MILLERHILL RECYCLING AND ENERGY RECOVERY CENTRE (RERC)

PROPOSED DEVELOPMENT OF AN INTEGRATED WASTE RECOVERY FACILITY ON LAND OFF AT THE FORMER MILLERHILL MARSHALLING YARDS, WHITEHALL ROAD, MILLERHILL, DALKEITH

HEAT AND POWER PLAN

MARCH 2015

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March 2014

This report is submitted in support of a detailed planning application for the above project. The application has been co-ordinated by AXIS with technical inputs from:

- AXIS – Project Management / Co-ordination, Planning Policy & Need, Traffic & Transportation, Landscape & Visual Effects, Cumulative Effects, Socio-Economics, Grid Connection and Heat and Power Plan
- GSDA – Architecture & Design;
- TERRACONSULT – Geology, Hydrogeology and Ground Conditions;
- ARGUS ECOLOGY – Ecology & Nature Conservation;
- Environmental Compliance – Air Quality and Human Health;
- NVC – Noise
- TIER / AXIS – Surface Water and Flood Risk

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1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

1.1.1 This Heat and Power Plan (HPP) supports and accompanies the planning application for the construction and operation of the Millerhill Recycling and Energy Recovery Centre (hereafter referred to as the Millerhill RERC); an integrated waste recovery facility, located on land at the former Millerhill Marshalling Yards, Whitehall Road, Millerhill, near Dalkeith.

1.2 Heat and Power Plan Requirements

1.2.1 The requirements for the preparation of a HPP are set out in Annex 2 of the Scottish Environmental Protection Agency's (SEPA's) Thermal Treatment of Waste Guidelines 2014. It provides an outline format for the HPP that applicants should provide at the time of submitting a planning application.

1.2.2 Annex 2 sets out the format that SEPA would expect the HPP to be prepared, this comprises:

- Section 1: Description of the facility technology;
- Section 2: Description of the waste to be treated and its energy value;
- Section 3: Heat and power plan; and
- Annexes: Any supplementary information referred to in the submitted plans.

1.2.3 This HPP has been prepared in accordance with the required format.

2.0 DESCRIPTION OF THE FACILITY TECHNOLOGY

2.1 Brief Description of Thermal Treatment Technology

2.1.1 FCC is proposing the development of the Millerhill RERC, an integrated waste recovery facility. The proposed development would have a capacity of throughput of 189,471tpa with a single boiler line. The core elements of the EfW facility would be as follows:

1) Weighbridge, access control, and traffic control;
2) a simple Mechanical Treatment facility for shredding of waste, removal of metals and items unsuitable for thermal treatment in the Energy Recovery Facility (ERF);
3) waste reception and storage bunker;
4) waste combustion system and boiler;
5) Boiler de-mineralisation plant;
6) Flue gas treatment system;
7) Steam generating system;
8) Electricity generation system;
9) Heat export system
10) Air cooled condenser;
11) chimney stack; and
12) Ancillary offices, buildings and staff welfare facilities.

2.1.2 A typical schematic of the process that is to be adopted within the Millerhill RERC development is provided in Annex 1.

2.1.3 The plant will be designed to process a total of 195,000 tonnes per annum (tpa) of residual municipal and commercial and industrial waste, of which circa 189,471tpa is expected to be transferred to the ERF following the recycling of metals and removal of unsuitable items. The throughput of the plant is based upon a worst case assumption regarding the calorific value of the incoming waste and it has been assumed that the net calorific value of the incoming waste would be 7.51MJ/kg.

2.1.4 The facility will be capable of exporting up to 11.09 MWe of electricity to the National Grid (with no heat export and taking into account parasitic loads).

2.1.5 The plant would be designed to be able to supply a maximum heat export to a district heating system of circa 20MWth. The exported electricity would reduce to 6.74MWe when supplying this heat load.

2.1.6 As the plant has not been fully designed, the heat to power ratio is estimated. In reality the real heat to power ratio could be less than the estimated value. Also the identified peak heat load is only theoretical, as the identified heat users cannot be secured at this stage.

2.1.7 The facility will be designed using proven technology. In particular, the moving grate combustion system will be similar to that installed on virtually all UK energy from waste plants and some 98% of European plants. It has been developed over a number of years and has been demonstrated to achieve all of the requirements of the Industrial Emissions Directive (IED).

Combustion Process

2.1.8 The combustion facility will use a moving grate which comprises of inclined fixed and moving bars that will move the waste from the feed inlet to the ash discharger. The grate movement turns and mixes the waste along the surface of the grate to ensure that all waste is exposed to the combustion process.

2.1.9 This is an established and robust form of combustion system which provides a good level of flexibility to fuel characteristics. The grate will be able to burn waste from 7MJ/kg to 12MJ/kg which will allow for changes in residual waste composition due to changes in recycling practises.

2.1.10 Primary air for combustion will be fed to the underside of the grates by inverter-driven fans. Secondary air will also be admitted above the grates to create turbulence and ensure complete combustion with minimum levels of oxides of nitrogen (NOx). The volume of both primary and secondary air will be regulated by a combustion control system.

2.1.11 The facility will be designed to meet the requirements of the IED. The combustion control system will regulate the combustion conditions (and thereby minimise the levels of pollutants and particulates in the flue gas before flue treatment) and will control the boilers. The furnaces will also be fitted with auxiliary burners, fired on low sulphur gasoil, which will automatically maintain the temperature above 850°C to ensure the destruction of dioxins, furans and other undesirable combustion products. Combustion chambers, casings and ducts, and ancillary equipment will be maintained under slight negative pressure to prevent the release of gases.

2.1.12 During operation the temperature in the combustion chamber will be continuously monitored and recorded to demonstrate compliance with the requirements of the IED. The combustion control system will be an automated system, including the monitoring of combustion and temperature conditions of the grate, modification of the waste feed rates and the control of primary and secondary air.

Energy Recovery

2.1.13 One of the major benefits of the ERF is its ability to recover energy from the waste in the form of heat from combustion. Such energy recovery is preferable when compared with sending the waste to landfill where the energy would potentially be lost. The combustion produces hot gases which pass to the boiler above the grate and the energy from the gases transfers to the boiler and produces steam.

2.1.14 The steam produced is then used in a steam turbine to generate electricity. The plant would be capable of generating approximately 13.45MWe of electricity in total, of which 2.36MWe would be needed for plant requirements. The remaining 11.09MWe would be fed to the local electricity network. This correlates to a net electrical efficiency of 22.6% (Net CV basis) and a gross efficiency of circa 23% (Gross CV basis).

2.1.15 In addition to the electricity output, the facility will also be capable of exporting heat. This will increase the overall efficiency of the facility. Depending on any heat customer's requirements, it is possible to export heat from the facility as either low pressure steam or hot water. Currently the plant is proposed to provide a heat load of up to 20MW. This correlates to a net plant efficiency of 50.2%.

2.2 Systems for Heat Recovery

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

2.2.2 Steam can be extracted from the steam turbine and is 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 facility. However care has to be exercised to avoid any contamination being carried in the condensate to the boiler. Heat can be recovered from one point in the plant.

2.2.3 Extracted steam can also be passed through a heat exchanger to allow a secondary water circuit to be heated, with this hot water then exported to heat customers. This reduces the risk of contaminated condensate being passed back to the boiler (which would be likely to cause long term deterioration of the plant).

2.2.4 Steam extracted from the steam turbine can be used to generate hot water typically used for district heating schemes or other space heating loads. District heating schemes typically operate with a flow temperature of 90^oC to 120^oC and return water temperatures of 50^oC to 80^oC. 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.

2.2.5 Where steam is used for heating hot water, it will be extracted from 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.

2.2.6 This source of heat offers the most flexible design for the plant. The steam bleeds will be sized to provide additional steam above the plant’s parasitic steam loads. The size of the heat load will be clearly defined to allow the steam bleeds and associated pipework to be adequately sized. The use of steam also allows the supply of low pressure steam as an alternative to hot water.

2.3 Details of the Grid Connection

2.3.1 Scottish Power (SP) Networks is the local district network operator for the plant and FCC has consulted with them in advance of submitting this planning application.

2.3.2 An initial feasibility study has highlighted that the likely connection point for the Energy-from-Waste plant is at the Niddrie sub-station. This will provide the necessary electrical export capacity for the steam turbine generator.

2.3.3 FCC will obtain a firm connection offer from Scottish Power once planning consent has been obtained. Obtaining a firm offer can be expensive as significant system studies may be required.

2.3.4 Scottish Power Energy has confirmed that a connection is feasible and have provided details of their preferred connection route, which is illustrated in Annex 2.

2.4 Details of How the Heat is to be Supplied and Used by the Customers

2.4.1 Given the types of heating requirements identified as being potentially available in the area surrounding the site of the Millerhill RERC development, heat could be supplied in the form of hot water. The temperature of the water would be supplied between 95°C and 120°C, depending on the end users requirements.

2.4.2 Heat would be distributed in buried pipework. Pre-insulated steel pipes would be 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. This technology is well proven and provides an energy distribution system with a 30 year design life. Additional pipe work can be added in the future and it is a straightforward process to add branches to serve new developments.

2.4.3 To supply a heat load of 20MWth it is estimated that 500mm internal diameter pipes would need to be installed for flow and return. The specific piping type and manufacturer would be selected as part of the project tendering exercise. The piping would meet BS EN 253 and be installed to BS EN 13941.

2.4.4 Heat would be supplied to a secondary heat exchanger on a consumer's premises. Typically, the hot water in the distribution system is supplied to one side of a heat exchanger at the end user, with the other side arranged to heat up the hot water required by the user. This heat exchanger can be arranged upstream of any boiler plant on the user's premises, so that the heat from the facility can top up any heat from the boiler.

2.4.5 Water is pumped continuously around the system. Pumps are operated with 100% standby capacity to maintain heat in the event of a pump failure. The pumps would have variable speed drives to minimise energy usage. Booster pumps can be installed within the distribution pipe network to increase the distance over which the energy can be delivered.

2.4.6 Providing the system design pressure is not exceeded then there is no limit as to the distance the water can be pumped. Heat exchangers can be used to provide pressure breaks to enable to network to be extended. A typical schematic arrangement of a CHP system is provided in Annex 3.

2.4.7 Where the heat supply is critical, such as e.g. for a hospital, this will require the installation, operation and maintenance of back up gas or oil-fired boiler plant.

2.4.8 At the present time, a fixed route has not been established for the connection from the ERF to the various potential users on the basis that no specific agreements have been made. However, an indicative pipe route has been identified, which is shown on Annex 4. This route is likely to offer the most sensible approach as it minimises the number of easements required.

2.4.9 Easements and Highways Licenses would need to be obtained for access, construction, and maintenance of the pipes. There is a significant financial implication for obtaining easements, and these would only be progressed once planning permission has been received and heat supply agreements put in place. There is also a considerable amount of work required to negotiate the traffic management requirements resulting from having to install pipes in large trenches within major access roads. The traffic management requirements would need to be agreed prior to being able to obtain the necessary Highways Licenses granting permission to install the pipework.

2.4.10 FCC has already commenced discussions with various potential heat users in the vicinity to the development which, if successful, would lead to the production of heat supply agreement and designs for the pipework. However, without planning permission, any firm commitment to a supply of heat is difficult to achieve. Further details regarding the discussions that have been held and the potential opportunities that exist in the area are provided in Section 4.0.

2.5 Engineering Issues Associated with the Supply of Heat

2.5.1 The predominant engineering issue associated with the supply of heat by hot water relates to the installation of the heat supply pipeline. The pipe line required to supply hot water is likely to be of a large diameter and requiring a trench up to 1.35m wide.

2.5.2 If the heat is to be used on site then existing cables and pipes may obstruct the most direct route to the end users. River and railway crossing can prove technically challenging and expensive. The operational needs of the whole Millerhill RERC development would also need to be taken into consideration in order to avoid conflict resulting in lost generation.

2.5.3 To export the heat from the site a pipeline has to be routed along public highways with the inevitable issues of traffic management and avoiding other buried utilities. These issues have a direct bearing on the cost and installation time for the pipeline.

2.5.4 If heat is to be delivered to an existing building then modifications will be required to the existing heating system. The cost of making a connection depends on the age and complexity of the system to be connected. Space may also be an issue if existing boiler plant is to be retained. Timing can also be an issue as interruptions to a buildings heating system during winter months may not be acceptable to the building occupier.

2.5.5 From an engineering point of view it is relatively straightforward to extract steam from the turbines and pass it through a shell and tube heat exchanger to produce hot water. Steam can also be extracted from the turbine for supply at defined conditions to industrial users. Installation of long steam mains can be expensive and technically challenging in an urban environment. Steam export can also increase the CHP plant operating costs as the condensate is not returned to the plant resulting in a higher use of water and treatment chemicals.

3.0 DESCRIPTION OF THE WASTE TO BE TREATED AND ITS ENERGY VALUE

3.1 Details of the Waste Input

3.1.1 It is anticipated that the fuel for the plant will be a mixture of residual non-hazardous municipal waste and third party (commercial and industrial) SRF.

3.1.2 It is anticipated that the primary source of waste to the facility would be residual non-hazardous municipal waste from the Edinburgh and Midlothian residual waste contract, which is expected to total 135,000tpa. Following further mechanical treatment on site and the removal of reject material it is anticipated that 129,471tpa of the residual municipal would be availiable for thermal treatment in the ERF.

3.1.3 Depending upon the CV of the incoming waste material, the facility could accept a further 60,000tpa of residual waste each year (based upon a CV of 7.51). This would equate to 189,471 tpa to the ERF and 195,000tpa in total.

3.1.4 It is anticipated that this additional waste would comprise either residual municipal waste from surrounding authorities (e.g. East Lothian Council or Scottish Borders Council) or third party residual commercial and industrial SRF. The C&I waste input would be collected from the wider region.

3.2 Waste Calorific Values

3.2.1 The main groups from the waste stream have been identified. These are shown in Table 3.1 over the page, together with their contribution to the total waste stream and the anticipated net calorific value.

Table 3.1: Waste Energy Content

Waste Stream	% of Content	Net Calorific Value MJ/kg
Paper / card	9.79%	10.90
Plastic Film	8.07%	22.37
Dense Plastic	5.19%	24.38
Textiles	2.76%	14.44
Misc. combustibles	23.48%	14.66
Misc. Non-combustible	3.28%	2.18
Glass	7.17%	0.04
Ferrous metals	3.01%	-
Non-ferrous metals	1.08%	-
Organic (Kitchen / Garden)	31.94%	3.77
Fines (< 10 mm)	3.53%	4.58
Others (HHW, WEEE)	0.72%	-

3.2.2 The overall waste characteristics are summarised in Table 3.2 below

Table 3.2: Combined Residual Waste Characteristics

Variable	Value
Average Moisture Content	31.63%
Average Ash (% by mass)	24,57%
Average Gross Calorific Value (GCV) MJ/kg	11.01
Average Net Calorific Value (NCV) MJ/kg	9.42

3.2.3 The analysis completed above suggests a waste net calorific value of approximately 9.42MJ/kg. At this calorific value the design point for the facility is for a waste throughput of approximately 150,000tpa. However, the design of the proposed facility allows the continuous firing of waste with an NCV of between 7.0MJ/kg and 12.0MJ/kg to allow maximum flexibility in waste characteristics. In light of this, the proposed design basis for the plant would not be limited by fluctuations in proposed recycling targets or potential changes in the CV of the waste. As such, it offers a robust solution for the disposal of the residual waste and SRF streams. As an example, if the NCV were to decrease, the facility would simply process slightly more waste but would continue to generate the same amount of power and heat. Similarly if the CV were to increase the facility would process slightly less waste whilst generating the same amount of power and heat.

3.2.4 For the purposes of the planning application, it has been assumed that the throughput of the ERF at the Millerhill RERC facility would be 189,471tpa with a NCV of 7.51MJ/kg. The rest of this Heat Plan is based on this CV. The reason that this level of throughput and NCV has been proposed is to ensure a worst case assessment.

3.3 Energy Production

3.3.1 The ERF facility will operate 24 hours a day, 7 days a week, with occasional offline periods for maintenance. Over the entire year, it is anticipated that the facility will be operational for approximately 7,900 hours, equivalent to an overall availability of 90%, and achieve a net electrical efficiency of circa 23%.

3.3.2 The following table outlines current design data for the ERF facility, which have been assumed for this HPP.

Table 3.3: ERF Facility Energy Production

Description	Value
Nominal waste throughput (ERF)	189,471 t/a
Availability of Plant	7,900 hours/a
Number of EfW streams	1
NCV of waste	7.51
Heat release from the combustion of waste (based on NCV)	50 MW
Heat release from the combustion of waste (based on GCV)	58.45 MW
Maximum gross electrical power output (MWe)	13.45
Maximum gross electrical power output (MWh/a)	103,590
Maximum gross electrical power output (GJ/a)	372,924
Total parasitic load (MWe)	2.36
Total parasitic load (MWh/a)	18,644
Total parasitic load (GJ/a)	58,145
Maximum power export capacity (MWe)	11.09
Total maximum electricity exported (MWh/a)	87,012
Total maximum electricity exported (GJ/a)	313,243
Net electrical plant efficiency based upon NCV (no heat export)	22.6%
Net electrical plant efficiency based upon GCV (no heat export)	23%

3.3.3 The actual design data for the plant may change slightly in the final design, as the steam conditions used for producing hot water could be further optimised by the technology supplier.

3.3.4 All plant systems shall be designed to operate for 7,900 hours continuously between outages for maintenance or cleaning. One short stop (3 days maximum) for inspection is required within the 7,900 hour period. The Common Services (being those services, equipment and facilities not forming an integral part of any individual incineration stream and on which the continuous operation of the plant depends) shall be designed to support continuous year-round operation except where there is a requirement for a statutory inspection on an essential item of central services plant for which it has been agreed there shall be no duplicate.

3.3.5 The maximum number of planned shut downs are:

- One main shut down for repair, statutory inspection and cleaning; and
- Not more than one short inspection shut down per year.

3.3.6 The turbine generation set and associated components and subsystems as well as the common services systems and controls will be designed with a high level of availability.

3.3.7 Components will be 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.

3.3.8 Certain major items of plant such as the turbine generation set and air cooled condenser will have an established track record of high availability. Critical equipment including but not limited to pumps, fans and compressors as well as Common Services will be duplicated to provide full run / standby operation (2 x 100% or 3 x 50%).

3.3.9 The plant will 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 will be designed such that replacement of wear components can be completed so far as is reasonably practicable, within 7 days of 24 hour working.

3.3.10 The plant will be 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 will 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;
4) 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; and
5) Care in the design of piping and ducting systems to achieve the optimum balance of pump or fan efficiency and economy of installation.

3.4 Seasonal Variation in Heat Load

3.4.1 Due to the nature of the types of services the district heating network is likely to be connected to and in particular the residential development, it is possible that there will be a strong seasonal variation in heat loads. Where a district heating system supplies a large number of buildings with seasonal demand the peak winter load can be as much as ten times higher than the summer load and up to four times the annual average load.

3.4.2 The district heating network design for the Millerhill RERC development will provide 20MW of heat to the district heating network. The heat would be transferred to recipients via large Heat Exchange units. Each area / zone of the district heating network will have its own local energy centre that will be served from the Millerhill RERC development supplemented with a thermal store and gas fired boilers to meet peak demand. This will provide resilience to the network and allow for daily and seasonal variations in heat demand to be taken into account.

3.5 Details of Assumptions Used in the Assessment of the Heat Export

3.5.1 The plant can be designed to supply up to at least 20 MWth in the form of hot water. This assumes that at least 20 MWth of instantaneous heat is provided by extracting steam from the turbine. It has been assumed that back-up boilers will be required when the EfW plant is not available and to take into consideration periods of peak demand.

3.5.2 Other technical assumptions used in the assessment of heat production include:

- Waste net CV of 7.51 MJ/kg;
- Annual waste consumption of 189,471 tonnes;
- Plant availability of 7,900 hours;
- Hot water temperature of no more than 115°C; and
- 100% condensate recovery.

3.6 Indicative Pipe Routes

3.6.1 An indicative heat pipe route has been provided in Annex 6.

4.0 HEAT USE PLAN

4.1 Introduction

4.1.1 A number of potential heat use projects exist, or are proposed in the area surrounding the proposed Millerhill RERC development including industry, commerce, residential and public services.

4.1.2 At the time of writing, a number of sites have been identified as potential users of heat derived from the proposed Millerhill RERC development. No agreements have yet been reached, as without the necessary planning consent and PPC Permit, heat users remain unable to take commercial decisions about the availability of heat. It must be recognised that in the commercial arena the certainty that potential heat users need to progress detailed commercial agreements is some way in the future.

4.1.3 In light of this, FCC is in a position that, until such time that planning and permitting consents have been obtained and the availability of heat more of a reality, potential users will be hesitant to enter in to any formal commercial agreements. This will extend to their propensity to develop detailed designs and obtain relevant authorisations for their operations.

4.1.4 The sections below detail the identified heat demands and any future potential heat users in the area.

4.2 Heat Use Options

4.2.1 As discussed above FCC has not been able to enter into any formal agreements regarding the use of heat from the proposed Millerhill RERC development. However, FCC has commissioned E.ON Energy Solutions Limited (EESL) to carry out a study into potential heat users, heat demand and likely infrastructure requirements. This has identified four potential zones which offer specific opportunities for the supply of heat from the facility, which are:

- Shawfair and Shawfair Park Hospital (Zone 1);
- REI and Biomedical Quarter (Zone 2);

- Craigmillar (Zone 3); and
- QMU and Newcraighall (Zone 4).

4.2.2 Further details regarding each of the proposed heat zones is provided below, their location and extent is illustrated in Annex 4.

Shawfair New Community

4.2.3 Of the zones identified for future heat distribution, the site for the proposed Shawfair new community and associated development is considered to be the most suitable for early heat off-take. The Shawfair site is immediately adjacent to the Millerhill RERC development and it is anticipated that construction of new homes could commence during 2016/17 with development progressing thereafter over a 15 year period.

4.2.4 Several meetings have taken place between the FCC and the main developers Buccleuch and Mctaggart and Mikel and their district heating network advisors. The developers have been very positive regarding the idea of developing a Heat Network solution to serve the new homes which has the Millerhill RERC as the main heat source. They see the positive local message that this creates and the opportunity of promoting the use of heat on their site.

4.2.5 To ensure the Developers are fully informed of the district heating network potential of their site, FCC has engaged in a number of meetings with them. These have included / covered the following matters:

- A visit to a site that is currently in development by EESL in Newcastle Upon Tyne; The Rise, Scotswood.
- Presentation and discussion on the Sheffield DHN development and how public buildings and retro connections have worked to combine with the DHN expansion for the City.
- Discussion and presentation on the appearance of the units within the properties, how they are managed and how EESL would be the interface with the Customer.

- Identify that the DHN would use the heat from the proposed Contractors plant at Millerhill, but this would not be the only potential source.
- Provision of billing and Customer management post installation
- Provision of pipelines, installation, who controls what and the location of heat units.

4.2.6 Discussions with both Midlothian Council and the Shawfair developers have evolved over the last two years and FCC now has a far greater knowledge and understanding of the development timelines for the Shawfair development. It is clear that the opportunity to develop a district heating network at this time matches the timescale for the development of the Millerhill RERC development. In light of this, the Council is seeking to include heat use as part of the future planning applications in relation to the Shawfair development and the aim is to provide an annual update of their Heat Plan. FCC would also have to prepare a similar update of their Heat Plan under the requirements of their PPC permit.

4.2.7 A provisional district heating network plan for the Shawfair development has been produced which has been based upon the proposed phasing of the development and the approved site masterplan. The Shawfair development only benefits from planning permission in principle and as such, the layout is likely to change as applications to address matters reserved in conditions are submitted by the developers. The indicative distict heating network plan is provided in Annex 5.

4.2.8 Table 4.1 below provides the estimated heat load for the proposed Shawfair development based upon the discussions that have been held with the developer.

Table 4.1: Shawfair and Shawfair Park Heat Loads

Estimated Heat Demand (MWh/a)	Estimated Heat Demand (GJ/a)	Percentage of Total Heat Supplied
44,346	159,645.6	28%

Edinburgh Royal Infirmary

4.2.9 The new Royal Infirmary of Edinburgh, together with an associated BioQuarter, is in the process of being developed approximately 3.5km to the south-west of the proposed Millerhill RERC development and has been identified as a potentially large heat user.

4.2.10 Whilst it has been established that the hospital development will include a CHP plant with a circa 1MW thermal output, this would only be capable of providing approximately 30% of the hospitals heat demand. As a consequence, there remains an opportunity for the Millerhill RERC development to meet the remaining heat demand and also an opportunity to add CHP systems to a wider district heating network.

4.2.11 FCC understands that the Royal Infirmary of Edinburgh and adjacent BioQuarters remaining annual heat demand would be similar that shown in Table 4.2 below.

Table 4.2: Royal Infirmary of Edinburgh and Biomedical Quarter

Estimated Heat Demand (MWh/a)	Estimated Heat Demand (GJ/a)	Percentage of Total Heat Supplied
63,960	230,256	40.5%

Craigmillar

4.2.12 There is considerable re-development taking place within the Craigmillar suburb of Edinburgh, which will comprise the development of several thousand new homes.

4.2.13 FCC has entered into discussions with Edinburgh City Council and a number of other organisations regarding the potential to supply heat to these properties and further details on the on-going discussions are provided later in this sub-section.

4.2.14 There is therefore an opportunity for the Millerhill RERC development to meet existing and future heat demand within this area and also an opportunity to add the universities CHP system to a wider district heating network.

4.2.15 FCC estimate that the likely annual heat demand that could be availiable would be similar to that shown in Table 4.3 over the page.

Table 4.3: Craigmillar

Estimated Heat Demand (MWh/a)	Estimated Heat Demand (GJ/a)	Percentage of Total Heat Supplied
30,901	111,243.6	19.5%

Queen Margaret University (QMU) and Newcraighall

4.2.16 The Queen Margaret University (QMU) is a modern campus which is located approximately 1km to the north of the Millerhill RERC development. The campus already benefits from a site wide district heating system, which is supplied by a 1.5MW biomass boiler. However, it is understood that this is only sufficient to meet the needs of the university itself.

4.2.17 The area immediately adjacent to the university campus has been allocated for mixed-use development within the emerging East Lothian Development Plan. Furthermore, the Newcraighall area, within which the university campus is located, already contains residential areas and an out-of-town shopping centre and is the subject of proposals for several hundred homes and medium sized business parks.

4.2.18 FCC estimate that the likely annual heat demand that could be availiable would be similar to that shown in Table 4.4 below.

Table 4.4: Queen Margaret University (QMU) and Newcraighall

Estimated Heat Demand (MWh/a)	Estimated Heat Demand (GJ/a)	Percentage of Total Heat Supplied
11,892	42811	7.5%

Local Energy Centres

4.2.19 The base heat load for the identified district heating zones would be supplied by the Millerhill RERC development which, as stated previously within this report, would be up to 20MW thermal. However, in order to meet the peak heat demand of the 4 zones, it would also be necessary to install ‘local energy centres’ within each.

4.2.20 The local energy centres would include plate heat exchangers to provide hydraulic separation and gas fired boilers to provide top up heat when necessary. The energy centres would provide resilience to the network when the facility has scheduled down time for maintenance.

4.2.21 In order to meet the average demand, the facilities within each local energy centre would also include thermal stores which would be used to ‘smooth-out’ the peak load demand ensuring that, where practically possible, peaks for the associated developments are met. The likely infrastructure requirements associated with each ‘energy centre’ is provided in Table 4.5 below.

Table 4.5: Local Energy Centre Requirements

Zone	Footprint	Proportion of Facility Generation	Plant including associated backup requirements
Zone 1 - Shawfair and Shawfair Park Hospital	30m Long x 20mW x 10mH	5.6MW	• 50m³ Thermal Store • 2No PHE Heat Substations • 4No 6MW Gas Fired Boilers (1No Standby) • Pumps • Pressurisation Unit • Water Treatment / Filtration • Multicore Flue
Zone 2 – RIE and Biomedical Quarter	30m Long x 20mW x 10mH	5.9MW	• 2No 50m³Thermal Store • 2No PHE Heat Substations • 4No 6MW Gas Fired Boilers (1No Standby) • Pumps • Pressurisation Unit • Water Treatment / Filtration • Multicore Flue
Zone 3 – Craigmillar	28m Long x 18mW x 10mH	3.9MW	• 50m³ Thermal Store • 2No PHE Heat Substations • 4No 4MW Gas Fired Boilers (1No Standby) • Pumps • Pressurisation Unit • Water Treatment / Filtration • Multicore Flue
Zone 4 - QMU and	25m Long x 15mW x	1.5MW	• 50m³ Thermal Store

Newcraighall	10mH		• 2No PHE Heat Substations • 4No 1.5MW Gas Fired Boilers (1No Standby) • Pumps • Pressurisation Unit • Water Treatment / Filtration • Multicore Flue

4.2.22 For Zone 2, it should be noted that a 1MWe CHP plant is proposed at the Royal Infirmary of Edinburgh Hospital. This installation could be incorporated into the DHN to provide top up to the Facility. Likewise, for Zone 4, a 1.5MW biomass boiler is installed in the Queen Margaret University campus that could potentially feed back into the Zone 4 network to provide top up.

Details On-going Discussions with Potential Heat Users

4.2.23 FCC has been in discussion with a number of key stakeholders in relation to the delivery of a district heating network with the Millerhill RERC development as the primary heat source. The potential heat users that FCC has been in discussion with include the following:

- The Shawfair development group and its district heating network advisors;
- Bio-quarter including Sick Kids Hospital through discussions with The City of Edinburgh Council;
- Midlothian Council in respect of public buildings to be developed on Shawfair including schools, leisure Centre, Social housing and other facilities;
- Scottish Government and Scottish Futures trust discussions on heat delivery to schemes;
- A Heat Workshop with key stakeholders.

4.2.24 The consultation with the aforementioned organisations has included meetings to discuss the approach to the delivery of district heating and how FCC, as the heat producer, would feed into this process. FCC has confirmed that they would seek to obtain a heat supply agreement with the operator of the local energy centres which would provide heat to the customers. The key issue and the subject of on-going discussion between all parties in this regard relates to who will actually be responsible for the operation and control the various local energy centres. During the consultations FCC has suggested that the relevant Local Authorities (City of Edinburgh Council, Midlothian Council and East Lothian Council) would need to be involved with and potentially take a lead regarding the deliverability of this to this element of the district heating network. The approach and practicalities of doing this have been the subject of discussion with the relevant stakeholders.

Implementation Timetable

4.2.25 It is anticipated that the provision of heat into a network could take between 3 to 5 years to achieve depending upon the creation and completion of heat supply agreements, associated infrastructure and the completion of the pipework networks and associated legal agreements to facilitate this. Working with potential users FCC is assisting in the process to establish the heat centres from which the heat would be distributed to customers. The control of the heat centre and who funds and installs the network is key to the deliverability of any district heating network scheme.

4.3 Potential Future Heat Users

Eco-Innovation Park

4.3.1 The growth in environmental development since the 1990s has been rapid. This encompasses a wide range of issues including water quality, air quality, resource management and security, energy production and security, the built environment, biodiversity, food security and clean technology development. Significant interest is also being shown in the concept of 'sustainable cities' through initiatives such as the Technology Strategy Board supported Future Cities demonstrator project and the development of a Future Cities Catapult.

4.3.2 The Millerhill RERC development represents a significant opportunity to demonstrate advanced sustainable systems driven by heat generated by the facility. The development can provide a key anchor system for energy production. To take advantage of this anchor the following concepts provide the opportunity to develop the land to the south of the Millerhill RERC development (which is within the ownership of Zero Waste Edinburgh and Midlothian) into a fully-fledged Eco-innovation Park.

4.3.3 There are a number of potential developments that could be accommodated on the land to the south to allow the formation of the Eco-innovation Park and FCC has explored all of them with key industry partners. Letters of support from the various potential developers are provided in Annex 6.

4.3.4 The following initial concepts have been considered at the site which are principally heat driven, they comprise:

- Solution 1 – Food Production – on-site food production in protected horticultural spaces using heat from the process; and
- Solution 2 – Biomass Fuel Supply Chain System – the development of a wood fuel drying and supply logistics facility.

4.3.5 As these proposals have not progressed beyond initial discussions with perspective development partners it is difficult to estimate the likely annual heat demand that could be availiable.

Other Potential Future Heat Users

4.3.6 As noted within the Introduction to the Planning Statement (contained within Part 3 of this Planning Application Document), it is likely that the area surrounding the proposed Millerhill RERC development is going to go through a process of urbanisation in the next 15 to 20 years. In addition to the developments that have already been identified within the aforementioned district heating zones, there are a large number of other developments proposed within the area that are either the subject of planning applications or allocations in in emerging development plans. All of these developments would offer potential opportunities regarding the creation of a district heating network in the area. They are detailed in Table 4.6 over the page.

Table 4.6: Other Proposed Developments / Applications

Name	Reference and Capacity
Newton Farm	The emerging Midlothian Local Development Plan Main Issues Report (Pre-consultation Draft) identifies the site as part of the preferred strategy under reference S2. It indicates that the site has an initial capacity for 450 houses with longer term capacity for a further 205 houses.
Cauldcoats	The emerging Midlothian MIR identifies the site as an 'alternative site for housing' under reference S6. It identifies an indicative capacity for 435 houses.
Craighall	The emerging East Lothian Main Issues Report (MIR) allocates the site (reference PREF-M1) for mixed-use development with the potential for more than 700 houses and 79ha of employment land.
Millerhill Marshalling Yards	The site benefits from planning permission (ref:12/00837/DPP) for the formation of a train maintenance, cleaning and stabling depot; erection of retaining wall and alterations to ground levels; formation of new railway lines; erection of boundary fencing; and formation of associated car parking and access.
Any other locations not in zones	

4.3.7 FCC will track any applications or proposals for these areas and if they represent a viable use of the heat from the proposed development, the company will engage with the relevant developers.

4.3.8 In addition to the above there are also existing areas of housing where retro-fitting of district heating infrastructure would be required. It is important to ensure that, where possible, these areas are also incorporated into any review of district hearting network potential.

4.4 Annual QI Values for the Heat and Power Plan

4.4.1 The expected QI values for the Millerhill RERC development in Full Condensing Mode, CHP Mode (10MW CHP Case) and CHP Mode (20MW CHP Case) are provided in Table 4.7 over the page. It is assumed that all heat users will be connected 60 months (5 years) after obtaining planning and permitting consents and therefore the QI values will not change year to year.

Table 4.7: Annual CHPQI Values (Full Condensing Mode, Interim 10MW CHP Case and 20MW CHP Case)

Outputs< /span>	Full condensation	Steam delivery 10 MW	Steam delivery 20 MW
Waste Energy Input (MWh/a)	450,220	450,220	450,220
Support Fuel Energy Input (MWh/a)	420	420	420
Electrical Power Energy Input (MWh/a)	413	413	413
Return Heat Energy Input (MWh/a)	0	11,389	22,703
Total gross energy input (MWh/a)	**451,053**	**462,442**	**473,756**
Electrical Generation - gross (MW)	13.45	11.10	9.10
Electrical Generation - net (MW)	11.09	8.74	6.74
Annual Electrical output - gross MWh/a	**103,590**	**85,503**	**70,097**
Annual Electrical output - net (MWh/a)	87,012	68,925	53,519
Electrical output/ tonne of waste (net) (MWh/t)	0.576	0.456	0.354
Electrical gross efficiency factor - ηel gross	**23.0%**	**18.5%**	**14.8%**
electrical net efficiency factor - ηel net	22.6%	17.9%	13.9%
Annual Heat output - gross (MWh/a)	**0**	**90,653**	**180,713**
Heat output/ tonne of waste (MWh/t)	0	0.600	1.197
Thermal net efficiency factor - ηth net	**0.0%**	**19.6%**	**38.1%**
QICHP (X x ηpower + Y x ηheat)	85	92	101
R1= (Ep-(Ef+Ei))/(0.97*(Ew+Ef))	0.70	0.83	0.99

4.5 Planning and Economic Development Offices

4.5.1 As part of the further development of the heat plan, FCC will consult with development bodies working with Scotland and the local community. It is difficult for development agencies to plan for the provision of the heat with any certainty at this early stage of development. However, it is recognised that the development of the heat plan should, where practical, be done in consultation with planning and economic development officers to ensure that where new developments would benefit from the heat available from the plant, these are identified and considered.

4.5.2 In this regard, FCC have also had discussions with Midlothian Council in relation to the potential to provide heat to the new schools, new leisure centre, swimming pool and other educational facilities that are proposed on the Shawfair site. Discussions have also been held more generally regarding the use of heat in new social housing.

Annex 1 – Schematic Process Flow Diagram

Annex 2 – Electricity Connection Route

Annex 3 – Typical Schematic CHP Arrangement

Annex 4 – Heat Connection Route

Annex 5 – Identification of Primary Heat Off-take Site Developments

Annex 6 – Letters of Support