Friends of the Earth Scotland's response to the Scottish Government's Call for Evidence on the Incineration Review

February 2022

Summary

Friends of the Earth Scotland believes that incineration of waste is incompatible with Scotland's climate goals including its Net Zero targets, circular economy aims and wider climate justice concerns. Scotland's waste policies aim to reduce the environmental impact of waste. Current policies have failed to do so, in large part because incineration has been given an unfair advantage over recycling and waste prevention activities. Unless large-scale change of the entire Scottish waste management system is affected immediately, the opportunity to create a circular economy in time to support climate goals will be lost. New policies to end incineration are a fundamental part of this change.

We have concerns that the timing of the review, its scope and some issues around data create a pro-incineration bias which, if unchecked, is likely to affect its conclusions. For example, the Call for Evidence cites total incineration capacity to be "approximately 1.32 Mt" when later communication to a limited group of stakeholders revealed the review team estimate capacity in 2020 to be 1.625 Mt. The Call for Evidence document was not publicly corrected, despite requests. It is difficult to see how the review recommendations are to be accepted by all stakeholders when the evidence used to justify positions is so unclearly presented.

Our key recommendations and messages in this response are:

1. Evidence on current and future incineration capacity and waste arisings make it clear **an exit strategy from incineration in Scotland is required**. The review should state this evidence and lay out key milestones and dates for the exit strategy. This should include:
    - Immediately extending the moratorium on new and current incineration applications to become an indefinite ban;
    - A ban on sending plastics to incineration; and
    - The rapid phasing out existing incineration plants.

2. Conversion of existing incinerators to combined Heat and Power Plants should not be at the public's expense. However, all existing plants should be held to their promises in planning applications to create CHP systems.

3. Financial mechanisms, such as a tax on incineration or inclusion in the UK ETS, would not be as effective as bans in driving the required change rapidly enough.

Scotland needs the right decisions about infrastructure now, if it is to reach its waste and climate goals by 2045.

4. Carbon Capture and Storage is a completely unsuitable solution for incineration. It is technically challenging, extremely expensive and leads to unnecessary lock in to unsustainable waste management practices. The review should send a strong, clear message that CCS will not be part of incineration's future in Scotland. Government plans to mitigate incineration emissions with CCS are unrealistic and reckless.

5. An improved data collection and reporting strategy is required to support better policy decisions. Changes should include:
    - Disaggregation of incineration with energy recovery from energy supply GHG emissions as reported in the Scottish Climate Change Plan;
    - Annual, public reporting of energy efficiency and carbon intensity of each incinerator; and
    - Mandatory waste composition reports for waste arriving at the incineration gate and at the point of burning.

6. Citizens and communities across Scotland have been affected and concerned by the rise in incinerators. Their views must be at the centre of this review and considered in any recommendations. Health concerns should be revisited in light of new evidence suggesting current air pollution limits are harmful to human health. As a minimum, the current moratorium should be extended until these concerns are fully considered.

The rest of this responses covers the evidence, issues and recommendations surrounding incineration which most concern Friends of the Earth Scotland. It begins with a detailed description of our concerns about the review itself and thereafter is structured using the questions set out by the call for evidence document.

About Friends of the Earth Scotland

Friends of the Earth Scotland exists to campaign, with partners here and across the globe, for a just transition to a sustainable society. We work in Scotland for socially just solutions to environmental problems and to create a green economy; we campaign to end the degradation of our environment and to create a society which cherishes and protects the natural world on which we depend; we think globally and act locally, enabling people to take individual and collective action.

We are part of Friends of the Earth International - the world's largest grassroots environmental network, uniting 75 national member groups, over 2 million members and 5,000 local activist groups around the world. We are an independent Scottish charity with a network of thousands of supporters and active local groups across Scotland. Friends of the Earth Scotland's vision is of a world where everyone can enjoy a healthy environment without exceeding their fair share of the planet's resources, now and in the future.

Detailed response and recommendations

1. Concern about the review scope

The incineration review's scope and timings limit its effectiveness as a decision-making tool for policy makers and others attempting to create a circular economy in Scotland.

Concerns about scope

The scope of the review, as set out in the Call for Evidence and stakeholder meetings, was too narrow. It was mainly limited to considering the technical differences between existing treatment technology and gathering data on incineration activity which should have been provided by SEPA. Mitigation options such as extending the moratorium on new incineration applications, creating a carbon tax on waste or a ban on burning plastics were not suggested as potential mechanisms for controlling incineration. This is despite the existing real-world applications of some of these options (e.g. the current moratorium on incinerators in Wales).

Concerns about timings

The Scottish Government announced the independent review into incineration on 30th September 2021. The review was set up quickly and a Call for Evidence document published on 20th December. Those wishing to respond have been given two months, to 21st February 2022, to do so. A period which includes the end of year holiday break.

More time would have allowed a more robust evidence-based approach and for stakeholders to respond. The views of communities directly affected by incineration was not properly considered in the initial review stages. Such stakeholders may need longer than others to respond, as they usually have to do so outside of working hours and other commitments. As a consequence, the views of such local stakeholders, so important in understanding the impacts of incineration, are unlikely to be fully captured by the review.

Data concerns

The Call of Evidence document presented a limited selection of waste data and evidence, which creates a partial and biased picture of the waste system and incineration's current role in Scotland today. However, with the exception of the CXC modelling data, this is presented as solid fact. Some specific data concerns include:

- Mis-use of a key finding from a Zero Waste Scotland study, stating: "incinerating municipal waste in Scotland resulted in 27% fewer greenhouse gas (GHG) emissions than landfilling the same waste." This is an over-generalisation of the report, which states this figure only in relation to a historic situation (circa 2018) and is caveated in the report by acknowledging the energy output and waste composition uncertainties. A more up to date and accurate data would be expected to eliminate this gap between the emissions from incineration and landfill. This figure is misused in the same way by the Scottish Government in its response to Parliamentary Question

ref. S6W-05517. The review should seek to update the ZWS figure with the latest data available to SEPA.

- The reviewers state they are working with SEPA, who have access to the full range of waste data for Scotland (although recent media coverage suggests this is not the case[1]). Yet, the data presented in the Call for Evidence covers "all waste" rather than the household and commercial and industrial waste streams which are the stated subject of the review. Given the higher than average recycling rates of the construction and demolition waste stream, it is likely this over-estimates recycling of the waste within the review scope. It would have been more informative to present data which reflected the scope of the review.
- The Call for Evidence cites total incineration capacity to be "approximately 1.32 Mt" when later communication to a limited group of stakeholders revealed the review team estimate capacity in 2020 to be 1.625 Mt (see Section 2.4 below). The Call for Evidence document was not publicly corrected, despite requests.
- The CXC model only considers capacity until 2025. However, as shown in later communications to some stakeholders, existing capacity was under-estimated by 0.3Mt and there are plants with live planning expected to come online after 2025. Taking this information into account reverses the main conclusion of the CXC study as presented in the Call for Evidence. It shows, even under current conditions, Scotland will soon have over-capacity of incineration by 2026.

The acknowledgement of these data concerns by reviewers but a lack of transparent communication of these updates affects the ability of all stakeholders to respond to the review.

It is likely that the review results will shape government thinking and any public consultation which follows. The inadequate attempts to reach individuals and communities means there is a risk that the democratic integrity of the whole process can be called into question. This is truly unfortunate given community groups have similar complaints about a lack of opportunity to raise concerns against the incinerator plants they are fighting across Scotland.

The nature of these issues indicates a pro-incineration bias in review's figure, which, if unchecked, is likely to affect its conclusions. In turn, this would call into question the ability of the review to act as a decision-making tool for policy makers. If these concerns are properly addressed, it is still possible for the review will become an important milestone in Scotland's pathway to a circular economy. Friends of the Earth Scotland have engaged in the review and responded to the Call for Evidence to highlight these issues and to support the much needed change in direction for waste policy and management in Scotland.

[1] The Ferret (2021) https://www.thenational.scot/news/19902913.ferret-disaster-warning-sepa-admits-15-months-data-lost-cyber-attack/

2. Given Scotland's waste reduction and recycling targets, and current progress towards these, what capacity is required to manage residual waste in Scotland?

2.1. Policy focus on landfill to incineration has resulted in poor recycling performance

The stated aim of Scotland's waste policies since the creation of the Zero Waste Plan[2] and the establishment of the landfill tax has been to reduce the environmental impact of Scottish waste. This aim has not been met: progress towards waste reduction and recycling of materials has been limited. Some of Scotland's most important waste targets are unlikely to be met, including 70% recycling of all waste[3] and sending no more than 5% of waste to landfill in 2025. Instead, the main fiscal and regulatory measures deployed by policy makers (the landfill tax and biodegradable municipal waste landfill ban) have shifted waste from landfill to incineration.

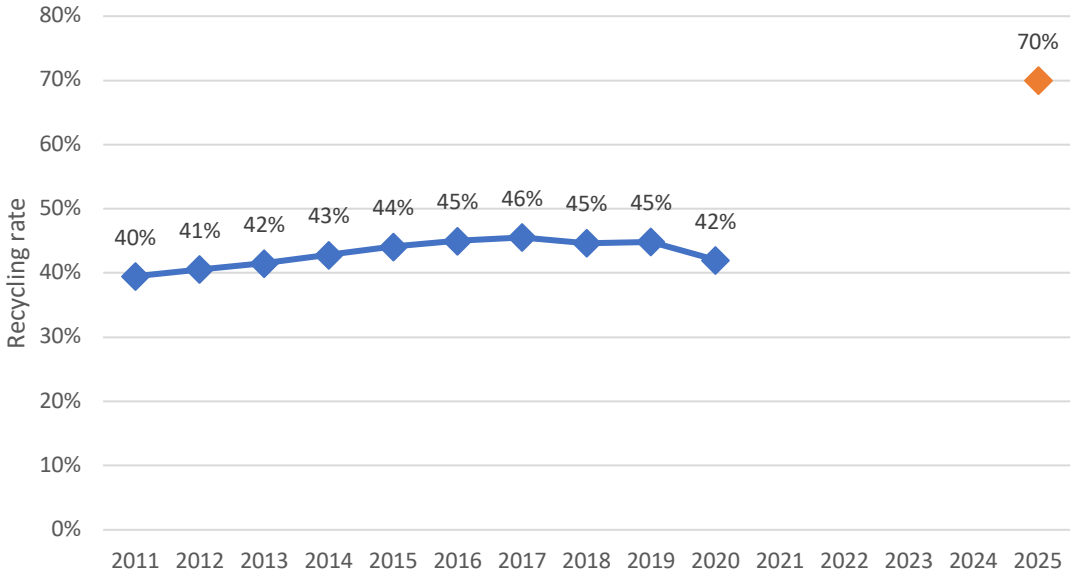
There is a lack of publicly available data on the waste streams of concern in this review: household (HH) and commercial and industrial (C&I) waste. It is worth noting that the latest recycling figure for "all waste" show that 55% of the total material managed comes from the two categories most commonly associated with construction and demolition (C&D) waste: "soil" and "mineral waste from C&D"[4]. This would suggest that poorer recycling rates for the HH and C&I streams are masked within the "all waste" dataset. Indeed, in the separately published household waste data, the latest figures should poor progress. Figure 1 below shows household recycling rates have started to decline and are worryingly far from the 70% 2025 recycling target.

[2] Scottish Government (2010) Zero Waste Plan

[3] Note that the Scottish Government's Zero Waste Plan (2010) also includes a 70% recycling target for household waste "5.5 As a consequence, the domestic 40, 50, 60 and 70% Zero Waste recycling, composting and preparing for re-use, targets will now apply to waste collected from households"

[4] SEPA (2020) Waste from all sources

Figure 1. Scottish household recycling rates 2011-20 and 2025 target[5]



Instead, waste policy in Scotland has driven a rapid increase in incineration. The landfill tax is the basis for the economy model on which the incineration industry is built[6]. Incineration gate fees are set just below landfill tax rates – median gate fees of in the UK in 2019 were £95/t for incineration and £116/t for landfill (including £91.35/t landfill tax). The biodegradable municipal waste landfill ban has created a panicked rush towards incineration from local authorities, who have had little national guidance on decisions.

The result of these policies, is now clearly evident in trends in waste data reported by SEPA, which shows a rapid rise in incineration. Between 2011 and 2020, overall incineration rates have tripled and incineration rates for household waste have risen eight-fold (see Figures 2 and 3). Landfilled household waste has reduced by 55% from 2011-2020 but diversion from landfill has increased by 508%.

[5] Adapted from SEPA (2021)

[6] From WRAP (2021) Gate Fees Report: "The key influencing factor on [landfill] gate fees in 2019 was the diversion of material into other facilities such as EfW and AD facilities. Their ability to price below landfill gate fees (with Landfill Tax included) is one of the main reasons for less commercial material entering landfills."

Figure 2. Landfill and incineration of all waste in Scotland, 2011-20 (tonnes)

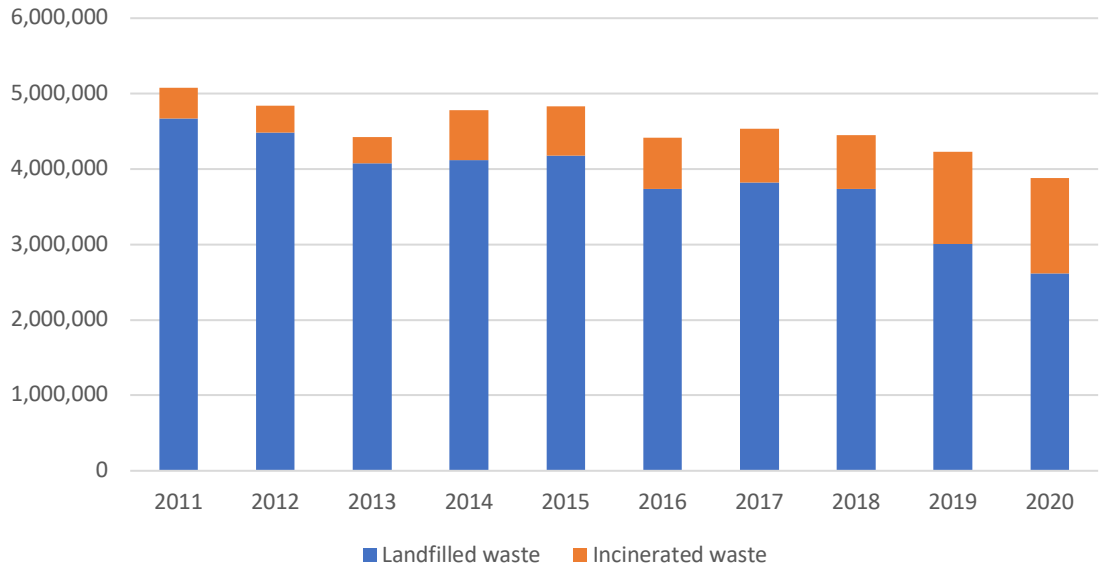
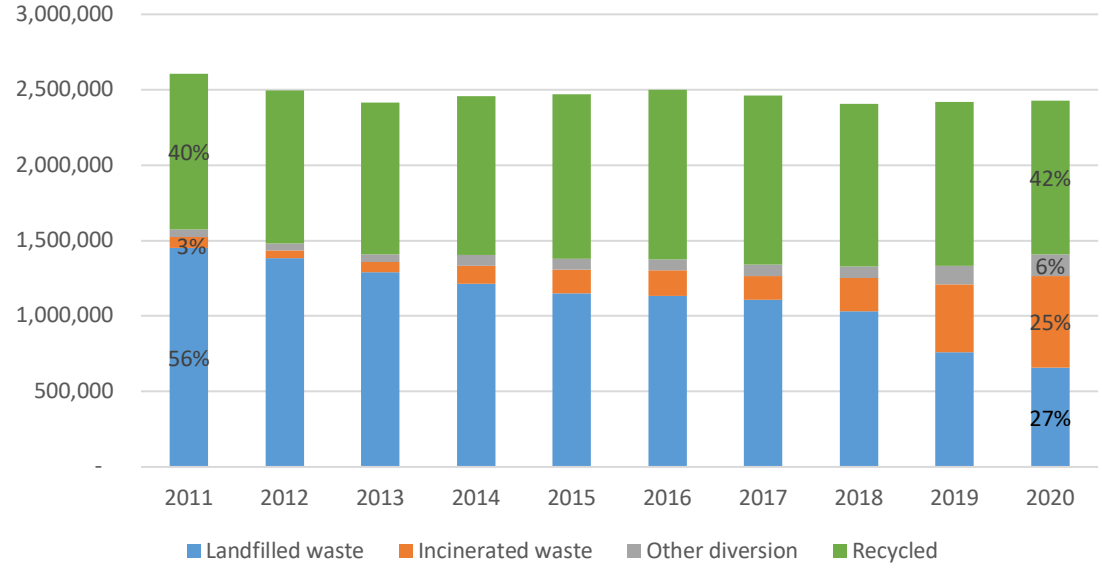


Figure 3. Household waste management in Scotland, 2011-20 (tonnes)

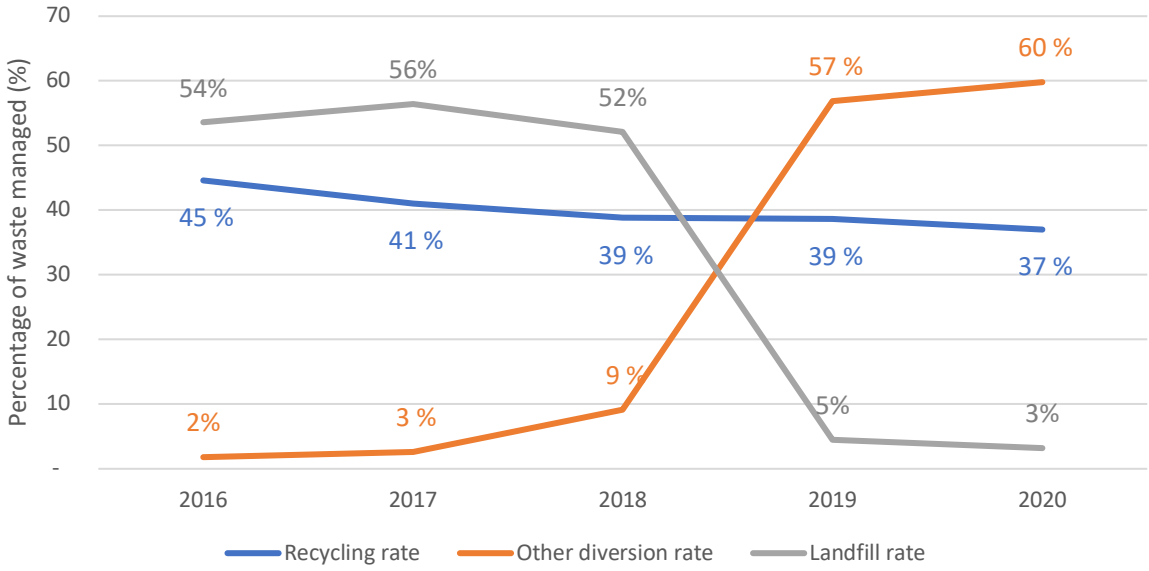


Progress towards the unambitious 15% reduction in waste prevention target from 2011 to 2025 is extremely variable (Figure 1 in the Call for Evidence). Lack of a clear downwards trend is worrying.

A local example of falling recycling rates in Edinburgh

These national level trends are reflected on a local scale. For example, Edinburgh Council have recently started sending residual household waste to the Millerhill incinerator in Midlothian. The incinerator started operating in 2018 and became fully operational in 2019. The graph below shows household recycling, other diversion (mainly through incineration) and landfill rates for Edinburgh (taken from SEPA 2020 household data).

Figure 4. Waste management trends for Edinburgh Council 2016-20 (%)



It is clear that there has been a diversion of waste from landfill to incineration. Over the same period, recycling rates have fallen.

Comparison with Wales

Wales have the same main recycling target as Scotland: 70% recycling by 2025. In Scotland there now seems to be an almost impossibly large gap to fill but in Wales steady progress has meant recycling has increased to a record high of 65.4% in 2020/21[7] and they are close to meeting their 70% target. Some communities have already met it. Over the same period, waste generation has fallen to its lowest levels in Wales.

In Scotland, the pandemic was used as an excuse for a fall recycling rates, however, Wales has managed an increase even during the pandemic. In Wales, their circular economy strategy[8] focuses on six key areas:

- Driving innovation in materials use
- Upscaling prevention and re-use
- Building on Wales's recycling record
- Investing in infrastructure
- Enabling community and business action
- Aligning government levers

In Wales focus has been driven up the waste hierarchy to prevention and recycling measures. The people of Wales have been empowered through support for local communities and businesses. The Minister for Climate Change, Julie James said "Ultimately this achievement has been down to people recycling at home in every part of Wales". A moratorium on incineration is also a key part of the Welsh waste strategy.

[7] https://www.letsrecycle.com/news/waless-recycling-rate-hits-record-65-4/
[8] https://gov.wales/sites/default/files/publications/2021-03/beyond-recycling-strategy-document.pdf

In Scotland, rather than moving activity as high as possible up the waste hierarchy to recycling and prevent measures, current waste policies have simply incentivised the next rung on the ladder – incineration. Recycling rates have struggled to rise because there has been a failure to create a demand for such activity compared to incineration – recycling is more expensive and complicated.

2.2. Incineration conflicts with circular economy

Minimising material consumption is a vital step in mitigating climate change and creating a circular economy is a necessary part of Scotland's ambitious climate change plans. Today, our economy is based on a linear consumption of materials: production, consumption and disposal. The value of the materials is lost, often after a single use, and new resources must be exploited for further consumption. A circular economy reduces the amount of raw materials required by society by making better use of materials which enter the economy. Products, business models and consumption patterns are revised to ensure materials are used for longer. In a circular economy, the production of waste is minimised. Any residual waste, created after all reuse and recycling options have been exhausted, must be managed in a way that meets climate change goals.

Managing residual waste currently involves either recovery or disposal technologies, such as incineration and landfill. Recovery plants are built to operate for 20-30 years so plants built today will still be operational when most long-term climate change targets are expected to be met. Building waste management facilities means committing to a certain level of annual waste input. If a rapid transitioned to a circular economy is successful, our waste will be very different, in quantity and composition, to today's waste. So, policy makers and planners must shape a nation's residual management around, not only the needs of our society today, but also those of the future.

Incineration is fundamentally a linear technology. Once material is burnt, opportunities to return it to the economy are lost. Efforts to minimise this loss (through recycling bottom ash to aggregate, metal recovery and energy offset) are only meaningful if every effort has been made to prevent and recycle waste first. This is clearly not happening in at the household recycling rates Scotland currently has. Incineration also creates lock-in to high levels of waste generation. So, to develop a circular economy, it is necessary (but not sufficient) to limit and reduce incineration as much as possible.

Incineration Lock-in

Lock-in is an established fact in infrastructure understanding and practice. For example, Corvellec et al. (2013)[9] examines four different types of lock-in (institutional, technical, cultural and material) related to a waste incinerator in Sweden.

Incineration can harm progress towards a circular economy by creating lock in to an unsustainable waste management system. Evidence for this is clear in countries with

[9] Corvellec et al. (2013) Infrastructures, lock-in, and sustainable urban development: the case of waste incineration in the Göteborg Metropolitan Area

high incineration rates, such as Denmark[10] and Germany[11]. Such countries typically have high waste arisings per capita and struggle to raise recycling rates. Their approaches to waste management have changed as it becomes clear that incineration is preventing them reaching both net zero and recycling targets. The 2020 Policy Connect report[12] was criticised for recommending that a move towards a Scandinavian style approach to residual waste by the Green Alliance[13] and others. Across Scandinavia, incineration is now recognised as a problem that needs to be fixed[14].

The rapid rise in incineration in Scotland since the introduction of the landfill tax and Biodegradable Municipal Waste ban to landfill and the stagnation of recycling rates strongly indicate that lock in has already started to occur. SEPA's waste data publications[15] show that landfill rates have fallen and incineration rates have risen since 2011, for all waste and household waste. Most of Scotland's incinerators are new plants, which began operating around 2018. Scotland will have a large incineration capacity for at least the next 20 years.

In the 2013 Göteberg study, Corvellec writes "It is not easy to break a lock-in. The coalitions that benefit from it are likely to resist any change; it is difficult to challenge established standards, and few wish to abandon the comfort of increasing returns. Yet, escaping lock-ins is possible." The study goes on to state "un-locking technology systems requires a combination of systematic efforts to promote alternatives, a critical mass or social and political recognition of a need for social action, and a focusing event that acts as a catalyst for concerns and initiatives." The importance of policy makers in un-locking systems is also considered: "The policies, laws, plans, and programs that aim at unlocking infrastructure need to acknowledge the local practices and the local lock-ins that hamper sustainability."

As a first step, lock-in can be limited by not building any more incineration plants in Scotland.

An example of lock-in to incineration in Aberdeen

Run by ACCIONA in partnership with Indaver, the NESS Energy project is expected to start operating later in 2022.[16] The plant will serve three local authorities: Aberdeen City Council, Aberdeenshire and Moray Councils. Aberdeen City Council, the lead Authority, granted planning permission on 10th October 2016.[17] The

[10] ZWE (2019) A Danish Fiasco
[11] NABU (2020) The future of waste incineration in a modern CE
[12] Policy Connect (2020) No time to waste
[13] Green Alliance (2020) Scandinavians call their waste incineration "crazy", so why copy them?
[14] For example, Peter Høngaard Andersen, Director of Innovation Fund Denmark: "Denmark is very, very bad (regarding) reusable plastic, and that is because, for many years, we have burned our waste using incinerator plants".
[15] SEPA (2021) Waste data for Scotland
[16] https://www.indaver.com/ie-en/installations-and-processes/project-development-click-here-to-see-map/ness/
[17] Aberdeen City Council (2016) Decision Notice for Planning Permission for EfW facility at Greenbank Crescent

construction costs of the plant of £365M are being financed by the three partner councils.[18]

The Environmental Statement for the project, written in 2016 and available on the Aberdeen city website states:

"Anticipated waste arisings from each council which would feed into the Energy from Waste (EfW) plant are:

- Aberdeen City Council 60,000 tonnes;
- Aberdeenshire Council 70,000 tonnes; and
- Moray Council 20,000 tonnes.

The Proposed Development has therefore been sized to accept 150,000 tonnes p.a. of residual municipal waste."[19]

There are no pre-treatment or significant storage onsite. The plans also show the plant is expected to be operational for 20 years. However, SEPA household waste data indicates that already, before the plant has even opened, there will not be enough waste to feed the plant as expected (Table 1 below).

Table 1. Household waste generated in 2020 from the three local authorities contractually obliged to supply residual waste to NESS Energy, tonnes

Local authority	Waste generated	Waste recycled	Residual waste	Contracted waste supply to NESS facility in 2022	Difference
Aberdeen City	95,919	43,778	52,140	60,000	-7,860
Aberdeenshire	114,951	46,942	68,009	70,000	-1,991
Moray	41,520	22,792	18,729	20,000	-1,271
Total	**252,390**	**113,513**	**138,878**	**150,000**	**-11,222**

The Environmental Statement suggests that a deficit in household waste to supply the plant could be met with commercial waste instead:

"Should the Councils efforts to recycle result in less residual municipal waste, the remainder can be sourced from local commercial/trade waste with a similar composition to household waste." Paragraph 2.2.3

However, the contract is clearly based on household waste estimates. This may be because the suitability of commercial waste for incineration is less certain. Business waste is not published by SEPA[20] at the same level of detail as household waste. The latest figures available are for 2018, not 2020 and do not include estimates of how much waste was sent to recycling. These figures indicate that 753,542 tonnes of

[18] Public Contracts Scotland (2020) In section II.2.4) "The construction costs are being financed by the Partner Councils." https://www.publiccontractsscotland.gov.uk/search/show/search_view.aspx?ID=NOV399697

[19] AMEC Foster Wheeler Environment & Infrastructure UK Limited (2016) East Tullos Energy from waste Environmental statement, volume 1 The document states that "should the Councils efforts to recycle result in less residual municipal waste, the remainder can be sourced from local commercial/trade waste with a similar composition to household waste." However, no figures are given on the scale of commercial waste available.

[20] https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/business-waste-data/

business waste were generated by the three local authorities in 2018. It is unclear how much of this is recyclable or recycled and how much of the remaining was is suitable for burning. For example, 55% (414,750 tonnes) of this waste is food and garden waste, which should be managed using a biological treatment method, such as anaerobic digestion, rather than incineration if a low carbon solution is sought[21].

The excessive incineration contracts mean that there is little incentive or scope for local authorities to improve their waste prevention and recycling activities, as these would reduce the supply of waste for incineration below the contract amount even further. Councils would end up paying for waste treatment twice – once to incinerate it and again to prevent or recycle the waste. Whilst some of these costs may be offset by electricity sales, it will not cover the capital costs and gate fees councils must now pay.

In conclusion, Aberdeen City, Aberdeenshire and Moray Council have opted for an expensive and high-carbon waste management solution which they are locked into for 20 years. The lock-in to incineration has already begun and will mean that these local authorities are very much less able to develop the new initiatives for waste prevention and recycling which are required to reach a circular economy for the lifetime of their contracts with the plant.

2.3. Incineration makes climate goals harder to reach

As well as limiting progress to a circular economy, incineration can harm efforts to mitigate climate change and reach climate change goals.

Evidence for the impacts of anthropogenic climate change is most comprehensively detailed in the Intergovernmental Panel on Climate Change assessment reports[22]. The Paris Agreement is an international treaty to limit global warming to 1.5 degrees as soon as possible. The UN[23], the World Resources Institute[24] and the Ellen MacArthur Foundation[25] have all set out the vital role that moving to a circular economy plays in achieving our climate goals. The economic case for mitigating climate change and the biodiversity crisis can be reviewed in the Stern[26] report. The Scottish[27] and UK governments[28] were amongst the first policy makers to recognise the importance of achieving a circular economy, developing strategies to reduce our material consumption. The evidence of the economic and environmental imperatives of mitigating the climate change and biodiversity crises and the vital role that the circular economy plays in this process are clear.

Incineration contributes directly to climate change by releasing carbon directly into the atmosphere from burnt material. These emissions contribute to climate change.

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[21] As set out in the Food waste hierarchy published in the Scottish Government (2019) Food waste reduction action plan https://www.gov.scot/publications/food-waste-reduction-action-plan/documents/

[22] IPCC reports

[23] UN (2021) Shifting to a CE essential to achieving Paris Agreement goals

[24] WRI (2021) How the CE can help nations achieve their climate goals

[25] EMF How the CE tackles climate change

[26] LSE (2006) The economics of Climate Change: the Stern Review

[27] Scottish Government (2016) Making things last

[28] UK Government (2020) CE Package policy statement

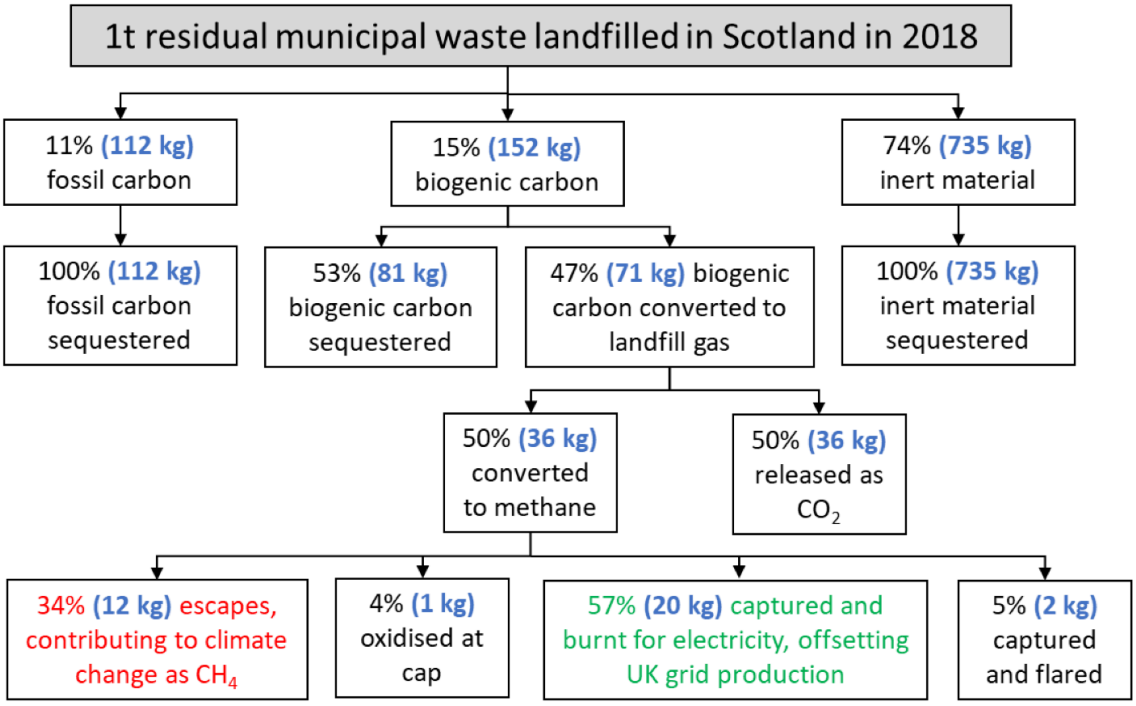
Scotland's main climate change target, to achieve Net Zero by 2045, cannot be met without reducing or counteracting these emissions from incineration in some way. Emissions from incineration are included in the energy sector, rather than the waste sector. However, in their latest progress report to Parliament the Climate Change Committee asked that emissions from incineration are reported separately from the rest of the power sector "to make it easier to track EfW emissions" [29]. This has helped to mask the climate impact of incinerators, as their impact are currently hidden within the general energy sector emissions. However, as the energy sector decarbonises, emissions from incineration will become clearer, given the high carbon intensity of waste incinerators compared to other energy generating technologies in a largely renewable system. The Scottish Government's climate change advisory body, the Committee on Climate Change estimates that incinerators now emit more carbon than coal in the UK[30].

Zero Waste Scotland estimated the carbon impact of sending one tonne of waste to incineration in Scotland in 2018 to be 246 $kgCO_2e/t$, which is 27% lower than the impact of sending the waste landfill[31]. However, this study excluded the storage of biogenic carbon in landfill. This conformed to traditional international reporting guidelines but is inappropriate for comparisons between technologies, used to aid policy decisions[32]. Policy choices must be made on the whole life carbon impacts of waste to be fair and this approach is more consistent with international best practice[33].

Figure 5 below, taken from the Zero Waste Scotland study, shows that about 53% of biogenic carbon is sequestered in landfill (along with 100% of fossil based carbon).

[29] CCC (2021) Progress Report Scotland p131
[30] https://www.letsrecycle.com/news/waste-sector-not-a-priority-for-cop-26-webinar-hears/
[31] ZWS (2021) Climate change impacts of burning municipal waste in Scotland
[32] UKWIN (2021) Good Practice Guidance for assessing the GHG impacts of waste incineration
[33] For example, US EPA Warm model

Figure 5. The fate of carbon in one tonne of residual municipal waste landfilled in Scotland in 2018



When biogenic carbon is included the emissions from incineration are comparable, or greater than landfill[34]. UKWIN estimated that in 2017 in the UK, waste incinerators released 1 tonne of CO2 for every tonne of waste incinerated on average. The release of CO2 from incinerators makes climate change worse and comes with a cost to society that is not paid by those incinerating waste. The 5 million tonnes of fossil CO2 released by UK incinerators in 2017 resulted in an unpaid cost to society of around £325 million.

Incineration also stands in the way of wider climate justice goals. Research[35] from RREUSE has shown that for 10,000 tonnes of waste can produce 1 job in incineration or 6 jobs in landfill versus 36 jobs if the waste is recycled or 296 jobs if waste is refurbished and reused. Jobs connected to incineration are also lower skilled than recycling and reuse jobs. The potential for a much more diverse and larger job market made possible by a more circular economy is being held back by a dependency on incineration.

2.4. Overcapacity of incineration will be a reality in Scotland by 2026

Incineration capacity and activity has grown rapidly in Scotland since 2011. A key driver in this increase is the 2025 biodegradable municipal waste landfill ban. The call for evidence cites the initial findings for the CXC study model which quantifies whether there will be a capacity gap when the landfill ban begins.

The Scottish Government's independent review on incineration was launched in December 2021. Stakeholders, including members of the public, have been given

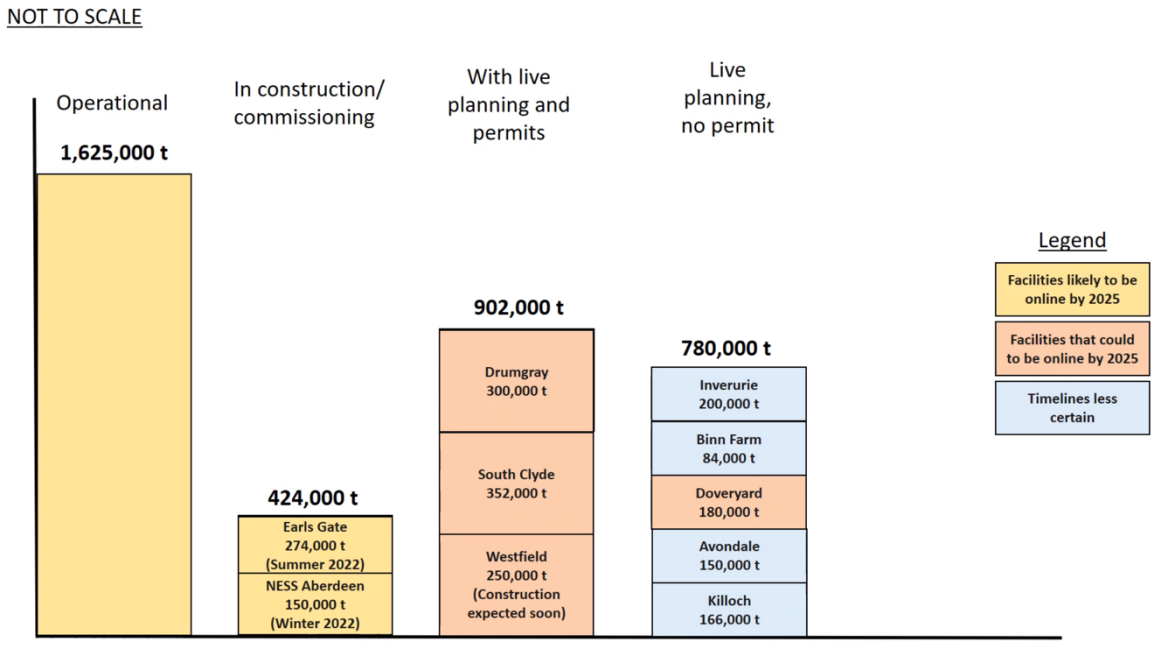
[34] UKWIN (2018) Climate change impacts of incineration in the UK
[35] RREUSE (2015) https://rreuse.org/re-use-has-higher-employment-potential-than-recycling/

two months to supply evidence to the reviewers, which includes Scottish Government civil servants and SEPA staff. A Call for Evidence document, written by the review team, set out the scope of the review, questions for responders to answer and presented evidence of the current situation.

Preliminary results from a model created by Ricardo for the ClimateXChange was also included. The model was based around three scenarios for how Scottish waste arisings and management capacity could change over time until 2025. This showed that, if recycling targets were reach it was likely there would be an over-capacity of waste treatment facilities (the majority of which are incinerators) in Scotland by 2025. However, if recycling targets are not reached and residual waste arisings do not fall, there will be a capacity gap of 0.86Mt by 2025.

After consultation with stakeholders, on 31st January 2022, a revised estimate of management capacity was created and sent to stakeholders via email, although the correction was not published more widely. The existing capacity was increased and consideration of plants expected to become operational after 2025 was included. The correction, presented in a graph and revised calculations on capacity (conducted by Friends of the Earth Scotland) is shown below.

Figure 6. Revised estimate of waste management capacity in Scotland, sent by the Incineration review team to stakeholders on 31st January 2022



The data in this graph can be combined with the CXC waste arising data and assumptions to create an estimate of the capacity gap in Scotland. This is shown in Table 2 below and the assumptions are listed below. These assumptions were mainly taken from the CXC study.

Table 2. Estimated waste management capacity and waste arisings for Scotland 2018-2030, millions of tonnes

Year	2018	2019	2020	2021	2022	2023	2024
Total operational capacity	1.54	1.54	1.54	1.54	1.76	1.95	1.95
Total waste arisings	2.52	2.58	2.45	2.47	2.56	2.58	2.60
Difference	0.98	1.04	0.91	0.93	0.80	0.63	0.65

Year	2025	2026	2027	2028	2029	2030
Total operational capacity	2.49	2.97	2.97	2.89	3.19	3.46
Total waste arisings	2.63	2.65	2.66	2.68	2.69	2.71
Difference	0.142	-0.329	-0.31	-0.21	-0.49	-0.748

Assumptions used to populate Table 2

- All new plants operate at 50% capacity in first year of operation (as per CXC model assumptions).
- All fully operational plants were taken at 95% capacity (as per CXC model assumption).
- Red plants (in the graph supplied by the reviewers) start operating in 2025
- White plant stops in 2028.
- Blue plants start operating in 2029.
- Waste arisings 2018-2025 taken form CXC study.
- Waste arisings 2026-2030 continue to increase in annual increments of 0.0157 Mt per year (based on annual change 2018-2025 as modelled by CXC).

This correction shows that, even if no progress is made towards recycling targets, Scotland will have a much smaller capacity gap of 0.142 Mt in 2025 and, by 2026, there will be over-capacity of treatment options. By 2030, it is likely, even with high waste arisings, there will be a large (0.748 Mt) over-capacity of treatment options.

If Scotland reaches its recycling targets, there will be management overcapacity by 2023. Even when the business as usual scenario and no plans which are currently live but which don't have permits (blue plants in Figure 6) become operational, there is still overcapacity by 2026.

Therefore, the data presented by the review itself indicates that there will be national overcapacity of waste management facilities in Scotland by 2026, under any scenario considered. It should be noted that the business as usual, (which is also the worst case) scenario is extremely unlikely to occur, given this ignores existing government interventions.

Recyclable waste is being burnt

It is widely acknowledged that much of what is burnt could have been recycled. Incineration is, by its nature, in conflict with recycling since the materials which burn

best – plastics, cardboard and paper – are some of the mostly easily recyclable. The most recent and complete composition analysis of residual waste in Scotland was conducted by Zero Waste Scotland in 2017. The study considered the composition of household waste at the kerbside in 2014-15 and found that: "Despite significant increases in the provision of kerbside recycling services in recent years, we estimate that approx. 670,000 tonnes, or 59% of the 1.13 million tonnes of residual waste is made up of waste types that are typically recycled at the kerbside in Scotland."

Pre-sorting processes are conducted at some incinerators. The planning statement for the Millerhill Plant[36], owned by FCC Waste Service and which receives HH and C&I waste, has a pre-burn mechanical treatment to "recover recyclables, remove reject material and produce a Solid Recovered Fuel (SRF)". However, the 2019 site return data published by SEPA shows that, apart from metals, no recyclable material was recovered. Using the Zero Waste Scotland finding that 59% of the residual waste could have been recycled[37], this would imply about 80,000t of recyclable waste may have been lost.

Table 3. Residual waste inputs and outputs from Millerhill plant in 2019

Input / Output	EWC Code	EWC Description	2019 tonnages
Waste Inputs	19 12 12	other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11	5,438
	20 03 01	mixed municipal waste	137,043
	20 03 03	street-cleaning residues	7
Waste Outputs	19 01 07*	solid wastes from gas treatment	3,453
	19 01 12	bottom ash and slag other than those mentioned in 19 01 11	32,899
	19 12 02	ferrous metal	960
	19 12 03	non-ferrous metal	138

This example demonstrates that recyclable material in residual waste is being unnecessarily burnt. Not only is there an over-capacity of incineration but most of the waste currently being burnt could have been recycled. If this was recycled instead, there would be even less need for incineration capacity.

2.5. More focused targets and an exit strategy from incineration are needed

The evidence above demonstrates that current waste targets are not fit for purpose. The goal for a waste disposal target should be *to minimise the environmental impact of waste*. Even if the 5% to landfill target was reached, this goal is unlikely to be achieved because reducing landfill is not equivalent to minimising environmental impact from waste. The increase in incineration in Scotland shows this.

[36] FFC Waste Services (2015) Planning statement

[37] There will be differences between kerbside and incineration gate compositions so this figure should only be taken as an estimate of the scale of recyclable material being lost.

The 5% landfill target is not informed by science. A better target would be based around the scientifically justifiable understanding that, once all prevention and recycling measures have been exhausted, any remaining residual waste is treated in the lowest carbon way possible: landfill for inert and fossil material and stabilisation for biodegradable material. A policy of landfill is always the worst option is too simplistic and unscientific.

A more appropriate target would be to reduce the absolute, whole life carbon impact of waste. This means measuring that impact, this could be done by adapting an existing tool like the Scottish Carbon Metric[38] (e.g. $kgCO_2e$ of waste generated per capita) and then setting a limit which would be compatible with global climate goals (no more than 1.5C warming by the end of the century or global net zero by 2050).

The evidence presented above demonstrates that Scotland is sleepwalking into over-capacity of incineration, which will threaten circular economy aims and climate change goals. A strategy to reverse this trend must now be applied immediately – the review should detail key milestones in this process.

The strategy should have two principals at its core:

1. A ban on new incineration; and
2. The rapid phasing out of existing plants.

Such an approach to incineration would be compatible with a waste disposal target based on reducing the absolute carbon impact of waste. This is because incineration is a wasteful and carbon-intensive practice compared to more circular activities, such as recycling and reuse.

2.6. Recommendations on targets and capacity

- The current moratorium on new and existing applications for incineration should be made permanent.
- The review should suggest milestones to phasing out existing incineration plants in Scotland as fast as possible.
- Waste targets should be revised to refocus policies on the circular economy. They should be absolute rather than relative targets. They should be carbon based and compatible with climate change goals.

[38] The Scottish Carbon Metric measures the whole life impacts of waste by material type and disposal route and has been published by Zero Waste Scotland since 2011.

3. What are the technically and commercially feasible options for managing residual waste in Scotland?

3.1. Extend moratorium on current and new applications

An immediate and indefinite ban on all new and existing incineration applications is required to meet circular economy aims in Scotland. Those plants which are already under construction but which have not received permits[39] should be halted immediately to avoid compounding overcapacity issues. The evidence presented in Section 1 details how incineration is incompatible with a circular economy and how there can be no justification for new plants as over-capacity of current demand is already a serious risk.

The planning mechanism used to enact the incineration moratorium in Scotland for the length of the review is similar to the initial approach used to ban fracking. This ban was extended to create an immediate and permanent ban on fracking and the same process could be used to immediately extend the incineration ban permanently. The fracking example demonstrates that Scotland has the legal means to extend the incineration moratorium.

A moratorium on large scale incineration was introduced recently in Wales[40] (where recycling rates are much higher than the rest of the UK). This ban is justified by the Welsh Government as part of its goal to create a circular economy. This precedent shows the economic feasibility of such an approach. Incineration bans have also been suggested recently in England, for example by the UK All-Party Parliamentary Group (APPG) on Air Pollution[41].

Large-scale market intervention is already a reality for the waste sector
The landfill tax represents a government intervention in the market on a scale unlike any other – the waste market is entirely artificial. The increasing the cost of landfill, 5 or 6 times its market level, has driven the economics of the whole waste sector for decades. Pushing up the cost of landfill has made incineration more competitive and is the cornerstone on which the modern industry is based. Much of Scotland's waste could technically be recycled but is incinerated instead because the artificially created market conditions make it cheaper. Since the market is entirely contrived and our willingness to intervene on a massive scale has already been demonstrated, we should have no problem in doing so again. Arguments which rely on the competitiveness of the waste market ignore this fact, presenting the current situation as something resembling a free market. This is not true. A ban on new incinerators would be in line with scale of market interventions required to shape the waste sector for many years.

[39] This includes the Earls Gate Energy Centre, the Dundee EfW CHP Facility, South Clyde Energy Centre and the NESS EfW facility as listed on the SEPA website (correct on 20.01.21)
[40] https://gov.wales/wales-takes-action-circular-economy-funding-upcoming-reforms-plastic-and-moratorium-large-scale
[41] APPG Air Pollution (2021) Pollution from waste incineration

3.2. A ban on burning plastics

A ban on burning plastic would dramatically reduce greenhouse gas emissions from existing incinerators. Burning plastics releases fossil carbon into the atmosphere directly contributing to climate change. There are two immediate technical consequences of a ban: firstly, an alternative disposal mechanism is required in the short term and secondly, plastic would need to be separated from the remaining residual waste streams. This section will address both these issues.

Creating a consistent approach for managing plastic
In 2021, the Green Alliance Circular Economy Task Force published a report that advises governments to move away from policies that address single issues and instead take "a more fundamental approach to how materials are used and managed"[42].

A ban on burning plastic would bring waste policies in line with those designed to reduce the production of plastic. Scotland will introduce a Deposit Return Scheme in August 2023. This will remove large amounts of plastic from the waste stream. The recent ban on single use plastic items and planned for extended producer responsibility schemes also mean that the amount of plastic in the waste will reduce. By banning the burning of any remaining plastic waste, the Scottish government could create a consistent set of policies which act to reduce the plastic crisis at every stage of its life cycle. This would also limit any chance of any temporary increase in plastic to landfill compromising the 5% to landfill target (which is of limited environmental value, as explained above).

Alternative disposal mechanism
Landfill is an existing disposal mechanism which could be used (temporarily) for plastic waste until these longer-term measures come into effect. Plastic would be stored, rather than released to the atmosphere, lowering greenhouse gas emissions.

Separating plastics from residual waste
Separating plastic from the remaining residual waste stream is sometimes problematic. Existing mechanical pre-treatment processes can separate plastic from other wastes even if they are not 100% effective. In Belgium, the recently opened PreZero Recycling facilities sorts plastic packaging into 14 fractions[43]. Some products are made from composite materials and it is difficult to separate such plastic from the other materials in the product, some of which should not be landfilled. Disposable cups, for example are often made of a mix of plastic and cardboard. The cardboard cannot be landfilled by 2025 (because it is biodegradable) and a ban on burning plastics would remove all traditional disposal options. This would mean the government need to drive the redesign of such products.

A staged ban would allow the proportion of plastic banned from incineration to increase in line with the introduction of other circular economy measures including extended producer responsibility schemes and DRS. Eventually, a full ban would help drive better source segregation and reduction in non-recyclable plastic products – both supportive measures to creating a circular economy and reducing climate

[42] Green Alliance 2021 https://green-alliance.org.uk/wp-content/uploads/2021/11/Fixing_the_system.pdf
[43] https://www.fostplus.be/en/blog/prezero-punctual-opening-of-sorting-facility-for-lightweight-packaging

change emissions. In the case of disposable cups, the upcoming ban will largely remove these products form the waste stream.

The goal should be to remove all plastics from incineration input streams as soon as possible. It is clear that industry agree and recognise that plastic reduction is of paramount importance to reaching environmental targets. The Environmental Services Association's Annual report for 2020-21 states[44]:

"Now that we have an ambitious Net-Zero strategy for the sector, we must start delivering on our commitments. In the first instance this means working with the government to remove plastics from the residual waste stream".

Ultimately, system changes to design out plastics from goods and products are required, particularly for packaging of fast-consumer goods. This will require action from producers and retailers and a co-ordinated effort along the whole supply chain. Such work would represent a true step forwards towards a circular economy.

Plastics, not fossil carbon should be the immediate focus

It has been suggested that all fossil carbon, not just plastic waste, should be removed from incineration. This would lower greenhouse gas emissions from incineration even further. However, a focus on plastic is a practical and realistic compromise to allow the majority of fossil carbon to be removed from incineration inputs. Table 4 below shows 70% of fossil carbon in waste is concentrated in plastic.

Table 4. Carbon content of one tonne of residual municipal waste in Scotland in 2018[45]

Waste material	Mass of waste in residual municipal waste (kg/t)	Carbon content (%)	Proportion of carbon which is biogenic (%)	Proportion of carbon which is fossil (%)	Mass of fossil carbon in 1t waste (kg)
Animal & mixed food waste	272	14%	100%	0%	0
Discarded equipment (excl. discarded vehicles, batteries & accumulators waste)	23	0%	0%	0%	0
Glass waste	29	0%	0%	0%	0
Health care & biological waste	103	19%	79%	21%	4
Household & similar waste	72	45%	50%	50%	16
Metallic waste, mixed	26	0%	0%	0%	0
Mineral waste from C&D	36	7%	50%	50%	1
Paper and card waste	160	32%	100%	0%	0

[44] ESA (2021) Annual report 2020-21

[45] ZWS (2021) The climate change impact of burning municipal waste in Scotland Table 2

Plastic waste	150	52%	0%	100%	78
Rubber waste	0	0%	0%	100%	0
Textile waste	65	40%	50%	50%	13
Vegetal waste	59	24%	100%	0%	0
Wood waste	7	44%	100%	0%	0
Total	1,000	23.4%	N/A	N/A	112

As Table 4 shows, the remaining fossil plastic is held in a mix of materials which can contain non-carbon and biogenic carbon content as well. Rubber waste is the one exception to this, as it is made up of 100% fossil carbon. However, it is present in such small quantities than plastic, it can be reasonably ignored for now. Removing non-plastic fossil carbon would be more technically difficult and expensive than concentrating on plastic – the marginal return on the additional carbon saved would be small. It is therefore suggested that an economically and technically feasible strategy to removing as much fossil carbon from incineration inputs is to concentrate on removing plastic, rather than all fossil carbon material, from the waste incinerated.

A ban on burning plastic would drive different design and operating choices for incinerators (as the Net Calorific Value of the waste input would change). It would reduce the economic case for building new incinerators as well.

3.3. Combined Heat and Power

The energy generated as a by-product by incinerators can be converted into a number of useful forms. When both electricity and heat are exported from a plant, this is known as a Combined Heat and Power (CHP) system. CHPs operate more efficiently and with lower environmental impacts than electricity-only plants. No plants in Scotland operate as CHPs (see Table 5 below). Scotland's only heat-only incinerate has been operational in Lerwick, Shetland for many years and the district heating scheme provides heat for local homes and businesses[46].

Table 5. Operational incinerators in Scotland in 2021 which are permitted to take residual municipal waste

Incinerator	Operational since	Plant type
Dunbar Energy Recovery Facility, East Lothians	2018	Electricity-only
MVV, Baldovie Industrial Estate, Dundee (1)	1998	Electricity-only
MVV, Baldovie Industrial Estate, Dundee (2)	2021	Electricity-only
Millerhill Energy Recovery Centre, Midlothian	2018	Electricity-only
Glasgow Recycling and Renewable Energy Centre (GRREC), Glasgow	2018	Electricity-only
Levenseat Thermal Waste Treatment Plant	2018	Electricity-only
Lerwick Energy Recovery Plant, Lerwick, Shetland	2000	Heat only

[46] https://sheap-ltd.co.uk/benefits

Current planning applications and regulations are designed to encourage incinerator plants to be designed, built and operate in an efficient manner. SEPA have stated that "it is important for new developments to maximise the opportunities to use existing and proposed heat and energy sources"[47]. As part of the planning application, all incineration plants must write a Heat and Power Plan which shows how, within seven years from cessation of commissioning, further energy can be recovered over and above the initial operational energy recovery. These plans should provide evidence of how the plant will achieve its relevant efficiency target (either 30% or 35%) and give an indication of anticipated progress for each year up to the end of the heat plan period. Not a single one of these plans has so far resulted in an incinerator exporting heat.

As with other parts of the waste management system, there is no economic incentive for incinerator plants to fulfil their obligations here. In fact, there are dis-incentives: developing local heat networks are expensive and reduce the efficiency of plants in generating electricity.

In 2020, 12 incinerators (22% of the total) across the UK exported heat[48]. The existence of such plants across the UK and Europe demonstrates the commercial viability of such models. In Scotland, plants claim to be "CHP-ready" – a completely meaningless term when no progress is being made.

The financial burden of conversion to CHP should fall on the operators, not government or citizens. This is for three reasons:

1. It is already a requirement to convert to CHP within seven years of operations commencing. Therefore, this should have been factored into business plans from the start of such projects.
2. Existing CHP plants across the UK demonstrate the commercial viability of such models.
3. The environmental savings from conversion to CHP are limited (see Section 5.1 for details). So, public funding for climate change mitigation should not be used for converting incinerators to CHP over other opportunities which offer greater carbon savings (such as reuse and recycling projects).

Despite the clear requirements, there is evidence that CHP retro-fitting is already drawing resources away from genuine climate causes. The Millerhill incinerator which has been operating since 2018, has plans to supply heat to a nearby local development known as Shawfair. According to the developers own website, the heat network will cost £20m and save 2,000 tCO_2e per year[49]. This is an extremely small carbon saving, represents a cost of £455 per tonne of carbon saved, which is eight times higher than the UK ETS price of carbon (£55/t in September 2021)[50]. £7.3m of the district heating project will be funded from the Scottish Government's Low

[47] SEPA (2014) Thermal Treatment of Waste Guidelines
[48] Tolvik (2021) EfW statistics 2020
[49] https://www.shawfair.co.uk/faqs/#what-future-developments-projects-are-on-the-cards (accessed on 15.12.21)
[50] https://www.endsreport.com/article/1727833/uk-ets-price-hits-record-amid-energy-price-spike

Carbon Infrastructure Transformation Programme[51]. Public funds meant to support low carbon infrastructure have been committed to a project which will save very little carbon for a very high price – this does not represent value for money.

Planning permission permits were submitted to Midlothian Council in October 2021. Even if plans to construct the District Heat Centre are approved, the details of how to retro-fit the network to houses are currently unanswered. It is unclear what residents will pay for their heat. Large backup boilers will be constructed on local woodland to supply heat to residents to cover failures at the Millerhill plant. It is clear the environmental and financial impacts of retro-fitting CHP to incinerators has not been thoroughly considered in Scotland. The example from Millerhill demonstrates that public funding for climate projects will be mis-directed towards prolonging the polluting practices of incineration.

3.4. Waste carbon tax

The landfill tax has shaped the economics of waste management in Scotland for many years. It has been successful in diverting waste from landfill. Given this success, some have argued that an incineration or a broader waste tax is now needed to continue to drive this diversion up the waste hierarchy. Friends of the Earth Scotland have a number of technical and economic concerns with this approach, which are laid out below.

Delayed impact
The landfill tax was introduced across the UK in 1996. The escalator meant that change was slow. An incineration tax would be equally slow to become effective, if a similar escalator was used. It is vital that any mechanism to change Scotland's waste management systems should act on the decisions taken today. It is these decisions, and their long-term consequences, which will affect whether we meet our climate and circular economy goals or not.

Root causes not addressed
Even if an incineration tax was introduced, the expected outcome would be that it would eventually drive waste one more step higher up the waste hierarchy towards recycling. An incineration tax does not alter the underlying problem of the production of waste.

A broader waste tax focused on residual waste management options (landfill, incineration and biostabilisation) still acts only on the very bottom of the waste hierarchy. If progress is to be made on reducing the amount of waste generated, policy makers must incentivise recycling and prevention as well.

A broader waste tax based on whole life carbon emissions per tonne of material managed and which includes recycling options which are not net carbon sinks, as well as residual treatment options would address this concern. However, it would be difficult to implement. How would carbon impacts per tonne be established for each

[51] https://www.edinburghnews.scotsman.com/news/people/ps20m-plans-for-green-heating-network-at-millerhill-3331775

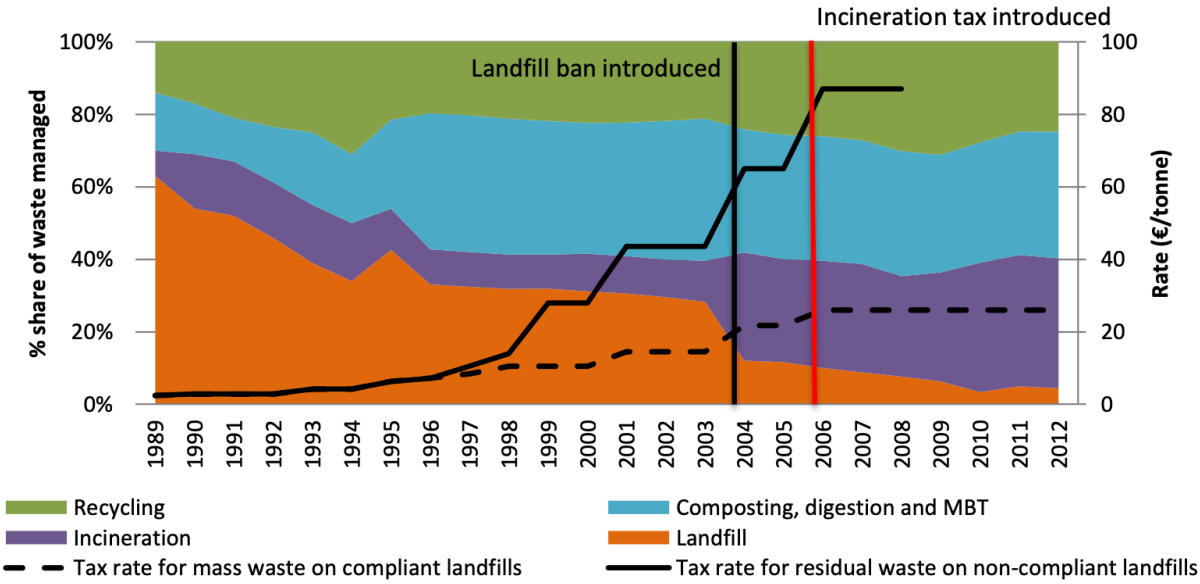
technology? How would they be applied to individual businesses? Would plastic buried in landfill be classed as a carbon sink?

No guarantee a tax will act as planned

A tax alone does not guarantee a desired outcome. The process is led by market forces and if no new management options emerge, local authorities may be forced to choose between two high-cost options, landfill and incineration. With no other regulation, there is no threshold for a maximum number of incinerators. The complexities and uncertainties of waste management mean that it is impossible to predict exactly what consequences an incineration tax would have.

Evidence of this can be seen in from Austria, which introduced a landfill tax (in 1989), a landfill ban (in 2004) and an incineration tax (in 2006). The figure below shows the changes in residual waste arisings and when each of these policy measures was introduced[52].

Figure 7. Landfill tax rates and waste management practices in Austria



The biggest change in the graph happens in 2004 when the landfill ban was introduced was a diversion of waste from landfill to incineration and very little change in recycling. When the incineration tax is introduced in 2006, there is no significant change in the amount of waste managed by incineration. By 2012, incineration has increased. The latest evidence from Eurostat indicates incineration tonnages have remained level since 2012 until the latest available year for reporting (2020).

Burden of costs falls to LAs

As with the landfill tax, the cost of the system would fall on local authorities, rather than incinerator operators, who would pass on the cost. The introduction of the Dutch incineration tax in January 2020 and the Swedish incineration tax on the 1st April 2020 has driven gate fees at EfW facilities up[53].

[52] Eunomia and IEEP (2016) Landfill tax, incineration tax and landfill ban in Austria
[53] WRAP (2021) Gate fees report 2019/20

Limits of devolved powers?
It is unclear if the Scottish Government have powers to introduce such a tax. Given the urgency of the climate crisis and the need to change trends in incineration as soon as possible, any delay in introducing a tax would be a significant disadvantage. Alternatives, such as including incineration in the UK Emissions Trading Scheme would also take a long time to set up.

Carbon-based tax options bring complexity
These objections can be partly overcome by creating a carbon, rather than a financial tax and introducing any tax at a high level immediately. A tax scaled to the average carbon impacts per tonne managed would be more aligned to Scotland's climate targets than a purely weight-based tax. Lower carbon management routes would be incentivised. However, with further complexity comes additional risks. Carbon accounting approaches vary in what should be included and excluded in factors[54]. Setting up and administrating such a system would require greater regulation than the current system.

Given these concerns, Friends of the Earth Scotland consider an incineration tax to be a poor mechanism for solving the incineration crisis in Scotland. If a tax is recommended, it should not sufficient to create a circular waste management system in Scotland. Any tax should be based on whole-life carbon impacts, measured by an independent body. Including incinerators in the UK ETS would be an alternative mechanism to such a carbon waste tax, although the need for change now in Scotland means this option is too slow to be an effective mechanism for change. It should also be noted that, even if incineration was included in a UK ETS it would still be priced 3-4 times lower than sending waste to landfill. If the object is to reduce carbon, a distorted carbon market is not fit for purpose – a single tax on the carbon emissions of waste would be required. This would encourage lowest carbon practices, whatever they may be.

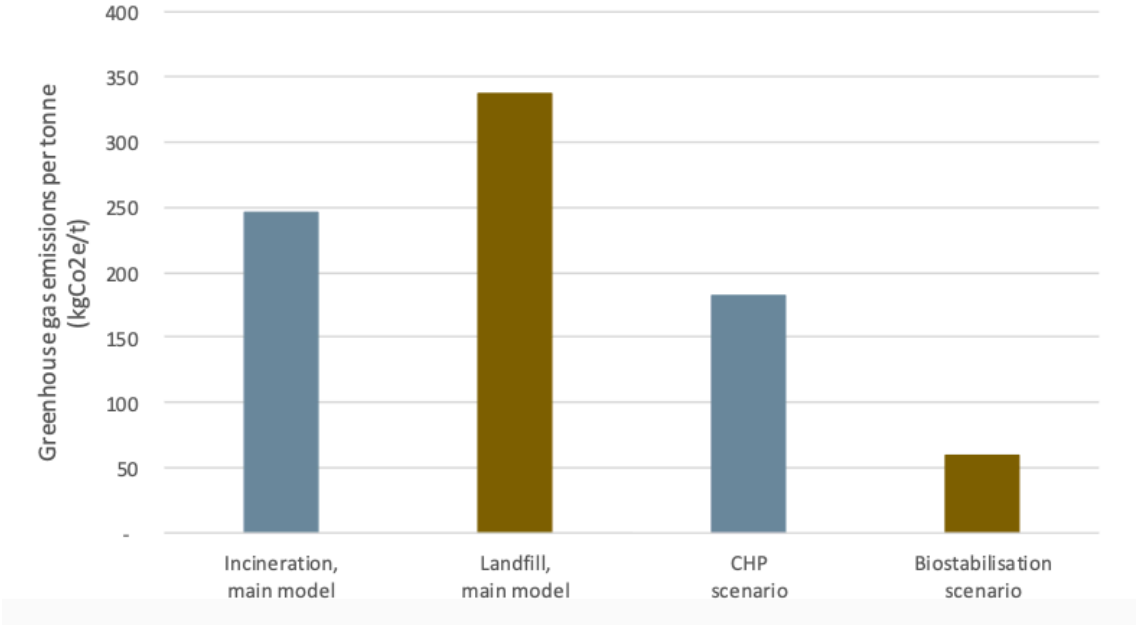
3.5. Biostabilisation

Scotland does not require any new incineration plants. However, even if the case was made for more capacity, this should be rejected because there is a lower carbon alternative. Biostabilisation offers much lower carbon emissions per tonne of waste managed than incineration (see Figure 8 below, taken from ZWS (2021) study[55]). Life Cycle Assessments indicate biostabilisation performs favourably compared to incineration[56].

[54] For example, should storage of biogenic carbon in landfill be included in carbon assessments comparing landfill and incineration? International reporting guidelines have traditionally excluded such emissions but this is changing. A growing number of LCA experts consider comparisons between landfill and incineration without the inclusion of biogenic carbon stored in landfill to be unfair. The latest guidance from IPCC is that it can be included.
[55] ZWS (2021) The climate change impact of burning municipal waste in Scotland Figure 16
[56] For example, Zhangetal (2011) Environmental and economic assessment of combined biostabilization and landfill for municipal solid waste, Journal of Environmental Management, Volume 92, Issue 10. and Mondello et al. (2017) found that sending 1t food waste to AD had an impact of 66 kgCO2e/t and incineration was more than an order of magnitude higher at 823 kgCO2e/t.

Biostabilisation is a form of Mechanical and Biological treatment (MBT) of waste where the waste is treated to ensure biological material is degraded aerobically. The stabilised product can be landfilled. Whilst no examples of biostabilisation exist in Scotland currently, the practice is common in Europe and used as a low carbon alternative to incineration[57].

Figure 8. Retrofitting CHP or biostabilisation technologies lowers the GHG emissions of waste management facilities compared to current incineration and landfill practices



The Waste (Scotland) Regulations 2012[58] lists two alternatives to landfill of biodegradable waste: incineration and biostabilisation. It may be that biostabilisation has not been explored because of artificial economic barriers created by the landfill tax. Outputs from biostabilisation process must pay the higher landfill tax figure[59] (£96.70/t in 2021[60]). Incineration Bottom Ash must also be sent to landfill but is exempt from this higher rate (so paid £3.10/t in 2021). The Zero Waste Scotland incineration study notes the "practical, legal and financial barriers to investing in this technology currently exist in Scotland".

The reason for IBA qualification for the lower rate of landfill tax is unclear given the environmental impacts of incineration[61]. This is one of many examples of unfair economic advantage given to incineration over other waste management practices[62]. Given the risk of over-capacity and the lower carbon alternatives, this should be amended. Biostabilised waste should pay the lower rate of landfill tax.

[57] https://futurenviro.es/en/new-biostabilisation-plant-puts-ecoparque-gran-canaria-norte-at-the-forefront-of-european-waste-management/
[58] The Waste (Scotland) Regulations 2012
[59] Scottish Parliament (2021) Parliamentary Question ref. S6W-04116
[60] Scottish Government (2021) Scottish Landfill Tax
[61] ZWE (2019) The hidden impacts of incinerator residues
[62] Another example is the exclusion of incineration from the EU ETS, despite its GHG emissions being 1.5 times higher than gas. https://www.endseurope.com/article/1737413/ets-reform-rapporteur-proposes-efw-inclusion-carbon-leakage-protection

3.6. Carbon capture and storage

This response notes the inclusion of a recommendation by the CCC to plan and fund a CCS retro-fitting project to all existing Scottish incinerators in its latest progress report to Parliament. It recommends the Scottish Government should:

"Work with the UK Government to develop a policy and funding framework to retrofit existing Energy from Waste plants with CCS from the mid-2020s, and ensure any new Energy from Waste plants are all built 'CCS-ready'."[63]

Friends of the Earth Scotland strongly disagrees with this recommendation, which pre-empts the findings of the independent review. This proposal is unrealistic and reckless. Our technical, economic, environmental and social concerns are listed below.

Technical concerns
CCS has a history of over-promising and under-delivering. Much hope is being pinned on CSS but there is currently not a single operational CCS plant in the whole of the EU or the UK. The lack of scaled CCS projects, particularly examples of retro-fitted incinerators, creates risks and uncertainties which cannot be ignored. Deployment times for CCS plants would typically be 6-10 years meaning existing incinerator plants in Scotland could be half way through their expected lifespans before a single tonne of carbon is captured from any retro-fitting project. Retro-fitting CCS to incinerators bring additional concerns. Electricity output reduces by one-third for power-only plants and halves for combined heat-and-power plants[64]. When coal and gas plants, of an order of magnitude larger than incineration plants, cannot make CCS a reality, then small-scale incinerators, not even subject to carbon pricing, are even less like to.

"CCS-ready" is a meaningless term, just as "CHP-ready" plants have proven to be. It requires almost no investment or planning, giving false reassurance that significant steps towards lowering carbon emissions has been taken whilst allowing business as usual to continue unbound.

Economic concerns
Economists and energy analysts commonly cite CCS as being "prohibitively expensive"[65]. Retro-fitting adds to the construction and running costs of plants. The Oslo incinerator, held up as a successful example of a proposed CCS pilot, not due to be operational until 2025, costs €700m, including €300m funding from the EU, in addition to investments from the Norwegian government and the plant's joint owners, the Oslo municipality and utility company Fortum[66]. The British Geological Survey states that CCS costs are increased when "applying the technology to pre-existing plants or plants far away from storage locations"[67].

[63] CCC (2021) Progress Report to Scottish Parliament
[64] Bisinella (2021) Environmental Assessment of CCS as a post-treatment technology in waste incineration
[65] For example Institute for Energy Economics and Financial Analysis (2019) and Forbes (2021)
[66] Guardian (2021) "We have to pay the price"
[67] BGS (2021) https://www.bgs.ac.uk/discovering-geology/climate-change/carbon-capture-and-storage/

Environmental concerns
CCS does not remove greenhouse gas emissions from the atmosphere. At best it prevents some emissions caused by the burning of carbon-based fuels from reaching the atmosphere. In practice, it's capacity to mitigate emissions is poor and CCS enables emissions from the underlying source, in this case, incineration, to be prolonged.

In the case of incineration, as well as allowing carbon emissions to be generated, CCS investment will allow a non-circular economy technology to persist, creating further distraction from recycling and waste prevention measures.

Social concerns
CCS brings unrecognised social costs. These 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[68].

CCS should be avoided as a solution to incineration as it does not offer the same economic, environmental and social benefits of true circular economy solutions, such as waste prevention and reuse.

3.7. Expanding BMW ban

The Scottish Government's Climate Change Plan includes a recommendation to expand the Biodegradable Municipal Waste ban to landfill to cover non-municipal waste by 2025. Given the role the BMW ban has played in creating the current incineration crisis, and the economic inequalities created in the legislative framework used to create the ban, it is difficult to see how such a suggestion can be justified.

The intention of the ban is to reduce the environmental impacts of waste and the most effective way to do this is to prevent waste being produced in the first place. The BMW ban failed to do this (as evidenced by current household waste trends which show total household waste managed to have fallen only 7% between 2011 and 2020[69]).

Instead, the BMW ban drove local authorities towards incineration. The residual municipal waste stream contains a mix of biodegradable and inert waste. Because it is not possible to completely sort biodegradable waste, the whole stream must be treated together. The ban means that local authorities had to find an alternative to landfill for all their municipal residual waste.

Two potential disposal routes which meet the ban criteria are outlined in the Waste (Scotland) Regulations: biostabilisation and incineration. As discussed above (Section 2.5), the artificial barriers to biostabilisation created by the same legislation means that, local authorities are left with only one economically viable option for managing all their residual municipal waste: incineration. Biostabilisation must pay the higher landfill tax rate, whereas incineration bottom ash is exempt. By driving all residual waste to incineration, much valuable material may be lost.

[68] ZWE (2021) CCS for incinerators? An expensive distraction to a circular economy
[69] SEPA (2021) Household Waste Statistics 2020 Table 6

In this way, the BMW ban has exacerbated the rush to incineration. It the ban is expanded to cover non-municipal waste it will only increase demand for incineration when climate goals require Scotland to be moving away from the technology. Instead, strategies and resources should be focused on removing biodegradable material from the residual stream through waste prevention and recycling measure. Incineration, with higher carbon impacts than its alternative, biostabilisation, should not be given unfair economic advantage of a lower landfill tax rate.

3.8. Recommendations on management options

- The current temporary ban on new and existing incineration applications should be extended immediately and indefinitely.
- A staged ban on plastics, rather than all fossil carbon waste, should be introduced immediately. The ban should be designed around existing sorting capabilities and increased in line with other circular economy measures until all plastics are banned from incineration.
- Existing and new incinerators should be required to convert to CHP systems as soon as possible to ensure they are operating efficiently. This cost should be borne by operators.
- A tax on incineration would not be as effective at reducing the environmental impacts of waste management as bans and restrictions.
- If a tax is introduced, it should be carbon-based and cover all waste disposal routes, not just incineration.
- Biostabilisation offers a lower carbon alternative to incineration of biodegradable municipal waste, and should be economically incentivised as such.
- Incinerator bottom ash should pay the higher rate of landfill tax.
- Carbon assessments comparing waste management schemes should be based on a whole life assessment, to allow decision makers to make a fair comparison. In particular, storage of biogenic carbon should be included.
- CCS should be avoided as a solution to incineration as it does not offer the same economic, environmental and social benefits of true circular economy solutions, such as waste prevention and reuse.
- The biodegradable municipal waste ban should not be expanded to non-municipal waste.

4. How do these options compare, in environmental, social and economic terms?

4.1. Comparison of options

Table 6 below summarises the environmental, social and economic considerations of each option considered in Section 2.

Table 6. Summary and comparison of environmental, social and economic factors for options to manage Scotland's waste

Option	Considerations			FoES Recommendation
	Environmental	Social	Economic	
1. Extend moratorium on applications	Absolute requirement to achieving a circular economy	Benefits of cleaner air, better waste service and lower long-term costs	Limited impact as current investment is minimal	Implement immediately
2. Ban on burning plastics	Fast, effective, high carbon savings possible	Fast, effective, clear public benefits	Affects industry energy output, composite products may be difficult to manage	Implement by 2025
3. CHP	Decreasingly small carbon savings possible	High costs likely to be passed on to local authorities	Affects industry energy outputs, high costs	Enforce strongly for all existing electricity only plants
4. Waste carbon tax	Focus on disposal, rather than reduction of waste	High costs likely to be passed on to local authorities	Risk market will not produce desired effect	Only apply if incineration is not phased out
5. Biostabilisation	Lower carbon alternative incineration	Likely to be almost as unpopular as incineration	Artificial barrier created by landfill tax rates	Unnecessary but preferable to new incineration plans if economic barrier is removed
6. CCS	Further lock in to a high carbon and wasteful practice	High costs likely to be passed on to public	Prohibitively expensive	Environmentally damaging, risky and expensive. "CCS-ready" a smokescreen for inaction.
7. Expanding BMW ban	Likely to increase incineration of non-municipal waste	Ineffective, no clear public benefits	Risk of loss of materials with economic value	Environmentally damaging, ineffective and a barrier to a circular economy

4.2. Recommendations

- Extending the moratorium of incineration applications and banning the burning of plastic have the potential to have greater environmental and social benefits than other interventions.
- CCS and expanding the BMW ban to non-municipal waste are likely to have negative environmental, social and economic consequences and should not be implemented as strategies to manage Scotland's waste.

5. How do we decide where capacity should be located, and in what form?

5.1. National strategy

A national study of waste arisings, incineration capacity and location projections is required urgently. The current spread and capacity of incineration facilities in Scotland are not part of an integrated system which balances waste generation and logistical requirements. An understanding of current and projected demand and supply is required to transform Scotland's current waste management system to one which ensures waste is minimised and managed in as low a carbon way as possible. Such an approach is needed if incineration capacity is to be reduced.

5.2. The role of data

The following data is required to create a full and ongoing understanding of incineration trends in Scotland:

- Annual reporting of national incineration capacity (for municipal and non-municipal waste), listing all existing plants;
- Projections of municipal and non-municipal waste arisings and landfill, incineration and recycling capacity from current time to 2045 (to allow decisions about waste management to align with climate targets);
- Composition studies of waste at both the incineration gate and of waste burnt;
- Annual updates on individual plant operating efficiencies including carbon intensity (GHG emissions per tonne of waste burnt) and energy efficiency (kWh generated per tonne of waste burnt).
- A league table of municipal incinerator plants by carbon intensity of operation should be published by SEPA annually. This should be benchmarked against the best performing international examples.

All reporting should be made publicly available in a timely manner to ensure regular, independent scrutiny of the system, enabling progress towards a more circular economy.

The Waste Data Strategy Board[70], consisting of Scottish waste data experts from the Scottish Government, SEPA and Zero Waste Scotland, should be tasked with leading the collection and analysis of this data.

5.3. Transport

The importance of transport of waste is often discussed. A whole life analysis of this life cycle stage is required to understand its true importance. The Scottish Carbon Metric 2018 factors show that transporting a tonne of inert material, such as glass, to landfill has an average impact of 4 $kgCO_2e$[71]. In comparison, producing one tonne of glass has an impact of 1,210 kgCO2e and recycling a tonne of glass saves 755 kgCO2e/t.

[70] SEPA (2020) Waste Data Strategy
[71] ZWS (2020) Carbon factors overview 2018

Using the Scottish Carbon Metric's estimate of the average carbon impact of household and similar waste production emissions (3,208 kgCO2e/t), transport emissions to residual waste management (4 kgCO2e/t) are 800 times smaller than the production emissions.

These examples demonstrate that the transport of waste material is generally not nearly as significant as the process emissions involved in the domestic treatment of waste, regardless of waste treatment option. When waste is exported, transport emissions can become a larger proportion of the overall life cycle emissions. Nevertheless, full life cycle analysis is still required when comparing the environmental impacts of waste treatment options for waste which may be exported. Reduced transport, without full life cycle knowledge, should never be used as a reason for justifying additional incineration plants.

5.4. Recommendations on capacity location and form

- More resources are required to co-ordinate and implement a national strategy to reduce and minimise incineration in Scotland. The strategy should be led by the Waste Data Strategy Board and include annual, publicly available updates.
- More resources should be available to regulators to measure and report incineration activities.
- SEPA should report annual capacity updates, and capacity projections to 2045.
- There should be a mandatory requirement on incinerator operators to report the carbon intensity and energy efficiency of individual plants on an annual basis. This data should be publicly available as it does not affect the commercial operations of plants.
- There should be mandatory reporting of composition of waste at incinerator gates and at the point of incineration.
- SEPA should publicly publish an annual league table of municipal incinerators by carbon intensity.
- Life cycle analysis should be used to understand the importance of transport emissions relative to the overall life cycle of material consumption and waste treatment options.

6. What can be done to improve existing Energy from Waste facilities in terms of a) carbon performance and b) their societal impact?

6.1. Improving carbon performance

An exit strategy for incineration

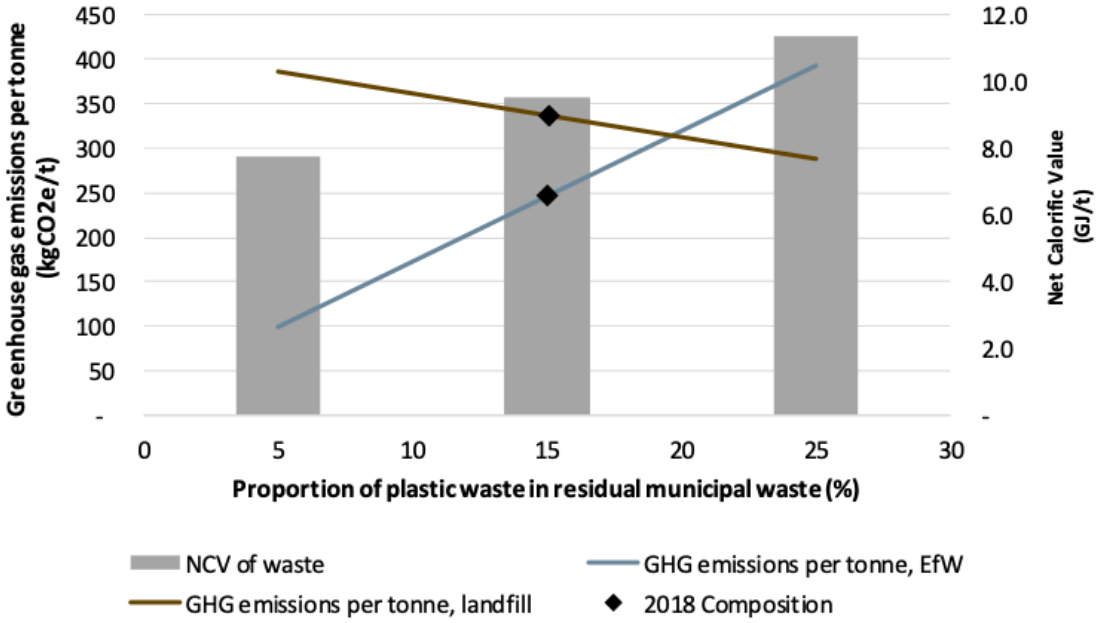
The simplest, surest way to reduce the carbon impact of incinerators is to stop burning waste as rapidly as possible. The immediacy of the climate crisis demands this option be considered seriously. Every tonne of greenhouse gas mitigated is progress towards a more sustainable future. Incineration is a polluting practice which generations carbon emissions both directly and indirectly. Apart from ending incineration, there are no technological or economic options which will reduce GHG emissions completely.

Friends of the Earth Scotland recommend that the Scottish Incineration Review sets out an exit strategy to end incineration in Scotland as quickly as possible. This is the only option which aligns with Scotland's climate change goals and would allow more circular solutions to replace incineration in the management of Scotland's waste.

Banning the burning of plastics

The emissions of residual municipal waste sent to incineration is highly dependent on the composition of that waste, which is varied and changes over time. The fossil content of waste burnt is the most significant factor affecting greenhouse gas emissions per tonne. Figure 9 below, taken from the ZWS (2021) study, shows the impact of varying the plastic content of residual waste on in greenhouse gas emissions and net calorific value (NCV). The NCV is key to the economics of incineration operations – the higher the NCV, the more energy can be generated.

Figure 9. Varying the proportion of plastic waste in residual municipal waste changes the net calorific value (NCV) and greenhouse gas (GHG) emissions of EfW and landfill [72]



In the main ZWS study, plastic wastes comprised 15% of residual municipal waste, has an NCV of 9.5 GJ/t and makes up 70% of its fossil carbon content. As shown in Figure 9, if the proportion of plastic in residual municipal waste increases, the greenhouse gas emissions of EfW rise. This is because more fossil carbon would be burnt and released into the atmosphere, contributing to climate change. NCV also rises because there is more carbon to burn and release energy from. Landfill emissions fall as plastic content rises, as all fossil carbon is stored in landfill[73].

If plastic waste can be reduced to 5% of residual waste composition, the GHG emissions from incineration are cut by 60% to 99 kgCO2e/t. This evidence demonstrates that removing plastic is a fast and effective way of reducing the carbon emissions of existing incinerators.

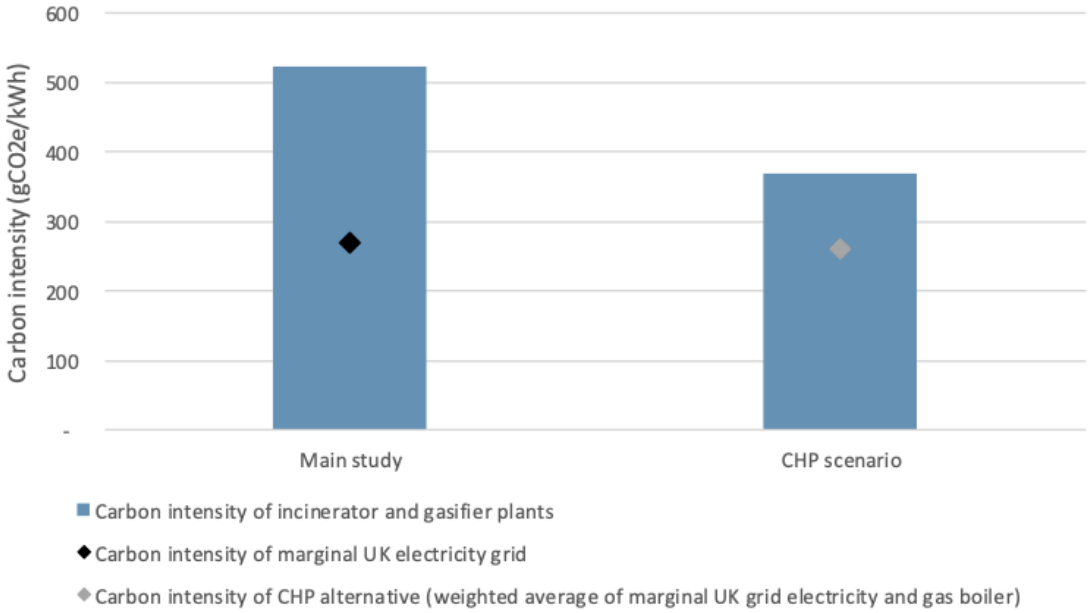
Combined Heat and Power

The ZWS (2021) study found that average carbon intensity of EfW plants was reduced by 30% from CHP conversion (Figure 10 below). This did not include the carbon impact of retrofitting the CHP network. Whilst the carbon intensity was reduced, it did not fall below the carbon intensity of alternatives. This means that every unit of energy supplied from CHP incinerators would emit more greenhouse gas emissions than the most likely alternative (for heat, this would be a gas boiler). The ZWS study concludes incineration "can no longer be considered a source of low carbon energy". As the UK electricity and heat networks continue to decarbonise, incineration will become an increasingly high carbon outlier.

[72] ZWS (2021) The Climate Change Impacts of burning municipal waste Figure 13

[73] Note that this analysis does not include the carbon savings from storage of biogenic carbon in landfill so a comparison between EfW and landfill emissions is incomplete.

Figure 10. Converting to CHP systems lowers the carbon intensity of EfW plants



So, CHP can reduce the greenhouse gas emissions of incinerators but not to levels which align with Net Zero targets.

Investing in CHP for incinerators would have indirect carbon impacts, through the construction of heat networks and retrofitting the heat capture system to incinerators. In addition, the lock-in to a waste disposal route would ensure carbon emissions from waste remained high compared to lower carbon waste prevention and recycling alternatives. 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"[74].

Carbon Capture and Storage

CCS would not prevent the emission of greenhouse gases from incineration directly, but could capture a proportion of these before they are emitted to the atmosphere. Fossil fuel-based CCS is not capable of operating with zero emissions. Operational CCS have reported initial deployment capture rates of 65%, taking several years to reach 90% capture[75].

As with CHP, CCS would create lock in to a high waste and high carbon system which would have indirect impacts on greenhouse gas emissions. The construction of a CCS network would have carbon impacts and the reduction in waste prevention and recycling measures would mean emissions remained high. CCS exacerbates the many problems associated with overconsumption, resource inefficiency, and the linear economy that give rise to significant losses to the wider economy[76].

[74] EU Technical Expert Group on Sustainable Finance (2020) Taxonomy Report: Technical Annex
[75] FoES and Global Witness (2021) CCS Briefing
[76] Fauset, C. (2008) Techno-fixes: a critical guide to climate change technologies

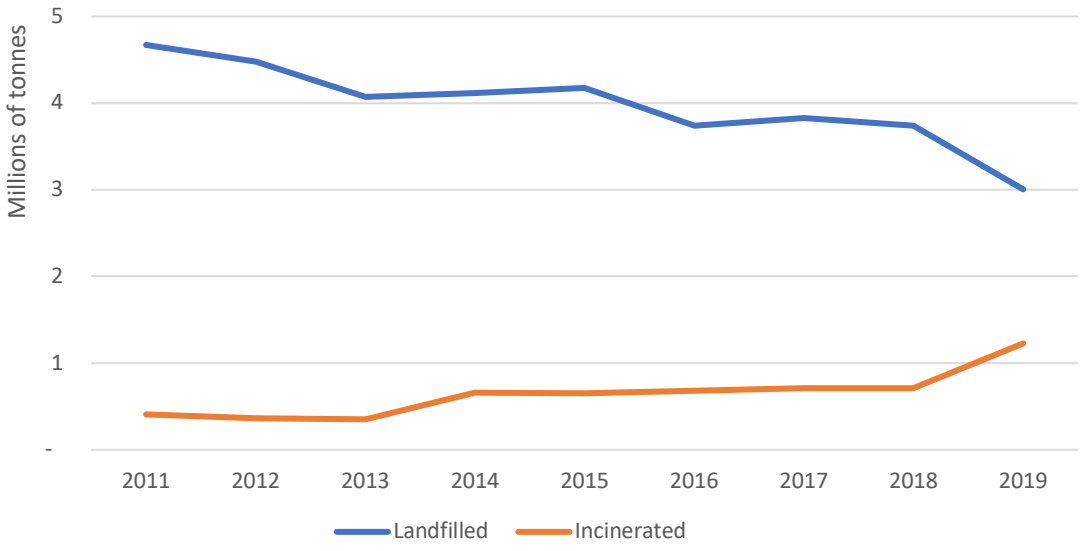
6.2. Improved reporting of the climate impacts of incineration

As noted in the call for evidence the Scottish Government's climate change plan excludes incineration with energy recovery emissions from what is termed "the waste sector". This is in line with domestic and international reporting requirements determined by the IPCC. However, this becomes extremely misleading when making statements about trends in waste sector emissions, which might be reasonably assumed to include incineration with energy recovery as part of this sector by a general audience.

In its climate change plan, the Government claims that "In 2018, waste and resources sector emissions were over 70% lower than in 1998." The biggest change in the sector has been the diversion of waste from landfill, and it is likely this emission reduction is associated with this change. Although it is not possible to verify this with the information available publicly, the reviewers should have access to more detailed information via the Scottish Government Environmental Statistics team.

Figure 11 shows that rather than this waste being reduced, waste diverted from landfill has instead been incinerated (data taken from SEPA[77]). Because incineration is reported under a different sector, energy supply, it appears that the waste sector emissions in the climate change plan have reduced. This misleading reporting severely hampers our ability to measure true progress. It is not possible for policy makers to understand if policies are working as intended if emissions reporting is so unclear.

Figure 11. Waste landfilled and incinerated in Scotland, 2011-19, in millions of tonnes



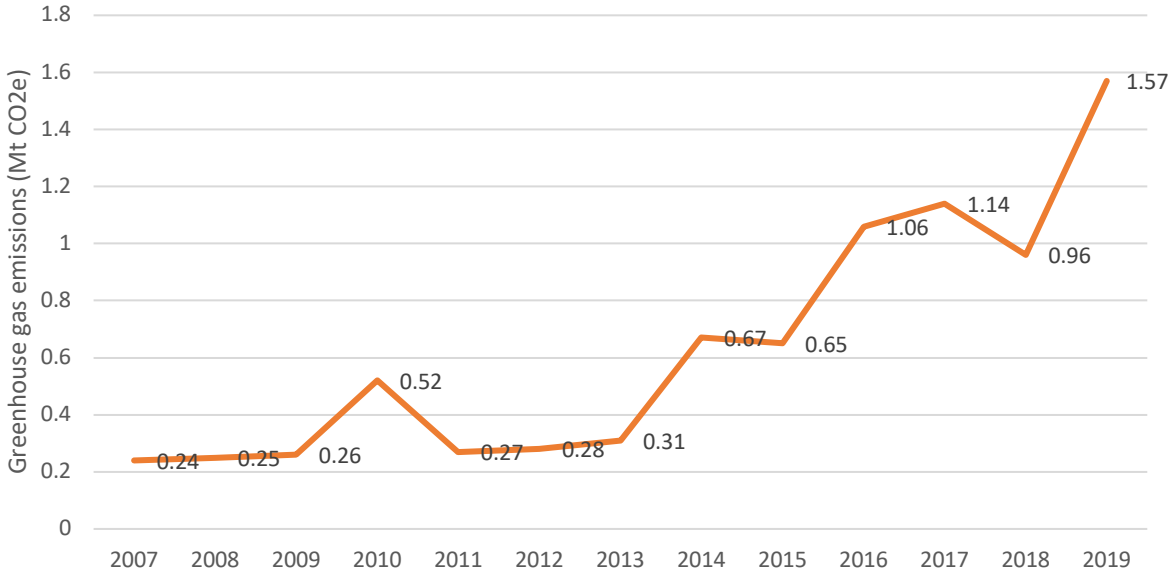
[77] SEPA (2021) https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/

It should also be noted that Figure 11 and the data which is used to create it stop at 2019. It is expected that the existing trends pictured here will only increase in 2020 and beyond, in line with known incineration capacity.

GHG emissions from the waste sector and incineration

Emissions data is usually reported on the SEPA website via the Scottish Pollution Release Inventory (SPRI). However, data which we would expect to be available from this service is currently limited and inconsistent due to the cyber-attack experienced by SEPA over a year ago. The emissions from Scottish incineration of all waste types, with and without energy recovery, was recently reported in Parliamentary Question S6W-05516[78] put to the Scottish Government. This data is shown in Figure 12 below and demonstrates a rise in emissions from incineration which aligns with the rise in tonnes of waste sent to incineration.

Figure 12. Greenhouse gas emissions from incineration of all waste in Scotland 2007-18



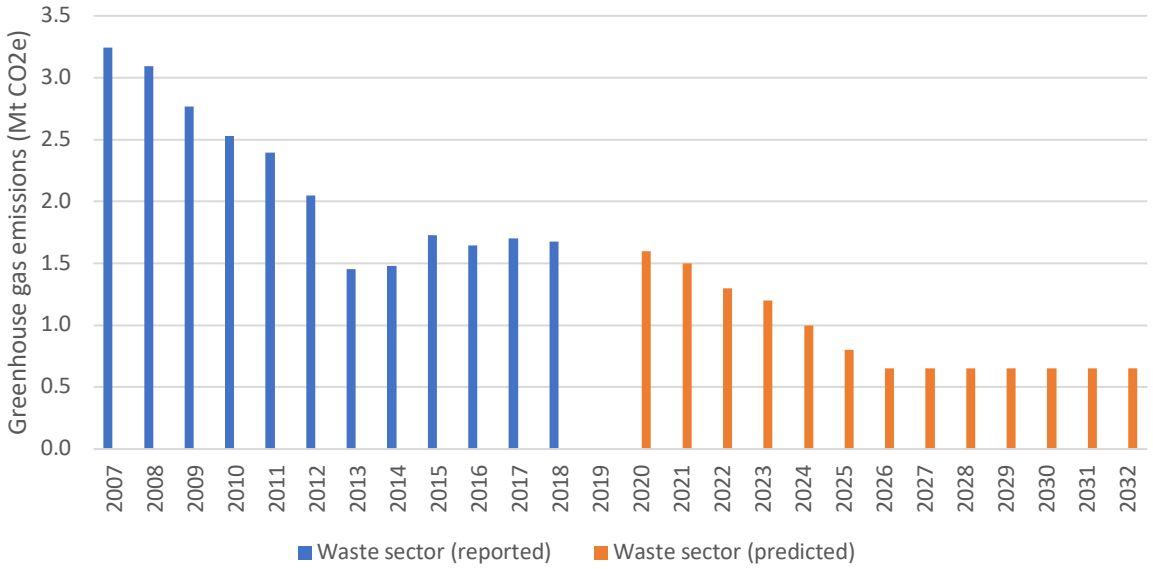
No information is given on what proportion of these emissions come from incineration with energy recovery. However, it is likely to be a large proportion as all household waste and some C&I and C&D waste is known to be incinerated in such plants.

The Scottish Government report GHG emissions by sector annually, although the most recent publication was in 2020 for the year 2018[79]. More up to date data would be have been useful. This can be combined with the Climate Change Plan estimates of future emissions from the waste sector to produce Figure 13 below. This includes methane released from landfill but not incineration with energy recovery.

[78] https://www.parliament.scot/chamber-and-committees/written-questions-and-answers/question?ref=S6W-05516

[79] Scottish Government (2020) https://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2018/

Figure 13. Greenhouse gas emissions from the waste sector (as defined by the Scottish Government and excluding waste incinerated with energy recovery), reported (2007-18) and predicted (2020-2032)

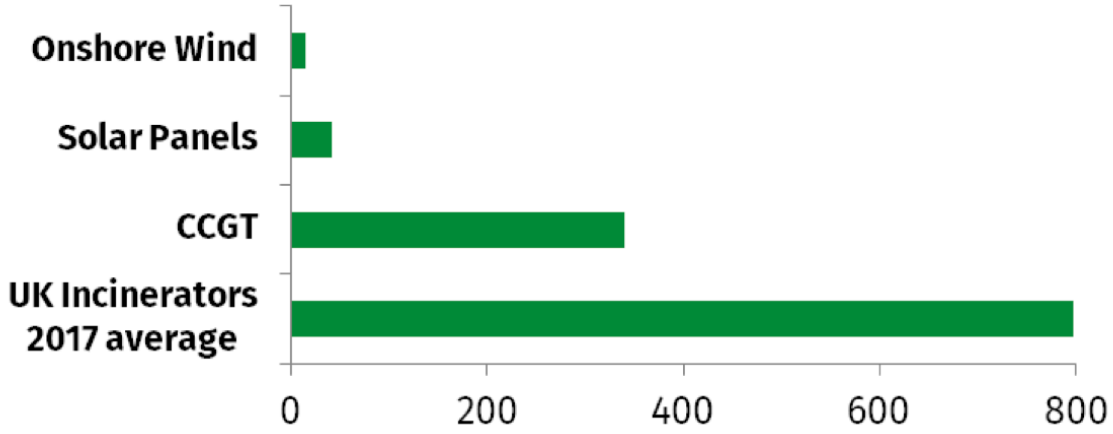


It is not possible to combine the data in Figures 12 and 13 because of differences in reporting boundaries. However, the trends presented in these figures show that a misleading picture of sector progress has been created by excluding emissions from waste managed by incineration with energy recovery.

The inclusion of incineration with energy recovery as part of the energy supply sector in the Scottish Government Climate Change Plan has masked the increase of these emissions within the rest of the emissions reported for this sector until now. However, it is likely that emissions from incineration will become more obvious as the rest of the energy supply sector rapidly decarbonises. The graph below, created by UKWIN[80], shows that incineration is a high carbon form of energy generation compared to other energy generation technologies: every kWh of energy produced with incineration is resulting in unnecessary GHG emissions being released into the atmosphere.

[80] UKWIN (2019) Evaluation of the climate change impacts of waste incineration in the United Kingdom

Figure 14. Fossil carbon intensity of electricity (gCO2/kWh) of energy generation technologies including incinerators in the UK in 2017



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.

6.3. Societal impact

In addition to greenhouse gas emissions that exacerbate climate change, incinerators emit many toxins and pollutants that reduce local air quality. Emissions include dioxins, NOx and ultrafine particulate matter that can be harmful to both human health and the natural environment. Incinerators are three times more likely to be in poorer areas in the UK[81], whose residents already suffer worse health outcomes from disproportionately higher levels of air pollution and inequality.

Several recent studies have highlighted new concerns around the health hazards of incinerators on human health. Most recently, a synopsis of expert presentations on health and air quality impacts from waste incineration was published by the UK All-Party Parliamentary Group (APPG) on Air Pollution[82]. Evidence presented included:

- A study led by Ruggero Ridolfi, MD which found a prevalence of heavy metals in the toenails of children living near incinerators in Italy, including nickel, which is associated with acute childhood leukaemia;
- Kirsten Bouman's findings of the accumulation of dioxins in chicken eggs — and in grass and moss — up to 10 kilometres from incinerators imply that health risks decrease, but still exist, if waste incineration is further afield from urban populations; and
- Prof. Vyvyan Howard found that if incinerator filters are successful in stopping small particulates like PM2.5 but allow ultrafine particulates into the local environment at scale, then the resulting emissions are very damaging to human health.

The report recommended a moratorium on incinerators in England. Just as the UK APPG questions the rationale of consent for new incineration developments in

[81] Greenpeace (2020) Unearthed
[82] APPG Air Pollution (2021) Pollution from waste incineration

England, this evidence also calls into question the approval any new incineration applications. The NESS plant in Aberdeen, currently being consulted on by SEPA[83], is situated less than 1km from the local primary school.

Health concerns around incineration have also been raised recently in Scotland. The NHS Ayrshire & Arran Respiratory Managed Clinical Network (MCN) responded in 2021 to the proposed energy recovery facility in Ochiltree, submitted to East Ayrshire Council. The MCN stated "The proposed development has the potential to detrimentally impact upon our population's future long-term respiratory health; particularly children affected with asthma and those with other chronic respiratory diseases." The response cited several academic and medical studies[84] to back its claims and concluded: "We would oppose this development on the grounds that there is good scientific evidence that it will directly increase respiratory symptoms and hasten the deaths of our residents for decades to come."

Physical health concerns can be compounded by the mental health concerns of living close to incinerators[85]. A recent scientific review[86] of the physical and mental health impacts of incinerators stated: "Older incinerator technology and infrequent maintenance schedules have been strongly linked with adverse health effects. More recent incinerators have fewer reported ill effects, perhaps because of inadequate time for adverse effects to emerge. A precautionary approach is required."

Dis-amenities such as noise, increased traffic and odours are often downplayed by operators during the planning process. However, such problems do often arise and are then dismissed as inevitable. The NHS Ayrshire & Arran Respiratory MCN also stated the proposed facility was "likely have a negative impact on the quality of life of those living in and around this area." It also suggested that the proposed contradicted the ambitions of the Scottish Government's Public Health Priorities for Scotland which includes aspirations that people live in a vibrant, healthy and safe place.

The societal risks of CCS are rarely disclosed or discussed with the public. Especially when moved over long distances and/or through heavily populated areas, piping carbon dioxide poses several risks from land disturbance and water contamination to the danger of explosions and other accidents (Ceil, 2021). The IPCC recognizes that "carbon dioxide leaking from a pipeline forms a potential physiological hazard for humans and animals"[87].

A full scientific assessment of the societal impacts of incineration is required to determine safe levels of exposure. This is beyond the scope of this review response

[83] SEPA (2021) NESS EfW facility application

[84] These included the findings of the ELAPSE study, published in the BMJ (2021) which concluded "Long term exposure to outdoor air pollution was positively associated with Mortality: even at levels well below the EU limit values, US Environmental Protection Agency national ambient air quality standards, and WHO air quality guidelines for fine particles and nitrogen dioxide".

[85] Lima (2004) On the influence of risk perception on mental health: living near an incinerator https://www.sciencedirect.com/science/article/abs/pii/S0272494403000264

[86] Tait et al (2019) The health impacts of waste incineration: a systematic review https://onlinelibrary.wiley.com/doi/full/10.1111/1753-6405.12939

[87] IPCC Special Report on Carbon Dioxide Capture and Storage Chapter 4, supra note 61, at 188

(and indeed the review itself). However, a precautionary approach which values people and the environment above commercial gain should be applied.

6.4. Recommendations on improving environmental and social impacts of existing incinerators

- The only way to sufficiently minimise environmental and societal impacts of incineration is to ending this polluting practice in Scotland as rapidly as possible.
- CHP and CCS will not address the hidden carbon costs of incinerating waste. A ban on burning plastics would be more effective at reducing carbon impacts of incineration.
- The reporting of the greenhouse gas emissions from waste must be more transparent. Incineration should be dis-aggregated from energy sector emissions and reported alongside waste sector emissions.
- Recent concerns raised by medical experts around the health impacts of incinerators justify an immediate review. ***No new incinerators in Scotland should be approved or given consent until this health review is complete.***

Conclusion

Friends of the Earth Scotland believe the environmental and social impacts of incineration to be unsustainable and in direct conflict with the future Scotland is aiming for. The evidence presented here shows the climate change, wider environmental impacts and health concerns surround incineration means that no level of waste incineration should be tolerated. Technical and commercially feasible alternatives exist. An immediate ban on new applications and the rapid phasing out of existing plants is required. For these reasons, the independent review on incineration in Scotland should recommend a comprehensive exit strategy for incineration in Scotland.