RIIO-ED2 Engineering Justification Paper (EJP)

PCB

Investment Reference No:**11/SSEPD/ENV/PCB Legislation**

Contents

Investment Summary Table

Table 1 below provides a high level summary of the key information relevant to this Engineering Justification Paper (EJP) and the management of removal of Polychlorinated Biphenyl (PCB) contaminated equipment.

Table 1: Investment Summary

Name of Scheme/Programme	PCB (Polychlorinated Biphenyl)
Primary Investment Driver	The primary investment driver is Environmental • Removal of PCB contaminated equipment
Scheme reference/ mechanism or category	11/SSEPD/ENV/PCB Legislation
Output references/type	Uncertainty Mechanism
Reporting Table	Business Plan Data Tables • CV22 - Environmental Reporting
Outputs included in RIIO ED1 Business Plan	Increased replacement of PCB contaminated transformers will commence the final years of RIIO-ED1 to ensure statutory deadline of 31/12/2025 can be achieved
Cost (Inlcuding UM)	£[redacted]

Spend Apportionment	**Licenced Area**	**ED1 (£m)**	**ED2 (£m)**	**ED3+ (£m)**
	SEPD	-	£[redacted]	-
	SHEPD	-	£[redacted]	-
Delivery Year	RIIO ED2 (2024 – 2026)			

Executive Summary

Our Environmental Action Plan (EAP) sets out our methodology that we propose to undertake during the RIIO-ED2 period in response to increasingly ambitious environmental drivers and stakeholder expectations. Ofgem have introduced a requirement to prepare an Environmental Action Plan as part of our RIIO-ED2 submission and setting a Science Based Target (SBT) is one of these minimum requirements for the EAP.

This paper sets out our plans for the removal of assets contaminated with Polychlorinated Biphenyl (PCBs) for the RIIO-ED2 period. Changes to European and UK regulations require the elimination of PCBs by 31st December 2025 in all network areas.

The primary driver for this scheme is Environmental and Regulatory Compliance. In summary, Table 2 shows that the cost to deliver the preferred solution within ED2 is £[redacted]. This includes £[redacted] as ED2 baseline and £[redacted] as ED2 Uncertainty Mechanism (UM). Note that we have been working with the ENA PCB ED1 Funding Mechanism group to engage with OFGEM for funding for the PCB programme in ED1 as the deadline to achieve legislative compliance is challenging and requires a programme that spans both price control periods. As part of this group, we have proposed a potential materiality range of £[redacted] (2020-21 prices) for the remainder of ED1 for SSEN as a whole (SEPD £[redacted] and SHEPD £[redacted]) based on agreed upon ED1 unit rates.

Table 2 Summary of RIIO-ED2 Asset Replacement Volumes and Expenditure for PCB Contaminated Transformers

[redacted]

1 Introduction

This Engineering Justification Paper (EJP) sets out our plans to implement an accelerated programme to replace electricity distribution assets containing PCBs in the RIIO-ED2 period in response to increasingly onerous environmental drivers and changes to European regulations that require the elimination of PCBs by 31st December 2025 in all network areas.

The primary investment driver for the planned programme of work is environmental, to remove PCB contaminated assets from our distribution networks. The key asset categories impacted by the forthcoming change in legislation are distribution transformers, which are divided into the following main groups:

- Pole Mounted Transformers (PMT); and
- Ground Mounted Transformers (GMT).

Compliance with the Persistent Organic Pollutants (POP) Regulations (2019/20) requires elimination of the use of PCBs by the end of 2025 for oil-filled equipment with an oil content greater than 50 ml and PCB concentration greater than 50 ppm. Such equipment must be remediated (so that the ultimate PCB content is not more than 50 ppm) or removed from service and disposed of safely.

The POPs Regulation has been recast and includes the following statement: “Member States shall identify and remove from use equipment (e.g., transformers, capacitors or other receptacles containing liquid stocks) containing more than 0,005 % PCBs and volumes greater than 0.05 dm3, as soon as possible but no later than 31 December 2025.” This is a more onerous requirement than the previous Regulation (EC No 850/2004), which permitted leaving electrical transformer equipment in place until the end of its useful life and required only equipment with volumes greater than 5 litres (5 dm3) to be eventually removed.

As the POP deadline falls within the RIIO-ED2 period, the planned investment programme for the RIIO-ED2 period only contains expenditure in the 2023/24, 2024/25 and 2025/26 (Q1, Q2 & Q3) financial years.

The Energy Networks Association (ENA) has developed a strategy for the identification and removal (or remediation) of affected oil-filled equipment owned by ENA Electricity Member Companies (ENA MCs) in Great Britain by the end of 2025. This high-level strategy is detailed in a Regulatory Position Statement (RPS) between the ENA and environment agencies party to the RPS, including the Environment Agency (EA) and also adoption (expected spring 2022) by the Scottish Environmental Protection Agency (SEPA).

All equipment containing or potentially containing PCBs are recorded on PCB registers which are reported to the relevant environment agencies. ENA Member Companies are committed to joint working with the environment agencies to ensure that items can be removed from these registers either by confirming that they do not contain more than 50 ppm of PCBs, by removing the equipment from service and disposing of it safely, or by safely removing the PCBs from the equipment.

The transformer population mostly affected is ground-mounted (GMT) and pole-mounted (PMT) distribution transformers that are not subject to regular oil-sampling for PCB content. The number of transformers initially identified as belonging to this population across the whole industry is approximately 320,000, of which approximately 200,000 are pole-mounted and the remainder ground-mounted. However, carrying out oil sampling of every transformer is impractical, because many smaller rated distribution transformers do not have suitable oil sampling points or valves, and many pole-mounted transformers cannot be safely sampled for oil in situ, even where a sampling point is present given the dangers include working at height, working in close proximity to high-voltage overhead lines and risk of oil spillage into the environment.

The approach being adopted for PMTs uses the statistical analysis of oil samples from equipment to identify sub-populations (cohorts) of transformers that can be categorised as containing no PCBs above 50 ppm, and cohorts which are believed to contain greater concentrations of PCBs and must therefore be considered for remediation or removal. This PMT approach is common across DNO's using the Environment Agency approved ENA Cohort model approach. This document also outlines our approach to GMT's.

1.1 Reference

The internal documents and external links detailed in Table 3 and Table 4 have been used to develop this document.

Table 3: Internal documents

Reference	Title
ST-NET-ENG-015	PCB Strategy
PLN-NET-ENG-001	Ground Mounted Transformers (GMT's) PCB Testing and Asset Intervention Strategic Plan
PLN-NET-ENG-002	Pole Mounted Transformers (PMT's) PCB Asset Intervention Strategic Plan
TG-NET-SST-029	On-site Handling and Testing of Mineral Insulating Oils
WI-NET-SST- 007	Removal, Reuse, Refurbishment and Disposal of Secondary Distribution Plant
WI-NET-SST-016	PCB Oil Sampling, Labelling, and Return of Samples

Table 4: External Reference

Reference	Title
Government PCB Guidance	https://www.gov.uk/guidance/polychlorinated-biphenyls-pcbs-registration-disposal-labelling
The Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and Wales) (Amendment) Regulations 2020	https://www.legislation.gov.uk/uksi/2020/489/made
The Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (Scotland) Amendment Regulations 2020	https://www.legislation.gov.uk/ssi/2020/434/made
Transformers containing PCBs: new rules - RPS 246	https://www.gov.uk/government/publications/transformers-containing-pcbs-new-rules-rps-246

2 Background Information

This section provides further information outlining the investment drivers regarding the replacement of transformers containing PCB contaminated insulating oil.

2.1 Background to PCBs

Polychlorinated Biphenyl Compound (PCBs) are classified as Persistent Organic Pollutants (POP). In general, POPs are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. POPs bioaccumulate with potential adverse impacts on human health and the environment. Production of certain types of chemical, including Polychlorinated Biphenyls (PCBs), has been banned by the Stockholm Convention on Persistent Organic Pollutants.

Historically PCBs were introduced via the supply chain into insulating oil and thus some electrical equipment. For some manufacturers the insulating oil they used for electrical equipment was the same oil used in other equipment and products that did specify the use of a proportion of PCB content. In those cases, this may have led to the introduction of contamination of electrical equipment when PCB contaminated oil was used during manufacture. Electricity Companies including SSEN have never specified insulating oil containing PCBs in our electrical equipment. When the electricity distribution industry became aware of the issues associated with PCBs in the 1980's appropriate actions were taken to ban PCBs from the supply chain and to start determining the level of PCB contamination within electrical transmission and distribution assets. Since this time, DNO's including SSEN have continued to act responsibly, establishing and implementing fit for purpose processes and controls to manage the risk from PCBs posed to people and the environment, from the conception of asset design through service life to appropriate safe disposal.

The use of PCBs as an insulating medium in newly manufactured equipment was banned in 1985. According to Environment Agency (EA) guidelines, any oil-filled equipment manufactured after 31 December 1986 is assumed to be free from PCBs.

Prior to 2020 UK/EU POPs legislation allowed transformers to remain in service until the end of their operational life but there is now a change in the legislation. The revisions to the Persistent Organic Pollutant Regulations now require that all EU Member States shall identify and remove from use equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) containing more than 50 ppm PCBs and volumes greater than 50 ml as soon as possible but no later than 31 December 2025. The recast of the EU legislation was enacted in English law in July 2020 and Scottish Law in February 2021.

As the POPs deadline falls within the RIIO-ED2 period, the planned investment programme for the RIIO-ED2 period only contains expenditure in the 2023/24, 2024/25 and 2025/26 (Q1, Q2 & Q3) financial years.

The planned intervention strategy for PMT's and GMT's will remove or remediate PCB contaminated assets to comply with the legislative deadline of the end of 2025.

The delivery of this extensive programme of work represents a considerable challenge for all electricity DNOs in terms of supply chain capability and managing reliable supplies to customers.

3 Stakeholder Engagement

We are actively engaging with the key stakeholder groups responsible for implementing the 2019 POP regulation changes with respect to PCB contaminated transformers. We are engaged with the following stakeholders and industry groups to comply with the emergent requirements.

3.1 Environmental Agency (EA)

In January 2021, the EA published the RPS that sets the approach and agreement for use of the ENA PCB Cohort model for statistical analysis of PMT's. We support this development and regards the approach as a pragmatic solution to achieve compliance (PMT's only).

3.2 Scottish Environment Protection Agency (SEPA)

In Scotland, we have held trilateral discussions with SEPA and SP Energy Networks. SEPA has also been engaging with the EA to understand the proposed approaches being developed in England. SEPA is reviewing its position which is likely to be based on the approach developed with the EA and the ENA.

3.3 Scottish Government

We responded to the Scottish Government consultation on the implementation of the EU regulations into Scottish Law. The Scottish Law has now been enacted and published – "The Environmental Protection (disposal of Polychlorinated Biphenyls and other Dangerous Substances) (Scotland) Amendment Regulations 2020" came into force on 14th February 2021.

3.4 DEFRA

The ENA PCB Liaison group, which we chair, has been the vehicle for the discussions with DEFRA on this challenging area.

3.5 ENA

Through the ENA we chair the PCB Liaison Group developing the industry wide strategy for PCB's. We are also key members of the ENA PCB Cohort group developing and progressing the statistical approach for PMT's working closely with the relevant environmental agencies.

4 Introduction to Investment Under Consideration

4.1 Primary Investment Driver

In 2014, the Environmental Agency required all Network Operators to place all transformers on an EA PCB register. UK legislation previously allowed transformers to remain in service until end of operational life but there is now a change in the legislation.

The revisions to the Persistent Organic Pollutant Regulations now require that all EU Member States shall identify and remove from use equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) containing more than 50 ppm PCBs and volumes greater than 50 ml as soon as possible but no later than 31 December 2025. This revision came across into UK law as part of the Brexit process and is now also in place in Scotland as part of the Scottish law.

This requirement is supported by the new RPS 246 from the EA which will be enforced to require PCB contaminated transformers employed within electricity distribution networks to be removed or replaced by 31 Dec 2025.

4.2 Identification of Assets Containing PCB Contaminated Oil

We have an extensive asset base of Distribution, Primary and Grid transformers operating at a range of voltages in England and Scotland. Investigations are underway across all GB electricity DNOs to identify the populations of ground mounted and pole mounted transformers containing insulating oil with a PCB concentration of greater than 50 ppm. The total size of our GMT and PMT transformer population varies by network and geographic area.

Table 5 & Table 6 segregate the PMT, and GMT asset populated by Year of Manufacture (where known) as this provides useful insights regarding the likelihood of PCB contamination. In general, in line with EA guidance, all transformers manufactured after 1987 are assumed not containing any PCBs and can therefore be removed from the asset population requiring replacement under the forthcoming regulation changes:

- For PMTs, this category represents about 53% of our PMT asset portfolio after the inspection programme. As of Nov 2021, 32,861 PMTs are still in the scope and pending for further actions.
- For GMTs, this category represents about 46% of our GMT asset portfolio after the inspection programme. As of Nov 2021, 21,188 GMTs are still in the scope and pending for further actions.

Table 5: Total size of the SSEN's Pole Mounted Transformer Asset Base

PMT Data Extracted as of May 2019				As of Nov 2021	
Licence Area	**Manufacture Date**	**No. of PMTs**	***PMT %***	**De-Registered**	**In Scope**
SEPD	Unknown	3,705	*15%*	364	3,341
SEPD	1901-1986	11,150	*44%*	347	10,803
SEPD	1987-date	10,521	*41%*	10,521	-
SEPD Sub total		25,376	*100%*	11,232	14,144
SHEPD	Unknown	2,084	*4%*	299	1,785
SHEPD	1901-1986	17,266	*36%*	334	16,932
SHEPD	1987-date	27,960	*59%*	27,960	-
SHEPD Sub total		47,310	*100%*	28,593	18,717
SSEN	Unknown	5,789	*8%*	663	5,126
SSEN	1901-1986	28,416	*39%*	681	27,735
SSEN	1987-date	38,481	*53%*	38,481	-
SSEN Total		**72,686**	***100%***	**39,825**	**32,861**

Table 6: Total size of the SSEN's Ground Mounted Transformer Asset Base

GMT Data Extracted as of May 2019				As of Nov 2021	
Licence Area	Manufacture Date	No. of GMTs	*GMT %*	De-Registered	In Scope
SEPD	Unknown	12	*0%*	4	8
SEPD	1901-1986	18,539	*55%*	1,326	17,213
SEPD	1987-date	15,073	*45%*	15,073	-
SEPD Sub total		33,624	*100%*	16,403	17,221
SHEPD	Unknown	6	*0%*	-	6
SHEPD	1901-1986	4,469	*50%*	508	3,961
SHEPD	1987-date	4,375	*49%*	4,375	-
SHEPD Sub total		8,850	*100%*	4,883	3,967
SSEN	Unknown	18	*0%*	4	14
SSEN	1901-1986	23,008	*54%*	1,834	21,174
SSEN	1987-date	19,448	*46%*	19,448	-
SSEN Total		**42,474**	***100%***	**21,286**	**21,188**

These tables highlight significant regional differences regarding the volumes of GMTs and PMTs installed within the SEPD and SHEPD network areas. In general, the SEPD network is characterised by a higher proportion of GMTs (80%) whereas SHEPD has a significantly higher proportion of PMTs (65%) reflecting network topology.

4.3 PMT Approach

Pole Mounted Transformers (PMT's) are not normally included in routine oil sampling and testing due them being sealed at time of manufacture and inaccessible due to their location. The Statistical Cohort approach, developed with the ENA and Environment Agency (EA), which has been adopted by us for PMTs, is based on an ISO approved methodology model which is populated by test results from all UK DNO's. The Make, Model and Year combination for each PMT manufactured before 1987 is recorded and allocated to a Cohort group as containing insulating oil that is either statistically contaminated, clean or more data required. The statistically contaminated assets are then placed in a register for assets for replacement by 31 December 2025. It is important to note that to test a PMT involves its removal form the network and intrusive intervention to gain access sot the oil to gain a test sample thus the PMT's required to be tested for the Cohort model approach will need to be replaced. The Cohort model approach provides an approved and reliable basis for scheduling our programme of contaminated transformer replacements. This approach is supported by the EA through the associated RPS 246 ("Transformers containing PCBs: new rules - RPS 246").

Table 7: Total size of the SSEN's Pole Mounted Transformer Status

PMT Data Extracted as of May 2019			As of Nov 2021	RAG			
Licence Area	Manufacture Date	No. of PMTs	In Scope	RED+	GREEN	AMBER	RED
SEPD	Unknown	3,705	3,341	3,011	-	330	-
SEPD	1901-1986	11,150	10,803	351	3,694	4,474	2,284
SEPD	1987-date	10,521	-	-	-	-	-
SEPD Sub total		25,376	14,144	3,362	3,694	4,804	2,284
SHEPD	Unknown	2,084	1,785	880	-	905	-
SHEPD	1901-1986	17,266	16,932	74	7,049	7,867	1,942
SHEPD	1987-date	27,960	-	-	-	-	-
SHEPD Sub total		47,310	18,717	954	7,049	8,772	1,942
SSEN	Unknown	5,789	5,126	3,891	-	1,235	-
SSEN	1901-1986	28,416	27,735	425	10,743	12,341	4,226
SSEN	1987-date	38,481	-	-	-	-	-
SSEN Total		**72,686**	**32,861**	**4,316**	**10,743**	**13,576**	**4,226**

As shown in Table 7, from our population of 32,861 PMTs (as of Nov 2021 and derived from the ENA Cohort Model September 2021 Version), which were either manufactured before 1987 or are of unknown age:

- 10,743 units (this figure is being continually updated once new information is received) have now been statistically confirmed as not contaminated. These have been logged as "Green/Negative" and can therefore be removed from the PCB replacement register.
- 13,576 units are still pending for decisions from the ENA Cohort Model. these have been logged as "Amber". From the ENA Cohort Model September 2021 Version, SSEN's share of PMT contribution stands as 3,166.
- 4,226 units (this figure is being continually updated once new information is received) have now been statistically confirmed as contaminated. These have been logged as 'Red/Positive' and have been included in the asset replacement programme.
- 4,316 units are still missing key information after inspection and therefore, no statistical approach can be applied. These have been logged as "Red+" and will be treated similarly to the "Red/Positive" Category.
- Work is ongoing with the Cohort testing so this figure will change each time the model is run.

4.4 GMT Approach

Our approach for Ground Mounted Transformers (GMT's) is to test our population of pre 1987 GMT's to determine the PCB concentration (if any) of the transformer oil in parts per million (ppm). For GMT's with a PCB level less than or equal to 50ppm, in line with the legislative requirement, SSEN Distribution can continue to operate those GMT's and dispose them as soon as possible after the end of their useful lives. Where a PCB test shows a sample of a GMT's oil to contain over 50 ppm of PCB then remedial work must be carried out.

Our intervention strategy for GMT's with PCB contamination over 50 ppm is to perform a "Drain and Refill" (oil change) in the first instance. (Draining off the original oil and replacing it with clean oil has been shown to reduce the residual PCB level to below 5 % of the initial value).

Should this not reduce the contamination of the oil to below 50ppm then further intervention in the form of full replacement may be necessary. A statistically significant sample of our GMT population was tested in spring 2021 in order to give an indication of the required level of intervention required to achieve legislative compliance across the fleet by the 2025 deadline.

Based on the proposed GMT approach and the asset intervention strategy across the programme for ED1 and ED2:

- the expected volume of GMT's requiring PCB testing will be 21,188, with 9,552 of these units being tested in ED2
- the expected volume of GMT's that will be subjected to drain & refill is 652, an estimated proportion is that 301 of this intervention will be in ED2
- the expected asset replacement is 455

Due to the testing programme beginning in 2021 only numbers forecast based on the statistical sample are available. As a result, the volume of replacements is proposed to be dealt with by an Uncertainty mechanism.

5 Summary of Options Considered

A single option has been developed for the replacement of PCB contaminated transformers, which is aligned with the mandatory requirement to remove such assets from distribution networks before 31 December 2025. This option is the only one available that will deliver compliance with the new European Regulation. In this Engineering Justification Paper, a 'Do nothing' option based on replacing transformers according to normal Business as Usual approaches at end-of- life has been rejected as it would not achieve compliance with new legislation. Therefore the 'Do Nothing' option has not been progressed further.

5.1 Option 1. Replacement of all PCB Contaminated PMTs and for GMTs an inspection, intervention, and replacement regime

Option 1 targets the remediation of all PCB contaminated GMTs and PMTs before 31 December 2025.

PMTs

This will require the replacement of all PMTs allocated to the RED category as determined by the Cohort model (live model approach that means the numbers will change each time the model is run) and RED+ Category. In addition, SSEN is also required to contribute 3116 PMTs from the Amber Cohort to support the ENA Cohort Model. Once it's been done, we project 50% of remaining Amber Cohort will turn Red eventually. In summary, the total forecast has identified a need to replace 16,913 (including ED1, ED2 and ED2 uncertain volume) PMTs as detailed in Table 8. 13,401 will be replaced in ED2 with 8,196 units are confirmed PMT replacement and 5,205 units are uncertain PMT replacement.

Table 8: Planned PMT Asset Replacements before end-2025

PMT		*Total Confirmed PMT Baseline*		UM	Total	Total
Activities	Licence Area	ED1	ED2	ED2	ED2	ED1+ED2+UM
Asset Replacement	SEPD	2,214	5,167	1,535	6,701	8,915
	SHEPD	1,298	3,029	3,670	6,699	7,998
	SSEN Total	**3,512**	**8,196**	**5,205**	**13,401**	**16,913**

GMTs

The population of GMTs to be tested is 21,188 units with 11,636 units in ED1 and 9,552 units in ED2. This is to ensure we have enough time to apply the appropriate asset interventions subject to testing results. Although, it is anticipated that a relatively small percentage of such transformers will have PCB contamination. By adopting a similar Cohort based model for GMTs as for PMTs (internal cohort approach following the statistically significant sample), supplemented with oil sampling from across the asset base, it is estimated that

652 units (ED1: 351, ED2:301) will require oil change (drain and refill) intervention and an estimated 455 (ED1: 113, ED2: 9, ED2 Uncertain: 333) units will require replacement as detailed in Table 9.

Table 9 Planned GMT Testing and Asset Intervention before end-2025

GMT (#)		*Total Confirmed GMT Baseline*		UM	Total	Total
Activities	Licence Area	ED1	ED2	ED2	ED2	ED1+ED2+UM
GMT PCB Testing	SEPD	7,669	9,552		9,552	17,221
	SHEPD	3,967	-		-	3,967
	SSEN Total	**11,636**	**9,552**		**9,552**	**21,188**
GMT PCB Oil Change	SEPD	306	242		242	548
	SHEPD	45	59		59	104
	SSEN Total	**351**	**301**		**301**	**652**
GMT Asset Replacement	SEPD	103	4	221	225	328
	SHEPD	10	5	112	117	127
	SSEN Total	**113**	**9**	**333**	**342**	**455**

6 Detailed Analysis

This section includes a detailed analysis of the costs associated with PCB contaminated GMT/PMT remedial work, the rationale underpinning these costs, regional variations, and timing of investments.

It should be noted that the new regulations come into effect close to the midpoint of the RIIO-ED2 period on 31st December 2025. The planned PCB replacements of PCB contaminated transformers will commence in the RIIO-ED1 period and continue through the early years of the RIIO-ED2 period, with no further replacements in the 2026, 2027 and 2028 calendar years (may be a small number due to supply chain issues). Financial years (FY) have been utilised within this cost analysis. Therefore, the PCB assets to be replaced in the 2025/26 financial year will be replaced in 9 months between April 1st, 2025 and December 31st, 2025, in order to comply with the legislation.

This EJP only considers the one option developed to achieve compliance with mandatory regulations. Consequently, a Cost Benefit Analysis has not been undertaken for this EJP.

PCBs have been identified as a combination of baseline funding and an uncertainty mechanism (UM) and as part of our ***Uncertainty Mechanisms Chapter (Chapter 17),*** we discuss Polychlorinated Biphenyls. For PMT's the cohorts that have been statistically proven to be contaminated using the ENA Cohort model are in the baseline funding as they are known to require replacement prior to end 2025. The UM provides flexibility to fund the replacement of assets containing Polychlorinated Biphenyls (PCBs), based on volume uncertainty. The UM provides flexibility to remove additional assets once better information is available on PCB volumes. For PMT's this could be undetermined Cohorts that become statistically proven to be contaminated. For GMT's this would be the GMT's whose PCB contamination is over 50ppm after the drain and refill intervention. The results of the statistically significant sample from Spring 2021 have informed the volumes in the UM for GMT's. The UM ensures the funding is based on the most accurate data, rather than a speculative large baseline with consumers over-paying. The issues around funding PCB removal have been discussed at length through Ofgem Working Groups and in the Energy Network Association (ENA).

6.1 Ground Mounted Transformers

GMT transformers that may be PCB contaminated include GMT Distribution and GMT Primary Grid assets. Our Cohort Model analysis from our statistically significant sample estimates that up to 455 GMT will need to be removed from the network, in order to comply with the legislative changes. At this stage, we have assumed from our modelling that no 66kV and above GMTs will be replaced. This figure will be applied across the

relevant years of ED2, and between SEPD and SHEPD. Table 10 shows a detail breakdown of volume for GMTs intervention and Table 11 shows a detail a detail breakdown of cost for GMT's intervention.

Table 10 Transformers to be remediated for GMT

GMT (#)		Total Confirmed PMT Baseline					ED2 Baseline	UM	Total
Activities	Licence Area	FY22	FY23	FY24	FY25	FY26	ED2	ED2	ED2
PCB Testing	SEPD	1,771	5,898	5,774	3,778	-	9,552		9,552
	SHEPD	1,203	2,764	-	-	-	-		-
	SSEN Total	**2,974**	**8,662**	**5,774**	**3,778**	**-**	**9,552**		**9,552**
PCB Oil Change	SEPD	102	204	235	8	-	242		242
	SHEPD	25	20	59	0	-	59		59
	SSEN Total	**128**	**223**	**293**	**8**	**-**	**301**		**301**
Asset Replacement	SEPD	30	73	4	-	-	4	221	225
	SHEPD	0	10	5	-	-	5	112	117
	SSEN Total	**30**	**83**	**9**	**-**	**-**	**9**	**333**	**342**

Table 11 Transformer remediation Expenditure for GMT

[redacted]

** Note: Minor discrepancies in total values attributable to model output rounding*

6.2 Pole Mounted Transformers

The September 2021 run of the ENA Cohort Model has been used to forecast the total volume of PMT replacements. Given the significant volumes of asset replacement required before the regulatory deadline, PMT replacement activities will be accelerated over consecutive years starting in the RIIO-ED1 period to minimise the delivery challenge as far as possible. This will enable the supply chain to be expanded and for internal resources to be mobilised before the start of the RIIO-ED2 period.

The asset replacement profile for the next 5-years is presented in Table 12. The reduction in the replacement volume for 2025/26 will reflects an incomplete financial year with the 31st of December 2025 deadline for PCB containing asset removal occurring after 9-months.

Table 12: PMT replacement percentage per Financial Year

Regulatory Period	RIIO-ED1		RIIO-ED2				
Year of Delivery	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
Asset Replacement Volume %	10%	20%	25%	25%	20%	---	---

The total volumes of transformers to be replaced in the early years of RIIO-ED2 period with corresponding costs over the RIIO-ED2 period is outlined in Table 13 & Table 14 below for SHEPD and SEPD. These figures are currently a forecast at this stage. The Cohort model is continuously being updated so the numbers will change.

Table 13 Transformers to be replaced for PMT

PMT		Total Confirmed PMT Baseline					ED2 Baseline	UM	Total
Activities	Licence Area	FY22	FY23	FY24	FY25	FY26	ED2	ED2	ED2
Asset Replacement	SEPD	738	1,476	1,845	1,845	1,476	5,167	1,535	6,701
	SHEPD	433	865	1,082	1,082	865	3,029	3,670	6,699
	SSEN Total	**1,171**	**2,342**	**2,927**	**2,927**	**2,342**	**8,196**	**5,205**	**13,401**

Table 14 Transformer Replacement Expenditure for PMT

[redacted]

7 Deliverability and Risk

The total number of estimated transformer replacements to be delivered amount to 16,913 (ED1: 3,512, ED2:13,401) PMTs as determined by the ENA Cohort statistical model and 455 (ED1: 113, ED2:342) GMTs. These replacement volumes present a significant challenge for us (and all electricity DNOs), particularly regarding PMTs. It will therefore be necessary to accelerate delivery through an enlarged supply chain of external contractors and manufacturers. It will also be necessary to increase internal resourcing in parallel to ensure the delivery profile presented in Table 10 & Table 13 will be achieved in advance of the regulatory deadline.

Delivery of the proposed PMT and GMT replacement volumes will present a challenge and will also require adequate system access to undertake the necessary works. These works will inevitably require de-energisation of some parts of the SEPD & SHEPD networks, which could present a major risk to the proposed programme from a quality of supply perspective. Additional challenges are also brought about by the compression of the delivery into 3 years of the RIIO-ED2 period, driven by the need to eliminate assets with 50ppm by 31st December 2025.

The proposed delivery volumes represent a 16-fold increase on current delivery rates of approximately 200 PMTs per annum. The planned delivery volumes have been based on top-down analysis, which will need to be supplemented by comprehensive bottom-up planning to reinforce and expand the supply chain in order to comply with the new legislative requirements coming into effect from 1 January 2026.

There is currently a process underway for ED1 funding for the programme. There is a risk that if the funding isn't available in ED1 the whole PCB programme will need to happen in ED2 to ensure legislative compliance. This would create the significant challenges with deliverability, supply chain and resource availability as well as the impact on the capacity for outages for other key elements of our ED2 plan.

8 Uncertainty Mechanism

We propose a UM because there will remain volume uncertainty going into ED2 as we continue to sample test our assets to determine the presence of PCBs. We propose a volume driver and with a final review on volumes. Allowance for PCB replacements will be increased annually and automatically through a volume driver, at the agreed RIIO-ED2 unit rates for individual asset classes, based on a DNO's reported volume of assets replaced. It would cover allowances for the volumes we are mandated to replace, and which have not already been funded via another source. We propose this arrangement remains in place until at least 2026 whereupon we should set out to Ofgem justification through a close out report, with independent verification, for the total volume of assets removed in accordance with meeting the legislative target. Ofgem would then have the right, but not the obligation, to adjust the total volumes of assets funded for removal via the volume driver, if evidenced that the total volumes exceed that which are required in order to comply with legal obligations. The final review we propose would only be triggered by Ofgem and would only be applicable to the volume of assets delivered and funded via the volume driver and not the unit cost of assets associated with replacement. The final review would only, if applied, be able to adjust the total volumes down from the total replacements declared by DNOs and standard materiality thresholds would apply. The scope of the volume driver should cover all asset classes which contain PCBs as identified by DNOs in submission of the close out report and independently verified. For further details see ***Strategic Investment UM (Appendix 17.1.1).***

9 Conclusion

This Engineering Justification Paper describes our investment strategy for implementation during the early years of the RIIO-ED2 period to eliminate PCB contaminated assets from our current asset base to achieve compliance with the change in PCP's legislation. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

The key investment driver is our commitment to eliminate PCBs in compliance with new Persistent Organic Pollutant Regulations which require that all EU Member States, and the UK post Brexit, to remove equipment containing PCBs (e.g. transformers, capacitors or other receptacles containing liquid stocks) containing more than 50 ppm PCBs in volumes greater than 50 ml as soon as possible but no later than 31 December 2025. This new regulation has been supported by the EA's RPS 246 which will be enforced to require PCB contaminated transformers employed within electricity distribution networks to be removed or replaced before 1 January 2026.

Ground Mounted (GMT) and Pole Mounted (PMT) transformers are the main equipment types containing PCB contaminated insulating oils in our asset base. The planned intervention strategy is based on identification and replacement of contaminated units for PMT's. These transformers are not normally included in routine oil sampling and testing, hence the selection of a statistical approach to identify cohorts of transformers with PCB contamination. The cohort model used for PMTs has been developed and agreed across all GB DNOs working in conjunction with the ENA. This model provides a reliable basis for scheduling our programme of contaminated transformer replacements. For GMT's our approach is a programme to test every GMT and then enact an oil change (drain and refill) intervention strategy followed by replacement should the oil change interventions not achieve compliance.

The total forecast based on the current run of the ENA PCB Cohort model, asset volumes and associated expenditure for PCB contaminated transformer interventions during RIIO-ED2 are summarised in Table 15.

Table 15: Summary of RIIO-ED2 Asset Replacement Volumes and Expenditure for PCB Contaminated Transformers

The delivery of this extensive programme of work represents a considerable challenge for all electricity DNOs in terms of supply chain capability and managing reliable supplies to customers. By commencing this programme of work immediately, we regard these challenges to be achievable.