Attachment H1.3

Modelling of PCDD/F Inhalation in vicinity of Proposed Waste to Energy Facility and Comparison with PCDD/F Intake for Milk Report, AWN Consulting Ltd, November 2001

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:14

TECHNICAL REPORT

MODELLING OF PCDD/F INHALATION IN VICINITY OF PROPOSED WASTE TO ENERGY FACILITY AT CARRANSTOWN AND COMPARISON WITH PCDD/F INTAKE FROM MILK

FOR

Indaver Ireland Ltd
Dun Laoghaire
Dublin

Consent of copyright owner required for any other use.
For inspection purposes only.

Report prepared by: **Dr Fergal Callaghan**
Our reference: FC/01/1345SR01
Date: 29 November 2001

EPA Export 25-07-2013:16:37:14

EXECUTIVE SUMMARY

At the request of Indaver (Ireland) Ltd, the potential inhaled PCDD/F dose for a theoretical maximum at risk individual (MARI) living at the point where ambient ground level PCDD/F concentrations are predicted to be highest when the proposed Carranstown Waste to Energy (WTE) facility is operational, was determined.

This report is based on the WTE plant operating at the maximum PCDD/F emission limit of 0.1ng/m^3 I-TEQ as per the waste incineration directive 2000/76/EC. Indaver (Ireland) Ltd will operate a two stage PCDD/F removal process as part of the combustion gas cleaning process and typical PCDD/F emissions are expected to be well below this maximum limit.

The PCDD/F intake by inhalation was then expressed in terms of unit volumes of milk produced in the Meath and Dublin area. The emissions from the proposed WTE facility are predicted to increase the inhaled daily PCDD/F dose to the MARI by the equivalent of an additional 0.38 – 0.43 glasses per month (4.6 – 5.3 glasses per year) of milk produced within the Meath/Dublin area, assuming a glass volume of 300 ml.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:14

CONTENTS

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:14

1.0 INTRODUCTION

AWN were instructed by Indaver (Ireland) Ltd to prepare an assessment of the potential PCDD/F (Polychlorinated Dibenzo Dioxin and Polychlorinated Dibenzo Furan) exposure through inhalation in the vicinity of the proposed Carranstown WTE facility.

Indaver (Ireland) Ltd requested that the potential extra PCDD/F intake through inhalation, when the proposed WTE facility is operational, be calculated and that this figure be expressed in unit volumes of milk, to demonstrate the potential extra PCDD/F intake by inhalation which may occur during operation of the proposed waste to energy facility, compared to that associated with drinking milk. Note that all PCDD/F values are expressed using the NATO/CCMS I-TEQ TEF system, which is used by EC countries.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15

2.0 MODELLING METHODOLOGY

The following modelling methodology was used to predict potential PCDD/F intake by inhalation and to then express this in terms of unit volumes of milk.

Determine PCDD/F concentrations in milk in likely to be consumed in Carranstown area;

Determine highest predicted annual average PCDD/F ambient air ground level concentration;

Determine predicted maximum potential PCDD/F intake through inhalation when waste to energy facility (WTE) fully operational;

Express this figure as intake of unit volumes of milk.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15

3.0 PCDD/F CONCENTRATIONS IN MILK

Milk consumed in the Carranstown area could be produced locally, could be sourced from elsewhere in Co. Meath, or could be produced in the Dublin area. EPA records were therefore consulted to determine the range of PCDD/F concentrations likely to be present in milk in the Carranstown area. The most recent EPA study on milk, published in the year 2000, was consulted, to determine these values [1]. The PCDD/F values, in terms of pg/kg full fat milk and the conversion to equivalent mass of PCDD/F per 300ml glass of milk, are presented as Table 3.1.

Dublin County Catchment Milk		
Mass of PCDD/F in 1 kg of full fat (3.7% fat) milk	11.5	pg
Density of milk (3.7% fat) at 20°C [2]	1029	kg/m^3
Volume of glass of milk	300	ml
Mass of glass (300ml) of milk	0.31	kg
Mass of PCDD/F in 300ml glass of full fat (3.7% fat) milk	3.55	pg
Crossakiel (near Kells) Milk		
Mass of PCDD/F in 1 kg of full fat (3.7% fat) milk	10.1	pg
Density of milk (3.7% fat) at 20°C [2]	1029	kg/m^3
Volume of glass of milk	300	ml
Mass of glass (300ml) of milk	0.31	kg
Mass of PCDD/F in 300ml glass of full fat (3.7% fat) milk	3.12	pg
Mulhuddart Co. Dublin Milk		
Mass of PCDD/F in 1 kg of full fat (3.7% fat) milk	9.9	pg
Density of milk (3.7% fat) at 20°C [2]	1029	kg/m^3
Volume of glass of milk	300	ml
Mass of glass (300ml) of milk	0.31	kg
Mass of PCDD/F in 300ml glass of full fat (3.7% fat) milk	3.06	pg

Table 3.1 PCDD/F concentration of milk from 3 possible sources of milk consumed in Carranstown area and PCDD/F intake from a glass of milk from each source.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:16:37:15

4.0 PREDICTED AMBIENT AIR PCDD/F CONCENTRATIONS AND INHALATION INTAKE DUE TO WTE EMISSIONS WHEN FACILITY OPERATIONAL

The predicted highest annual average ground level ambient air when the WTE facility is operational (assuming an emission concentration of 0.1 ngm^3 TEQ PCDD/F) [3] and the calculated potential PCDD/F intake due to the WTE facility emissions is shown in Table 4.1.

For the purpose of the modelling scenario, it was conservatively
assumed the MARI spent 24 hours per day, 365 days per year at the location of the predictedhighest average PCDD/F concentration and that the plant was operating at the maximum PCDD/F licence conditions of 0.1ng/m^3 I-TEQ (as per Directive 2000/76/EC).

Max. annual average ground level concentration PCDD/F pg/m^3	I-TEQ	2.90E-03
Normal breathing rate (m^3/day) [4]		20
Mass Fraction retained in the lungs (%) [5]		75
Mass of PCDD/F inhaled over a day (from incinerator) pg/day	I-TEQ	0.0435

For inspection purposes only. Consent of copyright owner required for any other use.

Table 4.1 Predicted ambient PCDD/F concentrations and predicted PCDD/F intake due to inhalation for MARI when WTE facility operational

The volume of milk from each source, which could potentially provide a PCDD/F intake equivalent to the PCDD/F intake by inhalation for the MARI, when the WTE is operational, is shown in Table 4.2.

It can be seen that predicted PCDD/F dose from inhalation of ambient air for the MARI, for the emissions from the WTE facility only, is predicted to be equivalent to the PCDD/F intake from 0.38 – 0.44 glasses of milk per month (4.6 – 5.3 glasses of milk per year), assuming a glass volume of 300 ml.

EPA Export 25-07-2013:16:37:15

Mass of PCDD/F absorbed through inhalation over a day	0.043500	pg/day
Volume Dublin County Catchment Milk equivalent to this mass PCDD/F	0.38	glasses of milk
Volume Crossakiel (near Kells) Milk equivalent to this mass PCDD/F	0.43	glasses of milk
Volume Mulhuddart Co. Dublin Milk equivalent to this mass PCDD/F	0.44	glasses of milk

Table 4.2 PCDD/F intake due to inhalation of ambient air, expressed as glasses of milk per month from 3 milk sources (for WTE facility only)

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15

5.0 CONCLUSION

It can be concluded from the modelling exercise that the emissions from the proposed WTE facility are predicted to increase the inhaled daily PCDD/F dose to the MARI by an extra 0.38 – 0.44 glasses per month of milk produced in the Meath/Dublin area (4.6 – 5.3 glasses of milk per year), assuming a glass volume of 300 ml.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15

6.0 REFERENCES

1. Dioxin levels in the Irish Environment, Table 1, Sample A3, Dublin County Catchment, EPA April 2001.

2. Goff, H.D. and A.R. Hill. In Y.H. Hui (ed.), Dairy Science and Technology Handbook Vol.1: Principles and Properties, pp. 1-82. VCH Publishers, New York, 1993.

3. *From* Carranstown WTE Facility EIS Air Dispersion Modelling Report, Table 5.1

4. Konz, J.J, Lisi, K., Friebele, E and Nixon, D. Exposure Factors Handbook, EPA/600/8-89/043, Washington DC EPA 1989.

5. Compilation of EU Dioxin Exposure and Health Data - Task 4; Human Exposure, European Commission DG Environment, October 1999.

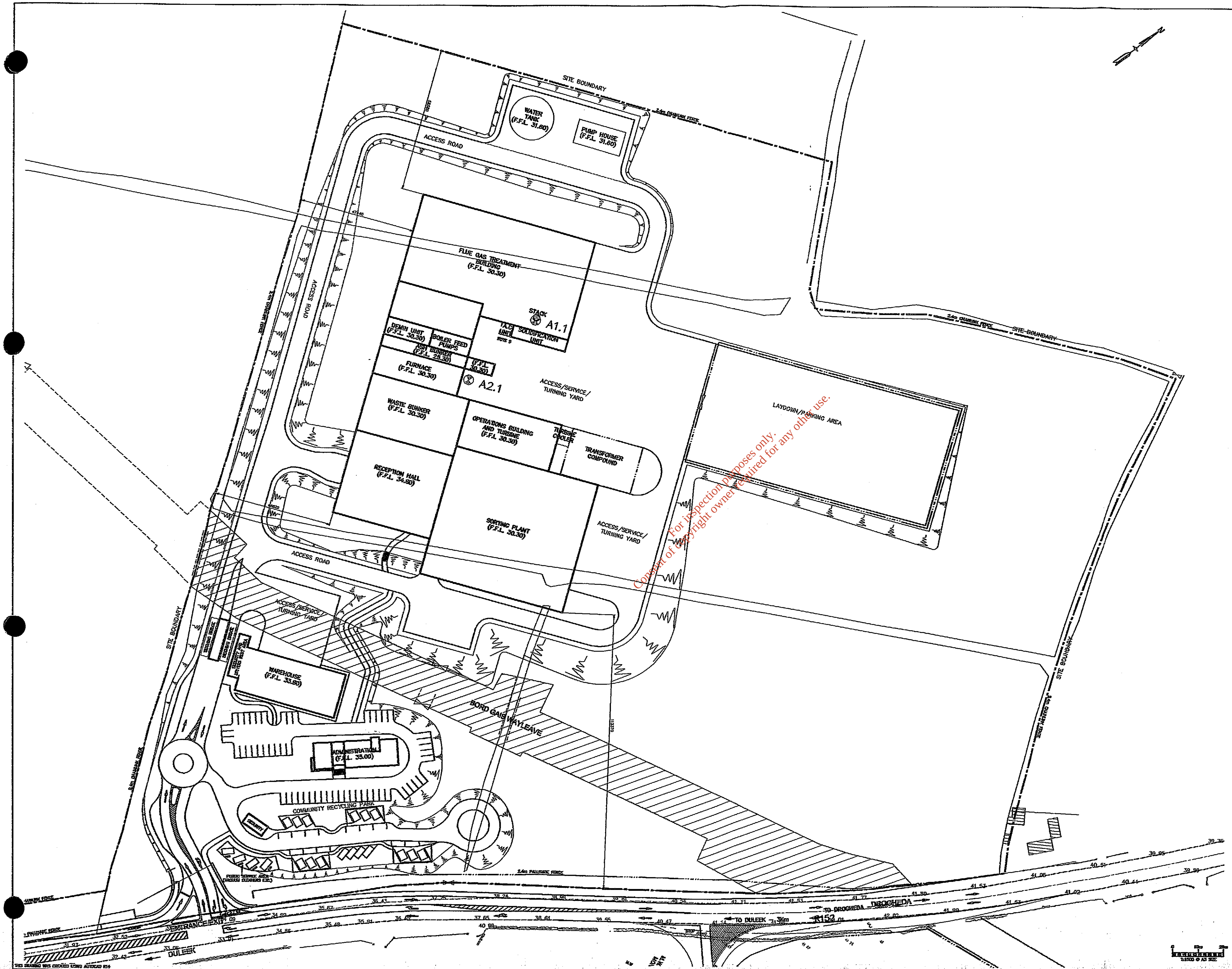
For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15

Attachment H1.4 **Drawing No. 2666-22-DR-009: Location of Air Emission Points**

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15



NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE – USE FIGURED DIMENSIONS ONLY
3. LEVELS ARE GIVEN IN METRES AND RELATE TO O.S. DATUM (MALIN HEAD).
4. ALL DIMENSIONS ARE GIVEN IN MILLIMETRES.
5. AC UNIT REFERS TO ACTIVATED CARBON / LIME MIXTURE UNIT

LEGEND

- A1.1 AIR EMISSION POINT – STACK
- A2.1 AIR EMISSION PT.– BACK-UP GEN.

ISSUE	DESCRIPTION	DRN	CHKD	AUTH CHK	APP	DATE
B	RE-ISSUE FOR INFORMATION					
A	FOR INFORMATION	GA	MG		MG	19/08/00

INDAVER IRELAND
4 HADDINGTON TCE.
DUN LAOGHAIRE
CO. DUBLIN
TEL: +353 1 2546830
FAX: +353 1 2807580

Project Management Group
Cork–Dublin

WILSON ASSOCIATES

PROJECT WASTE MGMT FACILITY - CARRANSTOWN

TITLE LOCATION OF AIR EMISSION POINTS

CLIENT REF.	CLIENT DRG No.
PROJECT No. 2866	
AD SCALE NONE	CONT'R DRG No. 2866-22-DR-009

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:16:37:15

Attachment H1.5 **Completed Waste Licence Application Tables 1.1 (Air Emissions), 1.2 (Air Emissions Characterisation) and 1.4 (Emissions Abatement)**

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:15

Table 1.1 AIR EMISSIONS

(ONE TABLE PER EMISSION POINT)

Emission Point Ref. Nº:	A1.1		
Name of emission point:	Stack		
Source of Emission:	Waste to Energy Plant		
Location of emission point:	Stack		
Grid Ref. (12 digit, 6E, 6N):	306221 E, 270914 N		
Date of commencement:	2004		
Periods of emission (avg.):*	60 min/hr	24 hr/day	365 day/yr
Volume to be emitted:	Average/day:		4,656,664 m^3/d
	Maximum rate/hour:		232,237 m^3/h
	Maximum rate/day:		5,573,688 m^3/d
Vent diameter:	....2.0 m		
Vent height above ground:	....40 m		
Min. efflux velocity:	8.6 m/sec		
Temperature:	Max........130.......°C	Min.......100........°C	Avg.......100........°C
For Combustion Sources:			
Volume terms expressed as :	√ wet	☐ dry	____8____%O_2

Consent of copyright owner required for any other use. For inspection purposes only.

* Each line is expected to operate a minimum of 7,500 hours per annum. However, both lines will discharge via one stack and maintenance times are expected to be staggered and therefore there will be continuous emissions to atmopshere.

EPA Export 25-07-2013:16:37:15

Table 1.2 AIR EMISSIONS CHARACTERISATION

Emission Point Reference Number: ***A1.1***

Parameter Name	Prior to treatment				As discharged					
	mg/Nm^3		g/s		mg/Nm^3		g/s		kg/year	
	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
NO_x (as NO_2)	350	600	12.25	25	150	200	5.25	8.389	141750	226500
SO_2	300	2000	10.5	83.9	20	50	0.7	2.097	18900	56625
Dust	3000	5000	105	209.7	1	10	0.035	0.419	945	11325
CO	20	100	0.7	4.2	20	100	0.7	4.19	18900	113250
TOC	5	10	0.18	0.419	1	10	0.035	0.419	945	11325
HCl	800	2000	28	83.9	1	10	0.035	0.419	945	11325
HF	10	50	0.35	2.097	1	1	0.035	0.042	945	1133
PCDD / PCDF	1×10^{-6}	1×10^{-5}	3.5×10^{-8}	4.19×10^{-7}	1×10^{-8}	1×10^{-7}	3.5×10^{-10}	4.19×10^{-9}	0.9×10^{-5}	1.13×10^{-4}
Cd & Tl	0.5	1	0.018	0.042	0.025	0.05	0.000875	0.002	24	57
Hg	0.5	1	0.018	0.042	0.025	0.05	0.000875	0.002	24	57
Sum of 9 Heavy Metals: Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V	5	30	0.18	1.26	0.25	0.5	0.00875	0.021	236	566

Concentrations are based on 0 °C, 101.3 kPa, 11% O_2 dry gas

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:16

Table 1.4 EMISSIONS ABATEMENT

Emission Point Reference Number: *A1.1* **Air √ Surface water ☐ Groundwater ☐**

Control[1] parameter	Equipment[2]	Equipment maintenance	Equipment calibration	Equipment back-up	Monitoring to be carried out[3]	Monitoring equipment	Monitoring equipment calibration
NO_x (as NO_2)	Urea Injection	As per supplier's recommendation	As per supplier's recommendation	Appropriate spares	Continuous	Individual monitor or multi-component analyser	As per supplier's recommendation
SO_2	Wet Scrubber	As above	As above	2 scrubbers/ standby pumps	Continuous	As above	As above
Dust	Furnace, Activated Carbon/Lime Mixture Injection and Baghouse Filter	As above	As above	2 furnaces, 2 baghouse filters, spares	Continuous	SIGRIST photometer or similar	As above
CO	Furnace	As above	As above	2 furnaces	Continuous	Individual monitor or multi-component analyser	As above
TOC	Furnace, Activated Carbon/Lime Mixture Injection & Baghouse Filter and Tail End Flue Gas Cleaning	As above	As above	2 furnaces, 2 baghouse filters, independent compartments for baghouse filter/carbon bed, spares	Continuous	Flame ionisation detector	As above
HCl	Wet Scrubber	As above	As above	2 scrubbers/ standby pumps	Continuous	Individual monitor or multi-component analyser	As above
HF	Wet Scrubber	As above	As above	2 scrubbers/ standby pumps	Discontinuous - quarterly for first year, 6 monthly for subsequent years	Multi-component analyser or sampling and analysis by accredited laboratory	As above

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:16:37:16

Table 1.4 contd. ***EMISSIONS ABATEMENT***

Emission Point Reference Number: ***A1.1*** **Air √ Surface water ☐ Groundwater ☐**

Control[1] parameter	Equipment[2]	Equipment maintenance	Equipment calibration	Equipment back-up	Monitoring to be carried out[3]	Monitoring equipment	Monitoring equipment calibration
PCDD / PCDF	First Pass of Boiler, Activated Carbon/Lime Mixture Injection & Baghouse Filter and Tail End Flue Gas Cleaning	As above	As above	2 furnaces, 2 baghouse filters, independent compartments for baghouse filter/carbon bed, spares	Continuous sampling with 20 samples analysed per year as well as bi-annual sample taken over 6 to 8 period	AMESA dioxin monitoring system or similar	As above
Heavy Metals	Activated Carbon/Lime Mixture Injection & Baghouse Filter, Wet Flue Gas Cleaning and Tail End Flue Gas Cleaning	As above	As above	2 baghouse filters, 2 scrubbers, independent compartments for baghouse filter/carbon bed, spares	Discontinuous - quarterly for first year, 6 monthly for subsequent years	Sampling and analysis by accredited laboratory	As above

[1] List the operating parameters of the treatment / abatement system which control its function.
[2] List the equipment necessary for the proper function of the abatement / treatment system.
[3] List the monitoring of the control parameter to be carried out with cross reference to the appropriate monitoring section.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:16:37:16

ATTACHMENT NUMBER H2

Climate

Contents

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:16

H2.1 IMPACT ON CLIMATE

INTRODUCTION

Indaver Ireland are in the process of applying for a waste licence for a proposed waste management facility in Carranstown, Co. Meath. As described in detail elsewhere, the waste management facility will be based on conventional grate incineration technology. The waste is tipped into a bunker prior to being fed into the furnace. In the furnace the waste is incinerated, producing heat, ash and combustion gases.

This study will describe and assess the impact of the proposed scheme, in terms of its impact on climate. Attention will be focused both on Ireland's obligations under the Kyoto Protocol and the effect of the scheme on the total national anthropogenic emissions of carbon dioxide and other greenhouse gases (GHGs) and also in the context of overall climatic impact in the presence and absence of the proposed development.

CLIMATIC BASELINE

Climate Agreements

Consent of copyright owner required for any other use. For inspection purposes only.

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997[1,2]. For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six GHGs (see Table 1 and Table 2) under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012[3]. In order to meet the ultimate objective of the Convention to prevent dangerous anthropogenic interference in the climate system, cuts of up to 70% in this century are expected to be required[4]. The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties (COP6) to the agreement was convened in Bonn in July 2001. In Article 5 of the Kyoto Protocol, it states that the methodologies for estimating anthropogenic emissions by sources and removal by sinks of all greenhouse gases (except those controlled by the Montreal Protocol) shall be those accepted by the Intergovernmental Panel on Climate Change (IPCC).

An important part of the approach to reducing greenhouse gas emissions, engrained in the Kyoto Agreement, is that emission reductions should reflect the most economically efficient cost of achieving the set target. As part of this approach, three "flexible mechanisms" are intended to facilitate the cost-effective implementation of the Protocol. These mechanisms are Emission Trading (ET), Joint Implementation (JT) and the Clean Development Mechanism (CDM). Emission trading is a development whereby polluting entities are allocated allowances for their emissions that can subsequently be traded with each other. Emitters for whom it is very expensive to reduce emissions are likely to buy permits from emitters for whom emissions reduction is relatively cheap thus ensuring that a pre-determined environmental outcome will take place where the cost of reduction is lowest. Due to significant economic growth in Ireland since 1990, it is envisaged that emission trading could be of significant benefit to Ireland in meeting its commitments to limit the growth of greenhouse gas emissions[4] (see Table 2). Both Joint Implementation and the Clean Development Mechanisms allow states to share reduction credits by investing in another territory with the aim of reducing emissions. However, the Clean Development Mechanism differs in that the projects are specific to

EPA Export 25-07-2013:16:37:16

assisting developing countries that are particularly vulnerable to the adverse effects of climate change to meet the cost of adaptation.

Baseline Conditions

Anthropogenic emissions of greenhouse gases included in the Kyoto Protocol are given in Table 1 and Table 2. Combustion of fossil fuels for energy purposes is the greatest source of emissions at 95% of CO_2 and 57% of total emissions (1995 data). The largest share of energy emissions in 1998 is from fuel combustion for power generation (25% of total emissions) and residential energy combustion (18%). Waste represented 2.5% of total emissions in 1998 and is envisaged to represent 1.5% of total emissions by 2010[4]. Emissions from waste consist of mainly of CH_4 with small amounts of other GHGs.

Greenhouse gases have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The GWP100 for CO_2 is the basic unit (GWP = 1) whereas CH_4 has a global warming potential equivalent to 21 units of CO_2 and N_2O has a GWP100 of 310. Using the aggregated IPCC 100-year Global Warming Potentials, CH_4 emissions from waste accounted for 98% of the Total GWP from waste in 1998.

IPCC Guidelines For National Greenhouse Gas Inventories

Consent of copyright owner required for any other use. For inspection purposes only.

The Intergovernmental Panel on Climate Change (IPCC) has outlined detailed guidelines on compiling National Greenhouse Gas Inventories. The guidelines are designed to estimate and report on national inventories of anthropogenic greenhouse gas emissions and removals in order to ensure compliance with the Kyoto Protocol. Anthropogenic refers to greenhouse gas emissions and removals that are a direct result of human activities or are a result of natural processes that have been affected by human activities[5,6]. The quantity of carbon from natural cycles through the earth's atmosphere, waters, soils and biota is much greater than the quantity added by anthropogenic GHG sources. However, the focus of the UNFCCC and the IPCC is on anthropogenic emissions because it is these emissions that have the potential to alter the climate by disrupting the natural balances in carbon's biogeochemical cycle, and altering the atmosphere's heat-trapping ability. The carbon from biogenic sources such as paper and food waste was originally removed from the atmosphere by photosynthesis, and under natural conditions, it would eventually cycle back to the atmosphere as CO_2 due to degradation processes. Thus, these sources of carbon are not considered anthropogenic sources and do not contribute to emission totals considered in the Kyoto Protocol[5,6].

In relation to solid waste disposal sites (SWDSs) including municipal landfills, detailed guidelines have been outlined for the calculation of GHG emissions[5,6]. The main GHG emission from SWDSs is methane. Even though the source of carbon is primarily biogenic, CH_4 would not be emitted were it not for the human activity of landfilling the waste, which creates anaerobic conditions conductive to CH_4 formation. Although CO_2 are also produced in substantial amounts, the primary source of CO_2 derives from the decomposition of organic material derived from biomass sources (crops, forests) which are re-grown on an annual basis. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology[6].

Similarly, in relation to incineration, a large fraction of the carbon in waste combusted (paper, food waste) is derived from biomass raw materials which are replaced by re-growth on an annual basis. Thus, these emissions should not be considered as net anthropogenic CO_2 emissions in the IPCC Methodology[6]. On the other hand, some carbon in waste is in the form of plastics or other products

EPA Export 25-07-2013:16:37:16

based on fossil fuel. Combustion of these products, like fossil fuel combustion, releases net CO_2 emissions. Thus, in estimating emissions from waste incineration, the desired approach is to separate carbon in the incinerated waste into biomass and fossil fuel based fractions and thereafter to use only the fossil fuel fraction in calculating net carbon emissions[5,6]. Other relevant gases released from combustion are net GHG emissions including CH_4 and N_2O.

The nature of municipal waste landfilled in Ireland has been catalogued in the National Waste Database Report 1998[7]. The breakdown of household and commercial waste is shown in Table 3 whilst the summary of major waste types landfilled in Ireland in 1998 is shown in Table 4. In relation to commercial and household waste, a significant fraction of the waste is derived from biogenic origins. A conservative estimate of the fraction of biogenic waste from households and commercial waste landfilled in Ireland in general and in the current region surrounding the proposed scheme in 1998 would be of the order of 0.70 (see Table 3). In relation to non-hazardous municipal, commercial and industrial waste, the key factor from a climatic viewpoint is the percentage of waste of non-biogenic origins. Although the detailed breakdown of each individual waste stream may vary significantly, non-hazardous waste from each sector would still be expected to consist mainly of biogenic waste. Thus, the categories non-hazardous municipal, commercial and industrial waste have been grouped as MSW in Table A1. Furthermore, it is conservatively estimated that 0.30 of the MSW waste incinerated is of fossil fuel origin and is thus a net contributor to greenhouse gas emissions. This conservative estimate has been used as outlined in Appendix 1 for estimating the net GHG emissions from the incineration of 150,000 tonnes/annum of municipal, commercial and/or industrial waste. Data from the USEPA indicates that typical USA mixed municipal solid waste (MSW) has about 10% non-biogenic carbon in MSW[5] and thus the estimate of 30% in the current analysis is likely to be pessimistic.

Consent of copyright owner required for any other use. For inspection purposes only.

CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

Forecasting Methods

Predictions of greenhouse gas emissions from the waste management facility were carried out using the emission factors derived from the IPCC[6] and AP-42 (USEPA)[8] and from information supplied by Indaver Ireland. The prediction of GHG emissions from landfills was developed using the USEPA Landfill Gas Emission Model (LandGEM)[9] and using emission factors derived from the USEPA[10] and the IPCC[6].

Construction

There is the potential for a number of emissions to atmosphere during the construction of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions.

Incineration

Incineration would be expected to be the dominant source of CO_2 and N_2O emissions from the development. Detailed waste throughput information was obtained from Indaver Ireland and this information has been used to estimate GHG emissions from the scheme. The total annual waste throughput for the proposed Waste Management Facility will be approximately 150,000 tonnes consisting of all non-recyclable household, commercial and/or industrial waste. The net greenhouse gas contribution from the waste was derived using the procedure recommended by the IPCC and is outlined in Appendix 1.

EPA Export 25-07-2013:16:37:16

Landfill

In the absence of incineration, the waste will be landfilled at a municipal landfill facility. Therefore, in the current study an assessment has been made of the likely production of greenhouse gases in the absence of incineration. Of the total emission of greenhouse gases from waste in Ireland, landfilling currently accounts for 98% of the total[3]. In the current assessment, all non-recyclable waste is assumed to be disposed off at a municipal waste landfill. In order to make a reasonable comparison with the incineration option, the scenario where 150,000 tonnes of waste is landfilled over a 25-year period has been assessed. The landfill is assumed to open in 2004 for a 25-year period. It has also been assumed that the landfill is operated to best practise standards and thus a landfill gas recovery system is installed and has a collection efficiency of 75% for CH_4. This is probably significantly above actual capture rates with rates likely to be between 50-70% for new landfills and 40%, at most, from existing landfills[3]. In addition, it is assumed that all recovered methane is used for energy recovery. In the Waste Management Act 1996, all Waste Licences issued by the EPA for Landfills now require landfill gas capture and utilisation in energy production or flared where use in energy production is not feasible. The calculation of landfill gas generation rates has followed USEPA methodology which recommends that landfill gas generation rates are derived from the USEPA Landfill Gas Emission Model (LandGEM)[9]. A summary of the methodology employed in the model is given in Appendix 1.

Road Traffic

Consent of copyright owner required for any other use. For inspection purposes only.

Road traffic would be expected to be an additional source of greenhouse gas emissions as a result of the development. Waste will be transported from the source of the waste to the site for disposal whilst the ash will subsequently be removed from the facility to be landfilled. In the absence of the development, this waste will also be collected and disposed of to landfill. In the absence of a detailed breakdown of the sources of waste and specific landfill locations, a detailed comparison of GHG emissions is not possible between the two options. However, it is likely that the transport associated with landfilling and incineration will lead to similar levels of emissions and moreover these emissions will be minor compared to emissions from the landfilling or incineration of waste. Thus, no detailed assessment has been carried out on the level of greenhouse gases from the transport of waste. However, analysis by the USEPA has estimated that the traffic-derived GHG emissions from both landfilling and waste-to-energy are approximately equivalent at 0.01 MTCE (metric tonnes of carbon equivalent) of anthropogenic CO_2 emission per ton (US) of material either landfilled or incinerated with the resulting ash landfilled[5]. In this context, the impact from the transport of waste accounts for less than 2.5% of the impact from the incineration of waste (excluding energy recovery) and thus is a minor contributor to the overall GHG emission total.

Modelling Methodology – Waste Management Facility

In order to calculate the scheme's net contribution to greenhouse gas emissions and the effect of the scheme on Ireland's obligations under the Kyoto Protocol, the total forecasted anthropogenic emissions of the proposed development has been calculated over a period of 25 years which is the lifespan of the development. The baseline year is assumed to be 2004. Given in Table 5 is the annual greenhouse gas emissions form the site and the total over the period of the development. The emissions have been compared with the estimated Total Greenhouse Gas Emissions in Ireland in 2004[3,11]. The contribution to the Total Greenhouse gas emissions, in the absence of power generation, is 0.09% of the Total Greenhouse Gas Emissions in Ireland in that year and thus is a very minor source compared to significant industrial sources such as cement manufacture.

EPA Export 25-07-2013:16:37:16

During the incineration of waste at the facility the thermal energy generated by the burning of waste will be recovered and will give an electrical output of about 14MW. As approximately 3MW is required for electrical demand within the plant, the net electrical output from the plant for export to the national grid will be 11MW. Thus, the export of 11MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 11MW from power stations. In order to calculate the net benefit in terms of greenhouse gas emissions, the likely greenhouse gas emissions from a Combined Cylce Gas Turbine (CCGT) power station (the most GHG efficient power source) producing 11MW of power has been calculated and subtracted from the site's greenhouse gas emissions (see Table 6). Currently, the breakdown of electricity generation in Ireland for the four main fossil fuels is coal at 39%, oil at 16%, peat at 22% and natural gas at 29% (1995 data) although projections for 2010 shown a significant shift away from coal, peat and oil and increased use of natural gas[(3)]. CO_2 emissions from coal are 77% higher per Joule, peat is 110% higher per joule whilst oil is 49% higher per Joule than natural gas[(3)]. Thus, the assumption that the displaced power generation is from a CCGT burning natural gas is a more pessimistic assumption than using the average fuel profile.

The production of power for export to the national grid is equivalent to a net reduction of 57% in the amount of greenhouse gases emitted from the site. Thus, the actual contribution to the Total Greenhouse Gas Emissions is 0.04% of the Total Greenhouse Gas Emissions in Ireland in 2004.

Modelling Methodology – Landfill

As stated above, it is assumed that 150,000 tonnes of waste will be landfilled annually in the absence of the development. The impact on climate of the landfilling of this waste over a 25-year period has been calculated using the USEPA approved Landfill Gas Emission Model (LandGEM)[(9)]. The model gives the production rate in terms of mass (in tonnes/annum) and volume (in terms of m^3/annum) for both CH_4 and CO_2. Shown in Figure 1 is the production rate of CH_4 (in tonnes of CO_2 equivalent) from a landfill which is in operation for 25 years. The model indicates that the peak in production of CH_4 occurs 25 years after opening. Indeed, significant quantities of landfill gas are produced even after 50 years of closing. In the model it is assumed that 50% of the landfill gas is CH_4, which is the which is the default value recommended by the USEPA[(9)] and the IPCC[(6)].

Consent of copyright owner required for any other use. For inspection purposes only.

After the calculation of both CH_4 and CO_2 generation rates, it is assumed that emissions from the landfill are controlled by installing a gas collection system followed by combustion of the collected gas through the use of turbines. Gas collection efficiencies are assumed to be 75% whilst the collection efficiency of the control device are assumed to average around 95-99%. These are probably significantly above actual capture rates with rates likely to be between 50-70% for new landfills and 40%, at most, from existing landfills[(3)]. The controlled CH_4 and CO_2 emission was estimated as shown in Appendix 1. Controlled CO_2 emissions include emissions from the CO_2 component of landfill gas (equivalent to uncontrolled emission) and additional CO_2 emissions formed during the combustion of landfill gas (mainly CH_4). The controlled GHG emission total over the period of gas generation is shown in Table 7. The controlled emission for CH_4 also includes for oxidation of the CH_4 which may occur in the top layer of soil over the landfill. The USEPA recommended 10% oxidation rate of methane generated has been applied in the current assessment[(10)]. This factor has also been applied in the current assessment. As stated previously, the primary source of CO_2 derives from the decomposition of organic material derived from biomass sources (crops, forests) which are re-grown on an annual basis and thus CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology[(6)].

The total GHG emissions given is over a period of over 100 years with peak generation occurring after 25 years at approximately 57,000 tonnes of CO_2 equivalent in that year. The contribution to the

EPA Export 25-07-2013:16:37:16

total greenhouse gas emissions, ignoring the generation of power, for the worst-case year is only 0.08% of the total greenhouse gas emissions in Ireland in 2004 and thus is relatively minor. However, it should be borne in mind that although the landfill is in operation for 25 years, landfill gases will be produced over a considerably longer timescale.

Again, energy recovery is possible using the landfill gas as the fuel source. Based on data from the USEPA[(5)], there is a net benefit in terms of greenhouse gas emissions, as a result of power generation from landfill gas as a fuel source, which would otherwise have been provided by fossil fuels. Thus, the contribution to the total greenhouse gas emissions, including the beneficial effect of the generation of power, for the worst-case year is approximately 0.04% of the total greenhouse gas emissions in Ireland in 2004. If the emissions are condensed to a 25-year time period (i.e. assuming that all emissions occur within a 25 year timeframe instead of the more than 100 years in reality), to allow a comparison with incineration, the annual contribution to the total greenhouse gas emissions, including the beneficial effect of the generation of power, is equivalent to 0.05% of the total greenhouse gas emissions in Ireland in 2004.

IMPACT OF DEVELOPMENT ON CLIMATE

Construction

The effect of construction on climate will not be significant.

Consent of copyright owner required for any other use. For inspection purposes only.

Incineration

The contribution of the Carranstown Waste Management Facility to total greenhouse gas emissions in Ireland is equivalent to only 0.04% of total emissions in 2004, when energy recovery in taken into account. Moreover, in the absence of the development, greenhouse gas emissions will occur from the landfilling of the waste. The contribution to the total greenhouse gas emissions from landfilling 150,000 tonnes of waste, including the generation of power, condensed to a 25-year period, is equivalent to 0.05% of the total greenhouse gas emissions in Ireland in 2004. Thus, the overall annual impact of the Carranstown Waste Management Facility on climate is to produce a net benefit of approximately 0.01% of the total greenhouse gas emissions in Ireland in 2004 and will thus make a small beneficial contribution to Ireland's obligations under the Kyoto Protocol.

DESCRIPTION OF MITIGATION MEASURES

Construction

N/A

Incineration

During the incineration of waste at the facility the thermal energy generated by the burning of waste will recovered and will give an electrical output of about 14MW with a net electrical output from the plant for export to the national grid will be 11MW (see Table 4). Thus, the export of 11MW will give a direct benefit in terms of greenhouse gas emissions which would have been released in the production of 11MW from power stations.

EPA Export 25-07-2013:16:37:16

The waste management facility will also recover and recycle ferrous and non-ferrous materials during the incineration process. The recycling of metals will require less energy than processes using virgin inputs and thus lead to a direct saving in energy and thus GHG emissions. A recent USEPA report has estimated that approximately 0.01 MTCE per ton (US) of mixed MSW is saved through recycling of metals[(5)].

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:17

REFERENCES

(1) Framework Convention On Climate Change Ireland - Report On The In-Depth Review Of The Second National Communication Of Ireland (1999)
(2) Framework Convention On Climate Change Kyoto Protocol To The United Nations Framework Convention On Climate Change (1997)
(3) ERM Limitation and Reduction of CO_2 and Other Greenhouse Gas Emissions in Ireland (1998)
(4) Department on Environment & Local Government Report on the Options For Greenhouse Gas Emission Trading (1999)
(5) USEPA Greenhouse Gas Emissions From Management of Selected Materials in Municipal Solid Waste (1998)
(6) IPCC Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1996)
(7) EPA National Waste Database Report 1998 (2000)
(8) USEPA Solid Waste Disposal 2.1- Refuse Combustion, AP-42 (1996)
(9) USEPA Landfill Gas Emission Model (Version 2.01) LandGEM (1997)
(10) USEPA Landfills, Volume III: Chapter 15, Emission Inventory Improvement Program (2001)
(11) Department of Environment & Local Government National Climate Change Strategy (2000)
(12) AEA Technology Economic Evaluation of Emission Reductions of Methane in the Waste Sector in the EU (Bottom-up Analysis) (2001)

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:17

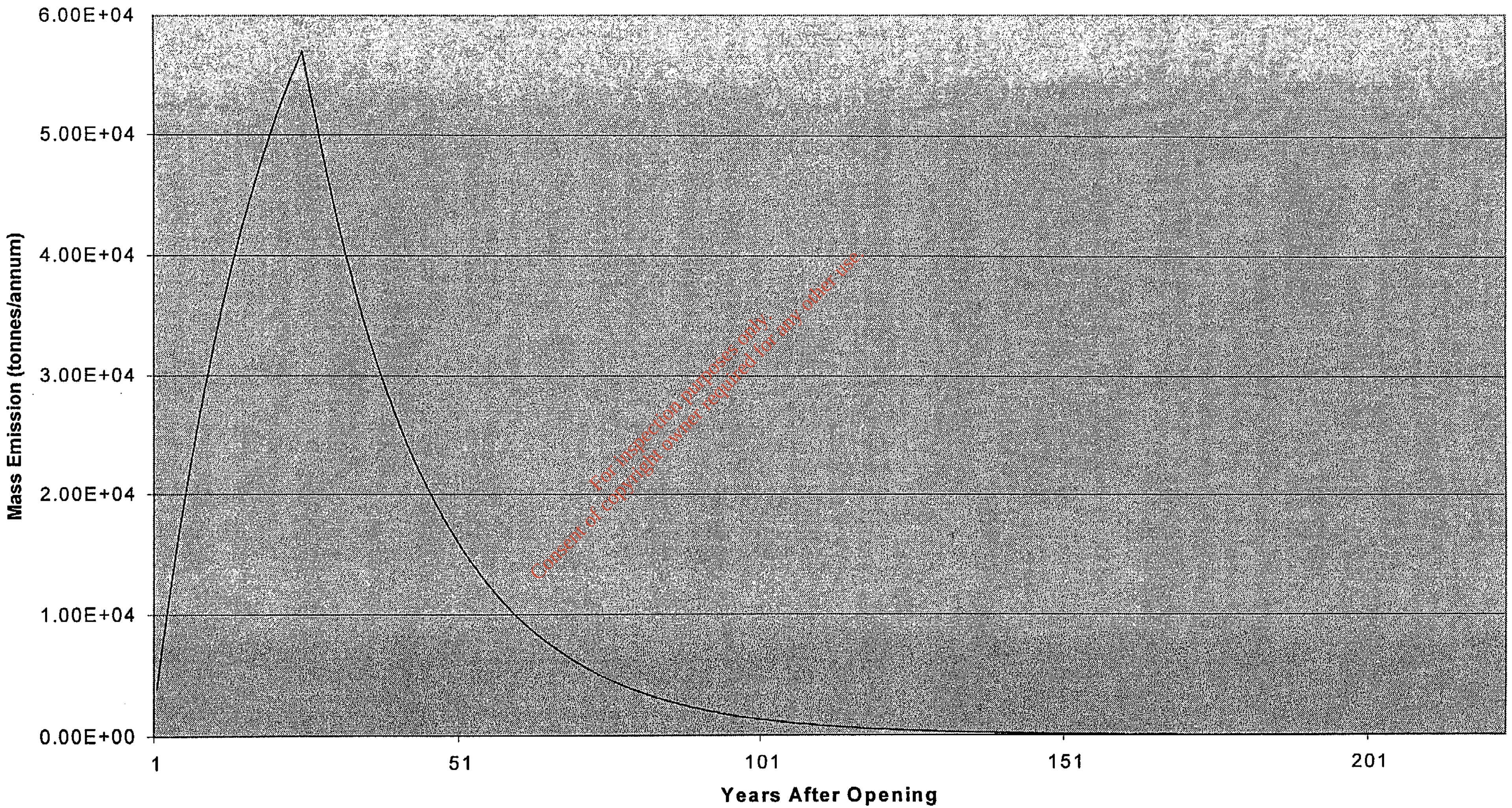


Figure 1: CO2 Equivalent GHG Emissions From Landfilling 150,000 tonnes/annum

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:17

Table 1: Greenhouse Gas Emissions (1995) ('000 tonnes)[3]

	CO_2	CH_4[2]	N_2O[2]	HFC	PFC	SF_6
Energy	32105	14.99	3.52			
Industrial Processes	1772		2.62			
Solvents & Other Product Use						
Agriculture		636.86	19.11			
Land Use Change & Forestry	-6230	24.36	0.79			
Waste	54	136.03	0			
Total	33931[1]	812.24	26.04	111	103	84

(1) Excluding land use change & forestry
(2) The global warming potential of CH_4 is 21 times that of CO_2 whilst N_20 is 310 times that of CO_2.
Data for HFCs, PFCs and SF_6 are estimated and are presented as CO_2 equivalents

Table 2: Greenhouse Gas Emissions ('000 tonnes CO_2 equivalent)[11]

Consent of copyright owner required for any other use. For inspection purposes only.

Year	CO_2	CH_4	N_2O	HFC, PFC, SF_6	Total Emissions	Emission Index	Sinks (Kyoto basis)	Net Total	Net Index
Base Year (1990)	31,575	12,836	9,085	256	53,752	100.0	0	**53,752**	**100.0**
1998	40,028	13,631	10,069	256	63,984	119.0	-745	**63,239**	**117.6**
2000	42,675	13,139	9,630	799	66,243	123.2	-991	**65,252**	**121.4**
2005	47,210	12,940	9,692	1,342	71,184	132.4	-1,523	**69,660**	**129.6**
2010 Low	51,373	12,185	9,720	672	73,950	137.6	-2,056	**71,894**	**133.8**
2010 High	51,373	12,185	9,720	1,885	75,163	139.8	-1,369	**73,794**	**137.3**

EPA Export 25-07-2013:16:37:17

Table 3: Composition of Household and Commercial Waste Landfilled In Ireland In 1998[7]

Material	Household		Commercial		Total	
	(%)	(tonnes/annum)	(%)	(tonnes/annum)	(%)	(tonnes/annum)
Paper	19.5	219,573	58.6	328,277	32.5	547,849
Glass	5.5	61,526	3.4	19,232	4.8	80,757
Plastic	11.9	133,453	10.6	59,475	11.4	192,927
Ferrous	2.0	22,793	1.0	5,698	1.7	28,491
Aluminium	1.0	11,231	0.6	3,493	0.9	14,724
Other Metals	0.5	5,828	0.1	381	0.4	6,209
Textiles	2.9	32,708	0.6	3,434	2.1	36,142
Organics	32.9	370,542	15.1	84,662	27.0	455,204
Others	23.8	268,046	9.9	55,417	19.2	323,463
Total	100.0	1,125,698	100	560,068	100	1,685,766

Note: "Others" mainly refers to composites, fine elements such as ash, unclassified incombustibles and unclassified combustibles including wood wastes.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 4: Summary of Major Waste Types Accepted into Landfills In Ireland In 1998[7]

Landfill Type	No.	Waste Accepted (tonnes)					
		Household	Commercial	Construction	Industrial	Others	TOTAL
Local Authority	76	1,116,688	536,068	1,887,751	181,548	194,018	3,916,073
Private / Industrial	50	9,010	24,000	817,207	3,717,133	296,778	4,865,128
TOTAL	**126**	**1,125,698**	**560,068**	**2,704,958**	**3,898,681**	**490,796**	**8,780,201**

EPA Export 25-07-2013:16:37:17

Table 5: Greenhouse Gas Emissions At Indaver Ireland's Waste Management Facility, Carranstown, Based on 150,000 Tonnes/Annum

	CO_2	N_2O	CH_4	% Of Ireland's Total Emissions[1]
Total / Annum (tonnes)[2]	62700	4.5	1[3]	-
Total / Annum (tonnes CO_2 Equivalent)	62700	1395	21	0.09
Total (tonnes CO_2 Equivalent) Over 25 Years	**1.57E+6**	**3.5E+4**	**525**	-

(1) Based on an approximate total emission of 70 million tonnes CO_2 equivalent in 2004 (based on estimates given in reference 11 for 2005)
(2) Based on Revised IPCC Guidelines as outlined in Appendix 1 and reference 6.
(3) Assuming, as a worst-case, that all organics are composed of methane.

Table 6: Greenhouse Gas Emissions At Indaver Ireland's Waste Management Facility, Carranstown As A Result of Exporting 11MW

Consent of copyright owner required for any other use. For inspection purposes only.

	CO_2	N_2O	CH_4	% Of Irelands Total Emissions[1]
CCGT Producing 11MW[2] (tonnes)	35600	1	0.09[3]	-
CCGT Producing 11MW (tonnes CO_2 Equivalent)	35600	310	1.9	
Total / Annum (tonnes CO_2 Equivalent) After Subtraction Of Power	27100	1085	19.1	**0.04**
Total (tonnes CO_2 Equivalent) Over 25 Years	**6.8E+5**	**2.7E+4**	**478**	-
Total After Power Generation Over 25 years	**Sum = 7.0E+5 Tonnes CO_2 Equivalent**			

(1) Based on an approximate total emission of 70 million tonnes CO_2 equivalent in 2004 (based on estimates given in reference 11 for 2005)
(2) Based on an energy saving of 0.37t CO_2 / MWh CCGT for electricity generation [12].
(3) Based on assumed methane content of 17% of Total VOCs (AP-42, 1996)[13].

EPA Export 25-07-2013:16:37:17

Table 7: Total Greenhouse Gas Emissions From The Landfilling Of 150,000 Tonnes/Annum For 25 Years

	CO_2	N_2O	CH_4	Annual % Of Irelands Total Emissions[1]
Total Emissions (tonnes CO_2 Equivalent)[2,3]	-	-	2.0E+6	0.11
Greenhouse Gas Avoid (tonnes CO_2 Equivalent)[4]	1.1E+6			
Total After Power Generation	**Sum = 8.77E+5 Tonnes CO_2 Equivalent**			**0.05**

(1) Based on an approximate total emission of 70 million tonnes CO_2 equivalent in 2004 (based on estimates given in reference 11 for 2005)
(2) Total over a period of over 100 years: peak generation will occur after 25 years at approximately 57,000 tonnes of CO_2 equivalent in that year).
(3) Based on an oxidation rate of 10% and a collection efficiency of 75%.
(4) Base on the USEPA default value of 0.18 MTCE avoided utility C per MTCE CH_4[6].

Table 8: Comparison of the Climatic Impact of Incinerating 150,000 Tonnes/Waste versus Landfilling of 150,000 Tonnes/Waste For 25 years

Process	Emissions of Carbon Dioxide Equivalent (Tonnes)
Total Incineration After Power Generation Over 25 Years	Sum = 7.0E+5 Tonnes CO_2 Equivalent
Total Landfilling After Power Generation	Sum = 8.8E+5 Tonnes CO_2 Equivalent
Net Impact Of Incineration On Climate	**- 1.8E+5 Tonnes CO_2 Equivalent** **(Net Benefit equivalent to 0.01% of emission total in 2004)**

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:16:37:17

APPENDIX 1

Revised 1996 IPCC Guidelines On The Incineration of Waste

Consistent with the IPCC Guidelines(6), only CO_2 emissions resulting from the incineration of waste of fossil origin (e.g. plastics, rubber, waste oil etc) should be included in emission estimates. The carbon fraction that is derived from biomass material (e.g. paper, food waste) is not included.

CO_2 Emissions

The most accurate CO_2 emission estimates results from disaggregating the activity into different waste types (municipal solid waste, sewage sludge, hazardous waste etc.) as the emission factor is based on the carbon content of the waste that is of fossil origin only. The following equation details the calculations involved:

$$CO_2 \text{ emissions (tonnes/yr)} = \Sigma_i(IW_i \times CCW_i \times FCF_i \times EF_i \times 44/12)$$

Where:

i	=	Municipal Solid Waste (MSW)
IW_i	=	Amount of incinerated waste of type i (tonnes/yr)
CCW_i	=	Fraction of carbon content in waste of type i
FCF_i	=	Fraction of fossil carbon in waste of type i
EF_i	=	burn out efficiency of combustion of incinerators for waste of type i
44/12	=	conversion from C to CO_2

Consent of copyright owner required for any other use. For inspection purposes only.

Table A1: Default Data For Estimation of CO_2 Emissions From Waste Incineration(6)

	MSW	Sewage Sludge	Clinical Waste	Hazardous Waste
C Content of Waste	33-50% default = 40%	10-40% default = 30%	50-70% default = 60%	1-95% default = 50%
Fossil Carbon as % of Total Carbon	30-50% default = 40%	0%	30-50% default = 40%	90-100% default = 90%
Efficiency of Combustion	95-99% default = 95%	95%	50-99.5% default = 95%	95-99.5% default = 99.5%

Note: MSW refers to non-hazardous municipal, commercial and industrial waste

In the current scenario:

$$CO_2 \text{ emissions (tonnes/yr)} = 150{,}000 \times 0.40 \times 0.30 \times 0.95 \times 44/12$$

CO_2 emissions = 62,700 tonnes/yr

Where:

i	=	MSW
IW_i	=	Amount of incinerated waste of type i (150,000 tonnes/annum)
CCW_i	=	Fraction of carbon content in waste of type i (default = 0.40)
FCF_i	=	Fraction of fossil carbon in waste of type i (maximum = 0.30)

EPA Export 25-07-2013:16:37:17

EF_i = Burn out efficiency of combustion of incinerators for waste of type i (default = 0.95)

In relation to the fraction of waste of non-biogenic origin, this has been conservatively estimated based on the detailed breakdown of household and commercial waste currently landfilled in Ireland (see Table 3). The value of 0.30 should be compared with the USEPA data that typical USA mixed municipal solid waste (MSW) has about 10% non-biogenic carbon in MSW[5].

N_2O Emissions

The calculation of N_2O emissions is based on waste input to the incinerators and an emission factor:

$$N_2O \text{ emissions (Gg/yr)} = \Sigma_i(IW_i \times EF_i) \times 10^{-6}$$

Where:

IW_i = Amount of incinerated waste of type i (Gg/yr)
EF_i = Aggregate N_2O emission factor for waste of type i (kg N_2O/Gg)

Table A2: Default Data For Estimation of N_2O Emissions From Waste Incineration[6]

Incineration Plant Type	MSW Kg N_2O / Gg waste (dry)	Sewage Sludge Kg N_2O / Gg sludge (dry)	Clinical Waste Kg N_2O / Gg waste (dry)	Hazardous Waste Kg N_2O / Gg waste (dry)
Hearth of grate	Germany 5.5-66 (average 5.5-11) UK Highest value - 30	400 (Japan: wet)	NA	NA
Rotating	NA	NA	NA	210-240 (Germany)
Fluidised Bed	240–660 Japan (wet)	800 (Germany) 100-1500 (UK) 300–1530 (Japan: wet)	NA	NA

Consent of copyright owner required for any other use. For inspection purposes only.

In the current scenario, using the highest report UK emission factor:

$$N_2O \text{ emissions (Gg/yr)} = 150 \text{ Gg/annum} \times 30 \text{ kg/Gg waste} \times 10^{-6}$$

N_2O emissions = 4.5 tonnes /annum

AP-42 - Municipal Solid Waste Landfills

The biodegradation of refuse in landfills produces landfill gas, mainly methane (CH_4) and carbon dioxide (CO_2) both of which are also greenhouse gases although only CH_4 is considered of non-biogenic origin. The USEPA[10] recommends that landfill gas emissions are calculated using the Landfill Gas Emission Model (LandGEM)[9]. Although other fates can exist for the gas generated in a landfill, including capture and subsequent microbial degradation, the bulk of the gas generated will be emitted through cracks or other openings in the landfill surface. USEPA recommends in the absence of site-specific data that the LFG consists of 55% CH_4, 40% CO_2 and 5% N_2[8]. For the purposes of estimating emissions both the IPCC[6] and USEPA[10] recommend the use of a 50% CH_4:50%CO_2 LFG ratio.

EPA Export 25-07-2013:16:37:17

Emissions from landfills may be controlled by installing a gas collection system and combusting the collected gas through the use of flares or turbines. Gas collection efficiencies are typically around 75% whilst the collection efficiency of the control device averages around 95-99%. The controlled CH_4 emission can be estimated by the equation outlined below:

$$CM_P = [UM_P*(1-\eta_{COL}/100)] + [UM_P*\eta_{COL}/100* (1-\eta_{Cnt}/100)]$$

Where:

CM_P	=	Controlled mass emission of pollutant P, kg/year
UMP	=	Uncontrolled mass emissions of P, kg/year (from LandGEM)
η_{COL}	=	collection efficiency of landfill gas collection system, percent
η_{Cnt}	=	collection efficiency of landfill gas control device, percent

Controlled CO_2 emissions include emissions from the CO_2 component of landfill gas (equivalent to uncontrolled emission) and additional CO_2 emissions formed during the CH_4 component of combustion of landfill gas (mainly CH_4). The following equation, which assumes 100% combustion efficiency for CH_4, can be used to estimate CO_2 emissions from controlled landfills:

$$CM_{CO_2} = UM_{CO_2} + [UM_{CH_4} *\eta_{COL}/100*2.75]$$

Where:

CM_{CO_2}	=	Controlled mass emission of CO_2, kg/year
UM_{CH_4}	=	Uncontrolled mass emissions of CH_4, kg/year (from LandGEM)
η_{COL}	=	collection efficiency of landfill gas collection system, percent
2.75	=	ratio of molecular weight of CO_2 to the molecular weight of CH_4

Consent of copyright owner required for any other use. For inspection purposes only.

Landfill Gas Emission Model (LandGEM)

The landfill gas emission model (LandGEM) estimates air emissions from landfills. The biodegradation of refuse in landfills produces landfill gas, mainly methane (CH_4) and carbon dioxide (CO_2). The model estimates emission rates based on the landfill gas generation rate and the amount of refuse in the landfill. The landfill gas generation rate in the model is based on a first order decomposition model, which estimates the landfill gas generation rate using two parameters: L_O, the potential methane generation capacity of the refuse, and k, the methane generation decay rate, which accounts for how quickly the methane generation rate decreases, once it reaches its peak rate. In the current model the L_O has been calculated as shown below[6]:

$$L_O = (MCF \times DOC \times DOC_F \times F \times 16/12) \text{ (Mg } CH_4\text{/Mg Waste)}$$

Where:

MCF	=	methane correction factor (default = 1)
DOC	=	Degradable organic carbon fraction (Mg C/Mg MSW)
DOC_F	=	Fraction DOC dissimilated (default = 0.77)
F	=	Fraction by volume of CH_4 in landfill gas (IPCC Default = 0.50)

And where:

$$DOC = (0.4 \times A) + (0.17 \times B) + (0.15 \times C) + (0.3 \times D)$$

Using Table 3:

A	=	fraction of MSW that is paper and textiles (approx. 33%)
B	=	fraction of MSW that is garden waste etc

EPA Export 25-07-2013:16:37:17

C	=	fraction of MSW that is food waste (sum of B & C = 27%)
D	=	fraction of MSW that is wood (estimate 5%)

Thus:

$$DOC = (0.4 \times 0.33) + (0.16 \times 0.27) + (0.3 \times 0.05)$$

$$\mathbf{DOC = 0.19}$$

This should be compared with the IPCC default value of DOC = 0.21

Thus:

$$L_O = (1.0 \times 0.19 \times 0.77 \times 0.50 \times 16/12)\ (Gg\ CH_4/Gg\ Waste)$$

$$L_O = (0.107)\ (Mg\ CH_4/Mg\ Waste)$$

$$\mathbf{L_O = 147\ m^3/Mg\ (site\ specific)}$$

$$L_O = 162\ m^3/Mg\ \ (IPCC\ Default)$$

Both of these values should be compared with the two suggested values given in the LandGEM model:

<u>AP-42</u>

Methane Generation Rate k = 0.04 1/yr
Methane Generation Potential L_O = 100 m^3/Mg

<u>Clean Air Act (CAA)</u>

Methane Generation Rate k = 0.05 1/yr
Methane Generation Potential L_O = 170 m^3/Mg

Consent of copyright owner required for any other use.
For inspection purposes only.

Thus, the CAA default parameters have been used in the following calculations as they represent the most appropriate values for the site.

Methane Percentage = 50% (IPCC and USEPA Default)

$$Q_{CH4} = L_O * R * (e^{-kc} - e^{-kt})$$

Where:

Q_{CH4}	=	methane generation rate at time t, m^3/yr
L_O	=	Methane generation potential, m^3 CH_4/Mg refuse
R	=	average annual refuse acceptance during active life, Mg/yr
k	=	Methane generation rate constant, yr-1
c	=	Time since landfill closure, yrs (c=0 for active landfills)
t	=	Time since the initial refuse placements, yrs

In order to enable a comparison between the landfill option and the waste-to-energy option, a length of active operation of the landfill of 25 years has been assumed.

EPA Export 25-07-2013:16:37:18

Glossary of Terms

Anaerobic Decomposition	The breakdown of organic material in the absence of air
Anthropogenic	Human induced; as a result of human actions
Biogenic	In the context of waste, biogenic refers to material which is derived from biomass sources (such as crops, forests) which are being sustainable produced
Biogeochemical cycle	In the context of greenhouse gases, the natural cycling of substances between water, land, air and biota.
CCGT	Combined Cycle Gas Turbine (for electricity generation). Electricity is generated from both the gas turbine (akin to a jet engine) and from the waste heat.
CFCs	Chlorofluorocarbons. A family of ozone depleting substances whose use is banned for most purposes under the Montreal Protocol on Substances that Deplete the Ozone Layer (1987). While CFCs are also greenhouse gases, they are excluded from the UNFCCC and the Kyoto Protocol as their use id controlled under the Montreal Protocol.
Climate Change	Change in climate which is attributable to human activity arising from the release of greenhouse gases into the atmosphere and which is additional to natural climate variability
CO_2 Equivalent	Where gases other than CO_2 are referred to, for comparison purposes these are converted to their equivalence in global warming terms to CO_2.
Greenhouse gas	A gas in the atmosphere that freely allows radiation from the sun through to the earth's surface, but traps the heat radiated back from the earth's surface. The heating effect is analogous to the manner in which the glass of a greenhouse traps the sun's radiation to warm the air inside the greenhouse. Most greenhouse gases occur naturally and are a necessary part of the global climatic system, but their concentrations can be increased by human action, causing climate change.
GWP	Greenhouse gases have different efficiencies in retaining solar energy in the atmosphere and also have different lifetimes in the atmosphere, before natural processes remove them. To compare the different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWP) over a normalised time horizon, giving a measure of their relative heating effect in the atmosphere. The 100 year time horizon (GWP100) is the one generally used and that provided for in relation to the Kyoto Protocol.
IPCC	Intergovernmental Panel on Climate Change. This is the authoritative scientific source on human interference with the global climate system
Kyoto Protocol	The second international agreement (1997) on climate change, setting binding limitation and reduction targets for developed countries. It is a protocol to the UN Framework Convention on Climate Change.
UNFCCC	UN Framework Convention on Climate Change, the first international agreement (1992) on action to tackle human induced climate change

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:16:37:18

ATTACHMENT NUMBER H3

Cultural Heritage

Contents

The impact on cultural heritage is described in detail in Sections 12.3, 12.4 and 12.5 of the Environmental Impact Statement (EIS) accompanying this licence application and therefore there is no attachment.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:18

ATTACHMENT NUMBER H4

Ecology

Contents

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:18

H4.1 IMPACT ON ECOLOGY

1. CONSTRUCTION IMPACTS AND MITIGATIONS

Construction at the site will be ongoing for approximately 18 to 24 months. Site clearance and construction will involve the removal of some of the existing habitats. A large section of the land under meadow and pasture will be built upon. All of the hedgerows that mark the internal boundaries within the site will be removed and the hedgerow that borders the R152 road will be removed to accommodate a site entrance and road widening. During the construction phase it is possible that some of the remaining hedgerows and ditches could be damaged by earthworks or machinery on site.

The removal of the meadow and pasture grassland habitats is not considered significant as these habitats are of negligible scientific interest and have little conservation value and therefore no mitigation measures are required. The internal hedgerows to be removed have negligible to low ecological value based on the survey and therefore their removal is not predicted to have a significant impact. Therefore no mitigation measures are required. The planting of a new hedgerow along the north-west boundary of the site parallel to the railway line will partly compensate for the loss of these hedgerows.

Consent of copyright owner required for any other use. For inspection purposes only.

Measures will be taken during the construction phase to prevent the remaining hedgerows from being damaged. Care will be taken while machinery is operating in the vicinity of the hedgerows and building materials will not be stored within 10 m of the hedgerows. Any sensitive areas will be protected with temporary fencing. Any accidental damage will be repaired using the same tree and shrub species that are already present (ash, hawthorn).

During landscaping of the site, preference will be given to the planting of native tree and shrub species most of which will already be established in the general vicinity. As part of the landscape plan 50,000 saplings are proposed to be planted. It is also proposed to enhance the wildlife value of the site by planting species which are useful to wildlife. Landscaping is discussed in greater detail in Attachment H7.1.

A wet drain in the field adjacent to the western boundary of the site feeds into a tributary of the River Nanny and it is possible that contaminated water could enter the wet drain during the construction phase. Silt traps will be used to prevent any suspended solids from entering the drain. Any potentially polluting substances such as oil, paints or other chemicals will be stored on site in properly bunded areas. These mitigation measures should prevent any contaminated water from entering the drain.

2. OPERATIONAL IMPACTS AND MITIGATION

Atmospheric emissions from waste to energy plant will consist of oxides of nitrogen (NO_X), sulphur dioxide (SO_2), metals and dioxins. Emissions of NO_X and SO_2 could contribute to acid rain which can cause acidification and degradation of ecosystems. These emissions can have local and transboundary effects. Emissions of dioxins and metals could also have a negative impact on flora and fauna, as these chemicals can be toxic at certain concentrations.

EPA Export 25-07-2013:16:37:18

Air dispersion modelling (see Attachment H1.1) has predicted a maximum annual average ground level concentration of 5.81 μg/m^3 NO_X and 1.45 μg/m^3 SO_2. EU Directive 99/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air sets ground level concentration limit values for the protection of human health and the environment. These limit values came into effect in July 2001. The Directive specifies an annual limit value for the protection of vegetation of 30 μg/m^3 NO_X and a limit value for the protection of ecosystems of 20 μg/m^3 SO_2. As the predicted concentrations of NO_x and SO_2 are well below the European limit values it is unlikely that atmospheric emissions from the proposed waste to energy plant will have any negative impacts on the surrounding habitats and ecosystems. Therefore, no further mitigation measures are required other than the design considerations.

The maximum hourly average ground level dioxin concentration is predicted to be 0.0074 pg/m^3 and the maximum predicted annual average concentration is 0.00029 pg/m^3. These predicted concentrations are significantly less than typical background concentrations measured throughout Europe and those measured by the survey on site (0.028 pg/m^3 to 0.046 pg/m^3). Given that the plant will not significantly increase background concentrations of dioxins, there will not be any significant impact on dioxins in vegetation.

3. CONCLUSIONS

The site is located in an area which has for a long period been intensively managed for agricultural purposes. This has resulted in a limited number of habitats on the site and consequently a low diversity of flora and fauna. The types of flora and fauna encountered on the site are typical of the agricultural area in which the site is located. Mitigation measures will be put in place to prevent any negative impacts occurring and therefore the construction and operation of the proposed development is not predicted to have a significant negative impact on flora and fauna.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:16:37:18

ATTACHMENT NUMBER H5

Human Beings

Contents

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:18

H5.1 IMPACT ON HUMAN ENVIRONMENT

1. GENERAL

The site is located in the townland of Carranstown approximately 3 km north-east of Duleek village. The R152 secondary road between Duleek and Drogheda runs along the southern boundary of the site.

Housing development in the area is scattered in nature and is typical of a rural area. There is ribbon housing development along the R152 to Duleek to the south-west of the proposed site. The closest residential dwellings to the site are a dwelling adjacent to the boundary at the eastern corner of the site and two dwellings located across the R152 to the south of the site. There is also a group of four dwellings located across the R152 road from the eastern corner of the site and a further group of dwellings include two farm houses located about 400 metres to the north-west of the site across the railway line.

Other buildings in the area include a primary school, Mt. Hanover, which is located about 1 km to the east of the proposed development site. There are three commercial premises (tyre centre, haulage yard and garage) located across the R152 road from the eastern corner of the site and a public house. Carranstown Lodge is located approximately 500 m south west of the site on the R152. Adjacent to Carranstown Lodge is a local football club.

For inspection purposes only. Consent of copyright owner required for any other use.

1.1 SITE SELECTION

The proposed site was selected on the basis of objective technical and environmental selection criteria as detailed in Section 2.10 of the Environmental Impact Statement (EIS). Although the site is not zoned in either the 1994 Development Plan or the Draft Development Plan, both plans accept the suitability of rural sites for industrial and other development.

The suitability of such sites is generally dependent on the sustainability of the industrial development in terms of its impact on infrastructure, visual amenity, tourism (particularly on the Boyne valley) and traffic. The sustainability of the development with regard to these and other environmental impacts has been ensured through appropriate design measures.

1.2 MITIGATION MEASURES

Measures to mitigate any impact of the proposed development on the surrounding environment, including human beings, are discussed in the relevant sections of the Waste Licence Application and accompanying EIS as follows:

EPA Export 25-07-2013:16:37:18

Table 1.1 Proposed Mitigation Measures

Parameter	Relevant Section of EIS/Waste Licence Application
Air	Sections 4.3 and 4.4 of EIS and Attachment H1.1 of Waste Licence Application
Climate	Sections 10.3 and 10.4 of EIS and Attachment H2.1 of Waste Licence Application
Cultural Heritage	Sections 12.3 and 12.4 of EIS and Attachment H3.1 of Waste Licence Application
Ecology	Sections 11.3 and 11.4 of EIS and Attachment H4.1 of Waste Licence Application
Human Beings	Sections 3.3 and 3.4 of EIS
Hydrogeology	Sections 8.3 and 8.4 of EIS and Attachment H6.1 of Waste Licence Application
Landscape	Sections 6.3 and 6.4 of EIS and Attachment H7.1 of Waste Licence Application
Noise	Sections 5.3 and 5.4 of EIS and Attachment H8.1 of Waste Licence Application
Surface Water	Sections 9.3 and 9.4 of EIS and Attachment H9.1 of Waste Licence Application

Consent of copyright owner required for any other use. For inspection purposes only.

2. CONSTRUCTION IMPACTS AND MITIGATION

2.1 LAND USE, ZONING AND HOUSING

Site clearance and construction on the development site will result in the loss of some land (ca. 25 acres) that was previously used for agricultural purposes. It is not predicted that the construction phase of the development will have any impact on land use in the surrounding area.

2.2 HEALTH

As with any major construction site there will be potential risks to the health and safety of construction personnel on site. A comprehensive Health & Safety programme will be put in place on the site to minimise any risks to and ensure the health and safety of construction personnel and site visitors. The construction of the development is not predicted to have any potential impacts on the health of local residents.

EPA Export 25-07-2013:16:37:18

2.3 EMPLOYMENT

The duration of the construction period will be between 18 and 24 months. During this period up to 300 workers, both skilled and unskilled, will be employed on site. Where possible, local services and construction staff from the surrounding areas and counties will be used. Therefore the construction of the development will have a significant temporary positive impact on employment.

2.4 POPULATION

There may be a short term increase in the population locally for the duration of the construction period.

2.5 AMENITIES AND TOURISM

The construction phase of the development is not predicted to have any significant impact on the amenities or tourist potential of the site or surrounding area.

3. OPERATIONAL IMPACTS AND MITIGATION

3.1 LAND USE, ZONING AND HOUSING

Consent of copyright owner required for any other use. For inspection purposes only.

As with the construction phase the operation of the development will result in the change of use of some land (ca. 25 acres) that was previously used for agricultural purposes. The operation of the development is not predicted to have any significant impact on the land use of the surrounding areas, be it for agricultural, commercial or residential purposes, and is not predicted to have any significant impact on the housing in the surrounding areas.

The U.K. National Society for Clean Air and Environmental Protection recently published a document entitled "The Public Acceptability of Incineration". In the document the subject of property prices in the vicinity of new incinerators is addressed – "Research in North America has shown that during the proposal, planning and conastruction stages for an incinerator (or any other large industrial project) there is a short-term impact on property values in the immediate vicinity. Much of this is as a result of the uncertantity while deliberations continue. Once the facility is operational, property values have been shown to recover".

3.2 HEALTH

3.2.1 Dioxins

There is much public concern about dioxins being emitted from the waste to energy plant.

Dioxins have always being present as a by-product of the combustion of wood and coal, their formation in the temperature range of between 200 °C and 800 °C corresponds to the "low temperature" burning range often occurring in domestic home heating and from back garden/ forest fires. A European Dioxin Inventory Study in 2000 demonstrates that 25 grams I-TEQ of dioxin was produced in Ireland and of this 22 grams came from non-industrial sources, primarily home heating and transport.

EPA Export 25-07-2013:16:37:18

Industrial sources have since the end of the 19th Century also contributed to the production of dioxins; such industries include, the production of steel/ copper, the incineration of waste and coal/ oil power plants. Early waste incineration plants provided little or no means for the cleaning of gases produced during combustion and as a result elevated levels of dioxins and other gases were emitted from these facilities for many years. Increased levels of environmental awareness coupled with a greater knowledge of the impacts of dioxins on the environment forced many of these dated incinerators to close.

Today, these old incineration plants have been replaced by modern Waste-to-Energy facilities that are capable of meeting stringent emission limits complying to new legislation (EU 2000/76) whilst also providing energy recovery from the waste material.

The reduction in the number of old plants has been offset by the increased capacity of the new waste to energy facilities, incineration capacity in Europe has increased from 32.7 million tonnes per year in 1996 to 46.7 tonnes per year in 2002. This value is expected to rise to almost 62.8 million tonnes per annum by 2006, with the total installed base of plants expected to rise to 474.

Modern incineration plants are required to operate under strict emission limits, in Europe the directive for waste incineration (2000/76/EC) has lowered the emission limit for dioxins to 0.1 nanogram/m^3.

The new EU directive (2000/76/EC) takes into account recent studies on dioxins and their effects and the WHO recommendations.

The new incineration Directive (EU 2000/76) will reduce emissions of dioxins and furans from incinerators in the European Union from an annual 2,400 grams in 1995 (out of approximately 5749 grams total dioxin emissions) to 10 grams after full implementation in 2005, or less than 1% of total dioxin emissions.

Consent of copyright owner required for any other use. For inspection purposes only.

The World Health Organisation have stated that 'The incineration of waste is an hygienic method of reducing its volume and weight which also reduces its potential to pollute". "In general, properly equipped and operated waste incinerators need not pose any threat to human health, and compared to the direct land filling of untreated wastes, may have a smaller environmental impact".

Incineration plants are in operation throughout the world, with over 300 in Europe alone. The location of these facilities varies from industrialised to urban areas and into rural areas. Waste to energy plants are located in Paris, Vienna, Monaca, Hamburg, Zurich, and Gien to name but a few. The occurrence of these plants throughout mainland Europe is such that incineration plants are frequently situated close to agricultural areas.

The proposed waste to energy plant will operate a two stage dioxin removal process. This will ensure that dioxin emissions will be well below the EU limit of 0.1 nanogram/m^3.

EPA Export 25-07-2013:16:37:18

3.2.2 Agriculture

During the consultation process, concerns over the effects of air emissions on agricultural practices in the area were raised. A study into the effects of air emissions on crops (Heck, W. W. 1990). Impacts of Air Pollution on Agriculture in North America. In Ecological Risks: Perspectives from Poland and the United States, W. Grodzinski, E. B. Cowling, and A. I. Breymeyer. National Academy Press, Washington, DC, p 171-195) indicated that the emissions of greatest concern are SO_2 and NO_2, which can damage crops if present in high concentrations over a period of time.

The EU has set Air Quality Standards for NO_2 and SO_2 for the protection of ecosystems (including vegetation and crops). Based on dispersion modelling of the emissions from the proposed plant (see Attachment H1.1), the NO_2 concentration is at most 17% of the relevant standard and the maximum SO_2 concentration is only 6% of the relevant standard. It is therefore concluded that NO_2 and SO_2 emissions will not impact on agriculture.

There is no known case in Europe whereby a food producer has had their produce refused by any food processing company or outlet as a result of the proximity of the producer to a modern incineration plant. In addition, there is no known policy in place by any food processing company or outlet stating that produce originating from lands located close to a modern incineration plant is to be refused acceptance by virtue of their origin.

There are six waste incinerators currently operating in Ireland. The Environmental Protection Agency has recently issued a report entitled "Dioxin levels in the Irish Environment"; this report details the level of dioxins measured in cow's milk taken at 25 locations throughout the country and in the vicinity of the incinerators in year 2000. The results of this report can be compared to a similar study also undertaken by the EPA in 1995. It is to be recorded that dioxin levels in the milk have fallen by approximately 16 per cent in the five year period, this reduction is in line with similar reductions in Europe.

Consent of copyright owner required for any other use.
For inspection purposes only.

The proposed development will be designed and constructed in such a way as to minimise environmental impacts as far as practically possible. The plant has been designed in accordance with Best Available Techniques (BAT) and will be operated in an environmentally sound manner.

Emissions from the plant will comprise of atmospheric emissions and discharges of treated domestic effluent to a percolation area on site. The potential impacts of these discharges are discussed in Attachment H1.1 on air quality and Attachment H6.1 on hydrogeology. All discharges from the plant will comply with the relevant regulatory limits designed for the protection of human health and the environment.

3.3 EMPLOYMENT

The facility will employ a permanent staff of approximately 50 people, comprising managerial, technical, skilled and unskilled workers. Therefore the development will have a positive impact on employment in the area. The direct expenditure on employees salaries will have a multiplier effect on employment, household income, government income and Gross National Product (GNP). Goods and services required

EPA Export 25-07-2013:16:37:18

during the operation of the plant will be sourced locally where possible, which will have a further positive impact on the local economy and employment in the area.

3.4 POPULATION

It is not envisaged that there will be a change in the overall population of the area due to the operation of the waste management facility. There are hundreds of modern incinerators located throughout Europe in urban, rural and industrial areas. These have not adversely affected the population living in the vicinity.

3.5 AMENITIES

As previously discussed, the development site and surrounding area does not possess a significant amenity value, and therefore operation of the development is not predicted to have any significant impact on the amenity value of the area.

A minor loss of amenity will be experienced by immediate neighbours due to a loss of open space.

As there will be no adverse impact, including visual impact (see Section 6 of the EIS), from the proposed facility, there will not be any significant impact on the tourism potential of the surrounding areas.

The provision of the community recycling park will add to the amenity of the area.

In addition, as part of the conditions attached to the notification of decision to grant planning permissions issued by Meath County Council, Indaver must contribute £1 per tonne of waste accepted at the facility to the local community for environmetal projects. This will total up to £132,000 per annum and a community liaison committee will determine the environmental, recreational or community facility projects to be funded.

Consent of copyright owner required for any other use. For inspection purposes only.

3.6 CUMULATIVE IMPACT

The cumulative effects of atmospheric emissions and traffic from the waste to energy plant, Platin Cement Works and the proposed Marathon Power Plant have been assessed in Attachments H1.1 and F8.1 respectively. The cumulative effects of noise emissions from the waste to energy plant and Platin Cement Works have been assessed in Attachment H8.1, as details on the anticipated noise sources at the power plant were not available. The cumulative impact of these facilities on the surrounding environment has been found to be insignificant.

EPA Export 25-07-2013:16:37:18

ATTACHMENT NUMBER H6

Hydrogeology

Contents

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:18

Attachment H6.1 Impact on Hydrogeology

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:16:37:18

H6.1 IMPACT ON HYDROGEOLOGY

1. CONSTRUCTION IMPACTS AND MITIGATION

There will be no direct discharges to groundwater during the construction phase of the development.

Any spillages of potentially polluting substances during construction could have a negative impact on the soils and hydrogeology of the site. A number of mitigation measures will be put in place to prevent any significant contamination of surface waters during the construction phase:

- Any oils, chemicals, paints or other potentially polluting substances used during construction will be stored in designated storage areas which will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s).
- Filling and draw-off points will be located entirely within the bunded area(s).
- Drainage from the bunded area(s) will be diverted for collection and safe disposal.
- All domestic effluent generated on site will be discharged to temporary sewage containment facilities prior to transport and treatment off-site.

The hydrogeological survey has demonstrated the soils and groundwater on site are free of contamination and therefore excavation works on site will not result in the mobilisation of any sub-surface contaminants.

Consent of copyright owner required for any other use. For inspection purposes only.

2. OPERATIONAL IMPACTS AND MITIGATION

2.1 DOMESTIC SEWAGE

The only emission to ground will be that of domestic sewerage, which will be treated with a Puraflo Liquid Effluent Treatment System prior to discharge. Table 1.6 from the waste licence application form has been completed and is included in Attachment H6.4. The treated effluent will then be released to ground via a 300m^2 percolation area. The Puraflo system is certified by the Irish Agrément Board, and is already proven in a variety of situations in over 2,000 locations throughout Ireland.

The system will consist of a collection chamber connected to the outlet of a septic tank. From this sump the effluent will be pumped through a rising main and into a system which distributes it evenly over biofibrous material through which it percolates, emerging as clean innocuous fluid at the base of the unit. The treatment is achieved by a combination of physical, chemical and biological interactions between the wastewater and the biofibrous medium. The location of the treatment system and percolation area is shown in Drawing No. 2666-22-DR-013 in Attachment H6.2.

The Puraflo system will treat the effluent to a very high standard (see Table 2.1 below) prior to it reaching the percolation area and therefore, there will be no

EPA Export 25-07-2013:16:37:18

significant impact upon the soils or hydrogeology of the site. A percolation test has been carried out for the proposed percolation area. The water table at the site is not high and would not cause a problem for percolation. However, the T-value is greater than 50, which means that the test has failed according to EPA Guidelines. This is due to the presence of clays beneath the site, which had become highly saturated due to rain storms prior to testing. Suitable material will be imported to build a percolation area according to the EPA Guidelines. A reserve percolation area will be provided in the event of the main area malfunctioning. Further details on the effluent treatment system are included in Attachment H6.3.

Table 2.1 Typical Treated Effluent Quality from Puraflo System

Parameter	Concentration
pH	5-8
B.O.D.	<15
T.S.S. (mg/l)	<15
NH_3-N (mg/l)	<5
Nitrate-N (mg/l)	20
Total Coliforms elimination	>99.9%
Faecal Coliforms elimination	>99.9%
Pathogenic Bacteria	Absent

Consent of copyright owner required for any other use.
For inspection purposes only.

2.2 POTENTIAL PROCESS IMPACTS

Waste delivered to the facility will be stored in a waste bunker located below ground level prior to undergoing thermal treatment. The 12,000 m^3 waste bunker will be designed to retain any firewater generated within the bunker. It will be constructed from one monolithic concrete slab as the base. Any potential points for leakage will be sealed with cold concrete seals. A steel plate will also be installed. The plate will be half in the wall and half in the base of the bunker to a depth of 10cm to prevent any possibility of leakage. In the event of a large volume of firewater remaining in the bunker as a result of use of the water cannons, the water will be removed from the bunker by vacuum tanker and sent off-site for biological treatment. These mitigation measures will prevent any potential leakage to soil or groundwater.

The community reycling park will provide for the collection of a number of types of waste including kitchen oil, car oil and car batteries which will be then be transported off-site for treatment. The waste oil and batteries collection area will be properly bunded to fully contain any spillages, which could negatively impact on soil or groundwater.

All chemicals or other potentially polluting substances used during the operational phase of the waste to energy plant will be stored within the main process building and

EPA Export 25-07-2013:16:37:18

will be provided with adequate containment and will also be handled in a manner to eliminate the risk of any spillages contaminating groundwater.

Bunding will also be provided for electrical transformers located in the transformer compound.

Petrol interceptors will be placed on surface water drainage lines draining car-parking and marshalling areas to contain any leakages of petrol or oil from vehicles on site and prevent any contamination of surface water and subsequent contamination of soils and groundwater.

Regular monitoring of groundwater will take place which will detect any changes in groundwater quality during the operational phase of the development.

3. CONCLUSIONS

The results of the soil and hydrogeological survey suggest that there is no significant soil or groundwater contamination at the development site. The slightly elevated levels of inorganic nitrogen compounds and heavy metals at some locations on the site are most probably due to previous agricultural practices on the site and surrounding area. The results of the pump test suggest a high potential for groundwater development at the site (approx. 20 m^3/hr) from a single borehole. Suitable mitigation measures will be put in place during the construction and operational phases of the development to ensure that the development will have no significant impacts on the geology, soils or hydrogeology of the site.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:16:37:18