

Ardley Waste Management Facility

Energy Plan
Viridor Waste Management Ltd

Viridor

March 2010

CONTENTS

1.0	INTRODUCTION	3
1.1	The Proposed Development.....	3
1.2	Review of Planning Guidance.....	3
2.0	PROCESS DESCRIPTION	7
2.1	General Overview.....	7
2.2	Steam Generation.....	9
2.3	Power Generation.....	9
2.4	Heat Generation.....	11
3.0	EMISSIONS SAVINGS	14
3.1	Introduction.....	14
3.2	Comparison with alternate technologies.....	14
3.3	Introduction of heat export.....	15
4.0	PRACTICAL IMPLEMENTATION	17
5.0	EXISTING COMBINED HEAT AND POWER SCHEMES	19
5.1	UK Schemes.....	19
5.2	European Schemes.....	19
5.3	Viridor's EfW/CHP Background.....	20
6.0	POTENTIAL HEAT USERS	21
6.1	Introduction.....	21
6.2	North West Bicester Eco Town.....	21
6.3	Industrial/Offices/Laboratories/Warehouses.....	24
6.4	Leisure Centres and Swimming Pools.....	24
6.5	Shopping Centres and Supermarkets.....	24
6.6	Residential Developments.....	24
6.7	The Horticultural Industry.....	25
7.0	CONCLUSIONS	27

DRAWINGS

Location of EfW/CHP Plant and the NW Bicester Eco Town

APPENDIX

NW Bicester Eco Town Concept Study – Viability Assessment, June 2009

1.0 INTRODUCTION

1.1 The Proposed Development

It is proposed to develop an Energy from Waste (EfW) facility at the existing Ardley Waste Management Facility near Bicester in Oxfordshire. This facility will produce renewable heat and power and this Energy Plan has been prepared to identify potential users of this renewable energy and to demonstrate how the EfW relates to future planned developments in the Bicester area.

1.2 Review of Planning Guidance

1.2.1 National Context

The period from 2005 to 2007 was an important time for the development of Government policy on sustainable waste management and renewable energy and key statements of Government policy were published during this time changing the national policy framework for the consideration of energy from waste development proposals. These documents were as follows:

- Waste Strategy 2007;
- Meeting The Energy Challenge 2007;
- Planning Policy Statement: Planning and Climate Change (supplement to PPS 1) (2007);
- PPS 10 – Planning for Sustainable Waste Management (2005);

In addition the following national planning policy documents have been considered with regards to the proposal:

- PPS 1 Delivering Sustainable Development (2005);
- PPS22 – Renewable Energy (2004);
- PPS23 - Planning and Pollution Control (2004); and

1.2.2 Waste Strategy 2007

Waste Strategy 2007 (WS 2007) sets out the Government's vision for sustainable waste management and advises that any given technology is more beneficial if both heat and electricity can be recovered. It is therefore a considerable advantage if the proposed plant is sited to maximise the opportunities for Combined heat and Power.

1.2.3 Meeting the Energy Challenge (2007)

This Government White Paper was published in May 2007 and it identified the planning system as a key area of delay and uncertainty affecting the delivery of renewable energy schemes, which have a key role to play in reducing carbon emissions and achieving a security of energy supply. In identifying the planning system as a significant barrier the Government set out in this White Paper the following actions:

- applicants will no longer have to demonstrate the overall need for renewable energy or for their particular proposal to be sited in a particular location;
- encouraging planners to create an attractive environment for innovation in which the private sector can bring forward investment in renewable energy; and

- giving a clear steer to planning professionals and local authority decision makers that in considering applications they should look favourably upon renewable energy projects.

The White Paper then went on to set a statement on the need for renewable energy which acknowledges that renewable projects may not always appear to convey any particular local benefits to their host community but that they do provide crucial national benefits (reduced emissions and security of supply) shared by all communities and this is a material consideration which should be given significant weight. These wider benefits are not always visible to the specific locality where the project is sited, but the benefits to society and the wider economy are significant and these must be reflected in the weight given to these considerations by the decision makers.

1.2.4 PPS 1 and Climate Change Supplement (2007)

PPS1 states that planning should facilitate and promote sustainable patterns of urban and rural development by making land available for development in line with economic, social and environmental objectives and protecting and enhancing the natural environment. PPS1 also stresses the importance of ensuring high quality development through good design and the efficient use of resources.

The supplement to Planning Policy Statement 1 (PPS1) 'Planning and Climate Change' sets out how planning should contribute to reducing greenhouse gas emissions and stabilising climate change and is considered to represent an important development in Government policy in establishing the national need for renewable energy projects. It also confirms within the glossary that the Government considers energy from waste to be a form of renewable and low carbon energy.

The supplement confirms that planning authorities should develop policy frameworks that promote and encourage renewable energy projects and in particular planning authorities should:

- not require need for renewable energy to be demonstrated or why a proposal should be sited in a particular location; and
- ensure the approach to protecting town and landscapes does not preclude the supply of any type of renewable energy other than in exceptional circumstances.

The supplement set out key planning objectives for planning authorities. Of these the following two objectives are considered to be of key relevance with respect to heat generated from the EfW:

- make a **full contribution to delivering the government's climate change programme** and energy policy and contribute to global sustainability – the proposed EfW will deliver 24MW of renewable energy making a significant contribution to Government energy policy by reducing carbon emissions and providing security of supply. It will also divert waste from landfill in accordance with Government policy;
- in providing for homes, jobs and infrastructure needed by communities **secure the highest viable resource and energy efficiency and reduction in emissions** – energy from waste will deliver a significant reduction in emissions when compared to current waste management practices, will provide a source of renewable energy to communities and businesses and a potential source of heat to the NW Bicester eco town proposals as well.

1.2.5 The South East Plan

Policy NRM 11 on Development Design for Energy Efficiency and Renewable Energy requires that local authorities promote and secure greater use of renewable/low carbon energy and that they actively promote the use of renewable energy where opportunities such as with eco towns. The renewable power this development will provide and its proximity to the NW Bicester eco town therefore indicates that this scheme should be actively promoted by the local authorities to accord with policy NRM11. Policy NRM 12 on Combined Heat and Power encourages the integration of CHP in all developments and again the proximity of the development to the eco town proposals means that this is eminently deliverable.

Policy NRM 15 deals with the Location of Renewable Energy and indicates that it should be located to minimise adverse effects on landscape, wildlife, heritage and amenity all of which have been taken into account with the proposed development and that outside urban areas priority should be given to less sensitive areas of countryside including previously developed land and major transport areas. The Ardley site is considered to comply with these locational criteria as it does not have any adverse impacts on designated landscape, wildlife or heritage areas, it is an active waste management facility which adjoins an active mineral working (see locational criteria for waste management development, Policy W17) and it is in close proximity to a motorway junction. In addition the location and design of the proposed development has been informed by the landscape and visual impact assessment process with the Landscape Architect working closely with the EfW Architect.

Policy NRM 16 then sets out the Renewable Energy Development Criteria which confirms that planning authorities should in principle support renewable energy schemes and consider the following:

- The contribution the development will make to national, regional and sub regional targets for reducing CO₂ – the Ardley proposals will make a substantial (24MW) contribution and national policy stresses the significant weight that should be attached to the provision of energy from renewable sources;
- The potential to integrate with new or existing development – the Ardley scheme offers excellent potential to integrate with the NW Bicester eco town proposals;
- The potential benefits to host communities and opportunities for environmental enhancement – the PPS1 supplement on climate change emphasises the importance of considering the benefits to the wider community of reducing CO₂ emissions but the proposed development also incorporates an improved restoration scheme with biodiversity enhancements for the landfill and provides for substantial improvements to be undertaken to the surrounding rights of way network which is considered to be of benefit to the host community;
- Proximity of biomass plant to fuel source and the adequacy of the local highway network – The Ardley proposals are not biomass but the local highway network has been demonstrated to be adequate to serve the proposed development; and
- The availability of a suitable grid connection – a suitable grid connection at the Bicester sub station is available for the proposed development.

The proposed development is therefore considered to fully comply with the up to date renewable energy policies of the South East Plan and will help to achieve the regional and

sub regional targets as well as offering the potential for CHP to the NW Bicester eco town proposals.

1.2.6 Local Policy

The following local planning policy in Oxfordshire has been considered as part of this comprehensive energy plan:

- the Oxfordshire Minerals and Waste Local Plan, 1996;
- the Cherwell Local Plan, 1996;
- the non statutory Cherwell Local Plan, 2004.

The local policy framework for this part of Oxfordshire is substantially out of date and does not take account of the latest national or regional policy (PPS1 supplement on climate change, Waste Strategy 2007 and the South East Plan) on planning for waste management and renewable energy. It is therefore considered that national and regional policies are the most relevant for the proposed development.

2.0 PROCESS DESCRIPTION

2.1 General Overview

The proposed Energy from Waste facility is based around a conventional combustion design. This type of combustion system has been used worldwide for many decades. There are several hundred such plants operating throughout Europe processing residual Municipal Solid Waste (MSW). This technology has been developed to a mature level where technical risks are low and costs are well understood.

The energy from waste process involves the combustion of residual waste to heat water into high pressure steam, which is then fed through turbines to generate electricity. The steam is then cooled to condensing point so that the process can be repeated. Heat can be easily exported from the facility by extracting steam from the turbine, diverting the energy away from power generation and towards a heat customer.

2.1.1 Combustion Process

An advanced combustion control system closely controls the conditions in the combustion chamber. The grate and combustion system include the following main components:

Incineration Grate

The primary combustion takes place on a moving grate. The waste is moved mechanically by means of reciprocating or rotating grate elements from the feed end, through a drying zone, a main combustion zone and, finally, a burn-out zone. The functions of the grate are to move and mix the waste and to distribute primary combustion air evenly across the burning bed of material.

In the combustion zone, volatile materials are driven off by the heat and carbon and hydrogen contained in the solid materials are converted to carbon monoxide and water vapour.

In the burn-out zone, most of the remaining carbon is oxidised to carbon monoxide or carbon dioxide to ensure that the ash discharged from the grate contains no more than 3% by weight of combustible matter.

Secondary Combustion Chamber

The partially oxidised gases are fully oxidised in the secondary combustion chamber so that the flue gases contain mainly carbon dioxide, nitrogen, oxygen and water vapour. Secondary air is introduced into this chamber to help mix the hot gases by creating turbulence and to maintain adequate oxygen levels.

The combustion chamber is designed so that a minimum temperature of 850°C is maintained for a minimum of 2 seconds in the presence of at least 6% oxygen. This is to ensure that compounds containing carbon and oxygen are fully oxidised in the combustion process to carbon dioxide and water vapour.

Because of the presence of chlorine and sulphur in the waste, the gases also contain hydrochloric acid and sulphur dioxide. These are neutralised in the flue gas treatment plant described below.

Small quantities of certain metals which are present in the waste and evaporate in the combustion process are also present. These and any remaining organic compounds are also removed in the flue gas treatment plant.

Primary air fan

Primary air is drawn from over the bunkers by means of the primary air fan and fed up through the grate via a number of distribution ducts and dampers. These enable the air to be accurately distributed across the grate. The flow of primary air can be varied by inverter control of the fan motor in accordance with the rate of heat release on the grate. The primary air also serves to keep the grate cool.

Secondary air fan

The secondary air fan supplies the secondary combustion chamber. The distribution of the secondary air between the front and the back of the furnace can be varied to optimise combustion conditions. Again, the flow of secondary air is varied by inverter control of the fan motor.

The secondary air is drawn from high level in the boilerhouse to provide some cooling air circulation at the top of the boilers.

NO_x Reduction

Oxides of nitrogen (NO_x) are produced in the combustion process due to nitrogen in the fuel and the combustion air. The new installation is designed to meet the stringent conditions which will be imposed by the proposed EC legislation for the incineration of waste. It is not possible to achieve the extremely low NO_x emission levels required by this legislation solely by combustion optimisation. The new boiler will therefore be equipped with ammonia injection into the secondary combustion chamber. The ammonia reacts with the oxides of nitrogen and converts a proportion back to nitrogen and water. This process is known as Selective Non-Catalytic reduction (SNCR).

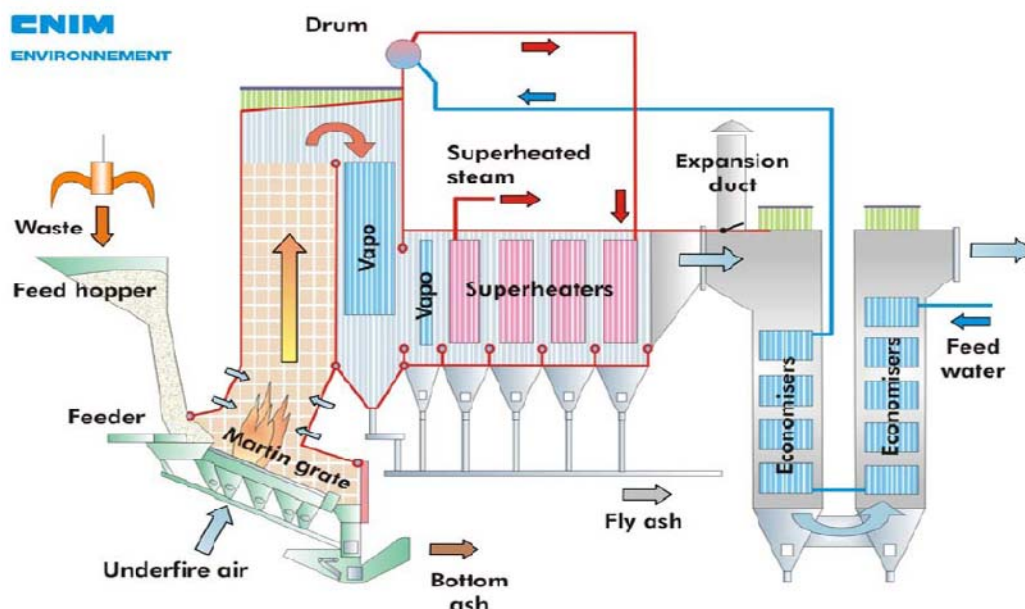
The equipment will include ammonia storage and circulating facilities as well as injection lances to introduce the ammonia into the combustion chamber.



Typical CNIM moving grate design.

2.2 Steam Generation

Heat generated from the combustion of waste is used to generate steam, which is then used to generate power or as heat transfer medium for heat export. Steam is generated through the transfer of energy in the combustion exhaust gas (known as the flue gas) to the boiler feed water or steam, depending on the position in the boiler. Energy transfer occurs in a series of tube heat exchangers located in the path of the flue gas. The flow of flue gas and water/steam through the boiler is illustrated below.



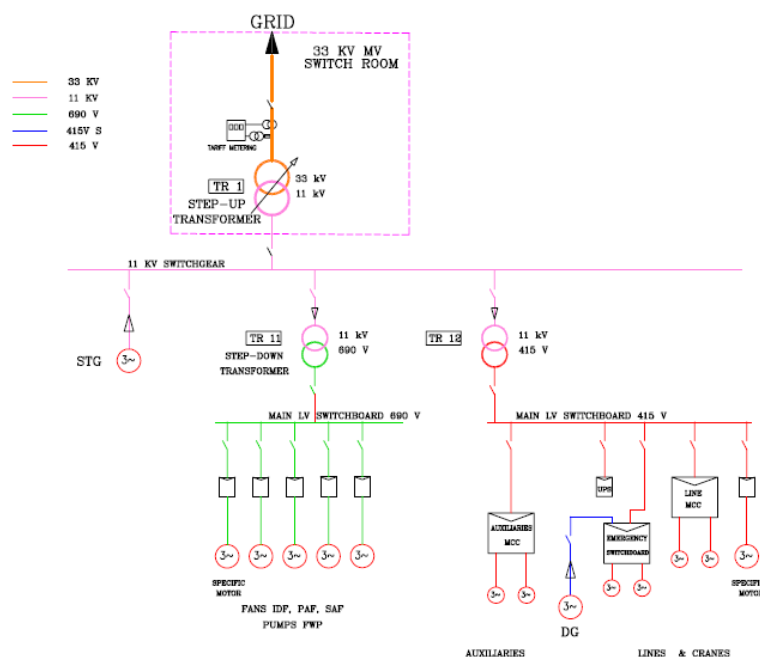
To keep the boiler operating at its maximum efficiency, it is important that the heat transfer surfaces are kept clear of dirt and debris. This design has been specifically tailored to minimise the carryover of ash from the grate into the tube bundles of the heat exchangers. It also includes a water spray and mechanical cleaning system that will force any ash that does settle to drop off.

2.3 Power Generation

The steam generated in the boiler is converted to electrical power in a steam turbine generator.

The plant will be capable of generating approximately [26 MW_e] of electricity in total, of which [3 MW_e] will be needed for plant requirements. The remaining [23 MW_e] is fed to the local electricity network.

The arrangements for the export of electricity will be agreed as part of ongoing connection studies carried out by Scottish and Southern.



The turbine generation set and associated components and subsystems as well as the common services systems and controls shall be designed with a high level of availability using components selected for their proven reliability in service and adequate redundancy such that the failure of any individual component or part of the plant does not cause a reduction in waste throughput or power output.

Certain major items of plant such as the turbine generation set, the air cooled condenser and the auxiliary cooler, which have an established track record of high availability and where the cost of duplication would be out of proportion to the consequent improvement in availability, are not required to be duplicated.

Critical equipment including but not limited to pumps, fans and compressors as well as Common Services shall be duplicated to provide full run/standby operation (2 x 100% or 3 x 50%).

The plant shall be designed in a manner that permits standard shut-downs for planned maintenance of no greater than 7 days of 24 hour working. Thus the plant shall be designed such that replacement of wear components can be completed so far as is reasonably practicable, within 7 days of 24 hour working.

The plant is designed for energy efficiency. This will be achieved by the selection of appropriate systems and components and the application of energy efficient principles in the design. The design shall include:

- 1) The use of low-loss motors;
- 2) High efficiency lighting and zoned lighting controls with daylight and sensing;
- 3) Occupancy sensing in irregularly occupied areas;

Inverter drives for larger motors which are not fully loaded in normal operation or whose load may vary in normal operation – this generally includes large fans, pumps and compressors;

Care in the design of piping and ducting systems to achieve the optimum balance of pump or fan efficiency and economy of installation.

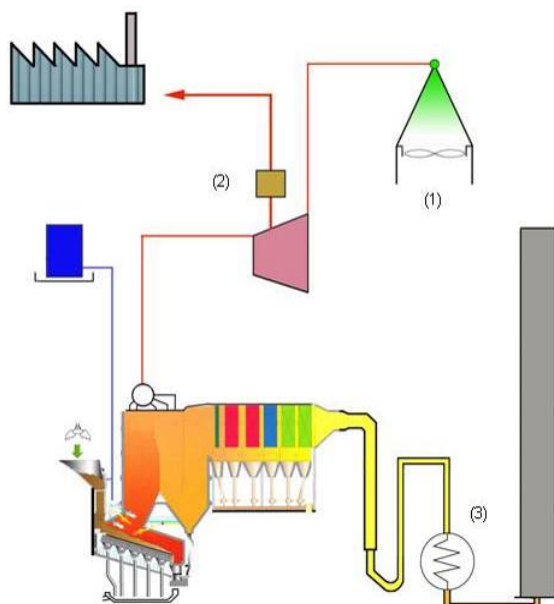
2.4 Heat Generation

Heat can typically be supplied from the process in the form of steam and/or hot water.

Steam can be extracted from the steam turbine and it typically used in processes where a high grade (temperature) of heat is required. Steam would be extracted via a bleed on the turbine and piped to the steam user. Where steam is captured from the process in the form of condensate, this can be returned to the boiler feedwater of the plant. However care has to be exercised to avoid any contamination being carried in the condensate to the boiler.

The supply of steam is limited by distance. Piping steam over long distance is usually expensive and inefficient as mains have to be oversized and insulated heavily to avoid loss of pressure or temperature. Process steam users require steam at particular temperatures and pressures, and loss of these specific conditions can result in the process working ineffectively or not at all.

Heat in the form of hot water however can be recovered from three points in the plant. These are shown in the drawing below:



- 1) **Condenser.** Wet steam emerges from the steam turbine typically at around 40°C. The steam holds approximately two thirds of the energy from the steam. This energy can be recovered in the form of low grade hot water from the condenser depending on the type of cooling implemented.

Currently it is expected that an air-cooled condenser will be installed at this facility. Steam is condensed in a large air cooled system which rejects the heat in the steam into the air flow. An air cooled condenser does generate condensate at approx. 35-40°C, but cooling this condensate further by using it for space heating requires more steam to be extracted from the turbine to heat the feedwater prior to being pumped into the boiler. The additional steam extraction reduces the power generation from the plant.

- 2) **Steam turbine.** Steam extracted from the steam turbine can be used to generate hot water for district heating schemes. District heating schemes typically operate with a flow temperature of 90°C to 120°C and return water temperatures of 50°C to 80°C. Steam is extracted from the turbine at low pressure to maximise the power generated from the steam. The steam is passed through a condensing heat exchanger, with condensate recovered back into the feedwater system.

The steam turbine in this facility has three extractions. Where steam is used for heating hot water, steam will be extracted from the two lowest pressure bleeds on the turbine. A 'base load' of heat can be supplied from the last extraction on the turbine, with peak heat loads met from the intermediate bleed.

This source of heat offers the most flexible design for the plant. The steam bleeds can be sized to provide additional steam above the plant's parasitic steam loads. However the size of the heat load will need to be clearly defined to allow the steam bleeds and associated pipework to be adequately sized. Increasing the capacity of the bleeds once the turbine is installed is difficult.

The use of steam also allows the supply of low pressure steam as an alternative to hot water.

- 3) **Flue gas.** The cool flue gas from the flue gas treatment plant contains water in vapour form. The flue gas from the flue gas treatment plant is typically around 140°C. This can be cooled further using a flue gas condenser to recover the latent heat from the moisture. This heat can be used to produce hot water for district heating (90°C to 120°C). Similarly to the heat available from the condenser, this does not significantly affect the power generation from the plant.

Condensing the flue gas can be achieved in a wet scrubber which can replace more typical lime and activated carbon injection systems. However the scrubber temperature is typically no more than 80°C, which restricts the hot water temperature available for the customer.

The additional cooling of the flue gas results in the frequent production of a visible plume from the chimney. Although this is only water vapour it can be misinterpreted as pollution. The water condensed from the flue gas needs to be treated and then discharged. The discharges are achieved through a controlled consent.

The plant will be able to supply heat by removing steam from the turbine. This could be supplied as steam or hot water. At the current time, it is thought that there is only likely to be demand for hot water for use in wet heating systems (typically in the region of 70°C to 100°C). This hot water will be raised from steam from at least one turbine bleed point to provide sufficient temperature. This method for the supply of heat is considered to be favourable because:

There are no obvious users within the immediate area of the plant for 30°C to 40°C hot water. It is likely that new opportunities to use heat from a cooling tower will be very limited, and will require the pumping of large volumes of water to deliver the necessary heat loads. This will reduce the efficiency of the plant. As such the plant will be installed with an air cooled condenser

The use of a flue gas condenser will generate a visible plume which will be present for significant periods of the year. This is not considered to be desirable as it will add significantly to the visual impact of the plant and as such has not been included.

It is considered that the use of steam from the turbine offers the most flexibility for allowing heat to be supplied to future developments.

3.0 EMISSIONS SAVINGS

3.1 Introduction

In order to understand the potential emissions savings obtained through generating power and heat a lifecycle assessment has been conducted. The Environment Agency has developed Life Cycle Assessment software specifically for the waste management industry. This software is called "Waste and Resources Assessment Tool for the Environment" (WRATE).

WRATE enables users to model a variety of waste management scenarios and provides an assessment of the environmental impacts. The most common use of WRATE is to calculate the global warming potential (more commonly known as the carbon footprint) of various solutions. WRATE does also consider other environmental impacts such as eutrophication, acidification, human toxicity, abiotic resource depletion and freshwater aquatic ecotoxicity.

WRATE considers the full lifecycle of waste, from arising to ultimate disposal. The environmental impacts of construction, operation, maintenance and decommissioning are also considered. WRATE however does not consider the social or economic impacts of the waste management strategy.

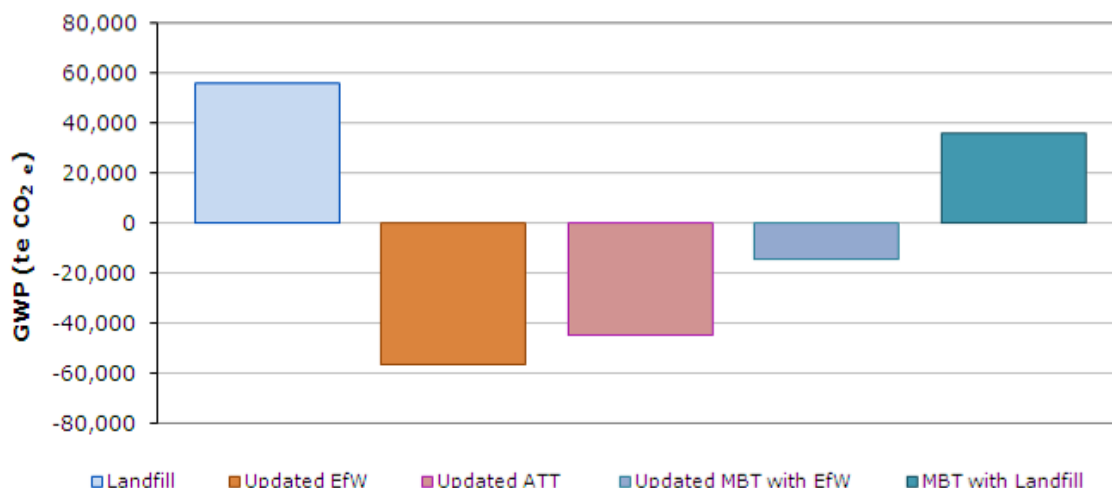
3.2 Comparison with alternate technologies

Four alternate waste management strategies have been considered in comparison with the proposed Ardley EfW facility, including:

- Landfill only;
- Advanced thermal treatment;
- Mechanical biological treatment with refuse derived fuel to EfW; and
- Mechanical biological treatment with refuse derived fuel to landfill.

In order to accurately model the environmental impacts associated with the proposed facility a bespoke process has been developed based on one of WRATE's default EfW processes (Billingham). WRATE's default processes have been used to model the other scenarios.

The global warming potential results of this assessment are provided below. A negative value indicates an environmental saving, whereas a positive value indicates an environmental burden. The results indicate that the proposed Ardley EfW achieves the highest environmental saving.



The EfW scenario achieves a net environmental benefit due to the production of electricity. The electricity produced by the facility offsets the electricity production from a fossil fuel based power station and therefore avoids CO₂ emissions. This offsetting outweighs the actual CO₂ emissions produced by the facility.

The five other environmental impact categories available within WRATE were also assessed and are discussed in detail within the Lifecycle assessment report (see Appendix 3, Volume 4 of the ES).

The overall results of the lifecycle assessment suggest that the best performing scenario, in terms of environmental impact, is the proposed EfW.

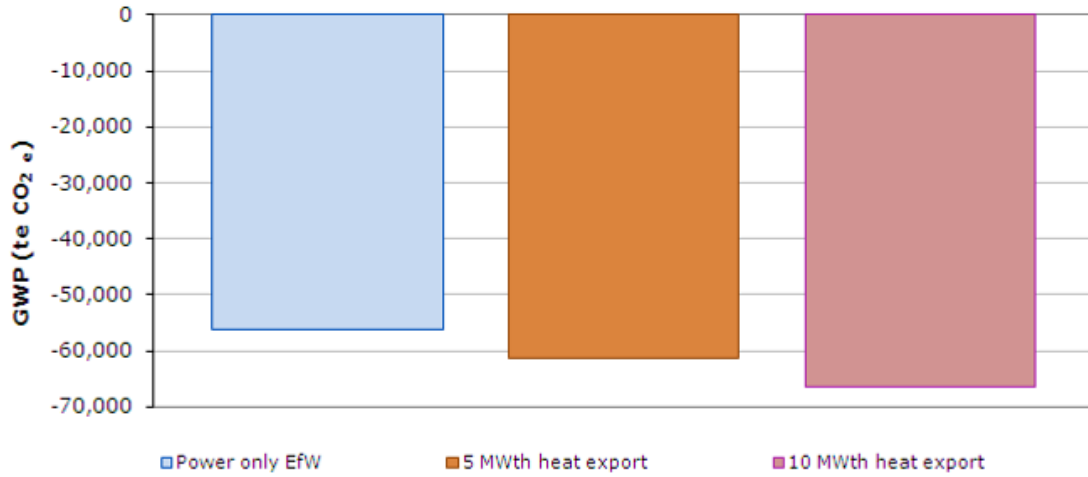
3.3 Introduction of heat export

The above analysis was conducted assuming that only power is exported from the facility. In order to analyse the environmental impact of the introduction of a heat export, two alternate scenarios have been compared with the power only Ardley EfW:

- 5 MW_{th} of heat exported; and
- 10 MW_{th} of heat exported.

The electrical power output from the facility has been reduced in each case, to reflect the loss of steam feed to the turbine.

The results from the WRATE model, in terms of global warming potential, are summarised below.



The results show, as expected, that by increasing the amount of heat exported the facility's environmental impact is improved. This is because the heat produced will directly replace heating requirements currently fulfilled by fossil fuel systems.

4.0 PRACTICAL IMPLEMENTATION

4.1.1 Power Export

The plant will be capable of generating approximately [26MWe] of electricity in total of which up to [3.0 MWe] will be required to run the plant. The remaining [23MWe] is exported to the grid. Scottish and Southern (S&S) are the Distribution Network Operator (DNO) who own and operate the distribution network in the Ardley area. S&S have conducted a desktop study and their initial findings have identified a likely connection point at 33 kV at the Bicester Primary 33/11 kV sub station. The initial findings of the desktop study carried out by S&S did not identify the need for any system reinforcements, for both thermal capacity and fault levels, as a consequence of the addition of a further 25.6 MVa of generation at Bicester Primary Substation.

The Long Term Development Statement (LTDS) produced by S&S includes fault level and fault ratings which show a 50% spare capacity level in the fault ratings of the equipment, which is significantly more than will be taken up by the new EfW generator.

4.1.2 Heat Export

Heat supplied in the form of hot water is the most viable option for the location of the facility. The temperature of the water will be supplied between 70°C and 120°C depending on the end user's requirements.

Heat will be distributed in buried pipework. Insulated steel pipes are used to supply pressurised hot water to the customer, and to return cooler water. Where pipes are small, two pipes may be integrated within a single insulation sleeve. However, single pipes are likely to be used to meet large heat demands.

Heat will be supplied to a secondary heat exchanger on a consumer's premises. Typically, the heat exchanger at the end user is arranged to supply heat to the tertiary heating circuit upstream of any boiler plant. The water in the tertiary circuit is heated to the temperature required to restrict the firing of the boiler.

Water is pumped around the system. Pumps are operated with 100% standby capacity to maintain heat in the event of a pump fault.

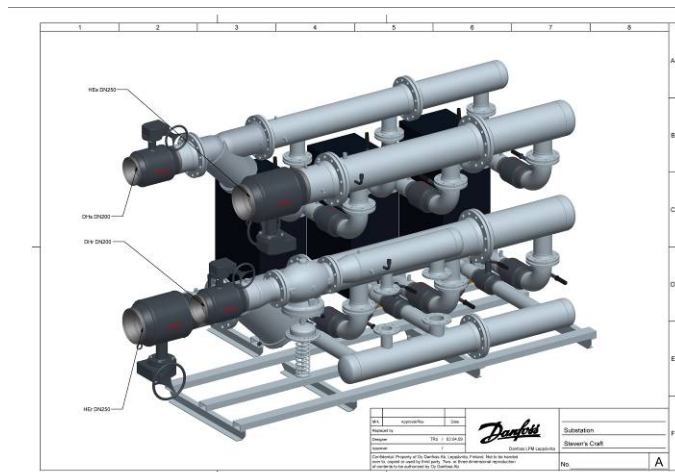
Currently there are no systems to provide back up heat to the attached users. Where the heat supply is critical i.e. for a horticultural application, this will require the installation, operation and maintenance of back up gas-fired or oil-fired boiler plant.



Example of a gas-fired back up boiler station

It is currently considered more efficient to install gas- or oil-fired auxiliary boilers at the point of use to minimise heat losses and minimise fossil fuels use. This will also give the customer the option to turn off the heat supply if they can reasonably avoid the high cost of heat produced from fossil fuels. It is likely to provide customers with additional confidence by being able to operate their own heating plant in the event of an emergency.

At the present time, no fixed route has been established for the connection from the EfW plant to the various potential users since no specific agreements have been made. Easements will need to be obtained for access, construction, and maintenance of the pipes. There is a significant financial implication for obtaining easements, and these will be progressed once planning permission has been received.



Examples of Customer Heat Stations for Small and Large Scale Users

5.0 EXISTING COMBINED HEAT AND POWER SCHEMES

Because of the UK's past reliance on landfill as the principal method for dealing with waste there are only a limited number of schemes in operation in the UK where waste is used to generate combined heat and power. However, it is clearly recognised throughout government policy and accepted that waste must now be diverted from landfill and renewable energy schemes must be secured and implemented if we are going to reduce carbon footprint levels and comply with the sustainability principle.

The following schemes are detailed below:

5.1 UK Schemes

5.1.1 *Sheffield's District Energy Scheme (DES)*

The scheme provides approximately 140 of Sheffield's landmark buildings with hot water for heating via a network of 44km of underground pipes as well as supplying electricity to the national grid.

The EfW facility accepts 225,000 tonnes of waste per annum and produces around 60MW of thermal energy and around 19MW of electrical energy. The scheme, established in 1988, is the largest of its type within the UK and is still expanding.

5.1.2 *Nottingham District Heating Scheme (DHS)*

The scheme was established in 1973 and currently provides heat and power to 4,800 homes, schools, shops, residential care homes, university buildings, hotels, leisure centres and swimming pools. The facility accepts approximately 145,000 tonnes of waste per annum and produces 15MW of Energy as combined heat and power.

5.1.3 *Cyclerval's plant near Grimsby*

The scheme produces around 3MW of heat and 3MW of electrical energy using 60,000 tonnes of waste per annum as fuel. The heat from the plant is fed directly to the adjacent Synthomer latex factory.

5.1.4 *Coventry EfW plant*

The EfW accepts approximately 200,000 tonnes of waste per annum and produces 11MW of energy, of which the heat is exported to the surrounding factories, with surplus electricity being exported to the national grid.

5.2 European Schemes

The situation in Europe is very different and many countries currently recover a much larger amount of EfW than the UK, with countries such as Denmark, Switzerland, the Netherlands, Sweden, France and Germany generating significant amounts of energy from waste. For Example, heat from EfW in Sweden and Denmark accounts for around 40% of the domestic heat requirement, unlike in the UK, where this kind of application is yet to find widespread use.

The European model of utilising the heat generated from the EfW process is often cited in UK planning guidance as an example that the UK should be looking to move towards.

5.3 Viridor's EfW/CHP Background

Viridor Waste Management currently has one operational CHP facility in the UK and also currently has two Energy from Waste plants in the design and construction phase, both of which have plans to incorporate CHP, as detailed below.

5.3.1 Derriford Hospital Clinical Waste Incinerator, Plymouth

Viridor has been operating the clinical waste incinerator at Derriford Hospital in Plymouth for 5 years. The facility utilises heat generated from the thermal treatment of clinical, confidential and some hazardous wastes to generate CHP. Heat from the incineration process is supplied to the adjacent hospital to help with heating and hot water needs, effectively reducing its fuel requirements.

5.3.2 Exeter CHP Plant, Devon

Viridor has recently been given planning permission for a CHP plant in Exeter by Devon County Council. Viridor aims to provide renewable energy at a steady price, protected from the volatility of fossil fuel prices in the form of heat to nearby energy users, as well as feeding electricity to the national grid.

The location of the plant offers the possibility of providing heat energy to a number of potential users, including a nearby rendering plant and a metal finishing company. Discussions with these and other potential users are to be held with the intention of entering into commercial and technical agreements. As the development is still in its early stage, no final heat uses have been agreed but this is hoped to be brought to fruition in the near future.

5.3.3 Lakeside EfW CHP Facility, Colnbrook, Slough

The Viridor site at Lakeside is currently under construction and is expected to be commissioned in mid 2008. The facility is designed to accept around 440,000 Tonnes of residual municipal waste per annum and produce around 30MW of electrical power which will be supplied to the national grid.

The facility will not have an operational facility to supply heat to nearby users from the outset; however the design of the facility is such that this is available for new development in the future. It is proposed that investigations and discussions into this will be ongoing.

6.0 POTENTIAL HEAT USERS

6.1 Introduction

The facility at Ardley will produce circa 180,000 Mega Watt hours of electrical energy based on an input of 300,000 Tonnes per annum, which will be exported to the National Grid. This is approximately enough to serve around 25,000 people.

The heat from the facility at Ardley could be piped in a heat main directly to developments, who effectively would take heat from the main via heat exchangers, with meters such that heat use by each user can be measured. No water is removed from the heat main, only the heat extracted from it.

The feasibility of a CHP scheme relies on a consistent market for the heat supplied by the plant. In order to determine the existing potential market for heat in the Bicester area, a baseline assessment was carried out which involved assessing the feasibility of a CHP scheme in Ardley. The study looked at the following areas of planned or potential future developments:

- NW Bicester eco town;
- Industrial/offices/laboratories/warehouses;
- Leisure centres and swimming pools;
- Shopping centres and supermarkets;
- Residential developments; and
- The horticultural industry.

Cost is a key element in delivering CHP schemes and because of the cost of installing the infrastructure, in the region of £1000 per metre, it is acknowledged that a distance of 5km is the limit of its viability. Thus short pipelines carrying large amounts of heat are most cost-effective, and also cause the least disruption on installation as compared to a large number of smaller pipelines.

The potential heat users are buildings planned to be developed, the cost and ease of connection has been considered to offer potentially a much easier and cheaper option than to several small systems.

The preferred option is for the integration of a CHP scheme into new development as it is being built, although retrofitting can be option for larger users.

The success of the CHP scheme also relies on an adequate heat demand throughout the day, and to achieve this, an industrial user who operates 24 hours a day is the most preferable option, followed by a balance of high density residential, where heat demand is in the evenings, mornings and overnight, and large commercial users whose heat use is mostly during the day.

6.2 North West Bicester Eco Town

North West Bicester has recently been confirmed as one of four eco-town projects to be taken forward by the Government. Eco towns are a key part of Government policy for providing new housing supply in a sustainable manner and the use of renewable/low carbon energy (heat and power) are crucial elements for the delivery of these projects.

The Ardley EfW site is considered to offer an excellent opportunity for the potential integration of a CHP system for NW Bicester's innovative Eco Town proposals.

The feasibility of a CHP scheme relies on a consistent market for the heat supplied by the plant. In order to determine the existing potential market for heat in the Ardley area, an assessment was carried out which involved looking at the NW Bicester eco town facility. The following potential heat users have been identified from the development proposals associated with the proposals at the Eco Town:

- Library
- Learning centre;
- Elderly and learning and physical disabilities day care and homes;
- Health care facilities;
- Police provision;
- Youth and community provision;
- Education (Zero Carbon Schools)
- Art and culture
- Housing

It is considered that all of the above could provide an essential base load for the proposed CHP scheme.

Most importantly, the Eco Town output is within close proximity (2.7km) to the site, and is expected to use large amounts of heat 24 hours a day.

6.2.1 Implementation

It is considered that the Energy from Waste Facility at Ardley provides an excellent opportunity to deliver the 'eco' infrastructure required to ensure the highest possible green infrastructure for the development.

The eco-town will also provide the opportunity to provide for further recycling of waste which effectively could feed directly into the Energy from Waste Facility with heat being generated in return this is considered to be a fantastic eco-friendly modern approach of self-sufficiency. In addition the bottom ash generated from the EfW process could be utilised as a recycled construction material in the eco town and could go on to provide employment by establishing a manufacturing plant utilising the bottom ash for the production of concrete blocks.

6.2.2 On-site Infrastructure

A significant amount of on-site infrastructure will be required to support the development of the eco town community.

As part of the Eco Town proposals a Viability Assessment (see Appendix) has been produced¹ which flags up site preparation and infrastructure costs

¹ Halcrow Study and Viability Assessment 2009

The Halcrow Concept Study identifies an Energy Strategy for the proposed development. As part of this study the cost of a combined heat power (CHP) plant is identified in the Halcrow report as £10 million but is considered an essential part of a successful development that innovates to deliver a zero carbon development. The Halcrow combined heat and power viability assessment sets out an optimistic scenario for infrastructure costs. With regard to energy the following costs have been flagged up:



- company / utilities provider meets costs of an on site CHP plant of an estimated £10 million.

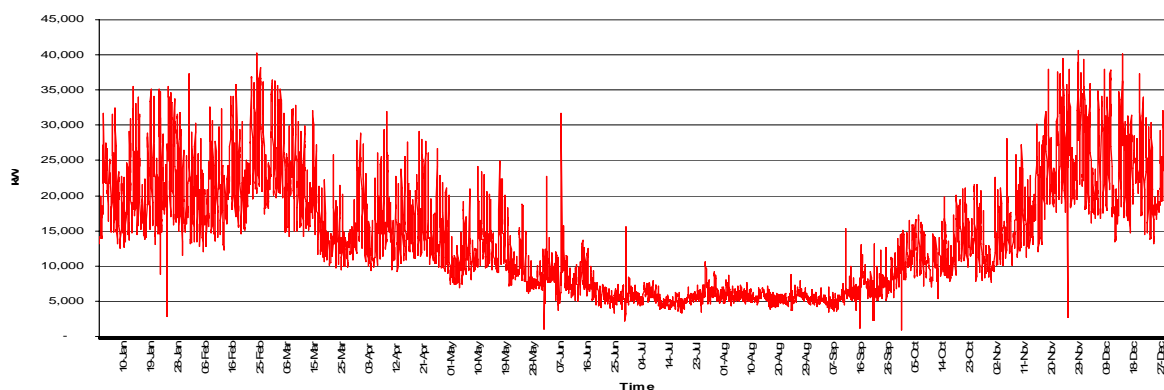
Having regard to the location of the proposed EfW/CHP plant at Ardley it is considered that this development could substantially reduce these costs by approximately £7.3 million pounds. This has been worked out on the following basis:

- Centre of application site to the centre of eco town is 2660m
- Cost of pipeline £1000 per metre
- $2660 \times 1000 = 2.660,000$ million pounds
- Rounded up £ 2.7 million pounds

6.2.3 Heat Load Profile

By the nature of the types of services the heat export will be providing, it is possible that there will be a strong seasonal variation in heat load on the plant. A heat load duration curve has been estimated for the scheme. The heat demand for each month has been adjusted based on degree day data for the local area.

It is important that the heat export is not designed for the peak requirement which, for example, might be in the winter months, as this would have a negative impact on the efficiency of the system in the summer months. Over sizing the system to accommodate short term peak flows will add considerable costs to the system which will make the cost of the heat unattractive to potential users; supplementary boilers will be used to provide peak load heat supplies.



Typical Annual Load Profile for a District Heating Network

6.3 Industrial/Offices/Laboratories/Warehouses

Identified below are a number of Industrial Units and estates that could potentially use the heat from the CHP facility:

- Rowood Industrial Estate, Bicester
- Talisman Business Centre, Bicester
- Chaucer Business Park, Bicester
- Launton Business Centre, Bicester
- Goodhead Print Works, Bicester
- Bicester Distribution Park, Bicester
- McKay Trading Estate, Bicester

6.4 Leisure Centres and Swimming Pools

Only one identified council run sports and leisure facility was found within the search area:

- Bicester & Ploughley Sports Centre

6.5 Shopping Centres and Supermarkets

There is a moderate amount of commercial activity within the search area, and so the largest and most viable areas were identified as potential heat users. These are listed below:

- Bicester Outlet Shopping Village
- Tesco Store, Bicester
- Co-Op Store, Bicester
- Wickes Building Supplies Ltd

6.6 Residential Developments

The District of Cherwell has recently seen some significant redevelopment in the form of low to medium density residential development into which CHP could be integrated without large amounts of disruption or cost. Listed below are a number of residential developments that have been granted permission and identified as being suitable:

- Former Highways Depot and Claypits, London Road, Bicester – Proposed redevelopment to create up to 40 no. residential units, a 60 no. place care home and 20 no. place care home apartments;
- Land between Birmingham/London rail line and Gavray Drive, Bicester – Proposed residential development (including affordable housing incorporating a County Wildlife site together with land reserved for a primary school and community facilities);
- Transco Depot, Launton Road, Bicester – Proposed residential development comprising of 35 flats;
- New House, Buckingham Road, Bicester – Proposed erection of 10 no. flats;
- 17 The Causeway and Land between The Causeway and Bryn House – Proposed construction of 21 flats & 3 cottages for elderly people and 5 open market dwellings;
- Bicester Fields Farm, South East Bicester – Residential development (indicative outline for 100 units) including open space (Bicester Linear Park) & place of worship; and

- Land at Slade Farm, Banbury Road, Bicester – Residential development incorporate local centre community facilities and school pitch provision;

6.7 The Horticultural Industry

Mindful that the proposed EfW would be sited within a predominately rural area. One source of potential users for the heat and energy produced from the scheme would be the horticultural industry.

Government statistics suggest that direct energy use in agriculture (including forestry) accounts for 1.26 million tonnes of carbon dioxide (expressed as carbon). Current study's suggest that horticulture accounts for around 28% of the total energy used in agriculture

The protected crops sector accounts for most of the energy used in horticulture, with horticultural field crops estimated to use just 3% of the total direct energy use. Around 37% of direct energy use in agriculture is for heating, and 61% of this is expended in the protected crops sector for greenhouse heating and humidity control.

Whilst it would not be unrealistic to reduce the heating energy used in agriculture by 20% from the 2005 base year by 2015, bigger reductions in carbon emissions could potentially be made by integrating low carbon / renewable energy sources. However, that is only the start if the UK is to meet the Climate Change Bill target of reducing CO₂ emissions by 60% by 2050.

Consideration has to be given to the fact that the potential CHP produced from the EfW can be a cost effective and energy efficient solution for local horticultural business in helping produce their crop.

Furthermore, the proposed EfW can offer the local horticulture industry a great opportunity to minimise carbon emissions by reducing the amount of fossil fuel energy used for growing crops (thus overall help reduce the horticultural industries carbon foot print). For example power from the proposed EfW can be used to power new energy efficient systems such as an integral vertical soil heat exchanger, which act as a heating and cooling systems for new green houses, reducing the necessity for external ventilation.

Examples of where this is already being provided elsewhere in the country are provided below:

6.7.1 Case study 1 - Thanet Earth

Thanet Earth is the official name for an £80 million investment proposing to utilise the products and by-products of a new combined heat and power (CHP) plant in Thanet, Kent. Building has commenced and the first products are expected to be in shops by the end of September 08.

The site, approximately 91 hectares in size, will comprise 7 glasshouses, each one the size of ten football pitches. Each glasshouse will contain crop after crop of tomato, pepper and cucumber plants using a hydroponic growing technique.

The CHP unit will produce enough electricity for 50,000 homes as well as a supply to the National Grid. A proportion of this electricity will also be used to light the glasshouses to create longer 'day light' growing hours. The by-products of CHP will be utilised by the hydroponic growing technique; heat will be used for heating the glasshouses and carbon dioxide will be absorbed by the plants photosynthesis process. The majority of the water

requirement for the site will be met by the collection of rainwater in to reservoirs capable of holding 50m gallons of water.

In all Thanet Earth will contain 1.3 million plants harvested 52 weeks a year, increasing the UK's salad production by 15%.

6.7.2 Case Study 2 – A. Pearson & Sons Ltd

A.Pearson & Sons Ltd, (APS) in Cheshire have been supplying Tesco with tomatoes since 1992 and to date have 123,000 plants on a 3.2 hectare site, producing 1,500 tonnes of tomatoes per year.

A combined heat and power (CHP) plant provides enough electricity to meet all of APS' requirements and the rest is sold to the National Grid to supply the local town of Alderley Edge. The by-product heat from the plant both heats the glasshouse during the day and is 'stored' as hot water to be piped out at night to maintain the optimum growing temperature. Carbon dioxide is absorbed by the tomato plants photosynthesis process, increasing flavour and yield. The site is responsible for a reduction of 3,000 tonnes of carbon emissions a year.

7.0 CONCLUSIONS

Government policy (PPS1) identifies the importance of the planning system in contributing to the reduction in green house gas emissions and achieving the Government's climate change objectives. The delivery of renewable energy schemes and the use of the heat and power they will provide in planned future developments in the locality are key elements in achieving this.

This Energy Plan identifies that Bicester is a key area of future growth in Oxfordshire and the Ardley EfW/CHP plant is considered to be in an excellent location to supply renewable heat and power and recycled construction aggregates to make future low carbon developments in the Bicester area a reality.

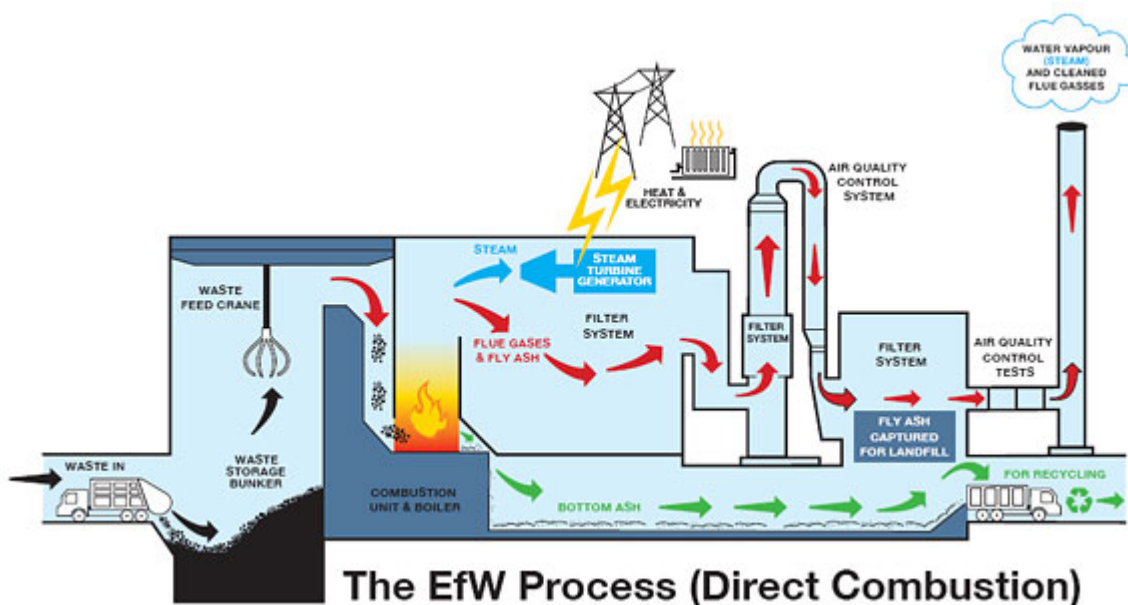
This new facility has the potential to provide the North West Bicester Eco Town as well as other future development in the local area (residential, commercial, industrial and horticultural uses) with sustainable and environmentally friendly heat, power and construction materials.

It is considered that the setting up of the appropriate infrastructure at the Ardley EfW/CHP plant to supply the eco town proposals with heat and power would be a more cost effective solution than the eco town providing their own stand alone plant. In addition the Ardley facility will be able to supply other developments in the area with heat and power as well.

The use of the energy and heat from the EfW/CHP as an integrating low carbon / renewable energy sources can reduce the carbon emissions and ensure the proposed Eco Town will benefit from a highly cost effective and green friendly source of energy.

Serious consideration has to be given to the fact that the potential heat and energy produced from the EfW/CHP can be (i) a cost effective and energy efficient solution for the (i) the Eco town (ii) other planned future developments in the Bicester area (iii) a great opportunity to develop a sustainable horticultural industry in the area.

Furthermore, if the above incentives are embraced and supported there could also be a potential for existing developments to be retrofitted out to receive heat and energy from the proposed EfW/CHP plant.



NW BICESTER ECO-TOWN

Concept Study

prepared for Cherwell District Council

Final Report, June 2009



Viability Assessment

Halcrow Group Limited

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1		Draft	5/2/09	PT
2		Revised Draft	10/2/09	PT
3		Revised Draft	26/2/09	MP
4		Revised Draft	1/06/09	MP
5		Final	1/07/09	MP

Contents

1.	Background	1
1.2	<i>Method</i>	2
1.3	<i>Sensitivity Testing</i>	5
1.4	<i>Viability Conclusions</i>	6
2	Annex A	9
	<i>Notes on Method</i>	9

1. Background

1.1.1 This report was prepared in conjunction with Michael Beaman Ltd. The viability analysis is based on the following land use budget:

Land Use Budget Summary

Summary	Area	%
Employment	31.80 ha	9
Residential	125.00 ha	36
Local Centre	9.91 ha	3
Education	17.16 ha	5
Open Space	138.23 ha	40
Infrastructure	23.00 ha	7
Total	345.10 ha	100

1.1.2 It is further assumed that the NW Bicester Concept would comprise 87.5 ha of homes for sale and 37.5 ha of affordable homes, most of which would be shared ownership. The scheme would be designed to meet sustainability objectives but beyond that there would be no requirement for innovative and untested building design.

1.1.3 At this stage the analysis is based on a wide range of assumptions and provisions. Estimates of current development land values usually involve a large margin of error and in this case that difficulty is compounded by the need to project these values into the future at a time when market predictions are particularly difficult. At present the property market is in deep decline and it is unlikely that developers would invest in taking the scheme forward. Therefore, the aim at this stage is to establish whether there is a prime facie case that a developer might be attracted to undertake this scheme once the market recovers. This is achieved using a high level analysis of the scheme's economics and an assessment of the commercial risks involved.

Carbon Challenge Update

A 650-home flagship zero-carbon development on government land has been put on hold because of the worsening recession. The Bickershaw Colliery scheme near Wigan was to have been the third of the Carbon Challenge sites promoted by the Homes and Communities Agency (HCA) to pilot zero-carbon building. However, the government withdrew its tender notice for private partners recently. The HCA says the scheme is now under review and may ultimately have to go ahead without initially meeting the zero-carbon standard.

The 18.3ha site was opened to developer bidding through a competitive dialogue process by the Northwest Regional Development Agency (NWDA) for the HCA in March 2008. However the NWDA informed developers in February that the

project was not going ahead. The Carbon Challenge was designed to get developers to meet level 6 of the Code for Sustainable Homes – equivalent to zero carbon – in advance of a 2016 legal requirement. A previous 344-home Carbon Challenge scheme in South Bank, Peterborough, developed by a consortium led by social housing provider Gentoo, had to have the equivalent of a £16m public sector subsidy, with three bidders pulling out. In a joint statement, the HCA and NWDA admitted the scheme was under review because of “issues” including “the financial viability of the project”. They said they would restart a developer selection process this summer. They added that the aim was still to build a zero-carbon development, but that the process might have to be “flexible in terms of seeking bids which incorporate Code for Sustainable Homes level 6 homes” given the market conditions.

1.2

Method

1.2.1

The economics of development have been analysed using a Net Present Value (NPV) model which aims to assess the land’s value for development. This differs from the conventional residual land value appraisal used in the property industry because it provides a better replication of the business approach of the volume housebuilders. But all of these methods are very sensitive to the various assumptions made and at this stage we have not undertaken a sensitivity analysis.

1.2.2

A base case scenario is modelled, as described below. To test the sensitivity of the assumptions “best case” and “worst case” scenarios have also been tested, as described in section 1.3.

1.2.3

The base case model adopts the following assumptions to assess the viability of the proposed Eco Town development in North West Bicester. Further details on these assumptions are provided in Annex A of this document.

Cost Assumptions

- Standard site preparation and secondary infrastructure for the 346 ha development are estimated at £250,000 per hectare¹.
- The model includes specific cost implications for primary on site infrastructure, social infrastructure (including developer contributions) and the necessary green infrastructure to facilitate the delivery of the proposed Eco Town. The primary, social and green infrastructure amounts to approximately £125 million for the base case or £25,000 per dwelling (for the proposed 5,000

¹ These may include drainage, ground works, providing services and transport access and providing basic facilities such as playgrounds, playing fields and parking space etc.

market and affordable units). A detailed breakdown of the cost schedule is presented in Annex A. The scenarios vary elements of these costs.

- The model also incorporates a cost assumption for fess at 5% of primary, standard secondary, social and additional green infrastructure proposed for the development.
- The base case model assumes that meeting zero carbon standards in 2010 would add 8.5% to costs with a further 5% in 2013. The implied assumption is that the achievement of higher Code for Sustainable Homes (CSH) standards would have to be paid for by a reduction in costs due to production efficiencies. The best case scenario varies elements of these costs.

Income Assumptions

- The base case model assumes residential values will not return to their 2007 peak until 2013 (based on Savills published research) and will grow thereafter at 2.5% p.a. (Barker report – see Annex). The worst case scenario varies this assumption.
- The base case model assumes that land prices will take longer to recover than house prices and that peak levels will not be achieved again until 2017.
- The revenue projections for marketable residential land (87.5 ha) have been derived as a function of annually forecasted house values and cost of building these units. These calculations also assume a development density of 40 homes per hectare of approximately 100 sq m each.
 - The annual house value projections built in the model reflect current trends and documented long term projections. These value assumptions do not include a premium for the eco homes.
 - The base case model also assumes that the cost of building a zero carbon dwelling will be approximately £1,814 per sq m in 2013. This assumption relates to a 13% higher per unit cost than the base assumption of building a standard home in 2007/08 (£1,600 per sq m). The best case scenario varies this assumption

- The model also assumes that the 37.5 ha of affordable housing land has ‘zero’ value².
- The model assumes a standard £1 million per hectare value assumption for the proposed 37.2 ha of commercial and retail land in the North West Bicester Eco Town. This value is informed by the current local commercial market situation. It has not been assumed that commercial land values will increase in real terms over the period.

Other Assumptions

- It has been assumed that a lead developer will aim to secure planning permission, prepare the site for development, provide the necessary infrastructure and then sell serviced plots of land for building development at the market price.
- It has been assumed that full scale development would commence in 2014. The entire development would take 20 years with on average 250 homes and 4,400 sq m of commercial development being completed each year³.
- Hence, the cost and revenues for the development have been equally dispersed in the development over 20 year periods:
 - Fees: 2011 to 2030
 - All infrastructure costs: 2013 and 2032
 - Income from residential and commercial land sales: 2014 to 2033
- The model assumes a 20% discount rate to assess the Net Present Value (NPV) of the proposed scheme. This approach is consistent with that adopted by volume house builders.

² It is assumed that serviced land for affordable housing is provided free of charge to RSL's who will be expected to make a full contribution to the cost of the enhanced social and environmental infrastructure. Any surplus on the sale of shared ownership homes can be used to cross subsidise social rented accommodation. It is not clear whether or not this would obviate the need for HCA grant as that would require further modelling.

³ By way of comparison, this is rather lower than planned at Camborne in Cambridge. It might be possible to accelerate this but the beneficial effect on the cash flow might be offset by lower house prices due to increased supply.

Note: The model does not make any input (cost) assumptions for potential land values. This is generated as an output in Net Present Value terms.

1.3

Sensitivity Testing

1.3.1

In order to test the robustness of the model, and to demonstrate the effects of varying the cost/revenue assumptions, we have tested two alternative scenarios, which vary the assumptions in respect of build costs, residential land values and infrastructure costs. There is currently a great deal of uncertainty over the long term costs of meeting zero carbon and other more demanding requirements from the Code for Sustainable Homes. The build cost variants tested in the two assumptions come largely from the Cost Analysis of the Code for Sustainable Homes⁴ (the CSH Costs Report). The variations in residential land values and infrastructure costs come from the consultants own estimates

Best Case

1. Residential build costs “best case” scenario. Mid point of the range in the CSH costs report – i.e. £1,361 per square metre, calculated as follows:

Source in CSH Cost Report	Residential build costs per sq.m.	low	high	mid
Table 1.1	Baseline	745	1,342	
Tables 4.1 – 4.3	Best case scenario	223	326	
		968	1,668	1,361

Note the baseline costs vary significantly depending on the housing type – i.e. flats, mid-terrace, end terrace/semi or detached dwelling

2. Reduction in energy compliance costs over time

21% reduction in 2013, 35% reduction in 2025 (Table 2.5, DCLG)

⁴ DCLG, July 2008

3. Optimistic scenario for infrastructure costs – for example an energy company / utilities provider meets costs of CHP plant (£10 million), developer meets some enhanced design costs through economies of scale in design (£10 million), education costs reduced (£8 million), bus subsidy requirement lower due to operator viability improvement over expected (£ 5 million), grant support achieved for community and sports hall provision (£2 million) – i.e. costs reduced by £35

Worst Case

1. Residential build costs “worst case” scenario. The starting point is the consultants own estimate that the residential build costs will be approximately £1600 per square metre, increasing by 8% in 2010 then a further 5% in 2013

2. It is assumed that residential values will not return to peak levels until 2016 (i.e. 3 years later than in the reference case) and thereafter there is no assumption of increasing value of market housing in real terms (compared with 2.5% in the reference case)

3. Pessimistic scenario for infrastructure costs – i.e. full costs as set out in the reference case, plus an additional allowance of 25% to provide for contingencies and off-site costs (£32.33 million)

1.3.2 The best case scenario produces an NPV of £48.8 million, or £141,213 per ha and the worst case scenario produces an NPV of -£27.4 million, or -£79,450 per ha.

1.4 Viability Conclusions

1.4.1 The base case scenario is considered to represent a cautious but realistic estimate of overall viability, given current market conditions and the uncertainties inherent in long term projections. The best and worst case scenarios are considered to represent the range of likely outcomes.

1.4.2 The analysis of the base case suggests that the value of the land required for the development proposed is marginally positive (approximately £7,000 per hectare or around £2.5m for the scheme as a whole). This low figure is primarily the result of the nature of the development proposed and the high level of cost that will be incurred. But in the context of the margin of error involved in such calculations it is a small surplus that it is a marginal proposition and merits more detailed analysis with a view to longer term delivery.

1.4.3

Assumptions about residential values are by far the most significant factor in the model. Variations in residential values can have a major impact on overall viability, as the scenarios demonstrate. There are also significant unknowns about the cost of meeting zero carbon requirements, and how these may reduce with economies of scale. However, this factor is less significant to the overall conclusions than the assumptions about residential values.

1.4.4

There are several factors that could affect the economics of the scheme to either improve or deteriorate. These are outlined below.

On the positive side:

- The cost of achieving both zero carbon and higher design standards has been factored into the costs but no explicit assumption has been made that this will add to sale values which would increase receipts.
- In practice, a developer will seek to improve the economics of any scheme by optimising the detail of the mix and layout of what is proposed as well as the financing arrangements. A high level analysis such as this cannot assess the positive effect of such tweaking.
- It is possible that some of the Section 106 costs could be reduced by using mainstream funding where possible. For instance, education costs which are based on Oxfordshire CC SPD seem high and might even be reduced by direct provision of necessary schools.
- RSLs making full contributions to the cost of enhanced social environmental infrastructure like the one that would be delivered by the scheme.
- No explicit assumption has been made about grant funding towards the environmental features, transport infrastructure and affordable housing in the scheme or the biddable funding streams that exist.
- Potential funding on the grounds of carbon savings which is a key national target.
- Judicious public sector support and intervention can make a big difference. A logical approach here might be for HCA to forward fund early stage infrastructure in return for rights to development land downstream. The net cost to the HCA would

be zero and this would have major benefits to the developer in terms of easing cash flow and mitigating risks.

- The value for affordable housing land.
- Potential stamp duty savings for environmentally friendly buildings that could lead to higher land values.
- The base case is based on a relatively high residential build cost (£1600 per square metre) to allow for the extra costs of meeting zero carbon standards. Exceeding current CSH standards is expensive but by the time the scheme is developed it is likely that environmental standards will be tighter and the costs required to meet them lower as a result of production efficiencies.
- The model makes no allowance for revenue from energy generation, since this is difficult to quantify at present. In practice this will generate some revenue to offset the costs assumed in the model.

On the negative side:

- A particular concern is the assumed land values in the context of the timing of market recovery although this is perhaps more of a threat to the timetable than the intrinsic viability of the scheme. The evidence to support our estimate of the value of new homes in 2007 was imperfect and evidence suggests that recovery in land prices can lag recovery in house prices.
- The basic layout and infrastructure has not yet been fully costed and the base case analysis does not include contingencies.
- Experience suggests that as cost plans are developed, the list of items that need to be paid for grows. In this case, the menu of necessary offsite infrastructure is undeveloped at this stage.

1.4.5

In the case of a development such as this, risk will rank alongside notional viability as a major issue for developers. Given the possibility that the property market will be frail at the time that any scheme on this land is promoted, a real effort would need to be made to limit the developer's exposure to cost increases arising from uncertain or changing planning requirements and to permit sufficient flexibility in the timing of delivery.

2

Annex A

Notes on Method

The Model

1. Many of the volume housebuilders who might be expected to take on a scheme of this scale will aim to sell a substantial portion of the land as development plots fully prepared and serviced for house building. Residual land value calculations based on normative assumptions about values and costs tend to undervalue the price that these development plots will fetch in a competitive market so assuming a programme of land sales can enhance projected returns as well as improving cash flow. Specialist 'lead developers' will take this approach to its logical conclusion and simply aim to sell development plots for others to build on.
2. The volume housebuilders who might be expected to take on the 'lead developer' role in a scheme of this scale are likely to base the critical decisions on a project that might span over decades on the annual return on their capital required over the life of the project. So the overall phasing strategy and the timing of costs and sales are critical to viability. Typically this target return is around 20% although a lower figure is sometimes accepted for affordable housing provision since there is less price uncertainty. This return is gross of financing costs because finance is usually secured at corporate level (in contrast, commercial developers and smaller housebuilders will often use expensive, project specific funding).
3. The model responds by analysing the Net Present Value of the projected cash flow using the 20% target return as a discount rate. This introduces its own biases into the calculation but is a better approximation of the real calculation at the point at which an investment decision is made.

Assumptions about Residential Development Receipts

4. Sales receipts are the most important variable in the economic equation that determines land values. In mid 2008 the specialist residential research department at Savills produced a report entitled "UK Residential Development Land" in which they forecast "a return of buyer confidence in most mainstream housing markets with values likely to be restored to their 2007 peak in most of the regions before 2014. (We) anticipate a return of developer confidence to boost land values ahead of this date but it is unlikely that land values will return to their 2007 peak by then".
5. We have used Savills forecast as a starting point. The issue then becomes what the peak land values were in Bicester. We do not have evidence to calculate past or current land values in Bicester, which is not covered by standard Valuation Office Agency (VOA)

analysis. In any event in order to compare the typical land values reported by the VOA with the value of the notional prepared and serviced sites that would be provided at the new development it would be necessary to make an adjustment for the effect on reported land prices of site characteristics and planning requirements. This is not straightforward.

6. We therefore sought to estimate peak house prices in Bicester and from these house prices we subtracted typical costs for development to assess the notional value per housing plot and by extrapolation the value of a typical hectare of serviced land for housing for sale. We then projected these forward over the projected timescale for development assuming that the highest values would be reached again in Bicester before 2014 in accordance with Savills' projection.
7. No generic allowance was made for underlying inflation in the economy, typically measured by the RPI. But two other critical long term adjustments were made:
 - The assumption was made that house prices will tend to rise at the rate of wage inflation which is usually higher than the rate of price inflation. The Barker Report pointed to a long term difference of around 2.7%. In the model we assumed that, after 2014, the long term increase in house prices in real terms would be 2.5%
 - We also assumed that meeting CSH standards in 2010 would add 8.5% to costs with a further 5% in 2013. The implied assumption is that the achievement of higher CSH standards would have to be paid for by a reduction in costs due to production efficiencies.
8. In estimating new house prices the best data is evidence from the sale of directly comparable property from another new development. At present the only scheme we have identified near Bicester is in Upper Arcott where Martin Grant Homes are marketing basic 3 bedroom houses for around £190,000. Assuming that this price would be discounted to achieve sales, this suggests that net receipts might equate to around £2,100 sq m. Asking prices at relatively recent schemes within Bicester also point to similar levels. Assuming a 15% (or greater) fall has already taken place, this suggests peak values at Bicester would have been around £2,500 sq m. (i.e. £250,000 for a substantial 3 bedroom house).
9. Valuation Office Agency data suggests that in Bicester the price of second hand homes peaked in 2007 at around £230,000 for semi detached homes and £190,000 for terraced homes which provides some support for this general range of figures.
10. We therefore conclude that house prices might return to around £2,500 sq m in Bicester before 2014. This figure is taken to be receipts net of sales costs. At this level the model suggests that residual land values should have reached around £3,600,000 per ha in 2007.
11. The model assumes that this level of land values is achieved again in 2017. Again, this echoes Savills' projection that land prices will take longer to recover than house prices.

Assumptions about Commercial and Retail Development Receipts

12. The proposed scheme comprises office, industrial and distribution land. Bicester has a small office market and there is no readily available, reliable and comparable information on prospective land values. It has rather more industrial and distribution space.
13. The relative political popularity of employment creating schemes coupled with the balance of supply and demand for new offices in marginal out of town locations such as Bicester tends to mean that land values are just adequate to pay for necessary infrastructure and provide a basic reward to a landowners for pursuing a change of use.
14. There is also limited rental data available. On this basis we attribute a notional land value of £1m ha to serviced development plots.
15. Both Bicester and nearby Banbury have active industrial and distribution space markets. A recent example in Bicester is the Arena 14 scheme where the current asking price seems to be around £1,070 sq m freehold. Valuation Office Agency data suggests that in the early part of 2008 land values in nearby Oxford (where property prices are not dissimilar) were at around £900k ha.

Assumptions about Development Costs

16. Normal site preparation costs cover strategic drainage, distributor roads and utilities, structural landscaping and public open space. We have assumed that all of these normal costs can be covered by an allowance of £250,000 per gross ha, with the lower costs associated with green areas offset by higher costs in developed areas. This assumes that there are no major problems with drainage and it will be possible to build off conventional foundations.
17. The additional costs assumed to arise from the special and specific nature of this scheme together with the infrastructure that might need to be provided directly or through Section 106 Agreements are listed in Table 1 below.
18. The basis of the list was a schedule of items that we understand was proposed by Arup in connection with the Weston Otmoor scheme. Many of these items are normally provided by a housebuilder as part of their normal on site works and we have subsumed them within our generic budget for secondary infrastructure. Arup appear to have relied heavily on Spons for their estimates with the result that they are at best only a partial reflection of the costs involved.
19. We have added additional items that are specific to this scheme or which Arup appear to have overlooked and adjusted costs to (a) omit budgets for items that are conventionally paid for by the developer as part of the scheme and (b) substitute cost estimates based on our own benchmark data (some of Arup's costs were based on use of Spons formulae which in our experience can be misleading).

20. The result is an estimate that the additional costs that will be incurred in providing this scheme with enhanced environmental and standard social infrastructure amount to some £129m (see table below). This is equivalent to around £26,000 per house on the assumption that charges are not levied on the employment space. The total cost of normal site preparation and the likely infrastructure required to deliver NW Bicester is £226m, or around £45,000 per house.

Cost Factor: Description	Budget	Basis
Normal site preparation costs(see para. 16)	£86,500,000	£250,000 per gross ha
Cost of achieving CSH	£0	In Residential Land Values Projection
Cost of achieving 'Home Zone' standards	£0	Incl in site preparation costs
Allowance for enhanced design	£25,000,000	Assume £5,000 per dwelling / Aesthetics / Homes for Life
Allowance for microgeneration	£0	Incl in achieving CSH
Bury overhead power lines	£3,300,000	Provision @ 31m per km
CHP Plant	£10,000,000	Provision
SUDS - On site	£0	Included in site preparation costs
SUDS - Off site	£1,000,000	Provision
Biomass Planting	£1,000,000	Provision
Dual A4095	£0	Not Built in the Model
Perimeter Road	£7,788,000	Halcrow est.
Works to rail bridge	£1,440,000	ditto to incl earthworks
Pedestrian Underpass under railway	£1,000,000	Halcrow est.
Car parks	£0	provided on plot.
Footpaths	£0	on site incl. in site preparation costs
Cyclepaths	£0	on site incl. in site preparation costs
Provision for rapid transport	£5,000,000	Provision
Subsidy for bus services	£10,750,000	£2.15m p.a. for 5 years average.
Library	£1,150,000	Based on SE Library Tariff 2007 approx.
Adult Learning Centre	£0	incl in above.
Elderly Day Care	£1,000,000	Provision
Elderly Care Homes	£0	Private provision

Physical & learning disability day centres	£250,000	Provision
Hospital	£0	Mainstream public investment
GP Surgeries / Health centre	£560,000	50% public provision in health centre with 8 GPs @ £185k per GP
Dental Surgeries	£0	Private provision
Pharmacies	£0	Private provision
Complementary Health and Care Services	£0	Private provision
Small Police Station	£0	Below provision threshold
Ploice Neighbourhood Team Bases	£100,000	Provision
Fire Station	£0	Below provision threshold
Youth Facilities	£1,000,000	Provision for special facilities
Community Hall	£3,520,000	0.4 sq m per dwelling @£1700 sq m
Sports Hall	£2,800,000	Sport England Kitbag approx.
Places of worship	£0	Land only provision
Early Years provision	£2,000,000	Provision for nurseries, children's centre etc.
Primary School	£19,335,000	Oxfordshire SPD @ £3867 for 3 bed dwelling
Secondary School	£25,845,000	Oxfordshire SPD @£5169 for 3 bed dwelling
6th Form	£3,830,000	Oxfordshire SPD @£766 for 3 bed dwelling
Public Squares	£0	on site incl. in site preparation costs
Sports Pitches: Formal sports provision	£0	on site incl. in site preparation costs
Sports Pitches: Pavilions	£500,000	Provision
Sports Pitches: equipment	£50,000	Provision for special facilities
Amenity Space/Informal sports provision	£0	on site incl. in site preparation costs
Woodlands/BioFuel	£0	In Environ. Infr
Woodland/possible cemetery	£0	In above
Structural Landscape/Linear Public Open Space	£0	on site incl. in site preparation costs
Allotments	£0	on site incl. in site preparation costs

Children Play Facilities: play area	£0	on site incl. in site preparation costs
Children Play Facilities: equipment	£0	on site incl. in site preparation costs
Waste Collection	£125,000	Basic collection infr. incl. recycling point @ £250 per home (OCC standard is £100)
Art	£1,000,000	Provision @ £200 per house
Fees	10,792,150	5% of site preparation and other infrastructure costs
Total	£226,635,150	£45,327 per Dwelling

RESIDENTIAL SITE VALUE CALCULATION

Project: North West Bicester Eco Town

Viability

Discount rate	20.00%	p.a.
NPV	£2,536,665	
NPV per gross ha	7,331	

Development Assumptions

	Ha.	
Gross Site Area	346	Ha.
Sales rate	5%	of total floorspace p.a

Income Assumptions

	Quantum		Price / Rate		Total
Market Housing	87.5	ha	See worksheet		510,478,240
Affordable Housing	37.5	ha	0		0
Commercial & Retail	37.2		1,000,000	ha net of costs	37,200,000
Total					547,678,240

Cost Assumptions

Standard Secondary Infrastructure	Provision	250,000	Per ha	86,500,000
Social & S106 Infrastructure	See worksheet			129,343,000
Fees & Other costs	5%			10,792,150
Total				215,843,000

Projected Land Values

Cash Flow

Year	Land Value - Market Resi	Land Value - Commercial	Income	Standard Secondary Infr	Additional Costs	Fees	Net cash
2011	0	0	0	0	0	539,608	-11,331,758
2012	0	0	0	0	0	539,608	-11,331,758
2013	0	0	0	4,325,000	6,467,150	539,608	-11,331,758
2014	13,091,750	1,860,000	14,951,750	4,325,000	6,467,150	539,608	3,619,993
2015	14,212,844	1,860,000	16,072,844	4,325,000	6,467,150	539,608	4,741,086
2016	15,361,965	1,860,000	17,221,965	4,325,000	6,467,150	539,608	5,890,207
2017	16,539,814	1,860,000	18,399,814	4,325,000	6,467,150	539,608	7,068,056
2018	17,747,109	1,860,000	19,607,109	4,325,000	6,467,150	539,608	8,275,352
2019	18,984,587	1,860,000	20,844,587	4,325,000	6,467,150	539,608	9,512,830
2020	20,253,002	1,860,000	22,113,002	4,325,000	6,467,150	539,608	10,781,244
2021	21,553,127	1,860,000	23,413,127	4,325,000	6,467,150	539,608	12,081,369
2022	22,885,755	1,860,000	24,745,755	4,325,000	6,467,150	539,608	13,413,997
2023	24,251,699	1,860,000	26,111,699	4,325,000	6,467,150	539,608	14,779,941
2024	25,651,791	1,860,000	27,511,791	4,325,000	6,467,150	539,608	16,180,034
2025	27,086,886	1,860,000	28,946,886	4,325,000	6,467,150	539,608	17,615,129
2026	28,557,858	1,860,000	30,417,858	4,325,000	6,467,150	539,608	19,086,101
2027	30,065,605	1,860,000	31,925,605	4,325,000	6,467,150	539,608	20,593,847
2028	31,611,045	1,860,000	33,471,045	4,325,000	6,467,150	539,608	22,139,287
2029	33,195,121	1,860,000	35,055,121	4,325,000	6,467,150	539,608	23,723,363
2030	34,818,799	1,860,000	36,678,799	4,325,000	6,467,150	539,608	25,347,041
2031	36,483,069	1,860,000	38,343,069	4,325,000	6,467,150	0	38,343,069
2032	38,188,946	1,860,000	40,048,946	4,325,000	6,467,150	0	40,048,946
2033	39,937,469	1,860,000	41,797,469	0	0	0	41,797,469
	510,478,240	37,200,000	547,678,240	0	0	0	

Revenue Projections: Residential Land (projection of real values)

Indicator	Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Residential Value	Note 1	2500	2100	1900	2100	2200	2300	2500	2563	2627	2692	2760
Build Costs	Note 2	1600	1600	1600	1728	1728	1728	1814	1814	1814	1814	1814
Revenue from residential land (per sq m)	Note 3	900	500	300	372	472	572	686	748	812	878	945
Revenue from residential land (per ha)	Note 4	3,600,000	2,000,000	1,200,000	1,488,000	1,888,000	2,288,000	2,742,400	2,992,400	3,248,650	3,511,306	3,780,529

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
2829	2899	2972	3046	3122	3200	3280	3362	3446	3532	3621	3711	3804	3899	3997	4097
1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814	1814
1014	1085	1157	1232	1308	1386	1466	1548	1632	1718	1806	1897	1990	2085	2182	2282
4,056,482	4,339,334	4,629,258	4,926,429	5,231,030	5,543,245	5,863,267	6,191,288	6,527,510	6,872,138	7,225,382	7,587,456	7,958,583	8,338,987	8,728,902	9,128,564

1. Per sq m net end value of the market dwellings once built; assumed to fall by 25% peak to trough to 2009 , returning to peak by 2013 then increasing at 2% p.a in real terms (i.e. after deducting general inflation)

2. Per sq m cost of building the homes (market units) increasing at rate of general inflation (i.e. Nil increase in real terms) plus 8% for CSH6 in 2010 and 5% for CSH6 in 2013

3. This is derived by deducting build costs from residential values

This is derived as a product of per sq m revenue from residential land and residential floorspace per ha. The model assumes 40 dwellings per hectare of approximately 100 sq m. This relates to 4,000 sq m of residential floorspace per sq m.