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Assessing the perception and reality of arguments against thermal waste treatment plants in terms of property prices

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ABSTRACT

The thermal processing of waste materials, although considered to be an essential part of waste management, is often sharply contested in the UK. Arguments such as health, depletion of resources, cost, noise, odours, traffic movement and house prices are often cited as reasons against the development of such facilities. This study aims to review the arguments and identify any effect on property prices due to the public perception of the plant. A selection of existing energy from waste (EfW) facilities in the UK, operational for at least 7 years, was selected and property sales data, within 5 km of the sites, was acquired and analysed in detail. The locations of the properties were calculated in relation to the plant using GIS software (ArcGIS) and the distances split into 5 zones ranging from 0 to 5 km from the site. The local property sale prices, normalised against the local house price index, were compared in two time periods, before and after the facility became operational, across each of the 5 zones. In all cases analysed no significant negative effect was observed on property prices at any distance within 5 km from a modern operational incinerator. This indicated that the perceived negative effect of the thermal processing of waste on local property values is negligible.

1. Introduction

Thermal waste processing with energy generation (electrical and heat) is seen as a sustainable and effective solution to both waste management and energy generation (Cheng and Hu, 2010; Institution of Mechanical Engineers, 2007; Jamasb and Nepal, 2010; Michaels, 2009; Murphy and McKeogh, 2004; Papageorgiou et al., 2009; Porteous, 2005; Porteous, 1998; Burnley et al., 2011; Haley, 1990). However, these plans are often fiercely contested by anti-incinerator groups and local residents (Jamasb and Nepal, 2010; Porteous, 1998; Achillas et al., 2011; DEFRA, 2007; Furuseth and O'Callaghan, 1991). The main protests against these facilities are related to perceived health risks, the effects on house prices and noise, smell and increased traffic (Achillas et al., 2011; Friends of the Earth, 2000; British Society for Ecological Medicine, 2008). The effect on recycling rates, depletion of resources and the effectiveness of alternative waste management solutions are also cited as reasons against such treatment options (Friends of the Earth, 2000).

Previous studies and reports largely agree that the health risks from modern thermal waste processing plants, especially increased cancer incidence related to dioxin emissions, are very small (Institution of Mechanical Engineers, 2007; Porteous, 2005; Porteous, 1998; HPA, 2009; Health Protection Scotland, 2009; DEFRA, 2004). Indeed, the reported emissions from modern facilities are significantly lower than the limits prescribed in the Waste Incineration Directive [2000/76/EC] (Council of the European Union, 1999), and is considered to be "the most strictly controlled combustion process in the UK" (Porteous, 1998).

Energy from Waste (EfW), specifically Mass Burn Incineration (MBI), is widely seen as an essential part of an integrated waste management solution but the primary constraint on the widespread uptake is the negative perceptions of politicians and the public. The justification is put down to the historic memory of "dirty" incinerators of the past, but this study will demonstrate that this is no longer the case with modern incinerators "being the natural companion to practicable recycling" (Porteous, 1998).

Incinerators have a chequered history with a large negative hang over from the dirty polluting plant of the 1970s. Opposition groups range from International, such as the Global Anti-Incinerator Alliance (GAIA); National, such as the United Kingdom Without Incineration Network (UKWIN) and local groups, such as the Cheshire Anti-Incinerator Network (CHAIN), Guildford Anti-Incinerator Network (GAIN) and Hatfield Anti-Incineration (HAI). Friends of the Earth and Greenpeace are vocal opponents of incineration and actively support local groups through publications such as "How to Win: Campaign Against Incinerators" (Friends of

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the Earth, 2000). These groups often vary between a genuine concern for the local area and a visceral, often illogical, abhorrence of incineration on ideological grounds.

2. Arguments against incineration

There are a number of offered disadvantages of EfW facilities, which include air pollution and health, effects on climate change and the destruction of valuable resources, toxic waste generation, noise and traffic, and poor public perception.

2.1. Air pollution and health

Health is a much cited argument against incineration. The public are very conscious of the perceived health risks, for example a study in Greece found that 43% of respondents cited health issues when asked for reasons to protest against a new incinerator (Achillas et al., 2011).

Anti-incinerator groups widely cite a report by the British Society for Ecological Medicine (2008), a charity aimed at promoting public health, as reference to the health impacts, which discusses several negative health effects of such facilities through the release of dioxins and particulates. However this report was widely rebuked by the Health Protection Agency (2005) and Enviros (2006) for using "inaccurate and outdated material" (Enviros, 2006) and confusing the issues of health impact and risk, especially with relation to alternatives to incineration.

The main thrust of opposition is related to the emissions of dioxins, a family of cancer causing compounds. Many processes produce dioxins and it is important to put the emissions from a modern incinerator in context. Table 1 shows the comparative amounts of dioxins produced by other processes from sinter plants to domestic coal combustion. As can be seen a modern EfW plant produces around half the dioxins as a coal power plant and less than four times that of domestic wood combustion.

The Institution of Mechanical Engineers describes the dioxin emissions limit for a modern EfW plant as "an equivalent concentration to one third of a sugar lump dissolved in Loch Ness" (Institution of Mechanical Engineers, 2007). Elliott et al. (2000) places the increased risk of cancer within 1 km of an EfW facility to be between 0.53 and 0.78 cases per million. Roberts and Chen (2006) state the overall risk of dying due to emissions within 5.5 km of a facility to be 2.49×10^{-7} or 1 in 4 million. This is compared to 10 cases of melanoma per 100,000 (from sunbathing/sunbed use) and 15,000 people a year which die from bowel cancer (which is mainly diet related) (Porteous, 1998).

Table 1
Comparison of dioxin levels from different processes 2011. *Source:* adapted from National Atmospheric Emissions Inventory (2013).

Process	Amount of dioxins produced (grams International Toxic Equivalent)
Power Stations – MSW	0.66
Power Stations – Coal	1.26
Road transport – cars (petrol)	1.27
Sinter plants – iron production	20.73
Electric arc furnaces – steel production	10.94
Domestic combustion – wood	3.07
Domestic combustion – coal	1.45
Landfill – escaping methane	0.63
Crematoria	10.23

2.2. Effects on climate change and the destruction of valuable resources

Energy from Waste proponents often report that incineration of MSW is carbon neutral (Jamasb and Nepal, 2010; Porteous, 1998). This is due to the mainly biodegradable component of the waste and the offsetting of green house gas (GHG) emissions from landfill and fossil fuel based electricity generation. For example, 1 tonne of waste incinerated instead of sent to landfill reduces emissions of carbon dioxide by 1.2 tonnes (Jamasb and Nepal, 2010) and electricity generated can offset 686 g CO_2 kW h^{-1} for coal and 261 g CO_2 kW h^{-1} for natural gas (Porteous, 1998).

Papageorgiou et al. (2009) modelled the greenhouse gas (GHG) emissions from the incineration of waste, critically including emissions from transport. The study concluded that without combined heat and power (CHP) the plant can contribute 3.93 kg CO_2 per tonne of waste, although with CHP, coupled with district heating, a reduction of 148.02 kg CO_2 per tonne of waste can be obtained. Cleary (2009) reviewed a range of published studies and concluded that recycling will often be more favourable, in terms of Carbon footprint, where the processing of raw materials is avoided. As such it is important to consider the boundaries used within a lifecycle assessment.

In the case of resource depletion, this is discussed with respect to recycling and resource recovery. However the case that incineration undermines recycling rates is widely disproved in the United States and across Europe, with countries and states that accept incineration also having higher recycling rates (Michaels, 2009; Porteous, 2005; Berenyi, 2008; Kiser, 2003).

Whereas recycling saves considerable energy for aluminium, steel and glass this cannot be said of plastics, as the energy inherent in the material can be better exploited through energy recovery, especially when transport and sorting are taken into account (Lea, 1996). The case for reducing waste is accepted across the board however the economic and practical issues of such widespread change is a barrier to implementation.

Therefore it is fair to say that recycling should not be automatically chosen above incineration if the energy used and carbon emitted to recycle the waste is more than could be generated and offset by incineration (Institution of Mechanical Engineers, 2007; Porteous, 1998). One could conclude that neither recycling nor incineration represent the complete solution to sustainable waste management, and should perhaps be considered together as part of a joint solution.

The full lifecycle of materials contained within residual waste streams needs to be considered along with the Carbon costs of recovering value (recycled material or energy) before a decision can be made on the most favourable option. This needs to take into account the biogenic fraction of the residual waste along with the fossil-derived fraction, such as plastics.

2.3. Toxic waste

The use of the term "toxic waste" from incinerators is an attempt to associate the process with the negative stigma of chemical and nuclear plants. The waste products from an incinerator are in two classes, bottom ash and fly ash. Both of which require careful management to ensure minimal impacts on the environment. Bottom ash is the larger of the two waste streams with 1 tonne of MSW producing typically 0.25 tonnes of bottom ash (Porteous, 2005). This bottom ash is chemically inert and is commonly used as a road building substrate (Porteous, 1998). In the case where stable bottom ash is used as a road aggregate, the leaching properties have been reported to be environmentally acceptable for use (Toraldo et al. 2013). The fly ash is a small proportion, typically 40 kg per tonne of MSW, and is termed hazardous waste, due to