Call for Evidence Response

UKWIN SUBMISSION TO THE SCOTTISH INCINERATION REVIEW

Covering the following topics:

- Recommendations
- Capacity Analysis
- Management Options
- Economic, Environmental and Social Trade-offs
- Locational Considerations
- Improving Existing Facilities

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About UKWIN

The United Kingdom Without Incineration Network (UKWIN) was founded in March 2007 to promote sustainable waste management. UKWIN works at a national level to make expertise available to those wishing to participate in environmental decisions relating to waste management, including providing support with accessing environmental information and pursuing justice in environmental matters.

UKWIN advocates for economic, policy and legislative drivers to support sustainability in general, and more specifically to support the move away from incineration and towards a sustainable low-carbon circular economy.

UKWIN also highlights social, environmental and economic issues associated with incineration, including through social media and our website, and by contributing to relevant public consultations, as well as through ongoing work with academics and journalists.

For more about UKWIN see our website at: https://ukwin.org.uk/

GLOSSARY OF TERMS USED

Term	Meaning
BEIS	Department for Business, Energy & Industrial Strategy, a part of the UK Government.
Biogenic carbon	Carbon from biogenic sources such as paper, card and food waste. When combusted, one tone of biogenic carbon results in the release of 3.667 tonnes of biogenic CO_2.
Biogenic CO_2	Carbon dioxide from biogenic sources such as paper, card and food waste. This is sometimes said to be part of a 'short cycle' of carbon emission and re-absorption through new growth.
CCGT	Combined Cycle Gas Turbine.
CH_4	Methane, a greenhouse gas.
CHP	Combined Heat and Power. Refers to incinerators exporting both heat and electricity.
CO_2	Carbon dioxide, a greenhouse gas.
CO_2e	Carbon dioxide equivalent. This includes CO_2 as well as other greenhouse gasses expressed in relation to their equivalent level of GHG impact within a given timeframe.
Defra	The Department for Environment, Food & Rural Affairs, a part of the UK Government.
Energy from Waste (EfW)	This can mean thermal treatment (incineration, gasification, pyrolysis) or a wider class of technologies which could also include anaerobic digestion, energy generated from landfill gas capture, and/or the conversion of waste into fuels such as transport fuels.
EA	The Environment Agency, a UK Government agency.
ERF	Energy Recovery Facility, e.g. a waste incinerator that generates energy.
Fossil carbon	Carbon from fossil fuel sources (e.g. conventional plastics). When combusted, one tone of fossil carbon results in the release of 3.667 tonnes of fossil CO_2.
Fossil carbon percentage	Depending on the context, this can either be the percentage of material which is fossil carbon or the proportion of the carbon which is fossil rather than biogenic carbon.
Fossil CO_2	This primarily refers to carbon dioxide from fossil fuel sources (e.g. conventional plastics). However, it is also used to refer to other greenhouse gases, such as methane, which are not considered to form part of the 'short cycle' of biogenic CO_2.
GHG	Greenhouse gas(es). A gas such as carbon dioxide (CO_2), methane (CH_4) or nitrous oxide (N_2O) that contributes to global warming.
ktpa	Kilotonnes per annum (1,000 tonnes per year).
kWh	Kilowatt hour.
MBT	Mechanical and Biological Treatment. Involves recycling and/or composting with residues going to incineration or landfill. Can be focussed more on RDF production than on maximising recycling.
MRBT	Material Recovery and Biological Treatment. A form of MBT focussed on maximising recyclate recovery, generally involving bio-stabilised residues going to a controlled landfill rather than to incineration.
MW	Megawatt.
N_2O	Nitrous oxide, a greenhouse gas.
RDF	Refuse derived fuels. A form of processed waste feedstock.
SRF	Solid recovered fuels. Refuse derived fuel produced to a detailed specification, e.g. to be burned at cement kilns.
tpa	Tonnes per annum (year).
tCO_2e	Tonnes of CO_2e (often expressed per annum / year).
UK	The United Kingdom of Great Britain and Northern Ireland.
UKWIN	The United Kingdom Without Incineration Network, founded in March 2007 to promote sustainable waste management. See: https://ukwin.org.uk/
ZWS	Zero Waste Scotland

RECOMMENDATIONS

UKWIN suggests the following recommendations, supported by the evidence set out in this submission, be made to the Scottish Government as part of the Incineration Review to inform Scottish Ministers on future policy around incineration in Scotland:

- The Scottish Government [SG] should immediately introduce an indefinite moratorium on new waste incineration capacity in Scotland. Such a moratorium should ensure that no new or expanded planning permission for waste incineration capacity will be consented. Modifications of planning permissions for existing capacity should be strictly controlled.
- The SG should move quickly to consulting on an 'Incineration exit strategy for Scotland', including setting a clear target date for ending incineration in Scotland.
- The SG should introduce a middle band of landfill tax (or a 'sliding scale') to encourage biostabilisation prior to landfill as part of revising the approach to the landfill ban to focus on reducing the harmful impacts of landfill rather than merely reducing the proportion of waste sent to landfill. Furthermore, the Scottish Government should fund an exemplar biostabilisation pilot, with detailed results to be made public. This can help inform consideration of future projects, as well as any changes to respiratory tests and standards.
- The SG should follow the Committee on Climate Change's (CCC's) recommendation that landfill diversion should be achieved through reduction, reuse, and recycling, and not through incineration. The Scottish Government should also follow the CCC's recommendation to set new ambitious recycling and waste prevention targets for 2030.
- Mandatory compositional analysis should be required of all existing incinerators in Scotland to determine how much of the materials currently being used as incinerator feedstock could have been collected for recycling, composting, reuse, or substituted with more recyclable materials (with the results made public).
- Incineration should be moved to its own category in Scotland's GHG inventory reporting, with figures based on real world monitoring, and with the level of biogenic CO_2 clearly reported, alongside fossil CO_2 emissions.
- Storage of biogenic carbon in landfill should be monitored and included in GHG inventory reporting in line with US Environmental Protection Agency's approach.
- The SG should, as a matter of urgency, require SEPA to make information available online, including information about existing incineration facilities that are required to be part of their public register, e.g. all Annual Environmental Performance Reports, all quarterly returns and similar reporting forms, etc.
- The SG should commit to the principle that no public funding (including public service pension funds) should be made available for incineration, including for either carbon capture or district heating schemes, in order to prevent adding new barriers to the transition to the circular economy.

- The SG should impose an incineration tax on existing waste incinerators, set at a meaningful rate that reflects the CO_2 emissions and encourages recycling and the move towards a circular economy. Where costs incurred through this tax relate to hard-to-recycle materials this cost should be passed on to producers through Scotland's Extended Producer Responsibility (EPR) scheme. Funds raised through the incineration tax should be spent on the top tiers of the waste hierarchy, in particular on waste prevention and reuse.
- The SG should require SEPA to ensure that, when reviewing existing incinerator permits or when considering permit applications for those incinerators that have been granted planning permission prior to the imposition of the moratorium, permits include strict conditions for operators to apply higher standards of Best Available Technique (BAT) and for operators to carry out more monitoring of emissions and their associated adverse impacts.
- Greenwashing terms such as 'low carbon' or 'renewable electricity' when applied to energy generated by waste incinerators should be declared 'false advertising', and incinerator operators and Government departments should be advised to refer to incinerators as 'incinerators' rather than euphemisms such as 'Energy from Waste' (a term that can also be used to describe non-incineration sources of energy, such as anaerobic digestion and landfill gas capture).
- To increase recyclate capture, the SG should investigate the feasibility and desirability of adopting collection and sorting systems whereby citizens can put all potentially recyclable dry materials (such as all grades of clean plastics) into their recycling bin, which can then be further sorted to determine the optimal treatment option for that material (as this would greatly increase capture rates for recyclable material while addressing problems associated with 'contamination').
- There should be monitoring of the prevalence of hard-to-recycle products to facilitate dialogue with the producers and designers of those products. This could also support the publication of 'league tables' showing which brands are the 'worst offenders' and which are 'most improved', etc. as part of an education drive to engage consumers in better (i.e. more prudent) resource management.
- Assessments of the impacts of the climate impacts of waste incineration when compared to landfill should be carried out in line with UKWIN's GHG Good Practice Guidance.[1]
- In circumstances where a Council's existing long-term waste contract is proving to be a barrier to improved recycling and waste prevention (e.g. due to put-or-pay clauses relating to incineration) then the Scottish Government should support them to renegotiate or exit that contract.

[1] Available at https://ukwin.org.uk/files/pdf/UKWIN-2021-Good-Practice-Guidance-for-Assessing-the-GHG-Impacts-of-Waste%20Incineration.pdf

ABOUT UKWIN

Q1. What is your name?

Josh and Shlomo Dowen, UKWIN Network Coordinators

Q2. What is your email address?

coordinator@ukwin.org.uk

Q3. Which category in the following list best describes you?

vii. Environmental group

Q4. If you are replying on behalf of a business or representative organisation, please provide the name of the organisation/sector you represent, where your business is located, and an approximate size/number of staff (where applicable).

Name of organisation: The United Kingdom Without Incineration Network (UKWIN)

Registered office: 25 The Birchlands, Mansfield, Nottinghamshire NG19 0ER

Phone number: (01623) 640134

Organisation size: UKWIN has no employees and is instead made up of hundreds of volunteers and several paid consultants located across the UK.

Q5. We confirm that we have read the privacy policy and that we consent to the data UKWIN has provided being used as set out in the policy. For the avoidance of doubt there are no elements of UKWIN's response that need to remain confidential.

Q6. The Review Team have permission to contact UKWIN about our response.

TOPIC 1: CAPACITY ANALYSIS

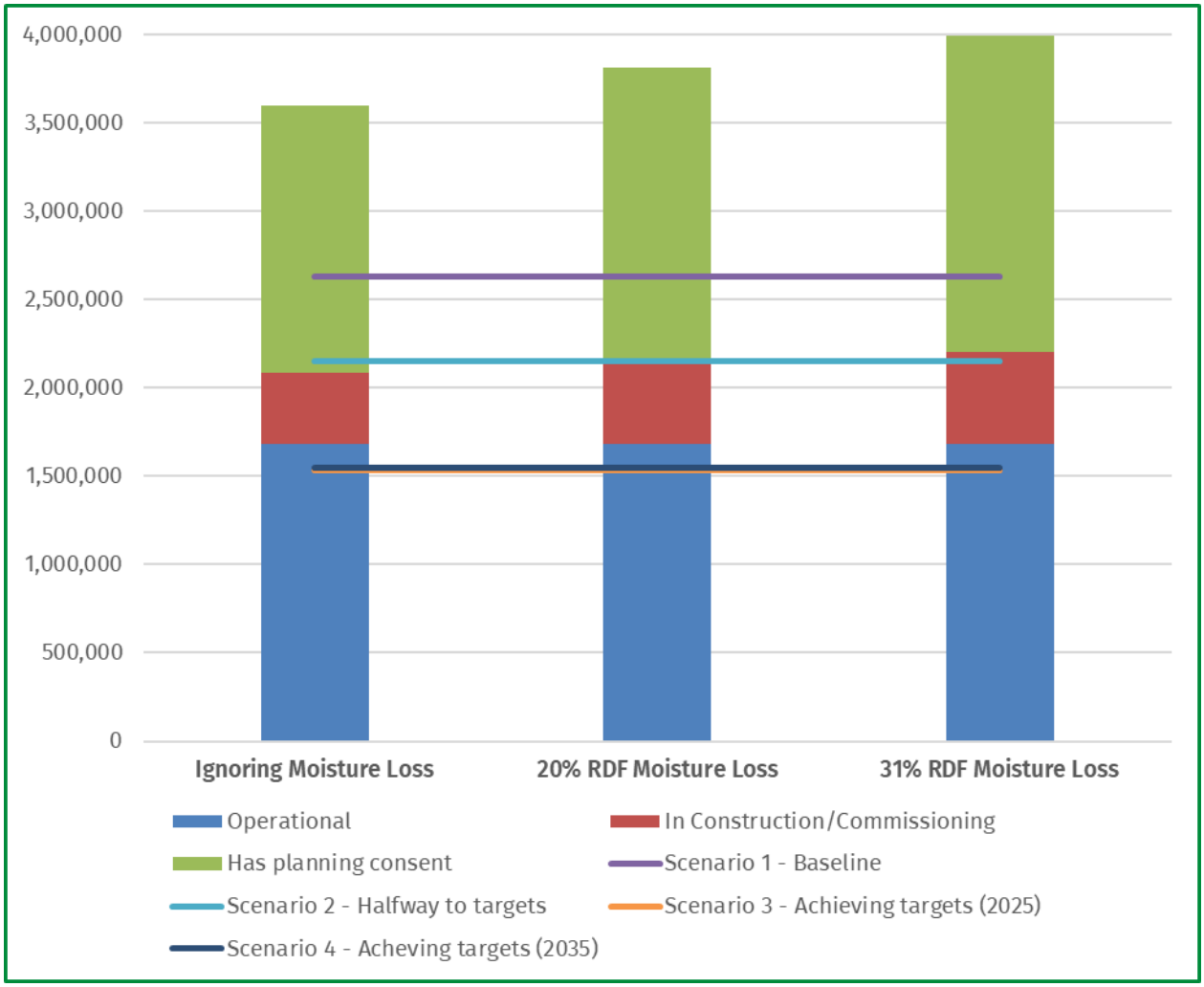
Estimate of Scotland's residual waste treatment overcapacity

The level of incineration and other residual waste treatment capacity in Scotland that is already built, under construction or consented currently exceeds the anticipated future levels of residual waste arising that would be available for use as incinerator feedstock. As such, Scotland clearly already has incineration overcapacity (see chart below, and description of the four scenarios further below).

Assuming Scotland's recycling and waste prevention targets are met (**Scenarios 3 and 4**), waste arisings exceed residual waste treatment capacity that is currently either operational or under construction by between around 530ktpa and 670ktpa. If the 1.5m – 1.8m tonnes of consented capacity is taken into account, then the level of overcapacity rises to between around 2m – 2.5m tonnes per annum.

Even if Scotland's recycling targets are not achieved (**Scenarios 1 and 2**), there remain an overcapacity of between around 960ktpa and 1,840ktpa when capacity which has been granted planning consent is taken into account.

Estimate of Incineration Overcapacity in Scotland



As set out further (below), because some of the residual waste treatment facilities are designed to process RDF, sensitivity analysis has been provided for the pipeline capacity to show the impact of assuming 20%–31% moisture loss for this RDF.

The Call for Evidence document provided three estimates for residual waste arisings in 2025:

- **Scenario 1 – Baseline** / 'Business as usual' – 2.63 Mt
- **Scenario 2 – Approaching targets ('Halfway to targets')** – 2.15 Mt
- **Scenario 3 – Achieving targets (2025)** – 1.53 Mt

While all scenarios have been considered for this submission, we see **Scenario 3** as the only reasonable basis for capacity analysis amongst the three scenarios proposed, as **Scenario 3** is the only scenario that is premised on actually meeting the Government's targets. **Scenario 1** does not take into account any of the policy measures currently in place, and **Scenario 2** is only halfway towards the targets compared to the baseline and so is not actually 'approaching' the targets as its title suggests.

The Call for Evidence projections do not go beyond 2025, but it is reasonable to assume for the purpose of the capacity analysis that **Scenario 3**'s 1.53 Mt arisings figure for 2025 would remain stable, with increases in population and/or economic activity being offset by increased recycling and per-capita waste prevention.

This assumption would provide a figure which is broadly in line with the figures in the Waste Market Study Full Report published by the Scottish Government in April 2019.[2] That report included a scenario "in which Scotland meets planned and likely recycling and waste prevention targets through to 2035" with residual waste arisings at the end of that period of around 1.55 Mt. For the purpose of this submission, we refer to this as **Scenario 4 – Achieving targets (2035)**.

[2] https://www.gov.scot/publications/waste-markets-study-full-report/

Principles

When it comes to residual waste treatment capacity analysis, we propose that the following principles be adopted:

1. It is desirable to avoid or limit incineration overcapacity, and this means that if current capacity exceeds future demand then this should be considered to constitute 'overcapacity'. Incinerators can last for decades, and so the construction of new incineration capacity cannot reasonable be justified on the basis of short-term residual waste treatment capacity gaps.
2. Any assessment of current capacity ought to include all capacity that is operational, under construction or consented. Consented capacity is included because it would be difficult or costly to prevent facilities with planning permission from obtaining a permit and being built (e.g. compensation may have to be paid to would-be operators in the event the Scottish Government decided to revoke permission or otherwise prevent a consented facility from being built and operated in accordance with its planning permission).
3. The production of 1 tonne of Refuse Derived Fuel (RDF) requires more than 1 tonne of waste, meaning that the capacity of incinerators designed to process RDF feedstock can be assumed to be higher than the headline RDF incineration capacity figure.
4. When determining future demand for incineration capacity, assessments should be made on the basis that national recycling and waste prevention targets will be met, because otherwise there is the real danger of a 'self-fulfilling prophecy' whereby incineration overcapacity prevents recycling and prevention targets from being met. Account should be taken not only of current recycling and waste prevention targets, but also of the desirability of achieving even higher levels in the future.

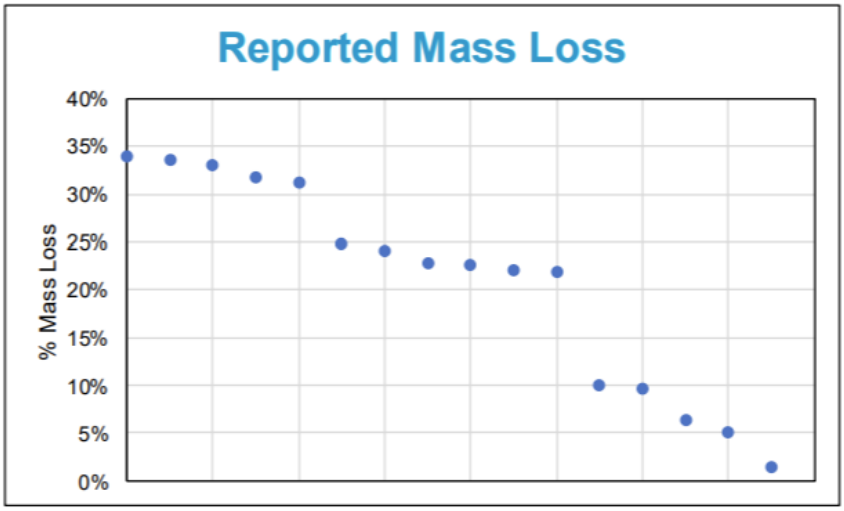
Moisture Loss from MBT processes

A number of the existing and emerging incinerators in Scotland are designed to process RDF, which means the feedstock would first have been treated (e.g. dewatered) at a Mechanical and Biological Treatment (MBT) facility.

According to Guidance for Local Authorities from Natural Scotland and SEPA: "Some unsorted waste processes such as MBT and MHT dry the waste as part of the preparation of a refuse derived fuel" which will cause a "reduction in mass".[3]

Tolvik has estimated moisture loss (reduction of mass) at MBT facilities in the UK to be on average around 20%, meaning incinerators in effect require around 1.25 times the quantity of source ('raw') waste[4] relative to the headline incineration capacity (excluding material loss through recycling).[5]

***Reported Mass Loss as % of input Tonnage** for UK MBTs (Tolvik 2017)*



For example, by way of illustration, the Fortum Glasgow South Clyde facility's is able to process 374,000tpa of feedstock (comprising RDF) based on the operator's assumption that the plant can treat 44 tonnes of waste per hour with the operator's expected NCV multiplied by an assumed 8,500 hours of operation.[6] If the facility treated 374,000tpa of RDF then it would in effect require around 467,000tpa of waste based on a 20% moisture loss (374,400 x 1.25) or around 542,300tpa of waste based on a 31% moisture loss (374,000 x 1.45).

[3] Zero Waste Plan – Guidance for Local Authorities. Use of Data to Support the Zero Waste Plan – Local Authority Recycling Targets, Landfill Diversion and the Landfill Allowance Scheme. March 2011. Available from: https://www.wastedataflow.org/documents/guidancenotes/Scotland/zero_waste_plan_recycling_guidance1.pdf

[4] The multiplication factor is based on the formula 100 ÷ (100-N) where N is the mass loss due to moisture loss. For example 100 ÷ (100-20) = 100 ÷ 80 = 1.25

[5] Briefing Report: Mechanical Biological Treatment – 15 Years of UK Experience. Tolvik, September 2017. Available from: https://www.tolvik.com/wp-content/uploads/2017/09/Tolvik-2017-Briefing-Report-Mechanical-Biological-Treatment.pdf

[6] 8,500 hours is considered a reasonable figure to take into account the high levels of availability which can be achieved, the potential for lower calorific values from the removal of plastics to increase the effective capacity of plants, and to take into account how if there is a moratorium on new incineration capacity this can be expected to encourage operators to maximise the availability of their plants. If fossil CO_2 emissions are taxed or included in the emissions trading scheme then this would provide an added incentive to remove plastics.

The 20% moisture loss assumption is lower than the figure used by some sources. Historic WasteDataFlow guidance from the Environment Agency advised a default adjustment factor of 1.33 "to take account of moisture loss from an MBT or similar process", which implies 25% moisture loss as being typical, and this higher figure was accepted as reasonable during the Call for Evidence workshop on incineration capacity attended by UKWIN.

In terms of data from Scotland, it was reported by Dumfries and Galloway Council that moisture loss represented 31% of the input of their MBT plant in 2018, based on a moisture loss of 15,800 tonnes for a total input tonnage of 51,000.[7]

Depending on the moisture loss assumptions used, taking moisture loss into account increases the effective capacity that in construction/commissioning and with a live planning consent by between around 217ktpa and 392ktpa. Further details of these calculations are available upon request.

Cement Kiln / Co-incineration capacity

The CxC analysis does not explicitly reference any SRF capacity and only refers to RDF capacity. Residual waste is increasingly being converted into Solid Recovered Fuels (SRF) for use as feedstock to provide heat for cement kilns as an alternative to the conventional use of fossil fuels. To account for this trend, it is assumed that 100,000 tonnes of waste per annum of additional waste will be converted into SRF for use in cement kilns in Scotland.[8]

[7] https://www.publiccontractsscotland.gov.uk/Search/show/Search_View.aspx?ID=MAY353279 with 15,800 ÷ 51,000 = 0.3098 = 31%

[8] This estimate was derived on the basis of Eunomia's prediction of 1.0m tonnes of UK cement kiln feedstock from residual waste by 2030 combined with an assumption that 10% of this will be from waste arising in Scotland. See: http://www.eunomia.co.uk/reports-tools/residual-waste-infrastructure-review-12th-issue/

Methodology for calculating existing/pipeline capacity

Operational Capacity

Facility	Type	Capacity (tpa)	Basis
East Lothian / Dunbar ERF	EfW	387,770	Based on PPC/A/1032878/CP01/VN02 capacity of 22.81 tonnes per hour per line for 2 lines.
Dundee (including Line 3)	EfW	286,450	Based on per-line capacities with 2 lines at 10 tonnes per hour and 1 line at 13.7 tonnes per hour specified in permit PPC/A/1003157.
Shetland Islands / Lerwick	EfW	23,749	95% of CxC modelled capacity
Edinburgh Millerhill Energy	EfW	204,000	Based on 24 tonnes per hour in permit for 8,500 hours (section 4.2.2 of permit PPC/A/1136072)
Glasgow GRREC	ATT	149,000	Based on Tolvik (May 2021) estimated treatment in 2020
Levenseat	ATT	109,650	Based on 12.9 tonnes per hour nominal design capacity in permit PPC/A/1150156.
Levenseat (Forth by Lanark)	MBT/RDF	250,000	CxC modelled capacity
Eco Deco Dumfries	MBT/RDF	70,000	CxC modelled capacity
Avondale	MBT/RDF	70,000	CxC modelled capacity
Dalinlongart Compost	MBT/Bio	10,000	CxC modelled capacity
Moleigh, Kilmore	MBT/Bio	10,000	CxC modelled capacity
Lingerton Compost	MBT/Bio	10,000	CxC modelled capacity
Co-incineration	Cement Kilns	100,000	See above
	Sub-Total	**1,680,619**	

Pipeline – In Construction

Facility	Type	Capacity (tpa)	Basis	RDF Uplift (20% Moisture)	RDF Uplift (31% Moisture)
Earls Gate Energy Centre	EfW	260,300	95% of CxC modelled capacity. Lower than theoretical maximum for 31.8 tph for 8,500 hrs (270,300 tpa)	+ 65,075	+ 117,135
Aberdeen Recycling & Energy Recovery (NESS)	EfW	142,500	95% of CxC modelled capacity.		
Sub-Total		**402,800**		**+ 65,075**	**+ 117,135**

Pipeline – Has planning consent (with/without permit)

Facility	Type	Capacity (tpa)	Basis	RDF Uplift (20% Moisture)	RDF Uplift (31% Moisture)
Drumgray (FCC)	EfW	260,300	Based on nominal design capacity of 37.5 tonnes per hour in permit application		
South Clyde (Fortum Glasgow)	EfW	318,750	Based on 44 tonnes per hour based on expected NCV in permit application PPC/A/11683564	+ 93,500	+ 168,300
Westfield, Fife (Hargreaves)	EfW	374,000	95% of CxC modelled capacity (although permit application refers to potential for 34.223 tph for lower NCV which would be 290,896 for 8,500 hours)	+ 59,375	+ 106,875
Old Hall, Irvine (Doveyard)	EfW	237,500	95% of CxC modelled capacity		
Binn Farm (Binn Group)	EfW	171,000	95% of CxC modelled capacity		
Avondale (NPL Group)	EfW	79,800	95% of CxC modelled capacity		
Inverurie (Agile Energy)	EfW	142,500	95% of CxC modelled capacity		
Sub-Total		**1,513,550**		**+ 152,875**	**+ 275,175**

Basis for Government intervention to address overcapacity issue through a moratorium on new capacity

The Scottish Government should intervene to prevent the exacerbation of incineration overcapacity through the immediate introduction of an indefinite moratorium on new waste incineration capacity in Scotland.

Reasons for this intervention include:

- The high level of residual waste treatment capacity operational, in construction / commissioning and which has planning consent compared to how much waste can be anticipated once recycling and waste prevention targets are met;
- The threat to recycling and the top tiers of the waste hierarchy posed by incineration overcapacity; and

- The presence of market failures which encourage new (surplus) incineration capacity to be built even if it would be undermining or competing with recycling and waste prevention.

These matters are set out within this section, either above for the first point or below for the second and third. However, there are also reasons not to support additional (new) incineration capacity – even if a residual waste treatment gap were identified – which are set out elsewhere in this submission, including because:

- Incineration creates pollution and harms air quality;
- Incinerators can be bad neighbours;
- Incineration exacerbates climate change, and can result in a net increase in climate change emissions compared to other residual waste treatment options;
- Material incinerated is lost to the circular economy of materials and nutrients, raising further sustainability and climate change concerns; and
- Incinerators are expensive and create lock-in issues.

The recyclability of the 'residual waste' stream

One of the reasons incineration competes with recycling is because much of the material used as incinerator feedstock could otherwise have been reused or recycled. It would be reasonable to assume that the level of recyclability of Scotland's waste is comparable to that of England and Wales.

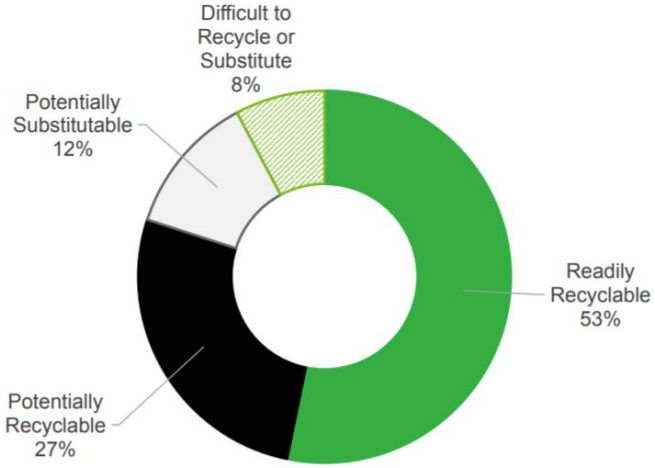
Defra's August 2020 'Resources and Waste Strategy Monitoring and Evaluation Report' found that only 8% of England's residual waste from household sources was "Difficult to Recycle or Substitute", concluding that the majority of the residual waste was readily recyclable.[9]

According to Defra's Report: "The large amount of avoidable residual waste and avoidable residual plastic waste generated by household sources each year suggests there remains substantial opportunity for increased recycling…The message from this assessment is that a substantial quantity of material appears to be going into the residual waste stream, where it could have at least been recycled or dealt with higher up the waste hierarchy".

[9] https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england-monitoring-and-evaluation

The Report goes on to explain how: "Of total residual waste from household sources in England in 2017, an estimated 53% could be categorised as readily recyclable, 27% as potentially recyclable, 12% as potentially substitutable and 8% as difficult to either recycle or substitute".

Chart 13 from Defra's 2020 Resources and waste strategy monitoring report showing avoidable residual waste from households in England



A WRAP Cymru study entitled 'Composition analysis of Commercial and Industrial waste in Wales' was published in January 2020.[10] According to WRAP Cymru: "This study was conducted to provide Welsh Government and WRAP Cymru up-to-date data on the composition of mixed residual commercial and industrial (C&I) waste in Wales. The main objective was to estimate the proportion of the residual waste produced in Wales which could be avoided through recycling or composting". The study found that the majority (74.5%) of the residual waste analysed could have potentially been recycled.

Table 3 from WRAP Cymru commercial & industrial (C&I) waste study showing the recyclability and biodegradability of 'residual' C&I waste in Wales

		Average	STDEV.S	C.I. 95%
Commercial	Recyclability	74.0%	13.8%	3.4%
	Biodegradability	60.5%	10.7%	2.6%
Industrial	Recyclability	80.5%	10.9%	8.7%
	Biodegradability	48.7%	11.0%	8.8%

Examples of market failures

It is not safe to assume that market forces will prevent the exacerbation of incineration capacity.

[10] https://wrapcymru.org.uk/resources/report/composition-analysis-commercial-and-industrial-waste-wales

According to an opinion piece by Adrian Judge (Director of waste consultancy Tolvik) published on 19th August 2020 on the *letsrecycle.com* website[11]: "…it increasingly appears that there is one critical skill necessary for a successful project which is being overlooked: 'understanding'…Above all, understanding is the thoughtful application of common sense…Tolvik is regularly asked to assess the future balance between Residual Waste supply and EfW capacity. To date we have assumed that the checks and balances of rational investors, particularly where external project finance is required, will ensure that, unlike northern Europe, the risk of EfW over-capacity in the UK is very low. However, increasingly, project developers seem willing to ignore the need for 'understanding' if it is going to give them the wrong answer".

Elaborating upon this point, Judge adds: "We see this with our market due diligence reports. As the market tightens, if our analysis is not favourable then we are increasingly being asked to change our assumptions. Most often this is a variant of 'can't you just increase the size of the modelled Catchment Area?' Having engaged experienced independent consultants, this appears to be a deliberate decision to redefine 'understanding'…But ignoring this need for 'understanding', when repeated across multiple projects, is starting to lead us to question whether the risk of EfW over-capacity is as low as we had previously assumed".

One reason that the market cannot be expected to prevent incineration overcapacity is that the adverse impacts of this overcapacity are not fully felt by the companies creating the overcapacity. For example, even if an incinerator harms recycling but it can still be profitable for the operator because they can profit from selling capacity and electricity without having to pay for the CO_2 released[12] or the harm caused due to virgin materials being used to remake a product that has been destroyed.

Given that incineration results in a range of unpaid environmental externalities and market failures (such as the cost to society of incineration, e.g. with respect to fossil CO_2 emissions, not being reflected in the cost of treatment), and given that sending material for incineration can come at the expense of reduction, re-use and recycling, it should not be left to the vagaries of market forces to 'manage' incineration overcapacity.

Instead of relying on market forces to control the level of incineration capacity in Scotland, the Scottish Government should introduce a moratorium on new incineration capacity, thereby sending a clear signal to councils and operators about the need to make better use of existing residual waste treatment capacity and the importance of focussing investment higher up the Waste Hierarchy.

[11] https://www.letsrecycle.com/news/latest-news/understanding-risk-efw-overcapacity/

[12] As set out at https://ukwin.org.uk/facts/#unpaidcost the unpaid cost to society from fossil CO_2 released from UK incinerators in 2020 amounted to more than £1.5bn.

UKWIN response to Call for Evidence questions

Q7 How much capacity do you think we need to build given the current waste produced, managed and disposed of in Scotland, as well as Scotland's waste and recycling targets? What evidence do you have to support this?

As explained above, there is no need for any new incineration capacity to be built in Scotland. Allowing additional (new) incineration capacity to be built in Scotland would result in exacerbating the harm associated with incineration overcapacity and the associated 'lock-in' that could prevent Scotland from reaching its current recycling and waste prevention targets and from adopting more ambitious targets in line with advice from the Committee on Climate Change (CCC).

One of the CCC's Recommendations for the Scottish Government set out in their December 2021 Report to Parliament ('Progress in reducing emissions in Scotland') is to: "Work with the waste sector and local authorities to set out a route-map detailing the policy and support needed to ensure the 2025 waste prevention and recycling targets (including the 70% recycling target) are delivered, and setting new ambitious targets for 2030".

Instead of planning for new incineration capacity, there an urgent need to develop an Incineration Exit Strategy for Scotland that considers how best to strategically reduce and eliminate the incineration of municipal solid waste in Scotland. Such an exit strategy is necessary for Scotland to transition promptly and smoothly towards a circular economy of materials and nutrients by doing away with this harmful leakage.

If there is to be any new 'transitional' residual waste treatment capacity built in Scotland then this should be in the form of MRBT or MBT – i.e. facilities to biostabilise material prior to landfill – to reduce the impact of landfilling waste and to avoid the lock-in associated with incineration capacity.

Q8 It is suggested that the development of incineration capacity could lead to a 'lock-in' effect which will prevent waste from moving further up the hierarchy to be reused or recycled. What evidence do you have about these valid concerns? How do we prevent this lock-in effect, if it is a real risk?

As set out above, much of what is currently being incinerated is material which could be recycled, and in any case Scotland has incineration overcapacity if it is to meet its current recycling and waste minimisation targets. The most reliable way to avoid the exacerbation of further incineration lock-in is to not allow new incinerators to be built.

According to a 2019 report by Eunomia for the Scottish Government: "It would be wise to limit development of new thermal treatment capacity to that required once any targets have been met to avoid creating overcapacity as recycling increases".[13]

Zero Waste Scotland has also warned against incinerator lock-in, for example stating in July 2021 that: “Residual waste treatment, whether landfill, or incineration, is the last port of call for waste. Our position is that we can make a lot more from the materials we have before EfW or landfill becomes the choice of disposal. If we are going to address the climate crisis, we must reuse products far more than we do just now. All our efforts need to go into keeping materials in use and in the system for as long as possible. Incineration and landfill are reserved for residual waste once all other, less environmentally damaging options, such as prevention, reuse and recycling, have been exhausted. The development of waste management technologies must consider the national climate change strategy to ensure Scotland is not locked into management routes which are higher carbon than necessary”.[14]

The Committee on Climate Change (CCC) warned in June 2021 that: "If EfW usage is left to grow unchecked, EfW emissions will quickly exceed those of the CCC pathway while undermining recycling and re-use efforts".[15] [emphasis added]

The CCC also warned in December 2020 as part of their Sixth Carbon Budget reports that: "Banning biodegradable waste from landfill from 2025 is a priority, and should be achieved via prevention, reuse and recycling, not via more energy-from-waste” and that: "An expansion in Scottish EfW capacity occurred ahead of their original 2021 biodegradable municipal waste ban date, and a repeat of this should be avoided (across the UK), due to the risk of locking-in increased EfW fossil emissions".[16]

In the UK, incineration capacity is accompanied by artificially low marginal costs because the majority of the true costs of waste incineration are not allocated to a per-tonne gate fee.

For non-merchant incinerators, once incineration capacity is paid for (or is committed to being paid for) then the amount charged per tonne is artificially lowered, meaning that the amount saved through avoiding incineration is artificially lowered, e.g. due to put-or-pay clauses in the long-term waste contracts.

[13] Source: Waste markets study: full report (Page 23). Scottish Government, 23 April 2019. Available from: https://www.gov.scot/publications/waste-markets-study-full-report/
[14] 'The climate change impact of burning municipal waste in Scotland' (report webpage). https://www.zerowastescotland.org.uk/content/climate-change-impact-burning-municipal-waste-scotland
[15] https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/
[16] 'Policies for the Sixth Carbon Budget and Net Zero' (9th December 2020). Available from: https://www.theccc.org.uk/publication/sixth-carbon-budget/

Furthermore, there are unpaid environmental externalities such as that recognised by Defra with respect to the greenhouse gasses produced when burning plastics.[17]

In essence, this means that, for both household waste and business waste, the 'incentives hierarchy' does not always currently match the waste management hierarchy, and therefore environmentally harmful activities are improperly encouraged and the incentive to invest in recycling and waste education is undermined. It is UKWIN's experience that this has impeded recycling across the UK.

A selection of relevant quotes is provided below, followed by examples of specific instances where incineration (and associated waste management contracts) was cited by councils as a barrier to improved recycling and composting in a local area. The specific examples are mostly about England, but the lessons learned should be applied to Scotland.

Eunomia Managing Director Mike Brown noted in September 2012 that: "Most local authorities that started incinerator projects, often with government PFI support, did so with a clear commitment to burn only what couldn't be recycled, but then found themselves tempted by a business case that stacked up better for a big plant than for a small one. Once the incinerator is built, they have to keep it supplied and rapidly the economic logic of return on investment trumps concerns about recycling".[18]

Defra's November 2012 statistical release noted: "At Local Authority level, individual recycling rates ranged from 14 per cent to 69 per cent…lower rates could result from an authority focusing on avoiding landfill by investing in incineration and targeting its waste management policies on that treatment solution, rather than poor recycling awareness or initiatives".[19]

According to Professor Nicky Gregson of Durham University's 2019 evidence to EFRACOM: "...there is a distinct trade-off. The areas with higher levels of incineration have the lowest recycling rates".[20]

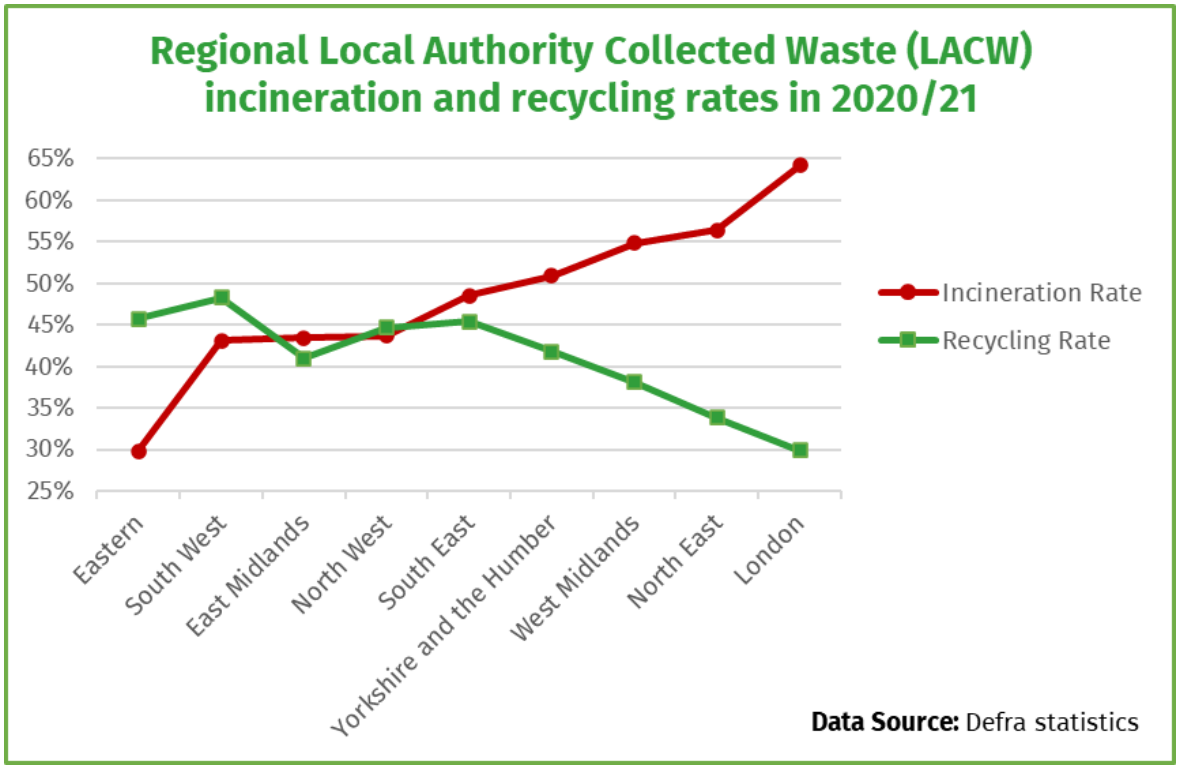
[17] The Economics of Waste and Waste Policy. Waste Economics Team Environment and Growth Economics, Defra (June 2011). Available from: http://www.defra.gov.uk/publications/files/pb13548-economic-principles-wr110613.pdf

[18] The tax that dare not speak its name. Mike Brown, September 2012. Available from: http://www.isonomia.co.uk/?p=1250

[19] Statistical Release: Local Authority Collected Waste Management Statistics for England – Final Annual Results 2011/12. Defra, November 2012. Available from: https://webarchive.nationalarchives.gov.uk/20130222092708/http://www.defra.gov.uk/statistics/files/mwb201112_statsrelease.pdf

[20] Source: Oral evidence: Implications of Waste Strategy for Local Authorities, HC 2071. EFRACOM, 20 May 2019. Available from: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/housing-communities-and-local-government-committee/implications-of-the-waste-strategy-for-local-authorities/oral/102483.pdf

This is borne out for example in English Regional Local Authority Collected Waste (LACW) incineration and recycling rates in 2019/20:[21]



In terms of incineration competing with recycling, there are important lessons that Scotland can learn from neighbouring Wales. For example, the Welsh Government observed in March 2021 that: "We have also seen innovation around Wales in tackling hard to recycle products including mattresses and nappies. But we know half of the household residual waste remaining in our black bags can still be recycled, with half of this being food waste. Three quarters of our residual commercial and industrial waste is also easily recyclable material. We therefore need to capture this material and stop sending recyclable waste to landfill or energy from waste plants and recycle it instead".[22]

The Green Alliance argued in November 2020 that: "Policy should…seek to dramatically reduce residual waste and support better product design, reuse, remanufacturing and high value recycling. Yet, over investment in EfW infrastructure risks locking the country into producing enough material to feed it, as has already happened in Scandinavian countries".[23]

[21] Table 2a of local authority collected waste generation from April 2000 to March 2021 (England and regions) and local authority data April 2020 to March 2021 (Defra, January 2022). Available from: https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables

[22] 'Beyond Recycling: A Strategy to make the circular economy in Wales a reality' (2nd March 2021). Available from: https://gov.wales/beyond-recycling-0

[23] 'Getting the building blocks right: Infrastructure priorities for a green recovery' (November 2020). Available from: https://green-alliance.org.uk/resources/Getting_the_building_blocks_right.pdf

Similarly, Greenpeace called in June 2020 for the UK to “End approvals for new incineration (also called energy-from-waste) facilities and prevent the replacement or upgrade of old plants that are near retirement, in order to support an overall reduction in incineration. This would send a market signal to support more sustainable solutions for resource use, including reduction of material use, reuse, repair and recycling”.[24]

The European Commission's Communication on 'The role of waste-to-energy in the circular economy' from 26th January 2017 explains that incineration can pose a barrier to higher rates of recycling, stating: "…the statistics show that some individual Member States are excessively reliant on incineration of municipal waste…such high rates of incineration are inconsistent with more ambitious recycling targets".[25]

This warning is in line with other similar warnings from Continental Europe, where countries that once embraced incineration are now implementing their own incineration strategies.

For example, Denmark's current resources and waste strategy, is appropriately subtitled "Recycle more - Incinerate less" (November 2013).[26] At the heart of Denmark's resource management strategy is the acknowledgement that incineration has come at the expense of recycling, and that the only way for Denmark to increase recycling is by reducing incineration.

To quote from Denmark's Resource Strategy ('Denmark Without Waste'): "We incinerate an enormous amount of waste in Denmark; waste which we could get much more out of by more recycling and better recycling…" (from Foreword on Page 7); and: "…the Government has a vision that Denmark will protect its resources and materials, and recycle more household waste, while incinerating less. This will entail more materials being sent back into the economic cycle with benefits for the environment…" (Page 9); "…far too many of the valuable materials today end in waste incineration plants…" (Page 11).

Denmark Without Waste also says that: "…By recycling more, we can ensure that many materials which could otherwise be exploited are not just wasted. Recycling a number of ordinary materials such as paper, cardboard, plastic, glass and food from households has not really moved forward for the past ten years…The Resources Strategy therefore anticipates that over the years to come more household waste will be separated and recycled rather than being incinerated at waste incineration plants…" (Page 23).

[24] https://www.greenpeace.org.uk/wp-content/uploads/2020/06/A-green-recovery-how-we-get-there-Greenpeace-UK.pdf
[25] http://ec.europa.eu/environment/waste/waste-to-energy.pdf
[26] Available from: http://mfvm.dk/fileadmin/user_upload/MFVM/Miljoe/Ressourcestrategi_UK_web.pdf

On the 16th of June 2020 the Government of Denmark agreed to a controlled decommissioning of incineration capacity in Denmark, requiring incineration plants to be shut down be drawn up and compensation be paid to municipalities for the costs of these stranded assets.

According to an article published in the Danish media, this process was intended to involve the creation of a 'death list' of incineration plants to reduce Denmark's incinerator capacity from 3.95 million tonnes to 2.6 million tonnes by 2030.[27]

Prohibiting the construction of new incineration capacity and preventing the extension of existing capacity would reduce the cost of Scotland's move away from incineration.

The UK Government's then Resource Minister Thérèse Coffey gave oral evidence to the Environmental Audit Committee on 12th September 2018. As the official transcript[28] (excerpts included below) demonstrates, in her evidence Dr Coffey characterised the European Commission's position as one of incineration scepticism rather than one of unqualified support:

> "Dr Thérèse Coffey: …the [European] Commission itself is very concerned about the explosion, if you like, of incineration around the European Union. It does not want to massively encourage it in the future. Some countries incinerate almost all of their waste, or they are reaching that very high level. I am not convinced that in respecting the waste hierarchy, we want to massively increase the amount of incineration that we are doing..." (Q93)
>
> "Dr Thérèse Coffey: I think, actually, there is sufficient capacity out there for incineration. Often what happens with policies is that they come out with unintended consequences. The general view I get from the [European] Commission in the report they did is that we now have too much incineration across the European Union, and we need to do more to refocus on recycling…" (Q94)

According to Christian Schaible, Policy Manager for Industrial Production at the European Environmental Bureau (EEB): "...There is no place for waste incineration in a circular economy...Ultimately, Europe must prevent waste and stop burning precious resources. To embrace the zero pollution strategy, we need to replace waste incineration with clean heating alternatives".[29]

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[27] https://www.thelocal.dk/20200617/danes-to-sort-trash-into-ten-types-under-new-green-deal-2/

[28] Oral evidence: The National Audit Office Report on Packaging Recycling Obligations, HC 1548. Available from: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environmental-audit-committee/national-audit-offices-report-on-packaging-recyclingobligations/oral/90137.pdf

[29] Source: Burning questions about the new EU waste incineration standards. European Environmental Bureau, 9 January 2020. Available from: https://meta.eeb.org/2020/01/09/burning-questions-about-the-new-eu-waste-incineration-standards/

Professor Sir Ian Boyd, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs told EFRACOM in January 2018 that: "…If there is one way of quickly extinguishing the value in a material, it is to stick it in an incinerator and burn it. It may give you energy out at the end of the day, but some of those materials, even if they are plastics, with a little ingenuity, can be given more positive value. One thing that worries me is that we are taking these materials, we are putting them in incinerators, we are losing them for ever and we are creating carbon dioxide out of them, which is not a great thing. We could be long-term storing them until we have the innovative technologies to reuse them and turn them into something that is more positively valued...It is a personal view, but I think that incineration is not a good direction to go in. If you are investing many tens of millions, probably hundreds of millions, in urban waste incineration plants, and those plants are going to have a 30-year to 40-year lifespan, you have to have the waste streams to keep them supplied. That it is a market pull on waste. It encourages the production of waste. It encourages the production of residual waste. It encourages people to think that we can throw what could be valuable materials, if we were to think about them innovatively, into a furnace and burn them...".[30]

Professor Boyd subsequently told Channel 4 Dispatches there is a risk that allowing new incinerators can undermine waste reduction efforts, stating: "There are a lot of people who are highly incentivised to incinerate waste. Because of the investments we make in waste power plants, we end up a lot of the time creating a market for waste, and therefore trying to generate more waste in order to generate the inputs for the power plants that we've made such large investments in. My feeling is that we've got to use the capacity we have rather than create more capacity, because if you create more capacity you create more demand for materials, and that is simply cranking up the amount of material that comes into the system, and the very last thing we should be doing is, when we throw it away, is putting it in an incinerator". [31]

The London Assembly noted in February 2018 that: "Investing in more EfW can negatively affect long term recycling rates. This investment needs to be paid for by an assured income stream, usually through contracts with local authorities to pay the EfW operator to take waste. Contracts are often lengthy – the majority are over 20 years".

[30] Oral Evidence: The Work of Defra's Chief Scientific Adviser, HC 775. Available from: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environment-food-and-rural-affairs-committee/work-of-the-chief-scientific-adviser-defra/oral/78127.html

[31] Channel 4 Dispatches: 'Dirty Truth About Your Rubbish' (8th March 2021). https://www.channel4.com/programmes/dirty-truth-about-your-rubbish-dispatches

“The terms of contracts, such as minimum annual payments, or a low fee per tonne of waste, can undermine the financial viability for the local authority of reducing waste, or sending it to other destinations such as recycling".[32]

UKWIN offers a number of case studies demonstrating the way that incineration competes with recycling for ‘feedstock’. Many of these case studies involve responses provided by waste authorities to letters written by then Resource Minister Dr Thérèse Coffey MP who contacted all underperforming councils asking for an explanation of why their recycling rates were so low.[33]

Brighton and Hove (2017 and 2018)

It was reported in January 2019 that: "Brighton and Hove has a recycling rate of 30%. The council is restricted to collecting plastic bottles from householders for recycling as a result of its contract with Veolia; many other UK councils collect trays and other plastic recyclate along with bottles. [Caroline] Lucas said: 'Brighton and Hove council have a 30-year PFI contract with Veolia. They are refusing to change the contract so that a wide range of plastics can be recycled. The council doesn’t have the £1m for the required machinery at the Veolia plant to enable a wide range of plastic to be recycled.'"[34]

To quote Brighton & Hove City Council's letter to Dr Thérèse Coffey MP on Brighton & Hove City Council Recycling Rates: "…in terms of contractual status, in partnership with East Sussex County Council, boroughs and Districts, Brighton & Hove City Council is contracted to Veolia as part of the 30 year PFI contact that was awarded in 2003. There are therefore 17 years of this contact remaining. Veolia will only take limited types of materials as they state they cannot find a guaranteed end market for products that can be recycled, such as certain types of plastics. Whilst other Councils can and do recycle these kinds of materials, the B&HCC is contractually obliged under the terms of the PFI agreement to provide all waste materials, whether residual or recyclable to Veolia. We have raised this anomaly with Veolia on a number of occasions, but they are not willing to change their position on this."[35]

Derby (2016)

Letsrecycle reported in April 2016 that: "In 2014/15, Derby recorded the largest fall in recycling among collection authorities in England - dropping from 42% to 32% in the course of 12 months"[36]

[32] London Assembly Environment Committee. Energy from Waste report (February 2018). https://www.london.gov.uk/sites/default/files/waste-energy_from_waste_feb15.pdf
[33] https://www.gov.uk/government/publications/local-authority-letters-on-recycling-rates
[34] https://www.theguardian.com/environment/2019/jan/08/caroline-lucas-calls-for-action-in-brighton-recycling-row
[35] https://www.gov.uk/government/publications/local-authority-letters-on-recycling-rates
[36] https://www.letsrecycle.com/news/latest-news/derby-defends-decision-to-remove-recycling-points/

Local anti-incineration campaigners believe cuts in recycling services (and the introduction of charges for some remaining services) which so drastically harmed recycling in Derby could be attributed to the incinerator contract.

In addition to the standard financial calculations which can push recyclable / compostable material to incineration, Schedule 17 ('Waste Reception Protocol') of the Derby waste contract includes specific provisions in relation to the composition of waste which could encourage the incineration of recyclable / compostable material to meet the specification. Table 17.1 states: "Minimum Organic Content: 21%. Maximum Moisture Content: 60%. Minimum Net Calorific Value: See Table 17.2. Maximum Net Calorific Value: 18 MJ/kg".[37]

Stoke-on-Trent City Council (2010)

Stoke City Council as faced the prospect of a £645,000 fine resulting from a failure to meet minimum contracted waste tonnage levels at their local incinerator.

It was reported by Letsrecycle in October 2010 that: "...Stoke-on-Trent city council could be forced to pay its energy-from-waste contractor hundreds of thousands of pounds after failing to deliver the minimum contracted tonnage for the facility in 2009/10... The issue was acknowledged in minutes from a transformation and services overview scrutiny committee meeting…The minutes state: 'Additional ongoing costs in respect of backdated claims from the Waste to Energy Plant made late in 2009/10 (£60,000) were also an unexpected pressure. A claim was received in June in respect of the city council failing to achieve minimum tonnage levels in 2009/10 for £645,000.' The minutes indicate that the actual cost of the claim is likely to be around £329,000, once a rebate of £316,000 is taking into account".[38]

Kent County Council (2008)

Regarding the Allington incinerator contract, the Kent Messenger reported that: "…what was initially seen as a cash-saving opportunity has quickly turned into a money pit, as the council is forced to send increasingly valuable recyclable material to the incinerator in order to meet its annual quota".[39]

Shropshire

As set out in UKWIN's response to Defra's Call for Evidence to inform the UK Government's Review of Waste Policies in October 2010: "Schedule 7a of the Shropshire waste PFI contract contains details showing the annual utility payment for the incinerator before the effect of adding inflation. It shows a £10.8 million fixed charge each year.

[37] http://www.derby.gov.uk/media/opendata/governance/q2-001.17-schedule-17-waste-reception-protocol.pdf
[38] https://www.letsrecycle.com/news/latest-news/stoke-faces-bill-for-sending-less-waste-to-efw/
[39] https://www.kentonline.co.uk/kent/news/kents-waste-contract-could-be-m-a42292/

It also shows the rebate for landfilling or burning less waste which is £63.10 per tonne before the incinerator is operational and £12 per tonne saving should the incinerator become operational. Unused incinerator capacity is in effect charged at £108 per tonne while used capacity costs £120 per tonne.

“The payment mechanism shows that Shropshire will receive a royalty payment of 80% of the third party income that Veolia generates from selling spare capacity. For example if the plant had 10,000 tonnes of spare capacity, of which 80% was used for third party waste, then the royalty would appear to be £512,000. That capacity would have cost the council taxpayer £1.2 million. It can therefore be concluded that the PFI incinerator contract is based on a massive fixed charge and a very low marginal charge. For Shropshire the fixed cost is 10 times the marginal cost for capacity that is not used, meaning every extra tonne recycled may only save the council £12 as the council has to pay £108 for the unused incinerator capacity in any case".[40]

East London Waste Authority (2017)

The London Borough of Newham's letter to Dr Thérèse Coffey MP in response to her request for an explanation of their low recycling rate: "…we are tied into an expensive and inflexible waste disposal PFI contract until 2027 that limits our ability to improve recycling performance. Agreed in 2002 by the East London Waste Authority (ELWA), this arrangement was encouraged and incentivised by central government when PFI credits represented the main source of funding available for such projects. In line with government policy goals at the time, it was designed with the primary aim of diverting waste from landfill rather than increasing recycling…the contract presents a major obstacle when it comes to recycling performance due to restrictions on what materials can be collected separately, the overall cost of the waste levy, and the lack of any financial incentives for the council to invest in achieving higher recycling rates".

The London Borough of Newham's letter goes on to explain how: "Newham is tied to ELWA by statute, and must deliver all its waste to that authority. Having been encouraged to adopt this approach by central government, we are now caught in an expensive PFI contract where we lack the choice, flexibility, and savings opportunities through recycling solutions that many other authorities are able to exercise."

"The ELWA PFI contract with Renewi is a major obstacle, both in terms of technical restrictions put on what materials can be collected separately, but also on the costs of disposing of waste and the lack of financial incentives for achieving higher recycling rates.”

[40] http://www.ukwin.org.uk/files/pdf/UKWIN_DEFRA_Submission_4_October_2010.pdf

“At present Newham is only permitted to collect a restricted range of materials for recycling, comprising paper, cardboard, tins, cans and plastic bottles. All other materials must go into the general refuse, and although some materials are subsequently recovered for recycling, the yields and quality do not match what other local authorities can achieve."

"The structure of the PFI contract essentially means that Renewi retains any financial benefits from recycling, rather than there being a notably reduced gate fee or any revenue-sharing for the boroughs. As such, the ELWA levy continues to be structured as per the basic model set out in The Joint Waste Disposal Authorities (Levies) (England) Regulations 2006, with no variation in prices for waste disposal according to the material being delivered. In short, Newham pays the same amount to dispose of a tonne of waste whether it is refuse or recycling, and as such the financial incentive to recycle that has driven most other local authorities to invest in collection services and achieve higher performance simply does not exist for us."[41]

Hampshire (2017)

Portsmouth's letter to Dr Coffey MP in response to her request for an explanation of their low recycling rate included the following: "There are challenges in adding materials into the recycling stream - Portsmouth is part of a Hampshire wide disposal contract... Hampshire wide contract [is an obstacle outside of our control that affects the recycling rate] - long term contracts (waste disposal contract ends 2030) requiring massive investment at the outset - difficult to make changes as markets and technology change".[42]

According to Southampton's Letter: "What can be recycled is currently constrained by disposal infrastructure and any changes to this would require significant financial investment. The waste disposal authorities in Hampshire, including Southampton have a long term integrated waste disposal contract which currently handles the disposal of residual waste and the processing of collected recyclables..."

Similar comments to those made by Southampton have been made by Basingstoke, Gosport and New Forest Councils in their respective response letters.[43]

[41] https://www.gov.uk/government/publications/local-authority-letters-on-recycling-rates
[42] https://www.gov.uk/government/publications/local-authority-letters-on-recycling-rates
[43] https://www.gov.uk/government/publications/local-authority-letters-on-recycling-rates

Q9 Are you aware of any evidence or data that could be used to improve the capacity analysis? It would be particularly helpful if you could provide us with data on:

- **HH and C&I waste composition.**
- **C&I waste arisings, recycling and treatment.**
- **The potential developments of future RDF export markets.**
- **composition and biodegradability of sorting residues from HH, C&I and C&D waste.**

Relevant documents on waste composition and recyclability include:

- WRAP's National Household Waste composition 2017, which includes data for Scotland which indicates that there is a significant proportion of the Scottish residual waste stream which is recyclable [44].
- The Zero Waste Scotland report entitled 'Methodology - The composition of household waste at the kerbside in 2021 – 2024' which is accompanied by a standard methodology for household sampling.[45]
- The analysis of the impacts of changing waste composition and biodegradability within UKWIN's Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration.[46]
- The aforementioned research for England and Wales which indicates that a significant proportion of the residual waste stream is recyclable. [47]

[44] https://wrap.org.uk/sites/default/files/2021-10/WRAP-national-household-waste-comparison-2017.pdf
[45] https://www.zerowastescotland.org.uk/content/waste-composition-analysis-programme-2021-2024
[46] https://ukwin.org.uk/files/pdf/UKWIN-2021-Good-Practice-Guidance-for-Assessing-the-GHG-Impacts-of-Waste%20Incineration.pdf
[47] https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england-monitoring-and-evaluation and https://wrapcymru.org.uk/resources/report/composition-analysis-commercial-and-industrial-waste-wales

TOPIC 2: MANAGEMENT OPTIONS

Q10 What treatment options for residual waste should Scotland consider?

For the reasons set out in this submission, additional incineration capacity should not be considered as a valid option for Scotland to consider. Allowing more incineration (and the lock-in and other issues it generates) is incompatible with Scotland's recycling, waste prevention, circular economy and climate change ambitions.

If there is a need for short-term 'transitional' capacity on the road to a circular economy, then this should be through biostabilisation of waste to reduce the methane impacts, whether as a standalone option or as part of a wider Material Recovery and Biological Treatment system. Evidence that supports biostabilisation as a viable waste management option which is preferable to incineration includes:

- Building a bridge for residual waste: Material Recovery and Biological Treatment to manage residual waste within a circular economy (Zero Waste Europe, January 2021)[48]
- Greenhouse Gas and Air Quality Impacts of Incineration and Landfill (ClientEarth, December 2020)[49]
- Report for the EC Directorate-General for Environment entitled 'Development of a Modelling Tool on Waste Generation and Management - Appendix 6: Environmental Modelling' which was used in the Impact Assessment of the European Circular Economy package (Eunomia and the Copenhagen Resource Institute, 2014)[50]
- Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration (UKWIN, July 2021)[51]
- The climate change impact of burning municipal waste in Scotland (Zero Waste Europe, July 2021)[52]
- Holistic Resource systems white paper (TOMRA, June 2021)[53]
- The Ultimate Guide to Mixed Waste Sorting (TOMRA, October 2021)[54]

[48] https://zerowasteeurope.eu/wp-content/uploads/2020/06/zero_waste_europe_policy-briefing_MRBT_en_with-annex.pdf
[49] https://www.eunomia.co.uk/reports-tools/greenhouse-gas-and-air-quality-impacts-of-incineration-and-landfill/
[50] https://web.archive.org/web/20150105033641/https:/ec.europa.eu/environment/waste/pdf/waste-generation-management-model.zip
[51] https://ukwin.org.uk/files/pdf/UKWIN-2021-Good-Practice-Guidance-for-Assessing-the-GHG-Impacts-of-Waste%20Incineration.pdf
[52] https://www.zerowastescotland.org.uk/content/climate-change-impact-burning-municipal-waste-scotland
[53] https://solutions.tomra.com/hrs-whitepaper-download
[54] https://solutions.tomra.com/mws-white-paper

- What is the best disposal option for the “Leftovers” on the way to Zero Waste? (Dr. Jeffrey Morris, Dr. Enzo Favoino, Eric Lombardi and Kate Bailey, May 2013)[55]
- Landfill Bans: Feasibility Research (WRAP, November 2012)[56]
- The Economics of Waste and Waste Policy (Defra, June 2011)[57]

While removing food waste from the waste stream will reduce the proportion of biowaste that would degrade if sent directly to landfill, there is still a need to consider how these emissions could be minimised if biowaste is sent to landfill (e.g. as part of a 'transitional' strategy to treat residual waste as recycling rates improve while avoiding the 'lock-in' of waste incineration).

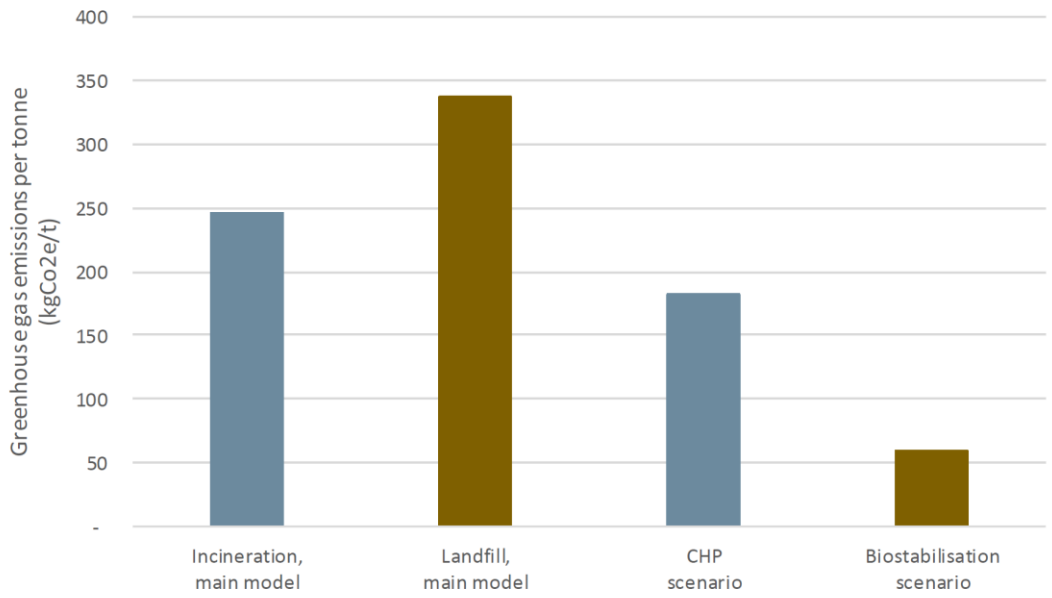
Even if there are potential challenges associated with the immediate use of bio-stabilisation, the potential savings from such approaches are very relevant when considering lower-cost medium-term residual waste treatment options that could allow for further increases in recycling and composting. This is especially relevant when considering whether or not to allow more waste incineration capacity which could lock in the use of that capacity for decades to come as the expense of the top tiers of the Waste Hierarchy.

The potential emissions savings from bio-stabilisation prior to landfill was considered in the July 2021 report from Zero Waste Scotland. The technical report summarises its findings in the following figure:

[55] https://www.ecocycle.org/specialreports/leftovers
[56] https://www.nswai.org/docs/Landfill%20Bans%20Feasibility%20Research%20Final%20Report%20Updated.pdf
[57] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69500/pb13548-economic-principles-wr110613.pdf

Extract from Zero Waste Scotland's July 2021 technical report

Figure 16. Converting to CHP or biostabilisation technologies lowers the GHG emissions of waste management facilities



The supporting text below the figure explains: "Figure 16 also shows a comparison to the potential savings from reducing biodegradable material to landfill. This could be achieved using biostabilisation. If levels of biogenic carbon can be reduced from 15% to 5% of residual municipal waste, landfill impacts would fall from 337 $kgCO_2e/t$ to 59 $kgCO_2e/t$."

Providing further detail, the report also notes: "The estimated greenhouse gas emissions from biostabilisation in this study are in line with estimates from such plants operating in Europe. The biostabilisation scenario in this study is illustrative only and further, more detailed research is required to understand the environmental impacts of this scenario in a Scottish context more fully."

"Biostabilisation as described in this report[3], refers to a specific type of technology where waste is pre-treated before landfill to reduces its biodegradable content, in accordance with the respiratory test criteria described in the section 4.2.b.i of the Waste (Scotland) Regulations 2012. Biostabilisation is a proven technology with plants operating across Europe, although there are no such plants in Scotland or the rest of the UK."

Footnote 3 states: "For example, J. de Araújo Morais et al. (2008) Mass balance to assess the efficiency of a mechanical–biological treatment, Waste Management, Volume 28, Issue 10 found that biochemical methane potential of residual municipal waste was reduced by over 80% after treatment."

According to the conclusions of the report: "The large potential savings from biostabilisation indicate this option warrants further consideration."

It is explained within the 'frequently asked questions' section of the report's webpage that: "…for residual waste which cannot be recycled, Biostabilisation technologies could offer a low carbon solution to landfill…"

'Mechanical and Biological Treatment' (MBT) and 'Material Recovery and Biological Treatment' (MRBT) processes can extract recyclates for recycling and then bio-stabilise any residues prior to landfill.

Assessments have found that MBT/MRBT approaches can result in significantly lower CO_2e emissions than sending the same waste to incineration, especially when the benefits of the biogenic carbon sink in landfill and the impact of the decarbonisation of the electricity supply are taken into account (see examples below).

MBT/MRBT systems are much cheaper to establish than incineration. This means that MBT/MRBT systems provide greater flexibility than incinerators, as they are more able to accommodate future improvements in waste prevention and recycling.

This means MBT/MRBT avoids the environmentally harmful impacts of feedstock 'lock-in' associated with residual waste treatment facilities such as incinerators[58] which cost hundreds of millions of pounds to build.[59]

Defra noted the potential benefits of MBT-landfill back in 2011, stating: "MBT (mechanical biological treatment)-landfill provides the best emissions performance in terms of the treatment/disposal of residual waste. It essentially involves landfilling somewhat stabilised wastes with some material recovery. The magnitude of the environmental impact depends on the extent to which the waste is stabilised".[60]

This issue was considered further by Eunomia and the Copenhagen Resource Institute (CRI) in 2014 in a report for Directorate-General for Environment at the European Commission entitled 'Development of a Modelling Tool on Waste Generation and Management - Appendix 6: Environmental Modelling' which was used in the Impact Assessment of the European Circular Economy package.[61]

[58] https://ukwin.org.uk/files/pdf/UKWIN-Examples-of-incineration-harming-recycling-July-2019.pdf
[59] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/221036/pb13889-incineration-municipal-waste.pdf
[60] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69500/pb13548-economic-principles-wr110613.pdf
[61] https://web.archive.org/web/20150105033641/https://ec.europa.eu/environment/waste/pdf/waste-generation-management-model.zip

According to the European Waste Model document: "The central aim of aerobic stabilisation processes is to produce an output which has a reduced biodegradability, thereby decreasing the environmental impacts associated with landfilling this material, although in some Member States such as France the stabilised output is applied to land. The pre-treatment process also typically removes metals and plastics for recycling."

"Eunomia on behalf of WRAP, which was based upon a raft of published research. The body of research included work by Baky and Eriksson, Sonneson, and Komilis and Ham, all of whom investigated the link between the biochemical composition of the waste and the release of CO_2 within composting processes. This research, together with data sourced from technology suppliers, was used to model the degradation of carbon fractions within our model and the subsequent release of biogenic CO_2 from the process."

Zero Waste Europe published a briefing note in January 2021 which includes information about the recyclate recovery performance of existing MRBT plants. The report explores MRBT's potential use as part of a 'bridge strategy' for managing residual waste within the context of the transition to a more circular economy.[62]

The report found that MRBT was the lowest-carbon option considered, with lower emissions even than incineration with plastics removed (referred to as 'MWS plus incineration' with MWS meaning 'municipal waste sorting').

According to the Zero Waste Europe report: "…a MRBT system that combines biological treatment and sorting equipment allows us to 'stabilise' the organics that are included in residual waste, so as to minimise their impact once buried in a landfill, while also helping to recover materials such as metals, plastics, paper that are still included in residual waste after separate collection…with ongoing decarbonisation of energy, and factoring the GHG savings from aerobic degradation, prior to landfilling, of biodegradable materials included in waste, MRBT becomes the most climate-friendly option, both whether biogenic CO_2 is considered or not."

"…replacing the RDF-production units in MBT plants with equipment to sort residual waste and recover the materials which are worth recovering…[This] could help ensure the:

1. Reduction of the negative impacts at landfills, due to the biological treatment of the dirty organics;

[62] https://zerowasteeurope.eu/library/building-a-bridge-strategy-for-residual-waste/

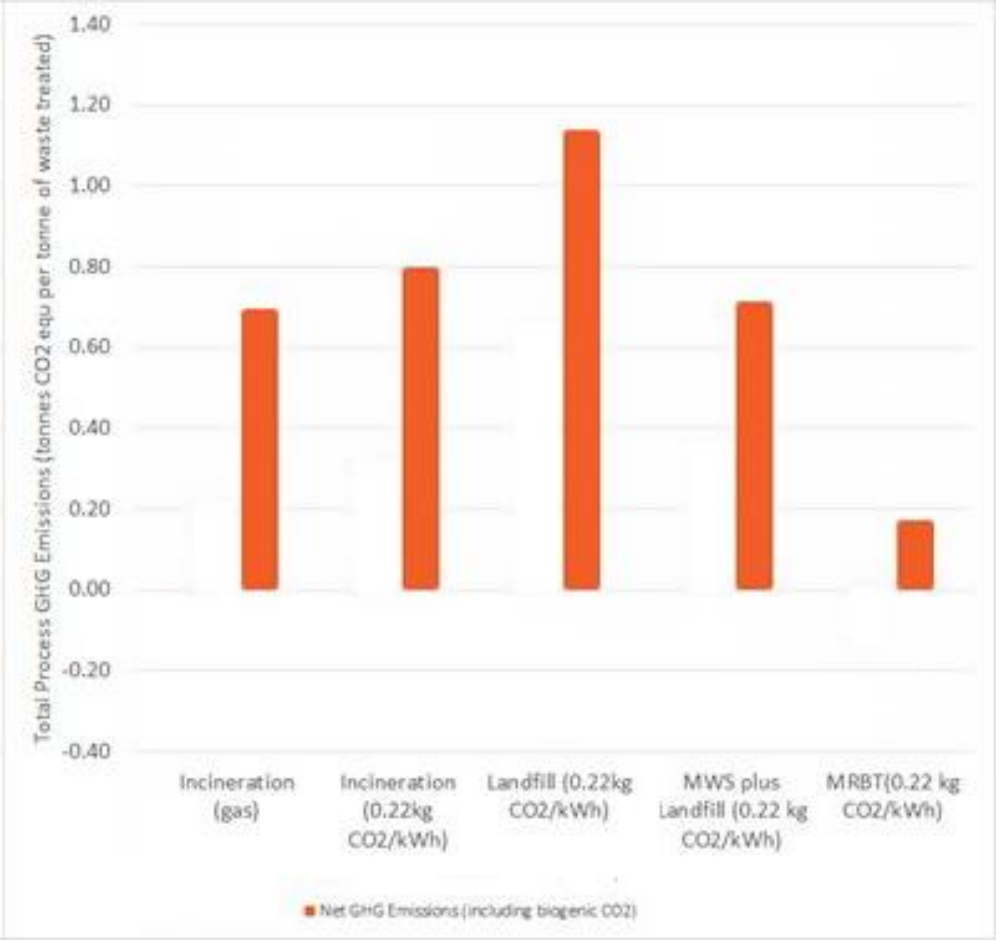
2. Sufficient diversion of materials from landfills, due to process losses from biological stabilisation and the recovery of some of the other materials;

3. Flexibility of the operational lay-out, given that the sorting systems may similarly be used with materials from kerbside programmes for further separation of different metals, different polymers and different paper grades after separate collection, to help enhance the effectiveness of collection and subsequent recycling systems.

The combination of these operational goals can be described as…MRBT. This is key as it distinguishes [MRBT] from old-fashioned MBT to emphasise the intended goal of merging…recovery of some waste materials and biological stabilisation of fermentable materials before landfilling."

Extract from January 2021 Zero Waste Europe Report

Figure 12: GHG emissions from treating 1 tonne of residual waste through different treatments assuming different carbon intensities of energy being avoided (0.22kg CO_2/kWh) (MWS = mixed waste sorting).



** Modified for clarity to show only the Net GHG Emissions (including biogenic CO_2) and to exclude MWS plus incineration and incineration/landfill with a coal counterfactual*

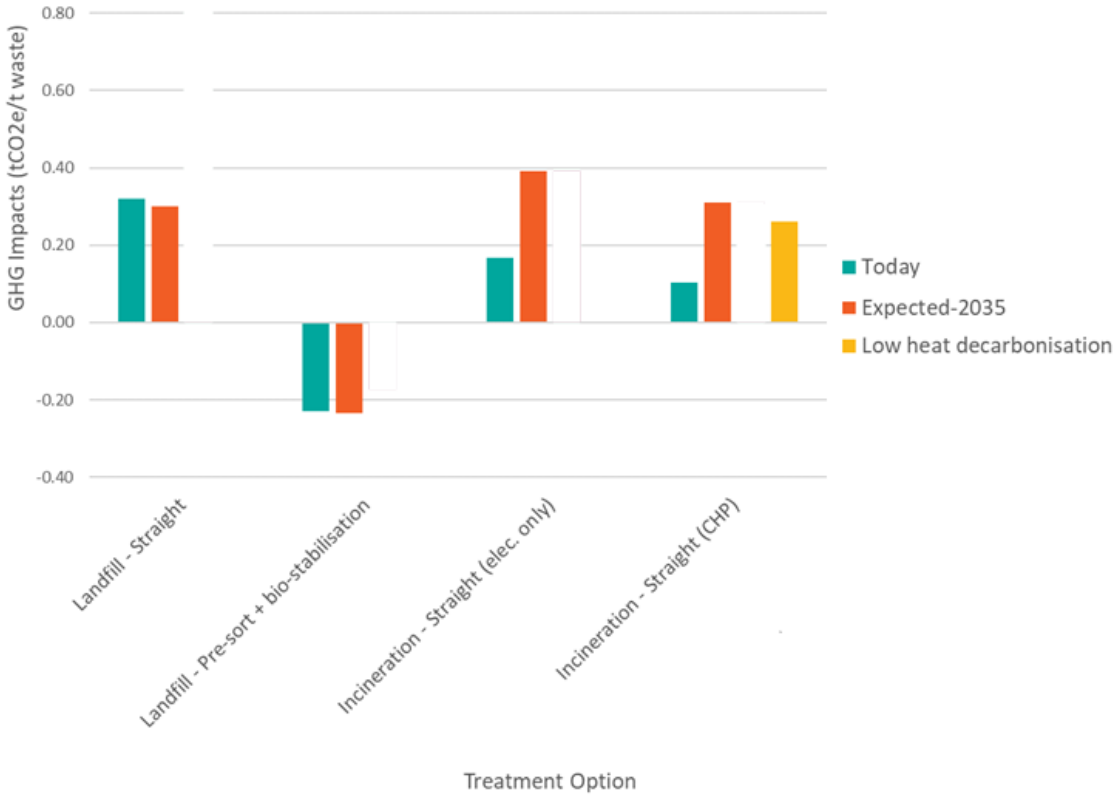
More recently, the potential for increased aerobic biological stabilisation prior to landfill as part of a system that includes increased sorting prior to landfill was explored in the ClientEarth report 'Greenhouse Gas and Air Quality Impacts of Incineration and Landfill'.[63]

According to the ClientEarth report: "The bio-stabilisation process allows the aerobic degradation of organic material in the residual stream to take place under controlled conditions, releasing biogenic carbon dioxide. This reduces the biogenic carbon content of the stream sent to landfill, thereby reducing methane emissions from the waste once in landfill."

The report found that landfill with pre-sorting and bio-stabilisation was roughly on par with incineration with plastics removed and recycled (what it calls 'incineration - pre-treatment') but significantly better than incineration of a mixed waste feedstock that includes plastic (what it calls 'incineration straight') even with combined heat and power (CHP).

Extract from December 2020 ClientEarth report

Figure 2-1 The GHG impacts of the treatment options under each scenario



** Modified for clarity to exclude GWP20 sensitivity analysis and incineration with 100% plastic removal/recycling*

[63] https://www.clientearth.org/latest/documents/greenhouse-gas-and-air-quality-impacts-of-incineration-and-landfill/

TOPIC 3: ECONOMIC, ENVIRONMENTAL & SOCIAL TRADE-OFFS

The relevant section of the Call for Evidence document opens with the statement that: "Identifying the appropriate options for the treatment of residual waste will require consideration of a range of trade-offs between several factors including feasibility, cost, environmental impact and societal impact".

Whilst UKWIN appreciates the implicit recognition that residual waste treatment capacity is associated with a range of disamenities for local residents and for society as a whole, the adoption of UKWIN recommendations would bring benefits across the board, extending the range of non-thermal treatments that would be feasible (because these approaches would no longer have to compete with ever-increasing incineration capacity), while providing value for money, environmental gains (including with respect to the nutrient cycle), and delivering beneficial societal impacts (e.g. promoting more prudent resource use and greater sufficiency, as well as job creation, within the context of the circular economy).

Information on MBT and biostabilisation is set out in our response to Q10 in Topic 2.

Q12 What data can you share with the review on the costs of operating any options for managing residual waste in Scotland, especially costs based on real experience?

When taking costs into account, it is important to consider not just the financial costs to the operator, waste authority, or waste producer, but to also consider the wider costs to the environment and to society.

When local authorities pay the landfill tax this is a type of 'transfer payment' rather than a cost as such, because the money remains within the public purse.[64] When businesses pay the landfill tax it increases the money in the public purse. This stands in stark contrast to any public funding that would be diverted to pay for carbon capture facilities at incinerators or to help fund combined heat and power schemes, which would reduce the money in the public purse.

At present the landfill tax system does not adequately distinguish between sending waste untreated to landfill and sending biostabilised waste to landfill. Furthermore, the CO_2 released from incineration is not currently taxed, and nor is the harm caused by incinerator lock-in reflected in the costs.

[64] To quote the Inspector in the Battlefield incinerator decision: "Landfill tax savings were claimed as a benefit of the appeal scheme in the appellant's presentation to EH [English Heritage]. In financial analysis terms such tax payments would be a cost. However, in an economic analysis it seems to me that it would be more of a transfer payment, and so not a cost to society as a whole. Landfill tax is a device to divert waste away from landfill with consequential climate change benefits. To factor in an additional benefit of landfill tax savings would, to my mind, introduce an element of double counting". Source: https://ukwin.org.uk/library/204-PlanningConsent-2012.pdf

These deficiencies and market failures can, and we argue should, be rectified. These adjustments would allow for the cost of treatment to more closely match the environmental impacts of those options, with benefits suitably rewarded and disbenefits appropriately penalised. However, in the meantime, it is important to consider that the overall costs of sending biostabilised waste to landfill is far less than the costs of building new incineration capacity, and it is the wider society who would be picking up the tab if the latter were allowed to proliferate at the expense of the transition to a more circular economy.

With regard to direct financial costs associated residual waste treatment options, UKWIN notes the following, taken from page 19 of 'Building a bridge: Strategy for residual waste'[65]: "Sites designed to operate through biological stabilisation and material recovery, are markedly **cost competitive** with incineration. Capital expenditure (capex) at a BAT level may be in the range of EUR 200-400 per t/year of installed capacity[66], while BAT incinerators typically are around EUR 1000 per t/year and more. This implies a lower use of financial resources for residual waste management, and a larger part of the budget may be dedicated to separate collection, reuse and recycling". [**emphasis in original**]

A focus on just biostabilisation (e.g. through aerobic digestion) could significantly decrease biological stabilisation costs. Furthermore, for some materials the cost of extracting them could be significantly less than the revenue generated from their sale.

Turning to evidence that is UK-based, UKWIN notes the May 2020 'Energy from Waste Plants with Carbon Capture' report from Energy Systems Catapult Limited[67] which provides an illustrative example of the capex associated with a 350,000 tpa incinerator with and without carbon capture as follows: £220m without carbon capture (£629 per tonne), and £320m with carbon capture (£914 per tonne). These cost estimates were based on historic data (from business cases, etc. published between 2014 – 2017), meaning the costs can be expected to have risen since then due to inflation and other economic factors (e.g. Brexit).

For data associated with Scotland we turn to the November 2015 'Addendum to Energy from Waste Business Case' produced by Amec Foster Wheeler Environment & Infrastructure UK Limited for Aberdeen City Council[68].

[65] Available at: https://zerowasteeurope.eu/wp-content/uploads/2020/06/zero_waste_europe_policy_briefing_MRBT_en.pdf
[66] See: Arcadis et al: Assessment of The Options to Improve the Management of Bio-waste in the European Union, Final Report, Annex E, Approach to estimating costs available at: https://ec.europa.eu/environment/pdf/waste/compost/ia_biowaste%20-%20ANNEX%20E%20%20-%20approach%20to%20costs.pdf
[67] Available via: https://es.catapult.org.uk/report/energy-from-waste-plants-uk-with-carbon-capture/
[68] Available at: https://committees.aberdeencity.gov.uk/mgConvert2PDF.aspx?ID=61677

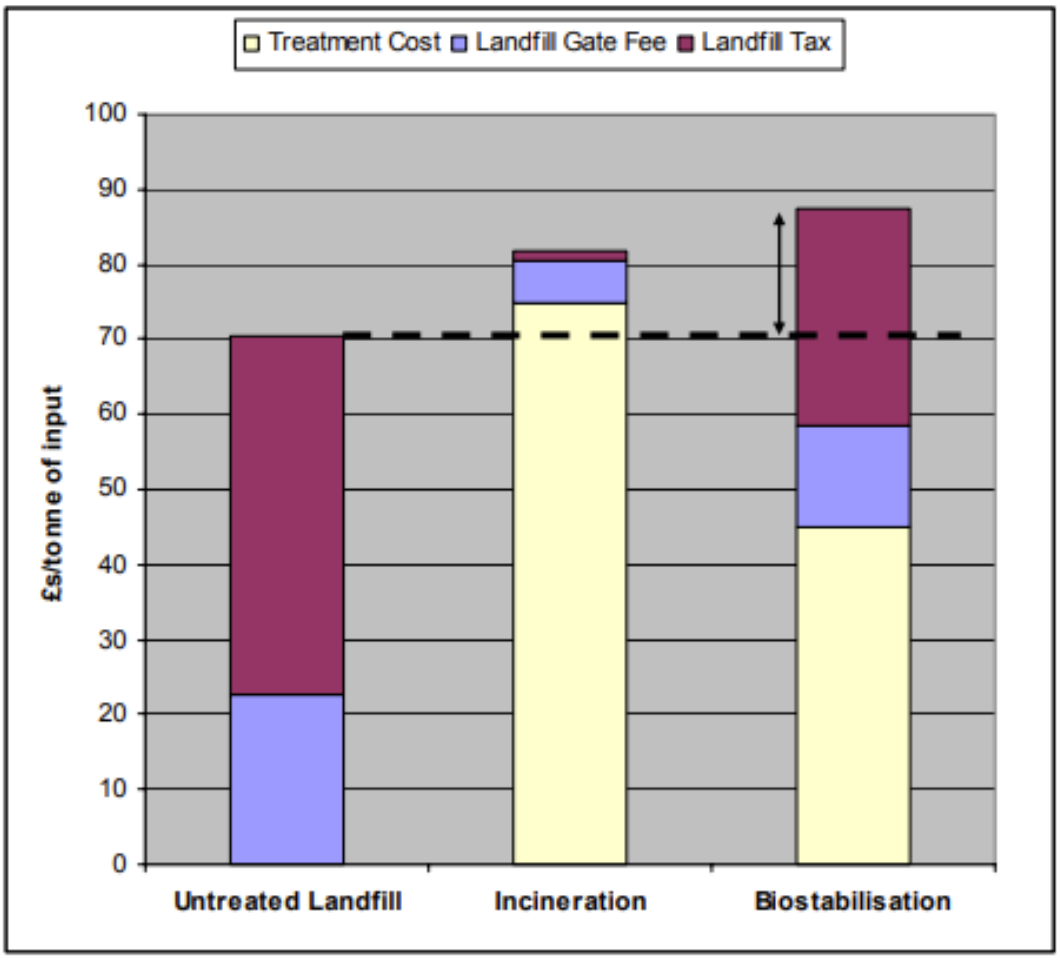
This provides a Total EfW EPC Cost Estimate (capex) of £870 per tonne/year capacity which is stated to be valid for projects between 50 and 120ktpa, and a Total Final Capex Estimate of £902 per tonne/year capacity for projects exceeding 120ktpa.

It is stated that these figures have an accuracy of +/- 50% and do not include contingency margins.

As above, economic circumstances have changed since 2015 which could be expected to have increased the CAPEX costs of incineration in Scotland.

Eunomia's January 2008 'Biostabilisation of Wastes: Making the Case for a Differential Rate of Landfill Tax'[69] report proves further evidence that biostabilisation is significantly less expensive per tonne than incineration, once the taxation issue has been resolved. Figure 3 from that report, reproduced below, estimates that the per-tonne treatment cost of biostabilisation is around half the per-tonne cost of incineration.

Figure 3: Estimated total cost of selected residual C&I waste management options in 2010/11



[69] Available at: http://www.organics-recycling.org.uk/dmdocuments/Eunomia_Jan_2008_report.pdf

According to a 2009 report by Arcadis and Eunomia for the European Commission[70]: "Stabilisation technologies are low capital cost treatments for residual waste. We have used a figure of €230 per tonne [of capacity], and an operating cost of €19 per tonne before disposal costs. A French study into the cost of MBT found that a 30,000 tpa stabilisation system with residues to landfill will cost €4.5 million in 2005 prices. This suggests a cost of €150 per tonne [of capacity]. This is considered to be quite a low cost. In the UK an examination of various MBT configurations from 2005 has suggested that for a stabilisation facility of this nature would incur a capital cost of €201 per tonne [of capacity]. These costs are similar to those for in-vessel composting, reflecting similarities in technology, though scale will usually be larger, and there are costs of residue disposal to be considered…"

A report entitled 'Approach to appraising the options for the long-term management of residual waste'[71] presented to the Highland Council's 12th May 2021 Communities and Place Committee considered the costs of a range of residual waste treatment options, including cost estimates for the construction of an 88ktpa incinerator in Inverness.

The Committee Report states: "The [2020 SLR[72]] report identified that the capex for developing a technically feasible EfW facility at the Longman site, capable of processing 88,000 tonnes of residual waste per annum, is likely to be a base cost of £95m, excluding any internal Council costs, uplifts for risk, optimism bias and funding. When incorporating adjustments for risk, optimism bias, cost escalation allowance for inflation post 2019/20 and interest during construction, the report forecasts the total Option 2 funding requirement at £185m".

[70] Arcadis et al: Assessment of The Options to Improve the Management of Bio-waste in the European Union, Final Report, Annex E, Approach to estimating costs available at: https://ec.europa.eu/environment/pdf/waste/compost/ia_biowaste%20-%20ANNEX%20E%20%20-%20approach%20to%20costs.pdf

[71] Available at: https://www.highland.gov.uk/download/meetings/id/78147/15_approach_to_appraising_the_options_for_the_long-term_management_of_residual_waste

[72] See: https://www.highland.gov.uk/download/meetings/id/76905/item_8i_waste_projects_update for presentation of key findings

The presentation of key findings from the 2020 SLR report includes the following costs table:

WtE Capital costs £98-124M (2019 costs and excluding risk, OB, funding)

Capex £	Option	1 Longman 72ktpa EfW plant	2 Longman 88ktpa EfW plant	3 Longman 128ktpa EfW plant
	Site acquisition	**0**	**0**	**0**
Civil works - buildings, ground works etc.	Civil & Buildings	22,505,961	23,332,084	29,815,322
	Mobile Plant	761,000	761,000	761,000
	Contingency (on Civils + Other)	2,250,596	2,333,208	2,981,532
	Fees	6,071,431	6,269,700	7,885,677
	EPC Contractor Margin	2,813,245	2,916,510	3,726,915
	Civil works total	**34,402,232**	**35,612,503**	**45,170,447**
M & E costs - process plant, utilities etc.	M&E	58,853,350	61,813,663	71,999,169
	Contingency (on M&E)	5,130,393	5,390,641	6,286,070
	M&E total	**63,983,743**	**67,204,303**	**78,285,239**
	DH CAPEX	0	0	0
	MT and EfW CAPEX total	**98,385,976**	**102,816,806**	**123,455,686**

Q13 What data can you share with the Review on the wider costs associated with options for managing residual waste in Scotland, especially where those costs have materialised?

In terms of wider financial costs, it is important to consider environmental externalities. In 2011 Defra identified three key market failures, none of which have been satisfactorily adressed in Scotland (or indeed in England):

- "On the whole, those treatment options which reduce embedded emissions by reducing energy associated with extraction, primary production etc., such as re-use and recycling, do not have their full external benefits reflected in the price of disposal."
- "The emissions from waste combustion of non-biogenic material (via any technology including mass-burn incineration) are also not comprehensively reflected in the price of disposal. Unless the installation in question is in the ETS (municipal solid waste incinerators are excluded) a negative externality persists – such installations are creating GHG emissions without paying the relevant price."
- "Subject to proving its environmental performance, MBT-landfill does not have its environmental benefits reflected in the price of disposal."

Incinerators emit around a tonne of CO_2 per tonne of waste incinerated, with around half of this being fossil CO_2. However, at present nothing is paid for the cost to society of this CO_2.

BEIS's central carbon values in £2020 prices per tonne of CO_2 rise from £241/tonne for 2020 to £280/tonne in 2030 and £378/tonne in 2050. However, this is not reflected in the price of incineration, nor is the impact of the material being lost to society which results in virgin materials from being used at significant carbon cost.

On the other hand, the cost of landfilling waste is around £100/tonne, with no discount for the impacts being reduced due to lower levels of food waste or waste being mostly biostabilised prior to landfill.

As such, there are currently perverse financial incentives to incinerate waste which would have lower impacts if they were biostabilised and sent to landfill, and recycling is having to compete with what is in effect a subsidised incineration market.

As noted in the Environment, Climate Change and Land Reform Committee's November 2020 report on the Green Recovery Inquiry, "a robust carbon pricing regime" is needed in Scotland.[73]

Addressing these market failures should result in lower overall emissions, especially if money raised from an incineration tax is invested in waste prevention efforts.

The introduction of an incineration tax would be consistent with the Zero Carbon Commission's September 2020 report on 'Helping Britain Achieve Net Zero by 2050'[74] which advocated for "a new carbon tax on incineration and other energy from waste schemes (i.e. Advanced Conversion Technologies)".

According to the Commission: "There is a good case for carbon taxation on incineration, which produces substantial emissions...a tax on incineration would increase incentives to recycle and/or generate less waste…".

Q14 Do you have any evidence that the Review should consider in comparing the carbon impacts of options for residual waste treatment? E.g. compositional analyses of waste streams, case studies, or reports on carbon impact.

This Call for Evidence question invites consultees to provide evidence such as compositional analysis. UKWIN's website[75] includes links to eight examples of compositional analysis (some of which are mentioned above, alongside references to WRAP data on recycling opportunities, etc.) covering a range of waste streams (e.g. Commercial and Industrial (C&I), household residual, municipal, landfilled C&I, etc.) undertaken at regional and national levels.

These studies demonstrate that much of what is incinerated is not genuinely residual waste, but rather valuable material that could and should have been recycled or composted.

[73] https://archive2021.parliament.scot/S5_Environment/Reports/ECCLRS0520R12.pdf
[74] https://zerocarbon.publicfirst.co.uk/
[75] At https://ukwin.org.uk/facts/#recyclability

Compositional analysis studies show that there are many instances where the majority (i.e. over 50%) of 'waste' collected at the kerbside could have been recycled or composted had it been put into the correct bin. And not all of these studies take account of the opportunities for Councils to extend the range of materials they accept for recycling at the kerbside.

The vast majority of incinerators in the UK have no facility to remove recyclable material prior to incineration, and so all of the recyclable and compostable material delivered to these facilities ends up in the incinerator. Difficult-to-recycle materials are increasingly being redesigned or phased out, meaning incinerators are becoming increasingly reliant upon burning recyclable and compostable material.

The more that citizens and businesses are confident that material collected for recycling or composting is in fact recycled or composted the more likely it will be that these materials end up in the recycling stream rather than the residual waste stream. The easier it is for consumers to recycle, e.g. through extending the range of plastics collected for recycling and allowing all dry materials to be collected for potential recycling, the greater the reduction in the quantity of material the makes up the residual waste stream. Much of what is left in the residual waste stream, e.g. ceramics and cat litter, are not combustible.

Responding to the Call for Evidence's invitation to provide case studies and carbon reports, UKWIN draws attention to both our 'Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration' and our 'Evaluation of the climate change impacts of waste incineration in the United Kingdom', as well as to Zero Waste Scotland's 'The climate change impact of burning municipal waste in Scotland' and Eunomia's report for ClientEarth entitled 'Greenhouse Gas and Air Quality Impacts of Incineration and Landfill'.

Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration (UKWIN, July 2021)[76]

When considering the impacts of incineration, it is necessary to take into account the recommendations made by UKWIN within our July 2021 Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration and the associated evidence base.[77]

The report's recommendations are outlined overleaf.

[76] https://ukwin.org.uk/files/pdf/UKWIN-2021-Good-Practice-Guidance-for-Assessing-the-GHG-Impacts-of-Waste%20Incineration.pdf
[77] https://ukwin.org.uk/files/pdf/UKWIN-2021-Good-Practice-Guidance-for-Assessing-the-GHG-Impacts-of-Waste%20Incineration.pdf

TRANSPARENCY AND OPENNESS TO SCRUTINY

1. Methodology and modelling assumptions, including underlying data and how it was derived, should be transparent and verifiable. Scrutiny of environmental claims made to support waste incineration should be facilitated rather than frustrated.

IMPACT OF WASTE COMPOSITION AND TECHNOLOGY ON ENERGY AND GHG OUTPUTS

2. Key outputs such as power export and greenhouse gas (GHG) emissions are dependent on waste composition and the processes used. When modelling future emissions it is necessary to ensure that outputs are internally consistent with inputs.

3. GHG impacts can be highly sensitive to waste composition. Waste composition assumptions should be justified and sensitivity analysis should be used to show the impacts of future changes such as increased food and biowaste collection.

4. While heat export, carbon capture, and pre-treatment to remove plastics can potentially reduce overall GHG impacts of incineration, there are also uncertainties regarding deliverability and/or overall impacts. Sensitivity and lifecycle analysis can be used to explore a range of possibilities and to reflect relevant uncertainties.

THE ROLE OF LANDFILL AS A BIOGENIC CARBON SINK

5. To produce a valid comparison when comparing waste treatment options such as landfill and incineration that release different quantities of biogenic CO_2 it is necessary to account for these differences, especially the impact of the biogenic carbon sink in landfill.

DISCREPANCIES BETWEEN THEORETICAL AND REAL WORLD PERFORMANCE

6. The carbon performance of modern waste incinerators is often significantly worse than was predicted through modelling at the planning and permitting stages. This discrepancy between predicted and actual carbon performance needs to be taken into account when modelling, and robust sensitivity analysis is needed to ensure that CO_2e emissions from incineration are not significantly underestimated.

7. Power export underperformance, e.g. due to turbine or generator failure or during commissioning, is a realistic prospect for modern waste incinerators that needs to be taken into account when modelling anticipated power output and associated climate impacts.

DISPLACEMENT OF OTHER SOURCES OF ELECTRICITY AND/OR HEAT

8. When considering the carbon intensity of displaced energy, it is necessary to take account of the progressive decarbonisation of the energy supply rather than simply assuming that a new energy source would displace fossil fuels. The carbon intensity of electricity displaced by a new incinerator can be estimated using the average BEIS Long-Run Marginal Emissions Factor (MEF) over the lifetime of the plant.

WASTE TREATMENT COMPARATORS/COUNTERFACTUALS

9. When considering how waste would be treated if it were not sent to an incinerator, account should be taken of the prospect that it might otherwise have been reduced, reused, recycled or composted. Account should also be made of how landfilled waste could be bio-stabilised to reduce methane emissions.

LOW CARBON CLAIMS

10. Energy from mixed waste incineration should not be described as 'low carbon'. Incineration involves the direct release of significant quantities of CO_2.

The analysis that informed Recommendations #6 and #7 found that, for the incinerators studied, on average:

a. The proportion of CO_2 that was fossil CO_2 was 13 percentage points higher than predicted at the planning or permitting stage.

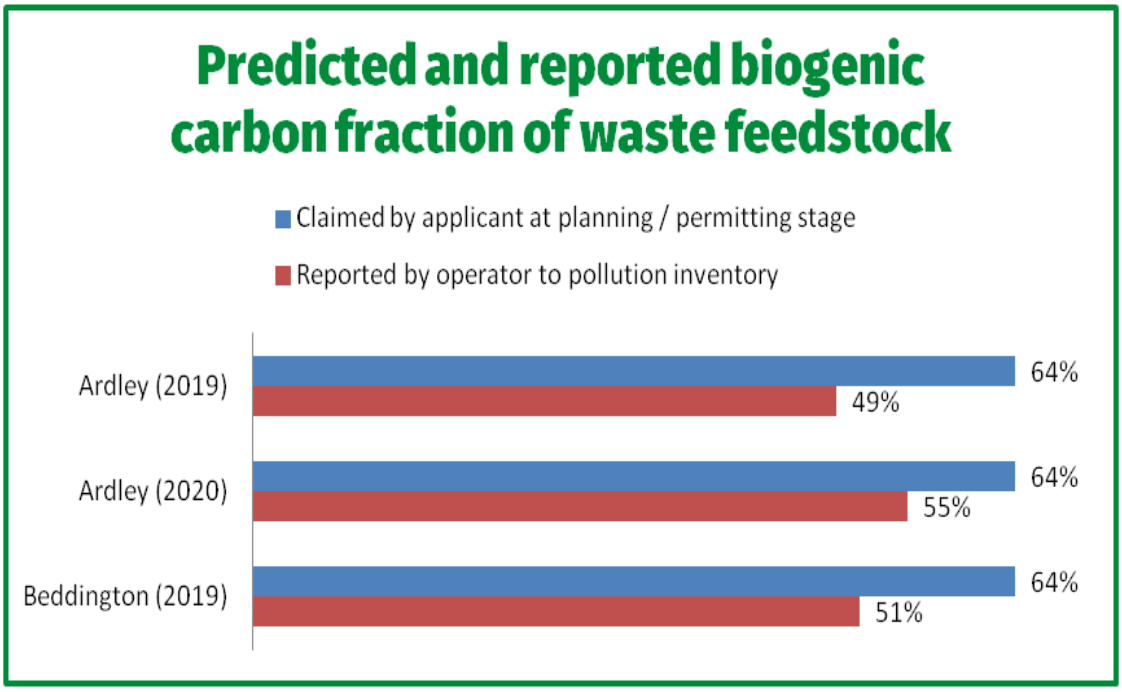
b. The fossil carbon intensity of electricity exported to the grid was around 49% higher than predicted by the applicant at the planning or permitting stage

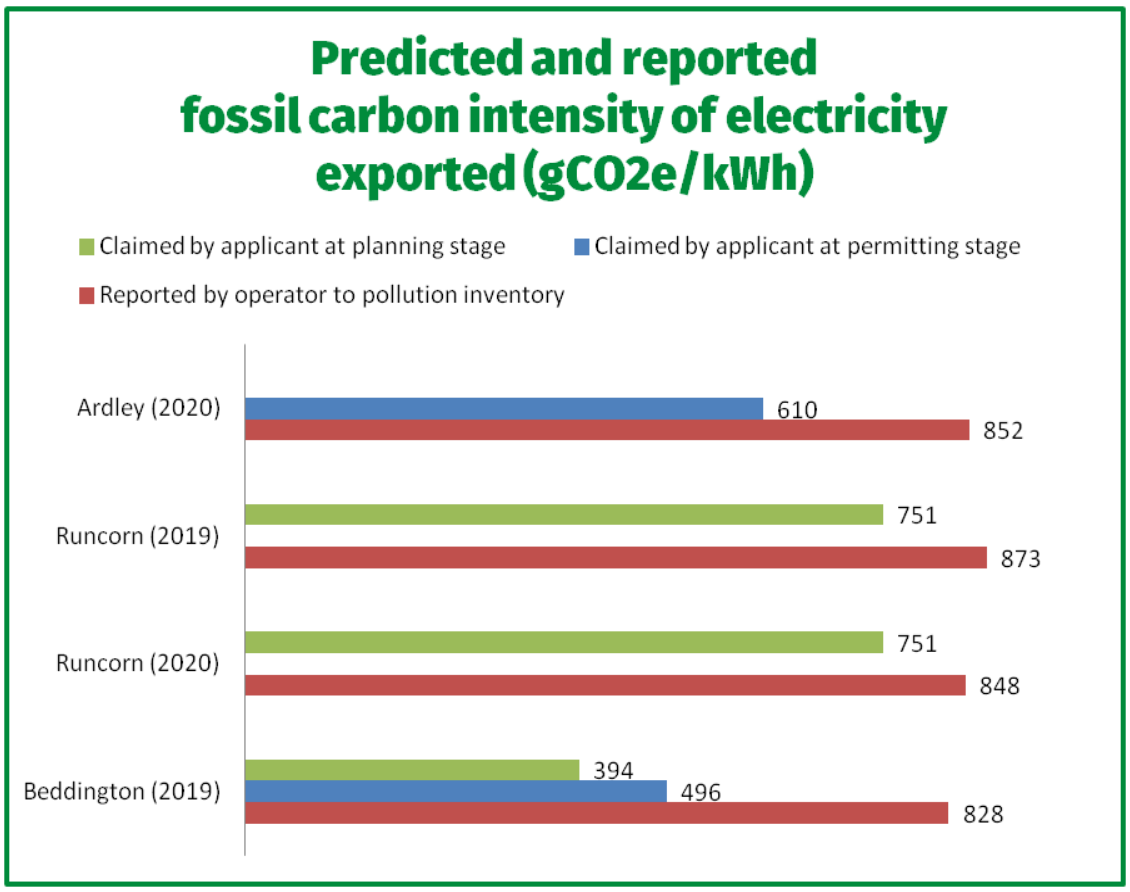
c. Reported fossil CO_2 released per tonne of waste feedstock incinerated was around 20% higher than that predicted at the planning or permitting stage.

d. Electricity generated by incinerators was 15% lower than implied by the claimed headline megawatt (MW) generation figure, i.e. an incinerator advertised as being capable of generating 10MW of electricity typically only generated 8.5MW.

e. Electricity exported was around 28% lower headline MW generation figures.

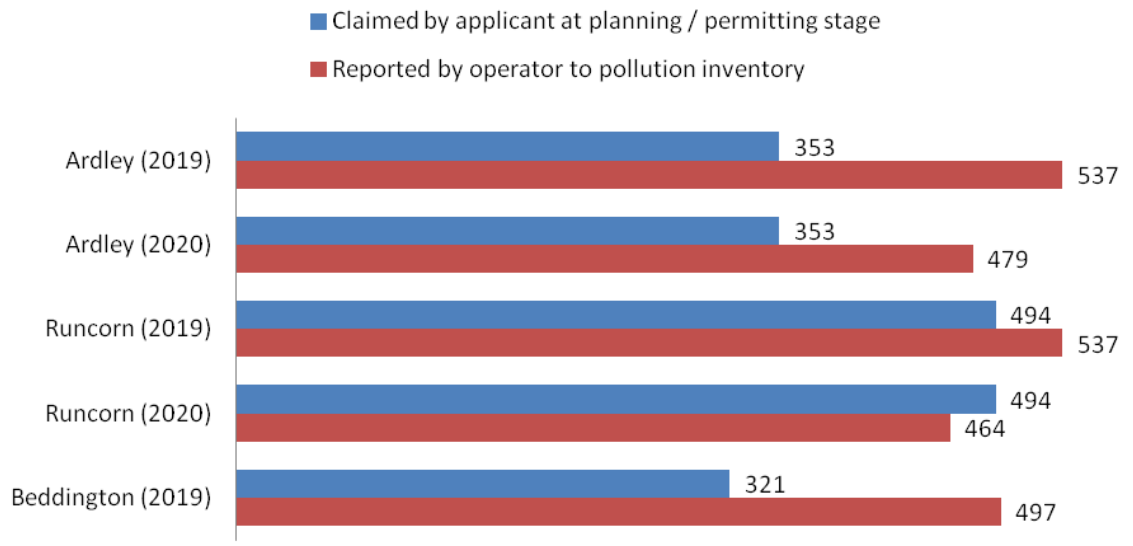
Figures from the report and associated presentation[78] included the following:



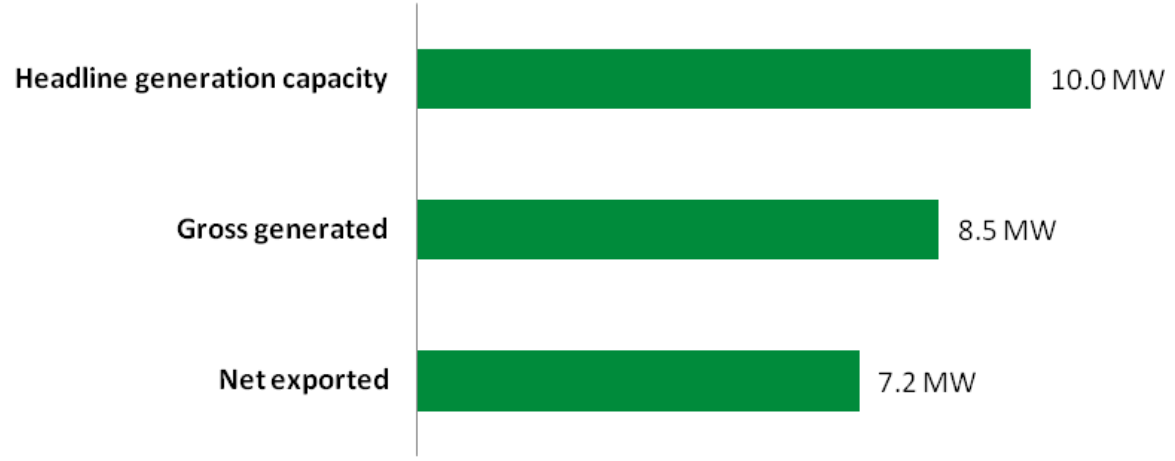


[78] https://ukwin.org.uk/files/pdf/UKWIN-Incinerator-GHG-Good-Practice-Guide-Presentation.pdf

Predicted and reported kg of fossil CO2 per tonne of waste feedstock incinerated



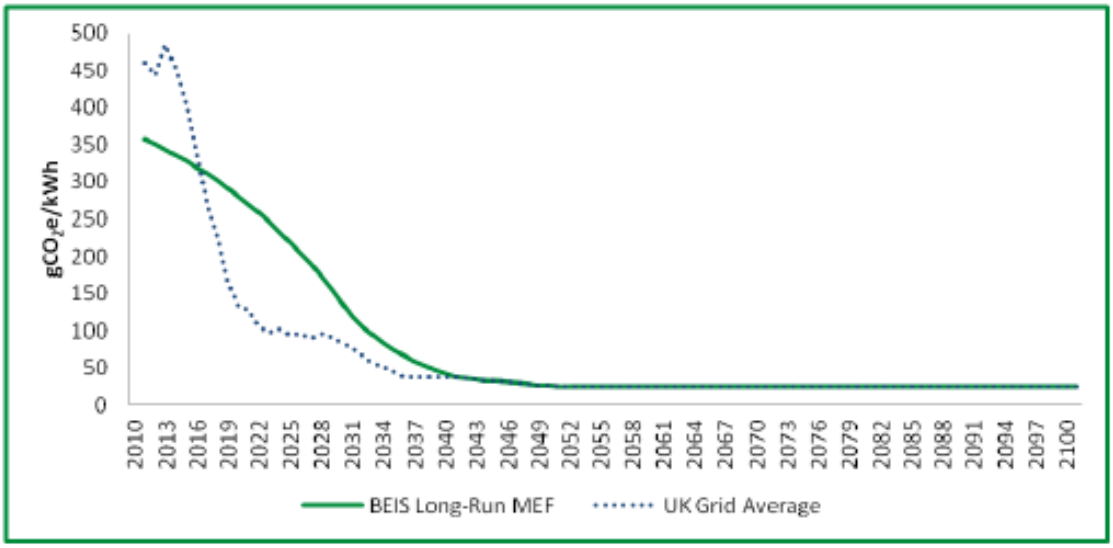
Performance of a 10 MW incinerator based on 2020 average performance



ESTIMATE OF UK TURBINE AVAILABILITY IN 2019

Waste Combustion Hours (Simple Average from Tolvik EfW Statistics Report)	Turbine Operation Hours (Simple Average from Tolvik EfW Statistics Report)	Turbine availability during combustion (Turbine hrs ÷ Waste Combustion hrs)
89.5%	81.9%	**91.5%**

GRAPH BASED ON BEIS DATA TABLE 1: 'ELECTRICITY EMISSIONS FACTORS TO 2100' FIGURES FOR GENERATION-BASED ELECTRICITY GENERATION



Reports and methodologies that take account of the role of landfill as a biogenic carbon sink

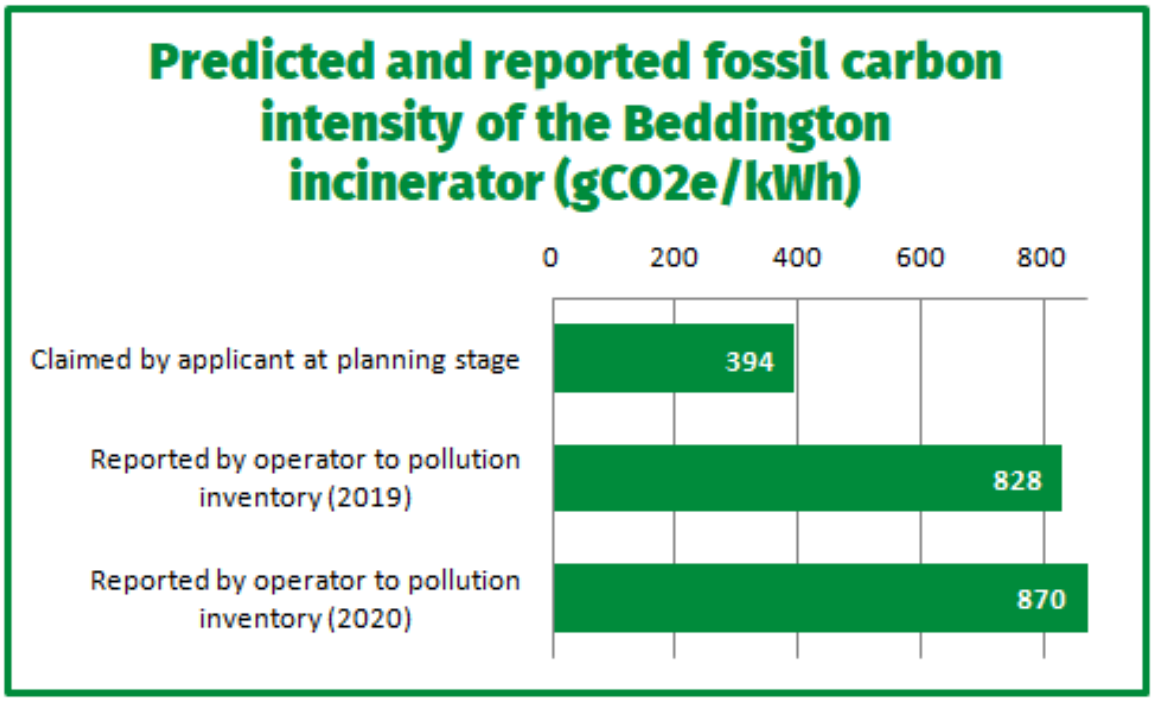
Further evidence on real world carbon performance for UK incinerators

UKWIN's Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration compared figures advanced by Viridor at the planning application and environmental permit application stages with the real world performance reported to England's incineration industry regulator, the Environment Agency, by Viridor.

This showed that real world performance was significantly worse than anticipated performance.

Beyond the values in the report's main findings, the report itself includes the data used to calculate the results. These calculations relied on knowing the fossil/biogenic fraction of the waste.[79]

Subsequent to the release of the Good Practice Guidance UKWIN managed to obtain Viridor's Beddington incinerator figures for 2020 from the Environment Agency. The Beddington incinerator's fossil carbon performance for 2020 was slightly worse than that for 2019:



This difference (i.e. the increase) can be attributed to the biogenic fraction of the waste falling from 50.6% in 2019 to 44.1% in 2020 (meaning that 55.9% of the carbon in the waste feedstock was fossil carbon).

With this information, it is now possible to produce updated figures for the carbon impacts of incineration facilities in England for 2019 and 2020 which includes the newly obtained 2020 Beddington figures and excludes the unreliable Peterborough figures (see overleaf).

[79] Note: while the report included data from Peterborough, Peterborough was excluded from the findings because the biogenic fraction reported for the Peterborough incinerator seemed to be based on an emissions factor rather than real world measurements. The Environment Agency subsequently confirmed with Viridor that Peterborough's biogenic fraction figures were not based on measurements. Evidence of this is available upon request.

Reported emissions for 2019 and 2020[80]

Incineration Plant	Carbon percentage in feedstock	CO_2e per tonne processed (tonnes)	Biogenic Fraction	Fossil CO_2e per tonne processed (tonnes)	Power Exported per tonne processed (kWh)	Fossil carbon intensity of energy exported (gCO_2/kWh)
Ardley (2019)	26.2%	1.005	48.7%	0.537		
Ardley (2020)	26.4%	1.013	55.2%	0.479	563	852
Runcorn (2019)	28.0%	1.033	48.2%	0.537	615	873
Runcorn (2020)	27.0%	0.992	53.3%	0.464	547	848
Beddington (2019)	25.7%	0.973	50.6%	0.497	600	828
Beddington (2020)	25.5%	0.971	44.1%	0.558	641	870
AVERAGE	26.5%	0.998	50.0%	0.512	593	854

This analysis of English carbon performance, as reported by Viridor to the Environment Agency, indicates that around 50% of the feedstock is considered biogenic, which means around 50% of the CO_2 is considered fossil CO_2. It also confirms that around 1 tonne of CO_2 is released per tonne of waste incinerated, and that energy exported by incinerators has a high carbon intensity.

Evidence on real world carbon performance of Scottish incinerators

By comparing CO_2 information provided by operators to SEPA's Scottish Pollutant Release Inventory for 2019[81] with information on the quantity of waste incinerated at those plants in 2019 stated in the operators' Annual Performance Reports[82], it can be estimated that incinerators in Scotland also release around 1 tonne of CO_2 per tonne of waste incinerated.

CO_2 reported per tonne of waste treated at Scotland's Municipal Waste Incinerators in 2019

Incineration Plant	Permit Number	Tonnes incinerated in 2019	Tonnes CO_2 in 2019	CO_2 emitted per tonne incinerated
Dunbar	PPC/A/1032878	250,729	274,260	1.09
Millerhill	PPC/A/1136072	142,489	131,860	0.93
Glasgow / Polmadie ACT	PPC/A/1110002	83,000	62,000	0.75
Baldovie	PPC/A/1003157	96,231	102,042	1.06
TOTAL		**572,449**	**570,162**	**1.00**

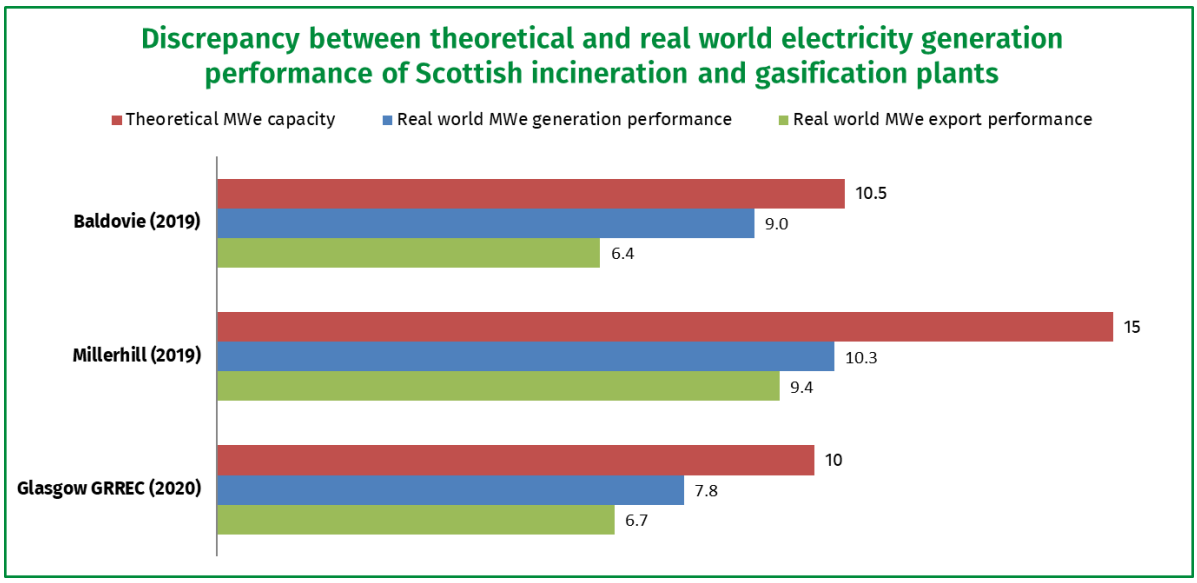
[80] As before, because N_2O figures were not reported for Peterborough it has been assumed to be zero. The Ardley values for power export and fossil carbon intensity are excluded as they relate to a period of prolonged generator non-availability which would dominate the results.

[81] https://informatics.sepa.org.uk/SPRI/

[82] https://www.tolvik.com/wp-content/uploads/2021/05/Tolvik-UK-EfW-Statistics-2020-Report_Published-May-2021.pdf for a summary. Individual reports available from https://ukwin.org.uk/library/98-AnnualPerformanceReport-2019.pdf (Dunbar), https://ukwin.org.uk/library/99-AnnualPerformanceReport-2019.pdf (Millerhill), and https://ukwin.org.uk/library/97-AnnualPerformanceReport-2019.pdf (Baldovie)

We know from the operator's annual report for Baldovie that the 102,042 tonnes[83] of CO_2 released in 2019 was based on CEMS measurements of CO_2 emissions. We do not have any evidence that any of the other Scottish emissions figures reported were based on CEMS monitoring, and so they are potentially less accurate than the figures for Baldovie.[84]

The Annual Environmental Reports provided to SEPA by plant operators provide information on electricity generation and hours of operation which can be used to compare the theoretical maximum MWe capacity of incinerators in Scotland against real world performance.[85]



This indicates that on average these incinerators operated at 78% of their electrical generation capacity, with real world export performance only 63% of the theoretical generation capacity.

Operator reports for Millerhill and Baldovie include information on electricity exported in 2019. This can be combined with information on CO_2 released in 2019 to estimate the carbon intensity of exported electricity from those incinerators (see overleaf).[86]

[83] This was reported as 'kilograms' but this is assumed to be a unit error, with the actual value being in tonnes. Such an interpretation would be consistent with the figures used for 'the specific mass emission kg/tonnes waste' in Figure 18 on the final page of the operator's report.

[84] Lerwick was excluded because the facility treated significant quantities of clinical and fish/animal waste, and such material is not typical of incinerator feedstock elsewhere. Levenseat was also excluded as we were unable to locate comparable CO_2 data for that facility.

[85] Calculated by dividing the MWh generated/net exported by the total hours of combustion to convert MWh to MW. Sources are as above, with the addition of the 2020 figure for the Glasgow GRREC which is available at https://www.whatdotheyknow.com/request/748716/response/1977006/attach/3/F0193795.zip?cookie_passthrough=1

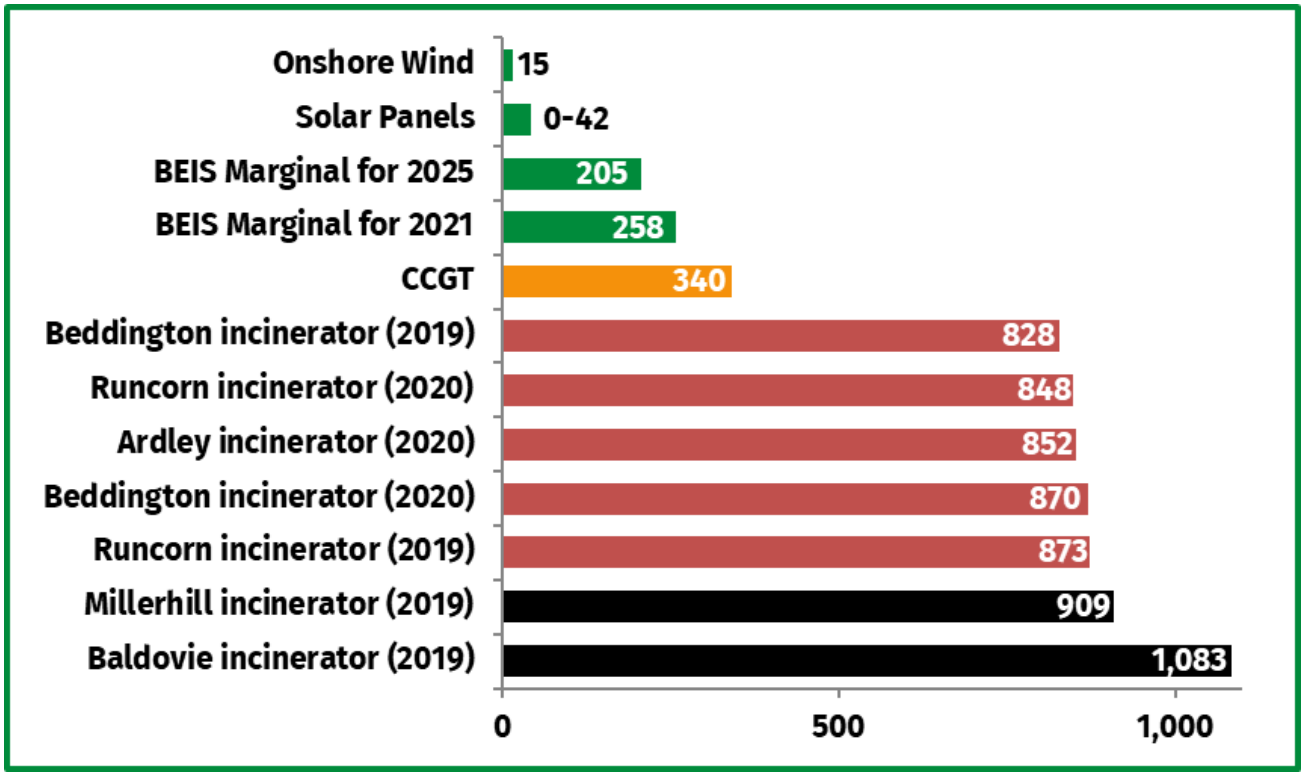
[86] The CO_2 figures reported by SEPA do not include estimates for the biogenic content of the waste feedstock, so it is assumed that 50% of the CO_2 is fossil and 50% is biogenic in line with the findings for the current biogenic fraction for England noted above. The precise figure will depend on the exact feedstock of the waste incinerated.

Carbon intensity of electricity exported at Scotland's MWI incinerators

Incineration Plant	Permit Number	Tonnes CO_2 in 2019	MWh electricity exported in 2019	Power Exported per tonne processed (kWh)	Carbon Intensity (gCO_2/kWh)	Fossil Carbon Intensity (gCO_2/kWh)
Millerhill	PPC/A/1136072	131,860	72,521	509	1,818	**909**
Baldovie	PPC/A/1003157	102,042	47,112	490	2,166	**1,083**
TOTAL		**233,902**	**119,633**	**501**	**1,992**	**996**

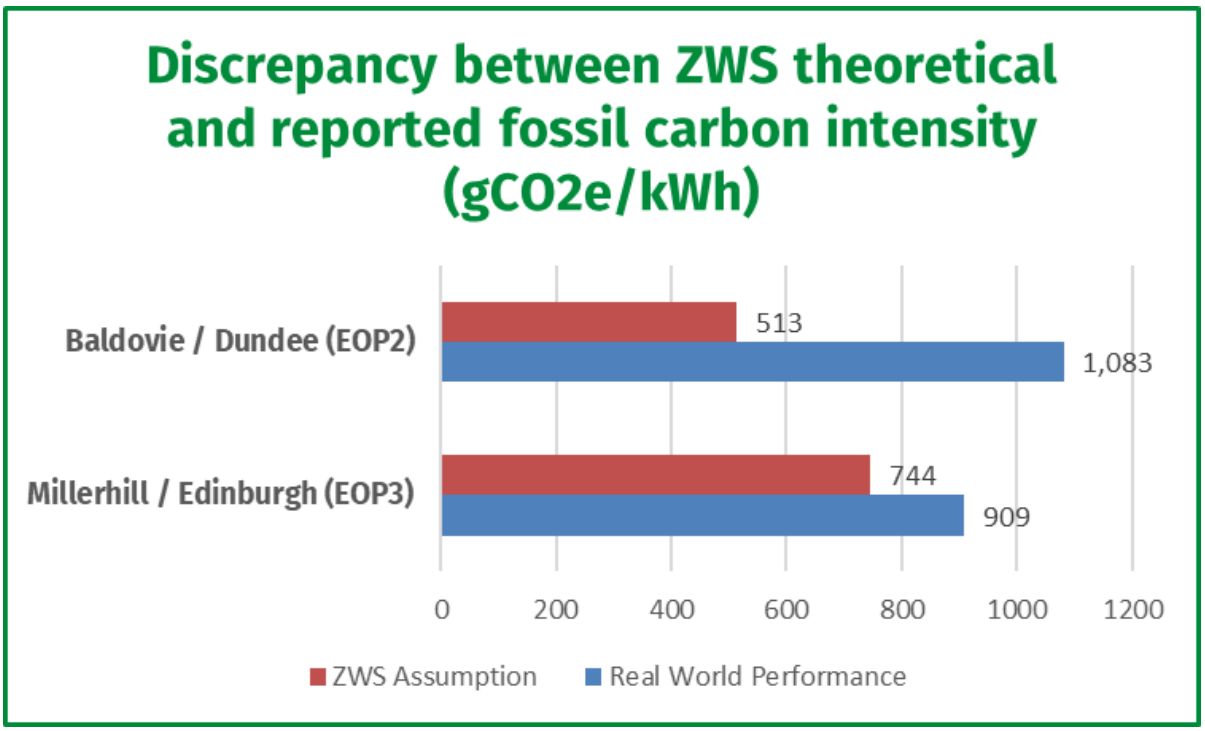
These figures indicate that the carbon intensity of these two Scottish incinerators was higher than the carbon intensity of all the incinerators studied in England.[87] As there is a similar level of CO_2 released per tonne processed this difference can largely be attributed to less electricity being exported per tonne processed for the facilities that reported CO_2 emissions.

To illustrate the performance of incineration plants relative to other forms of electricity generation, the figure from the UKWIN Good Practice Guide has been updated with Scottish incinerators shown below in black:



[87] This is only the direct CO_2 emissions and does not include other GHG emissions such as N_2O, meaning the actual impact could be slightly worse.

The performance for Baldovie and Millherhill is compared directly to the performance assumed for 2018 by Zero Waste Scotland in Table 3 of their technical report, where the plants appear to be referred to as EOP2 and EOP3 respectively (below).[88]



For the facilities where carbon intensities can be calculated, the ZWS assumption as to the carbon intensity of the electricity is between 47% and 87% of the real world figure (i.e. an average of 65% of the real world value).

This provides evidence that real world performance of Scottish incinerators is significantly worse than the performance assumed by Zero Waste Scotland (ZWS) in 'The climate change impact of burning municipal waste in Scotland' (July 2021)[89] which used operator-provided data on projected performance to estimate a far more optimistic (but still high carbon) performance. These discrepancies cannot be explained away by minor differences in calculation methodology.

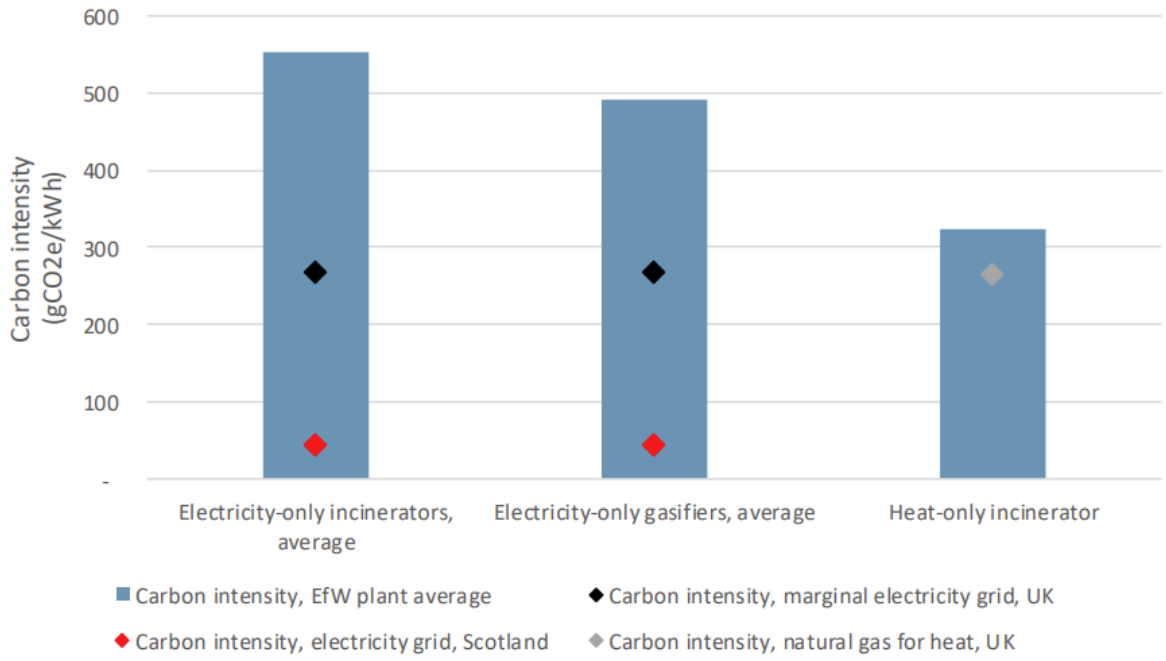
[88] The identity of the plants is more clear in the October 2020 of the report available from https://www.zerowastescotland.org.uk/sites/default/files/ZWS%20%282020%29%20CC%20impacts%20of%20incineration%20TECHNICAL%20REPORT.pdf but can be confirmed in the 2021 report by comparing the tonnes incinerated in Table 7 against the tonnes incinerated at those plants as report by Tolvik at https://www.tolvik.com/wp-content/uploads/2021/05/Tolvik-UK-EfW-Statistics-2020-Report_Published-May-2021.pdf

[89] https://www.zerowastescotland.org.uk/sites/default/files/The%20climate%20change%20impact%20of%20burning%20municipal%20waste%20in%20Scotland%20Technical%20Report%20July%202021.pdf

As shown below, the Zero Waste Scotland Report's average carbon intensity is similarly significantly below the carbon intensities observed in England and Scotland.

Estimate from 'The climate change impacts of burning municipal waste in Scotland' (Zero Waste Scotland, June 2021)

Figure 1. Average carbon intensity of EfW plant types in Scotland in 2018



Part of the reason for these discrepancies could be explained by the use of overly optimistic assumptions by ZWS regarding the efficiency of these incineration facilities based on theoretical generation capacities claimed by plant operators and applicants.

For example, the ZWS report assumed "Plant efficiency averaged 25% for the electricity-only plants" but in 2020 the Glasgow gasification plant reported a total electrical generation figure of just 17%.[90]

This evidence provides an additional indication that the current real world performance of incinerators in Scotland could be far worse than predicted by Zero Waste Scotland's modelling, thus calling into question the robustness of the ZWS report's conclusions regarding the current impacts of incineration compared to landfill.

[90] As per Viridor's 2020 Incinerator Efficiency Report provided to SEPA. See: https://www.whatdotheyknow.com/request/748716/response/1977006/attach/3/F0193795.zip?cookie_passthrough=1

The climate change impact of burning municipal waste in Scotland (Zero Waste Scotland, July 2021)

While the call for evidence document states "In July 2021, Zero Waste Scotland published a report, the Climate Change Impacts of Burning Municipal Waste in Scotland. This suggested that incinerating municipal waste in Scotland resulted in 27% fewer emission than landfilling the same waste" this is not an accurate representation of the report's findings.

In relation to the 27% figure, we note that:

- The 27% figure related to 2018 and not to present or anticipated future adverse climate impacts of incineration, and we further note that decarbonisation of the grid and removal of food waste would reduce the benefits of incineration.
- The 27% figure related to sending waste directly to landfill, and not to the biostabilisation scenario which indicated that landfill could have significantly lower impacts than incineration.
- Chapter 5 of the report acknowledges a number of data gaps, including with respect to the composition of residual municipal waste and the energy outputs of EfW incineration plants, and thus energy displacement.
- The impact of displaced electricity is assessed based on the UK grid, not the more-decarbonised Scottish grid.
- No account is made in the calculations for the fact that landfill releases less biogenic CO_2 than incineration, i.e. that landfill acts as a partial carbon sink for biogenic CO_2.
- The report figures are based on incinerator applicants' energy output estimates which, as per UKWIN's analysis above, is often unrealistically optimistic, e.g. due to the failure to take into account anticipated turbine non-availability.

To quote from the Zero Waste Scotland (ZWS) report (**with emphasis added**):

- "Sending one tonne of waste to EfW emitted 246 $kgCO_2e/t$ on average, which is 27% lower than the emissions from sending the same waste to landfill in Scotland **in 2018**. The emissions from both EfW and landfill are highly dependent on the composition of waste, which is **variable and changing over time. If the fossil carbon in waste increases, EfW emissions rise**. If the biogenic carbon in waste increases, landfill impacts rise."
- "The **significance and variability of key parameters such as the composition of waste and the decarbonisation of the grid**, illustrate the importance of regularly updating the evidence base for this subject area."

- “When biogenic carbon decreases (e.g. if the proportion of food and paper waste in municipal residual waste falls), landfill greenhouse gas emissions fall…Landfill and EfW impacts are equal when the proportion of food and paper waste in residual municipal waste falls from the main model assumptions by 10.4% from 43.1% to 32.7%.”

As such, the report itself acknowledges that looking back at assessments based on historic carbon intensities and waste composition (which is what the 27% figure does) results in an inaccurate assessment of the current and future impacts of incineration.

A number of limitations/deficiencies in the report raise doubts that the 27% was even accurate in 2018. These indicate that the report underestimated the carbon impacts of incineration and overestimated the impacts of landfill.

The ZWS report states that: "The EfW plants in this study are assumed to **displace UK marginal electricity grid**". Figure 1 of the report seems to indicate that the carbon intensity of the Scottish incineration grid is significantly lower than the UK average.

The ZWS report states that: "Data on the energy outputs of EfW plants, and thus energy displacement, are based on PPC permits, rather than annualised energy data or NCV".

As noted above, the evidence and analysis behind Recommendation #6 and #7 of UKWIN’s Good Practice Guidance indicates that the use of permit application data will tend to overestimate energy outputs, and this is supported by the above evidence from Scotland that both gasification and conventional incineration plants generate and export significantly less than the theoretical generation capacity, with observed efficiency being lower than predicted in the ZWS report.[91]

The ZWS report states that "biogenic and fossil carbon are counted differently" in the assessment, but this improperly skews the analysis in favour of incineration. Ignoring biogenic CO_2 means that the comparison fails to take into account the fact the ~50% of biogenic carbon which is sequestered in landfill means it is acting as a 'carbon sink' for CO_2 which would be released if the waste were to be incinerated.

The modelling fails to account for this difference in biogenic CO_2 emissions despite significant evidence and logic that failing to do so results in invalid comparisons.

[91] For more evidence on gasification under-performance see ‘Efficiency and Performance Assessment of Waste-to-Energy Melting Gasification in Relation to the EU Waste Framework Directive’ by Dr. Andrew Neil Rollinson, available at: https://www.vivis.de/wp-content/uploads/WM9/2019_WM_371-382_Rollinson.pdf

For example, a European Commission report has noted that: "…in comparative assessments between processes, it cannot be valid to ignore biogenic CO_2 if the different processes deal with biogenic CO_2 in different ways…".[92]

For more details see Recommendation #5 of UKWIN's Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration.

Based on the above, it would be reasonable to conclude that if the Zero Waste Scotland report were to be updated to address all of the issues raised then it would find that not only is incineration currently worse than landfill in Scotland but that as the grid decarbonises and the amount of food waste in the feedstock decreases incineration is set to get progressively worse over the coming years.

However, it should be noted that these observations strengthen rather than weaken the important conclusion of the ZWS report that "EfW can no longer be considered a source of low carbon energy within a UK and Scottish context".

Evaluation of the climate change impacts of waste incineration in the United Kingdom (UKWIN, October 2018)[93]

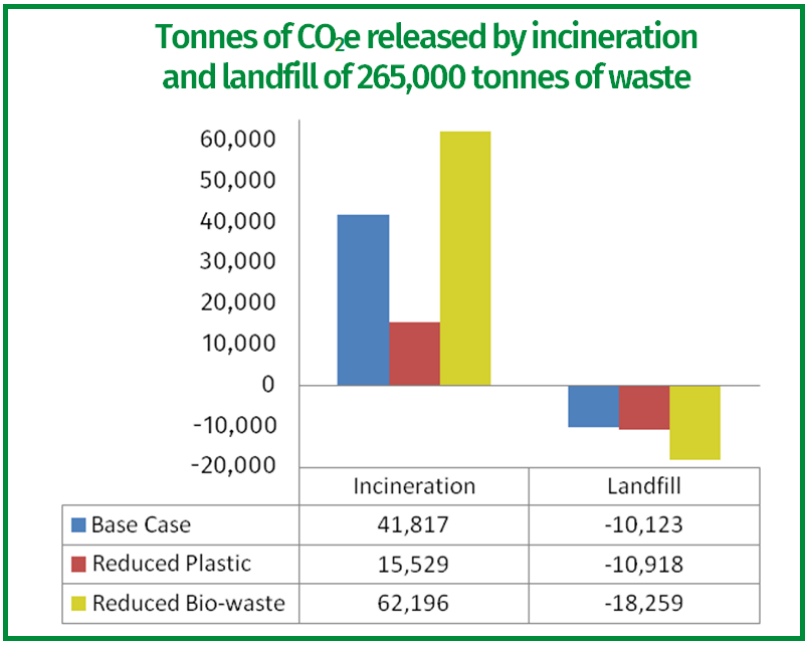
This report found that:

- Waste incinerators currently release an average of around 1 tonne of CO_2 for every tonne of waste incinerated.
- The release of CO_2 from incinerators makes climate change worse and comes with a cost to society that is not paid by those incinerating waste.
- In 2017 the UK's 42 incinerators released a combined total of nearly 11 million tonnes of CO_2, around 5m tonnes of which were from fossil sources such as plastic.
- The 5 million tonnes of fossil CO_2 released by UK incinerators in 2017 resulted in an unpaid cost to society of around £325 million.[94]
- Over the next 30 years the total cost to society of fossil CO_2 released by UK's current incinerators would equate to more than £25 billion pounds of harm arising from the release of around 205 million tonnes of fossil CO_2.[95]

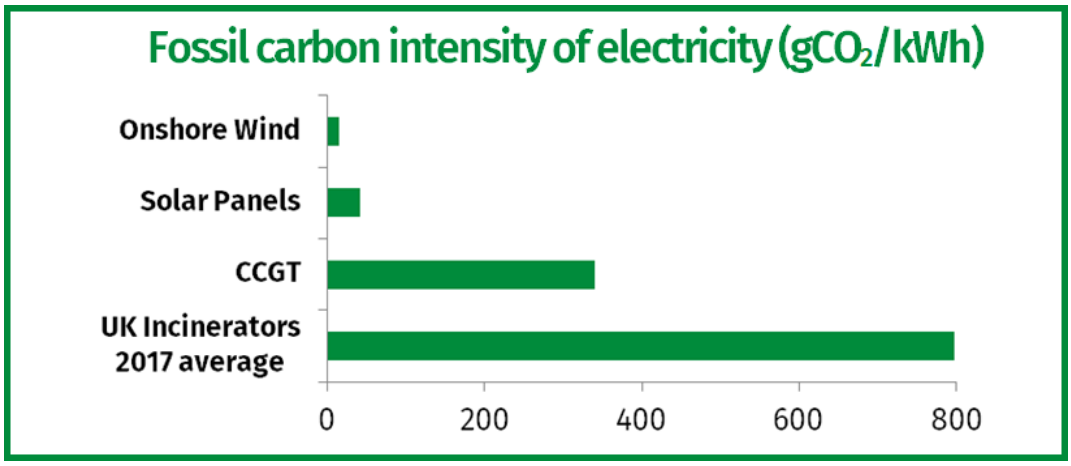
[92] https://ec.europa.eu/environment/pdf/waste/compost/ia_biowaste%20-%20ANNEX%20F%20-%20environmental%20assumptions.pdf
[93] https://ukwin.org.uk/files/pdf/UKWIN-2018-Incineration-Climate-Change-Report.pdf
[94] Note: As per https://ukwin.org.uk/facts/#unpaidcost the unpaid cost to society from fossil CO_2 released from UK incinerators rose significantly when the government increased their Central Non-traded carbon price, meaning that in 2020 the unpaid cost stood at more than £1.5bn.
[95] If the Central Non-traded carbon price remained fixed at 2020 levels (£241 per tonne) this figure would rise to nearly £50bn, however at https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation we read how Government expects this cost to rise from £241 per tonne in 2020 to £378 per tonne by 2050.

- Electricity generated by waste incineration has significantly higher adverse climate change impacts than electricity generated through the conventional use of fossil fuels such as gas.
- The 'carbon intensity' of energy produced through waste incineration is more than 23 times greater than that for low carbon sources such as wind and solar; as such, incineration is clearly not a low carbon technology.
- When waste is landfilled a large proportion of the carbon is stored underground, whereas when waste is burned at an incinerator the carbon is converted into CO_2 and immediately released into the atmosphere.
- Over its lifetime, a typical waste incinerator built in 2020 would release the equivalent of around 1.6 million tonnes of CO_2 more than sending the same waste to landfill. Even when electricity generation is taken into account, each tonne of plastic burned at that incinerator would result in the release of around 1.43 tonnes of fossil CO_2.
- Due to the progressive decarbonisation of the electricity supply, incinerators built after 2020 would have a relatively greater adverse climate change impact.
- Composition analysis indicates that much of what is currently used as incinerator feedstock could be recycled or composted, and this would result in carbon savings and other environmental benefits. Thus, incinerating waste comes with a significant 'opportunity cost'.

Figures from the report included:



	Incineration	Landfill
Base Case	41,817	-10,123
Reduced Plastic	15,529	-10,918
Reduced Bio-waste	62,196	-18,259



Greenhouse Gas and Air Quality Impacts of Incineration and Landfill (ClientEarth, March 2021)[96]

As noted in the previous section, this report was written by Eunomia for ClientEarth. The report highlights how biostabilising waste prior to landfill can result in significantly lower impacts than sending waste directly to incineration. It also shows that sending waste straight to landfill results in lower emissions than sending waste to incineration in the 'expected-2035' scenario.

While the report includes reference to the potential for reductions in fossil CO_2 emissions from diverting all plastics to recycling (when it calls incineration with "pre-treatment"), this scenario might be overestimating the potential for low-grade plastic to be recycled and for the extent to which the benefits of this compensate for the biogenic CO_2 emissions from incineration.

Unfortunately, the underlying information regarding these assumptions is not available, and so it is difficult to fully assess these claims. What we would not want to see is material being diverted for 'plastic recycling' only to then be converted into a fossil fuel for combustion or subjected to environmentally harmful pyrolysis treatment.[97]

Q15 What other aspects should the Review consider when assessing the environmental impacts of residual waste treatment options?

With respect to lock-in, the high Capex associated with building new incinerators, and the current level of existing incineration capacity in Scotland, mean that allowing new incinerators to be built would considerably increase the risk of lock-in. Furthermore, as recyclable and compostable material is progressively diverted from existing incinerators an increasing quantity of existing capacity is freed up.

[96] https://www.eunomia.co.uk/reports-tools/greenhouse-gas-and-air-quality-impacts-of-incineration-and-landfill/
[97] See https://www.no-burn.org/chemical-recycling-resources/ and https://www.no-burn.org/wp-content/uploads/2021/11/CR-Technical-Assessment_June-2020_for-printing-1.pdf and https://zerowasteeurope.eu/library/el-dorado-of-chemical-recycling-state-of-play-and-policy-challenges/

As has already been mentioned, incineration destroys materials, meaning that nutrients and materials are lost to the circular economy. Even when incineration produces material outputs such as incinerator bottom ash aggregate a significant proportion of the value in the material has been lost, and it means that the original product/material would need to be replaced. If properly designed, landfill can allow for future mining of materials such as hard-to-recycle plastics once recycling technologies have improved or circumstances have changed.

This means that, from a circular economy perspective, landfill can be better than incineration both in terms of preserving materials for future use and in terms of avoiding lock-in that harms the transition to a more circular economy

With respect to air quality, it must be said that the experience of Covid reinforces the urgency and importance of the need to improve air quality. Whilst the degree of harm caused to air quality by incinerators is a matter of debate, it is widely accepted that incinerators degrade air quality to some extent, moving in the wrong direction with respect to public health in this regard.

Furthermore, there are concerns that adverse health impacts of incinerators are being underestimated because of the emphasis on the mass of particulate matter released as distinct from the number of particles released.[98]

Q17 Do you have evidence or experience of the community impacts (positive and negative) of different residual waste treatment options, e.g. landfilling compared to incineration, that you could share?

Job creation can be considered a positive community impact, and in light of this it would be useful for the Review to consider evidence of how options other than incineration and landfill can result in the creation of far more by way of jobs (especially when account is taken of the land take associated with incineration facilities and landfill sites).

There are numerous studies showing that many employment opportunities could arise from a more circular economy. A small selection of recent studies include:

- 'Levelling up through circular economy jobs'[99] (August 2021) by Green Alliance, which shows how "Greater government ambition for an effective and expanded circular economy by 2035 would create hundreds of thousands of new jobs… we estimate that the government could help to create over 450,000 jobs in the circular economy by 2035".

[98] For more about these concerns see: https://ukwin.org.uk/particulates/
[99] https://green-alliance.org.uk/wp-content/uploads/2021/11/Levelling_up_through_circular_economy_jobs.pdf

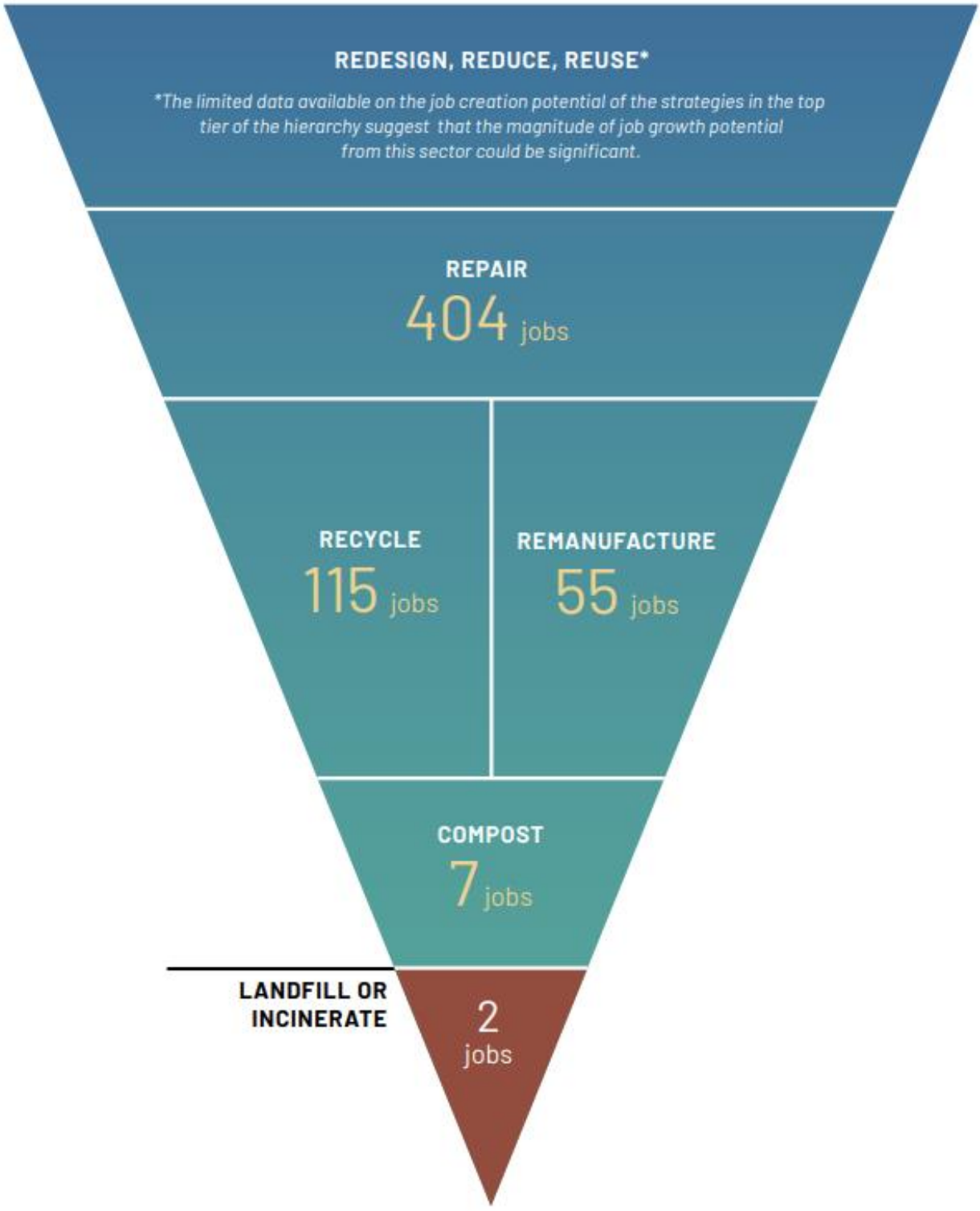
- ‘Effects of the Circular Economy on Jobs’[100] (November 2020) by the International Institute for Sustainable Development, which refers to many other studies.
- ‘London's circular economy route map’ (March 2021) by Circular London (ReLondon, formerly known as the London Waste and Recycling Board), which states: “By 2036, the circular economy could provide London with net benefits of at least £7bn every year. These benefits would be in the sectors of built environment, food, textiles, electricals and plastics. The circular economy could also generate 12,000 net new jobs in the areas of re-use, remanufacturing and materials innovation”.
- ‘Zero waste and economic recovery: The Job Creation Potential of Zero Waste Solutions’[101] (February 2021) by GAIA similarly highlights the job creation potential of the circular economy and states: “…zero waste approaches create orders of magnitude more jobs than disposal-based systems that primarily burn or bury waste. Indeed, waste interventions can be ranked according to their job generation potential, and this ranking exactly matches the traditional waste hierarchy based on environmental impacts (Figure 1). These results demonstrate the compatibility of environmental and economic goals and position zero waste as an opportune social infrastructure in which investments can strengthen local and global economic resilience. This study also finds evidence for good job quality in zero waste systems. Multiple studies of zero waste systems cite higher wages and better working conditions than in comparable fields, and opportunities to develop and use varied skills, from equipment repair to public outreach.”

  Figure 1 from the GAIA report is reproduced overleaf.

[100] https://www.iisd.org/system/files/2020-12/circular-economy-jobs.pdf
[101] https://zerowasteworld.org/wp-content/uploads/Jobs-Report-ENGLISH-2.pdf

Figure 1: Waste Hierarchy with mean job generation figures per ten thousand tonnes of waste processed per year.

The data show that waste management approaches that have the best environmental outcomes also generate the most jobs.



Communities living near incinerators have many complaints that arise during construction, pre-operational testing (commissioning) and full operation, including:

Noise, vibration, plume, flies and odours – These disamenities are often downplayed by operators during the planning and permitting application stages, however when problems do occur some of these same operators dismiss the problems as inevitable or unavoidable. Press coverage reflecting some of these problems with incinerators include:

- In Runcorn, where waste is delivered by rail, it was reported that: "one resident said she faced daily noise from cargo trains en route to deliver the waste to be burned, well into the evening" and that: "It's unbelievable – you can lie in bed at night and feel the vibration of the train as it goes past but it goes that slow it takes about two to three minutes to come past through the station."[102]
- It was also reported in Runcorn that: "Around 100 people attended a meeting…to protest over the noise, smell, steam and pollution from the plant." quoting one resident saying: "I've been awake most of the night and I'm losing the will to live. Then wagons beeping their horns this morning followed by banging of containers". The organiser of the meeting is quoted as stating: "People feel trapped. It's gone from a place where they could sit in their garden to closing doors and windows because it stinks". This report also quoted the local MP as follows: "People have been complaining about a droning noise disturbing their sleep. These are genuine concerns about the vapour, noise and smells."[103]
- In Derby, one resident stated: "Where we are, the stench is really strong and smells like rotting food. We have been getting loads of flies around here as well. The summer has been horrendous, we have had to keep our windows closed in the hot weather because when we open them it is just awful."[104] It was also reported that: "Bad smells from the controversial Sinfin waste treatment plant are still plaguing residents almost a year after the stink first started. Last August, residents and businesses near to the plant complained to the Environment Agency about a compost-like smell shortly after waste arrived for pre-opening commissioning. They were told the smell would disappear and was due to waste being stored on the site ahead of testing. But the smell has continued to plague residents – especially during the recent warmer weather – despite earlier promises from the operators that there would be no smell off-site from the facility".[105]

[102] https://www.liverpoolecho.co.uk/incoming/shadow-uks-biggest-incinerator-part-12406245
[103] https://www.runcornandwidnesworld.co.uk/news/11753701.health-fears-over-runcorn-incinerator/
[104] https://www.derbytelegraph.co.uk/news/derby-news/residents-slam-controversial-waste-plant-2021845
[105] https://www.derbytelegraph.co.uk/news/derby-news/smell-sinfin-derby-waste-plant-1641728

- In Derby, the operator stated: “we acknowledge…that some nuisance has been caused especially overnight when background noise levels are lower, and the warm weather leaves residents understandably wishing to have windows open”.[106]
- In Gloucestershire, the operator stated in relation to hot commissioning that: “During this period, up until the facility is fully operational in summer 2019, there will be occasional loud noises, which sound similar to when you bleed a radiator, and plumes of steam as the first combustion gases are pushed through the ducting to test all systems”.[107]
- An incinerator in Plymouth has also generated numerous complaints from local residents, with one commenting to the Plymouth Herald that: “The summer was awful, all the flies, the rubbish, the smell. I am looking to move because we have had enough of it”, and another stating: “It smells, it makes me feel sick”. According to an ITV report: “Residents nearby have complained about the smell, the noise and flies in their homes. They say their worst fears have been realised” (Source). It was also reported that: “A ‘rotten smell’ was frequently emitted when first constructed, and still occurs in the summer” (Source).

Light pollution – Bright lights are typically placed towards the top of the incinerator stack to reduce the risk of aircraft collision. This is a constant reminder of the incinerator and a source of distress to many residents. For example, it was reported in Runcorn that one resident: “said she now lives with her curtains drawn at night to block the lights from the site, which include a pair of red lights like eyes peering from the top of the main chimney stack, from shining into her home and bedroom, having previously enjoyed looking out at the trees behind her home and the site”.[108]

Visual impact of the chimney stack and building – Incinerators are often seen as a blot on the local landscape and a constant reminder of the pollution that they cause. For example, one local newspaper article about an incinerator in North Yorkshire described the Allerton plant as one which “dominates the skyline of the main road to the North” quoting a councillor as stating: “A lot of people do feel it is a blot on the landscape, I’m astonished that it can be seen from so many places”.[109]

Traffic – In addition to increases in the general volume of traffic and the pollution that this brings, some of those living near incinerators have observed HGVs ignoring planning conditions designed to control adverse impacts.

[106] https://www.derbytelegraph.co.uk/news/derby-news/furious-residents-hit-out-incinerator-1970834
[107] https://www.gloucestershirelive.co.uk/news/gloucester-news/residents-living-near-javelin-park-2918314
[108] https://www.liverpoolecho.co.uk/incoming/shadow-uks-biggest-incinerator-part-12406245
[109] https://www.thenorthernecho.co.uk/news/15891865.plan-visitor-attraction-colossal-1-4bn-incinerator-beside-a1-m-north-yorkshire/

For example, lorries delivering feedstock sometimes travel along routes that are disallowed by planning conditions, despite assurances made at the planning application stage that this would not happen. In other instances, after planning permission is granted on the basis of strict controls over when and where the HGVs can travel, it is not unusual for operators to seek to change the arrangement to enable increases in the number of vehicles, extensions of the time these vehicles are permitted, and expansion of the routes that they are allowed to take. Such changes are often allowed under delegated powers without any community consultation, even in circumstances where the changes directly break promises made to the community about how traffic impacts will be strictly controlled.

Broken promises, misinformation and lack of transparency – In addition to the broken promises referred to above in relation to disamenities, there are various other instances where operators behave differently to how they said they would during consultations or where operators have not acted with full candour. For example:

- Operators routinely state that inverse pressure will be used in buildings to avoid noise and odour issues, with doors being mostly shut, but then too often the operators end up leaving doors open for operational reasons which results in disamenities to neighbours.
- Areas have faced real-world reductions in recycling rates despite assurances that the incineration plant would only be used for “non-recyclable” waste. In some cases, this is a result reduced recycling services once the incinerator is in place.
- Liaison groups set up with the stated purpose of engaging with the community are often not informed of forthcoming changes to planning permissions and environmental permits, e.g. proposals to increase capacity. Those who ask tough questions are often excluded from liaison groups, and applicants often use participation in the liaison group as evidence of ‘community support’ for the facility (even in circumstances where the operator promised that they would not do so). In many cases, liaison groups are given the promise of helping to design the proposal but end up having influence over the location, capacity and technology choices adopted by the operator.
- Operators often try to give the impression that all emissions are continuously monitored when in most cases emissions of concern, such as dioxins, are only monitored a few times a year.
- Even in cases where operators have carried out compositional analysis of what they are burning, they often do not publish this information and will not release it to the public when this information is requested.

Inadequate responses to complaints – When communities face serious nuisance from an incinerator, residents who reach out to the operator are too often greeted with denials that the problems are caused by the incinerator. Even when the operator is subsequently found to be at fault, these operators rarely apologise for having denied the issues were their responsibility. It is extremely rare for an operator to provide any compensation for the nuisances that they cause.

Property values – Whether or not the loss of property value is a material planning consideration, it is not unusual for houses prices to fall when there is a proposed or actual incinerator. There are numerous instances where residents have reported experiencing difficulty selling their property due to the threat of an incinerator. Operators do not tend to compensate residents who have suffered financially as a result of incinerators or incinerator proposals.

Problems with district heating schemes including:

- **Outages**, where residents are left in the cold due with no heating or hot water, e.g. because of an unplanned incinerator shut-down.
- **Costs**, where residents may be tied into paying above-market-rate prices for their heating. Residents often do not have alternative means of powering their heating system (e.g. they have no boiler), and they are contractually obliged to pay for the heating network.
- For an account of some of the problems associated with the Sutton Decentralised Energy Network (SDEN) associated with London's Beddington incinerator as conveyed by Elliot Colburn MP to Parliament on the 4th of February 2022 see the Hansard record.[110]

[110] https://hansard.parliament.uk/Commons/2022-02-04/debates/02841671-B369-4CA1-B0D8-AEA3E66978AD/SuttonDecentralisedEnergyNetwork

Q18 Do you have evidence (reports, studies, data) that could help to inform consideration of the public health implications of different treatment options?

Incineration can be a significant source of air pollution in a local community, and as with the climate change impacts of incineration these costs are not reflected in the price of treatment and can therefore be considered 'externalities'.

The March 2021 ClientEarth report[111] provides evidence on quantifying the adverse health impacts of Municipal Waste Incineration and other waste treatment options based on values from Defra's air quality appraisal damage costs toolkit.

While the 'Central' values from Table 2-5 are used for Figure 2-3 and Table 2-6 we suggest that the 'high sensitivity' values are likely to be more accurate, as the current evidence and historic precedent indicate that adverse impacts of air pollution have often been underestimated rather than over-estimated.

While the values for incineration are based on PM2.5m it is expected that a higher value would have been achieved if the calculation had been based on the adverse impacts of PM<1s which could be a large proportion of the particulates released from incineration as filter efficiency tends to be lowest in the 0.05 to 0.5 range.[112]

Table 2-5 Damage cost data – health impacts of air pollution

Pollutant	Damage cost for air pollution health impacts, £ / tonne of pollutant		
	Low Sensitivity	Central	High Sensitivity
NH_3	£1,521	£7,923	£24,467
VOCs	£55	£102	£205
PM2.5	£15,799	£74,029	£216,443
SO_x	£2,893	£13,026	£37,611
NO_x	£663	£7,060	£26,837

Source: Defra Air Quality Appraisal Damage Costs Toolkit 2020

[111] https://www.clientearth.org/latest/documents/greenhouse-gas-and-air-quality-impacts-of-incineration-and-landfill/
[112] https://ukwin.org.uk/particulates

Figure 2-3 Air quality impacts of waste treatment systems (assuming typical performance of incineration facilities)

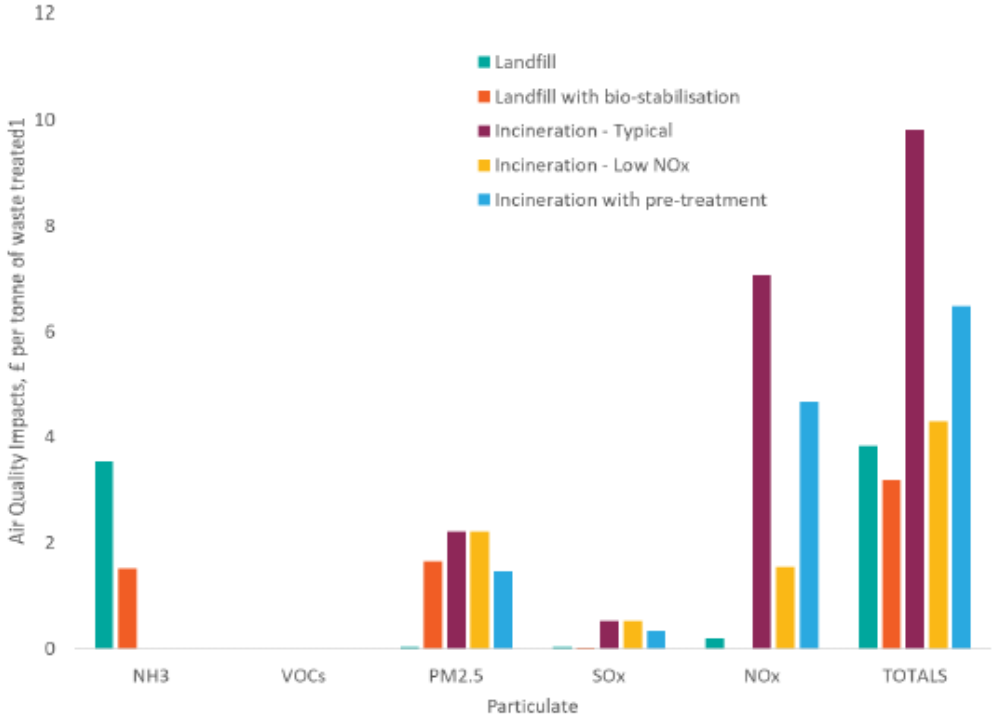


Table 2-6 Air quality impacts of waste treatment systems

	Air Quality Impacts, £ per tonne of waste treated[1]				
	Landfill	Landfill with bio-stabilisation	Incineration		Incineration with pre-treatment[2]
			Typical	Low NO_x	
NH_3	£3.55	£1.52			
VOCs		£0.01	£0.01	£0.01	£0.00
PM2.5	£0.04	£1.65	£2.22	£2.22	£1.47
SO_x	£0.04	£0.02	£0.52	£0.52	£0.34
NO_x	£0.20		£7.06	£1.55	£4.67
TOTALS	£3.83	**£3.19**	£9.81	£4.30	£6.48

Other relevant sources of information on the adverse impacts of incineration include:

- The All Party Parliamentary Group on Air Pollution's December 2021 report entitled 'Pollution from Waste Incineration A Synopsis of Expert Presentations on Health and Air Quality Impacts: A Synopsis of Expert Presentations on Health and Air Quality Impacts'[113].
- 'The health impacts of waste incineration: a systematic review' (Tait, 2020)[114]
- Health concerns about incineration expressed by NHS Ayrshire and Arran MCN (October 2021)[115]
- Health concerns about incineration raised by doctors in London (June 2020).[116]
- 'Toxic Falluot: Waste Incinerator Bottom Ash in a Circular Economy (GAIA / Zero Waste Europe, January 2022)[117]
- 'The True Toxic Toll: Biomonitoring of incineration emissions' (Zero Waste Europe, January 2022)[118]

As Aidan Farrow, a researcher at the Greenpeace International Science Unit, summarised the matter: "There's really strong evidence that even small increases in particulate pollution can have a measurable impact on health...Anything that is going to produce more air pollution in places where people are going to breathe it, there will be a health impact. It's effectively a political decision of how big you're willing that impact to be".[119]

This conclusion is supported by statements on the harmfulness of pollutants relevant to incineration from Government and other leading sources. For example:

- According to Defra, Public Health England and Local Government Association: "...the latest epidemiology demonstrates that harm occurs at pollution levels below EU limit values, so if your area doesn't have an AQMA it doesn't mean there isn't a public health issue to consider… There is no safe level for particulate matter (PM10, PM2.5), while NO2 is associated with adverse health effects at concentrations at and below the legal limits".[120]

[113] https://appgaq.wordpress.com/2021/12/14/report-pollution-from-waste-incineration/
[114] https://onlinelibrary.wiley.com/doi/full/10.1111/1753-6405.12939
[115] https://eplanning.east-ayrshire.gov.uk/online/applicationDetails.do?activeTab=summary&keyVal=QTAXJRGFG7L00
[116] https://www.nlwa.gov.uk/sites/default/files/2020-07/Supplementary%20Agenda%2025.06.2020.pdf
[117] https://zerowasteeurope.eu/wp-content/uploads/2022/01/zwe_Jan2022_toxic_fallout_research_report.pdf
[118] https://zerowasteeurope.eu/library/the-true-toxic-toll-biomonitoring-of-incineration-emissions/
[119] : 'Dirty white elephants: Incinerators were supposed to solve the UK's waste crisis. Are they making it worse?'. SourceMaterial in conjunction with The Telegraph, 4 February 2021. Available from: https://www.source-material.org/blog/dirty-white-elephants
[120] Air Quality: A Briefing for Directors of Public Health (Page 41 and 61). Defra, March 2017. Available from: https://laqm.defra.gov.uk/assets/63091defraairqualityguide9web.pdf

- According to European Parliament (Directorate General for Internal Policies): "Although WHO AQGs [World Health Organisation Air Quality Guidelines] are based on health considerations, exposure even below the guideline values may constitute health risks that cannot be excluded. This is especially true for pollutants such as PM [Particulate Matter] for which it has been found that there is no threshold level below which adverse effects can be excluded. Also, mixtures of pollutants might have additive effects; highly sensitive groups might also be affected when exposed to levels at or below the WHO AQG".[121]
- According to World Health Organisation (WHO): "PM [Particulate Matter] is a widespread air pollutant, present wherever people live. The health effects of PM10 and PM2.5 are well documented. There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. Since even at relatively low concentrations the burden of air pollution on health is significant, effective management of air quality aiming to achieve WHO AQG [World Health Organisation Air Quality Guidelines] levels is necessary to reduce health risks to a minimum".[122]

[121] EU Air Quality Policy and WHO Guideline Values for Health. Study for the ENVI Committee. European Parliament, October 2014. Available from: http://www.europarl.europa.eu/RegData/etudes/STUD/2014/536285/IPOL_STU(2014)536285_EN.pdf

[122] Health effects of particulate matter. Policy implications for countries in eastern Europe, Caucasus and central Asia. World Health Organisation / WHO, 2013. Available from: http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/health-effects-of-particulate-matter.-policy-implications-for-countries-in-eastern-europe,-caucasus-and-central-asia-2013

TOPIC 4: LOCATIONAL CONSIDERATIONS

Q19 What are the main considerations in deciding where capacity should be located, and in what form?

The starting point for considering where incineration capacity should be located is to note where such capacity already exists. If Scotland is to implement an 'incineration exit strategy' as part of the transition to a circular economy, then consideration also needs to be given to the anticipated need to formulate a strategic approach to reducing incineration capacity, including the progressive closure of all existing municipal waste incinerators to prevent this leakage from the circular economy.

Other countries are already making progress in this respect. For example, the aforementioned 'death list' associated with Denmark's resources and waste strategy.

The first step in any incineration exit strategy would be to stop building new incineration capacity anywhere in Scotland. The next step would be to identify which existing incinerators would be the first to be decommissioned.

Such an assessment would need to take account of factors such as:

- current performance levels, including plant efficiency;
- proximity to other residual waste treatment facilities;
- the age of the incinerator and the need for refurbishment; and
- the potential for an area to significantly move away from incineration, e.g. by reducing residual waste arisings.

It follows that the first incinerators to be decommissioned would be those shown to be the least efficient, closest to alternative residual waste treatment facilities, in most need of refurbishment, and/or where their closure would have the greatest potential to make progress towards a more circular economy.

To inform such analysis it would be helpful if waste composition studies were undertaken at local authority level.

TOPIC 5: IMPROVING EXISTING FACILITIES

Q20 Do you have evidence to support consideration of options to decarbonise the current residual waste treatment infrastructure in Scotland?

Q21 Do you have evidence of the main barriers and drivers of decarbonisation of this infrastructure?

Waste incineration has come in for some heavy criticism associated with adverse climate impacts, not least because incinerators release an average of around 1 tonne of CO_2 for every tonne of waste incinerated.[123] The release of CO_2 from incinerators makes climate change worse and comes with a cost to society that is not paid by those incinerating waste[124]. Electricity generated by waste incineration has significantly higher adverse climate change impacts than electricity generated through the conventional use of fossil fuels such as gas.[125]

Neither carbon capture nor combined heat and power (CHP) justify the expansion of waste incineration in Scotland, not least because these do not prevent incineration from being a leakage from the circular economy and because using carbon capture and CHP create and exacerbate problems such as incinerator lock-in.

One of the reasons that the circular economy is so important is that environmental harm (as well as social harm) caused by the extraction of raw materials for the production of products to replace materials that have been incinerated (lost to the circular economy) - and neither carbon capture nor CHP address this aspect of incineration, nor do they stop the climate harm (and other harms) caused by the use of virgin materials to replace materials lost through incineration.

Describing incineration as a leakage from the circular economy is consistent with international thinking. As acknowledged in the United Nations Environment Programme (UNEP) report from June 2019 entitled 'Waste to Energy: Considerations for Informed Decision-Making': "Incinerating materials, regardless of the amount of energy that may be recovered, constitutes a leakage from a circular economy".[126]

[123] Neuwahl, F., et al (2019) 'Best Available Techniques (BAT) Reference Document for Waste Incineration'. Available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC118637/jrc118637_wi_bref_2019_published.pdf
[124] Vähk, J. & Schägg, E. (2021) 'The benefits of including municipal waste incinerators in the Emissions Trading System'. Available at: https://zerowasteeurope.eu/wp-content/uploads/2021/04/zwe_april_2021_policybriefing_benefits_MWI_in_EUETS.pdf
[125] Vähk, J. (2019) 'The impact of Waste-to-Energy incineration on climate'. Available at: https://zerowasteeurope.eu/library/the-impact-of-waste-to-energy-incineration-on-climate/
[126] https://www.unenvironment.org/ietc/resources/publication/waste-energy-considerations-informed-decision-making

The Post Adoption Statement to Scotland's Zero Waste Plan, Safeguarding Scotland's Resources (SSR) and Making Things Last[127] provides an example of the Scottish government acknowledging how incineration is a leakage from the circular economy, as follows: "Both SSR and Making Things Last set out ambitions for moving Scotland towards becoming a circular economy, including reducing the 'leakage' of materials from the system (i.e. going to landfill, use as EfW)".

Carbon capture and the circular economy

Carbon Capture and Storage (CCS) is being explored in response to climate concerns. When considering CCS for incinerators, it should be kept in mind that the top rung of the carbon mitigation hierarchy is generally accepted to be the 'do not build' option, i.e. to "evaluate the basic need for the project and explore alternative approaches to achieve the desired outcome/s".[128]

Following this principle, proponents of CCS typically seek to justify their carbon capture projects on the basis that there is no viable alternative approach to delivering a necessary good or service. As there are viable alternative approaches to both resource management and energy generation, such an argument cannot be applied to defend CCS for municipal waste incinerators (MWIs).

When it comes to CCS, one of the main concerns is that investment in this approach could draw finance away from supporting urgent systemic changes required to genuinely address the climate emergency.[129] CCS has been criticised as being a distraction from the delivery of wind and solar energy, battery storage, and demand-side measures such as better insulation.[130]

CCS has also been described as a distraction from increased resource efficiency and from the transition to a more circular economy.[131]

Furthermore, it is argued that CCS has a history of over-promising and under-delivering, and that CCS offers poor value for money.[132]

[127] https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2016/02/making-things-last-circular-economy-strategy-scotland/documents/00494866-pdf/00494866-pdf/govscot%3Adocument/00494866.pdf
[128] Arup and IEMA (2017) 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance'. Available at: https://www.iema.net/preview-document/assessing-greenhouse-gas-emissions-and-evaluating-their-significance
[129] Kennedy, S. (2020) 'No more gaslighting: Let's get real about carbon capture and storage'. Available at: https://www.energyflux.news/p/no-more-gaslighting-lets-get-real
[130] Freites, S. G. & Jones, C. (2020) 'A Review of the Role of Fossil Fuel Based Carbon Capture and Storage in the Energy System'. Available at: https://foe.scot/wp-content/uploads/2021/01/CCS_REPORT_FINAL.pdf
[131] Drugmand, D. & Muffett, C. (2021) 'Confronting the Myth of Carbon-Free Fossil Fuels: Why Carbon Capture Is Not a Climate Solution'. Available at: https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf
[132] Drugmand, D. & Muffett, C. (2021) 'Confronting the Myth of Carbon-Free Fossil Fuels: Why Carbon Capture Is Not a Climate Solution'. Available at: https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

Social costs associated with CCS include adverse impacts on local citizens, accompanied by anxieties that something could go wrong, with the transportation of captured carbon in particular giving rise to serious risks.[133]

CCS is often described as a technology intended for use with otherwise unavoidable emissions associated with industries that provide essential products deemed necessary to support the economy.[134, 135]

CCS is most commonly associated with primary industries such as iron, steel, lime, fertilizer, cement, chemicals, and refining.[136]

The association between CCS and energy generation is increasingly being undermined by the rapid rise in renewables, which reflects the general approach of adopting lower carbon alternatives in preference to using high-carbon processes accompanied by CCS.[137]

In the words of the European Commission: "Carbon Capture and Storage (CCS) was originally viewed as a major decarbonisation option for electricity production. Today the potential need for it seems lower, due to the fall in the costs of renewables [and the emergence of] other options to reduce emissions in industrial sectors combined with the low social acceptability of CCS..."[138]

Reliance on incineration is inferior to minimising and progressively eliminating residual waste. Changing waste management practices to ensure materials are continually cycling through the economy avoids leakages of materials into residual waste treatments and delivers significant climate change benefits.[139, 140]

The concept that there will always need to be high levels of waste disposal through either incineration or landfill is premised on the long-term perpetuation of a linear 'take-make-dispose' economy that requires ever more resources to be extracted.

[133] Mahgerefteh, H., Denton, G. & Rykov, Y. (2008) 'Pressurised CO_2 Pipeline Rupture'. Available at: https://www.icheme.org/media/9765/xx-paper-71.pdf
[134] Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2019) 'Climate Action Programme 2030'. Available at: https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzprogramm_2030_en_bf.pdf
[135] IN4climate.NRW (2021) 'Carbon Capture'. Available at: https://www.in4climate.nrw/en/topics/technologies/carbon-capture-capturing-co2-emissions/
[136] CCSA (2021) 'Capturing CO_2' Available at: https://www.ccsassociation.org/discover-ccus/explore-ccus/
[137] Greenpeace (2021) 'Net Expectations: Assessing the role of carbon dioxide removal in companies' climate plans'. Available at: https://www.greenpeace.org.uk/wp-content/uploads/2021/01/Net-Expectations-Greenpeace-CDR-briefing.pdf
[138] Directorate-General for Climate Action, European Commission (2019) 'Going climate-neutral by 2050'. Available at: https://op.europa.eu/en/publication-detail/-/publication/92f6d5bc-76bc-11e9-9f05-01aa75ed71a1
[139] Hogg, D. & Ballinger, A, (2015) 'The Potential Contribution of Waste Management to a Low Carbon Economy'. Available at: http://zerowasteeurope.eu/wp-content/uploads/2019/10/zero_waste_europe_report_The-potential-contribution-of-waste-management-to-a-low-carbon-economy_en.pdf
[140] Ballinger, A., Chapman, L. & Fletcher, D. (2021) 'Waste in the Net-Zero Century: How Better Waste Management Practices Can Contribute to Reducing Global Carbon Emissions'. Available at: https://www.eunomia.co.uk/reports-tools/waste-in-the-net-zero-century-how-better-waste-management-practices-can-contribute-to-reducing-global-carbon-emissions/

Governments and others increasingly acknowledge that this linear paradigm is both unsustainable and undesirable.

Assumptions that depend on growing, or even stable, quantities of residual waste arising run contrary to the European Commission's Circular Economy Action Plan commitment to halve residual waste generation by 2030.[141] Indeed, in their report on the Circular Economy Action Plan, the European Parliament has called for a residual waste target to be set.[142]

The rejection of the linear approach is resulting in moves towards a circular economy that ensures products and materials are designed to last longer and to be reused or recycled rather than landfilled or incinerated.

Given that, as has already been outlined above, much of what is currently incinerated could be reused, repaired, recycled, or substituted, there are serious concerns that perpetuating incineration would be accompanied by an unacceptable opportunity cost through delaying or displacing these more desirable alternatives that could deliver significantly better climate change and environmental outcomes.

Concerns have been expressed by the EU Technical Expert Group on Sustainable Finance about the "large portion of waste currently incinerated that could be recycled, the reliance of some individual [EU] Member States on the incineration of municipal waste, and the risk that further increasing capacities risk overcapacity and could result in lock-in effects. This would in turn discourage more reuse and recycling, options higher in the waste hierarchy that could deliver higher climate mitigation benefits".[143]

CCS at MWIs could give rise to worse overall environmental outcomes by encouraging the construction of new incineration capacity or the continued use of existing capacity at the expense of options such as reduction, reuse, and recycling that result in lower environmental impacts as well as greater social and economic benefits.[144] These already-deliverable options are clearly preferable to CCS for a range of reasons, not least because of the nature of the risks and the costs associated with CCS.

[141] European Commission (2020) 'A new Circular Economy Action Plan For a cleaner and more competitive Europe'. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN

[142] European Parliament (2021) 'Report on the New Circular Economy Action Plan'. Available at: https://www.europarl.europa.eu/doceo/document/A-9-2021-0008_EN.html

[143] EU Technical Expert Group on Sustainable Finance (2020) 'Taxonomy Report: Technical Annex'. Available at: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy-annexes_en.pdf

[144] Department for Business, Energy & Industrial Strategy (2021) 'Carbon Capture, Usage and Storage: An update on the business model for Industrial Carbon Capture. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984119/industrial-carbon-capture-icc.pdf

In accordance with circular economy principles, as items that are repairable or reusable, and materials that are recyclable or compostable, are increasingly diverted from becoming incinerator feedstock, capacity will be freed-up at existing MWIs. This, in turn, gives rise to increasing opportunities to progress an incineration exit strategy through the prevention of new incineration capacity and through taxation and managed closure of existing facilities. Such an incineration exit strategy is simply a manifestation of the circular economy, which recognises incineration ('energy recovery') as a leakage - breaking the circle - to be minimised.[145]

As incineration gives rise to adverse climate impacts[146, 147, 148] it is easy to see how reducing the quantities of material, especially plastic, that is incinerated is an effective, efficient, low-cost, and ethical way of contributing to a low-carbon circular economy. Such an incineration exit strategy is incompatible with significant investment in carbon capture technologies for MWIs.

To align with the genius of the circular economy, any assessment of the impacts associated with the use of carbon capture at MWIs would have to extend beyond the CO_2 directly emitted by incinerators to include otherwise 'hidden' costs, such as the adverse impacts of replacing useful material lost through incineration. In stark contrast to an incineration exit strategy, CCS does nothing to address these adverse impacts. CCS exacerbates the many problems associated with overconsumption, resource inefficiency, and the linear economy that give rise to significant losses to the wider economy.[149]

Municipal waste incinerators are expensive to build, and carbon capture technologies are expensive to add or retrofit. It is estimated that, for a 350,000 tonne per annum municipal waste incinerator, the use of CCS would increase capital expenditure by more than 45% - from £220m to £320m - and would increase operational expenditure by more than 33% - from £12m to £16m.[150] As such, the introduction of CCS at MWIs raises 'value for money' concerns and gives rise to risks that investments and subsidies directed towards CCS at MWIs could displace support for the necessary systemic changes to resources and waste management.

[145] Ellen MacArthur Foundation (2013) 'Towards the Circular Economy (Volume 1)'. Available at: https://emf.thirdlight.com/link/x8ay372a3r11-k6775n/@/preview/1?o

[146] Dowen, J. (2018) 'Evaluation of the climate change impacts of waste incineration in the United Kingdom'. Available at: https://ukwin.org.uk/files/pdf/UKWIN-2018-Incineration-Climate-Change-Report.pdf

[147] Dowen, J. (2021) 'Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration'. Available at: https://ukwin.org.uk/files/pdf/UKWIN-2021-Incinerator-GHG-Guide.pdf

[148] UKWIN (2021) 'Fossil CO_2 released per tonne of plastic incinerated'. Available at: https://ukwin.org.uk/facts/#co2fromplastic

[149] Fauset, C. (2008) 'Techno-fixes: a critical guide to climate change technologies'. Available at: https://corporatewatch.org/wp-content/uploads/2017/09/Technofixes.pdf

[150] Gammer, D. & Elks, S. (2020) 'Energy from Waste Plants with Carbon Capture'. Available at: https://es.catapult.org.uk/reports/energy-from-waste-plants-with-carbon-capture/

Furthermore, the scale of the costs involved carry the risk of creating perverse incentives to maintain the status quo so as to avoid investments becoming 'stranded assets', i.e. the cost of CCS could result in increased incinerator lock-in.[151]

The problem of incinerator lock-in is widely recognised, including by the C40 Knowledge Hub[152] and by the European Parliament, who note how "the EU and Member States must strengthen prevention and preparation for reuse, increase high-quality recycling and move away from landfilling waste, **while minimising incineration**, in line with the waste hierarchy; [the European Parliament] calls on the Commission to define a common EU-wide approach for the management of residual municipal waste that is non-recyclable to ensure its optimal treatment **and to avoid building overcapacity of waste incineration at the EU level that could cause lock-in effects and hamper the development of the circular economy**…"[153] (**emphasis added**).

The European Union's commitment to reducing residual waste arisings, amplified by the growing citizen opposition to waste incineration, makes the potential prospect of incinerators becoming stranded assets increasingly likely, and this weighs heavily against supporting investment in expensive and experimental carbon capture technologies for MWIs.

The notion that public funding for a few MWI CCS demonstrator projects would act as a catalyst for significant levels of private investment in CCS for MWIs is flawed.

In addition to the certainties associated with opportunity costs - i.e. that the same money invested in CCS cannot also be spent on the top tiers of the waste hierarchy - there are also a host of uncertainties and risks surrounding CCS technologies in general, and the application of CCS to MWIs in particular.

CCS at MWIs could fail to attract private funding due to potential investors' concerns about the future of MWI technologies; for example, anticipated reductions in residual material to be used as incinerator feedstock as the result of increasing competition within the resource sector, in combination with increasing diversion from MWI's (as per requirements of the circular economy).

[151] European Commission (2017) 'The role of waste-to-energy in the circular economy'. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017DC0034

[152] According to the C40 Cities Climate Leadership Group (2019) 'Why solid waste incineration is not the answer to your city's waste problem'. Available at: https://www.c40knowledgehub.org/s/article/Why-solid-waste-incineration-is-not-the-answer-to-your-city-s-waste-problem?language=en_US (Accessed: 10 September 2021): "incineration is among the worst approaches cities can take to achieve both waste reduction and energy goals. It is expensive, inefficient, and creates environmental risks. It locks cities into high-carbon pathways by requiring them to continue producing lots of waste to feed the incinerator, undermining efforts to reduce waste generation or increase recycling rates…"

[153] European Parliament (2021) 'Report on the New Circular Economy Action Plan'. Available at: https://www.europarl.europa.eu/doceo/document/A-9-2021-0008_EN.html

With respect to the public funding of CCS for MWIs, it should be noted that the EU is turning away from incineration "with major European financial institutions excluding it from financial support…The construction of new waste incinerators was presented as an example of non-compliance with the ['do no significant harm'] DNSH principle [enshrined in the Recovery and Resilience Facility]…" Financial support for incineration is also excluded from the European Regional Development Fund and the Cohesion Fund, as well as from the Just Transition Fund and the EU Taxonomy Regulation.[154]

Incinerator operators hoping to install carbon capture technologies at a MWI can expect to face competition both within the waste management sector and from other sectors, e.g. steel and cement industries. Governments may need to step in to resolve some of the problems associated with a 'rush to CCS', including shortages of components, expertise, lorry drivers, etc. In such circumstances, governments should be expected to adopt a 'technology neutral' approach to reducing GHG emissions across the economy.[155] This means that, instead of favouring incineration, priority would be given to those applications of CCS that would be hoped to mitigate the largest quantities of genuinely unavoidable CO_2 emissions arising from the provision of essential goods, such as building materials.

Beyond the use of captured gases to flush out oil (and/or gas) from existing oil wells (a process known as 'enhanced oil recovery' or EOR), it is difficult at present to see how CCS at MWI could deliver profitable financial returns on investment. It is, however, easy to see how increased competition for climate mitigation funding (government subsidies), combined with increased demands on carbon capture technology providers (e.g. for components and expertise), could drive up costs and/or cause delays.

In order to store carbon captured at MWIs that are not connected by some sort of pipeline to undersea storage 'facilities' such as saline aquifers, the gases would need to be transported and would therefore require liquefaction to enable transport. Subjecting gases to the pressure required to convert them to a liquid form would require substantial quantities of energy, over and above the energy that would be required to operate the carbon capture technology itself. These energy demands would greatly increase the incinerator's parasitic load (the energy used by the incinerator).

[154] Makavou, K. (2021) 'The EU is clear: Waste-To-Energy incineration has no place in the sustainability agenda'. Available at: https://zerowasteeurope.eu/2021/05/wte-incineration-no-place-sustainability-agenda/

[155] Gates, B. (2021) 'How to avoid a climate disaster'. Available at: https://www.penguin.co.uk/books/317/317490/how-to-avoid-a-climate-disaster/9780241448304.html

Indeed, according to industry sources, "...the net electricity production [of MWIs fitted with carbon capture technology] would be almost halved due to the carbon capture energy requirement".[156]

In circumstances where CCS technologies are applied to MWIs, there is a need to measure the real-world impacts of this application in order to understand how this contributes or inhibits net decarbonisation. There are a number of criteria that could be applied to measure the success, or otherwise, of the transformation to a low-carbon circular economy through the decarbonisation of the resources and the waste management sector.

Criteria could include:

- measures of achievement of carbon reductions against both the current baseline and carbon reduction targets (efficacy);
- measures of actual costs alongside assessments of benefits and opportunity costs (efficiency);
- measures of contribution towards achieving a low-carbon economy (effectiveness); and,
- measures of (beneficial and detrimental) impacts on the local and global population and on future generations (ethicality).

The ability to measure some of these outcomes would depend on the degree of transparency required of CCS operators. Such honesty would be in the public interest and would be consistent with the need for transparency in environmental matters recognised by the Aarhus Convention. The Aarhus Convention includes the right of access to environmental information held by public authorities - and this includes information about CO_2 emissions - which would be expected to override commercial confidentiality. Very high degrees of transparency and accountability, including the imposition of regulatory requirements to report promptly into the public domain, should be mandatory conditions of any permission to experiment with CCS for MWIs, e.g. in the event demonstrator funding is made available for CCS at an incinerator.

Analysis shows that CCS is not a suitable approach to be applied to incinerators, not least because CO_2 emissions from municipal waste incinerators are avoidable through the diversion of material away from incineration; and because the benefits of such diversion contrast with the many shortcomings associated with CCS for MWIs.

[156] International Energy Agency (IEA) Technology Collaboration Programme (2020) 'IEAGHG Technical Report: CCS on Waste to Energy'. Available at: https://www.club-co2.fr/files/2021/01/2020-06-CCS-on-Waste-to-Energy.pdf

Diverting material from incineration would deliver lower carbon outcomes for much less money, and with much less risk, than through the use of carbon capture technology. CCS for municipal waste incinerators would come with significant opportunity costs, undermining more systemic change to resource and waste management, as well as creating perverse incentives to incinerate material that should otherwise be reduced, reused or recycled.

Investing in CCS for incinerators would create an additional barrier to the achievement of a low-carbon circular economy, for example by exacerbating the lock-in effect of incinerators, and would come at the expense of the significant environmental, economic and social benefits that such a transition would deliver.

In summary:

- CCS is expensive - both financially and environmentally - and the huge financial cost of installing CCS at existing incinerators (which could well equate to several hundred million pounds per plant) comes with opportunity costs, i.e. if money is spent on CCS that same money is not available for other ways to reduce the climate impacts of resource management, including public education, the promotion of reuse and waste minimisation, etc.
- CCS significantly increases the lock-in of incineration, as funders will look for a return on their investment. If - by way of illustration - £500m is spent on retrofitting CCS to an incinerator, the funder may expect / require that incinerator to continue to operate for at least an additional 25+ years to help defray their costs - so instead of phasing out incineration we would be facing another generation of refurbished incinerators and all the harm that would bring.
- Even if CCS could be made to work, it would take many years before we could expect to see CO_2 from incinerators actually being captured and stored, which is not good enough as we need to rapidly move away from incineration.
- Much of what is promoted as 'carbon capture' misses out the storage dimension, and so amounts to simply delaying rather than preventing the release of CO_2.
- When storing CO_2 is part of an operation to flush out fossil fuels it results in a net increase of CO_2 emissions.
- The quickest and cheapest way to rapidly reduce GHG emissions from waste management is to biostabilise waste that is not being composted and sent that stable material to landfill (although not an ideal solution, it does not lock-in the infrastructure in the way incineration does, because it is so much less expensive to build and because it does not 'need' feedstock to be constantly fed in).

We would strongly recommend that those who support CCS for incineration make clear that their support depends on CCS installation being part of a well-managed rapid incineration exit strategy that entails the progressive decommissioning of existing incineration capacity.

Under no circumstances should CCS be used to justify further exacerbating incineration overcapacity, and so cannot justify building any new incineration capacity in Scotland.

Combined Heat and Power (CHP)

The energy generation potential of incineration is becoming increasingly less valuable as the grid decarbonises. Even with heat export, incineration is a poor investment for energy generation. Indeed, problems at existing heat networks designed around incinerators raise concerns regarding their desirability[157], and issues regarding how to deal with the lifespan of the houses exceeding the lifespan of the incinerator have yet to be resolved.

CHP can be accompanied by a host of adverse unintended consequences, including:

- the lock-in of incineration capacity (to continue to serve buildings that can be expected to outlive incinerators, necessitating refurbishment of incinerators that would otherwise be decommissioned);
- the unreliable supply of heat to customers with little or no viable alternative sources of heat;
- high costs for heat users (which could exacerbate fuel poverty); and
- the adverse environmental pacts of installing pipes and retrofitting buildings.

A number of these issues regarding the heat network associated with the Beddington incinerator were highlighted by Elliot Colburn MP in Parliament on 28th April 2021[158] and on 4th February 2022.[159]

It should also be noted that where heat is diverted from use with turbines the level of electricity export is also reduced. As the use of heat pumps increases the heating sector progressively decarbonises, reducing any potential benefit of CHP.

[157] Hansard (2021) 'Statements by Elliot Colburn MP for Carshalton and Wallington as part of the Westminster Hall Debate on District Heat Networks that took place on Wednesday 28 April 2021'. Available at: https://hansard.parliament.uk/Commons/2021-04-28/debates/B969ABB2-D6F3-48A9-AF71-AC077E64F1CC/details
[158] See: https://hansard.parliament.uk/Commons/2021-04-28/debates/B969ABB2-D6F3-48A9-AF71-AC077E64F1CC/details
[159] https://hansard.parliament.uk/Commons/2022-02-04/debates/02841671-B369-4CA1-B0D8-AEA3E66978AD/SuttonDecentralisedEnergyNetwork

This is recognised by the Committee on Climate Change, who explain how, even without heat pumps, incineration is not particularly a 'low-carbon' method for heating: "Heat produced by unabated EfW plants (i.e. without CCS) is not particularly low-carbon – burning Municipal Solid Waste releases ~335gCO2/kWh of input (of which ~163gCO2/kWh is fossil CO2), compared to burning natural gas at ~184gCO2/kWh of input (all fossil CO2), so EfW can be worse in terms of fossil emissions once lower EfW generation efficiencies are accounted for compared to a gas boiler (although there are also upstream gas emissions as well). This will already be the case for EfW electricity generation compared to gas-fired generation".[160]

Another factor to consider is that heat networks require density (a large heat demand), and as such a potential unintended consequence of subsidising CHP for any currently un-built incinerators would be to encourage the siting of new incineration capacity in more densely populated areas, where a greater number of people would experience the associated air pollution.

[160] https://www.theccc.org.uk/publication/sixth-carbon-budget/