Consultation on petition P-04-341 Waste and Incineration
Response from Cardiff Against the Incinerator

Peer-reviewed and "grey" literature on incineration: the current understanding of health impact

January 3, 2012

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Re: P-04-341 Waste and Incineration – Call for Evidence 2012

Summary

- Independent, peer-reviewed evidence is critical for science-based decision making in public health;
  - Systematic reviews are of great importance in evaluating the available literature;
- Current peer-reviewed evidence supports the hypothesis that living near a waste incinerator, called by some an "energy from waste facility",[1] increases risk of cancers and other illnesses;
  - This increased risk is evident even from incinerators conforming to the Waste Incineration Directive and built after 2000;
- The waste industry and government generally favour non-peer-reviewed "grey literature" in making claims on the health impact of incineration;
  - This grey literature is generally of poor pedigree and often misleading;

[1] We adopt the Friends of the Earth convention of rejecting the term "energy from waste" as synonymous with "incineration"; using the two interchangeably introduces misleading ambiguity.

- In making public health decisions, grey literature should receive far less weight than peer-reviewed literature.

1 Introduction

Cardiff Against the Incinerator (CATI) is a non-partisan, community-led campaign group founded in 2010 in opposition to plans by Viridor Waste Management Ltd to construct and operate a municipal waste incinerator in Trident Park, Splott, Cardiff. While we work closely with Friends of the Earth and the UK Without Incineration Network, CATI's membership includes many people with extensive scientific backgrounds due to our individual associations with Cardiff University and other research instutitions and we are able to assess scientific & technical literature independently of other groups.

Central to our campaigning is raising the standard of dialogue on public health and engaging with public health officials constructively through an evidence-based based approach critically examining the available literature on waste management. We prepare this submission to examine the current state of scientific understanding of the health impact of waste incineration and contrast it with the state of non-scientific literature circulated by government and industry.

2 Science-based decision making in public health

A key issue in public health decision making is the fact that health officials must take outcome-based approaches, often on limited evidence. Scientific research in medicine suffers from natural limitations: ethical factors absolutely forbid truly controlled experiments on people for conditions seriously threatening survival or quality of life, selection biases are rampant in population studies, and even in the best of circumstances the waters of dialogue necessary to scientific reasoning are muddied by the presence of vested interests. The very real and important matter of controlling diseases through vaccination, for example, was obscured throughout the 2000's by outcry over the unsupported autism scare, the origin of which has since been revealed to be several instances of fraud in pursuit of one physician's personal financial gain.

With available evidence for many questions of major importance to public health still limited, the National Public Health Service for Wales [27], following the lead of the South West Public Health Observatory [28], have stated that a "precautionary principle" should be applied in waste management decisions where:

- "Health effects are most serious or irreversible
- The subject is a matter of scientific uncertainty and full evidence is lacking
- Cost-effective measures are possible".

All these criteria apply to the case of the incinerators proposed or planned for South Wales and under consideration by Prosiect Gwyrdd.

Given the variable quality of available public health literature and the need to draw conclusions from large numbers of often-contradictory small studies, since the 1990s the "systematic review" has emerged as the accepted tool for evaluating competing health claims.

2.1 Systematic reviews

Sytematic reviews rigorously synthesise available evidence to answer a specifically posed question. [26] The Cochrane Collaboration, which brings together over 28,000 health practitioners, was founded in 1993 "to help health care providers, policy-makers, patients, their advocates and carers, make well-informed decisions about health care, based on the best available research evidence". Their publication the *Cochrane Handbook [22]* has become recognised by the scientific community as setting out the standard for carrying out systematic reviews methodically and rigorously.

Among the criteria set out in [22] are many provisions ensuring the usefulness of a systematic review, particularly transparency in the selection of literature to a high level of detail, even demanding the exact search terms in a Google search be documented and published; quantitative evaluation of the usefulness of any given source; and the necessity of frequently updating systematic reviews as newer evidence becomes available.

Systematic reviews have helped overcome early difficulties in the application of meta-analysis, for example the drawing of conclusions when good-quality studies and poor, uncontrolled studies were given equal weight. Any examination of the evidence on the health impact of waste incineration should adopt a systematic approach, and not merely consider all sources equal, but take into consideration their origin, the rigour of their investigative methods, and their currency.

3 The current state of scientific knowledge on incineration

Since 2009, increased epidemiological investigation into incineration has provided new evidence showing a link between residing in proximity to a waste incinerator and increase risk of cancer and low birth weight.

The science of the environmental effects of incineration is a living field. Polychlorinated dibenzodioxins, polychlorinated dibenzofurans and polychlorinated biphenyls (PCDDs, PCDFs and PCBs, referred to here for simplicity collectively as "dioxins" unless necessary) were first declared carcinogenic by the Environmental Protection Agency in the United States in 1994. Since then the potential health effects of proximity to incinerators, which produce dioxins as a consequence of the combustion of chlorine-containing compounds, have been the subject of frequent study.

Studies on the health impact of incineration have been ongoing and frequent since the 1996 publication of [1], referred to for brevity as *Elliott 1996*. Elliott 1996, the first large-scale study of the health effects of incineration, analysed anonymised health records from across Britain from 1974 to 1987 and concluded that residing in proximity (1km) to an incinerator was associated with higher risk of liver cancer than found in people living at greater distances. However, a lack of knowledge at the time on the impact of socioeconomic conditions on health meant that Elliott's results, while strongly suggestive, could not be taken as conclusive. Elliott 1996 called in its conclusion for "further investigation including histological review of the cases" of liver cancer, later published as [2].

We summarise here the scientific findings since 2009, which have concentrated on disentangling the impact of incineration *per se* on health from the impact of other socioeconomic factors.

3.1 Recent peer-reviewed literature on the health impact of incineration

"Systematic review of epidemiological studies on health effects associated with management of solid waste" Late in 2009, an independent team of researchers based in Rome and London published "Systematic review of epidemiological studies on health effects associated with management of solid waste" [3], referred to as *Porta 2009* for brevity. Porta 2009 conducted an independent, peer-reviewed systematic review of the available information on the health effects of incineration and landfill, covering a multitude of previously-published studies.

While noting the still limited nature of evidence regarding the health effects of incineration, Porta 2009 argues that limited evidence shows populations living within 3 kilometres of an incinerator face "an increased risk of cancer, with an estimated excess risk of 3.5 percent." Porta 2009 concludes with high confidence that people living within a 3km radius of an incinerator have a 29% higher risk of liver cancer, 16% higher chance of STS and 11% higher chance of NHL than a control population, while people living within 2km of an incinerator also face a 6% higher risk of low birth weight.

Porta 2009 meets the Cochrane criteria for a systematic review. The problem under consideration, the quantification of potential health effects from landfill and incineration is clearly stated; selection criteria for the studies reviewed are explicitly given in detail; the method of critical appraisal is presented, with specific authors responsible for the appraisal decision named; the analysis and presentation of data is clear and complete, with weaknesses in the available material honestly discussed; interpretation of the results is conservative, avoiding meta-analysis entirely; and the information in the review is the most current available.

Porta 2009's authors are furthermore well-credentialed. Francesco Forastiere is an experienced, heavily-cited analytical epidemiologist specialising in the effects of air pollution; his current research, following on from Porta 2009, involves attempting to quantify the socio-economic factors which have complicated the

examination of waste management health effects.[?, ?] Lead author Daniela Porta has also published heavily on the effects of socioeconomic status on health, and Carlo Perucci is experienced in population studies and systematic review.

It should be noted that Porta 2009 re-assesses Elliott 1996's findings and, in contrast to **CoC 2000**, determines that the elevated cancer risk associated with incineration Elliott 1996 found is significant. These findings are consistent with subsequent papers for the three cancers mentioned above.

"Inequalities, inequities, environmental justice in waste management and health" In the wake of Porta's systematic review, work to untangle socioeconomic factors from environmental factors in the impact of incineration was rapid. Martuzzi's study [4] examined literature from 1983 to 2009 and underscored a factor neglected in the examination of public health impact: incinerators are disproportionately placed in areas which already face socioeconomic deprivation. Therefore, if incineration *per se* has a health impact, this impact will reinforce already poor health in deprived areas.

In light of this finding, it is worth noting that all four of the incinerator sites considered by Prosiect Gwyrdd, including the withdrawn bids in Barry Dock and Brig-y-Cwm, Merthyr Tydfil and the live bids in Splott, Cardiff and Llanwern, Newport, all lie in some of the most deprived areas of Wales according to information from the Public Health Wales Observatory.[8]

"Health impact assessment of waste management facilities in three European countries" Forastiere's investigation into specific countries' health impact from incineration [6] continued in the vein of separating socioeconomic factors from environmental factors in examining the health effects of incineration. Forastiere's drew made two conclusions of particular relevance to this call for evidence:

- 80% of people living near incinerators in the United Kingdom fall into the most deprived quintile of British society, a far greater proportion than in other countries examined. In other words, siting of incinerators (and landfills) in the United Kingdom represents a clear instance of discrimination against the deprived. Forastiere concludes,

  > *"Since lower socio-economic status is already associated with a higher risk of various negative health outcomes, an issue of environmental justice is present here because of the higher probability of exposure for less affluent people and their increased vulnerability. [...] decision makers should identify waste management policies that minimize their potential health impacts and unequal distribution."*

- When socioeconomic factors are accounted for, incineration has a siginificant negative impact on health, comparable to that from traffic or heavy industry. Forastiere states that, assuming no further incinerators are brought on line,

"In total, 1,125 additional cancer cases will be attributable to incinerators in England during 2001-2050".

"Mortality and morbidity among people living close to incinerators: a cohort study based on dispersion modeling for exposure assessment" Ranzi's study [7] of the health impact of two incinerators on populations near Forli, Italy takes the form of a pilot study; there has been no large-scale study on the health impact of incineration since Elliott 1996. The comparatively small scale of the study notwithstanding, Ranzi notes a 47% increase in the risk of liver, stomach, colon and breast cancers in the population living within 3.5km of the incinerators even when the impact of other pollution sources had been screened out, reinforcing Porta's conclusions. Ranzi particularly noted a doubling in the risk of breast cancer in women in his cohort. Ranzi notes that the increased incidence of cancers corresponds to exposure to heavy metals originating from the incinerators but also states that determining whether cancers originated from exposure to heavy metals, exposure to dioxins or soem combination of the two is difficult to discern. Ranzi's study concerns itself with exposure to incinerators built and operated after the coming into force of the Waste Incineration Directive.

3.2 Conclusions

With the introduction of modern statistical analysis techniques, it has been possible to begin rigorous investigation of the health impact of incineration, separate from the health impact of socioeconomic deprivation. Since 2009, a consensus has emerged among epidemiologists, largely based around work done by research groups in Italy, that living in proximity to a waste incinerator, even a modern, post-Waste Incineration Directive incinerator, increases risk of some cancers by up to double; however, further study is needed to determine whether the source of this increase is from dioxins or from heavy metals. Siting of waste facilities discriminates heavily against the most deprived populations.

4 A critique of non-peer-reviewed literature

Industry and government bodies both circulate a wide range of non-peer-reviewed documents on the health impact of incineration. Some of these documents are statements of position from DEFRA or the Health Protection Agency, but many arise from authors of unknown or unrevealed affiliation. In almost all cases, these documents, so-called "grey literature", have not been prepared by authors with expertise in the appropriate field to assess the health impact of incineration, that of epidemiology; many are presented with blatant bias toward incineration.

The information contained in these summary documents is based on a skewed, often outdated picture of the current state of the science and does not reflect the reality established by the preponderance of evidence regarding incineration.

"Cancer incidence near municipal solid waste incinerators in Great Britain" Of fundamental importance to all the summary documents put forward by government bodies is the Committee on Carcinogenicity's 2000 publication "Cancer incidence near municipal solid waste incinerators in Great Britain",[9] refered to for brevity as *COC 2000*. A clear understanding of the nature of this document is critical.

COC 2000 examines [1] and criticises its conclusions for not sufficiently screening out socioeconomic factors' impact on health. As seen above in section 3 of this submission, these concerns have since been made obsolete. Furthermore, COC 2000 commits a basic error of logic: the Committee intreprets the flaws in Elliott 1996 not just as "absence of evidence" but as "evidence of absence", asserting ambiguous information as a definitively null result. This failure of reasoning leads COC 2000 to an erroneous conclusion.

COC 2000, which forms the basis for DEFRA's position on incineration, is based on a single study, Elliott 1996. Frequent citation in documents by public bodies, followed by secondary citation through citation of those documents by other public bodies and private entities, has given it undue weight in analysis of the health effects of incineration. Nonetheless, it is an obsolete document based on research which has been superseded by newer studies and better data analysis, as described above.

"Update Statement on the Review of Cancer Incidence near Municipal Solid Waste Incinerators" In 2009, the Council on Carcinogenicity assessed seven studies which had been published following the publication of COC 2000. This assessment led to the publication of [10] in March 2009, the "Update Statement on the Review of Cancer Incidence near Municipal Solid Waste Incinerators", referred to as *COC 2009* for brevity. This report concludes:

> "Although these studies indicate some evidence of a positive association between two of the less common cancers i.e NHL [non-Hodgkin's lymphoma] and STS [soft-tissue sarcoma] and residence near to incinerators in the past, the results cannot be extrapolated to current incinerators, which emit lower amounts of pollutants, as noted by Viel et al (2008). Moreover, they are inconsistent with the results of the larger study on cancer incidence around municipal incinerators carried out by the Small Area Health Statistics Unit (Elliott et al, 1996). We conclude, therefore, that there is no need to change the advice given in the previous statement in 2000 but that the situation should be kept under review."

Firstly it should be noted clearly that COC 2009 is not a systematic review of the available research according to the Cochrane standard. Nowhere are its criteria for selecting studies nor the method by which these studies are evaluated presented, nor is there any means by which it could have been be independently reviewed before publication. Therefore, COC 2009 cannot be taken to represent

the consensus of the scientific community. At the time of COC 2009's composition no independent systematic review of the health effects of incineration was available; this has been rendered obsolete by the publication of [3] as discussed above.

The reasoning for COC 2009's dismissal of studies by Viel, Floret, Zambon and Comba [11, 12, 13, 14, 15, 16] is perplexing. While Elliott 1996 undoubtedly has the largest dataset of the various studies, the numbers of STS and NHL cases observed is of the same order of magnitude among all studies; all the studies are subject to identical post-hoc selection biases.

In assessing a study by Knox [17] meanwhile, the Council on Carcinogenicity seem to have concentrated on only some of the relevant areas. In that study, the author explicitly states, "For the time being we must probably suppose that the effect stems from large-scale combustion processes as a whole, of which the incinerators are but one component." It is reasonable to say that no conclusions about incineration specifically can be drawn from Knox; rather, though, Knox's study reinforces the suggestion that proximity to large-scale combustion processes overall, to which incineration contributes, is linked to increased cancer risk. In the context of civil planning & health impact, the difference is academic.

***The Impact on Health of Emissions to Air from Waste Incinerators - RCE 13* & "Position Statement on Municipal Solid Waste Incineration"** The Health Protection Agency discuss the health effects of incineration as part of their publications "Position Statement on Municipal Solid Waste Incineration" [18] and *The Impact on Health of Emissions to Air from Waste Incinerators - RCE 13* [19, page 11]. The latter document, which makes the former obsolete, bases its summary conclusions regarding cancer risk solely on COC 2000 and COC 2009, quoting from them extensively and adopting the COC's position wholesale. Ergo, the HPA's contribution to discussion of the cancer risks associated with incineration is neither primary nor secondary and need not be further analysed on its merits. Nonetheless it must be noted that [19]'s assertion that no further study on incineration is needed is invalidated by the HPA's own commissioning of a study this year on the health impact of incineration. [20]

Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes In 2004, DEFRA published its *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes* ([21], *DEFRA 2004* for short), a comprehensive document prepared by Enviros Consulting and the University of Birmingham which describes the state of wast management technology and research as of its publication.

A section of DEFRA 2004 (section 3.6.2) holds itself out to be a systematic review of available research on the health effects of incineration, and concludes

> "it can be said with some confidence that any impacts of dioxin and furan on cancer rates in local people are small or non-existent

and unlikely to be quantified through epidemiology".

This review can be criticised on several grounds.

Firstly, DEFRA 2004 relies very heavily on Elliott 1996. Similarly to CoC 2009, DEFRA 2004 dismisses several studies suggesting a link between incineration and cancer in favour of Elliott 1996, making use of a similar confused mismatching of data set sizes, and regarding Elliott 1996 as conclusive despite the already-discussed inconclusiveness of that study. Like [9], DEFRA 2004 adopts CoC 2000 wholesale without critical examination.

Secondly, DEFRA 2004 section 3.6.2 fails several basic criteria for a systematic review as outlined in [22]. The methods of critical appraisal are not clearly given; criteria for inclusion of studies are discussed only in vague and general terms; and no effort to update the review has been made in the intervening six years. The sentence "Most weight was given to those studies that took into account potential confounding factors, had a valid means of estimating exposure from the incinerator and had sufficient statistical power to produce results with a small confidence interval" (page 140) is particularly troubling, indicating a presupposition of a particular, undefined model of confounding factors; showing a failure to identify better means of estimating exposure than the zero-order approximation of concentric circles around the incinerator site; and underscoring the lack of discussion of what constitutes "sufficient statistical power."

Most damning for DEFRA 2004 is the peer review of the document by the Royal Society, included as Appendix 4 in the published document. The Royal Society found the entire report to have "significant limitations that restrict its usefulness to those making policy decisions" and found the document "potentially misleading both for national policy and for local authorities". The Royal Society in particular noted "[t]he report is mainly based on the health and environmental impacts of emissions to air, which might give the impression that impacts from alternative pathways, such as water, soil and food, are small when in fact there is a lack of good quality information"; this is of particular significance with regard to incineration given the contribution of fly ash to dioxin emissions. The Royal Society therefore "recommend[ed] that this report should only be used for general information". With regard to the review of the health effects of incineration particularly, the Royal Society stated

> *"Confounding factors and cancer latency are important but full comprehension of the potential health effects of the different options for waste management requires discussion of the susceptibility of populations to a particular health outcome and sensitivity to certain emissions, cumulative effects, timelines for exposure, effect of mixtures and synergies of emissions and the additive effects, for example, when combined with other environmental and occupational exposures. The latter is particularly important for workers involved in composting and material recycling facilities. Without consideration of these factors the report fails to recognise the limitations in the data."*

While some revisions to DEFRA 2004 were made between peer review and publication and the Royal Society agreed that many concerns were addressed, due

to material constraints the Royal Society did "not review the extended summary of this report on the environmental and health effects of waste management".

Finally, the assertion that the health effects of incineration are "unlikely to be quantified through epidemiology" have been contradicted by more recent publications as noted in section 3.

DEFRA 2004 is second only to the HPA's position statements in frequency of citation by public bodies. It suffers from numerous flaws in its assessment of incineration, it represents a further instance of overreliance on the COC 2000 analysis of Elliott 1996, and independent reviewers have concluded that it should not be used independently for making environmental decisions.

"The environmental and health impacts of Energy from Waste, the myths and the truth?" Prosiect Gwyrdd employees have circulated Enviros Consulting's publication "The environmental and health impacts of Energy from Waste, the myths and the truth?" ([23], *TRUTH!* for short) as evidence against the potential health impacts of incineration; this publication is also circulated by Viridor Waste Management and other incineration firms. TRUTH! is, simply, not a scientific paper.

TRUTH! makes a number of false assertions; for example, Table 1 describing sources of dioxin emissions, is entirely unsourced and claims that fireworks contribute fifty-two times as much to dioxin output in the UK as incineration does. The claim regarding fireworks, upon investigation, is revealed to be a misrepresentation of legitimate scientific literature; Fleischer's study [24] did find that while some dioxins of relatively low toxicity were generated by fireworks explisosions, "No indications were found that PCDD/F emissions from fireworks may cause air pollution" and "The extremely toxic 2,3,7,8 TCDD could not be detected in any of the samples".

The language of TRUTH! is thinly-veiled propaganda, with sentences like "At a time when there is a short fall in waste recovery capacity in the UK...incineration is the obvious choice" appearing throughout. The scientific content is hugely selective; while Elliott 1996 and Elliott 2000 are cited in the text, and [17] is mentioned in the references (despite no corresponding mention in the body of the paper), nowhere are studies of incineration from between 2000 and TRUTH!'s 2007 publication examined or referenced.

It is shameful that any other public body has taken up TRUTH! for any purpose of advice or decision-making. The existence and circulation of TRUTH! underscores the petty politicisation of environmental science, and discredits the good faith of any institution which promulgates it while calling it "science".

"Health Effects of Municipal Waste Incinerators -A Literature Survey" Industry sources such as Viridor Waste Management, Pearsons Recycling and Solution Group also circulate the document "Health Effects of Municipal Waste Incinerators -A Literature Survey" by Dieter Schrenk [25]. This paper has, as far as can be determined, never been published in a health journal nor ever faced any kind of peer review. Furthermore, the author, a toxicologist &

food chemist, has no background in epidemiology among his publications.

Schrenk's conclusion, that "modern Municipal Waste Incinerators can be regarded as safe facilities", is made irresponsibly: while he puts forward criticisms of the available literature up to 2006 (again, no update of the review has been made in the light of post-2009 work), in some instances Schrenk appears to misunderstand the original source material (for example, he claims that [2] makes "no attempt to speculate on the possible causal factor which should be responsible for the increased liver cancer risk" even though causal factors are explicitly discussed in the paper) and in any case, seems to regard ambiguity over the cause of health impacts as a reason to ignore the observed increased levels of cancers and other diseases.

Furthermore, Schrenk does not cite a single study which actually examines modern municipal waste incinerators on which to base his assertion.

The circulation of Schrenk, ignoring peer-reviewed systematic reviews on incineration which draw less positive conclusions, should be regarded as an act of wilful ignorance at best on the part of the waste industry.

4.1 Conclusions

It is irresponsible to engage in dialogue while ignoring inconvenient evidence. Nonetheless, as this review of grey literature shows, both industry and government bodies habitually ignore available peer-reviewed, scientific literature on the health impact of incineration. Documents presented as systematic reviews do not fit the recognised criteria for a systematic review, conclusions are drawn using faulty logic and extreme overemphasis of individual studies, and knowledge banks are not updated to take into account new research. Misrepresentation or misunderstanding of the available evidence is rife and materials circulated by industry are furthermore strongly biased in favor of industry's position.

A basic problem of all public health matters is the need to make decisions in the absence of ideal evidence. Nevertheless grey literature is no substitute for peer-reviewed literature. The grey literature in common circulation should be recognised as outdated and flawed at best, misleading at worst, and put aside in the presence of independent research.

5 Conclusions

Overall, a precautionary approach to waste management is indicated given the seriousness of the potential health impact of waste incineration.

Bodies making waste decisions should employ a systematic approach to considering the available evidence. Such an examination needs to be undertaken rigorously, with reference to established and widely-accepted procedures for aggregating and intepreting evidence and claims of widely varying quality.

The scientific community seems to be rapidly converging on a consensus that modern incinerators do have a measurable, negative impact on health, comparable to that of heavy industry or road traffic. Advances in analytic techniques

have allowed epidemiologists to discern the impact of waste incinerators on health and have showed significantly increased risk of soft tissue cancers, particularly liver cancer but with evidence of increased rates of soft tissue sarcoma, non-Hodgkins lymphoma and breast cancer. However the available information cannot yet determine whether dioxins or heavy metals are the primary source of this elevated cancer risk.

This understanding in the scientific community, developing since 2009, contradicts the consensus circulated by industry and government bodies that incineration is of undetectable health impact. This consensus, though, is based on poor and skewed interpretation of the available information on the part of government bodies – as [8] notes, *"Health effect studies in relation to waste management are, for a number of reasons, usually not of a sufficiently robust design to be able to prove causation. They might however provide strong supporting evidence."* – and reinforced by documents of questionable character and strong bias. When examined by experts in the field, grey literature claiming no health impact from incineration cannot hold up.

As such, the Welsh Government, Prosiect Gwyrdd and other bodies making waste decisions should weight the available peer-reviewed literature on incineration much more highly than industry-supplied and other "grey" literature. The balance of the literature shows sufficient evidence that living near a municipal waste incinerator increases risk of cancer that the precautionary principle should be invoked and no municipal waste incinerators should be built or operated in Wales at least until a full analysis of data from the planned HPA study on incineration is completed.

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