RIIO-ED2 Engineering Justification Paper (EJP)

Ashling Road 33/11kV Primary Substation

Investment Reference No: 48/SEPD/LRE/ASHR

Contents

1 Executive Summary

Our proposed investment at Ashling Road 33/11kV Primary Substation in the SEPD licence area will deliver P2/7 compliance for an expenditure of £6.01m during RIIO-ED2.

The primary investment driver for this scheme is load-related P2/7 compliance issue under a first circuit outage (FCO) condition at Ashling Road primary substation. The P2/7 compliance issue is apparent under all four distribution future energy scenarios (DFES)[1] for investment in ED2 due to forecast demand growth from our Stakeholder supported Distribution Future Energy Scenario (DFES).

Accelerating progress towards a net zero world

The 2019/20 peak demand at Ashling Road Primary Substation was 21.8MVA and the existing network assets are close to the FCO limit. This project is required under our accelerating progress towards net zero priority, as the primary substation would see approximately 25% of its demand in 2027/28 driven by uptake of low carbon technologies (LCT), such as heat pumps and electric vehicles (EVs). Without intervention we will experience increased demand leading to overloading issues. This will significantly impact our ability to meet the minimum level of security of supply to consumers, as we move towards a Net Zero network in RIIO-ED2.

This Engineering Justification Paper (EJP) considers a credible range of options to address the P2/7 compliance issue. It sets out the options that have been considered and rejected prior to the CBA analysis and provides the shortlist of those options included within the analysis, with a clear rationale for including or excluding each option. We have also considered the Local Area Energy Plans (LAEPs) from West Sussex council through our stakeholder engagement activities in the option analysis.

The Cost Benefit Analysis (CBA) results shown in Table 1 demonstrate that the most cost-effective solution, that delivers the best value for consumers in terms of the 45 years Net Present Value (£m), is Option 3 (‘Flexible solution’ followed by asset replacement and add new assets). This option involves utilising flexible solution for two years in 2025 and 2026 followed by replacing the overloaded assets and adding new assets at Ashling Road primary substation in 2027.

Options	Net Present Value (NPV) After 45 Years (£k)	Investment (£k)
Option 2– Asset Replacement & Add New Assets	-1,630	5,814
Option 3 – Flexible Solution Followed by Asset Replacement and Add New Assets	-1,582	6,011

Table 1: CBA and investment results for viable options

Following the optioneering and detailed analysis, as set out in this paper, the proposed scope of works for the preferred Option 3 is detailed in Table 2:

Assets & Services	Volume	Costs (£k)
33kV UG Cable (Non-Pressurised) (km)	12.9	[redacted]
33kV Transformer (GM) (no.)	2	[redacted]
33kV CB (Air Insulated Busbars) (OD) (GM) (no.)	1	[redacted]

1 DFES 2020: System Transformation, Consumer Transformation, Leading the way, and Steady Progression.

Cable Railway Crossing (no.)	I	[redacted]
Agricultural Compensation (no.)	I	[redacted]
Flexibility Solution (years)	2	[redacted]
Total		[redacted]

Table 2: Proposed scope of works and cost breakdown in the preferred investment option

This scheme delivers the following outputs and benefits:

- Ensures Ashling Road primary substation compliant with P2/7.
- Facilitates the continued uptake of low carbon technology (LCT) within Ashling Road Primary and helps support the climate change targets of West Sussex Council.
- Uplifts additional network capacity of approximately 12 MVA to meet the needs of our customers.
- Facilitates the efficient, economic, and co-ordinated development of our Distribution Network for Net Zero.

The existing Load Index (LI) for Ashling Road Primary is LI2 (84.4%) and, without intervention, is expected to be LI5 (119%) by the end of ED2 period (2027/28) following the DFES CT scenario. With the preferred reinforcement option, the LI will be LI2 (81%) by the end of ED2 period.

The cost to deliver the preferred solution is £6.011m including availability and utilisation cost of £0.197m for flexible generation for the first two years, and £5.814m for asset replacement and the installation of new assets. The reinforcement works are planned to be completed in 2027 taking into consideration our deliverability capability. This EJP investment sits within the Net Zero TOTEX part of our plan ask as shown in Figure 1.

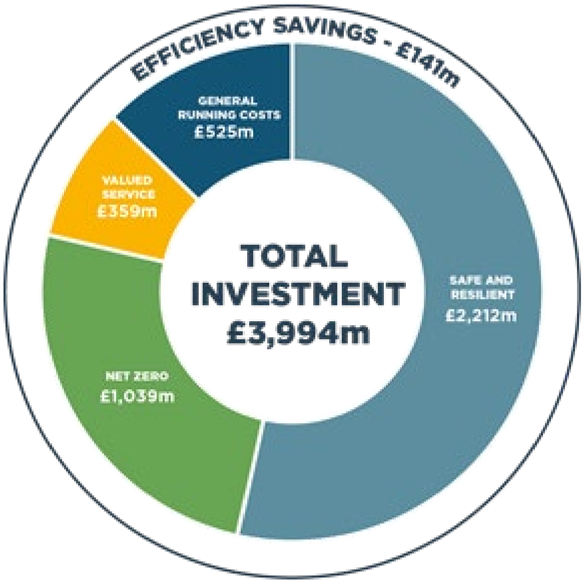


Figure 1: SSEN total investment cost within RIIO ED2

2 Investment Summary Table

Table 3 below provides a high-level summary of this EJP and the Cost and Volume (CV) impacts within our Business Plan Data Templates.

Name of Scheme	Ashling Road 33/11kV Primary Substation		
Primary Investment Driver	Load – P2/7 Compliance		
Scheme Reference	48/SEPD/LRE/ASHR		
Output References/Type	33kV Transformer (GM) 33kV CB (Air Insulated Busbars) (OD) (GM) 33kV UG Cable (Non-Pressurised) Cable Railway Crossing Agricultural Compensation Flexible Solution		
Cost	£6.01m		
Delivery Year	2026/27		
Reporting Table	CV1: Primary Reinforcement		
Outputs included in RIIO-ED1 Business Plan	No		
Spend Apportionment	**ED1**	**ED2**	**ED3+**
	0	£6.01m	0

Table 3: Investment Summary

3 Introduction

Our ***Load Related Plan Build and Strategy (Annex 10.1)***[2] sets out our methodology for assessing load-related expenditure and describes how we use the Distribution Future Energy Scenarios (DFES) 2020 as the basis for our proposals. We have established a baseline view of demand, providing a robust projection of the drivers of load-related expenditure for the ED2 period. Our ex-ante baseline funding request is based on the minimum investment required under all credible scenarios and is strongly supported by our stakeholders. Our plan will create smart, flexible, local energy networks that facilitate the accelerated progress towards net zero – with an increased focus on collaboration and whole-systems approaches.

This investment is a component of our strategic goal of 'Accelerating progress towards a net zero world'.

Section 4 of this Engineering Justification Paper (EJP) describes our proposed load related investment plan for the reinforcement of Ashling Road Primary Substation in RIIO-ED2. The primary driver considered within this paper is load related P2/7 compliance issue under an FCO condition due to forecast demand growth from our Stakeholder supported Distribution Future Energy Scenario (DFES).

[2] ***SECTION D: (Chapter 10), Responding to the net zero Opportunity, (Annex 10.1), Load Related Plan Build and Strategy***

This EJP provides high-level background information for this proposed scheme explaining the existing network arrangements, the load growth forecasts through the Distribution Future Energy Scenarios (DFES) and setting out the need for this project. The Detailed Analysis section of the EJP describes the network studies undertaken, detailing the results which further justify the need of the proposed investment.

Section 5 provides an exhaustive list of the options considered through the optioneering process to establish the most economic and efficient solution. Each option is described in detail, with the EJP setting out the justification for those options which are deemed unviable solutions, and therefore not taken forward to the Cost Benefit Analysis.

Section 6, Cost Benefit Analysis (CBA) Summary, provides the comparative results of all the options considered within the CBA and sets out the rationale and justification for the preferred solution. This section also describes how we have established the cost efficiency of the plan with reference to the unit costs that have been chosen.

Finally, **Section 7** of this EJP also sets out the deliverability of the plan for RIIO-ED2 and this proposed investment.

4 Background Information

Ashling Road Primary Substation is located within the Chichester region of the SEPD licence area and is supplied from both Chichester and Hunston Bulk Supply Points (BSP). Ashling Road currently supplies 14,337 customers via an 11kV network. The 2019/20 peak demand was 21.8MVA and there is currently 1.8MW of generation connected at 11kV.

4.1 Existing Network Arrangement

Ashling Road 33/11kV Primary Substation, as shown in Figure 2 and Figure 3, is currently fed via a single 33kV circuit from Hunston BSP and a single 33kV circuit from Chichester BSP. The circuits are connected via a normally closed 33kV circuit breaker located at Ashling Road. The first circuit from Chichester to Ashling Road consists of a 9.1km single circuit wood pole overhead line. The circuit has a maximum rating of 30.3MVA in the winter and 24.3MVA in the summer.

The second circuit to Hunston Substation consists of 6km of Overhead line and 600 meters of underground cable. The overhead line section is rated for a maximum demand of 30.7MVA in the winter, decreasing to 24.6MVA in the summer. The two existing 33/11kV transformers are from different manufacturers with one at 20MVA base rating and the other at 22.5MVA. The transformers were commissioned in 1963 and 1967 respectively.

At present the existing network assets are close to the first circuit outage (FCO) limit. As we move into RIIO-ED2, we anticipate an increase in both peak demand and reliance on the network. We expect to face thermal overload on network assets and increased incidence of customer interruptions and compliance with the P2/7 engineering standard. This will significantly impact our ability to meet the minimum level of security of supply that should be achieved for all consumers, regardless of location on our network, within the RIIO-ED2 period as we move towards a Net Zero network.

Therefore, investment is required to make Ashling Road primary substation P2/7 compliant within the RIIO-ED2 price control.

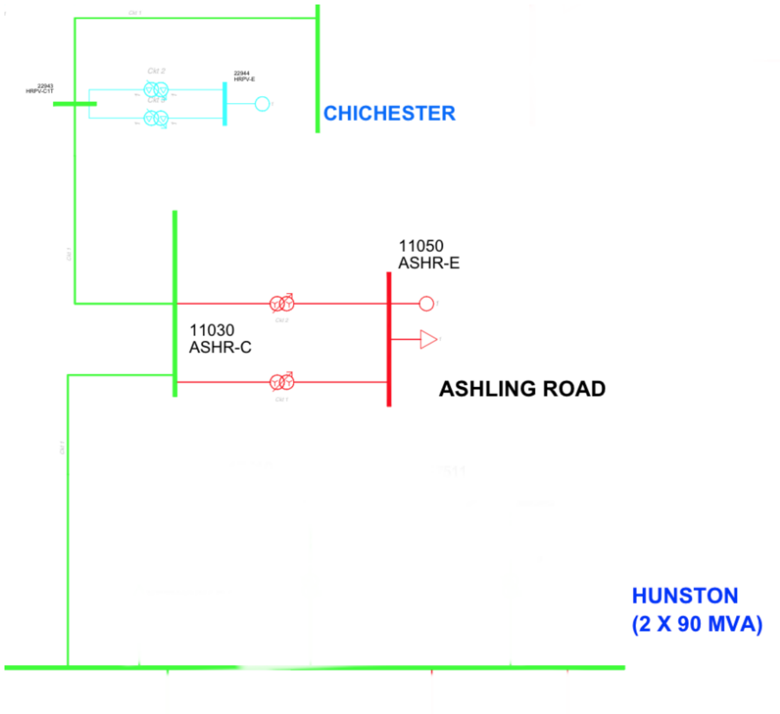


Figure 2: Ashling Road 33kV Network Arrangement (SLD)

Figure 3: Ashling Road Substation

4.2 Local Energy Plan

In April 2019 West Sussex Council recognised the climate emergency and has published a 10-year climate strategy[3] as a clear commitment and framework for other policies. Some key points from the strategy are as follows:

- Aim to be carbon neutral by 2030, enabling positive actions and behaviours across the county to mitigate climate change.
- Promote and move to more local renewable energy sources instead of fossil fuels.
- Ensuring projects, plans and processes reduce carbon and are resilient to climate change

Locally to Ashling Road, Chichester District Council declared a climate emergency in July 2019. Plans are currently in draft or under consultation, however key themes are as follows:

- Implementing a funding scheme to support energy efficiency measures and new Renewable energy in the District.
- Updating of planning policies, as part of the Local Plan review, to reduce carbon emissions from new developments
- Improve sustainable transport links, especially walking, cycling and electric vehicle charging networks

West Sussex Council's climate strategy is expected to have a significant impact on demand growth within the area including Ashling Road. This impact is visible within the SEPD DFES projections and directly contributes to the need for investment discussed within this paper.

4.3 Demand Forecast

We have undertaken extensive network studies based on the Distribution Future Energy Scenarios (DFES). The basis for DFES is National Grid's Future Energy Scenarios (FES) 2020. This framework comprises four potential pathways for the future of energy based on how much energy may be needed and where it might come from. The variables for the four scenarios are driven by government policy, economics and consumer attitudes related to the speed of decarbonisation and the level of decentralisation of the energy industry. We have worked closely with our partner Regen to develop the forecasts between 2020 and 2050 through enhanced engagement with the local authorities, local enterprise partnerships (LEPs), devolved governments, community energy groups and other stakeholders.

Based on the enhanced stakeholder engagement feedback, we have chosen Consumer Transformation (CT) as the best view scenario[4]. Full details on our DFES methodology, stakeholder input and regulatory treatments of load related investment can be found in the ***Load Related Plan Build and Strategy (Annex 10.1)***[5].

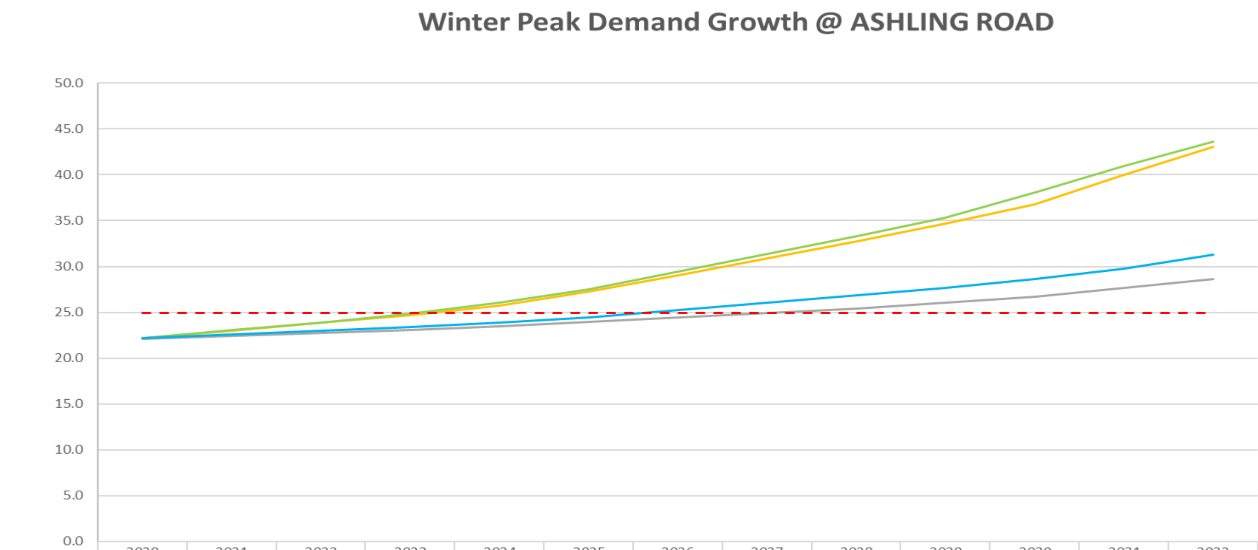
Figure 4 shows the demand growth and the FCO limit for this substation under all DFES scenarios in winter. The FCO capacity is limited at 24.9MVA by the winter rating of Ashling Road primary transformer C1MT. In this case, the FCO limit is exceeded for the CT and LW scenarios in 2024/25, ST scenario in 2026/27 and SP scenario in 2027/28. The current Load Index (LI) for Ashling Road is LI2 (84.4%) and it will be LI5 (119%) by the end of ED2 period (2027/28) when following the CT scenario without intervention.

[3] https://www.westsussex.gov.uk/media/14787/climate_change_strategy_2020-2030.pdf

[4] We are protecting customers from the impact of forecasting uncertainties by including in our ex-ante baseline funding request load related investment required for the CT scenario only in the first two years of the RIIO-ED2 period.

[5] ***Load Related Plan Build and Strategy (Annex 10.1)***

Network interventions are required to address this issue as not doing anything is anticipated to result in a licence condition (P2) breach and potentially a wide-spread blackout in the areas supplied by Ashling Road Primary.



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
SP	22.1	22.4	22.7	23.1	23.5	24.0	24.4	24.9	25.4	26.1	26.7	27.6	28.6
CT	22.2	23.0	23.9	24.7	25.7	27.2	29.1	30.9	32.8	34.7	36.8	40.0	43.1
LW	22.2	23.0	23.9	24.8	26.1	27.5	29.4	31.4	33.3	35.3	38.0	41.0	43.7
ST	22.1	22.6	23.0	23.4	23.9	24.4	25.2	26.0	26.8	27.7	28.6	29.8	31.3
FCO	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9

Figure 4: Ashling Road winter peak demand forecast

Peak demand is expected to increase at Ashling Road primary substation by approximately 8.7 MVA between 2020/21 (Year 2020 in Figure 4) and 2027/28 (Year 2027 in Figure 4) when following the CT scenario. The projected primary demand of 30.9MVA in 2027/28 in the CT scenario is split by demand type or composition and shown in Figure 5 below, which demonstrates that the largest impact on demand in the area is from heat pumps, representing 13% of the overall projected demand, followed by EVs with 12%.

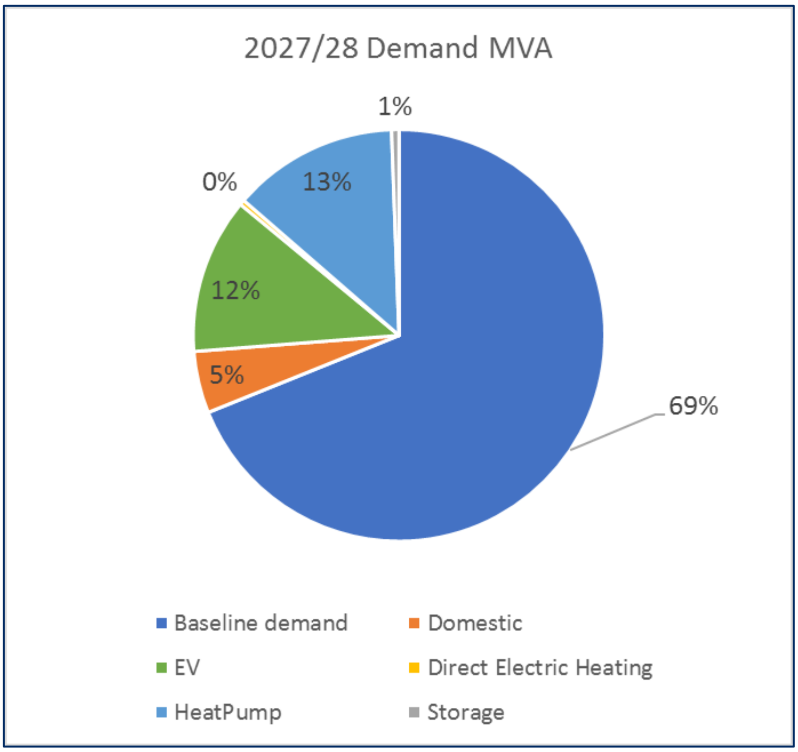


Figure 5: Demand Growth Breakdown in 2027/28

4.4 Existing Asset Condition

The existing transformers have a Health Index of HI2 and HI3 respectively with no plans for replacement in ED2 based on current conditions.

4.5 Thermal Flow Analysis

Based on the future demand forecast in Figure 4, the thermal flow analysis under an FCO condition has been undertaken to determine if the existing network assets have adequate capacity to meet the demand forecast at Ashling Road primary substation at the end of the ED2 regulatory period.

First Circuit Outage (FCO) Analysis in 2024/25:

Year	Demand Group	Season	Group Class	Contingency	Loaded Circuit / Transformer	FCO Demand to be Met	FCO Available Capacity
2025	Ashling Road T1 & T2	Winter	C	Fault on Ashling Road T1	Ashling Road T2	25.7 MVA	**24.9 MVA**
2025	Ashling Road T1 & T2	Spring/ Autumn	C	Fault on Ashling Road T1	Ashling Road T2	23.4 MVA	**23.4 MVA**

Table 4:Thermal Flow Analysis Results

The thermal analysis results show that following the CT scenario, the existing network assets at Ashling Road primary substation are unable to meet demand under an FCO condition in the ED2 period. Reinforcement is therefore required before 2024/25 due to P2/7 non-compliance. The overloaded assets are the incoming 33kV circuits and both primary transformers as follows:

- 33/11kV primary transformers
- 9.1km 33kV Overhead line between Chichester and Ashling Road
- 6km 33kV Overhead Line and 600m cable between Hunston and Ashling Road

4.6 Voltage Level Assessment

Reinforcement is not required as voltage compliance is met , which is indicated in Appendix 2.

4.7 Fault Level Assessment

There is no fault level constraint at Ashling Road 33kV, as both its three phase and single phas to ground fault currents in 2027/28 are far below the associated circuit beaker ratings. The results of this fault level analysis are shown in Appendix 2.

4.8 Network Analysis Summary

The analysis in section 4.5 has shown that intervention to reinforce Ashling Road primary substation will be required within the RIIO-ED2 period. The projected increase in demand, and in turn the increased reliance on the network, will impact a larger number of customers and more severely considering the LCT uptake. Also, the thermal overloading issue identified will hamper our own and stakeholder ambitions for a Net Zero network.

5 Optioneering and Analysis

This section of the report sets out the investment options that have been considered to address the overload constraint at Ashling Road primary substation. A holistic approach has been taken to ensure investment options consider value for money for network customers.

5.1 Whole System Considerations

Additionally, we have considered the potential for using Whole Systems solutions (involving collaboration with third parties) to deliver this investment programme. We set out our Whole Systems assessment in Appendix 4. This follows our standardised approach for embedding Whole System considerations into our load and non-load investment decisions (in line with Ofgem's ED2 business plan guidance), as described in our ***Whole System (Annex 12.1)***[6].

Our assessment enables us to take a proportionate consideration of Whole System options, based on the feasibility of such options existing and materiality of the costs involved.

In this case, our Whole Systems assessment finds that this programme is not expected to have any wider Whole System interactions and there are no feasible Whole Systems solutions.

5.2 Summary of Options

Table 5 below provides a high-level summary of the three investment options under consideration along with the advantages and disadvantages associated with each. A more detailed description of each option is then provided within the proceeding sub-sections.

[6] ***Whole Systems (Annex 12.1)***

Option	Description	Advantages	Disadvantages	Result
1. Do Minimum	This option usually involves demand transfer from the overloaded demand group to another suitable group.	Minimum cost and workload; Small impact to existing network; Short delivery time.	Does not increase network capacity, further reinforcement may still be required.	Considered but not progressed to CBA
2. Asset Replacement & Add New Assets	The replacement of the full overloaded equipment including: ▪ 2 x 33/11kV Transformers ▪ new equipment will be added into existing network. This involves: ▪ 2x 6.45km 33kV new cable circuit between Ashling Road and Hunston BSP ▪ A new circuit breaker at Hunston BSP	Allow latest and most efficient technology to be installed; Increase network resilience; Reduce environmental impact. Increase network resilience; Shorter outage time; Long term benefit.	Can incur long outages if replacement cannot be built offline; Some non-overloaded assets may also need to be replaced in-line with the new equipment. In this case, oil filled cable should be replaced with XLPE cable. Can incur large civil costs; Required new control strategy.	Progressed to CBA analysis
3. Flexibility Solution followed by Asset Replacement and Add New Assets	Assessing possibility to defer reinforcement in Option 2 by utilising flexibility. Flexible service contracts to reduce peak demand and defer capital investment	Relatively low cost Defers need for network reinforcement for two years	Amount of flexibility depends on location-specific resources and interests. CAPEX may still be required.	Progressed to CBA Analysis (Preferred Option)

Table 5: Summary of Investment Options

5.3 Detailed Option Analysis

5.3.1 Option 1: Do-Minimum

Estimated Cost: £N/A

The location of Ashling Road on the outskirts of Chichester in a rural area means interconnection at 11kV is limited with no ability to transfer significant load to another substation. Therefore, load transfer would not be considered as viable in this case.

As this option does not resolve the P2/7 non-compliance entirely and would result in poorer guaranteed standard performance and customer interruptions, it is rejected and is not progressed to the CBA analysis.

5.3.2 Option 2: Asset Replacement & Add New Assets

Estimated Cost: £5,813.9k

The overloaded equipment at Ashling Road is the two 33/11kV primary transformers and the incoming 33kV circuits from Chichester BSP and Huntson 33kV Substation. It is anticipated that the equipment will be subject to thermal overload constraint in 2024/25. The existing transformers can be replaced with two units rated at 40MVA, though the firm capacity will be limited by the 2000A 11kV CB to 38MVA.

The existing 33kV circuit from Chichester to Ashling Road consists of 9.1km of overhead line of two different types. The overhead line route is over arable land with several road crossings over smaller single carriage way A roads and B roads. The 33kV circuit from Ashling Road to Hunston consists primarily of Overhead line with short sections of cable at either end to connect to the substations and a section in the centre of the circuit. The circuit crosses the A27 dual carriageway and several smaller B roads. Direct replacement of the overhead line is not possible as the existing pole structures are unable to support a larger conductor size.

A new cable route for a dual 33kV cable with route length approximately 6.45km will therefore be required between Ashling Road and Hunston BSP, as showed in Figure 6. A site visit will be needed to verify the plausibility of this proposed cable route. A 33kV circuit breaker bay at Hunston BSP will also be required. The schematic diagram of existing network and the proposed reinforcement at Ashling Road primary substation is shown in Figure 7.

Figure 6: Proposed New Cable Route between Ashling Road and Hunston BSP

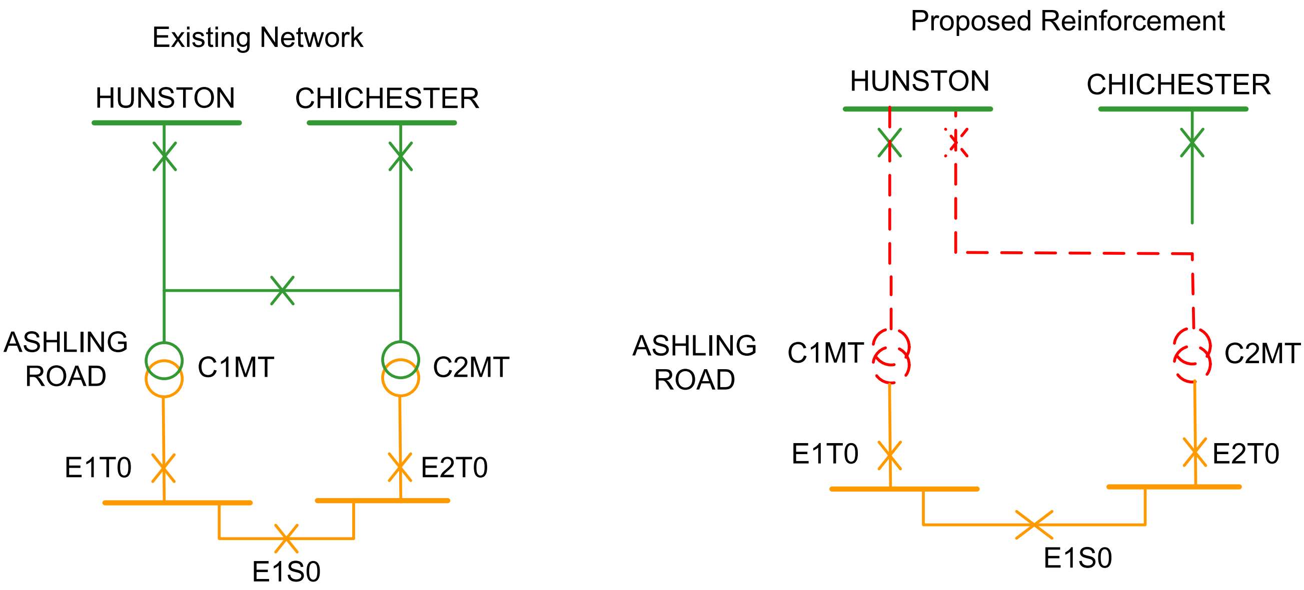


Figure 7: Existing network and proposed reinforcement scheme at Ashling Road primary substation

The reinforcement works at Ashling Road primary substation need to be completed before 2024/25 in order to be compliance with P2/7. Under this option, the LI will be LI2 (81%) by the end of ED2 period.

This option is used to feed into the Common Evaluation Methodology (CEM)[7] Flexibility CBA to determine if there are economic benefits in deferring this capital investment.

5.3.3 Option 3: Flexible Solution Followed by Asset Replacement & Add New Assets

Estimated Cost: £6,010.6k

This option considers utilising customer generation capacity or flexible demand to actively manage the peak power flow on existing assets. This will allow SEPD to utilise the existing network effectively and may defer or remove the need for reinforcement action proposed in Option 2.

Figure 8 shows that the peak demand at Ashling Road 33/11kV primary substation in the DFES CT scenario in 2027/28 exceeds the FCO capacity for approximately 7.5 hours each day over the winter months with a requirement of flexible generation between 0.0 - 6.0MW. It should be noted that the daily peak demand appears in a period from 16:00hrs to 21:30hrs.

[7] https://www.energynetworks.org/assets/images/Resource%20library/ON20-WS1A-P1%20Common%20Evaluation%20Methodology-PUBLISHED.23.12.20.pdf

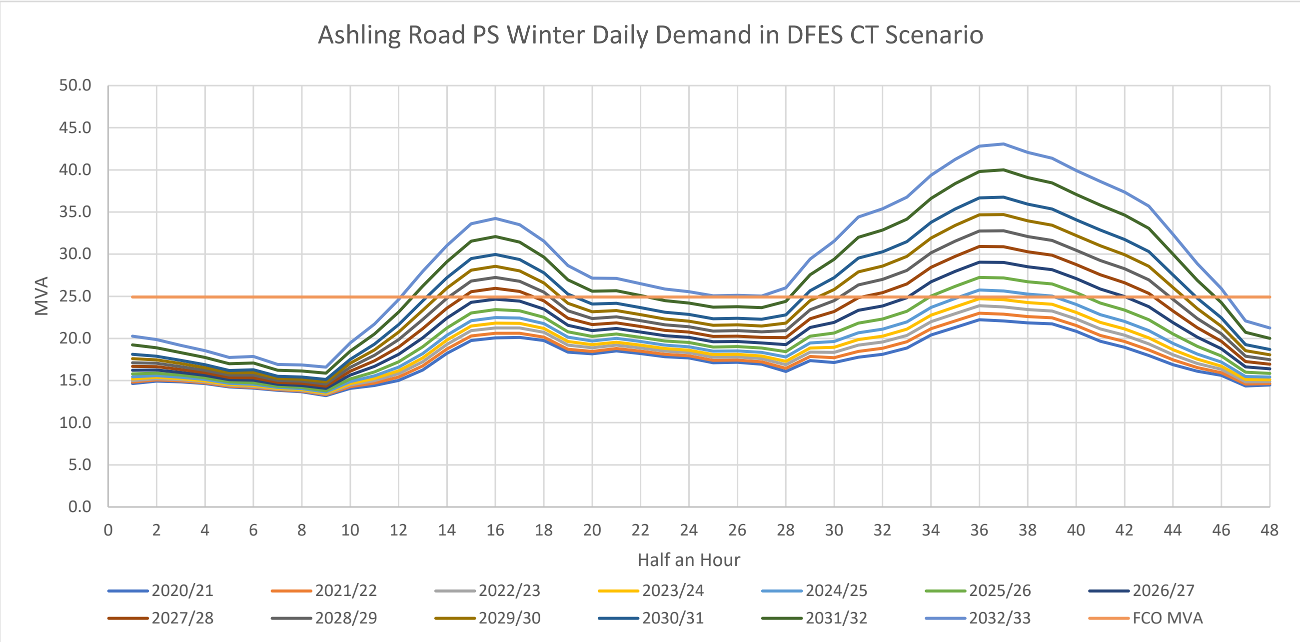


Figure 8: Ashling Road Primary winter daily demand without flexibility services.

The CEM CBA model was used to assess if there is any benefit in deferring the reinforcement. The CEM framework evaluates options around timing of network investments, in particular taking into account:

- the range of different options available (e.g., reinforcing the network, using flexibility, or doing nothing);
- the time periods in which actions can be taken; and
- the existence of uncertainty, and the impact of incremental information which becomes available over time.

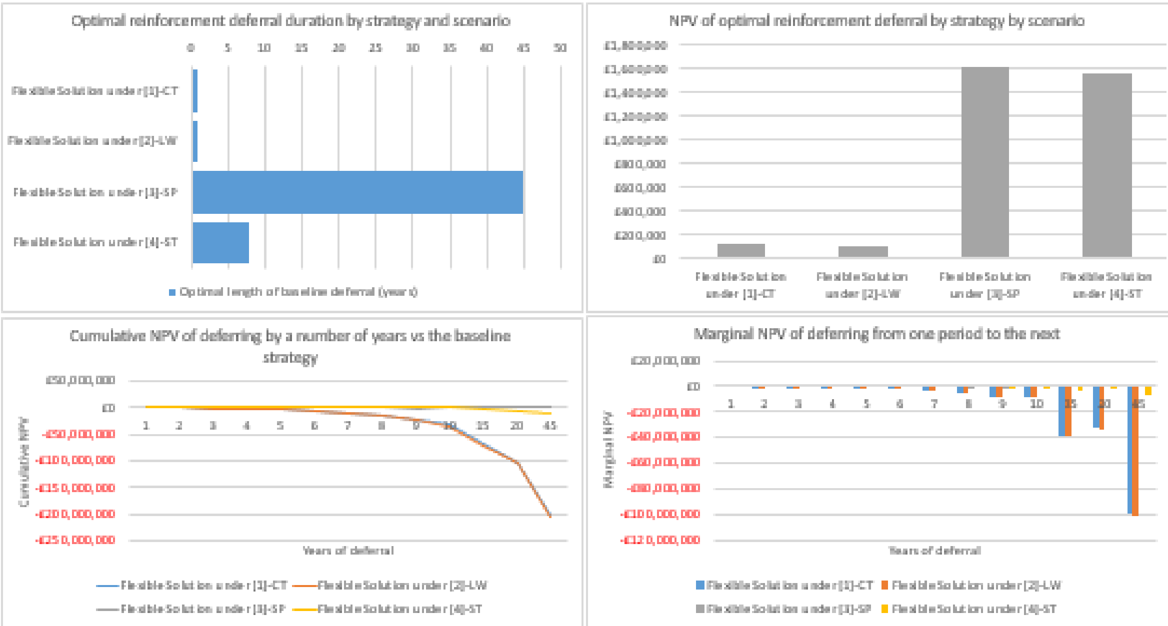
The MW exceedance, the daily availability and utilisation hours, the annual available and utilisation days (Table 6 below), and the flexibility unit costs of £150 per MW per hour and £150 per MWh have been used as input parameters in the CEM CBA model (full details of the flexibility methodology can be found in the ***Load Related Plan Build and Strategy (Annex 10.1)***.

Input to the CEM CBA	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
Availability capacity (MW)	0.0	0.0	0.0	0.0	0.3	1.7	3.4	3.9
Hrs/day of availability	0	0	0.0	0.0	1.0	2.5	4.2	1.0
Days/a year required	0	0	0	0	192	192	192	256
Utilisation (MWh)	0.0	0.0	0.0	0.0	27.6	409.6	1371	2622

Table 6: Estimated availability and utilisation requirements for flexibility solution.

The CEM model outcome in Figure 9 shows that by utilising flexible solutions, the reinforcement can be deferred for one year under the DFES CT scenario and one year under LW. If the future demand follows the ST trajectory it can be deferred by eight years while the reinforcement would not be needed under the DFES SP scenario.

Our deliverability plan suggests that it is best to deliver the capital investment in 2026/27. This effectively means we will need to procure flexibility for two years. The net benefit for doing this is positive and very close to that of the one year deferral (CT scenario – Figure 9).



Cumulative benefit of deferral (excluding benefit from further deferral, but including multi-year discount)	Baseline	1 Defer by 1 year(s) to 2026	2 Defer by 2 year(s) to 2027	3 Defer by 3 year(s) to 2028	4 Defer by 4 year(s) to 2029
Flexible Solution under [1]-CT	£0	£122,019	£121,226	-£230,829	-£1,034,530
Flexible Solution under [2]-LW	£0	£108,594	£80,020	-£326,426	-£1,208,606
Flexible Solution under [3]-SP	£0	£134,253	£309,138	£526,394	£774,192
Flexible Solution under [4]-ST	£0	£134,253	£309,138	£526,394	£757,188

Figure 9: Net benefit of deferring reinforcement for the four DFES scenarios

In this case, £6.011m investment would be needed in RIIO ED2 including availability and utilisation cost of £0.197m for flexible generation or flexible demand for two years and £5.814m for asset replacement and add of new assets. The flexible solution followed by Asset Replacement and Add New Assets is taken forward into the Ofgem CBA model (Option 3).

The CBA results in Table 7 show that Option 3 with flexible solution followed by assets replacement is the best option in terms of the NPV over the 45 years as compared with other options. Option 3 is the preferred option.

In line with our Flexibility First Approach, this project is technically compatible with a Flexibility Solution. We will carry out Flexibility market tests to establish the cost, location, and technical capabilities of the available flexibility.

If the market test is successful, a flexibility solution will be employed offering value to both us and our customers in terms of investment deferral and optionality. Should the market test fail or only partially succeed in identifying the required Flexibility, we will use the CEM Framework to assess the optimal secondary solution for this location, be that a further market test for full flexibility, accelerating the conventional solution or a hybrid scheme. We will also assess the opportunity to extend the flexible solution beyond year four, i.e. 2026/27, should the scheme be successful and demand growth is lower than currently forecasted.

Further detail of our Flexibility First approach and assessment methodology can be found in our ***DSO Strategy (Annex 11.1) Appendix F - Delivering Value through Flexibility***[8].

6 Cost Benefit Analysis (CBA)

This section provides an overview of the results from the Cost Benefit Analysis (CBA). This detailed exercise has been undertaken to support the investment strategies discussed within this EJP.

6.1 CBA of investment options

Ofgem's RIIO-ED2 standard CBA template has been used to assess costs and benefits of the conventional options for each circuit individually. Capital reinforcement costs, CI/CML penalties, network losses and other societal benefits are the key parameters used in the CBAs of the three options progressed. The customer interruptions / customer minutes lost (CI/CML) for the considered options were calculated based on the potential overloads and the probability of failure, and the CI and CML values are shown in Appendix 1.

The network losses (MWh) in Option 3 were calculated as the MWh difference after and before the proposed reinforcement taking into consideration the yearly average loading condition of 33kV circuits and 33/11kV transformers feeding Ashling Road primary substation 11kV busbars. Further information on our Cost Benefit Analysis (CBA) approach is set out within ***Cost Benefit Analysis Process (Annex 15.8).***

The CBA results in Table 7 below demonstrate that the most cost-effective solution is option 3 'Flexible Solution Followed by Asset Replacement & Add New Assets', as it has the most favourite NPV against the required investment. It is clear that the investment would reduce significant and even remove the CI and CML for supply to Ashling Road primary substation within RIIO-ED2, while providing efficient and enduring long-term security of supply as we move towards a Net Zero network. Therefore, based on the CBA results option 3 is the preferred solution to address the P2/7 compliance issue at Ashling Road primary substation and meet our deliverability requirements.

Options	Net Present Value (NPV) After 45 Years (£k)	Investment (£k)
Option 2 – Asset Replacement & Add New Assets	-1,630	5,814
Option 3 – Flexible Solution Followed by Asset Replacement & Add New Assets	-1,582	6,011

Table 7: Summary of CBA results

Options	Unit	2024	2025	2026	2027	2028	ED3	Total £k
Option 2 – Asset Replacement & Add New Assets	£k	0	5,814	0	0	0	0	5,814
Option 3 – Flexible Solution Followed by Asset Replacement & Add New Assets	£k	0	[redacted]	[redacted]	[redacted]	0	0	6,011

Table 8: Summary of capital costs in the options

[8] ***DSO Strategy (Annex 11.1) Appendix F - Delivering Value through Flexibility***

6.2 Options Summary

Option 1 has the lowest capital costs and so may initially appear to be the most favourable option. However, this option is unable to fully resolve the P2/7 compliance issue. Furthermore, it would result in poorer guaranteed standard performance and customer interruptions. Option 1 is not considered as a cost effective, long term enduring solution.

Option 2 is technically feasible to resolve the P2/7 issue in the RIIO ED2 and is regarded as the preferred conventional solution.

Option 3 is technically feasible and has benefits in deferring the reinforcement proposed in Option 2 for at least one year. The CBA outcome shows that flexible solution could be utilised to defer the reinforcement for two years to meet our deliverability capability. Option 3 is our preferred option.

6.3 Costing Approach

Our RIIO ED2 Business Plan costs are derived from our outturn RIIO ED1 expenditure. We have modified costs per activity, capturing and reporting those adjustments in our cost-book. By tying our costs back to reported, outturn, real-life data, this approach provides multiple data points on which both the Regulator and we can benchmark cost efficiency.

It provides a high-level of cost confidence in our Business Plan cost forecast for RIIO ED2. Through our benchmarking analysis, we recognise that not all RIIO-ED1 actual unit costs sit within the upper quartile efficiency band. Where this is the case, we have applied a catch-up efficiency to those cost categories.

Further detail on our unit cost approach, cost efficiency and cost confidence for RIIO-ED2 can be found within our ***Cost Efficiency (Annex 15.)1***[9]. Following our draft Business Plan, we have continued to develop project scopes and costs, utilising valuable stakeholder feedback. We have included developments of our Commercial Strategy within the updated project scope and delivery strategy.

Table 9 shows the cost breakdown for reinforcement in the final preferred Option 2 taking into consideration unique and site-specific costs. Through our detailed bottom-up project assessment, no other additional costs have been identified for this reinforcement scheme.

Category	Sub-category	Unit Cost (£k)	Unit	Asset Count	Predominant Costing Approach	Cost £k
Cable	33kV UG Cable (Non-Pressurised)	[redacted]	km	12.9	ED1 6yr average actual unit rates	[redacted]
Transformer	33/11kV transformers	[redacted]	#	2	ED1 6yr average actual unit rates	[redacted]
Switchgear	33kV CB (Air Insulated Busbars) (OD) (GM)	[redacted]	#	1	ED1 6yr average actual unit rates	[redacted]
					Project Sub Total	[redacted]
Category	Regional Variations and Site-Specific Factors Driving Costs				Predominant Costing Approach	Impact Cost £k
Civil Works Driven Costs	- Installation of the new 33kV cable circuits between Ashling Road and Hunston BSP needs to cross the existing railway, which incurs additional cost.				Utilisation of tendered Framework Rates/ED1 Actual Realised Costs	[redacted]

9 Link to ***Cost Efficiency (Annex 15).***

Civil Works Driven Costs	- Installation of the new 33kV cable circuits between Ashling Road and Hunston BSP is likely to damage crops and plants along the cable route and some kind of agricultural compensation is needed.	Utilisation of tendered Framework Rates/ED1 Actual Realised Costs	[redacted]
Flexible solution	- Availability and utilisation cost for flexible generation is needed in order to remove and mitigate the overloads under an FCO condition in 2025 and 2026.	Flexibility unit costs of £150 per MW per hour and £150 per MWh were used in the CEM CBA model	[redacted]
		Total Project Cost	[redacted]

Table 9: Cost breakdown for the preferred option

7 Deliverability and Risk

Between our Draft and Final Business Plans we have carried out a more detailed deliverability assessment of our overall plan as a package and its component investments. Using our draft Business Plan investment and phasing as a baseline we have followed our deliverability assessment methodology. We have assessed any potential delivery constraints to our plan based on:

- In-house workforce capacity and skills constraints based on our planned recruitment and training profile and planned sourcing mix as well as the efficiencies we have built into our Business Plan ***(detailed in our Workforce Resilience Strategy in (Annex 16.3)*** and ***Cost Efficiency (Annex 15.1)***.
- Assessment of the specific lead and delivery timelines for the asset classes in our planned schemes.
- We have evaluated our sourcing mix where there were known delivery constraints to assess opportunities to alleviate any constraints through outsourcing.
- We have engaged our supply chain ***Supply Chain Strategy (Annex 16.2)*** to explore how the supply chain could support us to efficiently deliver greater volumes of work and how we could implement a range of alternative contracting strategies to deliver this.
- We have also engaged with the supply chain on the delivery of work volumes that sit within Uncertainty Mechanisms to ensure we have plans in place to deliver this work if and when the need arises
- Specific to load schemes: We have carried out flexibility assessments at all voltage levels in order to understand when we can defer reinforcement through paying for flexibility services, therefore ensuring our investment profile is deliverable and at the lowest cost to (***see Flexibility within Load Related Plan Build and Strategy (Annex 10.1***)
- We have assessed the synergies between our planned load, non-load, and environmental investments to most efficiently plan the scheduling of work and minimise disruption to consumers
- Based on our assessment of delivery constraints and potential solutions to resolve them, we have revised our investment phasing accordingly to ensure our Business Plan is deliverable, meets our consumers' needs and is most cost efficient for our consumers

Table 10 sets out the revised investment phasing based on the outcome of our deliverability assessment for reinforcement at Ashling Road Primary Substation. The CEM model results show that there is benefit on deferring the reinforcement for at least one year depending upon the demand forecast in the DFES scenarios. Our draft deliverability plan for this scheme is the fourth year, i.e. 2026/27 in RIIO ED2. The CBA results concluded that Option 3 is the preferred option. We will utilise flexible solution in 2024/25 and 2025/26 followed by Asset Replacement & Add New Assets in 2026/27.

	2023/24	2024/25	2025/26	2026/27	2027/28
Revised Investment Phasing				X	

Table 10: Revised investment phasing of deliverability

The revised investment phasing is in line with our deliverability capability. This investment scheme is part of the wider load-related investment portfolio in RIIO-ED2. We have developed a strategy to deliver a much larger volume of work in comparison with the level of investment in ED1. Our deliverability testing has identified a major strategic opportunity which is relevant to all EJPs.

- In ED2 SSEN will change the way Capital Expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a Price Control period where volumes of work are increasing across all work types.
- The principle is to develop and deliver Programmes of work, manage risk and complexity at Programme level and to develop strategic relationships with our Suppliers and Partners to enable efficiency realisation.
- The Commercial strategy will explore the creation of Work Banks (WB) and identify key constraints. The Load work will be the primary diver for a WB, supplemented by Non-Load work at a given Primary Substation. This approach will capitalise on synergies between the Load and Non-Load work, whereby the associated downstream work from a Primary Substation will maximise outage utilisation, enabling the programme to touch the network in a controlled manner with the objective of touching the network once. Where there is no Primary Load scheme to support the Non-Load work, these will be considered and packaged separately, either insourced or outsourced dependant on volume, size, and complexity.
- Transparency with the Supplier in terms of constraints, challenges, outage planning and engineering standards will capitalise on efficiencies, supported by a robust contracting strategy.

The specific considerations for deliverability based on the scope of this EJP are detailed below:

- This investment scheme is part of the wider load-related investment portfolio in RIIO-ED2. We have developed a strategy to deliver a much larger volume of work in comparison with the level of investment in ED1. We have engaged with our supply chain to negotiate the most effective unit costs. We have carefully planned the future workforce with the right skills and competencies to deliver capital projects in ED2.
- In ED1, we have delivered a number of 33kV cable and overhead line installation projects in-house as well as primary transformer replacements. The experience and skills acquired from these projects lay the foundation for the delivery of the Ashling Road cable installation and transformer replacement project.
- A new cable route is proposed for this project in this EJP. A site visit would be needed to verify the plausibility of this proposed cable route in detailed design stage.
- Utilising the flexibility service can potentially defer the reinforcement for two years based on the output of the CEM CBA model under the CT scenario. However, the amount of flexibility depends on location-specific resources and interests.

8 Conclusion

This EJP has raised the need for load-related investment on reinforcement at Ashling Road primary substation within the ED2 price control period. This need for investment is driven by the compliance with P2/7 under an FCO condition. Given the increase of forecasted demand at Ashling Road primary substation and the significant impact on customers subsequent to an FCO event, reinforcement is required to remove this non-compliance in RIIO-ED2.

Three investment options have been considered and the preferred solution is Option 3, which involves utilising flexible solution to remove the peak demand at Ashling Road primary substation in 2025 and 2026 followed by installing the 2x6.45 km underground cable and replacing 2x33/11kV transformer at Ashling Road primary substation in 2027. All options are supported by a Cost Benefit Analysis (CBA) which provides further breakdown of economic viability over a 45-year period.

The current Load Index (LI) for Ashling Road is LI2 (84.4%) and it will be LI5 (119%) by the end of ED2 period (2027/28) following the DFES CT scenario without intervention. With the preferred reinforcement option, the LI will be LI2 (81%) by the end of ED2 period.

The proposed ED2 investment with the combined scheme total of £6.011m. It is proposed that after utilising flexible solution for the first two years in 2025 and 2026, all reinforcement works are carried out in the 2027 financial year to minimise the risk of thermal overload and network non-compliance. This is in line with our deliverability capability.

Appendix 1: Assumptions

CI/CML Tables

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CT (MVA)	22.2	23.0	23.9	24.7	25.7	27.2	29.1	30.9	32.8	34.7
Firm Capacity (MVA)	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Difference	0.0	0.0	0.0	0.0	0.8	2.3	4.2	6.0	7.9	9.8
Customer No. 1% Growth	14337	14480	14625	14771	14919	15068	15219	15371	15525	15680
MVA per customer	0.00154	0.00158	0.00163	0.00167	0.00172	0.00180	0.00190	0.00201	0.00211	0.00221
No. Faults per Year	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745
Final Input										
CI	0.000	0.000	0.000	0.000	-359.1	-959.8	-1620.5	-2222.1	-2774.8	-3296.4
CML	0.000	0.000	0.000	0.000	-64646.	-172764.	-291699.	-399983.	-499474.	-593359.

Table 11: CI/CML for Do Minimum Option

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CT (MVA)	22.2	23.0	23.9	24.7	25.7	27.2	29.1	30.9	32.8	34.7
Firm Capacity (MVA)	24.9	24.9	24.9	24.9	38	38	38	38	38	38
Difference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Customer No. 1% Growth	14337	14480	14625	14771	14919	15068	15219	15371	15525	15680
MVA per customer	0.00155	0.00159	0.00163	0.00167	0.00173	0.00181	0.00191	0.00201	0.00211	0.00221
No. Faults per Year	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745
Final Input										
CI	0	0	0	0	0	0	0	0	0	0
CML	0	0	0	0	0	0	0	0	0	0

Table 12: CI/CML for Asset Replacement & Add New Assets Option

Appendix 2: Network Analysis Results

Voltage Level Assessment

	SYSTEM VOLTAGE LEVELS						
Year	Season	Chichester 33kV voltage	Ashling Road Demand	Generation	Study Scenario	Ashling Road 11kV voltage	Busbar Name
[-]	[-]	[p.u.]	[MVA]	[MVA]	[-]	[p.u.]	[-]
2025	Winter	1.031	25.7MVA	0	Intact	1.031	ASHR-E
2025	Winter	1.027	25.7MVA	0	Fault on Ashling Road Primary T1	0.986	ASHR-E
	The Voltage levels are in the limit of ± 10% on 132KV. ± 6% on 33KV or 11kV under intact condition.						

Table 13: Voltage Level Assessment Results

Fault Level Assessment

Bus Number	Bus Name	Nominal Voltage (kV)	Pre-fault Voltage (p.u)	X/R ratio	Ik"-Initial Sym. (kA)	Ip-Peak Make (kA)	RMS Sym. Break (kA)	DC Component (kA)	RMS Asym. Break (kA)	Circuit Breaker Break Rating	Circuit Breaker Make Rating	Circuit Breaker Fault Level Index
3 Phase Fault Level Results at the End of ED2 2027/2028												
11030	ASHR-C	33.	1.013	3.1	9.13	18.19	8.48	0.19	8.48	25	62.5	FLI1
11050	ASHR-E	11.	1.031	5.1	11.08	24.66	9.95	1.12	10.01	13.1	33.4	FLI1
Single Phase to Ground Fault Level Results at the End of ED2 2027/2028												
11030	ASHR-C	33.	1.013	3.8	4.67	9.88	4.62	0.23	4.62	25	62.5	FLI1
11050	ASHR-E	11.	1.031	0.1	1.82	2.62	1.82	0	1.82	13.1	33.4	FLI1

Table 14: Fault Level Assessment Results

Appendix 3: Relevant Policy, Standards, and Operational Restrictions

The policies, manuals and standards and operational restrictions relevant to the content of this paper.

Policy Number	Policy Name / Description
TG-NET-OHL-010	Load Ratings of Overhead Lines – Data Sheet
TG-NET-OHL-012	Short Circuit Ratings of Overhead Lines – Data Sheet
TG-NET-OHL-104	Electrical Constants for Overhead Lines- Data Sheet
TG-NET-CAB-009	Load Ratings of LV to 33kV Underground Cables – Design Data
TG-NET-CAB-010	Electrical Constants for LV to 33kV Underground Cables- Data Sheet
TG-NET-CAB-011	Short Circuit Ratings of 6.6kV to 33kV Underground Cables - Design Data

Table 15: Relevant documents

Appendix 4: Whole Systems Consideration

In augmenting our decision-making processes to consider Whole System solutions, we have introduced an assessment to identify where a Whole Systems CBA would be a useful decision-making tool for ED2 load and non-load schemes. While our work with the ENA to undertake Whole Systems CBAs is ongoing, we have introduced the 'Whole Systems CBA test' to identify where a scheme may be suitable for a Whole Systems CBA to be conducted. Where a Whole Systems CBA is determined to be a useful decision-making tool, these would be conducted in addition to the standard Ofgem CBA and/or SSEN's flexibility CBA. We have introduced this test in line with Ofgem's expectations for "proportionality when submitting a Whole System CBA. For example, smaller or simple projects following the standard CBA template, whereas larger or more complex projects requiring bespoke analytical approaches" (Ofgem BPG, section 4.28, p.34).

The 'Whole Systems CBA test' involves assessing each investment scheme of over £2m (the threshold to develop an EJP for load and non-load investments) against 5 tests. These 5 tests help determine whether a Whole Systems CBA is a useful decision-making tool based on the characteristics of the scheme, including whether it will have wider cross sector or societal impacts.

Details on each of the tests are provided in case study 6 in our ***Whole Systems (Annex 12.1)***. Tests 1-3 are aligned with the ENA's guidance for Whole System CBA tests. We have added Tests 4 and 5 to clarify whether a Whole Systems CBA is required based on the materiality / proportionality of the investment (Test 4) and whether a flexibility CBA only is sufficient (Test 5). Table 16 below outlines our Whole Systems CBA test for Ashling Road 33/11kV Primary Substation.

Scheme	**Test 1: Are there Whole Systems interactions, or is there potential for it?**	**Test 2: Could a Whole Systems CBA drive you to make a different decision?**	**Test 3: Is a Whole Systems CBA reasonable?**	**Test 4 - Is the project valued at over £2m?**	**Test 5 - Is the investment plan related to procuring flexible solutions only?**
Ashling Road 33/11kV Primary Substation	No – We consider there to be limited potential for Whole Systems interactions with third parties to deliver this investment programme, and accordingly we do not consider there to be potential for Whole Systems solution(s).	No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case.	No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case.	Yes	No

Table 16: Whole Systems CBA test for Ashling Road 33/11kV Primary Substation

As the result of tests 1, 2 and 3 above is "No", a Whole Systems CBA is not required for this investment. It is not expected to have any wider Whole System interactions or potential Whole Systems solutions.

Appendix 5: BPDT Information

Asset & Services	Volume	Costs (£k)	BPDT	Delivery Year
33kV UG Cable (Non-Pressurised) (km)	12.9	[redacted]	CV1	2027
33kV Transformer (GM) (no.)	2	[redacted]	CV1	2027
33kV CB (Air Insulated Busbars) (OD) (GM) (no.)	1	[redacted]	CV1	2027
Cable Railway Crossing (no.)	1	[redacted]	CV1	2027
Agricultural Compensation (no.)	1	[redacted]	CV1	2027
Flexibility Solution (years)	2	[redacted]	CV1	2025, 2026
Total		[redacted]		

Table 17: BPDT Information

Appendix 6: Acronym Table

Acronym	Definition
AIS	Air-insulated Switchgear
ASCR	Aluminium Conductor Steel Reinforced
BSP	Bulk Supply Point
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CEM	Common Evaluation Methodology
CI	Customer Interruptions
CML	Customer Minutes Lost
CT	Consumer Transformation
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
EJP	Engineering Justification Paper
ESA	Electricity Supply Area
EV	Electric Vehicle
FCO	First Circuit Outage
FES	Future Energy Scenarios
GIS	Geographic Information System
GM	Ground Mounted
GSP	Grid Supply Point
HI	Health Index
IDP	Investment Decision Pack
LCT	Low Carbon Technology

LEP	Local Enterprise Partnership
LI	Load Index
LRE	Load Related Expenditure
LW	Leading the Way
NPV	Net Present Value
OHL	Overhead Line
PM	Pole Mounted
PV	Photovoltaics
RSN	Relevant Section of Network
SCO	Second Circuit Outage
SSEN	Scottish and Southern Electricity Network
SP	Steady Progression
ST	System Transformation
XLPE	Cross-linked Polyethylene