Appendix 4.c

Combined Heat and Power Potential

The following appendix provides a report on the Combined Heat and Power (CHP) potential for the new Energy from Waste (EfW) Facility.

Project Transform
Transforming waste into resources

CHP Potential of the Coventry EFW Site.

1 Aim of Report

1.1 Coventry Site

The Coventry Site has been identified as a potential site for a new energy from waste facility (EFW). The site is adjacent to the existing EFW facility which is now 33 years old. In addition, to the electricity generated by the EFW facility, there will be considerable heat available from the plant, in the form of steam or hot water.

It is advantageous if this heat can be used, as it brings environmental and economic benefits and will lead to classification of the EFW as a Combined Heat and Power plant.

This study examines the possible size of the EFW facility, and then seeks to identify possible heat users within a sensible distance of the site, and then comments on the potential for these users to be linked into the scheme as a CHP facility.

2 Potential Heat Supply

2.1 EFW with 305,000 (300,000 nominal) tonnes per annum (tpa) Residual MSW.

Entec modelled a 305,000 tpa EFW plant with a feedstock of residual MSW at the Coventry site. The calorific value (CV) of the residual waste was taken as 10 MJ/kg.

The anticipated design of the modelled EfW is a typical efficiency furnace/boiler unit, with high pressure steam (steam at nominally 400ºC and 50 bar pressure) fed into the high-pressure end of a steam turbine. Medium pressure (10 bar) would then be “bled” off the steam turbine as required to provide heat to third party industrial users, in a method known as controlled extraction. This steam pressure figure has been chosen as a typical industrial user steam requirement. Similarly steam could be extracted at a lower pressure (2 bar) in order to provide hot water for space heating via a district heating scheme. Lower pressure steam extraction would mean that the penalty on electricity production would not be so great for the same amount of heat provision as 10 bar steam.

The model assumes a typical controlled extraction steam turbine CHP system where the bled steam rate from the turbine is controlled by a control valve to match the third party heat demand. “Bleeding” steam out of the turbine means that there is less steam available to expand through the turbine, and therefore less output (electrical) from the turbine. The Entec model also considered the reduction in steam available for electricity generation, and noted the actual electrical output for each scenario modelled.

The model of the EFW anticipates that up to 55 tonnes per hour export of 10 bar steam for industrial use, or up to 75 tonnes per hour export available at 2 bar for heating use. The results from this model are shown in the table below.

Table 1- Steam Output Scenarios for Different Combinations of Steam and Power

Scenario Number	Unit	1	2	3	4	5	6	7	8	9
10.0 Bar Steam Flow	Tph	0.0	18.4	36.7	55.1	73.4	-	-	-	-
2.0 Bar Steam Flow	tph	0.0	-	-	-	-	18.8	37.6	56.3	75.1
Heating Steam Thermal Power	MWth	0.0	12.7	25.4	38.1	50.7	12.7	25.4	38.1	50.7
EfW Net Electricity Exported	MWh	24.6	22.5	20.5	18.5	16.5	22.8	20.9	19.1	17.3
Overall EfW Thermal Efficiency NCV Basis	%	23.3	33.3	43.4	53.5	63.6	33.5	43.8	54.1	64.4
QI Index		86	92	99	103	109	93	99	106	112
Eligible for ROCs ?	Y/N	×	✓	✓	✓	✓	✓	✓	✓	✓
Electrical Efficiency Criteria Met ?	Y/N	✓	✓	×	×	×	✓	×	×	×

The likely design of the facility at Coventry would allow operation on an electricity generation mode, with all required cooling (towers or condensers) available on the site. Steam or heat export would be in addition to this configuration, and it is assumed that any transmission equipment (e.g. pump houses, condensate return, balancing tanks, standby boilers) would either re-use the existing EFW heat pumping station, or would be new equipment located on the new site. Initial reviews of the available space confirm this assumption is reasonable.

2.2 Magnitude of the Heating Potential: District Heating

To put in perspective the heating potential of 350,000 MWh per annum of heat from the EfW, a typical house of reasonable energy efficiency might require of the order of 10 MWh per annum for space heating and hot water use. So theoretically something like 35,000 homes might be heated by the heat provided from the CHP plant at maximum heat output, assuming that the significant practical and capital cost issues of setting up a district heating scheme of this size are addressed.

In practice however, district heating is more complicated than this due to seasonal variations and daily demand cycles so that demand varies considerably. A more practical situation might be that the CHP might meet the needs of something like 15,000 homes throughout the course of the year with minimal assistance from backup and peak boiler plant, although backup/peaking boiler plant would still be required on occasions.

Ideally such schemes would be considered for higher density residential areas as the lengths of pipe work required per house would be less thus reducing the overall length of pipe work required. An indicative capital cost of £1,000 per metre of pipe may be approximated for residential district heating schemes

2.3 Magnitude of the Heating Potential: Industrial Users

Industrial customers with large steady heat demands on single sites are likely to be much more straight forward heat customers than domestic residences if available, as long as they are located within reasonable proximity of the site. Significant distances

mean that the heat supply infrastructure costs become excessive. The economics of transporting energy are better if the end user is very large and has a constant energy demand, thus making the capital investment in the steam transmission pipe work viable.

Entec is aware of CHP schemes in the UK where steam has been transported for up to 4.5 km from the generating site, and possibly longer distance connections have been set up to very large single point users, however shorter distances e.g. ~ 1km are more common.

To put the capacity for the EfW to supply industrial energy users in perspective, BERR defines a scale of industrial users based on their quarterly energy price statistics. If the EfW produces close to its maximum amount of steam energy solely for a single industrial energy user, e.g. 350,000 MWh per annum, this site would be considered at the lower end of the very large user category.

2.4 Financial Support Mechanisms

EfW plants operating in electricity only mode are not eligible for award of Renewable Obligation Certificates (ROCs) on the electricity generated.

From April 2009 plants operating in CHP mode will be eligible for ROCs, providing they meet quality assurance standards known as 'Good Quality' CHP which determines minimum levels of thermal and electrical efficiency which effectively sets minimum levels of heat and electricity export on an annual basis. This is administered by the CHPQA scheme set up by DEFRA (www.chpqa.com) and regulated by OFGEM. ROCs are only be awarded to the proportion of electricity generated from biodegradable matter, assumed to be between 35 % and 50% of the waste input at present. This can still represent a significant additional income from electricity sales, as well as ensuring income from heat sales, but the targets are very challenging.

The requirements for Good Quality Combined Heat and Power (GQCHP) are determined by a formula that considers the plant's thermal and electrical efficiency against a performance indicator, the Quality Index or "QI".

Following discussions with the CHPQA Program administrators, Entec understands that even if a EfW with CHP does not meet the required QI index level, that partial qualification is possible with the amount of eligible electricity for GQCHP and hence ROCs being determined by a scale back mechanism relating to the QI level achieved and the QI target.

It is noted however that a further requirement to achieve GQCHP is that a minimum electrical power efficiency of 20% must be maintained. By the nature of how EfW plant with steam turbines work, at high levels off steam offtake, electricity output from will fall significantly. This may make it difficult to achieve the minimum electricity output requirement. This is largely due to a well established technical constraint which limits overall EfW electricity output well below fossil fuel plant (since there are particular steam conditions that cannot be exceeded safely due to the potential for boiler tube corrosion resulting from chlorine content of the waste). Hence should a high level of heat demand be found, ROCs revenue may not necessarily ensue due to failure to maintain the minimum electrical power efficiency requirement.

3 Local Heat Demand

3.1 Methodology

Entec used six different approaches to identify potential heat users close to the Coventry site:

- Review of PPC permits in the Coventry area. The PPC permits should identify all organisations with particular carbon emissions, which are likely to correspond to energy use. This gives a quick screen to identify organisations likely to be interested in alternative energy sources.
- Review of the UK National Allocation Plan Phase 1 EU ETS. The EU ETS phase one allocation plan gives information on all organisations with significant carbon trading. Any organisation on this list is considered likely to be interested in alternative fuel/energy sources.
- Review of Carbon Trust Community Heating Potential Sites report[1]. This report looked at high potential areas for community heating within the UK.
- Site visit / mapping review. A brief site visit and local map review was made to identify significant areas with potential for centralised heating scheme development (such as leisure centres, hospitals, schools).
- Review of Development Plans to identify areas which are earmarked for significant investment / redevelopment / new development.
- Review using the BERR sponsored "industrial heat map" website (www.industrialheatmap.com).

In addition to these desk-based screens, the Coventry and Solihull Waste Disposal Company have provided information on their current commercial activities. They are actively seeking new customers for the existing heat export capability. At present there is no active heat export from the existing site due to the recent closure of a local manufacturing site. The back-up boilers and heat transfer network infrastructure are still in place.

The results of these reviews are given in the following sections.

[1] "The UK Potential for Community Heating with Combined Heat & Power", Carbon Trust Report 211-533

3.2 PPC Screen

The screen of current PPC permits identified the following 17 sites with Coventry postcodes:

Operator / Site Name	Site Address	Authorisation No.
Acetate Products Limited, Distillation	PO Box 13, Little Heath Works, Old Church Road, CV6	QP3834SA
Advanced Surface Treatments Ltd	Alpha Business Park, Deedmore Road, CV2	ZP3239PJ
Berryfields Farm	Berryfields Farm, Berkswell Road, CV6	TP3939UF
Brita Finish (T/A Aluminium Surface Engineering)	Brita Finish Ltd, Bodmin Road, CV2	ZP3639PX
Bubbenhall Landfill Site	Bubbenhall Landfill Site, Weston Lane,	BW0037IA
Coventry Brakes	Dunlop Aerospace Braking Systems, Holbrook Lane, CV6	BN7109IH
Coventry Waste Disposal Facility	The Coventry & Solihull Waste Disposal Company Ltd, Bar Road, CV3	MP3338UN
Coventry Non Ferrous Metal Works	Coronel Avenue, Rowleys Green Industrial Estate, CV6	BL4478IN
CSG Coventry Treatment Plant	CSG, Colliery Lane, Exhall	HP3331SW
Finham Sewage Treatment Works Combined Heat and Power Plant	Finham Sewage Treatment Works, St. Martins Road, CV3	ZP3338LA
Foleshill Plating	Foleshill Plating Ltd, Bayton Road, CV7	BN9403IX
Little Heath Combustion Plant	PO Box 13, Little Heath Works, Old Church Road, CV6	YP3335LF
Lockhurst Lane Alginate Works	Lockhurst Lane Alginate Works, 101 Lockhurst Lane, CV6	PP3838LA
PMD (UK) Ltd	PMD (UK) Ltd, Broad Lane, CV5	TP3935PJ
Rohm and Haas Electronic Materials Europe Ltd	Herald Way, Binley Industrial Estate, CV3	BP5697IL
Sandvik Hard Materials UK, Coventry Works	PO Box 89, Torrington Avenue, CV4	BX0954IH
Surface Technology Plc	Surface Technology Plc, Godiva Place, CV1	BP7339IY

The suitability of these sites for taking heat was then screened on the basis of process and distance from the Coventry site [postcode taken as CV3 4AN]. Sites which are further than 5km from the Coventry site are considered unsuitable for CHP due to the significant cost and heat losses from any transmission system.

Operator / Site Name	CHP Suitability
Acetate Products Limited, Distillation	No – further than 5 km from the site
Advanced Surface Treatments Ltd	No – further than 5 km from the site
Berryfields Farm	No – further than 5 km from the site
Brita Finish	No – further than 5 km from the site
Bubbenhall Landfill Site	No – further than 5 km from the site
Coventry Brakes	No – further than 5 km from the site
Coventry Waste Disposal Facility	n/a
Coventry Non Ferrous Metal Works	No – further than 5 km from the site
CSG Coventry Treatment Plant	No – further than 5 km from the site
Finham Sewage Treatment Works Combined Heat and Power Plant	Possibly, depending on site CHP heat requirements and current fuel use.
Foleshill Plating	No – further than 5 km from the site
Little Heath Combustion Plant	No – further than 5 km from the site
Lockhurst Lane Alginate Works	No – further than 5 km from the site
PMD (UK) Ltd	No – further than 5 km from the site
Rohm and Haas Electronic Materials Europe Ltd	No – further than 5 km from the site
Sandvik Hard Materials Uk, Coventry Works	No – further than 5 km from the site
Surface Technology Plc	Possibly.

This review did not identify any suitable energy user in the nearby area which could directly use all the available heat energy from the plant.

The most likely candidates for partial heat use are the Finham sewage treatment works and Surface Technology plc (from a heat network around the Alma Street/Lower Ford Street/Hood Street/Read Street area).

3.3 UK National Allocation Plan Phase 1 EU ETS

The UK national Allocation Plan Phase 1 EU ETS screen identified the following organisations within Coventry:

Permit No.	Operator	Site	Sector
GB-EA-ETCO2-0552	Peugeot Citroen Automobiles UK Ltd	PSA Peugeot Citroen Stoke Plant PO Box 25 Humber Road Coventry CV4 9EF	Vehicle Manufacture – SMMT
GB-EA-ETCO2-0352	Lafarge Roofing Limited	Lafarge Roofing Bayton Road Ind. Estate Exhall Coventry CV7 9EJ	Ceramics -- BCC-N
GB-EA-ETCO2-0080	Websters Hemming & Sons Ltd	Websters Hemming & Sons Ltd 274 Stoney Stanton Road Coventry	Ceramics -- BCC-N

The Peugeot-Citroen Stoke site is now closed.

The Lafarge site is approximately 10 km from the Coventry site, and it is unlikely to be economic to connect to this site.

Webster Hemming & Sons is listed as a brick manufacturer, however is to the north-east of Coventry City Centre, and it is unlikely to be economic to connect to this site.

3.4 UK Potential for Community Heating CHP systems (The Carbon Trust, report 211-533)

The report for the Carbon Trust identifies three districts with Coventry postcodes of sufficient high-density housing to consider the installation of a district heating scheme. These are around the postcodes CV5 7 (Allesley), CV2 3 (Wyken Green) and CV6 1 (Coundon Green).

These are all some distance from the Coventry site, and therefore have limited potential.

3.5 Industrial Heat Users.

The BERR web-tool www.industrialheatmap.com was used to identify large industrial heat users with CV postcodes.

The complete list of organisations with CV postcodes is shown below:

Organisation	Postcode	Sector	Distance
Land Rover - Gaydon	CV35 0RR	Engineering & Vehicles	>5 km from site
UW Construction Ltd / University Of Warwick	CV4 7AL	Services	>5 km from site, already CHP
Jaguar Cars Ltd	CV5 9DR	Engineering & Vehicles	>5 km from site, already CHP
Speciality Fibres and Mineral Ltd. (Previously Acordis Acetate Chemicals Ltd.)	CV6 7DW	Chemicals	c.3km, but other side of city centre, possibly not suitable
Gastec Packington Partnership	CV7 7HN	Services	>5 km from site
Rolls-Royce Plc.	CV7 9JR	Engineering & Vehicles	>5 km from site
Peugeot Citroen Automobiles Ltd. Ryton Plant.	CV8 3DZ	Engineering & Vehicles	c.3km. Factory closed, but site redeveloped ?

Speciality Fibres and Minerals Ltd is close enough to the Coventry site to be of interest as a heat/steam offtaker.

The other site close to the proposed Coventry Site, Peugeot at Ryton, has closed, although there may be some potential for CHP if the site is redeveloped.

The other sites are all further than 5km from the Coventry Site, and are therefore unlikely to be suitable for CHP development.

3.6 Site Visit / Mapping Review

A review of local maps was used to identify large buildings within 5km of the Coventry Site which may be suitable for a heat connection. The results of this review is in the table below.

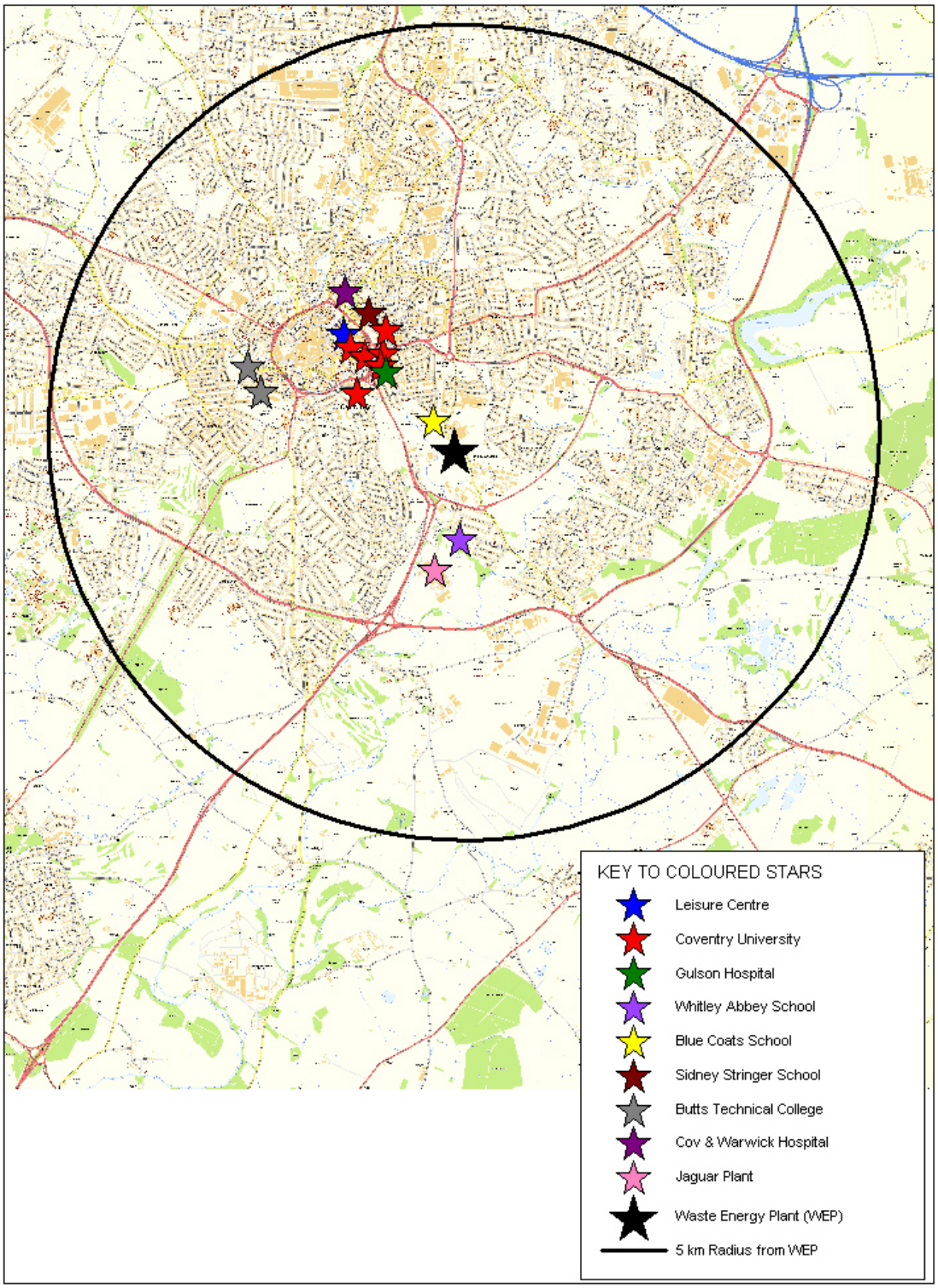
Buildings	Location
Car Manufacturer	Jaguar Cars, large factory to the south of the site
Airport	Coventry Airport
Business Park	Coventry Airport Business Parks, adjacent to the airport
Sewage Treatment Works	off the B4113, near King's Hill
Motor Works	Ryton Site (was Peugeot, potential if re-developed)
Leisure Centre	Coventry Leisure centre
Civic Buildings	General civic buildings within Coventry City Centre
Industrial Estate	Wheeler Rd Industrial Estates (c2 km east of site) (off Wheeler Road, Pinley)
Industrial Estate	Stoke Business Park (off Humber Road, B4110)
University	Coventry University
Hospital	Coventry and Warwickshire Hospital
Hospital	Gulson Hospital
Schools	Whitley Schools (adjacent to Jaguar)

The two hospitals, the leisure centre, Coventry University and the general city civic buildings are all quite close to each other. This would make a district heating scheme quite feasible, and with a number of varying users, could be a robust and secure heat outlet.

Similarly, the large Jaguar manufacturing plant to the south of the site could be a significant single user, with a possible connection to heat the two Whitley schools next to the factory. In addition, Coventry airport and the adjacent business parks may be suitable for district heating.

Connection to the Ryton site (previously a Peugeot car factory) would be dependent on the scale of site redevelopment.

MAP SHOWING POTENTIAL HEAT USERS FOR RESIDUAL PROJECT



3.7 Development Proposals

The Coventry Local Development Framework strategy includes three specific areas close to the Coventry site as part of the regeneration proposals, as well as continued general redevelopment of the city centre. ("Coventry's Future: July 2007).

These sites are the area to the south of the site around the Jaguar manufacturing facility, the Peugeot Ryton site, and an area immediately north of the site (the Peugeot Stoke site).

In general, a lot of this development is likely to be housing, and the provision of an environmental and affordable source of heating could be very attractive to both developers and new residents.

4 Summary of CHP Potential

The results from the various screens have identified several locations with good potential heat demand. These locations are all within sensible transmission distances from the Coventry site. The quantity of heat demand of these sites is not known, however no single site would appear to be exactly matched to the heat supply output from the facility.

No individual locations or organisations were contacted as part of this study. However, some of the organisations identified were grouped quite closely, in particular to the north-east of the city centre, with the leisure centre, Coventry & Warwickshire Hospital (site), Coventry University and the Gulson Hospital. A district heating network in this area could also connect to a large number of public buildings in the city centre.

The car manufacturing site at Stoke is likely to be re-developed. As the heat supply network is already in place, the developers should be encouraged to provide district heating as part of the re-development. This development is understood to have started, so this may restrict the potential of this site.

The Peugeot Ryton site is being re-developed. this may provide an opportunity to introduce a district heating infrastructure.

The large Jaguar manufacturing works to the south of the site appears a good prospect, and in addition, there are two local schools. Further discussion would define the potential heat demand from this area.

4.1 Implementation of Steam/Heat Supplies

The infrastructure cost for any specific heat supply have not been calculated. No assessment of required way leaves or pipe network have been made. This could lead to quite significant project timescale and costs, in particular for river, motorway and railway crossings.

The current infrastructure at each site is not known, nor the current commercial energy supply arrangements. For example, a particular organisation may already get heat under a long-term supply contract which has high breakage penalties.

There is no information on any of the identified sites long-term energy demand projections.

The Carbon Trust paper suggested a “cost-per-connection” to a district heating grid of around £950, as follows:

Control unit	£350
Heat meter (ultrasonic type)	£250
Installation	£250
Survey, design and commissioning	£100

Further costs of £510 per dwelling would be incurred for internal connections on a multiple dwelling building (e.g. high-rise flats).

The individual dwellings would require assessment, as ideally, the district heating system would run at slightly lower temperatures (68ºC instead of 77ºC), and at higher pressures (7 bar instead of 4.4 bar).

Implementation of a district heating scheme would clearly require a significant marketing effort, commitments by local authorities to connect their property and possible Government regulation to require connection to the system within a given timescale.

5 Recommendations

5.1 Develop Heat/Energy Market

5.1.1 Support CSWDC activities to establish heat contracts as soon as possible, with a view to continuing the heat supply from the new EfW.

5.1.2 Contact all the organisations identified in the study and interview them to improve the understanding of their current and future energy requirements, and their level of interest in heat supplies. In particular, discuss heating demands with Jaguar, the Stoke site developers, the two hospitals and Coventry University.

5.1.3 Develop a seasonal model of the heat requirements in the area, and the extent of providing a annual balanced demand including the likely availability of heat, and any requirements for guarantees of quantity of heat.

5.1.4 Examine the potential for a district heating supply scheme to the east and north-east area of the city centre, in particular the additional users who could connect to such a scheme. Multiple users are likely to reduce specific demand fluctuations on the scheme.

5.2 Develop Contract position

Review the:

- PFI contract, and how multiple-offtake supply agreements could be captured within the procurement process.
- Risk position from providing heat to other organisations, and whether this can be transferred from the local authority.
- Likelihood of being able to “bank” heat provision/sales within a PFI contract.

5.3 Costs

- Prepare outline scheme of transmission mains and connection points to suitable heat users to allow preliminary project cost development.
- Consider market value of heat provision, and how individual use contracts could be prepared to capture that benefit.
- Contact various government bodies, such as the Carbon Trust or Defra with regard to grants or other forms of funding, which may be available for developing the schemes.