



**Energy from Waste and Recycling Facility , Trident Park
Cardiff**

Carbon Footprint Assessment



**January 2010
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CONTENTS

1.0	INTRODUCTION.....	1
1.1	Background	1
1.2	Structure of Report	1
2.0	THE PROPOSED DEVELOPMENT	3
3.0	PLANNING POLICY, GUIDELINES AND INDICATORS	7
3.1	Introduction	7
3.2	Planning Policy Wales (WAG, 2002)	7
3.3	Environment Strategy for Wales (WAG, 2006).....	8
3.4	Technical Advisory Note 21: Waste (WAG, 2001).....	8
3.5	South Glamorgan (Cardiff Area) Replacement Structure Plan 1991-2011 (Cardiff City Council, 1997).....	9
3.6	Cardiff Local Development Plan 2006-2021 - Preferred Strategy Report (Cardiff Council, 2007)	9
4.0	SOUTH EAST WALES REGIONAL WASTE PLAN	11
4.1	Regional Waste Plan Overview and Development	11
4.2	LCA-SA Options	11
4.3	LCA - SA Results and Conclusions	13
5.0	METHODOLOGY OF WRATE ANALYSIS OF PROPOSED FACILITY	15
5.1	Introduction	15
5.2	Methodology	15
5.3	WRATE Default Incineration Processes.....	16
5.4	Creating User Defined Processes.....	16
5.5	Results	17
5.6	Conclusions.....	20
6.0	CONCLUSIONS.....	23
7.0	REFERENCES.....	25
8.0	CLOSURE.....	27

TABLES

Table 5-1	Incinerator WRATE Process Options	16
Table 5-2	Modifications to Default Processes.....	17

FIGURES

Figure 2-1	Project Gwyrdd Authority Boundaries	4
Figure 4-1	Valued and Weighted Sustainability Appraisal Scores for South East Wales	13
Figure 5-1	WRATE Default Waste Composition.....	15
Figure 5-2	Direct, Indirect and Avoided Life Cycle Global Warming Potential (tonnes CO ₂ eqv)	19
Figure 5-3	EfW Carbon Footprint	20

1.0 INTRODUCTION

1.1 Background

Viridor Limited has commissioned SLR Consulting Limited (SLR) to undertake an assessment of the greenhouse gas emissions (or the "Carbon Footprint") that will be generated throughout the lifetime of the proposed Energy from Waste and Recycling Facility at Trident Park, Cardiff. This report details the assessment methodology, as well as its results, and any assumptions made in the assessment. The emissions related to other forms of waste treatment including landfill and Advanced Thermal Treatment options have also been assessed in order to enable comparison and to demonstrate the advantages associated with the proposed EfW facility.

1.2 Structure of Report

The report comprises seven sections that set out the background to the project, the intended development, regional planning guidance and projected greenhouse gas emissions from the development.

- Section 1 - Introduction
- Section 2 – The Proposed Development
- Section 3 - Policy, Guidance and Indicators Review
- Section 4 - South East Wales Regional Waste Plan 1st Review
- Section 5 – WRATE Analysis of Proposed Development
- Section 6 – Conclusions
- Section 7 – References

2.0 THE PROPOSED DEVELOPMENT

The site of the proposed development is located some 2 kilometres south-east of Cardiff City Centre and immediately north of Cardiff Docks, at Trident Park. The facility is to be situated on currently derelict land on the site of the former Nippon Electric Glass cathode ray tube components factory which ceased production in 2005. The application site extends to 4.63 hectares.

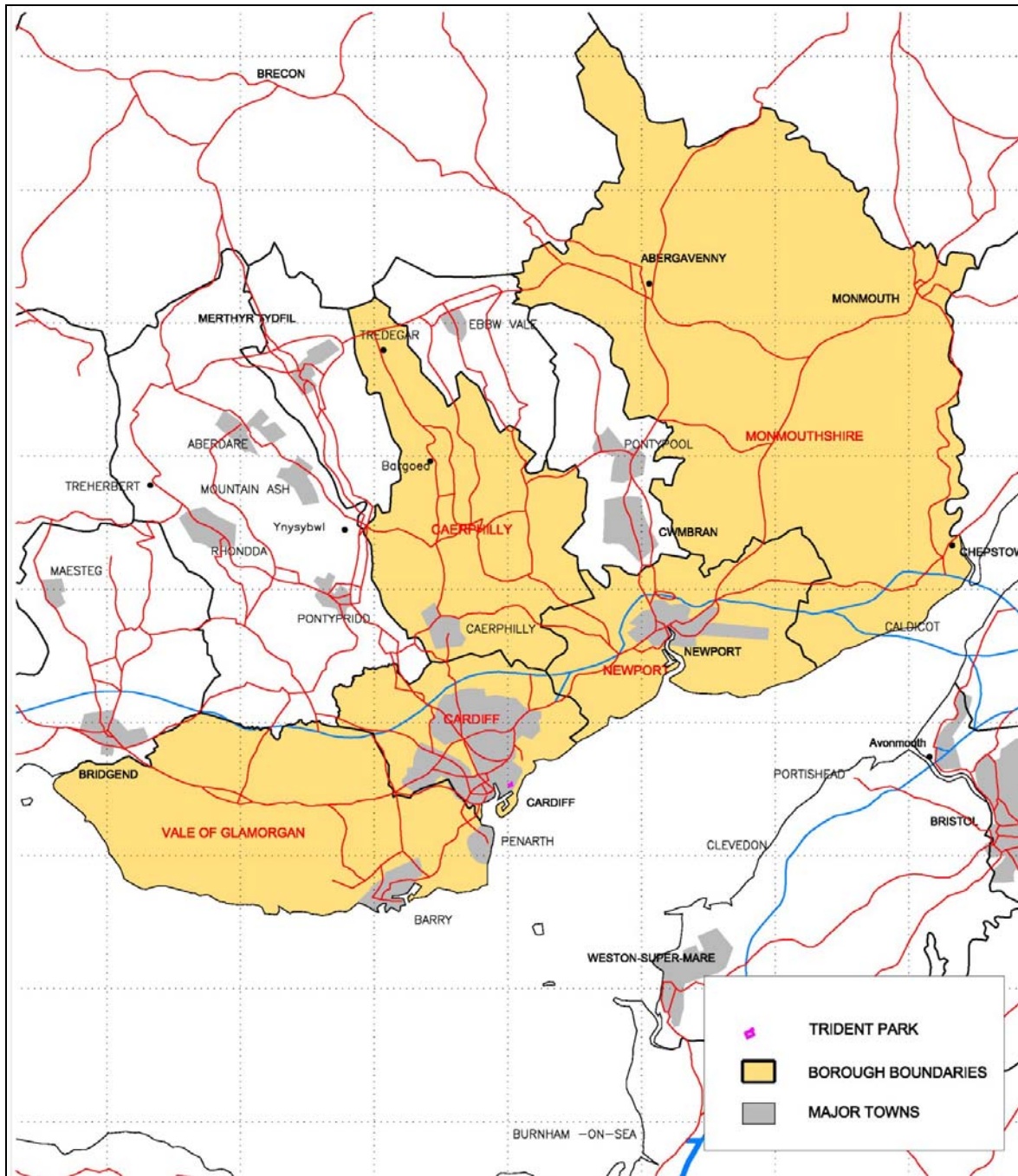
The site is set within an urban environment, with light, medium and heavy industries units and commercial facilities in the immediate locality, including the operational Port of Cardiff and the two Celsa steelwork facilities.

It is proposed that the EfW facility could provide waste management services to the five local authority members of "Project Gwyrdd", a consortium of authorities seeking a unified waste management strategy for the future. The five authorities are:

- Cardiff Council;
- Caerphilly County Borough Council;
- The Vale of Glamorgan Council;
- Newport City Council; and
- Monmouthshire Council.

The extent of the Project Gwyrdd area is shown in figure 1.1

Figure 2-1
Project Gwyrd Authority Boundaries



2.1.1 The Energy from Waste Process

The proposed facility will be an Energy from Waste (EfW) plant with Combined Heat and Power (CHP), designed to accept some 350,000 tonnes per year of non-hazardous residual waste. The EfW facility will use proven, highly regulated technology to extract energy from the residual wastes that remain after materials suitable for recycling and composting have been removed. The waste incineration process will involve the reception of waste from roadside collection vehicles (RCVs) and bulk vehicles into a reception bunker in a sealed hall with quick-closing doors to prevent noise and odour release. The waste will then be transferred via a grab crane to a "moving-grate" type combustion chamber, where the waste is combusted at high temperature to ensure complete combustion. The hot flue gases are then used to generate steam which drives turbines and potentially provides heat to a district heating system or for nearby industrial processes. The gases are then cleaned using a dry Selective Non-Catalytic Reduction (SNCR) process and bag filtering to prevent environmental harm and comply with strict emission limits specified by legislation.

The waste will be handled by two identical lines running in parallel to each other, such that if maintenance on one was necessary, the facility will not have to shut down completely at any one time. The facility will produce around 30MW of electrical energy to be supplied to the national grid, and 70MW of thermal energy which could potentially be supplied to premises in the local area. The facility is designed to be operational for 25 years.

2.1.2 Incinerator Bottom Ash Facility

It is proposed that Incinerator Bottom Ash, a by-product of the combustion process, will be treated to produce aggregate material at an on site plant adjoining the EfW. The material will be moved from the EfW via a covered conveyor to the bottom ash facility.

The bottom ash material is wet on leaving the EfW and needs to be matured and turned for between 4-6 weeks before it can be processed for aggregate. At full capacity it is estimated that the plant will produce approximately 75,000 tpa of recycled aggregate for the local market.

2.1.3 Pre- Treatment Area

The proposed pre- treatment area at the western end of the EfW building will ensure that any unsuitable residual waste delivered to the site can be 'picked-out' or shredded to increase the efficiency of the facility. Waste materials will be delivered into the building and deposited within a designated tipping area. From here material will be screened and sorted prior to being moved to the waste bunker

2.1.4 The Site Infrastructure

The facility and its related infrastructure will comprise the following:

- a dedicated internal site access road network with weighbridge and weighbridge office;
- a waste reception area including a tipping hall and bunkers;
- storage silos – raw materials and fly ash;
- two boilers and grates;
- a flue gas treatment system;
- two stacks;
- turbines and generators;
- air cooled condensers;
- electrical connections to the national grid;

- offices and ancillary areas;
- a visitors centre;
- car-parking; and
- HGV parking areas.

This carbon footprint assessment has considered only the emissions relating to the plant infrastructure and operations, including the process itself, the construction of the facility, and the removal of residues. Emissions related to the transport of waste to the site, ancillary offices, staff transport and amenity facilities have not been included, as it is considered that these will largely be the same for all of the scenarios modelled and will be insignificant in their quantities in comparison to the main processes.

It should be noted however that the current nature of waste management and disposal in South East Wales is such that there are likely to be significant carbon savings in terms of the transport of material. For example, all residual waste from Monmouthshire is currently transported to Wiltshire in England, and the residual waste from Vale of Glamorgan is delivered to Trecatti Landfill in Merthyr Tydfil. The relatively central location of Trident Park in terms of the sub-region means that the number of kilometres the average tonne of waste is likely to travel is significantly reduced from the existing scenario.

3.0 PLANNING POLICY, GUIDELINES AND INDICATORS

3.1 Introduction

The management of waste is a key issue in national and local planning policy, and all relevant policy identifies a "waste hierarchy" in order of preference of waste management options. This is usually cited as:

- prevent / eliminate waste;
- reduce generation of waste;
- re-use waste;
- recycle waste;
- recover energy from waste; and
- sensitively dispose of waste.

Any development that enables local waste management to be moved up the hierarchy is in line with planning policy objectives and as such, EfW with CHP is considered to be an improvement on the current situation of a landfill-led strategy. This approach is reflected in several national, regional and local planning and environmental guidance documents, as reviewed below, demonstrating the commitment of government to move towards a more sustainable means of waste management.

3.2 Planning Policy Wales (WAG, 2002)

Planning Policy Wales states the waste hierarchy, and the importance of moving up the hierarchy to increase the sustainability of waste disposal in Wales. Specifically (Para.12.5.2):

"The UK Government's general policy towards waste management is based on a hierarchy of reduction, re-use and material recovery (including recycling and composting), energy recovery with effective use of waste heat, and safe disposal. A sustainable approach to waste management will require greater emphasis on reduction, re-use and recovery and less reliance on disposal without recovery."

Also, regarding issues of transport emissions due to the transportation of waste prior to disposal, the policy states (Para 12.5.3):

"Waste should be managed (or disposed of) as close to the point of its generation as possible, in line with the proximity principle."

The policy also discusses renewable energy generation as a means of reducing greenhouse gas emissions and increasing sustainability in Wales (Para 12.8.6):

"Consequently, the Assembly Government is committed to:

- *Achieving its specific targets for renewable energy (electricity) production*
- *Maximising the opportunity for renewable energy (heat)*
- *Where possible combining the two in combined heat and power systems*
- *Recognising the benefits of renewable energy as part of its overall commitment to reduce greenhouse gas emissions."*

Also discussing the facilitation of renewable energy facilities in Wales (Para 12.8.12)

- *“Local Planning Authorities should facilitate the development of all forms of renewable energy and energy efficiency and conservation measures which fit within a sustainable development framework.”*

3.3 Environment Strategy for Wales (WAG, 2006)

The Environment Strategy for Wales sets out the hierarchy for waste treatment options. The hierarchy reads in order of sustainability (P29):

Reduce material use and eliminate waste: *Make most effective use of materials – minimise materials required and maximise the amount used productively*

Reuse and Repair: *Design to facilitate this – support a culture change and move away from viewing materials and products as disposable or throwaway. Reuse and repair buildings, including, where appropriate the reuse of traditional materials*

Recycle: *Recover resources to reuse – waste as a source of materials for industry and business and composting of waste to return to the land in a beneficial form*

Derive any other benefits: *Manage the residual waste we cannot reduce, reuse or recycle by extracting energy*

Landfill or incinerate without energy recovery: *As a last resort*

The strategy also addresses sustainable materials production and waste strategies, stating as a sustainable option:

- *Producing energy from waste that cannot practically be recycled*

3.4 Technical Advisory Note 21: Waste (WAG, 2001)

Technical Advisory Note (TAN) 21: Waste, sets out a framework for the development of sustainable waste management in Wales, and identifies a number of options including Energy from Waste technologies:

“4.8 Another potential role for the waste resource is as a fuel. Recovery of energy can be done in a number of ways, including direct incineration of parts of the waste arising that are otherwise of limited use, or from collection and combustion of recovered gases (such as landfill gas). Proposals that incorporate combined heat and power plant could contribute toward district heating schemes for development such as schools or hospitals, providing these are environmentally acceptable. This makes the recovery of energy more efficient and it would potentially reduce the impact of using primary fuels.

4.9 Energy recovery via incineration is known not to be popular with some sectors of the public, even though the industry is now using cleaner and safer technologies than ever, with vastly reduced and controllable emissions. In a policy area that is aiming to rely less and less on landfill, the potential for energy from waste facilities is growing although it is likely that only a limited number of energy from waste schemes will be necessary or acceptable in Wales in the next 10 years. Local planning authorities should work closely with the Environment Agency and the waste management industry to consider the future role of such facilities in an integrated network and in accordance with BPEO principles.”

Tan 21 also sets targets for waste diversion from landfill and energy recovery:

“D7 Waste Strategy 2000 (England and Wales) sets out that we are to recover value (via recycling, composting, energy recovery) to meet the following targets (although these may change in the Wales Waste Strategy):

- *recover value from 40% of municipal waste by 2005*
- *recover value from 45% of municipal waste by 2010*
- *recover value from 67% of municipal waste by 2015”*

3.5 South Glamorgan (Cardiff Area) Replacement Structure Plan 1991-2011 (Cardiff City Council, 1997)

The structure plan, adopted in 1997, states under Environment Policies:

EV1. Proposals which encourage sustainable practices and are consistent with other development plan policies will be favoured, including:

- l) Proposals which contribute to energy conservation or energy efficiency, waste reduction and recycling, improved pollution control, biodiversity and reduction of dependency on fossil fuels;*

3.6 Cardiff Local Development Plan 2006-2021 - Preferred Strategy Report (Cardiff Council, 2007)

The new Local Plan for Cardiff is currently at an early stage of development, but contains some reference to sustainable waste management practices, for example, in paragraph 4.9:

The Strategy identifies the following environmental priorities of particular relevance to the LDP:

- *To promote sustainable development and a clean environment;*
- *To respond to urgent global problems, like climate change, and balance growth and development against environmental imperatives;*
- *To develop sustainable waste management practices;*

The Local Plan Preferred Strategy also aims to pursue as one of its main objectives:

- 4. Reduce emissions of greenhouse gases that cause **Climate Change** and adapt to its effects – including promoting energy conservation and efficiency, renewable energy generation, sustainable land use patterns and travel options, and reducing vulnerability to flood risk and climate change;*

It can be seen that the relevant planning policy places an emphasis on sustainability in all areas, including waste management. This includes reducing carbon emissions and overturning the current reliance on landfill for waste disposal.

4.0 SOUTH EAST WALES REGIONAL WASTE PLAN

4.1 Regional Waste Plan Overview and Development

The South East Wales Regional Waste Group (SEWRWG) is responsible for preparing, monitoring and reviewing the South East Wales Regional Waste Plan (SEWRWP). The first RWP was published in 2004 (WAG, 2004) and provided a framework for managing wastes within the region in accordance with best practice and modern environmental standards.

In 2007 the RWP was subject to its first review, in which a variety of waste management options were considered using various tools, such as a lifecycle impact assessment, sustainability review, health impact assessment and environmental studies. These studies are being used to revise and update the 2004 RWP, and publication is expected during the latter part of 2008.

The environmental and sustainability aspects of the review were published in the Sustainability Appraisal and Life Cycle Analysis (LCA-SA), undertaken by the Environment Agency (Environment Agency, 2008). The LCA-SA assessed environmental, socio-economic and implementation issues associated with each waste management option through the use of 22 sustainability indicators. Indicator scores were generated using quantitative means, generic data and professional judgement. By taking account of such a wide variety of indicators, the SA methodology is considered to provide a robust and comprehensive approach to identifying 'preferred options' for waste management in the region (SEWRWG, 2008).

The quantitative aspect of the assessment compared the environmental performance of the various options under consideration using the Waste and Resources Assessment Tool for the Environment (WRATE) software tool. WRATE was developed by the Environment Agency for comparing different management systems and technologies treating Municipal Solid Waste (MSW) over the lifetime of the treatment option. The software was released in 2007 and the review of the RWP was the first ever project to be delivered using WRATE (Environment Agency, 2008).

This chapter describes the scenarios and conclusions from the LCA-SA.

4.2 LCA-SA Options

4.2.1 Introduction

A total of 19 waste management options, divided into five categories, were considered in the LCA-SA study. Each category covered a key waste management approach, such as landfill, thermal treatment, etc. In all instances it was assumed that a high level of recycling and composting had already taken place, hence the waste management option was only applicable to the residual waste fraction, comprising around 50% of the MSW collected. Each of the five categories and associated options are detailed below.

4.2.2 Option 0: A 'do nothing' strategy

This option was included for assessment purposes only, as a baseline to compare the other options against. Front end levels of recycling / composting have been applied as in all the other options, but with no further treatment, projected on to tonnages arising in 2013.

4.2.3 Option 1: A landfill led strategy for residual waste

High recycling and composting levels with *low* levels of thermal treatment of residual waste using either:

- Pyrolysis (sub-Option 1A); or
- Gasification (sub-Option 1B); or
- Incineration with energy recovery (sub-Option 1C).

All remaining residual waste will then be sent to landfill. Recycling / treatment levels are those required to achieve the 2020 BMW Landfill Directive target in 2013.

4.2.4 Option 2: An energy from waste led strategy for residual waste

High recycling and composting levels with all remaining residual wastes, where possible, being managed by *high* levels of thermal treatment using either:

- Pyrolysis (sub-Option 2A); or
- Gasification (sub-Option 2B); or
- Incineration with energy recovery (sub-Option 2C); or
- Anaerobic Digestion (sub-Option 2D).

Any remaining residual waste will then be sent to landfill. Recycling levels are those required to achieve the 2020 BMW Landfill Directive target in 2013. Energy from Waste levels aims to minimise waste to landfill.

4.2.5 Option 3: An MBT / BMT led strategy for residual waste

High recycling and composting levels with all remaining residual wastes managed by MBT / BMT with the output recovered / disposed of using either:

- Pyrolysis (sub-Option 3A); or
- Gasification (sub-Option 3B); or
- Incineration with energy recovery (sub-Option 3C); or
- RDF to off-site energy use (sub-Option 3D); or
- On-site Anaerobic Digestion (sub-Option 3E); or
- Landfill (sub-Option 3F).

For sub-Options 3A-3E, any remaining residual waste will then be sent to landfill. Recycling levels are the maximum possible – may exceed those required to achieve the 2020 BMW Landfill Directive target in 2013.

4.2.6 Option 4: An autoclave led strategy for residual waste

High recycling and composting levels with all remaining residual wastes managed by Autoclave with the output recovered / disposed of using either:

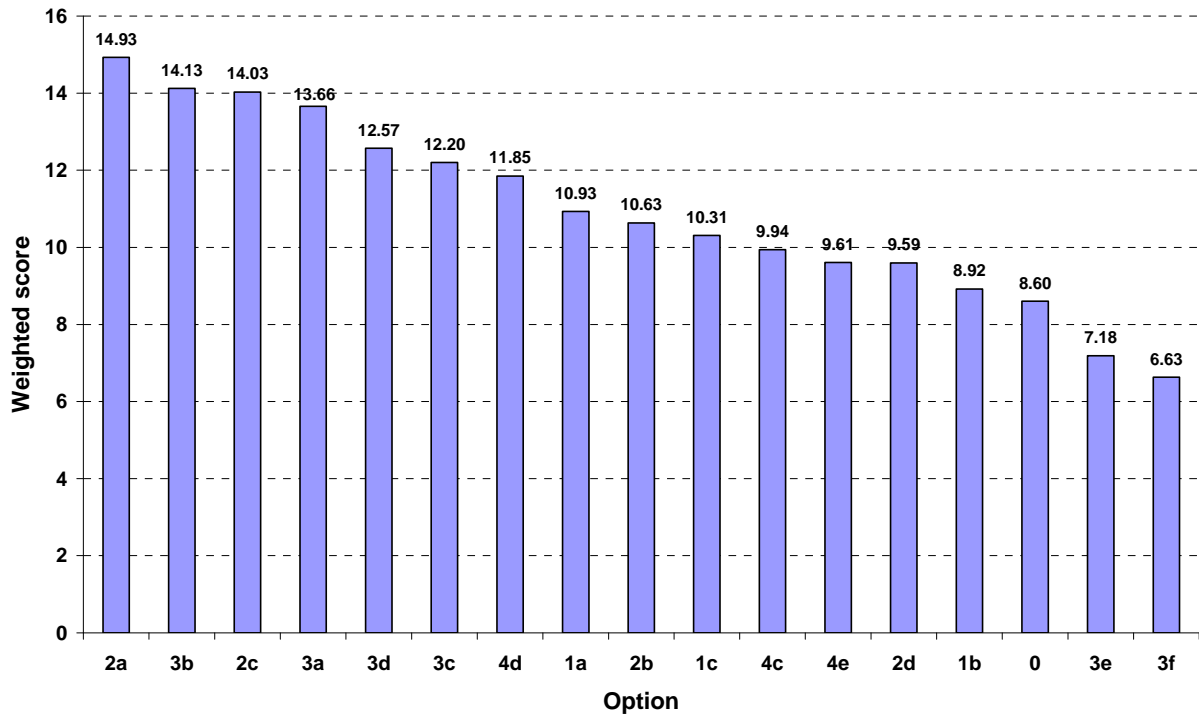
- Pyrolysis (sub-Option 4A); or
- Gasification (sub-Option 4B); or
- Incineration with Energy Recovery (sub-Option 4C); or
- RDF to off-site energy use (sub-Option 4D); or
- Landfill (sub-Option 4E).

For sub-Options 4A-4D, any remaining residual waste will then be sent to landfill.

4.3 LCA - SA Results and Conclusions

The autoclave led options 4A and 4B were not assessed, as fibre produced from autoclaving was considered by the Environment Agency to be unsuitable for advance thermal treatment (pyrolysis / gasification). Consequently only 17 options were evaluated. The results from the LCA-SA, as presented in the final document (Environment Agency, 2008), are shown in Figure 4-1; the higher the score the better the performance of the option.

Figure 4-1
Valued and Weighted Sustainability Appraisal Scores for South East Wales



As can be seen above, the best performing options are high source segregated recycling and composting levels are option:

- 2a – with all remaining residual wastes, where possible, being managed by high levels of pyrolysis;
- 3b – with all remaining residual wastes being managed by MBT followed by gasification;
- 2c – followed by incineration with energy recovery;
- 3a – with all remaining residual wastes being managed by MBT followed by pyrolysis;
- 3d – with all remaining residual wastes being managed by MBT followed by RDF to offsite energy use;
- 3c – with all remaining waste being treated using MBT followed by incineration; and
- 4d – with all remaining residual wastes being managed by autoclave followed by RDF to offsite energy use.

The discussion of the results presented in the LCA-SA study raised questions over whether gasification and pyrolysis were suitable technologies, on the grounds that they have no track record of treating MSW in the UK. The suitability of autoclaving and other options reliant on off-site users of refuse-derived fuel (RDF), such as cement kilns, was also questioned on the grounds that there is unlikely to be sufficient capacity to take the mass of RDF produced. In conclusion the LCA-SA stated that Options 2C and 3C may look like the more attractive and deliverable options. From the information provided in Figure 4-1, Option 2C (high source segregated recycling, followed by incineration with energy recovery) is the more sustainable of these options. A WRATE assessment of the energy from waste facility is provided in Section 5.0.

5.0 METHODOLOGY OF WRATE ANALYSIS OF PROPOSED FACILITY

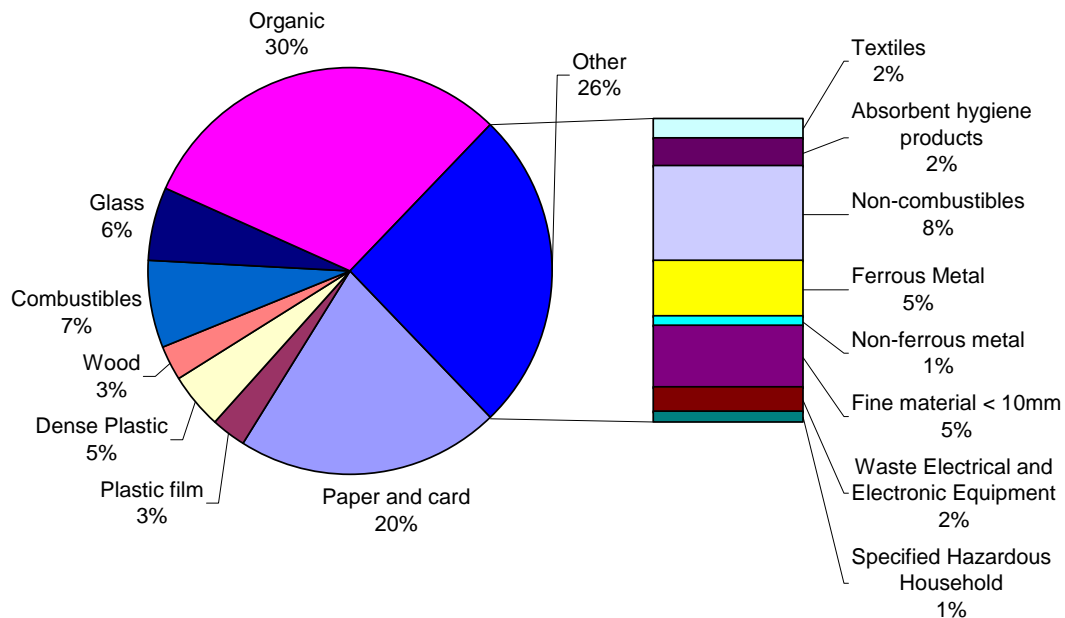
5.1 Introduction

The WRATE assessment undertaken as part of the RWP included an evaluation of greenhouse gas emissions. This considered all waste arisings from south east Wales in 2013, amounting to over 5 million tonnes. The proposed Trident Park EfW will process around 350,000 tonnes of municipal and commercial / industrial waste. To evaluate the impact of the proposed development a site-specific WRATE assessment was undertaken, comparing emissions from the business as usual scenario, in which all waste is sent to landfill, with the proposed energy from waste facility. The purpose of this was to understand the relative difference from the base case.

5.2 Methodology

SLR has developed a WRATE project to assess the impact of processing 350,000 tonnes of waste in the year 2013 (the proposed first year of operation). The project compares the impacts of landfill disposal (as the baseline situation) with treatment via Energy from Waste (based on a process designed with the technology parameters of the Trident Park process). The Trident Park facility is designed to accept municipal waste and industrial/commercial wastes which are similar in nature to municipal wastes; the WRATE default composition has been applied to the input waste, as detailed in Figure 5-1.

**Figure 5-1
WRATE Default Waste Composition**



The WRATE models discussed herein and the results presented relate to the carbon footprint of the technology (treatment and disposal) processes only; collection, transportation and transfer of the waste to the treatment facility are discounted, as it is assumed that the impacts will be comparable across the scenarios in the year 2013.

5.3 WRATE Default Incineration Processes

The WRATE LCA tool currently contains 7 (seven) default incinerator processes that the user can choose to model; these processes are summarised below in Table 5-1.

**Table 5-1
Incinerator WRATE Process Options**

Location	WRATE process name	Process type	Capacity (tpa)
Billingham	Incinerator large, power BILLINGHAM (11264)	Moving grate	225,000
Coventry	Incinerator large, heat and power COVENTRY (13041)	Moving grate	315,000
Sheffield	Incinerator large, district heat and power SHEFFIELD (21309)	Moving grate	225,000
Grimsby	Incinerator medium, heat and power GRIMSBY (11262)	Oscillating kiln	56,000
Chineham	Incinerator medium, power CHINEHAM (12300)	Moving grate	95,000
Dundee	Incinerator medium, power DUNDEE (11047)	Fluidised bed	120,000
Shetland	Incinerator small, district heating SHETLAND (11048)	Moving grate	26,000

5.4 Creating User Defined Processes

The WRATE software allows the creation of 'user defined' processes to allow an assessment of an actual or proposed facility. Creating a user defined process involves using the background database for a facility from Table 5-1 as a template, and modifying the more sensitive elements of the database with facility specific values.

The Coventry facility is deemed the most suitable template to modify with Trident Park specifications for the following reasons:

- It is a large process (with a capacity of 315,000 tonnes per annum), similar in size to the Trident Park facility;
- the facility operates moving grate technology, the system proposed for Trident Park;
- Coventry utilises dry gas abatement technology, comparable to that proposed for Trident Park; and
- The facility has the ability to model CHP in addition to power only; the Trident Park facility will generate electrical power, and (if a suitable industrial user or district heating scheme is devised) recover heat.

Operational parameters and process information was provided for the Trident Park facility, by Viridor. The EfW technology is supplied by CNIM.

SLR modified the default Coventry process to be more reflective of the proposed technology solution at Trident Park. Table 5-2 below outlines the modification to the Coventry template. Where process details were modified, the data were prorated from the Trident Park data to the throughput of the default process to maintain representativeness.

**Table 5-2
Modifications to Default Processes**

Modification	Coventry
Operation fuel inputs / Energy Inputs	
Remove quantity of natural gas purchased	✓
Modify quantity of light fuel oil purchased (for burner start up)	✓
Modify quantity of electricity purchased	✓
Operational material inputs (gas treatment)	
Modify input quantity of activated carbon	✓
Modify input quantity of lime	✓
Include input quantity of urea powder	✓
Modify input quantity of caustic soda	✓
Modify input quantity of Hydrochloric acid	✓
Process energy production	
Modify quantity of electrical energy generated	✓
Modify quantity of heat recovered	✓
Process emissions	
Modify quantity of carbon dioxide (fossil and biogenic) emitted	✓
Modify quantity of water vapour emitted	✓
Modify quantity of nitrogen oxide emitted	✓
Modify quantity of nitrous oxides emitted	✓
Modify quantity of dioxins/furans emitted	✓
Modify quantity of hydrogen chloride emitted	✓
Modify quantity of sulphur oxides emitted	✓
Modify quantity of particulate matter emitted	✓
Modify quantity of cadmium, thallium, chromium, mercury emitted	✓
Modify quantity of ammonia emitted	✓
Modify quantity of water discharge	✓
Process output / Process waste outputs	
Modify quantity of ferrous metals recovered for recycling	✓
Modify quantity of APC residues produced	✓
Modify quantity of bottom ash produced	✓

Note: Original default figures and the modified Trident Park EfW figures prorated to the process throughput are contained within supporting spreadsheet files.

5.5 Results

5.5.1 Overview

Two scenarios were modelled using the WRATE tool, and the life cycle impact for global warming potential assessed:

- Waste to landfill as the baseline scenario to allow benchmarking; and
- Waste to EfW using modified WRATE processes incorporating anticipated Trident Park performance data.

Within the energy from waste scenario a number of sub scenarios have been assessed to demonstrate the impacts of recovering electrical power only, recovering heat (in addition to electrical power) and recycling the incinerator bottom ash.

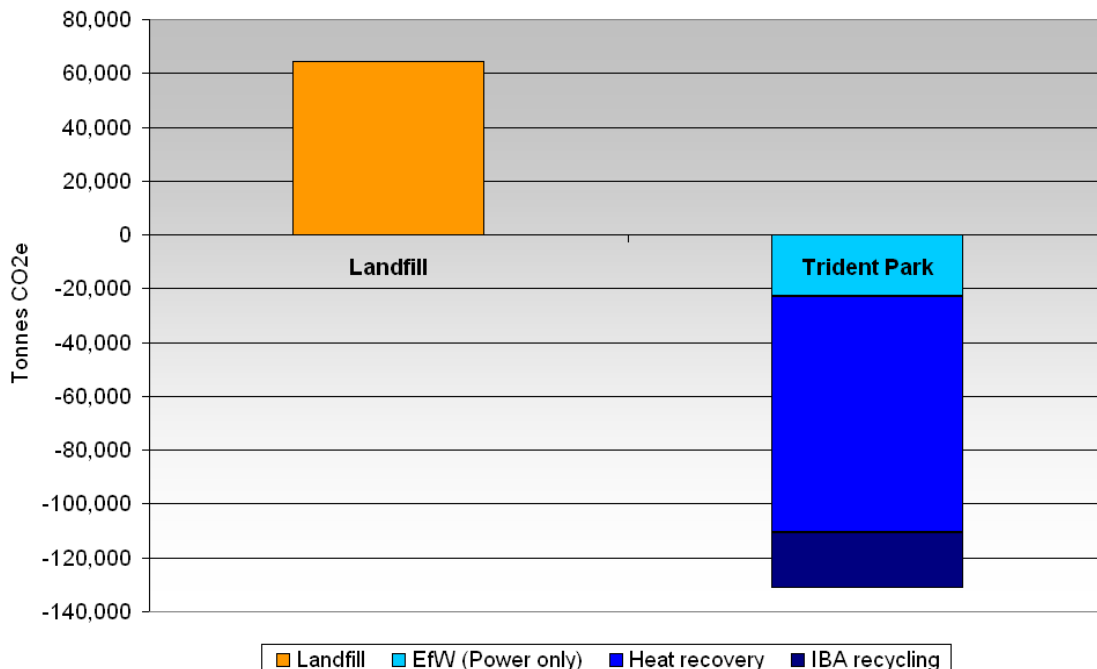
Results from modelling the above scenarios in WRATE are presented in Figures 2 and 3. The life cycle impact 'global warming potential (GWP)' measures the impact of gases (carbon dioxide, methane, nitrous oxide and other global warming gases) on the environment. Each gas species has a differing impact on the warming of the environment; for convenience values are normalised to carbon dioxide equivalent (CO₂eqv). The life cycle impact GWP is commonly referred to as the carbon footprint.

The values presented in the following charts are tonnes of carbon dioxide equivalent (tonnes CO₂eqv); a positive value is an environmental burden, where as a negative value demonstrates an avoided burden or carbon saving.

5.5.2 Comparison of Trident Park against Landfill

The carbon footprint of the baseline scenario (waste to landfill) is compared against the Trident Park modified Energy from Waste processes in Figure 5-2. Landfill of waste exhibits a clear environmental burden when compared to Energy from Waste as an alternative treatment, which demonstrates not only a reduction in carbon footprint, but an avoided burden of CO₂eqv emissions.

Figure 5-2
Life Cycle Global Warming Potential (tonnes CO₂eqv)



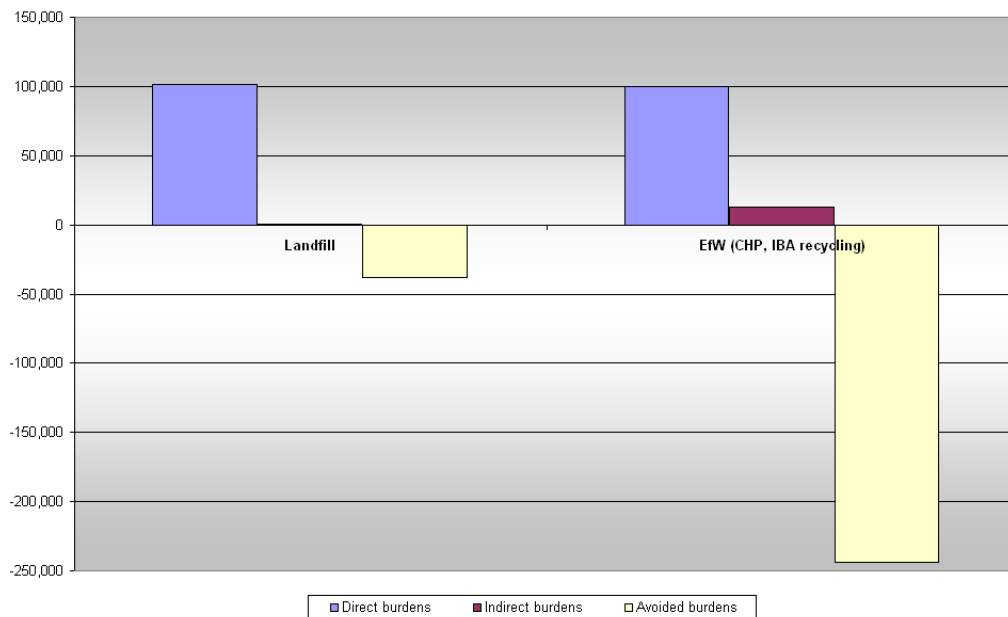
The results in 5-2 illustrate the carbon footprint of Trident Park facility generating power only, recovering heat (in addition to power generation) and details the additional environmental benefits or recycling incinerator bottom ash. As shown in Figure 5-2 the recovery of heat

has a significant impact on the overall avoided environmental burdens associated with Energy from Waste, accounting for approximately two thirds (-88,000 tonnes CO₂eqv) of the avoided burdens. The recycling of incinerator bottom ash results in an avoided burden of approximately 21,000 tonnes CO₂eqv.

The credit for the heat recovery component of this scheme is considered appropriate, as there is clear evidence of use of heat in the neighbouring buildings around the proposed development. Information on the potential for this is provided in the Heat Plan associated with this application.

Figure 5-3 shows the scenarios sub-divided into direct emissions, indirect emissions and avoided emissions to provide further analysis of the main sources of environmental burdens and avoided burdens.

Figure 5-3
Direct, Indirect and Avoided Life Cycle Global Warming Potential (tonnes CO₂eqv)



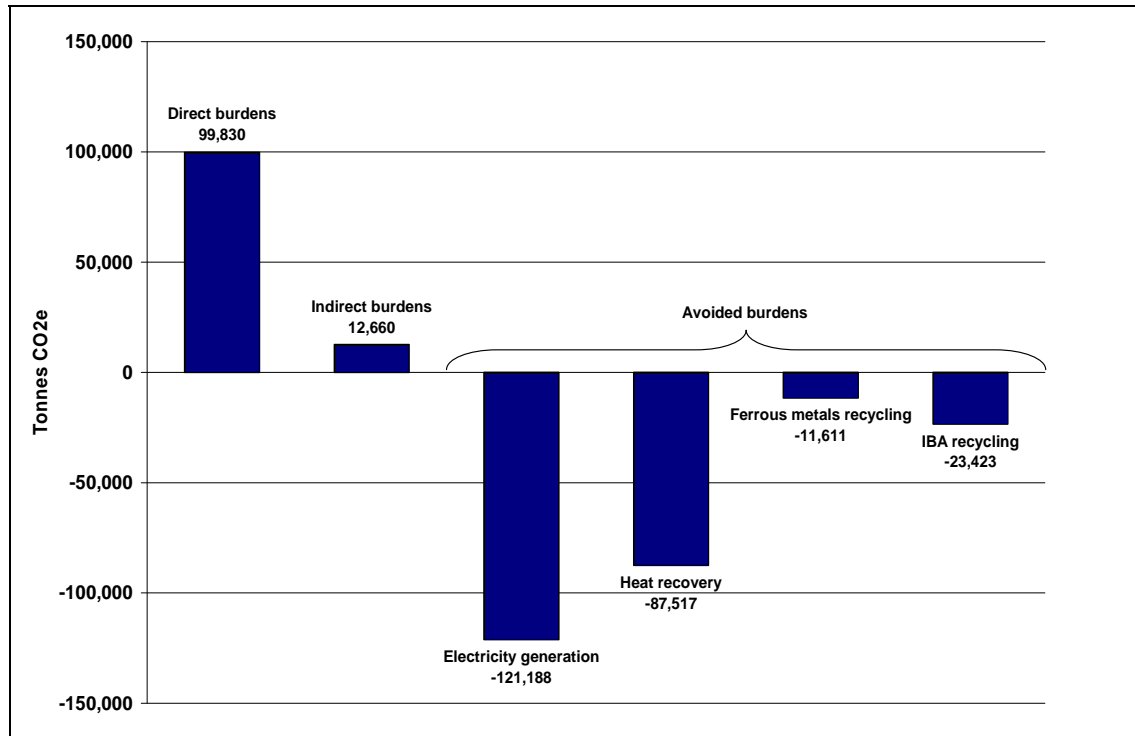
Direct burdens result from the direct processing of waste in the landfill or EFW facility; direct burdens are shown to have a large positive impact on the environment, with the direct burdens for EFW being slightly lower than those associated with landfill.

Indirect burdens result from construction, maintenance, energy input and operational materials. The energy from waste process clearly exhibits greater indirect impacts than those associated with landfill. The majority of the indirect burdens for energy from waste are associated with operational material inputs (chemicals for gas and water treatment) which have high embodied energy contents due to the large degrees of processing required.

Avoided burdens include the benefits of recycling materials (for example metals or the incinerator bottom ash) and generating electricity and/or heat. The landfill scenario contains an avoided burden which is associated with the capture of landfill gas and subsequent combustion of methane to generate electricity. The avoided burdens for Trident Park are considerably greater, and these are associated with the recycling, the electrical energy and heat recovery. Electricity and heat generation from waste offset the extraction, processing and combustion of fossil fuels, which is a positive benefit for the environment.

A detailed breakdown of the make-up of the avoided burden is provided in Figure 54, which demonstrates that the largest reduction in emissions arises from the power generation aspect of the development, saving over 120,000 tonnes CO₂eq per year.

**Figure 5-4
EfW Carbon Footprint**



The net electricity sold from the Trident Park development to the grid is estimated at around 180GWh per year. In 2006 domestic energy consumption in Cardiff City was 561.3Gwh (BERR, 2008). Consequently the Trident Park EfW facility will provide approximately 30% of Cardiff's domestic electricity demand.

5.6 Conclusions

This report presents the environmental burdens (specifically global warming potential commonly known as carbon footprint) for the processing of 350,000 tonnes of waste (with a composition comparable to municipal solid waste) through a modified (user defined) Energy from Waste treatment processes which represents the proposed Trident Park facility. Modelling has been carried out using the Environment Agency's Life Cycle Assessment Tool, WRATE.

The WRATE modelling results indicate that energy from waste results in a lower carbon footprint than landfill. The carbon footprint is negative, indicating that processing of waste through an energy from waste facility results in an overall carbon dioxide saving. The negative footprint is associated with the avoidance of conventional fossil based electricity and heat generation, the recovery of ferrous metal from the bottom ash, and subsequent displacement of virgin iron ore extraction and processing.

Displaced energy generation, in all cases, has a significant impact on the carbon footprint, because the modelling assumes displacement of coal and gas fired (fossil fuel) electricity generation. It is noted that the electricity aspect alone will provide approximately 30% of Cardiff City's domestic electricity demand.

The treatment of 350,000 tonnes of municipal type waste through an energy from waste facility results in an avoided burden of between -44,000 tonnes and -131,000 tonnes of CO₂eqv, depending on whether the facility generates electricity only, or recovers heat (with a suitable industrial or district heating end user), or a balance between the two. When compared to landfill (the baseline scenario), an overall carbon saving of between -108,000 tonnes and -196,000 tonnes will be achieved in the year 2013. Assuming the best case, that a user for the heat can be located and the maximum efficiency of the facility is achieved, the carbon footprint of the Trident Park facility is estimated to be in the order of -130,000 tonnes CO₂eqv in 2013.

In conclusion, through the use of the WRATE life cycle assessment software, it can be demonstrated that Energy from Waste yields a carbon footprint that is better than landfill. On this basis it is concluded that the proposed Viridor Trident Park EfW facility will result in a negative carbon footprint, that is, an overall reduction in global CO₂ emissions.

6.0 CONCLUSIONS

Viridor Waste Management Ltd is applying for planning permission to construct an energy from waste (EfW) plant at Trident Park in Cardiff for the treatment of 350,000 tonnes of municipal and industrial / commercial waste per year. The regional waste plan for South East Wales, prepared during 2007 and 2008, reviewed a number of options for the management of waste in the area. EfW was identified as one of the preferred options and, based on current knowledge of available technologies and UK experience, is identified as the most sustainable option for waste management in the area.

A WRATE assessment was undertaken as part of the regional waste plan preparation, and included an evaluation of carbon emissions from the process. The assessment was based on the total regional waste production, in excess of 5 million tonnes per year. This report evaluated the specific impact of the Trident Park proposal; for comparative purposes data were also generated for the baseline case in which all waste will be landfilled.

The results from the assessment indicated that approximately 130,000 tonnes per year of carbon dioxide equivalent emissions will be prevented as a consequence of power generating, which offsets fossil fuel combustion, heat recovery, which is a major component of the proposed scheme, and recycling of incinerator bottom ash. The comparative reduction in emissions when compared to landfilling of waste will be in excess of 190,000 tonnes carbon dioxide equivalent. Additionally the proposed development will provide over 30% of Cardiff's domestic electricity demand.

The carbon footprint of the development shows a clear reduction in emissions of greenhouse gases when compared with the base case, as a consequence of power generation, heat recovery and recycling of by-products. In conclusion therefore, the Trident Park proposal provides a waste management solution that is aligned with the sustainability criteria outlined in the regional waste plan and local waste strategies.

7.0 REFERENCES

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8.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

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