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Removing barriers to a circular economy
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FOR CONSIDERATION BY HM TREASURY

Estimate of revenue that could be raised by internalising environmental externalities through an incineration tax (August 2018)

Purpose of this submission

The purpose of this submission is to provide HM Treasury with an estimate of some of the quantifiable environmental externalities arising from waste incineration in England in order to provide an indication of the level of incineration tax that would be required to internalise such externalities.

These estimates are based on direct harm arising from incinerator emissions, and do not include calculations of indirect harm such as the 'opportunity cost' of materials lost to recycling and composting. Such additional externalities could justify a higher rate of incineration tax and/or the introduction of other measures to encourage greater recycling and composting of material that is currently incinerated.

Background

On the 18th of August 2018 HM Treasury released a summary of responses to their call for evidence on tackling the plastic problem. Paragraph 6.14 of the Summary noted that: *"Respondents from across the supply chain have suggested a tax on the incineration of waste. This could be done based on input tonnages or the material composition of waste, or using some form of emissions metric..."*

The volume of waste landfilled at the Standard Rate has seen a strong downward trend (even taking into account the devolution of Landfill Tax in Scotland from April 2015). According to HMRC the total cash receipts from Landfill Tax has fallen from nearly £1.2bn in 2013/14 to only around £750m in 2017/18.[1] Landfill Tax is currently £88.95/tonne. In 2017 more than 10m tonnes of waste was incinerated in England, so we can expect an incineration tax set at £50/tonne to raise more than £500m a year.

Evidence suggests that much of what is currently being incinerated could have been recycled. For example, South Gloucestershire Council commissioned analysis into their residual waste which found: "A total of 52 percent of the contents of the average black bin could have been recycled in 2014-15 through the existing kerbside recycling service...A further 10.1 percent could have been recycled through the Sort It recycling centres...In 2014-15 the council spent over £3m disposing of this recyclable material in the residual waste stream. The majority of this was processed into material used for energy production".[2] Studies from elsewhere in England similarly found that the majority of what was in the residual bin could have been recycled, including 51.2% in Hertfordshire[3], 54.9%-56.8% in Barnet[4] and 57.9% in Warwickshire.[5]

[1] https://www.uktradeinfo.com/Statistics/Pages/TaxAndDutybulletins.aspx - Sheet 4 of Landfill Tax Bulletin for April 2018
[2] http://edocs.southglos.gov.uk/wastestrategyevidence/pages/waste-composition-kerbside/
[3] http://bailey.persona-pi.com/Public-Inquiries/Rattys%20Lane%20-%20Hoddesdon/C%20-%20During%20PI%20dox/doc-54.pdf
[4] https://open.barnet.gov.uk/dataset/waste-composition-analysis---houses
[5] https://democratic.warwickshire.gov.uk/Cmis5/Document.ashx?czJKcaeAi5tUFL1DTL2UE4zNRBcoShgo=4q0E1ezo4bT3scKUwLoCx%2Bm4

Quantity of waste incinerated

The estimates of financial cost set out below are based on 12.5 million tonnes of waste being incinerated per annum. This incorporates the more than 10 million tonnes of waste incinerated in England in 2017,[6] and approximately 2.5 million tonnes of capacity which is currently either under construction or in commissioning.[7]

UKWIN notes that the 12.5 million tonne figure can be considered conservative insofar as the figure is less than the c. 15 million tonnes of headline capacity at existing and emerging incinerators in England. If an incineration tax extended to cover RDF export, then this would add an additional c. 3 million tonnes to the rate of incineration.

The financial cost associated with fossil CO2 emissions from English incinerators

The quantity of CO2 released by an incinerator depends upon the carbon content of the waste and the number of tonnes incinerated. Furthermore, if one is to distinguish between 'fossil carbon' (e.g. plastics) and 'biogenic carbon' (e.g. food, paper, card) then the origin of the carbon is also relevant. Whilst the environment cannot distinguish between the two types of carbon, UKWIN's estimate is based on fossil CO2 as this is the emission for which a Government cost figure is readily available.

Whilst there are figures available for the composition of material in residual bins or for residual waste in general, it is often difficult to obtain detailed information on the composition of the actual feedstock sent for incineration due to issues such as commercial confidentiality and a lack of incentive for operators to publish the data they hold. One operator of a London incinerator has however published information on the carbon intensity of their facility, based on feedstock analysis carried out in 2015, and this indicates that 0.454 tonnes of fossil CO2 (and 0.536 tonnes of biogenic CO2) is released per tonne of waste burned.[8]

Extrapolating, 0.454 tonnes of fossil CO2 per tonne × 12.5 million tonnes of waste treated = 5.675 million tonnes of fossil CO2 released per year by English waste incinerators.

To translate this into a financial externality, we can use the figures from BEIS' 'Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal'. Specifically, the CO2 figures from Table 3 of 'Data tables 1 to 19: supporting the toolkit and the guidance'.[9] As waste incineration is not part of the Emissions Trading Scheme, the relevant figures are those for non-traded carbon. The cost starts at £34–£101 per tonne in 2017 and rises to £110–£329 per tonne by 2049.

Applying the 5.675 million tonnes of Fossil CO2 estimate to these figures provides the results set out in Table 1. Estimated cost to society from CO2 released by English incinerators.

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[6] Environment Agency. Incineration facilities that accepted waste in England during 2017: permitted capacity and tonnage incinerated (available on request from the Environment Agency).

[7] http://www.tolvik.com/wp-content/uploads/Tolvik-UK-EfW-Statistics-2017.pdf

[8] https://www.coryenergy.com/wp-content/uploads/2018/01/Cory-Carbon-Report-v1.1.pdf

[9] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

The financial cost associated with NOx emissions from English incinerators

The rate of NOx emissions from an individual incinerator will depend on various factors, including the specific emissions reduction technologies used. According to the Environment Agency's 2016 Pollution Inventory[10] the average rate of emissions of NOx was around 0.0011 tonnes of NOx per tonne of waste incinerated. Assuming that newer incinerators will perform relatively better than older incinerators, we adopt a figure of 0.001 tonnes of NOx per tonne of waste treated.

12.5 million tonnes of waste × 0.001 tonnes of NOx per tonne = 12,500 tonnes of NOx.

The Supplementary Green Book guidance on how to value changes in air quality[11] provides NOx damage cost assumptions for policy appraisal purposes based on 2015 prices which we have not adjusted for inflation. Different sets of figures are provided for different emissions sources, including separate calculations for NOx emissions from 'Waste' and from 'Industry' sources. We have modelled the central estimates and central ranges for both of these sources.

In our understanding, NOx emissions from incinerators are currently attributed to the 'Industry' category for policy appraisal purposes. For sensitivity analysis we have also evaluated the effect of attributing NOx emissions from incinerators to the 'Waste' category.

If NOx emissions from incinerators are attributed to the 'Industry' category, the results are as set out in Table 2. Estimated cost to society from NOx released by English incinerators (Source category: Industry), and if NOx emissions from incinerators are attributed to the 'Waste' category, then the results are as set out in Table 3. Estimated cost to society from NOx released by English incinerators (Source category: Waste).

Conclusion

It has long been acknowledged that incinerators are "*creating GHG emissions without paying the relevant price*" and that *"Where there remain un-priced environmental impacts in the management of waste, there [market failures] are grounds for considering further intervention in the market to reflect these impacts*".[12]

The 'polluter pays' principle means the cost to society of harmful emissions should be reflected in the price of that activity. Landfill has the landfill tax, but incineration does not yet have its own equivalent. The introduction of an incineration tax would help address this market failure by internalising some of the adverse environmental externalities associated with the harmful emissions arising from waste incineration including the release of CO2 and NOx.

Even if other measures are introduced to promote recycling and recyclability then an incineration tax would still be necessary to internalise the adverse externalities of waste incineration and this would complement rather than duplicate other interventions such as those listed in HM Treasury's summary of responses to the call for evidence on tackling the plastic problem.

[10] https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory
[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/460398/air-quality-econanalysis-damagecost.pdf
[12] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69500/pb13548-economic-principles-wr110613.pdf

As set out in the tables (overleaf) our analysis reveals that over 30 years:

- The estimate for fossil CO2 externalities from English incinerators rises from around £380m (£190m to £570m) in 2019 to £1.2 billion (£623m to £1.9bn) in 2049. Over 30 years this amounts to a total of £21.5 billion (£10.7bn to £32.2bn) which equates to an average cost of £55 (£28 to £83) per tonne of waste incinerated.
- Assuming incineration is an 'industrial' emissions source, the estimate for NOx externalities from English incinerators is £164m (£65m to £262m) per year which over 30 years amounts to a total of £4.9bn (£2bn to £7.9bn) which is equivalent to £13 (£5 to £21) per tonne of waste incinerated.
- If incineration is considered to be a 'waste' emissions source, the estimate for NOx externalities is £136m (£54m to £217m) per year which amounts to £4bn (£1.6bn to £6.5bn) over 30 years or £11 (£3 to £17) per tonne of waste incinerated.
- As such, the combined cost to society of burning 12.5 million tonnes of waste per annum for 30 years ranges from £12.3bn to £40.1bn, which equates to between £32 and £104 per tonne.

Based on this analysis, an incineration tax of £50+/tonne (or a rate pegged to half the Standard Rate of Landfill Tax), or starting at £43/tonne and rising in line with inflation and non-traded CO2 prices, could be justified on the basis of internalising the environmental externalities of waste incineration. An additional benefit of such an incineration tax would be to encourage the recycling of material that is currently being incinerated. If 12.5 million tonnes of waste a year were subject to a £50/tonne incineration tax then this would raise £625m a year, or £18.75bn over 30 years.

An incineration tax which focuses only on plastics would need to be set at a higher per-tonne rate to reflect the fact that virtually all plastics constitutes fossil fuels. A plastic-only incineration tax would not come with the additional benefit of discouraging the incineration of recyclable and compostable materials such as food, paper and card even though some of the NOx and other harmful emissions derive from the incineration of such material.

Whilst the analysis in this submission is sufficient to estimate the magnitude of costs to society from some of the key incinerator emissions, further analysis could be conducted to quantify the impact of relevant matters such as:

- Anticipated changes to waste composition (e.g. as the result of the removal of plastics and the introduction of separate collection for biowaste);
- Anticipated rates of inflation over the next 30 years;
- Assuming varying levels of waste incineration over the next 30 years;
- The cost to society of other direct emissions (e.g. particulate matter, SOx, dioxins & furans); and
- The 'opportunity cost' of incinerating material that could be reduced, re-used, recycled or composted (including through anaerobic digestion).

TABLE 1. ESTIMATED COST TO SOCIETY FROM CO2 RELEASED BY ENGLISH INCINERATORS

	Cost per tonne of fossil CO2			Fossil CO2 from incineration			Total externality of Fossil CO2			Fossil CO2 externality per tonne of waste		
	Low	Central	High	Tonnes of waste	Fossil CO2 per tonne of waste	Total tonnes of fossil CO2	Low	Central	High	Low	Central	High
2019	£34	£67	£101	12,500,000	0.454	5,675,000	£190,331,003	£380,662,006	£570,993,009	£15	£30	£46
2020	£34	£68	£102	12,500,000	0.454	5,675,000	£193,185,968	£386,371,936	£579,557,904	£15	£31	£46
2021	£35	£69	£104	12,500,000	0.454	5,675,000	£196,405,734	£392,811,468	£589,217,202	£16	£31	£47
2022	£35	£70	£106	12,500,000	0.454	5,675,000	£199,625,500	£399,251,000	£598,876,501	£16	£32	£48
2023	£36	£71	£107	12,500,000	0.454	5,675,000	£202,845,266	£405,690,533	£608,535,799	£16	£32	£49
2024	£36	£73	£109	12,500,000	0.454	5,675,000	£206,065,033	£412,130,065	£618,195,098	£16	£33	£49
2025	£37	£74	£111	12,500,000	0.454	5,675,000	£209,284,799	£418,569,597	£627,854,396	£17	£33	£50
2026	£37	£75	£112	12,500,000	0.454	5,675,000	£212,504,565	£425,009,130	£637,513,694	£17	£34	£51
2027	£38	£76	£114	12,500,000	0.454	5,675,000	£215,724,331	£431,448,662	£647,172,993	£17	£35	£52
2028	£39	£77	£116	12,500,000	0.454	5,675,000	£218,944,097	£437,888,194	£656,832,291	£18	£35	£53
2029	£39	£78	£117	12,500,000	0.454	5,675,000	£222,163,863	£444,327,726	£666,491,590	£18	£36	£53
2030	£40	£79	£119	12,500,000	0.454	5,675,000	£225,383,629	£450,767,259	£676,150,888	£18	£36	£54
2031	£43	£87	£130	12,500,000	0.454	5,675,000	£246,312,109	£492,624,218	£738,936,328	£20	£39	£59
2032	£47	£94	£141	12,500,000	0.454	5,675,000	£267,240,589	£534,481,178	£801,721,767	£21	£43	£64
2033	£51	£102	£152	12,500,000	0.454	5,675,000	£288,169,069	£576,338,138	£864,507,207	£23	£46	£69
2034	£54	£109	£163	12,500,000	0.454	5,675,000	£309,097,549	£618,195,098	£927,292,646	£25	£49	£74
2035	£58	£116	£174	12,500,000	0.454	5,675,000	£330,026,029	£660,052,057	£990,078,086	£26	£53	£79
2036	£62	£124	£186	12,500,000	0.454	5,675,000	£350,954,508	£701,909,017	£1,052,863,525	£28	£56	£84
2037	£66	£131	£197	12,500,000	0.454	5,675,000	£371,882,988	£743,765,977	£1,115,648,965	£30	£60	£89
2038	£69	£138	£208	12,500,000	0.454	5,675,000	£392,811,468	£785,622,936	£1,178,434,405	£31	£63	£94
2039	£73	£146	£219	12,500,000	0.454	5,675,000	£413,739,948	£827,479,896	£1,241,219,844	£33	£66	£99
2040	£77	£153	£230	12,500,000	0.454	5,675,000	£434,668,428	£869,336,856	£1,304,005,284	£35	£70	£104
2041	£80	£161	£241	12,500,000	0.454	5,675,000	£455,596,908	£911,193,816	£1,366,790,723	£36	£73	£109
2042	£84	£168	£252	12,500,000	0.454	5,675,000	£476,525,388	£953,050,775	£1,429,576,163	£38	£76	£114
2043	£88	£175	£263	12,500,000	0.454	5,675,000	£497,453,868	£994,907,735	£1,492,361,603	£40	£80	£119
2044	£91	£183	£274	12,500,000	0.454	5,675,000	£518,382,347	£1,036,764,695	£1,555,147,042	£41	£83	£124
2045	£95	£190	£285	12,500,000	0.454	5,675,000	£539,310,827	£1,078,621,655	£1,617,932,482	£43	£86	£129
2046	£99	£197	£296	12,500,000	0.454	5,675,000	£560,239,307	£1,120,478,614	£1,680,717,921	£45	£90	£134
2047	£102	£205	£307	12,500,000	0.454	5,675,000	£581,167,787	£1,162,335,574	£1,743,503,361	£46	£93	£139
2048	£106	£212	£318	12,500,000	0.454	5,675,000	£602,096,267	£1,204,192,534	£1,806,288,801	£48	£96	£145
2049	£110	£220	£329	12,500,000	0.454	5,675,000	£623,024,747	£1,246,049,493	£1,869,074,240	£50	£100	£150
	Over 30 years (2019-2049)			**387,500,000**	0.454	**175,925,000**	**£10,751,163,919**	**£21,502,327,838**	**£32,253,491,757**	**£28**	**£55**	**£83**

TABLE 2. ESTIMATED COST TO SOCIETY FROM NOx RELEASED BY ENGLISH INCINERATORS (SOURCE CATEGORY: INDUSTRY)

	Cost per tonne of NOx			NOx from incineration			Total externality of NOx			NOx externality per tonne		
	Low Central Range	Central Estimate	High Central Range	Tonnes of waste	NOx per tonne of waste	Total tonnes of NOx	Low Central Range	Central Estimate	High Central Range	Low Central Range	Central Estimate	High Central Range
1 Year	£5,253	£13,131	£21,010	12,500,000	0.001	12,500	£65,662,500	£164,137,500	£262,625,000	£5	£13	£21
30 Years	£5,253	£13,131	£21,010	375,000,000	0.001	375,000	£1,969,875,000	£4,924,125,000	£7,878,750,000	£5	£13	£21

TABLE 3. ESTIMATED COST TO SOCIETY FROM NOx RELEASED BY ENGLISH INCINERATORS (SOURCE CATEGORY: WASTE)

	Cost per tonne of NOx			NOx from incineration			Total externality of NOx			NOx externality per tonne		
	Low Central Range	Central Estimate	High Central Range	Tonnes of waste	NOx per tonne of waste	Total tonnes of NOx	Low Central Range	Central Estimate	High Central Range	Low Central Range	Central Estimate	High Central Range
1 Year	£4,343	£10,858	£17,373	12,500,000	0.001	12,500	£54,287,500	£135,725,000	£217,162,500	£4	£11	£17
30 Years	£4,343	£10,858	£17,373	375,000,000	0.001	375,000	£1,628,625,000	£4,071,750,000	£6,514,875,000	£4	£11	£17