
Frederick Rd BSP	LRE CBA 2	LRE EJP 2
Southern Gateway	LRE CBA 3	LRE EJP 3
South Heywood/Northern Gateway	LRE CBA 4	LRE EJP 4
Mayfield Re-gen	LRE CBA 5	LRE EJP 5
Lower Darwen 132kV Voltage Step Mitigation	LRE CBA 13	LRE EJP 13
Service Unlooping programme	LRE CBA 7	LRE EJP 8
LV Network Monitoring programme	LRE CBA 8	LRE EJP 9
132kV Harmonic Filter at Bredbury	LRE CBA 14	LRE EJP 14
Harker 132 kV Switchgear Replacement		PRO EJP 2

The load related investment plan described in this Annex aligns with and references the following other Annexes:

- DSO Transition Plan – Annex 2
- Load Related Expenditure, Methodology – Annex 3B
- Load Related Expenditure, Access SCR Impact – Annex 3C
- Network Visibility Strategy – Annex 4
- Enabling Whole System Solutions – Annex 6
- Major Connections Customers Strategy – Annex 16
- Costing and Benchmarking – Annex 20
- Data Strategy – Annex 21
- Digitisation Strategy – Annex 23
- Innovation Delivery Plan – Annex 24
- Workforce Resilience (incl. diversity and inclusion strategy) – Annex 27
- Uncertainty Mechanism for Load Related Expenditure – Annex 29

1.2 Overview of load related investment plan for Net Zero transition

Our approach for developing our network is guided by our RIIO-ED2 plan's primary benefit that: *"Our network will not be a barrier to connecting EV chargers or other low carbon technologies"*.

All our plan's detailed benefits are important, having scored high on acceptability through rigorous engagement with our customers, independent Customer Engagement Group and Sustainability panel of experts. The benefit shown in Table 2 requires us to develop our network in a timely manner to meet our customers' needs.

Table 2: Leading the North West to Net Zero main plan 'Benefit #27'

Benefit	Target
Helping customers connect low carbon technologies	Ensuring capacity is provided in the right place and at the right time as electricity demands increase

Through the stakeholder engagement that underpins all our plans for the next regulatory period, we have heard that our customers, local and national organisations do not want our network to be a barrier to the uptake of LCTs. We are committed to enabling decarbonation, including the electrification of transport and heat as key components in achieving Net Zero, along with increasing distributed generation. With a national target of 2050 and regional targets of 2030, 2037 and 2038, the RIIO-ED2 price control period from 2023 to 2028 will be a critical phase in the transition. Significant changes in the way our customers use electricity and increases in electrical demand mean that our network must adapt and efficient network investment is required to accommodate the predicted greater number of electric vehicles and heat pumps.

Components of our RIIO-ED2 load related investment plan, as shown in Fig. 2, include named schemes for EHV load related and fault level reinforcements due to the scale and complexity of the work involved, and HV and LV network reinforcement and service solution programmes.

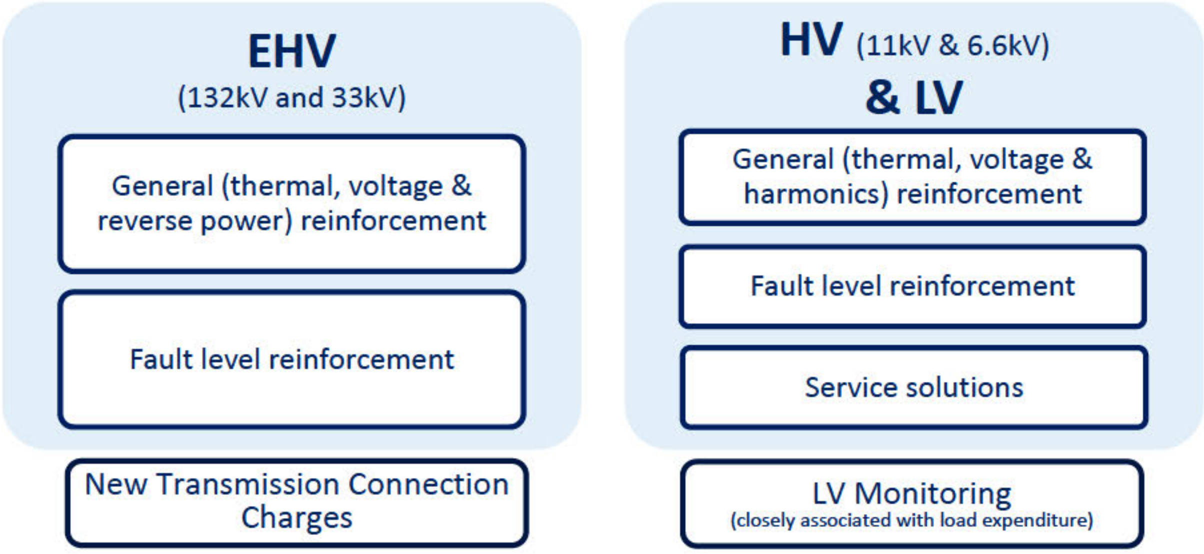


Fig. 2. Load related investment categories

1.3 Document structure

This document comprises six further main sections:

- Section 2 summarises the value and components of our baseline load related investment plan along with our rationale for the associated high certainty needs;
- Section 3 presents the starting position of our network with regards its use at the start of the RIIO-ED2 period and the predicted impact of our load interventions when customer connections occur as forecast.
- Section 4 covers our strategic vision and proposes output metrics for how we shall demonstrate the effectiveness of our load investment in terms of its efficiency and our network not being a barrier to Net Zero targets.
- Section 5 details the components of our load investment plan that we propose will be more suitably addressed by Uncertainty Mechanisms and quantifies the possible total extent of network needs during the RIIO-ED2 period.
- Section 6 comments on our assumptions regards the shape and operation of the Uncertainty Mechanisms necessary to cover the potential value of our load plan beyond the baseline.
- Section 7 addresses the deliverability of our load plan in acknowledgement that the volumes of work are greater than those of the current RIIO-ED1 period and the importance of our strategic objective of not being a barrier for our region achieving its Net Zero ambition.

2 RIIO-ED2 LOAD RELATED INVESTMENT PLAN

2.1 Overview

Investment in load driven network developments is one of the areas of highest growth in our business plan due to the expected increased requirements of our network as our region decarbonises moving towards Net Zero as many of our customers will to adopt EVs and heat pumps. 27% of our customers are forecast to drive EVs by the end of the RIIO-ED2 period compared to the current level of less than 1%.

The value of our "best view" baseline (ex-ante) load investment plan is £141.4 million, split into the components shown in Table 3 with more detail of each given in subsequent subsections. An additional £20.6 million for LV monitoring closely associated with load related expenditure is reported with Op IT and Telecoms costs.

In line with Ofgem guidance, Access SCR impacts are detailed in the Load Related Expenditure Annex 3C and are totally excluded from our baseline load investment plan.

Table 3: Baseline load related investment plan

Load related investment area	Baseline (ex-ante) value £m
Primary (132kV and 33kV)	£28.0m
Secondary (11kV, 6.6kV and LV)	£61.1m
Primary and secondary fault level reinforcement	£32.2m
NTCC	£0
Unlooping	£20.1m
LV monitoring	£20.6m
Total	£162m **£141.4m excluding LV monitoring**

By adopting our unique ATLAS forecasting methodology, along with assessment and optioneering approaches following our normal network planning processes, we have ensured that our plan is considerate of downward cost drivers such as existing network capacity, energy efficiencies, use of flexibility services and network visibility.

With the adoption of our DSO strategy and transition plan, our load related expenditure plan is optimised to ensure efficient investment using flexibility services first and innovative smart solutions when economic, instead of the traditional installation of assets. Comprehensive optioneering processes using projected unit costs reflecting future efficiency assumptions have ensured that our load related investment plan is made up of only the most cost-efficient solutions. Overlaps between load driven reinforcement and the need for replacements due to asset condition were removed to avoid duplication and double counting.

Our load related investment plan is our best view of what we expect will be required during the RIIO-ED2 period, built up from low regret actions responding to the network needs aligned with our high certainty Central Outlook scenario. To avoid foreclosing alternative future pathways, we have also considered the range of other Net Zero compliant scenarios created through a robust stakeholder led methodology with suitable due diligence applied as described in our Load Related Expenditure Methodology (Annex 3B). Our DFES forecasts closely agree with the ranges of FES and CCC forecasts and any differences are well justified as explained in the methodology presented in Annex 3B. The forecast numbers of EVs in our DFES were found to be in the middle of the combined range of the FES and CCC scenarios. We forecast fewer heat pumps because factors for our region are not typical; there is greater than average access to gas, the highest level of regional poverty and lower levels of building thermal efficiency.

We have considered network requirements beyond the RIIO-ED2 period by analysing our network for forecast 2030 demand and generation levels. The network developments included in our RIIO-ED2 plan are considerate of future needs and have been designed to not exclude impending expansion. Just one network reinforcement scheme has been included in our RIIO-ED2 plan where the requirement is expected to occur between 2028 and 2030 and the potential build period means that it was necessary to begin planning in RIIO-ED2 if flexibility is not available or proves unviable. Our RIIO-ED2 plan includes preparatory work to resolve a voltage step issue at Lower Darwen BSP predicted in 2030. As explained in the associated EJP, a small part of the total value of the investment is included in the RIIO-ED2 plan so that flexibility services can be engaged, and planning can begin to ensure that if necessary the work to resolve the issue can be completed by 2030. The small financial amount for planning in the RIIO-ED2 period is justified on the basis that the timing of the issue is particularly uncertain because the predicted voltage step is very sensitive to not only the magnitude of the load but also its voltage response which will vary as load composition changes between now and then. Consequently, we are less certain of the need to intervene at this stage.

Other RIIO-ED3 schemes have not been brought forward because there is potential for stranded assets that could be also be avoided through the use of flexibility services which can be deployed more quickly than asset-based solutions.

Although our load related investment plan is our best view of what we expect will be required during the RIIO-ED2 period, the underlying assessments are made in advance of those on which development decisions are normally made. As we approach the RIIO-ED2 period and within this period decisions will be reviewed closer to the time of intervention when latest information is available. We continually review capacity on our network and the need for interventions to increase capacity by checking the actual conditions on our network and up to date forecasts. Investment plans are scrutinised as part of this process to assess whether they still provide the optimal way forward and will deliver the necessary benefits at the required time. This way we ensure that our plans flex to reflect the changing energy landscape and network requirements.

As with all network capacity needs, the market is tested at that time to determine if a flexibility service can be obtained to provide a solution, with the associated cost compared, within a comprehensive cost benefit analysis, against more traditional asset-based interventions to establish the most efficient solution to be taken forward. Further synergies including potential opportunities for whole system outcomes and solutions will be further investigated in period when network needs are further understood. We have a strong track record of engagement with the ESO, IDNOs and our DNO neighbours through which we attempt to discover whole system opportunities; we shall provide evidence of this via the new licence condition requiring us to publish our first register of whole systems activities in May 2022.

Consideration of our Central Outlook scenario in our load investment plan ensures that our customers' bills are not increased in anticipation of more uncertain decarbonisation pathways or potential changes to charging mechanisms. Our approach is consistent with the requirements of the RIIO-ED2 Business Plan Guidance that investment plans should incorporate the use of uncertainty mechanisms in addition to baseline allowances to fund the required investment.

Table 4 shows that the phasing of our overall load related investment results in relatively even spend throughout the period assisting with deliverability. However, there are differences in individual elements of the load related investment plan due to the basis that the needs arise as explained in the comments column of Table 4. Timing of investments is important over the critical RIIO-ED2 period of network development to meet the challenges of decarbonisation and smooth work over multiple periods. Deliverability risks associated with increased workload compared to that delivered in RIIO-ED1 are described in section Fig. 21 along with our plan to manage the larger volumes and uncertainty.

Table 4: Phasing of load related investment (baseline including service solutions and LV monitoring)

All values £m	FY24	FY25	FY26	FY27	FY28	Total	Comment on phasing
Primary load investment, £m	5.1	9.3	5.0	4.8	3.8	**28.0**	Phasing is based on timing of overloads and solutions for specific schemes
Secondary load investment including service solutions, £m	9.6	12.2	16.0	18.1	25.3	**81.2**	Phasing of secondary reinforcement is based on the timing of exceedances coming from modelling of our network subject to forecast LCT uptakes. Service solution requirements, including baseline allowance for unlooping, match battery EV uptake rates.
Fault level reinforcement investment, £m	2.5	4.5	8.9	8.6	7.8	**32.2**	Phasing of primary reinforcement is timed according to the needs of specific schemes and secondary network values follow modelling outputs.
LV monitoring investment, £m	8.2	8.2	2.1	1.0	1.0	**20.6**	80% the LV monitoring programme is phased in the first two years to better support HV and LV network planning and mitigate risks associated with significant and unknown LCT penetration.
Overall Load Related investment, £m	**25.5**	**34.2**	**32.0**	**32.5**	**37.8**	**162**	

2.2 Components of baseline load related investment plan

2.2.1 Summary of baseline primary load investment plan

The associated total cost for primary networks load related investment is £28 million. Table 5 lists the load related network primary intervention schemes included in our baseline load related plan excluding customer connections and their contributions. Further detail on named schemes valued at more than £2 million is provided in their EJP, listed in Table 1.

Detailed optioneering has been undertaken to determine the most cost effective solutions for resolving forecast exceedances on our 33kV and 132kV systems as described in our Load Related Expenditure Methodology (Annex 3B). Significant savings of £7.8 million come from the reduced costs identified in Table 8 where our analysis of network needs and the availability of flexibility services has shown them to be a likely approach for deferring asset-based reinforcement.

At this voltage we have adequate short-term capacity to accommodate load growth at 16 of our 17 Grid Supply Points with the exception of the Harker/Hutton group in Cumbria where large numbers of existing windfarms and accepted solar generation and BESS have essentially used up the capacity. To increase this, National Grid are expected to replace Harker substation by December 2026 because of their redesign which is necessary to replace assets in poor condition. The currently proposed offline build means that we shall need to construct a new 132kV switchboard as discussed in section 2.5 of this document and the associated EJP.

Table 5: Primary network load related investment schemes

Scheme name/location	Description	Value £m
Little Hulton	Use flexibility services as alternative to uprating transformers at Little Hulton Primary and incoming 33kV circuits.	[redacted]
Frederick Rd BSP	Uprating of 3 x 60MVA GTs to 90MVA units to meet increased demand	
Southern Gateway	New Primary to meet increased demand	
South Heywood/ Northern Gateway	New Primary to meet increased demand	
Mayfield Re-gen	New Primary to meet increased demand	
Lower Darwen 132kV voltage step mitigation	Early RIIO-ED3 exceedance - Use flexibility services as alternative to installation of 132kV switchgear to mitigate voltage step issues which limit available capacity in the area –	
132kV harmonic filter at Bredbury	Installation of 132kV harmonic filter to mitigate against EREC G5 harmonic exceedances in the area.	
Other load related interventions	Load related intervention at 12 other sites, including 5 where the use of flexibility services is assumed as alternative to circuit upgrades and transformer replacements at the other 7 sites.	
	Total	**£29.6m**
	Customer driven EHV load related investment	-£7.4m
	Customer reinforcement from RIIO-ED1	£5.8m
	Overall total	**£28m**

2.2.2 Summary of baseline secondary load investment plan

The results of our accurate HV and LV network modelling based on the actual connectivity and half-hourly load growth forecasts show the quantity, location and nature of the many constraints that are expected to appear in the short term across our secondary network as a result of LCT connections. Table 6 lists the programmes of load related secondary network interventions included in our baseline load related plan. This includes the costs of both conventional reinforcement and flexibility services and covers solutions for thermal, voltage and harmonic distortion issues. The associated total cost for secondary networks load related investment if £61.1 million taking into account contributions from customers.

Most secondary network interventions in terms of both volumes and costs correspond to tackling thermal and voltage issues. These include HV and LV feeder reinforcement, as well as reinforcement of distribution substations with ground and pole mounted transformers. Using our network planning optimisation process described in our Load Related Expenditure – Methodology (Annex 3B), we will improve cost efficiencies by providing only the capacity required with minimum cost options.

Our plan for rolling out more LV monitoring is our first step for ensuring that interventions are only made at the right place and time, avoiding stranded assets or delaying the uptake of LCTs. Using extensive LV monitoring for the first time in RIIO-ED2, we expect that significant savings of £6.2 million can be made from the use of flexible services to tackle thermal and voltage issues in secondary networks. Most of these savings (around two thirds of savings) will arise from the deferral of asset solutions to resolve constraints on HV feeders, where flexibility services can be provided by a larger number of domestic, commercial and industrial customers. We also expect that LV customers and especially domestic customers will be able to mainly shift demand of EV charging and heat pumps to reduce network investment (around one third of savings).

Apart from thermal and voltage issues, we will use LV filters to tackle harmonic distortion issues in areas of the network with clusters of LCTs. To target their installation, we will use monitoring devices to measure harmonic voltages at distribution substations. Our LV monitoring programme uses the PRESense system that allows us monitor power quality parameters, so no additional monitoring is required on distribution substations with ground mounted transformers and the associated cost efficiencies are £1.2 million. The associated programme for monitoring harmonics is purely for pole mounted transformers.

Table 6: Load related investment programmes in secondary networks

Intervention Programme	Quantity	Value £m
LV feeder reinforcement	[redacted]	
Distribution substation reinforcement with ground mounted transformers		
Distribution substations reinforcement with pole mounted transformers		
HV feeder reinforcement		
LV monitoring for harmonics (only for pole mounted transformers without PreSense)		
LV harmonic distortion filters		
Flexibility services at LV feeders		
Flexibility services at distribution substations with ground mounted transformers		
Flexibility services at HV feeders		
Secondary network load related investment:		**£70.3m**
Customer driven HV & LV load related investment		**-£9.2m**
Overall total		**£61.1m**

2.2.3 Summary of fault level reinforcement investment plan

We are additionally planning for the continuation of programmes to remove fault level constraints. The 'fault level' refers to the ability of switchgear to safely withstand and clear fault current in the event of a fault and it can limit the capacity to connect additional demand or generation customers.

The associated total cost for fault level reinforcement is £32.2 million.

We are particularly focussing on addressing extensive potential fault level issues on our 6.6kV network which forms the majority of our HV system in Greater Manchester. As a result, we have pioneered innovative re-rating techniques on certain types of existing switchgear, which has resulted in lower costs per intervention.

Across our EHV network there are a number of sites where the prospective fault level is approaching the rating of the existing switchgear. Through careful analysis via our network models, these sites have been identified and a program of work developed to replace the switchgear at these locations. The intervention in the majority of these cases is expected to involve replacement with new equipment of a greater rating, with innovative techniques applied at some sites to reduce the value of investment.

Table 7: Fault level related investment programmes and schemes

Intervention Programme	Quantity	Value, £m
Fault level secondary network reinforcement – innovative	[redacted]	
Fault level secondary network reinforcement – conventional		
6.6/11kV Primary Switchboards fault level interventions Conventional - Replacement of switchgear at 10 x locations Innovative - Two sites to be addressed		
33kV fault level interventions - innovative Replacement of switchgear at 17 x 33kV Substations and two sites wit innovative. One site to be jointed out.		
total fault level related investment:		**£32.2m**

2.2.4 Summary of service solutions investment plan

In some cases, it is necessary for us to make alterations to our network when customers want to connect LCTs. The interventions required to ensure the continued safe operation of our network may include changing the fuse in the cut-out at the point where the customer connects to our network, changing the cut-out itself if we cannot just change the fuse alone, or uprating the service cable connecting the property to our mains cable. We have cautiously estimated £8.2 million of investment to replace fuses or whole cut-outs to accommodate LCTs a[redacted] properties during the RIIO-ED2 period.

Although looped services are suitable for present levels of domestic demand, it is necessary to unloop them to remove the potential barrier to LCT adoption by avoiding the prospective overloading that could occur if customers on looped services connect EVs or heat pumps.

With approximately 500,000 customers (~20% of customers) being supplied via looped services, our current programme of unlooping is expected to ramp up significantly during the RIIO-ED2 period as more of our customers are predicted to adopt EVs. Based on our Central Outlook forecast, analysis of the population of looped services, types of housing and a reactive approach, we estimate that [redacted] customers will require unlooping during the RIIO-ED2 period, costing £102.6 million.

Although we are confident in the robust forecasting methodology informing the expected number of EVs in our region, there are significant uncertainties around the number of unloops that we will be required to undertake due to the dependence on our customers' behaviours. The number of services we shall unloop will be affected by whether customers accept the potential physical disruption of unlooping and whether they will need to charge their vehicle at home or can do that at work or a charging hub.

With consideration of these uncertainties and to keep customer bills low, we have included £20.1 million in our baseline load related investment plan for unlooping and £1.6 million for other service solutions such as changing fuses or cut-outs. This baseline value is only approximately 20% of the estimated RIIO-ED2 requirement with the remaining £89.14 million of forecast expenditure to be covered by an Uncertainty Mechanism. Further detail on our assumptions on load related Uncertainty Mechanisms is given in section 6 of this Annex.

2.2.5 Summary of baseline LV monitoring investment plan

Our baseline load related investment plan includes £20.6 million for the installation of permanent LV monitoring to give us visibility of the LV network that supplies 95% of our customers by the end of RIIO-ED2.

LV monitoring will ensure that we can use the full capacity of our existing network by enabling proactive management and optimisation of HV and LV network planning. This first step is vital for the efficient development of our HV and LV network where capacity is expected to be a significant challenge due to large increases in demand associated with the forecast uptake of LCTs.

Allowing us to target interventions only when, where and at the proper size needed to avoid stranded or overloaded assets, the installation of LV monitoring at [redacted] ground mounted distribution substations will release approximately 20% of the capacity of the associated existing network during the RIIO-ED2 period and beyond. This capacity would not be available otherwise because our planning is currently based on cautious assumptions based on the temporary deployment of monitoring equipment providing short term measurements.

Our permanent LV monitoring programme complements the increase in smart meter data expected during the RIIO-ED2 period by filling gaps in customers' usage information. The functionality of the proposed PRESense monitors extends beyond the parameters measured by smart meters, allowing us to balance phase connections and address harmonic issues through earth return current and power quality measurements respectively as described in our LRE EJP 9 - LV Network Monitoring.

2.2.6 Summary of baseline NTCC investment plan

Our load related investment plan does not include any baseline allowance for New Transmission Connection Charges (NTCC). This is because we currently do not know of or anticipate any projects increasing capacity at existing transmission connection points or for new transmission connection points initiated by ourselves.

Our conclusion that no NTCC are expected during the RIIO-ED2 period is based on a collaborative review with National Grid of the requirements at transmission network interfaces. The review covered known ongoing projects, planned transmission works and the need for future interventions based on NGET's most recent security of supply compliance assessment at our interface points. Presently, the planned interventions at our transmission interfaces during the RIIO-ED2 period are driven by National Grid factors and not DNO capacity requirements. Details for specific interface substations are provided in the commentary accompanying Business Plan Data Table, CV4.

We are proposing a change to the regulatory treatment of NTCC, to change these from load related expenditure to pass-through. More details on the rationale for this change can be found within our Managing Uncertainty Annex 29.

2.3 Incorporating smart and flexible benefits

The amount we need to invest in our network to meet load requirements is inextricably linked to our transformational strategies as shown in Fig. 3. During the RIIO-ED2 period when the uptake of LCTs is forecast to increase steeply, these strategies will be more important and continue to shape how our network is operated, capacity is managed, and additional capacity is created to accommodate the LCTs essential for meeting Net Zero.

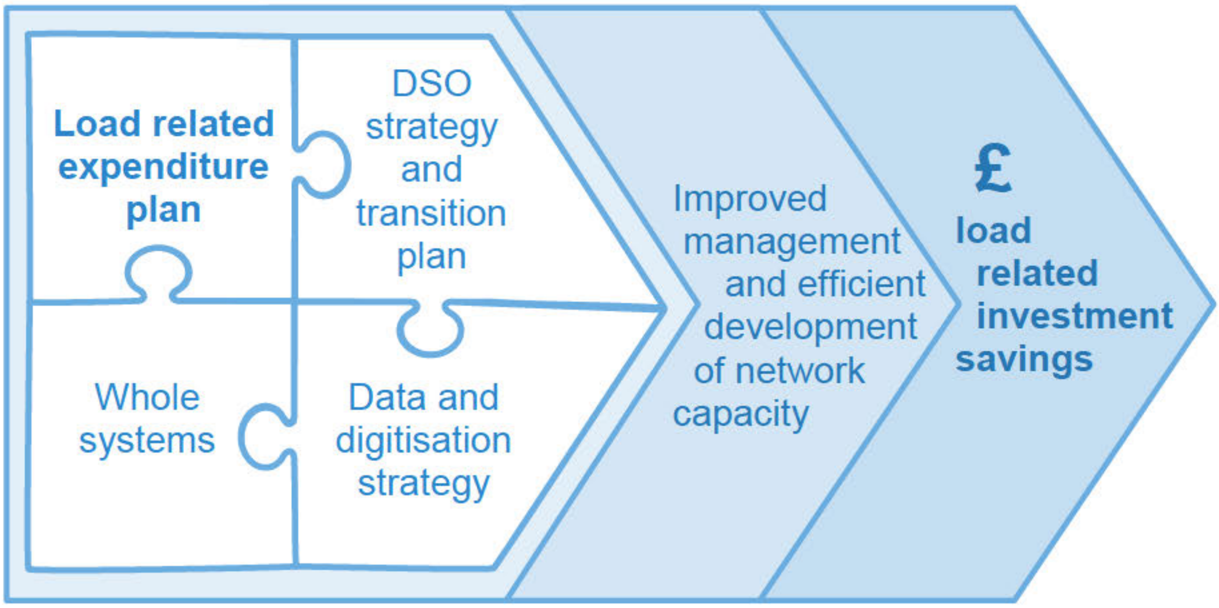


Fig. 3. Linkage of our load related investment plan and the key strategies driving savings

Through the application of our strategic vision action plan for network planning as detailed in section 4, our load related plan has been optimised by incorporating smart and flexible benefits from DSO and whole systems approaches described in their respective Annexes. Responding to the need to not be a barrier to Net Zero, keep customers bills down and connections costs low, we are continuing to use our existing network more by applying innovative operational control and flexibility techniques, reducing the need for the expansion that would be needed to increase capacity otherwise.

Our load related investment of £162 million (£141.4 million excluding LV monitoring) reflects the savings that are expected from our approach to forecasting and incorporation of business as usual innovations as shown in Fig. 4. Without the benefits arising from previous interventions and those planned in the RIIO-ED2 period it is estimated that the necessary load related investment would be approximately £320 million greater. Savings arise from distribution system operation, DSO, functionality and the application of innovations.

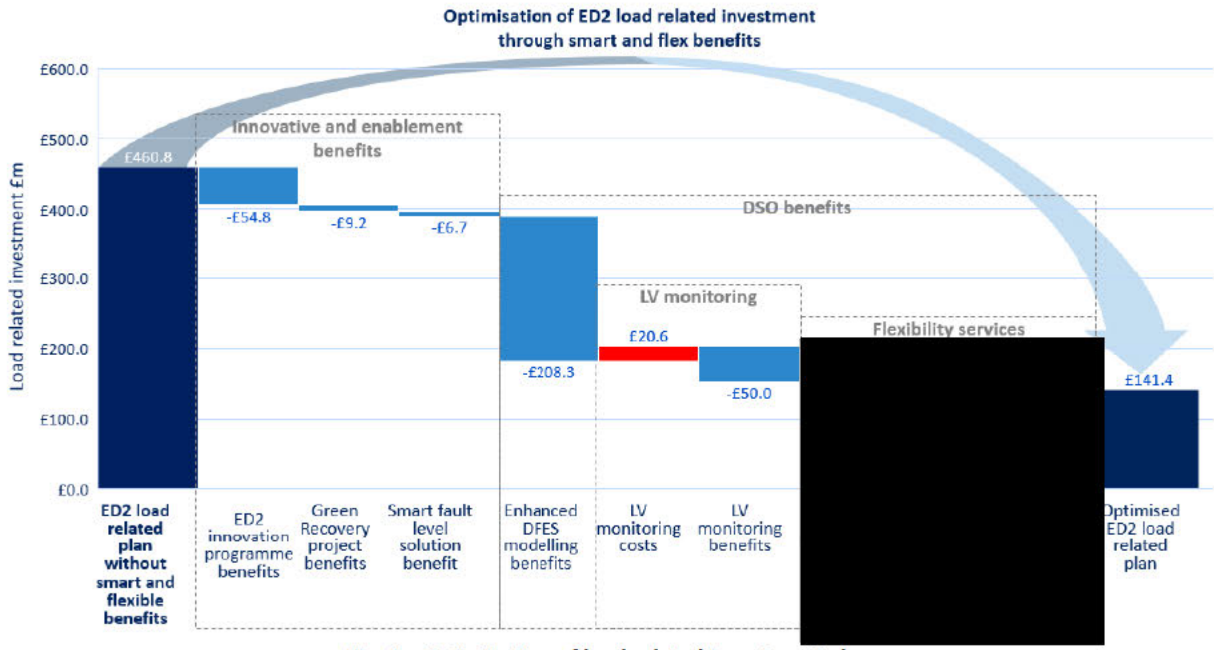


Fig. 4. Optimisation of load related investment plan

[redacted]

Flexibility will always be considered first as a solution for when actual network developments are implemented during the RIIO-ED2 period, when a flexibility tender will be used to recruit service providers. Ahead of normal timescales, our plan has been built up based on the use of flexibility services instead of asset solutions by checking network needs against existing potential providers and the outcomes of our anticipatory expression of interest. Detailed analysis of the forecast magnitude and duration of the need for additional capacity on a half hour by half hour basis has been used to judge that 7 out of 18 EHV reinforcement requirements may potentially be permanently or temporarily solved using flexibility services to defer asset-based interventions beyond the RIIO-ED2 period. On our secondary network, we are expecting that flexibility services will potentially be used as an alternative to asset-based solutions in approximately 5% of LV feeder and distribution transformer interventions and 15% of HV feeder reinforcement cases.

Table 8 summarises the EHV and HV/LV sites where flexibility services are judged feasible to provide the required capacity to defer conventional asset-based reinforcement. Greater detail on the outcomes of our flexibility assessments is provided in our EJPs for load related EHV reinforcements greater than £2 million.

Table 8: Summary of flexibility service costs and savings

Reinforcement scheme description	No. of sites where reinf. deferred by flex	Estimated conventional cost £m	ED2 flexibility cost £m	ED2 flexibility saving £m
EHV flexi[redacted]				
Baguley	1	[redacted]		
Hattersley	1			
Little Hulton	1			
Wigan BSP	1			
Bow Lane - Whittle Le Woods - Buckshaw - Botany Bay group	2			
Amble Side - Windermere group	3			
Lower Darwen	1			
		EHV flexibility savings after ED2 costs: £7.88m		
HV and LV flexibility assessment				
Distribution substations	13 out of 400 GMT subs	[redacted]		
LV feeders	21 out of 254			
HV feeders	32 out of 221 requiring interventions			
		HV & LV flexibility savings after ED2 costs: £6.2m		
Total flexibility savings after costs:				**£14 million**

£50 million of savings, offset by £20.6 million for installation, will be gained from more monitoring to resolve “blind spots” that currently require us to take cautious planning assumptions, potentially resulting in us not using the full capacity of our existing network. Not only will this additional measurement data enable us to employ network investments more efficiently, but by sharing it as described in our Data and Digitalisation Strategies (Annexes 21 and 23 respectively), we shall empower our stakeholders, stimulating flexibility markets and further innovation.

£208.3 million savings will come from the more accurate network planning using forecasts created using our ATLAS methodology. This advanced modelling of system wide demand diversification, impact of time of use charging and smart charging avoids the need for imprecise assumptions that would otherwise increase the effect of additional EVs and heat pumps on electrical demand. By avoiding overestimating peak demand, we don’t identify too many overloads and have not overvalued our load related investment plan.

Even though we currently consider that alternatives to asset-based solutions for resolving fault level issues on our EHV network, such as fault current limiters, will not be economically viable in the RIIO-ED2 period, we have factored in £6.7 million savings from innovative solutions including our pioneering Respond project that has developed a toolbox of techniques we can employ to manage fault levels. Further details of our fault level innovations can be read in our Innovation Delivery Plan, Annex 24.

Our Green Recovery investment has brought forward support for projects prioritised through public consultation to help drive a green recovery from the effects of the Covid-19 pandemic. As part of Ofgem’s Green Recovery scheme, launched to kick start the recovery, our investment is creating network capacity that will speed up green growth through the delivery of shovel-ready projects. All our Green Recovery projects are helping the region hit its Net Zero carbon targets by accelerating changes including electric vehicle charging at motorway services. Our investment in Windemere will increase network capacity to facilitate EV charging facilities in tourist carparks and the replacement of a diesel ferry with an electric alternative. This investment is offsetting over £9.2 million of load related network investment that would otherwise have been required in the RIIO-ED2 period.

£54.8 million savings are expected from the further roll out and enhancement of proven innovations developed in RIIO-ED1 and previous price control periods. Continuing to build on our strong record for implementing innovations into business as usual, additional savings will come from the further application of our Smart Street approach and CLASS integrated with learnings from our QUEST project to deliver more comprehensive voltage management across all voltages.

2.4 Incorporating customer driven reinforcement

Adjustment to our load related investment plan has been made to account for customer driven reinforcement necessary for their new connection. We have assumed 100% overlap between network investment identified from our analysis of growth forecasts and the reinforcement identified for new connections. Double counting is avoided by reducing our general load growth reinforcement by £39.7 million customer driven investment for reinforcement needed for new connections.

2.5 Harker Grid Supply Point

Harker Energy Enablement is a significant project identified in NGET’s RIIO-T2 program. Harker is an existing Grid Supply Point in our region between Carlisle and the Scottish border. NGET has determined that the existing Super Grid Transformers (SGTs) at Harker need to be upgraded from 120 to 240MVA units as part of an offline rebuild due to numerous drivers dominated by asset condition. The work will fortuitously create additional capacity to accommodate further distributed generation connections on our network in RIIO-ED2 after completion of the works currently expected in December 2026. The offline build approach means that we shall need to build a new 132kV switchboard and reconnect it to our existing network.

With regards to our RIIO-ED2 submission, we have taken the decision to separate Harker out as a High Value Project instead of including it within our load related expenditure plan, essentially ringfencing the allowance for this project tied to outputs. This approach will provide flexibility in relation to the level of expenditure and the present uncertainty around the solution depending on the outcome of the Large Onshore Transmission Investments (LOTI) reopener process. It also provides visibility, ensures that the load plan is not distorted by its inclusion, and allows inclusion within baseline allowances.

2.6 Summary of baseline load related investment reported in BPDTs

Table 9 summarises the costs of our proposed baseline load related investment plan based on our best view of the network development required during the RIIO-ED2 period as reported in the related Business Plan Data Tables (BPDTs). The baseline load investment is not reported purely in CV1, CV2 and CV3 BPDTs, but extends to C2 BPDT including customer driven reinforcement, plus the LV monitoring (PRESense) programme included in CV11.

The values of customer driven reinforcement and their contributions given in table C2 have been derived from an analysis of historic connections. C2 includes £1.6 million for service solutions including fuse replacements, cut-out replacements and service uprates, but excludes unlooping interventions.

Tables CV1, CV2 and CV3 include the values of EHV, HV and LV load driven investments based on asset and flexibility service solutions required to mitigate network exceedances identified from the analysis of our network subject to forecast future demand. A baseline allowance of £20.1 million is included in CV2 for service unlooping.

Our forecasts are taken to include new customer connections because they take account of the overall increase in electricity usage across our network driven by load growth and connections. For this reason, we have assumed that the network reinforcement attributed to customer connections corresponds directly with the network reinforcement needs identified via our network analysis. Consequently, we have subtracted the customer driven reinforcement values in C2 from CV1, CV2 and CV3 to reflect this overlap. Our approach ensures that we avoid double counting when splitting our load related reinforcement between connections driven reinforcement and general reinforcement.

Table 9: Summary of load related expenditure reported per BPDT

Description	C2	CV1	CV2	CV3	CV11	Totals
	all costs in £ million					
EHV load driven excluding Harker and including savings from the use of flexibility services		29.6		17.8		
EHV customer driven total reinforcement (DUoS and customer funded)	10.0	-10.0				
EHV customer funded reinforcement	-7.4					
EHV customer reinforcement from RIIO-ED1	5.8					
HV & LV load driven			70.3	14.4		
HV & LV customer driven total reinf. (DUoS and customer funded) including cut-out and fuse changes	29.7		-29.7			
HV & LV customer funded reinforcement	-9.2					
LV service unlooping			20.1			
LV asymmetrical monitoring (PRESense)					20.6	
Overall total	28.9	19.6	60.7	32.2	20.6	**£162**
Total EHV investment value including reduction due to customer contribution:						45.8
Total HV & LV investment value including unlooping, LV monitoring and including reduction due to customer contribution:						116.2
Total cost including customer contribution, but excluding LV monitoring:						**£141.4**

2.7 Stakeholder support

We have received support for our LRE approach and our split between baseline and uncertainty mechanisms to avoid ex-ante allowances being set at levels which may increase charges to customers unnecessarily. They want us to support the move to a low carbon economy by managing network constraints and providing the necessary capacity with sufficient timely funding and flexibility. They do not want delays to funding to result in lack of timely investment so that networks become a barrier to the uptake of EVs in particular.

Engagement with our independent Sustainability Panel and Customer Engagement Group (CEG) led to us developing the proposal to ensure that we provide the capacity required to meet these stakeholders' ambitions as they emerge. We expressed this as:

Ensuring capacity is provided in the right place and at the right time as electricity demands increase

This proposal was tested and refined through all the phases of our ED2 stakeholder engagement programme and resulted in a high customer and stakeholder acceptability score of 82%.

In bi-lateral discussions with key stakeholders such as Greater Manchester Mayor Andy Burnham, the key expectation is that we will keep up with the pace of development and not become a blocker on regional ambition, nor impede customers meeting their needs. We have received stakeholder's endorsement for our proposal for strategic investment to support Net Zero.

In November 2020 we hosted our Powering up the North Summit, which provided a forum to bring together senior political and business leaders and stakeholders across the region to debate some of the key issues facing the energy sector. Following this summit three additional events were organised to look at the distinct issues and challenges that each sub-region (Cumbria, Lancashire and Greater Manchester) faces and bring together business and political leaders from those specific regions.

During the summit we asked the question: *What are the key environmental and economic challenges faced on the road to Net Zero?*

Our LRE plan addresses the challenges to decarbonising at pace identified by stakeholders from three areas within our region as listed in Table 10. A great deal of commonality was observed in the feedback with community engagement, workforce availability and a supportive policy environment perceived to be the key challenges. There were also some localised nuances with improving air quality and alleviating fuel poverty referenced in Greater Manchester and expansion of electric vehicle infrastructure given extra emphasis in Cumbria. All these challenges are addressed in one way or another by our LRE plan.

Table 10: Key environmental and economic challenges identified by our stakeholders

Key environmental and economic challenges	Cumbria	Lancashire	GM
Producing more energy locally	✓		✓
Charging infrastructure expansion	✓		
Community engagement – take people with us	✓	✓	✓
Workforce availability/ skills and supply chain	✓	✓	✓
Telecommunication – broadband	✓	✓	
Innovation stimulus/grants to overcome barriers	✓		✓
Supportive national energy policy	✓	✓	✓
Improve air quality			✓
Lifting people out of fuel poverty			✓

In September 2021 we held a second Powering up the North event where we received further support for our LRE approach and network investment plan. Martin Cave, Chair of the Gas and Electricity Markets Authority, stated “It seems to us that the North West is well-placed to lead the fight against climate change, with bold and ambitious targets to achieve net zero across the region. When society moves to clean up heating, transport and power, it will do so at a local level. In fact, it’s difficult to overstate the role of local in driving forward this change.”

At the same event, Paul van Heyningen, Deputy Director of Net Zero Electricity Networks at the Department for Business, Energy and Industrial Strategy said: “I echo the points that Martin Cave and others have made about the importance of locally-led development and local action in terms of meeting our net zero commitments.” He went on to say “The sixth Carbon budget published in 2021 requires us to reduce total emissions by 78% by 2035 which when you think about what that means for our electricity system, it basically means full decarbonisation, pretty much, of our electricity system by 2035. We’re talking about unprecedented pace and scale”.

2.8 Comparison of RIIO-ED1 and RIIO-ED2 load related investment plans

Transition to Net Zero over the RIIO-ED2 period will affect the way that our customers use and produce electricity. The value of our load related expenditure plan reflects the increased investment in our network to ensure that we continue to meet our customers’ needs efficiently.

Average total annual RIIO-ED2 load investment is 108% greater than the equivalent ED1 Latest Best Estimate (LBE) amount (5 year equivalent), corresponding to 62% and 152% increases in primary and secondary load investments respectively.

Our LBE of load related investment corresponds to approx. 5% of our 5 year total RIIO-ED1 expenditure, compared to approximately 10% for the RIIO-ED2 period when including LV monitoring and Harker works with general load interventions. This doubling of load investment as a percentage of the value of the total plan is due to the connection of significant volumes of LCTs to meet the government’s 2050 Net Zero target and also new connections of industrial, commercial and housing developments associated with the significant economic development in our region.

Fig. 5 presents summaries of the RIIO-ED1 and RIIO-ED2 load related investment for all scenarios taking account the reduction in expenditure due to the use of smart and flexible solutions. Both the RIIO-ED1 allowance and LBE as an equivalent 5-year cost (ie, 5/8 of the 8-year RIIO-ED1 costs) inflated for FY2020/21 prices are also shown to allow a comparison with corresponding RIIO-ED1 costs. As expected the RIIO-ED2 scenarios have higher costs than RIIO-ED1 as they consider higher LCT uptakes to meet Net Zero carbon by 2050. Only the Steady Progression scenario which is not Net Zero compliant exhibits a similar cost to RIIO-ED1 allowance.

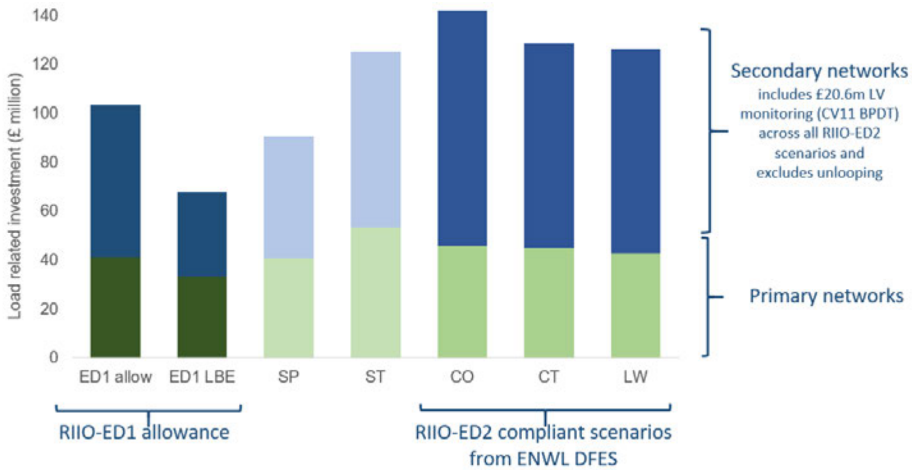


Fig. 5. Cost of RIIO-ED2 load related investment for all scenarios compared to corresponding RIIO-ED1 costs
(SP – Steady Progression, ST – System Transformation, CO – Central Outlook, CT – Consumer Transformation, LW – Leading the Way)

The cost comparison between the RIIO-ED2 scenarios reveals that:

- Central Outlook load related investment costs (£141.4 million excluding LV monitoring) are very close, ie less than 10% different, to the equivalent costs for the other two RIIO-ED2 compliant DFES scenarios that meet the 2050 Net Zero carbon target;
- in the extreme case of the Steady Progression scenario, which does not meet the Net Zero target, where developments with secured funding and strong LA and UK government backing do not proceed as expected and connections pipeline significantly underperforms, the overall investment could be 30% less than the equivalent Central Outlook cost.

Analysis of the sensitivity of the load related investment plan costs across all RIIO-ED2 scenarios allows us to conclude that:

- Central Outlook can be used to inform our RIIO-ED2 baseline allowance given that:
  - it exhibits similar costs with all other DFES scenarios meeting the 2050 Net Zero carbon target; and,
  - it is in the middle of the range of forecasted demand both during RIIO-ED2 and RIIO-ED3 across all scenarios and it does not foreclose network futureproof in case that electrification of transport and mainly heating is accelerated due to either local pre-2040 Net Zero targets met and/or post-ED2 role of hydrogen in heating is limited,
  - there is immaterial risk of asset stranding in the event of another Net Zero compliant scenario.

2.9 Load related investment beyond 2030

Our forecasts show that the significant increase in electricity usage continues beyond 2030, driven by the government's 2050 net zero carbon target. Between 2030 and 2050, our forecasts show electrical energy consumption and peak demand growing across all scenarios and doubling at the extreme.

Our Regional Insights[1] document describes what this means in terms of network capacity up to 2050 and signposts where the uptake of these low carbon technologies could cause constraints on our network and where investment will be needed. Our analysis shows that in many cases we can accommodate our customers' long-term requirements, but additional capacity will be needed on some parts of the network. Exactly where we will need to invest and how much depends on many factors including the location and type of interventions employed in the RIIO-ED2 period. Government policy will affect the rate that our transport and heat will decarbonise, whilst market development will affect our use of flexibility and energy efficiency services to manage network constraints and regulatory changes, including charging reforms, will affect customer connections and how we develop our network. Increased visibility of our network capacity will allow our stakeholders to understand which parts of the network are more suited to new connections and in turn affect the need for network reinforcement.

By considering all our forecasts and our Regional Insights beyond 2030, we can ensure that network investment is carried out timely and efficiently and provides the best value for money for our customers.

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1 https://www.enwl.co.uk/globalassets/get-connected/network-information/dfes/current/regional-insights-2021.pdf

3 STARTING POSITION AND EFFECT OF INTERVENTIONS

The overall peak demand served by our network has typically reduced or remained static over the past decade as our customers adopt more energy efficient technologies, industries have closed down and more DG has connected supplying loads locally and masking true demand. However, individual parts of our network have experienced greater changes, such as where generation has clustered due to there being the most suitable environmental conditions or where demand has grown due to developments in urban areas. Network issues must be dealt with locally. The challenges of undiversified impacts include increases in fault level and insufficient capacity in some areas, for example as equipment's thermal limits are reached. Maintaining voltages within limits is an increasing issue due to a greater range in power flows as demand, storage and generation fluctuate driven by new customer connections, market prices and delivery of network services. For these reasons, visibility of our network through our planned installation of monitoring is important as more new technologies connect and new behaviours are adopted during the RIIO-ED2 period.

3.1 Primary networks

We track network utilisation at higher voltages (132kV and 33kV network) using Load Indices showing the ratio of peak demand to firm substation capacity. To produce our RIIO-ED2 load investment programme, we have considered the network utilisation at the starting point of the RIIO-ED2 period. Fig. 6 and Fig. 7 show the forecast network utilisation at the beginning of RIIO-ED2 in FY23 for primary and BSP substations, respectively.

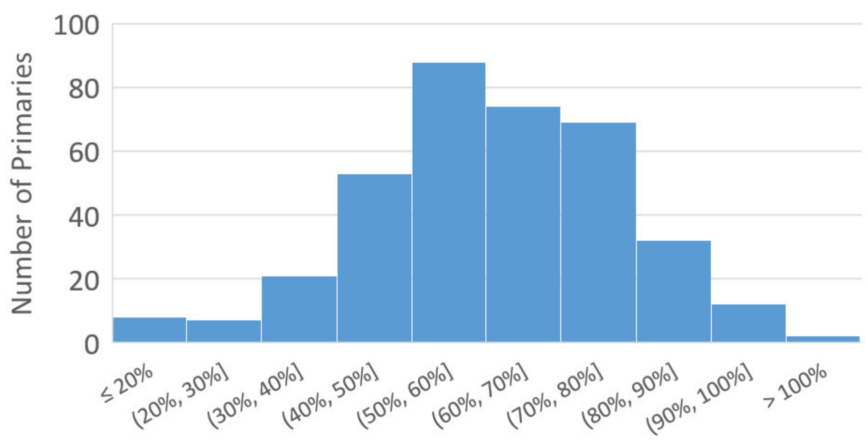

Fig. 6. Utilisation of primary substations at the beginning of RIIO-ED2 in FY23 (2020 DFES Central Outlook)

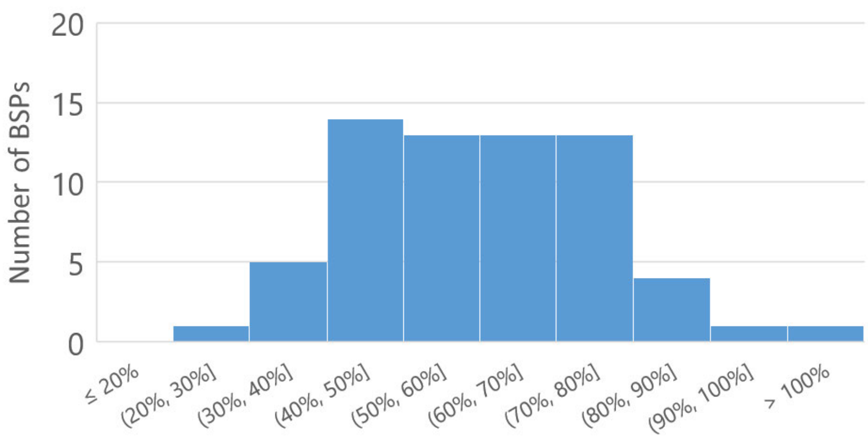

Fig. 7. Utilisation of Bulk Supply Point substations at the beginning of RIIO-ED2 in FY23 (2020 DFES Central Outlook)

As we enter the RIIO-ED2 period, the electricity consumption and volumes of LCTs are expected to grow continuously until the end of the decade as shown in Table 11. The demand growth during RIIO-ED2 will require targeted interventions to provide the additional network capacity needed.

At the end of RIIO-ED1 eight BSP and primary sites are predicted to have an LI rating of LI3 or higher. Based on our Central Outlook forecast, we predict that without our intervention this will rise to thirty sites by the end of RIIO-ED2.

Our investment plan aims to maintain the profile of utilisation to manage risk whilst continuing to avoid over or under investment. This is evident in Table 12, where the LI index is used to show that the utilisation profile with interventions for EHV substations (BSP and primary substations) by the end of RIIO-ED2 is similar to the corresponding profile in FY23 at the start of RIIO-ED2. It is predicted that there will be no sites in either LI4 or LI5 category, with eleven sites being classed as LI3 at the end of the period in March 2028. This is achieved through a range of interventions, with several new primaries proposed in Manchester city centre, resulting in the ability to transfer load between existing heavily loaded primary substations where we are forecasting demand growth driven by LCT uptake and strong economic development. Our plans also include the deployment of flexibility services at some sites to mitigate against predicted short term overloads at peak times as EVs and LCT uptake increases across the region to reach Net Zero. This range of interventions provides capacity differently and so shift utilisation values; asset-based solutions use standard sizes and therefore normally cause a dramatic change in utilisation, whilst the nature of flexibility services is continuous and so changes utilisation gradually.

Table 11: Forecasts of electricity demand and LCT volumes (2020 DFES Central Outlook)

	2023 value	2030 value	Change from 2023 to 2030
Total electricity demand (TWh)	23.7	29.0	5.3
Total demand from heat pumps (TWh)	0.079	0.186	0.107
Total electricity demand from EVs (TWh)	0.336	1.936	1.600
Peak demand (GW)	4.26	4.87	0.61
Penetration of electric vehicles (millions)	0.04	0.638	0.634
Penetration of domestic heat pumps (millions)	0.025	0.068	0.043
Penetration of non-domestic heat pumps (millions)	0.006	0.011	0.005

Table 12: Load Index ratings of BSP and primary substations

LI Rating	Utilisation Range		Number of substations 2021	Number of substations 2023 forecast	2028 without interventions	2028 with interventions
LI 1	0%	<80%	387	378	323	336
LI 2	80%	95%	33	42	74	83
LI 3	95%	100%	2	3	6	11
LI 4	100% less than 9 hours		2	3	4	0
LI 5	100% more than 9 hours		1	1	20	0

Utilisation metrics illustrate just one aspect of the capability of our network; they are indicators of the thermal loading of our substations under maximum demand conditions and do not show the impact of generation. Other factors which affect the capacity of our network include maintenance of voltage within statutory limits, satisfactory fault levels within equipment ratings and power quality. Our load related investment plan is based on ensuring that all parameters remain satisfactory for all network conditions.

3.2 Secondary networks

Similarly for HV and LV networks, without any interventions during RIIO-ED2 the utilisation profile would move to more distribution substations being overloaded (>100% utilisation) as shown in Fig. 8 and Fig. 9 for substations with ground and pole mounted transformers respectively. With the targeted interventions included in our proposed load investment programme, the utilisation profile is expected to not have any overloaded distribution substations (>100% utilisation), but our proposed programme avoids unnecessary investment. More specifically, as shown in the same figures and especially in Fig. 8 for the ground mounted transformer substations, even with the proposed RIIO-ED2 interventions there are more substations with >40% utilisation during the last year compared to the first year of RIIO-ED2. This shows that the planned interventions allow a marginal increase in the level of utilisation whilst managing the associated risk.

However, we expect more secondary network substations to be operating in the greater utilisation bands by the end of RIIO-ED2 because our load investment plan is to use flexibility first and only install greater capacity assets which significantly reduce utilisation figures when economic. This shift to more substations operating in the greater utilisation bands poses a risk after the RIIO-ED2 period. Specifically, by only undertaking necessary investment during RIIO-ED2 there is the potential for higher associated load related expenditure during RIIO-ED3 as the associated starting point will have more substations with greater utilisation levels.

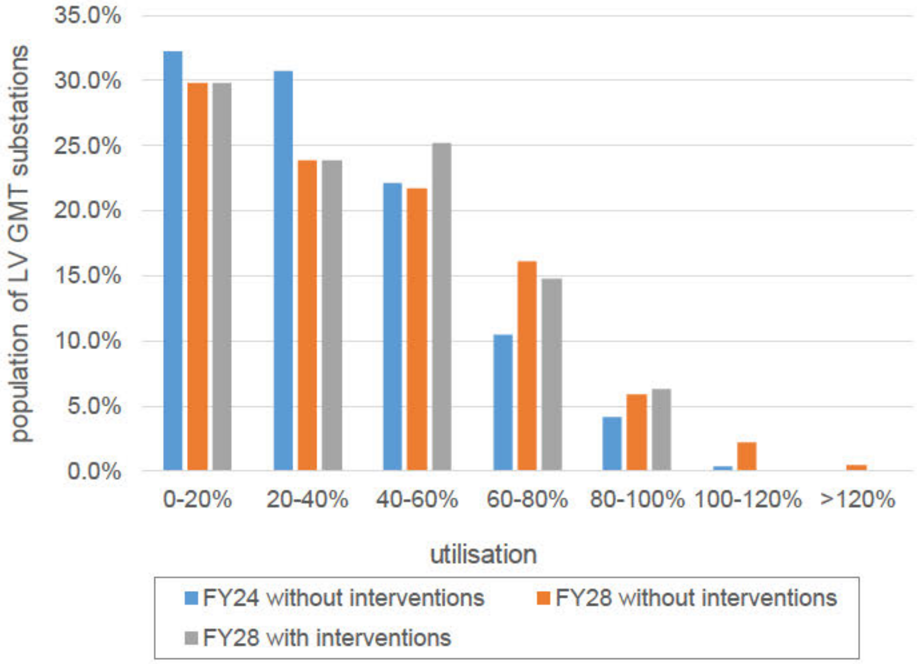

Fig. 8. Utilisation in first and last year of RIIO-ED2 for distribution substations with ground mounted transformers. End of RIIO-ED2 forecast utilisation shown with and without interventions.

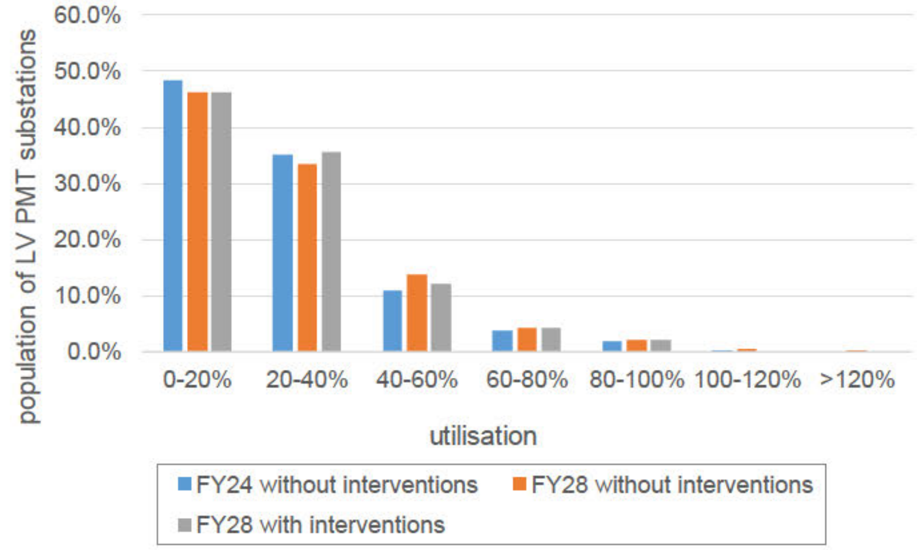

Fig. 9. Utilisation in first and last year of RIIO-ED2 for distribution substations with pole mounted transformers. End of RIIO-ED2 forecast utilisation shown with and without interventions.

4 STRATEGIC VISION

4.1 Objectives and action plan

Our strategic vision underpinning our RIIO-ED2 load related expenditure is aligned with the overarching outputs of our main business plan and defined by three objectives, which are:

i. to make sure that our network will not be a barrier to Net Zero;
ii. to implement an efficient and economic network development; and,
iii. to manage uncertainties in a transparent manner.

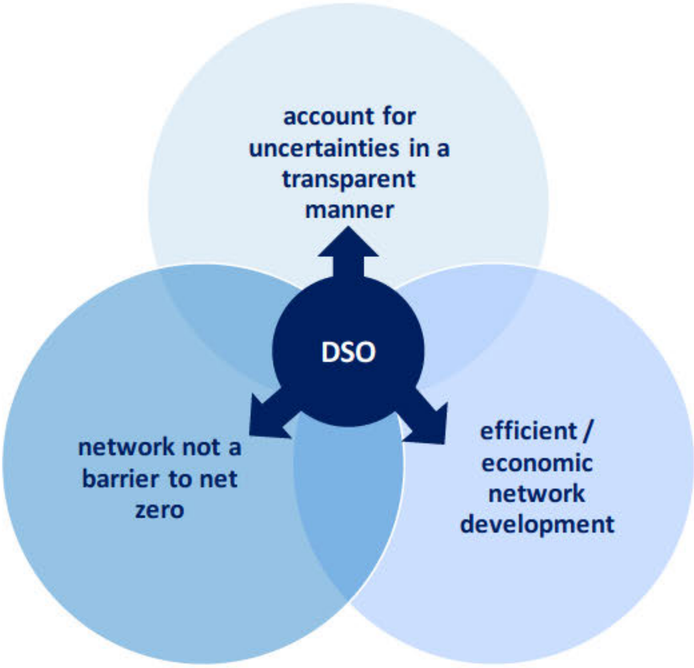

Fig. 10. Our RIIO-ED2 strategic vision with a DSO focused on market development in the centre playing a key role to meet the main three objectives.

In order to meet these objectives, our action plan for load related network investment in RIIO-ED2 is driven by the activities of distribution system operation (DSO) with a focus on flexibility services and energy efficiency markets as shown in Fig. 10. Our DSO based action plan for end to end load related investment decision making comprises the four steps listed in Table 13.

The first step of our load related strategic vision action plan is to better understand our network through increased visibility and analysis of big monitoring data. Next, we will establish network capacity needs with more accuracy and in greater detail through the enhancement of our forecasts using Net Zero compliant scenarios based on the latest policies and stakeholder input. Our network development plans will continue to be considerate of all scenarios to not foreclose the transition to Net Zero. Having established the capacity requirements, in step 3 we will promote opportunities for flexible services using the "flexibility first" approach as described in our DSO Transition Plan. We will also promote innovative solutions and energy efficiency as additional ways to help us establish local energy markets and increase savings to our customers.

Our final step is to develop the network in the "right place" and at the "right time", not only to avoid stranded or overloaded assets, but importantly also to implement cost efficient strategic network interventions that facilitate the transition to Net Zero and avoid piecemeal network expansion. More information on the initiatives and the enabling data corresponding to each of these four steps are shown in Table 13.

Table 13: Action plan to meet the objectives of our strategic vision for load related investment

Load Investment Strategic Vision Action Plan		
Steps	**Initiatives**	**Enabling Data**
Step 1: better understand our network	• Deliver greater network visibility through: o Expansion of network monitoring including neutral currents and power quality o Integration of Smart Meter and other third party data sources • Analysis of measurements to understand impacts of new customer behaviours including changes in the time of day and year that energy is consumed and produced	• Raw measurements, time sequence loading data and consumption profiles
Step 2: establish network capacity needs	• Deliver granular forecasts and undertake network impact assessments o Develop DFES forecasts to quantify uncertain Net Zero future pathways o Develop LTDS/ Network Development Plan cognisant of all Net Zero compliant scenarios to not foreclose credible alternative pathways	• Distribution Future Electricity Scenarios (DFES), • Long Term Development Statement (LTDS), • Network Development Plan (NDP)
Step 3: promote flexible and innovative solutions	• Deliver connect and manage approach at LV • Deliver flexibility first to reduce costs, defer costs and mitigate risks • Deliver flexible solution options including flexible connections/ANM • Deliver heatmaps enabling customers to connect in locations with favourable network conditions • Signpost network needs to promote opportunities bolstering flexibility services/energy efficiency market and facilitating third party solutions provision and innovations • Promote and deliver energy efficiency to reduce network loading	• heatmaps, • flexibility services / energy efficiency tenders, • market operation data
Step 4: develop our network in the right place at the right time using the optimal solution	• Use flexibility services to manage uncertainty, and only install new assets when there is high certainty of the needs and little risk of stranding • Apply fully integrated strategic planning for efficient network development, avoiding piecemeal network expansion • Evaluate intervention options always factoring in asset condition and connection requirements • Prioritise vulnerable customers and worst served customer needs	market operation data, evaluation tools and outcomes

4.2 Outcomes and feedback

Output metrics will provide understanding of how successful we are at achieving our strategic vision allowing us to refine our action plan as shown in Fig. 11. We will be able to modify internal processes to improve customer service and also adjust planning approaches to further optimise deployment of network solutions.

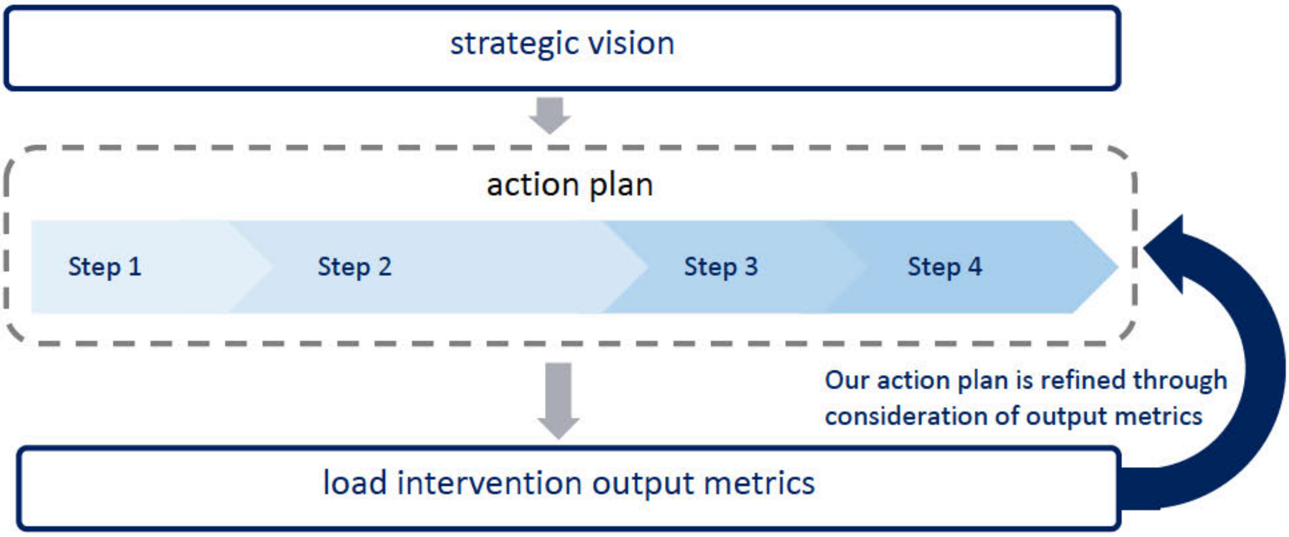

Fig. 11. Refinement of Strategic Vision action plan through feedback from output metrics

4.3 Output metrics

Following our action plan to meet the objectives of our strategic vision, we expect the following outcomes during the RIIO-ED2 period:

- customers will be able to connect LCTs simply and without delay due to our network;
- customers are not going to pay for unnecessary network development;
- customers and third parties will be empowered to deliver flexibility services to support the network; and
- we will continue leading the North West to Net Zero.

Performance measures are required to make sure that these outcomes will be delivered during RIIO-ED2. Fig. 12 shows two indicators proposed as output metrics, accompanied by transparent evidence and reporting, to assess whether our load related investment is proving to be effective. They correspond to our strategic vision outcomes and the two aspects that Ofgem is asking that the metrics consider, namely not being a barrier to customers' connections and ensuring that load investment is efficient. We intend to integrate these parameters to further enhance our network development and refine our internal processes for serving our customers.

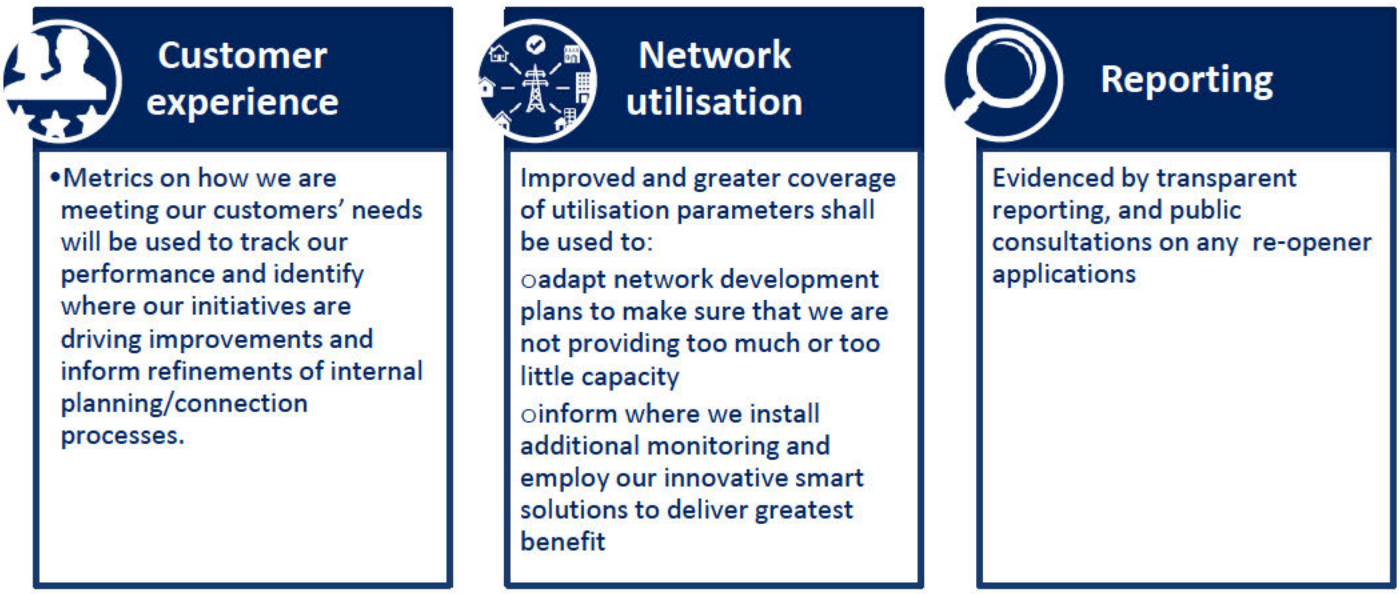

Fig. 12. Proposed load related investment output metrics and approach

Checks on whether output targets are meeting expectations, are improving or getting worse will inform us when we need to adapt our action plan to change course in order to achieve our strategic outcomes. Customer experience metrics will be updated on a regular basis as they will relate to immediate and quickly explaning data sets, so can be used to inform reviews of our effectiveness and change processes continuously. However, utilisation metrics are normally updated annually when the latest maximum demand values are available, so we shall look to other indicators to help refine network development processes in between, such as monitored LV circuit flows judged against profiled thresholds reflecting normal demand profiles, voltage complaints or voltage readings from smart meters.

4.3.1 Customer experience metrics

The current ENA processes for the connection of EVs and heat pumps have flow charts that show when a customer 'connections and notifies' the DNO and when they 'apply to connect'. Where the Maximum Demand of the whole customer connection is less than 100A (23kVA), the DNO will respond within ten working days where all required information has been provided. This response tells the customer whether they can connect without any further work by the DNO or if work is necessary.

In addition to existing reported Customer Satisfaction (CSAT) indicators which measure our general enquiry performance, we propose further specific metrics to track performance where further work is required to enable our customers to connect their LCTs.

Each will measure average performance and performance against an absolute target. We believe that these complementary approaches will show the true average but also indicate where the average is skewed by a small number of instances that take significantly longer.

All metrics will be measured from the customers initial application as this gives the timescale from start to finish from a customer's perspective. The timescales for both the 'no-dig' and 'dig' solutions metrics will therefore be inclusive of the initial response with the ten-day response time. The timescales recognise that there are aspects of the delivery that are outside our control. For example, NRSWA notices or permits may be required where work on the highway is needed, the work may need the consent of neighbours who have not initiated the work. These metrics would apply to interventions on 100A services. The timescales indicated by 'X' would need to be identified once we had some experience of reporting these timescales.

Response to customer 'apply to connect'	
Average number of working days to respond	% of responses within 10 working days

Response when a 'no-dig' solution is required	
Average number of days to change fuse	% of fuses changed within [X] working days
Average number of days to change cut-out live	% of cut-outs changed live within [X] working days

Response when a 'dig' solution is required	
Average number of days to change cut-out dead	% of cut-outs changed dead within [X] working days
Average number of days to change service	% of services changed within [X] working days
Average number of days to remove constraint due to a looped service	% of looped constraints resolved within [X] working days

We are proposing these metrics to help us understand the timescales from start to finish from a customer's perspective. The performance will not be completely in our control and will be affected by customer's behaviour and in some cases the behaviour of their neighbour. For example, the resolution might be delayed by the customer being on holiday or requires extended discussions with a neighbour who needs work on their premises but has not instigated the work. Other metrics could be developed that are more within our control, such as timescales to make contact to arrange the work, but we consider our current proposals provide better insight into the timescales from a customer perspective.

The arrangements for larger connections is less straightforward. The 'minded to' position for Access SCR is likely to result in more connections progressing where reinforcement is needed but there will be no contribution from the customer.

A simple metric on the time between acceptance and connection for connections that require reinforcement before they can connect to the network is not appropriate. There is still uncertainty in the policy position between developing strategic solutions (that generally are more expensive and take longer) and facilitating the connection of an individual customer. In addition, the timescales are often dependent of the progress of the site and desired date from the customer and so outside our control. We therefore consider that it is premature to develop metrics until there is greater clarity on the final Access SCR decision.

The Access SCR 'minded to' position recognises that Access Rights are likely to be utilised to help facilitate quicker connections where customers might accept an earlier connection with a level of curtailment risk than wait for the necessary reinforcement to be completed.

We propose some metrics to track the deployment of temporary Access Rights. These are likely to only apply at HV.

Response to customers where reinforcement needed	
% of customers where a quicker connection offered	Average time for quicker connection from acceptance to proposed date with curtailed access

Our proposals are for new metrics and as such they are not currently tracked. Each would require changes to our systems to allow reporting to be developed. These metrics have not been discussed at any Ofgem work groups, so we would envisage that a common set of metrics is desirable. We are happy to work with Ofgem and other DNOs to develop a common set of clearly defined metrics. Changes can then be made to reporting systems to allow the capture and reporting. Once some initial experience is gained, the reporting thresholds can be identified for the '% in X days'.

4.3.2 Network utilisation metrics

General duties of licence holders defined in The Electricity Act 1989 require us to "develop and maintain an efficient, co-ordinated and economical system of electricity distribution". This means that we are obliged to not over invest in our network to provide too much capacity or create stranded assets. Each year we provide to Ofgem a Reinforcement Load Index (LI) report in accordance with the RIIO-ED1 Regulatory Instructions and Guidance (RIGs) to allow compliance with the electricity distribution licence conditions to be checked. As described in section 3, LI utilisation metrics are one indicator of the spare capacity in our network and annual LI profiles can be compared to assess whether we are adding capacity at a similar rate as load growth.

We intend to improve and extend Load Index reporting as an indicator of the effectiveness of our load investment.

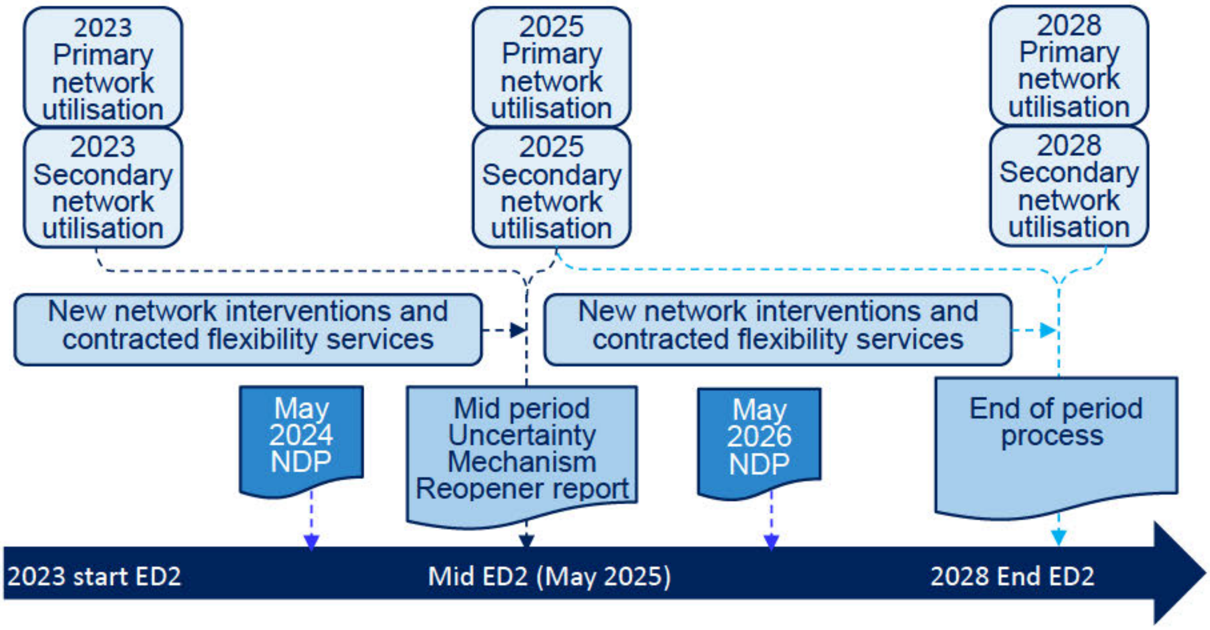

Fig. 13. Network utilisation reporting process for monitoring the effectiveness of load reinforcement

Although we shall constantly review load output metrics internally to refine our strategic vision, we will include comprehensive analysis of Load Indices and network utilisation, plus any other new regulated reporting on use of our network, in any re-opener application made during the period as shown in Fig. 13. Loading information at the start of the RIIO-ED2 period will be compared to the latest and forecast situations, alongside details of interventions carried out during the regulatory period and planned interventions. Differences in the utilisation profiles shall be described to examine the impact of reinforcement and load growth.

LI reporting in ED1 has been limited to primary network substations and groups, covering Bulk Supply Point and primary substations. To demonstrate efficient load investment in the RIIO-ED2 period, we shall extend this analysis to our LV networks by including metrics for approximately 34,000 distribution substations. It is expected that the accuracy of the utilisation metrics for these secondary substations (HV/LV) will improve throughout the period as we install more permanent LV monitoring there. Historically, like all other DNOs, our approach has been to gather Maximum Demand Indicator values approximately every three years as part of regular maintenance procedures. As described in our LRE EJP 9 – LV Network Monitoring, we have already started to install permanent LV monitoring and the programme will extend into RIIO-ED2 as we need greater visibility of our LV networks with demand expected to significantly increase due to the connection of EVs and heat pumps. The availability of more detailed and up to date loading information from this monitoring will mean that secondary substation utilisation metrics will continue to improve throughout the RIIO-ED2 period and become a more useful indicator of the effectiveness of our load reinforcement. Further improvements, such as weather correction that can adjust measured maximum demand values by up to 7%, shall be considered when the data becomes sufficiently robust since there is no value in correcting data which is already known to be potentially outside these tolerances.

The secondary substation ratings to which the loading values are compared shall consider factors such as upstream and downstream circuit capacity in addition to the transformer rating where appropriate and possible. Utilisation assessments shall importantly incorporate the capacity provided through the use of flexibility services which are expected to become more prevalent in the short term.

Our approach will form an integral part of internal processes for evaluating the effectiveness of our interventions. It will play a part in informing our Network Development Plan (NDP) and the associated Cost Benefit Analysis that form a critical input for deciding what interventions to apply when. Through this integrated methodology with a common dataset and basis, our understanding and reporting shall be consistent and give a transparent and true picture of network capacity. By reporting network utilisation that matches the network headroom report part of our NDP, we are presenting the same data for two different purposes;

- to check that the risk of loading is not increasing or overly reduced, and
- to enable customers to connect where capacity is available or take opportunities where there are needs for flexibility services.

4.3.3 Tracking strategic investments

£300k strategic investment is included in our load related expenditure plan for preparatory works and to engage early flexibility services to address a voltage step change issue at Lower Darwen predicted in 2030. We are less certain of the timing of this compared to other overload issues due to the sensitivity to the load's voltage response as well as its magnitude.

We propose that the Lower Darwen reinforcement is a named output scheme to ensure that the associated allowance is only used for its intended purpose of planning suitable intervention to relieve the predicted voltage step change issue.

5 LOAD RELATED INVESTMENT PLAN UNCERTAINTIES

5.1 Incorporating uncertainty in RIIO-ED2 load related budgets

The investment contained in our baseline load related investment plan is our best view of the requirements with a pragmatic allowance for service solutions including unlooping, balancing uncertainties and impacts on customer bills. Our plan is based on our stakeholder supported view of the most probably adoption and growth scenarios and we have assumed that suitable Uncertainty Mechanisms will be available to cover potential investments needed under more onerous conditions. These would include some actions to further future proof our network as illustrated in Fig. 14.

Our baseline load related investment plan is insufficient to cater for investment needs arising from more onerous LCT adoption scenarios or changes in connection charging rules. Although unpredictable by their nature, the potential magnitude of load related expenditure funding that may be required through uncertainty mechanisms within period is addressed in this section in accordance with Ofgem's guidance.

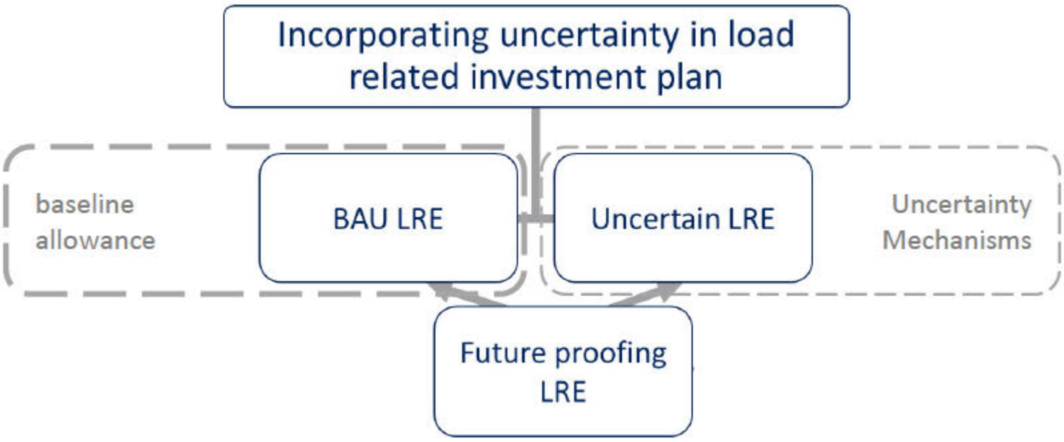

Fig. 14. Illustration of load related investment plan covered by baseline allowance and use of Uncertainty Mechanisms

Uncertainty Mechanisms are assumed to cover other potential investments triggered by requirements beyond our best view, in particular:

1. £89.1 million for service solutions due to uncertainty in customer requirements and acceptance as explained in section 2.2.4,
2. Requirements for service solutions that are different to our plan due to requirements following a higher LCT uptake associated with an accelerated region scenario and customer behaviours not being as assumed,
3. Network reinforcement to support accelerated local decarbonisation to meet Net Zero before 2050 (i.e. accelerated DFES forecasts as described in our Load Related Expenditure Methodology Annex 3B), and
4. Ofgem's minded to position on the Access SCR.

Our assessments have established that Uncertainty Mechanisms will be required to cover an additional £570.2 million based on the sum of the potential requirements above our baseline as shown in Fig. 15.

We have summed the individual values because of the interdependency between each category, for example, network reinforcement and service solution requirements will both increase if the actual numbers of EVs in our region is greater than predicted by our DFES forecasting. The value of the potential Uncertainty Mechanisms rises to over £1 billion based on our high view of the impact of Access SCR charging reforms as detailed in our Load Related Expenditure – Access SCR Impact (Annex 3C).

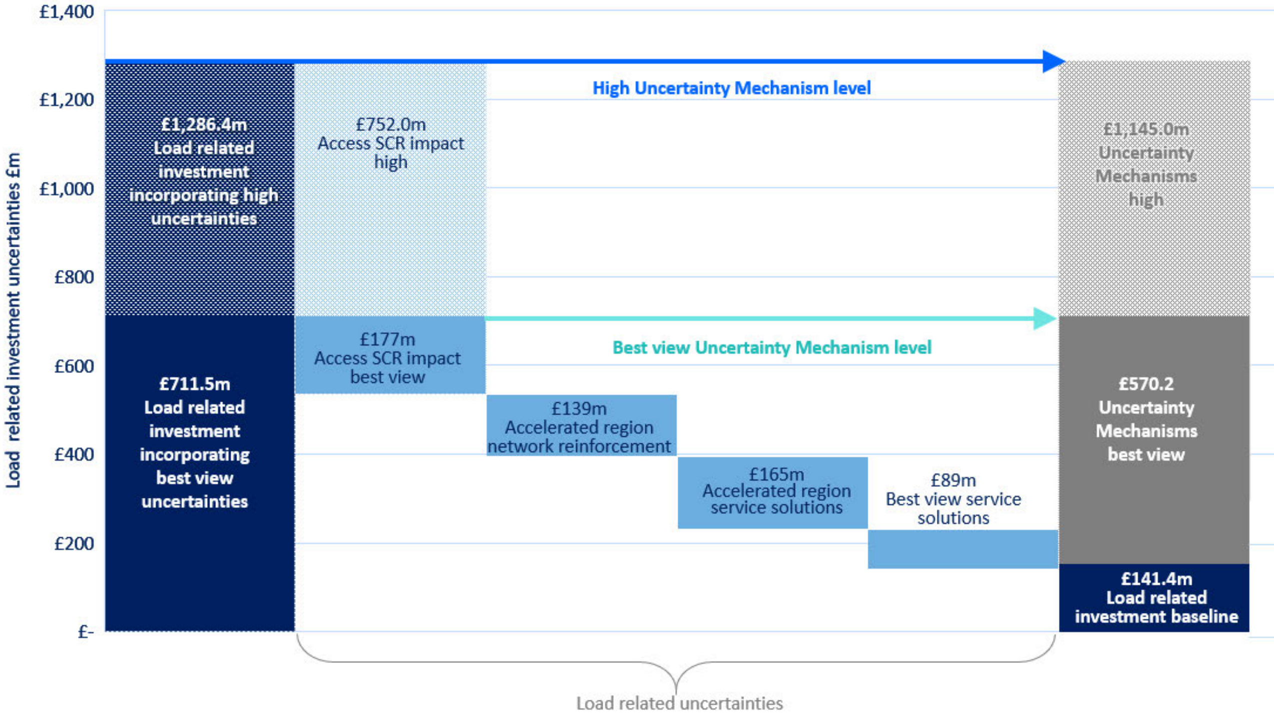

Fig. 15. Load related investment assumed to be covered by Uncertainty Mechanisms

The need for network investment during the RIIO-ED2 period is expected to exceed the value included in our baseline allowances. The use of uncertainty mechanisms is proposed to cover additional potential expenditure should additional network capacity be required because:

- More service solutions and looped services require unlooping to ensure the safe connection of our customers' LCTs,
- More LCTs connect than included in our "best view" Central Outlook scenario, potentially driven by the more ambitious Net Zero target set by Local Authorities in our region, and
- Changes arising due to the Access SCR result in more connections and more expensive network reinforcements.

5.2 Uncertainties due to Ofgem's minded-to position on the Access SCR

One area of uncertainty in the network investment required in the RIIO-ED2 period relates to the impact of the eventual outcomes from the "Access and Forward Looking Charges Significant Code Review: distribution connection charging, the definition and choice of access rights, and transmission charges for small distributed generators" (Access SCR) and the effect of the changes already occurring due to the Targeted Charging Review (TCR). Customer behaviour is likely to change although the extent and speed will depend on the final detail of the implementation, accompanied by other influences.

How our spending plans and associated volumes of connections could be impacted by changes to the existing charging arrangements arising from the (Access SCR) is inherently uncertain. In many cases shallower connection charges are expected to incentivise customers to proceed with demand and generation connections, which is expected to further increase load related investment for the required network capacity reinforcement. However, the situation will be complex as there will be moderating counteracting influences such as changes in TUoS and DUoS charges and regional variances.

An initial RIIO-ED2 plan was submitted based on existing connection charging arrangements (ie no change). However, in accordance with Ofgem's latest business plan guidance, our final plan reflects Ofgem's minded to proposals for the Access SCR published in June 2021 as part of a consultation. Our Load Related Expenditure Access SCR Impact Annex 3C explains the approach that we have taken to estimate the expected increase in load related investment needs due to the introduction of shallower charges to understand the potential magnitude of Uncertainty Mechanisms during the RIIO-ED2 period.

Table 14 summarises the estimated increases in load related investment needs and the associated value of Uncertainty Mechanisms covering the significant investment due to potential impacts of Access SCR charging reforms. These are additional expenses on top of the value of our load related baseline investment, affecting several components such as primary network, secondary network, customer connections, indirects and business support costs.

Best view, low and high levels of additional load related investment needs have been estimated including lack of customer contributions accounted for in our baseline plan, accommodating more customers' connections, more expensive reinforcement when customers are no longer disincentivised from connecting where there is less capacity currently available, and closely related indirect costs. Our best view is less than the low estimate of the impacts because we consider that some requirements are coincident and that our holistic approach for managing network capacity will deliver efficiencies. For example, our best view of additional network interventions driven by the impact of the Access SCR on generation connections is limited to reinforcement of the Cumbrian Ring 132kV circuit. This is because levels of existing generation are greatest there and it is where we have historically seen most generation connection applications. Our best view does not include interventions to accommodate generation attracted to other areas in our region because it is expected to be less clustered and needs will overlap with the additional network capacity created to accommodate more demand customers with firm connections.

Table 14: Estimated increases in load related investment needs due to Ofgem's minded to Access SCR reforms

	Low	Best View	High
Estimated value of additional load related investment to be covered by Uncertainty Mechanisms, £m	£269.7	£177.2	£752.0

5.3 Uncertainties in network reinforcement to support accelerated local decarbonisation

Local Authorities in our region have committed to decarbonisation targets which are more ambitious than the government's 2050 Net Zero emissions target enshrined in law. This means that our region's decarbonisation trajectory exceeds the scenarios underpinning our baseline load related investment plan. Both Cumbria County Council and Greater Manchester Combined Authority (GMCA) have announced their intention to reach Net Zero carbon by 2037 and 2038 respectively, whilst Lancashire has set a target of 2030 for its own activities. This is in addition to other county and borough councils in our region declaring a climate emergency as part of their action to avert a climate crisis. These moves by our regional governing bodies and the steps already being taken by local organisations are clear indications of the commitment to accelerated decarbonisation.

At this year's Green Summit, Greater Manchester Local Enterprise launched their Bee Net Zero scheme committed to making the region the easiest place in the UK to become a green business. The scheme is supporting businesses to deliver their large contribution necessary for reaching the Net Zero target by providing practical advice on renewable energy and transitioning to electric vehicles and heat.

Strong local commitment to early transition to Net Zero is also evident to us through the engagement with local stakeholders on our DFES, and through our involvement developing the Bury Local Area Energy Plan. For this reason, we must be considerate of the rapid impactful actions that will be needed to make a difference quickly in order to meet the challenge of becoming Net Zero 12 years in advance of the national obligation. More EVs will need to be on our streets and heat pumps in our homes sooner if the local target is to be achieved. Greater numbers of EVs and heat pumps in our accelerated decarbonisation versions of the DFES scenarios will increase peak demand and escalate the costs of the reinforcement necessary to mitigate the greater impact on our existing network.

We cannot be as certain of the rate and extent of local transformation without central government's funding and ability to change policies to influence the transition. For this reason, our baseline investment plan does not include the investment we could need to make to ensure that our network can cope with the earlier increase in demand, but instead we have assumed that this would be covered by a suitable uncertainty mechanism. This approach is mindful of the trade-offs between the costs, benefits and risks of early action in line with Ofgem's Decarbonisation Action Plan published in February 2020.

We applied the same methodology used to establish our best view plan to determine the additional investment that may be necessary to manage the impact on our network of more EVs and heat pumps even sooner. We reviewed the capacity of our 132kV and 33kV network against the increased needs to identify individual exceedances and where specific additional interventions will be required. A greater programme of work for reinforcing our HV and LV networks has been established by running our Future Capacity Headroom model with the numbers corresponding to the accelerated decarbonisation versions of DFES scenarios (see Load Related Expenditure Methodology Annex 3B section 4.6).

As shown in Fig. 16, accelerated decarbonisation in our region corresponds to an additional £139 million for primary and secondary network reinforcement investment during the RIIO-ED2 period to be covered by Uncertainty Mechanisms above our baseline load related investment plan.

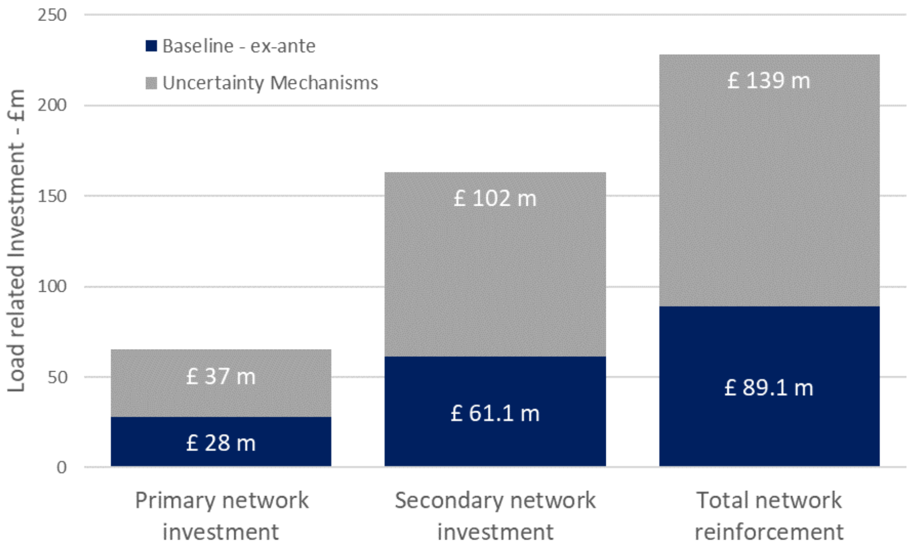

Fig. 16. Range of uncertainty in primary and secondary network investment (excluding fault level reinforcement and service solutions) for accelerated regional decarbonisation

Our network planning approach already combines consideration to not foreclose efficient future pathways. We may ensure that land is initially available to expand a switchboard in the future, may lay ducts alongside new cables where we expect that a second will be required soon and may route circuits or create interconnections in anticipation of the next phase of network development.

We have assumed that the uncertainty associated with accelerated decarbonisation in our region will also cover the uncertainty of developing our network to be ready for the next stage. Further load related investment beyond that included in our baseline plan may be identified in period if actual conditions differ to those we have forecast and we identify other first steps or compatible alternative designs to not foreclose efficient future enhancement. We have also assumed that uncertainty mechanisms will cover other additional investment brought forward because our forecasts beyond RIIO-ED2 show that future interventions will be undeliverable because there are too many or limited by the sequencing of circuit outages.

5.4 Uncertainties in emerging influences our DFES modelling

The annual update of our DFES aims to capture the latest available information and data that bring additional certainties to recalibrate our "best view" and update our understanding of uncertainties. As our forecasts are an ongoing process and evolve beyond benchmarking against Electricity System

Operator's 2020 FES, and the Climate Change Committee's (CCC) 6th Carbon Budget considered in our RIIO-ED2 load related investment plan in accordance with Ofgem guidance, we have some information and data already processed in preparation for our forthcoming DFES 2021. Although the ultimate uptake of EVs and heat pumps by 2050 are similar for our 2021 and 2020 DFES, our draft DFES 2021 future peak demand forecast for the end of the RIIO-ED2 period are greater than the corresponding 2020 DFES values. This is aligned with the latest national FES which also shows faster decarbonisation. The change in trend is explained by recent technical and policy developments, in particular;

- higher uptakes of EVs are mainly driven by lower prices for batteries as battery costs dropped lower within the last financial year than previously forecasted; and,
- higher uptakes of heat pumps are expected following UK government policies to accelerate the decarbonisation of heating.

Considering the total amount of LCTs by 2030, ie EVs and heat pumps combined, the top range of our accelerated RIIO-ED2 scenarios are approximately 14% greater than the corresponding top of the range from our draft DFES 2021. This means that, at high level, we expect that our detailed forecasting, impact analysis, optioneering and cost assessment for our RIIO-ED2 accelerated decarbonisation scenarios will cover the investment range necessary for our draft DFES 2021 scenarios. Consequently, the uncertainty of our accelerated scenarios will cover the uncertainty of the difference between our 2020 and 2021 DFES.

5.5 Uncertainties in service solution requirements

The quantity of unloops and service interventions, along with the number of fuses and cut-outs we will need to replace in the RIIO-ED2 period to allow our customers to safety connect LCTs is uncertain. This uncertainty is further exacerbated by changes to the interpretation to the Common Connection Charging Methodology which are expected to clarify that DNOs shall be responsible all fuse, cut-out and service upgrades irrelevant of whether the additional load for which they are required is due to an LCT or not.

Interventions are required to mitigate against the potentially unsafe conditions due to looped services becoming overloaded when our customers adopt EV chargers and heat pumps in excess of the service capacity as explained in our associated Engineering Justification Paper (EJP). £82.5 million of the £102.6 million, that we have evaluated as the expected cost of unlooping interventions during the RIIO-ED2 period, has been excluded from our baseline load related investment plan and instead it is assumed to be covered by an appropriate Uncertainty Mechanism because of the unpredictability of customer behaviour. However, there are further uncertainties in potential unlooping requirements beyond this.

Fig. 17 shows the best view unlooping case alongside two levels of uncertainty. First, the cost of unlooping will vary if customers react differently than assumed meaning that we deliver a different mix of full and partial unlooping where we move the loop outside of the property rather than fully removing it by laying another service cable. Secondly, unlooping requirements will differ if the actual number of EVs and heat pumps does not match the forecast underpinning our baseline programme. It will be necessary to unloop more services if more EV chargers and heat pumps are connected as being forecast by our 2020 DFES or in line with our region decarbonising more quickly to meet Net Zero in advance of 2050.

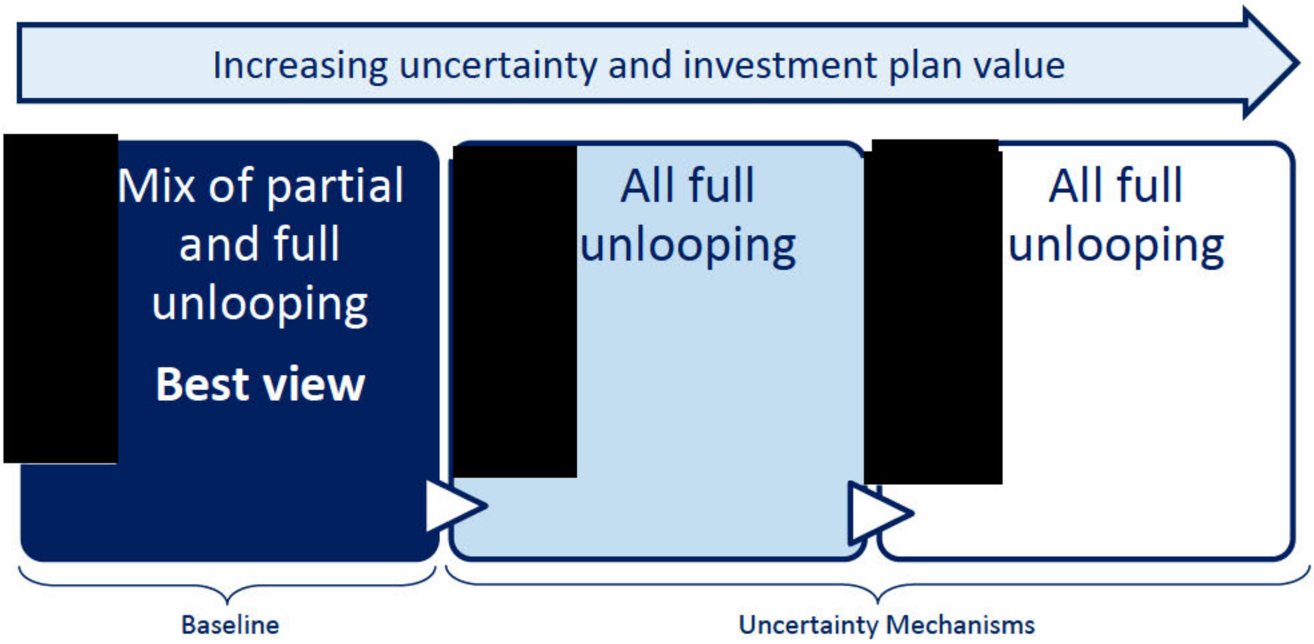

Fig. 17. Uncertainty in service unlooping interventions

Our best view plan for service unlooping is based on a cautious and pragmatic view of the expected type of unlooping interventions during the RIIO-ED2 period as shown in Fig. 18. We have assumed [redacted] full unlooping interventions and [redacted] partial delooping interventions as some customers may prefer and be safe with this less intrusive form of unlooping. However, as the type and number of interventions are uncertain it would be preferable to futureproof the network by undertaking full unlooping interventions in all instances.

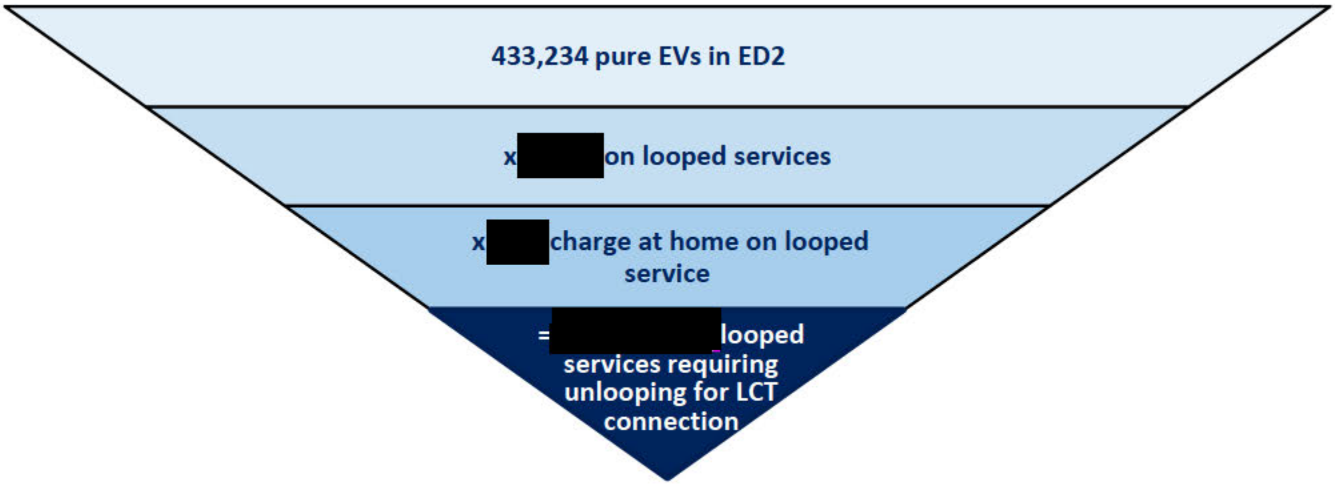

Fig. 18. Evaluation of unlooping requirements

More full unlooping interventions will be required to futureproof customer connections and avoid the need to revisit locations where an initial partial unlooping subsequently proves to be inadequate when additional low carbon technologies are connected. The additional cost of employing full rather than partial service unlooping at [redacted] locations is shown in Fig. 19.

Accelerated decarbonisation will nearly triple unlooping costs due to the requirement for approximately three times the number of full unlooping interventions compared to our baseline service unlooping plan. This is necessary to allow nearly 650,000 more domestic heat pumps and 100,000 more EVs to connect across our region, including at premises currently supplied by looped services.

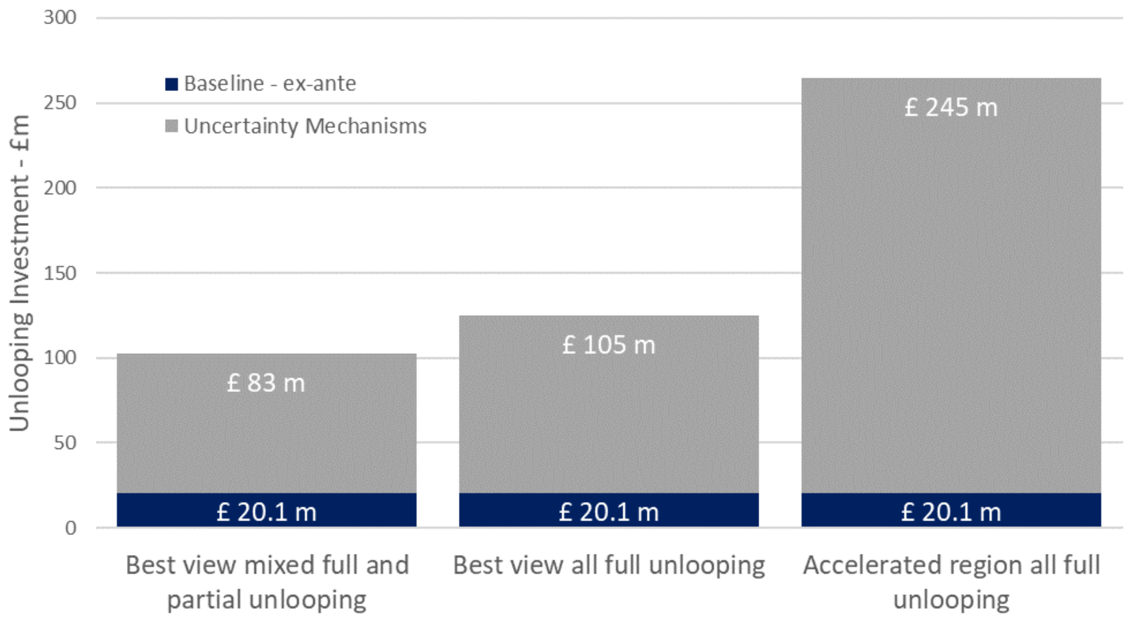

Fig. 19. Range of uncertainty mechanisms for different scales and types of service unlooping interventions

In addition, intervention may be required when a customer connects a LCT even if they are not supplied by a looped service. We need to change the fuse at the point that their electrical system connects to ours if the existing fuse is not adequately rated. Sometimes we have to also change the fuse carrier, known as a cut-out, if the existing setup cannot accommodate the larger fuse. Occasionally we may also have to uprate the service cable which connects the customer's property to our main LV circuit if it is not adequately rated. The £1.6 million included in our baseline load plan for service uprates, fuse and cut-out replacements covers only 20% of the potential need corresponding to the number of EVs in our DFES forecast. Due to the uncertainty in where customers will charge their EVs, we have assumed that the £6.6 million remainder of the expected £8.2 million investment will be covered by Uncertainty Mechanisms as shown in Fig. 20. The value of the prospective Uncertainty Mechanism increases to £15.8 million for the accelerated regional decarbonisation scenario with increased numbers of domestic heat pumps and EVs connecting during the RIIO-ED2 period.

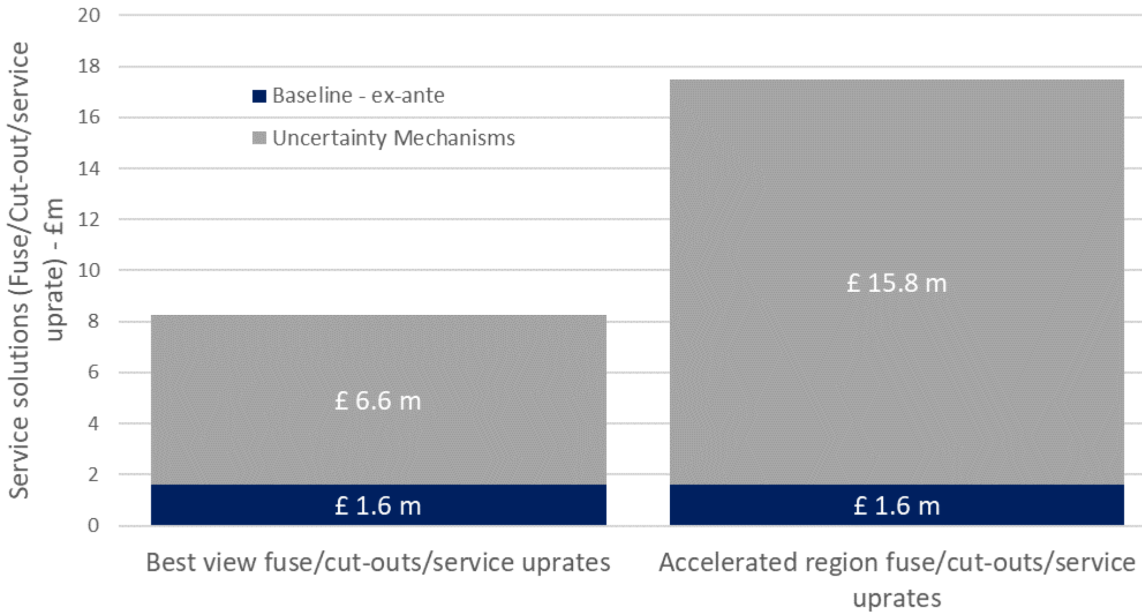

Fig. 20. Uncertainty in other service solutions including replacement of fuses and cut-outs

6 UNCERTAINTY MECHANISMS

Each regulatory period brings differing uncertainties, however, in the case of Load Related Expenditure (LRE) this has been and will continued to be, an enduring uncertainty. Drivers of uncertainty and investment need change from one period to the next and it is expected that the level of LRE uncertainty in RIIO-ED2 will be even higher than we have seen in previous periods. This is mainly due to uncertainty in decarbonisation pathways and outcomes of Ofgem's Access SCR.

In section 5 we have identified a range of load related network investments which we are currently less certain of and have therefore not included in our baseline plan. Our estimates show that the corresponding financial cost could be large if it becomes apparent that they are necessary during the RIIO-ED2 period. For this reason, it is essential that effective approaches are available to handle this uncertainty in expenditure and allow revenues to be adjusted accordingly. Appropriate mechanisms are essential for us to continue to develop a cost-effective network for our customers whilst maintaining financially viable delivery with acceptable cash flow risks.

Uncertainty Mechanisms must accommodate all forms of solutions for resolving network constraints, including traditional approaches and the use of flexibility services. Flexibility markets will be used as an alternative to and approach for deferring the installation of more assets. With a maturing market for these services, regulatory control will need to balance the incentives from efficient delivery whilst recognising that some outcomes will be undeliverable in the absence of economically viable services or providers.

Our proposals for load related uncertainty mechanisms are detailed in our Managing Uncertainty Annex (Annex 28) and associated appendices. Overall, we consider that the approach for LRE in previous price controls has served customers well for many years, and so our proposal is to take the existing elements of the ED1 mechanisms with a limited number of revisions to ensure that they continue to be fit for purpose for the challenges we will face in RIIO-ED2. Our proposal takes a holistic look at all the components of load investment plan and delivers Ofgem's aim of simplification in the price control where possible. Fig. 21 shows our proposal comprising six key mechanisms, each dealing with uncertainty in a slightly different manner. Together, they are complementary and provide a whole solution to the range of load related expenditure that may be incurred. High Value Projects are covered in the Managing Uncertainty Annex, our proposed Load Related Re-opener approach is described in Appendix A to that Annex and Appendix B covers proposals for a service solution volume driver to cover unlooping and other service interventions.

LRE Re-opener

- To amend allowances to reflect changes in expenditure requirements for load related activities, including Access SCR
- Covers all reinforcement drivers, all voltages and all solutions including flexibility services and energy efficiency

Service Solution Volume Driver

- To amend the price control in response to service interventions allowing customers to connect LCTs safely
- Keeps bills as low as possible, only increasing as requirements increase

High Value Projects

- To amend the price control in response to large projects (£18m) allowing an appropriate level of project level scrutiny
- Protects customers from risk of non-delivery whilst allowing DNOs to revise allowances, or bring forward new projects

Regulatory Changes Re-opener

- To amend the allowance to reflect indirect and direct costs resulting from Significant Code Reviews or other major Ofgem programmes of work and not funded elsewhere

Net Zero Re-opener

- To amend the price control in response to changes connected to meeting Net Zero carbon targets that have an effect on the costs and outputs of licensees

Moorside Re-opener

- To amend the price control in response to decisions to site nuclear generation within the Cumbria region

Fig. 21. Proposed load related Uncertainty Mechanisms

7 DELIVERABILITY

7.1 Deliverability Plan

Driven by our customers' further decarbonisation and economic growth, our RIIO-ED2 load related baseline plan is approximately double the corresponding spend in the RIIO-ED1 period, as discussed in section 2.7. We must transition from delivering the lower level of investment in the RIIO-ED1 period to increased levels in RIIO-ED2 and potentially much higher levels if the predicted range of expenditure covered by Uncertainty Mechanisms is necessary. Increases will occur across all spend categories including labour provided by the Direct Labour Organisation (DLO), by support roles and contractors. In addition to contracting extra flexibility services, we may need to install more equipment and deploy more smart grid technologies. Deliverability challenges arise from both the increase in the number and complexity of planned network interventions, exacerbated by their significant uncertainties.

Further detail on our deliverability plan for the whole of our RIIO-ED2 plan is provided in our Delivery Strategy Annex 22.

We have enhanced our deliverability plan for load related work, shown in Fig. 22, to ensure that we can ramp up activity to the level of network development that we are required to deliver in RIIO-ED2.

Our enhanced delivery plan for load related work starts with the integration of deliverability in planning so that adequate lead times are factored into optioneering and decision making considers the availability of resources. Previously when the availability of equipment and resourcses was not a constraint, the timing of network interventions was chiefly determined according to when the network capacity was needed, build time and scheduling of outages necessary to undertake the work. With increased volumes of work, the timing and phasing of work must also be considerate of the availablity of resources and equipment.

Working closely with our Procurement department and the DSO directorate, we shall integrate consideration of deliverability into our planning starting when preparing our Network Development Plan (NDP) and tendering for flexibility services. We shall phase the work identfied in our NDP to ensure that it can be resourced and shall tender for flexibility allowing sufficient time for equipment procurement should the services be unavailable.

7.2 Deliverability procurement plan

Recent disruption due to the pandemic has illustrated the fragility of the supply chain and the need to plan differently to increase resilience. Changes in our procurement processes are required to build on our approaches that are already considerate of extended delivery times. For example, our procurement of wood poles factors in that it takes two years to cut, treat, store and deliver them. We are reviewing our procurement strategy to;

- diversify critial supplies,
- work more closely with our suppliers to understand their resilence plans, and
- review stocking approaches for critical components.

The initial step is for our Procurement team to work more closely with internal planning and innovation teams to understand procument needs early and to share information on lead times so that this can be factored into planning processes. Even earlier knowledge of changes to specifications shall be gained by working with our Policy team to enable us to give manufacturers greater advanced warning.

We have already worked with existing supply and logistics contract providers to assess their forward capacity into RIIO-ED2. In addition, we have identified priorities for new contracts and our Commercial team have started pre-contract work.

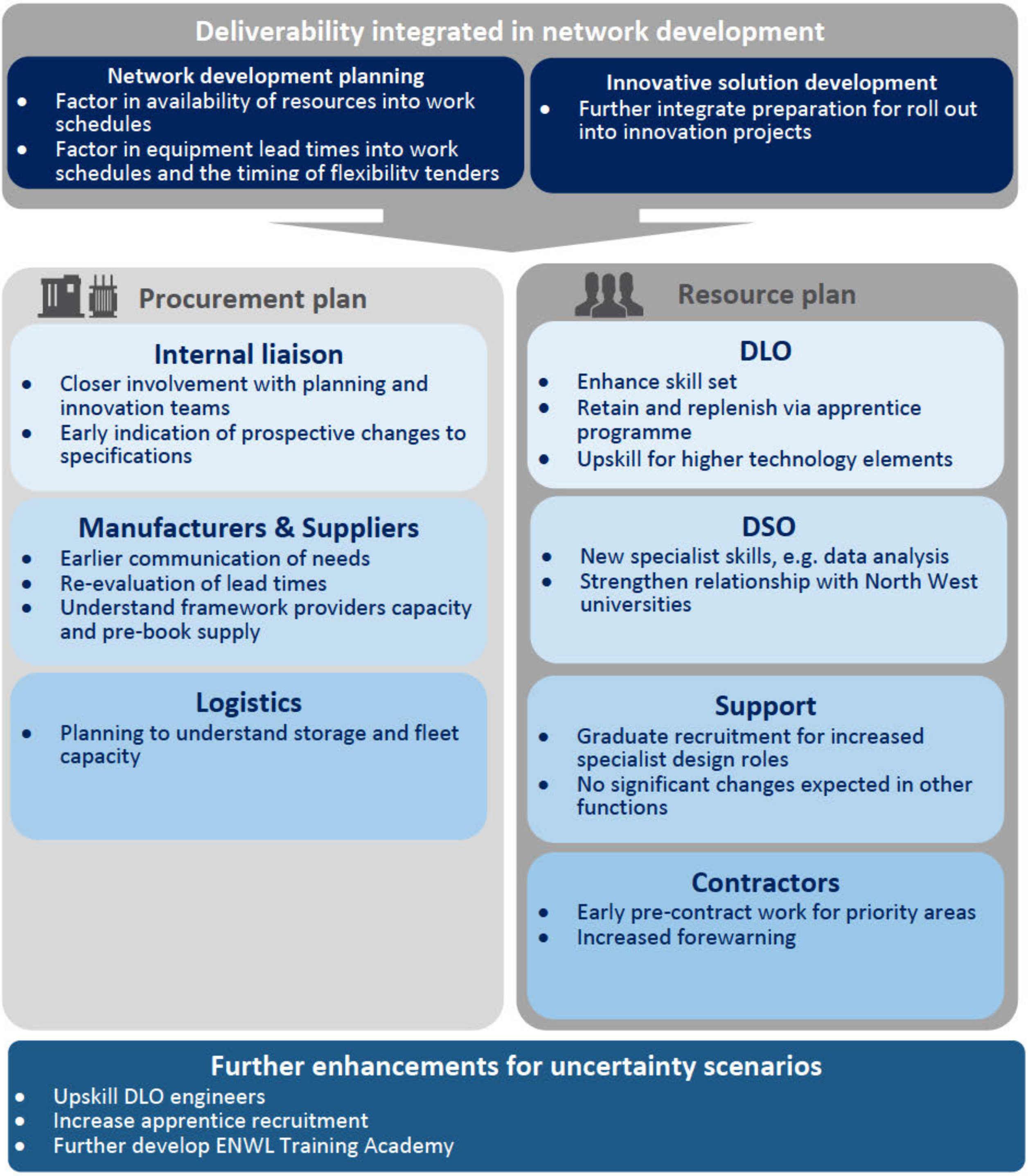

Fig. 22. Enhanced deliverability plan

7.3 Deliverability resource plan

The objective of our resource plan is to ensure that sufficient resource at the required levels is available to deliver the necessary network development when necessary. Our approach builds on our current resource framework as shown in Table 15 which utilises a mix of internal and external capacity to deliver network investment. Our Direct Labour Organisation (DLO) is mainly used for specialist technical resources and lower skilled resources come from contractors who can flex according to the variable and uncertain requirements.

For context, our load related expenditure programme is currently split as shown in Fig. 23.

Subsequent subsections explain our forward plan for how the elements of our resourcing framework will adjust to cater for increased and uncertain volumes of network investment during the RIIO-ED2 period.

Table 15: Resourcing framework

Resource		Typical scope
Internal DLO		Carry out a range of activities, focused on lower voltage overhead and plant work; also majority of SAP functions
Contractors	Termed framework contracts	Broad scopes of work, often geographically-based and fixed for a set term (eg three years) with extension options. Generally agreed with Tier 2 contractors
	Individually-tendered contracts	Mainly used for higher value Transmission projects; enables best market value at time of tender
	Contractor panels	Typically used for high volume, low cost work eg civils. Enables use of wider set of locally-based contractors
	Specialist contracts	Usually related to innovative or specialist projects and programmes with limited or unique supply chain
	Contractor panels / ENWS	Established to provide specific delivery capability in defined areas, particularly at the service position, e.g. unlooping and fuse/ cut-out replacement

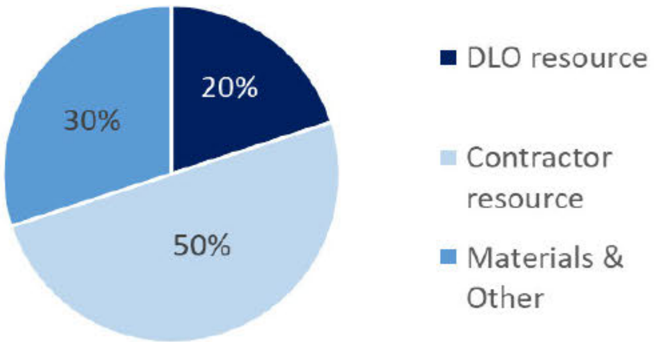

Fig. 23. Typical split of load related network investment costs

7.3.1 DLO resource

We are planning that the increase in workload during the RIIO-ED2 period is picked up by a proportionate scaling up of both our DLO and contracting capacity. This approach together with the development of additional internal skills shall allow us to manage future uncertainties to ensure deliverability and scalability.

The DLO is responsible for the most technical tasks so we manage a skill set to ensure that we are not exposed to the market price variability for scarce skills such as SAPs, protection engineers, jointing and design. The minimum size of the DLO is set by the requirement to provide a resilient response to faults and storm events. In addition to faults, the DLO perform the vast majority of inspection and maintenance (I&M) activities and deliver 20% of the network investment programme. With fixed volumes of fault and I&M requirements year to year, it is important to manage the size of the DLO.

Attrition will be compensated for through the recruitment of additional apprentices through our successful programme which was recently oversubscribed by a factor of 15. Training at our dedicated award-winning training academy to upskill existing employees will deliver teams are suitably qualified to deliver the wider range and quantity of DLO activities. To make this resource available to meet the forecast increase in load related expenditure, a corresponding number of non-skilled mates will need to be recruited to backfill roles. Our approach to training will maintain colleague development and progression which along with our regular reviews of remuneration packages will strengthen staff retention. To ensure the training academy is sufficient to meet the above requirement it is planned to increase the classroom and workshop training facilities by approximately 25% at a cost of £1 million.

The business plan contains several complex technology elements, such as sensors and Smart Street, which have similar labour content to traditional activities, but deploy more expensive materials. Where these are core activities it is planned to insource these, for example RTU support and installation, by upskilling existing DLO employees.

7.3.2 DSO

Establishing further DSO activities that are critical to our network development approach will require additional resource depending on the eventual scale of network investment and creates the need for some resources with new skills including data analytics. In addition, new roles in IT, marketing and commercial trading will be required.

These pioneering resources will need to work at the cutting edge to deliver novel approaches and develop, implement and maintain new processes. Suitable resources will be obtained by further developing our existing relationships with universities in the North West and implementing agile and remote working practices to allow us to recruit for these new specialisms from a wider talent pool.

These roles classified as Closely Associated or Business Support Indirect Costs by Ofgem categorisation.

7.3.3 Support resource

With regards support, specialist roles such as design will increase with the volume of work associated with the load related plan. Our plan to respond to increasing needs for specialist roles is to fill vacancies through graduate recruitment.

Other support roles such as Finance, People Services, Commercial and other back office functions are not directly proportional to the volume of work so we do not anticipate significant increases in needs due to increases in load related expenditure. However, should needs increase, we are confident that the roles are readily available in the general market.

7.3.4 Contractor resource

Some of the increase in the baseline plan will be delivered via the contractor market as reflected in our load related BPDTs. Existing skills within the market are suitable for the mix of work in our baseline load related plan and discussions with major partners indicate that the additional resources will be available as long as we give adequate forward visibilty of requirements.

Much of the network development within our plan can be split into two groups;

1. equipment supplier contracted delivery; for example large power transformers, or
2. general contractor delivery eg cable installation and civil works.

Group 1 is resourced by the equipment supplier via the Global supply procurement process.

The civil, excavation and cable lay activities of group 2 are delivered by contractors primarily due to the efficient nature of these comparatively lower skilled activities. These contractors are mainly not specific to the electricity industry and we use general utility contractors who operate across water, waste water, gas, telecoms and electricity sectors. This market is large compared to our requirements and has already proven to be successful at flexing to meet annual variations in our needs which is a similar magnitude to the difference between our RIIO-ED1 and RIIO-ED2 requirements.

We shall up-scale the ENWS business through external recruitment to deliver the significant volumes of unlooping of service cables included in our load related investment plan. The skill levels required to undertake this work are relatively low with training times for upskilling recruits typically being 6 to 12 months.

7.4 Resourcing uncertainties

The significant uncertainties in load related expenditure, discussed in section 5, mean that our resource plan will need to quickly adapt to meet network development needs. We have determined a large range of load related investment, potentially increasing its value from £141.4 million baseline to £711.5 million based on our best view of uncertainty.

We have assessed potential resource requirements factoring in expected increases in expenditure on materials. Again, we anticipate that even at the greatest levels, higher skilled work will be delivered by up-scaling the DLO, whilst the increased lower skilled activities, such as cable installation, will continue to be delivered through the contractor market.

At the high end of load related expenditure uncertainty, the additional full-time engineers would need to be met through a significant increase in apprentice intake in addition to the recruitment of tier 1 contractors. However, we would work to avoid this level of expenditure by recognising the coincidence of network reinforcement needs for the various elements making up the estimate as described in section 5, along with the application of efficiencies and holistic planning approaches.

8 GLOSSARY

Acronym	Definition
Access SCR	Access and Forward Looking Charges Significant Code Review - the Ofgem led review of the distribution connection and use of charging arrangements
ATLAS	Architecture of Tools for Load Scenarios
BESS	Battery Energy Storage System
BSP	Bulk Supply Point substation, typically 132/33kV
CBA	Cost Benefit Analysis
CCC	Committee on Climate Change
CO	Central Outlook scenario from ENWL DFES 2020
COP	Heat pump coefficient of performance
CT	Consumer Transformation scenario from FES/DFES 2020
DFES	Distribution Future Electricity Scenarios
DNO	Distribution Network Operator
DSO	Distribution System Operation
DUoS	Distribution Use of System
EHV	Extra High Voltage, typically 132kV and 33kV
EJP	Engineering Justification Paper
ENA	Energy Networks Association
ENWL	Electricity North West Ltd
EoI	Expression of Interest
EREC	Engineering Recommendation
ESC	Energy Systems Catapult
ESO	Electricity System Operator
EV	Electric vehicle
FCH	Future Capacity Headroom model
FES	Future Energy Scenarios
FY	Financial year
GMSF	Greater Manchester Spatial Framework
GSP	Grid Supply Point substation, transmission-distribution interface, typically 400 or 275/132kV
HIF	Housing Infrastructure Fund
HP	heat pump
HV	High Voltage, typically 11kV and 6.6kV
LA	Local Authority
LAEP	Local Area Energy Plan
LEP	Local Enterprise Partnership
LRE / LRI	Load Related Expenditure / Load Related Investment
LTDS	Long Term Development Statement
LW	Leading the Way scenario from FES/DFES 2020
LV	Low Voltage, typically 0.4kV
NRSWA	New Roads and Street Works Act (1991)
NTCC	New Transmission Connection Charges
ON	ENA Open Networks project
Primary	Primary substation, typically 33/11 or 6.6kV
RIIO	Revenue=Incentives+Innovation+Outputs
SCR	Significant Code Review
Secondary	Secondary substation, typically 11 or 6.6/0.4kV
SIWG	Strategic Investment Working Group
SP	Steady Progression scenario – FES/DFES 2020
SSMD	Sector Specific Methodology Decision
SRF	Strategic Regeneration Framework

Acronym	Definition
ST	System Transformation scenario – FES/DFES 2020
ToU	Time of Use (for tariffs)
TUoS	Transmission Use of System
WS1b P2	Open Networks Workstream 1b Product 2 – Whole System FES