

# Govan-St.Andrews Cross 6.6kV Upgrade

## ED2 Engineering Justification Paper

### ED2-LRE-SPD-026-CVI-EJP

Issue	Date	Comments
Issue 0.1	Jan 2021	Issue to internal governance and external assurance
Issue 0.2	Apr 2021	Reflecting comments from internal governance
Issue 0.3	May 2021	Reflecting assurance feedback
Issue 1.0	Jun 2021	Issue for inclusion in Draft Business Plan submission
Issue 1.1	Oct 2021	Reflecting updated DFES forecasts
Issue 1.2	Nov 2021	Reflecting updated CBA results
Issue 2.0	Dec 2021	Issue for inclusion in Final Business Plan submission

<b>Scheme Name</b>	Govan-St. Andrews Cross 6.6kV Upgrade		
<b>Activity</b>	Primary Reinforcement		
<b>Primary Investment Driver</b>	Thermal Constraints		
<b>Reference</b>	ED2-LRE-SPD-026-CVI		
<b>Output</b>	Load Index		
<b>Cost</b>	£7.820m		
<b>Delivery Year</b>	2023-2027		
<b>Reporting Table</b>	CVI		
<b>Outputs included in ED1</b>	Yes/No		
<b>Business Plan Section</b>	Develop the Network of the Future		
<b>Primary Annex</b>	Annex 4A.2: Load Related Expenditure Strategy: Engineering Net Zero Annex 4A.6: DFES		
<b>Spend Apportionment</b>	<b>ED1</b> £m	<b>ED2</b> £7.820m	<b>ED3</b> £m



## Technical Governance Process

### Project Scope Development

# IPI(S)

To be completed by the Service Provider or Asset Management. The completed form, together with an accompanying report, should be endorsed by the appropriate sponsor and submitted for approval.

IP1 – To request project inclusion in the investment plan and to undertake project design work or request a modification to an existing project

**IP1(S) – Confirms project need case and provides an initial view of the Project Scope**

IP2 – Technical/Engineering approval for major system projects by the System Review Group (SRG)

IP2(C) – a Codicil or Supplement to a related IP2 paper. Commonly used where approval is required at more than one SRG, typically connection projects which require connection works at differing voltage levels and when those differing voltage levels are governed by two separate System Review Groups.

IP2(R) – Restricted Technical/Engineering approval for projects such as asset refurbishment or replacement projects which are essentially on a like-for-like basis and not requiring a full IP2

IP3 – Financial Authorisation document (for schemes > £100k prime)

IP4 – Application for variation of project due to change in cost or scope

### PART A – PROJECT INFORMATION

Project Title:	<b>Govan-St. Andrews Cross 6.6kV Upgrade</b>
Project Reference:	<b>ED2-LRE-SPD-026-CVI</b>
Decision Required:	<b>To give concept approval for the project scope of rationalising the legacy Govan / St. Andrews Cross GSP network: replacement and uprating of Admiral St / Elizabeth Street primary substations and removal of St Andrews Cross primary.</b>

#### Summary of Business Need:

The Govan / St. Andrews Cross GSP area is served by a legacy area of network, primarily running at 6.6kV. Significant connection volumes are accepted for the area with further enquiries expected due to the requirements of the broadcasting sector and council redevelopment plans. Uprating of the 6.6kV network to 11kV is required to provide thermal headroom for these connections and future network growth.

In addition to the forecasted load issues, the ageing legacy assets and civils require remedial works. The civils are of particular concern and require significant expenditure to address due to the age of buildings and significant cost of land in the area.

Rationalisation of the network is proposed to minimise overall cost to the customer. This would involve upgrading primary substations so that others can be decommissioned, and civils costs avoided.

#### Summary of Project Scope, Change in Scope or Change in Timing:

There are 10 work packages spaced across RIIO-ED1 and RIIO-ED2. This paper details the thermal reinforcement projects for carryover into RIIO-ED2:

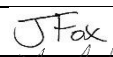

- Work Package 7: Elizabeth Street primary phase 2 (including installation of 1 x 20MVA transformer and 7 x 11kV primary circuit breakers)
- Work Package 8: Decommission and re-establish Admiral St (including the installation of 2 x 32MVA transformers and 21 x 11kV primary circuit breakers)
- Work Package 10: Secondary network upgrade (including installation of dual ratio transformers and replacement of legacy 6.6kV glover underground cable)

The estimated cost for the above is £7.820m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.


#### Expenditure Forecast (in 2020/21)

Licence Area	Reporting Table	Description	Total (£m)	Incidence (£m)				
				2023/24	2024/25	2025/26	2026/27	2027/28
SPD	CVI	Primary Reinforcement	<b>7.820</b>	0.782	1.564	3.128	2.346	-
SPD	<b>Total</b>		<b>7.820</b>	<b>0.782</b>	<b>1.564</b>	<b>3.128</b>	<b>2.346</b>	-

### PART B – PROJECT SUBMISSION

Proposed by	Jonathan Fox	Signature		Date:	30/11/2021
Endorsed by	David Neilson	Signature		Date:	30/11/2021

### PART C – PROJECT APPROVAL

Approved by	Malcolm Bebbington	Signature		Date:	30/11/2021
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## I Introduction

Govan Grid Supply Point (GSP) and St. Andrews Cross GSP are geographically located within the Glasgow region of SP Distribution (SPD) licence area. The groups supply a number of primary substations and currently serves ca. 35,211 customers.

The Govan / St. Andrews Cross GSP area is served by a legacy area of network, primarily running at 6.6kV. The non-standard voltage network results in constrained system capacity, additional reinforcement needs (e.g. 6.6kV cables overloading before their 11kV equivalent) and incremental costs for dual ratio equipment for plant installations and replacements. The diminishing population of plant also presents risks for the perspective of fault repairs and the availability of spares.

Significant connection volumes are accepted for the area with further enquiries expected due to the requirements of the broadcasting sector and council redevelopment plans. Upgrading of the 6.6kV network to 11kV is required to provide thermal headroom for these connections and future network growth.

In addition to the expected load issues, the ageing legacy assets and civils require remedial works. The civils are of particular concern and require significant expenditure to address due to the age of buildings and significant cost of land in the area.

As part of the RIIO-ED1 business plan, SP Distribution proposed a multi-phase plan to upgrade the legacy 6.6kV network to 11kV in the area between Govan GSP substation and St. Andrews Cross GSP substation in the south of Glasgow. There are 10 work packages spaced across RIIO-ED1 and RIIO-ED2 and across different funding mechanisms. This paper details the thermal reinforcement projects for carryover work packages into RIIO-ED2 relating to Elizabeth Street, Admiral Street and St Andrews Cross primary substations. The proposed carryover work packages are as follows:

- Work Package 7: Elizabeth Street primary phase 2 (including installation of 1 x 20MVA transformer and 7 x 11kV primary circuit breakers)
- Work Package 8: Decommission and re-establish Admiral St (including the installation of 2 x 32MVA transformers and 21 x 11kV primary circuit breakers)
- Work Package 10: Secondary network upgrade (including installation of dual ratio transformers and replacement of legacy 6.6kV glover underground cable)

The estimated cost for the above carryover work packages is £7.820m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

In order to resolve the forecast thermal issues, it is proposed to continue the works during RIIO-ED2 and the release capacity of 21MVA will be claimed in 2026/27 at the end of the project.

## 2 Background Information

### 2.1 Existing / Authorised Network

The network under consideration is the distribution network between Govan GSP and St. Andrews Cross GSP. These GSPs support eight primary substations; Helen Street (6.6kV), Linthouse, Cardonald, Southern General (Customer Owned), Elizabeth Street (6.6kV), Admiral Street (6.6kV), Leslie Street and St Andrews Cross (6.6kV). A number of these primary substations supply legacy 6.6kV networks. Interconnection between Govan GSP and St. Andrews Cross GSP is available at 33kV via a switching station at Elizabeth Street primary.

The 33kV networks at Govan GSP and St. Andrews Cross GSP are shown in Figure 1 and Figure 2.

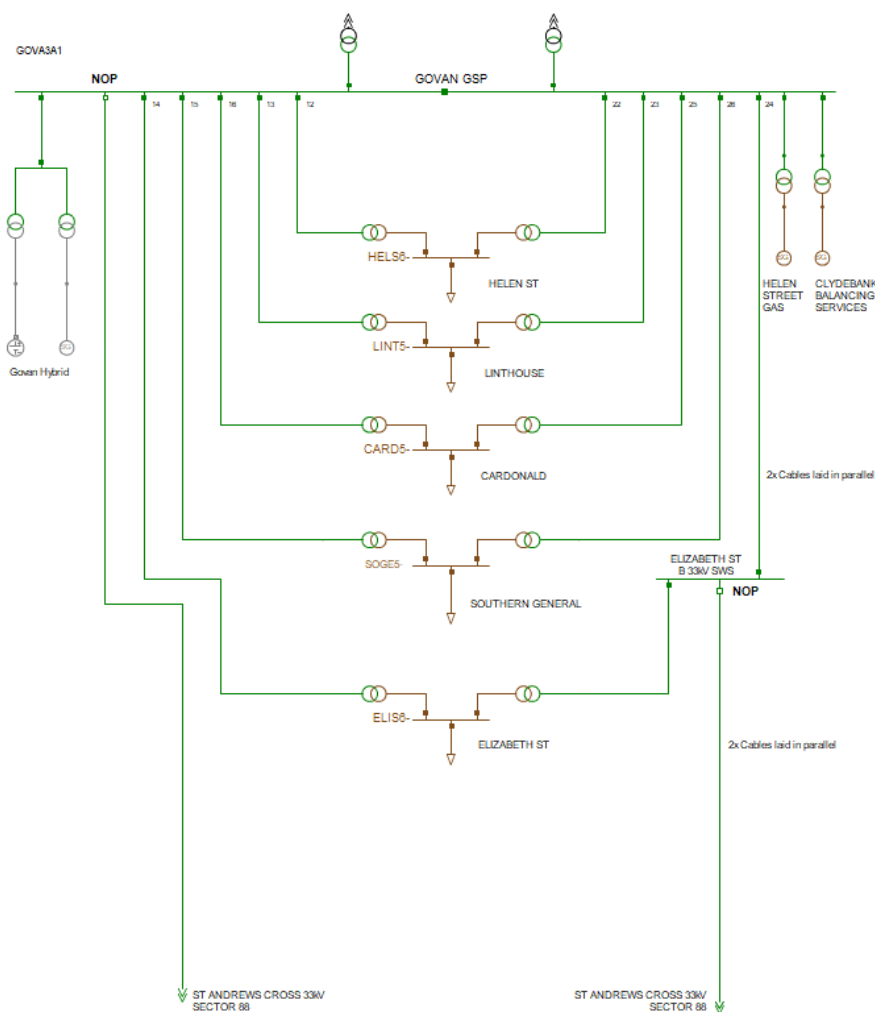


Figure 1. Existing 33kV Network (Govan GSP)

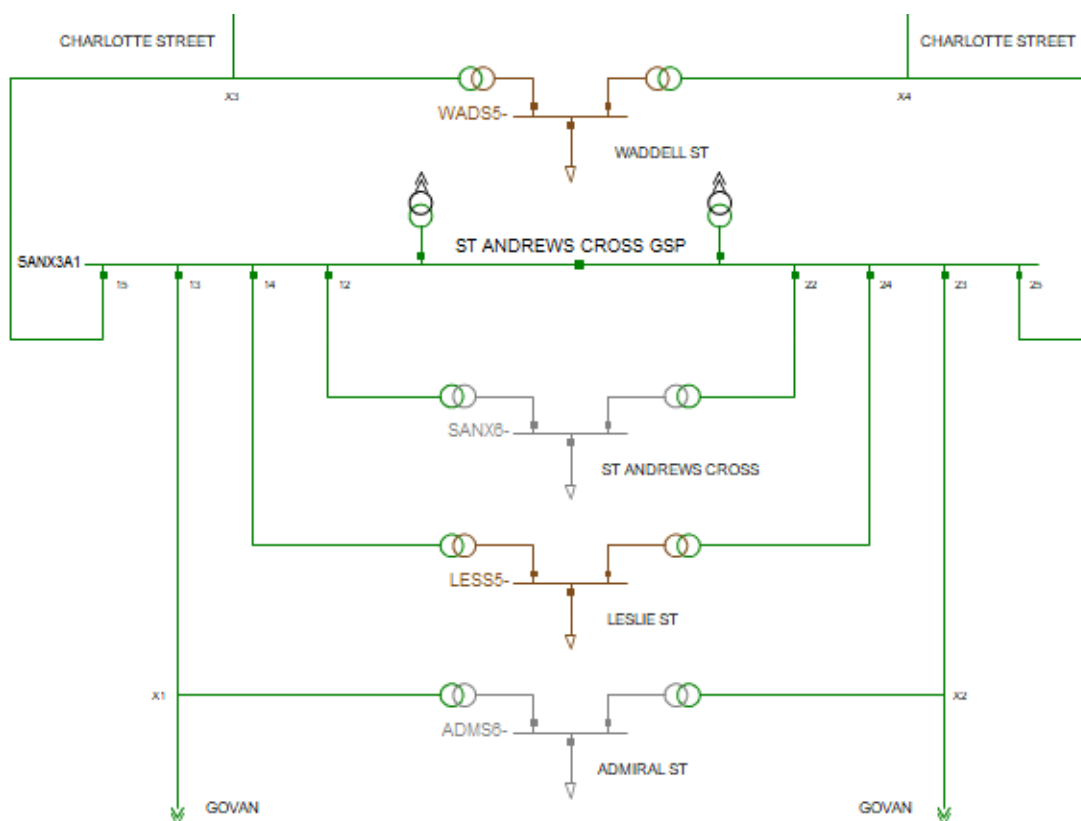


Figure 2. Existing 33kV Network (St. Andrews Cross GSP)

## 2.2 Group Demand & Security of Supply

The 2020 maximum demand for each of the primary substations under review within the Govan / St. Andrews Cross GSP group is shown in Table 2.1. All demand groups are currently a class ‘B’ of supply as per Energy Network Association (ENA) Engineering Recommendation (EREC) P2/7. However, significant volumes of connection acceptances and enquiries are present in the area.

Table 2.1. Govan / St. Andrews Cross GSP primary group demands under review (2020 Load Index)

Demand Group	Customers (#)	Firm Capacity (MVA)	Max Demand (MVA)	Load Index	P2/7 Class of Supply
Elizabeth Street	3,485	10	6.7	LII	B
Admiral Street	3,558	21	10.7	LII	B
St Andrews Cross	2,922	21	5.0	LII	B

All three primary substations are fed via two 33kV underground cable circuits. A summary of the transformer and switchgear data is presented in Table 2.2 and Table 2.3 respectively.

Table 2.2. Primary transformer data

	Elizabeth Street	Admiral Street	St Andrews Cross
Manufacturer	English Electric	Johnson & Phillips	Bruce Peebles
Manufacturer Year	1955	1960	1960
Voltage	33/6.6kV	33/6.6kV	33/6.6kV
Thermal Rating	10MVA	21MVA	21MVA
Health Index	HI4	HI2	HI3
No of transformers	2	2	2

Table 2.3. Primary switchgear data

	<b>Elizabeth Street</b>	<b>Admiral Street</b>	<b>St Andrews Cross</b>
<b>Model</b>	Reyrolle C6TX10	Reyrolle C6TX10	Reyrolle C6TX10
<b>Manufacturer Year</b>	1955	1960	1960
<b>Voltage</b>	6.6kV	6.6kV	6.6kV
<b>Health Index</b>	4x HI5, 12x HI4	27x HI4	1x HI5, 14x HI4
<b>No of panels</b>	16	27	15

## 2.3 Embedded Generation

There is no embedded generation connected at primary substations under consideration (Elizabeth Street, Admiral Street and St Andrews Cross primary substations).

## 2.4 Fault Levels

Studies indicate that there are no fault level issues at primary substations under consideration (Elizabeth Street, Admiral Street and St Andrews Cross primary substations).

## 3 Needs Case

The Govan / St. Andrews Cross GSP area is served by a legacy area of network, primarily running at 6.6kV. The non-standard voltage network results in constrained system capacity, additional reinforcement needs (e.g. 6.6kV cables overloading before their 11kV equivalent) and incremental costs for dual ratio equipment for plant installations and replacements. The diminishing population of plant also presents risks for the perspective of fault repairs and the availability of spares.

Significant connection volumes are accepted for the area with further enquiries expected due to the requirements of the broadcasting sector and council redevelopment plans. Uprating of the 6.6kV network to 11kV is required to provide thermal headroom for these connections and future network growth.

In addition to the expected load issues, the ageing legacy assets and civils require remedial works. The civils are of particular concern and require significant expenditure to address due to the age of buildings and significant cost of land in the area.

### 3.1 Forecast Demand

The system is forecast to grow and exceed firm capacity within the RIIO-ED2 period. This forecast is based on actual system measurement data from the Process Instrumentation (PI) system and stakeholder endorsed Distribution Future Energy Scenarios (DFES) and considers our pipeline of known developments.

#### 3.1.1 Distribution Future Energy Scenarios

DFES includes granular forecasts to 2050 for demand, generation and Low Carbon Technologies. They assess credible future scenarios covering a range of uncertainties, including differing levels of consumer ambition, policy support, economic growth and technology development and the forecasts are underpinned by extensive stakeholder engagement.

The peak demand forecast based on the SPD Distribution Future Energy Scenarios along with the projected demand from authorised connections is depicted in Figure 3, Figure 4 and Figure 5.

The scenario range considers the range of Net Zero compliant scenarios developed by us, the Electricity System Operator (ESO), and the Climate Change Committee (CCC). These are the five scenarios from the CCC 6th carbon budget, and the Leading the Way and Consumer Transformation scenarios from our DFES and the ESO Future Energy Scenarios (FES). We haven't included the System Transformation (ST) scenario as it is an outlier against the other Net Zero compliant scenarios and does not achieve interim carbon targets.

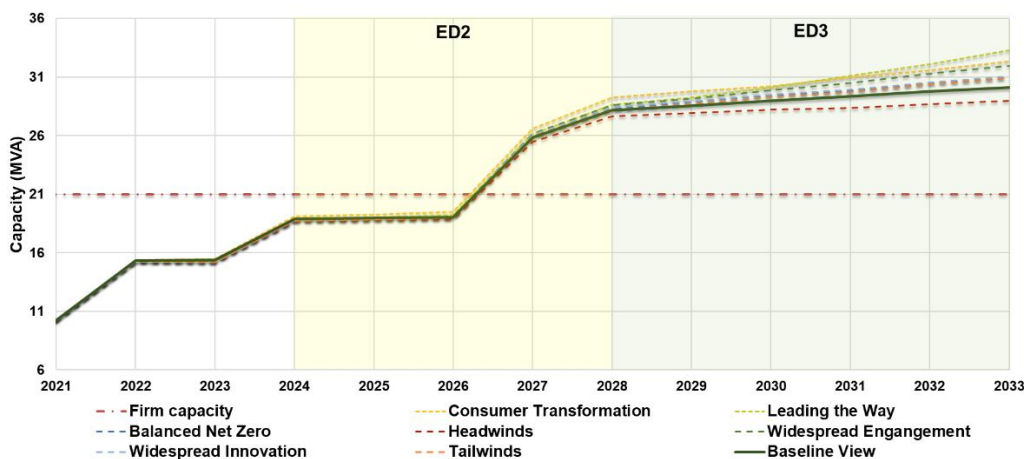


Figure 3. Demand (MVA) forecast for Admiral Street demand group\*

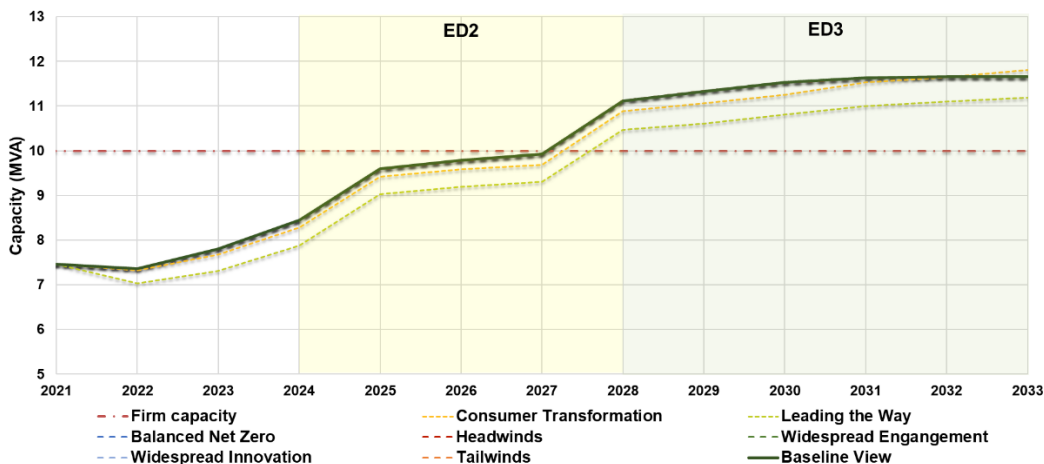


Figure 4. Demand (MVA) forecast for Elizabeth Street demand group



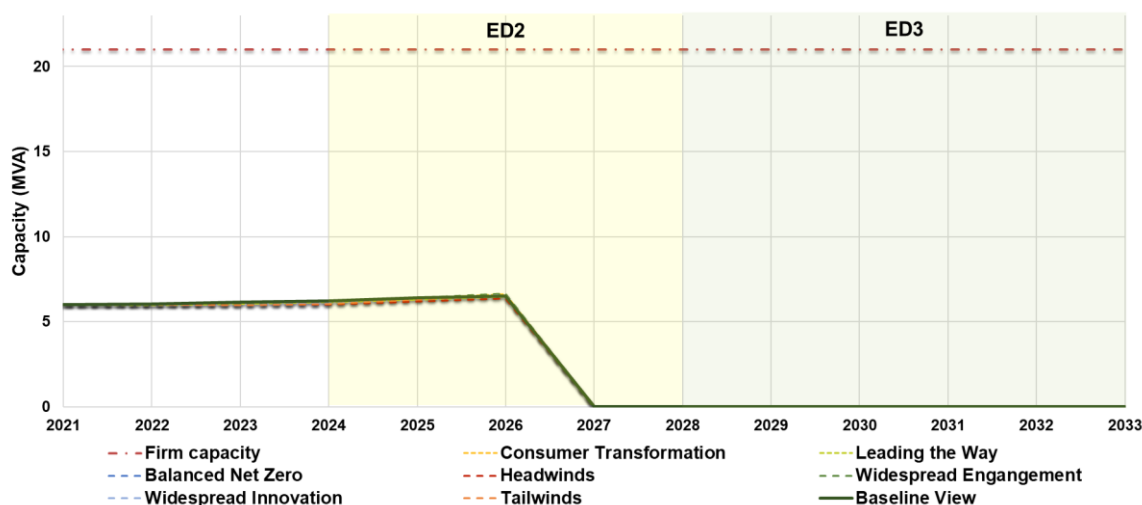


Figure 5. Demand (MVA) forecast for St Andrews Cross demand group\*

### 3.1.2 Baseline View

For the primary substations requiring reinforcement within the Govan / St. Andrews Cross GSP area, the forecast demand growth under our Baseline scenario, along with the firm capacity and utilisation through to RIIO-ED3 period is shown in Table 3.1.

Table 3.1. Baseline View forecast

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Admiral Street*													
Forecast Demand (MVA)	11.2	15.3	15.4	18.9	19.0	19.0	25.1	27.4	27.7	28.1	28.5	28.9	29.2
Firm Capacity (MVA)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Utilisation (%)	53	73	73	90	90	90	119	130	132	134	136	138	139
Load Index	L11	L11	L11	L12	L12	L12	L15	L15	L15	L15	L15	L15	L15
Elizabeth Street													
Forecast Demand (MVA)	7.0	6.9	7.4	8.0	9.2	9.4	9.5	10.7	10.9	11.1	11.2	11.2	11.2
Firm Capacity (MVA)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Utilisation (%)	70	69	74	80	92	94	95	107	109	111	112	112	112
Load Index	L11	L11	L11	L12	L12	L12	L12	L15	L15	L15	L15	L15	L15
St Andrews Cross*													
Forecast Demand (MVA)	5.3	5.4	5.4	5.5	5.7	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Firm Capacity (MVA)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Utilisation (%)	25	26	26	26	27	28	0	0	0	0	0	0	0
Load Index	L11	L11	L11	L11	L11	L11	L11	L11	L11	L11	L11	L11	L11

\*Proposed load transfer from St Andrews Cross to Admiral Street included in forecast to avoid double counting

## 3.2 Network Impact Assessment

Detailed network studies covering network intact and outage (N-I) conditions and fault level assessments were carried out for the primary substations requiring reinforcement within the Govan / St. Andrews Cross GSP area considering the different demand forecast scenarios.

### 3.2.1 Thermal Constraints

Table 3.2 shows the identified thermal constraints on the 33/6.6kV network level.

Table 3.2. Thermal constraints at 33/6.6kV level

Network Item	Voltage	Outage
Admiral Street T1	33/6.6kV	N-1
Admiral Street T2	33/6.6kV	N-1
Elizabeth Street T1	33/6.6kV	N-1
Elizabeth Street T2	33/6.6kV	N-1

### 3.2.2 Voltage Constraints

There were no voltage constraints at 6.6kV network fed from the Admiral Street, Elizabeth Street and St Andrews Cross primary demand groups.

### 3.2.3 EREC P2/7 – Security of Supply

The peak demand and firm capacity of the primary substations requiring reinforcement within the Govan / St. Andrews Cross GSP area are shown in Table 3.1.

EREC P2/7 states that a group demand, with a class ‘B’ of supply, must secure the following minimum demand for a first circuit outage (FCO):

- a) Group demand minus IMW must be met within 3 hours;
- b) Group demand must be met within repair time.

Therefore, based on the minimum demand requirements to be met under FCO conditions and the available firm capacity this site is predicted to be non-compliant under EREC P2/7 by the end of the RIIO-ED2 price control period.

## 4 Optioneering

Table 4.1 shows a summary of the options considered for this reinforcement. The baseline option represents the lowest cost conventional option, i.e. the minimum level of intervention without application of innovation.

Table 4.1. Longlist of solution options

#	Options	Status	Reason for rejection
(a)	Do nothing	Rejected	Rejected as it does not address the thermal headroom issues and leads end of life electrical & civils assets on the system
(b)	Intervention plan using only Energy Efficiency	Rejected	Discounted due to lower cost effectiveness (peak MW reduction per £) and the number of individual interventions required across the wide area supplied by this network.
(c)	Replace like for like	Rejected	Rejected as it does not address the thermal issues from accepted connections and future network growth
(d)	Upgrade network to 11kV and rationalise loads	Shortlisted as <b>Baseline</b> option in Detailed Analysis	
(e)	Upgrade network to 11kV by keeping current site locations	Shortlisted as <b>Option 1</b> in Detailed Analysis	

## 5 Detailed Analysis & Costs

Both the options taken forward for detailed analysis consider upgrading the 6.6kV network to 11kV. With the proposed uprating scheme, the network groups also benefit from the reduction of technical losses. In theory, uprating to 11kV can reduce the losses as much as 2.78 times compared to 6.6kV networks, which gives significant savings over the lifetime of the assets and thereby contributing to reduction in CO<sub>2</sub> emissions. The network losses reduction post uprating is estimated to be 1.6GWh/year per group upon the project completion.

### 5.1 Proposed Option (Baseline) – Upgrade Network to 11kV and Rationalise Loads

As part of the RIIO-ED1 business plan, SP Distribution proposed a multi-phase plan to upgrade the legacy 6.6kV network to 11kV in the area between Govan GSP substation and St. Andrews Cross GSP substation in the south of Glasgow. Rationalisation of the network is considered to minimise overall cost to the customer. This involves upgrading primaries so that others can be decommissioned, and civils costs avoided.

Efficiency over the original work programme has been achieved by upgrading Admiral Street to 32MVA and rationalising network loads which is proposed in this option. Work packages 3 and 9 have therefore been removed. Summary of the work packages for the Baseline option is shown in Table 5.1.

Table 5.1. Baseline option project work package summary

Work Package	Work Pack Name	Carryover into RIIO-ED2
3	St. Andrews Cross offloading, 11kV board installation and T1 installation	Not required – Rationalise with Admiral Street. Decommissioning costs to be included within WP8.
4	St. Andrews Cross 33kV switchboard replacement	Completed in RIIO-ED1
6	Elizabeth Street primary phase 1 (including purchasing of 2 x 20MVA transformers, installation of 1 x 20MVA transformer and eight circuit breakers)	Completed in RIIO-ED1
7	Elizabeth Street primary phase 2 (including installation of 1 x 20MVA transformer and 7 x 11kV primary circuit breakers)	Yes
8	Decommission and re-establish Admiral Street primary and rationalise St Andrews Cross	Yes
9	St. Andrews Cross primary T2 installation	Not required - Rationalise with Admiral Street. Decommissioning costs to be included within WP8.
10	Secondary substation and cable uprating works	Yes – Split between RIIO-ED1 and RIIO-ED2

The proposed option for this scheme is to upgrade the network to 11kV and rationalise loads. Table 5.2 shows the scheme summary.

Table 5.2. Baseline option summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Govan-St. Andrews Cross 6.6kV Upgrade	Upgrade network to 11kV and rationalise loads	7.820	-

### 5.1.1 Work Packages 6 & 7: Elizabeth Street Phase 1 / Phase 2

Work package 6 seeks to install two dual-ratio 33/11-6.6kV 20MVA Continuous Maximum Rating (CMR) Midel transformers within the RIIO-ED1 period. Work package 7 seeks to replace the existing 6.6kV switchboard at Elizabeth Street primary with an 11kV switchboard to facilitate the uprating of the primary substation.

There are 3MW of accepted customer connections due to be connected to Elizabeth Street in addition to further expected load growth given the council's development plans for the area.

These work packages will provide the required thermal headroom (which would otherwise be exceeded by connections) and address the asset health and civils issues at the site. The replacement of the primary transformers at Elizabeth Street is also recognised as high priority due to the health index of the existing plant.

### 5.1.2 Work Package 8: Decommission and Re-establish Admiral Street and Rationalise St Andrews Cross

Work package 8 seeks to decommission the existing site, install new primary equipment and reconnect newly updated 11kV feeders interconnecting with adjacent primary networks. It is proposed to increase the capacity of the Admiral Street primary from a 2 x 21MVA CMR substation to 2 x 32MVA CMR substation due to load growth within the local area and proposed network rationalisation.

There are 10MW of accepted customer connections due to be connected to Admiral Street / St Andrews Cross in addition to further expected load growth given the council's development plans for the area and ambitions of broadcasters in the area to install electric car chargers.

Efficiency over the original work programme has been achieved by removing work packages 3 and 9 through upgrading Admiral Street to 32MVA and rationalising the network by removing St Andrews Cross primary substation. This provides the least cost solution given the significant asset health and civils issues at St Andrews Cross. An additional £100k worth of costs should be allowed for the decommissioning of St Andrews Cross primary.

This will provide the thermal headroom (which would otherwise be exceeded by connections), enable the rationalisation of the network and address the asset health and civils issues at the both Admiral Street and St Andrews Cross.

### 5.1.3 Work Package 10: Complimentary Secondary Network Works

To enable the delivery of the works packages described above, execution of these projects is dependent on works being carried out on the HV network. This consists of uprating and transferring a portion of the HV circuits within the local network plus the installation of dual ratio transformers and replacement of legacy 6.6kV glover underground cable. A portion of this will be carried out during

RIIO-ED1 in association with the work packages which will also be carried out during this period. The remaining secondary network upgrades will then be carried out during RIIO-ED2 to support the work packages described above.

#### 5.1.4 Data Tables

Table 5.3 details the breakdown of the project spends and Table 5.4 shows capacity outputs across the RIIO-ED2 period.

Table 5.3. Baseline option project spends

Work Package	Work Package Name	Reporting Table	Project Forecast (£m)	RIIO-ED1 (£m)	RIIO-ED2 (£m)	Incidence (£m)				
						2023/24	2024/25	2025/26	2026/27	2027/28
6	Elizabeth Street Primary Phase 1 (RIIO-ED1)	CVI	2.460	2.460	-	-	-	-	-	-
7	Elizabeth Street Primary Phase 2 (RIIO-ED2)	CVI	0.701	-	0.701	0.070	0.140	0.280	0.210	-
8	Decommission and re-establish Admiral Street primary and rationalise St Andrews Cross	CVI	3.529	-	3.529	0.353	0.706	1.412	1.059	-
10	Secondary Substation and Cable Upgrading Works	CVI	6.800	3.211	3.589	0.359	0.718	1.436	0.077	-
<b>Total</b>			<b>13.500</b>	<b>5.671</b>	<b>7.820</b>	<b>0.782</b>	<b>1.564</b>	<b>3.128</b>	<b>2.346</b>	<b>-</b>

Table 5.4. Baseline option RIIO-ED2 capacity released

Work Package	Work Package Name	Capacity Released RIIO-ED2
7	Elizabeth Street primary phase 2	10
8	Decommission and re-establish Admiral Street primary and rationalise St Andrews Cross	11

Table 5.5 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.5. Baseline option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
LV Board (WM)	14	0.141	0.141	-
6.6/11kV UG Cable	19	2.232	2.232	-
6.6/11kV CB (GM) Primary	28	0.776	0.776	-
6.6/11kV RMU	14	0.347	0.347	-
6.6/11kV Transformer (GM)	27	0.388	0.388	-
33kV UG Cable (Non Pressurised)	0.14	0.028	0.028	-
33kV Transformer (GM)	2	0.790	0.790	-
Batteries at 33kV Substations	2	0.018	0.018	-
Pilot Wire Underground	5.14	0.569	0.569	-
Civil Works at 33 kV & 66 kV Substations		1.396	1.396	-
Other Costs (Identify Below)		1.133	1.133	-
<b>Total Costs</b>		<b>7.820</b>	<b>7.820</b>	<b>-</b>
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and Design (£150k)				
Asbestos Management (£70k)				
Oil Pollution Mitigation Schemes (£200k)				
Black Start (£10k)				
Telecoms (£145k)				
33kV transformers electrical installation (£100)				
11kV CB electrical installation (£260)				
AVC (£100k)				
Decommissioning of St Andrews Cross (£100k)				

In order to resolve the forecast thermal issues, it is proposed to continue the works during RIIO-ED2 and the release capacity of 21MVA will be claimed in 2026/27 at the end of the project.

## 5.2 Option 1 – Upgrade Network to 11kV by Keeping Current Site Locations

This solution proposes to retain St Andrews Cross primary by replacing the end of life electrical assets and civils under work packages 3 and 9 (CV7). Table 5.6 shows the scheme summary.

Table 5.6. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Govan-St. Andrews Cross 6.6kV Upgrade	Upgrade network to 11kV by keeping current site locations	9.054	-

This would provide extra flexibility on the network as we would have an extra primary in the area to facilitate the future connections. The remaining work packages are identical to the Baseline option as all other work is required to meet the project objectives. Summary of the work packages for the Option 1 is shown in Table 5.7.

Table 5.7. Option 1 project work package summary

Work Package	Work Package Name	Carryover into RIIO-ED2
3	St Andrews Cross 11kV board installation and TI installation	Yes
4	St Andrews Cross 33kV switchboard replacement	Completed in ED1
6	Elizabeth Street primary phase 1 (including purchasing of 2 x 20MVA transformers, installation of 1 x 20MVA transformer and eight circuit breakers)	Completed in ED1
7	Elizabeth Street primary phase 2 (including installation of 1 x 20MVA transformer and 7 x 11kV primary circuit breakers)	Yes
8	Decommission and re-establish Admiral Street primary	Yes
9	St Andrews Cross primary T2 installation	Yes
10	Secondary substation and cable uprating works	Yes – Split between RIIO-ED1 and RIIO-ED2



## 5.2.1 Data Tables

Table 5.8 details the breakdown of the project spends for Option I and Table 5.9 shows capacity outputs across the RIIO-ED2 period.

Table 5.8. Option I project spends

Work Package	Work Package Name	Reporting Table	Project Forecast (£m)	RIIO-ED1 (£m)	RIIO-ED2 (£m)	Incidence (£m)				
						2023/24	2024/25	2025/26	2026/27	2027/28
3 / 9	St Andrews Cross Primary Replacement	CV7	2.414	-	2.414	0.241	0.483	0.965	0.724	-
6	Elizabeth Street Primary Phase 1 (RIIO-ED1)	CV1	2.460	2.460	-	-	-	-	-	-
7	Elizabeth Street Primary Phase 2 (RIIO-ED2)	CV1	0.701	-	0.701	0.070	0.140	0.280	0.210	-
8	Decommission and re-establish Admiral Street Primary	CV1	3.529	-	3.429	0.343	0.686	1.372	1.029	-
10	Secondary Substation and Cable Uprating Works	CV1	6.810	4.300	2.510	0.251	0.502	1.004	0.753	-
<b>Total</b>			<b>15.814</b>	<b>6.760</b>	<b>9.054</b>	<b>0.905</b>	<b>1.811</b>	<b>3.622</b>	<b>2.716</b>	<b>-</b>

Table 5.9. RIIO-ED2 Option I capacity released

Work Package	Work Package Name	Capacity Released RIIO-ED2
7	Elizabeth Street primary phase 2	10
8	Decommission and re-establish Admiral Street primary	11

Table 5.10 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.10. Option 1 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIO-ED2 Contribution (£m)	Customer Contribution (£m)
LV Board (WM)	12	0.121	0.121	-
6.6/11kV UG Cable	12	1.410	1.410	-
6.6/11kV CB (GM) Primary	43	1.192	1.192	-
6.6/11kV RMU	12	0.297	0.297	-
6.6/11kV Transformer (GM)	22	0.316	0.316	-
33kV UG Cable (Non Pressurised)	0.28	0.056	0.056	-
33kV Transformer (GM)	4	1.529	1.529	-
Batteries at 33kV Substations	4	0.037	0.037	-
Pilot Wire Underground	5.28	0.585	0.585	-
Civil Works at 33 kV & 66 kV Substations		2.196	2.196	-
Other Costs (Identify Below)		1.315	1.315	-
<b>Total Costs</b>		<b>9.054</b>	<b>9.054</b>	<b>-</b>
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and Design (£200k)				
Asbestos Management (£80k)				
Oil Pollution Mitigation Schemes (£200k)				
Black Start (£10k)				
Telecoms (£205k)				
33kV transformers electrical installation (£100)				
11kV CB electrical installation (£260)				
AVC (£100k)				
Directional drilling under the railway (£160k)				

### 5.3 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5.11.

Table 5.11. Cost summary for considered options

Options	Option Summary	RIO-ED2 Cost (£m)
Baseline	Upgrade network to 11kV and rationalise loads	7.820
Option 1	Upgrade network to 11kV by keeping current site locations	9.054

Derivation of costs for these options are based on the SPEN RIO-ED2 Unit Cost Manual for intervention. This is based on bottom up cost assessment of the components of activity detailed within the RIGs Annex A for the above activities, SPEN's contractual rates for delivery, market available rates and historic spend levels.

## 6 Deliverability & Risk

### 6.1 Preferred Options & Output Summary

The adopted option is the Baseline option to upgrade the network to 11kV and rationalise loads.

### 6.2 Cost Benefit Analysis Results

A cost benefit analysis (CBA) was carried out to compare the NPV of the options discussed in the previous sections. Considering the lowest forecast capital expenditure, the proposed option has the highest total NPV against other options. The summary of the cost benefit analysis is presented in Table 6.1. The full detailed CBA is provided within 'ED2-LRE-SPD-026-CVI-CBA – Govan-St. Andrews Cross 6.6kV Upgrade'.

Losses are considered for both options and Option 1 when compared to Baseline has additional 211.15MWh/year which is included in CBA under societal benefits.

Table 6.1. Cost benefit analysis results

Options considered	Decision	Comment	NPVs based on payback periods, £m (2020/21 prices)			
			10 years	20 years	30 years	45 years
Baseline – Upgrade network to 11kV and rationalise loads	Adopted					
Option 1- Upgrade network to 11kV by keeping current site locations	Rejected	Discounted based on NPV.	-0.71	-1.07	-1.29	-1.46

### 6.3 Cost & Volumes Profile

Table 6.2 shows the breakdown of expenditure for the proposed scheme (in 2020/21 prices) and the cost incidence (in 2020/21 prices) over the RIIO-ED2 period is shown in Table 6.3. The total cost of the proposed scheme is £7.820m.

Table 6.2: Summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
LV Board (WM)	14	0.141	0.141	-
6.6/11kV UG Cable	19	2.232	2.232	-
6.6/11kV CB (GM) Primary	28	0.776	0.776	-
6.6/11kV RMU	14	0.347	0.347	-
6.6/11kV Transformer (GM)	27	0.388	0.388	-
33kV UG Cable (Non Pressurised)	0.14	0.028	0.028	-
33kV Transformer (GM)	2	0.790	0.790	-
Batteries at 33kV Substations	2	0.018	0.018	-
Pilot Wire Underground	5.14	0.569	0.569	-
Civil Works at 33 kV & 66 kV Substations		1.396	1.396	-
Other Costs (Identify Below)		1.133	1.133	-
Total Costs		7.820	7.820	-

Identify activities included within other costs (please provide high-level detail of cost areas)
Planning and Design (£150k)
Asbestos Management (£70k)
Oil Pollution Mitigation Schemes (£200k)
Black Start (£10k)
Telecoms (£145k)
33kV transformers electrical installation (£100)
11kV CB electrical installation (£260)
AVC (£100k)
Decommissioning of St Andrews Cross (£100k)

Table 6.3: Cost incidence over the RIIO-ED2 period, £m (2020/21 Prices)

Total Investment	Total RIIO-ED1 (£m)	Total RIIO-ED2 (£m)	Incidence (£m)				
			2023/24	2024/25	2025/26	2026/27	2027/28
CVI Expenditure	5.671	7.820	0.782	1.564	3.128	2.346	-

## 6.4 Risks

There are multiple risks associated with the delivery of this scheme. The main risk is a discovery of non-standard 6-core legacy 6.6kV glover underground cables during the uprating of secondary network. This would require more experienced jointers to complete the work which could lead to longer lead times if they are not available.

Another risk is the requirement for extended outages as all substations are within the legacy buildings which require non-standard engineering solution. As we have previous experience with legacy sites, we will mitigate this risk by allowing subsequent time for site specific designs.

There is also a risk of council embargos on road closures when uprating the secondary network. We would mitigate these risks by engaging early with local authorities.

As dual ratio transformers will need to be installed to allow smooth uprating of the secondary network, there is a risk of longer lead times as these transformers are non-standard. We would mitigate this risk by early engagement with suppliers.

## 6.5 Outputs Included in RIIO-ED1 Plans

There are no capacity release volumes associated with these work packages included within the RIIO-ED1 period.

## 6.6 Future Pathways – Net Zero

### 6.6.1 Primary Economic Driver

The primary drivers for this investment are insufficient thermal headroom and security of supply risk. The investment does not have a strong reliance on environmental benefits.

### 6.6.2 Payback Periods

The CBA indicates that for the proposed option demonstrates better NPV results in all assessment periods (10, 20, 30 & 45 years) against other two options. As the intervention is forecast to carry at

least a 45-year asset life expectancy, the CBA at this time justifies the intervention. Consumers will also benefit from reduced network risk immediately on completion of the project.

### 6.6.3 Sensitivity to Future Pathways

The network capacity and capability that result from the proposed option is consistent with the network requirements determined in line with the section 9 of the Electricity Act and Condition 21. Additionally, the proposed option is consistent with the SPEN's Distribution System Operator (DSO) Strategy and Distribution Future Energy Scenarios.

Table 6.4 shows electric vehicle and heat pump uptakes across a range of future pathways and Table 6.5 shows the sensitivity of the proposed solution and Table 6.6 shows the sensitivity of the proposed RIIO-ED2 expenditure against the full ranges of Net Zero complaint future pathways other Climate Change Committee (CCC) scenarios.

Table 6.4: Electric Vehicle and Heat Pump uptakes across a range of future pathways for Elizabeth Street, Admiral Street and St Andrews Cross Primary

End of RIIO-ED2	SPEN	DFES			CCC				
	Baseline	System Transformation*	Consumer Transformation	Leading the Way	Balanced Net Zero Pathway	Headwinds	Widespread Engagement	Widespread Innovation	Tailwinds
EVs	385		534	656	462	318	502	458	458
HPs	974		1,233	1,190	858	653	987	927	824

\*Note: We have excluded System Transformation from our future pathways assessment as it does not meet interim greenhouse gas emission reduction targets.

Table 6.5: Sensitivity of the proposed solution against future pathways

Solution Requirements	RIIO-ED1				RIIO-ED2					RIIO-ED3				
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Baseline								R <sup>1</sup>						
Consumer Transformation								R <sup>1</sup>						
Leading the Way								R <sup>1</sup>						
Balanced Net Zero Pathway								R <sup>1</sup>						
Headwinds								R <sup>1</sup>						
Widespread Engagement								R <sup>1</sup>						
Widespread Innovation								R <sup>1</sup>						
Tailwinds								R <sup>1</sup>						

**R<sup>1</sup>** – Upgrade network to 11kV and rationalise loads

The proposed solution is robust across the range of future pathways. The proposed solution is expected to be required under all scenarios and in all cases to endure beyond RIIO-ED3.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	Uncertain
RIIO-ED2 Expenditure (£m)	7.820	N/A
Comment	Proposed option	

### 6.6.4 Asset Stranding Risks & Future Asset Utilisation

Electricity demand and generation loadings are forecast to increase under all scenarios. The stranding risk is therefore considered to be low.

### 6.6.5 Losses / Sensitivity to Carbon Prices

Losses have been considered in accordance with Licence Condition SLC49 and the SP Energy Networks Losses Strategy and Vision to “consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers”. Reasonable design efforts have been taken to minimise system losses without detriment to system security, performance, flexibility or economic viability of the scheme. This includes minimising conductor lengths/routes, the choice of appropriate conductor sizes, designing connections at appropriate voltage levels and avoiding higher impedance solutions or network configurations leading to higher losses.

The adopted solution is found to be sensitive to the impact of the carbon cost of losses. The proposed solution will reduce the network losses to the tune of 1.6GWh/year per group upon the project completion. Losses have been considered as part of this design solution and it has not been necessary to carry out any losses justified upgrades.

During the evaluation of the options associated with the proposed scheme, we have embedded within the CBA, where data are available, an assessment of the embodied carbon and the associated carbon cost to inform our NPV evaluation. The mass of carbon dioxide emitted (CO<sub>2</sub>e) during the manufacture of the main equipment deployed to deliver this scheme is estimated to be 586 tonnes. The monetised embodied carbon value associated with this emission is £33k. It should be noted that the embodied carbon evaluation undertaken has only considered the manufacture and supply of materials. Solution selection was not found to be sensitive to the impact of the carbon cost of losses. Further collaborative industry-wide work is planned for the RII0-ED2 price review period to better understand the overall embodied carbon values including, for example installation and commissioning services, decommissioning and disposal activities as well as refurbishment opportunities. More information regarding this can be found in Section 3.1.2 of our Environmental Action Plan<sup>1</sup>.

### 6.6.6 Whole Systems Benefits

Whole system solutions have been considered as part of this proposal. No alternatives have been identified that could be provided through a whole systems solution. The completion of this scheme will maintain the integrity of the distribution network and its enduring ability to facilitate wider whole system benefits.

## 6.7 Environmental Considerations

### 6.7.1 Operational and Embodied Carbon Emissions

The Govan-St. Andrews Cross 6.6kV Upgrade programme has the potential to impact on the embodied carbon resulting from the delivery of the programme, including for example from the installation of new transformers and from remedial civils works.

Upfront costs associated with replacement assets (e.g. embodied carbon in the materials and emissions associated with civil engineering works) should be considered against the potential operational efficiency improvements associated with replacement assets from a lifetime carbon perspective. For example, with the carbon emissions resulting from the raw materials and manufacture of new assets only contributing around 5-10% of the whole-life carbon impact of a transformer, it is entirely possible

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<sup>1</sup> Annex 4C.3: Environmental Action Plan, SP Energy Networks, Issue 2, 2021.

that a transformer with a higher embodied carbon footprint may have lower whole-life carbon emissions if it can operate more efficiently with fewer losses.

As network losses currently account for 95% of our BCF, even a marginal improvement in the efficiency of a transformer can bring a significant reduction in lifetime losses and the resulting carbon emissions. Therefore, it is important that efficiency criteria inform the decision-making process.

#### **6.7.2 Supply Chain Sustainability**

For us to take full account of the sustainability impacts of the Govan-St. Andrews Cross 6.6kV Upgrade programme, we need access to reliable data from our suppliers, including information on the embodied carbon from the manufacture of transformers, and on the fixed and variable losses from their operation. The need for carbon and other sustainability credentials to be provided now forms part of our wider sustainable procurement policy.

#### **6.7.3 Resource Use and Waste**

The Govan-St. Andrews Cross 6.6kV Upgrade programme will result in the consumption of resources and the generation of waste materials from end of life assets.

Where waste is produced it will be managed in accordance with the waste hierarchy which ranks waste management options according to what is best for the environment. The waste hierarchy gives top priority to preventing waste in the first instance, then preparing for re-use, recycling, recovery, and last of all disposal (e.g. landfill).

#### **6.7.4 Biodiversity / Natural Capital**

The Govan-St. Andrews Cross 6.6kV Upgrade Reinforcement programme will only affect developed sites containing existing assets. Therefore, the impact on, and the opportunity to improve biodiversity and natural capital is expected to be minimal.

#### **6.7.5 Preventing Pollution**

SPEN will always follow all relevant waste regulations and will make sure that special (hazardous) waste produced or handled by our business is treated in such a way as to minimise any effects on the environment.

#### **6.7.6 Visual Amenity**

SPEN continually seeks to reduce the landscape and visual effects of our networks and assets but recognises that the nature of our substations makes it challenging to minimise their visual impact.

#### **6.7.7 Climate Change Resilience**

In addition to our efforts to minimise our direct carbon emissions in line with our Net Zero ambitions, we are also conscious of the need to secure the resilience of our assets and networks in the face of a changing climate. We have also modified our policy on vegetation control in the face of higher temperatures and longer growing seasons.

## 7 Conclusion

Govan Grid Supply Point (GSP) and St. Andrews Cross GSP are geographically located within the Glasgow region of SP Distribution (SPD) licence area. The groups supply a number of primary substations and currently serves ca. 35,211 customers.

The Govan / St. Andrews Cross GSP area is served by a legacy area of network, primarily running at 6.6kV. Significant connection volumes are accepted for the area with further enquiries expected due to the requirements of the broadcasting sector and council redevelopment plans. Upgrading of the 6.6kV network to 11kV is required to provide thermal headroom for these connections and future network growth. In addition to the forecasted load issues, the ageing legacy assets and civils require remedial works. The civils are of particular concern and require significant expenditure to address due to the age of buildings and significant cost of land in the area.

As part of the RIIO-ED1 business plan, SP Distribution proposed a multi-phase plan to upgrade the legacy 6.6kV network to 11kV in the area between Govan GSP substation and St. Andrews Cross GSP substation in the south of Glasgow. There are 10 work packages spaced across RIIO-ED1 and RIIO-ED2 and across different funding mechanisms. This paper details the thermal reinforcement projects for carryover work packages into RIIO-ED2 relating to Elizabeth Street, Admiral Street and St Andrews Cross primary substations. Rationalisation of the network is proposed to minimise overall cost to the customer. This would involve upgrading primary substations so that others can be decommissioned, and civils costs avoided.

The estimated cost for the above is £7.820m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. In order to resolve the forecast thermal issues, it is proposed to continue the works during RIIO-ED2 and the release capacity of 21MVA will be claimed in 2026/27 at the end of the project.