Landfill Ban Assurance Study

Assessment of Scotland's Infrastructure Associated Risks for Implementation of Ban on Landfilling of Biodegradable Municipal Waste

Prepared by: SLR Consulting Limited

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ZERO WASTE SCOTLAND

Basis of Report

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Executive Summary

Introduction

This landfill ban Assurance Study was commissioned by Zero Waste Scotland (ZWS) in December 2023 on behalf of Scottish Government's Environment and Forestry Directorate. The overall aim of SLR Consulting's work is to provide an assessment of Scotland's current level of preparedness for implementation of the landfill ban (the ban) from January 2026, based on an updated understanding of EfW infrastructure capacity development (from operator dialogue) and an analysis of the infrastructure capacity gap profile in the medium term and the risks to full implementation of, and compliance with the ban, and risk mitigation options.

EfW Capacity Update

A survey of existing EfW plant owners / operators and developers of planned new EfW plants in Scotland was carried out in February 2024 using a proforma questionnaire (refer Appendix A) and follow-up communications. This questionnaire was issued to operators and developers with EfW planning consent. The findings confirmed the permitted and operational capacity of the existing eight operational EfW facilities in Scotland, along with details of the six plants currently being commissioned or under construction (refer Table 2-1 for list of EfW plants and details). The findings of this industry survey indicated that:

- There are currently eight operating EfW plants in Scotland (including two separate plants in Dundee), with a total permitted capacity of 1.25 million tpa, and a reported operating capacity of up to 1.22 million tpa.
- Six new EfW plants are currently either at commissioning or under construction, with these scheduled to become fully operational between 2024 and 2027 as follows:
    - 2024 (Q1): Earls Gate Energy Centre
    - 2025 (Q2): Oldhall ERF
    - 2025: Westfield Energy Centre
    - 2026 (Q1): Binn Farm EfW
    - 2026 (Q2): South Clyde Energy Centre
    - 2027: Drumgray Recycling and Energy Recovery Centre.
- If fully delivered, these six new EfW plants would provide an additional permitted capacity of 1.48 million tpa by the end of 2027 (and 1.38 million tonnes of operating capacity).
- The combined total capacity forecast from all 14 EfW plants in Scotland by the end of 2027 equates to 2.73 million tpa of permitted capacity (and 2.60 million tpa of operating capacity); this reduces to 2.66 million tpa of permitted capacity and 2.53 million tpa of operating capacity, once MVV's older EfW plant in Dundee is closed from around 2028.

Operators and developers responding to the survey also provided commentary on key issues including plant CHP status, POPs acceptance capability, plant shutdown contingency planning concerns, ETS readiness approach, feedstock NCV, SEPA's compliance monitoring and reporting regime, and 'orphaned' wastes, i.e. BMW streams captured by the ban but potentially unsuitable for, or harmful to EfW. Of particular concern was the current lack of options to adequately manage waste diverted during extended plant shutdowns across the likely future Scottish EfW fleet of 14 plants. A summary of the operator questionnaire responses is presented in Section 2.2.2 of this report.

Infrastructure Gap Analysis

SLR completed an analysis of the medium-term infrastructure gap profile, based on (a) updated waste projections to 2035, and (b) revised EfW capacity forecasts from the February 2024 operator survey (refer Table 3-2 for infrastructure capacities used in this modelling). Comparison was also made with the previous capacity gap modelling work that supported the Scottish Government's Independent Review

reports *('Stop, Sort, Burn, Bury?')* in May 2022 and February 2023 (which was based on 2018 baseline data).

SLR's waste arisings projections modelling used the latest available baseline waste data (2022) for LACW and CIW arisings, NRS forecasts for population growth driving future waste arisings, and three modelling scenarios of future waste arisings, i.e. 'Business as usual' (BAU), 'Modest Improvements' and 'Meeting Targets'. The key assumptions regarding future unit waste generation and recycling rates underpinning each scenario are set out in Table 3-1 of this report.

The combined footprint of LACW and CIW used in this analysis is larger than the formal definition of BMW as set out by legislation, as it includes a quantity of wastes which are not from municipal sources and therefore not subject to the landfill ban. An adjustment is made to discount EWC code 19 12 12 waste with a likely C&D origin rather than municipal origin. The tonnage of non-BMW included within the waste projections in this analysis is estimated as circa 250ktpa - 400ktpa.

SLR's 2022 baseline for the analysis identifies residual waste arisings in Scotland in the region of 2.25 - 2.3 million tonnes, i.e. similar to that projected by the previous modelling. The results of SLR's updated capacity gap assessments for Scotland are presented in Figure 3-1. This shows the three waste arisings scenario projections to 2035, overlying the forecast EfW facility capacity development profile over the same period. A more detailed breakdown of the capacity gap profile changes in 2025-208 under the BAU scenario is shown in Figure 3-3 of this report.

Under the 'BAU' and 'Modest Improvements' scenarios (considered to be the most likely outcome in the short term) these figures project a remaining infrastructure capacity deficit at the outset of the first year of the ban (2026), Under BAU projections and assuming that all Scottish BMW arisings are managed in Scotland, this deficit is forecast to be c.600kta[1] at the start of 2026 but reduce to <200ktpa during 2026 and subsequently change to a small capacity surplus from 2027 onwards, provided that all of the new EfW infrastructure currently under construction is fully delivered within the planned 2024-2027 timescale. Beyond 2028 there is the likelihood of significant EfW overcapacity (c.10-18% of total operating capacity) occurring, if all new EfW capacity is fully built and recycling performance improves from the current BAU level. The specific date of capacity gap closure in Scotland is also linked to progress with improving recycling rates and the level of RDF exports. However, even under worst case (BAU) waste arisings projections, Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented.

External Markets

SLR's review of the neighbouring external markets available to Scotland indicates that:

England:- Export of residual waste from Scotland in 2022 comprised c.29kt of household and C&I waste going to EfW[2] and c.3kt to landfill. At a national level, England is forecast to have a continued aggregate EfW infrastructure capacity deficit until around 2030. However an additional 1.75 million tpa of new merchant EfW capacity is scheduled to come online in northern England by 2026 and while much of this will already be contracted out, it is possible (subject to commercial and logistical considerations) that some capacity will be available to Scottish waste producers from 2026.

Northern Europe:- between 2019-2023, Scotland exported c.40-60ktpa of RDF to energy plants in mainland Europe, with 2022 exports reported to energy plants in Sweden (c.60%) and Denmark (c.40%). This trend of well-established, stable and continuing RDF exports to north European energy plants is also apparent from England. Subject to ongoing commercial, logistical and permitting considerations, this end-route is likely to continue into the medium term and therefore contribute towards managing any capacity deficit in Scotland from 2026. However, given the more complex logistical and permitting issues and delivery timescales associated with transfrontier shipment of waste from the UK,

[1] c.24% of total planned operating capacity
[2] Primarily comprising transport of RDF from Dumfries & Galloway Council MBT plant to private sector waste aggregator in Carlisle as feedstock to merchant EfW plants in N. England

this end-route is unlikely to be able to accommodate significant quantities of waste diverted in response to short-term requirements or immediate / emergency plant closure scenarios.

Landfill Capacity

The forecast permitted landfill capacity for active non-hazardous waste in Scotland in the pre-ban years 2024 and 2025 (refer Table 5-2 of this report) far exceeds the forecast EfW capacity deficit in these years, i.e. c.1million tonnes (2024) and c.600kt (2025). However, permitted landfill capacity is not directly representative of engineered cell capacity, and this latter figure will likely differ significantly from this forecast, particularly since many landfills in Scotland are in the process of closing down.

Key Findings and Risk Appraisal

In summary, the findings of this infrastructure capacity gap analysis forecast:

1. The likely closure of the current national EfW capacity gap by around 2027, under worst-case BAU conditions, with the specific timing subject several factors including the rate of new EfW infrastructure capacity delivery in 2025-2027, the extent of RDF export flows (to England and Europe) and progress with improving recycling rates.
2. The likelihood of a significant capacity deficit (c.600kta) at the outset of 2026, the first year of the ban, with this expected to fall substantially (to <200kta) during 2026, subject to the new EfW facilities at Binn Farm and South Clyde, opening as currently scheduled.
3. Capacity for continuation and temporary expansion of the established but limited quantity of RDF export flows to England and northern Europe, in the medium term that could potentially mitigate the period of EfW capacity deficit forecast from 2026 and beyond.
4. Likely emergence of significant EfW infrastructure overcapacity (c.10-18% of total operating capacity) beyond 2028, if all currently planned EfW capacity is fully developed, and recycling performance significantly improves from current BAU levels.

The key risks, arising from the above issues, for successful implementation of the landfill ban (and associated mitigations) are:

EfW Infrastructure Capacity Deficit 2026 Risk:- It is probable that a substantial capacity gap of c.600kta will exist at the start of 2026. Although this is expected to be short-lived and reduce to <200kta during 2026, as new EfW capacity comes online, the current level of RDF exports from Scotland will need a short-term substantial increase to meet this demand and ensure compliance with the ban. ***Recommended mitigation***: *Scottish Government engage with relevant industry bodies and commercial operators during 2024 (including SESA and RMAS), to highlight this issue and support the facilitation of timely securing of RDF export contracts in advance of late 2025.*

EfW Infrastructure Capacity Gap Closure Risk: Although the analysis forecasts closure of the EfW infrastructure capacity gap by around 2027 (under worst-case BAU conditions), there is a significant risk that delivery of merchant EfW infrastructure capacity by 2028 is either delayed or has lower capacity than currently anticipated, due to unforeseen conditions. This would result in a longer period of national capacity deficit during the early years of the ban, and increase reliance on a combination of higher RDF exports, alternative management options for the non-municipal fractions and increased recycling. However, even under worst case (BAU) waste arisings projections, Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented. Beyond 2028, there is the likelihood of significant EfW surplus capacity (c.10-18% of total operating capacity) occurring, if all new EfW capacity is fully built and recycling performance improves from the current BAU level. ***Recommended mitigation:-*** *Scottish Government closely monitor the progress of the development of the EfW projects that are scheduled for delivery in 2024-2027 for material changes in timing and/or scale, so that appropriate mitigation actions can be considered.*

EfW Plant Outage Management Risk:- Poor co-ordination of plant outages across Scotland's network of EfW facilities may drive leakage of Scottish BMW to landfills in England, albeit on a temporary basis.

Although EfW operators can be expected to fully comply with the terms of their existing contracts with respect to landfill ban-compliant contingency obligations, significant scope for BMW leakage exists from early contracts, 3rd party contracts, and during extended unplanned or emergency closures. ***Recommended mitigation:-*** *Scottish Government engages with the Scottish EfW industry and plant operators to support the development of suitable industry-wide measures and agreements (including reciprocal arrangements between EfW plants) that could be put in place over time to mitigate this risk.*

Although not considered critical to successful implementation of the landfill ban, a number of other significant risks and issues were identified for consideration:

- **Engineered Landfill Capacity:-** although forecast permitted landfill capacity for active non-hazardous waste in Scotland in years 2024 and 2025 far exceeds the forecast EfW capacity deficit in these years, this is not directly representative of available engineered cell capacity. *It is recommended that Scottish Government separately confirm the adequacy of available engineered cell capacity, as a matter of urgency, since many landfills in Scotland are now in the process of closing.*
- **Orphaned Wastes:-** Operators identified the lack of specific provision for 'Orphaned Wastes' i.e. those BMW wastes which cannot be landfilled but do not combust well or are unsuitable for EfW. While this is not considered to be a significant risk (in terms of waste quantity), it is nevertheless an issue that requires more detailed consideration in order to identify an agreed approach for these waste materials. *It is recommended that this issue is included in the future engagement process with industry bodies and operators regarding SEPA's published guidance for monitoring and reporting compliance with the ban requirements; this should include developing a process to identify potentially problematic materials and wastes streams for consideration and analysis / testing.*
- **ETS / CCUS Regime:-** Operators are beginning to develop their approach to the application of the UK ETS scheme to the EfW sector from 2028, with some considering access to the Acorn CCS infrastructure to decarbonise their operations, and others more likely to rely on increasing gate fees to fund the additional costs associated with the carbon levy on stack emissions. This issue is not considered to be an immediate risk for successful implementation of the ban. However since a key impact of this measure will be to substantially increase EfW gate fees to waste producers (by c.£50+/tonne), it may have the effect of driving waste management towards increased use of the lower cost landfill route (including use of English landfills for Scottish non-municipal waste fractions) unless restrictions on landfilling of BMW apply in England by 2028, and/or landfill tax increases sufficiently to balance the two options. *It is recommended that Scottish Government take account of this in their planning of future changes to the Scottish Landfill Tax rate, as well as monitoring of future LFT rates in England.*
- **Extension of ban to all biodegradable wastes:-** the findings of this study should be used to inform Scottish Government decision making regarding any future extension of the current ban to include biodegradable wastes of non-municipal origin.

Conclusion

Scotland's current infrastructure capacity gap is forecast to close by around 2027, as new EfW plants currently under construction, and scheduled for completion become operational during the period to 2027, with an EfW capacity surplus possible from 2028 onwards.

However an EfW infrastructure capacity deficit is forecast for the start of the first year of the ban (2026); filling this deficit will require a substantial increase in the current tonnage of RDF exported from Scotland via well-established RDF export routes to England, Sweden and Denmark, with increased export contracts for BMW waste from commercial sources required by late 2025. Scottish Government engagement with industry and commercial operators is recommended in 2024 in order to facilitate securing of the required new RDF export contracts to commence in 2025.

Although Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented, unexpected delay or reduction in the delivery of planned new EfW capacity would extend the period of the national capacity deficit and require increased reliance on a combination of higher RDF exports, alternative management options for the non-municipal fractions and (over time) higher recycling rates.

Therefore, close monitoring of the new EfW infrastructure delivery progress by Scottish Government is recommended over the next 4 years as essential to tracking and responding to the development of Scotland's EfW capacity. Other interventions by Scottish Government are also recommended in the short term (in partnership with industry) with respect to the coordination of EfW plant outage management, confirmation of adequate engineered landfill capacity in 2025, and consideration of options for management of orphaned wastes. In the longer term SG should monitor the impacts of ETS implementation on increases in EfW gate fee (post 2028) and consider appropriate rates of Scottish Landfill Tax, once EfW gates fees increase significantly in response to ETS implementation.

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Acronyms and Abbreviations (Glossary)

ATT	Advanced Thermal Treatment
BAU	Business as Usual
BMW	Biodegradable Municipal Waste
BW	Bulky Waste
CCS / CCUS	Carbon Capture, Utilisation and Storage
CIW	Commercial and Industrial Waste
CDW	Construction and Demolition Waste
CHP	Combined Heat and Power
DHN	District Heat Network
EfW	Energy from Waste
ERF	Energy Recovery Facility
ETS	Energy Trading Scheme
EWC	European Waste Catalogue
GRREC	Glasgow Recycling and Renewable Energy Centre
kt	Kilo-tonnes
ktpa	Kilo-tonnes per annum
LACW	Local Authority Collected Waste
LF	Landfill
MBT	Mechanical and Biological treatment
MJ/kg	Mega-joules per kilogramme
Mt	Million tonnes
MT	Mechanical Treatment
NCV	Net Calorific Value
NR	Not Reported
NRS	National Records of Scotland
POPs	Persistent Organic Pollutants
RDF	Refuse Derived Fuel
RERC	Recycling and Energy Recovery Centre
RMAS	Resource Management Association Scotland
SEPA	Scottish Environment Protection Agency
SESA	Scottish Environmental Services Association
SRF	Solid Recovered Fuel
SSBB	Stop, Sort, Burn, Bury (SG Independent Review Report)
tpa	Tonnes per annum
TFS	Trans-Frontier Shipment

1 Introduction

1.1 Project Background

The Scottish Government (SG) ban on landfilling of biodegradable municipal waste (the 'ban') is scheduled to take effect from 01 January 2026. As part of its planning and preparation for implementation of the ban, the SG Environment and Forestry Directorate commissioned this study to provide an assessment of Scotland's level of preparedness for implementation of the ban.

The overall aim of the work is to provide an updated understanding of the key infrastructure capacity, based on operator dialogue, and an analysis of these findings and the wider risks related to full implementation of, and compliance with the ban, including potential risk mitigation options.

This landfill ban Assurance Study was commissioned by Zero Waste Scotland (ZWS) in December 2023 on behalf of SG's Environment and Forestry Directorate, under the current call-off contract between ZWS and SLR Consulting Limited (SLR) for the provision of specialist consultancy support for residual waste management to meet the requirements of the ban.

1.2 Scope of Work

The scope of work for this study comprises an assessment of the following:

1 The timelines and risks around the delivery of residual waste treatment capacity to manage Scotland's residual waste – via mechanical treatment (MT), Mechanical and Biological Treatment (MBT) and Energy from Waste (EfW) infrastructure.

2 The feasibility of managing any short-term capacity gap in Scotland through (i) export of refuse derived fuel (RDF) to neighbouring markets in England or mainland Europe and (ii) opportunities for existing infrastructure to close the capacity gap.

3 The likely availability of engineered landfill capacity to the end of 2025 to manage wastes falling under the ban, as well as wastes out of scope, e.g. non-municipal commercial and industrial waste (CIW), asbestos, industrial sludges, ash, contaminated soils and construction and demolition waste (CDW) residues; *NOTE: as agreed with ZWS and SG, this task was limited in scope to an update of SEPA 2022 data regarding permitted LF capacity in Scotland.*

4 The options and associated risks of managing waste during planned and unplanned outage of EfW plants; and

5 Other risks to implementation and compliance with the ban; potentially these include (i) the requirement to incinerate soft furnishings containing Persistent Organic Pollutants (POPs), (ii) waste infrastructure capacity data reliability, and (iii) the likely requirements of SEPA guidance on the duties of waste producers and facility operators regarding the ban compliance monitoring and reporting regime.

1.3 Report Structure

This report is structured as follows:

- **Executive Summary:**- presents a concise outline of the study methodology and key findings.
- **Section 1 Project Background:**- sets out study background, key objectives and agreed scope of work.
- **Section 2 Infrastructure Capacity Update:**- informed by dialogue with waste facility operators and developers regarding current position and future plans.

- **Section 3 Capacity Gap Analysis:**- revision of supply - demand projections to 2030 and comparison with forecasts from previous SG Independent Review, 2022.
- **Section 4 External Markets Review**:- presents update of the current position in England and key markets in northern mainland Europe, regarding capacity to accept RDF exports from Scotland.
- **Section 5 Landfill Capacity Assessment:**- presents summary of SEPA 2022 permitted LF capacity data and position of key LF capacity providers in Scotland, regarding wastes targetted by the ban and other wastes.
- **Section 6 Landfill Ban Implementation Risk Assessment:**- review of risks to full implementation of ban and consideration of potential mitigation options.
- **Section 7 Key Findings:**- reporting on summary of key findings, with conclusions and recommendations.

Supporting data for the study is provided in the Appendices:

- **Appendix A:** Proforma Questionnaire for EfW Plant Operators / Developers
- **Appendix B:** Map of EfW Plants, Scotland 2024 (Operational and Under Construction)

2 Infrastructure Capacity Update

2.1 Methodology

In order to inform the infrastructure side of the capacity gap analysis (refer Section 3) and provide an updated assessment of current and future EfW capacity, SLR carried out a survey of existing EfW plant owners / operators in Scotland, and of the developers of planned new EfW plants, i.e. those with planning consent. This survey was carried out during January and February 2024, by issuing a proforma questionnaire to each organisation in the first instance, and a follow-up telephone conversation to confirm relevant or additional details.

A copy of the proforma questionnaire is provided in Appendix A. This was issued to each of the EfW operators and developers listed in Table 2-1. Completed questionnaires were received from all operators except Levenseat. Avondale Environmental were also contacted and confirmed that they have no plans to progress their EfW project at this current time.

2.2 Findings

Relevant details of operational EfW plants in Scotland, and those being developed, are shown in Table 2-1.

Table 2-1: Consented EfW Facility List and Permitted / Operational Capacity

EfW Facility Name	Location	Operator / Developer	Capacity ktpa Permitted / (operational)[1]	Status
1 Lerwick ERF	Shetland	SIC	25 (22.7)	Operational
2a Baldovie[5]	Dundee	MVV	70 (NR)	Operational
2b Dundee EfW	Dundee	MVV	150 (NR)	Operational
3 Millerhill RERC	Midlothian	FCC	156 (160)	Operational
4 Dunbar ERF	East Lothian	Viridor	390 (350-375)	Operational
5 GRREC, Polmadie	Glasgow	Viridor	200 (190)	Operational
6 Levenseat	S. Lanarkshire	LREL	105 (NR)	Operational
7 Ness Recycling and Energy[3]	Aberdeen	Acciona/Indaver	150 (150)	Operational
8 Earls Gate Energy Centre	Grangemouth	Brockwell	274 (216)	Commissioning
9 Westfield Energy Centre	Fife	Brockwell	250 (240)	Advanced Construction
10 Oldhall ERF	N. Ayrshire	Doveryard[4]	185.6 (185.6)	Advanced Construction
11 Drumgray RERC	N. Lanarkshire	FCC	300 (300)	Early Construction
12 South Clyde Energy Centre	Glasgow	Fortum	385.4 (350)	Early Construction
13 Binn Farm EfW	Perth & Kinross	Paprec Energies Binn Ltd.	84.9 (84.9)	Early Construction
14 Thainstone ERF	Inverurie	Agile Energy[2]	240 (220)	Pre-Construction

Notes:

1. *Permitted and Operating capacities reported by operators.*
2. *Agile Energy's proposed Thainstone ERF project has not yet achieved financial close..*
3. *Contacted via Aberdeen Council*

4. *Contacted via MRE UK Ltd.*
5. *MVV plan to close the Baldovie plant in 2028 (although they hold planning consent to operate it to January 2031)*
6. *Table 2-1 excludes* MBT / MT plants; refer Table 3-2 for inclusion of these.

A map showing the location of the operational EfW plants and those currently under construction (i.e. facilities 1-13 in Table 2-1) is presented in Appendix B.

2.2.1 Plant Capacities

A high-level summary of the key findings from these responses with respect to current and planned EfW capacity, and delivery schedules for new capacity follows:

- As noted in Table 2-1, there are currently eight operating EfW plants in Scotland (including the two separate MVV plants in Dundee). These have a total permitted capacity of 1.25 million tonnes per annum; the actual operating capacity reported by operators is up to 1.22million[3] tpa.
- Six additional EfW plants are currently either under construction in Scotland, or at commissioning stage, with these scheduled to become fully operational between 2024 and 2027; the delivery timeline for these is as shown below:
    - 2024 (Q1): Earls Gate Energy Centre
    - 2025 (Q2): Oldhall ERF
    - 2025: Westfield Energy Centre
    - 2026 (Q1): Binn Farm EfW
    - 2026 (Q2): South Clyde Energy Centre
    - 2027: Drumgray Recycling and Energy Recovery Centre.
- Assuming all six new EfW plants are constructed as reported, they would deliver a total of 1.48 million tpa of permitted capacity by the end of 2027 (and 1.38 million tonnes of operating capacity).
- Hence the total EfW capacity scheduled for delivery by the end of 2027 across all 14 EfW plants in Scotland equates to 2.73 million tpa of permitted capacity (and 2.60 million tpa of operating capacity).
- However the scheduled closure of MVV's older EfW plant in Dundee (reported for 2028) would reduce this permitted capacity to 2.66 million tpa (and the operating capacity to 2.53 million tpa).
- The above capacities include feedstock pretreatment – currently carried out at Baldovie, Dundee and Polmadie, and planned for the new plants at Binn Farm and Drumgray.
- Most plants will accept feedstock with NCV in range 8-12MJ/kg which gives flexibility in the actual volume of feedstock processed. Plant capacities quoted are typically based on a feedstock NCV of c.10MJ/kg.
- Only c.140 ktpa of capacity at operational EfW plants is not under long-term contract and available to third party customers. This excludes any new capacity that may be available within plants in early development.

2.2.2 Other Findings

Other significant findings from the survey questionnaire responses are noted below:

[3] Based on upper end of reported EfW plant operating capacity.

EfW Technology:- all plants are based on grate-based combustion, with the exception of Baldovie (fluidised bed), GRREC (gasification) and Levenseat (gasification).

CHP:- Three facilities currently export process heat (Shetland, Dundee, Ness); Millerhill is also close to exporting heat to a local DHN; all other plants are engineered to export process heat, if a viable heat sink is developed and available.

POPs capability:- of the existing EfW plants, the Shetland and Ness plants currently accept POPs materials for destruction, and it is understood that MVV accept POPs from Dundee and Angus Councils at their new plant. Acceptance of POPs materials is under consideration at Millerhill and Dunbar. Currently there are no plans to accept POPs at GRREC. Levenseat did not provide a response to this.). For the new EfW facilities (with the exception of Oldhall) the developers of all of the new plants confirmed that they either will accept, or are considering accepting, POPs materials for destruction at their new EfW facilities, once operational.

Plant Shutdown / Contingency:- Most plants have an annual shutdown (typically for less than 2 weeks) during which waste is stored on site, with CHP plant operators preferring to schedule this for the summer months[4]. Every 5-7 years[5], a longer process shutdown is required (of c.30 days); this requires incoming waste to be diverted to another end-route for this period. Residual waste under local authority contract typically requires the Operator to provide a contingency arrangement to manage this during all planned and unplanned plant shutdowns (by diversion of waste to other landfill ban-compliant EfW or RDF export routes). Other 3rd party commercial or 'spot' waste inputs may not have this contractual obligation and may be refused access during periods of plant shutdown.

Operators expressed significant concern over this issue; and considered that some industry planning or national contingency plan for shutdown management was required by government. Ideas offered included:

- A mobile shredder/baler capability that can be moved around the country as outages occur. Identify waste transfer stations and redundant landfills under care/ maintenance as potential sites for this service.
- SG should consider landfill as an alternative to EfW when the abnormal does occur, e.g. giving each EfW an annual allowance for diversion to landfill of 10% of permitted capacity.
- Some sort of short-term derogation should be considered, and/or exemption process be established at least for a defined transition period.

ETS Readiness:- operators have no definitive plans yet regarding how they will respond to the planned application of the ETS regime to include the UK EfW sector by 2028. Some operators located in central and NE Scotland (including Ness, Earls Gate, Westfield) are considering options to install CCUS and connect into the Acorn CCS 'Scottish cluster' network, to transport captured CO_2 to permanent storage beneath the North Sea and decarbonise their operations. Some operators commented that government should seek to ensure that ETS implementation to EfW does not lead to increased competition from landfill operations in England at the expense of Scottish EfW.

Orphaned Wastes:- some operators noted that there is no provision for 'orphaned wastes', i.e. wastes that cannot be landfilled but which may not combust well or are unsuitable or harmful for EfW (e.g. certain trommel fines, treatment residues, grit, rope etc).

Waste NCV Trends:- operators reported current NCV as around 10 MJ/kg, which leaves some flexibility (up and down) to manage future NCV variations resulting from composition changes from new waste measures.

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[4] To minimise impact on local / district heat end users

[5] Viridor stated their routine plant shutdown frequency is every 18-24 months (for Polmadie and Dunbar).

SEPA Compliance Monitoring and Reporting Regime:- Some operators expressed doubt over the level of staff resources available to SEPA to police this adequately, and considered there is a risk of materials going to landfill that shouldn't. They also noted that there is currently insufficient information available for operators of landfill on how this is going to be implemented and operated.

3 Infrastructure Capacity Gap Analysis

3.1 Introduction

The 'capacity gap' refers to the shortfall in Scotland's residual waste treatment infrastructure capacity compared with the overall arisings of residual waste. This section summarises the capacity gap modelling results and assumptions that underpin the SG Independent Incineration Review Reports, and reports the results of SLR's updated capacity gap modelling for Scotland, using the latest published baseline data. The scope of this analysis relates to medium term forecasts, up to and including 2035.

The Independent Review of the Role of Incineration in the Waste Hierarchy in Scotland published their '*Stop, Sort, Burn, Bury?*' (SSBB) report in May 2022, followed by a second report in February 2023 that focused on EfW sector decarbonisation options in more detail. Chapter 3 of the original SSBB report examines the capacity to manage residual waste in Scotland, and this analysis was underpinned by modelling undertaken by Ricardo-AEA Ltd in their report 'Incineration Review – Capacity Analysis' published in April 2022 (Ricardo Report).

SLR reviewed the Ricardo Report to identify the key assumptions underpinning the modelling outcomes. This section summarises the assumptions and results from Ricardo's capacity gap analysis and contextualises these with SLR's revised modelling results. Comment is also made on SEPA's capacity gap estimations, which are referenced in section 3.4.4 of the original SSBB report.

3.2 General Approach

The Ricardo Report was undertaken between December 2021 and March 2022, and used 2018 baseline data on waste arisings, composition and destination. SLR's current modelling has used 2022 baseline waste data for the main analysis; however RDF exports are based on the latest available 2021 data.

The Ricardo modelling takes the 2018 baseline data and applies a series of assumptions around future waste growth, and performance against recycling and landfill diversion targets. This calculates the overall quantum of residual waste arisings available for treatment at EfW facilities in Scotland. The report includes arisings forecasts for a Business as Usual (BAU), Meeting Targets (MT), and Best Efforts (BE) scenario, which assume different levels of waste reduction and recycling performance. This is a broadly similar methodology to SLR's modelling, albeit with some differences in the underlying assumptions made, which are discussed below.

In both the Ricardo and SLR modelling the annual tonnage of residual waste disposed of by Scottish treatment facilities has been calculated to derive the capacity gap. Different types of facility are taken into consideration with adjustments made for Mechanical Biological Treatment (MBT) facilities and or EfW/Advanced Thermal Treatment (ATT) facilities with pre-processing at the front-end.

Whilst Ricardo's model applies different operational lifespans of MBT, EfW and ATT facilities this has only a minor impact in the medium term (i.e. up to 2035) with the modelled closure of several MBT facilities constructed around the year 2000. The forecasted future capacity is made up of a combination of operational and pipeline facilities, noting the different stages of development for each pipeline facility. Ricardo included 'pre-construction' facilities with various degrees of planning consent, whereas SLR's modelling analysis only includes operational facilities and those developments reported to have achieved financial close and are currently under construction.

3.3 Key Assumptions Underpinning SLR Projections

SLR's waste arisings projections modelling is based on:

- 2022 Baseline data for LACW and CIW[6];
- NRS forecasts for growth in population driving future waste arisings;
- 'Untaxed waste' estimate (c.40ktpa)[7]; and
- Three SLR modelling scenarios, i.e. 'BAU', 'Modest Improvements' and 'Meeting Targets' – with the key assumptions for each, regarding future unit waste generation and recycling rates, summarised below:

Table 3-1: Key SLR Modelling Assumptions

Assumption	Year	Hitting targets	Modest improvements	BAU
Change in LACW generation per person, relative to 2022 baseline	2025	-17.5%	0%	0%
	2030	-17.5%	-1%	0%
Proportion of LACW recycled	2025	50%	45%	43.3%
	2030	60%	47.5%	43.3%
	2035	65%	50%	43.3%
Assumed change in CIW generation per capita, relative to 2022 baseline	2025	-17.5%	0%	0%
	2030	-17.5%	-1%	0%
Recycling rate of municipal-like CIW	2035	70%	60%	55%

The 'Hitting targets' column in Table 3-1 is based on meeting Scotland's 2025 food waste reduction target (applicable to both LACW and CIW). The CIW recycling rate is based on meeting Scotland's 'all waste' recycling target, assuming a current CIW rate of 55%. Given the improbability of achieving 70% LACW recycling by 2025, and in the absence of a specific LACW target for Scotland, LACW recycling performance have been aligned to the Waste Framework Directive municipal waste targets, i.e. 55% (2025)[8], 60% (2030), and 65% (2035).

3.3.1 Legal Definition of Biodegradable Municipal Waste (BMW)

The legal definition of Biodegradable Municipal Waste (BMW) to which the landfill ban refers is based on the following:

- Biodegradable Municipal Waste is defined in Regulation 11(3) of the Landfill (Scotland) Regulations 2003 (as amended) ("the Regulations) as "municipal waste that is also biodegradable".
- Biodegradable waste is defined (in Regulation 2 (1) of the Regulations) as "any waste capable of undergoing anaerobic or aerobic decomposition such as food, garden waste, paper and cardboard".

[6] This exceeds the formal definition of biodegradable Municipal Waste targeted by the Bioban
[7] There is a c.80ktpa discrepancy between residual waste recorded on permitted landfill site returns and full rate landfill tax receipts – it is assumed that half of this waste will be diverted to the EfW market following the ban.
[8] 50% has been used as the 2025 target since the current recycling rate is much less than this.

- Municipal waste is defined (in Regulation 2(1) of the Regulations) as "waste from households as well as other waste which because of its nature or composition is similar to waste from households".

Therefore BMW includes biodegradable household waste together with biodegradable waste which is similar to household waste such as, for example, waste from the retail and hospitality sectors.

SEPA Guidance Note WST-G-55 (April 2018) also provides a list of the specific EWC waste codes that fall within the scope of BMW landfill ban. These all fall within waste stream codes 15, 19 and 20, i.e.:

- **EWC Code 15:** Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified;
- **EWC Code 19:** Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use; and
- **EWC Code 20:** Municipal wastes (Household waste and similar commercial, industrial and institutional wastes) including separately collected fractions.

The main quantum of BMW arisings fall within the following EWC codes:

- Mixed municipal ('black bag') waste (20.03.01) and bulky waste (20.03.07);
- Sorting residues (mixed materials) from mechanical treatment of wastes (19.12.12)[9];
- Mixed packaging (15.01.06)
- Combustible waste – RDF (19.12.07)

Other target waste streams within the BMW ban include separately collected food/kitchen waste, wood, garden waste, market waste, and process residues from composting.

BMW does not include construction and demolition wastes (CDW) or other wastes which are not similar to household wastes; such wastes may be landfilled directly.

3.3.2 Waste Footprint used in Analysis

As noted above, SLR has used a combined footprint of LACW and CIW in the Capacity Gap analysis in this study. This waste footprint is larger than the formal definition of BMW as set out by legislation (refer 3.3.1), as it includes a quantity of wastes which are not from municipal sources and therefore not subject to the landfill ban. . However an adjustment is made to discount 19 12 12 waste with a likely C&D origin rather than municipal origin[10].

It is considered that this combined footprint is the most appropriate waste footprint to use in this analysis, for the following reasons:

- continuity with previous analyses;
- conservative approach to residual waste tonnage supply forecasting;
- waste streams included in this footprint that are outside the legal definition of BMW will be generated by and managed by the private sector (including collection, transport and treatment / disposal), with the decision on end-route driven largely by commercial considerations[11]; a

[9] Only a proportion of this waste stream is considered to be biodegradable.Refer 3.5 for SEPA % estimates.
[10] Based on Defra's 'Commercial and Industrial Waste Arisings Methodology Revisions for England'. Refer https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/778779/CommercialandIndustrial_WasteArisings_Methodology_Revisions_Feb_2018_Oct_2018_rev2_update.pdf

[11] Operators with access to both Landfill and EfW will select the end-route based on internal commercial and facility planning considerations.

significant proportion of this is likely to be sent to EfW for processing, with this proportion likely to increase over time as available landfill capacity reduces.

- SG has indicated that it intends to extend the Bioban to cover all biodegradable CIW fractions in due course, although a timetable for this has not been published.

It is estimated that the tonnage of non-BMW included within the total waste projections in this analysis is likely to be between c.250ktpa (assuming 60% of 19 12 12 is of municipal origin) and c.400ktpa (assuming 40% of 19 12 12 is of municipal origin).

3.4 Results Comparison

The modelling outputs present a time series of supply vs. demand. Essentially these forecast future levels of residual arisings against the feedstock demand profile from treatment facilities. Ricardo's report presents these results across four different supply vs. demand diagrams, however only one is used in the SSBB report (Figure 3-2): the '*Capacity Analysis results (all scenarios and full pipeline) excluding C&D waste*', which is therefore considered the primary forecast.

- **Baseline Waste Arisings in 2022**: Both the Ricardo 'BAU' projection and SLR baseline identify 2022 residual waste arisings in Scotland arisings in the region of 2.25-2.3Mt. Ricardo's chart has different 2022 arisings figures for the Best Efforts and Meeting Targets scenarios because the model is based on 2018 data, with four years of growth/recycling assumptions applied in-between which vary by scenario. The results suggest that, of Ricardo's three projections, BAU has been the closest reflection of progress since publication.
- **Lower Boundary of Waste Forecasts**: In both models, achieving the lower boundary of forecasted waste arisings would require a substantial and swift reduction in waste arisings and increase in recycling performance across municipal and C&I sectors in Scotland, particularly to meet the 2025 targets. Therefore from an infrastructure risk perspective, this lower level forecast of residual waste arisings is considered to be low likelihood.
- **Upper Boundary of Waste Forecasts (BAU)**: The Ricardo BAU models a gradual decline in residual arisings from 2022 onwards, driven by the waste generation and recycling assumptions.
    - **Underlying waste growth**: Ricardo's total waste arisings forecast for household and C&I waste combined predicts a 1.89Mt (37%) net reduction between 2018 and 2050, driven by an extrapolation of the year-on-year downward trend in C&I generation observed between 2011 and 2018 in SEPA's 'waste from all sources' publication; these underlying growth assumptions are applied equally to the BAU, BE and MT scenario. SLR's BAU forecast is based on continuation of 2022 per capita generation rates for household and C&I waste.
    - **Recycling diversion**: In addition to the underlying downward waste growth described above, Ricardo's BAU assumes an annual increase of 0.3% in the household recycling rate and 0.2% in the C&I recycling rate. SLR has assumed no change to future household/C&I recycling rates in the BAU.
    - **Combined impact on upper boundary waste forecasts:** Ricardo's forecast (excluding C&D waste) predicts residual waste arisings of 1.74Mt by 2035 (a 0.5Mt reduction), whilst the SLR model predicts arisings of 2.33Mt by 2035 (a 0.03Mt increase). From an infrastructure risk perspective, the SLR BAU projection is considered more conservative in minimising the potential to underestimate future residual waste arisings.
- **Demand Profile from Operational Treatment Facilities**: Both the Ricardo and SLR demand profiles project c.1Mt of capacity from currently operational facilities up to 2035. The only differences are an additional c.75ktpa increase in 2023 in the SLR model from the opening of the new Dundee facility, as well as a small reduction of c.40kt from Shanks PFI legacy MBT capacity coming offline in Ricardo's model. There is also a slight timing difference in switching

off 70kt of capacity at the ageing Baldovie DERL (indicated in SLR's chart as the fall in total infrastructure capacity from around 2030).

- **Demand Profile from Facilities Under Construction**: The SLR model has approximately 1Mt of capacity categorised as under construction, which is c.0.45Mt more than Ricardo's model, due to construction having commenced at facilities since the publication of Ricardo's report, including at Oldhall ERF and the South Clyde Energy Centre. SLR's facility capacity list was updated and agreed in collaboration with operators, developers, SEPA and Zero Waste Scotland in February 2024 and is therefore considered the most current profile for the infrastructure risk assessment.
- **Demand Profile from 'Pre-Construction' Facilities**: The Ricardo demand assessment includes pipeline facilities listed under the status of 'proposed', 'planning granted' or 'fully consented', several of which have now entered the construction phase. Whilst SLR's model also notes similar 'pipeline' facilities, these are not presented in this capacity gap analysis, since they are considered as low likelihood to progress to construction and operation (refer Table 3-2).

The processing facilities included in SLR's modelling analysis are tabulated below. The modelled capacity is based on (a) current feedback from the EfW sector regarding plant operational capacity, and (b) market intelligence and process understanding regarding efficiency of currently operating MBT / MT facilities.

Table 3-2: Residual waste processing facilities (EfW, MBT, MT) included in SLR Modelling

EfW Plant	Location	Status	Nominal capacity	Comment	Modelled capacity
1 Lerwick ERF	Shetland	Operational	26,000		26,000
2 MVV Baldovie & Dundee	Dundee	Operational	220,000	Modelled as 100+150 kt. Reduces to 150kt from 2030.	220,000
3 FCC Millerhill RERC	Edinburgh	Operational	160,000	Excludes closed 158kt MT	160,000
4 Viridor Dunbar ERF	E. Lothian	Operational	375,000	Excludes proposed 65kt extension ('low' likelihood)	375,000
5 Viridor GRECC, Polmadie	Glasgow	Operational	130,000	Excludes MT	130,000
6 Levenseat ERF	S. Lanarkshire	Operational	100,000	Excludes proposed 268kt extension ('low' likelihood)	100,000
7 Ness Recycling and Energy	Aberdeen	Operational	150,000		150,000
8 Earls Gate Energy Centre	Grangemouth	Commissioning - due Feb 2024	216,000	In construction - due 2024	216,000
9 Westfield Energy Centre	Fife	Advanced Construction - due March 2025	240,000	In construction - due 2025	240,000
10 Oldhall ERF	N. Ayrshire	Advanced Construction - due Oct 2025	185,000	In construction - due 2025	185,000
11 FCC Drumgray RERC	N. Lanarkshire	Early Construction – due July 2027	300,000	In construction - due 2027	300,000
12 South Clyde Energy Centre	Glasgow	Early Construction - due May 2026	350,000	In construction - due 2026.	350,000

EfW Plant	Location	Status	Nominal capacity	Comment	Modelled capacity
13 Paprec Binn Farm EfW	Perth	Early Construction - due March 2026	85,000	In construction - due 2026	85,000
14 Agile Energy, Thainstone	Aberdeenshire	Construction not started	240,000	Planning consent(no financial close)	0
Polmadie MBT	Glasgow	Operational	190,000		45,600
Levenseat MT	S. Lanarkshire	Operational	200,000		8,000
Millerhill MT	Edinburgh	Operational	158,000	MT currently mothballed and likely to be removed in time.	0
Bargeddie MT – Original	N. Lanarkshire	Operational	75,000		3,000
Bargeddie MT - Clyde Valley	N. Lanarkshire	Operational	190,000		7,600
Locharmoss MBT	Dumfries	Operational	41,000		9,840

Notes:

1. *Agile Energy's proposed Thainstone EfW is excluded from the analysis since it has not yet concluded financial close.*
2. *The table excludes the existing three Renewi MBT plants in Argyll & Bute (combined total throughput c.15kta); these are reported to be scheduled to close by 2026.*
3. *Assumes diversion efficiency for MBT 24% and MT 4%.*

Regarding future EfW capacity, our analysis assumes that all new EfW plants currently at construction will be developed on the basis of the full operational capacity and development timings noted in Table 3-2. This is a key assumption, but one that can change due to changing market circumstances. For example, it was reported in February 2024 that Fortum is seeking to sell its share of the South Clyde Energy Centre (jointly owned with Macquarie) and exit the UK EfW market, which creates uncertainty around this project (although construction has commenced onsite).

The results of SLR's updated capacity gap assessments for Scotland and Ricardo's previous assessment are presented below in Figure 3-1 and Figure 3-2 respectively. SLR's diagram presents the waste arisings scenarios as the three blue lines, whilst facility capacity is indicated by the stacked red (operational) and orange (in construction) areas.

The forecasted capacity gap can also be visualised as a bar chart, which is presented in Figure 3-3 for SLR's BAU scenario. In this diagram positive values indicate a shortfall in capacity (i.e. a gap), and negative values indicate a capacity surplus.

Figure 3-1: SLR Supply-Demand Forecast

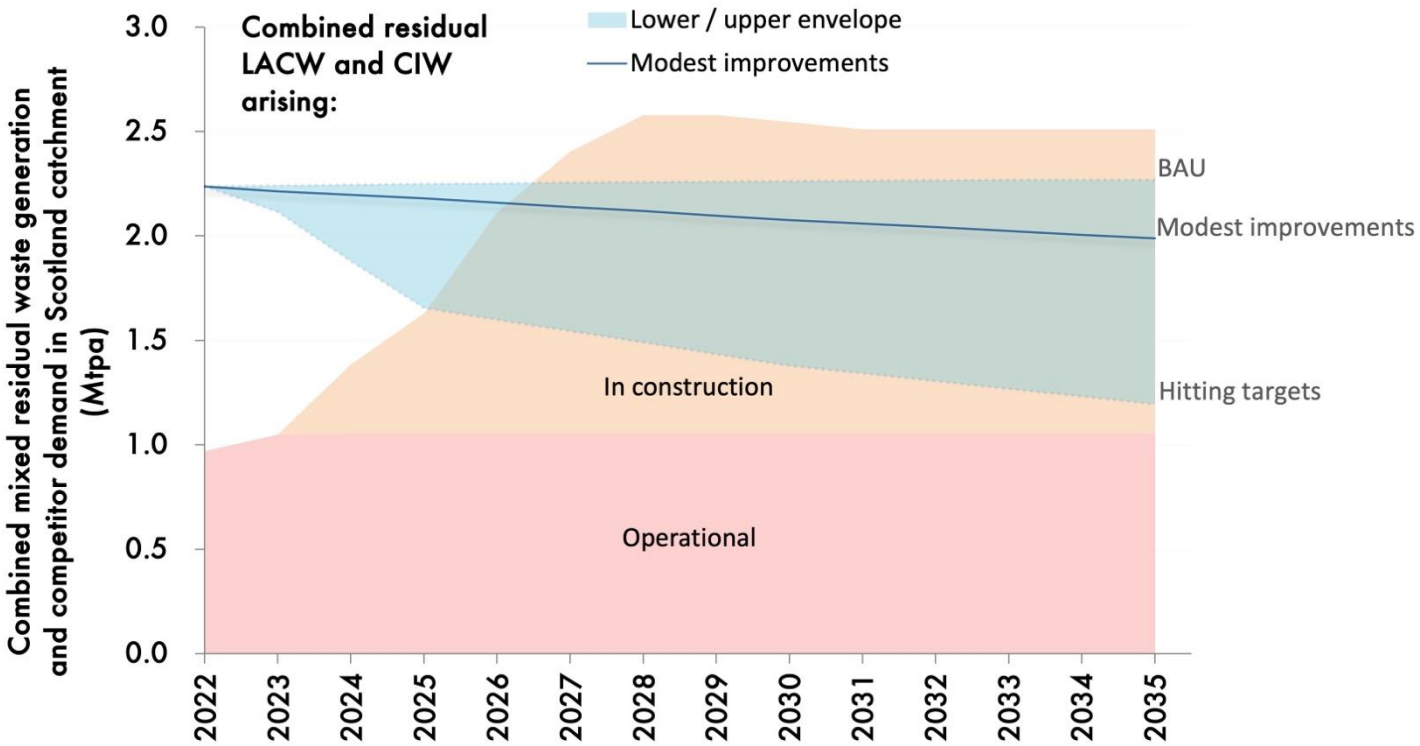


Figure 3-2: Ricardo Supply-Demand Forecast (full pipeline excl. C&D)

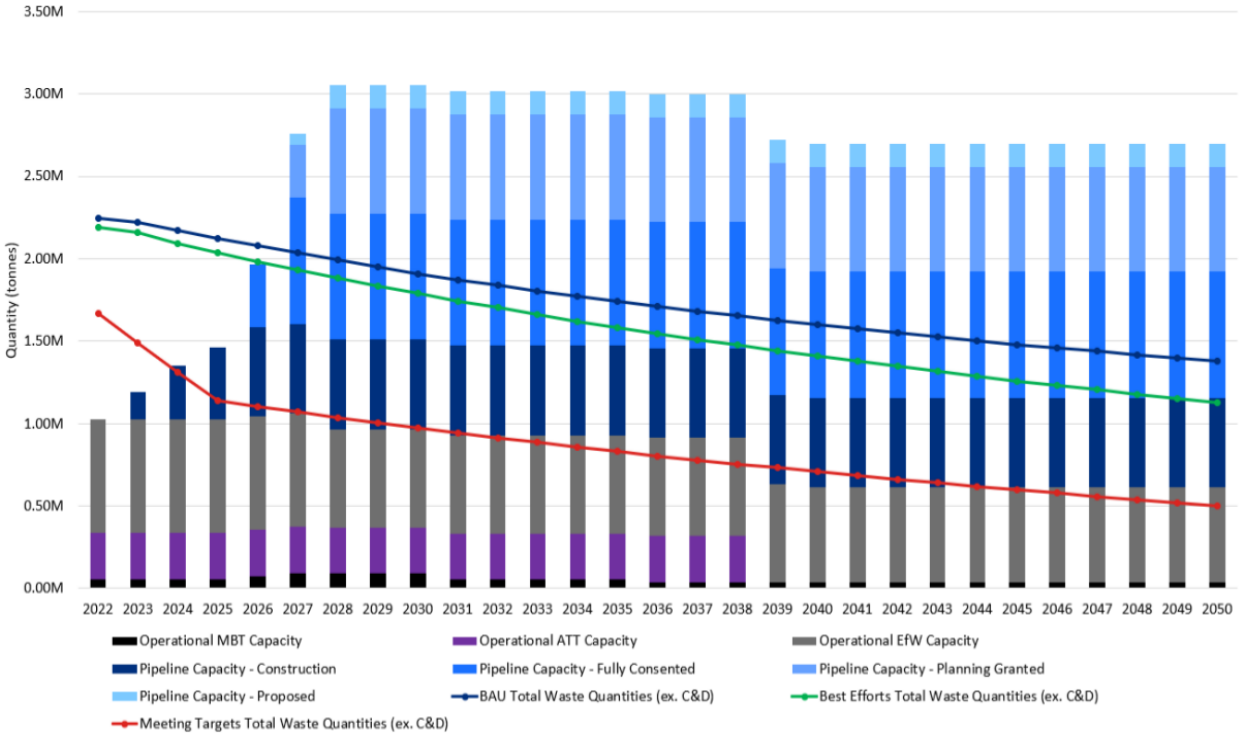


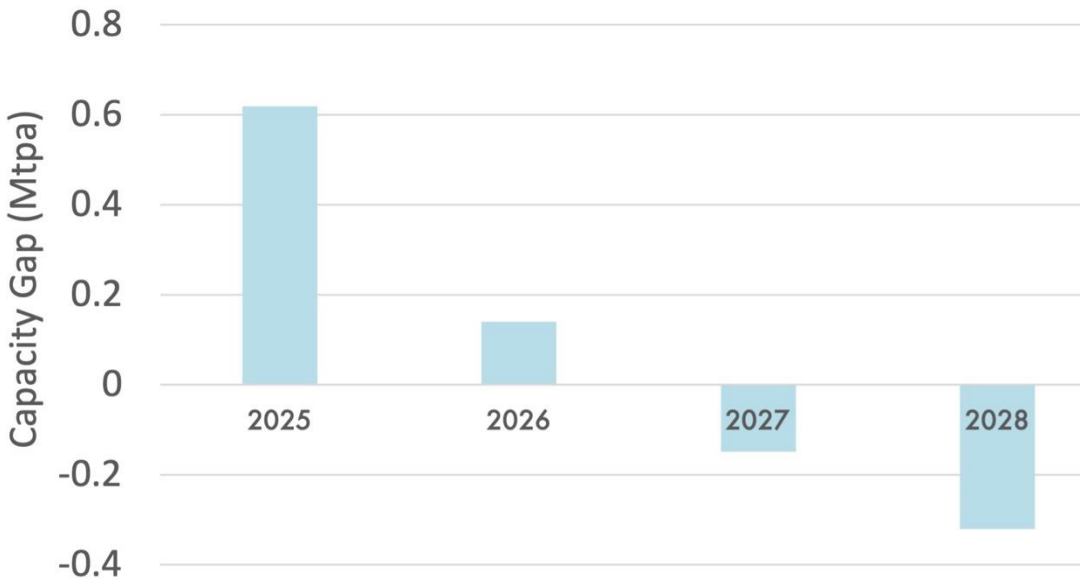
Figure 3-1 indicates that under the BAU and Modest Improvements projections (considered as the most likely outcome in the short-medium term), a capacity gap is anticipated in 2026, the first year of the landfill ban. This forecast gap is expected to transition towards a capacity surplus during 2027, as newly constructed facilities begin to ramp up their operations and throughputs.

The duration of the period where a capacity gap exists in Scotland will mainly depend on the timing of these new facilities coming online, although the period could be either reduced if more rapid progress is made towards Scotland's waste targets, or lengthened if delays occur with new plant construction or commissioning.

Figure 3-3 indicates the forecast capacity gap position under the BAU scenario, in more detail, at the end of years 2025, 2026, 2027 and 2028, based on the new EfW plant delivery dates reported by operators (refer 2.3.1 and Table 3-2). Assuming the Westfield and Oldhall EfW plants are operational by end of 2025 (as currently scheduled), the BAU capacity gap at the start of 2026 exceeds 600kta, although this reduces substantially through 2026 to c170kt, as the South Clyde and Binn Farm EfW plants commence operations.

Clearly in the event that some of the new EfW infrastructure currently in early construction stage was delayed or its capacity reduced, this would have a direct impact on the timing of the capacity gap closure shown in Figure 3-3. For example cancellation of the South Clyde project (capacity 350kta) would delay closure of the capacity gap, from late 2026 to beyond 2028.

Figure 3-3: SLR Estimated Capacity Gap 2025-2028, BAU Scenario



3.5 SEPA Capacity Gap Assessment

SEPA developed an alternative mechanism to forecast the potential capacity gap; the methodology for this is described in SEPA's response to the '*Incineration in the waste hierarchy review*' consultation[12]. This approach is based on establishing the quantum of BMW included within the upcoming ban that is currently disposed in Scottish landfills, and comparing this to the scale of confirmed new EfW capacity due to come online by 2025. A small adjustment is made to account for waste that is currently exported as RDF being diverted to new Scottish EfW facilities.

The table below presents SLR's update of this capacity gap estimate published in SEPA's consultation response (which uses 2020 BMW landfill data) using 2022 BMW landfill data and the latest understanding of new EfW capacity under construction in Scotland. The same tonnage has been applied for RDF diversion, which is a relatively small component of the calculation. A range of assumptions of BMW % of sorting residues (EWC 19 12 12) is applied.

[12] https://consult.gov.scot/environment-forestry/incineration-review-call-for-evidence/consultation/view_respondent?uuId=539587232

	% of 19 12 12 that is BMW		
	40%	50%	60%
BMW ban waste to landfill 2022	972,653	1,031,925	1,091,198
Confirmed new EfW Capacity by 2025	672,500	672,500	672,500
Confirmed new EfW Capacity by 2026	1,324,500	1,324,500	1,324,500
Adjustment for RDF export displacement	48,000	48,000	48,000
Remaining Capacity Gap to 2025	348,153	407,425	466,698
Remaining Capacity Gap to 2026	-303,847	-244,575	-185,302

The results of this approach anticipate a capacity gap in the region of 0.35Mt to 0.47Mt at the end of 2025, which is anticipated to reduce and eventually close over the course of 2026. This outcome is broadly similar to the results from SLR's capacity gap analysis, set out in 3.4. As with Ricardo and SLR's forecasts, the scale and duration of this capacity gap period will depend on the degree to which construction timelines of new EfW facilities stay on track.

4 External Markets Review

4.1 Overview

The modelling results suggest there is likely to be a period immediately following implementation of the BMW landfill ban where there is a deficit between residual waste arisings and treatment capacity in Scotland, particularly if current construction timelines of pipeline facilities were to be delayed.

This section considers the potential for treatment and disposal options outside Scotland to receive surplus residual waste arisings following introduction of the BMW landfill ban, as well as market trends and influencing factors in this area. The section is split into the English and Northern European markets.

4.2 England

4.2.1 Policy Context and Market Trends

Through the Environment Act 2021 Defra has set a target to halve residual waste generation on a per capita basis by 2042. A number of interventions are scheduled in England with the intention of reducing English residual waste volumes, including for example the (delayed) deposit return scheme (DRS), extended producer responsibility (EPR) for packaging, a move to "simpler recycling" collections (including introduction of collections for plastic films and flexible packaging), as well as the mandatory introduction of food waste collection across all councils by 2026.

Similarly to Scotland, England has seen a long-term shift away from the landfill of residual waste towards EfW. The 'Waste (England and Wales) Regulations 2011' obliges organisations to take reasonable measures in implementing the 'waste hierarchy' when managing waste, which prioritises energy recovery over landfill disposal. The development of EfW facilities has been stimulated by government subsidies, notably through the Renewable Obligation Certificates (ROCs) scheme.

The most impactful UK wide policy in driving residual waste to EfW facilities has been the Landfill Tax, however Scotland is ahead of England in terms of implanting a ban on BMW to landfill. Over the period May to July 2023, Defra held a call for evidence in relation to "Near elimination of biodegradable waste disposal in landfill from 2028"[13]. However, Defra has yet to publish its summary of responses to this consultation[14], and its position in respect of any future ban therefore remains unclear.

4.2.2 Supply-Demand Outlook

Assuming the above recycling interventions gain traction, modelling suggests that England's residual waste volumes will decline to some extent in coming years. Simultaneously, England's installed EfW capacity is continuing to grow. Environment Agency records show 48 EfW facilities operational in England in 2022, with a further 12 facilities in construction, and additional EfW projects still being actively pursued by developers. Dependent on the success of recycling efforts and the rate of build out of EfW capacity, it is anticipated that England's residual waste treatment capacity gap will begin to close by 2030, with much lower levels of residual waste being disposed of to landfill thereafter.

As the January 2026 Scottish BMW landfill ban enforcement date approaches, it is anticipated that attention will increasingly turn towards England as a potential recipient of any "overspill" of residual waste above and beyond available Scottish EfW capacity. Noting that the capacity of operational EfW facilities in England is generally already fully utilised, those EfW facilities which are currently in

[13] https://consult.defra.gov.uk/waste-and-recycling/cfe-near-elimination-bio-waste-to-landfill/
[14] https://www.gov.uk/government/consultations/near-elimination-of-biodegradable-waste-to-landfill

construction are of particular relevance. The North West of England is currently a focus of EfW development activity, with three facilities currently in construction:

- **Protos Energy Recovery Facility (ERF)**, a 500 ktpa incineration facility in Ince Park, Cheshire
- **Lostock Sustainable Energy Plant (LSEP)**, a 600 ktpa incineration facility in Northwich, Cheshire
- **Hooton Park Bio Power**, utilising a gasification process requiring 240 ktpa of RDF, in Ellesmere Port, Cheshire

Protos ERF developers Encyclis and Biffa state that the facility is due to be operational in 2024, while LSEP developers FCC and CIP have indicated an aim to begin operations at the end of 2025. The status of Hooton Park, developed by CoGen, is currently unclear, albeit it has been indicated that commissioning is expected to be complete in 2024.

In Yorkshire and the Humber, Enfinium is constructing a 410 ktpa EfW facility at Skelton Grange, Leeds, with some sources indicating that this facility will be operational in 2025.

While a number of planning permissions exist for additional EfW capacity in the North East of England, no new facilities are understood to currently be in construction in the region.

In light of these findings, while noting that construction and commissioning of EfW facilities frequently overruns projections, it is possible that up to four new EfW facilities will be operational in the north of England by 2026. While much of the capacity of these facilities will already be accounted for by established feedstock supply agreements, operators typically leave headroom to receive feedstock on an ad hoc "spot market" basis. In the event that Scottish domestic EfW capacity is insufficient at the point of enforcement of the ban, it is plausible that these new facilities could absorb surplus residual waste exported from Scotland.

Review of Environment Agency records of inputs to permitted waste management facilities in England in 2022 indicates that exports from Scotland to England are well established[15]. These include flows of Scottish residual waste recorded to both English EfW facilities (c.29kt of household/C&I waste received in 2022[16]) and to English landfills (c.2.7kt of household/C&I waste received in 2022[17]). It is possible that these flows could potentially increase temporarily to overcome a short-term capacity gap in Scotland when the landfill ban is introduced.

As a general market principle, any non-LACW biodegradable municipal waste which cannot be landfilled in Scotland will be diverted by waste operators to the most economic alternative outlet (allowing for transport costs, and the gate fee charged at the receiving facility).

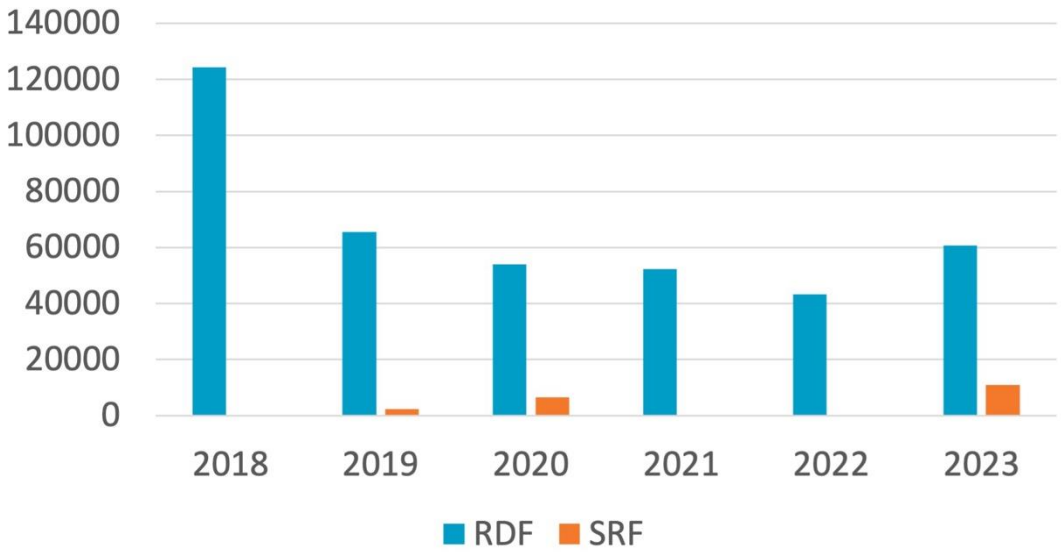
4.3 N. Europe

Overall tonnage of RDF and SRF exports from Scotland to Europe between 2018 and 2023 are presented in Figure 4-1. The chart highlights that whilst tonnages have declined since 2018, the rate of decline has slowed since 2019, with an increase in exports recorded in 2023. Whilst SRF volumes are considerably smaller than RDF, these exports have increased over the time frame.

Although Scottish RDF export data by destination country was not available for 2023 at the time of writing, data previously collated and published by SEPA indicates that, over the course of 2022, c.60% of RDF exports from Scotland were to Sweden, with the remaining c.40% to Denmark.[18,19]

[15] 2022 Waste Data Interrogator, Environment Agency. Inputs to English facilities with recorded origin 'Scotland'.
[16] Ibid. Inputs of 'Hhold/Ind/Com' to 'Incineration' facilities with recorded origin 'Scotland'.
[17] Ibid. Inputs of 'Hhold/Ind/Com' to 'Landfill' facilities with recorded origin 'Scotland'.
[18] https://www2.sepa.org.uk/disclosurelog/uploads/f0195683_docc1d1da0c29_f0195683_eir_response.pdf
[19] https://www2.sepa.org.uk/disclosurelog/uploads/f0195683_docc28b77ca85_report_f0195683_final_rr.xlsx

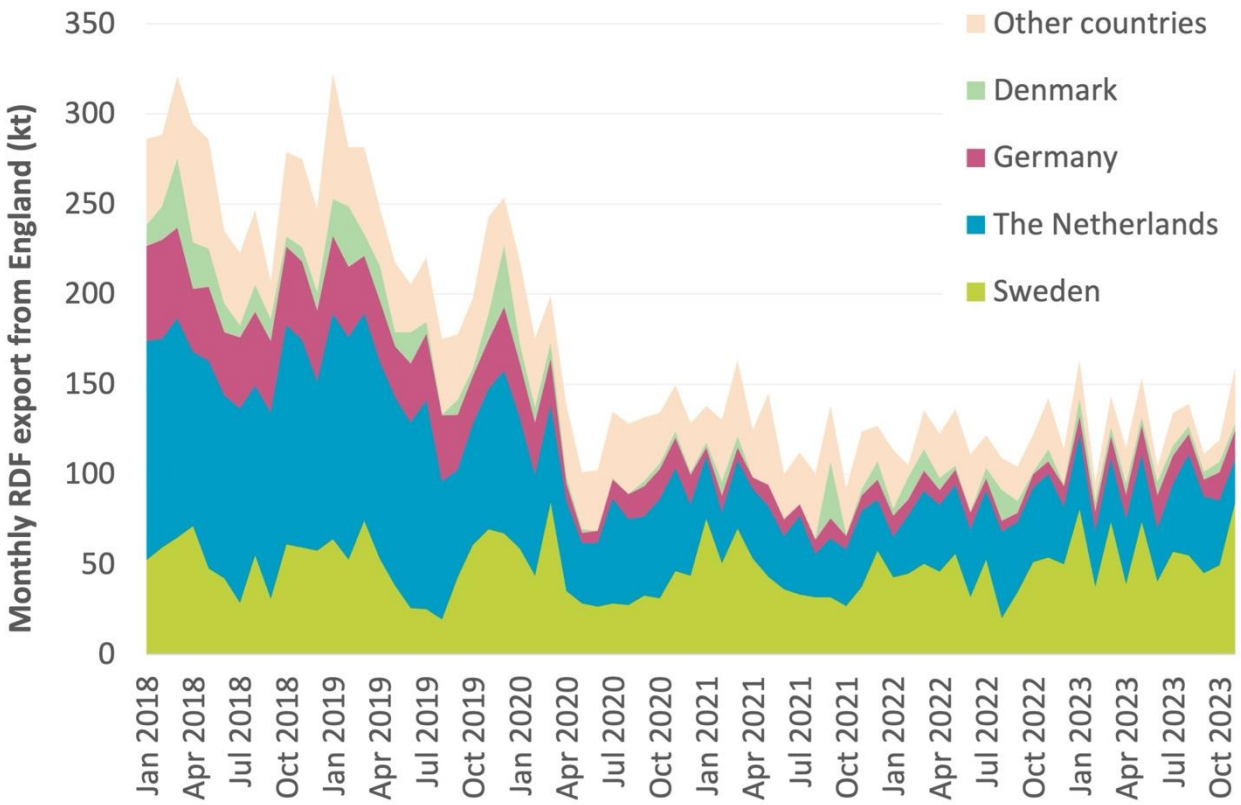
Figure 4-1: RDF and SRF Exports from Scotland, tonnes (2018 - 2023) [20]



To provide further context at UK export level, analysis was also undertaken of Environment Agency export records for England. The results show that Sweden is also the single largest recipient of RDF exported from England. Historically, exports from England to Germany and the Netherlands have been particularly high, albeit English exports to these countries have declined markedly in recent years.

[20] Source: FOI Request received 26/02/2024. No SRF exports occurred in 2018, 2021 and 2022.

Figure 4-2: Monthly RDF exports from England, Jan 2018 to Nov 2023



In some European countries, government interventions have, or may in future, contribute to reductions in RDF exports. For example the Netherlands introduced a tax of €32.63 EUR/t on RDF imports[21], while in Germany CO_2 emissions from incineration are to be subject to a tax under the German Fuel Emissions Trading Act (BEHG), reportedly reaching €50/t in 2025[22]. In contrast, Sweden is reported to have ended its incineration tax as of January 2023[23].

The data suggests that both Scotland and England's RDF export market appear to be in a current period of relative stability, with export tonnages likely to remain at broadly similar levels in the short to medium term, in the absence of external shock factors.

It appears reasonable to assume that, if required, and with suitable advanced notice, RDF exports from Scotland to Europe could potentially increase to absorb a proportion of any additional residual waste volume which cannot be accommodated by Scotland's domestic EfW capacity, or export to the adjacent English market. Notwithstanding this, the ability of RDF exports to respond to disposal needs on a rapid, short-term basis may be limited and this route is unlikely to be able to accommodate significant quantities of waste diverted in response to short-term requirements or immediate or emergency plant closure scenarios. Rather than occurring on an ad hoc basis, RDF export typically occurs under supply contracts, and all trans-frontier shipments (TFS) must be consented in advance by SEPA.

In a similar effect to potential exports of waste from Scotland to England, exports of RDF to Europe will continue to be driven by market forces whereby waste moves to the most economic outlet after accounting for processing costs, transport, gate fees, and any applicable taxes. While the gate fees of large-scale municipal EfW facilities in northern Europe remain relatively low, and in the absence of any

[21] https://www.eea.europa.eu/publications/many-eu-member-states/netherlands
[22] https://envirotecmagazine.com/2023/10/06/german-co2-tax-will-change-european-waste-streams/
[23] https://www.euwid-recycling.com/news/policy/sweden-scraps-waste-incineration-tax-110123/

new tax burdens, RDF exports from Scotland to the near mainland of Europe will likely continue to be a viable outlet in the medium term.

5 Landfill Capacity Assessment

Within the limited scope of work agreed for inclusion in this study, SLR undertook a review of the available data on permitted landfill capacity in Scotland to determine the potential volume available for disposal of biodegradable municipal wastes (BMW) included in the ban, over the next few years prior to, and post implementation of the ban, from January 2026.

5.1 SEPA 2022 Landfill Dataset

Our analysis of available remaining permitted landfill capacity was based on the waste data interrogator dataset provided by SEPA; this records the total non-hazardous waste (BMW and non-BMW) landfilled in Scotland during the calendar year 2022. In discussions with SEPA and ZWS, and via interrogation of this available dataset, SLR identified the key relevant landfill operators and sites in Scotland and their near term capacity and plans.

The 27 non-hazardous waste landfills in Scotland, actively accepting waste during 2022 were narrowed down to ten (10) priority sites. These landfills provided 83% of all non-hazardous landfill capacity in Scotland during 2022. The total tonnage recorded as landfilled at each (and the estimated tonnage of BMW landfilled) in 2022, are summarised below:

- Avondale Non Haz (Avondale Enviro): 389kt (219 – 254 kt of BMW)
- Stoneyhill (SUEZ): 202kt (147-153 kt of BMW)
- Greenoakhill (Pattersons): 184kt (122-129 kt of BMW)
- Dunbar (Valencia Waste Management): 150kt (57-83 kt BMW);
- Lochhead (Fife Council): 142kt (86-89 kt BMW)
- Greengairs (FCC): 135kt (59-64 kt of BMW)
- Auchencarroch (Barr Enviro): 109kt (97kt BMW)
- Levenseat (Levenseat): 76kt (18-27 kt of BMW)
- Lower Melville Wood (Fife Council); 66kt (52kt of BMW)
- Straid Farm (Straid Farms Ltd): 59kt (56kt of BMW)

In addition to the above landfills, Duisky Landfill (Locheil Logistics) in Lochaber was considered regionally significant for north-west Scotland; this accepted a total of 12kt of non-hazardous waste for disposal in 2022 (of which 9.5-10.5kt of BMW) was included for consideration in the analysis (also due to the high proportion of BMW landfilled).

Our analysis focussed on these eleven priority landfills, as being of most relevance, in terms of capacity and location. No island landfills were included, due to their small size and also our understanding that sufficient landfill capacity exists in the main island groups (i.e. Western Isles, Northern Isles) for BMW waste up until the 2026 ban implementation.

5.2 LF Capacity Projections from 2022

5.2.1 LF Closures

Three sites were reported to be closing in the near term and cease accepting waste; these were removed from our future capacity projections, i.e.

- Auchencarroch
- Lower Melville Wood
- Straid Farm.

5.2.2 Permitted Capacity Analysis

5.2.2.1 Scope

The theoretical, permitted capacity for each of the remaining eight priority landfills was assessed to provide an evidence-based forecast of the remaining total landfill capacity to 2025. Based on the SEPA landfill waste data for 2022, the total landfilled tonnage for each of the sites was assumed to have remained the same during 2023 for the purpose of this theoretical review of 'landfill capacity'. This reported cumulative tonnage was subtracted from the remaining permitted capacity, as provided in the SEPA Waste Interrogator, to indicate the likely residual permitted landfill capacity remaining for 2024 and 2025.

This study was based on the reported waste tonnages landfilled in 2022, and theoretical remaining tonnage allowance on each sites permit. However, in reality, the remaining landfill void space will differ from this permitted capacity forecast, since the engineered cell capacity development of each operator is not known.

The forecast permitted capacity for the identified eight priority landfills was analysed as follows:

- Assume 2023 landfill tonnages are identical to reported 2022 LF data;
- Estimate BMW accepted in 2023 and 2024, based on three potential composition characteristics for the EWC Code 19 12 12 waste; i.e. 60% BMW, 50% BMW or 40% BMW.
- Calculate annual available capacity in 2024 and 2025, based on three different composition scenarios to provide a range of BMW likely to be accepted at each site in these years.

5.2.2.2 Results

The total remaining permitted tonnage for the eight priority LF sites during 2023 was estimated as 4,889,627 tonnes. This is summarised in the table below and is based on the reported total waste acceptance during 2022, subtracted from the dataset's summary of remaining permitted capacity per site.

Table 5-1: Remaining landfill capacity for 2023

Site	Total capacity for 2023
Avondale Non-Haz	36,981
Duisky Landfill	40,700
Dunbar Landfill	167,000
Greengairs Landfill	2,869,878
Greenoakhill Landfill	720,000
Levenseat Landfill	92,914
Lochhead Landfill	188,320
Stoneyhill Landfill	773,834
Total	**4,889,627**

Table 5-2 summarises the total permitted capacity projections for 2024 and 2025, taking account of the likely range of BMW for each site in 2023 and 2024. Assuming the same reported tonnage accepted during 2022 continued in 2023, the remaining permitted capacity would be 3,950,147 tonnes for 2024 and 3,335,564 tonnes for 2025.

Table 5-2: Priority Landfills:- Permitted Capacity Summary

Site	Percentage of 19 12 12 as BMW	2023 total BMW input	2024 total BMW input	2024 remaining Permitted Landfill Capacity	2025 remaining Permitted Landfill Capacity
Avondale Non-Haz	60%	24,195	0	0	0
	50%	22,509	0		
	40%	20,823	0		
Duisky Landfill	60%	10,642	10,642	27,916	15,132
	50%	10,136	10,136		
	40%	9,630	9,630		
Dunbar Landfill	60%	83,145	9,387	16,941	0
	50%	70,390	7,947		
	40%	57,636	6,507		
Greengairs Landfill	60%	64,524	64,524	2,734,522	2,599,166
	50%	61,851	61,851		
	40%	59,177	59,177		
Greenoakhill Landfill	60%	129,387	129,387	535,518	351,037
	50%	125,749	125,749		
	40%	122,111	122,111		
Levenseat Landfill	60%	27,568	6,219	17,103	0
	50%	23,024	5,194		
	40%	18,479	4,169		
Lochhead Landfill	60%	89,930	29,164	46,116	0
	50%	88,285	28,630		
	40%	86,640	28,097		
Stoneyhill Landfill	60%	153,317	153,317	572,032	370,229
	50%	150,332	150,332		
	40%	147,347	147,347		
Total Projected Permitted Landfill Capacity (tonnes)				**3,950,147**	**3,335,564**

Based on this projection, several sites had limited permitted capacity remaining during 2023 and 2024, and in these cases the sites predicted total waste tonnage acceptance was based on fulfilling the remaining permitted capacity only.

Notably, Avondale Landfill is reported to have very limited residual permitted capacity with zero forecast for 2024 and 2025. Dunbar, Lochhead and Levenseat landfills also exhibit zero residual permitted capacity by 2025.

A summary of the position at each of the priority landfills listed in Table 5-2, follows.

Avondale Non Hazardous landfill

Avondale was expected to reach its permitted capacity in 2023, with only 36,981 tonnes remaining after 2022. The site would therefore only have the potential to accept waste up to this total permitted capacity in 2023, which would result in a predicted range of landfill ban waste between 20,823 tonnes and 24,195 tonnes. This is a substantial reduction from the 2022 total waste reported by SEPA (389,235 tonnes).

Although Table 5-2 indicates that Avondale currently has no permitted capacity, SEPA noted that it is entirely likely that they will apply to extend their permitted capacity and that this application is quite likely to succeed, thus significantly increasing the total capacity projections in this table and allowing it to continue to accept waste for landfill in 2024 and 2025.

In light of this, Avondale should be considered with capacity to potentially accept a total waste input of 389,235 tonnes in 2024, with a BMW variation between 219,167 and 254,663 tonnes depending on the composition of the 19 12 12 waste stream.

Duisky Landfill

Duisky has limited capacity and ZWS suggests that it could close before its remaining permitted capacity is spent. If not, there would potentially be 27,916 tonnes (total waste) available during 2024 and 15,132 tonnes available during 2025. Landfill ban waste capacity could vary between 9,630 – 10,642 tonnes each year.

Dunbar Landfill

The site is likely to reach its permitted tonnage capacity during 2024. It is therefore likely to have accepted between 59,177 and 83,145 tonnes of BMW in 2023, but only between 6,507 and 9,387 tonnes in 2024.

Greengairs Landfill

This remains by far the largest capacity non-hazardous waste landfill in Scotland during 2023 and 2024, with a remaining permitted capacity of 2,734,522 tonnes in 2024 and 2,599,166 tonnes in 2025. The proportion of BMW accepted at Greengairs is, however, significantly less than other sites in the study. Based on their 2022 waste stream, Greengairs is likely to only have a proportion of BMW ranging from 38% to 48% of its total waste acceptance.

For the three scenarios for 60%, 50% or 40% BMW composition of 19 12 12, Greengairs could accept the following tonnage of BMW each year:

- 64,524 tonnes, at 60% of 19 12 12
- 61,851 tonnes, at 50% of 19 12 12
- 59,177 tonnes, at 40% of 19 12 12

The site's theoretical remaining permitted capacity in 2025 would be circa 2.6 million tonnes.

Greenoakhill Landfill

Greenoakhill is indicated to have sufficient permitted capacity to continue accepting waste through 2024. The estimated volume accepted in 2023 and predicted for 2024 was based on the reported figures for 2022, at 184,482 tonnes. While the total waste acceptance figures for the concurrent years is smaller than the largest site, Greengairs, the proportions of BMW accepted at Greenoakhill are significantly higher.

For the three scenarios of 60%, 50% or 40% BMW composition of 19 12 12, Greenoakhill could accept the following tonnage of BMW each year:

- 129,387 tonnes, at 60% of 19 12 12
- 125,749 tonnes, at 50% of 19 12 12

- 122,111 tonnes, at 40% of 19 12 12

The site's theoretical remaining permitted landfill capacity in 2025 would be c.351,000 tonnes.

Levenseat Landfill

Levenseat was estimated to have a remaining permitted capacity of 92,914 tonnes at the end of 2022, according to the SEPA dataset. Assuming the same quantity of waste accepted in 2022 was accepted in 2023, the capacity at the site for 2024 would be just over 17,000 tonnes only. This would result in a relatively low capacity for BMW, ranging from 4,196 tonnes to 6,219 tonnes in 2024 depending on the composition of the 19 12 12 wastes accepted at the site.

Lochhead Landfill

Lochhead was also estimated to have limited remaining permitted capacity at the end of 2022, relative to its annual reported waste input. With an estimated remaining capacity of 188,320 tonnes after 2022, and assuming the same waste input quantity during 2023, the site would only have a total remaining permitted capacity of 46,116 tonnes for 2024. With this limited remaining capacity, the site would theoretically only accept between 28,097 and 29,164 tonnes in 2024. There would be no remaining capacity during 2025 in this case.

Stoneyhill Landfill

Stoneyhill had the second largest waste input volumes in 2022, with 201,802 tonnes reported. There is also sufficient, indicated remaining permitted capacity for the site to continue accepting waste at this rate into 2025.

For the three scenarios of 60%, 50% or 40% BMW composition of 19 12 12, Stoneyhill could accept the following tonnage of BMW each year:

- 153,317 tonnes, at 60% of 19 12 12
- 150,332 tonnes, at 50% of 19 12 12
- 147,347 tonnes, at 40% of 19 12 12

The site's theoretical remaining permitted landfill capacity in 2025 would be c.370,000 tonnes.

5.3 Engineered Cell Capacity

The quantity of engineered cell capacity at the eight priority landfill sites was not available from existing data (SEPA, ZWS). Further investigation to contact the relevant operators and calculate the actual available void space was outside the scope of this review of permitted capacity.

It is, however, recommended that this is considered as part of a future investigation as the permitted capacity calculations are theoretical only. As demonstrated by the calculations for Avondale Landfill, significant discrepancies between the permitted capacity and physical remaining void space are likely when analysing the capacity for these sites over their entire lifespan.

5.4 Summary

The investigation into the remaining permitted capacity and potential BMW waste acceptance available up until the ban was based on the data available in the online SEPA waste data interrogator and the 2022 reported waste volumes. The 2022 volumes of waste landfilled for each site were assumed to be replicated during 2023 and 2024, subject to the availability of permitted capacity at the respective sites.

The total remaining permitted capacity at the eight priority sites was therefore 3,950,247 tonnes in 2024, reducing to 3,335,564 tonnes in 2025. If Avondale's reported capacity is included in this total available, the capacity figures increase to 4,339,383 tonnes and 3,724,799 tonnes respectively for 2024 and 2025.

The potential BMW tonnages for 2023 and 2024 were calculated for three scenarios at each site; 60%, 50% and 40% biodegradable proportion of the waste code 19 12 12 containing biodegradable MSW.

Excluding Avondale Landfill, the potential BMW volumes at the 7 landfills with permitted capacity in 2023 would have ranged from 501,021 tonnes (40%) to 558,514 tonnes (60%).

In 2024, the capacity is significantly lower, with Dunbar, Levenseat and Lochhead indicated to meet their total permitted capacity. In the event of permitted capacity being achieved during 2024, only the indicated capacity was utilised for our calculations, rather than the total volume accepted previously. This would potentially result in a lower range of BMW capacity, between 377,038 tonnes (40%) and 402,641 tonnes (60%).

Avondale has the potential to increase the BMW accepted in both 2023 and 2024 between 219,167 to 254,663 tonnes, if they are to continue operating at the same rates reported in 2022.

In summary, the permitted capacity forecast for 2024 and 2025 (refer

Table 5-2), indicates sufficient availability of landfill in Scotland to accept the surplus residual waste forecasts (refer Section 3) for the two years immediately preceding the introduction of the ban.

However it is acknowledged that actual engineered landfill cell capacity will likely differ significantly from this forecast, and so a separate investigation of engineered capacity is recommended to be undertaken to confirm this data.

6 Landfill Ban Implementation Risk Review

6.1 Analyses Findings Summary

The key outcomes from the preceding analyses set out in Sections 3, 4 and 5 of this report can be summarised as:

- **National Capacity Gap Analysis:-**
  - **Capacity Gap Closure:-** An infrastructure capacity gap deficit (of c.600kt) will likely remain at the outset of the first year of the ban (2026), under BAU conditions, with this reducing to <200kta during 2026, becoming a small capacity surplus the following year, and stabilising at a surplus of c.240kta beyond 2028, i.e. after full development of the planned South Clyde and Drumgray EfW plants and closure of the aging Baldovie plant in Dundee. The specific date / timing of capacity gap closure in Scotland is dependent on progress with improving recycling rates and the rate of new EfW infrastructure capacity delivery. However, even under worst case (i.e. BAU) waste arisings projections, Scotland's EfW capacity gap is forecast to close, unless one or more of the larger 'pipeline' EfW projects (e.g. South Clyde, Drumgray) fails to be fully implemented. Scotland exports a total of c.70-100ktpa of waste to EfW facilities in both England and mainland Europe, and if this continues to 2026, it would act to reduce the demand for Scotland-based EfW capacity.
  - **Capacity Balance Beyond 2028:-** although not the primary focus of this study, the projections indicate that there is a potential for significant overcapacity of EfW if all planned facilities are built, current RDF exports continue and recycling performance increases significantly from current BAU levels. While achieving the Hitting Targets waste arisings projection is not considered likely in the medium term, an overcapacity of 240-450ktpa is forecast for 2031 (i.e. 10-18% of the national total EfW operating capacity) under the BAU and 'Modest Improvements' scenarios respectively.
- **External Markets:-** Our review of external markets available to Scotland indicates that:
  - **England:-** is expected to have an aggregate national EfW infrastructure capacity deficit until around 2030. However, an additional 1.75 million tpa of new merchant EfW capacity is scheduled to come online in northern England (in Cheshire and Leeds) by 2026. While much of this will already be contracted out prior to commencement, it is possible (subject to commercial and logistical considerations) that EfW capacity will exist to contribute towards accommodation of surplus Scottish waste that is forecast to require treatment from 2026. Export of residual waste from Scotland to England in 2022 comprised c.29kt of household/C&I waste going to EfW[24] and c.3kt to landfill.
  - **Northern Europe:-** between 2019-2023, Scotland exported c.40-60ktpa of RDF to energy plants in mainland Europe, with the 2022 exports reported to be received at energy plants in Sweden (60%) and Denmark (40%). A similar trend of well-established and continuing RDF exports from England to north European energy plants, is also

[24] Understood to primarily comprise transport of RDF from Dumfries & Galloway Council MBT plant to private sector waste aggregator in Carlisle as feedstock to merchant EfW plants in N. England

apparent. This route appears to be a stable end-route / market and (subject to ongoing commercial, logistical and permitting considerations) is likely to continue into the medium term and therefore contribute towards managing any capacity deficit apparent from 2026 by reducing the demand for Scotland-based EfW capacity. However, given the more complex logistical and permitting issues and delivery timescales associated with transfrontier shipment of waste from the UK, this route is unlikely to be able to accommodate significant quantities of waste diverted in response to short-term requirements or immediate / emergency plant closure scenarios.

- **Landfill Capacity**:- our review of landfill capacity in Scotland in the pre-landfill ban years 2024 and 2025, indicates that the 'permitted' landfill capacity of eight priority Scottish landfills (i.e. excluding small and island landfills) equates to around 3.95 million tonnes in 2024, and 3.34 million tonnes in 2025. This capacity far exceeds the forecast EfW deficit in these years, of c.1million tonnes (2024) and 600kt (2025). However as noted in our analysis, permitted landfill capacity is not directly representative of engineered cell capacity, and it is therefore recommended that this latter figure is separately established by SG, since many landfills in Scotland are now in the process of closing down for active, non-hazardous waste.

In summary, the findings of this study forecast:

1. The likely closure of the current national EfW capacity gap by around 2027, under worst-case BAU conditions, with the specific timing subject several factors including the rate of new EfW infrastructure capacity delivery in 2025-2027, the extent of RDF export flows (to England and Europe) and progress with improving recycling rates.
2. The likelihood of a significant capacity deficit (c.600kta) at the outset of 2026, the first year of the ban, with this expected to fall substantially (to <200kta) during 2026, subject to the new EfW facilities at Binn Farm and South Clyde, opening as currently scheduled.
3. Capacity for continuation and expansion of the established but relatively small RDF export flows to England and northern Europe, in the medium term that could potentially mitigate the lshort interim period of EfW capacity deficit forecast from 2026 and beyond.
4. Likely emergence of significant EfW infrastructure overcapacity (c.10-18% of total operating capacity) beyond 2028, if all currently planned EfW capacity is fully developed, and recycling performance significantly improves from current BAU levels.

6.2 Risk Assessment

This section considers the potential risks to successful implementation of the ban and the implications of these, and potential mitigation measures.

6.2.1 Areas of Uncertainty

6.2.1.1 Waste Data Reliability / Future Projections

Future waste arisings tonnage forecasts to 2030 and beyond are based on the range of assumptions set out in section 3.3, relating to waste footprint (combined LACW & CIW), 2022 baseline and future waste generation and recycling projections.

Although the 2022 baseline position is considered data-based and reliable, it is recognised that the future projections are illustrative only, and dependent on a range of underlying factors. However, given the recent slow progress by Scotland towards meeting its recycling targets and the current position regarding implementation of the SG Circular Economy and Waste Route Map to 2030, it is considered that the actual outcome in the near term will most likely align more closely with the 'BAU' and 'Modest Improvements' projections, rather than the 'Hitting Targets' projection (refer Figure 3-1).

6.2.1.2 EfW Infrastructure Delivery – Capacity and Timing

Regarding the EfW infrastructure capacity supply-side projection, this is based on operator feedback regarding planned plant capacity and delivery timeline. The EfW capacity projections are conservative since they use the reported plant operating capacities, rather than permitted capacities. However it must be recognised that construction / contract issues can often significantly delay plant completion timelines, and in addition, global market conditions can adversely impact the plans of project developers to the extent that planned projects are scaled back or cancelled altogether.

For example, the recent market reports regarding Fortum's intention to sell its share of the South Clyde project, indicate the uncertainties that can apply to all merchant EfW projects, that are not yet operational.

However, as noted above, and even under the worst case (BAU) waste arisings projection, Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects (300+kta capacity) scheduled to become operational between 2024-2027, are not fully delivered at the intended capacity. In the event of loss of one of these larger plants from the total EfW capacity outcome, the resulting short-term deficit would need to be filled by a combination of continued RDF exports and diversion of non-municipal streams away from Scottish EfW plants, although, as noted above this capacity gap would likely disappear over time as recycling levels improve.

6.2.1.3 Infrastructure Overcapacity Risk

Although the most likely forecast outcome is considered to be a small potential infrastructure overcapacity during the early years of the Bioban (refer Figures 3-1 and 3-3), the capacity gap modelling also indicates that if all EfW infrastructure is fully built out as planned, and significant improvements are also made to current (BAU) recycling rates, then there is a significant risk of EfW overcapacity occurring, beyond 2028. For example an overcapacity of 240-450ktpa is forecast for 2031 under the BAU and 'Modest Improvements' scenarios respectively, and following closure of Baldovie. In the longer term, if recycling levels substantially improve beyond the Modest Improvements projection, then the forecast EfW overcapacity increases. However it is worth acknowledging that there are numerous assumptions underpinning these projections and also that there will never be a 'perfect equilibrium' in the system, and that a degree of cross border imports /exports will always naturally occur within the market at any given point in time.

6.2.1.4 POPs Capacity

Three of the operational EfW plants (Shetland, Ness and Dundee) already accept POPs materials for destruction, with most of the remaining plant operators and developers reporting that they ether intend to, or are considering installing the necessary equipment to enable them to accept POPs.

Only the contacts at GRREC and Oldhall reported that they do not intend to accept POPs, with GRREC citing technical reasons for this related to their existing integrated pretreatment process. No information regarding POPs acceptance was provided by Levenseat.

Overall, the ability for most EfW plants to accept POPs streams for destruction was not questioned by operators and questionnaire responses did not flag this as an issue of significant concern. Therefore it appears that the bulk of Scottish EfW plants will provide capacity for POPs destruction and that this is not considered to be a significant risk for successful Bioban implementation.

6.2.1.5 Plant Outage Management (planned and unplanned)

The responses from operators and developers highlight this issue as being of significant concern to the industry. While most operators consider that it is possible to manage the annual plant shutdown (typically less than 2 weeks) via increased temporary onsite feedstock storage, this is not the case for longer plant stoppages for either periodic planned maintenance (typically 4 weeks) or triggered by the need to initiate unplanned or immediate emergency plant closure due to technical / safety / operational issues.

Recent local authority contracts with EfW operators typically require a contingency plan to be in place to divert waste on a pre-arranged basis to other landfill ban-compliant end-routes (e.g. 3rd party EfW or RDF export) during periods of plant closure. However this requirement is unlikely to apply to other 3rd party waste contracts, or to emergency situations, and clearly the industry is concerned about its ability to manage longer plant closures while still also complying with the requirements of the ban.

A number of suggestions to manage the impacts of planned and unplanned outages were put forward by operators in the questionnaire responses, for consideration (refer section 2), including designation of contingency facilities and use of short term derogations to allow landfilling, during abnormal circumstances.

Clearly this issue is a significant concern to the industry and also a significant risk to the successful implementation of the landfill ban. Without relevant measures or management plans in place, it could potentially result in BMW waste being exported to landfills or EfW plants in England, at short notice (and high cost) for unplanned outages.

Operators and developers consider that planning at a government and industry-wide level in Scotland is required to adequately manage the issues associated with diversion of waste during planned and unplanned outages across an expected national fleet of around 14 EfW plants.

The measures required for planned and unplanned outages may differ, but it is clear that this issue requires more detailed consideration to mitigate the significant risks it brings to successful implementation of the landfill ban.

6.2.1.6 Landfill Capacity

The quantity of permitted landfill capacity in Scotland to accept BWM for disposal in the years leading up to the Bioban greatly exceeds the forecast demand. However the volume of engineered landfill cell capacity is not currently known and may be significantly less than the permitted capacity. Carrying out a specific investigation into the engineered landfill capacity available for use in years 2024 and 2025 is recommended in order to provide certainty over this issue.

6.2.1.7 Proposed Monitoring / Compliance / Reporting Regime

SEPA[25] published guidance[26] in March 2024 for waste producers, managers and landfill operators, setting out the planned regime for monitoring compliance with the ban requirements and reporting. This includes details regarding waste characterisation, compliance testing and onsite verification. The ban will be implemented via Regulation 11 of the Landfill (Scotland) Regulations 2003 (as amended) and by monitoring compliance with the conditions of landfill operator permits. All non-hazardous landfill Permits will specify that BMW cannot be accepted for landfill disposal; all wastes that fall within the specified EWC codes for BMW will be excluded, unless they are demonstrated to be either non-Municipal or sufficiently treated to fall beneath the specified biodegradability thresholds applicable to biostabilised and incinerated wastes.

Some operators expressed concerns over the lack of details available at this stage (including regarding the roles and responsibilities) and also over the staff resources that will be made available to implement and police this adequately, also noting the associated risk of BMW materials going to landfill in the event of poor compliance monitoring and reporting.

However the recent publication of this guidance and planned industry engagement by SEPA regarding the details is considered to be a significant element of risk mitigation and ensuring successful landfill ban compliance by industry.

[25] With support from SESA and their members
[26] The ban on landfilling Biodegradable Municipal Waste (scope and testing guidance), WST-G-68, March 2024

6.2.1.8 Orphaned Wastes

Operator feedback raised the issue of lack of specific provision for 'Orphaned Wastes' i.e. those BMW wastes which are not permitted to be landfilled, but which may not combust well or are otherwise unsuitable for EfW. Operators cited examples, including certain trommel fines, treatment residues, grits, rope etc[27].

Although the tonnages of these wastes is small, it is recognised that some material types are less attractive to EfW operators due to attributes that make them ether out of specification for the specific EfW technology, or difficult / impossible to accommodate within the EfW feedstock intake process train.

While this is not considered to be a significant risk (in terms of quantity), it is nevertheless an issue that requires more detailed consideration in order to identify an approach for management of waste materials that fall within the landfill ban definition, but are unsuitable for EfW, including agreement regarding materials and wastes streams for inclusion and commencement of analysis and testing of these.It is worth noting that in the Netherlands, landfill operators may apply for an exemption from the national landfill ban, for specific orphaned wastes.

6.2.1.9 ETS and CCUS

Operators are beginning to consider their approach to the intended application of the UK ETS scheme to the EfW sector. While some EfW plants, located in central and NE Scotland and with access to the Acorn CCS infrastructure, are considering implementation of CCUS to decarbonise their operations, others will likely rely on increasing user gate fees to fund the additional costs associated with the levy on stack emissions.

Given the planned timing for application of ETS to the EfW sector (2028), this issue is not considered to be an immediate risk for the early years of the ban. However since a key impact of this measure will be to substantially increase EfW gate fees to waste producers (by c.£50+/tonne), it may have the effect of driving waste management towards increased use of the lower cost landfill route (including use of English landfills for Scottish non-municipal waste fractions) unless restrictions on landfilling of BMW apply in England by 2028, and/or landfill tax increases sufficiently to balance the two options.

6.2.2 Key Risks and Mitigation Measures

The key risks identified to successful full implementation of the landfill ban are discussed below along with recommended potential mitigation measures.

6.2.2.1 EfW Infrastructure Capacity Deficit 2026

An EfW capacity deficit of c.600kta is forecast at the outset of 2026, the first year of the ban, under 'worst case' BAU conditions, although this deficit is expected to fall substantially to <200kta during 2026, as the new EfW facilities at Binn Farm and South Clyde open during that year. Current RDF exports from Scotland (to England and mainland Europe) are <100kta and although sufficient additional capacity likely exists across both of these external RDF markets to accommodate the required temporary increase in exports, the necessary contracts (including TFS permits for exports to Europe) will need to be put in place well in advance of Q4 2025. The bulk of the required exports will be for BMW from commercial rather than local authority sources.

It is recommended that SG engage with relevant industry bodies (including SESA and RMAS) and commercial operators in 2024, to highlight this issue and support the facilitation of timely securing of export contracts in advance of late 2025.

[27] In the Netherlands operators may apply for a landfill ban exemption for materials that are considered damaging to the EfW process.

6.2.2.2 EfW Infrastructure Capacity Gap Closure

Although closure of the current EfW capacity gap is forecast by around 2027, under worst-case or BAU conditions, unforeseen construction issues and/or changes in international market conditions may trigger significant delays and/or lower capacity outcomes in the Scottish EfW infrastructure capacity than are currently predicted. While plant construction or commissioning delays would simply push back the forecast date of capacity gap closure beyond 2027, any significant reduction in EfW capacity delivered could potentially increase the national capacity deficit and extend its period during the early years of the ban, thus increasing reliance on a combination of higher RDF exports, alternative management options for the non-municipal fractions and increased recycling. However, even under worst case (BAU) waste arisings projections, Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented.

Beyond 2028 there is the likelihood of significant EfW overcapacity occurring (c.10-18% of total operating capacity), if all planned new EfW capacity is fully built and recycling performance improves from the current BAU level.

It is recommended that SG closely monitor the progress of the new EfW projects that are currently under construction and scheduled for delivery between 2024-2027, and remain alert to any material changes in timing and/or scale, so that appropriate mitigation actions can be considered.

6.2.2.3 EfW Plant Outage Management

Poor management of plant outages across Scotland's fleet of EfW facilities presents a significant risk to achieving full landfill ban compliance by driving leakage of Scottish BMW streams to landfills in England, albeit on a temporary basis. Although EfW operators with recent LACW contracts are obliged to provide ban-compliant contingency plans for plant outages, this may not apply to earlier local authority contracts and is also unlikely to apply to 3rd party waste contracts. In addition, the ability of operators to provide fully landfill ban-compliant contingency solutions to unplanned immediate and/or emergency plant closures is a concern.

While it is reasonable to expect that EfW operators will fully comply with the terms of their existing contracts, regarding contingency obligations, it is clear that significant scope for BMW leakage exists, i.e. from early contracts, 3rd party contracts, and during unplanned or emergency closures that last for more than a few days. In addition, the operators of CHP plants with heat exports will prefer summer closures, when heat offtake demand is lowest.

Therefore it is recommended that SG takes steps to engage with the Scottish EfW industry and plant operators to support the development of suitable industry-wide measures and agreements (including reciprocal arrangements between EfW plant operators) that could be put in place over time to mitigate this risk.

7 Key Findings

7.1 Summary

A summary of the key findings from the analyses completed in this report is presented below:

1. **National Capacity Gap:-** The analysis indicates that an infrastructure capacity gap deficit) will likely remain at the outset of the first year of the ban (2026), under worst case waste (BAU) projections and assuming that all Scottish BMW arisings are managed in Scotland. This deficit is forecast to be c.600kta[28] at the start of 2025 but reduce to <200ktpa during 2026 and subsequently change to a small capacity surplus from 2027 onwards, provided that all of the new EfW infrastructure currently under construction is fully delivered within the planned 2024-2027 timescale. Beyond 2028 there is the likelihood of significant EfW overcapacity (c.10-18% of total operating capacity) occurring, if all new EfW capacity is fully built and recycling performance improves from the current BAU level. The specific date of capacity gap closure in Scotland is also linked to progress with improving recycling rates and the level of RDF exports. However, even under worst case (BAU) waste arisings projections, Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented.
2. **External Markets:-** Scotland exports a total of c.70-100ktpa of waste to EfW facilities in neighbouring markets in England and mainland Europe (Sweden and Denmark). These appear to be stable and durable end-route markets in the near term at least (although subject to changing commercial and logistical arrangements) for a limited quantity of Scottish RDF. It is considered that these external markets have capacity for continuation and expansion in the short-medium term and also to mitigate the forecast short-term infrastructure capacity gap. However a substantial temporary increase in current RDF exports will be required by late 2025 in order to meet the forecast capacity deficit for the start of 2026, while taking account of the time required to secure the necessary contracts (and permits for exports to Europe) well in advance of Q4 2025.
3. **Landfill Capacity:-** forecast permitted landfill capacity for active non-hazardous waste in Scotland in the pre-ban years 2024 and 2025, far exceeds the forecast EfW capacity deficit in these years, i.e. c.1million tonnes (2024) and c.600kt (2025). However, permitted LF capacity is not directly representative of engineered cell capacity, and this latter figure should be separately established, since many landfills in Scotland are in the process of closing down.
4. **Risks and Mitigations:-** the key risks to successful implementation of the Bioban and associated mitigations are:
    - **EfW Infrastructure Capacity Deficit 2026 Risk:-** It is probable that a substantial capacity gap of c.600kta will exist at the start of 2026. Although this is expected to be short-lived and reduce to <200kta during 2026, as new EfW capacity comes online, the current level of RDF exports from Scotland will need to substantially increased to meet this demand and ensure compliance with the ban. ***Recommended mitigation***: *SG engage with relevant industry bodies and commercial operators during 2024 (including SESA and RMAS), to highlight this issue and support the facilitation of timely securing of RDF export contracts in advance of late 2025.*
    - **EfW Infrastructure Capacity Gap Closure Risk**: Although the analysis forecasts closure of the current EfW infrastructure capacity gap by around 2027, under worst-case or BAU conditions, there is a significant risk that delivery of merchant EfW infrastructure capacity by 2028 is either delayed or significantly lower capacity than currently anticipated, due to unforeseen conditions. This would result in a longer period of national capacity deficit during the early years of the ban, and increase reliance on a combination of higher RDF exports, alternative management options for the non-municipal fractions and increased recycling. However, even

[28] c.24% of total planned operating capacity

under worst case (BAU) waste arisings projections, Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented. In addition, there is the likelihood of significant EfW overcapacity (c.10-18% of total operating capacity) occurring beyond 2028, if all new EfW capacity is fully built and recycling performance improves from the current BAU level. ***Recommended mitigation:-*** *SG closely monitor the progress of the development of the EfW projects that are scheduled for delivery in 2024-2027 for material changes in timing and/or scale, so that appropriate mitigation actions can be considered.*

- **EfW Plant Outage Management Risk:-** Poor co-ordination of plant outages across the Scotland's network of EfW facilities may drive leakage of Scottish BMW to landfills in England, albeit on a temporary basis. Although EfW operators can be expected to fully comply with the terms of their existing contracts with respect to landfill ban-compliant contingency obligations, significant scope for BMW leakage exists from early contracts, 3rd party contracts, and during extended unplanned or emergency closures. ***Recommended mitigation:-*** *SG engages with the Scottish EfW industry and plant operators to support the development of suitable industry-wide measures and agreements (including reciprocal arrangements between EfW plants) that could be put in place over time to mitigate this risk.*

5. **Other significant issues:-** although not considered to present significant risk for successful implementation of the ban in 2026, the following issues and actions should be considered further by SG:

   - **Engineered Landfill Capacity:-** although forecast permitted landfill capacity for active non-hazardous waste in Scotland in years 2024 and 2025 far exceeds the forecast EfW capacity deficit in these years, this is not directly representative of available engineered cell capacity. *It is recommended that SG should separately confirm the adequacy of available engineered cell capacity, as a matter of urgency, since many landfills in Scotland are now in the process of closing.*

   - **Orphaned Wastes:-** Operators identified the lack of specific provision for 'Orphaned Wastes' i.e. those BMW wastes which cannot be landfilled but do not combust well or are unsuitable for EfW, citing certain trommel fines, treatment residues and rope as examples. While this is not considered to be a significant risk (in terms of waste quantity), it is nevertheless an issue that requires more detailed consideration in order to identify an agreed approach for these waste materials. *It is recommended that this issue is included in the future engagement process with industry bodies and operators regarding SEPA's published guidance for monitoring and reporting compliance with the ban requirements, and this should include developing a process to identify potentially problematic materials and wastes streams for consideration and analysis / testing.*

   - **ETS / CCUS Regime:-** Operators are beginning to develop their approach to the application of the UK ETS scheme to the EfW sector from 2028, with those located in central and NE Scotland considering access to the Acorn CCS infrastructure to decarbonise their operations, and others more likely to rely on increasing gate fees to fund the additional costs associated with the carbon levy on stack emissions. This issue is not considered to be an immediate risk for successful implementation of he ban. However since a key impact of this measure will be to substantially increase EfW gate fees to waste producers (by c.£50+/tonne), it may have the effect of driving waste management towards increased use of the lower cost landfill route (including use of English landfills for Scottish non-municipal waste fractions) unless restrictions on landfilling of BMW apply in England by 2028, and/or landfill tax increases sufficiently to balance the two options. *It is recommended that SG take account of this in their planning of future changes to the Scottish Landfill Tax rate, as well as monitoring of future LFT rates in England.*

- **Extension of Bioban to all biodegradable wastes:-** the findings of this study should be used to inform SG decision making regarding any future extension of the current ban to include biodegradable wastes of non-municipal origin.

7.2 Conclusions

Scotland's current infrastructure capacity gap is forecast to close by around 2027, as new EfW plants currently under construction, and scheduled for completion become operational during the period 2024 – 2027, with an EfW capacity surplus possible from 2028 onwards.

However an EfW infrastructure capacity deficit is forecast for the start of the first year of the ban (2026); filling this deficitwill require a substantial increase in the current tonnage of RDF exported from Scotland via well-established RDF export routes to England, Sweden and Denmark, with increased export contracts for BMW waste from commercial sources required by late 2025. SG engagement with industry and commercial operators is recommended in 2024 in order to facilitate securing of the required new RDF export contracts to commence in 2025.

Although Scotland's EfW capacity gap is expected to close, unless one or more of the larger 'pipeline' EfW projects fails to be fully implemented, unexpected delay or reduction in the delivery of planned new EfW capacity would extend the period of the national capacity deficit and require increased reliance on a combination of higher RDF exports, alternative management options for the non-municipal fractions and (in time) higher recycling rates.

Therefore close monitoring of the new EfW infrastructure delivery progress by SG is recommended over the next 4 years as essential to recording and responding to development of Scotland's EfW capacity. Other interventions by SG are also recommended in the short term with respect to the coordination of EfW plant outage management, confirmation of adequate engineered landfill capacity, and consideration of options for management of orphaned wastes. In the longer term SG should monitor the impacts of ETS implementation on EfW gate fee increases (post 2028) and consider what rate of Scottish Landfill Tax is appropriate once EfW gates fees increase significantly in response to this.

Appendix A

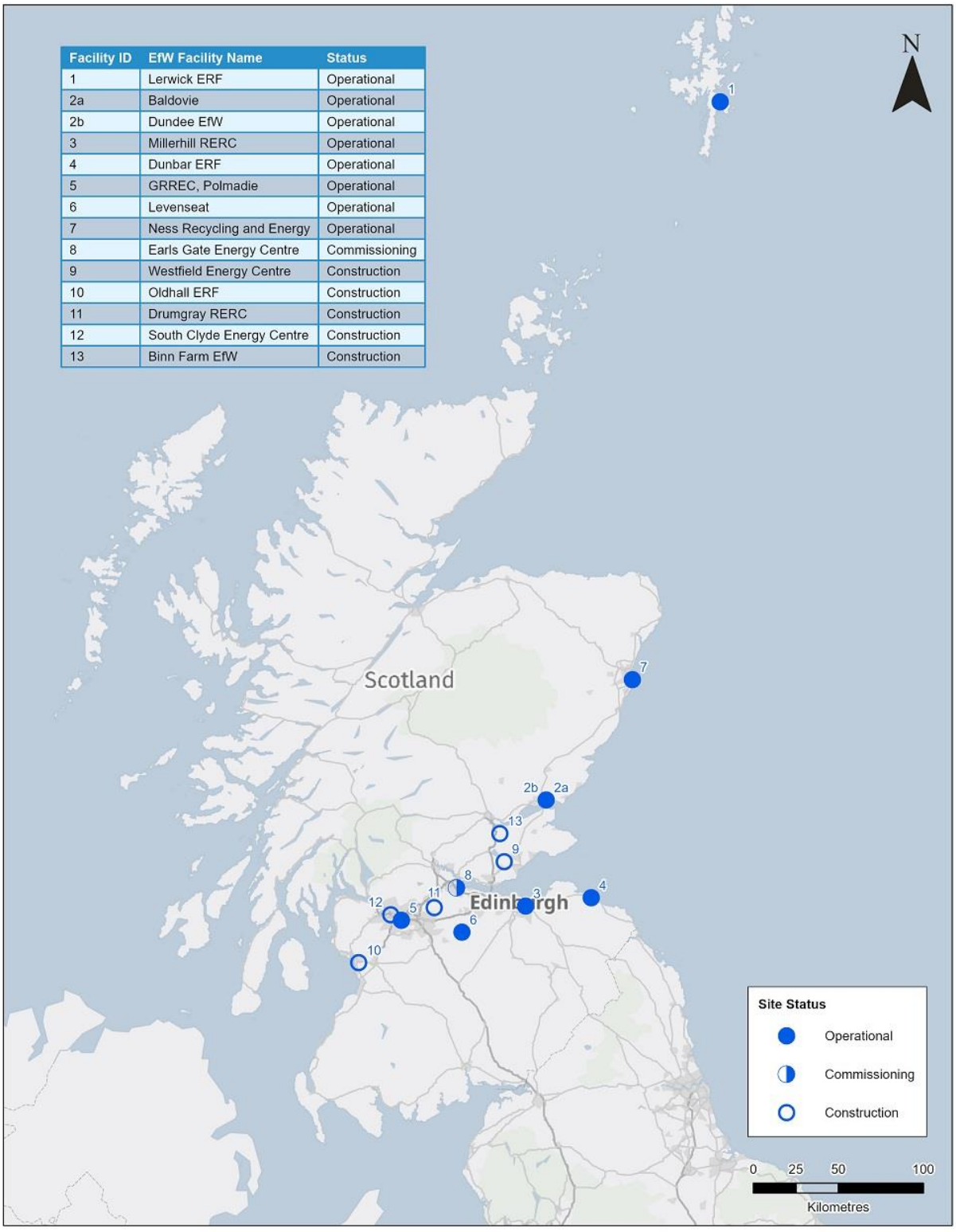
EfW Operator Proforma Questionnaire

Question / Issue	Comment / Supplementary Questions
Facility Name	Common Name
Operator Name	
Location	Nearest Town or City
Service Commencement Date	Actual or predicted if not yet achieved
	If not achieved SC yet, when is the facility likely to be accepting waste for hot commisisoning?
Closure Date	Is there a known or predicted closure date for the facility?
Fuel Type	Municipal, Municipal like C&I and/or Clinical
Permitted annual capacity	What is the maximum permitted waste input under the Environmental permit?
Actual operating capacity	What is the actual or predicted annual input allowing for tolerances?
Tonnes per hour throughput	What is the design throughput?
Fuel Specification	What is the design point?
	What is the designed CV range?
	Current average CV, if known
Grate Type	Mass Burn, Gasification
CHP	Is the facility currently exporting heat as well as electricity
	If no, what is the planned date for connection?
Pretreatment	Does the facility include pretreatment facilities?
	If so, what capability is available? e.g. shredding of oversize, front end removal of metals/plastics?
POPs	Is the facility currently accepting POPs wastes?
	If no, do you have any plans to do so in the future? Please provide planned date if so.
Capacity under Contract	How much capacity is guaranteed to producers under contract?
	Who are the major producers under contract ?
Is 3rd party waste allowable and what level of spare capacity is predicted?	SG would like to know if there is likely to be any spare or additional capacity that could be made available to others but understands this is not guaranteed
Capacity available to market	How much capacity is under short term contract or made available on a spot market basis?
Maintenance Schedule and Contingency Arrangements	Do you plan for annual outages or other time period? Please explain if not annual.
	In what month are these planned for?
	What is the planned period of outage?
	Does waste required to be dealt with offsite during these periods and how is this managed? If currently landfill, what are your plans from 2026?
	How often are longer/major periods of downtime planned for?
	For how long is the plant expected to be down during a major outage?
	What will happen to the waste during a major outage? e.g. exported/baled & stored/sent to alternative EfW in Scotland/sent to alternative EfW outside Scotland
Emissions Trading Scheme	Do you have plans to alter the operation of the facility post 2028 when the ETS charges come into force?
Any other comments on future operations	If there is anything you think SG should be considering wrt to the landfill ban, please add here

Appendix B

EfW Plants Map Scotland 2024

Facility ID	EfW Facility Name	Status
1	Lerwick ERF	Operational
2a	Baldovie	Operational
2b	Dundee EfW	Operational
3	Millerhill RERC	Operational
4	Dunbar ERF	Operational
5	GRREC, Polmadie	Operational
6	Levenseat	Operational
7	Ness Recycling and Energy	Operational
8	Earls Gate Energy Centre	Commissioning
9	Westfield Energy Centre	Construction
10	Oldhall ERF	Construction
11	Drumgray RERC	Construction
12	South Clyde Energy Centre	Construction
13	Binn Farm EfW	Construction




ZERO
WASTE
SCOTLAND