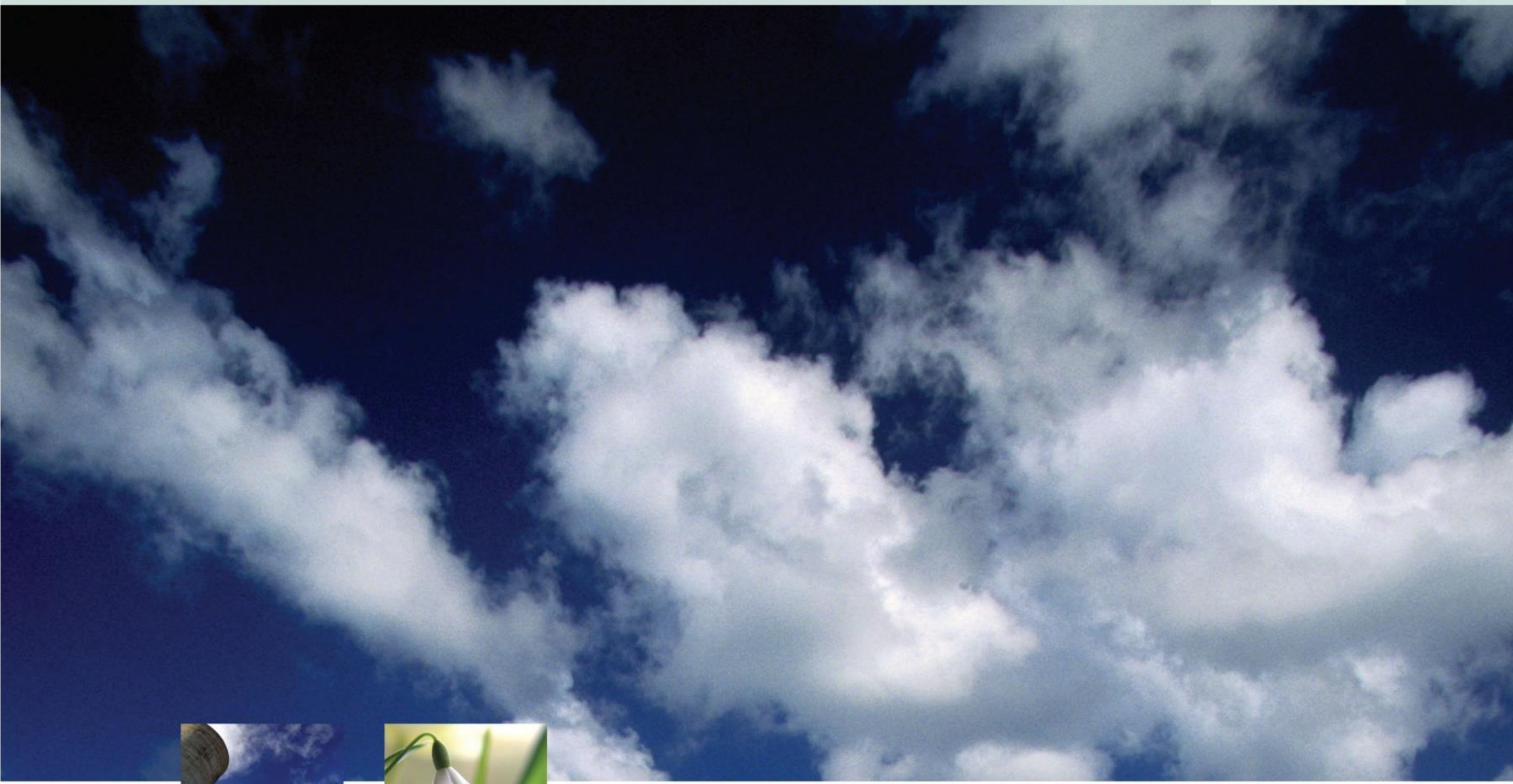

CHP ASSESSMENT

Biomass No.4 Limited
Energy Production Facility

Prepared by:
Sol Environment Ltd

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1	First Submission to Environment Agency	17th September 2023	SB

1. HEAT EXPORT FEASIBILITY STUDY

1.1 Introduction

This document has been prepared by Sol Environment Ltd on the behalf of Biomass No.4 Limited (hereafter referred to as 'Biomass No.4 or the 'Applicant') for the proposed operation of an Energy from Waste (EfW) Plant at their site at Units 21-29, Belliver Way, Roborough, Plymouth, Devon, PL6 7BW (National Grid Reference: SX 49890 62378).

This document supports the wider Environmental Permit (EPR) application for the site and associated processes.

The document is a desk-based study detailing the demand and initial feasibility for exportation of heat from the proposed development.

The Facility will comprise a single-line waste incineration plant to incinerate pre-processed refuse derived fuel (RDF) / solid recovered fuel (SRF) (herein referred to collectively as 'RDF', for simplicity).

Assuming a design NCV of 10.11 MJ/kg, the Facility will process approximately 50,000 tonnes of waste per year (at a design capacity of 6.33 tph and assuming 7,900 hours availability).

However, the Facility will be capable of processing waste with a range of NCVs. The maximum throughput for the Facility will be up to 60,000 tpa of RDF.

The total aggregate thermal capacity of the plant is 17.75MWth and as such is below 20MWth and is therefore not defined as being an Article 14 facility under the EU Energy Efficiency Directive. Therefore a cost-benefit analysis in accordance with Part 2 of Annex IX is not required to be carried out[1]. Accordingly this CHP assessment provides a BAT assessment only and does not provide a Cost Benefit Analysis.

The Plant will have the potential capacity to export up to 10 MWth of heat. The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during the detailed feasibility stages, should a commercially viable heat offtake be identified.

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1 Article 14 (5-8) states:
a) A new thermal electricity generation installation with a total thermal input exceeding 20 MW is planned, in order to assess the cost and benefits of providing for the operation of the installation as a high-efficiency cogeneration installation;
b) An existing thermal electricity generation installation with a total thermal input exceeding 20 MW is substantially refurbished,in order to assess the cost and benefits of converting it to high-efficiency cogeneration;

This report identifies potential commercially viable existing heat consumers as well as prospective heat consumers within a 10 km study area. The design of the plant will be aligned with BAT guidance given in *'CHP Ready Guidance for Combustion and Energy from Waste Power Plants'.*

1.2 Objective

The principal objectives of this CHP assessment are as follows.

- Prepare a CHP Assessment in line with the Environment Agency (EA) guidance *CHP Ready Guidance for Combustion and Energy from Waste Power Plants'*, which will support an Environmental Permit (EP) application.
- Provide a technical description of the proposed Facility and heat export infrastructure.
- Calculate heat demands based on identified heat consumers and assess the feasibility of connecting identified heat consumers to the network.
- Based on the heat loads anticipated for the outline solution identified, calculate relevant energy efficiency measures to demonstrate legislative compliance.
- Produce a drawing of the provisional pipe routing from the Facility to the likely heat consumers.
- Produce a CHP-Ready Assessment as required under the EA CHP-Ready guidance, including a clear statement on best available techniques (BAT), combined heat and power (CHP) envelope and the CHP-Ready Assessment form.

2. TECHNOLOGY DESCRIPTION

2.1 Plant Design and Configuration

Pre-processed Refuse Derived Fuel (RDF) will be delivered directly to the Fuel Reception Hall. HGV's will unload in the internal offloading area and a visual inspection will take place. The delivered RDF feedstocks will then be transferred directly to walking floor fuel bunkers prior to be conveyed into the feed system of the plant.

The site will have a single line moving grate combustion system with a fuel feed system to deliver the waste into the incoming metering bins. The waste is then introduced to the grate and combusted for the purposes of heating a thermal fluid through a recovery boiler, which is subsequently passed to a ORC turbine for the production of renewable electricity. The gross electrical output of the plant is up to 4.7MWe.

The thermal oil media is then cooled and condensed before returning to the system. Currently, the design includes air cooled condensers (ACC), but if significant heat offtake is required then these will be replaced by V air blast coolers/radiators using water in a closed system. The design is yet to be confirmed.

Detailed Computational-Fluid-Dynamic modelling (CFD) of the combustion process will be carried out to demonstrate complete combustion of the fuels under varying conditions and also to guarantee the 2 seconds minimum combustion time above 850°C as compliance with IED.

Flue gas cleaning and pollution control consists of Selective Non-Catalytic Reduction (SNCR) through ammonia hydroxide injection within the combustion chambers, followed by bag filtration with upstream sodium bicarbonate injection for acid gas neutralisation and activated carbon powder injection for absorption and removal of heavy metals, dioxins, VOCs and other harmful substances.

- The Facility will have a gross electrical output of approximately 4.64 MWe, (when operating in fully condensing mode), with a parasitic load of 0.75 MWe. Therefore, the Facility will export approximately 3.9 MWe to the local electricity distribution network.
- Simultaneously, the Facility is designed with capability to export up to 10 MWth of heat to local consumers. The maximum heat capacity will be subject to the demands of the heat consumers and confirmed during the detailed design stage.
- Heat extraction from the Organic Rankine Cycle (ORC) turbine/generator set will be transferred to a closed hot water circuit via a series of condensing heat exchangers and supplied to consumers through a pre-insulated buried hot water pipeline network. Having delivered the heat, the water will be returned to the Facility for reheating, then recirculated. The technology for providing this heat network is well proven and highly efficient.

- The Facility turbine design will be optimised to maximise electrical efficiency while allowing for the possibility of a heat export capacity of 10 MWth. On this basis, the Facility will be able to supply the full heat network demand independently and therefore the heat consumers will be provided with a stable heat supply throughout the year.

The plant has been configured to maximise power generation and can be configured for CHP mode operation. The turbine has the capacity to operate in CHP mode and heat could be diverted to heat exchangers if required (CHP-ready). Lower (low value) temperature (55°C) hot water can be provided via the air cooled condenser circuits without impacting the overall electrical output of the facility.

3. HEAT DEMAND INVESTIGATION

The base case for export of energy from the facility will be electrical power. In 100% power generation mode, the heat energy generated by the boiler is used solely by the ORC generation plant. A basic Heat and Mass Balance diagram can be found in Annex G1.

A review of the existing and future potential energy demands within the vicinity of the facility has been undertaken within a 10 km radius of the site. The potential heat consumers have been identified using heat mapping tools and visual inspection of maps.

The viability of connecting the proposed development with potential heat users has been considered on the basis of export capacity and distance from the site. Where present, larger heat consumers and those in close proximity to the site have been prioritised ahead of other consumers. Unfortunately, based on the initial study, no large scale users have been identified in the immediate surroundings of the site with no existing heat distribution networks known to be available or proposed.

3.1 National Heat Map

Heat consumers have been identified using publicly available data in the National Comprehensive Assessment, heat mapping tools and satellite imagery. Identified existing local heat consumers include many industrial estates located nearby surrounding the Facility.

The Department for Business, Energy and Industrial Strategy (BEIS) UK CHP Development Map [2] has been utilised to carry out a review of potential heat loads within 10km of the site.

The table below shows a breakdown of the heat demand of all sectors and building types within a 10km radius of the site.

Table 3.1: Local Heat Demand within 10km by Sector

Sector	Total MWh	Share
Communications and Transport	3,028	0.23%
Commercial Offices	11,148	0.83%
Domestic	1,132,922	84.61%
Education	25,479	1.9%
Government Buildings	62,078	4.64%

[2] https://chptools.decc.gov.uk/developmentmap

Hotels	8,427	0.63%
Large Industrial	40,325	3.01%
Health	4,398	0.33%
Other	1,620	0.12%
Small Industrial	27,091	2.02%
Prisons	0	0%
Retail	17,566	1.31%
Sport and Leisure	4,036	0.30%
Warehouses	892	0.07%
District Heating	0	0%
Total Heat Load in Area	**1,339,011**	**100%**

The primary sector for heat demand within the 10km radius of the site is domestic household use, requiring 1,132,022 MWt and making up 84.61% of the total share, Large Industrial is another significant user, needing 40,325 MWt (3.01% of the total share).

It is key to keep these figures in context as the a simple search of the locality has also identified a number of other major industrial sites that are likely to have industrial heat requirements beyond those recorded on the CHP heat map, indicating that local heat users may be present.

Including domestic properties within a heat network comes with challenges due to the high costs of replacing existing heating systems, the highly variable daily and seasonal nature of the heat demand and the complexities connecting a number of small heat consumers to a network. However, large new scale high density housing developments can represent a potential viable option should they be developed within a commercially viable distance to the site.

3.2 Large Heat Consumers

There is one Large Heat Loads within 10km of the site, identified through using the DBEIS UK CHP Development Map.

This is owned and operated by Babcock International Ltd and is a Naval Base Management service.

Table 3.2 shows a summary of the large heat load within 10km.

Table 3.2: Large Heat Loads within 10km		
Operator (Estimated)	Heat Demand (MWh/annum)	Approximate distance from site (km)
Babcock International Ltd	51,156	8.9

In addition to the identified large heat users, there aare other identified industrial facilities in the proximity of the site that have not identified on the BEIS CHP Development Map. These oiperators have been included in Figure 3.1.

The identified major user is nearly 10km away from the development, showing potential economic and physical constrains of exporting heat to them. Given the industrial nature of these consumers, it is likely that high grade heat may be required and the practicality of collecting and returning condensate is unknown.

Given that there is no existing heat distribution network infrastructure in the proximity of the site, additional third / private finance and associated planning permissions would be required to facilitate the construction and operation such systems. The lack of existing distribution infrastructure and / or the associated permissions / wayleaves to construct the facility creates further tangible barriers to the viability of the export.

3.3 Feasibility of Export to Existing Residential / Domestic Consumers

The facility will have an export capacity of approximately 10 MW for CHP operation. Therefore, it is possible for the development to supply the majority of available heat to all of the identified domestic / residential heat consumers within 10km.

However, given the high costs of replacing existing heating systems and the distance from the site creating physical constraints, the supply of existing residential / domestic consumers is not considered a viable option. The site is within a private industrial area, development of the heat network within this area, as well as suitable consumers for the heat means the feasibility of this consumer is significantly higher. For this reason, the remainder of this CHP assessment will focus upon the surrounding identified industrial uses.

3.4 Prospective Developments

A review of potential developments nearby to the site has been carried out and shown in Table 3.3 and Figure 1. A search distance of 10km has been used.

An analysis of the Local Planning Authorities Planning Portal was undertaken as part of this assessment, to identify any prospective developments that would have the potential to be a viable heat consumer. These prospective developments are found in Table 3.3.

An estimate of the potential heat demands from the specific heat user types has been provided through the use of the Chartered Institution of Building Services Engineers (CIBSE) Guide F (Efficiency in Buildings) has been used. The heat demands for residential developments have been calculated based on a benchmark figure of 65kWh/m^2/year per property and 55kWh/m^2/year per commercial property.

The CIBSE Guide provides good practice benchmark figures based on the energy performance of existing buildings. In the CIBSE Guide, loads are expressed in terms of kWh per square metre of floor space per year of fossil fuel use and for the purpose of this assessment natural gas is typically assumed.

The annual energy demand has been estimated based on an estimate of the floor space of the developments. Converting natural gas use to actual heat loads (which can be provided by a hot water distribution system) requires an assumption of gas-fired boiler efficiency. In this study, an efficiency of 85% is assumed, based on industry norms.

The Facility is well located for potential heat users with extensive industrial energy demand existing within the local area. The following new and existing opportunities have been identified to be potential heat customers and are in surrounding areas at a reasonable distance from the Facility to enable a heat connection. Engagement with potential developers is a key aspect to delivering a district heating scheme. Development proposals are currently at various stages within the planning process and may therefore be subject to change.

3.4.1 Belliver Industrial Estate

The location of the development within Belliver Industrial Estate, provides an excellent opportunity for heat generated by the facility to be used by the existing and future businesses within this industrial estate. There is currently no heat network present at the this industrial estate, however due to the development residing within this area it is still considered as a feasible heat consumer.

Table 3.3 overleaf shows estimated annual heat demand for the potential heat users within Belliver Industrial Estate and Figure 3.1 shows their location.

The heat demand have been estimated using the floor space of the proposed developments based on use. This means that the numbers will not fully represent the potential heat demand of the industrial sites which neighbour the proposed development, meaning that the estimated values could be significantly higher and provide a supply for all of the available heat produced by the development.

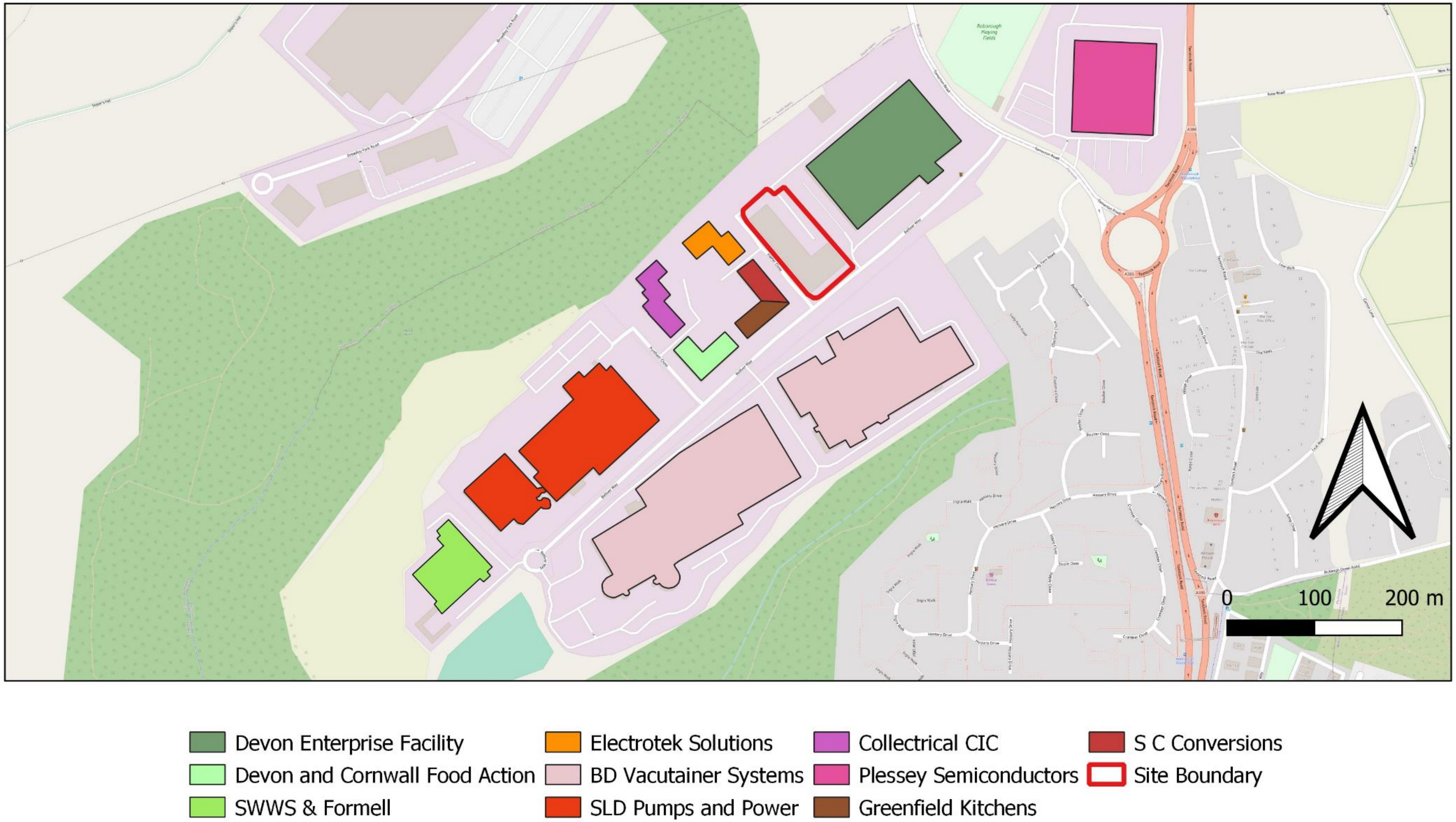

Figure 3.1 Map of Prospective Developments for the proposed plant at the Belliver industrial estate

Table 3.3: Prospective Developments for Potential Heat Export				
Scheme	Development Proposals	Approximate Distance from EfW site	Estimated Heat Demand Based on Floor Space (MWh/yr)	Estimated Heat Demand of Industrial Process (MW)
Devon Enterprise Facility	A warehouse development, B8 and B2 uses	60m east	573	N/A
BD Vacutainer Systems	Hospital equipment and supply facility, B8 and B2 uses	60m south	2239	5-10
S C Conversions	Car and Van Conversion service, B2 use	28m west	69	N/A
Electrotek Solutions	Electrical store, B8 use	28m west	135	N/A
Collectrical CIC	Electrical store, B8 use	130m west	149	N/A
Greenfield Kitchens	Kitchen store, B8 use	50m west	65	N/A
Devon & Cornwall Food Action	Food bank, B8 use	100m west	64	N/A
SLD Pumps and Power	Industrial supplier, B2 and B8 use	231m west	885	3-6
SWWS & Formell	Warehouse, B8 use	480m west	255	N/A
Plessey Semiconductors	Electronics manufacturer, B2 and B8 uses	300m northeast	550	2-4
Total			**4984**	**10-20**
*The heating values provided are estimates, based primarily on floor space without industrial process knowledge.				

3.4 Feasibility of Export

The Site is within a predominantly industrial location which lends itself to having feasible and economically viable heat distribution network developed to serve potential consumer sites.

The closest potential heat user is considered to be the neighbouring BD Vacutainer Systems Ltd. Although the reported heat use for his building is considered to be quite low, given that they are a manufacturer of medical good, it is likely that they will have a materially large industrial process heat requirement. The proximity to the site means that it is both technically viable and feasible to directly supply heat via a direct local connection. Given that the exact heat and energy requirements of the BD Vacutainer Systems site are not known, it is proposed that further detailed technical feasibility is carried out to fully understand the viability of a direct heat supply connection.

In addition, supplying heat to Devon Enterprise Facility as well as Plessey Semiconductors has potential to take a significant portion of the heat produced at the plant, due to its immediate location to the site further studies will be undertaken to analyse the feasibility of these connections.

One of the primary heat demands of the area is residential areas including Woolwell, Southway and Roborough, all of which lie within a 5km radius of the proposed development. Given that all housing is ‘traditionally’ using gas boilers and that no pre-existing heat distribution infrastructure is available within the area, the connection and supply of heat to this development is not considered viable.

An assessment of proposed developments which are still subject to planning approval have been investigated and included within the appraisal. There were no suitable proposed developments which have the viability to have a connection with the facility.

In conclusion, the lack of any high density, residential heat users, combined with the lack of any local heat distribution networks creates a significant constraint to the commercial viability of heat exportation from the facility to residential areas.

The nearest viable heat connection is considered to be the neighbouring BD Vacutainer Systems Ltd development. This site will be subject to further detailed technical evaluation to fully understand their heat requirement and further detailed feasibility completed.

4. CONCLUSION

An assessment of all potential domestic and commercial heat users within 10km distance from the site has been carried out using The Department for Business, Energy and Industrial Strategy (BEIS) UK CHP Development Map.

This study has concluded that although there are identified large commercial heat consumers within 10km of the development, the nature and profile of the heat use, which in the event of suitable infrastructure being developed would be considered viable users of thermal energy from the plant.

Given that the plant has been designed as a CHP facility that is capable of supplying and exporting renewable / low carbon heat, this document will be supplemented with further studies assessing the economic business case and local market for the construction of suitable heat distribution infrastructure.

In addition, this report will be subject to ongoing review to ensure that any 'new' heat users or distribution infrastructure identified or constructed within the vicinity of the plant, will be reviewed every 4 years to identify and assess the potential commercial and technical viability for the heat export to the local area.

The study also confirms that due to the relatively remote and low density nature of the residential properties in the vicinity of the site, it is not feasible to use the site as a regional source of domestic heat.

The most viable consumer of the heat produced on site is found within the Belliver Industrial Estate, at BD Vacutainer Systems (BDVS). This development has the potential to take a significant amount of the heat produced at the facility, and the location being within 100m, all of which is located on private land, further increases the viability of this being a potential consumer. Further studies as well as conversation with the operators of BDVS will be occurring to analyse the feasibility of this.

Due to the site being below the 20MWth threshold defined under Article 14 of the Energy Efficiency Directive, a formal cost benefit analysis is not required and has not been considered further.

ANNEX G1 – HEAT AND MASS BALANCE

ANNEX G2 – EA CHP SPREADSHEET

CHP-R Assessment Form			
Number	Description	Units	Notes / Instructions
Requirement 1 – Plant, Plant Location and Potential Heat Loads			
1.1	Plant Name		Biomass No.4 Ltd
1.2	Plant Description		The main activities associated with the operation of the Facility will be the combustion of RDF, operation of thermal oil boilers, generation of electricity using an Organic Rankine Cycle (ORC) turbine, and the potential to export heat subject to commercial and economic viability. The Facility includes two waste incineration lines, waste reception hall, two thermal oil boilers, ORC turbine/generator set, turbine hall, on-site facilities for the treatment or storage of residues and waste water, flue gas treatment, stack, boilers, devices and systems for controlling operation of the waste incineration plant and recording and monitoring conditions. The Facility will also include weighbridges, water, auxiliary fuel and air supply systems, site fencing and security barriers, external hardstanding areas for vehicle manoeuvring, internal access roads and car parking, transformers, grid connection compound, firewater storage tanks, offices, workshop, stores and staff welfare facilities. The Facility has been designed to export power to the National Grid. The Facility will generate approximately 4.64 MWe of electricity in full condensing mode. The Facility will have a parasitic load of 0.75 MWe. Therefore, the net power export capacity of the Facility is 3.89 MWe. In addition to generating power, the Facility has been designed to be capable of exporting up to 10 MWth heat to local heat users. The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during detailed design stage. At the time of writing this report, there are no formal agreements in place for the export of heat from the Facility. The power exported may fluctuate as fuel quality fluctuates, and if heat is

			exported from the Facility to local heat users in the future.
1.3	Plant Location		Units 21-29, Belliver Way, Roborough, Plymouth, Devon, PL6 7BW (National Grid Reference: SX 49890 62378).
1.4	Factors Influencing Selection of Plant Location		The site is pre-existing and was approved for construction in line with relevant Local Plan(s) and the NPPF together with other relevant planning considerations . The site is in close proximity of suitable connection point to the National Grid Electricity Transmission System, and available capacity for export to the Electricity Transmission System is suitable. Fuel source is in appropriate distance and draft long term fuel contract is in place.
1.5	Operation of Plant		
a)	Proposed Operational Plant Load	%	100
b)	Thermal Input at Proposed Operational	MW	17.77
c)	Net electrical output at proposed operational plant load	MW	3.89
d)	Net electrical efficiency at proposed operational plant load	%	21.90
e)	Maximum plant load	%	100
f)	Thermal input at maximum plant load	MW	17.77
g)	Net electrical output at maximum plant load	MW	3.89
h)	Net electrical efficiency at maximum plant load	%	21.9
i)	Minimum stable plant load	%	70
j)	Thermal input at minimum stable plant load	MW	12.44
k)	Net electrical output at minimum stable plant load	MW	1.9
l)	Net electrical efficiency at minimum stable plant load	%	15.37

1.6	**Identified Potential Heat Loads**		Please refer to main CHP report – The estimated heat use of the identified network is 4985 MWh/year
1.7	**Selected Heat Load(s)**		
a)	Category (e.g. industrial / district heating)		Industrial
b)	Maximum heat load extraction required	MW	Please refer to main CHP report
1.8	**Export and Return Requirement of Heat Load**		
a)	Description of heat load extraction		n/a - no suitable heat load found
b)	Description of heat load profile		n/a - no suitable heat load found
c)	Export pressure	bar a	n/a - no suitable heat load found
d)	Export temperature	ºC	n/a - no suitable heat load found
e)	Export flow	t/h	n/a - no suitable heat load found
f)	Return pressure	bar a	n/a - no suitable heat load found
g)	Return temperature	ºC	n/a - no suitable heat load found
h)	Return flow	t/h	n/a - no suitable heat load found
Requirement 2 – Identification of CHP Envelope			
2.1	**Heat extraction at 100% plant load**		
a)	Maximum heat load extraction at 100% plant load	MW	10
b)	Maximum heat extraction export flow at 100% plant load	t/h	Assuming heat extraction at 1.5 bar(a), export flow rate would be: 2.7 t/h
c)	CHP mode net electrical output at 100% plant load	MW	2.64
d)	CHP mode net electrical efficiency at 100% plant load	%	14.88
e)	CHP mode net CHP efficiency at 100% plant load	%	71.14
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	31.84
2.2	**Heat extraction at minimum stable plant load**		
a)	Maximum heat load extraction at minimum stable plant load	MW	4.6

b)	Maximum heat extraction export flow at minimum stable plant load	t/h	Assuming heat extraction at 1.5 bar(a), export flow rate would be: 1.27 t/hr
c)	CHP mode net electrical output at minimum stable plant load	MW	1.9
d)	CHP mode net electrical efficiency at minimum stable plant load	%	15.37
e)	CHP mode net CHP efficiency at minimum stable plant load	%	CHP net CHP efficiency at minimum stable plant load based on the LHV is 53%.
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	24.72
2.3	Can the plant supply the selected identified potential heat load		Yes
Requirement 3 – Operation of the Plant with the Selected Identified Heat Load			
3.1	**Proposed operation of plant with CHP**		
a)	CHP mode net electrical output at proposed operational plant load	MW	3.67
b)	CHP mode net electrical efficiency at proposed operational plant load	%	20.64
c)	CHP mode net CHP efficiency at proposed operational plant load	%	30.68
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	MW	0.22
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	1.25
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	10.71

g)	Z ratio		Same as example
Requirement 4 – Technical Provisions and Space Requirements			
4.1	Description of likely suitable extraction points		Heat for the district heating system could be supplied via a heat flow extraction from low pressure turbine bleed at approximately 1.5 bar(a).
4.2	Description of potential options which could be incorporated in the plant, should a CHP opportunity be realised outside the 'CHP envelope'		The CHP opportunity lies within the CHP envelope.
4.3	4.3.Description of how the future costs and burdens associated with supplying the identified heat load / potential CHP opportunity have been minimised through the implementation of an appropriate CHP-R design		If the scheme were to be implemented, space will be allocated for the CHP equipment within or in the area adjacent to the turbine hall to avoid the cost of building a dedicated heat station at a later date. The turbine design will be selected to maximise electrical efficiency while allowing for the option of heat export to be implemented in the future. This is in line with the EA CHP-Ready Guidance which states that the initial electrical efficiency of a CHP-R plant (before any opportunities for the supply of heat are realised) should be no less than that of the equivalent non-CHP-R plant.
4.4	Provision of site layout of the plant, indicating available space which could be made available for CHP-R		Detailed design of the Facility has not been undertaken at this stage. However, space will be left available on site for heat export infrastructure. Please see the site layout in Appendix F. The heat network will (likely) include low pressure vapour extraction piping, control and shutoff valves, heat exchangers, district heating supply and return lines, district heating circulation pumps, condensate fluid return piping (to the condensate tank), control and instrumentation / electrical connections, an expansion tank for pressurisation of the district heating pipe network and heat metering. If necessary, a back-up boiler will be located at a suitable location within the

			installation boundary for ease of connection to the primary hot water circuit.
Requirement 5 – Integration of CHP and Carbon Capture			
5.1	**Is the plant required to be CCR?**		No
5.2	**Export and return requirements identified for carbon capture**		
a)	Heat load extraction for carbon capture at 100% plant load	MW	n/a
b)	Description of heat export (e.g. hot water)		n/a
c)	Export pressure	bar a	n/a
d)	Export temperature	ºC	n/a
e)	Export flow	t/h	n/a
f)	Return pressure	bar a	n/a
g)	Return temperature	ºC	n/a
h)	Return flow	t/h	n/a
i)	Likely suitable extraction points		n/a
Minimum Stable Plant Load			
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	n/a
k)	Description of heat export (e.g. hot water)		n/a
l)	Export pressure	bar a	n/a
m)	Export temperature	ºC	n/a
n)	Export flow	t/h	n/a
o)	Return pressure	bar a	n/a
p)	Return temperature	ºC	n/a
q)	Return flow	t/h	n/a
r)	Likely suitable extraction points		n/a
5.3	**Operation of plant with carbon capture (without CHP)**		
a)	Maximum plant load with carbon capture	%	n/a
b)	Carbon capture mode thermal input at maximum plant load	MW	n/a

c)	Carbon capture mode net electrical output at maximum plant load	MW	n/a
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	n/a
e)	Minimum stable plant load with CCS	%	n/a
f)	Carbon capture mode CCS thermal input at minimum stable plant load	MW	n/a
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	n/a
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	n/a
5.4	**Heat extraction for CHP at 100% plant load with carbon capture**		n/a
a)	Maximum heat load extraction at 100% plant load with carbon capture	MW	n/a
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	n/a
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	n/a
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	n/a
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	n/a
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	n/a

5.5	**Heat extraction at minimum stable plant load with carbon capture**		
a)	Maximum heat load extraction at minimum stable plant load with carbon capture	MW	n/a
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	n/a
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	n/a
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	n/a
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	n/a
f)	reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	n/a
5.6	**Can the plant with carbon capture supply the selected identified potential heat load (i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?**		n/a
5.7	**Description of potential options which could be incorporated in the plant for useful integration of any realised CHP system and carbon capture system**		n/a
Requirement 6 – Economics of CHP-R			
6.1	**Economic assessment of CHP-R**		It has not been possible to assess the economic feasibility of a CHP scheme as the infrastructure required remains unknown.
BAT Assessment			

	Is the new plant a CHP plant at the outset (i.e. are there economically viable CHP opportunities at the outset)?		No
	If not, is the new plant a CHP-R plant at the outset?		Yes
	Once the new plant is CHP-R, is it BAT?		Yes