

Exeter Energy Network

University of Exeter

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Exeter Energy Network

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Prepared for
University of Exeter
Northcote House
The Queen's Drive
Exeter
EX4 4QJ

Prepared by
Parsons Brinckerhoff
The Forum
Barnfield Road
Exeter
EX1 1QR
01392 229 700

www.pbworld.com

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Prepared by : Digby Morrison
Checked by : Bruce Geldard
Approved by : Jonathan Dronsfield

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EXECUTIVE SUMMARY

The Exeter Energy Network is an initiative supported by the University of Exeter, Royal Devon and Exeter NHS Foundation Trust, Devon County Council and Exeter City Council. The reduction of CO₂ emissions is a key component of each of these organisations' long term energy plans and the network is seen as a major component for achieving this goal.

There are low carbon and renewable energy policy drivers at national and international levels. The Government's Heat Strategy, published in March 2012, works in parallel with the proposed decarbonisation of the electricity system and promotes the use of district heating in dense urban areas as a means to help meet ambitious UK carbon reduction targets. The Heat Strategy emphasises that district heating networks are an enabling technology which allows future low carbon technologies to be implemented quicker and at lower cost.

This study has assessed the economic and emissions reduction performance of potential energy networks. These range from a small scheme serving mainly new developments around the Sidwell Street area to a scheme also serving loads at Marsh Barton, Wonford and Heavitree Hospitals and St Luke's University Campus. Heat supply from gas fired Combined Heat and Power (CHP) and the Energy from Waste (EfW) plant at Grace Road were compared against the current supply from gas boilers. This analysis was based on an assumption that energy prices rise in line with DECC's central energy price scenario. The sensitivity of the best option within each scheme was also assessed using DECC's high and low energy price scenarios. Finally the sensitivity of the schemes supplying heat from the EfW to high and low levels of support under the Renewable Heat Incentive has also been assessed.

A scheme supplying Wonford and Heavitree Hospitals, St Luke's University Campus and new developments and existing loads in the City Centre from a gas fired energy centre at Wonford hospital is the most financially attractive scheme under all price scenarios examined. Using DECC's Central price scenario this Wonford and City Centre scheme provides an IRR of 8.9%. The smallest scheme based on energy supply from an existing BT exchange to the Sidwell Street area provides a 4.5% IRR while the largest scheme based around heat supply from the EfW plant, yields a 3.9% rate of return (with the RHI at 1p/kWh). The heat supply tariff for EfW heat is subject to commercial negotiations.

The level of RHI payments has a significant impact on the schemes supplied with heat from the EfW plant. At central prices with the RHI at 1p/kWh the NPV is £1.1m. If the tariff for RHI rises to 4.1p/kWh as indicated in a recent Government consultation then the NPV rises to £10.3m and the IRR to 7.4%.

The EfW heat supply schemes also perform significantly better at higher energy prices than the purely gas fired schemes. This is because the heat price at the EfW plant is less sensitive to energy price rises and so the relative cost benefit of EfW heat supply increases faster than schemes with gas as the fuel. A combination of higher prices and increased RHI support would favour the EfW supply schemes.

During the study period it became clear that the speed with which planning applications are being brought forward in the SW Exeter master plan area was increasing. A high level assessment of the potential heat supply available from the EfW plant to support these developments and the associated costs was therefore included. This scheme has the benefit of a £1m RGF grant to connect to the EfW

plant which needs to be spent within 2 years. The SW Exeter masterplan area is potentially a stand-alone scheme although the EfW heat supply to it would be better delivered under the same project delivery vehicle as the city centre schemes. SW Exeter has not been evaluated in detail by this study and therefore needs to be investigated with some urgency and quickly move towards implementation if feasible. As the masterplan area crosses authority boundaries and the scheme relies on heat from the DCC commissioned EfW plant, the fact that the New Growth Point already brings together all of the necessary parties in support of low carbon development is a major advantage.

At Cranbrook, the Exeter and East Devon Growth Point has proven success in delivering low carbon infrastructure in new developments. This study builds on previous work related to the City centre and shows that retrofit district heating schemes can also be viable in Exeter and deliver 11,250 tCO_{2e} of annual emissions reduction (excluding the additional potential in SW Exeter).

As with DH schemes in other cities in the UK it is likely that the Exeter Energy Network will expand over time. Once in progress this type of scheme can underpin delivery of an overarching vision for a low carbon city. The key challenge is deciding how and where to start.

It is clear from this study that the hospital is critical to the initial development of retrofit district heating in Exeter. It represents about half the heat load of the potential customers identified; has a site for a gas fired CHP energy centre and, most importantly, can consume the electricity generated on-site thereby maximising the value of the scheme. This conclusion is timely as the RD&E is currently reviewing its carbon reduction strategy and planning implementation. As the hospital will be investing in energy solutions over the next few years there is an opportunity to align stakeholders' objectives to benefit the City as a whole.

The financial indicators of the best performing scheme suggest that it could be partly funded by private sector investment. The scheme cashflows would cover all the costs of funding if it were to be financed via prudential borrowing. This conclusion is cautious because there is considerable further work needed to develop these economics into an ESCO business case which captures all of the potential value identified. Collaboration and openness between the stakeholders through a District Heating Group, preferably as part of the Growth Point Low Carbon Task Force, will be important if this is to be achieved. It will also be essential to engage the right private sector delivery partner to bring expertise and management drive to a suitable delivery vehicle. Development of a clear set of agreed objectives between the stakeholders, and then instigating a process to select the best structure and partner to achieve these objectives, is a priority.

Other parts of the network, while showing positive NPVs, are less financially attractive and have potential barriers to implementation. However, if the vision for a greater city wide scheme is to be realised stakeholders will need to tackle these barriers. To do so the stakeholders will need to be able to exert a degree of control over the investment policy of the delivery vehicle. This may include reinvestment of surpluses from most viable parts of the network and/or bringing in lower cost finance from public sector sources. The stakeholders will need to have the same control across the various projects and the three key projects identified should be carried forward as part of the same project delivery vehicle. There also needs to be awareness that changing energy and technology prices and Government policy may reduce barriers and create other attractive opportunities that have yet to be identified. Flexibility will be important.

The one area of the proposed City Centre scheme that encompasses significant new developments is the Sidwell Street scheme. The assessment shows that, while connection to a larger scheme would be preferable, a scheme based on serving new developments around Sidwell Street could be viable in its own right. The impending build out of the new developments connecting to this scheme suggest that the Sidwell Street area merits further dedicated follow up to maximise the future benefits to the wider scheme. The planning led nature of this scheme will need the involvement of the City Council.

Three clear development opportunities have therefore emerged from the study; Wonford and the City Centre, SW Exeter and Sidwell Street. The need for, and benefits of, the coordinated development of these and involvement of all the stakeholders has also been clearly identified.

At this stage, the most likely structure for taking forward district energy in Exeter is a public/private sector ESCO. This would have at least a partial involvement in all these networks and would therefore retain the ability to influence the development of schemes both in the City and across the Growth Point.

Making resource available within each stakeholder organisation and the need to commission external support (technical, financial and legal) during the process of selecting a private sector partner will be important for success. Estimates of up to £0.5m are typical for establishing an ESCO. This sum, while high, should be seen in the context of the overall level of investment in the City that would result from these schemes.

The DECC Low Carbon City programme, the EU and sources such as the Technology Strategy Board may provide some of this funding.

Recommendations for implementing the Exeter Energy Network are summarised as follows:

1. Establish a stakeholder District Heating Group, as part of the Growth Point Low Carbon Taskforce, to drive and coordinate the development of District Heating
2. Establish a mechanism for support to stakeholders in delivering necessary studies to enable decision making and underpin internal governance requirements
3. Develop a stakeholder agreement setting clear objectives and the basis for participation
4. Identify and apply for funding where/when available
5. Create work groups to follow up the three network workstreams; Wonford and the City Centre, SW Exeter and Sidwell Street.
6. Identify/appoint legal, financial and technical advisors
7. Develop the overall business case for the DH scheme(s) including selection of preferred structure for ESCO participation
8. Undertake the selection of a private sector partner based on the stakeholder agreement and business case
9. Develop the ESCO structure and associated documents
10. Establish the ESCO and commence delivery

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SECTION I

INTRODUCTION

1 INTRODUCTION TO EXETER ENERGY NETWORK

1.1 Project background

The Exeter Energy Network is an initiative supported by the University of Exeter, Royal Devon and Exeter NHS Foundation Trust, Devon County Council and Exeter City Council. The reduction of CO₂ emissions are a key component of each of these organisations long term energy plans and the network is seen as a major component for achieving this goal.

1.2 Rationale for study

1.2.1 Policy Background

There are renewable energy policy drivers at national and international levels. The Climate Change Act places legally binding obligations on the UK to reduce its CO₂ emissions by 80% by 2050 over 1990 levels. The UK has also signed up to delivering 15% of its primary Energy from renewable energy sources by 2020 in line with the commitment to the European Directive. This reduction in carbon emissions is expected partially to be driven by rising fossil fuel costs over the long term. The Government's Heat Strategy, published in March 2012 promotes the use of district heating as a means to meet our carbon reduction targets. The UK's decarbonisation agenda is also supported by a range of other legislation, strategies and policies including:

- UK Renewable Energy Strategy
- Household Energy Management Strategy: Warm Homes, Greener Homes
- Energy Act 2008
- Low Carbon Transition Plan
- Carbon Reduction Commitment (CRC)
- National Indicators 185, 186, 187, and 188

Government is driving the growth of the Combined Heat and Power (CHP) and district heating sectors through subsidies, under the Renewable Obligation Certificates and Renewable Heat Incentive, depending on the type and size of system installed.

On 18 October 2012 the government announced the Growth and Infrastructure Bill and referred to the forthcoming Energy Bill, both as a means to enable investment in low carbon energy projects.

1.2.2 Exeter City Council Policy

Exeter City Council set out its vision for Carbon Management in its Carbon Management Programme Strategy and Implementation Plan policy document published in March 2008 as part of the City Council's involvement in the Carbon Trust Local Authority Carbon Management Programme:

Exeter City Council recognises the need to tackle climate change at a local level. We will reduce the impact on climate change in all we do through achieving a continual reduction in greenhouse gas emissions from our operations. We will lead the local community by example and work with our partners to reduce Exeter's greenhouse gas emissions and improve the city's capacity to respond to climate change.

To achieve the Council's aims a set of carbon management targets have been adopted, as follows:

- To reduce carbon dioxide emissions from energy, water, waste and transport by 10% by 2009/10 and 20% by 2012/13 from a baseline of 2006/07.*

The main target has been broken down into individual targets for energy, transport and waste:

- To reduce carbon dioxide emissions from energy use in buildings by 25% by 2012/13*
- To reduce carbon dioxide emissions from transport by 10.5% by 2012/13*
- To reduce carbon dioxide emissions from waste by 20% by 2012/13*

The City Council's Greenhouse Gas Emissions Report 2011/2012 recorded a 9% reduction on 2010/2011 emissions. The gross level of emissions was calculated at 5253 tonnes CO_{2e} (Scope 1,2 &3).

The planning framework provides support for decentralised energy networks. Exeter Core Strategy Submission Document February 2011 includes policy CP13: Decentralised Energy Networks:

Decentralised Energy Networks will be developed and brought forward. New development (either new build or conversion) with a floorspace of at least 1,000 square metres, or comprising ten or more dwellings, will be required to connect to any existing, or proposed, Decentralised Energy Network in the locality to bring forward low and zero carbon energy supply and distribution.

Policy CP17 which sets sustainability aims for development as follows:

- at Newcourt, Monkerton and Hill Barton should aim to install district heating and CHP as the low and zero carbon energy solution*
- in the Water Lane Regeneration Area and the south of Alphington should aim to connect to a heat supply from the Marsh Barton EfW facility and aim to utilise low carbon heat from it, respectively*

- and, in the City Centre and Grecian Regeneration Area, should contribute to the establishment of a decentralised energy network

Bus Station Redevelopment

Exeter City Council produced ten design principles for the bus station redevelopment:

The Bus and Coach Station Development Principles have been drawn up to guide preparation of a development scheme for this area by a prospective developer, allowing a degree of flexibility whilst ensuring that key principles are delivered.

The development must adopt high standards of sustainable design and enhance biodiversity.

The City Centre has been identified as having potential to create an energy network delivering carbon savings and lower energy costs. Any development scheme should be designed to be able to be part of such a network.

Other City Centre Developments

The new John Lewis and Waitrose stores have been designed to be 'DH ready' under planning conditions.

New student accommodation has been consented with Section 106 requirements to contribute to a district heating scheme.

Table 1-1: s106 contributions secured by Exeter City Council

Site	Address	Planning Reference	s106 Contribution
Portland House	New North Road	11/0895/03	LEN Contribution £31,000
Stoneman & Bowker	Sidwell St	10/1906/03	Requires payment of a contribution of £40,000 (index-linked) to the proposed city centre local energy network scheme.
Townsend's	Sidwell St/ Western Way	11/0140/03	the development to be designed and built so as to be compatible with the Council's proposed Local Energy Network (LEN) scheme for the City centre, and a payment prior to occupation of £81,000 towards the scheme;
Kingfisher House	Western Way	11/0959/03	Requires payment of the following contributions: To the City Council: £46,898 for the local energy network

1.2.3 Devon County Council Policy

The following text is extracted from Devon County Council policy documents and a paper on District Heat and ESCO models submitted to Cabinet and sets out the Carbon Dioxide Emissions targets and environmental policies relevant to this study:

Devon County Council set out its vision for Carbon Management in its Carbon Management Programme Strategy and Implementation Plan policy document published in May 2007 as part of the County Council's involvement in the Carbon Trust Local Authority Carbon Management Programme:

To be recognised by our community, our staff, our partners and our peers as a leading carbon-conscious council through "becoming a low carbon authority".

Accepting the 2.1% minimum reduction target already agreed by the Executive enhanced in FY 2009/10 by the EPC proposed target of 3.3% would produce a 13.3% reduction in emissions over the 5 year implementation period. Based on this premise our target is to make an absolute reduction of 5,620 tonnes of CO_{2e} (1,533 tonnes of carbon) by 2011/12.

The County Council's Strategic Plan sets out principles and objectives for helping to develop a competitive economy and supporting local business. The County Council's Environmental Policy includes policy objectives in relation to waste, to make best use of resources. It provides for the County Council to provide community leadership on environmental issues and to improve energy efficiency. Combined Heat and Power and District Heating schemes are compatible with these principles.

National waste policy and the emerging Waste Local Plan recognise waste as a resource and energy recovery from residual waste as a key principle. This can take many forms including the generation of heat, electricity or biogas, which can be used as part of a Combined Heat and Power or District Heating scheme.

Energy from Waste Plant

The County Council has already acknowledged the potential for residual waste to play a significant role as an energy resource. The Exeter Energy from Waste plant promoted by the County Council includes an obligation on the project to make best endeavours to use and market energy from the plant. The plant is currently orientated towards generation of electricity which is exported to the National Grid. There is the potential to increase the efficiency of the plant by taking off heat to supply a District Heating Network.

This plant is a Public Private Partnership (PPP) scheme designed, built, financed and operated by Viridor under a modification to the waste disposal contract between Viridor and Devon County Council as the Waste Authority.

The planning permission includes an obligation, "to use best endeavours to use and market the energy generated from the incineration process". Exeter City Council received the following legal advice with regards to that obligation:

The exact scope of such an obligation is difficult to define, and will always depend on the nature and terms of the particular contract in question.

As outlined in Ross' previous note (see below), there tend to be three possible formulations of this type of obligation, namely "reasonable endeavours", "all reasonable endeavours" and "best endeavours". The courts have established the following principles:

- 1. The key difference between these phrases is that the last two require the party to take all the reasonable courses that they can in order to fulfil the obligation, rather than just one course.*
- 2. Whichever phrase is used however, an obligation of this nature does not require the obligee to disregard his own commercial interests. So to ask "Has the party used his best endeavours in this case?" is to ask (in the case of a company) "What would a reasonable and prudent Board of Directors, acting properly in the interests of their company and applying their minds to its contractual obligations, have done in this case?".*
- 3. The party concerned may be required to incur expenditure/loss in fulfilling its obligations, however in considering the steps that it would be reasonable to expect that party to take, the court has to consider whether those steps are likely to be successful, i.e. whether there is any real prospect of success. In other words the party concerned is not obliged to incur expenditure pursuing a possible course of action which has no reasonable prospect of bearing fruit, and it may be sufficient for them to rely on expert advice as to the prospects of a particular course of action (i.e. not pursue it if the advice is against doing so).*

Extract from earlier advice referred to above:

'For a long time, lawyers have assumed meanings for "best endeavours" and "reasonable endeavours", and even "all reasonable endeavours", but there has been surprisingly little case law on the subject. Then in 2007 a case went to the High Court (Rhodia v Huntsman - ironically about a CHP plant, but apart from that there was no similarity with our present situation). The judge reviewed previous cases and reached the following conclusions:-

"An obligation to use reasonable endeavours to achieve the aim probably only requires a party to take one reasonable course, not all of them, whereas an obligation to use best endeavours probably requires a party to take all the reasonable courses he can. In that context, it may well be that an obligation to use all reasonable endeavours equates with using best endeavours." "

1.2.4 Exeter and East Devon Growth Point

The following text is extracted from the Exeter and East Devon Growth Point website and sets out the aims of the Growth Point:

A Growth Point is a Government initiative to support local authorities with plans for long-term sustainable growth. By supporting areas as Growth Points, the Government is entering into a long-term partnership, subject to the statutory regional and local planning process.

Exeter and East Devon Growth Point is a partnership between East Devon District Council, Exeter City Council and Devon County Council, to deliver a number of strategic developments in the Exeter and East Devon area.

This growth point programme is also supported by the Homes and Communities Agency through their Growth Point funding schemes (HCA) and by the South West Regional Development Agency (RDA) through Regional Infrastructure Funding (RIF) and a Deliverly Team grant.

The vision for Exeter and East Devon Growth Point is to help Exeter and East Devon realise it's full economic potential by providing a range of employment opportunities alongside new communities where people will have the ability to live close to where the majority of jobs will be provided.

Many of the developments have a resolution to grant planning permission and plans to include low carbon district heating schemes are now well under way.

Sustainable Growth targets include:

- *Producing 16.7% of the new community's energy from renewable sources*
- *Producing 10% of non residential development's energy from renewable sources*

To achieve these targets Exeter and East Devon Growth Point commissioned Element Energy to undertake an analysis of CO₂ emissions in the Growth Point up to 2020. The study concluded that each development would need to assess their energy provisions individually, but for larger sites a District Heating scheme would be the most cost effective way to achieve a higher code for sustainability: a district heating scheme is a locally situated combined heat and power plant providing lower energy bills and constant hot water, fuelled by locally sourced wood fuel.

Cranbrook

Cranbrook is set to be the first mass open market low carbon development in the country, with a single energy centre providing heat and hot water through a district heating network to all residents.

The energy centre, constructed and managed by E.ON, will generate heat and hot water through its own combined heat and power (CHP) units and supplementary boilers. It will be located on the £120 million Skypark development and will supply both the new community of Cranbrook and the Skypark business development, significantly reducing emissions across both and helping them reach higher standards of sustainability.

1.2.5 Low Carbon Task Force

The following text is extracted from the Exeter and East Devon Growth Point website and sets out the aims of the Low Carbon Task Force:

Exeter City Council, East Devon District Council and Devon County Council have formed a Low Carbon Task Force, together with energy company E.ON, to improve the energy efficiency of homes and to use renewable power sources to drive down residents' fuel bills and cut carbon emissions.

This is a pioneering agreement to create more sustainable communities – improving energy efficiency and working to combat climate change across Exeter, East Devon and the whole of Devon County. The agreement was signed at a landmark ceremony on the 18 June 2011.

Teignbridge District Council have since joined the Task Force.

Energy measures feature strongly, accounting for three of the ten Principal Objectives:

- *Reduce energy consumption & energy costs*
- *Increase energy efficiency*
- *Promote the transition to a low carbon economy*

1.2.6 Royal Devon and Exeter NHS Foundation Trust

The Trust's Sustainable Energy Strategy 2012-2015 outlines the targets it has set:

The Trust has set its carbon reduction target to reduce its 2007 energy carbon emissions by 10% to approximately 14,453 tonnes of CO₂ by 2015.

And to

[...] generate on-site up to 50% of its electricity demand

And recommends participation in this study:

From the wide variety of renewable energy systems assessed, it is recommended that the following schemes are implemented:

- *Solar photovoltaic: in 2011/12 (saving 150 tonnes CO₂).*
- *Energy from waste: in 2013/14 (saving 652 tonnes CO₂).*
- *Second CHP: in 2013/14 (saving 544 tonnes CO₂).*
- *Ground source heat pump: in 2014/15 (saving 1632 tonnes CO₂).*
- *The introduction of a scheme for biomass boilers in 2014/15 may become part of a wider district heating/energy scheme, subject to the outcome of a feasibility study with Exeter City Council.*

[...] the implementation of the potential schemes should enable the Trust to exceed its 2015 target but at this stage there would be a shortfall of circa 700 tonnes against the 2020 carbon reduction target. A district heating scheme, if feasible, would therefore make a significant contribution towards the longer term carbon savings targets.

1.2.7 University of Exeter

The University Carbon Management Plan 2010-2020 outlines the targets the board have adopted:

EDS [Estate Development Service] presented a paper to the Carbon Management Board on 2nd Sept 2010 illustrating possible Scope 1 and Scope 2 emissions reduction targets for 2020/21. The Board adopted a target of 28% reduction by 2020/21 as being the most appropriate for the University's present circumstances. This is equivalent to a reduction of 2% per year.

The target requires that University Scope 1 and Scope 2 emissions should be less than 18,000 tonnes per year by 2020/21.

An interim milestone target is to achieve Scope 1 and Scope 2 emissions of less than 20,000 tonnes by 2015/16.

The University Scope 1 and Scope 2 target is to achieve a reduction of 28% by 2020/21, requiring annual emissions to be less than 18,000 tonnes carbon dioxide equivalent.

The University of Exeter has been recognised by the Carbon Trust for its achievements to date:

In addition, the University has also recently retained its Carbon Trust Standard. The university was awarded the recertification for a 13% reduction in its carbon footprint relative to turnover since the original certification in 2008. This was achieved through internal schemes such as the Student Re-use Project and investment by the University in energy saving.

The University of Exeter is one of only two Higher Education institutions in the UK to have so far achieved recertification for this prestigious award.

The award requires organisations to measure, manage and reduce their carbon footprint and make real reductions years on year.

1.2.8 Previous studies

An outline scoping report ¹has previously been prepared to establish the potential for a commercially viable DH system near the city centre connecting a number of significant buildings in the surrounding area including the proposed new bus station, the Civic Centre and adjacent buildings, the Pyramids leisure centre, Heavitree Hospital and adjacent police/ambulance/courts buildings, the University's St Luke's campus buildings and the new Waitrose supermarket. This report, found that a scheme could be potentially viable.

Prior to this, Growth Point commissioned a study² of the options for new developments across the Exeter area which included assessment of approaches to low carbon energy for new development in the City Centre and Alphington areas.

¹ Exeter City Centre CHP/DHS Study January 2011, I.C.E. UK

² East of Exeter New Growth Point Energy Strategy July 2008, element energy

1.3 Scope

1.3.1 ITT Scope

The Invitation to Tender issued by the University and commissioned on behalf of Exeter City Council and the RD&E (at Appendix G) sets out the basis of the study. Key extracts are as follows:

“Having established [in an earlier outline scoping report] that a DH scheme is potentially commercially viable this detailed feasibility study (DFS) will develop the engineering, economic, environmental and commercial issues and provide sufficient information on priority sections of the larger scheme to enable principle stakeholders and other users in these areas to make strategic decisions on participation in a network(s).

For the purposes of the DFS the term “other users” should be considered as organisations other than the principle stakeholders that could benefit by the use of lower cost or lower carbon energy from a district heating network. These other users may decide to pay for the energy or participate in the running of the network itself.

The DFS will specifically provide:

- 1. A detailed study of the “Eastern network” – a cluster of heat customers to the east of the city centre centred around RD&E Wonford and St Luke’s University Campus. The study will include all significant buildings in the RDE Wonford Hospital site, St Luke’s University Campus, Exeter School, Waitrose, and the Heavitree Road police station, ambulance station and courts (and any other sites adjacent to Wonford which may not have been identified in the scoping report).*
- 2. A detailed study of the “Sidwell Street network” – a cluster of new build student accommodation and the new John Lewis store in the Sidwell Street area of the City. The DFS will include all significant buildings within these sites and consider the potential for connecting other nearby users in the adjacent Sidwell street area.*
- 3. An overall review of the potential for a full Exeter District Energy Network including all the potential sites identified in the scoping report and the potential for a variety of uses for the bus station site (retail / leisure / swimming pool).*

1.3.2 Extension to Include EfW plant and Matford Park

Subsequent to the ITT Devon County Council joined the other commissioning parties and the study's scope was extended to progress "best endeavours" for the EfW plant to market energy by including;

- assessment of the viability and benefit of supplying low carbon heat from the Energy from Waste plant currently under construction at Grace Road in Marsh Barton to the City Centre Scheme and;
- assessment of the viability of a wider network to serve industrial consumers on the Marsh Barton industrial estate and further to supply the proposed development at Marsh Barton Phase III and into the SW Exeter Masterplan area.

The study's commissioning partners formed a Steering Group to oversee the progress of the work.

2 APPROACH

2.1 Data Collection

A range of Request for Information forms were issued to various parties covering:

- Study area information such as mapping and proposed developments
 - issued to Exeter City Council
- Existing buildings energy systems and consumption data
 - issued to each building/site owner
- Future development site information
 - issued to developers where known
- Energy from Waste Plant data
 - issued to Devon County Council

Representatives for each site were contacted directly and followed up a number of times. Where contacts were out of date or contact information incorrect, efforts were made to identify and approach alternate contacts.

2.2 Site Visits

A site visit to Wonford Hospital was made. Key sections of the potential routes and the St Luke's campus were walked to identify viable routes and barriers to network installation.

2.3 Site Selections

In the first instance sites for inclusion in the assessment and modelling were agreed with the Steering Group. Some further sites were identified beyond this list and approached.

2.4 Energy Centre Locations

The project brief (ITT) mentioned some Energy Centre locations suggested and offered by the Steering Group. Further options came to light through the course of the study.

As the outline scheme designs were considered, and with reference to the heat mapping completed, the full list of potential energy centres was established.

An initial assessment was made and the list reduced to a short list on the basis of proximity to the heat demands mapped and the least barriers to gaining agreement to use the site. No further optimisation of energy centre location selection was necessary since this exercise quickly reduced the list to the locations used within the outline scheme designs.

2.5 Network Outline Designs

Based on the heat map prepared, strategic routes were sketched with Google Maps Pro. This enabled viable routes and barriers to be identified quickly and alternate routes established.

Three distinct strategic routes were identified, based on the three 'landing points' established for the Exe crossing routes feasibility study. Since the output of the Exe Crossing study was not available at the point that outline designs needed to be set in order to enable modelling of the schemes, the central route was selected as the basis on which the outline designs would be prepared. It subsequently transpired that this was marginally the lowest cost crossing route (see 5.3.5).

Having sketched the potential routes out, these were then walked to identify any significant barriers not obvious from mapping data and also any opportunities for more favourable routes.

Finally, the routes were imported to CAD design software and detailed to a level necessary to model the network operation and pipe sizes.

2.6 District Energy Network Constraints

Data and mapping information provided in response to the RFI on the study area and that related to potential network constraints was reviewed.

A brief conversation and review of the archaeological constraints was undertaken with Parsons Brinckerhoff's Archaeological and Heritage consultant.

Buried Statutory Utility routes were reviewed using direct access portals provided by South West Water, Western Power Distribution and National Grid Gas Networks. This review sought to identify 'pinch points' and significant utility corridors that would require more detailed consideration if they cannot be avoided.

Telecommunications data was not requested or reviewed. In general routing DH mains around, or diverting, communications networks requires good coordination in design and construction but is not a significant factor in pricing of network installation.

SECTION II

TECHNICAL OPTIONS ASSESSMENT

3 NETWORK STRATEGY, SCHEME AND ROUTE OPTIONS

3.1 Energy Demand Estimation

3.1.1 Existing Buildings

Metered gas consumption data was provided, in response to the RFI, for most of the existing buildings included in the study. A summary of the data received and basis for the heat demand used in the study is shown below in Table 3-1. Where a figure was not provided the conversion from gas consumption to heating demand is calculated on an assumed seasonal boiler efficiency of 80%.

Table 3-1: Basis of Existing Buildings demand estimates

Building	Basis of demand estimate	Date	Source
Civic Centre	Annual oil consumption figure in kWh and seasonal efficiency	2012	Exeter City Council
Pyramid Leisure Centre	Previous Study floor area from GIS and benchmark W/m ²	-	Previous Study Report
Ambulance Station	Previous Study floor area from GIS and benchmark W/m ²	-	Previous Study Report
Police HQ & Magistrates Court	Previous Study floor area from GIS and benchmark W/m ²	-	Previous Study Report
Heavitree Hospital	Monthly metered gas consumption data	Oct 2011 Jun 2012	Royal Devon & Exeter NHS Foundation Trust
Job Centre	Annual metered gas consumption data	2009 to date	Trillium FM provider for building
St Luke's	Rounded summary annual consumption figures	-	Exeter University
County Hall	Monthly metered gas consumption biomass boiler heat meter data	Apr 2011 Mar 2012	Devon County Council
Crown and County Court Complex	Monthly metered gas consumption data	Sep 2011 Sep 2012	HM Courts Service
Wonford Hospital	Monthly metered gas consumption data	2008 to date	Royal Devon & Exeter NHS Foundation Trust
Waitrose	Half Hourly gas consumption volumes	Oct 2011 Aug 2012	John Lewis Partnership
Hendy Van & Truck	Monthly gas invoice consumption data including some estimates	2011	Hendy Group
EIC South West Metal Finishing	Annual rounded gas consumption figure	2009	Data provided to previous study by EIC via Tony Norton
Polestar Wheatons	60% of monthly metered gas consumption data (adjusted for non heating gas uses)	2007-2009	Data provided to previous study by Polestar Group via Tony Norton

3.1.2 Campus sites

The four main public sector sites comprise multiple buildings. It is important to establish where consumption occurs on such sites. The data provided in response to the RFI in most cases provided this level of detail but some further analysis and assumptions were necessary.

The **Civic Centre** is all heated from one main plant room, although there is some electric heating to ancillary parts of the building. Heat demand has been based on the total annual oil consumption.

County Hall has recently installed a biomass boiler and, in order to aggregate load at the central plant room, some heat network connections were also installed to link decentralised plant rooms into the main boiler house. This study assessed the heat demand at County Hall proportionate to the annual gas consumption, on the assumption that the biomass boiler would be retained.

St Luke's University of Exeter Campus is heated by decentralised plant rooms in each building. Heat demands have been established based on annual consumption figures provided by the University.

Heavitree Hospital is heated by a steam network serving plate heat exchangers in each building. The Occupational Health building has a separate plant room and separate gas meter data was provided. The main hospital has been included as a single site in the assessment with the heat demand based on the full gas consumption.

Wonford Hospital is made up of multiple buildings with the main hospital building and a number of adjacent wards heated centrally from the energy centre whilst the majority of outlying treatment and research centres have their own decentralised boiler plant. There is steam supply also provided for although this is to a minority of the buildings, with one stand alone decentralised supply. There is also oil fuelled heating in the residences.

The main complexity in identifying the locations at which consumption occurs at Wonford is the metering of the internal gas network. A number of clusters of buildings are supplied from the same meter point. Where available the individual meter data for a decentralised plant room was used. Where multiple plant rooms are supplied off a single meter, the consumption measured at the meter was apportioned across the buildings it served proportionately in line with the size of the boilers installed in each. The single oil consumption figure was also apportioned across the residences in proportion to the boiler plant installed in each.

As discussed at 3.6, gas consumption associated with steam raising at Wonford was also included in the overall calculation of heat demand (for the purposes of economic modelling). The HSDU steam demand is currently served locally. A capital allowance was included for a further steam connection required to centralise the HSDU steam demand and therefore enable it to also be served by a potential city centre energy centre located at the hospital. It should be noted that the hospital engineering team has indicated that they would seek to retain control over back up steam plant – which is already installed at the hospital. The capital costs currently assume that all peak boiler plant would be procured new by the ESCO. Potential ownership options have not been investigated at this stage.

3.1.3 Existing Buildings for which no data was received

Sites were excluded from the assessment where RFI information was not received and/or responses were either non-existent or very limited and no data was available from the previous study.

Table 3-2: Buildings for which no data was received

Building	RFI Response	Action
Prison and Remand Centre	Data provided too late to be included	Not included but data presented below
DCHA	No data supplied	Not included
Pyramid Leisure Centre	Not contractually obliged to provide this data (to ECC)- likely to close within 5 yrs and move to Bus Station	Previous study data used and site included but with demand ending in five years time
Ambulance Station	Trust not inclined to be involved due to high prices in previous study	Previous study data used
Police HQ & Magistrates Court	No data supplied Site scheduled to close when new replacement ready 2015	Not included
Exeter School	No data supplied	Not included
Nuffield Hospital	No data supplied	Not included

For sites where no data was received or available in response to the RFI but which had a load calculated in the previous study, that load was used.

Table 3-3: Heat demand data used from previous study

Building	Heat demand (kWh/year)
John Lewis	764,797
Pyramid Leisure Centre	588,015
Ambulance Station	59,353

John Lewis is included above even though an RFI response was received. That RFI indicated there was no historic consumption information available since the site had only recently been completed. No response was received to a further request for design forecast energy demand data. A search of the City Council planning register also failed to identify any such data submitted as part of the planning application for the site.

The Ministry of Justice provided an annual gas and electricity consumption figure for Exeter Prison and a plant schedule. However this information was provided too late to be used in the study. There are 11 plant rooms on site totalling 3.5MW of gas boilers and water heaters mostly installed in 1997. 2.6MW of this capacity is located across just two plant rooms (2MW in the main plant room). The gas consumption for 2012 was over 3.5GWh and electricity almost 3GWh (figures for financial year 2011-12).

3.1.4 Proposed Development

For proposed new development sites, where energy demand estimates were available from the developer either directly or from planning applications, these were used. If no data was available, a forecast for the annual energy demand and peak load for the site was established based on benchmark data.

Table 3-4: basis of new development demand estimates

Building	Source of floor area data	Basis of demand estimate
Bus Station Redevelopment	Land Securities RFI response Hotel estimate from no. of rooms	Benchmark demand data
Townsend's Site	Gross application area from RFI response - use split estimated based on unit numbers	Benchmark demand data
Portland House	Planning application schedule	Benchmark demand data
Kingfisher House site	Measured off planning drawings	Benchmark demand data
Stoneman & Bowker site	Measured off planning drawings	Benchmark demand data
RILD (at Wonford Hospital)	Royal Devon & Exeter NHS foundation Trust	Benchmark demand data
Aseptic Unit (at Wonford Hospital)	Royal Devon & Exeter NHS foundation Trust	Data from M&E consultant
Former St Nicholas Primary - new extension to St Leonard's Primary	Estimate from preliminary planning application drawing	Benchmark demand data
Former RWE School for the Deaf site	Estimate provided by City Council	Benchmark demand data
Former St. Loye's College site	Original Outline application schedule for whole site	Benchmark demand data
Former University of Plymouth site	Application schedule	Benchmark demand data
Matford Park Ph III	Planning Application	planning application Energy Statement
SW Exeter Masterplan	Local Authority masterplan	Masterplan Study estimate

Benchmark energy demand figures have been reduced in line with anticipated improvements to building fabric required by future revisions to Part L of the Building Regulations.

Devon County Council provided data for St Leonard's Primary School after modelling had been completed. These consumption figures (a range of 245 - 375MWh/annum over previous years) were much greater than the figures estimated from benchmark data and used in the report. These excluded any forecast consumption for the proposed developments. The proposals involve adding 800m² in three phases 2013 - 2017. The first phase is essentially an extension of the existing building and will be served by the existing plant room. The second and third phases form a new building of 600m² (built in two stages 2015-2017). This second phase would present an opportunity to connect to a district heat network and it is understood that boilers in the existing building may reach, or be beyond their serviceable life by that time.

As with all new development there remains considerable uncertainty over the final nature, timing and loads for all these sites:

- It is understood from conversations with developers that two of the four student schemes are likely to be redeveloped as different uses. No details have been provided of these emerging redesigns. This could reduce the demand density somewhat but could also lead to a more consistent load
- We sought feedback from the developers of the Bus Station site on our estimates of energy demand forecast but received no response. The developer's consultant has indicated that the majority of demand would be for cooling and power but our estimate establishes significant heat demand. There is therefore a risk over this figure and economic assessment resulting from it.
- It is not clear if the SW Exeter Masterplan energy figures include the Matford Park Phase 3 demand since this development appears to be included in the Masterplan area. Our calculations have reduced the Masterplan energy demand forecast by the demand presented in the Matford Park Phase III Energy Statement. This uncertainty needs be resolved by the future study work on the SW Exeter area referred to in section 12.3.2.

One of the proposed development sites, the temporary ward at Wonford Hospital (due for completion in 2013), did not have enough information available to establish a heat demand forecast. This site was not therefore included in the assessment.

The Aseptic Unit at Wonford Hospital was also not included in the study as this building will be a highly sterile environment heated by air source heat pumps. The Unit is therefore not compatible with district heating.

3.2 Demands used for the assessment

The annual heat demands established for each site included in the assessment are discussed below. For clarity, larger, campus sites have been listed as a single heat demand. A full list of potential building connections in the study and the heat demand assessed at each is included at Appendix C and as part of the heat map in section 3.3

3.2.1 Public Sector Buildings - existing

Table 3-5: Public Sector Building Heat Loads

ID	Load	Heat demand (kWh/year)	Peak load (kW)	Load factor
1	Civic Centre	170,415	500	4%
2	Pyramid Leisure Ctr	588,015	400	17%
3	Ambulance Station	59,353	100	7%
5	Heavitree Hospital	3,048,697	1,600	22%
7	Job Centre	101,891	550	2%
8,9 & 28-35	St Luke's	3,451,767	1,550	25%
17	County Hall	1,075,109	1,820	7%
26	St Leonard's Primary - extended	168,000	200	10%
36-66	Wonford Hospital	26,746,542	9,824	31%
	TOTAL	35,409,789	16,544	24%

NOTE: The Wonford Hospital figure here includes the RLID which is a new development

Two public sector buildings, the Heavitree Road police station (scheduled for closure when a new custody suite is built elsewhere by 2015) and the Crown and County Court Complex (data provided too late) are shown on the heat map at Figure 3.3-1 but were not included in any of the network modelling.

Table 3-6: Public Sector sites for which data was available but which were not included in modelling

ID	Load	Heat demand (kWh/year)	Peak load (kW)	Load factor
18	Crown & County Court Complex	693,280	-	-
4	Heavitree Road Police Station	1,044,679	1,500	8%

3.2.2 Private Sector Buildings - existing

Table 3-7: Private Sector Building Heat Loads

ID	Load	Heat demand (kWh/year)	Peak load (kW)	Load factor
12	John Lewis	764,797	1,000	9%
15	Waitrose	449,157	1,966	3%
67	EIC South West Metal Finishing	2,800,000	1,750	18%
68	Polestar	1,199,930	300	46%
70	Hendy Van & Truck	304,477	400	9%
13	BT Exchange	170,000	-	
	TOTAL	5,688,361	5,416	12%

3.2.3 Proposed New Development

Table 3-8: Proposed New Development Heat Loads

ID	Load	Heat demand (kWh/year)	Peak load (kW)	Load factor
10	Bus Station Redevelopment	6,889,527	7,851	10%
14	Townsend's Site	1,478,857	1,727	10%
19	Portland House	492,786	621	9%
20	Kingfisher House site	645,408	754	10%
21	Stoneman & Bowker site	368,082	464	9%
26	St Leonard's Primary - extended	168,000	200	10%
23	Former RWE School for the Deaf site	483,014	608	9%
69	Matford Park Ph III	2,419,300	8,029	3%
71-77	SW Exeter Masterplan	16,739,700	16,099	12%
	TOTAL	29,684,674	36,350	9%

Two proposed new developments for which data was available are shown on the heat map at Figure 3.3-1 but were not included in any of the network modelling.

Table 3-9: Development Sites for which data was available but which were not included in modelling

ID	Load	Heat demand (kWh/year)	Peak load (kW)	Load factor
24	Former St. Loye's College site	2,915,917	1,844	18%
25	Former University of Plymouth site	625,625	730	10%

Initial energy demand calculations for the former St Loye's College site were based on planning application accommodation schedules. However, the developers of the former St Loye's College (Lower) residential development site informed us that they were not under any conditions to seek to connect to a City Centre decentralised energy network and would be building out the site without provision for a future district heat network connection. We had no contact with the developers of either the St Loye's (Upper) retirement development or the Former University of Plymouth residential development site (Earl Richard's Road North).

In addition the St Loye's site was judged to be too far off the proposed route to be included in the network modelling. Although a proposed route runs through the Former University of Plymouth site, we assumed a similar approach would be taken to that of the developer of the St Loye's (Lower) residential development site and did not include this demand in our modelling.

3.3 Heat Map

The spatial distribution of the existing heat demand in Exeter identified and assessed is illustrated in Figure 3.3-1. Existing loads were plotted onto the base map located on the building as identified on the map (and, if known at the plant room of that building). Where necessary the building positions were reviewed and corrected.

Within the heat map, load size is denoted by the area of the circle centred on each building. The area of each circle is extrapolated directly from the calculated annual heat demand (kWh) listed in the tables at 0 above and so an accurate visual and spatial representation of heat demand is produced.

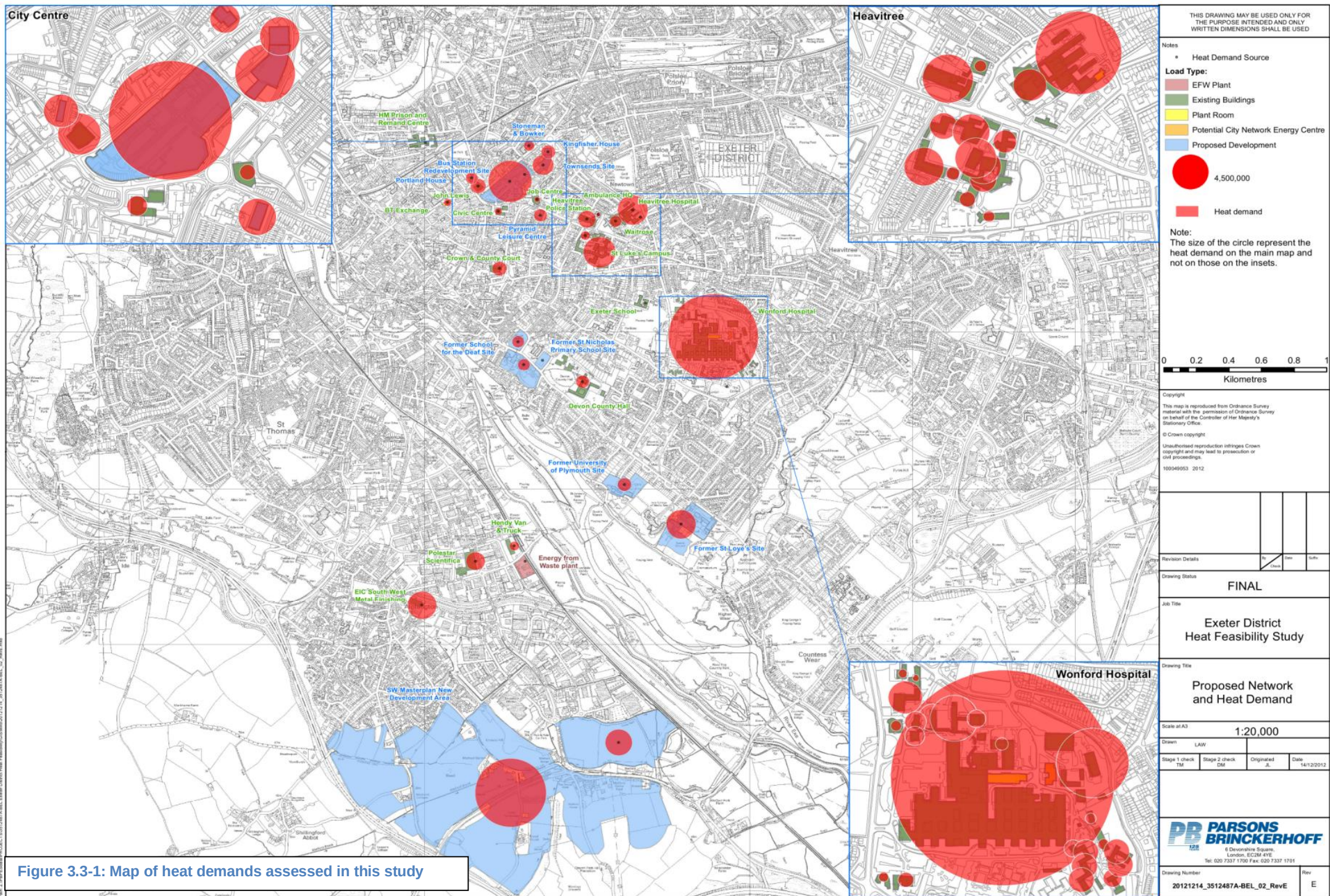


Figure 3.3-1: Map of heat demands assessed in this study

3.4 Phasing of Connections

3.4.1 Existing buildings

All existing buildings have been assumed to connect as soon as the network is constructed and available. Some RFI responses and discussion with site representatives indicated that there were medium term plans to redevelop or end the current use of a site. In particular:

- The Estates Strategy for Heavitree Hospital is currently uncertain. Although RD&E have indicated that there are plans to redevelop the site; potentially in five years' time, no details of proposed future uses were available. Therefore the existing demands calculated at the hospital have been retained beyond five years. Based on building regulations advances (if demolished or redeveloped) it is likely that any future uses at the site would have a lower energy demand than the current operation but at a similar scale.
- Pyramids Leisure Centre is likely to be closed down once a replacement has been provided at the Bus Station Redevelopment. This replacement is not guaranteed as the masterplan and uses within the bus station redevelopment are not yet finalised. Modelling in this study has included the demand at Pyramids Leisure Centre ending in five years.

3.4.2 New development phasing

The accommodation schedule for the bus station redevelopment site provided in Land Securities RFI response indicated two phases of development but with no forecast dates for these phases. Exeter City Council Planning Department provided the forecast completion dates used in the modelling. The schedule includes a swimming pool operating from 2018. The modelling therefore has the Pyramids Pool demand stopping in 2018 as the Bus Station pool comes online.

Table 3-10: Proposed New Development Phasing of Completions

ID	Building	Phasing	Source
10	Bus Station Redevelopment	Ph 1 Jun 2016 Ph 2 Jan 2018	Developer RFI
14	Townsend's Site	Sept 2013	Exeter City Council
19	Portland House	Sept 2014	Exeter City Council
20	Kingfisher House site	2014	<i>Assumed - no data available</i>
21	Stoneman & Bowker site	Sept 2013	Exeter City Council
44	RLID (at Wonford Hospital)	October 2013	RD&E NHS Foundation Trust
23 & 27	Former RWE School for the Deaf site		No estimate available
26	St Leonard's Primary - extended	Sept 2013	Indirectly via planning consultant
24	Former St. Loye's College site	Lower - 2013 Upper -	Linden Homes no information
25	Former University of Plymouth site		No information on phasing
69	Matford Park Ph III		No information available
71-77	SW Exeter Masterplan	2013-2032	LDA Design - South West Exeter Masterplan, June 2012

Completion dates were also provided for the Temporary Ward and Aseptic Unit at Wonford Hospital although only the RLID was included in the modelling (as discussed at 3.1.4 above).

3.5 Effect of Energy Efficiency Measures

The existing buildings included in this study are a mixture of recent development and older buildings. There is the potential to reduce the heating demand for a number of these buildings and given government policy and the financial savings available, the majority of these improvements can be expected to be implemented within the period over which this study has developed economic modelling.

Profiles of likely reductions in demand for each site have been assumed based on the type and age of the building. These range between a flat profile (i.e. no reduction) for newer buildings to 10% savings implemented over 20 years.

3.6 Steam at Wonford Hospital

Steam demand was included in the total demand. Capital estimates for the costs of steam infrastructure and connections were included in the economic modelling. The CHP layouts have been specified to allow for steam heat recovery alongside LTHW. A steam to hot water plate heat exchanger is included to allow for load balancing.

3.7 Additional Considerations

3.7.1 Burnthouse Lane

The opportunity to supply low carbon heat to the City Council housing estate in the Burnthouse Lane area has not been evaluated as part of the study because these connections are unlikely to have a material impact on the overall viability of the scheme. Recommendations relating to Burnthouse Lane are made in section 6.2

3.7.2 Marsh Barton Trading Estate

The Exe Crossing Study considers a route to the east of the rail line to supply the Matford Phase 3 extension which, if taken up would forego the opportunity to supply low carbon heat from the EfW plant to businesses in Marsh Barton and Matford. The Exe Crossing Study identifies the cost of the east of the rail line route (see Option 4 in section 5.3.5) at £4.1m, higher than the cost of taking the network to the Phase 3 extension along the highway. The east of the rail line route was therefore not taken forward in the study.

4 HEAT SUPPLY OPTIONS

4.1 Gas Combined Heat and Power Energy Centres

There has been rapid development over the last 10 years in the efficiency and reliability of gas reciprocating engine CHP plant. For all but the largest industrial and steam demands gas engines are now the fossil fuel technology of choice over gas turbines. Modern plant is relatively low cost, achieves high electrical and overall efficiencies. Efficiencies of 40% electrical and 80% overall are readily achievable at scales over 1 MWe output. The carbon performance by comparison with grid supplied electricity and gas boilers is excellent with sites able to achieve CO₂ emissions reduction in excess of 40% provided installations are well designed and carefully managed. In many cases sites are only limited by the level of heat demand that can be accessed. Linkage to other consumers with DH networks can overcome this maximising the scale and cost effectiveness of the CHP scheme.

There is some uncertainty at present as to the incentive regime for CHP. The current CCL exemption for "Good Quality" CHP will come to an end next year but the replacement promised by Government is not yet known. Therefore no exemption has been modelled in this study.

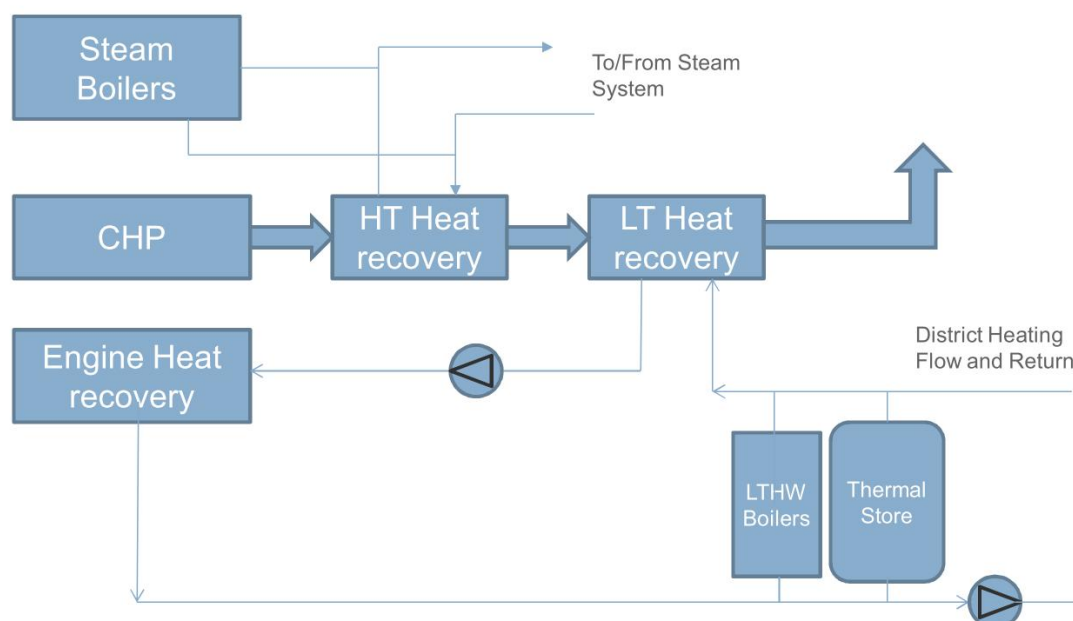
The value of electricity production means that CHP remains good value, particularly in the South West where higher transmission costs are included in tariffs. As an illustration, the cost of transmission in the South West for 2012/13 is £31.06/kW per year, the second highest in the country after London. Typically costs in the rest of England range from £20/kW in the north to £28/kW in the Midlands and South East.³

The inclusion of the Wonford site in the scheme makes gas CHP particularly attractive as the relatively easy connection to a large on site electrical demand avoids transmissions costs and therefore ensures that scheme value can be maximised. Alternative locations where the majority of generation will be sold to the grid suffer by comparison. Typically only a significant saving in DH pipework costs (for example through a more central location) would overcome this advantage. The impacts of the onsite electricity supply on scheme economics can be seen in the results presented later in the report.

³ Source "Explanation of TNUoS tariffs for 2012/13" published by National Grid -

<http://www.nationalgrid.com/NR/rdonlyres/E37E6642-F2A4-4A85-8B8B-57958B4B1675/51451/FinalTNUoS tariffs for 2012.pdf>

Figure 4.1-1: Schematic of CHP connection to DH



Gas CHP is normally linked to thermal storage systems to allow the heat and electricity production to be decoupled. This allows CHP scale, and economics, to be maximised while meeting the maximum heat demands without the use of gas boilers. Typically CHP plant is run during “daytime” electricity tariff periods and shut down over night. Suitable thermal storage allows the CHP unit to store heat during the day to serve residual night time demands and contribute to morning peak supply. This is the sizing and design approach used in this study. In order to take into account planned and unplanned maintenance it is assumed that the CHP is available for 92% of available operating hours. This is based on levels of availability offered in a standard maintenance contract for this type of plant.

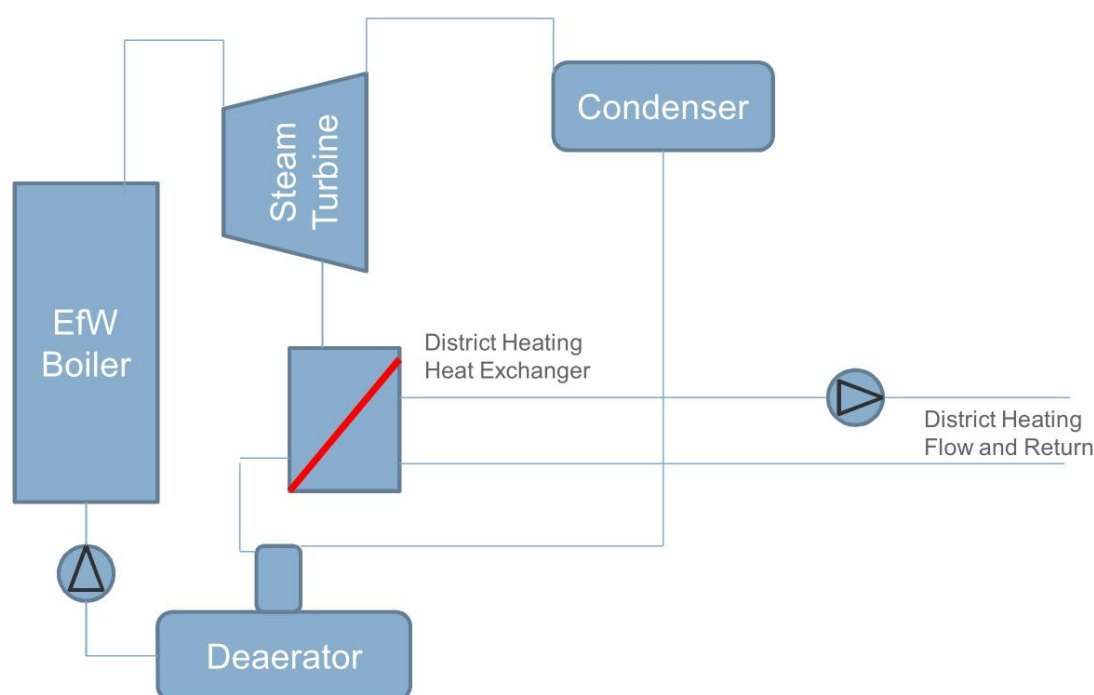
The CHPs have been modelled to be heat load following, they will modulate with the heat demand to their minimum level (50% of the rated maximum capacity is quoted by the majority of engine suppliers). If there is no available capacity in the thermal store they will switch off until the demand increases above their minimum turn down level. The heat demand is then supplied from the thermal store, subject to capacity. Gas fired boilers will supply the heat demand if the CHP is switched off and there is no remaining heat stored in the thermal store. Repeated stopping and starting leads to significant degradation of the engine, therefore the CHP units have been restricted to no more than two starts per day to reflect good industry practice.

Three combinations of CHP engine sizes have been modelled around a combined thermal kW output rating that, based on previous projects, typically provide the best financial return. These options were modelled to identify the most advantageous configuration for each scheme. Where supply from the Energy from Waste (EfW) plant at Marsh Baron was modelled, this was alongside a range of three increasing sizes of single engines in a similar approach.

4.2 The Marsh Barton Energy from Waste Plant

The Marsh Barton energy from waste plant is currently under construction and is due to come into operation in 2014. The facility will consume 60,000 tonnes per annum of household waste from Exeter and the surrounding area. The plant is designed to produce some 3.5MW of electricity. The plant is “CHP ready” and is able to providing up to 8.5MW or 66GWh of heat per annum. The production of heat reduces electricity generation. However, the overall efficiency of EfW plant is of the order of 20% when producing electricity only but can rise to 50% or more when producing both electricity and heat. The planning consent for the EfW plant therefore requires “best endeavours” to market the energy.

Figure 4.2-1: Schematic of EfW connection to DH



The supply of heat from the EfW plant is based on the recovery of the “heat of evaporation” of steam which is otherwise rejected to atmosphere as a part of the electricity generation cycle. In order to extract heat at a suitable temperature the steam must be extracted before all the energy has been extracted for electricity – in this case at approximately 170°C. There is therefore a small loss of electrical output associated with heat extraction.

Data provided by the designers of the Exeter plant indicates that approximately 5MW of heat can be extracted with the loss of only 1 MW of electricity output. This makes the heat low carbon, with an approximately 55% reduction against gas boiler heat, and relatively low cost at around 1.1p/kWh against around 3.6p/kWh for gas boiler heat. These figures are based on an assessment of the cost and carbon content of the lost electrical generation and associated revenues (ignoring any incentive revenues). There are a range of calculation methods for assessment of the carbon content of the heat – alternatives include a detailed calculation of carbon in the waste with a split between electricity

generation and heat. The carbon emission figures used in this study are based on figures published in the assessment of new building performance for Building Regulations (SAP 2009⁴).

EfW plants are normally some distance from major centres of population and hence heat loads. In recognition of the potential benefits of EfW heat use the Government supports this source of heat through either the Renewable Obligation, based on electricity, or the Renewable Heat Incentive. Both these incentive regimes are due to change significantly in the next few years so there is currently some uncertainty in the industry as to how much this type of scheme would attract. For example figures for renewable heat incentive vary between 0.5 and 2.05p/kWh of heat supplied from EfW plant (based on 1.0p/kWh to 4.1p/kWh Renewable Heat Incentive levels (currently subject to consultation) and an assumed 50% renewable fraction in the waste stream). This range of RHI payments is evaluated in this study. The uncertainty should be resolved during the lifecycle of this project development enabling investment decisions to be made with more confidence.

This study has established a cost of heat and associated incentive revenues that may be available. In line with the overall study approach of establishing a gross value/benefit of an Energy Network, these figures have been used in the modelling of financial performance on the assumption that full incentive revenue benefit is allocated to the Energy Network. A commercial agreement will need to be struck for the supply of heat from the EfW plant to the Energy Network. The level of incentive revenue allocated to the Energy Network will be subject to commercial negotiation.

Full cycle performance data has not been available from the EfW plant developers during the course of this study. However, in our assessment, sufficient information has been received to allow reasonable, conservative assumptions to be made for the heat extraction capacity and efficiency. (although it should be noted that this is not sufficient for a heat supply agreement).

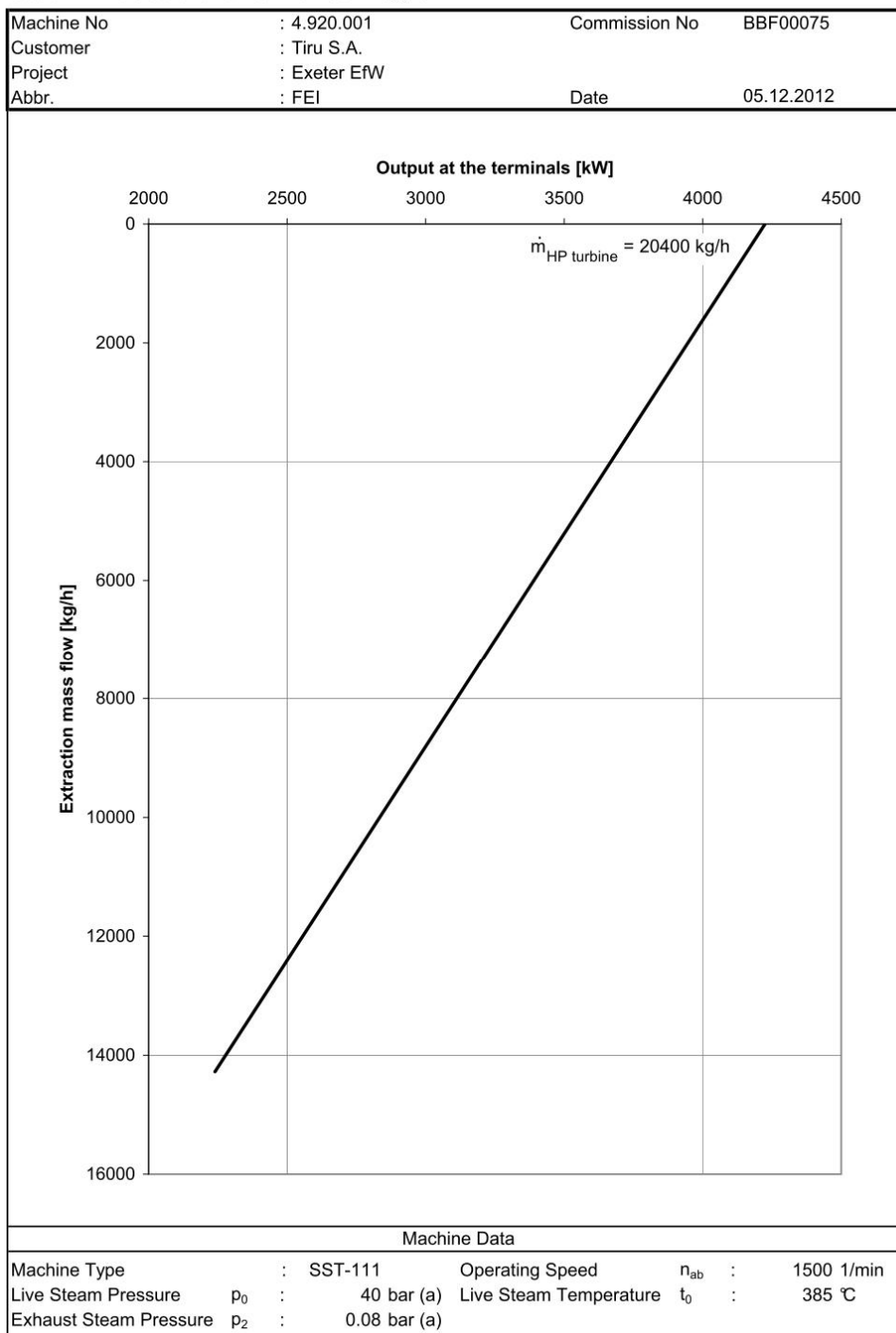
4.2.1 Calculation of Z Factor for EfW Plant

The steam turbine for the EfW plant is a Siemens SST-111. The EfW plant designers have provided a graph showing the relationship between steam extraction from the turbine and the gross electrical power output for a range of flows between 0 and 14Te/hr of steam.

⁴ SAP 2009 , The Government's Standard Assessment Procedure for Energy Rating of Dwellings - BRE March 2011

Figure 4.2-2 - Tiru Steam Extraction/Performance Diagram for ST-111 turbine

Steam Extraction/Performance Diagram



In order to calculate the Z factor the heat recovery from the steam was calculated over a range of extraction from 1.6 to 8.9 Te/hr. This is shown on the graph to relate to a reduction in electrical generation from 4 to 3 MWe (i.e. a reduction in output of 1MWe). In this calculation it is assumed that the condensate will be sub-cooled (i.e. the temperature of the condensate will be reduced before returning it to the steam cycle). The data and assumptions used in this calculation are shown below:

Table 4-1: Steam Extraction

Steam Extraction	
Pressure	3.9 bara
Temperature	171°C
Enthalpy	2796 kJ/kg

Table 4-2: Condensate Return

Condensate return	
Pressure	1.0 bara
Temperature	105°C
Enthalpy	335 kJ/kg

The heat contained in the steam extract is therefore:

$$2,796 - 335 = 2,461 \text{ kJ/kg.}$$

The graph provided by Siemens indicates that the extraction from the turbine would be approximately 2.05kg/s for a reduction in output of 1MWe. This equates to:

$$2.05 \times 2461 = 5,045 \text{ kW}$$

of heat extraction. The Z factor for this turbine is therefore approximately 5. This figure is in line with experience on other plants with steam extraction at similar pressures.

It should be noted that the revenue implications of heat extraction will also be impacted by other aspects of the overall power generation cycle including lower extract of steam for feed water preheating and a reduction in electrical load due to a reduction in heat rejection in the air cooled condensers. These impacts should tend to improve the overall Z factor. The developers of the EfW plant have not, however, been able to provide an overall process flow diagram or heat and mass balance showing the impact of these factors. We have therefore used a Z factor of 5 in this study as a conservative estimate for scheme selection. It is recommended that as the EfW plant is commissioned heat extraction trials are conducted in the presence of independent verification to establish the plant's actual performance. This data can then be used in a heat supply agreement.

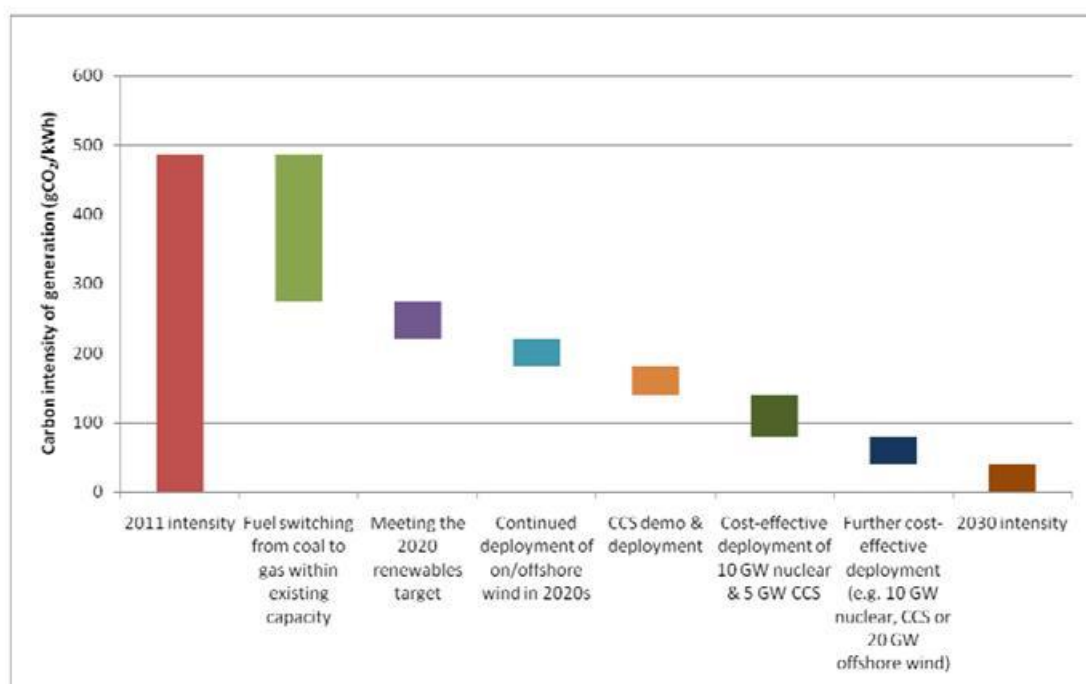
4.3 Impact of decarbonisation of electricity supply

Any assessment of the carbon reduction benefits of a district heating scheme must take into account the potential impacts of future changes in the carbon content of the utilities used. The Government has set out a route towards decarbonisation of the electricity generation sector and there are also incentives in place to reduce the carbon content of the gas network. There are however no specific decarbonisation targets in place and in the Energy Bill the Government is currently indicating that these targets will not be set until 2016.

Many of the discussions on decarbonisation of the economy focus almost exclusively on the electricity system. The Committee on Climate Change has indicated that they see a 50g/kWh carbon content of electricity by 2030 as a key marker on the route to the overall target of 80% reduction in national emissions by 2050. It also indicates that this target would need to be met while also meeting nearly 40% increase in electricity demands. This increase is driven by more use of electricity in transport and for heating using heat pumps.

Figure 4.3-1 shows that a switch from coal to gas fired generation is a key part of the transition. The Committee does not include an assessment of the impact of using gas fired CHP as part of this switch or of moving generation closer to demands and thus reducing losses in the electrical network both of which will add to the benefits.

Figure 4.3-1 - Climate Change Committee grid electricity carbon emissions



More recently the Government has published a heat strategy (March 2012) which sets out three strands for the decarbonisation of heat:

1. Low carbon heat networks (district heating) in urban areas
2. Renewable heat supply in rural areas (solar and biomass)
3. A more gradual switch to low carbon heat primarily from heat pumps in sub-urban areas.

Where there are concentrated heat loads and constraints on increasing electrical supply capacity, these should be served through heat networks. The strategy notes that:

“Heat networks are compatible with a wide range of heat supply options and provide a way to distribute low carbon heat, which makes them easily upgradeable, creating flexibility to make the transition to low carbon heat over time with less disruption for consumers and businesses. Most of the cost and disruption occurs at the point of initial construction and installation”

The heat network should be seen as an enabler of low carbon heat supply in dense areas where deployment of renewable and low carbon sources such as heat pumps, biomass and solar thermal is more challenging. Heat networks with thermal storage also provide a valuable service in allowing electrical generation to be more easily balanced with demand. This may be by allowing lower carbon gas fired generation to be maximised, by reducing losses in transmission and distribution network or by absorbing excess electrical output (e.g. wind power) at times of low demands.

The selection of the initial low carbon heat supply technology is therefore primarily driven by the need to develop the heat distribution network in an economically sustainable way. Gas fired CHP provides a low cost, low risk entry technology which will normally be replaced on a 15 year cycle. The existence of the network provides opportunities for connection of other, lower carbon technologies either as new loads are connected or when the initial plant is due for replacement. Current technologies or heat sources that can be considered as and when the economics and demands allow include:

- Heat from the Energy from Waste plant at Grace Road – as carbon costs increase and electrical grid carbon emission decrease this source will become progressively more economic and desirable.
- Other renewable fuel boilers e.g. biomass, bio-oils or bio-gas – the future market and sources of these fuels is subject to a great deal of uncertainty at present. As technologies such as oils from algae and biogas from waste treatment develop these may become attractive sources of low carbon fuel.
- Heat pumps using waste heat from, for example, industry or large air-conditioning plants (such as in data centres or food production). This technique is used on a small scale within many commercial developments – effectively moving heat from areas which need cooling due to large heat gains to those which need heating.

In all these cases it is the heat network which allows more efficient use of resources, whether new or recycled, and provides access to a heat market for low carbon supplies which could not otherwise be used.

5 OUTLINE SCHEME DESIGNS

5.1 Energy Centre Locations

5.1.1 Locations assessed

The potential Energy Centre locations mentioned in the project brief (ITT) were:

- St Luke's University Campus
- Wonford Hospital

Exeter City Council, during the initial stakeholder meetings identified:

- Bus Station Redevelopment - subject to development agreement
- Triangle Car Park
- Clifton Sports Centre

BT also offered their Exchange in the city centre as a potential energy centre location

Within the Royal Devon and Exeter Hospital Trust Estate the former energy centre at Wonford was identified as a viable location. Heavitree Hospital was also discussed.

5.1.2 Locations excluded early

St Luke's

On review of the site plans and schedule of boiler plant it was apparent that the existing buildings at St Luke's did not offer a suitable plant room with the access and available space necessary to accommodate a larger energy centre. The site is heated through individual plant rooms in each building. Space could be found within the less densely developed southern part of the site comprising car parking and College House areas. However, there are medium to long term plans to reconfigure the current building stock which makes the location of an energy centre questionable at the present time. This situation could be revisited at some time in the future subject to a more detailed understanding of the proposals at that stage.

Clifton Sports Centre

In the context of the Triangle Car Park site being identified as a possible site, the Clifton Sports Centre site was excluded on the basis of distance from the demand and likely network routes.

Heavitree Hospital

As this site has an existing energy centre serving the majority of heat demand through a steam network it is an obvious contender for an Energy Centre. However, early on in discussions with the RD&E Hospital Trust it was established that the future of this site is uncertain so basing an outline scheme design on a potential energy centre on this site would not be sensible. This does not exclude the site as a future potential energy centre location dependant on the Trust's ultimate decision on the future of the Heavitree site.

Bus Station Redevelopment

Land Securities, developer of the bus station redevelopment site, expressed concerns at the initial stakeholder meeting over the viability of accommodating a heat network energy centre within the development. The developer's consultant confirmed that initial servicing plans did involve a plant room for the whole development located to the north east of the site but that the demand this would be serving would be a combination of power and cooling with a relatively low heat load. Land Securities also expressed concerns over the viability of the wider development with a large area of developable land removed for this use.

Exeter City Council confirmed that the possibility of accommodating an energy centre for a City Centre Energy Network was within the development brief and that the development agreement was not yet complete leaving the opportunity open to include a requirement to provide space for an energy centre within the agreement.

Land Securities agreed to review an indicative plant room layout for City Centre network plant to assess the viability of accommodating this alongside the plant room currently proposed.

Accommodation of energy centres to serve larger energy networks (beyond the site boundary) is a common aspiration which has to stand the test of viability within a development brief and will, ultimately, be a commercial decision based on a number of other demands on the development site for which the local authority holds an aspiration.

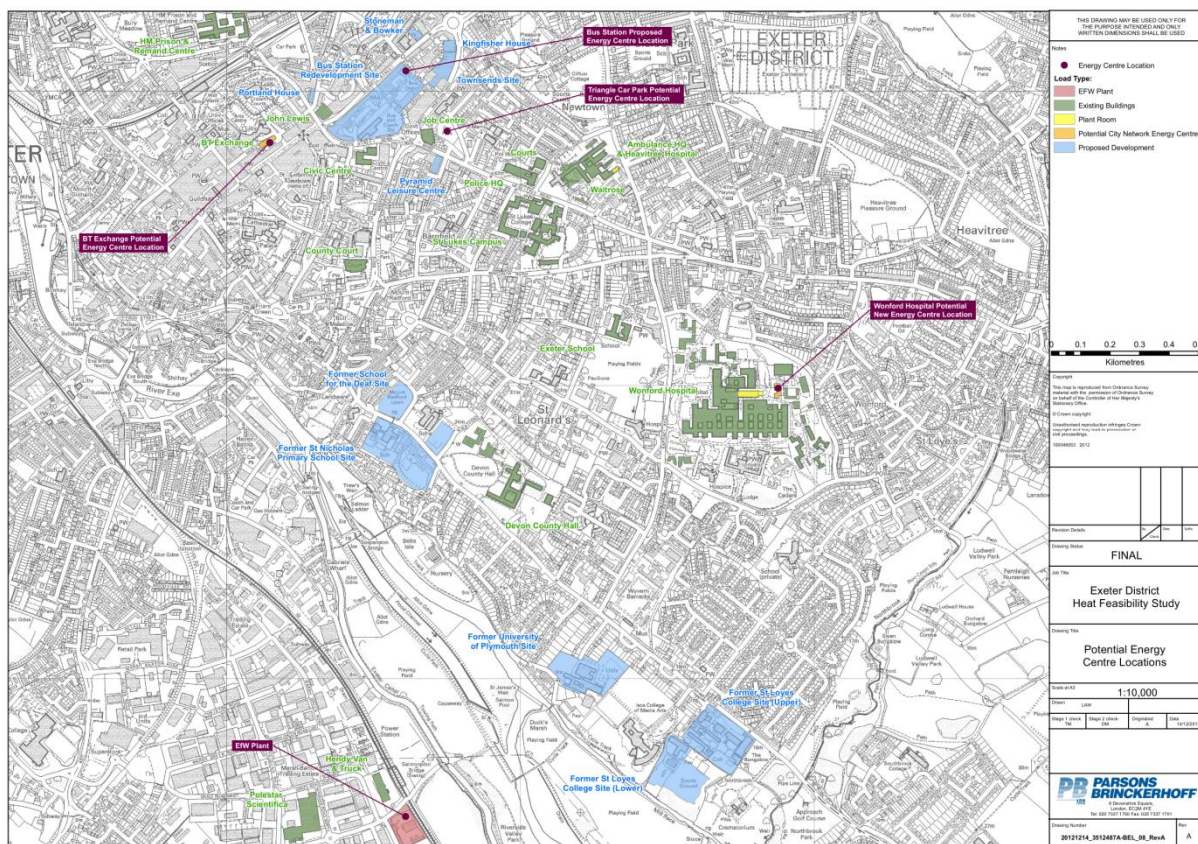
On this basis the Bus Station redevelopment site was excluded as a potential energy Centre location for the purposes of this study with the Triangle Car Park and BT Exchange being useful proxies for an energy centre site which was located a suitable, short distance away from the centre of demand identified in the heat mapping.

5.1.3 Locations selected for modelling

- BT Exchange
- Wonford Hospital
- Triangle Car Park
- Grace Road Energy from Waste plant and adjacent proposed waste transfer station

5.2 Energy Centre Feasibility

Figure 5.2-1 - Energy Centre Locations selected for modelling



The rationale for the sites selected is set out below.

5.2.1 BT Exchange

- Existing building
- Utilities - already in place
- Significant onsite electrical demand
- Central location in City
- Limited space available
- At end of network route

5.2.2 Wonford Hospital -former energy centre

- Existing building
- Utilities - already in place
- Largest electrical demand
- At point of most significant heat demand
- Opportunity to also serve a steam demand for the laundry
- Asbestos removal required
- Potentially competing uses in the Estates Strategy

5.2.3 Triangle Car Park

- City Centre proximity
- Between Sidwell St and Heavitree/St Luke's
- Well located to serve phased network development extending from St Luke's/Heavitree to Sidwell St later
- Good access
- Residential proximity
- Sloping site in a local topographical low point
- High rise hotel, offices and modern religious centre on other boundaries

5.2.4 EfW and transfer station

- space for auxiliary plant necessary for Marsh Barton network
- waste transfer station adjacent offered for further plant
- limited space on site itself for more than required heat take off plant

5.3 Network Constraints

5.3.1 Relief

The topography of an area proposed to be served by a district heat network has an impact on the pressure of the water in the system and therefore needs to be included in any assessment of network pipe sizes and other infrastructure (such as pumping).

Table 5-1: Height above sea level of key sites

Location	Height above sea level [m]
Energy from Waste plant	5m
Exe crossing	5-10m below
Wonford Hospital	40m
St Luke's	45-50m
Heavitree (Energy Centre)	55m
Bus Station redevelopment	45m
John Lewis	50m

5.3.2 Utilities

Utility network maps were reviewed for the three major utilities, gas, electricity and water and sewage. No significant barriers to implementation of the network routes were identified. Some areas of significant infrastructure that needs to be considered during detailed design were noted. The full review with associated mapping outputs is presented at Appendix B.

5.3.3 Sites of Archaeological or Historic Importance

A review of the sites of Historic or Archaeological importance provided by the City Council was conducted. This identified that the proposed outline strategic routes did not conflict with any significant sites but that further detailed assessment would need to be made at design stage to ensure no impact on the City Passages or Wall when considering routes to serve the Bus Station Redevelopment site, John Lewis and any potential connection to the BT Exchange.

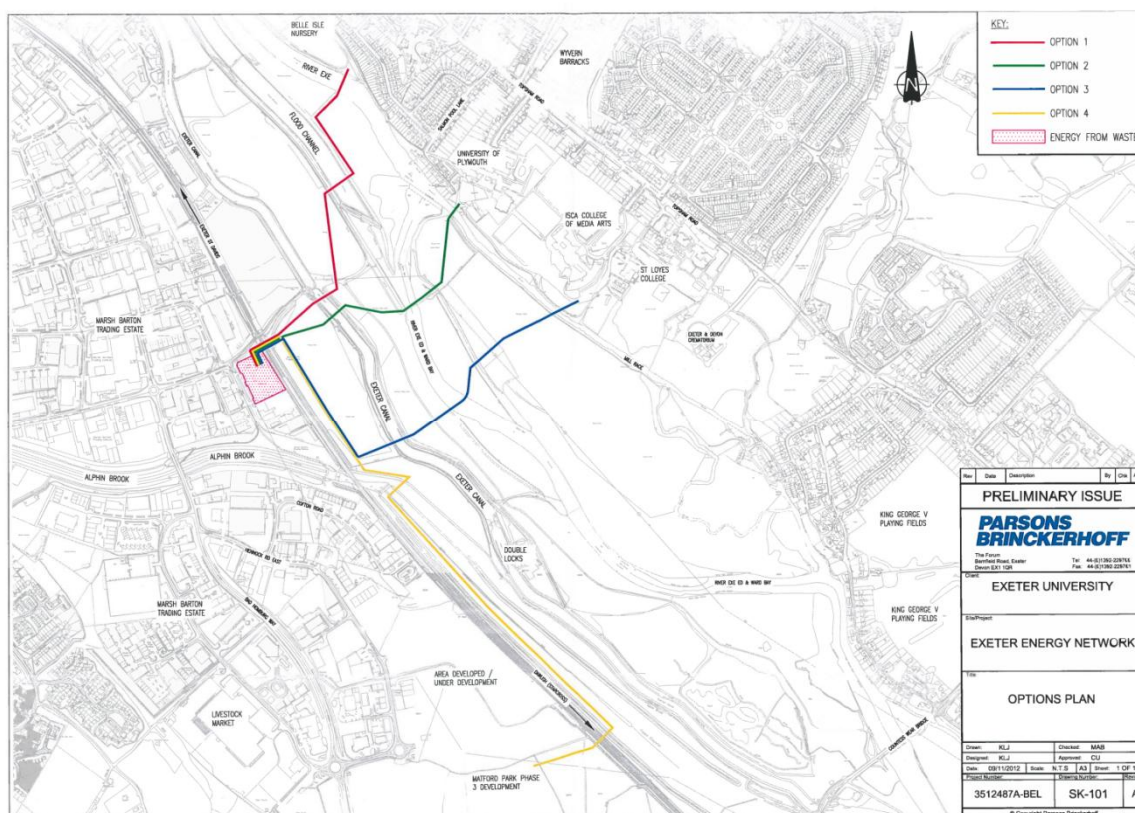
5.3.4 Ordnance

As a result of a brief Archaeological and Heritage review, it was noted that Exeter is a 'problem city' in terms of installation of buried utilities (such as a district heat network) due to the risk of unexploded ordnance from the Blitz being disturbed during excavation.

5.3.5 Exe Crossing Feasibility Study Conclusions

A parallel study has been performed alongside this feasibility study to investigate the technical feasibility and provide a budget cost estimate for installing heat network pipes across the River Exe. The crossing was found to be feasible and costs were presented for three crossing routes, and an additional route that runs directly to the Matford Park Phase III development along the eastern side of the rail line.

Figure 5.3-1 - Exe Crossing feasibility study route options map



Two options are presented for each route using either underground thrust boring or pipe bridging to cross each obstacle. Pipe bridging is the lowest cost solution but carries a greater technical and implementation risk. Thrust boring which routes the heat network pipes under all obstacles, presents a lower risk option but with a little over half a million more in capital costs for each route. Exeter City Council's conditions for bridging over the canal result in pipe bridging being an unviable for that crossing. Exeter City Council has also indicated that pipe bridging would be unlikely to receive planning approval, except over the railway.

Table 5-2: Exe Crossing Study results - ranked by cost

Ranked	Option	Pipe Bridges* (£m)	Thrust Boring** (£m)	Length (km)
1	Route Option 2	3.15	3.77	0.77
2	Route Option 1	3.19	3.92	0.96
3	Route Option 3	3.70	3.99	1.16
* With exception of thrust boring at canal, conventional cut and cover across the flood relief channel and installation of new pipe bridges only. ** With exception of conventional cut and cover across the flood relief channel.				
N/A	Route Option 4	3.50	4.10	1.73

The study concludes that all routes considered are technically viable. Thrust boring is recommended over the lower cost pipe bridges option and Route Option 2 is recommended as the lowest cost route. However, it is only some £200,000 less than thrust boring Route Option 3 (the highest cost route assessed). The benefits of Route Option 3, particularly simpler routing into Wonford Hospital and the opportunities that routing through the Burnthouse Lane housing estate may provide, have been discussed at section 3.7.1 and are again at section 5.4.3.

For the purposes of this feasibility study, the recommended Route Option 2 from the Exe Crossing Study has been used in the network routing options and the lower risk option, of thrust boring has been included in the capital costs of the network.

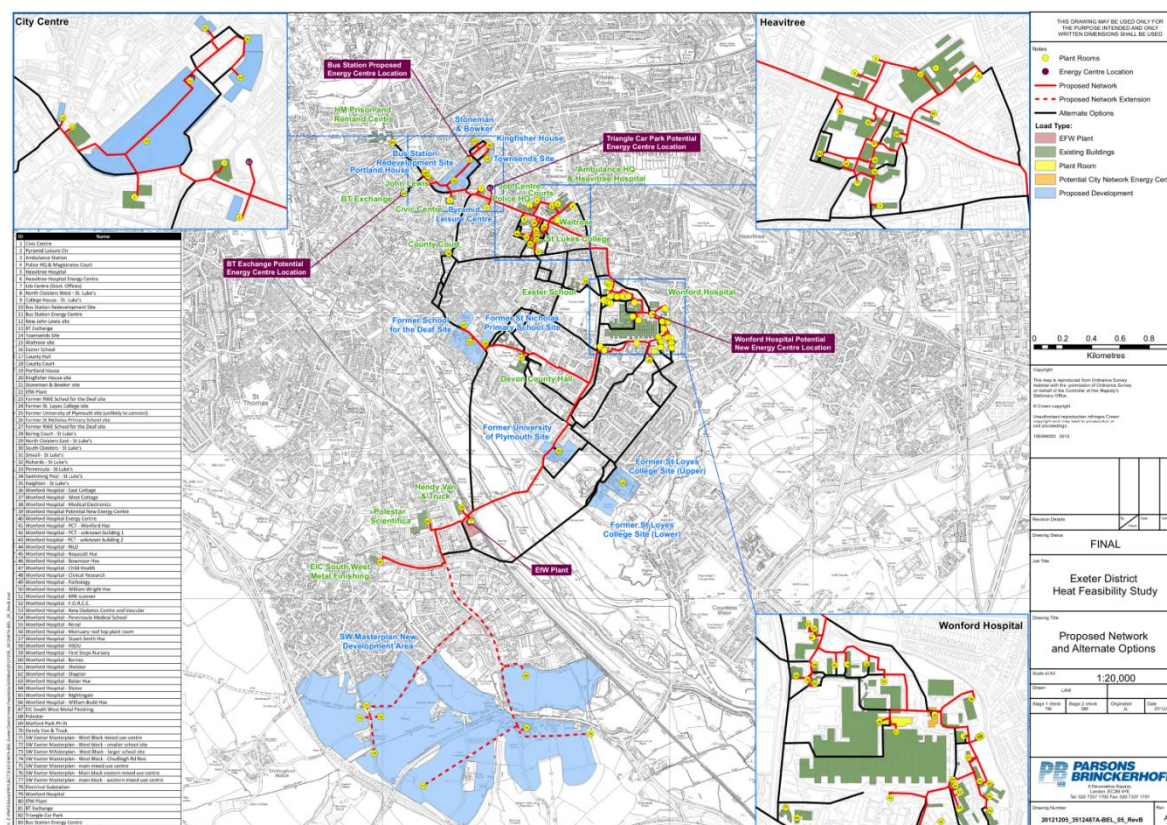
There are proposals for a new railway halt adjacent to the Energy from Waste plant incorporating a footbridge over the line. There may be an opportunity to reduce the cost of the rail crossing by combining a pipe bridge with this proposed footbridge.

In reviewing the Exe Crossing Study, alternative drilling approaches have been suggested by members of the Steering Group. Quotes have been supplied for Directional Drilling and case studies presented for previous district heating network installations using this approach. On the basis of these further discussions and quotes supplied we have estimated a total cost saving, versus the Option 2 Pipe Jacking approach, of approximately £1,000,000. These calculations are presented at Appendix I. The impact of such a saving is discussed in the conclusions of the assessment of the 'Whole Network' scheme at section 11.8.

5.4 Strategic Route considerations arising from Exe Crossing

For any scheme that includes a link from the Energy from Waste Plant, the decision on routing across the Exe and therefore the resulting 'landing point' on the northern side of the river valley has significant implications for the overall routing strategy.

Figure 5.4-1 - Route Alternatives



[Alternate route options in black]

5.4.1 Exe Crossing Route Option 1

This option provides a more direct route to the City Centre, avoiding some of the major roads in the Wonford and Heavitree area, serving County Hall, development sites at St Nicholas Primary and the Former Royal School for Deaf Education and taking in the Crown and County Court Complex on the way to the Bus Station Redevelopment and City Centre. However, there is very little other heat demand (as identified under this study) on the route making it very unlikely to be viable.

This study has not established heat demand estimates for either of the development sites. Data from the Courts Service was not received in time to include in the assessment. As a result the viability of this route is not able to be formally assessed.

5.4.2 Exe Crossing Route Option 2

This is the most obvious and direct route to deliver low carbon heat supply direct to the most significant consumer, the Wonford Hospital. However, this route results in the need for a connection to be installed along Barrack Road, a major utility corridor and strategic road network route.

The only sensible alternative to routing along Barrack Road is to cross the Wyvern Barracks site. No contact was made with Defence Estates but anecdotal evidence is that this is a training barracks, not occupied full time and therefore represents a relatively small potential demand. Therefore there is little advantage to routing via this site in terms of achieving increased total load connected to the network.

Given the central location and anecdotally light use of the barracks there must also be a risk that it could come forward for redevelopment. At least it will be a consideration of the land agents at Defence Estates. It can therefore be expected that potential sterilisation of the site will be high up the list of concerns of the landowner. These routes have therefore been documented as alternates worth investigating should further assessment identify significant barriers to routing along Barrack Road.

Although an alternate route has been identified, the most efficient route to Barrack Road involves using a residential road that has not yet been built or adopted (within the Earl Richards Road North Site). The developers of this site engaged with the study but were clear that they have no condition to consider or allow for a heat network connection and would deliver the development without such. This does not, therefore, provide a useful heat load along the route to add to its economic viability.

The alternate route (noted above) would provide the opportunity to offer a connection to the ISCA College. However, the value of this connection (to the network) cannot be established as this opportunity was identified relatively late in the programme and no meaningful contact was achieved in the time available.

There is no feasible route directly out of the western side of Wonford Hospital onto Barrack Road. As a result the routing strategy is to go round the Wonford site to the east to connect first to the Energy Centre and then loop north and west. This means that only a relatively short section of Barrack Road must be used. This section is wide with bus lanes and large verges in places.

Once at the hospital the route cuts through the car park and runs the long way round along the circulating road around the main hospital building. This route has been provided to the Trust for comment and no significant issues have been raised except for a general caveat around sterilising areas of the site for future development which would need to be dealt with during detailed design. The two buildings on the corner here (F.O.R.C.E and Bowmore House) provide only small heat demands so, in themselves, are not the reason for routing through this area. The location of these buildings was not a factor in the routing.

Routing around the site in this way, avoids a significant section of Barrack Road which is an advantage in itself. However, there is also very little load accessible at Wonford from this section, except at the very northern end, where any route serving the Wonford Energy Centre would have to run anyway.

As discussed at 5.5.1 below, County Hall is a long way off this direct route and therefore is best served by a separate section of network running west off the main route to Wonford Hospital. As also discussed, there is a question over the scale of load to be served at County Hall and therefore this route does not best serve County Hall, in terms of providing a viable connection (where a strategic route that ran much closer to the County Hall site would).

5.4.3 Exe Crossing Route Option 3

The eastern EfW link route provides the opportunity to offer viable connections to the Former St Loye's College site and to ISCA College. The lack of engagement with ISCA College has already been discussed. Although identified at the outset, the study achieved a similarly poor level of engagement with the developers of the St Loye's College sites. Accommodation schedules, but no energy demand forecast information, are available from the planning register. Benchmark data can be used to establish a demand estimate. This could provide an assessment of the potential benefit to the network routing in this direction to compare against the likely greater capital expenditure required for this longer route to Wonford Hospital.

The main benefit of this strategic route option would be the economic and social benefits of potentially providing a low cost, low carbon heat supply to the Burnthouse Lane estate. Connections to low rise, relatively low density, housing such as that which predominates on Burnthouse Lane estate are not normally commercially deliverable without significant grant funding. Funding schemes such as the Energy Company Obligation can be used by social landlords to deliver energy efficiency and carbon reduction schemes. This estate could also be connected to the scheme in future phases even if this route option is not adopted. The applications for funding may be made easier once the DH scheme is in place and operational.

A final consideration providing a further case for the benefits of this route over the central link route discussed above is that it results in a much more favourable entry point into the Wonford Hospital Estate. This part of the estate is less developed, and as such has significant areas of grass that provide the opportunity to 'soft dig' reducing the network installation costs. This is also a much more direct route to the Hospital Energy Centre requiring much shorter lengths of network to be installed on the Wonford site.

This part of the route (from/to Wonford Hospital) could be utilised independently even if Exe Crossing Route 2 were selected, as an additional branch of network, perhaps implemented later, serving the Burnt House Lane Estate.

5.4.4 Exe Crossing Route Option 4

In running a route south east from the EfW plant before crossing the Exe there is an opportunity to serve the Matford Park Phase III development and then on to the SW Exeter Masterplan area beyond. Indeed there is allowance for this route within the planning conditions on the Matford Park development. This route avoids public highways in Matford which has a benefit in terms of disruption, and risks and costs of installation.

The Exe Crossing Feasibility study assessed this route as Route Option 4 and established a much greater cost of implementation than would be required for a route along public highways.

There is a feasible route through Marsh Barton which involves 'soft digging' along the embankment of Grace Rd which is also relatively low impact in terms of disruption, and risks and costs of installation. This route would retain the benefit of the ability to supply existing industry. This is the route that was selected for the modelling.

5.5 Other significant routing considerations

5.5.1 Barrack Road to County Hall

County Hall is represented on the heat map with a larger demand than may realistically be served by a district heat network, at least for the first 10-15 years of any proposed district heat network. There is a recently installed biomass boiler which, once clear of an initial period operation issues should provide a significant portion of base load for the site.

Three parallel routes to provide this connection have been established. There is little difference in these routes for the purposes of this study and therefore they have been documented to the level of detail that they have been reviewed but one has been selected as a proxy for this route. The existence of viable alternates simply provides confidence that a feasible route can be found.

5.5.2 Wonford to St Luke's

There was some discussion and interest within the Steering Group of the potential to cross the grounds of Exeter School in order to facilitate an extended section of 'soft dig' reducing the cost of installation of the network, taking in a further significant load on the way and providing a more direct route between the Wonford Hospital and the next load along the line, St Luke's.

All are valid benefits of this route but no further assessment was made since engagement with the school was not established.

5.5.3 Through St Luke's

The St Luke's Campus offers a potential route that provides further avoidance of public highways for the network. However, this route is entirely dependent on a viable route being identified through Exeter School as discussed above at 5.5.2.

The option was discussed with the University and routes around the perimeter of the St Luke's Campus offered in principle. However, these were taken no further given the combination of no feasible route being established out of Wonford Hospital onto Barrack Road adjacent Exeter School and the lack of engagement with the school itself resulting in the only strategic route option being to follow the public highway from Wonford Hospital to St Luke's.

5.5.4 Sidwell Street

Given the proposed redevelopment of the bus station site along Sidwell Street, there is no obvious reason to investigate a heat network route along Sidwell Street itself. Land Securities have indicated that a heat network, for the purposes of the site alone, is part of their current outline design thinking. This development represents 60% of the heat demand in the area as shown in Figure 3-3.1

There will therefore, only be the northern side of Sidwell Street to provide potential windfall connections of existing or new development sites. This means that a Sidwell Street pipe route would have very little demand along it. The resulting route options are either through or along the southern boundaries of the bus station redevelopment.

Routing through the bus station site would be the most efficient but is dependant on commercial arrangements, masterplan, sterilisation of the site for future masterplan changes in line with market changes and phasing of the development in terms of its correlation, or otherwise, with the proposed and then actual installation programme for any proposed City Centre heat network.

The network modelled indicates a route through (within the boundary of) the bus station redevelopment site but alternatives around it have been documented and do not result in significantly longer routes.

5.5.5 Exeter Prison and on to the University of Exeter Streatham Campus

Although the data was provided too late to be included in our assessment, the Ministry of Justice did provide a plant schedule and energy consumption figures for Exeter Prison. These showed a significant demand available to potentially be served by a relatively short (approximately 600m from John Lewis to the prison main plant room) extension of a city centre network albeit needing to cross over the railway line at New North Road.

Once at Exeter Prison, it is approximately a further kilometre to run a network connection to the centre of the University of Exeter Streatham Campus. As plans for the development of a network progress these opportunities merit further investigation.

6 NETWORK DEVELOPMENT OPTIONS

6.1 Phasing of network installation

The majority of the loads assessed under this study are existing buildings and the majority of those in public sector control. This means that there are fewer commercial barriers to the implementation of a district heat network. Buildings and developments under private sector control hold an inherently higher risk that commercial arrangements will not be agreed and no connection will be made.

For new development network infrastructure installation needs to be phased in line with the development programme. For existing buildings a decision needs to be made when to implement the network and make connections to begin supplying heat from the Energy Network.

There are a number of options to phasing the implementation of the Exeter Energy Network based around concentrations of existing buildings or in line with likely phasing of new development. These options then establish the variants that need to be modelled to inform decisions on network development strategy.

6.1.1 Public sector led

Since existing public sector buildings provide much less commercial risk there is a benefit to connecting these sites first. Wonford Hospital and the Heavitree and St Luke's cluster provide this concentration of public sector buildings and would provide a starting point for the implementation of a City wide network, with relatively low commercial risk.

Wonford Hospital provides the largest demand and a possible location for a city wide network energy centre. Starting the implementation of a network here would avoid the abortive costs involved in serving the St Luke's and Heavitree area with an energy centre which may become obsolete once a larger energy centre is provided at Wonford Hospital.

The Sidwell Street standalone network is the only network modelled that is not public sector led.

6.1.2 St Luke's extending to Sidwell St

The heat map, presented at Figure 3.3-1 shows that the heat demand within the Sidwell Street cluster is almost exclusively made up of new development with the majority provided by the Bus Station Redevelopment site.

The phasing dates used for this Bus Station were provided, as an estimate, by the City Council. This development has not yet applied for planning permission and the development agreement between the developer and the land owner (the City Council) has not been agreed. Therefore there is considerable chance that these dates will change. Indeed, any property development can be subject to delays (and sometimes advances) to phasing programmes in line with market conditions.

There are only four, relatively small, existing loads identified in this area, one of which (the Pyramids Pool) has an uncertain future, with a replacement potentially coming forward as part of the bus station

redevelopment. So, the Sidwell Street area heat network is dependant on new development and as such represents significant risk of loads materialising.

The St Luke's and Heavitree cluster on the other hand is exclusively made up of existing developments; Although, the uncertainty over the future of the Heavitree site does provide a level of risk to the future energy demands in this area as well.

An energy centre located between these two clusters of head demand, could initially serve the existing buildings in Heavitree and St Luke's and then extend to the Sidwell Street area, as development comes forward there.

This scenario also offers a public sector building led approach (similar to that outlined above in section 6.1.1) but requires construction and provision of an energy centre at the Triangle Car Park which may not be required once Wonford Hospital connected.

6.1.3 Timing of a connection to County Hall

County Hall is potentially a relatively small load at the end of quite a long connection (for the load served). With a biomass boiler recently installed, the potential demand for low carbon heat through a heat network connection may be limited. The link to County Hall has therefore been assessed as a variant.

There are some proposed developments adjacent to the County Hall site which would add to the demand served in this area and may turn an unviable link, viable. There is an implementation phasing option worth considering that involves only connecting County Hall to the network as the new developments adjacent come forward and provide a viable level of demand.

6.1.4 Timing of the EfW connection

The EfW plant is under construction and therefore there is certainty on the likely timing of availability of heat from the plant. A supply to Wonford from the EfW plant is reliant on a connection across the Exe being constructed. This connection also carries greater construction and planning risk than a highway routed network. It is therefore quite likely that some network could/would be implemented in the City Centre prior to a connection from the Energy from Waste plant having been established. A parallel or alternative option (not evaluated in this study) would be for the heat from the EfW plant to be taken south to Marsh Barton, Matford Phase 3 and SW Exeter before the Exe crossing is pursued.

The eventual timing of connections to the EfW plant and the loads to be served initially will be dependant on a number of factors. It is also desirable to make these decisions once there is more clarity on the final plant performance and eligibility for, and level of, low carbon heat incentives. This choice will be strongly influenced by the release of the "best endeavours" planning condition, the Matford Phase 3 planning conditions, the pace at which the SW Exeter development comes forward and the need to deploy the £1m of Regional Growth Fund grant available within the time constraints attached to this funding and is therefore clearly an operational priority for Stakeholders.

6.1.5 Marsh Barton Network implemented alongside new development

Similar to the Sidwell Street cluster, the majority of the load around Marsh Barton is provided by new development although there are some existing loads identified in this study around the Energy from Waste plant.

The wider sections of potential network serving Matford Park Phase III (which has planning conditions relating to DH), and the SW Exeter Masterplan area would only come forward in line with the phasing of those developments. It may be that connections to the existing industrial sites around the Energy from Waste plant could be delayed to be constructed alongside the connection to the SW Exeter Masterplan area.

6.2 Future potential extensions

It has been noted during the course of the study that there are a number of potential future extensions of an Exeter DH scheme which could be considered. The main of these are:

- Exeter Prison
- If the prison connection across the railway is viable then consideration could be given to connection to the main University Streatham Campus
- New developments planned for Water Lane and developments on the Quay
- Interconnection to the new Monkerton developments

These future opportunities should only be considered once the core of the network has actually started in development. Trying to include too large an expansion in initial stages is a key factor in stalling DH schemes as complexities and management issues become too great.

It is recommended that the connection of individual homes in Burnthouse Lane is studied when;

- it is clear that heat mains will be routed through this area (to or from Wonford);
- the funding support available for domestic district heating under the Green Deal and ECO is fully understood; and
- to what extent Green Deal and ECO funding applies in this part of Exeter.

7 MODELLING ASSUMPTIONS

Economic modelling requires capital and operating costs and associated assumptions about income to enable the viability of scheme options to be assessed on a whole life-cost basis. For each of the various options, the economic model uses discounted cashflow analysis to calculate the whole life cost economic value (net present value or NPV) and return on investment (internal rate of return or IRR).

7.1 Carbon Dioxide Emissions

7.1.1 Emissions Factors

The carbon emissions for each scheme option have been assessed using the following carbon factors:

Table 7-1: Carbon Emission Factors

Utility	Emissions Factor kgCO ₂ /kWh	Source/Basis
Gas (Wonford)	0.198	SAP 2009
Gas & Oil (BAU whole network)	0.200	combined BAU average (including oil emissions) from SAP 2009
Heat from Energy from Waste	0.040	SAP 2009
Industrial Electricity Import	0.517	SAP 2009
Wholesale Electricity Export	0.529	SAP 2009

7.1.2 Emissions Calculations

In the business as usual case, the emissions associated with supplying heat have been calculated on the basis of the gas burnt by the boilers in each building.

In the District Heat schemes options the emissions associated with supplying heat have been calculated on the basis of the gas burnt in the CHP engines and auxiliary boilers. Since CHP engines also generate electricity, the gas burnt (and associated emissions) could also be attributed to the electricity generated.

Emissions associated with electricity consumption have been included in calculations where the generation from CHP engines serves this demand and therefore offsets electricity import. This is the case with the consumption at the BT Exchange (for the Sidwell St option) and at Wonford Hospital (for both the Wonford and City Centre Scheme and the Whole Network Scheme).

Where electricity is supplied onsite, this displaces the need to import electricity and therefore a significant saving in emissions can be attributed to the supply. The business as usual case accounts

for emissions at the power stations supplying the electricity demand. The CHP options also account for emissions at the power station taking into account the reduction in generation at the power stations as a result of both offset of onsite demand and due to electricity export to the grid. The calculations presented below attribute all savings to heat supply.

The calculation of actual emissions savings is dependent on the methodology being used as set by the body assessing the emissions. Individual connecting customers will need to consider carefully how their reporting and accounting for carbon emissions will be affected by a connection to a district heat network.

7.2 Business as Usual and Technology Options Operating Costs

It is important to understand existing energy strategy and investment plans for each stakeholder so that any existing budget allocation for energy infrastructure investment can be captured and included in the business as usual (BAU) case. The BAU case operating costs have been calculated for each option. Operating costs included in the base case include:

- Utility tariffs
- Cost of carbon
- Maintenance costs
- Boiler plant replacement (annualised set aside fund)
- For new developments not yet in construction only – cost of on-site boiler house/energy centre plus low carbon plant (gas fired CHP)

In order to assess the economic performance of each scheme variant a set of economic parameters need to be established. This section sets out the costs values which remain constant across all the schemes modelled.

Operating costs have been calculated using data provided in response to the RFI's issued, published utility tariff data, government low carbon support tariffs and maintenance cost information. Replacement costs for plant items have been included in a replacement schedule throughout the project life.

7.2.1 Energy Tariffs

The following cost inputs were used to calculate the annual operating costs for the BAU case and the modelled heat network heat generation plant options.

Table 7-2: Energy Tariff cost inputs

Utility	Tariff [p/kWh]	Source/Basis
Gas (Wonford)	2.68	latest month's Wonford fuel only tariff incl CCL
Gas (BAU all sites)	2.90	amalgamated average for all sites based on RFI responses
Heat from Energy from Waste	1.10	estimated cost of supply
Industrial Electricity Import	8.40	midpoint of latest Wonford day/night energy only tariff incl CCL
Wholesale Electricity Export	5.00	current market benchmark tariff
Oil	7.00	Exeter City Council & Wonford Hospital latest rate

The industrial electricity import tariff is used in calculating the value of electricity generated by CHP engines installed at Wonford Hospital and used within the Wonford site. The wholesale export tariff is used to establish the revenue generated by any electricity exported to the national grid (when demand on the Wonford site is not available to meet the supply).

7.2.2 Cost of Carbon

The cost of carbon in the Carbon Reduction Commitment (CRC) is currently £12 per tonne and this has been included, in the energy tariffs that note the inclusion of CCL in Table 7-2 above. In the April 2011 budget the Chancellor announced a £16 a tonne carbon floor price, starting in 2013 and rising to £30 per tonne in 2020. There is a degree of uncertainty about the implementation of these floor prices. but if they are implemented the value of the carbon savings will increase proportionally.

7.2.3 Maintenance and Replacement Costs

The following gas boiler maintenance rates were used in calculating the base, BAU case:

Table 7-3: Annual maintenance costs used in BAU case

Individual Boiler Capacity [kWth]	Annual maintenance per boiler (£)
0-100	150
151-300	350
301-500	550
501-1000	850
1001-2000	1,250
>2001	2,000

Replacement costs were calculated on the basis of £25/kW at 25 years old. Where the boiler age was unknown it was assumed to be five years old.

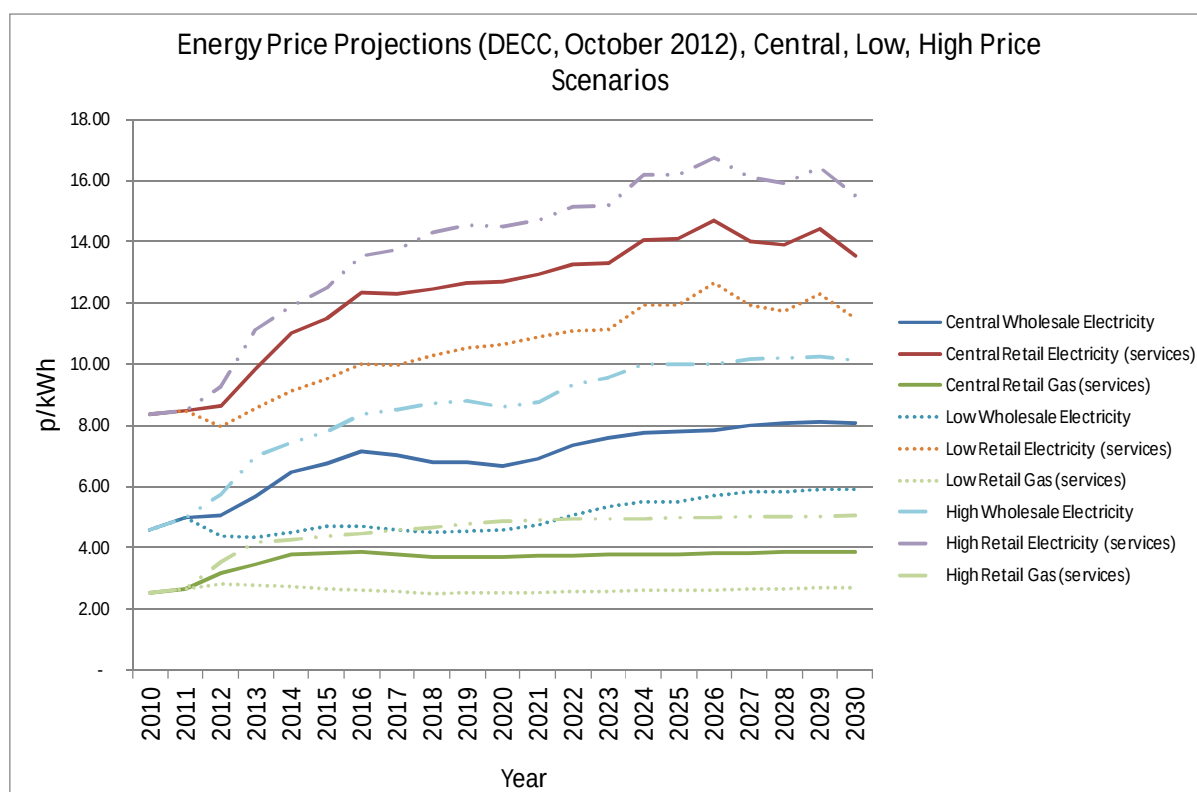
7.3 Future Prices Scenarios

The DECC forward projections (October 2012) of energy prices have been used to analyse the sensitivity of the NPV results to energy prices.

The key energy streams that are utilised in modelling of options are the prices of electricity (wholesale and retail), and retail gas prices. The retail prices for electricity and gas are used as the basis for the projection of gas costs for energy centre plant operation and power import. The wholesale electricity price is used as a basis for valuing electricity export.

The low, central, and high scenarios for these three utility streams are displayed below. Note that tables showing the contributing data for Figure 7-1 are presented in Appendix H.

Figure 7-1: Energy price projections graph



This figure illustrates that under all scenarios there is a general upward trend anticipated in energy prices. This upward movement is likely to favour CHP installations, as the differential between gas and electricity prices is generally increasing. It is the differential between gas and electricity prices that drives the profitability of gas-fired CHP, and hence these price trends should help CHP to emerge.

Section 13 provides a sensitivity analysis of the impact of variation of energy prices in line with these scenarios

7.4 Capital Costs

An indicative cost for the energy plant, district heating network and energy centre building has been produced for each option. The capital costs for the project have been calculated using quotations from suppliers where available and cost estimation benchmarks where quotations are not possible. It has been assumed that the delivery organisation for the district energy scheme would pay all of the costs required to sell heat to existing buildings. Costs are broken down under elemental headings for buildings works, generation plant, flues, ventilation, thermal storage tanks etc. and incoming utility connections.

Existing buildings would pay an annual availability charge, to cover interface maintenance, and a unitised tariff for their heat. The cost of network within new residential and non-residential buildings is not covered in the capital cost make up. It is assumed that the district heating network would provide a connection to new developments; however developers would need to pay for the connection from this point to the individual buildings. They would also need to fund the cost of the district heating interface unit to allow the network to supply the building. These costs are broadly equivalent to the utility connection and heating plant costs that would otherwise be paid by the developer. A summary of the capex for each scheme is provided in the financial assessment section of the individual scheme.

7.5 Connection Charges

7.5.1 Calculating the benefit to new development of connecting to a District Heat Network

The majority of new developments will be required to implement a low carbon energy design by either planning requirements or increasingly stringent building regulations. At present the requirements for town planning tend to be more onerous. In many cases these planning requirements lead development to implement low carbon energy supply systems as well as energy efficiency measures. Where this is the case developments can often benefit from lower costs of provision of this low carbon energy supply by connection to a district heating network.

Typically the tariff for a new development connected to a DH network will include three elements. These are a one off connection charge, an annual availability charge and an energy charge.

One challenge in setting these tariffs is that there is generally a big difference in the cost base between a DH solution and an on-site low carbon energy solution. Typically the DH solution will have higher capital costs and lower operating and energy costs than the on-site solution.

A further challenge is that the costs for the development of the on-site solution will normally fall on different parties. The capital costs will be met by the developer- who is incentivised to minimise these costs potentially at the expense of life time costs. Operating costs will be met by the management company for the development and ultimately by the occupiers.

The aim in tariff setting is therefore to ensure that each of the parties will see a benefit whilst also ensuring that the additional risks to the DH company as a result of having a large upfront investment are minimised

1. A connection charge – this is a single upfront charge based on the capacity of the connection and can be set to reflect the avoided costs of alternative low carbon energy supply
2. An annual availability charge – this is an annual (or monthly) charge for the maintenance of the capacity and can be set to reflect the avoided costs of operation, maintenance and plant replacement costs of alternative low carbon energy supply
3. An energy charge – this is a charge per unit of energy consumed based on accurate metering and is set to ensure an acceptable cost of energy by comparison with normal alternatives while ensuring adequate cost recovery and margins for the DH company

The area which often gets most focus is the connection charge. The identification and agreement on avoided costs, or what constitutes a benefit for the developer, can be difficult. For non-residential sites, where onsite CHP would be the alternative to taking a DH connection, or where a stand alone DH network on a large residential development would be required to meet planning policy an assessment of avoided costs should consider:

- The equipment costs – for provision of low carbon energy generation systems (CHP, heat pumps and bore holes, boilers etc or possibly solar PV/thermal)
- Utility connection costs – both gas and electrical connections are likely to be more expensive where there is an on-site CHP
- Space and construction costs – the area required for a DH interface substation is significantly less than for an on-site CHP system. The difficulties in routing for flues, ventilation and other elements of an on-site solution will also increase costs.
- Consenting costs – getting consents for an energy centre can involve significant additional costs in modelling of emissions, transport requirements, fire regulations, noise and other environmental impacts.
- Design costs – the fees for developing this more complex solution may be considerable
- Additional saleable/lettable areas - Simplifying the designs for energy systems, if done at an early enough stage, can allow for additional developed area to be provided thus turning a cost into a potential revenue.

For larger residential developments an assessment of avoided costs should consider:

- Equipment costs - micro renewables can add significant costs per dwelling to construction costs whereas the DH connection is often provided by an energy supply company with costs recovered in energy charges
- Utility connection costs - Gas infrastructure around the site is not required where a district heat network provides all heat demand
- Construction costs - a single standard low carbon energy solution reduces complexity and detail design changes to standard house types where micro-renewables may require significantly more detail effort both at design and construction
- Consenting costs - no consent is needed to install a DH connection
- Additional saleable area - heat recovery, ground source heat pumps and solar thermal systems all require equipment installed within a dwelling at least double the size of a standard gas boiler installation

Realising these benefits, and so allowing the investment to be made in DH via a connection charge, is dependent on early and clear discussions between developer, DH company and town planners.

7.5.2 Contributions secured under planning conditions

Exeter City Council has secured district heat network contributions from a number of new developments in the City Centre under s106 planning conditions as detailed above at 1.2.2. These have been included in the modelling, offsetting some of the capital costs required.

7.5.3 General approach to connection charges

No account has been included for the avoided cost of low carbon plant that may be necessary to meet planning policy imposed targets. No connection charges have been included in the financial modelling.

7.6 Calculating the value of electrical generation

Deriving the greatest possible value from the CHP electricity is imperative to maximise the chances that the scheme will be financially viable. The options for selling electricity from the CHP depend on:

7.6.1 The ability to use CHP generation 'on-site'

It may be possible to 'embed' a CHP within a single building or a small cluster of buildings to supply their on-site demand; the value of any electrical export 'spilled' to the grid will be nominal. The advantage of being able to use all CHP generation on-site is that on-site generation is valued at the relevant import tariff. This study has focussed on the Wonford Hospital as the most obvious location for an energy centre to maximise on this arrangement. The use of the BT Exchange as a potential energy centre would also utilise this approach although at a much smaller scale.

7.6.2 The potential to supply buildings via a private wire network

Connecting the CHP to a number of buildings that are able to absorb all CHP generation 'on-site' offers the potential to derive significant value for the generation. In order to achieve this situation it is necessary to either install a new private wire network or to purchase existing infrastructure off the Distribution Network Operator (DNO). A significant barrier to the adoption of this strategy is that following an EU ruling (referred to as the "city works" case) it is not possible to exclude other electricity suppliers from the private wire network. The implications of this are that it is not financially prudent to invest in the electrical network if the revenue from electrical sales cannot be guaranteed because other suppliers have the ability to sell to the customers connected.

In Exeter the most obvious choice for a private wire connection would be Heavitree Hospital and St Luke's and County Hall. There is also the potential for such a connection from the Triangle Car Park to the bus station redevelopment.

7.6.3 The ability to export electricity to the grid

It is necessary to get an export agreement with the DNO before being able to connect to the local electricity network. If an agreement is granted then the price of CHP generation will need to be negotiated via a power purchase agreement (PPA). A large generator with a steady export profile will be able to achieve a greater value than a smaller CHP or an engine with a more variable export profile. Values vary with scale a reliability of generation, but typically might be in the range of 4.5p/kWh to 7.5p/kWh. As set out at 0 above, this study has set the rate at 5p/kWh.

7.6.4 The potential for a 'netting off agreement'

A 'netting off agreement' would be made between one of the public sector bodies and their electricity supplier. The principle is that electricity generated from the CHP is sold back to the consumer by the supplier at a value at or slightly lower than their existing tariff. This creates a situation that is essentially a virtual private wire, where CHP electricity is transmitted over existing infrastructure and is able to derive a value that allows decentralised CHP to become viable. The primary disadvantage of netting off is that it is a **discretionary** agreement between the consumer and their supplier. The

supplier is under no obligation to offer a netting off agreement in the first place and is further able to cancel the agreement when the electricity purchase agreement is periodically re-negotiated. This type of arrangement allows for sales values that are competitive with the wider market, but there are administrative costs associated with the sales.

7.6.5 The potential for a 'light electricity supply licence'

One key mechanism that is under development is the 'electricity supply licence light'. This is a novel electricity supply licensing arrangement contained in proposals that Ofgem published in February 2009⁵. The broad rationale behind these proposals was to provide a cost-effective means for smaller electricity generators / supply companies to operate as licensed suppliers on the public networks. It is widely acknowledged that the existing licensed supply and generation markets are complex and difficult to access, with high levels of fixed cost that require large volumes of sales to be delivered commercially.

The 'supply licence light' seeks to disaggregate the electricity industry-facing services that are intrinsic to the functioning of the wider system (e.g. Balancing and Settlement Code, Master Registration Agreement), from the customer facing services (e.g. meter reading / billing) that can be carried out by an ESCO or other special purpose vehicle. However, a licensed body needs to carry out the industry-facing services, and hence the proposal is that an organisation wishing to benefit from the 'supply licence lite' would have to procure certain services from a registered supply company (e.g. one of the 'big six'⁶). These services would be covered by a 'Supplier Services Agreement' and work is on-going to define these services to the extent that they could be priced by licensed suppliers.

However, certain barriers to the realisation of this system include:

- There is no legal obligation on existing licensed suppliers to provide the services encompassed by a 'Supplier Services Agreement', and indeed they have a vested interest to preserve their markets (e.g. to prevent the entry of smaller suppliers).
- A lack of price control and transparency on the 'Supply Services Agreement' services could lead to prices that render the whole arrangement uneconomic.

The concern when looking at this option is that it is difficult to see where the additional value to the scheme operator would come from. The licence arrangement would still require the electricity supply company to undertake all the normal processes (and therefore incur the same costs as they would under their normal operations). There are no changes to the DUoS charges (and indeed in some cases the DNOs have argued that the charges should be higher where assets are notionally used both up and down the voltage chain. The scheme operator would have to carry the costs of customer management which may actually be higher than for a larger supplier.

⁵ Distributed Energy – Final Proposals and Statutory Notice for Electricity Supply Licence Modification: Ref:08/09, Ofgem

⁶ British Gas, EDF, E.ON, Npower, Scottish and Southern, Scottish Power.

The critical issue in relation to the 'light licence' is the electricity supply company arrangement. The general understanding that DECC has is that the provision of these services to a 'light' licence holder should represent a negligible cost to the electricity supply company. The rationale for introducing the light licence was to be able to introduce the opportunity of selling electricity directly to customers, without the burdens of being a signatory to the various industry codes (Master Registration Agreement; the Distribution Connection and Use of System Agreement; the Connection and Use of System Code; and the Balancing and Settlement Code) and having to invest in the IT systems required to administer these.

The only area where the electricity supply company may be willing to offer something extra is in sharing margin, it is not apparent at present how this would differ to a normal negotiation on sale price for export. It therefore appears that any net revenue benefit would be marginal at best and the scheme operator would carry some significant additional risks.

7.7 Presentation of Financial performance

The relative net present value benefit of all options modelled for each scheme against the business as usual case is presented in sections 8 to 12 below. These figures provide an indication of the potential cost saving in the supply of heat for each scheme option over a 25 year period. They have been calculated on the basis of setting the revenue of the scheme equal to the business as usual costs that connecting buildings would have incurred were they not to have connected to the heat network. The discount rate has been set at 3.5% and energy prices have been varied through the project life in line with the DECC Central Prices scenario as set out in section 7.3. A positive NPV in the analysis indicates the scheme would generate a saving in the cost of heat over life.

A full break down of the energy balance and financial cashflows for each option, including the Business as Usual case, is provided in Appendices C and D.

SECTION 3

SCHEME MODELLING AND RESULTS

8 SIDWELL ST
8.1 Overview
8.1.1 Overall Demand Projections
Table 8-1: Sidwell Street Network Loads

ID	Load	Heat demand (kWh/year)	Peak Load (kW)
1	Civic Centre	170,415	500
2	Pyramid Leisure Ctr	588,015	400
10	Bus Station Redevelopment	6,889,527	7,851
12	John Lewis	764,797	1,000
14	Townsend's Site	1,478,857	1,727
19	Portland House	492,786	621
20	Kingfisher House site	645,408	754
21	Stoneman & Bowker site	368,082	464
13	BT Exchange	170,000	-
	TOTAL	11,567,887	13,315

8.2 Network Options

8.2.1 District Heat Network Route

The Sidwell St network option is based around the Bus Station Redevelopment which provides 60% of the total demand. The network modelled is indicated in Figure 3.3-1 below.

Figure 8.2-1 - Sidwell Street network route map

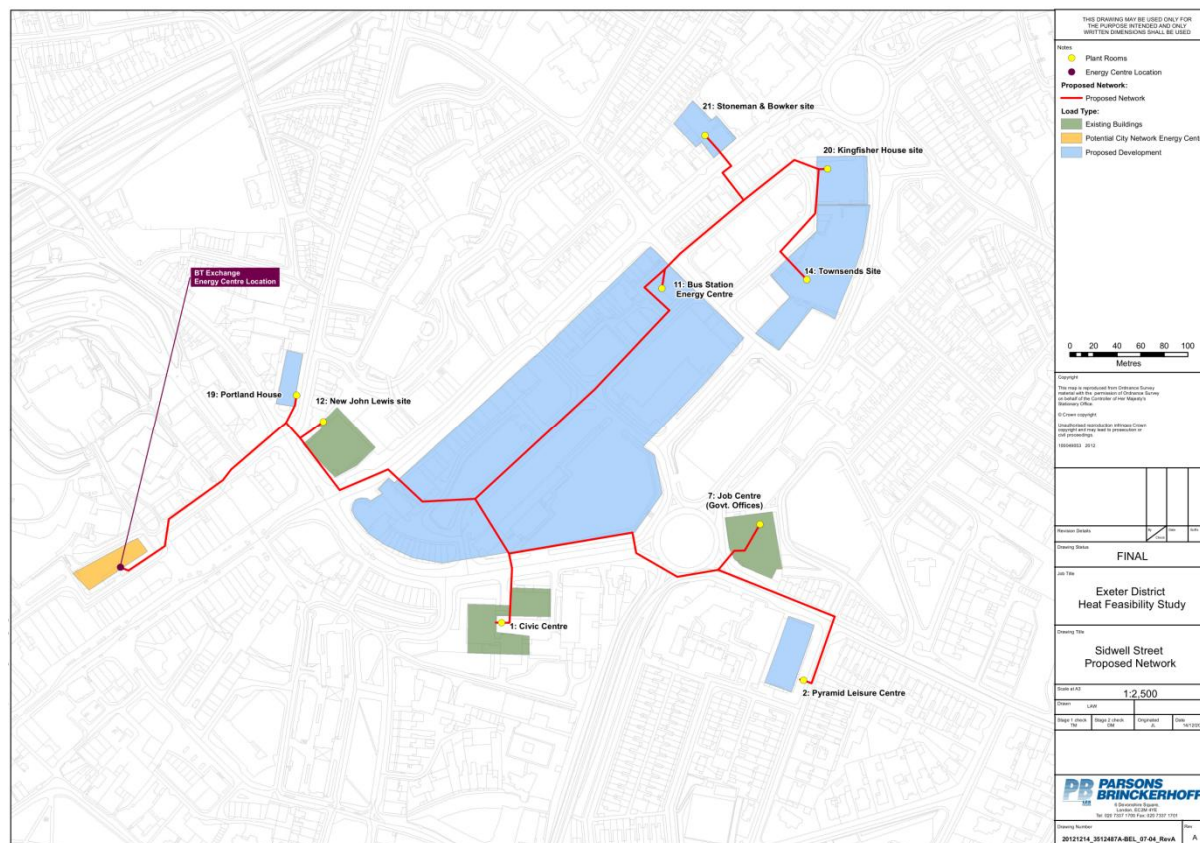


Table 8-2: Sidwell Street Network Parameters

Network	
Network length (m)	1,489
Heat Loss	6.8%
Pump Power (kWe)	25

8.2.2 Energy Centre Location

This network option had three potential energy centre locations identified and potentially available. The full list (including those excluded for modelling as discussed at section 5.1) comprises:

- BT Exchange building
- Triangle Car Park
- Bus Station Redevelopment

The Bus Station Redevelopment has not been included in the list of viable locations to assess since locating an energy centre here for a City Wide Energy Network would require commercial negotiations with the developer which carry a number of risks and would carry a higher energy centre construction cost compared to the existing BT Exchange building.

Therefore the choice of location, for the purposes of modelling the network at this stage, came down to the BT Exchange building and Triangle Car Park. The two sites are located at equal distance from the centre of heat demand. Using the BT Exchange building provided a significant on site electricity demand to serve which improves the financial performance of the scheme. The energy centre costs are reduced for the BT Exchange location since there is an existing building and utility connections available. The BT Exchange was therefore selected. However, it is important that space provision for an energy centre (550 m²) is retained in the bus station redevelopment scheme pending negotiations with BT and subject to a full understanding of the electricity and heat loads in the bus station redevelopment.

8.2.3 Options Modelled

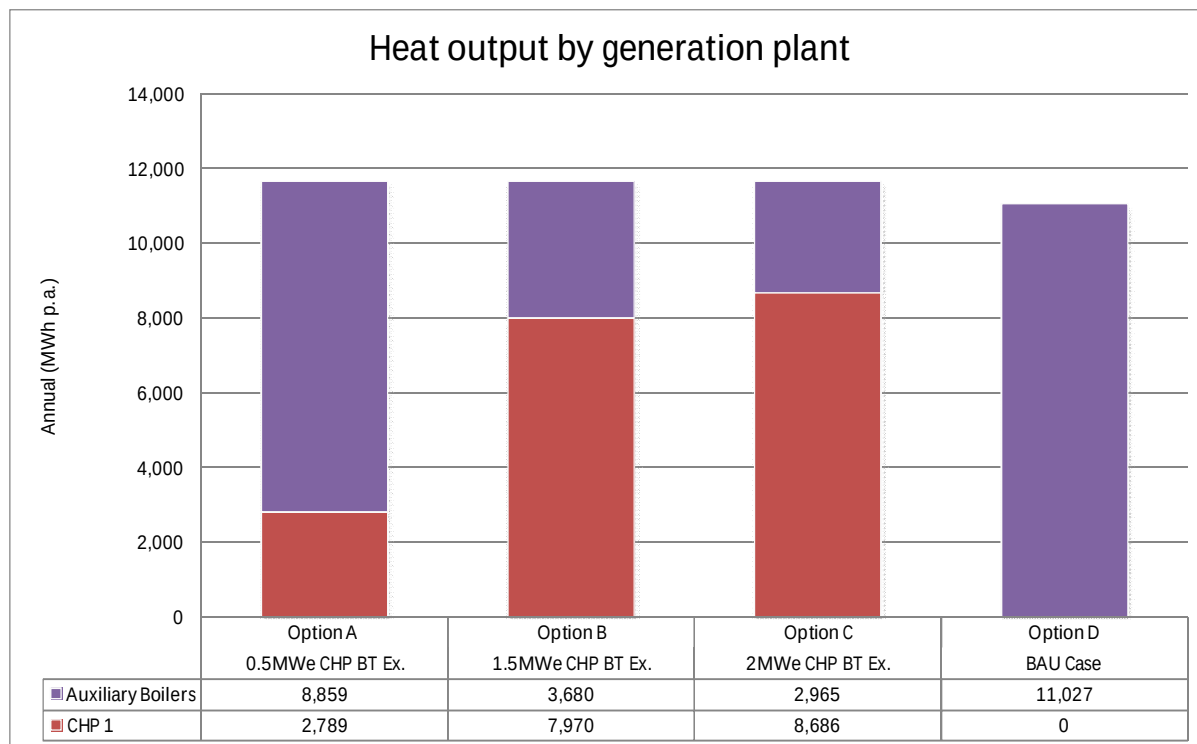
Three single engines of increasing size were modelled from 500kWe through 2MWe

Table 8-3: Sidwell Street Plant Options

Option	A	B	C
Plant	CHP 1	CHP 1	CHP 1
Electrical output (kWe)	500	1,487	2,002
Electrical efficiency (GCV)	35%	38%	40%
Heat output (kWth)	527	1,622	1,916
Thermal efficiency (GCV)	37%	41%	38%

Option C, the 2MWe engine, provides a small increase in heat supply little benefit over Option B, a 1.5MWe engine with an increased provision of only 700MWh annually. The electrical output is however somewhat more significantly higher, some 1,770MWh per year, due to the higher electrical efficiency and lower heat to power ratio.

Figure 8.2-2 - Sidwell Street energy balance



8.3 Financial Assessment

8.3.1 Capital Cost Estimates

Capital costs have been estimated for the installation of the necessary plant in the existing BT Exchange building, and the network required to serve heat to the connected sites.

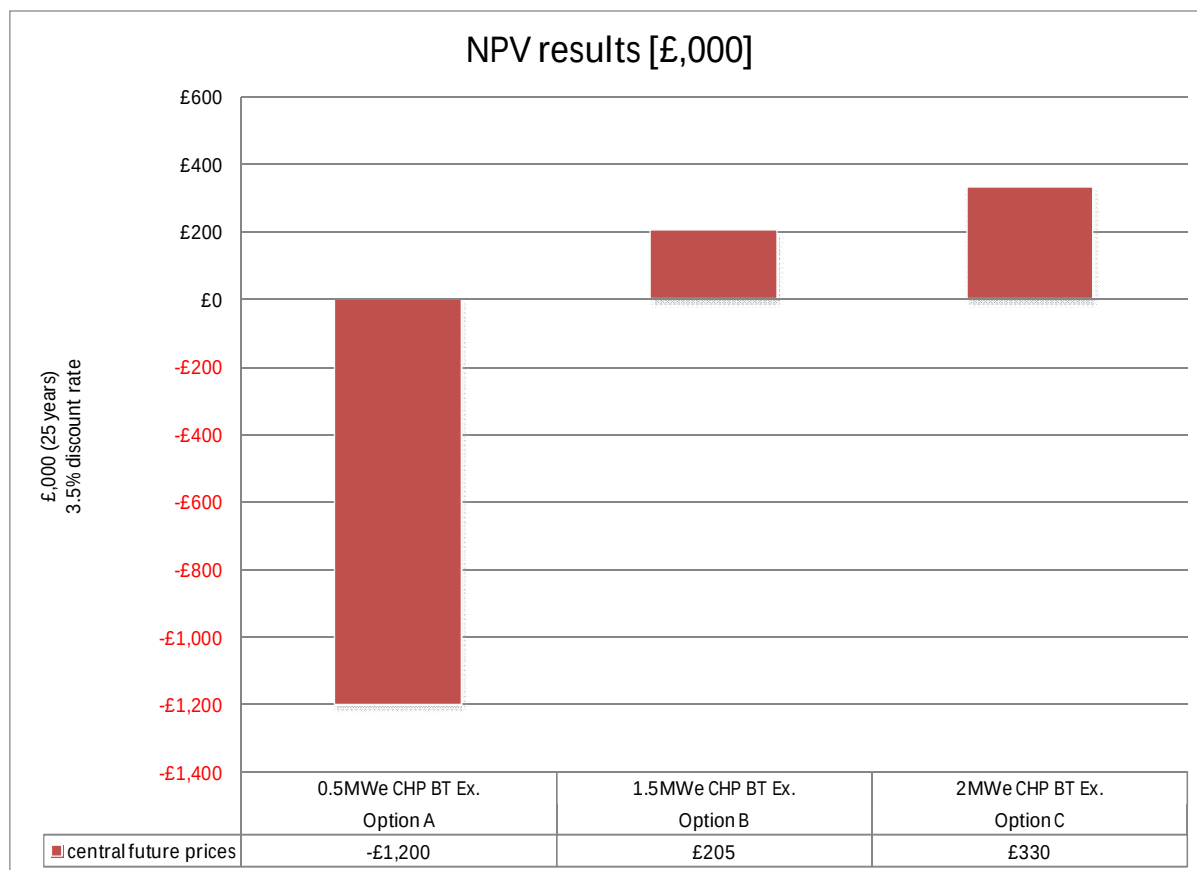
Table 8-4: Sidwell Street Capital Cost Estimates

	0.5MWe CHP BT Ex.	1.5MWe CHP BT Ex.	2MWe CHP BT Ex.
Main plant	£312,000	£594,174	£748,452
Energy centre	£1,237,339	£1,287,339	£1,356,044
Network	£1,350,000	£1,350,000	£1,350,000
Fees & PM	£205,000	£205,000	£205,000
Contingency	£581,068	£647,503	£692,099
Total	£3,685,407	£4,084,016	£4,351,596
S106 Contributions	-£199,000	-£199,000	-£199,000
Net Investment	£3,486,407	£3,885,016	£4,152,596

8.3.2 Results – DECC Central Prices Scenario

The financial modelling reflects the benefit of the higher electrical output from the larger (Option C) 2MWe engine noted above. This option provides the best economic results but by only a small margin over the smaller 1.5 MWe engine. These two options, in turn, represent a marginally lower cost of heat supply than providing the heat in the current way, through individual gas boilers installed in each building.

Figure 8.3-1 - Sidwell Street Energy Net Present Value results at Central Future Energy Prices



8.3.3 Projected Emissions Savings

Figure 8.3-2 - Sidwell Street Projected Emissions

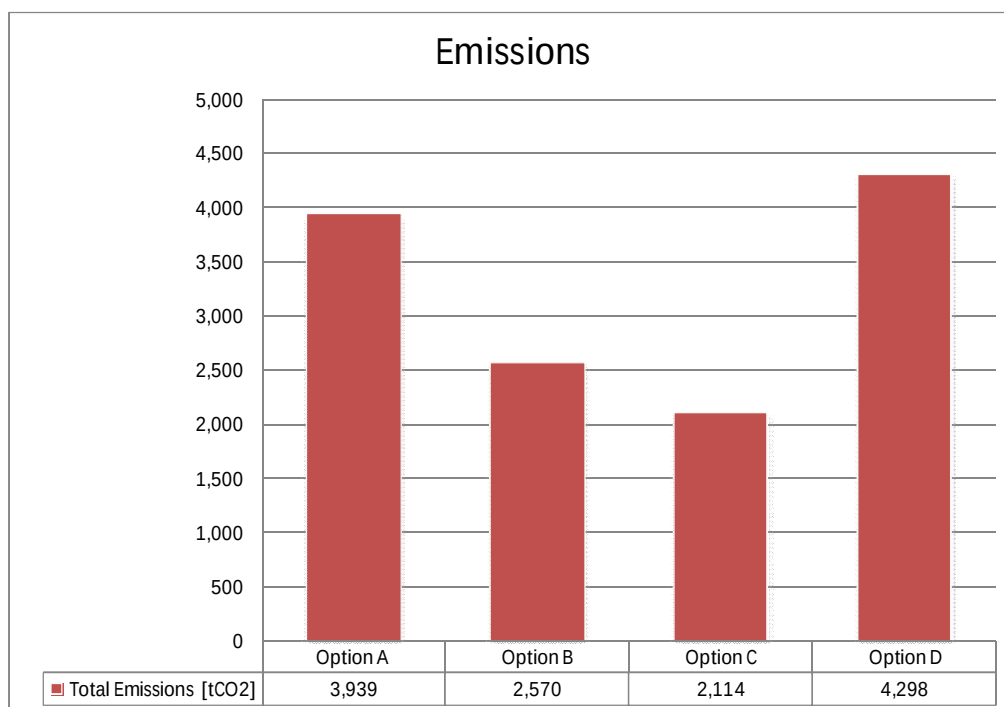


Table 8-5: Sidwell Street Projected Emissions Savings

Option	Option A	Option B	Option C	Option D
Total Emissions [tCO ₂]	3,939	2,570	2,114	4,298
Emissions reduction versus Base Case [tCO ₂]	359	1,728	2,185	

Note: The total emissions presented relate only to the supply of heat at connected buildings with no allowance for electricity consumption except for the BT Exchange which houses the energy centre. Further discussion at section 7.1.2.

8.4 Scheme Conclusions

A 2MWe engine installed at the BT Exchange would provide a lower cost of heat provision to the connected loads than a gas boiler only solution. It would also reduce the carbon dioxide emissions for the connected buildings by 2,185 Te per year. Much of the value in this option relates to the onsite supply of electricity to the BT exchange. It is possible that locating the energy centre in the bus station redevelopment may be a preferable option so space provision should be retained in the development until there is sufficient data to fully evaluate the alternatives.

9 ST LUKE'S EXTENDING TO SIDWELL ST

9.1 Overview

9.1.1 Overall Demand Projections

Table 9-1: St Luke's extending to Sidwell St Network Loads

ID	Load	Heat demand (kWh/year)	Peak Load (kW)
1	Civic Centre	170,415	500
2	Pyramid Leisure Ctr	588,015	400
3	Ambulance Station	59,353	100
5	Heavitree Hospital	3,048,697	1,600
7	Job Centre	101,891	550
8,9 & 28-35	St Luke's	3,451,767	1,550
10	Bus Station Redevelopment	6,889,527	7,851
12	John Lewis	764,797	1,000
14	Townsend's Site	1,478,857	1,727
15	Waitrose	449,157	1,966
19	Portland House	492,786	621
20	Kingfisher House site	645,408	754
21	Stoneman & Bowker site	368,082	464
	TOTAL	18,508,752	19,081

9.2 Network Options

9.2.1 District Heat Network Route

The St Luke's and Sidwell St combined network option is based around a main route along Heavitree Road. The two clusters are separated by a section of network along which there is very little demand likely to connect. The network modelled is indicated in Figure 9.2-1 below.

Figure 9.2-1 - St Luke's extending to Sidwell St Network Route Map

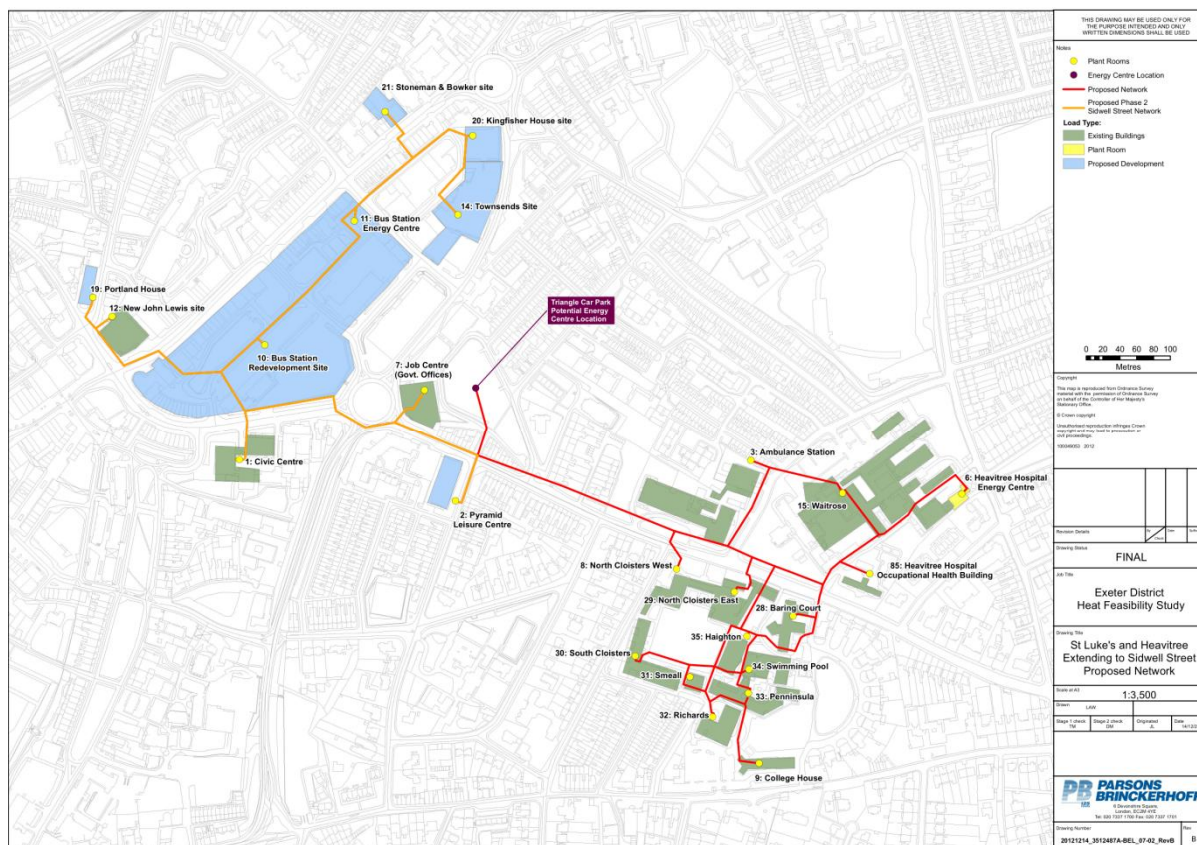


Table 9-2: St Luke's extending to Sidwell St Network Parameters

Network	
Network length (m)	3,208
Heat Loss	5.7%
Pump Power (kWe)	40

9.2.2 Energy Centre Location

This network option had the most potential energy centre locations identified and potentially available. The full list (including those excluded for modelling as discussed at section 5.1) comprises:

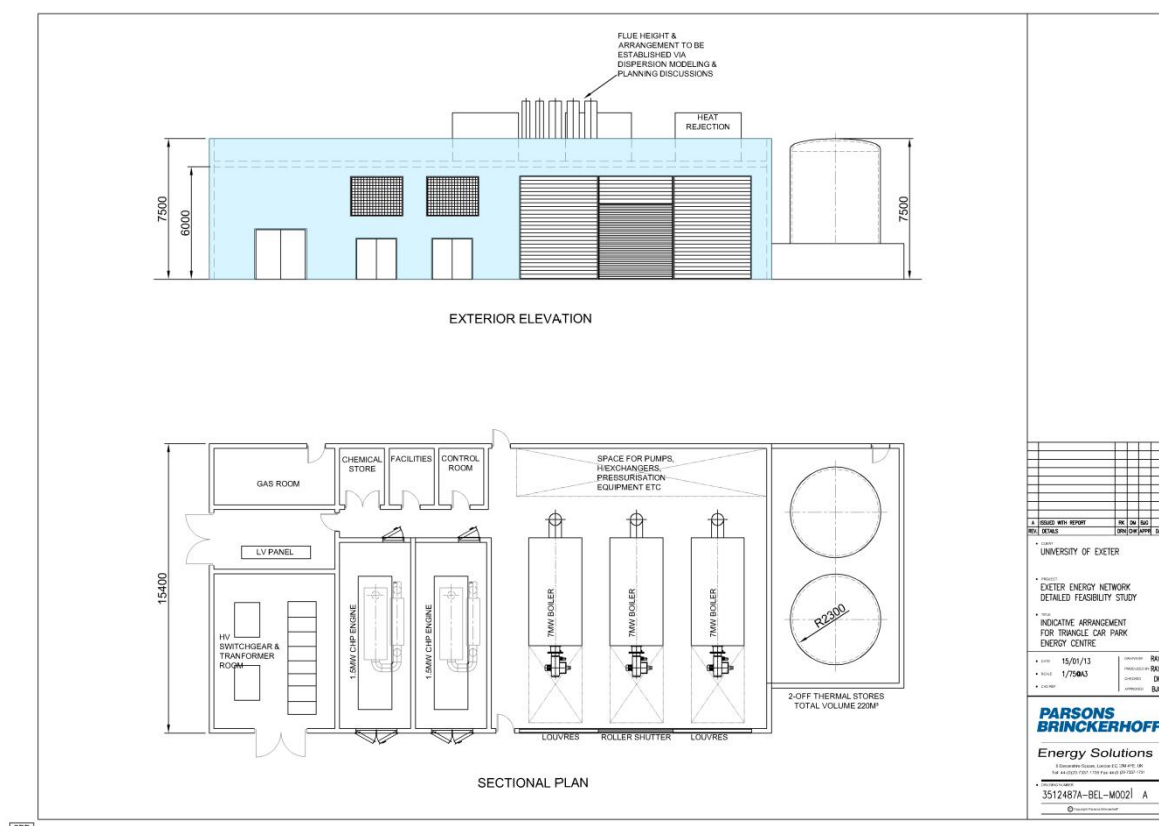
- Heavitree Hospital
- St Luke's
- Triangle Car Park
- Bus Station Redevelopment
- BT Exchange building

St Luke's does not provide a viable energy centre location and Heavitree Hospital, although potentially viable, was excluded due to the uncertainty of future development plans for the site. Heavitree Hospital should remain in a list of potential locations dependant on the Trust's eventual decision for the site.

The Bus Station Redevelopment has not been included in the list of viable locations to assess since locating an energy centre here for a City Wide Energy Network would require commercial negotiations with the developer which carry a number of risks.

Therefore the choice of location, for the purposes of modelling the network at this stage, came down to the BT Exchange building and Triangle Car Park. The Triangle Car Park was selected simply for its location between the two clusters of potential heat demand, namely the Sidwell St and the Heavitree and St Luke's clusters. There is no implied recommendation of this site over the BT Exchange other than the location providing a useful proxy for all the energy centre locations that are potentially available to serve these clusters.

Figure 9.2-2 - St Luke's extending to Sidwell St Indicative Energy Centre drawing



The BT Exchange has limited space available and would not be able to accommodate the two CHP engines modelled here. Similar levels of generation could be provided with one engine if the BT Exchange building were used.

This scheme does not benefit from savings through the use of the electricity generated by the CHP engines as there is no electrical load to serve at the Triangle Car Park. Serving the proposed bus station redevelopment would not be possible under private wire arrangements due to the multiple users that would occupy the site.

An energy centre located within the bus station redevelopment, and serving the same network assessed under this scheme may be able to benefit from the electricity cost savings that improve the finances of the other schemes assessed, but still only to the value of landlord services electrical demand.

9.2.3 Options Modelled

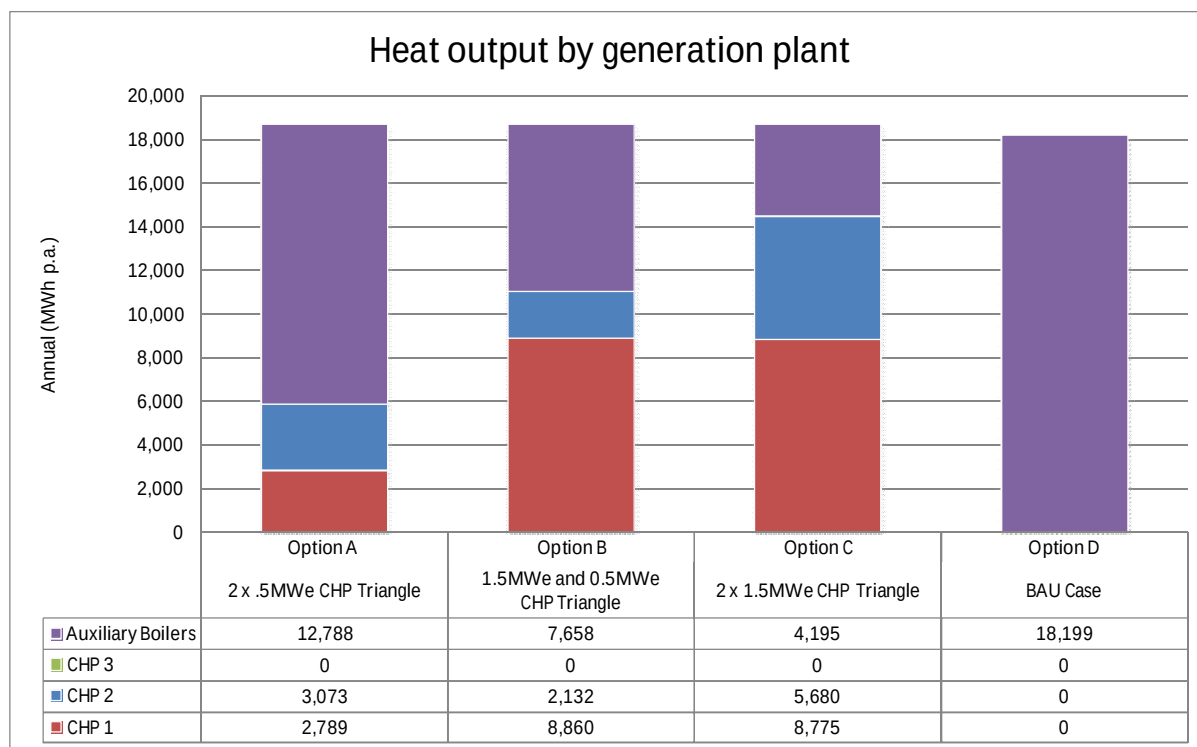
Three combinations of a 500kWe and 1.5MWe gas CHP engine were modelled.

Table 9-3: St Luke's extending to Sidwell St Plant Options

Option	A		B		C	
Plant	CHP 1	CHP 2	CHP 1	CHP 2	CHP 1	CHP 2
Electrical output (kWe)	500	500	1,487	500	1,487	1,487
Electrical efficiency (GCV)	35%	35%	38%	35%	38%	38%
Heat output (kWth)	527	527	1,622	527	1,622	1,622
Thermal efficiency (GCV)	37%	37%	41%	37%	41%	41%

Option A, comprising a pair of 500kWe engines looked to be undersized from the small proportion of total heat demand that they provided.

Figure 9.2-3 - St Luke's extending to Sidwell St Energy Balance



9.3 Financial Assessment

9.3.1 Capital Cost Estimates

Capital costs estimated for the construction of an energy centre on the Triangle Car Park site, and the network required to serve heat to the connected sites were established.

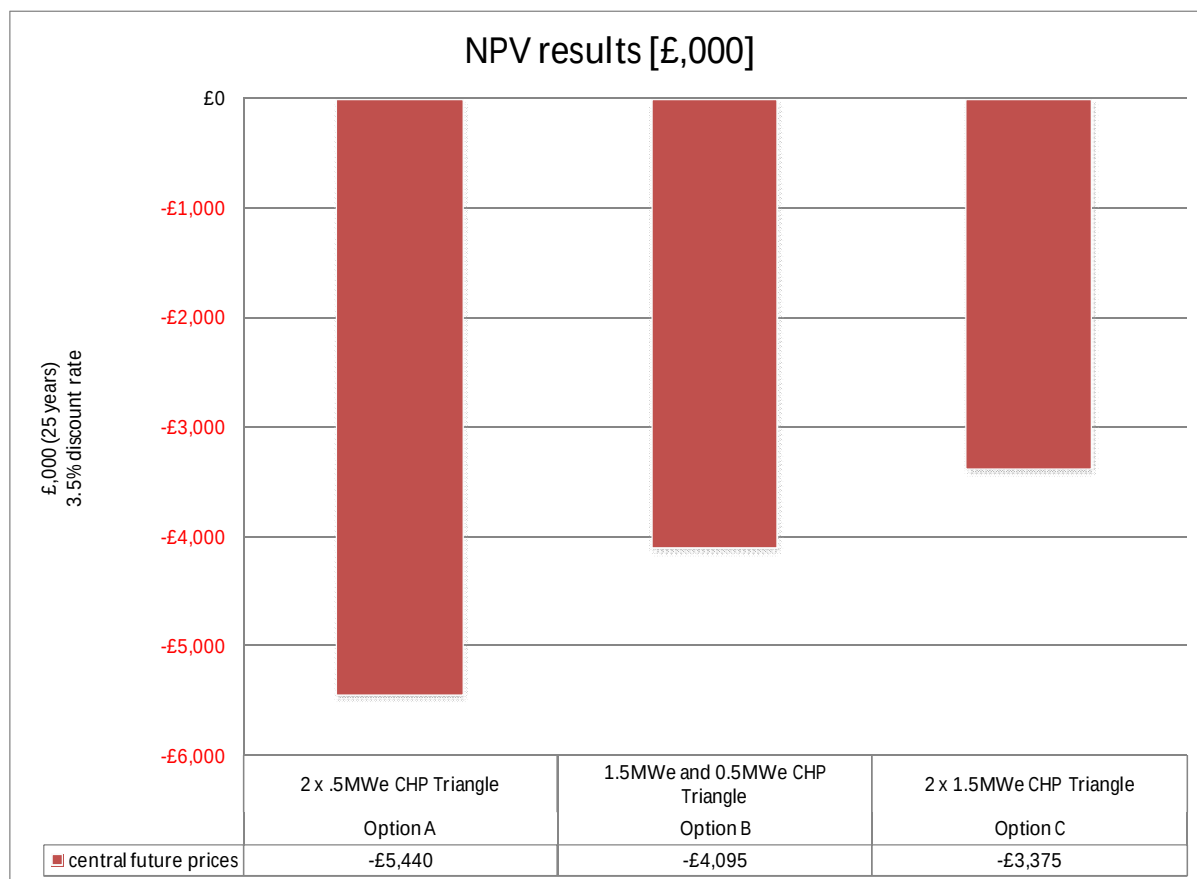
Table 9-4: St Luke's extending to Sidwell St Capital Cost Estimates

	2 x .5MWe CHP Triangle	1.5MWe and 0.5MWe CHP Triangle	2 x 1.5MWe CHP Triangle
Main plant	£624,000	£906,174	£1,188,348
Energy centre	£2,184,081	£2,259,081	£2,439,081
Network	£2,800,000	£2,800,000	£2,800,000
Fees & PM	£375,000	£375,000	£375,000
Contingency	£1,156,816	£1,228,251	£1,320,686
Total	£7,139,897	£7,568,506	£8,123,115
S106 Contributions	-£199,000	-£199,000	-£199,000
Net Investment	£6,940,897	£7,369,506	£7,924,115

9.3.2 Results – DECC Central Prices Scenario

Option C, comprising two 1.5MWe gas CHP engines housed in a newly constructed energy centre on the site of the existing Triangle Car Park provided the best economic results but all three options still represented a greater cost of heat supply than providing the heat in the current way, through individual gas boilers installed in each building.

Figure 9.3-1 - St Luke's extending to Sidwell St Net Present Value Results at Central Future Energy Prices



9.3.3 Projected Emissions Savings

As the CHP engine sizes increased (through the options A to C) carbon emissions savings also increased. All three gas CHP engine options serving an energy network provided reduced emissions associated with supply of heat compared to the business as usual case of individual gas boilers.

Figure 9.3-2 - St Luke's extending to Sidwell St Projected Emissions

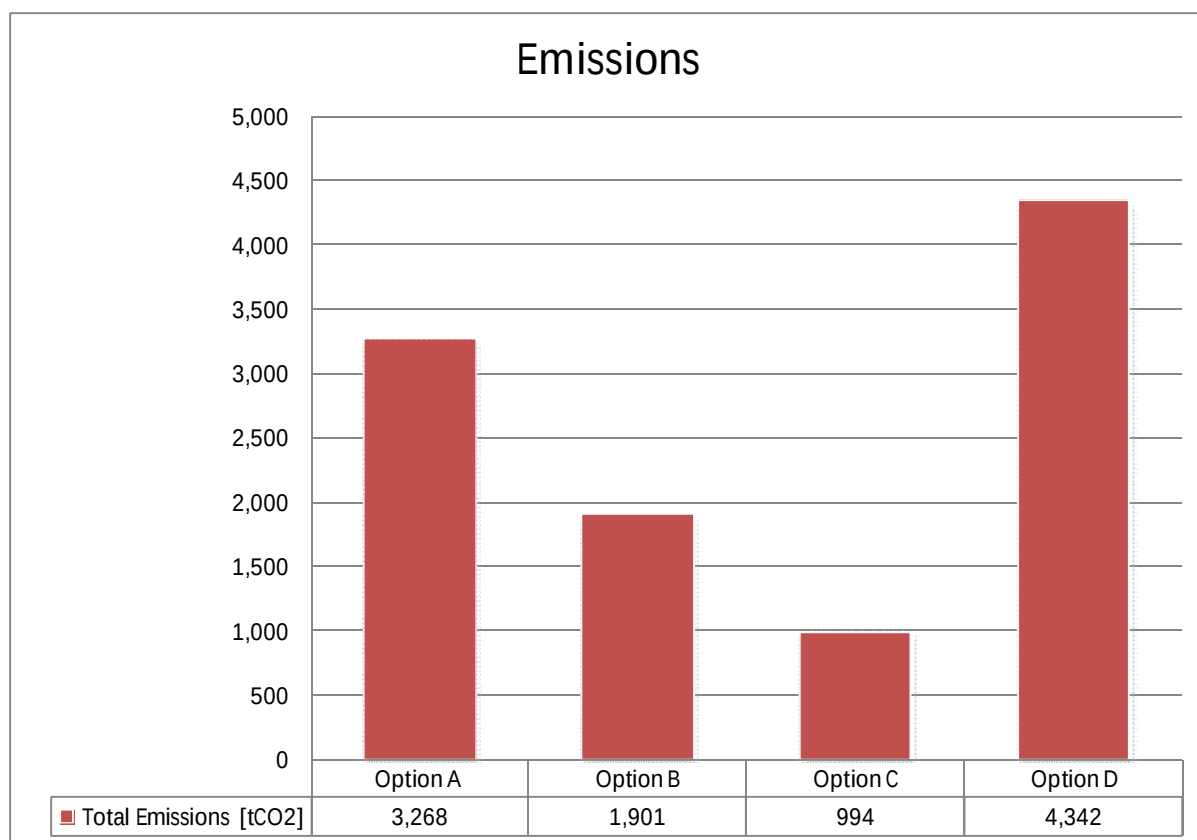


Table 9-5: St Luke's extending to Sidwell St Projected Emissions Savings

Option	Option A	Option B	Option C	Option D
Total Emissions [tCO ₂]	3,268	1,901	994	4,342
Emissions reduction versus Base Case [tCO ₂]	1,074	2,441	3,348	

Note: The total emissions presented relate only to the supply of heat at connected buildings with no allowance for electricity consumption. Further discussion at section 7.1.2.

9.4 Scheme Conclusions

This scheme does not provide a financial case for development based on central price projections. Sensitivities to future prices are shown in section 13.

10 WONFORD AND CITY CENTRE
10.1 Overview

10.1.1 Overall Demand Projections

Table 10-1: Wonford and City Centre Network Loads

ID	Load	Heat demand (kWh/year)	Peak Load (kW)
1	Civic Centre	170,415	500
2	Pyramid Leisure Ctr	588,015	400
3	Ambulance Station	59,353	100
5	Heavitree Hospital	3,048,697	1,600
7	Job Centre	101,891	550
8,9 & 28-35	St Luke's	3,451,767	1,550
10	Bus Station Redevelopment	6,889,527	7,851
12	John Lewis	764,797	1,000
14	Townsend's Site	1,478,857	1,727
15	Waitrose	449,157	1,966
17	County Hall	572,273	1,820
26	St Leonard's Primary - extended	168,000	200
19	Portland House	492,786	621
20	Kingfisher House site	645,408	754
21	Stoneman & Bowker site	368,082	464
23 & 27	Former RWE School for the Deaf site	483,014	608
36-66	Wonford Hospital	26,746,542	9,824
	TOTAL	46,478,580	31,533

10.2 Network Options

10.2.1 District Heat Network Route

The Wonford and City Centre network option is simply an extension of the St Luke's to Sidwell Street option modelled above. The network modelled is indicated in Figure 10.2-1 below.

Figure 10.2-1 - Wonford and City Centre Network Route Map

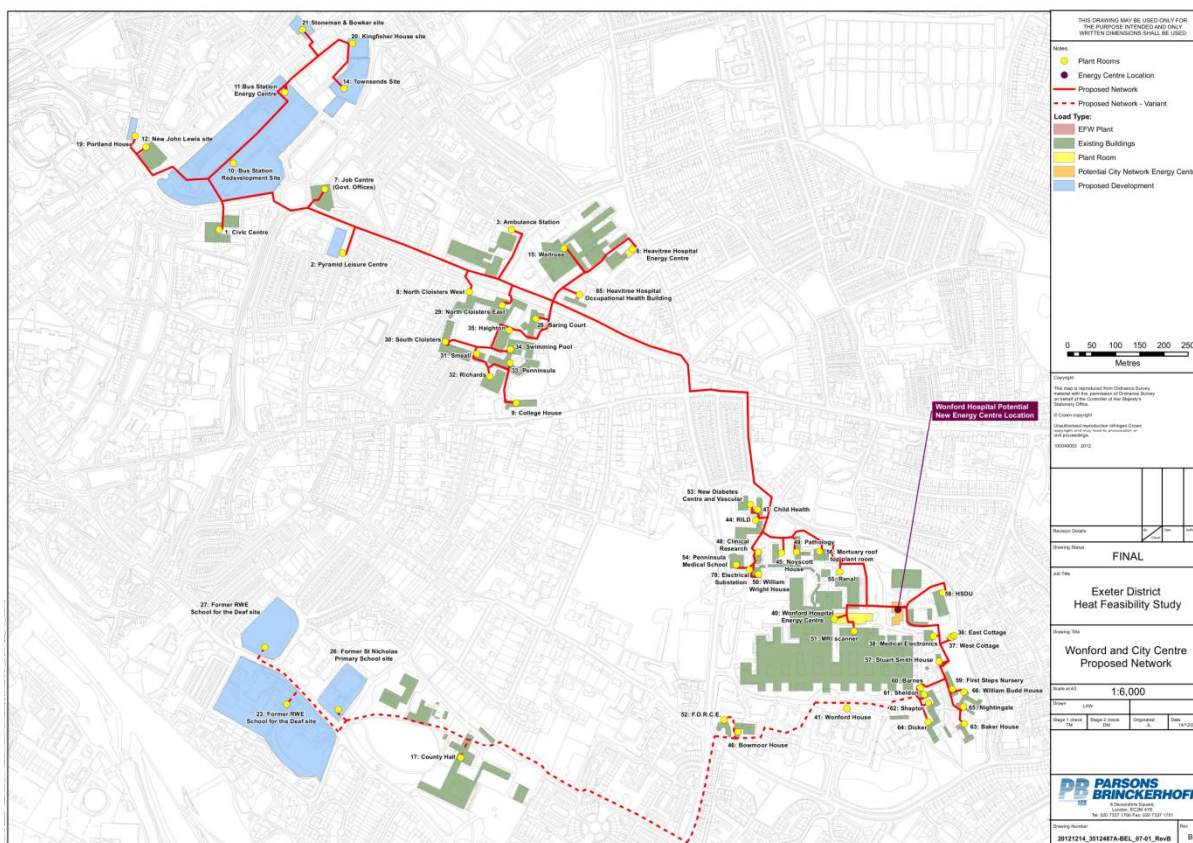


Table 10-2: Wonford and City Centre Network Parameters

Network	
Network length (m)	7,402
Heat Loss	7.0%
Pump Power (kW)	181

10.2.2 Energy Centre Location

This option is based on provision of an energy centre at Wonford Hospital serving heat to the whole network mapped. This enables the electricity generated by the CHP engines to be used within the Wonford Hospital and therefore a higher value attained for it (since it offsets the need for the Hospital to purchase that electricity at retail rates).

10.2.3 Options Modelled

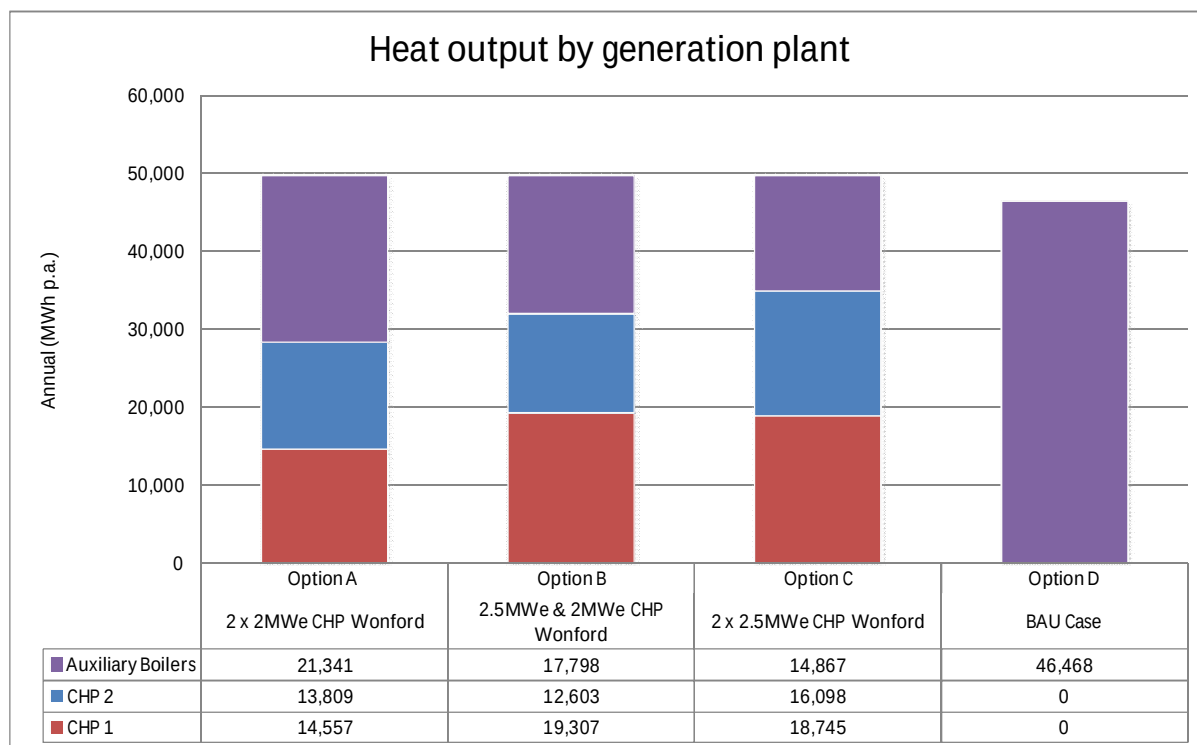
Three combinations of a 2MWe and 2.5MWe gas CHP engine were modelled.

Table 10-3: Wonford and City Centre Network Loads

Option	A		B		C	
Plant	CHP 1	CHP 2	CHP 1	CHP 2	CHP 1	CHP 2
Electrical output (kWe)	2,002	2,002	2,555	2,002	2,555	2,555
Electrical efficiency (GCV)	40%	40%	38%	40%	38%	38%
Thermal efficiency (GCV)	38%	38%	40%	38%	40%	40%

All three combinations of engine modelled provided a significant proportion of total heat demand.

Figure 10.2-2 - Wonford and City Centre Network Energy Balance



10.3 Financial Assessment

10.3.1 Capital Cost Estimates

Capital costs estimated for the provision of an energy centre at the Wonford Hospital, and the network required to serve heat to the connected sites were established.

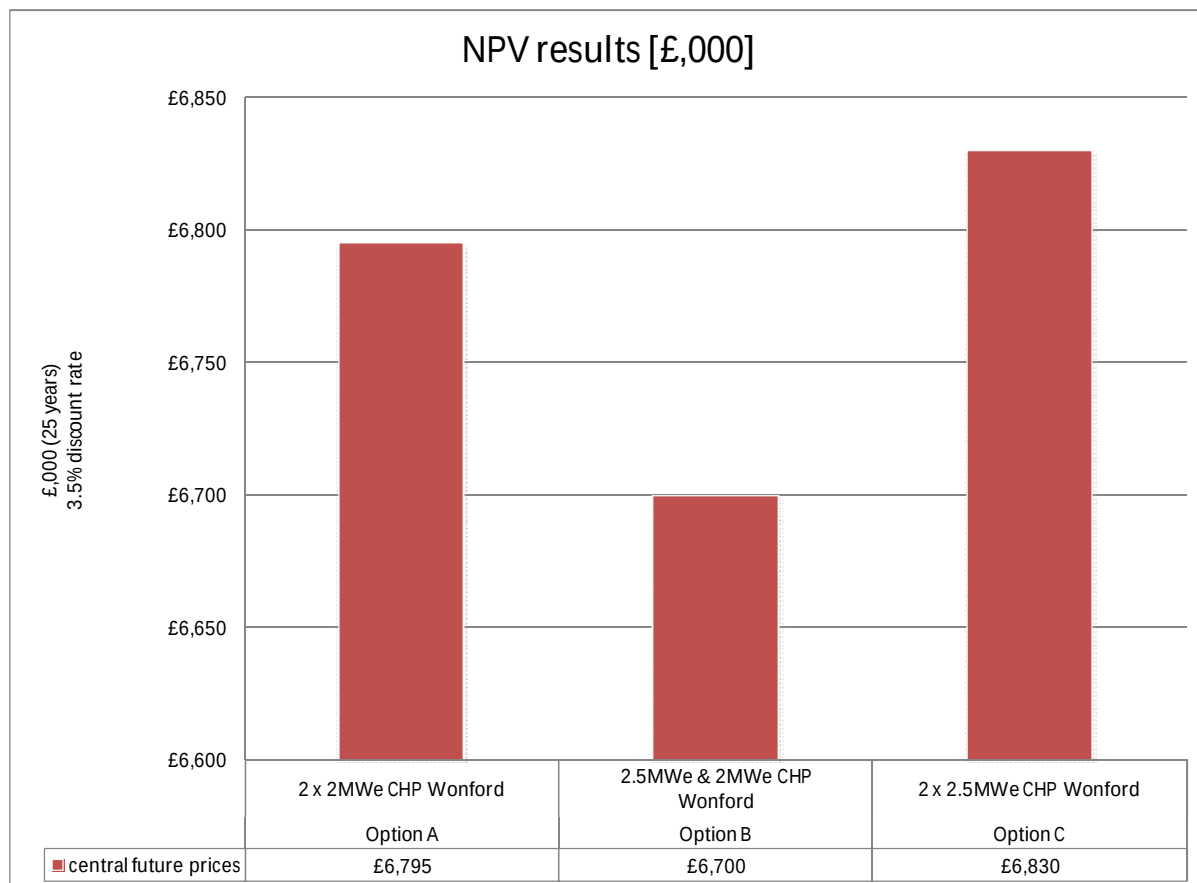
Table 10-4: Wonford and City Centre Network Capital Cost Estimates

	2 x 2MWe CHP Wonford	2.5MWe & 2MWe CHP Wonford	2 x 2.5MWe CHP Wonford
Main plant	£1,497,084	£1,699,803	£1,902,522
Energy centre	£3,946,387	£3,946,387	£3,946,387
Network	£6,750,000	£6,750,000	£6,750,000
Fees & PM	£710,000	£710,000	£710,000
Contingency	£2,540,894	£2,581,438	£2,621,982
Total	£15,444,365	£15,687,628	£15,930,891
S106 Contributions	-£199,000	-£199,000	-£199,000
Net Investment	£15,245,365	£15,488,628	£15,731,891

10.3.2 Results – DECC Central Prices Scenario

All three options show a reduced cost of heat supply to the connected buildings than providing the heat in the current way, through individual gas boilers. Option C, comprising two 2.5MWe gas CHP engines housed in an energy centre at Wonford Hospital, provided the best economic results but the differences between the options are quite small.

Figure 10.3-1 - Wonford and City Centre Network Net Present Value Results at Central Future Energy Prices



10.3.3 Projected Emissions Savings

As the CHP engine sizes increased (through the options A to C) carbon emissions savings marginally increased. All three gas CHP engine options serving an energy network provided reduced emissions associated with supply of heat compared to the business as usual case of individual gas boilers.

Figure 10.3-2 - Wonford and City Centre Network Projected Emissions

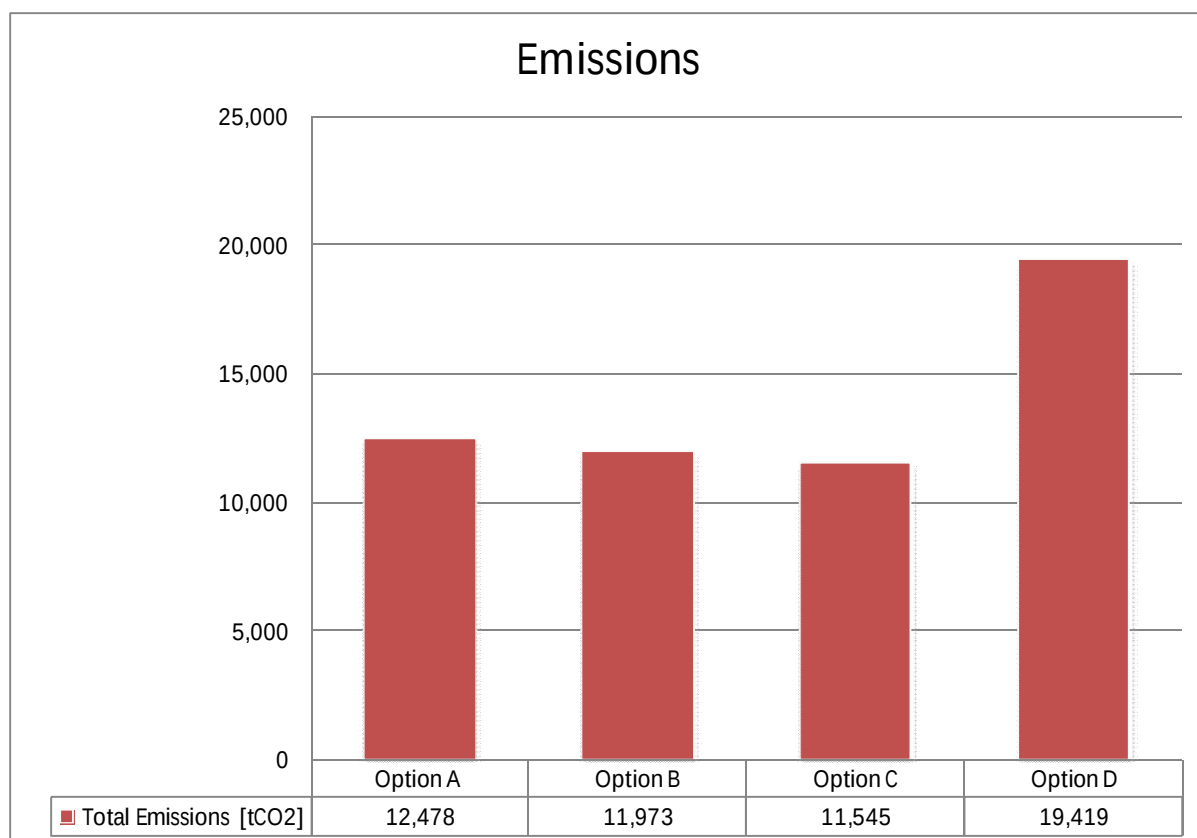


Table 10-5: Wonford and City Centre Network Projected Emissions Savings

Option	Option A	Option B	Option C	Option D
Total Emissions [tCO ₂]	12,478	11,973	11,545	19,419
Emissions reduction versus Base Case [tCO ₂]	6,941	7,446	7,874	

Note: The total emissions presented relate only to the supply of heat at connected buildings with no allowance for electricity consumption except for Wonford Hospital which houses the energy centre. Further discussion at section 7.1.2.

Option C, which provided the best economic results, also provides the greatest reduction in emissions versus the current approach of heating from individual gas boilers.

10.4 Devon County Hall Link Assessment

County Hall and the proposed development site adjacent provide 3% of the total heat demand of the scheme, whilst accounting for 30% of the total network costs. On this basis it was worth assessing the potential improvement to the scheme that excluding this link (to County Hall and beyond) could make. This link (removed in this option) is presented as a dotted line on the network map at Figure 10.2-1.

Table 10-6: Wonford and City Centre, Devon County Hall Link Assessment Network Parameters

Network	excl County Hall
Network length (m)	5,446
Pump Power (kWe)	164

Table 10-7: Wonford and City Centre, Devon County Hall Link Loads

ID	Load	Heat demand (kWh/year)	Peak Load (kW)
17	County Hall	572,273	1,820
26	St Leonard's Primary - extended	168,000	200
23 & 27	Former RWE School for the Deaf site	483,014	608
46	Wonford Hospital - Bowmoor Hse	97,197	100
52	Wonford Hospital - F.O.R.C.E.	41,656	50
	TOTAL REMOVED	1,362,139	2,778
	RESULTING TOTAL	45,116,441	28,755

As noted in 3.1.4, the consumption used for St Leonard's Primary School underestimated the existing consumption (data provided late) let alone the forecast consumption of the site once developed as proposed. The total consumption could reach 500MWh per annum once complete. This could add to the viability of the County Hall link but has not been included in this assessment.

10.4.1 Options Modelled

The heat generation plant options were unchanged.

Table 10-8: Wonford and City Centre, Devon County Hall Link Assessment Plant Options

Option	A		B		C	
Plant	CHP 1	CHP 2	CHP 1	CHP 2	CHP 1	CHP 2
Electrical output (kWe)	2,002	2,002	2,555	2,002	2,555	2,555
Electrical efficiency (GCV)	40%	40%	38%	40%	38%	38%
Thermal efficiency (GCV)	38%	38%	40%	38%	40%	40%

10.4.2 Capital Cost Estimates

The most significant difference in capital cost is in the reduced cost of network a reduction of £1.45m.

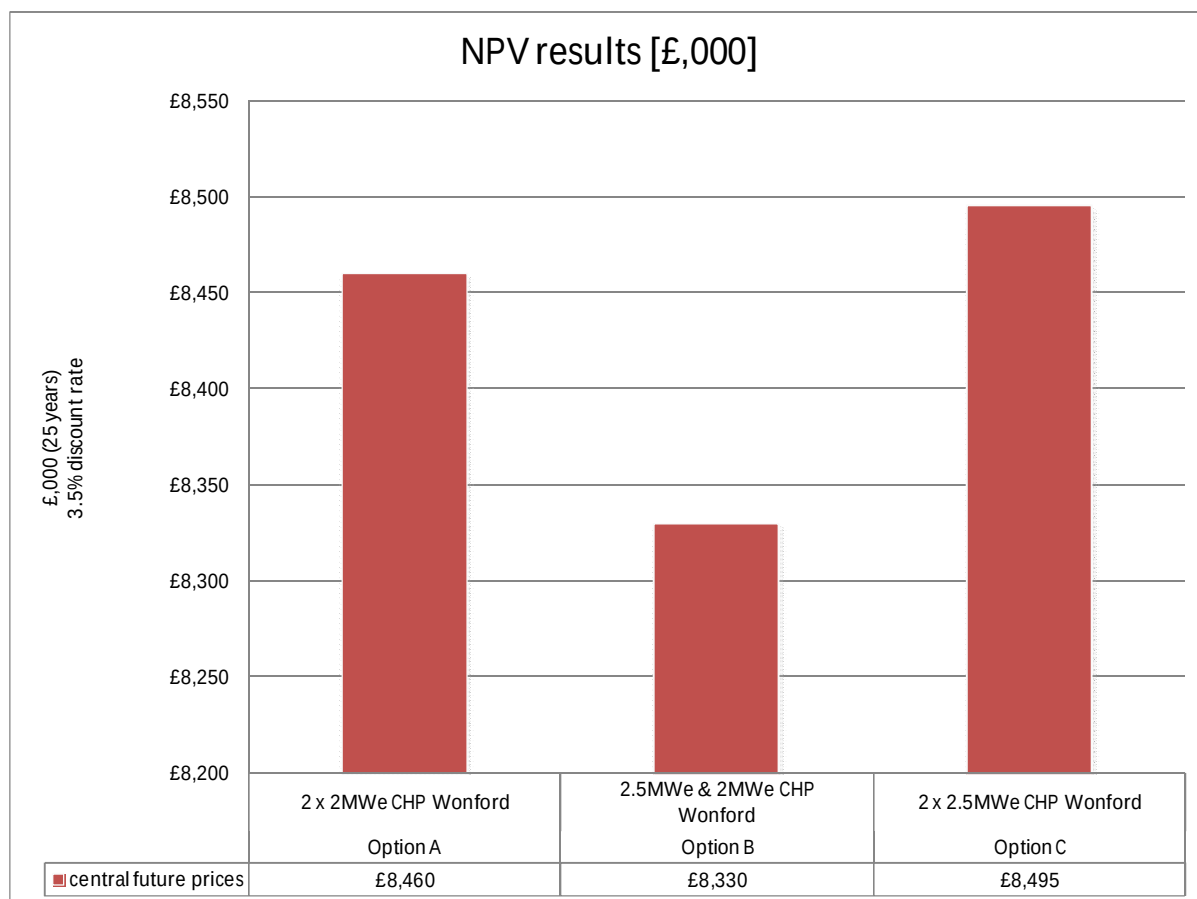
Table 10-9: Wonford and City Centre, Devon County Hall Link Assessment Capital Cost Estimates

	2 x 2MWe CHP Wonford	2.5MWe & 2MWe CHP Wonford	2 x 2.5MWe CHP Wonford
Main plant	£1,497,084	£1,699,803	£1,902,522
Energy centre	£3,946,387	£3,946,387	£3,946,387
Network	£5,290,000	£5,290,000	£5,290,000
Fees & PM	£710,000	£710,000	£710,000
Contingency	£2,248,894	£2,289,438	£2,329,982
Total	£13,692,365	£13,935,628	£14,178,891
S106 Contributions	-£199,000	-£199,000	-£199,000
Net Investment	£13,493,365	£13,736,628	£13,979,891

10.4.3 Results – DECC Central Prices Scenario

Option C, remains the option providing the best economic performance.

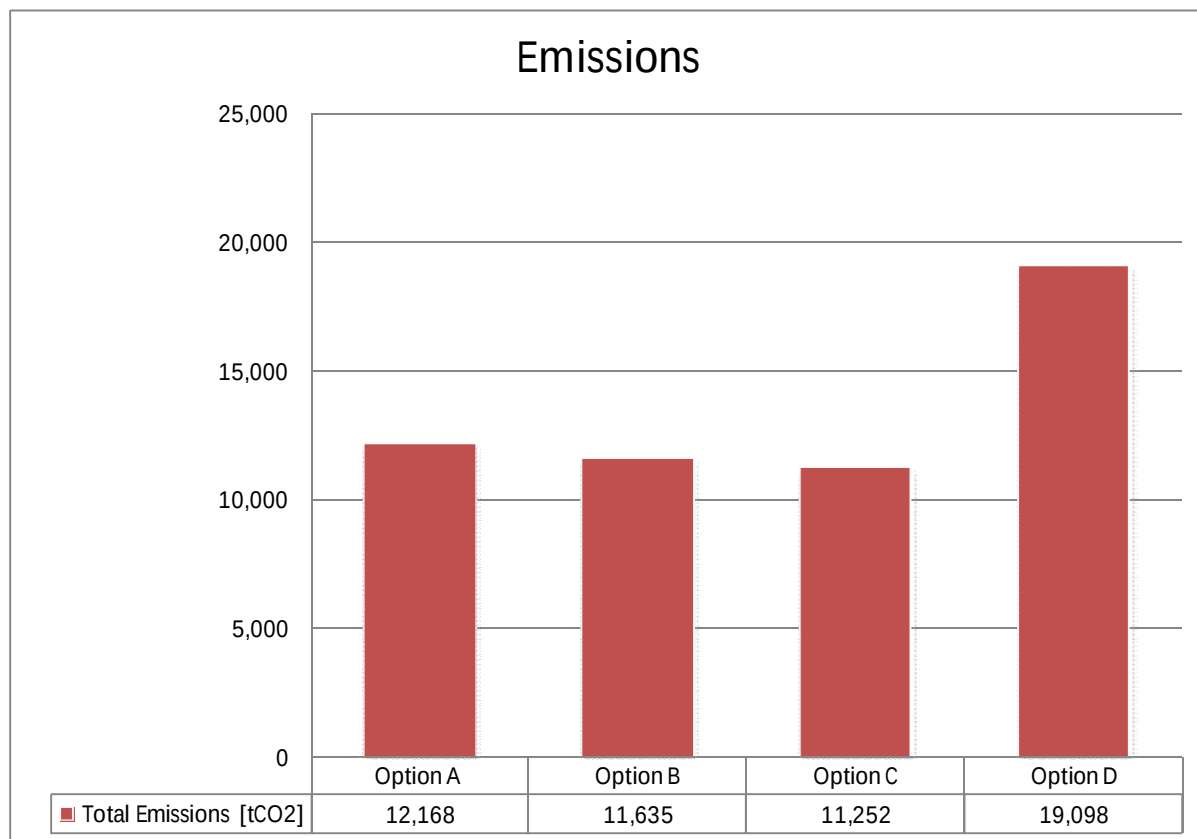
Figure 10.4-1 - Wonford and City Centre, Devon County Hall Link Assessment Net Present Value Results at Central Future Energy Prices



The overall net present value of this option is improved by almost £1.7million over the life of the scheme.

10.4.4 Projected Emissions Savings

Figure 10.4-2 - Wonford and City Centre, Devon County Hall Link Assessment Projected Emissions



The reduction in emissions savings as a result of serving less demand is insignificant.

Table 10-10: Wonford and City Centre, Devon County Hall Link Assessment Projected Emissions Savings

Option	Option A	Option B	Option C	Option D
Total Emissions [tCO ₂]	12,168	11,635	11,252	19,098
Emissions reduction versus Base Case [tCO ₂]	6,930	7,463	7,845	

Note: The total emissions presented relate only to the supply of heat at connected buildings with no allowance for electricity consumption except for Wonford Hospital which houses the energy centre. Further discussion at section 7.1.2.

10.5 Scheme Conclusions

The exclusion of the link to County Hall and the adjacent developments improves the financial performance of the scheme without significantly reducing the overall emissions savings. The potential for connection to County Hall would be best considered at the end of the useful life of the biomass boiler when capital will be available to support alternative low carbon supply options. The potential is also improved when considered alongside connection to the EfW plant as the route of the heat main passes closer to the site. There is potential to improve this assessment given the increased demand figures for St Leonard's Primary discussed at 10.4 and 3.1.4 above.

11 WHOLE NETWORK
11.1 Overview

11.1.1 Overall Demand Projections

Table 11-1: Whole Network Loads

ID	Load	Heat demand (kWh/year)	Peak Load (kW)
1	Civic Centre	170,415	500
2	Pyramid Leisure Ctr	588,015	400
3	Ambulance Station	59,353	100
5	Heavitree Hospital	3,048,697	1,600
7	Job Centre	101,891	550
8,9 & 28-35	St Luke's	3,451,767	1,550
10	Bus Station Redevelopment	6,889,527	7,851
12	John Lewis	764,797	1,000
14	Townsend's Site	1,478,857	1,727
15	Waitrose	449,157	1,966
17	County Hall	572,273	1,820
26	St Leonard's Primary - extended	168,000	200
19	Portland House	492,786	621
20	Kingfisher House site	645,408	754
21	Stoneman & Bowker site	368,082	464
23 & 27	Former RWE School for the Deaf site	483,014	608
36-66	Wonford Hospital	26,746,542	9,824
67	EIC South West Metal Finishing	2,800,000	1,750
68	Polestar	1,199,930	300
70	Hendy Van & Truck	304,477	400
	TOTAL	50,782,987	33,983

11.2 Network Options

11.2.1 District Heat Network Route

The Wonford and City Centre with EfW supply network option is a further extension of the Wonford and City Centre option modelled above but with the addition of a link from the Energy from Waste plant and a connection to County Hall and the proposed new developments located adjacent to it. The network modelled is indicated in Figure 11.2-1 below.

Figure 11.2-1 - Whole Network Route Map

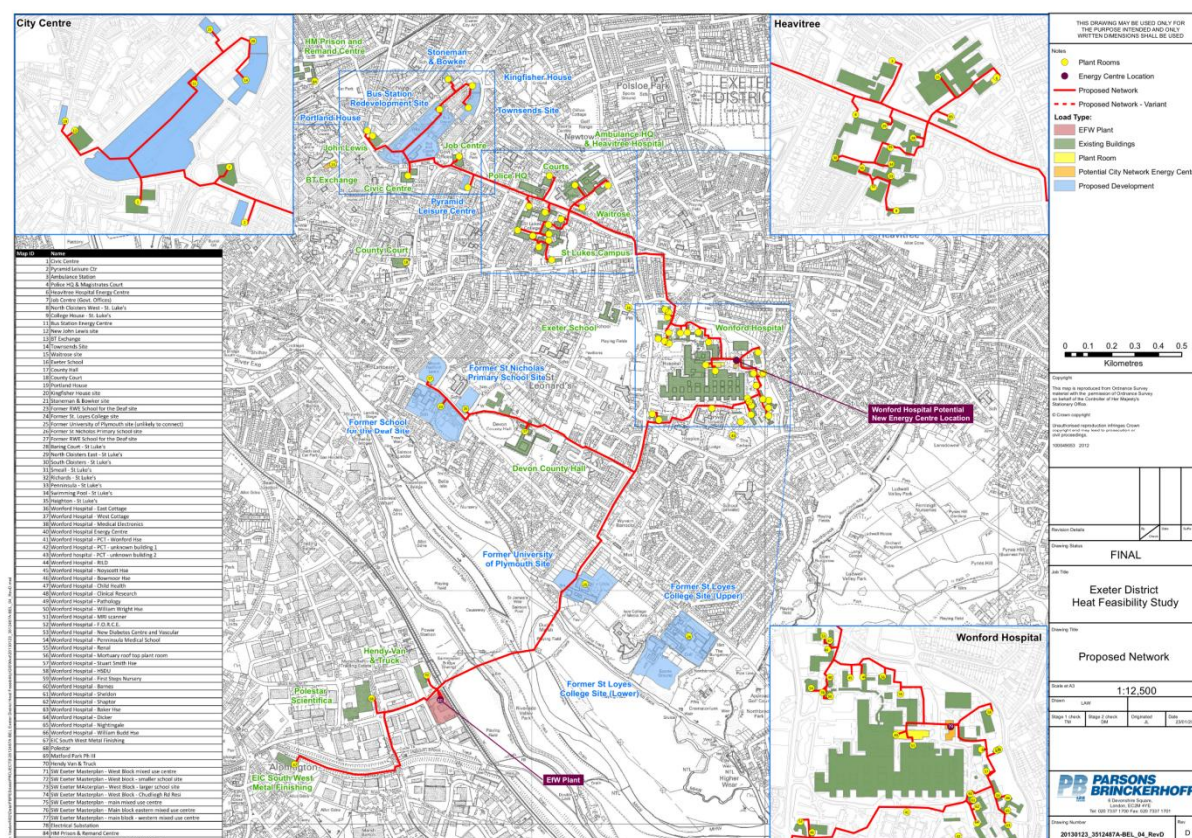


Table 11-2: Whole Network Parameters

Network	
Network length (m)	10,014
Heat Loss	9.0%
Pump Power (kW)	433

11.2.2 Energy Centre Location

This network option models an energy centre still located at Wonford Hospital but with the additional supply of low carbon heat from the Energy from Waste Plant at Marsh Barton. The main Wonford energy centre would house the auxiliary boiler plant required to supplement the supply from the Energy from Waste Plant and provide heat during operational down time of the plant. Any CHP engines would also be housed here and provide electricity to the hospital.

A small boiler house is also required at or close to the EfW plant to house back up boilers for the local loads and also the pumps, water treatment plant and thermal storage required to extract and circulate the heat from the EfW plant to the main energy centre.

11.2.3 Options Modelled

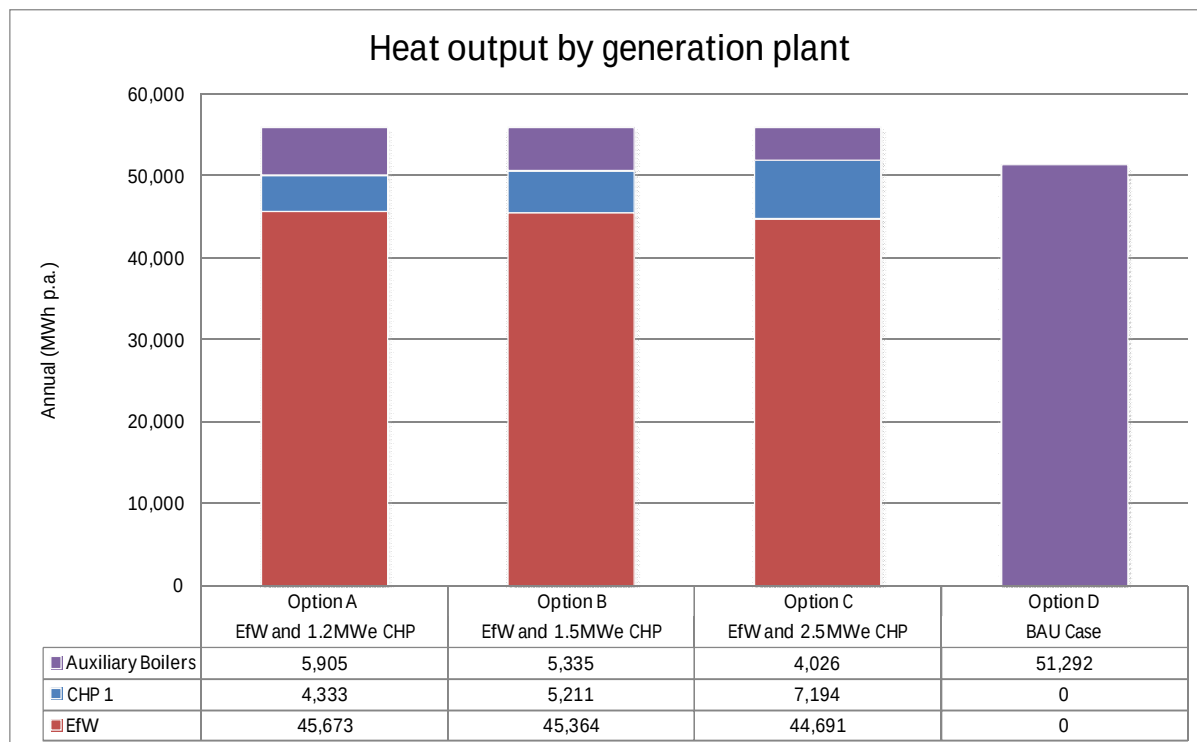
Since the Energy from Waste plant provides a significant proportion of the heat demand assessed on the network, there is less potential for CHP engines to add to this supply. The modelling therefore assesses all three options with a single CHP engine at Wonford alongside the heat supply from the Energy from Waste plant.

Table 11-3: Whole Network Plant Options

Option	A		B		C	
Plant	EfW	CHP 1	EfW	CHP 1	EfW	CHP 1
Electrical output (kWe)		1,190		1,487		2,555
Electrical efficiency (GCV)		38%		38%		38%
Heat output (kWth)	8,500	1,296	8,500	1,622	8,500	2,679
Thermal efficiency (GCV)		41%		41%		40%

All three combinations of low carbon heat supply modelled provided a significant proportion of total heat demand, with the majority provided by the EfW plant. With larger CHP engines, the Energy from Waste supply is slightly reduced due to interaction of the EfW supply and the CHP engines with thermal storage on the network.

Figure 11.2-2 - Whole Network Energy Balance



11.3 Financial Assessment

11.3.1 Capital Cost Estimates

The capital costs estimated for the provision of an energy centre at the Wonford Hospital, and the network required to serve heat to the connected sites are shown below.

Table 11-4: Whole Network Capital Cost Estimates

	EfW and 1.2MWe CHP	EfW and 1.5MWe CHP	EfW and 2.5MWe CHP
Main plant	£1,305,000	£1,395,000	£1,750,000
Energy centre	£5,125,000	£5,125,000	£5,125,000
Network	£12,750,000	£12,750,000	£12,750,000
Fees & PM	£900,000	£900,000	£900,000
Contingency	£3,976,200	£3,994,200	£4,065,200
Total	£24,056,200	£24,164,200	£24,590,200
S106 Contributions	-£199,000	-£199,000	-£199,000
Net Investment	£23,857,200	£23,965,200	£24,391,200

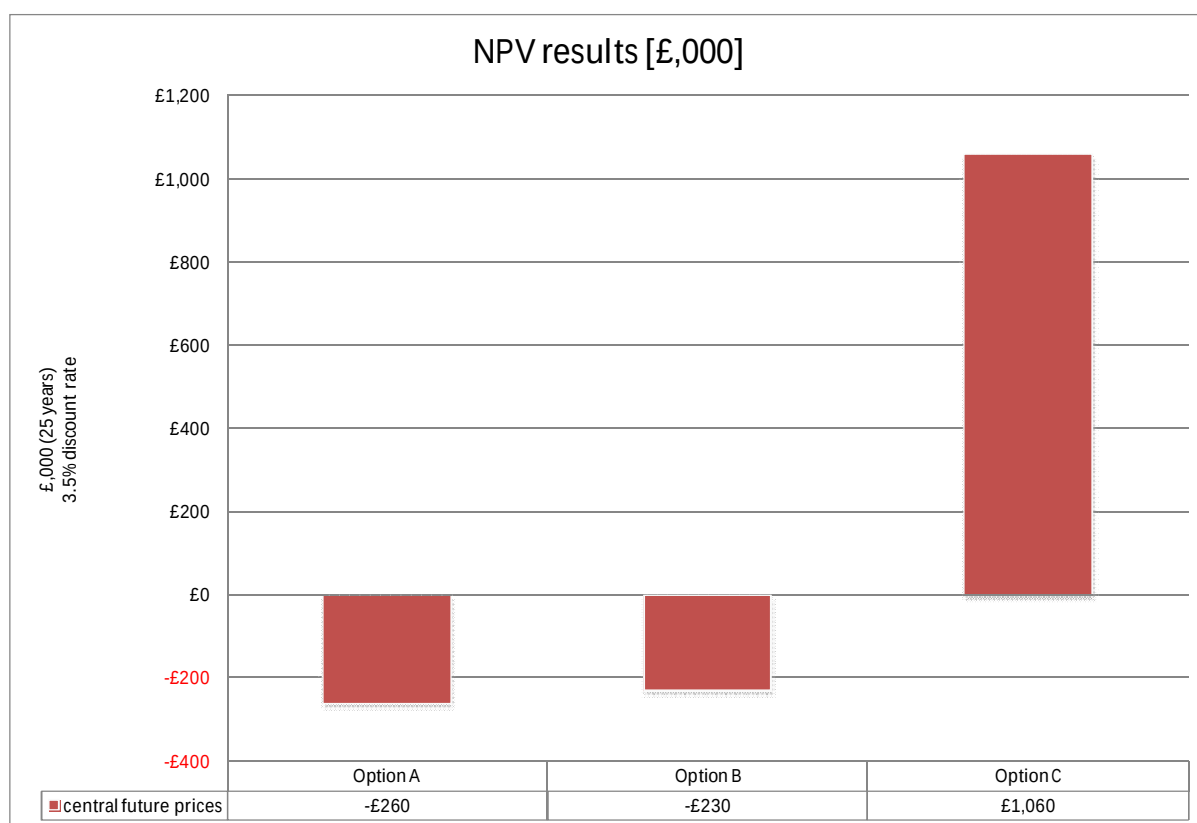
11.3.2 Costs of EfW heat supply

The cost of heat from the EfW plant is assumed to recover lost electricity revenues. On this basis, assuming an electricity value of 5.5p/kWh and a loss of 1 kWh electrical generation for each 5 kWh of heat extracted, a heat price of 1.1p/kWh is calculated. No margin has been allowed at this stage for management of the heat supply arrangements and incentive revenues.

11.3.3 Results – DECC Central Prices Scenario

The economic assessment for this scheme assumes that 50% of the heat supply from the EfW plant, the deemed renewable fraction for EfW set by OFGEM, is eligible for the Renewable Heat Incentive (RHI) at the current tariff for large biomass which is 1 p/kWh. The heat from the EfW eligible Option C, comprising the EfW supply alongside a single 2.5MWe gas CHP engine housed in an energy centre at Wonford Hospital provided the best economic results and this option represents a lower cost of heat supply than providing the heat in the current way, through individual gas boilers installed in each building.

Figure 11.3-1 - Whole Network Net Present Value Results at Central Future Energy Prices



11.3.4 Projected Emissions Savings

Option C, the best performing option in financial terms provided the greatest reduction in emissions although the difference between the best and worst performing options in terms of emissions savings was only 750tCO₂.

Figure 11.3-2 - Whole Network Projected Emissions

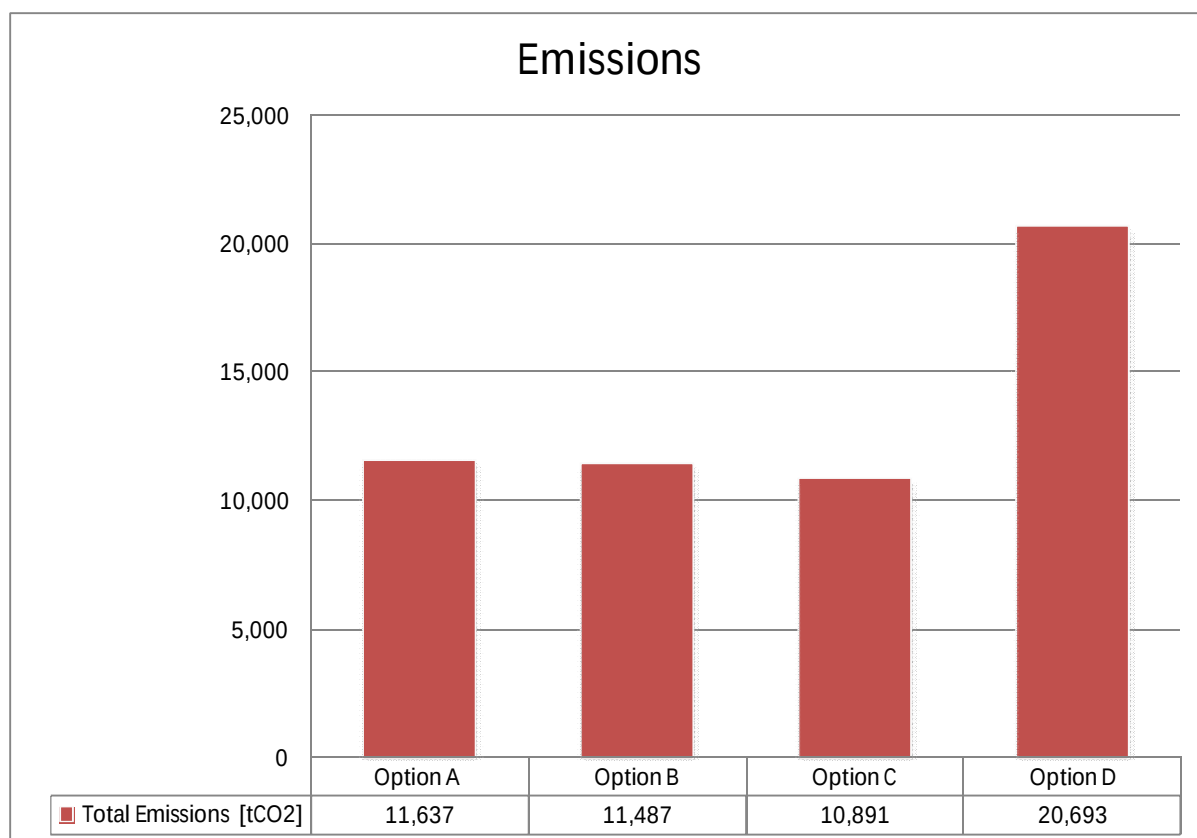


Table 11-5: Whole Network Projected Emissions Savings

Option	Option A	Option B	Option C	Option D
Total Emissions [tCO ₂]	11,637	11,487	10,891	20,693
Emissions reduction versus Base Case [tCO ₂]	9,056	9,207	9,802	

Note: The total emissions presented relate only to the supply of heat at connected buildings with no allowance for electricity consumption except for Wonford Hospital which houses the energy centre. Further discussion at section 7.1.2.

All three combinations of gas CHP engine and EfW supply options serving an energy network provided reduced emissions associated with supply of heat compared to the business as usual case of individual gas boilers.

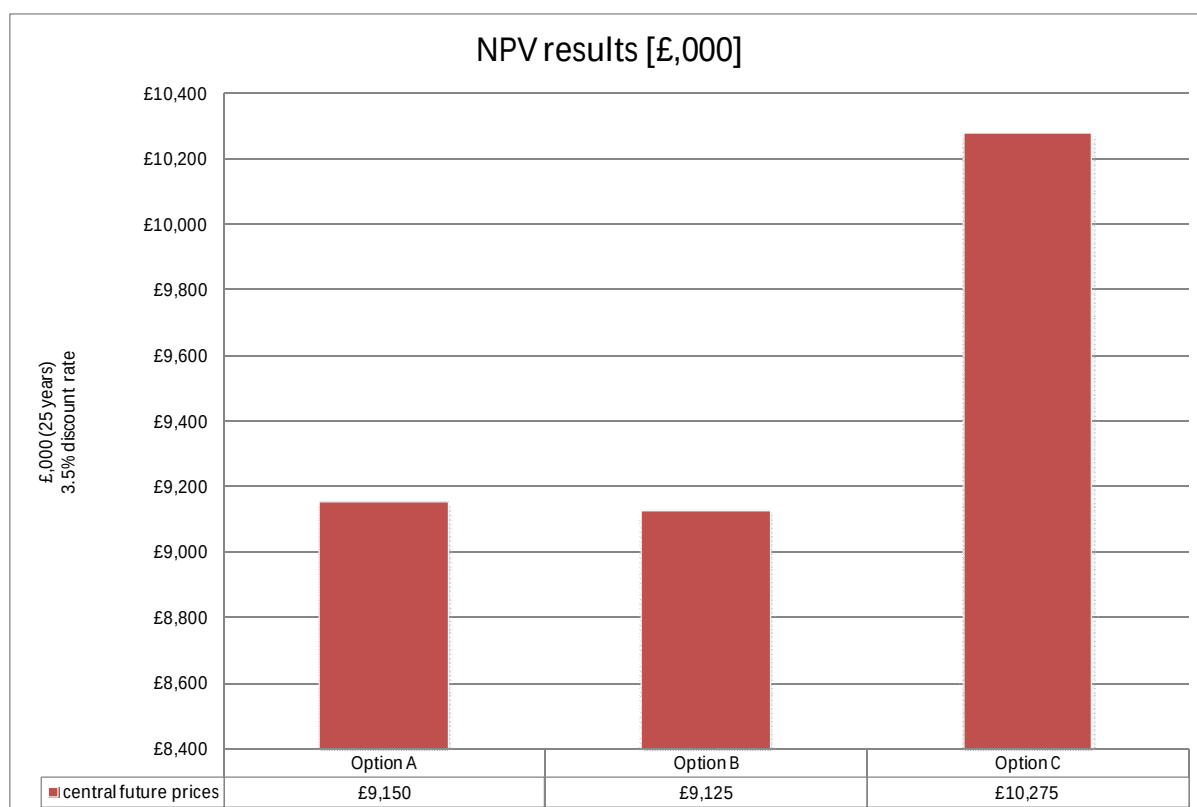
The exploitation of the Energy from Waste plant low carbon heat supply does not provide reduced carbon dioxide emissions versus supplying heat to a similarly sized network (the County Hall link is additional in this network) with gas CHP engines at Wonford Hospital only. It should be noted that this is due primarily to the benefit provided by a gas CHP scheme in offset of the emissions related to electricity production. As the electrical grid decarbonises this credit will reduce and the relative benefit of EfW heat will be more clearly shown.

11.4 Inclusion of Increased Incentive Revenues at central future energy prices

Recent Government consultations on the RHI has indicated that the RHI value for biomass/EfW CHP schemes may be increased to 4.1p/kWh of renewable heat supplied. For an EfW plant this equates to a value of 2.05p/kWh of heat supplied as the deemed renewable fraction is 50%.

The financial model was re-run with the inclusion of this incentive revenue to the DH scheme. The results of this are shown below:

Figure 11.4-1 - Whole Network Net Present Value Results at Central Future Energy Prices with increased RHI tariff



As can be seen from this the inclusion of the increased incentive revenues means all three EfW CHP schemes provide a positive return compared to the business as usual costs. Option C continues to provide the best return driven by the value of the electricity generated by the CHP at Wonford.

It should be noted that the modelled level of RHI incentive payments is set at 4.1p/kWh. This level has been published in the recent Government consultation as applying to "Biomass CHP schemes". It is not clear at present whether this level will actually be applied as published, nor whether it will equally apply to EfW CHP because although biomass and EfW are currently treated the same under the RHI there is no guarantee that this will continue. A final investment decision should not be taken until the incentive levels and their applicability have been confirmed. Further modelling is provided at section 13 showing the impact of RHI rates at both 1p and 4.1p/kWh.

11.5 Benefit of Marsh Barton Industrial Loads

11.5.1 District Heat Network Route, excluding Marsh Barton Industrial Sites

Figure 11.5-1 - Whole Network excluding Marsh Barton Industrial Loads Route Map

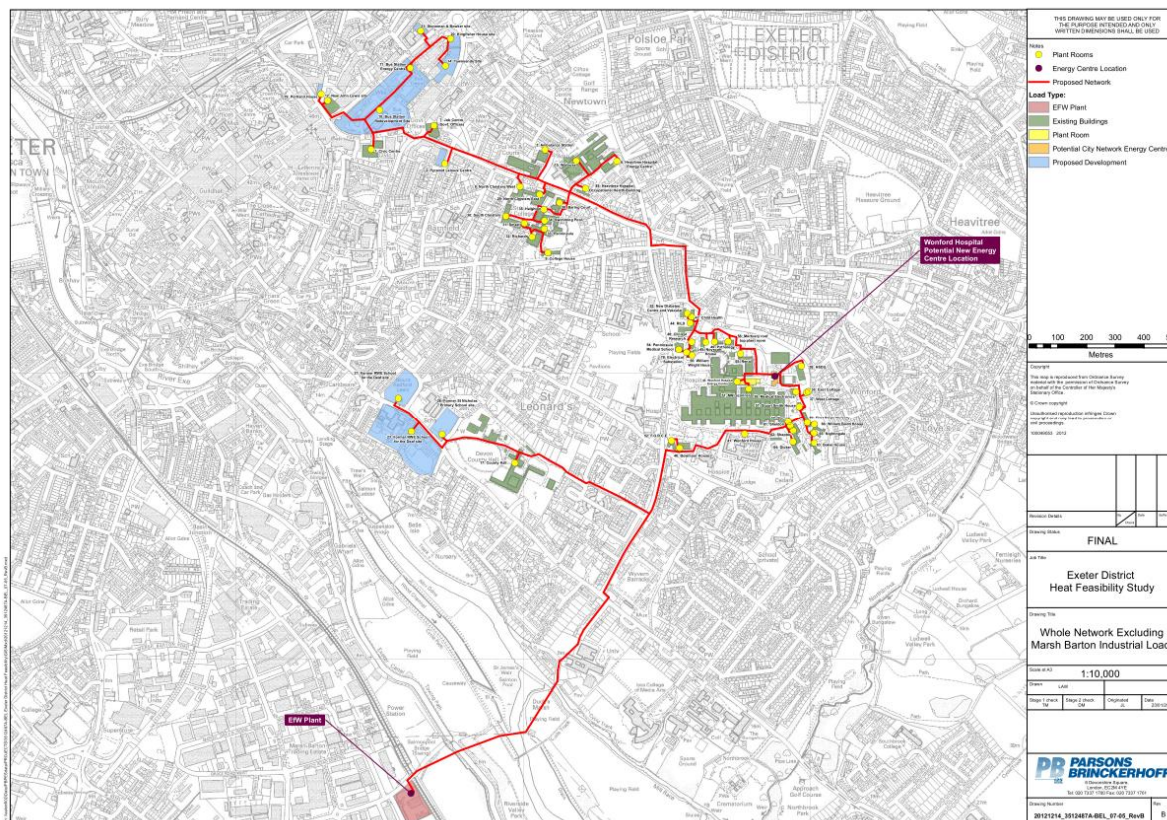


Table 11-6: Whole Network, excluding Marsh Barton Industrial Loads Network Parameters

Network	
Network length (m)	8,809
Heat Loss	7.4%
Pump Power (kWe)	228

11.5.2 Marsh Barton Loads removed

Table 11-7: Marsh Barton Industrial Loads

ID	Load	Heat demand (kWh/year)	Peak Load (kW)
67	EIC South West Metal Finishing	2,800,000	1,750
68	Polestar	1,199,930	300
70	Hendy Van & Truck	304,477	400
	TOTAL REMOVED	4,304,407	2,450
	RESULTING TOTAL	46,478,580	31,533

11.5.3 Options Modelled

The Energy from Waste plant was modelled alone as the sole low carbon plant (Option A) and the two further options included a single CHP engine of increasing size, 1.2MWe and 1.5MWe.

Table 11-8: Whole Network, excluding Marsh Barton Industrial Loads Plant Options

Option	A	B		C	
Plant	EfW	EfW	CHP 1	EfW	CHP 1
Electrical output (kWe)			1,190		1,487
Electrical efficiency (GCV)			38%		38%
Thermal efficiency (GCV)			41%		41%

11.5.4 Capital Cost Estimates

The most significant reductions in capital costs are due to removal of provision of plant in the vicinity of the Energy from Waste plant to act as auxiliary and backup heat generation plant for the local loads.

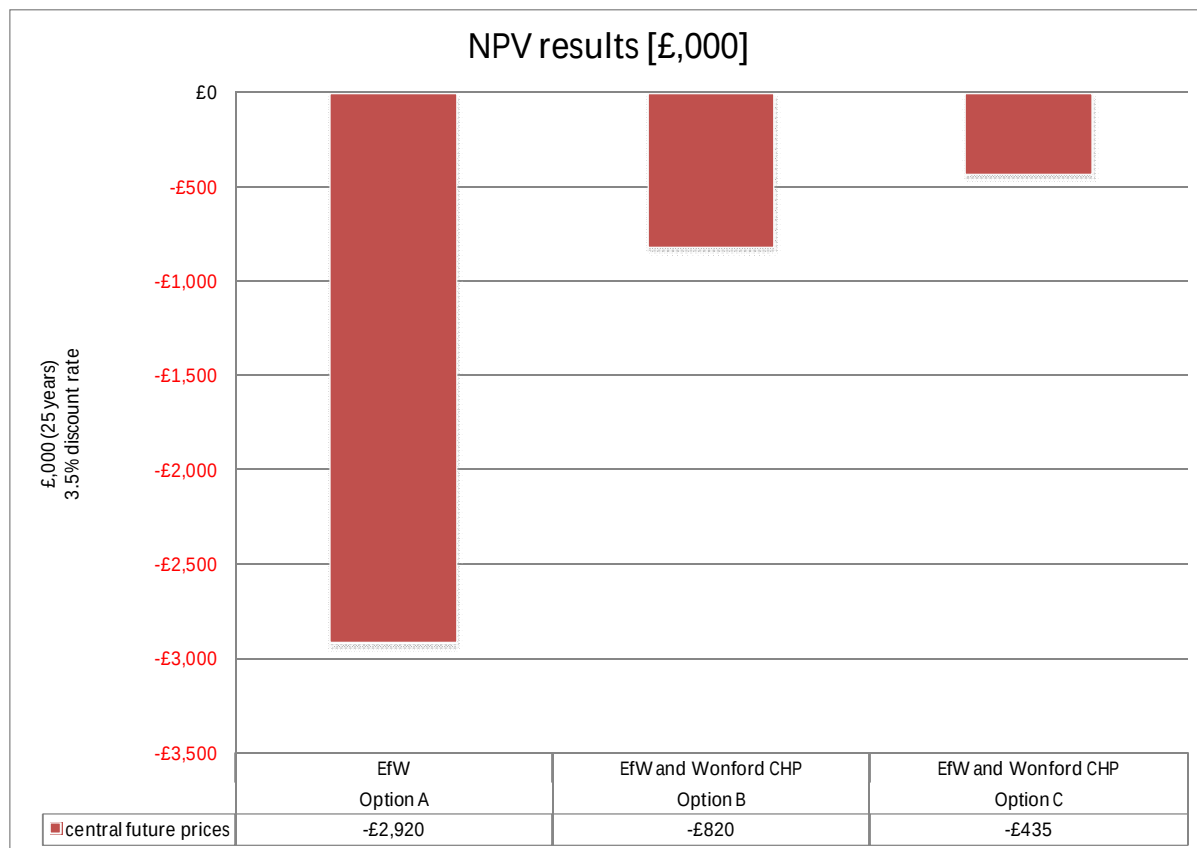
Table 11-9: Whole Network, excluding Marsh Barton Industrial Loads Capital Cost Estimates

	EfW	EfW and Wonford CHP	EfW and Wonford CHP
Main plant	£800,000	£1,305,201	£1,394,174
Energy centre	£4,718,000	£4,718,000	£4,718,000
Network	£11,450,000	£11,450,000	£11,450,000
Fees & PM	£900,000	£900,000	£900,000
Contingency	£3,533,800	£3,634,840	£3,652,635
Total	£21,401,800	£22,008,041	£22,114,809
S106 Contributions	-£199,000	-£199,000	-£199,000
Net Investment	£21,202,800	£21,809,041	£21,915,809

11.5.5 Results – DECC Central Prices Scenario

Again option C provides the best economic case but all three options provide a higher cost of heat supply than the Business as Usual case. The removal of the industrial loads, and the associated reduction in CHP generation at Wonford, reduces the value of the scheme against the previous case including these loads.

Figure 11.5-2 - Whole Network excluding Marsh Barton Industrial Loads Net Present Value Results at Central Future Energy Prices



11.5.6 Projected Emissions Savings

Figure 11.5-3 - Whole Network excluding Marsh Barton Industrial Loads Projected Emissions

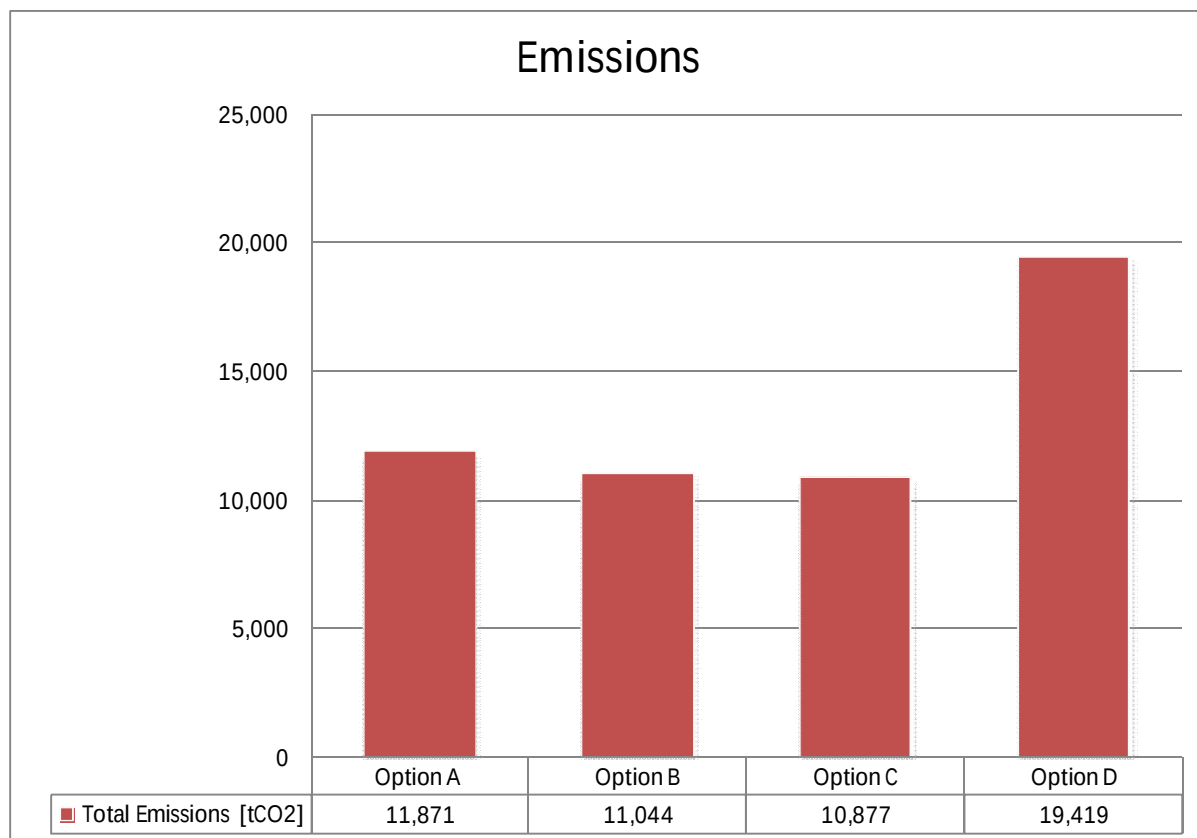


Figure 11.5-4 - Whole Network excluding Marsh Barton Industrial Loads Projected Emissions Savings

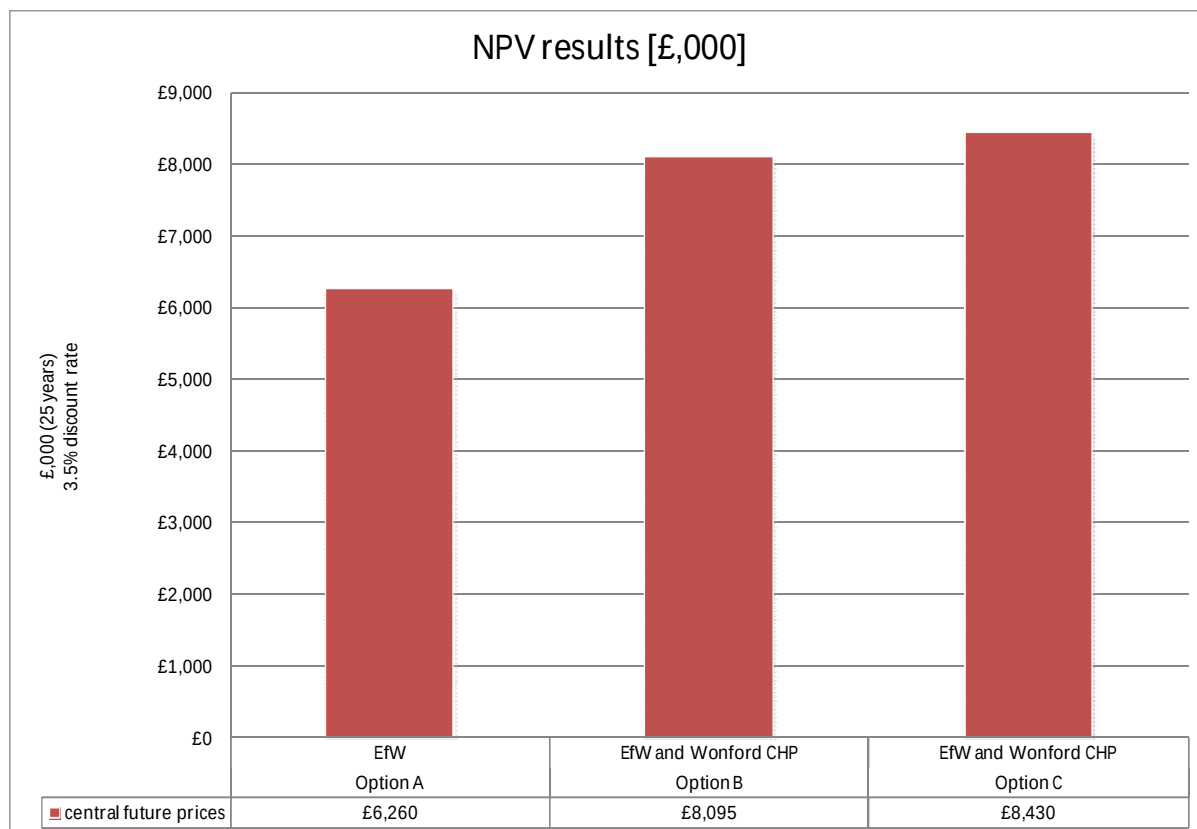
Option	Option A	Option B	Option C	Option D
Total Emissions [tCO ₂]	11,871	11,044	10,877	19,419
Emissions reduction versus Base Case [tCO ₂]	7,548	8,374	8,542	

Note: The total emissions presented relate only to the supply of heat at connected buildings with no allowance for electricity consumption except for Wonford Hospital which houses the energy centre. Further discussion at section 7.1.2.

The removal of the industrial loads also reduces the environmental benefits in terms of carbon emission reductions. Carbon Dioxide emissions savings reduce by nearly 1,300 Tc per year against the previous case.

11.6 Inclusion of Increased Incentive Revenues, with Marsh Barton Loads removed at central future energy prices

Figure 11.6-1 - Whole Network excluding Marsh Barton Industrial Loads Net Present Value Results at Central Future Energy Prices with increased RHI Tariff



The inclusion of the RHI at 4.1p/kWh provides positive NPVs for each option considered.

11.7 Devon County Hall Link Assessment

Although an assessment of the value to the network of the link to Devon County Hall and adjacent new developments is as valid for this (the whole network) scheme as it is for the Wonford and City Centre scheme, it has not been assessed as part of this study. This section outlines the reason for not assessing the link.

There are already four variants of this scheme that were modelled and are presented here. To add a further variant, of modelling the scheme with and without the County Hall link, would multiply up the number of cases that needed to be presented to eight (assessing the value of the County Hall link in or out of each of the four variants presented already). This number of variants would begin to cloud the conclusions able to be drawn from the results.

The County Hall link is shorter for this (whole network) scheme. Adding County Hall and adjacent proposed developments onto the Wonford and City Centre network involves additional network from Wonford to County Hall. The connection to the Energy from Waste plant in the Whole Network

scheme runs along this route and so the connection to County Hall only needs to run from this route (along Barrack Road) to County Hall, a much shorter run.

The benefit/impact of the Devon County Hall link has already been assessed for the Wonford and City Centre scheme. That is a smaller scheme (in terms of both the magnitude of loads served and the length of network installed) and the addition/exclusion of the County Hall link will have more impact on that scheme than on the "Whole Network" scheme. We can draw the conclusion on this basis, that the impact/benefit of the Devon County Hall link on the Whole network scheme will be similar but slightly reduced compared to the impact on the Wonford and City centre scheme.

For the purposes of this study and in the light of the significant additional complexity that modelling this link in or out of the network would add, it was decided that no further analysis was necessary.

11.8 Scheme Conclusions

Without the incentive revenues the supply of heat from the EfW does not provide additional value to the DH network based on the DECC Central Prices scenario. This is largely due to the reduction in electricity generation at Wonford Hospital. With incentive revenues the scheme becomes much more attractive.

It should be noted that in this section the RHI incentive payment is modelled at 4.1p/kWh. This level has been published in the recent Government consultation as applying to "Biomass CHP schemes". It is not clear at present whether this level will actually be applied as published or if it will equally apply to EfW CHP because although biomass and EfW are currently treated the same under RHI there is no guarantee that this will continue. A final investment decision should not be taken until the incentive levels and their applicability have been confirmed.

Further modelling is provided at section 13 showing the impact of RHI rates at both 1p and 4.1p/kWh and the impact of different energy prices.

As discussed in section 5.3.5 Exe Crossing Feasibility Study Conclusions, the feasibility of using Directional Drilling to route a heat network pipe from the EfW to the City Centre was researched further after the completion of the Exe Crossing Study. Our estimates have calculated that this method may offer a saving on the capital costs in the order of £1,000,000. Such a saving, if applied to the financial model for the Whole Network including Marsh Barton Industrial Loads at 4.1p/kWh RHI and central prices, would result in the Net Present Value increasing from £10,275m to £11,241m and the IRR from 7.43% to 7.94%.

12 POTENTIAL EXTENSION TO SW EXETER AND MATFORD PHASE 3

12.1 Overview

12.1.1 Background

The masterplan for SW Exeter shows the provision of some 2,500 new homes in Alphington and adjoining to the south in Teignbridge. Planning consent is also in place for the southern extension (Phase 3) of the Matford business park. This consent includes the section 106 conditions to:

- Design buildings to be DH ready
- Provide easement for and facilitate installation of DH mains to serve and run through the site
- Pay a penalty for any buildings that do not connect to DH
(with some caveats about the timing of DH availability)

Exeter and East Devon's success in promoting district heating and CHP in new developments such as Cranbrook, Exeter's policies encouraging CO₂ reduction and connection to district heating and the proximity to a potential low carbon heat supplier (the energy from waste facility in Marsh Barton) provide the ingredients for a district heating network in SW Exeter.

The economics of new build domestic district heating are critically dependent on the avoided costs for the developers and the economies of scale which the company providing the network can bring to the project. The approach to the assessment of SW Exeter therefore needs to be more detailed than that adopted for this study. This section therefore provides a consistent set of engineering and cost assumptions for connection to the EfW plant and an assessment of the impacts of connecting SW Exeter on other parts of the network to support a more detailed assessment of the area.

12.1.2 Overall Demand Projections

The following loads have been assessed for the connection of the area based on the masterplan and information for Matford Phase 3. The calculations reduced the Masterplan energy demand forecast by the demand presented in the Matford Park Phase III Energy Statement. These demands are very uncertain, in both scale and timing. The actual demands will depend on the final proposals for low energy design and the specific uses for commercial property.

Table 12-1: Alphington and SW Exeter Masterplan Loads

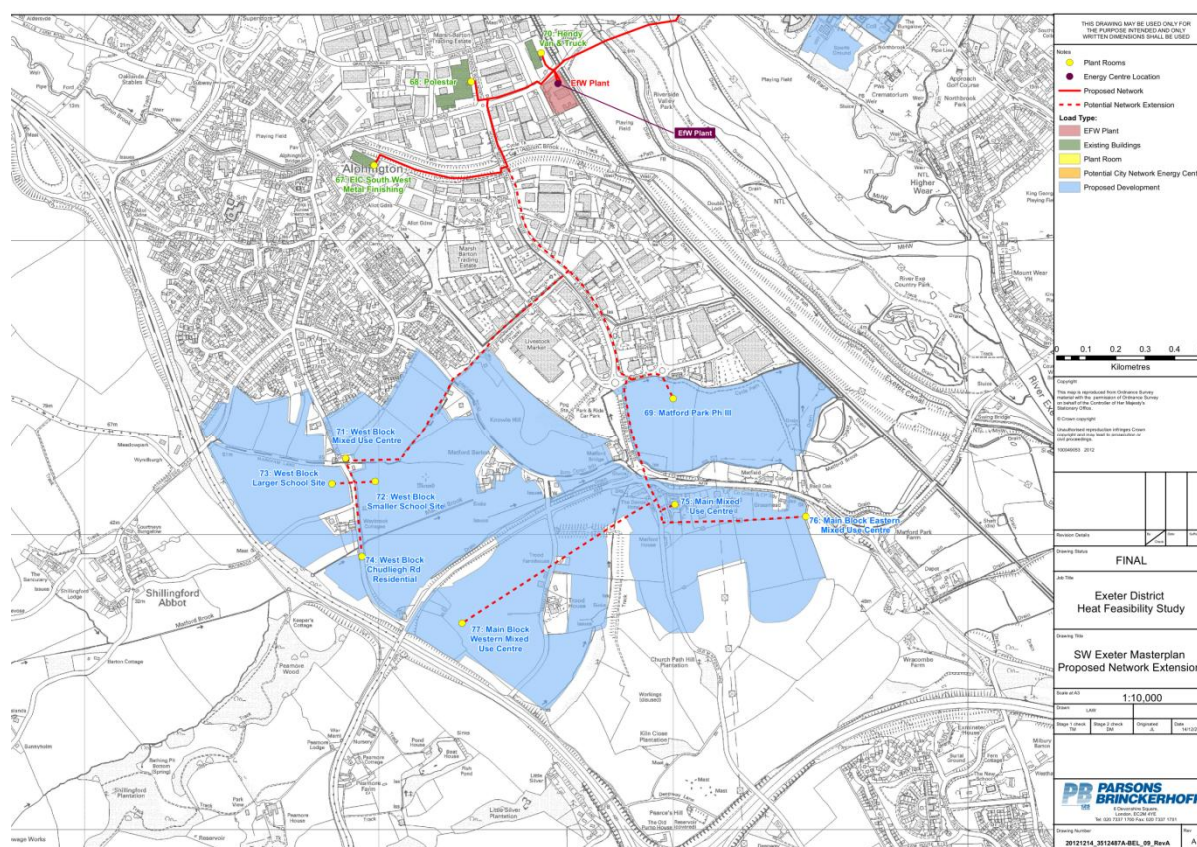
ID	Load	Heat demand (kWh/year)	Peak load (kW)	Load factor
69	Matford Park Ph III	2,419,300	8,029	3%
71-77	SW Exeter Masterplan	16,739,700	16,099	12%
	TOTAL	19,159,000	24,127	

12.2 Potential Network Extension Route

12.2.1 District Heat Network Route

The Marsh Barton to SW Exeter and Matford Phase 3 network option is considered here as a further extension of the Whole Network option modelled above. In order to assess the potential for heat supply to these developments it is necessary to make assumptions regarding how the energy supply would be configured. It is assumed that these developments would be designed to use district heating from the outset and that local energy centres would be available to supply both top up and back up heat supplies and local distribution pumping. The network assumed here would therefore be for transmission of the low carbon heat from the EfW plant to these local centres. A potential provisional network extension route is indicated in Figure 12.2-1 below. This network would form part of more extensive local networks which can only be optimised and fully costed once more details of the site layouts are known. If heat is not taken across the Exe and DH at SW Exeter and Matford Phase 3 is viable on a stand-alone basis this scheme could tie in with the EfW plant.

Figure 12.2-1 - Marsh Barton to SW Exeter and Matford Phase 3 Potential Network Extension Route Map



12.2.2 Energy Centre Location

It is assumed that the developments would be designed to use district heating from the outset and that local energy centres would provide top up and back up heat supplies. The main Whole Network

energy centre would remain located at Wonford Hospital with the EfW plant site providing only heat exchange and pumping/thermal storage for the EfW plant heat supply.

12.2.3 Heat supply available

In the Whole Network scheme the CHP capacity which can be installed at Wonford Hospital when operating in conjunction with the EfW plant is significantly reduced from that where the hospital acts alone as the main heat supply. Ideally the CHP capacity at the hospital would be increased to maximise the proportion of the on site electrical load that is supplied locally. The preferred scale of CHP at Wonford would be a total of 4MWe as against 1.1MWe when supplying alongside the EfW plant. With 4MWe of CHP at Wonford an additional supply of around 3MWth of low carbon heat capacity could be provided to the SW Exeter area. This heat would be supplied from the EfW plant and hence would be available for some 7500 hrs per year giving an annual heat supply of around 22,500MWh per year.

This is greater than the heat load in SW Exeter and Matford Phase 3 however it would not be practicable to meet the total annual load as supply and demand would not always be coincident and peaking boilers would be needed to meet peak demands. Based on experience we would estimate that the EfW plant could meet some 70% of the annual heat demands or around 15,000MWh per year.

None the less, the provision of heat to SW Exeter potentially enables the Wonford Hospital CHP to provide higher value to the Whole Network option.

12.3 Financial Assessment

12.3.1 Capital Cost Estimates

Based on the assumptions above the additional costs for this extension would be restricted to network and interface costs plus some minor additional pumping costs. A high level capital cost assessment for this gives the total capital cost estimates as shown below. This is presented as an extra cost of installing the network as an extension of an existing network serving the Marsh Barton Industrial loads.

These calculations are based on two options, firstly to supply base load only from the EfW plant and secondly to supply full peak load demand. The baseload is estimated at 6MW and the peak at 20MW. The network for which these costs have been estimated is a subset of the whole network in the drawing above on the assumption that the further network branches would be installed by the developer. This network serves only two points in the SW Exeter Masterplan area at load 71, and 75 as identified in Figure 12.2-1.

Table 12-2: Alphington and SW Exeter Masterplan network cost estimates

	Length [m]	Peak load pipe diameter	cost	Base load pipe diameter	cost
from existing network to split	424	250mm	£ 514,500	150mm	£ 406,500
from split to load 75	959	200mm	£ 995,500	150mm	£ 918,500
from split to load 71	1,065	150mm	£ 1,020,500	100mm	£ 1,020,500
Pumping			£ 20,000		£ 20,000
	2,448		£ 2,550,500		£ 2,365,500

If the network serving Marsh Barton Industrial loads is not developed, then a further section of network would be required to connect the EfW to the network outlined above. The cost estimates for this section are presented below. However, an estimate has not been made of the stand alone plant required at the EfW plant in this instance. The incremental cost increase from baseload to peak is approximately 10% of the total capital cost of the installed network.

Table 12-3: Additional network costs if no existing Marsh Barton Industrial Load network

	Length [m]	Peak load pipe diameter	cost	Base load pipe diameter	cost
from EfW to network above	550	250mm	£ 667,500	150mm	£ 527,000
	2,998		£ 3,218,000		£ 2,892,000

In 2012 the Regional Growth Fund allocated a £1,000,000 grant to support the use of heat from the EfW plant in Matford and SW Exeter. This grant offsets a significant proportion of the capital cost of the network.

12.3.2 Factors affecting the SW Exeter Network

Further site specific study is required to assess the SW Exeter network. Key factors affecting the network will be:

- Site layout and the resulting DH network layout which, in turn will establish the correct incremental cost of connection to the EfW plant
- The price of heat from the EfW plant, the level of the RHI and commercial negotiations on the EfW heat supply tariff and allocation of RHI revenue
- The on-site district heating economics for the SW Exeter including developer avoided costs and the economies of scale achieved by the network operator

12.4 Potential Network Extension Conclusions

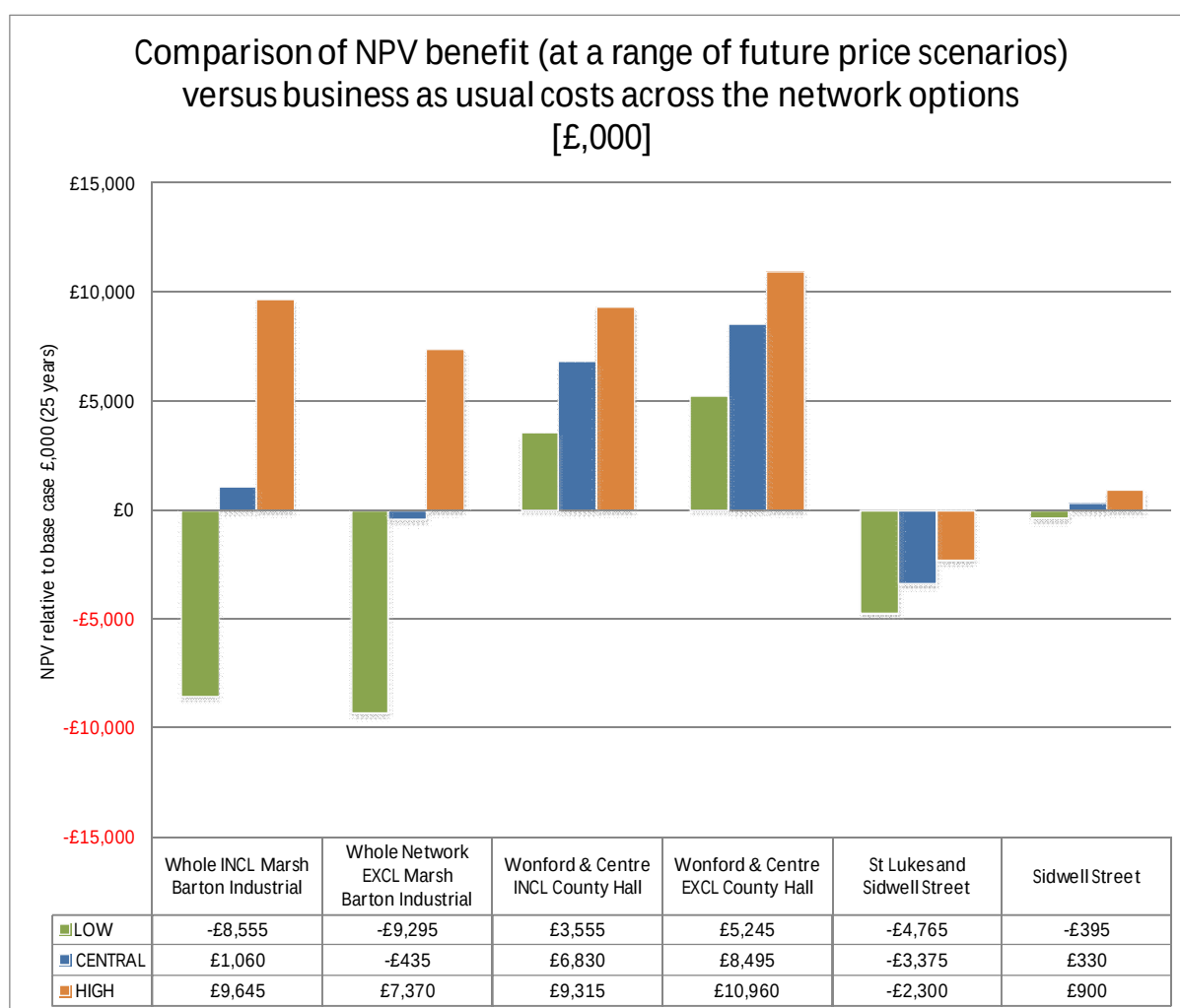
There is the potential for heat supply capacity to be made available from the EfW plant to the SW Exeter masterplan area. If this were to be combined with the Whole Network scheme this would require additional CHP plant to be installed at Wonford Hospital. This additional capacity would be welcome as it would allow more local electrical supply of on-site loads. Further site specific assessment is required to fully evaluate the SW Exeter network. Depending on the timing of development and the Exe crossing, consideration may need to be given to taking forward the SW Exeter and Matford Phase 3 scheme ahead of the Exe crossing being in place.

13 SCHEME ECONOMIC MODELLING AND SENSITIVITY ANALYSIS

13.1 Comparison of Scheme performance

In order to understand how the schemes perform under potential future energy price inflation, two further scenarios have been calculated, based on DECC low and high future price scenarios (presented at 7.3 and data provided in Appendix H). The full range of results for these varying future price scenarios is presented below. Again, the two schemes that could benefit from the Renewable Heat Incentive have been presented here with it set to 1p/kWh and all schemes at a discount rate of 3.5%.

Figure 13.1-1 - Net Present Value Comparison across the network options at a range of future energy prices



The sensitivity to RHI payment levels at 1p/kWh and 4.1p/kWh (used in the Whole Network evaluation at sections 11.4 & 11.6) is shown below using the central price scenario.

Figure 13.1-2 - Net Present Value Comparison across the network options at CENTRAL prices

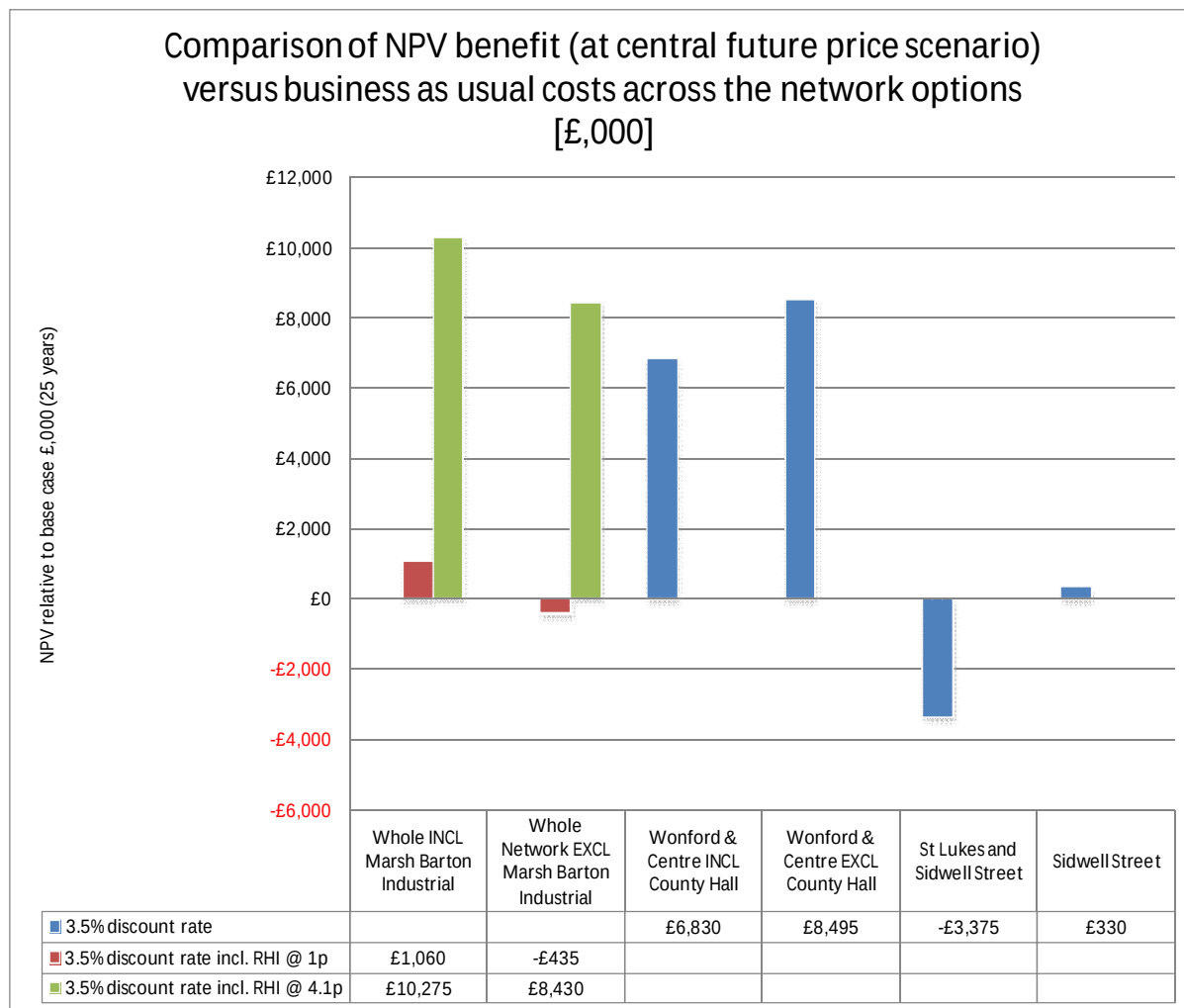


Table 13-1: IRR results for CENTRAL price scenario

IRR	Whole INCL Marsh Barton Industrial	Whole Network EXCL Marsh Barton Industrial	Wonford & Centre INCL County Hall	Wonford & Centre EXCL County Hall	St Luke's and Sidwell Street	Sidwell Street
	Option C	Option C	Option C	Option C	Option C	Option C
			7.4%	8.8%	-'ve'%	4.5%
RHI = 1p	3.9%	3.3%				
RHI = 4.1p	7.4%	7.3%				

These IRR results are presented for the purposes of comparison of performance of the options within this study. They are only representative of the potential levels of IRR the schemes may achieve.

13.2 Results Summary

A summary of the main parameters of the preferred options for each scheme is presented in the table below.

Table 13-2: IRR results for CENTRAL price scenario

		Whole INCL Marsh Barton Industrial	Whole Network EXCL Marsh Barton Industrial	Wonford & Centre INCL County Hall	Wonford & Centre EXCL County Hall	St Luke's and Sidwell Street	Sidwell Street
		Option C	Option C	Option C	Option C	Option C	Option C
		Wonford Hospital	Wonford Hospital	Wonford Hospital	Wonford Hospital	Triangle Car Park	BT Exchange
network	m	10,014	8,809	7,402	5,446	3,208	1,489
CHP 1	MW _e	2.5	1.5	2.5	2.5	1.5	2.0
	MW _{th}	2.7	1.6	2.7	2.7	1.6	1.9
	MWh	7,194	4,513	18,745	18,521	8,775	8,686
CHP 2	MW _e			2.5	2.5	1.5	
	MW _{th}			2.7	2.7	1.6	
	MWh			16,098	16,124	5,680	
EfW	MW _{th}	8.5	8.5				
	MWh	44,691	41,034				
auxiliary	MW						
	MWh	4,026	4,338	14,867	13,625	4,195	2,965
CO ₂	BAU t	20,693	19,419	19,419	19,098	4,342	4,298
	DH t	10,891	11,074	11,545	11,252	994	2,114
	saving tCO _{2e}	9,802	8,344	7,874	7,845	3,348	2,185
financial							
network	£,000	12,750	11,450	6,750	5,290	2,800	1,350
full cost	£,000	24,391	21,916	15,245	13,493	7,924	4,153
NPV	£,000	1,060	-435	6,830	8,495	-3,375	330
IRR	%	3.9%	3.3%	7.4%	8.8%	-'ve'	4.5%

NPV and IRR values calculated at CENTRAL future price scenario, NPV at 3.5% discount rate and where eligible RHI at 1p

13.3 Conclusions

The detailed modelling in earlier sections has been used to identify the financially best performing plant selection for each scheme. This analysis was based on an assumption that energy prices rise in line with DECC's central energy price scenario. In this section we have assessed the sensitivity of the best option within each scheme using DECC's high and low energy price scenarios. This analysis shows the sensitivity of the scheme economics to variations in future energy prices. The sensitivity of the EfW schemes to high and low RHI levels has also been assessed.

Projecting future energy prices is highly complex and previous projections have been subject to large variations from actual outturn prices – both high and low. It should also be noted that the relative performance of all the schemes is very sensitive to the relative change in price between electricity and gas markets as well as general energy price increases. All the results presented are therefore indicative only and investors' views of future energy prices will significantly impact on the viability of the schemes.

The Wonford and City Centre scheme is the most financially attractive scheme under all price scenarios examined. Using DECC's Central price scenario the Wonford and City Centre scheme without the County Hall link provides an IRR of 8.9%. The smaller Sidwell Street scheme shows a 4.5% IRR while the Whole Network including Marsh Barton scheme, based around heat supply from the EfW plant, yields a 3.9% rate of return (with the RHI at 1p/kWh).

The analysis shows that with the exception of the St Luke's and Sidwell Street scheme all schemes can potentially provide a positive NPV at 3.5% if energy prices increase in line with DECC's Central or High scenarios.

The level of RHI payments has a significant impact on the Whole Network scheme. At central prices with the RHI at 1p/kWh the NPV is -£1.1m. If the tariff for RHI rises to 4.1p/kWh the NPV rises to £9.6m. The allocation of the RHI revenues is subject to commercial negotiations on the supply of heat from the EfW plant to the Energy Network.

The assessment of the Whole Network scheme shows that it is significantly more sensitive to higher energy prices than the purely gas fired schemes. This is because the heat price at the EfW plant is less sensitive to energy price rises and so the relative cost benefit of EfW heat supply increases faster than schemes with gas as the fuel. This is illustrated by comparing the change in NPV for the Whole Network (with a RHI of payment of 1p/kWh) and Wonford and City Centre schemes when switching between price scenarios. In moving from Central to High prices scenarios the Whole Network scheme increases NPV by some £8.6 million. The Wonford and City Centre scheme by comparison increases NPV by only £2.5 million. This indicates that if prices rise beyond the High scenario, or the RHI for EfW supply increases above 1p/kWh) then the supply of heat from the EfW plant is likely to become the preferred option.

SECTION 4

DELIVERY AND BUSINESS MODEL OPTIONS

14 BUSINESS PLANNING AND OPTIONS

14.1 Local Authority Role and Commercial arrangements

The success of any strategy to develop DH in Exeter will depend critically on the availability of:

- Funding
- An agreed commercial framework
- Commercial and regulatory (including planning) drivers for connections
- An acceptable risk profile for investment
- Suitably qualified technical resources

In addition to the above the following issues need to be considered: political commitment, support from stakeholders, successful communications programme to gain widespread support for the scheme. This section of the report considers the structures, approaches and funding sources that are available, discusses the advantages and disadvantages of these, using case studies to illustrate these, and suggests likely preferred route for the Local Authorities (the LA's) in delivering their long term objectives for Exeter.

14.1.1 Background

Historically the development of district heating in the UK has been; with some significant but isolated exceptions (see below) relatively small scale, developed by local authorities to serve social housing, funded from public finances and often not maintained or developed in a commercially sustainable way. More recently there has been a move to develop schemes in partnership with the private sector and specifically towards the creating of Energy Service Companies (ESCOs). This move has been primarily due to the lack of public funding for infrastructure projects but has also been driven by the acceptance that systems need to be managed and maintained in a commercially viable manner and that this requires a range of technical and commercial skills which are not always available in the public sector.

Therefore the process of investigating potential business models for district heating based ESCOs and energy services schemes starts with an acknowledgement that, until recently, there were no private sector companies capable of delivering large scale DH projects connecting existing buildings without specific local authority sponsorship. This is changing and there are now significant opportunities to develop successful projects. A decentralised energy approach provides the opportunities for energy cost and carbon emission reduction under which developers responsible for large new-build projects may build flexible energy systems for the future. The development of such schemes can also act as a catalyst for the decarbonisation of existing buildings in the surrounding area.

There are two examples of urban DH schemes that have successfully developed beyond the "estate project" scale and have delivered significant private sector commercial connections, of

new and existing development, in Sheffield and Southampton. Both of these are now wholly private sector owned but were originally developed with significant support from the local authority, both in terms of access to funding and in provision of base load heat off-take and long term connection agreements.

The development of the private sector ESCO market reflects the requirement from planning authorities that energy generation and supply to buildings be considered with the aim of minimising carbon footprint of buildings overall. This has created a market of developers who are seeking to contract out their commitments under planning permissions. The planning process is likely to remain a key driver in the short-term but there are also more strategic approaches being developed towards the use of district heating, in major cities such as Leicester, Coventry and Newcastle. Birmingham in particular has partnered with a private sector firm to develop schemes in the city with a view to developing a city-wide district energy network. Two schemes are currently operational, both of which centre around public sector core loads.

14.1.2 Potential commercial arrangements

There is a range of potential approaches to the general development of district energy schemes under sponsorship by the public sector, which are summarised in the table on the following page. It should be noted that this list is not exhaustive of all the potential commercial arrangements possible for public-private partnerships but it does cover the main types of scheme development that have been undertaken to date. It should also be noted that there is no restriction to using different forms of organisation during different phases of the project life. For example the ownership of the Sheffield scheme was originally a mix of public and private but the local authority disposed of its share once the scheme was developed and could be re-financed. This is a good example of a local authority taking some risk early in a project to reduce the costs of finance and then disposing of its interest once these risks have fallen away.

Description	Funding	Construction	Ownership	O&M	Examples
Public Sector - traditional	the LAs funds Grant funding Over public funds	Public procurement of construction contracts by the LAs	the LAs direct	the LAs internal or public procurement of O&M contract	LB Southwark New Place Estate, Lerwick
Public sector – arms length organisation	the LAs funds Grant funding Over public funds ALMO Borrowing	Public procurement of construction contracts by ALMO	ALMO	ALMO direct or public procurement of O&M contract	Pimlico District Heating Undertaking, Aberdeen Heat and Power
Public Private Partnership – JV company	Part as Public Sector plus private sector equity plus private sector debt	Public/private sector procurement of construction contracts (depends on JV structure and partner capabilities)	JV Co Ltd	JV Co direct or Public/private sector procurement of O&M contracts (depends on JV structure and partner capabilities)	Thamesway Woking, initial Sheffield scheme, BirminghamCC/Utilicom
PPP – split responsibilities (e.g. energy supply private – infrastructure public sector)	Part as public sector plus private sector equity plus private sector debt	Split public/private procurement with interface management	Split public/private	Split public/private procurement of O&M services. Public O&M potentially packaged with private sector partner	Nottingham
Private sector – direct ES contract	Private sector debt/equity Grant funding – limited availability Supported by contract for services	Public procurement for ES Service – fixed scope Private sector construction contracts	Private sector – possible future reversion to public after defined period	Private sector	SSE Woolwich, Eon Dalston Square
Private sector – concession	Private sector debt/equity Grant funding – limited availability Supported by concession	Public procurement for concession – fixed area/service variable scope (likely base case fixed scope required). Private sector construction contracts	Private sector – possible future reversion to public after defined period	Private sector	Olympic Park/Stratford City
Private sector speculative	Private sector debt/equity Grant funding – limited availability	Private sector	Private sector	Private sector	Southampton

14.1.3 Key commercial variables

The options given in the table above have varying advantages and disadvantages which generally fall under the following headings:

- Cost of funding
- Risk versus control
- Regulations and licensing
- Availability of resources/skills

14.1.3.1 Cost of Funding

The cost of funding is critical for DH projects as the cost of infrastructure is generally high and the life of the system long. This has been recognised by central Government. There has historically been a mismatch between the nature of returns for these projects and the needs of private sector finance. Due to the lack of regulatory structure and high costs of market entry DH projects are treated individually (i.e. project financed) and the costs of private sector funds is driven by competition with other generally faster return projects rather than as a low risk long term investment.

Generally the public sector has better access to funding at lower cost than the private sector. The private sector generally has access to more funding from the debt markets albeit that this is now less easy to obtain and available at a higher rate than has previously been the case. The private sector generally has a shorter timeframe for economic analysis and a stronger focus on pure financial returns than the public sector, which are often able to take account of the value of other potential returns such as environmental and social improvements.

14.1.3.2 Risk versus Control

Public sector organisations are generally risk averse and there has historically been a tension between the desire from local authorities, and others, to move all risk to the private sector and the desire to retain control over the development of potentially high profile and high impact projects. If there is a full transfer of risk to one party then that party will, naturally, require full control over management of the risks and will be unwilling to allow outside influence on the operation and development of a project.

The transfer of risk also has implications for the costs of funding and a realistic approach to risk needs to be adopted to give a project a chance of proceeding. The principle by which an ESCO should operate in terms of dealing with risk is the same as any other business operation – allocate the risks to the party most familiar with the specific risk and by implication most able to deal with it easily as a result of their normal operational practices and structures. The means by which risk is dealt with – transfer, distribution, mitigation and tolerance – reflects the aim to reduce the possibility of occurrence and impact as far as is practically possible, thereby minimising obstacles to the long-term financial stability of the organisation ultimately responsible for the projects.

Responsibility for risk has important implications financially for the partners engaged in the development of the ESCO – where risk is allocated within a partnership determines where the financial benefits are distributed. Capital and operational risks will have a proportion of finance or a share of profits associated with them – this is where careful consideration of the objectives of the ESCO from the point of view of the LAs should take place.

14.1.3.3 Regulations and Licensing

Note that we are not able to provide legal advice. The following section sets key issues and some potentially beneficial legislation. We are not able to advise on any specific use of this legislation and this section should not be seen as providing any recommendation in relation to LA powers or procurement requirements.

The heat market in the UK is unregulated at present. This lack of specific regulation may act as both a help and a hindrance to the development of DH. Whilst the lack of regulation provides commercial freedom to develop schemes as required by local circumstances, schemes are generally caught by a range of different regulations related to issues such as town planning, carrying out streetworks and environmental compliance without a national framework for how these will be applied. This can mean a significant amount of work being required to mutually agree the way in which regulations will be applied to this type of scheme and restrictions on ability to access equipment which can create difficulties throughout the project life.

Local authorities can help to get over some of these issues in a number of ways. The Local Government Act 2000 gives local authorities broad powers to act for “Community Wellbeing” In addition the local authority can add value by providing a coordination role for their various departments that will have an input to control of such a scheme, such as Highways, Environmental Health and Planning.

The Local Government (Miscellaneous Provisions) Act 1976 also gives Local Authorities broad powers in relation to the production, procurement and sale of heat and electricity. Careful thought, and legal advice, will be required to ensure that the LAs correctly exercise their powers to, for example, let a concession for delivery of low carbon schemes or to require/encourage others to connect to such schemes. Any procurement process for this type of arrangement will have to be carefully thought through. The potential risks perceived by the private sector in this regard should not be underestimated; private companies will be unwilling to commit significant resources or funds to a process which they are not confident can be completed. In addition the value that can be placed on commitments by the LAs to require connection to new developments will depend critically on the robustness of these commitments as well as the perceived development risk.

14.1.3.4 Availability of Resources and Skills

No matter which approach the LAs finally chooses to take they will wish to ensure that the delivery of schemes is achieved safely, to programme and to a quality specification. Achievement of this requires the use of high quality resources, with sufficient experience of delivery of this type of schemes. The way in which the LAs can ensure adequate resources are available, and engaged on

their projects, will vary depending on the final route selected. What must be noted is that, even where an organisation has an excellent track record in project delivery, the specific personnel who will be in key positions will have a significant impact on actual project outcomes. Which ever approach is taken the LAs will need to ensure that they have the ability to monitor progress and quality – the self-interest of a concessionaire will not necessarily make up for lack of experience of key people and the LAs will always retain some reputation risk whatever the structure adopted for delivery.

14.1.4 Funding Available

There are a range of options for funding of this type of scheme. It is likely that the funding scheme will be made up from a range of sources both public and private. The most likely sources of funding are:

1. Connection charges to new developments – these reflect the offset of on site costs for the provision of low carbon energy supply plant
2. Section 106 agreement or infrastructure levy payments by developers not connecting to the scheme
3. Existing funds held by stakeholders or potential connections for plant replacement or on site low carbon plant e.g. Wonford Hospital intends to invest in additional CHP plant and will need to replace its existing CHP in the medium term and may be willing to invest in the DH scheme instead in return for additional carbon or energy cost savings.
4. Grant or low costs loads from publicly supported schemes such as Green Bank or European Investment Bank. No specific grant schemes for DH are available at present but a range of options for low cost investment in green infrastructure are being developed.
5. Private sector funds – likely to be invested via an Energy Services Company (ESCO)

14.1.5 Operation of Schemes

The requirement for skilled and experienced resources is not restricted to scheme development. There has been a history of scheme performance deteriorating over time in the UK due to inadequate training and supervision of operations and maintenance. There has also been a tendency towards short-term thinking in relation to maintenance, particularly of CHP units but also of DH assets. Finally whilst short-term contracting for maintenance is undesirable there are also pitfalls in long term arrangements particularly in ensuring performance is incentivised appropriately over the life of the contract, and in dealing with indexation for cost increases over time.

Arrangements will ideally be:

- long term - preferably matched to the expected life of the asset and with provisions for hand-back of plant at the end of the term in a suitable condition for ongoing operation for at least 12-24 months
- simple - avoiding trying to address all possibilities for the future now but with straightforward management procedures which allow each party appropriate control over changes requested by the other
- flexible - able to adapt straight forwardly to changing market conditions preferably via defined negotiation and modelling processes
- with sufficient provision for oversight and reporting that the asset owners and end users of the system can be assured they are getting good value over time.

14.1.6 Commercial Conclusions and Recommendations

There are several common factors in successful schemes which develop beyond their initial scope:

- Strong public sector involvement in promoting and sponsoring the scheme
- Maximising access to public funding, particularly in the early development stages
- A clear risk allocation structure which only transfers those risks that can be properly managed to the parties which can manage them
- Use of experienced and competent resources
- A recognition of the commercial drivers and limitations of the private sector partners
- Clear and standard arrangements for ongoing connections and charging
- Ongoing public sector monitoring and involvement – potentially as regulator of the service or operator of last resort

The main options that the LAs could adopt) are:

- To build the scheme under the LAs control and then contract with the private sector for O&M
- To build the schemes under the LAs control and then transfer to private sector or a joint public/private ESCO later should the returns be acceptable
- To form a joint public/private ESCO to build and operate the scheme

The future partnership with the private sector could take either of the forms identified above and the final decision on this will reflect the proposed ongoing strategy the LAs have for the development rather than specific advantages of one structure over the other.

The decision between the different options should be made based on the programme for the initial projects and the availability of public funds to develop them. We therefore recommend that the LAs:

- Ensure current levels of support from the LAs directors and council members for the schemes are maintained.
- Engage with the customers identified in this study with the aim of agreeing heads of terms for heat purchase from the Exeter network.
- Carefully consider the options for ownership/development to decide which most closely meets their requirements for ongoing involvement – we would propose that a working group is established by the key stakeholders to take the project forward.

14.2 Options for setting up an ESCO and programme for delivery

The proposed scheme will require a dedicated company with energy system delivery expertise, the ability to raise and manage significant capital investment and the experience to ensure that maximum value is derived from the various potential revenues. This would indicate that involvement of a private sector energy company with DH experience is necessary. It is however also true that there will need to be public sector involvement in the development of the scheme to overcome some of the up front development risks and as much as is possible facilitate a lower cost of capital. This involvement will be critical to the project's success but will need to avoid the potential for political risk to be seen as excessive by funders and partners.

It is therefore recommended that an ESCO is developed which will be led by a private sector partner but with participation from the public sector. Previous experience suggests that the simplest and lowest cost route to delivery of this partnership is via a Special Purpose Vehicle (SPV) – a limited company set up with a mix of public and private sector shareholdings. It may be however that an alternative structure would better suit the needs of the stakeholders and the options for Limited Liability Partnership or Co-operative models could be examined in development of the Business Plans.

A clear set of priorities, short and long term, for the public sector partners should be developed which can be written into the founding documents of SPV. This will provide clarity for the partners and should reduce the perceived political risk.

The preferred scheme relies heavily on the inputs from key Stakeholders. These are set out at high level below. A negotiation between the Stakeholders will be required prior to engaging with the private sector to confirm the participation of each in the SPV.

14.2.1 Royal Devon and Exeter NHS Foundation Trust

The development on the hospital site will require the following main inputs from the Trust:

- Provision of the building required for the energy centre on a secure long term lease
- Agreement to a long term energy supply contract for electricity, steam and hot water
- Agreement to long term wayleaves, easements etc for pipework and other equipment
- Investment of capital current set aside for alternative low carbon investments either direct in the ESCO or via connection payments
- Agreement to long term carbon benefit sharing arrangements

It is currently understood that the Trust would prefer to remain as host and customer to the ESCO with clear energy supply and service level agreements to ensure security of supply and cost effectiveness for the hospital. It is clear that the participation of the Trust is vital to the success of the scheme. There is therefore a specific need to provide more detailed information for the Trust to allow them to make the necessary investment and property decisions. This will require a further study from the Trust perspective which will need to cover:

- A financial comparison of the proposed Exeter District Heating scheme with potential Trust only options for CHP and/or other renewable energy and energy from waste – this assessment must take into account the costs and benefits related to all connections at both Wonford and Heavitree sites
- A comparison of the emissions savings for these options from the trust perspective across both sites
- A comparison of the risks to the Trust, technical, operational and financial for the various options
- An assessment of potential risks and opportunities related to the property requirements for the proposed DH scheme – this assessment should consider the potential implications for development of services at both sites

14.2.2 University of Exeter

It is currently understood that the University is a potential heat customer. In this scenario the development of the network will require the following main inputs from the University:

- Agreement to a long term heat supply contract for the St Luke's site
- Agreement to long term wayleaves, easements etc. for pipework and other equipment
- Investment of capital current set aside for alternative low carbon investments either direct in the ESCO or via connection payments
- Agreement to long term carbon benefit sharing arrangements

As a potential customer the University would require clear energy supply and service level agreements to ensure security of supply and cost effectiveness for their buildings.

The University should also consider investigating the viability of a network extension via Exeter Prison to the Streatham Campus.

14.2.3 Exeter City Council

The development of the network will require the following main inputs from the City Council:

- Support in negotiation of agreement to a long term energy supply contract for heat to new developments, City Council buildings (including those operated by contractors)
- Agreement to long term wayleaves, easements etc. for pipework and other equipment where these cross their land
- Investment of capital raised from Section 106 agreements, currently set aside for low carbon infrastructure and potentially other low cost capital that can be accessed via DECC or other Government sources either direct in the ESCO or via connection payments

- Support in planning and other consents for the network and energy centre – for example the City Council may have powers to install and operate heat networks as a pseudo-statutory authority and this should be investigated

It is believed that the City should take a more active role in development and running of the ESCO to ensure that policy requirements are delivered effectively and ongoing development of the network encouraged.

14.2.4 Devon County Council

The development of the network will require the following main inputs from the County Council:

- Agreement to a long term energy supply contract for heat to County Council buildings
- Agreement to long term wayleaves, easements etc. for pipework and other equipment where these cross their land
- Investment of capital currently set aside for low carbon infrastructure and potentially grants and low cost capital that can be accessed via DECC or other Government or EU sources either direct in the ESCO or via connection payments
- Support in highway consents for the network
- Support in agreement of heat off-take agreements with the EfW plant operators as such a connection becomes economic

It is believed that the County should take a more active role in development and running of the ESCO to ensure that policy requirements are delivered effectively and on-going development of the network encouraged.

14.3 Support for economic development created by DH

14.3.1 Stimulating residential development / regeneration

The supply of district heating to a new development can help developers to achieve compliance with building regulations. The availability of an approved 'off the shelf' route for compliance with building regulations and the code for sustainable homes, in the form of a DH network, represents a significant advantage for developers. It is anticipated potential development sites along the DH route would have an advantage compared with schemes that do not have the opportunity to connect to the low carbon scheme.

The supply of existing private housing, whilst technically feasible, has not been considered because of the significant financial, contractual and technical issues associated with connecting multiple homes in separate ownership. Generally, the connection of local authority housing would not currently be considered to be viable unless the dwellings were multiple address buildings, for example flats or other higher density housing stock that could be supplied from a single point.

14.3.2 Stimulating commercial development / regeneration

The potential for DH being able to supply low carbon, low cost heat has the potential to attract new business for which either of these two factors would be seen as a reason for relocating or re-investing in Exeter. The incentives for business to respond to the potential availability of such a network could be driven by some or all of the follow considerations

- cost savings from reduced fuel usage and reduced carbon emissions
- energy security
- marketing and external perception

The financial analysis undertaken in this study indicates that there is little or no scope for DH to produce in a reduction in average energy cost savings compared to the business as usual. However the considerable CO₂ reduction possible with various options could be used to promote a green image for businesses.

The DH network could stimulate industrial and business activity in a range sectors including:

- Food production / preparation / catering
- A low carbon office development with space heating/hot water provided via DH
- horticulture
- aquaculture

It is postulated that industrial restructuring over the next 10-15 years may create opportunities for the recycling of sites on some of the older industrial areas / estates in the Exeter Estuary area to create platforms for new investment from users of low carbon, low cost energy that would be supplied from DH

The other conditions that will need to be satisfied in order that the potential economic and business benefits of DH are captured include:

- the availability of planning permissions and other necessary permits
- a strong promoter/developer or , if public sector led, the leadership and on-going support of a strong partnership mechanism (such as the existing Growth Point), particularly if a combination of industrial, commercial, institutional, municipal and residential uses are in the proposed mix of uses for the heat/energy to be supplied from DH.

14.4 Commercial and residential sales model

The majority of the loads to be supplied from the DH Scheme are under the direct control of the stakeholders, therefore the sales model for these loads is a function of internal governance. Nevertheless, it is important to have an indicative commercial sales model in place in order to supply the limited private sector load. In addition a commercial sales model would be required should the scheme expand to supply 3rd party loads in the future.

The preferred residential sales model for developments in the City Centre would be direct between the DH ESCO to the customer, with no intermediary input. In order to provide transparency of costs the sales model must be simple and analogous to the gas and electricity energy purchase models that residential customers are familiar with.

It may be desirable to have a different model for development of DH in SW Exeter. This may effectively have two separate ESCOs – the Exeter DH developer who would be responsible for the link from the EfW to the development area and a separate developer ESCO to sell energy to the residents as described above.

It is suggested that the commercial and residential energy sales are broken down in the following manner

- Unit based tariff to cover the annual consumption of heat, this is charged on a p/kWh basis.
- Fixed or standing charge element. This should take the form of a monthly charge for maintenance, administration and other fixed operational costs.

It is suggested a comparison to the equivalent cost of heat provision from natural gas and a standard boiler is provided. Tariffs should be set based on a selection of other gas tariffs that are available for commercial or residential customers in Exeter. The heat tariff should then be indexed to this selection in order to provide a transparent means of setting the tariff and illustrating that the scheme represents better value for money than using gas.

14.5 Future Integration into City Wide Strategy

The retrofit district heating networks evaluated in this study have the potential to form part of a broader energy strategy across the greater Exeter area.

There are currently plans to follow the successful private sector district heating and biomass CHP scheme at Cranbrook and Skypark with a similar private sector scheme at the 2000 home Monkerton development in the east of the city. The energy centre currently proposed for Monkerton adjacent to the M5 may also connect across the motorway to Science Park and an 800 home new development which has recently received planning permission on land around Science Park.

As discussed in this study, a scheme is possible in the SW Exeter area serving new development there, possibly using heat from the Marsh Barton EfW plant. More broadly, the Whole Network

scheme evaluated in this study may link the EfW plant north across the river to the RD&E Hospital at Wonford. Heat supply from the EfW plant would be supplemented and backed up by a gas CHP at Wonford which would provide electricity and heat for the hospital and export heat to the network running into the City centre via St Luke's and nearby public buildings. As a scheme largely based around public sector assets it is likely that the retrofit scheme would have public sector involvement in the energy services company which delivers it. The creation of an energy entity with public sector involvement gives a structure which may have the potential for other activity across the city.

While such a significant deployment of district heating and CHP addresses new build and existing public sector heat loads and would significantly reduce the City's CO₂ emissions there is a potential for these schemes to be part of an even wider vision for a City wide energy strategy. The network could be extended beyond the city centre to the prison and beyond. In the longer term, heat links between the retrofit scheme, Monkerton and on to Cranbrook may become attractive giving the potential of large areas of the city to connect to the network. Retrofit to district heating supported by the Green Deal and ECO may support routing networks through and connection of residential areas. The presence of a City ESCO may stimulate the public sector to take a broader and more active role in the provision and delivery of non-district heating related energy efficiency and renewable energy across the City.

The challenge in taking forward the findings of this study will be to identify a long term vision and strategy and to create flexible structures which have the potential to play a role in achieving such a vision while not overcomplicating the first steps or being distracted from getting the initial network delivered.

14.6 Conclusions and recommendations

The Exeter and East Devon Growth Point has demonstrated the potential for development of low carbon infrastructure in new developments. This study builds on previous work related to the City centre and shows that retrofit district heating schemes can also be viable in Exeter and deliver 11,250 tCO_{2e} of annual emissions reduction (excluding the additional potential in SW Exeter). The most financially attractive scheme identified develops a heat network, supplied from gas fired CHP plant, from the RD&E hospital at Wonford into the City Centre.

As with DH schemes in other cities in the UK it is likely that the Exeter Energy Network will expand over time. Once in progress this type of scheme can underpin delivery of an overarching vision for a low carbon city. The key challenge is deciding how and where to start.

It is clear from this study that the hospital is critical to the initial development of retrofit district heating in Exeter. It represents about half the heat load of the potential customers identified; has a site for a gas fired CHP energy centre and, most importantly, can consume the electricity generated on-site thereby maximising the value of the scheme. This conclusion is timely as the RD&E is currently reviewing and planning implementation of its carbon reduction strategy and will need to invest in energy solutions over the next few years. There is therefore the opportunity to align stakeholders' objectives to benefit the City as a whole.

Financial evaluation of the Wonford to City Centre scheme, assuming energy price rises in line with the DECC central projection, gives a NPV of £8.5m (at a 3.5% discount rate) and an IRR of 8.9% based on an investment of £13.5m. These indicators suggest that this scheme could be partly funded by private sector investment. Such an investment would however need to be matched with some lower cost public finance for example via prudential borrowing or access to grants for low carbon development. This conclusion is cautious because there is considerable further work needed to develop these economics into an ESCO business case which captures all of the potential value identified. Collaboration and openness between the stakeholders through a District Heating Group, preferably as part of the Growth Point Low Carbon Taskforce, will be important if this is to be achieved. It will also be essential to engage the right private sector delivery partner to bring expertise and management drive to a suitable delivery vehicle. Development of a clear set of agreed objectives between the stakeholders, and then instigating a process to select the best structure and partner to achieve these objectives, is a priority.

Other parts of the network, while showing positive NPVs, are less financially attractive and have potential barriers to implementation. However, if the vision for a greater city wide scheme is to be realised stakeholders will need to tackle these barriers. To do so the stakeholders will need to be able to exert a degree of control over the investment policy of the delivery vehicle. This may include reinvestment of surpluses from most viable parts of the network and/or bringing in lower cost finance from public sector sources. The stakeholders will need to have the same control across the various projects and the three key projects identified should be carried forward as part of the same project delivery vehicle. There also needs to be awareness that changing energy and technology prices and Government policy may reduce barriers and create other attractive opportunities that have yet to be identified. Flexibility will be important.

While the most financially attractive scheme is centred at Wonford, an acceleration in the speed with which planning applications are being brought forward in SW Exeter mean that there is considerable urgency to establish the viability of a DH network for SW Exeter and Matford Phase 3. This scheme has the benefit of a £1m RGF grant to connect to the EfW plant which needs to be spent within 2 years. The SW Exeter masterplan area is potentially a stand-alone scheme. This has not been evaluated in detail by this study and therefore needs to be investigated with some urgency and quickly move towards implementation if feasible. As at Cranbrook, this development area is mainly outside of the Exeter City Council area and so coordination and cooperation with Teignbridge District Council will be critical. Lessons from the Cranbrook development should be considered and in particular coordination of planning conditions mandating the use of district heating should be considered alongside development of the link to the EfW plant to support this. It is likely that a mixed model would be preferable here whereby the private sector could be encouraged to develop a stand-alone scheme within the development based on a bulk low carbon heat supply from the EfW plant made available by the Exeter DH delivery vehicle. The potential EfW connection, Devon County Council's role in the EfW plant, the City's planning obligation for the plant to use "best endeavours" to market the energy from the plant, and the potential for heat from the EfW to be transported elsewhere in the City all point to a need for considerable stakeholder involvement here too. The fact that the New Growth Point already brings together all of these parties in support of low carbon development is a major plus point.

The one area of the proposed City Centre scheme that encompasses significant new developments is the Sidwell Street scheme. The assessment shows that, while connection to a larger scheme would be preferable, a scheme based on serving new developments around Sidwell Street could be viable in its own right. The impending build out of the new developments connecting to this scheme suggest that the Sidwell Street area merits further dedicated follow up to maximise the future benefits to the wider scheme. The planning led nature of this scheme will need the involvement of the City Council.

Three clear development opportunities have therefore emerged from the study; Wonford and the City Centre, SW Exeter and Sidwell Street. The need for, and benefits of, the coordinated development of these and involvement of all the stakeholders' has also been clearly identified.

At this stage, the most likely structure for taking forward district energy in Exeter is a public/private sector ESCO. This would have at least a partial involvement in all these networks and would therefore retain the ability to influence the development of schemes both in the City and across the Growth Point.

Making resource available within each stakeholder organisation and the need to commission external support (technical, financial and legal) during the process of selecting a private sector partner will be important for success. Estimates of up to £0.5m are typical for establishing an ESCO. This sum, while high, should be seen in the context of the overall level of investment in the City that would result from these schemes.

External funding from DECC Renewable Heat programmes, the EU and sources such as the Technology Strategy Board may provide a source for some of this funding.

Recommendations for implementing the Exeter Energy Network are summarised as follows:

1. Establish a stakeholder District Heating Group, as part of the Growth Point Low Carbon Taskforce, to drive and coordinate the development of District Heating
2. Establish a mechanism for support to stakeholders in delivering necessary studies to support decision making and underpin internal governance requirements
3. Develop a stakeholder agreement setting clear objectives and the basis for participation
4. Identify and apply for funding where/when available
5. Create work groups to follow up the three network workstreams; Wonford and the City Centre, SW Exeter and Sidwell Street.
6. Identify/appoint legal, financial and technical advisors
7. Develop the overall business case for the DH scheme(s) including selection of preferred structure for ESCO participation
8. Undertake the selection of a private sector partner based on the stakeholder agreement and business case
9. Develop the ESCO structure and associated documents
10. Establish the ESCO and commence delivery

APPENDIX A

STAKEHOLDER REFERENCE SHEETS

A.1 Approach to Stakeholder Reference Sheet Calculations

The stakeholder reference sheets present the data for each stakeholder site that was fed into the modelling performed in the study. Benefits to each site have been established pro-rata per kWh of annual heat demand from the overall benefits calculated in the study.

A.1.1 Business As Usual Data

The business as usual data section presents the business as usual costs and emissions established from the data provided by each stakeholder. This is the data that was fed into the modelling in the study. Where data was lacking, estimates, assumptions and benchmark data were used. Therefore this data should not be viewed as an accurate calculation of these costs to be used for other purposes.

The emissions factors on which the business as usual emissions were established are presented below. As discussed at section 7.2.2 of the main report, these were merged into an average rate across all connecting sites for the purposes of the modelling in the main study.

	Emissions Factor kgCO ₂ /kWh	Source
gas	0.198	SAP 2009
electricity	0.517	
oil	0.297	

Total emissions calculated in the main report were for heat only, except for sites that hosted CHP engines in the DH modelling. In this case the electricity consumption was included in the emissions calculation of the business as usual case to provide a valid baseline to establish savings against.

Estimated annual demand profiles were established from previous project data and experience. Data granularity required to establish actual profiles was not provided for any site.

No data on maintenance or replacement costs was provided by any stakeholder, or potential site. Therefore all replacement and maintenance costs were established from benchmark data and previous project experience. These are presented at section 7.2.3 of the main report.

A.1.2 Financial and Environmental Stakeholder Benefits

The actual benefits of a connection to a district heat network will be dependent on the commercial structure decided upon for the operation of the network and the commercial arrangements between individual stakeholders and the operating body. Since these are not known at this stage the stakeholder reference sheets provide an indication of the scale of benefit available as a proportion of the total benefit of the preferred scheme.

Whole life cost benefit and carbon emissions factors per kWh of heat demand were established on which to base the calculation of the benefits that each site would see. These factors were based on the best performing scheme (in terms of Net Present Value). Since this scheme excluded County Hall, the benefits to County Hall of connecting were based on the best performing scheme which included County Hall. Therefore not all stakeholder benefits sheets are based on the same scheme.

Scheme	Option	demand served kWh	capital investment £	capital investment £ per kWh	whole life cost benefit £	whole life cost benefit £ per kWh
With County Hall Link	C	46,478,000	15,245,000	0.328	6,830,000	0.147
Without County Hall Link	C	45,116,000	13,493,000	0.299	8,495,000	0.188

The whole life cost benefit presented here is based, as in the main report, on a 25 year period and a 3.5% discount rate. This value would only be achieved alongside a proportionate investment in the scheme. Non investing connections could expect to achieve 5-10% savings on their whole life energy supply costs.

Scheme	Option	demand served kWh	emissions for DH heat tCO ₂	emissions factor for DH heat kg/kWh
With County Hall Link	C	46,478,000	4,144	0.089
Without County Hall Link	C	45,116,000	3,834	0.085

CRC treats heat delivered through a district heat network as carrying no emissions (since CRC is attributed to the fuel not the energy generated). Therefore, for CRC purposes the emissions savings at each site would be greater (zero emissions for heat). However, the heat network operator, whoever that may ultimately be, would be accountable for the full emissions from the fuel required to generate the heat provided through the network. Therefore the cost of these emissions would still need to be accounted for in heat supply tariffs and declaring a zero carbon heat supply in any other reporting could be misleading.

There are various methodologies that can be used in apportioning emissions savings from a CHP engine. To be representative of the approach an ESCO might adopt in calculating the emissions factor of heat supplied, the full savings of a scheme have been applied to the heat supply only for the purposes of these stakeholder reference sheets. This effectively leaves the hospital with full, grid imported electricity emissions even for CHP supplied electricity (the 8,334 tCO₂).

Percentage savings have not been presented in the main report to avoid confusion over these results. The percentage savings presented in these sheets will be higher than any that may be calculated for a full network option. This is simply a matter of calculating a percentage of a smaller total. The savings presented within the stakeholder reference sheets are referenced against a baseline emissions total that excludes the emissions from electricity at Wonford Hospital.

A.2 University of Exeter

A.2.1 Business As Usual Data - St Luke's Campus

A.2.1.1 Annual Energy Consumption, CO₂ Emissions and Costs

A summary of the current energy consumption and associated fuel costs and emissions is presented in the table below. This is based on data provided by the University. Data was provided as annual rounded totals.

Annual Consumption	energy [kWh]	cost [£]	emissions [tCO ₂]
heat	3,451,767	£ 143,000	854
power	2,074,000	£ 323,200	1,072
total	5,525,767	£ 466,200	1,927

A.2.1.2 Plant Replacement and Maintenance Costs

Maintenance and plant replacement costs were estimated based on the age and rated power of each boiler.

Heat plant costs		
annual maintenance	£	8,000
replacement cost over 25yrs	£	120,865

A.2.2 Network Connection - St Luke's Campus

Heat at St Luke's Campus is currently supplied by boilers housed in individual plant rooms in each building. A district heat network would therefore need to connect to each of these plant rooms to replace this current supply. An outline network design was established on which to base the modelling in the main study. This network serves all plant rooms on the campus.

A.2.3 Benefits of University participation in Exeter Energy Network

These benefits are based on the scheme wide benefits of the Wonford and City Centre scheme, without County Hall (Option A - preferred). Based on the heat demand at St Luke's the level of financial benefit attributable to the University has been calculated below.

Financial benefit of connection		
whole life cost benefit	£	649,941

It should be noted that in the scenario where the University was a heat customer only whole life cost benefit would be reduced. A connection to the heat network for the supply of heat would reduce the overall annual carbon dioxide emissions of the St Luke's Campus by 29%.

Emissions if connected to network	annual tCO ₂	reduction vs BAU
heat	293	66%
power	1,072	0%
total	1,366	29%

Greater benefits could result if a network link to the Streatham Campus, via Exeter Prison is viable.

A.3 Devon County Council
A.3.1 Business As Usual Data - County Hall
A.3.1.1 Annual Energy Consumption, CO₂ Emissions and Costs

A summary of the current energy consumption and associated fuel costs and emissions is presented in the table below. This is based on data provided by the County Council.

Annual Consumption	energy [kWh]	cost [£]	emissions [tCO ₂]
heat	1,075,109	£ 41,660	266
power	2,740,901		1,417
total	3,816,010		1,683

Data was provided as metered annual consumption prepared for CRC reporting. The heat supplied by the biomass boiler has been included in these figures and costs based on provision of that heat by gas boilers. We have not received fuel costs figures for biomass and understand that a year's data of the biomass boiler operating fully has not yet been collected.

Although electricity tariffs were provided, the consumption data did not provide a day/night split on which to calculate power costs.

A.3.1.2 Plant Replacement and Maintenance Costs

Maintenance and plant replacement costs were estimated based on the age and rated power of each boiler.

Heat plant costs		
annual maintenance	£	1,700
replacement cost over 25yrs	£	50,000

A.3.2 Benefits of County Council participation in Exeter Energy Network

These benefits are based on the scheme wide benefits of the Wonford and City Centre scheme, WITH County Hall (Option A).

Financial benefit of connection		
whole life cost benefit	£	157,989

A connection to the heat network for the supply of heat would reduce the overall annual carbon dioxide emissions of the County Hall site by 10%. This is calculated against a base case of gas heating, not accounting for any biomass boiler supply.

Emissions reduction	annual tCO ₂	reduction Vs BAU
heat emissions	96	64%
total emissions	1,513	10%

The higher consumption figures for St Leonard's Primary School would improve these benefits.

A.4 Royal Devon and Exeter Hospital Trust
A.4.1 Business As Usual Data - Wonford
A.4.1.1 Annual Energy Consumption, CO₂ Emissions and Costs

A summary of the current energy consumption and associated fuel costs and emissions is presented in the table below. This is based on data provided by the Trust.

Annual Consumption	energy [kWh]	cost [£]	emissions [tCO ₂]
heat	26,746,542	£ 904,898	6,381
power	16,119,084	£ 1,523,013	8,334
total	42,865,626	£ 2,427,911	14,714

Data was provided as monthly metered consumption. Modelling included the full steam demand at the hospital, on the assumption that a link would be installed to the HSDU. Steam demand is assumed to be served by a combination of CHP engines and dedicated steam boilers as currently. Business as usual emissions exclude the benefits of any current CHP operation.

A.4.1.2 Plant Replacement and Maintenance Costs

Maintenance and plant replacement costs were estimated based on the age and rated power of each boiler.

Heat plant costs			
annual maintenance		£	34,450
replacement cost over 25yrs		£	529,763

A.4.2 Business As Usual Data - Heavitree
A.4.2.1 Annual Energy Consumption, CO₂ Emissions and Costs

A summary of the current energy consumption and associated fuel costs and emissions is presented in the table below. This is based on data provided by the Trust.

Annual Consumption	energy [kWh]	cost [£]	emissions [tCO ₂]
heat	3,048,697	£ 169,231	755
power	1,606,091	£ 133,218	830
total	4,654,788	£ 302,449	1,585

Data was provided as monthly metered consumption over a nine month period. Annual estimates (presented in the table) were extrapolated from these figures.

A.4.2.2 Plant Replacement and Maintenance Costs

Maintenance and plant replacement costs were estimated based on the age and rated power of each boiler.

Heat plant costs		
annual maintenance	£	2,700
replacement cost over 25yrs	£	51,800

A.4.3 Benefits of Trust participation in Exeter Energy Network

A.4.3.1 Economic and Environmental Benefits - Wonford

These benefits are based on the scheme wide benefits of the Wonford and City Centre scheme, without County Hall (Option A - preferred)

Financial benefit of connection	
whole life cost benefit	£ 5,036,171

A connection to the heat network for the supply of heat would reduce the overall annual carbon dioxide emissions of the Wonford Hospital site by 28%. This is calculated against a base case of gas heating, not accounting for any existing CHP supply and having apportioned emissions savings associated with electricity generation, evenly across all heat provision on the network.

Emissions reduction	annual tCO ₂	reduction Vs BAU
heat emissions	2,273	64%
total emissions	10,607	28%

A.4.3.2 Economic and Environmental Benefits - Heavitree

These benefits are based on the scheme wide benefits of the Wonford and City Centre scheme, without County Hall (Option A - preferred)

Financial benefit of connection	
whole life cost benefit	£ 574,046

A connection to the heat network for the supply of heat would reduce the overall annual carbon dioxide emissions of the Heavitree Hospital site by 28%.

Emissions reduction	annual tCO ₂	reduction Vs BAU
heat emissions	259	66%
total emissions	1,089	31%

A.5 Exeter City Council

A.5.1 Business As Usual Data - Civic Centre

A.5.1.1 Annual Energy Consumption, CO₂ Emissions and Costs

A summary of the current energy consumption and associated fuel costs and emissions is presented in the table below. This is based on data provided by the Council.

Annual Consumption	energy [kWh]	cost [£]	emissions [tCO ₂]
heat	170,415	£ 15,800	67

A.5.1.2 Plant Replacement and Maintenance Costs

Heat plant costs		
annual maintenance	£	2,700
replacement cost over 25yrs	£	58,500

A.5.2 Benefits and Risks of Council participation in Exeter Energy Network

A.5.2.1 Economic and Environmental Benefits

These benefits are based on the scheme wide benefits of the Wonford and City Centre scheme, without County Hall (Option A - preferred)

Financial benefit of connection		
whole life cost benefit	£	32,088

A connection to the heat network for the supply of heat would reduce the annual carbon dioxide emissions associated with the supply of heat to the City Council site by 79%. This particularly high figure is due to the current heating being provided by oil which carries a high emissions factor.

Emissions reduction	annual tCO ₂	reduction vs BAU
heat emissions	14	79%

APPENDIX B

UTILITIES ASSESSMENT MAPS

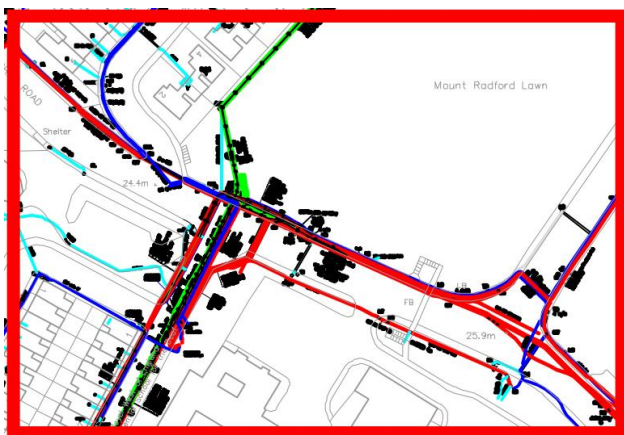
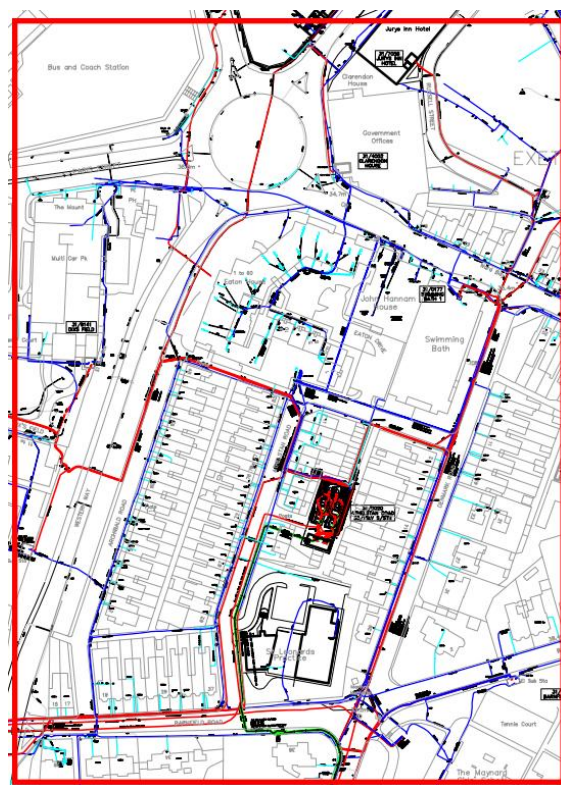
B.1 Western Power Distribution, Electricity Distribution Network

The Parsons Brinckerhoff Exeter office holds a CD of Western Power distribution network data. Mapping was sourced for the study are from this CD. The whole proposed network was reviewed and the following points of note identified. These maps are not presented at scale.

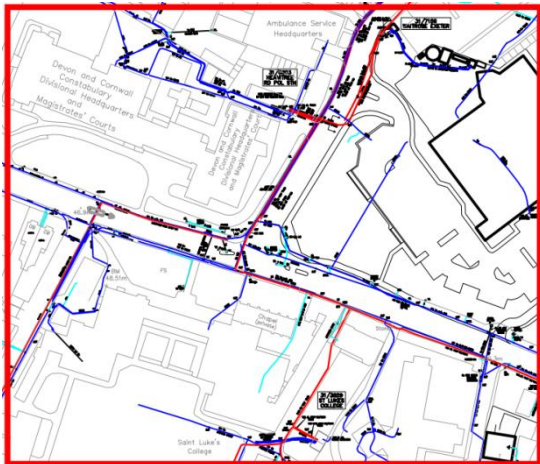


The junction of New North Road, Sidwell Street, Paris Street and the High St (the site of John Lewis) has various lower voltage distribution mains crossing but no significant network installed.

There is a 33kV distribution substation located in the block behind the Pyramids Leisure Centre. The 33kV network runs to this site from the south, therefore not impacting any proposed network routes. This substation is located in close proximity to one of the potential energy centres at Triangle Car Park.

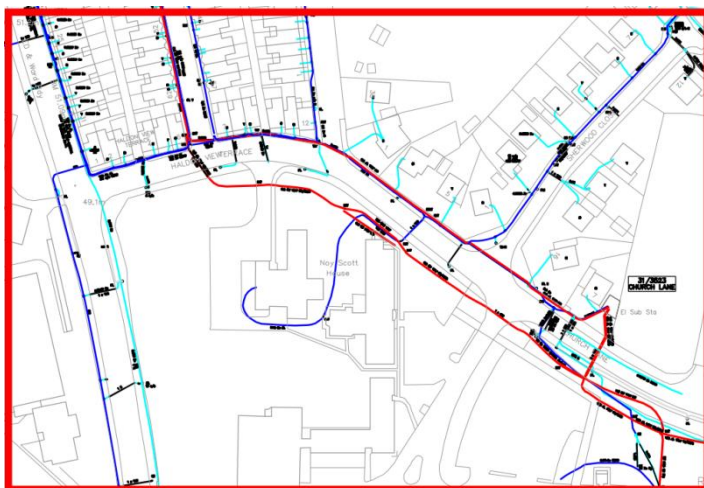


This substation is served by a line that runs from Weirfield Road, along the western boundary of the Former Royal School for Deaf Education, across Topsham Road and under Mount Radford Lawn, to the west of St Leonard's Primary School. This line would need to be crossed if the alternate route option from County Hall and the adjacent development sites were proposed, to connect to the City Centre via the Crown and County Court Complex.



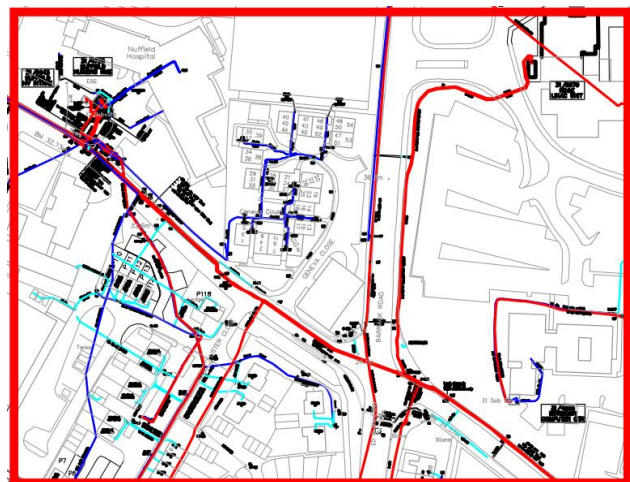
An 11kV line crosses Heavitree Road into Gladstone Road, that provides access to Waitrose and the Ambulance Station opposite St Luke's

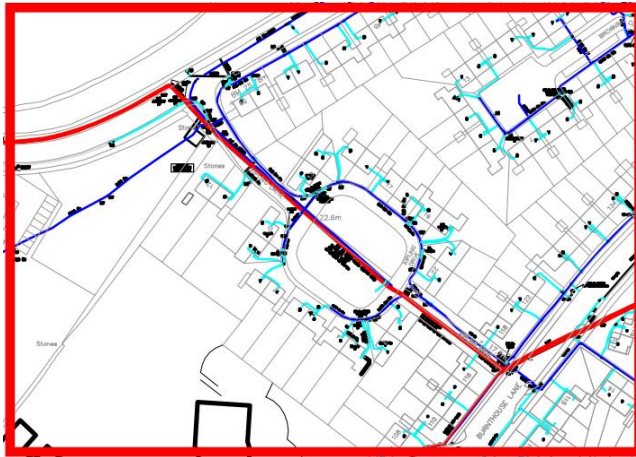
Although still 11kV and below, there is some significant network present in the highway at the junction of Magdalen Road and Barrack Road, on the route from Wonford Hospital to St Luke's at a point that would be avoided if a route through Exeter School were available.



Church Lane, along the northern boundary of Wonford Hospital has some distribution mains running along it, but mainly these are within the Wonford site. The proposed route linking buildings within the site in this northern part of it would avoid this network save for some lower voltage building connections.

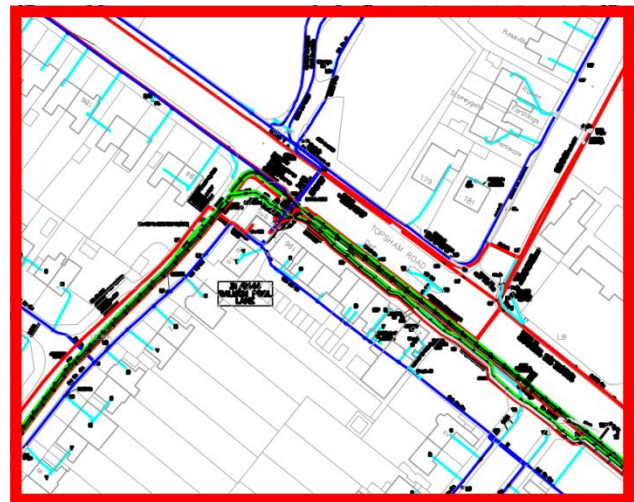
The Junction of Barrack Road and Wonford Rd/Dryden Rd (on the south west corner of the Wonford site) has 11kV lines running up both sides of Barrack Rd and one crossing it.



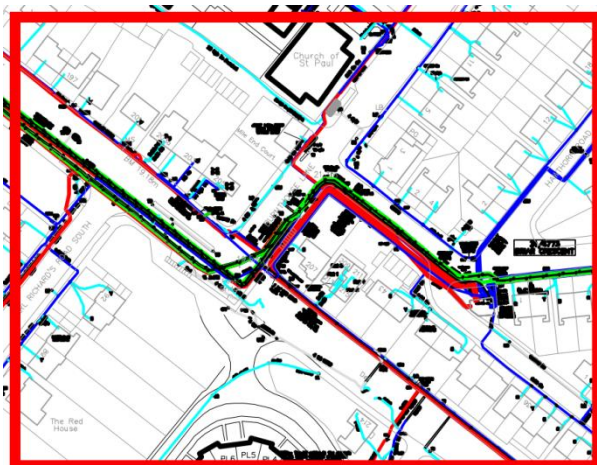


There is 11kV network through Kipling Drive, proving that wayleaves are viable through this route. The ownership and therefore ability to route through this drive was not identified as part of the network routing but the route is included as an alternate route options if the easterly Exe crossing route were selected and therefore the route to Wonford was run through Burnhouse Lane.

Topsham Road, at the junction with Barrack Road in the vicinity of Earl Richard's Road North (Former University of Plymouth Site) has a number of 33kV and lower voltage lines running up from Salmonpool Lane and along the southern side of Topsham Road. These lines cross the top of Earl Richards Road North where the proposed network route crosses Topsham Road and therefore these lines.



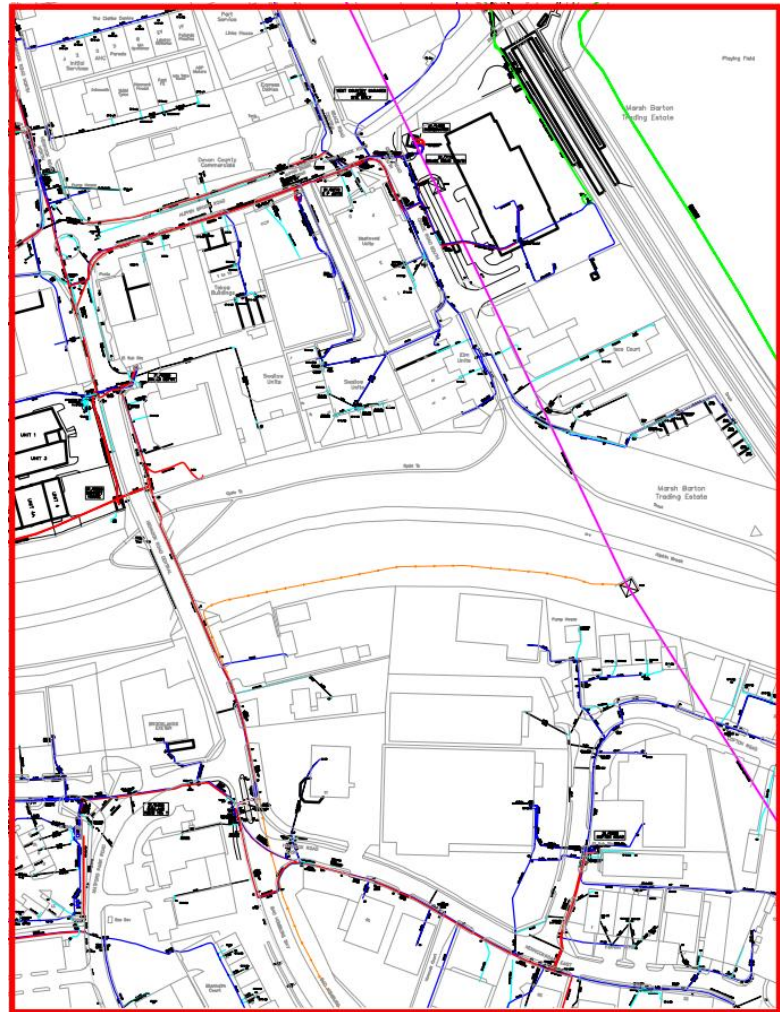
These same 33kV lines continue along Topsham Road and turn into Burnhouse Lane. These would need to be crossed if the alternate route to Wonford Hospital from the River Exe were selected, along Burnhouse Lane.



33kV lines run along the River side of the mainline railway line at the Energy from waste plant but these are covered in the Exe Crossing study.

There are High Voltage overhead lines running through Marsh Barton.

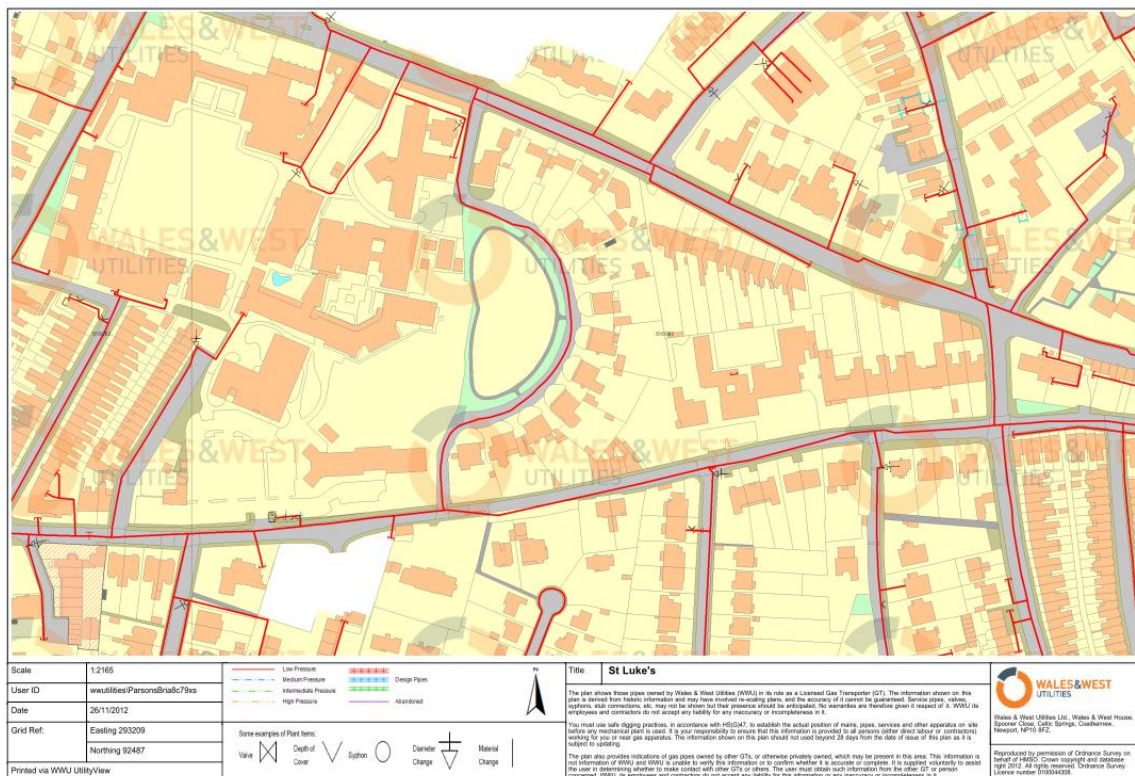
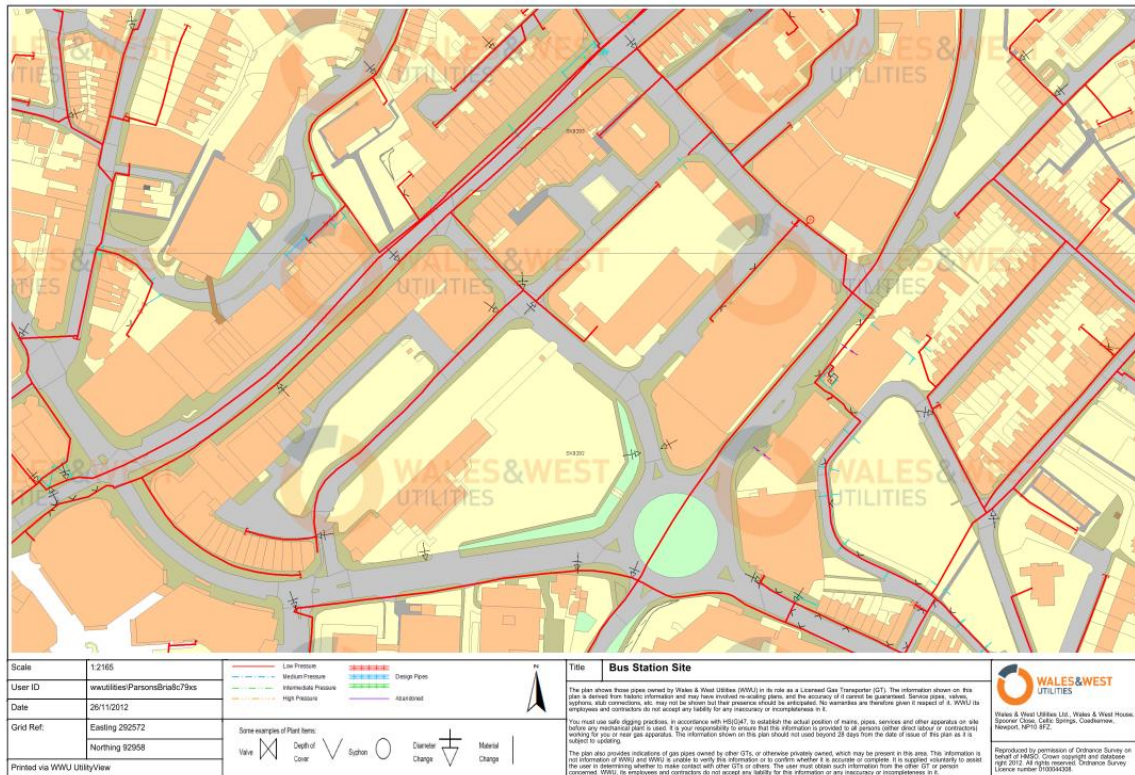
Routes south within the Marsh Barton Estate have very little network within the highway.

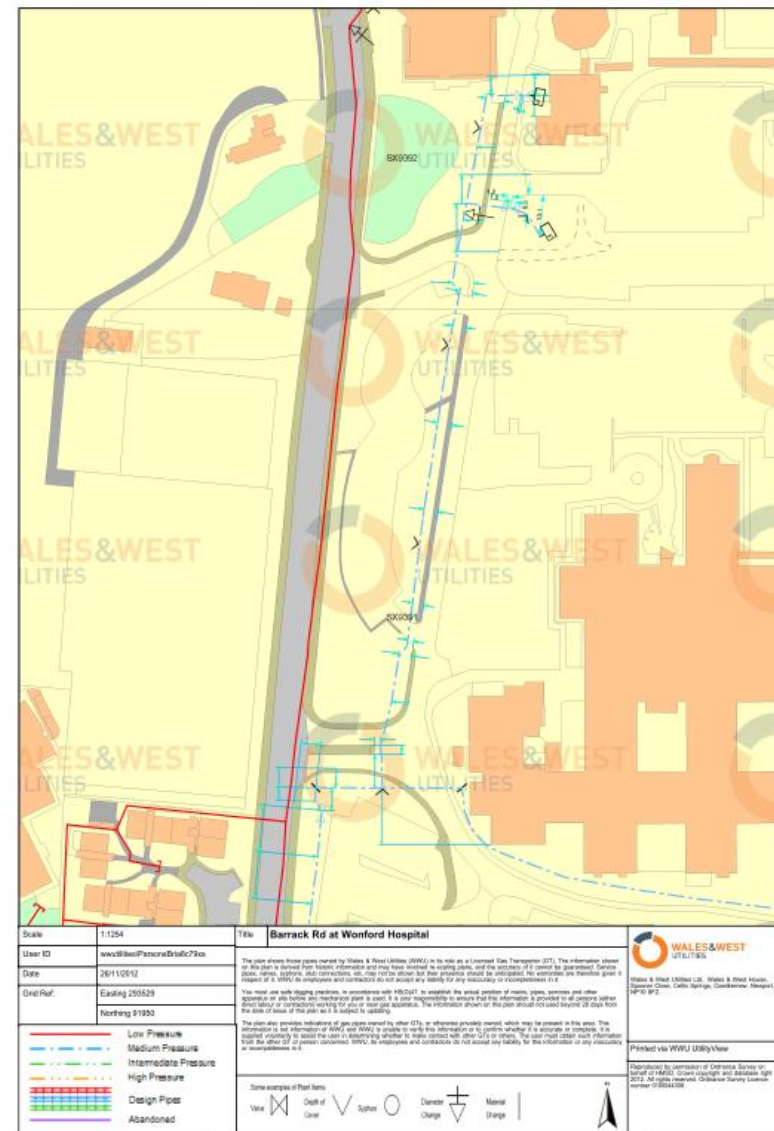
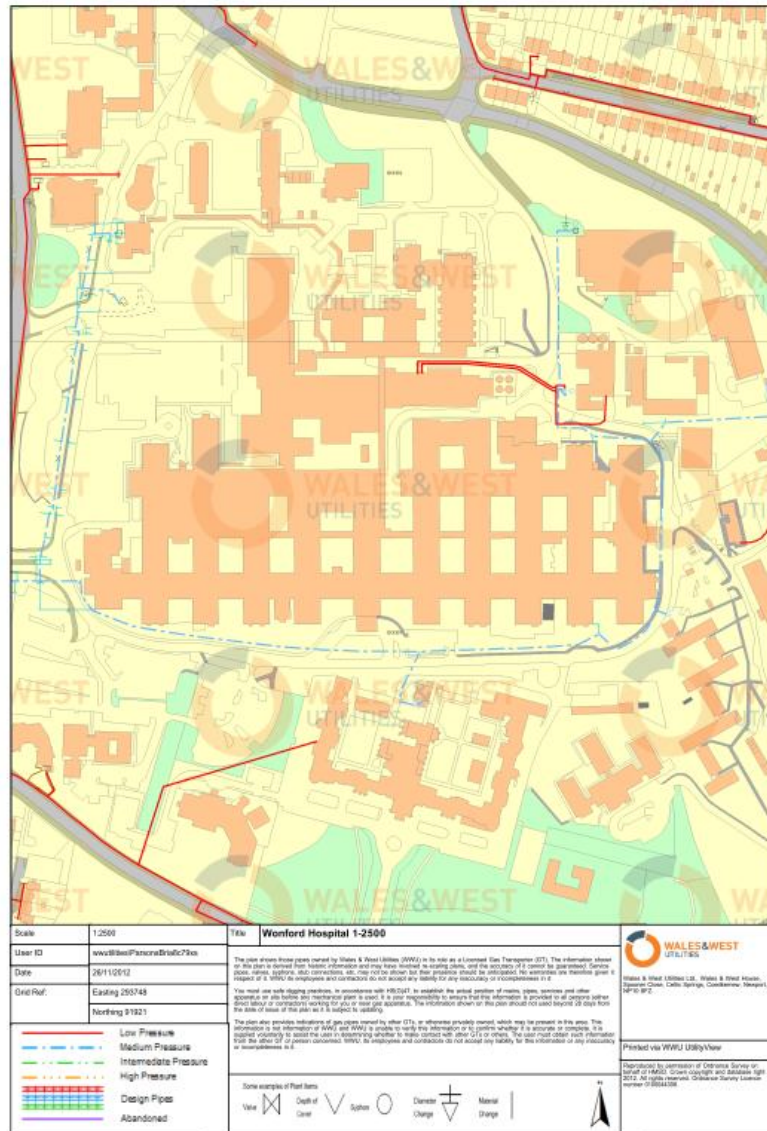


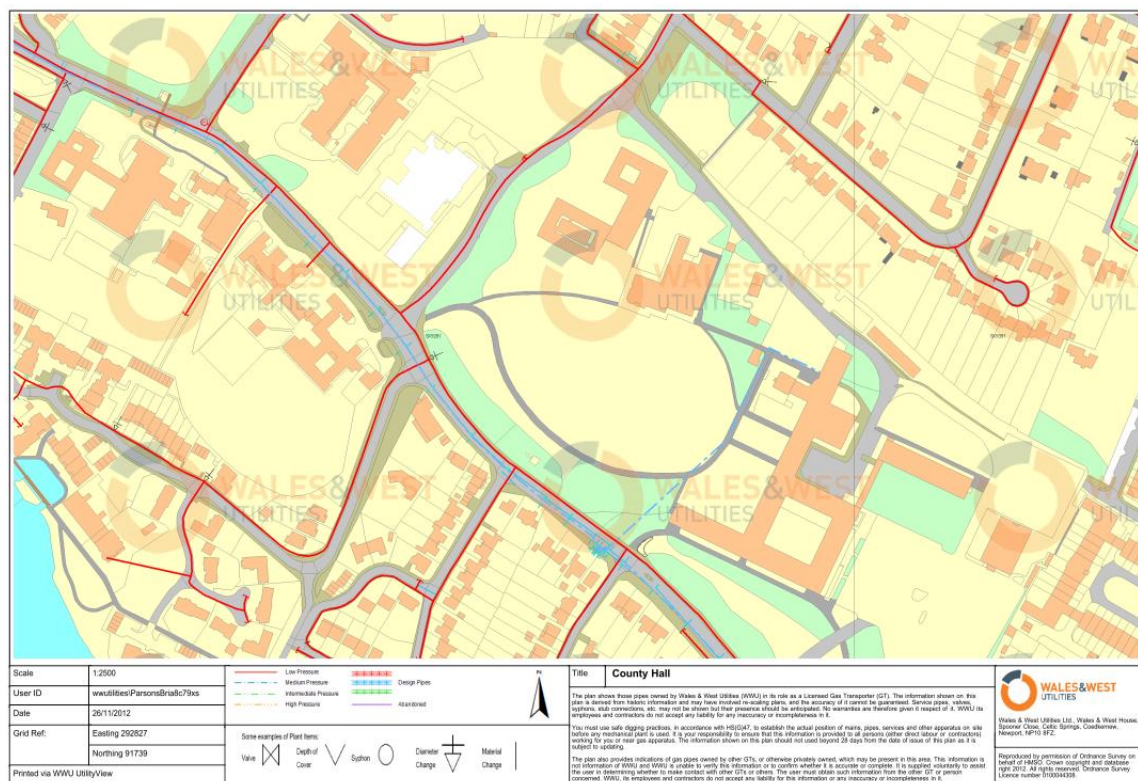
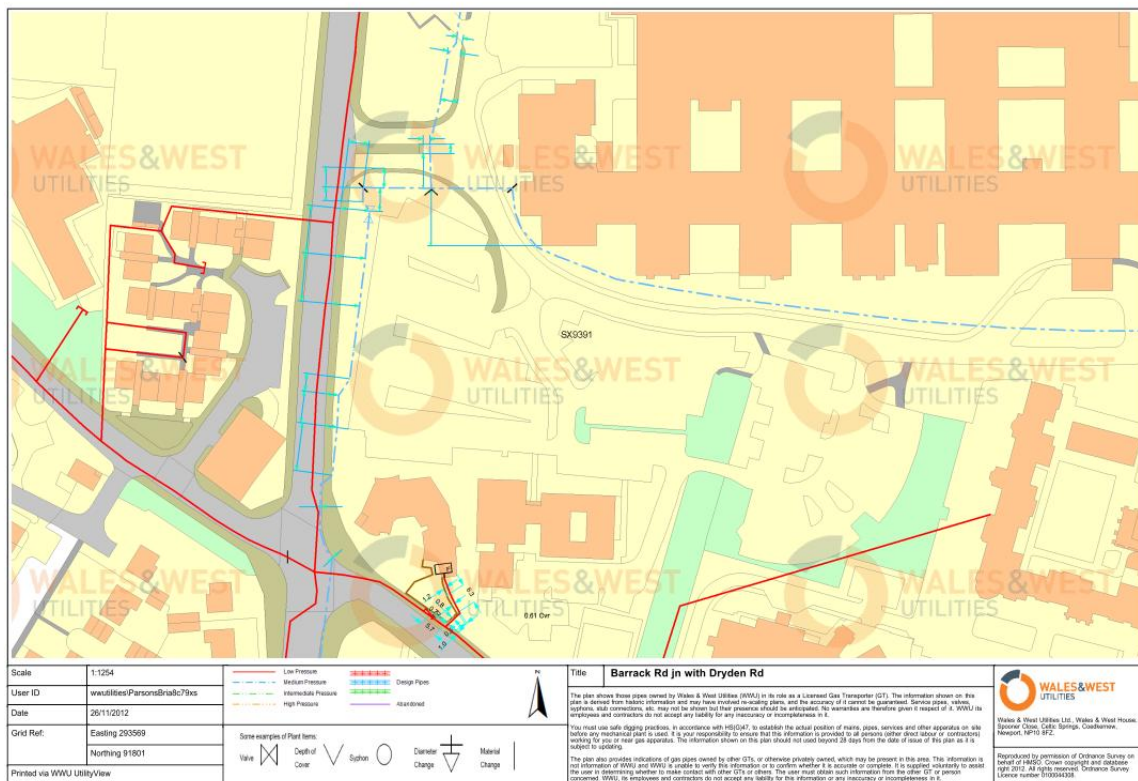
The network around the Matford Park Phase III development is light, with no higher voltage lines that would need to be crossed. There are High Voltage power lines running over the site.

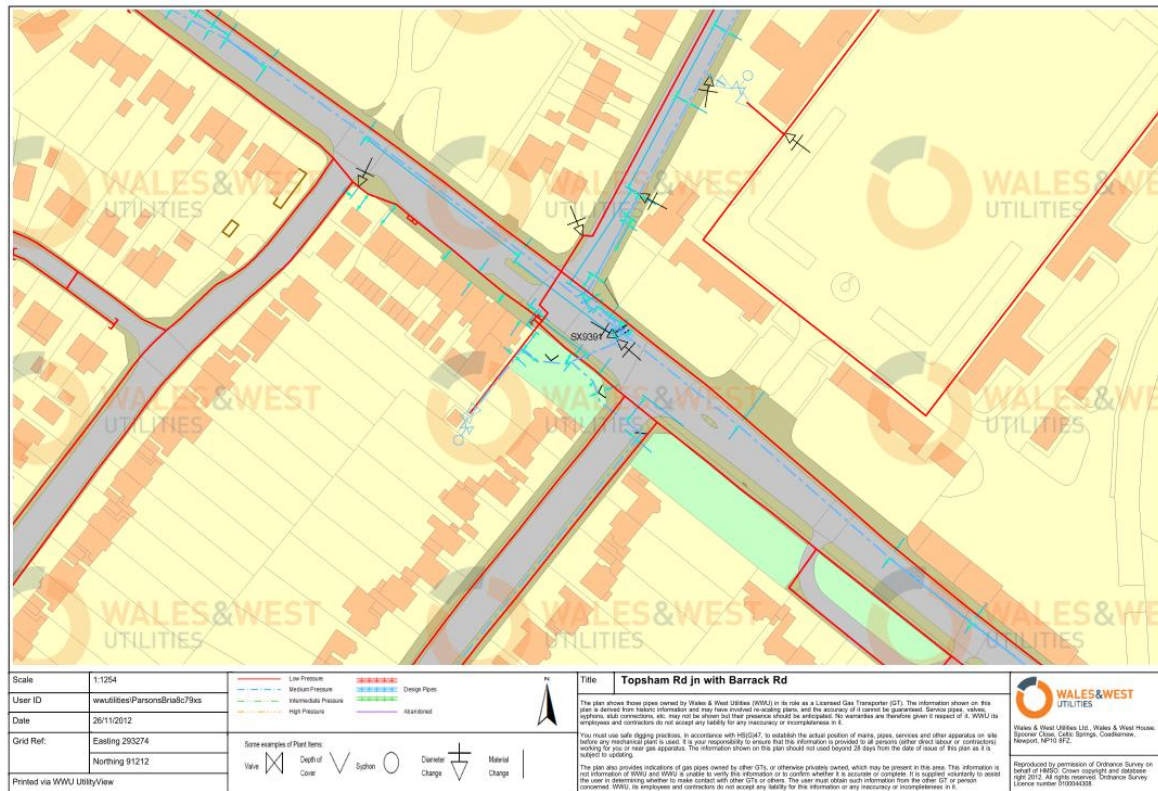
Wales and West Utilities offer an online mapping viewer application to which Parsons Brinckerhoff has been provided access. This tool was used to review the proposed network routes and produce the maps of significant points presented below. The scale on these maps is for an A4 page print of the map, not as an image presented within this report.

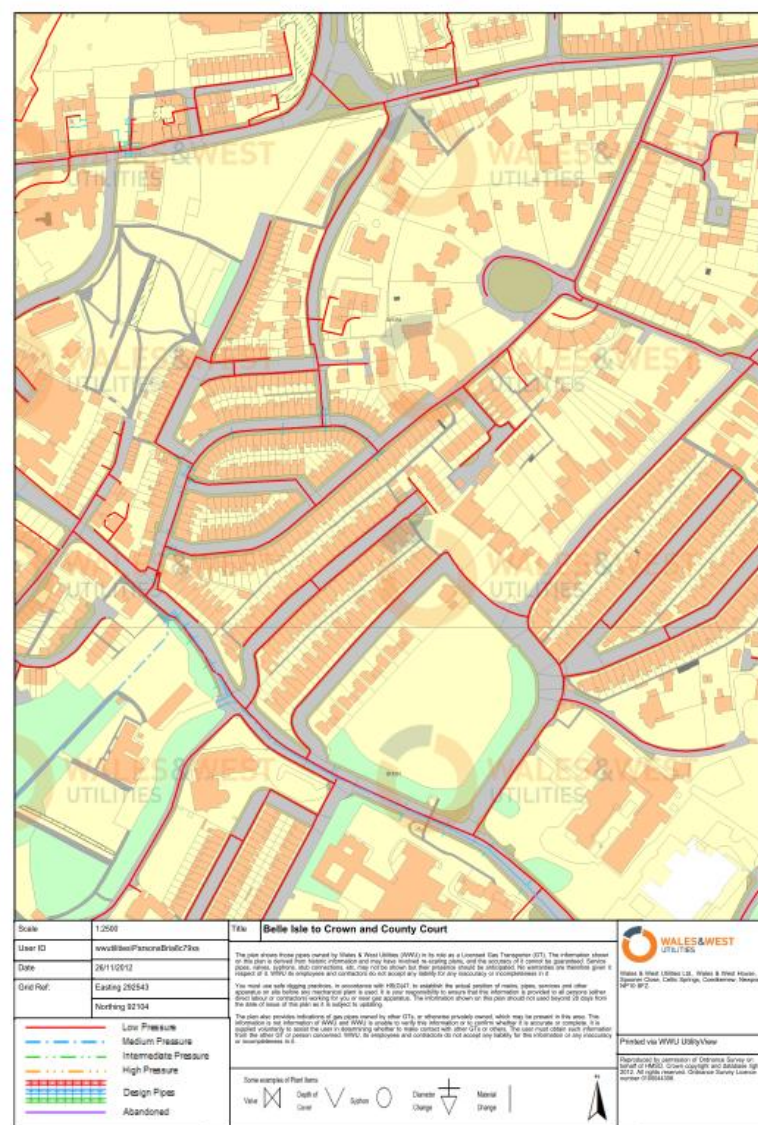












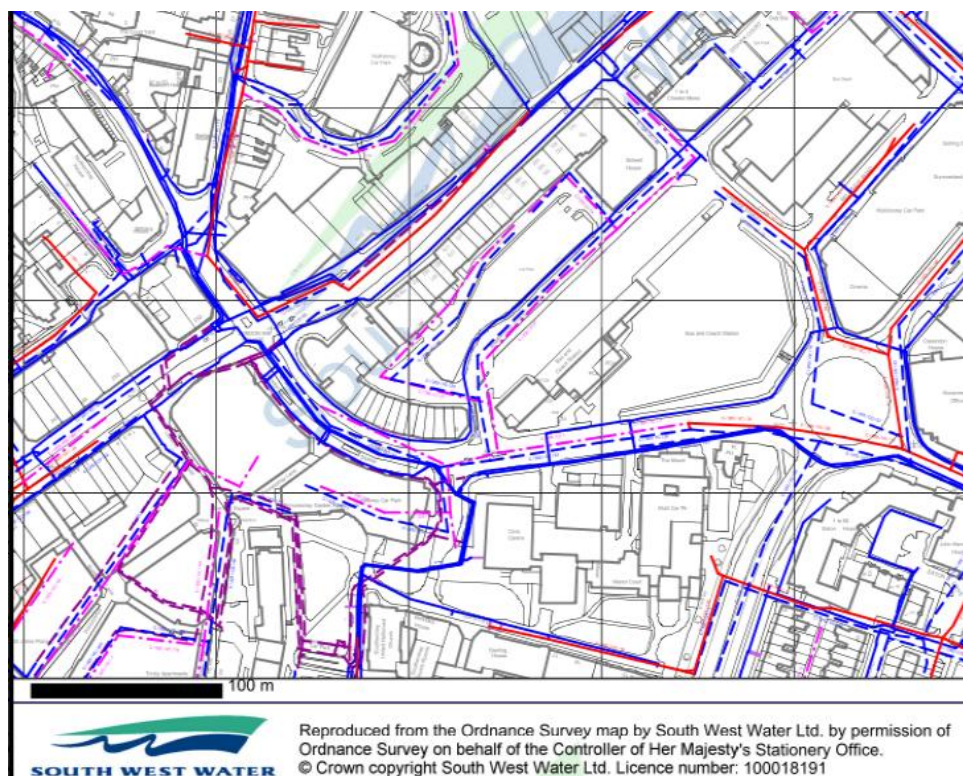
B.3 South West Water, Water and Sewage Networks

South West Water offer an online mapping viewer application to which Parsons Brinckerhoff has been provided access. This tool was used to review the proposed network routes and produce the maps of significant points presented below. The scale on these maps is for an A4 page print of the map, not as an image presented within this report.

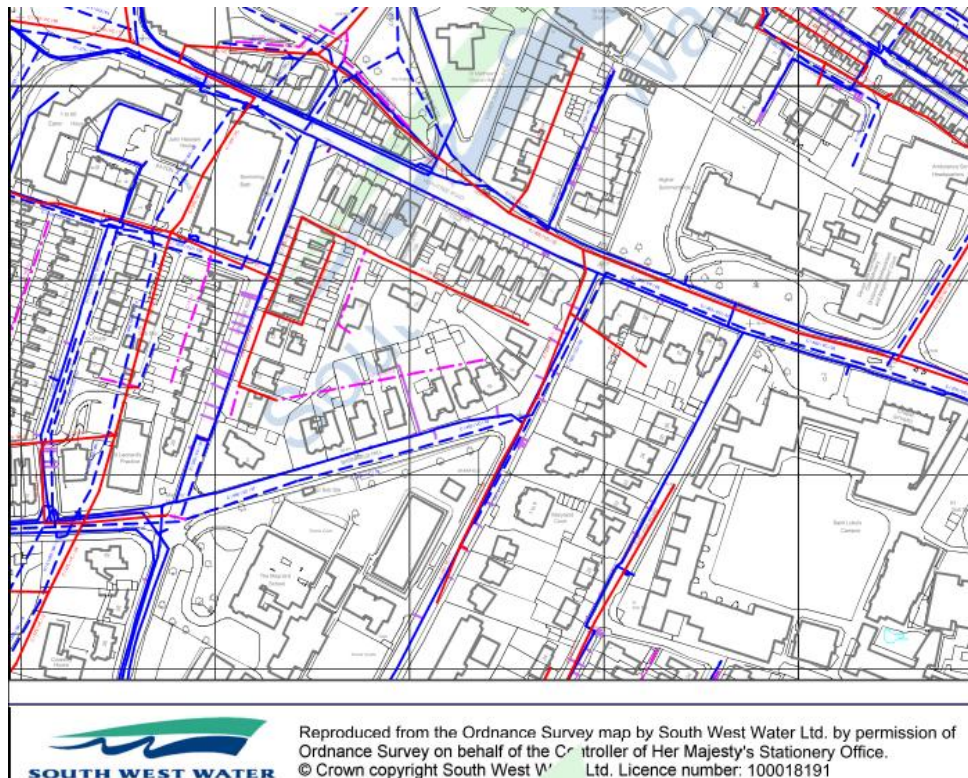
Key to SWW maps

Water Colour Codes and Abbreviations		A	B	A: Size	B: Material Abbreviation
Examples of the abbreviation details above a Water Pipe (details will be in the same colour as the pipe itself):		3 in Cl			
Distribution Main		Untreated Main			
Trunk Main		Private Pipe			
Communication Pipe		Abandoned Main			

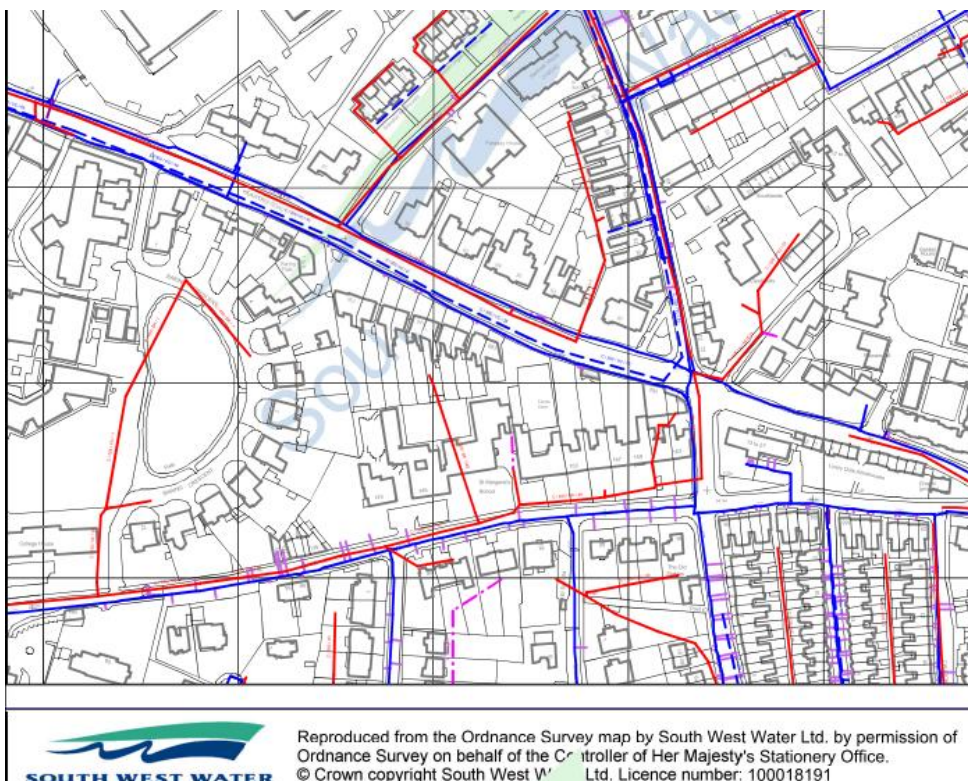
City Centre - Bus Station Redevelopment Site, John Lewis and Civic Centre



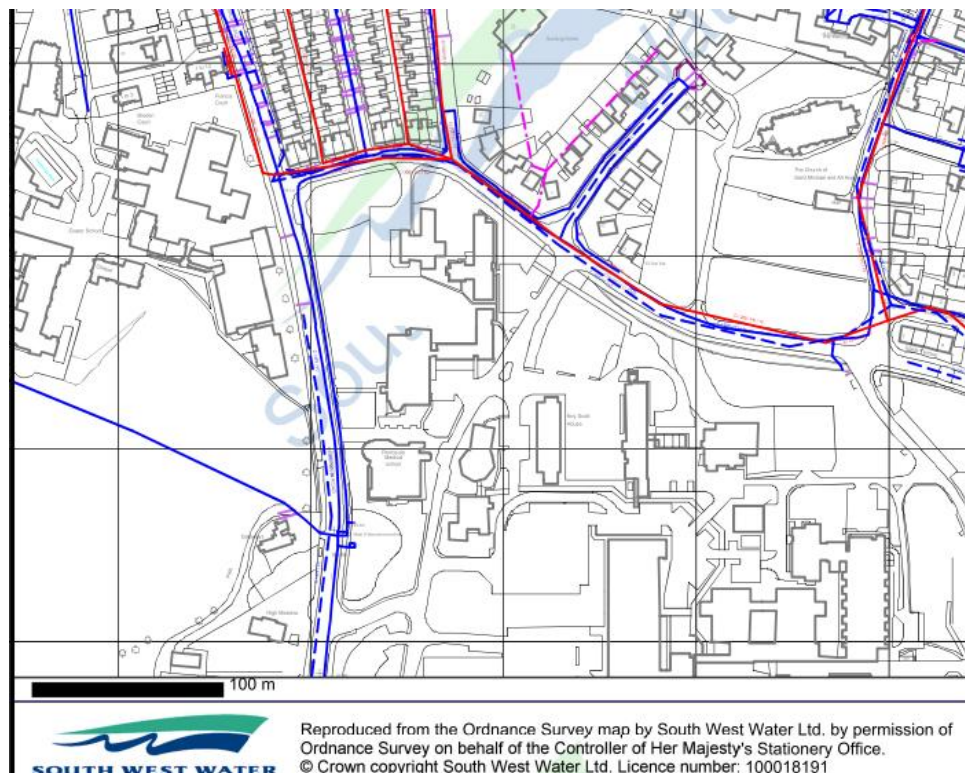
Civic Centre to St Luke's



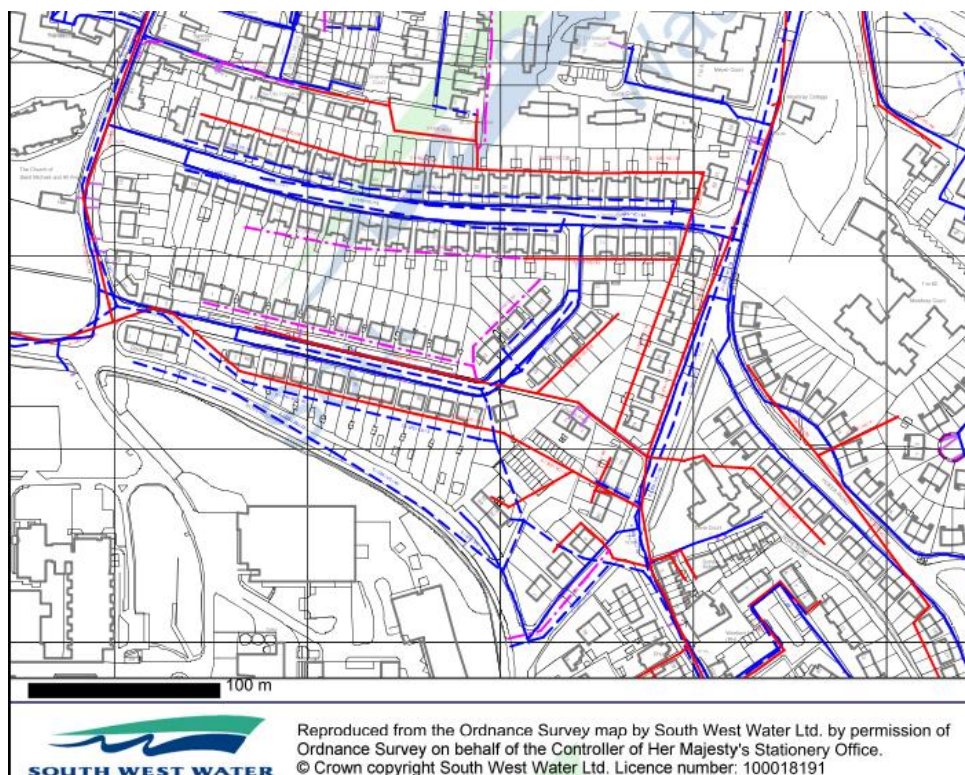
St Luke's to Wonford Hospital



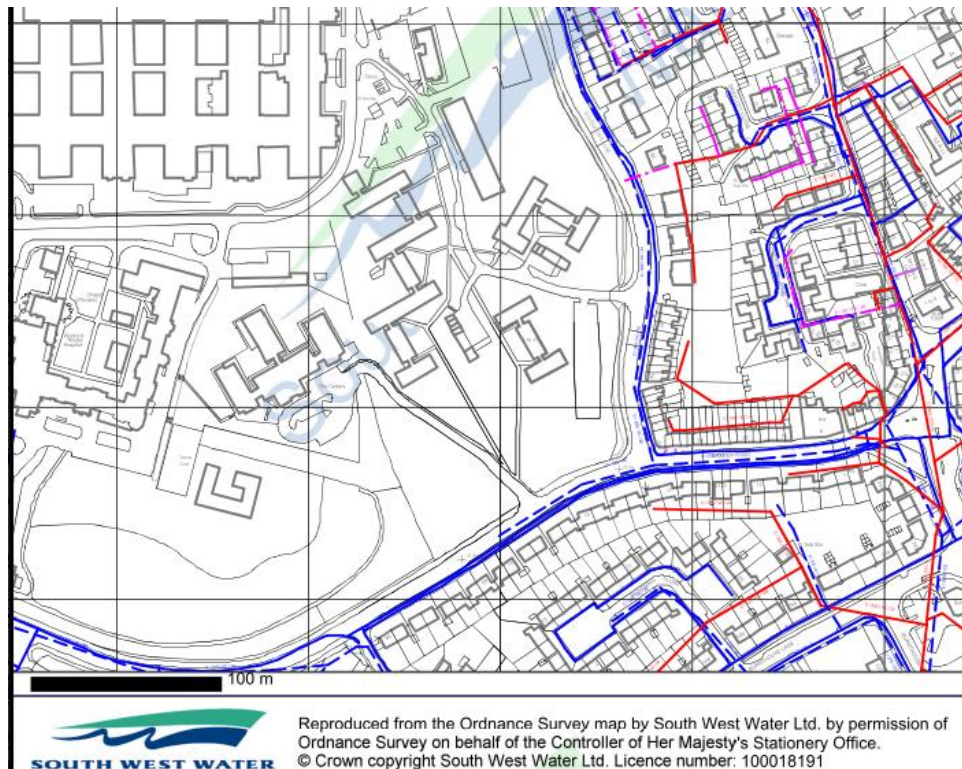
North side of Wonfrod Hospital



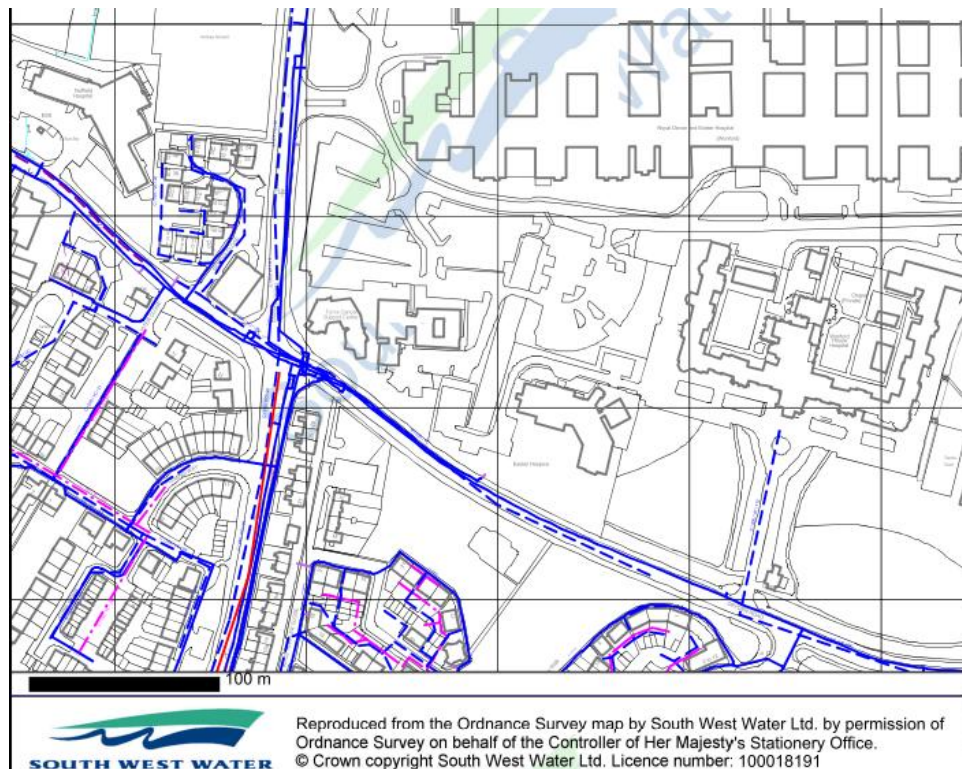
North East Side of Wonfrod Hospital



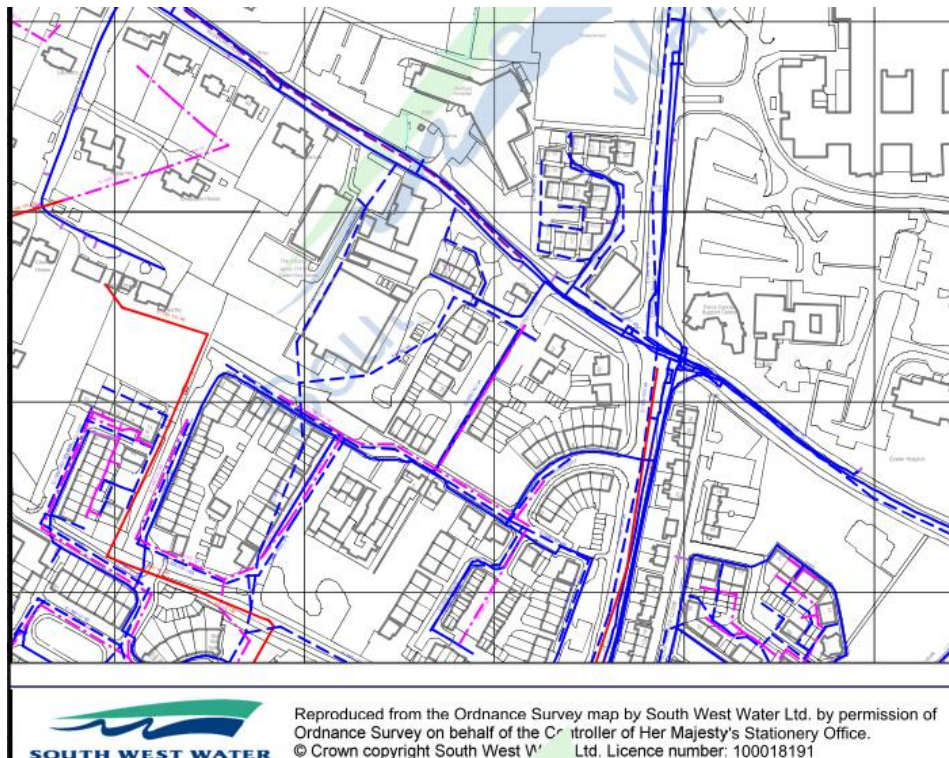
South east side of Wonford Hospital



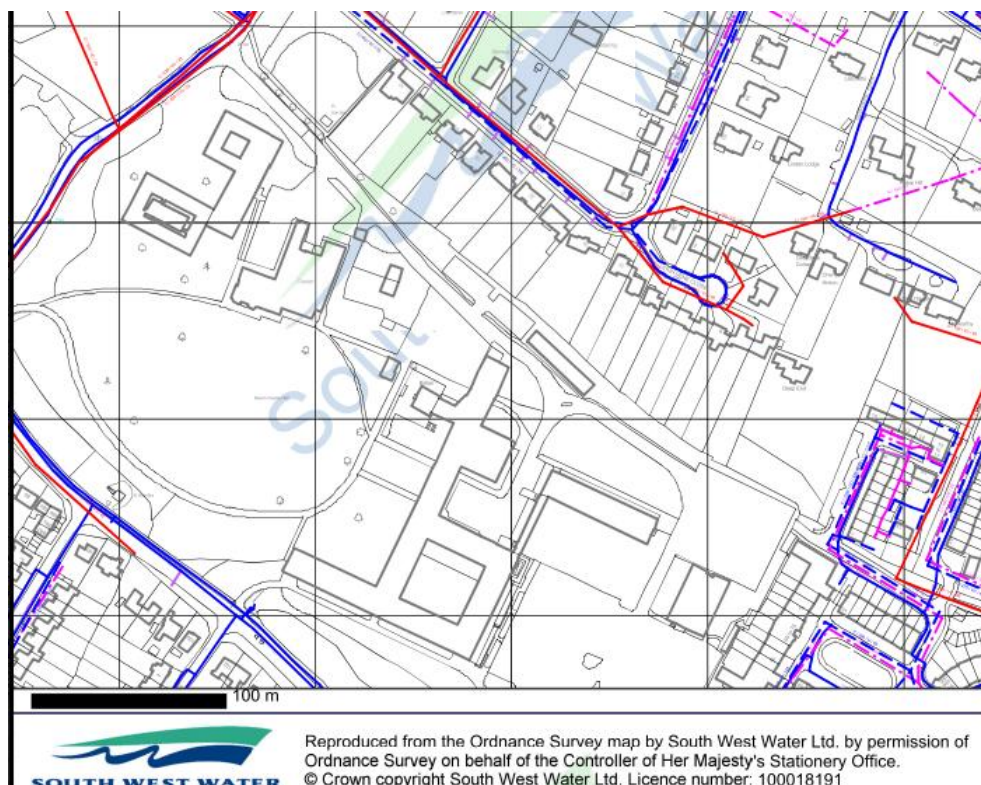
South west side of Wonford Hospital



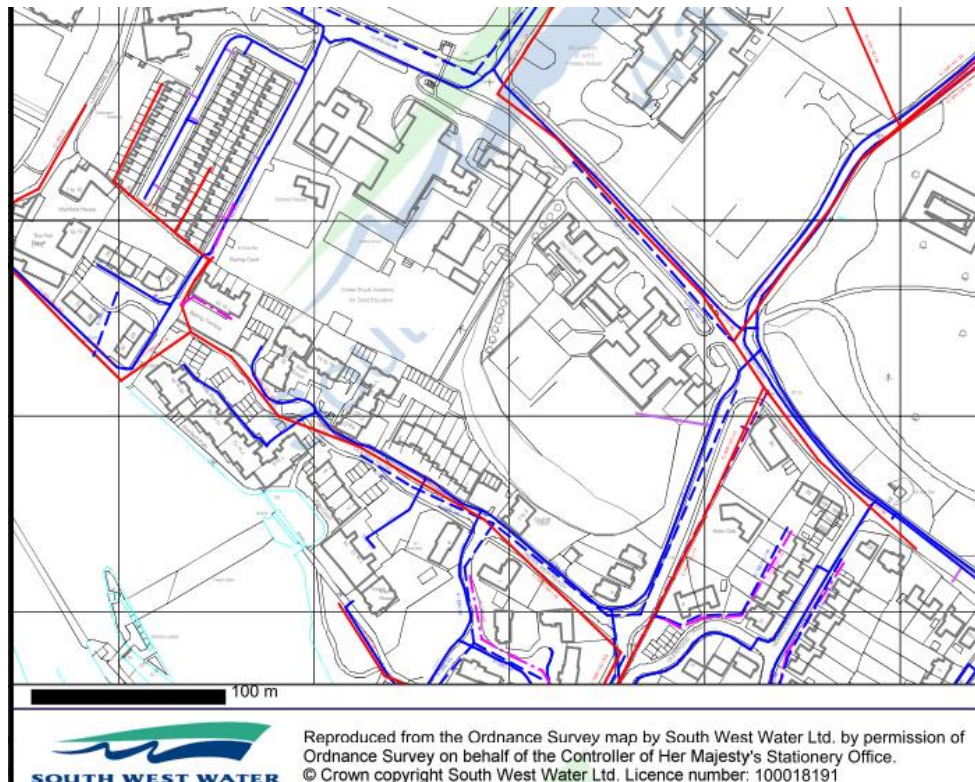
Wonford Hospital to County Hall



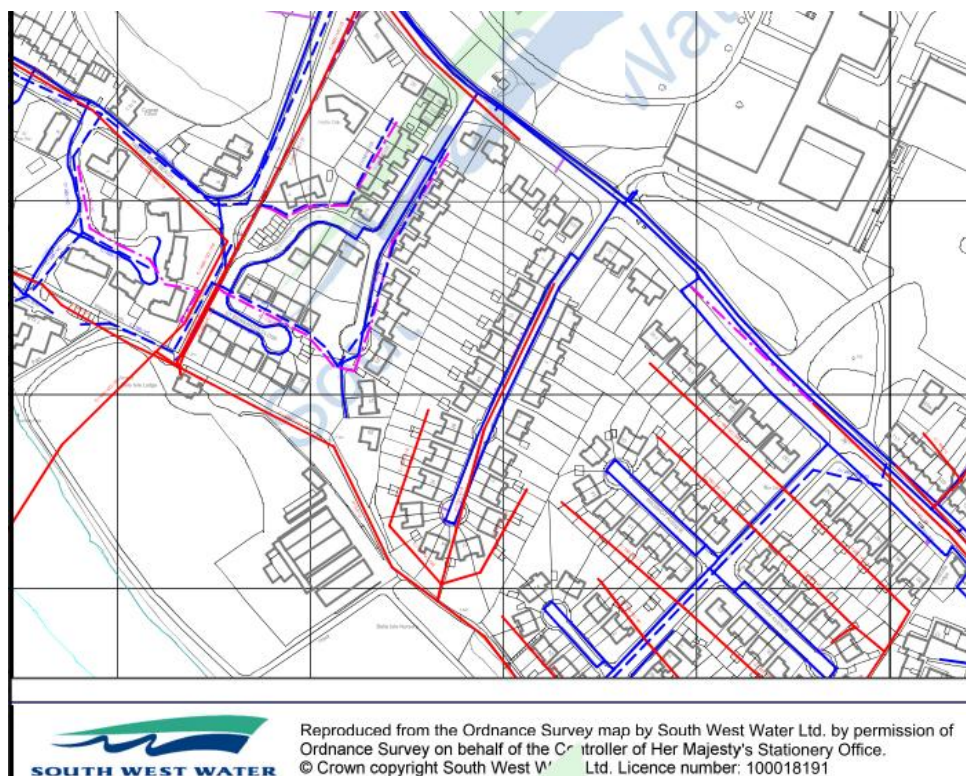
County Hall



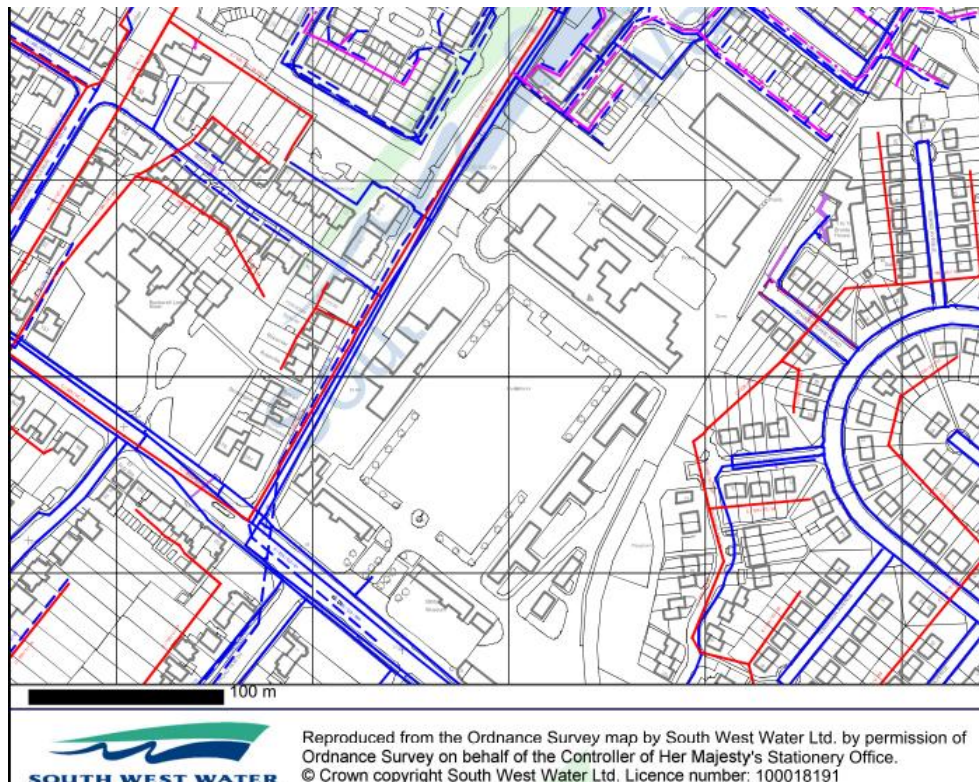
Proposed developments adjacent County Hall



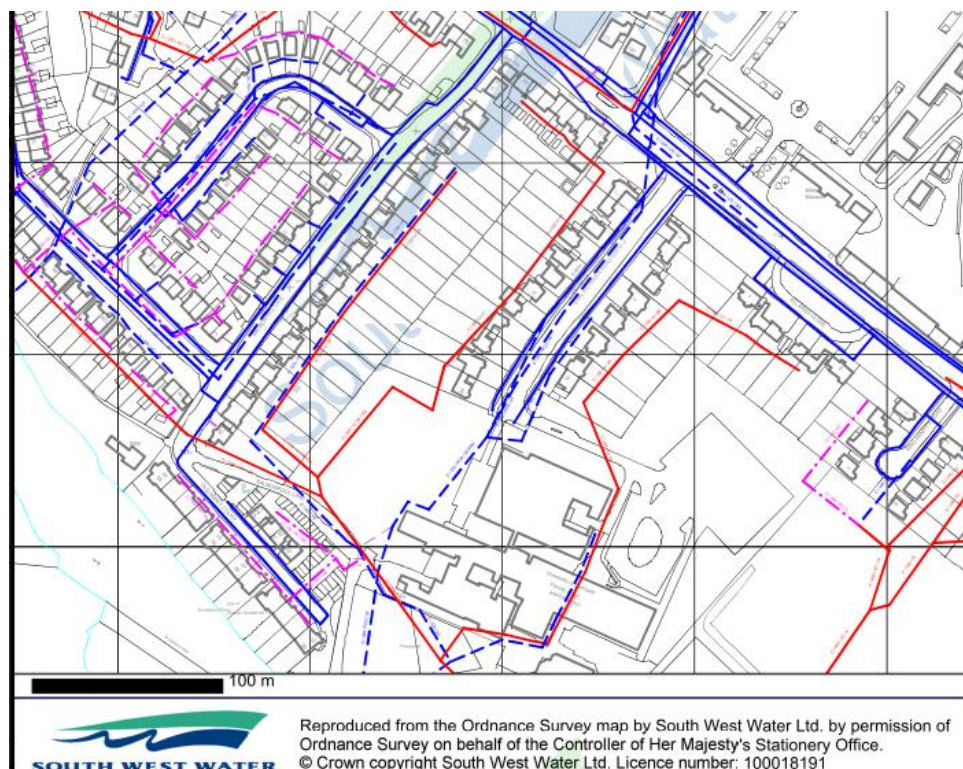
County Hall to Belle Isle Nursery



Barrack Road at Wyvern Barracks



Barrack Road to Earl Richards Road North



APPENDIX C

FULL LIST OF BUILDING LOADS ASSESSED

ID	Building	Heat demand (kWh/year)	Heat load (kW)
1		170,415	500
2		588,015	400
3		59,353	100
4	Heavitree Road Police Station	1,044,679	1,500
5		3,048,697	1,600
7		101,891	550
8,9 & 28-35		3,451,767	1,550
10		6,889,527	7,851
12		764,797	1,000
13		170,000	-
14		1,478,857	1,727
15		449,157	1,966
17		1,075,109	1,820
18		693,280	-
19		492,786	621
20		645,408	754
21		368,082	464
24		2,915,917	1,844
25		625,625	730
26		168,000	200
23 & 27		483,014	608
36-66		26,746,542	9,824
67		2,800,000	1,750
68		1,199,930	300
69		2,419,300	8,029
70		304,477	400
71-77		16,739,700	16,099
		75,894,325	62,185

For clarity, the missing ID numbers in the table above were assigned to:

ID	Building
6	Heavitree Hospital Energy Centre
11	Bus Station Energy Centre
16	Exeter School
22	EfW Plant

APPENDIX D

ENERGY BALANCE DETAIL

Sidwell Street Option C

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																					
Demands																					
Heat demand (LTHW)	-	-	-	4,749,309	5,437,581	6,125,853	6,915,062	8,292,287	9,669,511	11,046,736	11,046,055	11,045,375	11,044,694	11,044,013	11,043,332	11,042,652	11,041,971	11,041,290	11,040,609	11,039,928	11,039,248
Heat losses (LTHW)	-	-	-	270,711	309,942	349,174	394,159	472,660	551,162	629,664	629,625	629,586	629,548	629,509	629,470	629,431	629,392	629,354	629,315	629,276	629,237
Heat supply																					
BT CHP 1 - LTHW output	-	-	-	4,477,587	5,042,208	5,711,293	6,433,866	7,475,765	8,177,432	8,690,817	8,690,682	8,690,547	8,690,411	8,690,276	8,690,141	8,690,005	8,689,870	8,689,734	8,689,599	8,689,464	8,689,328
BT CHP 2 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BT CHP 3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	-	-	-	540,835	704,466	762,750	874,211	1,287,503	2,038,486	2,980,560	2,979,976	2,979,391	2,978,807	2,978,223	2,977,639	2,977,055	2,976,471	2,975,887	2,975,302	2,974,718	2,974,134
HS1 - Electricity generation	-	-	-	4,678,564	5,268,529	5,967,646	6,722,651	7,811,316	8,544,478	9,080,906	9,080,765	9,080,623	9,080,482	9,080,340	9,080,199	9,080,058	9,079,916	9,079,775	9,079,633	9,079,492	9,079,350
HS2 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	-	-	-	11,680,987	13,153,953	14,899,441	16,784,465	19,502,538	21,333,026	22,672,329	22,671,976	22,671,622	22,671,269	22,670,916	22,670,563	22,670,210	22,669,856	22,669,503	22,669,150	22,668,797	22,668,444
HS2 -Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	-	-	-	651,609	848,754	918,976	1,053,266	1,551,208	2,456,007	3,591,036	3,590,332	3,589,628	3,588,924	3,588,221	3,587,517	3,586,813	3,586,109	3,585,405	3,584,702	3,583,998	3,583,294
EC Parasitic demands	-	-	-	129,017	128,864	128,877	127,218	127,830	128,320	128,715	128,717	128,719	128,721	128,723	128,725	128,727	128,729	128,731	128,733	128,735	128,737
Total parasitics	-	-	-	129,017	128,864	128,877	127,218	127,830	128,320	128,715	128,717	128,719	128,721	128,723	128,725	128,727	128,729	128,731	128,733	128,735	128,737
Electricity export	-	-	-	3,212,070	3,679,888	4,217,302	4,842,237	5,732,901	6,347,456	6,783,168	6,783,025	6,782,882	6,782,738	6,782,595	6,782,452	6,782,308	6,782,165	6,782,022	6,781,878	6,781,735	6,781,592
Electricity import	-	-	-	1,862,523	1,740,223	1,578,533	1,446,804	1,249,415	1,131,298	1,030,977	1,030,977	1,030,978	1,030,978	1,030,978	1,030,978	1,030,978	1,030,978	1,030,978	1,030,978	1,030,979	1,030,979
Electricity generated and used on site	-	-	-	1,466,494	1,588,640	1,750,344	1,880,414	2,078,415	2,197,022	2,297,738	2,297,740	2,297,742	2,297,744	2,297,746	2,297,747	2,297,749	2,297,751	2,297,753	2,297,755	2,297,757	2,297,758
Top-up and standby boilers																					
Heat top-up and standby supply as LTHW	-	-	-	540,835	704,466	762,750	874,211	1,287,503	2,038,486	2,980,560	2,979,976	2,979,391	2,978,807	2,978,223	2,977,639	2,977,055	2,976,471	2,975,887	2,975,302	2,974,718	2,974,134
Fuel input (GCV)	-	-	-	651,609	848,754	918,976	1,053,266	1,551,208	2,456,007	3,591,036	3,590,332	3,589,628	3,588,924	3,588,221	3,587,517	3,586,813	3,586,109	3,585,405	3,584,702	3,583,998	3,583,294
Run hours																					
HS1	-	-	-	2,520	2,871	3,243	3,551	4,053	4,362	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620
HS2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																					
-	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)
Demands																					
Heat demand (LTHW)	-	-	-	3,880	4,486	5,093	6,169	7,383	8,597	9,811	9,810	9,809	9,808	9,807	9,806	9,805	9,804	9,804	9,803	9,802	9,801
Heat losses (LTHW)	-	-	-	31	35	40	45	54	63	72	72	72	72	72	72	72	72	72	72	72	72
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	-	-	-	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916
HS2 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	-	-	-	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002
HS2 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	0	0	0	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998
HS2 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	-	-	-	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	-	-	-	1,869	1,872	1,892	1,901	1,903	1,904	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905
Electricity import	-	-	-	816	815	815	813	812	812	812	812	812	812	812	812	812	812	812	812	812	812
Top-up and standby boilers																					
Heat top-up and standby supply as LTHW	-	-	-	3,376	3,899	4,422	5,340	6,386	7,432	8,479	8,478	8,477	8,477	8,476	8,475	8,474	8,474	8,473	8,472	8,471	8,471
Fuel input (GCV)	-	-	-	4,068	4,697	5,327	6,433	7,694	8,955	10,215	10,215	10,214	10,213	10,212	10,211	10,210	10,209	10,208	10,207	10,207	10,206
Emissions	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
HS1 Fuel input (GCV)	-	-	-	2,313	2,604	2,950	3,323	3,862	4,224	4,489	4,489	4,489	4,489	4,489	4,489	4,489	4,489	4,489	4,488	4,488	4,488
HS2 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	-	-	-	129	168	182	209	307	486	711	711	711	711	710	710	710	710	710	710	710	709
Electricity export	-	-	-	1,699	1,947	2,231	2,562	3,033	3,358	3,588	3,588	3,588	3,588	3,588	3,588	3,588	3,588	3,588	3,588	3,588	3,587
Electricity import	-	-	-	963	900	816	748	646	585	533	533	533	533	533	533	533	533	533	533	533	533
Electricity generated and used on site	-	-	-	18	19	21	23	25	26	28	28	28	28	28	28	28	28	28	28	28	28
Total emissions under this scenario	-	-	-	1,688	1,707	1,696	1,696	1,757	1,911	2,117	2,117	2,117	2,117	2,117	2,117	2,116	2,116	2,116	2,116	2,116	2,116

Sidwell Street Option C

Year	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																		
Demands																		
Heat demand (LTHW)	11,038,567	11,037,886	11,037,205	11,036,525	11,035,844	11,035,163	11,034,482	11,033,802	11,033,121	11,032,440	11,031,759	11,031,079	11,030,398	11,029,717	11,029,036	11,028,355	11,027,675	11,026,994
Heat losses (LTHW)	629,198	629,160	629,121	629,082	629,043	629,004	628,965	628,927	628,888	628,849	628,810	628,771	628,733	628,694	628,655	628,616	628,577	628,539
Heat supply																		
BT CHP 1 - LTHW output	8,689,193	8,689,057	8,687,964	8,687,829	8,687,694	8,687,559	8,687,424	8,687,289	8,687,154	8,687,019	8,686,883	8,686,748	8,686,613	8,686,478	8,686,343	8,686,208	8,686,073	8,685,938
BT CHP 2 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BT CHP 3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	2,973,550	2,972,966	2,973,340	2,972,755	2,972,171	2,971,586	2,971,002	2,970,417	2,969,833	2,969,248	2,968,664	2,968,079	2,967,495	2,966,910	2,966,326	2,965,742	2,965,157	2,964,573
HS1 - Electricity generation	9,079,209	9,079,067	9,077,925	9,077,784	9,077,643	9,077,502	9,077,360	9,077,219	9,077,078	9,076,937	9,076,796	9,076,655	9,076,514	9,076,372	9,076,231	9,076,090	9,075,949	9,075,808
HS2 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	22,668,091	22,667,737	22,664,885	22,664,533	22,664,180	22,663,828	22,663,476	22,663,123	22,662,771	22,662,418	22,662,066	22,661,714	22,661,361	22,661,009	22,660,656	22,660,304	22,659,952	22,659,599
HS2 -Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	3,582,590	3,581,886	3,582,337	3,581,633	3,580,928	3,580,224	3,579,520	3,578,816	3,578,112	3,577,408	3,576,703	3,575,999	3,575,295	3,574,591	3,573,887	3,573,183	3,572,478	3,571,774
EC Parasitic demands	128,739	128,741	128,743	128,745	128,747	128,749	128,751	128,753	128,755	128,757	128,759	128,761	128,763	128,765	128,767	128,769	128,771	128,773
Total parasitics	128,739	128,741	128,743	128,745	128,747	128,749	128,751	128,753	128,755	128,757	128,759	128,761	128,763	128,765	128,767	128,769	128,771	128,773
Electricity export	6,781,449	6,781,305	6,780,880	6,780,737	6,780,594	6,780,451	6,780,308	6,780,165	6,780,022	6,779,879	6,779,736	6,779,593	6,779,450	6,779,307	6,779,164	6,779,022	6,778,879	6,778,736
Electricity import	1,030,979	1,030,979	1,031,698	1,031,698	1,031,698	1,031,698	1,031,698	1,031,698	1,031,699	1,031,699	1,031,699	1,031,700	1,031,700	1,031,700	1,031,700	1,031,700	1,031,700	1,031,700
Electricity generated and used on site	2,297,760	2,297,762	2,297,045	2,297,047	2,297,049	2,297,051	2,297,053	2,297,054	2,297,056	2,297,058	2,297,059	2,297,061	2,297,063	2,297,065	2,297,067	2,297,069	2,297,070	2,297,072
Top-up and standby boilers																		
Heat top-up and standby supply as LTHW	2,973,550	2,972,966	2,973,340	2,972,755	2,972,171	2,971,586	2,971,002	2,970,417	2,969,833	2,969,248	2,968,664	2,968,079	2,967,495	2,966,910	2,966,326	2,965,742	2,965,157	2,964,573
Fuel input (GCV)	3,582,590	3,581,886	3,582,337	3,581,633	3,580,928	3,580,224	3,579,520	3,578,816	3,578,112	3,577,408	3,576,703	3,575,999	3,575,295	3,574,591	3,573,887	3,573,183	3,572,478	3,571,774
Run hours																		
HS1	4,620	4,620	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619	4,619
HS2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																		
Demands	-	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)
Heat demand (LTHW)		9,800	9,799	9,798	9,797	9,797	9,796	9,795	9,794	9,793	9,792	9,791	9,790	9,789	9,789	9,788	9,787	9,785
Heat losses (LTHW)		72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72
Low carbon heat supply units output		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)		1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916	1,916
HS2 output (LTHW)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 output (LTHW)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)		2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002	2,002
HS2 output (electricity)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 output (electricity)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)		4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998	4,998
HS2 Fuel input (GCV)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS3 Fuel input (GCV)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands		120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export		1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905
Electricity import		812	812	812	812	812	812	812	812	812	812	812	812	812	812	812	812	812
Top-up and standby boilers																		
Heat top-up and standby supply as LTHW		8,470	8,469	8,468	8,468	8,467	8,466	8,466	8,465	8,464	8,463	8,463	8,462	8,461	8,460	8,460	8,459	8,457
Fuel input (GCV)		10,205	10,204	10,203	10,202	10,201	10,200	10,199	10,199	10,198	10,197	10,196	10,195	10,194	10,193	10,192	10,191	10,190
Emissions	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
HS1 Fuel input (GCV)	4,488	4,488	4,488	4,488	4,488	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487
HS2 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	709	709	709	709	709	709	709	709	708	708	708	708	708	708	708	707	707	707
Electricity export	3,587	3,587	3,587	3,587	3,587	3,587	3,587	3,587	3,587	3,587	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586
Electricity import	533	533	533	533	533	533	533	533	533	533	533	533	533	533	533	533	533	533
Electricity generated and used on site	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Total emissions under this scenario	2,116	2,116	2,116	2,116	2,115	2,115	2,115	2,115	2,115	2,115	2,115	2,114	2,114	2,114	2,114	2,114	2,114	2,114

St Lukes and Sidwell Street Option C

[illegible]

St Lukes and Sidwell Street Option C

[illegible]

Wonford and City Centre with County Hall Option C

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																						
Demands																						
Heat demand (LTHW)	-	-	40,366,174	40,829,264	41,488,521	42,147,778	42,966,865	44,632,468	45,980,678	47,328,888	47,299,192	47,269,496	47,239,800	47,210,104	47,180,408	47,150,713	47,121,017	47,091,321	47,061,625	47,031,929	47,002,233	46,972,538
Heat losses (LTHW)	-	-	2,825,632	2,858,049	2,904,196	2,950,344	3,007,681	3,124,273	3,218,647	3,313,022	3,310,943	3,308,865	3,306,786	3,304,707	3,302,629	3,300,550	3,298,471	3,296,392	3,294,314	3,292,235	3,290,156	3,288,078
Heat supply																						
HS1 - LTHW output	-	-	17,658,027	17,970,827	18,210,382	17,899,093	18,491,821	18,769,966	18,607,621	18,506,290	18,505,216	18,504,978	18,503,216	18,599,068	18,514,081	18,513,878	18,645,165	18,635,330	18,675,949	18,670,635	18,586,208	18,584,355
HS2 - LTHW output	-	-	15,632,491	15,490,131	15,456,670	15,931,601	15,517,825	15,730,245	16,059,387	16,474,443	16,468,348	16,461,878	16,454,183	16,377,677	16,419,295	16,412,745	16,305,435	16,302,156	16,272,212	16,270,607	16,324,791	16,321,731
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	-	-	9,890,946	10,215,784	10,714,876	11,256,509	11,953,844	13,245,198	14,520,719	15,649,312	15,624,711	15,599,650	15,577,336	15,526,221	15,537,821	15,512,804	15,457,058	15,438,401	15,395,958	15,371,107	15,369,581	15,342,724
HS1 - Electricity generation	-	-	16,840,708	17,139,030	17,367,497	17,070,617	17,635,910	17,901,181	17,746,350	17,649,709	17,648,685	17,648,458	17,646,778	17,738,193	17,657,140	17,656,946	17,782,156	17,772,777	17,811,515	17,806,447	17,725,928	17,724,161
HS2 - Electricity generation	-	-	14,908,927	14,773,155	14,741,244	15,194,192	14,799,568	15,002,156	15,316,063	15,711,908	15,706,095	15,699,924	15,692,586	15,619,621	15,659,313	15,653,065	15,550,723	15,547,596	15,519,037	15,517,507	15,569,183	15,566,264
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	-	-	43,930,191	44,708,385	45,304,357	44,529,922	46,004,531	46,696,510	46,292,622	46,040,526	46,037,854	46,037,264	46,032,881	46,271,342	46,059,910	46,059,405	46,386,024	46,361,558	46,462,610	46,449,389	46,239,349	46,234,739
HS2 -Fuel input	-	-	38,891,000	38,536,831	38,453,588	39,635,135	38,605,731	39,134,195	39,953,045	40,985,634	40,970,472	40,954,374	40,935,231	40,744,898	40,848,435	40,832,139	40,565,172	40,557,015	40,482,517	40,478,524	40,613,326	40,605,713
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	-	-	11,916,802	12,308,173	12,909,489	13,562,059	14,402,222	15,958,070	17,494,842	18,854,593	18,824,953	18,794,758	18,767,875	18,706,291	18,720,266	18,690,126	18,622,961	18,600,483	18,549,347	18,519,406	18,517,567	18,485,210
EC Parasitic demands	-	-	167,128	166,002	164,518	163,144	160,438	158,735	156,839	155,162	155,173	155,183	155,193	155,203	155,214	155,224	155,234	155,245	155,255	155,266	155,276	155,287
Total parasitics	-	-	167,128	166,002	164,518	163,144	160,438	158,735	156,839	155,162	155,173	155,183	155,193	155,203	155,214	155,224	155,234	155,245	155,255	155,266	155,276	155,287
Electricity export	-	-	17,639,758	17,850,740	18,014,370	18,128,020	18,354,400	18,725,994	18,946,582	19,234,540	19,227,694	19,221,287	19,213,551	19,228,302	19,202,642	19,196,192	19,206,777	19,196,108	19,200,583	19,196,439	19,175,785	19,170,186
Electricity import	-	-	2,176,335	2,223,640	2,189,231	2,145,439	2,198,444	2,100,475	2,160,092	2,147,169	2,147,170	2,147,171	2,148,464	2,144,775	2,160,488	2,160,488	2,148,216	2,150,063	2,144,370	2,146,834	2,155,034	2,154,131
Electricity generated and used on site	-	-	14,109,877	14,061,446	14,094,371	14,136,789	14,081,078	14,177,343	14,115,831	14,127,077	14,127,086	14,127,096	14,125,812	14,129,512	14,113,810	14,113,820	14,126,102	14,124,265	14,129,969	14,127,515	14,119,325	14,120,239
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	9,890,946	10,215,784	10,714,876	11,256,509	11,953,844	13,245,198	14,520,719	15,649,312	15,624,711	15,599,650	15,577,336	15,526,221	15,537,821	15,512,804	15,457,058	15,438,401	15,395,958	15,371,107	15,369,581	15,342,724
Fuel input (GCV)	-	-	11,916,802	12,308,173	12,909,489	13,562,059	14,402,222	15,958,070	17,494,842	18,854,593	18,824,953	18,794,758	18,767,875	18,706,291	18,720,266	18,690,126	18,622,961	18,600,483	18,549,347	18,519,406	18,517,567	18,485,210
Run hours																						
HS1	-	-	6,817	6,925	7,016	6,893	7,096	7,205	7,141	7,094	7,094	7,094	7,095	7,134	7,100	7,100	7,149	7,146	7,162	7,160	7,129	7,128
HS2	-	-	6,026	5,975	5,958	6,123	5,965	6,056	6,182	6,322	6,320	6,318	6,316	6,290	6,304	6,302	6,264	6,264	6,254	6,254	6,275	6,274
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																						
Heat balance																						
Demands																						
Heat demand (LTHW)	-	-	20,854	21,269	21,857	22,445	23,478	24,806	26,002	27,197	27,177	27,158	27,138	27,118	27,099	27,079	27,060	27,040	27,021	27,001	26,982	26,962
Heat losses (LTHW)	-	-	323	326	332	337	343	357	367	378	378	378	377	377	377	377	377	376	376	376	376	375
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	-	-	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS2 output (LTHW)	-	-	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	-	-	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS2 output (electricity)	-	-	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	0	0	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS2 Fuel input (GCV)	0	0	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	-	-	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	-	-	4,545	4,545	4,545	4,545	4,545	4,546	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,552
Electricity import	-	-	4,209	4,208	4,207	4,206	4,204	4,202	4,200	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	18,107	18,465	18,973	19,481	20,364	21,513	22,546	23,578	23,561	23,545	23,528	23,511	23,495	23,478	23,461	23,444	23,428	23,411	23,394	23,378
Fuel input (GCV)	-	-	21,816	22,248	22,859	23,471	24,535	25,920	27,163	28,407	28,387	28,367	28,347	28,327	28,307	28,287	28,266					

Wonford and City Centre with County Hall Option C

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																	
Demands																	
Heat demand (LTHW)	46,942,842	46,913,146	46,883,450	46,853,754	46,824,058	46,794,362	46,764,667	46,734,971	46,705,275	46,675,579	46,645,883	46,616,187	46,586,492	46,556,796	46,527,100	46,497,404	46,467,708
Heat losses (LTHW)	3,285,999	3,283,920	3,281,841	3,279,763	3,277,684	3,275,605	3,273,527	3,271,448	3,269,369	3,267,291	3,265,212	3,263,133	3,261,054	3,258,976	3,256,897	3,254,818	3,252,740
Heat supply																	
HS1 - LTHW output	18,582,830	18,486,287	18,436,366	18,433,472	18,699,603	18,785,033	18,785,842	18,769,591	18,816,737	18,816,391	18,680,529	18,595,465	18,584,544	18,577,134	18,572,320	18,747,202	18,744,513
HS2 - LTHW output	16,311,029	16,399,128	16,441,592	16,434,650	16,160,487	16,108,018	16,244,149	16,308,301	16,259,675	16,252,724	16,340,541	16,261,595	16,256,023	16,255,970	16,271,479	16,102,137	16,097,701
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	15,323,181	15,299,855	15,275,544	15,253,610	15,229,872	15,165,141	14,996,431	14,916,761	14,886,472	14,862,000	14,878,275	15,010,515	14,995,239	14,970,932	14,928,467	14,891,158	14,866,513
HS1 - Electricity generation	17,722,706	17,630,632	17,583,022	17,580,262	17,834,075	17,915,551	17,916,322	17,900,824	17,945,786	17,945,457	17,815,883	17,734,757	17,724,341	17,717,274	17,712,683	17,879,470	17,876,906
HS2 - Electricity generation	15,556,058	15,640,080	15,680,577	15,673,957	15,412,484	15,362,444	15,492,274	15,553,456	15,507,081	15,500,451	15,584,204	15,508,912	15,503,597	15,503,547	15,518,338	15,356,835	15,352,604
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 - Fuel input	46,230,945	45,990,763	45,866,568	45,859,368	46,521,458	46,733,993	46,736,006	46,695,577	46,812,866	46,812,006	46,474,003	46,262,381	46,235,210	46,216,776	46,204,800	46,639,874	46,633,187
HS2 - Fuel input	40,579,088	40,798,965	40,903,906	40,886,635	40,204,566	40,074,032	40,412,702	40,572,302	40,451,328	40,434,034	40,652,510	40,456,105	40,442,241	40,442,110	40,480,694	40,059,401	40,048,364
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	18,461,664	18,433,561	18,404,269	18,377,843	18,349,243	18,271,254	18,067,990	17,972,001	17,935,509	17,906,024	17,925,632	18,084,957	18,066,553	18,037,267	17,986,105	17,941,154	17,911,461
EC Parasitic demands	155,297	155,308	155,318	155,329	155,339	155,350	155,360	155,371	155,381	155,392	155,403	155,413	155,424	155,435	155,445	155,456	155,467
Total parasitics	155,297	155,308	155,318	155,329	155,339	155,350	155,360	155,371	155,381	155,392	155,403	155,413	155,424	155,435	155,445	155,456	155,467
Electricity export	19,159,446	19,154,711	19,148,036	19,138,645	19,123,828	19,146,158	19,225,291	19,259,602	19,243,972	19,237,525	19,202,610	19,105,665	19,092,387	19,086,973	19,090,437	19,109,118	19,102,313
Electricity import	2,155,063	2,158,391	2,158,838	2,158,839	2,151,691	2,142,597	2,091,139	2,079,776	2,065,569	2,066,093	2,077,009	2,136,493	2,138,956	2,140,670	2,133,944	2,147,354	2,147,354
Electricity generated and used on site	14,119,318	14,116,000	14,115,563	14,115,573	14,122,731	14,131,836	14,183,305	14,194,678	14,208,896	14,208,383	14,197,478	14,138,004	14,135,552	14,133,848	14,140,585	14,127,187	14,127,197
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	15,323,181	15,299,855	15,275,544	15,253,610	15,229,872	15,165,141	14,996,431	14,916,761	14,886,472	14,862,000	14,878,275	15,010,515	14,995,239	14,970,932	14,928,467	14,891,158	14,866,513
Fuel input (GCV)	18,461,664	18,433,561	18,404,269	18,377,843	18,349,243	18,271,254	18,067,990	17,972,001	17,935,509	17,906,024	17,925,632	18,084,957	18,066,553	18,037,267	17,986,105	17,941,154	17,911,461
Run hours																	
HS1	7,128	7,092	7,074	7,074	7,174	7,207	7,200	7,192	7,215	7,215	7,163	7,132	7,128	7,124	7,124	7,186	7,186
HS2	6,269	6,304	6,320	6,317	6,211	6,190	6,231	6,257	6,241	6,239	6,273	6,250	6,249	6,250	6,258	6,193	6,193
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																	
Heat balance	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)
Demands																	
Heat demand (LTHW)	26,943	26,923	26,904	26,884	26,864	26,845	26,825	26,806	26,786	26,767	26,747	26,728	26,708	26,689	26,669	26,650	26,630
Heat losses (LTHW)	375	375	375	374	374	374	374	373	373	373	373	373	372	372	372	372	371
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS2 output (LTHW)	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS2 output (electricity)	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS2 Fuel input (GCV)	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	4,552	4,552	4,552	4,552	4,552	4,552	4,552	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546
Electricity import	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199	4,199
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	23,361	23,344	23,327	23,311	23,294	23,277	23,261	23,244	23,227	23,210	23,194	23,177	23,160	23,144	23,127	23,110	23,093
Fuel input (GCV)	28,146	28,125	28,105	28,085	28,065	28,045	28,025	28,005	27,984	27,964	27,944	27,924	27,904	27,884	27,864	27,844	27,823
Emissions	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
HS1 Fuel input (GCV)	9,154	9,106	9,082	9,080	9,211	9,253	9,254	9,246	9,269	9,269	9,202	9,160	9,155	9,151	9,149	9,235	9,233
HS2 Fuel input (GCV)	8,035	8,078	8,099	8,096	7,961	7,935	8,002	8,033	8,009	8,006	8,049	8,010	8,008	8,008	8,015	7,932	7,930
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	3,655	3,650	3,644	3,639	3,633	3,618	3,577	3,558	3,551	3,545	3,549	3,581	3,577	3,571	3,561	3,552	3,546
Electricity export	10,135	10,133	10,129	10,124	10,117	10,128	10,170	10,188	10,180	10,177	10,158	10,107	10,100	10,097	10,099	10,109	10,105
Electricity import	1,114	1,116	1,116	1,116	1,112	1,108	1,081	1,075	1,068	1,068	1,074	1,105	1,106	1,107	1,103	1,110	1,110
Electricity generated and used on site	169	169	169	169	169	170	170	170	171	171	170	170	170	170	170	170	170
Total emissions under this scenario	11,653	11,648	11,642	11,637	11,631	11,616	11,574	11,554	11,547	11,541	11,546	11,579	11,576	11,570	11,560	11,551	11,545

Wonford and City Centre without County Hall Option C

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																						
Demands																						
Heat demand (LTHW)	-	-	38,679,949	39,148,415	39,813,047	40,477,680	41,234,943	42,805,121	44,158,706	45,512,291	45,487,971	45,463,651	45,439,331	45,415,010	45,390,690	45,366,370	45,342,049	45,317,729	45,293,409	45,269,089	45,244,768	45,220,448
Heat losses (LTHW)	-	-	2,707,596	2,740,389	2,786,913	2,833,438	2,886,446	2,996,358	3,091,109	3,185,860	3,184,158	3,182,456	3,180,753	3,179,051	3,177,348	3,175,646	3,173,943	3,172,241	3,170,539	3,168,836	3,167,134	3,165,431
Heat supply																						
HS1 - LTHW output	-	-	18,096,899	18,128,747	17,843,767	17,988,413	17,905,524	18,470,440	18,312,120	18,471,881	18,468,051	18,464,968	18,465,085	18,740,649	18,738,492	18,737,290	18,737,548	18,733,690	18,744,878	18,448,924	18,468,778	18,472,429
HS2 - LTHW output	-	-	14,724,473	14,860,125	15,370,460	15,466,875	15,660,064	15,580,539	16,164,772	16,388,833	16,384,306	16,378,024	16,371,259	16,094,111	16,089,577	16,085,393	16,078,557	16,076,474	16,046,020	16,274,643	16,206,088	16,197,064
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	-	-	8,556,204	8,889,733	9,375,210	9,845,080	10,544,917	11,739,342	12,761,498	13,825,746	13,808,085	13,791,432	13,772,061	13,747,628	13,728,301	13,707,668	13,688,229	13,668,151	13,661,400	13,702,713	13,725,396	13,704,751
HS1 - Electricity generation	-	-	17,259,268	17,289,641	17,017,852	17,155,803	17,076,750	17,615,519	17,464,527	17,616,893	17,613,240	17,610,411	17,610,300	17,873,220	17,871,163	17,870,017	17,870,264	17,866,584	17,877,254	17,594,998	17,613,934	17,617,415
HS2 - Electricity generation	-	-	14,042,937	14,172,311	14,659,024	14,750,976	14,935,223	14,859,379	15,416,571	15,630,261	15,625,943	15,619,952	15,613,501	15,349,180	15,344,856	15,340,866	15,334,346	15,332,360	15,303,315	15,521,356	15,455,974	15,447,368
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	-	-	45,022,032	45,101,264	44,392,283	44,752,136	44,545,923	45,951,339	45,557,465	45,954,923	45,945,394	45,937,724	45,938,015	46,623,572	46,618,206	46,615,216	46,615,859	46,606,260	46,634,093	45,897,809	45,947,204	45,956,286
HS2 -Fuel input	-	-	36,632,004	36,969,484	38,239,112	38,478,975	38,959,596	38,761,753	40,215,226	40,772,652	40,761,388	40,745,760	40,728,931	40,039,433	40,028,152	40,017,745	40,000,737	39,995,556	39,919,791	40,488,566	40,318,012	40,295,562
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	-	-	10,308,680	10,710,522	11,295,434	11,861,543	12,704,719	14,143,785	15,375,298	16,657,525	16,636,247	16,616,183	16,592,845	16,563,407	16,540,122	16,515,263	16,491,842	16,467,652	16,459,518	16,509,293	16,536,622	16,511,749
EC Parasitic demands	-	-	174,203	172,688	170,721	168,916	165,142	162,437	160,117	158,090	158,087	158,084	158,080	158,077	158,074	158,070	158,067	158,064	158,060	158,057	158,054	158,050
Total parasitics	-	-	174,203	172,688	170,721	168,916	165,142	162,437	160,117	158,090	158,087	158,084	158,080	158,077	158,074	158,070	158,067	158,064	158,060	158,057	158,054	158,050
Electricity export	-	-	17,294,731	17,459,406	17,633,229	17,788,405	17,916,550	18,400,544	18,683,416	19,093,537	19,087,236	19,079,290	19,072,953	19,097,148	19,090,769	19,087,135	19,081,107	19,076,590	19,065,323	18,961,037	18,948,151	18,943,538
Electricity import	-	-	2,285,813	2,289,226	2,246,157	2,169,625	2,188,802	2,207,166	2,081,519	2,123,558	2,125,224	2,126,206	2,126,206	2,151,908	2,151,908	2,153,406	2,153,649	2,154,794	2,161,898	2,121,823	2,155,380	2,155,889
Electricity generated and used on site	-	-	14,007,474	14,002,545	14,043,647	14,118,374	14,095,424	14,074,354	14,197,681	14,153,616	14,151,946	14,150,962	14,150,958	14,125,253	14,125,250	14,123,749	14,123,502	14,122,354	14,115,246	14,155,317	14,121,757	14,121,244
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	8,556,204	8,889,733	9,375,210	9,845,080	10,544,917	11,739,342	12,761,498	13,825,746	13,808,085	13,791,432	13,772,061	13,747,628	13,728,301	13,707,668	13,688,229	13,668,151	13,661,400	13,702,713	13,725,396	13,704,751
Fuel input (GCV)	-	-	10,308,680	10,710,522	11,295,434	11,861,543	12,704,719	14,143,785	15,375,298	16,657,525	16,636,247	16,616,183	16,592,845	16,563,407	16,540,122	16,515,263	16,491,842	16,467,652	16,459,518	16,509,293	16,536,622	16,511,749
Run hours																						
HS1	-	-	6,983	6,991	6,881	6,944	6,892	7,094	7,025	7,085	7,084	7,079	7,079	7,179	7,179	7,179	7,179	7,178	7,184	7,078	7,084	7,086
HS2	-	-	5,703	5,759	5,937	5,974	6,033	5,988	6,224	6,283	6,282	6,279	6,277	6,172	6,171	6,170	6,166	6,165	6,152	6,238	6,210	6,206
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																						
Heat balance																						
Demands																						
Heat demand (LTHW)	-	-	18,991	19,413	20,008	20,602	21,640	22,973	24,175	25,377	25,365	25,352	25,339	25,327	25,314	25,302	25,289	25,277	25,264	25,251	25,239	25,226
Heat losses (LTHW)	-	-	309	313	318	323	330	342	353	364	363	363	363	363	363	363	362	362	362	362	362	361
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	-	-	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS2 output (LTHW)	-	-	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	-	-	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS2 output (electricity)	-	-	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	0	0	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS2 Fuel input (GCV)	0	0	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	-	-	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	-	-	4,545	4,545	4,545	4,545	4,545	4,545	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546
Electricity import	-	-	4,215	4,214	4,212	4,211	4,208	4,206	4,204	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	16,531	16,895	17,409	17,923	18,809	19,960	20,998	22,037	22,026	22,015	22,004	21,993	21,982	21,972	21,961	21,950	21,939	21,928	21,917	21,906
Fuel input (GCV)	-	-	19,917	20,356	20,975	21,593	22,661	24,048	25,299	26,5												

Wonford and City Centre without County Hall Option C

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																	
Demands																	
Heat demand (LTHW)	45,196,128	45,171,807	45,147,487	45,123,167	45,098,846	45,074,526	45,050,206	45,025,886	45,001,565	44,977,245	44,952,925	44,928,604	44,904,284	44,879,964	44,855,644	-	-
Heat losses (LTHW)	3,163,729	3,162,027	3,160,324	3,158,622	3,156,919	3,155,217	3,153,514	3,151,812	3,150,110	3,148,407	3,146,705	3,145,002	3,143,300	3,141,597	3,139,895	-	-
Heat supply																	
HS1 - LTHW output	18,471,079	18,468,412	18,522,846	18,521,436	18,513,107	18,510,452	18,423,200	18,422,627	18,439,411	18,437,281	18,483,272	18,392,115	18,391,811	18,389,794	18,387,668	-	-
HS2 - LTHW output	16,190,052	16,182,762	16,128,232	16,124,001	16,120,356	16,116,271	16,192,157	16,186,048	16,176,766	16,167,318	16,128,459	16,215,545	16,213,548	16,208,332	16,201,118	-	-
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	13,687,096	13,671,033	13,645,112	13,624,735	13,610,690	13,591,413	13,576,761	13,557,425	13,523,905	13,509,464	13,476,316	13,454,369	13,430,652	13,411,866	13,395,189	-	-
HS1 - Electricity generation	17,616,128	17,613,585	17,665,499	17,664,154	17,656,211	17,653,679	17,570,466	17,569,919	17,585,926	17,583,895	17,627,756	17,540,819	17,540,529	17,538,606	17,536,577	-	-
HS2 - Electricity generation	15,440,680	15,433,728	15,381,722	15,377,687	15,374,211	15,370,315	15,442,688	15,436,861	15,428,009	15,418,999	15,381,938	15,464,993	15,463,089	15,458,114	15,451,235	-	-
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	45,952,928	45,946,294	46,081,715	46,078,208	46,057,488	46,050,882	45,833,814	45,832,388	45,874,144	45,868,845	45,983,261	45,756,479	45,755,722	45,750,706	45,745,414	-	-
HS2 -Fuel input	40,278,117	40,259,982	40,124,320	40,113,795	40,104,726	40,094,564	40,283,354	40,268,156	40,245,064	40,221,561	40,124,885	40,341,539	40,336,572	40,323,595	40,305,649	-	-
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	16,490,477	16,471,125	16,439,894	16,415,343	16,398,422	16,375,196	16,357,544	16,334,247	16,293,862	16,276,463	16,236,525	16,210,083	16,181,508	16,158,875	16,138,781	-	-
EC Parasitic demands	158,047	158,044	158,040	158,037	158,033	158,030	158,027	158,023	158,020	158,016	158,013	158,010	158,006	158,003	157,999	-	-
Total parasitics	158,047	158,044	158,040	158,037	158,033	158,030	158,027	158,023	158,020	158,016	158,013	158,010	158,006	158,003	157,999	-	-
Electricity export	18,935,567	18,926,075	18,912,791	18,907,414	18,898,438	18,892,565	18,891,091	18,887,162	18,893,178	18,882,176	18,884,604	18,880,825	18,877,926	18,871,032	18,864,383	-	-
Electricity import	2,155,889	2,155,889	2,142,694	2,142,694	2,145,133	2,145,685	2,155,048	2,157,488	2,156,347	2,156,383	2,152,006	2,152,106	2,151,398	2,151,398	2,153,654	-	-
Electricity generated and used on site	14,121,241	14,121,238	14,134,430	14,134,427	14,131,984	14,131,428	14,122,062	14,119,619	14,120,757	14,120,717	14,125,090	14,124,988	14,125,691	14,125,688	14,123,429	-	-
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	13,687,096	13,671,033	13,645,112	13,624,735	13,610,690	13,591,413	13,576,761	13,557,425	13,523,905	13,509,464	13,476,316	13,454,369	13,430,652	13,411,866	13,395,189	-	-
Fuel input (GCV)	16,490,477	16,471,125	16,439,894	16,415,343	16,398,422	16,375,196	16,357,544	16,334,247	16,293,862	16,276,463	16,236,525	16,210,083	16,181,508	16,158,875	16,138,781	-	-
Run hours																	
HS1	7,086	7,086	7,107	7,107	7,104	7,103	7,070	7,067	7,075	7,075	7,093	7,060	7,059	7,059	7,059	-	-
HS2	6,203	6,201	6,189	6,187	6,186	6,186	6,213	6,211	6,208	6,206	6,191	6,222	6,221	6,220	6,217	-	-
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																	
Heat balance																	
Demands																	
Heat demand (LTHW)	25,214	25,201	25,189	25,176	25,163	25,151	25,138	25,126	25,113	25,101	25,088	25,075	25,063	25,050	25,038	-	-
Heat losses (LTHW)	361	361	361	361	360	360	360	360	360	359	359	359	359	359	358	-	-
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	-	-
HS2 output (LTHW)	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	-	-
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	-	-
HS2 output (electricity)	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	-	-
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	0	0
HS2 Fuel input (GCV)	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	0	0
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	-	-
Electricity export	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	4,546	-	-
Electricity import	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	4,202	-	-
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	21,895	21,885	21,874	21,863	21,852	21,841	21,830	21,819	21,809	21,798	21,787	21,776	21,765	21,754	21,743	-	-
Fuel input (GCV)	26,380	26,367	26,354	26,341	26,328	26,315	26,302	26,288	26,275	26,262	26,249	26,236	26,223	26,210	26,197	-	-
Emissions																	
HS1 Fuel input (GCV)	9,099	9,097	9,124	9,123	9,119	9,118	9,075	9,075	9,083	9,082	9,105	9,060	9,060	9,059	9,058	-	-
HS2 Fuel input (GCV)	7,975	7,971	7,945	7,943	7,941	7,939	7,976	7,973	7,969	7,964	7,945	7,988	7,987	7,984	7,981	-	-
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	3,265	3,261	3,255	3,250	3,247	3,242	3,239	3,234	3,226	3,223	3,215	3,210	3,204	3,199	3,195	-	-
Electricity export	10,017	10,012	10,005	10,002	9,997	9,994	9,993	9,991	9,994	9,989	9,990	9,988	9,986	9,983	9,979	-	-
Electricity import	1,115	1,115	1,108	1,108	1,109	1,109	1,114	1,115	1,115	1,115	1,113	1,113	1,112	1,112	1,113	-	-
Electricity generated and used on site	169	169	170	170	170	170	169	169	169	169	170	169	170	170	169	-	-
Total emissions under this scenario	11,267	11,263	11,257	11,252	11,249	11,245	11,241	11,237	11,229	11,225	11,217	11,212	11,207	11,202	11,198	-	-

Whole network Inc Marsh Barton Industrial Sites Option C

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																						
Demands																						
Heat demand (LTHW)	-	-	41,991,566	46,946,821	47,569,976	48,193,132	48,976,118	50,605,619	51,917,727	53,229,835	53,164,037	53,098,240	53,032,442	52,966,645	52,900,847	52,835,050	52,769,253	52,703,455	52,637,658	52,571,860	52,506,063	52,440,265
Heat losses (LTHW)	-	-	3,779,241	4,225,214	4,281,298	4,337,382	4,407,851	4,554,506	4,672,595	4,790,685	4,784,763	4,778,842	4,772,920	4,766,998	4,761,076	4,755,154	4,749,233	4,743,311	4,737,389	4,731,467	4,725,546	4,719,624
Heat supply																						
HS1 - LTHW output	-	-	-	42,491,995	42,815,097	43,173,606	43,522,005	44,412,952	45,110,728	45,819,754	45,790,046	45,742,840	45,702,690	45,665,889	45,628,817	45,584,167	45,544,310	45,505,530	45,459,064	45,420,849	45,381,513	45,340,183
HS2 - LTHW output	-	-	20,603,891	5,882,413	6,121,366	6,297,417	6,567,466	6,973,329	7,310,398	7,571,154	7,550,045	7,546,435	7,535,599	7,521,384	7,507,183	7,500,463	7,488,942	7,476,339	7,471,388	7,458,155	7,446,007	7,435,823
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	-	-	25,137,552	2,768,264	2,885,448	3,030,128	3,265,134	3,744,480	4,139,832	4,600,249	4,579,346	4,558,444	4,537,710	4,517,006	4,496,560	4,476,211	4,455,871	4,435,533	4,415,232	4,394,961	4,374,725	4,354,520
HS1 - Electricity generation	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS2 - Electricity generation	-	-	21,603,845	6,167,900	6,418,450	6,603,045	6,886,200	7,311,760	7,665,189	7,938,599	7,916,466	7,912,681	7,901,318	7,886,414	7,871,524	7,864,477	7,852,397	7,839,183	7,833,991	7,820,116	7,807,379	7,796,700
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	-	-	-	42,491,995	42,815,097	43,173,606	43,522,005	44,412,952	45,110,728	45,819,754	45,790,046	45,742,840	45,702,690	45,665,889	45,628,817	45,584,167	45,544,310	45,505,530	45,459,064	45,420,849	45,381,513	45,340,183
HS2 -Fuel input	-	-	53,746,722	15,344,694	15,968,021	16,427,261	17,131,704	18,190,426	19,069,696	19,749,896	19,694,833	19,685,414	19,657,147	19,620,067	19,583,023	19,565,493	19,535,439	19,502,566	19,489,649	19,455,130	19,423,441	19,396,875
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	-	-	30,286,208	3,335,258	3,476,444	3,650,756	3,933,897	4,511,422	4,987,750	5,542,469	5,517,285	5,492,101	5,467,120	5,442,176	5,417,542	5,393,026	5,368,519	5,344,016	5,319,556	5,295,133	5,270,753	5,246,410
EC Parasitic demands	-	-	173,567	178,176	176,233	174,427	170,965	168,523	165,996	163,754	163,736	163,718	163,700	163,681	163,663	163,645	163,627	163,609	163,590	163,572	163,554	163,535
Total parasitics	-	-	173,567	178,176	176,233	174,427	170,965	168,523	165,996	163,754	163,736	163,718	163,700	163,681	163,663	163,645	163,627	163,609	163,590	163,572	163,554	163,535
Electricity export	-	-	9,824,476	1,819,117	1,901,277	1,964,366	2,051,473	2,203,697	2,339,071	2,450,447	2,446,419	2,444,969	2,440,198	2,434,347	2,430,985	2,426,645	2,421,957	2,417,013	2,412,261	2,406,195	2,402,816	2,397,396
Electricity import	-	-	4,513,281	11,948,477	11,778,144	11,654,832	11,455,322	11,179,543	10,958,962	10,794,685	10,812,772	10,814,990	10,812,663	10,830,698	10,842,209	10,844,896	10,852,271	10,860,522	10,868,944	10,868,735	10,878,075	10,883,315
Electricity generated and used on site	-	-	11,779,370	4,348,782	4,517,173	4,638,679	4,834,727	5,108,063	5,326,118	5,488,153	5,470,048	5,467,812	5,461,120	5,452,067	5,440,538	5,437,832	5,430,440	5,422,171	5,421,730	5,413,921	5,404,563	5,399,304
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	25,137,552	2,768,264	2,885,448	3,030,128	3,265,134	3,744,480	4,139,832	4,600,249	4,579,346	4,558,444	4,537,710	4,517,006	4,496,560	4,476,211	4,455,871	4,435,533	4,415,232	4,394,961	4,374,725	4,354,520
Fuel input (GCV)	-	-	30,286,208	3,335,258	3,476,444	3,650,756	3,933,897	4,511,422	4,987,750	5,542,469	5,517,285	5,492,101	5,467,120	5,442,176	5,417,542	5,393,026	5,368,519	5,344,016	5,319,556	5,295,133	5,270,753	5,246,410
Run hours																						
HS1	-	-	-	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800
HS2	-	-	8,065	2,389	2,491	2,557	2,659	2,814	2,951	3,045	3,034	3,032	3,030	3,025	3,022	3,018	3,013	3,009	3,007	3,003	3,000	2,997
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																						
Heat balance																						
Demands	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)
Heat demand (LTHW)	-	-	20,797	22,754	23,329	23,905	24,925	26,242	27,425	28,608	28,576	28,544	28,512	28,481	28,449	28,417	28,385	28,353	28,322	28,290	28,258	28,226
Heat losses (LTHW)	-	-	431	482	489	495	503	520	533	547	546	546	545	544	544	543	542	541	541	540	539	539
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	-	-	-	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 output (LTHW)	-	-	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS2 output (electricity)	-	-	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	0	0	0	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 Fuel input (GCV)	0	0	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	-	-	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	-	-	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056
Electricity import	-	-	4,917	4,918	4,917	4,916	4,914	4,912	4,910	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	18,674	14,220	14,676	15,132	15,979	17,061	18,088	19,132	19,113	19,093	19,073	19,053	19,033	19,014	18,994	18,974	18,954	18,934	18,915	18,895
Fuel input (GCV)	-	-	22,499	17,132	17,682	18,232	19,252	20,556	21,792	23,051	23,027	23,003	22,979	22,956	22,932	22,908	22,884	22,860	22,836	22,813	22,789	22,765
Emissions	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
HS1 Fuel input (GCV)	-	-	-	1,700	1,713	1,727	1,741	1,777	1,804	1,833	1,832	1,830	1,828	1,827	1,825	1,823	1,822	1,820	1,818	1,817	1,815	1,814
HS2 Fuel input (GCV)	-	-	10,642	3,038	3,162	3,253	3,392	3,602	3,776	3,910	3,900	3,898	3,892	3,885	3,877	3,874	3,868	3,862	3,859	3,852	3,846	3,841
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	-	-	5,997	660	688	723	779	893	988	1,097	1,092	1,087	1,082	1,078	1,073	1,068	1,063	1,058	1,053	1,048	1,044	1,039
Electricity export	-	-	5,197	962	1,006	1,039	1,085	1,166	1,237	1,296	1,294	1,293	1,291	1,288	1,286	1,284	1,281	1,279	1,276	1,273	1,271	1,268
Electricity import	-	-	2,333	6,177	6,089	6,026	5,922	5,780	5,666	5,581	5,590	5,591	5,595	5,599	5,605	5,607	5,611	5,615	5,615	5,619	5,624	5,627
Electricity generated and used on site	-	-	141	52	54	56	58	61	64	66	66	66	66	65	65	65	65	65	65	65	65	65
Total emissions under this scenario	-																					

Whole network Inc Marsh Barton Industrial Sites Option C

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																	
Demands																	
Heat demand (LTHW)	52,374,468	52,308,670	52,242,873	52,177,075	52,111,278	52,045,481	51,979,683	51,913,886	51,848,088	51,782,291	51,716,493	51,650,696	51,584,898	51,519,101	51,453,303	51,387,506	51,321,708
Heat losses (LTHW)	4,713,702	4,707,780	4,701,859	4,695,937	4,690,015	4,684,093	4,678,171	4,672,250	4,666,328	4,660,406	4,654,484	4,648,563	4,642,641	4,636,719	4,630,797	4,624,876	4,618,954
Heat supply																	
HS1 - LTHW output	45,296,687	45,257,582	45,217,476	45,184,474	45,148,660	45,116,481	45,077,890	45,036,662	44,995,146	44,961,563	44,923,259	44,887,232	44,849,798	44,810,021	44,771,334	44,727,899	44,691,010
HS2 - LTHW output	7,427,585	7,396,940	7,385,177	7,386,752	7,370,214	7,368,459	7,355,171	7,344,367	7,333,751	7,314,938	7,280,393	7,263,807	7,248,668	7,235,570	7,221,035	7,211,054	7,194,375
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	4,334,535	4,332,566	4,312,715	4,272,424	4,253,056	4,215,270	4,195,430	4,175,742	4,156,156	4,136,833	4,137,963	4,118,856	4,099,710	4,080,866	4,062,368	4,044,065	4,025,914
HS1 - Electricity generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS2 - Electricity generation	7,788,062	7,755,930	7,743,597	7,745,248	7,727,908	7,726,067	7,712,134	7,700,806	7,689,949	7,669,949	7,633,727	7,616,336	7,600,462	7,586,729	7,571,489	7,561,023	7,543,534
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 -Fuel input	45,296,687	45,257,582	45,217,476	45,184,474	45,148,660	45,116,481	45,077,890	45,036,662	44,995,146	44,961,563	44,923,259	44,887,232	44,849,798	44,810,021	44,771,334	44,727,899	44,691,010
HS2 -Fuel input	19,375,385	19,295,445	19,264,762	19,268,869	19,225,731	19,221,151	19,186,489	19,158,307	19,130,615	19,081,538	18,991,424	18,948,159	18,908,667	18,874,501	18,836,586	18,810,549	18,767,040
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	5,222,331	5,219,959	5,196,042	5,147,498	5,124,164	5,078,639	5,054,735	5,031,015	5,007,416	4,984,136	4,985,497	4,962,478	4,939,410	4,916,706	4,894,420	4,872,368	4,850,499
EC Parasitic demands	163,517	163,499	163,480	163,462	163,444	163,425	163,406	163,388	163,369	163,351	163,332	163,313	163,295	163,276	163,257	163,239	163,220
Total parasitics	163,517	163,499	163,480	163,462	163,444	163,425	163,406	163,388	163,369	163,351	163,332	163,313	163,295	163,276	163,257	163,239	163,220
Electricity export	2,394,035	2,376,220	2,370,040	2,378,749	2,370,475	2,378,324	2,372,583	2,368,286	2,364,077	2,356,387	2,334,013	2,327,293	2,320,115	2,317,085	2,309,815	2,305,543	2,301,349
Electricity import	10,888,574	10,902,872	10,909,007	10,916,047	10,925,094	10,934,766	10,942,938	10,949,952	10,956,855	10,968,873	10,982,702	10,993,355	11,002,032	11,012,716	11,020,667	11,026,843	11,040,118
Electricity generated and used on site	5,394,027	5,379,710	5,373,557	5,366,499	5,357,433	5,347,743	5,339,552	5,332,520	5,325,598	5,313,561	5,299,713	5,289,042	5,280,347	5,269,643	5,261,674	5,255,479	5,242,185
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	4,334,535	4,332,566	4,312,715	4,272,424	4,253,056	4,215,270	4,195,430	4,175,742	4,156,156	4,136,833	4,137,963	4,118,856	4,099,710	4,080,866	4,062,368	4,044,065	4,025,914
Fuel input (GCV)	5,222,331	5,219,959	5,196,042	5,147,498	5,124,164	5,078,639	5,054,735	5,031,015	5,007,416	4,984,136	4,985,497	4,962,478	4,939,410	4,916,706	4,894,420	4,872,368	4,850,499
Run hours																	
HS1	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800
HS2	2,996	2,983	2,979	2,978	2,971	2,969	2,965	2,958	2,955	2,947	2,935	2,929	2,922	2,917	2,911	2,906	2,899
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																	
Heat balance																	
Demands																	
Heat demand (LTHW)	28,194	28,163	28,131	28,099	28,067	28,035	28,004	27,972	27,940	27,908	27,876	27,845	27,813	27,781	27,749	27,717	27,686
Heat losses (LTHW)	538	537	537	536	535	535	534	533	533	532	531	531	530	529	529	528	527
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 output (LTHW)	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555	2,555
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS2 output (electricity)	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679	2,679
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 Fuel input (GCV)	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665	6,665
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056	2,056
Electricity import	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,909	4,908	4,908	4,908	4,908	4,908	4,908	4,908
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	18,875	18,855	18,836	18,816	18,796	18,776	18,756	18,737	18,717	18,697	18,677	18,657	18,638	18,618	18,598	18,578	18,559
Fuel input (GCV)	22,741	22,717	22,693	22,670	22,646	22,622	22,598	22,574	22,550	22,527	22,503	22,479	22,455	22,431	22,407	22,384	22,360
Emissions																	
HS1 Fuel input (GCV)	1,812	1,810	1,809	1,807	1,806	1,805	1,803	1,801	1,800	1,798	1,797	1,795	1,794	1,792	1,791	1,789	1,788
HS2 Fuel input (GCV)	3,836	3,820	3,814	3,815	3,807	3,806	3,799	3,793	3,788	3,778	3,760	3,752	3,744	3,737	3,730	3,724	3,716
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	1,034	1,034	1,029	1,019	1,015	1,006	1,001	996	991	987	987	983	978	974	969	965	960
Electricity export	1,266	1,257	1,254	1,258	1,254	1,258	1,255	1,253	1,251	1,247	1,235	1,231	1,227	1,226	1,222	1,220	1,217
Electricity import	5,629	5,637	5,640	5,644	5,648	5,653	5,657	5,661	5,665	5,671	5,678	5,684	5,688	5,694	5,698	5,701	5,708
Electricity generated and used on site	65	65	64	64	64	64	64	64	64	64	64	63	63	63	63	63	63
Total emissions under this scenario	10,980	10,980	10,974	10,963	10,957	10,947	10,941	10,935	10,929	10,924	10,924	10,919	10,913	10,908	10,902	10,897	10,891

Whole network excl Marsh Barton Industrial Sites Option C

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	
Heat balance																						
Demands																						
Heat demand (LTHW)	-	-	40,099,271	40,829,265	41,488,522	42,147,779	42,966,867	44,632,470	45,980,679	47,328,889	47,299,193	47,269,497	47,239,801	47,210,105	47,180,410	47,150,714	47,121,018	47,091,322	47,061,626	47,031,930	47,002,235	46,972,539
Heat losses (LTHW)	-	-	2,967,346	3,021,366	3,070,151	3,118,936	3,179,548	3,302,803	3,402,570	3,502,338	3,500,140	3,497,943	3,495,745	3,493,548	3,491,350	3,489,153	3,486,955	3,484,758	3,482,560	3,480,363	3,478,165	3,475,968
Heat supply																						
HS1 - LTHW output	-	-	37,204,359	37,663,356	38,110,779	38,546,087	38,995,221	39,998,596	40,788,320	41,535,676	41,517,447	41,499,935	41,482,969	41,466,082	41,449,823	41,431,516	41,414,017	41,395,319	41,378,603	41,362,944	41,345,742	41,328,526
HS2 - LTHW output	-	-	3,217,350	3,372,287	3,494,752	3,645,914	3,831,777	4,162,051	4,414,623	4,644,341	4,640,934	4,636,796	4,632,101	4,627,330	4,621,928	4,618,571	4,614,400	4,611,428	4,606,475	4,600,463	4,595,993	4,591,533
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	-	-	2,624,181	2,794,261	2,932,415	3,053,986	3,298,690	3,753,899	4,159,580	4,630,482	4,620,225	4,609,982	4,599,749	4,589,515	4,579,281	4,569,052	4,558,829	4,548,605	4,538,382	4,528,159	4,517,938	4,507,720
HS1 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS2 - Electricity generation	-	-	2,949,568	3,091,610	3,203,882	3,342,463	3,512,856	3,815,641	4,047,191	4,257,790	4,254,666	4,250,872	4,246,569	4,242,194	4,237,242	4,234,165	4,230,341	4,227,616	4,223,075	4,217,564	4,213,465	4,209,377
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 - Fuel input	-	-	37,204,359	37,663,356	38,110,779	38,546,087	38,995,221	39,998,596	40,788,320	41,535,676	41,517,447	41,499,935	41,482,969	41,466,082	41,449,823	41,431,516	41,414,017	41,395,319	41,378,603	41,362,944	41,345,742	41,328,526
HS2 - Fuel input	-	-	7,111,098	7,453,545	7,724,221	8,058,324	8,469,125	9,199,108	9,757,350	10,265,081	10,257,551	10,248,405	10,238,029	10,227,482	10,215,544	10,208,124	10,198,905	10,192,337	10,181,388	10,168,102	10,158,220	10,148,364
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	-	-	3,161,664	3,366,579	3,533,030	3,679,502	3,974,325	4,522,770	5,011,542	5,578,894	5,566,537	5,554,196	5,541,866	5,529,536	5,517,206	5,504,882	5,492,565	5,480,247	5,467,930	5,455,613	5,443,299	5,430,988
EC Parasitic demands	-	-	168,667	166,218	164,729	163,349	160,631	158,920	157,018	155,336	155,346	155,356	155,366	155,377	155,387	155,398	155,408	155,418	155,429	155,439	155,450	155,460
Total parasitics	-	-	168,667	166,218	164,729	163,349	160,631	158,920	157,018	155,336	155,346	155,356	155,366	155,377	155,387	155,398	155,408	155,418	155,429	155,439	155,450	155,460
Electricity export	-	-	452,625	460,791	472,887	490,004	510,188	551,438	584,404	621,273	620,599	619,972	618,979	618,326	617,726	616,826	616,851	616,133	614,904	613,926	612,984	611,731
Electricity import	-	-	13,790,808	13,654,483	13,552,818	13,429,974	13,277,046	13,013,800	12,813,315	12,637,903	12,640,363	12,643,539	12,646,861	12,650,592	12,654,955	12,657,143	12,661,002	12,663,018	12,666,341	12,670,884	12,674,052	12,676,897
Electricity generated and used on site	-	-	2,496,943	2,630,819	2,730,995	2,852,459	3,002,669	3,264,203	3,462,786	3,636,516	3,634,067	3,630,900	3,627,590	3,623,868	3,619,516	3,617,338	3,613,490	3,611,483	3,608,171	3,603,638	3,600,481	3,597,647
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	2,624,181	2,794,261	2,932,415	3,053,986	3,298,690	3,753,899	4,159,580	4,630,482	4,620,225	4,609,982	4,599,749	4,589,515	4,579,281	4,569,052	4,558,829	4,548,605	4,538,382	4,528,159	4,517,938	4,507,720
Fuel input (GCV)	-	-	3,161,664	3,366,579	3,533,030	3,679,502	3,974,325	4,522,770	5,011,542	5,578,894	5,566,537	5,554,196	5,541,866	5,529,536	5,517,206	5,504,882	5,492,565	5,480,247	5,467,930	5,455,613	5,443,299	5,430,988
Run hours																						
HS1	-	-	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800
HS2	-	-	2,033	2,129	2,201	2,296	2,410	2,614	2,768	2,913	2,911	2,909	2,905	2,902	2,898	2,897	2,894	2,893	2,889	2,884	2,881	2,879
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																						
Heat balance	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)
Demands																						
Heat demand (LTHW)	-	-	20,509	21,269	21,857	22,445	23,478	24,806	26,002	27,197	27,177	27,158	27,138	27,118	27,099	27,079	27,060	27,040	27,021	27,001	26,982	26,962
Heat losses (LTHW)	-	-	339	345	350	356	363	377	388	400	400	399	399	399	399	398	398	398	398	397	397	397
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	-	-	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 output (LTHW)	-	-	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS2 output (electricity)	-	-	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	0	0	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 Fuel input (GCV)	0	0	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	-	-	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	-	-	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864
Electricity import	-	-	4,916	4,915	4,914	4,913	4,911	4,909	4,908	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906
Top-up and standby boilers																						
Heat top-up and standby supply as LTHW	-	-	12,740	13,253	13,663	14,073	14,776	15,785	16,838	17,892	17,883	17,874	17,865	17,857	17,848	17,839	17,830	17,822	17,813	17,804	17,795	17,787
Fuel input (GCV)	-	-	15,349	15,968	16,462	16,956	17,802	19,018	20,287	21,556	21,546	21,535	21,525	21,514	21,504	21,493	21,483	21,472	21,461	21,451	21,440	21,430
Emissions	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
HS1 Fuel input (GCV)	-	-	1,488	1,507	1,524	1,542	1,560	1,600	1,632	1,661	1,661	1,660	1,659	1,659	1,658	1,657	1,657	1,656	1,655	1,655	1,654	1,653
HS2 Fuel input (GCV)	-	-	1,408	1,476	1,529	1,596	1,677	1,821	1,932	2,032	2,031	2,029	2,027	2,025	2,023	2,021	2,019	2,018	2,016	2,013	2,011	2,009
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	-	-	626	667	700	729	787	896	992	1,105	1,102	1,100	1,097	1,095	1,092	1,090	1,088	1,085	1,083	1,080	1,078	1,075
Electricity export	-	-	239	244	250	259	270	292	309	329	328	328	327	327	327	326	326	326	325	325	324	324
Electricity import	-	-	7,130	7,059	7,007	6,943	6,864	6,728	6,624	6,534	6,535	6,537	6,538	6,540	6,543	6,544	6,546	6,547	6,548	6,551	6,552	6,554
Electricity generated and used on site	-	-	30	32	33	34	36	39	42	44	44	44	44	43	43	43	43	43	43	43	43	43
Total emissions under this scenario	-	-	10,383	10,433	10,477	10,516	10,582	10,714	10,830	10,960	10,957	10,954										

Whole network excl Marsh Barton Industrial Sites Option C

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)	Annual (kWh p.a.)
Heat balance																	
Demands																	
Heat demand (LTHW)	46,942,843	46,913,147	46,883,451	46,853,755	46,824,059	46,794,364	46,764,668	46,734,972	46,705,276	46,675,580	46,645,884	46,616,189	46,586,493	46,556,797	46,527,101	46,497,405	46,467,709
Heat losses (LTHW)	3,473,770	3,471,573	3,469,375	3,467,178	3,464,980	3,462,783	3,460,585	3,458,388	3,456,190	3,453,993	3,451,795	3,449,598	3,447,400	3,445,203	3,443,005	3,440,808	3,438,610
Heat supply																	
HS1 - LTHW output	41,310,921	41,293,210	41,276,610	41,260,547	41,247,533	41,229,147	41,210,091	41,191,476	41,175,810	41,156,935	41,139,433	41,121,968	41,103,765	41,085,123	41,066,627	41,052,019	41,033,947
HS2 - LTHW output	4,587,463	4,583,499	4,578,424	4,571,999	4,563,329	4,560,031	4,557,399	4,552,687	4,546,576	4,543,666	4,539,377	4,535,044	4,531,381	4,528,069	4,524,609	4,517,246	4,513,342
HS3 - LTHW output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - LTHW output	4,497,502	4,487,284	4,477,066	4,467,661	4,457,451	4,447,242	4,437,036	4,428,470	4,418,353	4,408,245	4,398,142	4,388,047	4,378,020	4,368,081	4,358,144	4,348,221	4,338,304
HS1 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS2 - Electricity generation	4,205,646	4,202,012	4,197,359	4,191,469	4,183,521	4,180,497	4,178,084	4,173,765	4,168,162	4,165,494	4,161,562	4,157,590	4,154,232	4,151,195	4,148,023	4,141,273	4,137,694
HS3 - Electricity generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 - Fuel input	41,310,921	41,293,210	41,276,610	41,260,547	41,247,533	41,229,147	41,210,091	41,191,476	41,175,810	41,156,935	41,139,433	41,121,968	41,103,765	41,085,123	41,066,627	41,052,019	41,033,947
HS2 - Fuel input	10,139,369	10,130,607	10,119,390	10,105,189	10,086,027	10,078,736	10,072,921	10,062,506	10,048,998	10,042,566	10,033,088	10,023,509	10,015,414	10,008,093	10,000,446	9,984,172	9,975,543
HS3 - Fuel input	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers - Fuel input	5,418,677	5,406,366	5,394,055	5,382,724	5,370,423	5,358,122	5,345,827	5,335,506	5,323,317	5,311,138	5,298,966	5,286,804	5,274,723	5,262,748	5,250,776	5,238,820	5,226,873
EC Parasitic demands	155,471	155,481	155,492	155,502	155,513	155,523	155,534	155,545	155,555	155,566	155,577	155,587	155,598	155,609	155,620	155,630	155,641
Total parasitics	155,471	155,481	155,492	155,502	155,513	155,523	155,534	155,545	155,555	155,566	155,577	155,587	155,598	155,609	155,620	155,630	155,641
Electricity export	611,123	609,949	608,981	608,100	607,338	606,625	605,837	605,701	605,494	604,900	604,296	603,538	602,716	601,994	601,166	600,541	600,028
Electricity import	12,680,032	12,682,502	12,686,197	12,691,217	12,698,414	12,700,736	12,702,370	12,706,565	12,711,971	12,714,056	12,717,394	12,720,620	12,723,166	12,725,492	12,727,846	12,733,982	12,737,059
Electricity generated and used on site	3,594,523	3,592,063	3,588,378	3,583,369	3,576,183	3,573,872	3,572,248	3,568,064	3,562,668	3,560,594	3,557,266	3,554,051	3,551,516	3,549,201	3,546,857	3,540,732	3,537,666
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	4,497,502	4,487,284	4,477,066	4,467,661	4,457,451	4,447,242	4,437,036	4,428,470	4,418,353	4,408,245	4,398,142	4,388,047	4,378,020	4,368,081	4,358,144	4,348,221	4,338,304
Fuel input (GCV)	5,418,677	5,406,366	5,394,055	5,382,724	5,370,423	5,358,122	5,345,827	5,335,506	5,323,317	5,311,138	5,298,966	5,286,804	5,274,723	5,262,748	5,250,776	5,238,820	5,226,873
Run hours																	
HS1	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800
HS2	2,877	2,876	2,874	2,869	2,861	2,860	2,860	2,856	2,850	2,848	2,846	2,842	2,839	2,838	2,837	2,831	2,829
HS3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUTS (PEAKS)																	
Heat balance	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)	Peak (kW)
Demands																	
Heat demand (LTHW)	26,943	26,923	26,904	26,884	26,864	26,845	26,825	26,806	26,786	26,767	26,747	26,728	26,708	26,689	26,669	26,650	26,630
Heat losses (LTHW)	397	396	396	396	396	395	395	395	395	394	394	394	394	393	393	393	393
Low carbon heat supply units output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (LTHW)	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 output (LTHW)	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622	1,622
HS3 output (LTHW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS2 output (electricity)	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487
HS3 output (electricity)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HS1 Fuel input (GCV)	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500
HS2 Fuel input (GCV)	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585	3,585
HS3 Fuel input (GCV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC Parasitic demands	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
Electricity export	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864	864
Electricity import	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906	4,906
Top-up and standby boilers																	
Heat top-up and standby supply as LTHW	17,778	17,769	17,760	17,752	17,743	17,734	17,725	17,717	17,708	17,699	17,690	17,682	17,673	17,664	17,655	17,647	17,638
Fuel input (GCV)	21,419	21,409	21,398	21,388	21,377	21,367	21,356	21,345	21,335	21,324	21,314	21,303	21,293	21,282	21,272	21,261	21,251
Emissions	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
HS1 Fuel input (GCV)	1,652	1,652	1,651	1,650	1,650	1,649	1,648	1,648	1,647	1,646	1,646	1,645	1,644	1,643	1,643	1,642	1,641
HS2 Fuel input (GCV)	2,008	2,006	2,004	2,001	1,997	1,996	1,994	1,992	1,990	1,988	1,987	1,985	1,983	1,982	1,980	1,977	1,975
HS3 Fuel input (GCV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Top-up boilers	1,073	1,070	1,068	1,066	1,063	1,061	1,058	1,056	1,054	1,052	1,049	1,047	1,044	1,042	1,040	1,037	1,035
Electricity export	323	323	322	322	321	321	320	320	320	320	320	319	319	318	318	318	317
Electricity import	6,556	6,557	6,559	6,561	6,565	6,566	6,567	6,569	6,572	6,573	6,575	6,577	6,578	6,579	6,580	6,583	6,585
Electricity generated and used on site	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	42	42
Total emissions under this scenario	10,922	10,919	10,916	10,914	10,911	10,908	10,905	10,903	10,900	10,897	10,894	10,891	10,888	10,885	10,882	10,880	10,877

APPENDIX E

ECONOMIC RESULTS DETAIL

Sidwell St only

OPTION A		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£0	£0	£3,486,407	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£218,400	£0	£0
Maintenance		£0	£0	£0	£33,581	£65,143	£65,320	£65,362	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405
HS1 fuel costs	Gas (Wonford)	£0	£0	£0	£198,970	£202,301	£203,352	£203,600	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£0	£74,024	£96,058	£119,101	£145,947	£192,873	£239,911	£286,948	£286,925	£286,902	£286,879	£286,855	£286,832	£286,809	£286,786	£286,762	£286,739	£286,716	£286,693
Import elec	Electricity industrial	£0	£0	£0	£117,271	£115,362	£114,859	£114,678	£114,602	£114,607	£114,611	£114,611	£114,611	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612
Export elec	Elec Wholesale	£0	£0	£0	£32,510	£33,543	£33,925	£34,061	£34,149	£34,127	£34,110	£34,110	£34,110	£34,110	£34,110	£34,110	£34,110	£34,110	£34,110	£34,110	£34,109	£34,109
Other Costs		£0	£0	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£0	£-75,000	£-3,952,744	£-520,321	£-543,707	£-570,526	£-617,582	£-664,647	£-711,706	£-711,683	£-711,660	£-711,637	£-711,614	£-711,590	£-711,567	£-711,544	£-711,521	£-692,898	£-711,475	£-711,451

OPTION B		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£0	£0	£3,885,016	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£415,922	£0	£0
Maintenance		£0	£0	£0	£41,608	£78,875	£84,472	£89,619	£96,134	£100,239	£104,101	£104,100	£104,099	£104,092	£104,091	£104,090	£104,089	£104,088	£104,087	£104,086	£104,085	£104,084
HS1 fuel costs	Gas (Wonford)	£0	£0	£0	£295,939	£340,520	£380,329	£416,933	£463,273	£492,469	£519,937	£519,930	£519,923	£519,878	£519,871	£519,864	£519,857	£519,850	£519,843	£519,835	£519,828	£519,821
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£0	£15,536	£16,948	£20,748	£29,527	£53,483	£86,046	£119,464	£119,445	£119,425	£119,424	£119,404	£119,384	£119,365	£119,345	£119,325	£119,306	£119,286	£119,266
Import elec	Electricity industrial	£0	£0	£0	£136,339	£122,108	£110,827	£102,291	£90,486	£81,723	£74,173	£74,173	£74,173	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233
Export elec	Elec Wholesale	£0	£0	£0	£122,742	£145,617	£166,886	£187,621	£213,139	£228,423	£243,218	£243,213	£243,208	£243,212	£243,207	£243,202	£243,197	£243,192	£243,187	£243,181	£243,176	£243,171
Other Costs		£0	£0	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£0	£-75,000	£-4,326,696	£-487,834	£-504,489	£-525,750	£-565,237	£-607,054	£-649,457	£-649,434	£-649,412	£-649,415	£-649,393	£-649,370	£-649,347	£-649,324	£-649,302	£-1,065,201	£-649,256	£-649,234

OPTION C		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£0	£0	£4,152,596	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£523,916	£0	£0
Maintenance		£0	£0	£0	£42,107	£78,417	£84,709	£91,504	£101,302	£107,900	£112,728	£112,727	£112,726	£112,724	£112,723	£112,722	£112,721	£112,719	£112,718	£112,717	£112,715	£112,714
HS1 fuel costs	Gas (Wonford)	£0	£0	£0	£313,284	£352,789	£399,603	£450,159	£523,058	£572,152	£608,072	£608,062	£608,053	£608,043	£608,034	£608,024	£608,015	£608,006	£607,996	£607,987	£607,977	£607,968
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£0	£17,476	£22,764	£24,647	£28,249	£41,603	£65,870	£96,312	£96,293	£96,274	£96,255	£96,236	£96,217	£96,198	£96,179	£96,161	£96,142	£96,123	£96,104
Import elec	Electricity industrial	£0	£0	£0	£156,452	£146,179	£132,597	£121,532	£104,951	£95,029	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602	£86,602
Export elec	Elec Wholesale	£0	£0	£0	£160,604	£183,994	£210,865	£242,112	£286,645	£317,373	£339,158	£339,151	£339,144	£339,137	£339,130	£339,123	£339,115	£339,108	£339,101	£339,094	£339,087	£339,080
Other Costs		£0	£0	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£0	£-75,000	£-4,596,311	£-491,154	£-505,690	£-524,331	£-559,269	£-598,578	£-639,555	£-639,533	£-639,510	£-639,488	£-639,466	£-639,443	£-639,421	£-639,398	£-639,376	£-1,163,270	£-639,331	£-639,308

OPTION D		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£0	£0	£1,104,950	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance		£0	£0	£0	£0	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750
HS1 fuel costs	Gas & Oil (BAU whole network)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	Gas & Oil (BAU whole network)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas & Oil (BAU whole network)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas & Oil (BAU whole network)	£0	£0	£0	£165,940	£189,988	£214,036	£241,611	£289,731	£337,850	£385,970	£385,947	£385,923	£385,899	£385,875	£385,851	£385,828	£385,804	£385,780	£385,756	£385,732	£385,709
Import elec	Electricity industrial	£0	£0	£0	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800
Export elec	Elec Wholesale	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£0	£0	£-1,539,690	£-496,538	£-520,586	£-548,161	£-596,281	£-644,400	£-692,520	£-692,497	£-692,473	£-692,449	£-692,425	£-692,401	£-692,378	£-692,354	£-692,330	£-692,306	£-692,282	£-692,259

Sidwell St only

OPTION A	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£218,400	£0	£0	£0	£0	£0
Maintenance	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£65,405	£90,405
HS1 fuel costs	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852	£203,852
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£286,669	£286,646	£286,623	£286,600	£286,576	£286,553	£286,530	£286,507	£286,483	£286,460	£286,437	£286,414	£286,390	£286,367	£286,344	£286,321	£286,297	£286,274
Import elec	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612	£114,612
Export elec	£34,109	£34,109	£34,109	£34,109	£34,109	£34,109	£34,109	£34,109	£34,109	£34,108	£34,108	£34,108	£34,108	£34,108	£34,108	£34,108	£34,108	£34,108
Other Costs	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	-£711,428	-£711,405	-£711,382	-£711,359	-£711,336	-£711,313	-£711,289	-£711,266	-£711,243	-£711,220	-£711,197	-£711,174	-£929,551	-£711,127	-£711,104	-£711,081	-£711,058	-£736,035

OPTION B	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£0	£0	£375,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£415,922	£0	£0	£0	£0	£0
Maintenance	£104,083	£104,082	£104,081	£104,080	£104,079	£104,078	£104,077	£104,076	£104,076	£104,075	£104,074	£104,073	£104,072	£104,071	£104,070	£104,069	£104,068	£129,067
HS1 fuel costs	£519,814	£519,807	£519,800	£519,793	£519,786	£519,779	£519,772	£519,765	£519,758	£519,751	£519,744	£519,737	£519,730	£519,723	£519,716	£519,709	£519,702	£519,695
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£119,246	£119,226	£119,207	£119,187	£119,167	£119,147	£119,127	£119,108	£119,088	£119,068	£119,048	£119,029	£119,009	£118,989	£118,969	£118,950	£118,930	£118,910
Import elec	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233	£74,233	£74,234	£74,234	£74,234	£74,234	£74,244	£74,244	£74,244	£74,244	£74,244	£74,244
Export elec	£243,166	£243,161	£243,156	£243,151	£243,146	£243,141	£243,136	£243,131	£243,126	£243,121	£243,116	£243,111	£243,112	£243,107	£243,102	£243,097	£243,092	£243,087
Other Costs	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	-£649,211	-£649,188	-£1,024,165	-£649,143	-£649,120	-£649,097	-£649,074	-£649,052	-£649,029	-£649,006	-£648,983	-£648,961	-£1,064,864	-£648,919	-£648,897	-£648,874	-£648,851	-£673,828

OPTION C	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£0	£0	£375,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£523,916	£0	£0	£0	£0	£0
Maintenance	£112,713	£112,712	£112,701	£112,700	£112,699	£112,698	£112,696	£112,695	£112,694	£112,692	£112,691	£112,690	£112,689	£112,687	£112,686	£112,685	£112,684	£137,682
HS1 fuel costs	£607,958	£607,949	£607,872	£607,863	£607,853	£607,844	£607,834	£607,825	£607,816	£607,806	£607,797	£607,787	£607,778	£607,768	£607,759	£607,749	£607,740	£607,730
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£96,085	£96,066	£96,078	£96,059	£96,041	£96,022	£96,003	£95,984	£95,965	£95,946	£95,927	£95,908	£95,889	£95,871	£95,852	£95,833	£95,814	£95,795
Import elec	£86,602	£86,602	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663	£86,663
Export elec	£339,072	£339,065	£339,044	£339,037	£339,030	£339,023	£339,015	£339,008	£339,001	£338,994	£338,987	£338,980	£338,973	£338,965	£338,958	£338,951	£338,944	£338,937
Other Costs	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000	£75,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	-£639,286	-£639,263	-£1,014,270	-£639,248	-£639,226	-£639,203	-£639,181	-£639,158	-£639,136	-£639,113	-£639,091	-£639,068	-£1,162,962	-£639,024	-£639,001	-£638,979	-£638,956	-£663,934

OPTION D	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£0	£0	£504,500	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750	£37,750
HS1 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£385,685	£385,661	£385,637	£385,614	£385,590	£385,566	£385,542	£385,518	£385,495	£385,471	£385,447	£385,423	£385,399	£385,376	£385,352	£385,328	£385,304	£385,281
Import elec	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800	£268,800
Export elec	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	-£692,235	-£692,211	-£1,196,687	-£692,164	-£692,140	-£692,116	-£692,092	-£692,068	-£692,045	-£692,021	-£691,997	-£691,973	-£691,949	-£691,926	-£691,902	-£691,878	-£691,854	-£691,831

St Lukes and Sidwell only

[illegible][illegible][illegible][illegible]

Wonford and City centre WITH County Hall

OPTION A		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£15,444,365	£0	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,047,959	£0	£0	£0	£0
Maintenance		£0	£0	£325,161	£380,939	£381,975	£383,005	£383,168	£385,461	£386,360	£387,962	£387,936	£387,910	£387,884	£387,850	£387,822	£387,844	£387,810	£387,784	£387,905	£387,863	£387,837
HS1 fuel costs	Gas (Wonford)	£0	£0	£988,849	£999,627	£1,002,565	£1,007,008	£1,005,256	£1,015,360	£1,013,569	£1,022,100	£1,021,632	£1,021,507	£1,021,382	£1,021,257	£1,021,132	£1,021,414	£1,021,360	£1,021,238	£1,023,063	£1,023,140	£1,023,015
HS2 fuel costs	Gas (Wonford)	£0	£0	£937,644	£933,374	£939,109	£943,288	£946,405	£955,495	£964,808	£969,692	£969,941	£969,850	£969,757	£969,596	£969,485	£969,390	£969,158	£969,062	£968,249	£967,817	£967,723
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£505,510	£518,515	£537,303	£556,115	£583,805	£632,527	£675,666	£716,084	£715,158	£714,231	£713,305	£712,411	£711,493	£710,380	£709,485	£708,559	£707,065	£706,202	£705,277
Import elec	Electricity industrial	£0	£0	£158,800	£154,612	£153,158	£152,093	£155,255	£149,656	£152,389	£149,597	£149,647	£149,647	£149,647	£149,647	£149,491	£149,491	£149,491	£149,491	£148,322	£148,322	£148,322
Export elec	Elec Wholesale	£0	£0	£718,720	£721,143	£726,828	£732,700	£735,737	£746,820	£754,159	£762,598	£762,464	£762,302	£762,139	£761,925	£761,748	£761,794	£761,580	£761,417	£761,476	£761,211	£761,047
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£15,444,365	-£2,312,245	-£2,380,925	-£2,402,283	-£2,423,808	-£2,453,152	-£2,506,677	-£2,553,632	-£2,597,836	-£2,397,850	-£2,595,843	-£2,594,837	-£2,593,836	-£2,592,831	-£2,591,725	-£3,638,683	-£2,589,717	-£2,588,128	-£2,587,133	-£2,586,127

OPTION B		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£15,687,628	£0	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,189,862	£0	£0	£0	£0
Maintenance		£0	£0	£329,626	£385,627	£386,774	£388,126	£387,978	£391,726	£393,620	£394,993	£394,950	£394,913	£394,872	£394,834	£394,803	£394,761	£394,721	£394,683	£394,642	£394,511	£394,444
HS1 fuel costs	Gas (Wonford)	£0	£0	£1,249,588	£1,253,254	£1,244,930	£1,249,405	£1,267,857	£1,284,594	£1,269,179	£1,300,128	£1,300,080	£1,299,689	£1,299,567	£1,298,288	£1,297,020	£1,296,905	£1,296,698	£1,296,428	£1,296,241	£1,295,418	£1,295,036
HS2 fuel costs	Gas (Wonford)	£0	£0	£842,613	£847,705	£864,776	£872,073	£854,279	£870,638	£900,317	£884,037	£883,723	£883,768	£883,530	£884,361	£885,237	£884,994	£884,846	£884,764	£884,593	£884,237	£884,011
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£400,973	£412,854	£431,791	£449,044	£476,641	£518,560	£558,931	£598,075	£597,217	£596,359	£595,501	£594,710	£593,893	£593,034	£592,176	£591,318	£590,461	£589,997	£589,260
Import elec	Electricity industrial	£0	£0	£167,728	£167,303	£168,296	£168,441	£168,917	£162,792	£162,760	£162,792	£162,760	£162,792	£162,794	£162,434	£162,092	£162,093	£162,095	£162,097	£162,145	£161,875	£161,814
Export elec	Elec Wholesale	£0	£0	£807,753	£813,978	£821,441	£829,053	£834,307	£854,824	£860,840	£872,445	£872,177	£871,949	£871,684	£871,176	£870,720	£870,456	£870,198	£869,945	£869,712	£868,696	£868,218
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£15,687,628	-£2,297,774	-£2,367,764	-£2,390,125	-£2,411,035	-£2,442,655	-£2,494,611	-£2,536,348	-£2,582,548	-£2,382,555	-£2,580,573	-£2,579,579	-£2,578,451	-£2,577,325	-£2,576,332	-£3,765,200	-£2,574,345	-£2,573,371	-£2,572,342	-£2,571,347

OPTION C		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£15,930,891	£0	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,331,765	£0	£0	£0	£0
Maintenance		£0	£0	£333,122	£389,341	£390,816	£391,986	£393,266	£396,775	£397,968	£400,212	£400,161	£400,113	£400,045	£400,184	£399,873	£399,825	£399,997	£399,903	£399,979	£399,930	£399,713
HS1 fuel costs	Gas (Wonford)	£0	£0	£1,178,208	£1,199,079	£1,215,063	£1,194,293	£1,233,842	£1,252,400	£1,241,568	£1,234,807	£1,234,735	£1,234,719	£1,234,602	£1,240,997	£1,235,327	£1,235,313	£1,244,073	£1,243,417	£1,246,127	£1,245,773	£1,240,139
HS2 fuel costs	Gas (Wonford)	£0	£0	£1,043,057	£1,033,558	£1,031,325	£1,063,014	£1,035,406	£1,049,579	£1,071,541	£1,099,235	£1,098,828	£1,098,396	£1,097,883	£1,092,778	£1,095,555	£1,095,118	£1,087,958	£1,087,739	£1,085,741	£1,085,634	£1,089,249
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£319,609	£330,105	£346,233	£363,734	£386,268	£427,995	£469,212	£505,680	£504,885	£504,075	£503,354	£501,703	£502,078	£501,269	£499,468	£498,865	£497,493	£496,690	£496,641
Import elec	Electricity industrial	£0	£0	£182,812	£186,786	£183,895	£180,217	£184,669	£176,440	£181,448	£180,362	£180,362	£180,362	£180,471	£180,161	£181,481	£181,481	£180,450	£180,605	£180,127	£180,334	£181,023
Export elec	Elec Wholesale	£0	£0	£881,988	£892,537	£900,719	£906,401	£917,720	£936,300	£947,329	£961,727	£961,385	£961,064	£960,678	£961,415	£960,132	£959,810	£960,339	£959,805	£960,029	£959,822	£958,789
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£15,930,891	-£2,289,819	-£2,361,332	-£2,381,613	-£2,401,843	-£2,430,730	-£2,481,990	-£2,529,407	-£2,573,569	-£2,373,587	-£2,571,602	-£2,570,678	-£2,569,408	-£2,569,182	-£2,568,197	-£3,898,372	-£2,565,724	-£2,564,439	-£2,563,539	-£2,562,977

OPTION D		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£1,746,732	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance		£0	£0	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000
HS1 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (BAU whole network)	£0	£0	£1,410,384	£1,426,565	£1,449,599	£1,472,633	£1,501,252	£1,559,448	£1,606,554	£1,653,660	£1,652,622	£1,651,585	£1,650,547	£1,649,510	£1,648,472	£1,647,435	£1,646,397	£1,645,359	£1,644,322	£1,643,284	£1,642,247
Import elec	Electricity industrial	£0	£0	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	Elec Wholesale	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-1,746,732	£-2,819,387	£-2,835,568	£-2,858,602	£-2,881,636	£-2,910,255	£-2,968,451	£-3,015,557	£-3,062,663	£-3,099,275	£-3,060,588	£-3,059,550	£-3,058,513	£-3,057,475	£-3,056,438	£-3,055,400	£-3,054,362	£-3,053,325	£-3,052,287	£-3,051,250

Wonford and City centre WITH County Hall

OPTION A	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£150,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,047,959	£0	£0	£0	£0	£0	£0	£0
Maintenance	£387,808	£387,654	£387,628	£387,531	£387,504	£387,481	£387,455	£387,428	£387,406	£387,334	£387,307	£387,280	£387,253	£387,226	£387,199	£387,164	£387,136	£442,109
HS1 fuel costs	£1,022,887	£1,020,717	£1,020,667	£1,018,391	£1,018,596	£1,018,515	£1,018,503	£1,018,382	£1,018,275	£1,019,172	£1,019,123	£1,019,006	£1,018,966	£1,018,917	£1,019,007	£1,018,700	£1,018,590	£1,018,501
HS2 fuel costs	£967,609	£968,497	£968,326	£969,789	£969,362	£969,245	£969,039	£968,941	£968,863	£967,357	£967,181	£967,076	£966,891	£966,712	£966,395	£966,405	£966,287	£966,147
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£704,362	£703,928	£703,003	£702,352	£701,428	£700,492	£699,567	£698,641	£697,700	£696,954	£696,032	£695,107	£694,185	£693,263	£692,342	£691,452	£690,531	£689,610
Import elec	£148,326	£149,519	£149,519	£150,579	£150,627	£150,670	£150,819	£150,819	£150,819	£150,154	£150,154	£150,154	£150,151	£150,151	£150,106	£150,299	£150,299	£150,300
Export elec	£760,868	£760,620	£760,455	£760,478	£760,340	£760,217	£760,143	£759,979	£759,840	£758,990	£758,820	£758,655	£758,483	£758,313	£758,116	£758,010	£757,838	£757,667
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£2,735,124	£2,584,695	£2,583,688	£2,583,164	£2,582,177	£2,581,186	£2,580,239	£2,579,232	£2,578,223	£2,576,982	£3,623,935	£2,574,969	£2,573,962	£2,572,956	£2,571,932	£2,571,011	£2,570,005	£2,623,999

OPTION B	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,050,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,189,862	£0	£0	£0	£0	£0	£0	£0
Maintenance	£394,393	£394,351	£394,293	£394,253	£394,213	£394,173	£394,120	£394,072	£394,021	£393,976	£393,839	£393,806	£393,761	£393,729	£393,729	£393,680	£393,634	£448,450
HS1 fuel costs	£1,294,101	£1,293,999	£1,294,814	£1,294,613	£1,294,350	£1,294,097	£1,294,574	£1,294,320	£1,294,220	£1,295,135	£1,293,581	£1,292,935	£1,292,910	£1,291,765	£1,290,583	£1,290,632	£1,290,610	£1,288,202
HS2 fuel costs	£884,426	£884,169	£882,953	£882,792	£882,697	£882,591	£881,716	£881,541	£881,206	£880,007	£880,255	£880,559	£880,208	£880,962	£882,028	£881,569	£881,207	£881,828
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£588,495	£587,636	£586,776	£585,921	£585,066	£584,211	£583,357	£582,534	£581,711	£580,795	£580,406	£579,552	£578,700	£577,879	£576,933	£576,094	£575,245	£575,098
Import elec	£161,655	£161,657	£162,038	£162,040	£162,095	£162,097	£162,363	£162,419	£162,422	£162,929	£163,679	£163,682	£163,737	£163,392	£162,896	£163,090	£163,093	£164,116
Export elec	£867,764	£867,500	£867,401	£867,138	£866,911	£866,652	£866,497	£866,218	£865,897	£865,957	£865,478	£865,244	£864,996	£864,535	£864,190	£863,998	£863,714	£863,064
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£3,620,305	£2,569,312	£2,568,474	£2,567,481	£2,566,510	£2,565,517	£2,564,633	£2,563,668	£2,562,682	£2,561,884	£3,751,144	£2,560,290	£2,559,319	£2,558,191	£2,556,978	£2,556,067	£2,555,076	£2,609,630

OPTION C	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,050,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,331,765	£0	£0	£0	£0	£0	£0	£0
Maintenance	£399,678	£399,591	£399,530	£399,477	£399,407	£399,349	£399,585	£400,564	£400,907	£400,897	£400,844	£400,501	£399,328	£399,210	£399,156	£399,233	£399,272	£454,221
HS1 fuel costs	£1,240,016	£1,239,914	£1,233,472	£1,230,141	£1,229,948	£1,247,705	£1,253,406	£1,253,460	£1,252,375	£1,255,521	£1,255,498	£1,246,433	£1,240,757	£1,240,028	£1,239,534	£1,239,213	£1,250,881	£1,250,702
HS2 fuel costs	£1,089,045	£1,088,331	£1,094,209	£1,097,043	£1,096,580	£1,078,286	£1,074,786	£1,083,869	£1,088,149	£1,084,905	£1,084,441	£1,090,300	£1,085,033	£1,084,661	£1,084,657	£1,085,692	£1,074,393	£1,074,097
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£495,773	£495,142	£494,388	£493,603	£492,894	£492,127	£490,035	£484,583	£482,009	£481,030	£480,240	£480,765	£485,039	£484,545	£483,760	£482,387	£481,182	£480,385
Import elec	£180,947	£181,025	£181,305	£181,342	£181,342	£180,742	£179,978	£175,656	£174,701	£173,508	£173,552	£174,469	£179,465	£179,672	£179,816	£179,251	£180,378	£180,378
Export elec	£958,509	£957,972	£957,736	£957,402	£956,932	£956,191	£957,308	£961,265	£962,980	£962,199	£961,876	£960,130	£955,283	£954,619	£954,349	£954,522	£955,456	£955,116
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£3,611,950	£2,561,031	£2,560,169	£2,559,204	£2,558,238	£2,557,019	£2,555,481	£2,551,867	£2,550,162	£2,548,662	£3,879,464	£2,547,337	£2,549,338	£2,548,497	£2,547,575	£2,546,254	£2,545,650	£2,599,668

OPTION D	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,584,515	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000
HS1 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£1,641,209	£1,640,172	£1,639,134	£1,638,096	£1,637,059	£1,636,021	£1,634,984	£1,633,946	£1,632,909	£1,631,871	£1,630,833	£1,629,796	£1,628,758	£1,627,721	£1,626,683	£1,625,646	£1,624,608	£1,623,571
Import elec	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£4,634,727	£3,049,175	£3,048,137	£3,047,099	£3,046,062	£3,045,024	£3,043,987	£3,042,949	£3,041,912	£3,078,524	£3,039,837	£3,038,799	£3,037,761	£3,036,724	£3,035,686	£3,034,649	£3,033,611	£3,032,574

Wonford and City centre WITHOUT County Hall

OPTION A		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£13,692,365	£0	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,047,959	£0	£0	£0	£0
Maintenance		£0	£0	£322,851	£373,601	£374,560	£376,116	£376,116	£378,540	£380,417	£381,766	£381,742	£381,716	£381,767	£381,742	£381,503	£381,478	£381,452	£381,427	£381,402	£381,368	£381,342
HS1 fuel costs	Gas (Wonford)	£0	£0	£967,098	£971,786	£986,948	£999,765	£1,012,576	£1,007,707	£1,015,457	£1,019,712	£1,019,604	£1,019,235	£1,020,961	£1,020,857	£1,017,122	£1,017,025	£1,017,131	£1,017,106	£1,017,280	£1,017,306	£1,017,210
HS2 fuel costs	Gas (Wonford)	£0	£0	£940,063	£941,650	£934,515	£934,724	£921,910	£947,072	£955,030	£962,070	£961,970	£962,123	£960,826	£960,721	£962,452	£962,341	£962,021	£961,831	£961,451	£961,144	£961,020
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£456,139	£469,438	£488,710	£505,672	£531,856	£576,772	£616,317	£657,899	£657,155	£656,413	£655,374	£654,630	£654,715	£653,970	£653,228	£652,487	£651,741	£651,030	£650,290
Import elec	Electricity industrial	£0	£0	£166,165	£165,026	£162,892	£153,324	£154,279	£154,317	£149,328	£149,613	£149,703	£149,804	£148,694	£148,694	£150,685	£150,688	£150,687	£150,737	£150,657	£150,661	£150,669
Export elec	Elec Wholesale	£0	£0	£708,315	£712,398	£717,219	£721,342	£722,096	£737,407	£746,282	£754,987	£754,885	£754,785	£754,445	£754,289	£753,977	£753,824	£753,664	£753,533	£753,332	£753,125	£752,966
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£13,692,365	-£2,259,002	-£2,324,103	-£2,345,405	-£2,363,261	-£2,389,642	-£2,442,002	-£2,485,267	-£2,531,074	-£2,331,288	-£2,529,507	-£2,528,178	-£2,527,356	-£2,527,499	-£2,526,678	-£3,573,815	-£2,525,054	-£2,524,199	-£2,523,385	-£2,522,567

OPTION B		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£13,935,628	£0	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,189,862	£0	£0	£0	£0
Maintenance		£0	£0	£326,705	£377,723	£378,982	£380,403	£381,323	£383,245	£386,803	£387,649	£387,625	£387,550	£387,496	£387,491	£387,414	£387,375	£387,337	£388,669	£388,633	£388,596	£388,562
HS1 fuel costs	Gas (Wonford)	£0	£0	£1,261,802	£1,264,322	£1,244,206	£1,243,484	£1,251,584	£1,267,831	£1,278,108	£1,291,933	£1,290,758	£1,289,518	£1,290,555	£1,291,565	£1,290,263	£1,290,424	£1,290,157	£1,291,545	£1,291,113	£1,290,751	£1,290,242
HS2 fuel costs	Gas (Wonford)	£0	£0	£807,209	£813,464	£842,055	£854,593	£855,030	£856,539	£877,098	£871,773	£872,630	£873,110	£871,733	£870,784	£871,310	£870,835	£870,756	£880,662	£880,750	£880,763	£880,930
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£353,112	£365,197	£384,711	£402,245	£424,299	£470,014	£502,337	£544,901	£544,233	£543,771	£543,064	£542,172	£541,719	£541,020	£540,345	£534,257	£533,585	£532,913	£532,241
Import elec	Electricity industrial	£0	£0	£169,079	£166,879	£170,319	£169,415	£168,192	£174,706	£165,872	£167,929	£167,370	£168,164	£168,635	£167,736	£168,738	£168,739	£163,972	£163,874	£164,164	£164,165	£164,165
Export elec	Elec Wholesale	£0	£0	£790,496	£795,735	£804,853	£813,251	£818,827	£835,578	£853,132	£860,361	£859,829	£859,774	£859,767	£859,310	£859,303	£859,065	£858,816	£864,367	£864,066	£863,990	£863,752
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£13,935,628	-£2,242,411	-£2,306,851	-£2,330,420	-£2,351,889	-£2,376,601	-£2,431,758	-£2,472,087	-£2,518,823	-£2,318,788	-£2,517,339	-£2,516,716	-£2,515,547	-£2,515,140	-£2,514,327	-£3,703,380	-£2,509,738	-£2,508,889	-£2,508,197	-£2,507,389

OPTION C		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£14,178,891	£0	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,331,765	£0	£0	£0	£0
Maintenance		£0	£0	£329,767	£380,965	£382,577	£384,301	£385,090	£388,562	£391,608	£394,354	£394,294	£394,227	£394,179	£394,168	£394,120	£394,082	£394,035	£393,992	£393,854	£393,373	£393,024
HS1 fuel costs	Gas (Wonford)	£0	£0	£1,207,491	£1,209,616	£1,190,601	£1,200,252	£1,194,722	£1,232,415	£1,221,851	£1,232,511	£1,232,255	£1,232,050	£1,232,058	£1,250,444	£1,250,300	£1,250,220	£1,250,237	£1,249,980	£1,250,726	£1,230,979	£1,232,304
HS2 fuel costs	Gas (Wonford)	£0	£0	£982,470	£991,522	£1,025,573	£1,032,006	£1,044,896	£1,039,590	£1,078,572	£1,093,523	£1,093,220	£1,092,801	£1,092,350	£1,073,858	£1,073,555	£1,073,276	£1,072,820	£1,072,681	£1,070,649	£1,085,903	£1,081,329
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£276,479	£287,256	£302,944	£318,127	£340,741	£379,336	£412,366	£446,755	£446,184	£445,646	£445,020	£444,231	£443,606	£442,939	£442,311	£441,662	£441,444	£442,779	£443,512
Import elec	Electricity industrial	£0	£0	£192,008	£192,295	£188,677	£182,249	£183,859	£185,402	£174,848	£178,379	£178,519	£178,601	£178,601	£180,760	£180,760	£180,886	£180,906	£181,003	£181,599	£178,233	£181,052
Export elec	Elec Wholesale	£0	£0	£864,737	£872,970	£881,661	£889,420	£895,827	£920,027	£934,171	£954,677	£954,362	£953,964	£953,648	£954,857	£954,538	£954,357	£954,055	£953,829	£953,266	£948,052	£947,408
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£14,178,891	-£2,238,478	-£2,303,683	-£2,323,710	-£2,342,514	-£2,368,480	-£2,420,278	-£2,460,074	-£2,505,844	-£2,306,111	-£2,504,361	-£2,503,561	-£2,503,603	-£2,502,803	-£2,502,046	-£3,833,019	-£2,500,488	-£2,500,007	-£2,498,216	-£2,498,814

OPTION D		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£1,746,732	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance		£0	£0	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000
HS1 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (BAU whole network)	£0	£0	£1,351,468	£1,367,836	£1,391,058	£1,414,280	£1,440,739	£1,495,601	£1,542,895	£1,590,188	£1,589,339	£1,588,489	£1,587,639	£1,586,790	£1,585,940	£1,585,090	£1,584,240	£1,583,391	£1,582,541	£1,581,691	£1,580,841
Import elec	Electricity industrial	£0	£0	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	Elec Wholesale	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-1,746,732	£-2,760,471	£-2,776,839	£-2,800,061	£-2,823,283	£-2,849,742	£-2,904,604	£-2,951,898	£-2,999,192	£-3,035,992	£-2,997,492	£-2,996,642	£-2,995,793	£-2,994,943	£-2,994,093	£-2,993,243	£-2,992,394	£-2,991,544	£-2,990,694	£-2,989,844

Wonford and City centre WITHOUT County Hall

OPTION A	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£150,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,047,959	£0	£0	£0	£0	£0	£0	£0
Maintenance	£381,248	£381,220	£381,194	£381,161	£381,136	£381,101	£381,080	£381,053	£381,027	£380,997	£380,977	£380,951	£380,932	£380,878	£380,851	£380,758	£145,000	£200,000
HS1 fuel costs	£1,016,590	£1,016,474	£1,016,366	£1,016,228	£1,016,262	£1,016,222	£1,016,135	£1,016,095	£1,015,989	£1,015,882	£1,015,787	£1,015,748	£1,015,744	£1,013,747	£1,013,699	£1,011,939	£0	£0
HS2 fuel costs	£960,848	£960,730	£960,621	£960,484	£960,245	£959,993	£959,898	£959,716	£959,601	£959,387	£959,205	£959,054	£959,054	£960,598	£960,419	£961,404	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£649,815	£649,083	£648,342	£647,628	£646,882	£646,176	£645,420	£644,681	£643,943	£643,216	£642,453	£641,714	£640,945	£640,314	£639,578	£639,095	£0	£0
Import elec	£150,919	£150,926	£150,928	£150,975	£150,973	£151,022	£151,023	£151,024	£151,069	£151,070	£151,070	£151,071	£151,072	£151,848	£151,850	£152,917	£0	£0
Export elec	£752,523	£752,353	£752,191	£752,014	£751,861	£751,672	£751,537	£751,372	£751,233	£751,049	£750,924	£750,760	£750,644	£750,768	£750,600	£750,657	£0	£0
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-2,671,897	£-2,521,080	£-2,520,259	£-2,519,462	£-2,518,638	£-2,517,843	£-2,517,019	£-2,516,198	£-2,515,395	£-2,514,576	£-3,561,709	£-2,512,930	£-2,512,103	£-2,511,616	£-2,510,796	£-2,510,456	£-260,000	£-315,000

OPTION B	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,050,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,189,862	£0	£0	£0	£0	£0	£0	£0
Maintenance	£388,494	£388,463	£388,433	£388,372	£388,329	£388,188	£388,157	£388,106	£388,048	£388,004	£387,961	£387,923	£387,872	£387,829	£387,761	£387,710	£145,000	£200,000
HS1 fuel costs	£1,289,885	£1,289,557	£1,288,775	£1,289,738	£1,289,916	£1,285,970	£1,285,753	£1,286,115	£1,286,026	£1,285,910	£1,285,858	£1,285,499	£1,286,233	£1,286,023	£1,286,714	£1,286,611	£0	£0
HS2 fuel costs	£880,683	£880,718	£881,173	£879,794	£879,280	£881,637	£881,568	£880,819	£880,418	£880,153	£879,841	£879,837	£878,752	£878,584	£877,397	£877,060	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£531,688	£530,989	£530,318	£529,647	£528,957	£528,939	£528,235	£527,565	£526,953	£526,290	£525,619	£524,954	£524,259	£523,597	£522,970	£522,334	£0	£0
Import elec	£164,262	£164,262	£164,070	£164,389	£164,703	£165,488	£165,471	£165,431	£165,568	£165,614	£165,615	£165,615	£165,712	£165,713	£165,982	£166,049	£0	£0
Export elec	£863,370	£863,163	£862,828	£862,677	£862,608	£862,015	£861,798	£861,474	£861,193	£860,940	£860,670	£860,411	£860,183	£859,909	£859,676	£859,391	£0	£0
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-3,556,641	£-2,505,828	£-2,504,940	£-2,504,263	£-2,503,578	£-2,503,207	£-2,502,385	£-2,501,562	£-2,500,820	£-2,500,032	£-3,689,086	£-2,498,416	£-2,497,644	£-2,496,838	£-2,496,148	£-2,495,373	£-260,000	£-315,000

OPTION C	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,050,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,331,765	£0	£0	£0	£0	£0	£0	£0
Maintenance	£392,986	£392,926	£392,855	£392,854	£392,814	£392,728	£392,680	£392,599	£392,551	£392,605	£392,522	£392,573	£392,544	£392,527	£392,475	£392,409	£145,000	£200,000
HS1 fuel costs	£1,232,548	£1,232,458	£1,232,280	£1,235,912	£1,235,818	£1,235,262	£1,235,085	£1,229,263	£1,229,225	£1,230,345	£1,230,202	£1,233,271	£1,227,189	£1,227,168	£1,227,034	£1,226,892	£0	£0
HS2 fuel costs	£1,080,727	£1,080,259	£1,079,773	£1,076,134	£1,075,852	£1,075,609	£1,075,336	£1,080,400	£1,079,992	£1,079,373	£1,078,742	£1,076,149	£1,081,960	£1,081,827	£1,081,479	£1,080,998	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£442,845	£442,275	£441,756	£440,918	£440,260	£439,806	£439,183	£438,709	£438,085	£437,001	£436,535	£435,464	£434,754	£433,988	£433,381	£432,842	£0	£0
Import elec	£181,095	£181,095	£181,095	£179,986	£179,986	£180,191	£180,238	£181,024	£181,229	£181,133	£181,136	£180,769	£180,777	£180,717	£180,717	£180,907	£0	£0
Export elec	£947,177	£946,778	£946,304	£945,640	£945,371	£944,922	£944,628	£944,555	£944,358	£944,659	£944,109	£944,230	£944,041	£943,896	£943,552	£943,219	£0	£0
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-3,548,023	£-2,497,234	£-2,496,454	£-2,495,165	£-2,494,358	£-2,493,674	£-2,492,893	£-2,492,440	£-2,491,723	£-2,490,797	£-3,821,794	£-2,488,995	£-2,488,183	£-2,487,332	£-2,486,535	£-2,485,828	£-260,000	£-315,000

OPTION D	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,584,515	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000
HS1 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£1,579,992	£1,579,142	£1,578,292	£1,577,442	£1,576,593	£1,575,743	£1,574,893	£1,574,043	£1,573,194	£1,572,344	£1,571,494	£1,570,644	£1,569,795	£1,568,945	£1,568,095	£1,567,245	£0	£0
Import elec	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£0	£0
Export elec	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-4,573,510	£-2,988,145	£-2,987,295	£-2,986,445	£-2,985,596	£-2,984,746	£-2,983,896	£-2,983,046	£-2,982,197	£-3,018,997	£-2,980,497	£-2,979,647	£-2,978,798	£-2,977,948	£-2,977,098	£-2,976,248	£-55,000	£-55,000

Whole network incl Marsh Barton Industrial Sites with RHI

OPTION A		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£20,080,000	£3,976,200	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£913,500	£0	£0	£0	£0
Maintenance		£0	£0	£187,788	£223,654	£224,306	£224,973	£225,811	£227,240	£228,320	£229,460	£229,379	£229,343	£229,214	£229,173	£229,119	£229,085	£229,028	£229,002	£228,938	£228,893	£228,856
HS1 fuel costs	Energy from Waste	£0	£0	£0	£475,515	£479,914	£484,157	£488,678	£499,105	£507,174	£514,730	£514,357	£513,915	£513,493	£513,059	£512,643	£512,195	£511,782	£511,323	£510,921	£510,481	£510,038
HS2 fuel costs	Gas (Wonford)	£0	£0	£620,435	£223,436	£228,707	£234,095	£240,866	£252,412	£261,140	£270,348	£269,693	£269,408	£268,033	£267,595	£267,323	£266,863	£266,651	£266,129	£265,769	£265,468	
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£1,140,267	£134,081	£140,238	£146,788	£157,398	£177,876	£195,635	£214,641	£213,777	£212,913	£212,405	£211,541	£210,683	£209,829	£208,976	£208,123	£207,271	£206,440	£205,589
Import elec	Electricity industrial	£0	£0	£716,060	£1,107,900	£1,101,815	£1,095,446	£1,087,275	£1,073,523	£1,063,243	£1,052,739	£1,053,521	£1,053,806	£1,054,804	£1,055,205	£1,055,707	£1,056,001	£1,056,587	£1,056,813	£1,057,428	£1,057,846	£1,058,157
Export elec	Elec Wholesale	£0	£0	£91,521	£17,437	£17,989	£18,456	£19,003	£19,871	£20,629	£21,612	£21,572	£21,521	£21,305	£21,292	£21,253	£21,219	£21,213	£21,184	£21,147	£21,118	£21,072
Other Costs		£0	£0	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£886,187	£894,385	£902,293	£910,719	£930,151	£945,188	£959,269	£958,574	£957,750	£956,964	£956,155	£955,380	£954,546	£953,776	£952,919	£952,170	£951,351	£950,525
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£20,080,000	-£6,699,229	-£1,410,962	-£1,412,606	-£1,414,710	-£1,420,307	-£1,430,135	-£1,439,695	-£1,451,037	-£1,251,581	-£1,450,113	-£1,450,005	-£1,449,564	-£1,449,113	-£1,448,669	-£2,361,748	-£1,447,808	-£1,447,368	-£1,446,959	-£1,446,510

OPTION B		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£20,170,000	£3,994,200	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£976,500	£0	£0	£0	£0
Maintenance		£0	£0	£206,953	£228,765	£229,517	£230,377	£231,638	£233,341	£234,738	£235,932	£235,896	£235,841	£235,776	£235,748	£235,675	£235,621	£235,553	£235,503	£235,442	£235,394	£235,329
HS1 fuel costs	Energy from Waste	£0	£0	£0	£472,460	£476,983	£481,283	£485,459	£495,880	£503,885	£511,737	£511,284	£510,856	£510,439	£509,964	£509,546	£509,108	£508,688	£508,232	£507,790	£507,331	£506,903
HS2 fuel costs	Gas (Wonford)	£0	£0	£775,543	£264,820	£270,903	£277,849	£288,043	£301,810	£313,098	£322,755	£322,461	£322,012	£321,494	£321,262	£320,675	£320,235	£319,688	£319,283	£318,795	£318,402	£317,982
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£1,055,299	£120,347	£125,692	£131,221	£140,976	£160,252	£176,801	£194,684	£193,859	£193,041	£192,233	£191,435	£190,666	£189,875	£189,090	£188,333	£187,579	£186,824	£186,047
Import elec	Electricity industrial	£0	£0	£627,566	£1,074,590	£1,067,869	£1,060,746	£1,049,357	£1,034,168	£1,021,952	£1,011,902	£1,012,314	£1,012,876	£1,012,876	£1,013,098	£1,013,709	£1,014,163	£1,014,786	£1,015,256	£1,015,794	£1,016,191	£1,016,779
Export elec	Elec Wholesale	£0	£0	£158,626	£29,552	£30,352	£31,575	£32,851	£34,577	£36,161	£37,576	£37,532	£37,431	£37,366	£37,313	£37,231	£37,161	£37,110	£37,078	£37,021	£36,954	£36,903
Other Costs		£0	£0	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£880,494	£888,924	£896,937	£904,720	£924,141	£939,058	£953,692	£952,847	£952,050	£951,272	£950,388	£949,608	£948,793	£948,009	£947,159	£946,337	£945,481	£944,684
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£20,170,000	-£6,650,936	-£1,400,935	-£1,401,688	-£1,402,965	-£1,407,902	-£1,416,734	-£1,425,254	-£1,435,435	-£1,236,022	-£1,434,583	-£1,434,180	-£1,433,795	-£1,433,433	-£1,433,048	-£2,409,185	-£1,432,370	-£1,432,042	-£1,431,706	-£1,431,354

OPTION C		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£20,525,000	£4,065,200	£0	£0	£0	£0	£0	£0	£0	-£199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,225,000	£0	£0	£0	£0
Maintenance		£0	£0	£283,831	£245,343	£247,348	£248,824	£251,090	£254,494	£257,322	£259,509	£259,332	£259,301	£259,211	£259,091	£258,972	£258,916	£258,819	£258,713	£258,672	£258,561	£258,459
HS1 fuel costs	Energy from Waste	£0	£0	£0	£467,412	£470,966	£474,910	£478,742	£488,542	£496,218	£504,017	£503,691	£503,171	£502,730	£502,325	£501,917	£501,426	£500,987	£500,561	£500,050	£499,629	£499,197
HS2 fuel costs	Gas (Wonford)	£0	£0	£1,310,443	£374,132	£389,329	£400,526	£417,702	£443,516	£464,954	£481,538	£480,196	£479,966	£479,277	£478,373	£477,470	£477,042	£476,310	£475,508	£475,193	£474,351	£473,579
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (Wonford)	£0	£0	£812,276	£89,452	£93,238	£97,913	£105,507	£120,996	£133,771	£148,649	£147,974	£147,298	£146,628	£145,959	£145,298	£144,641	£143,984	£143,327	£142,670	£142,015	£141,362
Import elec	Electricity industrial	£0	£0	£379,116	£1,003,672	£989,364	£979,006	£962,247	£939,082	£920,553	£906,754	£908,273	£908,459	£909,020	£909,779	£910,746	£910,971	£911,591	£912,284	£912,319	£912,974	£913,758
Export elec	Elec Wholesale	£0	£0	£491,224	£90,956	£95,064	£98,218	£102,574	£110,185	£116,954	£122,522	£122,321	£122,243	£122,010	£121,717	£121,549	£121,332	£121,098	£120,851	£120,613	£120,310	£120,141
Other Costs		£0	£0	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£871,086	£877,709	£885,059	£892,201	£910,466	£924,770	£939,305	£938,696	£937,728	£936,905	£936,151	£935,391	£934,475	£933,658	£932,863	£931,911	£931,127	£930,321
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	-£20,525,000	-£6,509,641	-£1,367,969	-£1,367,472	-£1,367,902	-£1,370,513	-£1,375,980	-£1,381,094	-£1,388,640	-£1,189,448	-£1,388,224	-£1,387,950	-£1,387,659	-£1,387,463	-£1,387,189	-£2,611,934	-£1,386,679	-£1,386,381	-£1,386,094	-£1,385,893

OPTION D		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£1,584,515	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£162,217	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance		£0	£0	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000
HS1 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas & Oil (BAU whole network)	£0	£0	£1,466,149	£1,639,285	£1,661,058	£1,682,830	£1,710,188	£1,767,122	£1,812,967	£1,858,812	£1,856,513	£1,854,214	£1,851,915	£1,849,616	£1,847,317	£1,845,018	£1,842,719	£1,840,420	£1,838,121	£1,835,822	£1,833,523
Standby elec	Electricity industrial	£0	£0	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	Elec Wholesale	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-1,584,515	£-2,878,152	£-3,051,288	£-3,073,061	£-3,094,833	£-3,122,191	£-3,179,125	£-3,224,970	£-3,270,815	£-3,306,166	£-3,266,217	£-3,426,134	£-3,261,619	£-3,259,320	£-3,257,021	£-3,254,722	£-3,252,423	£-3,250,124	£-3,247,825	£-3,245,526

Whole network incl Marsh Barton Industrial Sites with RHI

OPTION A	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£180,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£913,500	£0	£0	£0	£0	£0	£0	£0
Maintenance	£228,788	£228,745	£228,694	£228,624	£228,554	£228,509	£228,433	£228,406	£228,339	£228,289	£228,232	£228,155	£228,107	£228,042	£227,978	£227,909	£227,861	£297,831
HS1 fuel costs	£509,639	£509,205	£508,779	£508,375	£507,977	£507,541	£507,151	£506,684	£506,279	£505,840	£505,419	£505,026	£504,588	£504,169	£503,747	£503,330	£502,880	£502,401
HS2 fuel costs	£264,924	£264,570	£264,160	£263,593	£263,031	£262,665	£262,049	£261,837	£261,295	£260,892	£260,431	£259,808	£259,415	£258,892	£258,377	£257,819	£257,428	£257,186
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£204,738	£203,891	£203,047	£202,225	£201,383	£200,546	£199,709	£198,877	£198,047	£197,238	£196,408	£195,582	£194,766	£193,965	£193,166	£192,378	£191,595	£190,817
Import elec	£1,058,802	£1,059,183	£1,059,644	£1,060,290	£1,060,969	£1,061,365	£1,062,190	£1,062,394	£1,062,988	£1,063,442	£1,063,970	£1,064,717	£1,065,122	£1,065,722	£1,066,347	£1,067,021	£1,067,401	£1,067,668
Export elec	£21,035	£20,990	£20,947	£20,894	£20,866	£20,818	£20,834	£20,793	£20,728	£20,687	£20,646	£20,610	£20,547	£20,501	£20,476	£20,446	£20,371	£20,343
Other Costs	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£949,783	£948,972	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-1,626,073	£-1,445,631	£-2,393,376	£-2,392,211	£-2,391,049	£-2,389,807	£-2,388,697	£-2,387,406	£-2,386,220	£-2,385,014	£-2,383,314	£-2,382,679	£-2,381,450	£-2,380,289	£-2,379,140	£-2,378,011	£-2,376,794	£-2,445,559

OPTION B	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,080,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£976,500	£0	£0	£0	£0	£0	£0	£0
Maintenance	£235,273	£235,214	£235,149	£235,085	£235,038	£234,992	£234,914	£234,860	£234,800	£234,756	£234,682	£234,612	£234,522	£234,445	£234,370	£234,309	£234,269	£304,221
HS1 fuel costs	£506,463	£506,023	£505,594	£505,161	£504,703	£504,245	£503,834	£503,385	£502,943	£502,479	£502,057	£501,629	£501,232	£500,814	£500,392	£499,949	£499,472	£499,009
HS2 fuel costs	£317,423	£316,952	£316,421	£315,909	£315,529	£315,153	£314,526	£314,099	£313,605	£313,245	£312,647	£312,085	£311,354	£310,734	£310,127	£309,631	£309,314	£308,924
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£185,274	£184,506	£183,739	£182,971	£182,205	£181,438	£180,672	£179,911	£179,154	£178,397	£177,644	£176,892	£176,139	£175,387	£174,639	£173,894	£173,150	£172,407
Import elec	£1,017,235	£1,017,714	£1,018,251	£1,018,810	£1,019,184	£1,019,585	£1,020,328	£1,020,757	£1,021,244	£1,021,580	£1,022,192	£1,022,767	£1,023,519	£1,024,202	£1,024,875	£1,025,457	£1,025,782	£1,026,171
Export elec	£36,821	£36,742	£36,652	£36,590	£36,520	£36,469	£36,427	£36,345	£36,262	£36,185	£36,088	£35,996	£35,880	£35,808	£35,740	£35,703	£35,653	£35,584
Other Costs	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£943,862	£943,042	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-2,510,984	£-1,430,624	£-2,372,500	£-2,371,346	£-2,370,139	£-2,368,945	£-2,367,846	£-2,366,656	£-2,365,484	£-2,364,272	£-2,339,635	£-2,361,988	£-2,360,886	£-2,359,775	£-2,358,664	£-2,357,536	£-2,356,335	£-2,425,148

OPTION C	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,080,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£1,225,000	£0	£0	£0	£0	£0	£0	£0
Maintenance	£258,374	£258,304	£258,047	£257,949	£257,962	£257,823	£257,809	£257,697	£257,606	£257,517	£257,360	£257,070	£256,931	£256,804	£256,694	£256,572	£256,488	£326,348
HS1 fuel costs	£498,742	£498,264	£497,833	£497,392	£497,029	£496,635	£496,281	£495,857	£495,403	£494,947	£494,577	£494,156	£493,760	£493,348	£492,910	£492,485	£492,007	£491,601
HS2 fuel costs	£472,931	£472,407	£470,458	£469,710	£469,810	£468,758	£468,647	£467,801	£467,114	£466,439	£465,243	£463,045	£461,991	£461,028	£460,195	£459,270	£458,635	£457,575
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£140,709	£140,063	£139,999	£139,358	£138,056	£137,430	£136,209	£135,568	£134,932	£134,299	£133,675	£133,711	£133,094	£132,475	£131,866	£131,268	£130,677	£130,090
Import elec	£914,198	£914,640	£915,841	£916,357	£916,948	£917,708	£918,520	£919,207	£919,796	£920,376	£921,385	£922,547	£923,442	£924,171	£925,068	£925,736	£926,255	£927,370
Export elec	£119,870	£119,702	£118,811	£118,502	£118,937	£118,524	£118,916	£118,629	£118,414	£118,204	£117,819	£116,701	£116,365	£116,006	£115,854	£115,491	£115,277	£115,067
Other Costs	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000	£150,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£929,474	£928,582	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-2,465,610	£-1,385,394	£-2,313,368	£-2,312,263	£-2,310,868	£-2,309,831	£-2,308,550	£-2,307,501	£-2,306,438	£-2,305,374	£-2,529,420	£-2,303,828	£-2,302,852	£-2,301,819	£-2,300,879	£-2,299,840	£-2,298,785	£-2,367,917

OPTION D	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,584,515	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000	£58,000
HS1 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£1,831,224	£1,828,925	£1,826,626	£1,824,327	£1,822,028	£1,819,730	£1,817,431	£1,815,132	£1,812,833	£1,810,534	£1,808,235	£1,805,936	£1,803,637	£1,801,338	£1,799,039	£1,796,740	£1,794,441	£1,792,142
Import elec	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-4,827,742	£-3,240,928	£-3,238,629	£-3,236,330	£-3,234,032	£-3,231,733	£-3,229,434	£-3,227,135	£-3,224,836	£-3,260,187	£-3,220,238	£-3,217,939	£-3,215,640	£-3,213,341	£-3,211,042	£-3,208,743	£-3,206,444	£-3,204,145

Whole network excl Marsh Barton Industrial Sites with RHI

OPTION A		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£21,401,800	£0	£0	£0	£0	£0	£0	£0	£0	£-199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£560,000	£0	£0	£0	£0
Maintenance		£0	£0	£175,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000
HS1 fuel costs	Energy from Waste	£0	£0	£421,923	£427,809	£433,176	£438,378	£443,908	£455,728	£464,871	£473,350	£473,162	£472,974	£472,785	£472,596	£472,407	£472,217	£472,026	£471,835	£471,644	£471,453	£471,262
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (BAU whole network)	£0	£0	£163,840	£172,538	£180,229	£188,446	£201,616	£226,574	£248,126	£271,785	£271,268	£270,752	£270,238	£269,724	£269,210	£268,699	£268,191	£267,683	£267,175	£266,668	£266,161
Import elec	Electricity industrial	£0	£0	£1,368,171	£1,367,965	£1,367,840	£1,367,724	£1,367,496	£1,367,352	£1,367,193	£1,367,051	£1,367,052	£1,367,053	£1,367,054	£1,367,055	£1,367,056	£1,367,056	£1,367,057	£1,367,058	£1,367,059	£1,367,060	£1,367,061
Export elec	Elec Wholesale	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£786,312	£797,281	£807,283	£816,977	£827,284	£849,312	£866,350	£882,153	£881,802	£881,451	£881,099	£880,746	£880,394	£880,040	£879,684	£879,329	£878,973	£878,617	£878,260
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-21,401,800	£-1,457,623	£-1,521,032	£-1,523,962	£-1,527,571	£-1,535,736	£-1,550,343	£-1,563,839	£-1,580,034	£-1,380,680	£-1,579,328	£-1,578,978	£-1,578,628	£-1,578,278	£-1,577,932	£-2,137,590	£-1,577,247	£-1,576,905	£-1,576,564	£-1,576,223

OPTION B		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£22,008,041	£0	£0	£0	£0	£0	£0	£0	£0	£-199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£913,641	£0	£0	£0	£0
Maintenance		£0	£0	£195,267	£256,139	£256,861	£257,743	£259,031	£260,978	£262,293	£263,497	£263,478	£263,448	£263,428	£263,399	£263,365	£263,328	£263,232	£263,211	£263,194	£263,167	£263,147
HS1 fuel costs	Energy from Waste	£0	£0	£410,542	£415,973	£420,918	£425,774	£430,813	£441,916	£450,728	£459,470	£459,268	£459,081	£458,880	£458,691	£458,509	£458,333	£458,128	£457,928	£457,720	£457,526	£457,323
HS2 fuel costs	Gas (Wonford)	£0	£0	£180,130	£187,876	£194,297	£202,138	£213,581	£230,887	£242,570	£253,275	£253,103	£252,843	£252,661	£252,403	£252,102	£251,769	£250,922	£250,732	£250,585	£250,346	£250,161
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (BAU whole network)	£0	£0	£103,591	£109,588	£115,183	£120,301	£128,909	£146,881	£163,230	£180,326	£179,945	£179,566	£179,187	£178,810	£178,434	£178,060	£178,047	£177,672	£177,297	£176,925	£176,554
Import elec	Electricity industrial	£0	£0	£1,177,795	£1,168,824	£1,161,696	£1,153,108	£1,140,519	£1,121,597	£1,109,023	£1,098,036	£1,098,223	£1,098,482	£1,098,644	£1,098,943	£1,099,272	£1,099,640	£1,100,332	£1,100,519	£1,100,652	£1,100,898	£1,101,086
Export elec	Elec Wholesale	£0	£0	£13,351	£13,581	£13,927	£14,398	£15,088	£16,079	£16,906	£17,978	£17,968	£17,938	£17,907	£17,903	£17,886	£17,871	£17,886	£17,663	£17,639	£17,616	£17,598
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£765,101	£775,222	£784,438	£793,488	£802,878	£823,571	£839,994	£856,286	£855,909	£855,559	£855,185	£854,834	£854,495	£854,165	£853,785	£853,411	£853,023	£852,662	£852,285
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-22,008,041	£-1,403,874	£-1,464,598	£-1,465,591	£-1,466,178	£-1,469,887	£-1,477,608	£-1,485,944	£-1,495,340	£-1,296,141	£-1,494,922	£-1,494,708	£-1,494,509	£-1,494,302	£-1,494,093	£-2,407,831	£-1,493,987	£-1,493,787	£-1,493,584	£-1,493,388

OPTION C		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£22,114,809	£0	£0	£0	£0	£0	£0	£0	£0	£-199,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£975,922	£0	£0	£0	£0
Maintenance		£0	£0	£197,122	£258,187	£259,029	£260,068	£261,346	£263,617	£265,354	£266,933	£266,910	£266,882	£266,849	£266,816	£266,779	£266,756	£266,728	£266,707	£266,673	£266,632	£266,601
HS1 fuel costs	Energy from Waste	£0	£0	£409,248	£414,297	£419,219	£424,007	£428,947	£439,985	£448,672	£456,892	£456,692	£456,499	£456,313	£456,127	£455,948	£455,747	£455,554	£455,349	£455,165	£454,992	£454,803
HS2 fuel costs	Gas (Wonford)	£0	£0	£209,792	£219,894	£227,880	£237,737	£249,856	£271,392	£287,861	£302,840	£302,618	£302,348	£302,042	£301,731	£301,379	£301,160	£300,888	£300,694	£300,371	£299,979	£299,688
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (BAU whole network)	£0	£0	£91,688	£97,631	£102,458	£106,706	£115,255	£131,160	£145,335	£161,788	£161,430	£161,072	£160,714	£160,357	£159,999	£159,642	£159,284	£158,927	£158,570	£158,213	£157,856
Import elec	Electricity industrial	£0	£0	£1,158,428	£1,146,977	£1,138,437	£1,128,118	£1,115,272	£1,093,159	£1,076,318	£1,061,584	£1,061,790	£1,062,057	£1,062,336	£1,062,650	£1,063,016	£1,063,200	£1,063,524	£1,063,694	£1,063,973	£1,064,354	£1,064,620
Export elec	Elec Wholesale	£0	£0	£22,631	£23,040	£23,644	£24,500	£25,509	£27,572	£29,220	£31,064	£31,030	£30,999	£30,949	£30,916	£30,886	£30,841	£30,843	£30,807	£30,745	£30,696	£30,649
Other Costs		£0	£0	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£762,689	£772,099	£781,271	£790,195	£799,402	£819,971	£836,161	£851,481	£851,108	£850,749	£850,401	£850,055	£849,721	£849,346	£848,987	£848,604	£848,261	£847,940	£847,588
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-22,114,809	£-1,395,957	£-1,456,848	£-1,457,107	£-1,456,940	£-1,460,766	£-1,466,770	£-1,473,159	£-1,482,493	£-1,283,303	£-1,482,111	£-1,481,905	£-1,481,710	£-1,481,514	£-1,481,317	£-2,457,070	£-1,480,960	£-1,480,745	£-1,480,534	£-1,480,331

OPTION D		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPEX		£0	£1,746,732	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance		£0	£0	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000
HS1 fuel costs	Energy from Waste	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	Gas (Wonford)	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	Gas (BAU whole network)	£0	£0	£1,401,059	£1,426,565	£1,449,599	£1,472,633	£1,501,252	£1,559,448	£1,606,554	£1,653,660	£1,652,622	£1,651,585	£1,650,547	£1,649,510	£1,648,472	£1,647,435	£1,646,397	£1,645,359	£1,644,322	£1,643,284	£1,642,247
Import elec	Electricity industrial	£0	£0	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	Elec Wholesale	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges		£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin		£0	£-1,746,732	£-2,810,062	£-2,835,568	£-2,858,602	£-2,881,636	£-2,910,255	£-2,968,451	£-3,015,557	£-3,062,663	£-3,099,275	£-3,060,588	£-3,059,550	£-3,058,513	£-3,057,475	£-3,056,438	£-3,055,400	£-3,054,362	£-3,053,325	£-3,052,287	£-3,051,250

Whole network excl Marsh Barton Industrial Sites with RHI

OPTION A	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£180,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£560,000	£0	£0	£0	£0	£0	£0	£0
Maintenance	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000	£235,000
HS1 fuel costs	£471,071	£470,879	£470,688	£470,496	£470,304	£470,112	£469,920	£469,727	£469,533	£469,338	£469,143	£468,947	£468,751	£468,555	£468,359	£468,163	£467,966	£467,770
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£265,654	£265,147	£264,641	£264,137	£263,632	£263,128	£262,623	£262,120	£261,623	£261,127	£260,633	£260,141	£259,649	£259,157	£258,666	£258,175	£257,684	£257,193
Import elec	£1,367,062	£1,367,063	£1,367,063	£1,367,064	£1,367,065	£1,367,066	£1,367,067	£1,367,068	£1,367,069	£1,367,070	£1,367,071	£1,367,071	£1,367,072	£1,367,073	£1,367,074	£1,367,075	£1,367,076	£1,367,077
Export elec	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£877,904	£877,548	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-1,755,682	£-1,575,541	£-2,452,392	£-2,451,696	£-2,451,001	£-2,450,305	£-2,449,610	£-2,448,915	£-2,448,225	£-2,447,535	£-3,006,846	£-2,446,159	£-2,445,472	£-2,444,786	£-2,444,099	£-2,443,412	£-2,442,726	£-2,442,040

OPTION B	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,080,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£913,641	£0	£0	£0	£0	£0	£0	£0
Maintenance	£263,134	£263,108	£263,088	£263,065	£263,047	£263,023	£263,009	£262,981	£262,948	£262,925	£262,908	£262,886	£262,863	£262,843	£262,827	£262,810	£262,796	£262,776
HS1 fuel costs	£457,108	£456,912	£456,707	£456,507	£456,299	£456,099	£455,884	£455,691	£455,505	£455,304	£455,093	£454,892	£454,689	£454,484	£454,271	£454,060	£453,844	£453,638
HS2 fuel costs	£250,049	£249,819	£249,642	£249,434	£249,272	£249,061	£248,940	£248,691	£248,396	£248,193	£248,044	£247,841	£247,645	£247,463	£247,320	£247,172	£247,048	£246,869
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£176,183	£175,815	£175,447	£175,079	£174,712	£174,345	£173,978	£173,611	£173,245	£172,879	£172,513	£172,147	£171,780	£171,417	£171,054	£170,690	£170,327	£169,964
Import elec	£1,101,193	£1,101,433	£1,101,590	£1,101,776	£1,101,909	£1,102,119	£1,102,234	£1,102,498	£1,102,813	£1,103,029	£1,103,187	£1,103,414	£1,103,629	£1,103,823	£1,103,963	£1,104,107	£1,104,204	£1,104,360
Export elec	£17,582	£17,563	£17,532	£17,495	£17,460	£17,437	£17,419	£17,400	£17,380	£17,365	£17,354	£17,346	£17,335	£17,322	£17,305	£17,285	£17,256	£17,222
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£851,884	£851,518	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-2,573,201	£-1,493,006	£-2,343,943	£-2,343,366	£-2,342,778	£-2,342,211	£-2,341,627	£-2,341,072	£-2,340,527	£-2,339,964	£-3,253,032	£-2,338,833	£-2,338,272	£-2,337,707	£-2,337,130	£-2,336,554	£-2,335,964	£-2,335,385

OPTION C	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,080,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£975,922	£0	£0	£0	£0	£0	£0	£0
Maintenance	£266,570	£266,542	£266,515	£266,480	£266,436	£266,376	£266,354	£266,336	£266,303	£266,261	£266,241	£266,212	£266,182	£266,157	£266,134	£266,110	£266,060	£266,033
HS1 fuel costs	£454,614	£454,420	£454,225	£454,043	£453,866	£453,723	£453,521	£453,311	£453,106	£452,934	£452,726	£452,534	£452,342	£452,141	£451,936	£451,733	£451,572	£451,373
HS2 fuel costs	£299,397	£299,132	£298,873	£298,542	£298,123	£297,558	£297,343	£297,171	£296,864	£296,466	£296,276	£295,996	£295,714	£295,475	£295,259	£295,033	£294,553	£294,298
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£157,499	£157,142	£156,785	£156,428	£156,099	£155,742	£155,386	£155,029	£154,730	£154,376	£154,023	£153,670	£153,317	£152,967	£152,620	£152,272	£151,926	£151,579
Import elec	£1,064,859	£1,065,123	£1,065,330	£1,065,641	£1,066,062	£1,066,667	£1,066,862	£1,066,999	£1,067,351	£1,067,806	£1,067,981	£1,068,261	£1,068,532	£1,068,746	£1,068,941	£1,069,139	£1,069,654	£1,069,913
Export elec	£30,587	£30,556	£30,497	£30,449	£30,405	£30,367	£30,331	£30,292	£30,285	£30,275	£30,245	£30,215	£30,177	£30,136	£30,100	£30,058	£30,027	£30,001
Other Costs	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000	£115,000
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£847,235	£846,874	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-2,560,118	£-1,479,928	£-2,326,231	£-2,325,684	£-2,325,182	£-2,324,699	£-2,324,133	£-2,323,554	£-2,323,070	£-2,322,568	£-3,297,924	£-2,321,458	£-2,320,910	£-2,320,350	£-2,319,790	£-2,319,229	£-2,318,738	£-2,318,195

OPTION D	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
CAPEX	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
REPEX	£1,584,515	£0	£0	£0	£0	£0	£0	£0	£0	£37,650	£0	£0	£0	£0	£0	£0	£0	£0
Maintenance	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000	£55,000
HS1 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS2 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
HS3 fuel costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Top-up standby fuel costs	£1,641,209	£1,640,172	£1,639,134	£1,638,096	£1,637,059	£1,636,021	£1,634,984	£1,633,946	£1,632,909	£1,631,871	£1,630,834	£1,629,796	£1,628,758	£1,627,721	£1,626,683	£1,625,646	£1,624,608	£1,623,571
Import elec	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003	£1,354,003
Export elec	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other Costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Heat sales	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Other income	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Connection Charges	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Operating margin	£-4,634,727	£-3,049,175	£-3,048,137	£-3,047,100	£-3,046,062	£-3,045,024	£-3,043,987	£-3,042,949	£-3,041,912	£-3,078,524	£-3,039,837	£-3,038,799	£-3,037,761	£-3,036,724	£-3,035,686	£-3,034,649	£-3,033,611	£-3,032,574

APPENDIX F

DETAILED SCHEME DESIGN DETAILS

F.1 System Design Description

F.1.1 Energy Centre

The Energy Centre outline design is based on:

- Supply of electricity, steam and hot water to various buildings at the RD&E Hospital via connection to existing utility infrastructure and some new district heating network connections
- Supply of heat as hot water via a district heating network to properties as shown on individual network drawings presented in main report.

The Energy Centre equipment will comprise:

- 2 No 2MWe natural gas fuelled spark ignition reciprocating CHP engine systems – these will be housed in acoustic cells and will incorporate heat recovery from lubricating oil, jacket water and exhaust gases.
- 2 No 10MWth natural gas fired hot water boilers
- 2 No 5MWth natural gas fired steam boilers
- Steam to hot water plate heat exchangers
- District heating pumps – 3 No 50% duty variable speed drive pumps for each circuit – basic design for 175 l/s at 579kPa at maximum duty for circuit
- District pressurisation and water treatment systems
- 4No 100m³ thermal storage tanks connected in parallel with the heat supply equipment
- HV and LV electrical systems
- Plant control system
- Ancillary plant and systems including ventilation, lighting and small power
- Utility connections to:
 - o Hospital electrical HV system
 - o Hospital existing steam distribution system
 - o Hospital existing MTHW distribution system
 - o Natural gas connections to local utility

F.1.2 District Heating Network

The DH network comprises flow and return, pre-insulated, buried pipework. The pipework system is assumed to:

- comprise a bonded system in which the carrier pipe, insulation and outer casing are moulded together to form a solid unit. Expansion movements of the carrier pipe are transferred to the outer casing via the foam insulation.
- be installed as a system locked / restrained by friction, in which the temperature variations in the District Heating Pipe system are absorbed either as axial stresses in the carrier pipe, by reduced expansion movements, or by a combination of both.
- Be installed in strict accordance with the pipework manufacturer's specification and with current European and British Standards, e.g. BS EN253, BS EN448, BS EN488, BS EN489, BS EN13941 and BS EN14419
- comprise a steel pipe system with electro-fusion welded type outer casing jointing
- be suitable for eventual operation at PN16 and maximum temperature of 120°C

The network is sized based on the following key operational criteria:

Flow temperature: 105°C
Return Temperature: 64°C
Operating pressure: 9.5bar

				Allowable velocities / pressure drop for sizing			
				Main SPINE		Branches (final connections)	
Diameters (nominal) (mm ID)	Cost per m (trench) (£ capex)	Insulation thickness	Heat loss W/m (TRENCH)	Max allowable pressure drop (pa/m)	Max velocity (m/s)	Max allowable pressure drop (pa/m)	Max velocity (m/s)
mm (ID)	£ / m Trench	mm	W/m trench	pa/m	m/s	pa/m	m/s
25	£611	38.15	19	150	0.5	150	0.5
32	£628	41.3	21	150	0.5	150	0.5
40	£658	38.35	24	150	1	150	1
50	£672	39.85	27	150	1	150	1
65	£717	41.95	30	150	1	150	1
80	£755	45.55	32	150	1.5	150	1.5
100	£827	55.35	33	150	1.5	150	1.5
125	£897	55.15	39	150	2	150	1.5
150	£958	55.85	44	200	2	200	1.5
200	£1,039	67.95	47	200	2.5	200	2
250	£1,213	88.5	45	200	2.5	200	2
300	£1,294	88.05	52	200	3	200	2
350	£1,458	102.2	49	200	3	200	2
400	£1,579	111.8	51	200	3.5	200	2
450	£1,667	86.5	70	200	3.5	200	2
500	£2,156	101	67	200	4	200	2
600	£2,548	95	83	200	4	200	2
700	£3,260	94.5	95	200	4	200	2
800	£3,722	93.5	109	200	4	200	2

F.1.3 Customer Connections

Connections to customers will be made via prefabricated plate heat exchanger substations and costing assumes a single PHE per connection. Each connection will be controlled to achieve the required flow temperature on the consumer side of the PHE via a flow regulating valve. The connection will include a differential pressure control valve to allow for close control of flow in the primary DH network and to minimise return water temperatures under varying load conditions.

Connections will NOT include permanent by pass. Any by-pass included to ensure maintenance of flow temperatures, or to avoid dead legs, under low demand conditions will be temperature controlled to minimise the return temperature.

F.1.4 Energy from Waste Interface

The potential connection to the energy from waste plant makes the following key assumptions:

- Heat will be extracted from the EfW plant cycle as low pressure steam
- Steam will be converted to hot water suitable for circulation in the DH network via condensing plate heat exchangers
- Plant located at or near to the EfW plant will include:
 - o Steam to hot water PHE plus controls and valving
 - o DH circulation pumps and pressurisation system and water treatment for connection from the EfW plant only.
 - o Necessary electrical and control equipment to operate this system
 - o Thermal storage of approximately 600m³
- The supply of heat from the EfW plant will be base load only - no peaking or back up heat supply plant will be included. All back up plant would remain at the hospital site or would be provided by existing heat supply plant at the Marsh Barton industrial loads if supplied.

F.2 Whole Network
F.2.1 Scheme Costs

Preferred Option A EfW and 1.2MWe CHP		
Main plant		
EfW connection	£800,000	
Wonford 1.2MWe CHP	£505,000	
		£1,305,000
Energy centre		
Gas Boilers	£900,000	
Flues (CHP and boilers)	£350,000	
Thermal Store	£550,000	
Metering	£60,000	
Controls and instrumentation	£150,000	
Pumps and VSDs (including flex connections, anti vibration mounting, plant room pipework, valves, insulation and accessories)	£180,000	
Alarm System	£60,000	
Security system	£30,000	
Dosing, sidestream filtration, expansion, make-up water, pressurisation	£50,000	
Connecting Pipework and Valves	£275,000	
Electrical cabling and switchgear	£195,000	
Testing and cleaning, commissioning	£165,000	
Mech Building Services	£225,000	
Ventilation	£135,000	
Construction Costs	£1,800,000	
		£5,125,000
Network		
Network	£9,330,000	
Exe Crossing	£3,770,000	
		£13,100,000
Fees		
Design fees (EC plant)	£750,000	
Architects fees	£150,000	
		£900,000
Contingency		
		£4,046,200
Total		
		£24,476,200
S106 Contributions		-£199,000
Net Investment		
		£24,277,200

F.2.2 Network Pipe Costs

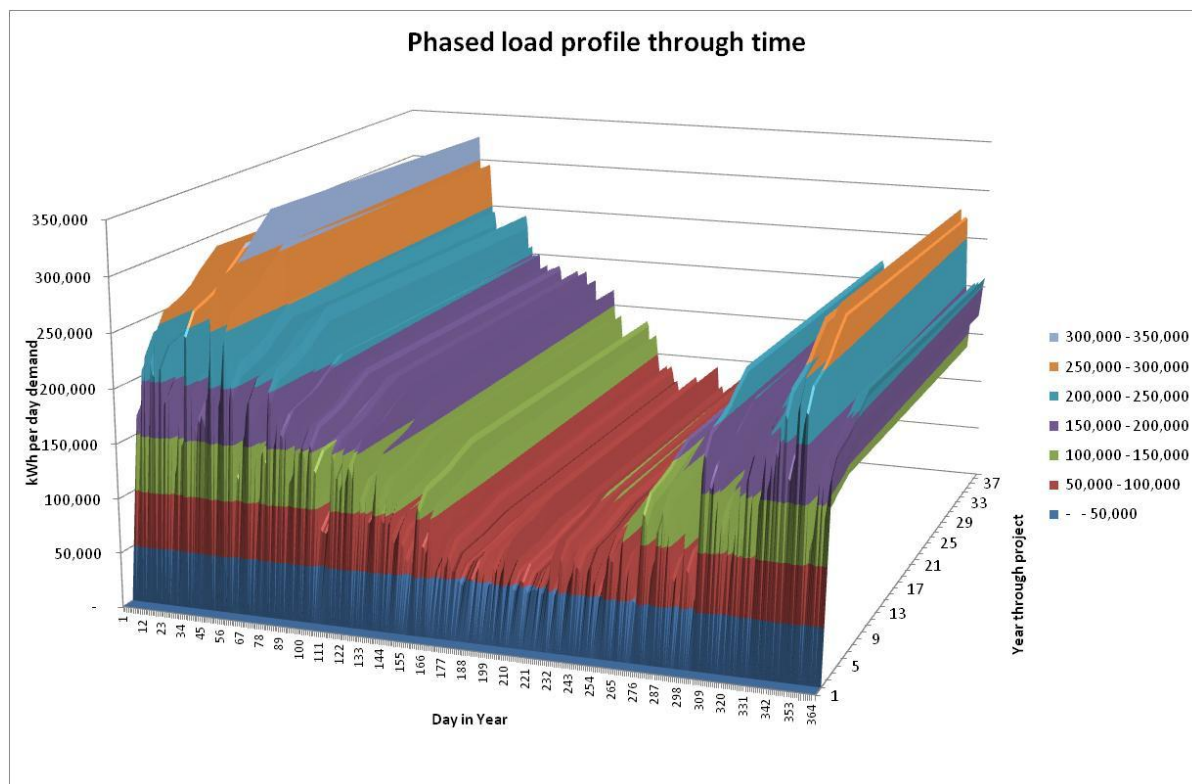
Whole network		
Diameter (mm)	Length (m trench)	Cost (£)
40	£601	£395,794
50	£675	£453,567
65	£818	£587,024
80	£390	£294,227
100	£831	£686,866
125	£957	£858,911
150	£964	£923,569
200	£3,617	£3,756,853
250	£1,278	£1,550,609
300	£78	£100,372

F.2.3 Staffing

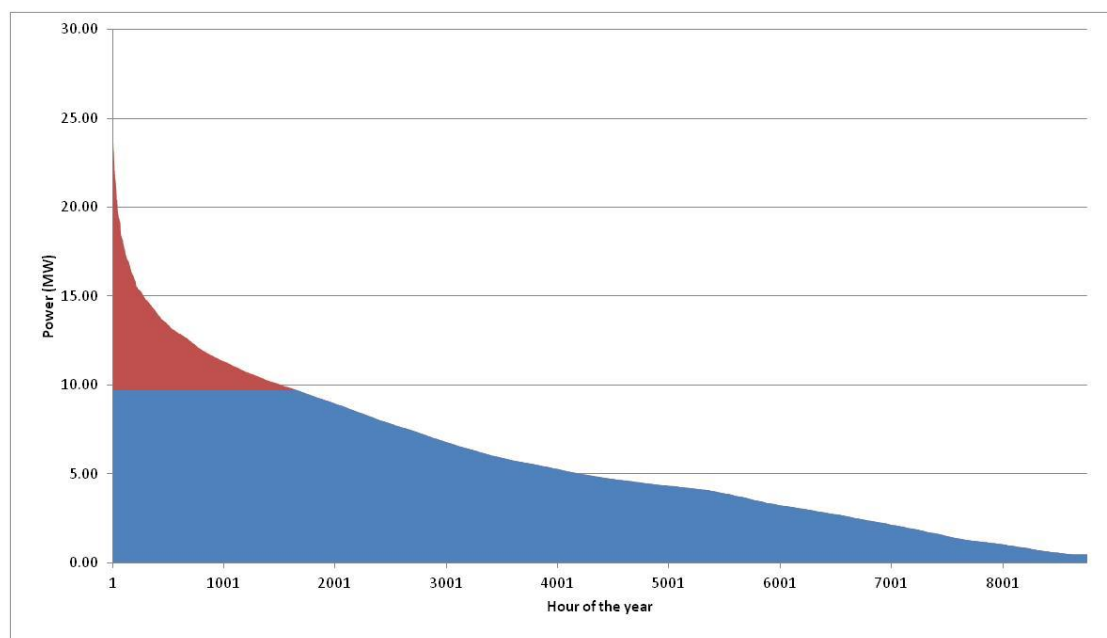
Staff costs estimated at £115,000 for:

- ½ time of a manager
- Full time mechanical and full time electrical engineers
- ½ time of an administrator

F.2.4 Daily Load Profiles



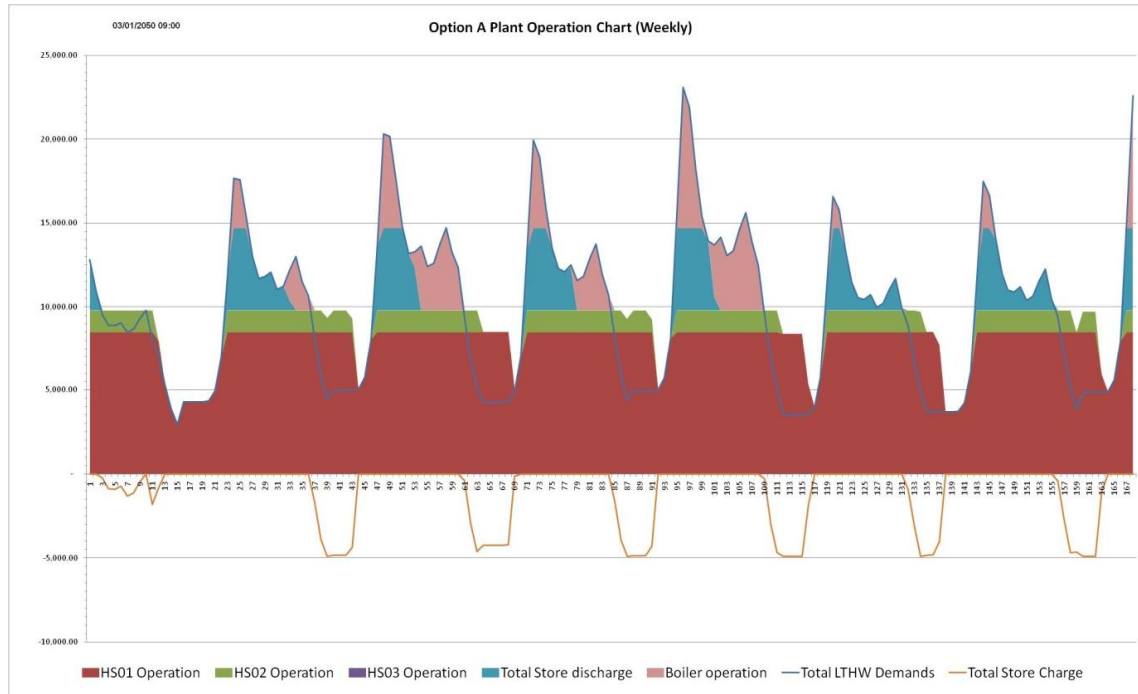
F.2.5 Heat Load Duration Curve



The red filled area indicates demand greater than the combined maximum EfW and CHP generation capacity.

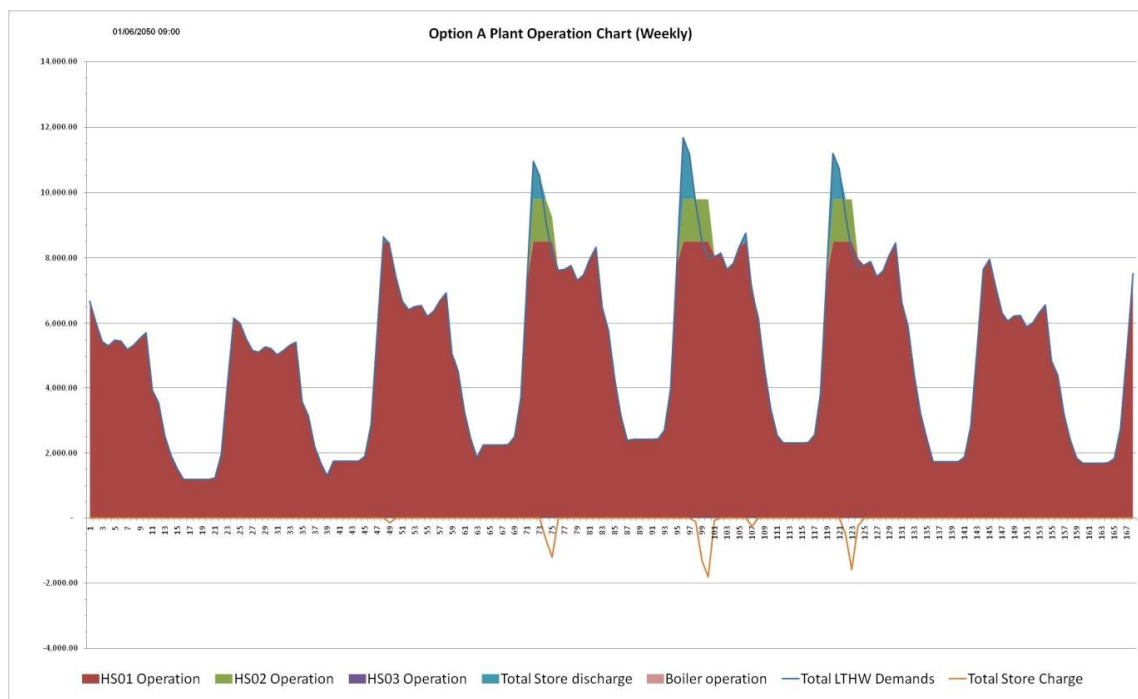
F.2.6 Plant Operation Weekly Chart

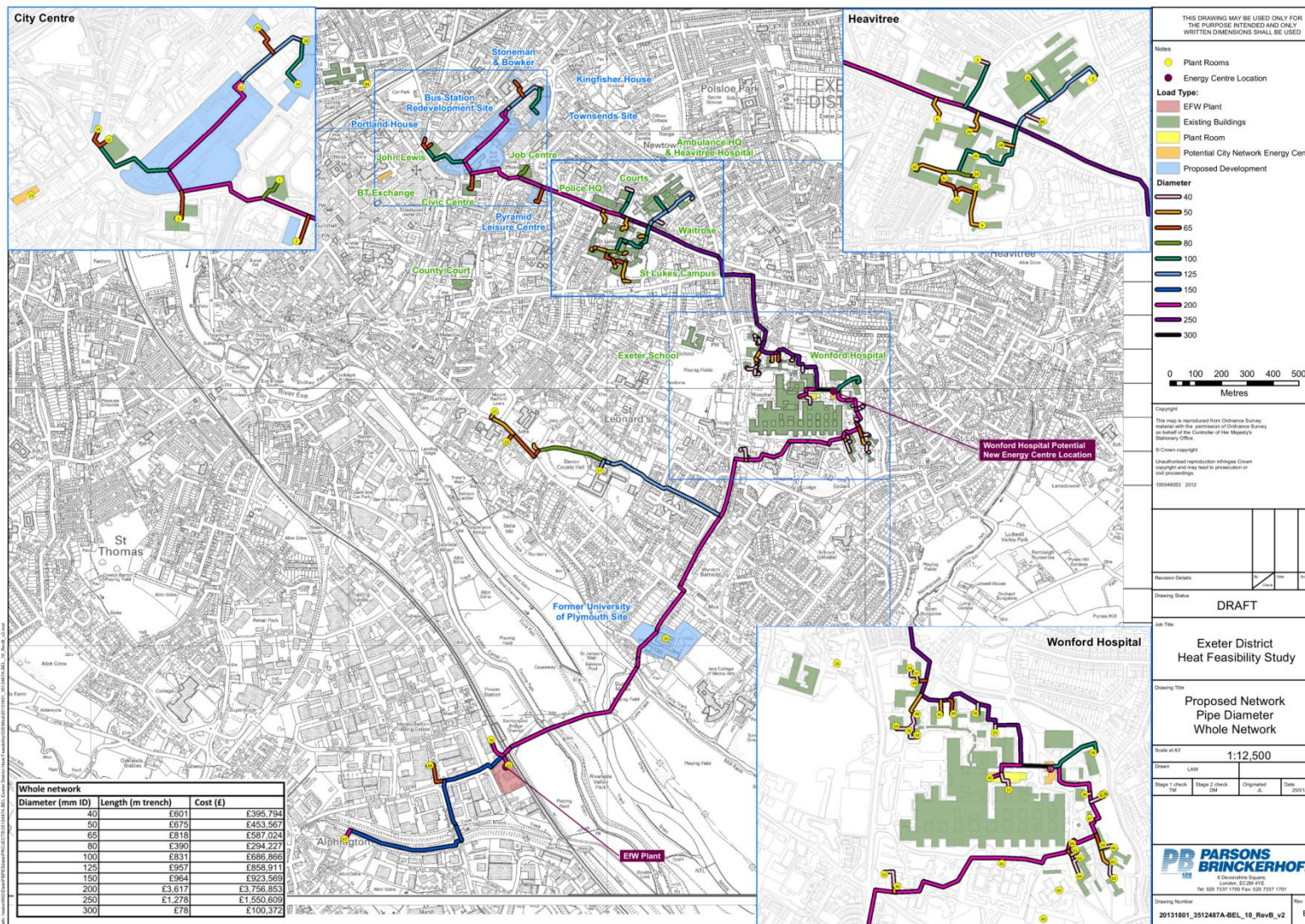
F.2.6.1 Winter

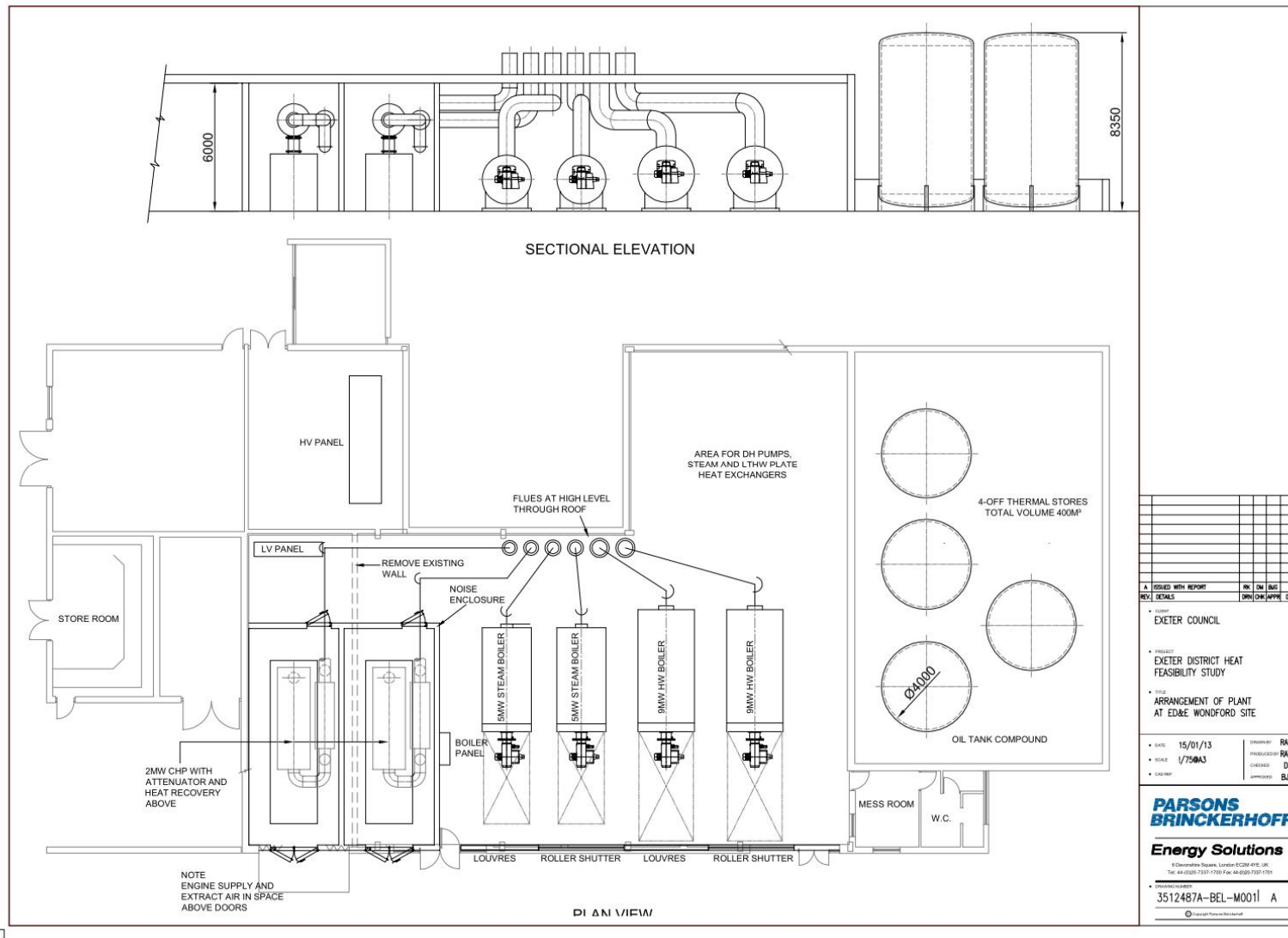


Where HS01 is Heat Supply 1 - the Energy from Waste Plant, HS02 is the CHP engine, HS03 is not used, and boiler operation is the auxiliary boilers in the energy centre.

F.2.6.2 Summer







REV	DETAILS	DATE	BY	CHK	APP	DATE
1	ISSUED WITH REPORT					
EXETER COUNCIL EXETER DISTRICT HEAT FEASIBILITY STUDY ARRANGEMENT OF PLANT AT ED&E WONDFOOD SITE DATE: 15/01/13 SCALE: 1/750A3 DESIGNED BY: RAYK PRODUCED BY: RAYK CHECKED BY: DM APPROVED BY: BJG PARSONS BRINCKERHOFF Energy Solutions 3512487A-BEL-M001 A						

F.3 Wonford and City Centre
F.3.1 Scheme Costs

Preferred Option A EfW and 1.2MWe CHP		
Main plant		
Wonford CHP1 2MWe	£748,542	
Wonford CHP2 2MWe	£748,542	
		£1,497,084
Energy centre		
Gas Boilers	£900,000	
Flues (CHP and boilers)	£288,000	
Thermal Store	£403,579	
Metering	£50,280	
Controls and instrumentation	£120,000	
Pumps and VSDs (including flex connections, anti vibration mounting, plant room pipework, valves, insulation and accessories)	£150,000	
Alarm System	£50,000	
Security system	£25,000	
Dosing, sidestream filtration, expansion, make-up water, pressurisation	£41,880	
Connecting Pipework and Valves	£185,000	
Electrical cabling and switchgear	£120,000	
Testing and cleaning, commissioning	£127,648	
Mech Building Services	£150,000	
Ventilation	£85,000	
Construction Costs	£1,250,000	
		£3,946,387
Network		
Network	£5,050,000	
		£5,050,000
Fees		
Design fees (EC plant)	£600,000	
Architects fees	£110,000	
		£710,000
Contingency		
		£2,200,894
Total		
		£13,404,365
S106 Contributions		-£199,000
Net Investment		
		£13,205,365

F.3.2 Network Pipe Costs

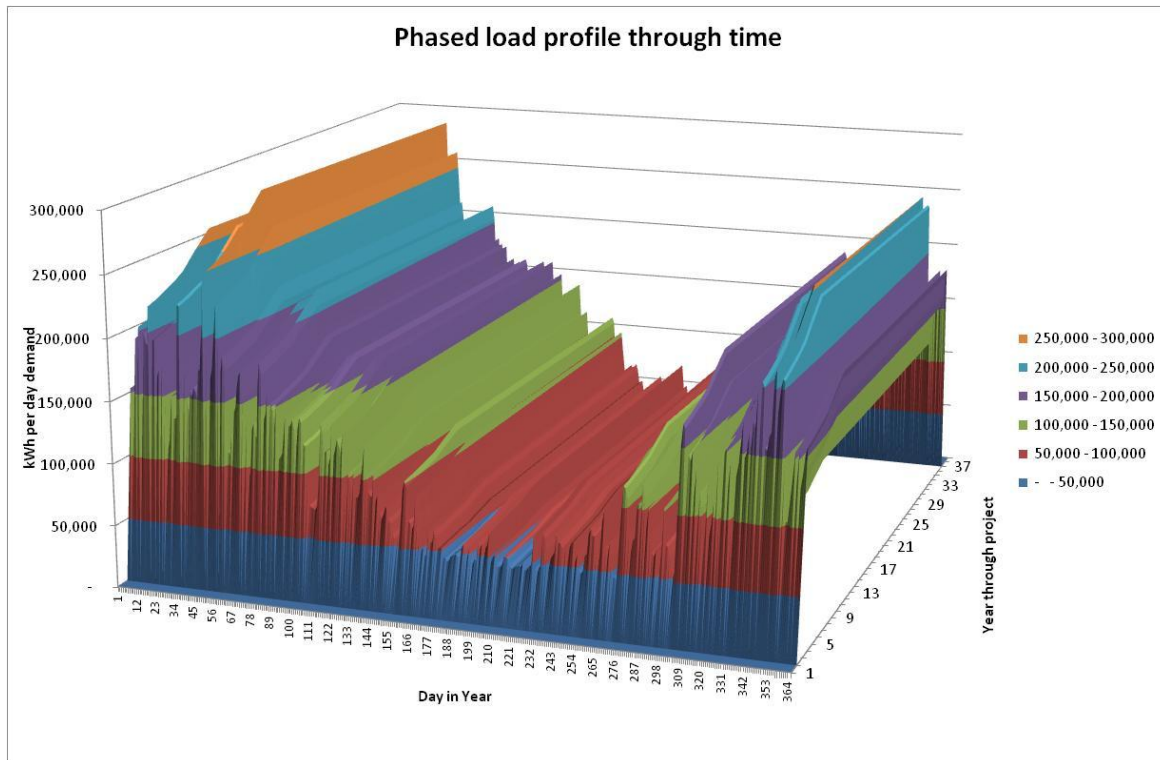
Wonford and City		
Diameter (mm)	Length (m trench)	Cost (£)
40	538	£354,365
50	497	£333,624
65	506	£362,709
80	126	£94,874
100	831	£686,866
125	403	£361,452
200	1387	£1,440,655
250	1278	£1,550,609
300	78	£100,372

F.3.3 Staffing Costs

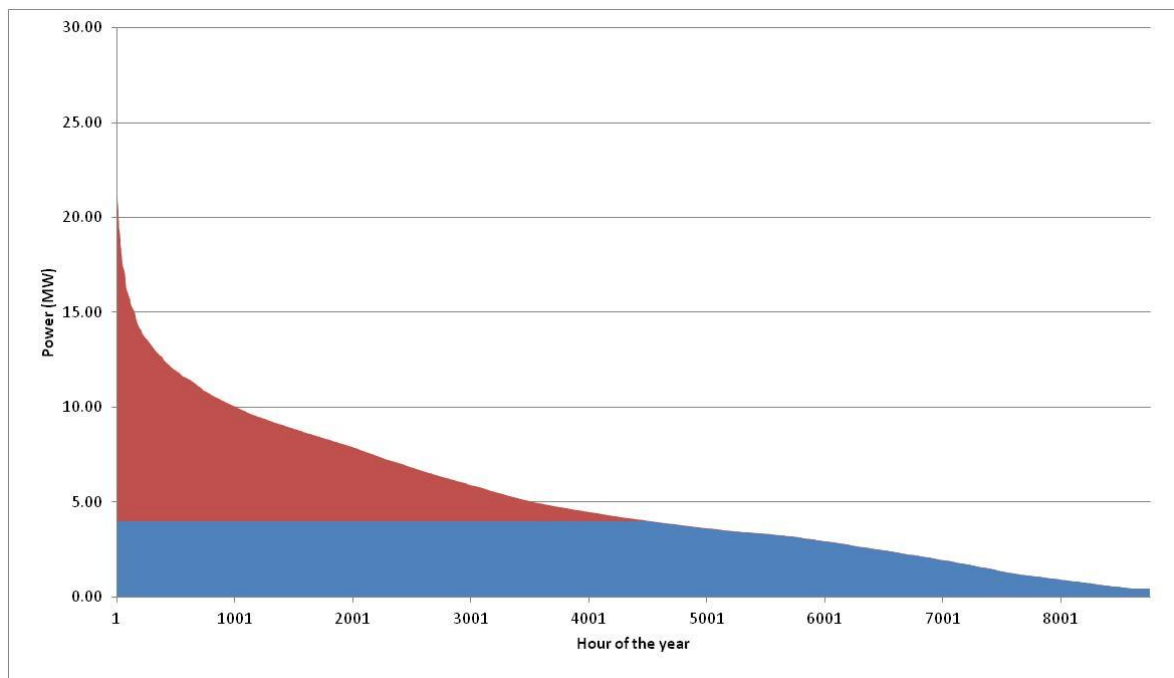
Staff costs estimated at £150,000 for full time:

- Manager
- Mechanical Engineer
- Electrical Engineer
- Administrator

F.3.4 Daily Load Profiles



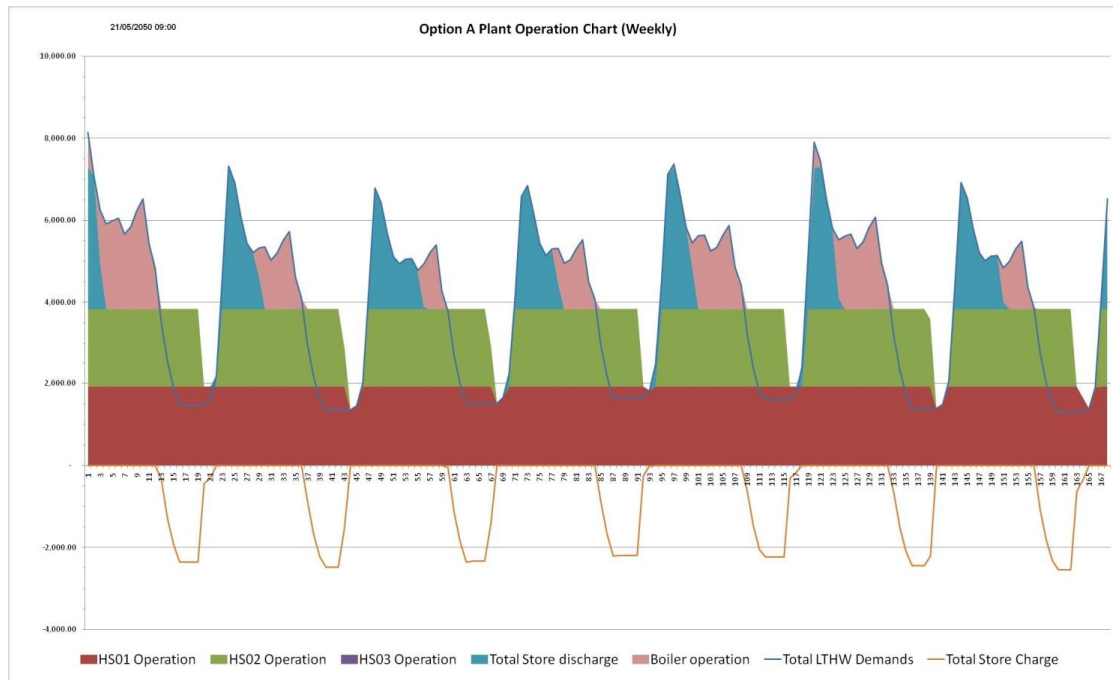
F.3.5 Heat Load Duration Curve



The red filled area indicates demand greater than the combined maximum generation capacity of the two CHP engines.

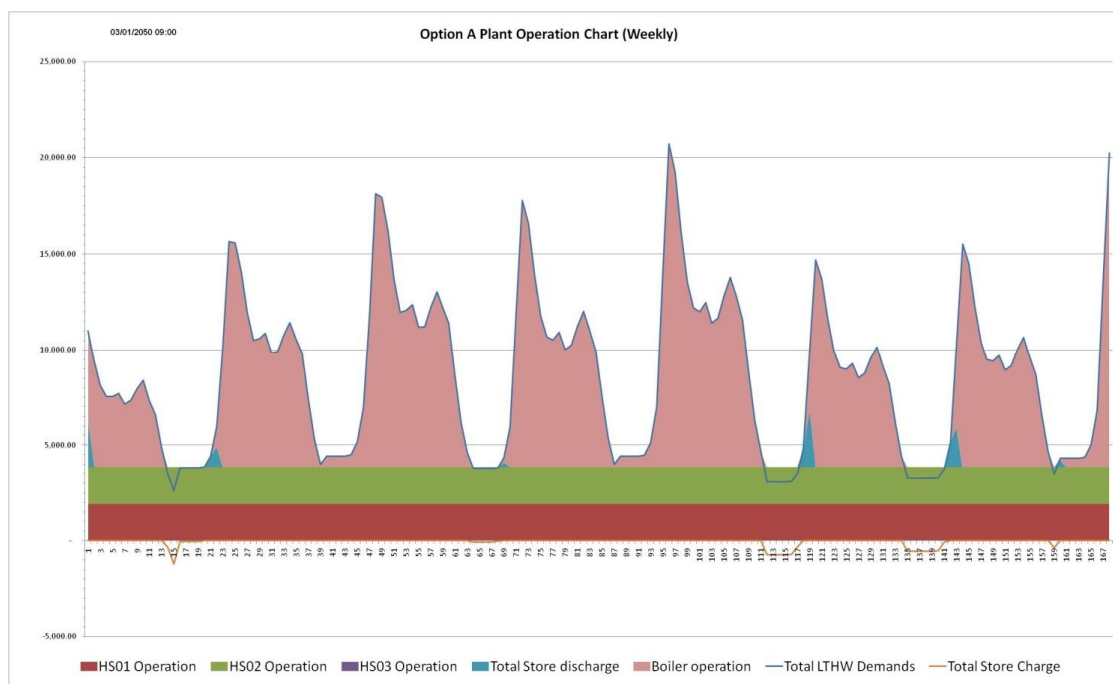
F.3.6 Plant Operation Weekly Chart

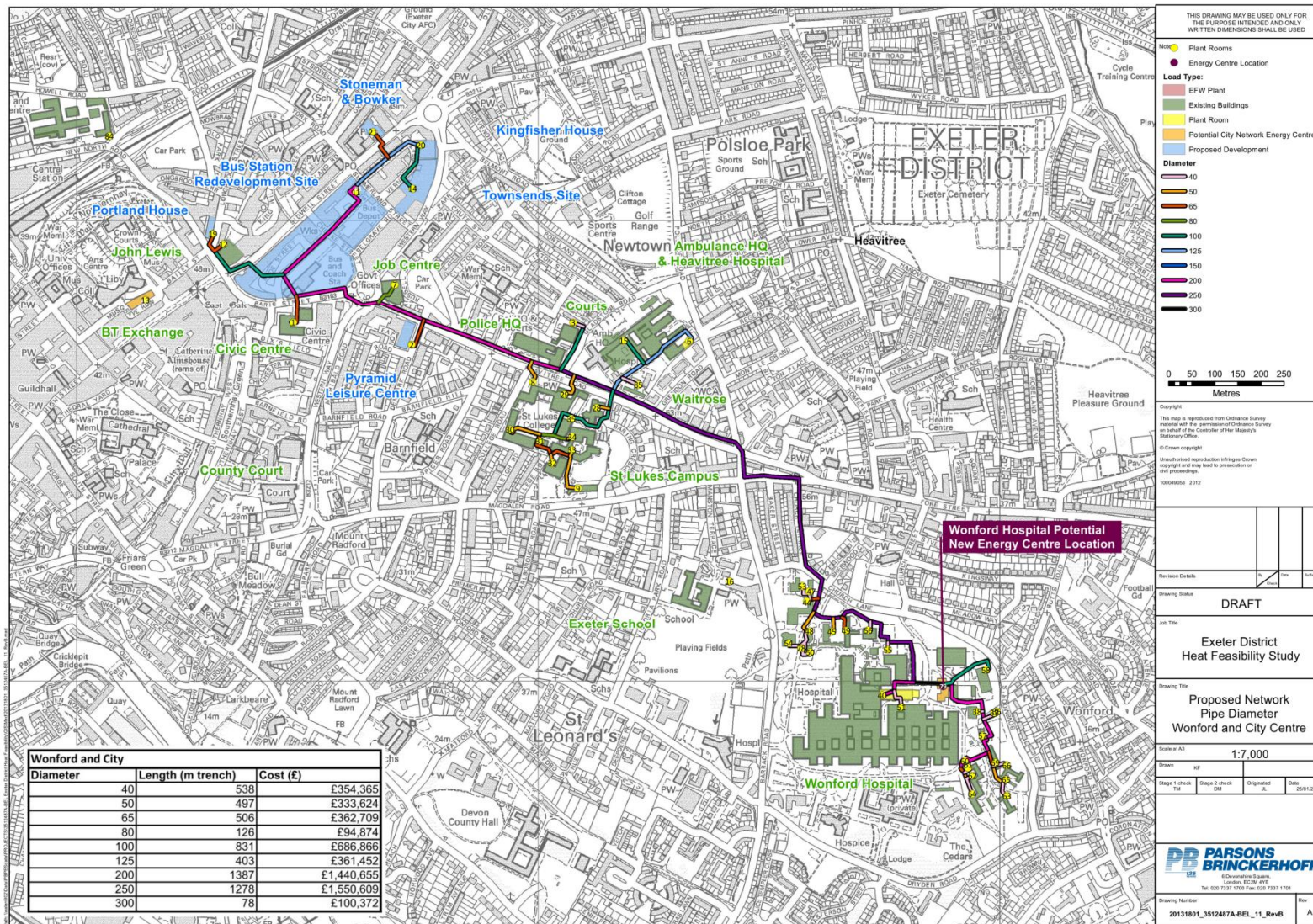
F.3.6.1 Summer



Where HS01 and HS02 are Heat Supply 1 & 2 - the two CHP engines at Wonford, HS03 is not used, and boiler operation is the auxiliary boilers in the energy centre.

F.3.6.2 Winter





APPENDIX G

INVITATION TO TENDER



ESTATE DEVELOPMENT SERVICE

Report Invitation to Tender
Detailed feasibility study

Project: Exeter Energy Network

Project number: 2011593

Amendment record for this report					
Date	Purpose	Author	Reviewed	Approved	Issue
16 03 12	Supporting information	DD	KF	PRM	Rev 0
19 07 12	Scope clarification introducing Marsh Barton EfW plant	DD	KF	PRM	Rev 1

CONTENTS

- 1.0 General
- 2.0 Deliverables
- 3.0 Reporting
- 4.0 Management
- 5.0 Performance management
- 6.0 Form of Appointment

Appendices

- 1. Exeter City Centre District Heating Study for Exeter City council – July 2011.
- 2. EDS-Deed of appointment – Draft Issue
- 3. EDS-Outline Scope of Consultancy Services
- 4. Resource Requirement Request Schedule SWCF.
- 5. Contact details for Principle stakeholder organisations
- 6. Draft program for report production and delivery
- 7. Sustainable Energy strategy – RD& E
- 8. Sidwell Street Student Halls and John Lewis store planning drawing.

9. Wonford Hospital site Plan

ITT for Exeter District Energy Network

1.0 General

The Exeter District Energy Network is an initiative supported by the University of Exeter, Royal Devon and Exeter Health Trust and Exeter City Council (referred to as the principle stakeholders for the purposes of this ITT). The reduction of CO₂ emissions are a key component of each of these organisations long term energy plans and the network is seen as a major component for achieving this goal.

This study will initially focus on two areas of Exeter but it is intended that the network will be capable of linking up across the city centre and potentially with schemes towards the outskirts (e.g Marsh Barton and Monkerton).

The network will have the capacity to serve a number of building types including academic, hospital / health, leisure facilities, retail and local government and commercial buildings. It is intended that the network will optimise energy generation and distribution by centralising production using renewable and low carbon energy sources, cogeneration and/or high efficiency plant. The network will be capable of supplying district heating, and local to the energy centre(s), may also supply cooling and on site electricity. As it is anticipated that the majority of the scheme will be district heating (DH) this terminology is used below.

An outline scoping report has previously been prepared to establish the potential for a commercially viable DH system near the city centre connecting a number of significant buildings in the surrounding area including the proposed new bus station, the Civic Centre and adjacent buildings, the Pyramids leisure centre, Heavitree Hospital and adjacent police/ambulance/courts buildings, the University's St Luke's campus buildings and the new Waitrose supermarket. This earlier report, which found that a scheme could be potentially viable, is attached to this ITT for information. The details of this earlier report should be checked and verified as part of this new feasibility study.

Having established that a DH scheme is potentially commercially viable this detailed feasibility study (DFS) will develop the engineering, economic, environmental and commercial issues and provide sufficient information on priority sections of the larger scheme to enable principle stakeholders and other users in these areas to make strategic decisions on participation in a network(s). For the purposes of the DFS the term "other users" should be considered as organisations other than the principle stakeholders that could benefit by the use of lower cost or lower carbon energy from a district heating network. These other users may decide to pay for the energy or participate in the running of the network itself.

The DFS should include the following potential sites:

- RD&E Wonford main hospital site and surrounds
- Sidwell Street area

Wonford Hospital: Since the original scoping report the Wonford site has adopted a sustainability strategy which includes cogeneration and district heating. The Wonford site is also able to host an energy centre. The addition of the Wonford site adds to the commercial viability of a scheme and, by extending the scheme to the east, enables new potential heat loads, such as Exeter School, to be considered. It should also be taken into account that the Wonford Hospital site has a number of alternative energy production opportunities, including committed capital to using medical waste as a fuel and an existing CHP plant which could contribute to the energy mix.

Sidwell Street: the DFS will consider the Sidwell Street area where 4 recent planning permissions will allow for the provision of approximately 1100 student bed spaces and the 12600 m² John Lewis department store building which will be designed to be District Heating – “ready coupled”. The location of these proposed student based spaces is documented in the Appendix.

The DFS will specifically provide:

1. A detailed study of the “Eastern network” – a cluster of heat customers to the east of the city centre centred around RD&E Wonford and St Luke’s University Campus. The study will include all significant buildings in the RDE Wonford Hospital site, St Lukes University Campus, Exeter School, Waitrose, and the Heavitree Road police station, ambulance station and courts (and any other sites adjacent to Wonford which may not have been identified in the scoping report).
2. A detailed study of the “Sidwell Street network” – a cluster of new build student accommodation and the new John Lewis store in the Sidwell Street area of the City. The DFS will include all significant buildings within these sites and consider the potential for connecting other nearby users in the adjacent Sidwell street area.
3. An overall review of the potential for a full Exeter District Energy Network including all the potential sites identified in the scoping report and the potential for a variety of uses for the bus station site (retail / leisure / swimming pool).

2. Deliverables

The deliverables will include, but not be limited to, the following:

2.1 Eastern network study

2.1.1 A detailed heat and electricity assessment. The DFS should provide detailed analysis of consumer’s thermal loads including future projections, on a building by building basis to

produce a heat load profile that accounts fully for hourly, daily and monthly demand variations.

2.1.2 A review of the available options for locating the principle cogeneration unit(s) including the Wonford Hospital, St Luke's Campus and any other potential sites and consider any longer term implications for the wider network of the energy centre sites.

2.1.3 Preparation of a full life cycle analysis identifying capital, operating and maintenance expenditures and annual revenues from heat and electricity sales. The analysis should provide detailed annual cash flows for the life of the scheme and calculate key economic indicators (NPV, IRR payback etc.) The financial appraisal should also include income from government incentives (ROCs, FIT and RHI) where relevant. A sensitivity analysis is also to be included which will consider the likely impact of energy demand reduction measures (retrofit technologies), projected demand growth and increases in fuel costs. It should also consider and report on the impact on the overall scheme should one or more key loads not participate.

2.1.4 An analysis of physical barriers to the development of the DH network including route options and constraints and the energy input integration options (by means of a building by building survey of the existing energy plant).

2.1.5 A survey and outline design of DH routes, DH network hydraulic design and detailed cost estimate of materials, installation and commissioning.

2.1.6 Techno-financial modelling to determine options for the energy centre plant configuration and heat network development. This will include the consideration of energy centre(s) location(s) and allowance for future central plant upgrade / replacement (future thermal generation technologies).

2.1.7 An outline design for the connection of the CHP generated electricity to the local electricity network or national grid and/or the potential for onsite use of electricity.

2.1.8 Determine any potential process waste heat input options to the district heating scheme and the potential for trigeneration and/or district cooling and or local absorption chilling.

2.1.9 Engagement with, and an analysis of individual stakeholder organisations estate development plans, timescales and specific requirements etc and the expected resultant impact on the phasing and development of the DH network. This should seek to highlight any major obstacles that arise as a consequence of incompatible timescales or proposed technical solutions which may discourage a stakeholder from pursuing scheme participation. Details of stakeholder contacts will be provided to the successful Consultant.

2.1.10 A building by building survey of existing heating systems to confirm compatibility with DH, identification of any required modifications, estimation of efficiencies of existing generation systems (to inform the financial case). Outline design and replacement costs will be required for the addition, or replacement, DH interface equipment, metering, monitoring and controls.

2.1.11 A programme and phasing for the scheme to enable practical roll out in an economically effective manner (eg with the use to temporary heat sources where necessary).

2.1.12 An evaluation of the physical impact of installing the plant and network .The study will evaluate and report on the consequence of disruption and the impact of new buildings and/or plant associated with the central heat source(s). A review of planning implications and regulatory consents will be undertaken and reported by the study.

2.1.13 Quantification of the estimated carbon savings and resultant impact on CRC reporting obligations and financial liability.

2.1.14 Discussion on the scheme participation options available to the principle stakeholders and other users, which should include information on indicative unit costs for heat (as heat only customers), options for investing in ownership of the District Heating Scheme (ESCO) and review funding opportunities there may be available from private external investment sources and central government and energy related funds which support renewable technologies.

2.1.15 The study should also identify the main risks for this project - from all phases of its life - planning, financing, procurement, construction, and operation.

2.1.16 Provision of information (via Case Study or Good Practice Guidance) on typical DH systems service availability, typical service failure compensation arrangements and standard solutions for the provision of back-up heat in the event of DH system outages. This must include specific focus on measures currently in use within hospital and other health care facilities.

2.1.17 An assessment of and a recommendation for the role for the local authority in the development of the scheme including any support which might be required to provide the necessary confidence for ESCO's to invest in the network.

2.2 Sidwell Street network

2.2.1 A detailed heat and electricity assessment. The DFS should provide detailed analysis of consumer's thermal loads including future projections, on a building by building basis to produce a heat load profile that accounts fully for hourly, daily and monthly demand variations.

2.2.2 A review of the available options for locating the principle cogeneration unit(s) including the development sites and separate local sites to be identified by Exeter City Council and consider any longer term implications for the wider network.

2.2.3 Preparation of a full life cycle analysis identifying capital, operating and maintenance expenditures and annual revenues from heat and electricity sales. The analysis should provide detailed annual cash flows for the life of the scheme and calculate key economic indicators (NPV, IRR payback etc.) The financial appraisal should also include income from government incentives (ROCs, FIT and RHI) where relevant. A sensitivity analysis is also to be included which will consider the likely impact of energy demand reduction measures (retrofit

technologies), projected demand growth and increases in fuel costs. It should also consider and report on the impact on the overall scheme should one or more key loads not participate.

2.2.4 An analysis of physical barriers to the development of the DH network including route options and constraints and the energy input integration options (by means of a building by building survey of the existing energy plant).

2.2.5 A survey and outline design of DH routes, DH network hydraulic design and detailed cost estimate of materials, installation and commissioning.

2.2.6 Techno-financial modelling to determine options for the energy centre plant configuration and heat network development. This will include the consideration of energy centre(s) location(s) and allowance for future central plant upgrade / replacement (future thermal generation technologies).

2.2.7 An outline design for the connection of the CHP generated electricity to the local electricity network or national grid and/or the potential for onsite use of electricity.

2.2.8 Determine any potential process waste heat input options to the district heating scheme and the potential for trigeneration and/or district cooling and or local absorption chilling.

2.2.9 Engagement with, and an analysis of individual stakeholder organisations estate development plans, timescales and specific requirements etc and the expected resultant impact on the phasing and development of the DH network. This should seek to highlight any major obstacles that arise as a consequence of incompatible timescales or proposed technical solutions which may discourage a stakeholder from pursuing scheme participation. Details of stakeholder contacts will be provided to the successful Consultant.

2.2.10 A building by building survey of existing heating systems to confirm compatibility with DH, identification of any required modifications, estimation of efficiencies of existing generation systems (to inform the financial case). Outline design and replacement costs will be required for the addition, or replacement, DH interface equipment, metering, monitoring and controls.

2.2.11 A programme and phasing for the scheme to enable practical roll out in an economically effective manner (eg with the use to temporary heat sources where necessary).

2.2.12 An evaluation of the physical impact of installing the plant and network .The study will evaluate and report on the consequence of disruption and the impact of new buildings and/or plant associated with the central heat source(s). A review of planning implications and regulatory consents will be undertaken and reported by the study.

2.2.13 Quantification of the estimated carbon savings and resultant impact on CRC reporting obligations and financial liability.

2.2.14 Discussion on the scheme participation options available to the principle stakeholders and other users, which should include information on indicative unit costs for heat (as heat only customers), options for investing in ownership of the District Heating Scheme (ESCO)

and review funding opportunities there may be available from private external investment sources and central government and energy related funds which support renewable technologies.

2.2.15 The study should also identify the main risks for this project - from all phases of its life - planning, financing, procurement, construction, and operation.

2.2.16 Provision of information (via Case Study or Good Practice Guidance) on typical DH systems service availability, typical service failure compensation arrangements and standard solutions for the provision of back-up heat in the event of DH system outages. This must include specific focus on measures currently in use within hospital and other health care facilities.

2.2.17 An assessment of and a recommendation for the role for the local authority in the development of the scheme including any support which might be required to provide the necessary confidence for ESCO's to invest in the network.

2.3 Full network review

Review the potential for a full city centre/Heavitree Road scheme including all the sites identified in 2.1 and 2.2 above and the potential sites identified in the scoping report and the potential for a variety of uses for the bus station site (retail / leisure / swimming pool) *and possible heat provision from the EfW plant in marsh Barton.*

For sites not considered as part of the Eastern and Sidwell Street networks, the review should use the data from the scoping study and benchmark data for other potential uses on the Bus Station site.

The review should include but not be limited to:

- o The viability of the development of a wider scheme
- o The implications of the wider scheme on the sizing of the Eastern and Sidwell Street networks
- o The optimum location of energy centre(s).
- o *Possible routes and the necessary size and associated costs for heat mains to deliver heat from the EfW plant (various potential DH heat main routes are available to take heat from the EfW plant; existing tunnels under the Exe, existing bridges or a more direct new drilled routes).*
- o *On the north side of the Exe the routing options should account for the areas of new development along the Topsham road which can potentially be served by DH.*
- o *Possible routes and the necessary size and associated costs for heat mains to deliver heat from the Marsh Barton EfW plant to the southern extension of the Matford business park and the cost of up-sizing of this line to supply the potential new urban extension to the south of Exeter and in the adjacent part of Teignbridge*
- o The phasing for an overall city wide scheme to enable practical roll out in an economically effective manner.

The review should conclude with an assessment of and a recommendation for the overall role for the local authority in the development of a city-wide scheme.

3. Reporting

A comprehensive report shall be prepared detailing the findings of the study. As there are a number of principle stakeholder organisations who will be considering whether or not participation in any scheme is right for them the format and structure of the report should be such that relevant and key information pertinent to these stakeholders can be easily identified from the report. As such we request that the report structure includes the following:

3.1 A section, or sections, specific to the scheme as a whole covering issues such as life cycle analysis, energy centre requirements, heat network requirements etc.

3.2 A section, or sections, specific to each principle stakeholder which will address issues pertaining to each. This will include the comment on the strategic alignment between stakeholder's estate and the recommended DH strategy, information on the benefits and risks associated with stakeholder participation, expected carbon savings and, on a building by building basis, suggestions regarding technical compatibility requirements and future connectivity facilitation.

4. Management

A Project Steering Group shall be formed comprising:

- o University of Exeter –EDS - David Dollman (project leader)/Paul Mucklow
- o RD&E - Keith Farley
- o Exeter City Council – Howard Smith
- o Exeter Low Carbon Taskforce – John Rigby & Tony Norton

The steering group shall have responsibility for ensuring the study is progressing in line with the clients requirements (as described in Section 2) and liaising with the wider stakeholder group.

The successful Consultant will attend an inception meeting within 1 month of being appointed (preferably earlier) where the programme for the study will be presented to the wider stakeholder group.

The final report will be presented to the wider stakeholder group at a meeting within 1 month of the submission of the final report (preferably earlier).

The project will be managed on the basis of regular progress review meetings to be attended by the Steering Group and submission of a short report at the end of each calendar month containing;

- a) Activity report for the month
- b) Identifications of issues that may affect progress
- c) Firm activity programme for the subsequent months

5. Performance management

The overall objective of this activity is the cost effective delivery of carbon dioxide emission abatement. The overall measure of the success of this contract will be whether or not it has accurately established the technical and financial case for DH a scheme and if stakeholders are able to make informed decisions as a result of the findings.

As part of their tender submissions, bidders will be expected to put forward between 2 and 4 Key Performance Indicators ("KPIs") that will form part of the final Scope of work as documented in the ITT proposal requirements.

6. Form of Appointment

The successful Consultant will be appointed directly by the University of Exeter with direct collateral warranties to be supplied to the RD&E and Exeter City Council.

Appendices

1. Exeter City Centre District Heating Study for Exeter City council – July 2011.
2. EDS-Deed of appointment – Draft Issue
3. EDS-Outline Scope of Consultancy Services
4. Resource Requirement Request Schedule SWCF.
5. Contact details for Principle stakeholder organisations
6. Draft program for report production and delivery
7. Sustainable Energy strategy – RD& E

8. Sidwell Street Student Halls and John Lewis store planning drawing.

9. Wonford Hospital site Plan

APPENDIX H

**DECC FUTURE ENERGY PRICE SCENARIO
DATA**

H.1 Central Scenario

Real Energy Prices¹: 2001-2030 DECC Updated Energy & Emissions Projections - October 2012

2012 prices

SCENARIO ASSUMPTIONS	
PRICES	Central
POLICY	Current
GROWTH	Central

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

WHOLESALE PRICES	Electricity ²	p/KWh	5.0	5.7	6.5	6.8	7.1	7.0	6.8	6.8	6.7	6.9	7.4	7.6	7.8	7.8	8.0	8.1	8.1	8.1
	Gas	p/therm	61	69	76	77	77	75	72	72	72	72	72	72	72	72	72	72	72	72
	Crude Oil (\$/bbl)	\$/bbl	115	116	117	118	119	120	121	122	124	125	126	127	128	129	130	131	133	134
	Coal	\$/tonne	102	110	116	117	117	118	119	119	120	120	120	120	120	120	120	120	120	120

Electricity	Residential	p/KWh	14.5	14.9	16.2	17.5	18.4	18.8	18.9	19.0	19.1	18.9	18.9	18.5	19.3	19.6	20.1	19.3	19.3	19.8	19.0
	Services	p/KWh	8.6	9.8	11.0	11.5	12.3	12.3	12.5	12.6	12.7	12.9	13.2	13.3	14.1	14.1	14.7	14.0	13.9	14.4	13.5
	Industrial	p/KWh	7.5	8.6	9.7	10.2	11.1	11.0	11.2	11.3	11.4	11.6	11.9	11.9	12.7	12.7	13.3	12.6	12.5	13.0	12.1

Gas	Residential	p/KWh	4.5	4.8	5.2	5.5	5.6	5.7	5.5	5.5	5.5	5.5	5.4	5.3	5.3	5.3	5.3	5.3	5.4	5.4	5.4
	Services	p/KWh	3.2	3.5	3.8	3.8	3.9	3.8	3.7	3.7	3.7	3.7	3.7	3.8	3.8	3.8	3.8	3.8	3.8	3.9	3.9
	Industrial	p/KWh	2.6	2.9	3.2	3.2	3.3	3.2	3.1	3.1	3.11	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2

Fuels for private vehicles	Premium unleaded	p/litre	135	138	138	139	141	142	143	145	146	147	148	149	150	151	152	153	154	155	157
	Super unleaded	p/litre	142	146	146	147	149	150	151	152	154	155	156	157	158	159	160	161	162	163	164
	DERV	p/litre	143	146	147	148	149	150	152	153	154	155	157	158	159	160	161	162	164	165	166
	Average ⁴	p/KWh	13.8	14.2	14.2	14.3	14.4	14.6	14.7	14.8	14.9	15.0	15.1	15.2	15.4	15.5	15.6	15.7	15.8	16.0	16.1

¹ Historical prices are converted to constant prices using the GDP Deflator series from ONS/DMT, the calculation of the GDP deflator was revised for Blue Book 2012 and last updated 28-Jun-2012

² Electricity prices are based on implementation of the EMR programme as outlined in the Draft Energy Bill and on the relevant growth projection. Carbon prices for Electricity generation include the impact of the Carbon Price Support Floor commitment in Budget 2011

³ Projected retail prices are based on projected wholesale prices, on averaged historical no-fuel costs and are uplifted by Taxes, Fuel Duties and policy costs recovery, including any announced future changes

⁴ Weighted average for private vehicles, weights reflect the fuel use mix in each year, including a small contribution by electric and plug-in hybrid cars at the residential electricity price.

H.2 Low Scenario

Real Energy Prices¹: 2001-2030 DECC Updated Energy & Emissions Projections - October 2012

2012 prices

SCENARIO ASSUMPTIONS	
PRICES	Low
POLICY	Current
GROWTH	Central

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

WHOLESALE PRICES	Electricity ²	p/KWh	4.4	4.3	4.5	4.7	4.7	4.6	4.5	4.6	4.6	4.8	5.1	5.3	5.5	5.5	5.7	5.8	5.9	5.9
	Gas	p/therm	52	50	48	47	45	43	41	41	41	41	41	41	41	41	41	41	41	41
	Crude Oil (\$/bbl)	\$/bbl	105	103	102	100	99	97	96	95	93	92	90	89	88	86	85	84	83	81
	Coal	\$/tonne	97	94	92	89	86	84	81	79	76	76	76	76	76	76	76	76	76	76

Electricity	Residential	p/KWh	14.5	14.2	14.8	15.4	16.2	16.2	16.3	16.6	16.7	16.6	16.6	16.0	16.9	17.1	17.7	17.0	16.9	17.4	16.6
	Services	p/KWh	8.0	8.6	9.1	9.5	10.0	10.0	10.3	10.5	10.6	10.9	11.1	11.1	11.9	12.6	11.9	11.7	12.3	11.5	
	Industrial	p/KWh	6.9	7.4	7.9	8.3	8.7	8.7	9.0	9.2	9.3	9.6	9.7	9.8	10.5	10.5	11.2	10.5	10.3	10.9	10.1

Gas	Residential	p/KWh	4.5	4.4	4.4	4.4	4.4	4.3	4.2	4.2	4.2	4.2	4.2	4.0	4.0	4.0	4.1	4.1	4.1	4.1
	Services	p/KWh	2.8	2.8	2.7	2.7	2.6	2.6	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.7
	Industrial	p/KWh	2.3	2.2	2.1	2.1	2.0	2.0	1.9	1.9	1.93	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Fuels for private vehicles	Premium unleaded	p/litre	130	132	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
	Super unleaded	p/litre	138	140	139	139	139	139	139	139	139	139	139	139	139	138	138	138	138	138
	DERV	p/litre	137	139	138	138	138	138	138	138	138	137	137	137	137	137	137	136	136	136
	Average ⁴	p/KWh	13.3	13.5	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3

¹ Historical prices are converted to constant prices using the GDP Deflator series from ONS/DMT, the calculation of the GDP deflator was revised for Blue Book 2012 and last updated 28-Jun-2012

² Electricity prices are based on implementation of the EMR programme as outlined in the Draft Energy Bill and on the relevant growth projection. Carbon prices for Electricity generation include the impact of the Carbon Price Support Floor commitment in Budget 2011

³ Projected retail prices are based on projected wholesale prices, on averaged historical no-fuel costs and are uplifted by Taxes, Fuel Duties and policy costs recovery, including any announced future changes

⁴ Weighted average for private vehicles, weights reflect the fuel use mix in each year, including a small contribution by electric and plug-in hybrid cars at the residential electricity price.

H.3 High Scenario

Real Energy Prices¹: 2001-2030 DECC Updated Energy & Emissions Projections - October 2012

2012 prices

SCENARIO ASSUMPTIONS	
PRICES	High
POLICY	Current
GROWTH	Central

			2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity ²	p/KWh	5.7	7.0	7.4	7.8	8.4	8.5	8.7	8.8	8.6	8.8	9.3	9.6	10.0	10.0	10.0	10.2	10.2	10.2	10.1
	Gas	p/therm	70	87	89	91	93	95	98	100	102	103	103	103	103	103	103	103	103	103	103
	Crude Oil (\$/bbl)	\$/bbl	125	128	131	134	137	140	144	147	151	154	158	162	165	169	173	177	181	186	190
	Coal	\$/tonne	107	121	134	139	144	149	154	159	164	167	171	174	177	181	182	184	186	187	189

Electricity	Residential	p/KWh	14.5	15.7	17.7	18.5	19.5	20.2	20.5	21.1	21.2	21.0	20.9	20.6	21.5	22.0	22.5	21.6	21.6	22.1	21.3
	Services	p/KWh	9.3	11.1	11.9	12.5	13.5	13.7	14.3	14.5	14.5	14.7	15.1	15.2	16.2	16.2	16.7	16.1	15.9	16.4	15.5
	Industrial	p/KWh	8.2	9.9	10.6	11.2	12.2	12.4	13.0	13.2	13.2	13.4	13.8	13.8	14.8	14.8	15.4	14.7	14.5	15.0	14.1

Gas	Residential	p/KWh	4.5	5.2	5.9	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.7	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6
	Services	p/KWh	3.5	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.9	4.9	4.9	5.0	5.0	5.0	5.0	5.0	5.0	5.1
	Industrial	p/KWh	3.0	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.27	4.3	4.3	4.3	4.3	4.3	4.4	4.4	4.4	4.4	4.4

Fuels for private vehicles	Premium unleaded	p/litre	139	144	145	147	149	152	154	156	159	161	163	165	168	170	172	175	178	180	183
	Super unleaded	p/litre	147	151	153	155	157	160	162	164	166	169	171	173	176	178	180	183	185	188	191
	DERV	p/litre	148	153	154	156	159	161	164	167	169	171	174	177	179	182	184	187	190	193	196
	Average ⁴	p/KWh	14.3	14.8	14.9	15.1	15.3	15.6	15.8	16.1	16.3	16.5	16.7	17.0	17.2	17.5	17.8	18.0	18.3	18.6	18.8

¹ Historical prices are converted to constant prices using the GDP Deflator series from ONS/DMT, the calculation of the GDP deflator was revised for Blue Book 2012 and last updated 28-Jun-2012.

² Electricity prices are based on implementation of the EMR programme as outlined in the Draft Energy Bill and on the relevant growth projection. Carbon prices for Electricity generation include the impact of the Carbon Price Support Floor commitment in Budget 2011.

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⁴ Weighted average for private vehicles, weights reflect the fuel use mix in each year, including a small contribution by electric and plug-in hybrid cars at the residential electricity price.

APPENDIX I

**DIRECTIONAL DRILLING ESTIMATE FOR
OPTION 2**

Project: Exeter Energy Network - Exe Crossing Study
 Project No.: 3512487A-BEL
 Date: 05/02/13

Quote for 450mm od - quote R3

2 x 630m x 450mm installations split into 8 "shots" via HDD **219/450mm (DN200)** details provided by Chris Weatherall

Section	Description	No	Unit	Rate	Total
mobilisation	Transport of All Vehicles & Equipment to and from Site	1		5,000	5,000
materials	all 450mm pipe materials (1300m estimation)	1300		450	585,000
	Drilling fluids as required	1			-
excavations	Launch/ Receive/ Intermediate connection pits to complete works	1		50,000	50,000
utility survey	Full Radiodetection survey of drilling area	1		2,000	2,000
set up	Set up of JT 4020 "All Terrain" Drilling Rig or similar	8		1,000	8,000
network rail	Form C settlement report	1		5,000	5,000
calculations	Calculations of surface settlements for Road/ Rail crossings	1		500	500
installations	HDD pilot bores requiring "All Terrain" rock drilling equipment	1300	Mtr	200	260,000
	Reaming of pilot bores to 450mm for all ground material types	1300	Mtr	400	520,000
wear parts	Expected damage to HDD "Wear Parts" - Reamers/ Drill Heads Etc	1		50,000	50,000
spoil	Spoil and Slurry Removal to complete the works	1		20,000	20,000
geotechnical	10m Boreholes to establish ground conditions along route	4		1,000	4,000
design	HDD Long Sections and route design as required	1		10,000	10,000
					915,500

Option 2 - Works Budget Estimate (HDD)		
Works	Estimate £'s	Notes
Preliminaries	219,826	Assumed at 12% of Works cost.
Site Clearance	2,864	Notional clearance such as vegetation etc.
Fencing	1,909	Allowance for permanent fencing that may be required as part of the works i.e. Network Rail.
Pipe Jacking	1,552,759	Pipe Jacking under railway, canal, river Exe and Mill Race.
Earthworks	67,677	Removal of spoil risings from pipe jacking activity.
HDD	915,500	HDD full costs as per SW Directional Drilling quote
Pavement	135,975	1.95km temporary haul road.
TM	477	Notional sum near Energy from Waste site.
Pipework	660,613	Including district heating pipework, specialist design, project management and open cut cover in soft areas.
Temporary access bridge	114,545	1 No. Bailey bridge required for site plant access.
Total	2,051,709	

Option 2 - Budget Estimate (HDD)					
Ref. to Assumptions	Summary of Estimate	Estimate (£'s)	Risk Factor* (5 = high, 1 = low, 0 = no risk)	Contingency £'s (based on risk factor)	Total inc. Contingency £'s
1	Land	100,000	3	20,000	120,000
2	Consultation with Statutory Undertakers	1,500	3	300	1,800
3	Site Investigations	33,000	2	3,300	36,300
4	Planning	2,000	2	200	2,200
5	Design and Supervision Fees	249,831	1	12,492	262,323
6	Works	2,051,709	2	205,171	2,256,880
	Total	2,438,040			2,679,502
	Inflation	3.50%		Inflated Total	2,773,285

Assumptions

1. The only land outside the consortium is owned by Network Rail and the Environment Agency. Costs include for £50k BAPA and £50k Easement.
 2. Consultation with Statutory Undertakers includes obtaining the latest utility information. This excludes negotiation and costs associated with any unexpected diversions that may be required as part of the works.
 3. Allows for sufficient site investigations to enable pipe jacking works including testing for appropriate disposal identification.
 4. Budget planning fees. Exact costs to be determined with Local Authority.
 5. Based on 3 person team full time for design duration of 6 months plus 2 No. Project Manager and Supervisor full time for Construction duration, assumed at 20 weeks.
 6. Refer to Works budget estimate for inclusion/exclusion assumptions.
- * Where Risk Factor No. relates to: 1 = 5%, 2 = 10%, 3 = 20%, 4 = 35%, 5 = 50%

