WYG Engineering

part of the WYG group

Sheffield Energy and Water Infrastructure Study

Part II: Infrastructure Investment Need and Development Constraints

Sheffield City Council

Yorkshire Forward – The Region's Development Agency

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2 Introduction

This study is being carried out by WYG on behalf of Creative Sheffield (CS) and Sheffield City Council (SCC) in order to understand the existing energy and water infrastructure within Sheffield and the ability to accommodate population and economic growth as proposed in the Sheffield Economic Masterplan. The 319 proposed development allocations within the emerging Sheffield Development Framework (SDF) are being used to test this baseline infrastructure. These 319 sites include all sites as of March 2009 within the adopted Sheffield Economic Masterplan (EMP) and the City Centre Masterplan 2008 (CCMP) to 2026[1], however it should be noted that the base data, calculations and findings within this report will need to be updated as circumstances and policies change during the lifetime of the SDF and as sites are developed.

The Economic Masterplan (EMP) identifies three specific programmes relevant to this commission:

- Building assets for the 21st century
- Developing competitive sectors
- Implementation of sustainable development

The City Centre Masterplan (CCMP) builds firmly upon the EMP, developing the following themes:

- Building assets for the 21st century
- Increasing innovation and harnessing knowledge
- Maximising Sheffield's image and identity
- Rousing aspirations and encouraging enterprise
- Increasing employability and learning
- Enhancing neighbourhood cohesion
- Integrating sustainable development
- Improving connectivity
- Housing and neighbourhood development

[1] Sheffield Energy and Water Infrastructure Strategy Consultancy Brief

Sheffield City Centre Masterplan

FIGURE 2.1 – City Centre Masterplan[2]

For the purposes of this study, the City Centre Masterplan is contained within the analysis of the 319 sites earmarked for development in April 2009 within the emerging Sheffield Development Framework (SDF), however City Centre Masterplan boundaries are not necessarily the same as those provided by SCC for the 319 sites and are illustrated within Appendix A of this report.

It is vital that this report is read in conjunction with the Methodology and Assumptions contained within section 10 of this report.

2.1 Study Aims and Objectives

The first aim of this study is to understand the current network characteristics for the utility infrastructure within and supporting the study area and then to establish whether there are any existing constraints or deficiencies within these utility networks which would restrict the proposed employment and population growth identified within the EMP and CCMP. The utility infrastructure considered within this study is as follows:

- Gas
- Water
- Electricity
- Telecommunications

[2] Images taken from City Centre Masterplan 2008 as available on Creative Sheffield website

- District Heating
- Foul and surface water sewerage (excluding sustainable drainage assets and flooding defence assets)

The consideration of flooding defence assets and flood risk are excluded from this report, however the identification of the flood zone for each development site has been shown on the data sheets contained within Part III of this report. The consideration of flooding defence assets is being considered by WYG as part of a separate commission.

This study ultimately examines the impact of the proposed growth within Sheffield (as defined by the development allocations contained within the EMP, CCMP and emerging SDF) on the existing strategic utility infrastructure, and identifies the likely infrastructure reinforcement requirements for delivering this growth, the mechanisms for funding this infrastructure and the likely programme for delivery.

It could be argued that economic growth is a function of the willingness of both new and mature businesses to invest in and commit to a region, its people, resources and services, which is only possible if affordable, fit for purpose premises and/or land is available to support growth and enable an interface with local and wider supply chain businesses. As this is partly dependent on the provision of affordable and secure utility infrastructure (water, sewerage, energy and digital telecommunications) it might reasonably be concluded that the timely procurement of this infrastructure is fundamental to the aspirations of Creative Sheffield and Sheffield City Council.

Furthermore the location of strategic infrastructure services, especially in an urban environment, may physically constrain development potential – high pressure gas transmission mains and extra-high-voltage electricity transmission cables are examples of services that are not easily diverted and carry safety and health risks.

Given the strategic importance of utility provision it is perhaps surprising that the only utility undertaker that is statutorily bound into the planning consultation process is the licensed sewerage undertaker. Although this is slowly changing with public access to water undertakers' twenty-five year Water Resources Plans and occasionally Water- Cycle Studies there is still a significant disparity between established spatial and economic planning periods and the regulated 5-year capital investment programmes in which the utility companies are expected to operate.

In addition to investment programme disparities there are also significant investment model disparities - licensed utility companies are focused mostly on regulated operational and customer service targets (pressure, leakage, sewer-flooding, security of supply and customer responsiveness) and the need to deliver shareholder value – investment in population and employment growth is often secondary, and therefore infrastructure required for development is generally developer funded as a result.

As the provision of new connections to meet population and employment growth is often a secondary investment need, utility undertakers may not always give appropriate weighting to some of the water and energy demand-side management technologies and strategies that are being implemented to meet sustainable development targets. Anticipated step changes in Building Regulations in 2010, 2013 and 2016 plus sustainable building codes, BREEAM and Code for Sustainable Homes, provide a framework for significant reductions to annual water and energy demand across new developments. However Utility companies typically design strategic infrastructure based on peak demands and take a very conservative view of reductions to peak demands associated with water and energy efficiency and therefore to the scale of their investment need.

A sustained dialogue with utility undertakers may often influence the capital investment process – and the need to alter existing services - provided each utility company is confident that they will recover all capital expenditure in line with primary legislation and their licence conditions. This is supported by HCA (formerly English Partnerships) who state:

> *"Regional, sub-regional and local development frameworks: the regeneration and development aspirations of the public sector need to be expanded in Regional Economic Strategy formulation to consider utility implications of the economic priorities, and sub-regional and local implications for reinforcement" and that "Where new settlements……and other types of longer term comprehensive developments are planned, the sponsoring organizations ought to consider the appointment of a Utility Liaison Officer.*[3]

A disparity in investment planning is not the only hurdle to overcome in achieving a better level of support from utility companies. Survey data provided by Lattice, the former parent company

[3] English Partnerships' Utilities Infrastructure Study dated April 2002

to Transco (historically the national gas transportation company), suggested that the procurement of water, gas, electricity and telecommunication services would cost on average six percent of total development costs. WYG's experience would lead to the conclusion that the time and effort utilised to procure utility services for new development projects is greater than 6%. Again, English Partnerships (now HCA) state in their Utilities Infrastructure Study:

The process of buying utilities does not seem to be subject to the normal EU and UK rules of procurement.....and there is a general lack of effective responsibility and understanding on the part of principals and consultants".

"There is a lack of transparency and price competition in the transportation and distribution of utilities which is reflected in a higher than necessary development costs".

These quotes undoubtedly reflect elements of the frustration felt by development agencies, landholders and private developers. A greater degree of service and transparency might be realised by increased competition in the utility connections sector, which is slowly becoming a more liberated environment. Although the more recent changes were triggered primarily by the Competition Act 1998 there is a significant amount of regulation that governs competition in this specialised sector:

- **Telecommunications Act 1984**
- **Gas Act 1986 (as amended)**
- **Electricity Act 1989 (as amended)**
- **Water Industry Act 1991**
- **Competition Act 1998**
- **Utilities Act 2000**
- **Communications Act 2003**
- **Water Act 2003**
- **Energy Act 2004**

A crucial part of this study is an understanding of the role that energy consumption plays in contributing to climate change and the important part that the integration of low/zero carbon and renewable energy sources can have in reducing carbon emissions and creating more sustainable communities. The impact of integrating low/zero carbon and renewable technologies on the requirement for established traditional infrastructure systems (gas and electricity distribution

networks) is not commonly understood and a full understanding of how such technologies can affect the modelling of traditional grid supplied infrastructure will form a fundamental part of the Sheffield Energy and Water Infrastructure Study.

Effectively there are very few low to zero-carbon or renewable energy technologies that are not topped-up, to meet peak demand or backed-up, to offer security of supply by traditional gas and electricity connections. Where large scale energy facilities are proposed there will equally need to be sufficient power infrastructure to export green energy.

Ultimately this commission will provide a strategic demand-side and supply-side overview of the increased energy, water, wastewater and telecommunication requirements associated with Sheffield Development Framework, Sheffield's Economic Masterplan and the City Centre Masterplan 2008, a review of supply and distribution shortfalls and options for balancing supply with demand in a sustainable and secure manner, whilst mitigating any other risks associated with existing utility assets in the City.

3 The Sheffield Development Framework, Economic Masterplan & City Centre Masterplan

The Sheffield Development Framework (SDF) is a suite of spatial and land use policy documents relating to new development and the environment. The SDF comprises a series of local development documents which collectively cover the Sheffield District (excluding the Peak Park) and will eventually replace the Unitary Development Plan.[4]

The documents that have currently been prepared for the SDF are the 'Local Development Scheme' and the 'Core Strategy' documents, however, it is intended that the SDF will comprise a wide range of documents including the 'City Policies and Sites Proposals Map', which will identify criteria for planning briefs and deciding planning applications.

The SDF Core Strategy Document was adopted by Sheffield City Council on 4th March 2009 and is intended to set out;

- the vision, aims, objectives and overall strategy including links to other strategies proposed within the City.
- identifies the main spatial policies up to 2026 including an indication of how they will be implemented.
- defines the criteria where it is not possible to be more specific about spatial policy and on other matters critical to the city's sustainable development.

It is currently thought by Sheffield City Council that there will be approximately 30 development management policies within the City Policies and City Sites documents which will mainly identify what would be needed to obtain planning permission including:

- Policy Areas with their preferred and acceptable land uses (intended to be shown on the OS base of the Proposals Map).
- Site allocations (required land uses to help meet city wide requirements in the context of the policy area distribution).

[4] Information relating to the Sheffield Development Framework derived from Sheffield City Council website

- The Proposals Map on an Ordnance Survey base showing precise boundaries of areas and sites.

This study was initially conceived by Creative Sheffield (Sheffield's Economic Development Agency) following the publication of the Sheffield Economic Masterplan (EMP) in January 2007. The EMP included a theme of "Creating the Conditions for Sustainable Growth" which noted under Programme 3.1 that the major environmental challenges of economic growth include providing the energy infrastructure for growing business and resident populations, ensuring a sustainable water supply, improving energy efficiency and changing resident and business behaviours.

For the purposes of this study, the city centre Masterplan is contained within the analysis of the 319 sites earmarked for development in April 2009 within the emerging Sheffield Development Framework (SDF).

4 Current Utility Supply Capacity in Sheffield

4.1 Water

Yorkshire Water and Severn Trent Water have both confirmed that there are no strategic shortfalls in water abstraction, water treatment or water distribution which currently affect Sheffield or would affect the development of the SDF to 2026.

Yorkshire Water - Water Resource Zones

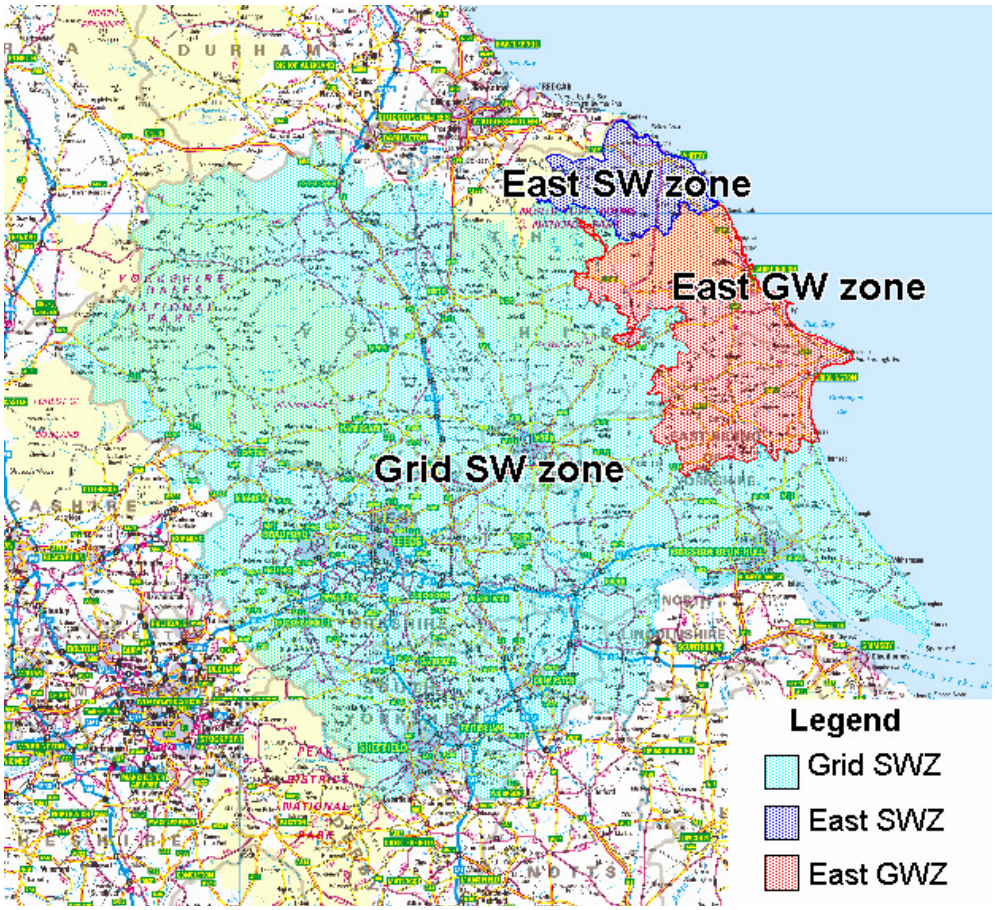

FIGURE 4.1 – Yorkshire Water – Water Resource Zones[5]

[5] Water Resource Zones taken from Yorkshire Water Draft Water Resources Management Plan – Periodic Review 2009

4.2 Sewerage and Sewage Treatment

Yorkshire Water has confirmed that there are no strategic shortfalls in foul water sewer capacity, however have stated that levels of surface water discharge should be limited to existing levels for brownfield sites (although EA advice is to reduce runoff by 30%) and any additional discharge should be conveyed via a sustainable drainage method. For greenfield sites, Yorkshire Water have stated that a sustainable drainage hierarchy should also be utilised, whereby infiltration drainage should firstly be considered before a limited discharge to a watercourse or sewer.

The consideration of the capacity or suitability of existing culverts or watercourses to accept surface water discharge from development is excluded from this report.

Yorkshire Water have informed WYG that further significant expansion in the catchment of Woodhouse Mill Sewage Treatment Works would require investment to increase the treatment capacity to meet growth in this catchment. Where this is required, it is important that it is coordinated with development in accordance with PPS12 – Local Spatial Planning. This Sewage Treatment Works may receive investment in AMP5 (2010 – 2015) although this will only take into consideration the growth allowed for in the Yorkshire Water PR09 bid (Periodic Review 2009)[6] which included committed sites as of December 2008 and sites in the Sheffield City Council 'City Sites Preferred Options document'.

It is important to note however that Woodhouse Mill Sewage Treatment Works also serves north east Derbyshire and Rotherham Local Authorities. Sheffield District accounts for 71% of the population served by Woodhouse Mill Sewage Treatment Works and it is strongly recommended that Sheffield City Council liaise with the neighbouring authorities and Yorkshire Water in this regard.

Yorkshire Water has advised that Stocksbridge Sewage Treatment Works is a relatively small works with very limited capacity for additional growth. Yorkshire Water has planning permission for a new Sewage Treatment Works close to the Morehall Bridge Water Treatment Works but has confirmed that this is dependent on funding from the prospective developer of the former industrial site off Station Road (former Steins Tip Deepcar site, Station Road). Agreement on this

[6] PR09 – Periodic Review 2009; review of price limits to be completed in 2009 to set prices for 2010 – 2015.

proposal is still some way from being concluded and Yorkshire Water have assumed that the existing Sewage Treatment Works will continue to be the only treatment for sewage within this catchment.

Yorkshire Water has confirmed that there is only limited capacity for further housing growth in Stocksbridge and the redevelopment of former industrial sites, including the steel works sites, (P00284 - Site G, Stocksbridge Steelworks, Stocksbridge, P00291 - Stocksbridge Steelworks Trailer Park and P00290 - Stocksbridge Steelworks Eastern End), cannot be accommodated without further investment for which, currently, there is no provision with AMP5 (2010 – 2015).

Yorkshire Water has advised that Blackburn Meadows Sewage Treatment Works should have adequate capacity for the level of development proposed in the catchment, however, this Sewage Treatment Works may receive investment in AMP5 (2010 – 2015) and will only take into consideration the growth allowed for in their PR09 bid, this includes committed sites as of December 2008 and sites in the City Sites Preferred Options document. It is therefore anticipated that some level of investment will also be required in AMP6 (2015-2020) once the SDF has been fully adopted and that if all development in Blackburn Meadows was brought forward (<2016) there would be insufficient capacity.

As part of the consultation, Yorkshire Water have identified that there are no capacity issues associated with the Don Valley Interceptor sewer, although it has been highlighted that development would not be permitted a direct connection to this sewer due to its depth being in excess of 15 metres deep and a diameter of approximately 3 metres.

4.3 Gas

National Grid Gas has confirmed that there is no strategic gas network capacity shortfall currently affecting Sheffield or which would affect the development of the SDF to 2026.

The need for reinforcement of the local low or medium pressure distribution networks within proximity to a small number of sites (or a more remote point of connection to a more robust intermediate pressure gas network) has been identified in this study, however, this is limited to a small number of sites.

National Grid have confirmed that the Barnsley network reinforcement scheme due to be undertaken in 2011 \ 2012 will benefit the north of Sheffield, while ongoing mains replacement programmes will also create additional network capacity to accommodate organic growth within Sheffield.

4.4 Electricity

From a review of the YEDL Long Term Development Statement in conjunction with discussions with YEDL and a review of Central Networks' Long Term Development Statement it has been determined that there are currently capacity shortfalls at Wheatacre Road, Dronfield, and Claywheels Lane 33/11kV Primary Substations, although at Claywheels Lane, YEDL have recently secured enough 11kV interconnection to increase the firm capacity above the existing 8MVA.[7]

Additionally capacity shortfalls will be triggered at Ellin Street and Arundel Street Primary Substations within the next few years as a result of development planned within the SDF.

The Sheffield City Bulk Supply Point is also at risk over the duration of the SDF if all loads are applied to the YEDL network, however this could be mitigated if YEDL apply a Sheffield wide diversity factor to the loads identified for the SDF.

Although the Sheffield 11kV network has its origins in primarily heavy industry, YEDL have advised that the Sheffield 11kV network does not cause them many issues and have stated that it is the most robust of the YEDL city centre 11kV networks. It is therefore unlikely that the shift from heavy industry to IT related industry within Sheffield would impact on the network any more when compared to any other city centre within the UK.

[7] Email from David Van Kesteren of YEDL dated 9th November 2009

YEDL – Long Term Development Statement Extract

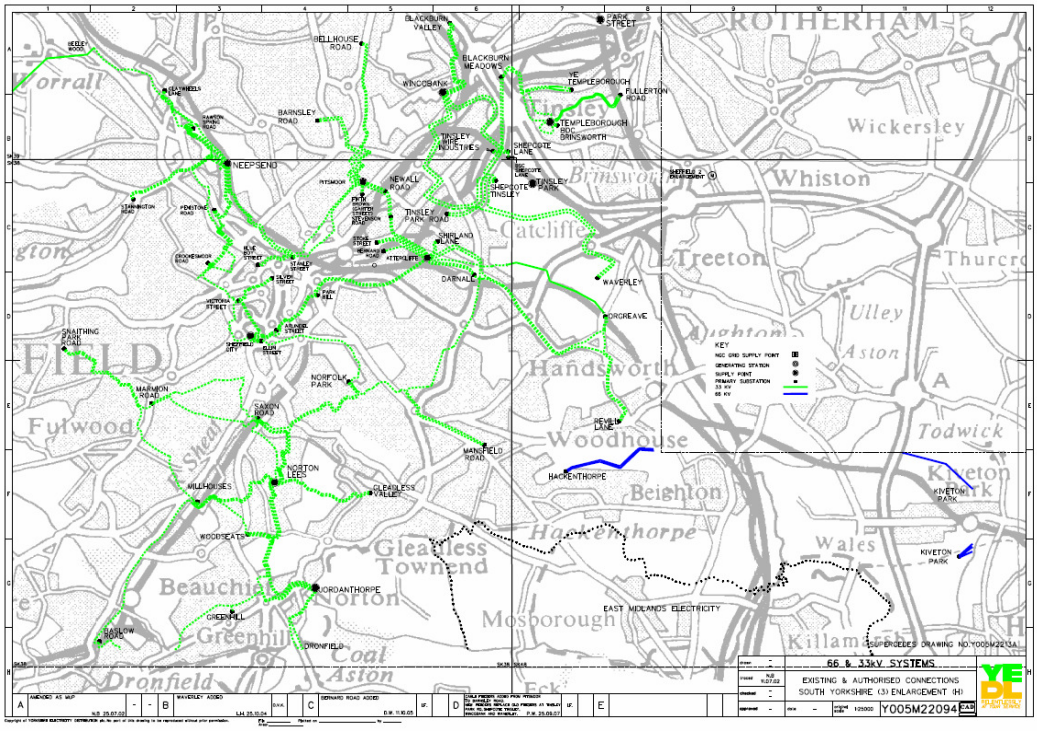

FIGURE 4.2 – YEDL 66 and 33kV Networks [8]

4.5 Telecommunications

The current limitations of the BT Openreach network are not known at this time due to the fact that BT Openreach have been unwilling to share information relating to network capacity or future capital investment. However it is understood that Sheffield telephone exchanges will not be enabled with 'superfast broadband' i.e. Fibre to the cabinet networks. This might be because Digital Region Ltd are investing in a superfast broadband fibre network.

[8] YEDL 66 and 33kV networks diagram taken from 2008 Long Term Development Statement

BT Openreach will extend their network to accommodate new development on receipt of a formal application (once a development has obtained planning approval and typically 6 weeks before site commencement of the development)

4.6 District Heating

Veolia (ES) Sheffield Limited has advised that the Energy Recovery Facility (ERF) has a notional thermal capacity of 60MW, however this total can only be used in exceptional circumstances as a proportion of the energy is used to generate electricity.

Veolia has estimated that there is currently 21MW of headroom on the network at peak demand (suggesting that the current peak demand from the network is approximately 39MW) and it is considered probable that Veolia will augment the reduction in the residential waste stream over the life of Energy Recovery Facility (ERF) with waste from outside the City in order to maintain peak supply capacity at its current rate (43MW from the ERF with the remainder from oil and gas led district boilers across the City Centre). Veolia have stressed that this is a simplistic overview of available capacity and to understand how much heat can be distributed via a district heating network extension would involve detailed network analysis including assessment of existing pipe capacity and pumping requirements which are likely to be more constrained than the thermal capacity at the ERF.[9]

In the short term, Veolia have advised that they have no plans to invest in additional generation plant within Sheffield. Furthermore Veolia confirm that they have longer term aspirations to extend the district heating network, however have stated that the direction of growth will be determined by pipe and energy constraints at the extremities of the network – Each new connection request will be analysed both technically and financially to ensure the optimum solution, and therefore Veolia are unable to provide indicative budget costs for connection activities, however the financial model assumes that the capital cost of the connection is recovered through long term revenue receipts and therefore capital costs are shared by Veolia \ Developer.

[9] Letter from Veolia dated 24th December 2009

The unit energy charge levied to individual customers is linked to alternative fuel prices and RPI through an indexation mechanism in the Energy Supply Contract. This uses market determined trade prices published by the ICE or Heron. Additionally Veolia have advised that a standing charge may be levied depending on the financing structure agreed with the customer.

Veolia (ES) Sheffield Limited have provided a detailed map identifying the location of all of their district heating pipework, and this has been included within the GIS database.

SDF development sites in Sheffield City Centre are considered to have the opportunity to connect to the existing Veolia network and the Sheffield Core Strategy states that where appropriate, "developments will be encouraged to connect to this existing City Centre District Heating Scheme".

The table below outlines the key elements of new development connections to Sheffield's existing district heating network.

Veolia will install all new pipework from the point of mains connection to the consumer building. They will also install internal heat exchangers, metering and control equipment along with connection to the consumer buildings internal services.

Extending the Existing Network	New pipes are laid from the closest part of the network to the new development (VEOLIA)
Development Connection	The pipes enter the building at an agreed location above or below ground. Holes for entry are created by diamond drilling and the entry point is sealed with specialised equipment. The pipes used for this connection are typically 40mm in diameter[10]. (VEOLIA)
Energy Supply	Heat exchangers are installed and internal works completed at the new development. The control equipment enables occupant's access to heat and hot water. (VEOLIA \ DEVELOPER)
Measurement & Control	Veolia install a heat meter and control equipment which is read the meter on a monthly basis and provide a consumption statement with an invoice. This meter can be read remotely so access does not need to be gained to a property every month. (VEOLIA)

TABLE 4.1 – New Development Connections to Sheffield's Existing District Heating Network

[10] http://www.veoliaenvironmentalservices.co.uk/sheffield/pages/district_theconnection.asp

From discussions held between WYG and Veolia it is anticipated that significant future growth of the existing Sheffield heat distribution network will likely require new energy centres and thermal stores. Any requirement for new energy centres to support Sheffield growth might be funded by Veolia (subject to a financial assessment), and recovered over the life of any new asset and from new developer connection charges. The future extension of the district heating network within the city centre could result in demand exceeding supply from the existing ERF facility and the need for additional generation capacity. Again network reinforcement will likely be triggered before new generation need unless the largely carbon led strategies are to be implemented with low carbon assets.

It is understood at this stage the Veolia does not have a capital investment programme for the extension of the district heating network or the installation of new generation plant to capture the development growth within Sheffield, and all new connection activities or extensions to the district heating network are understood to be reactive and developer funded.

5 Energy and Water Demand and Supply to 2026

5.1 Utility Undertaker Demand Forecast and Methodologies

5.1.1 Water and Sewerage

Yorkshire Water Services (YWS) advised, at a meeting held with WYG on 16th July 2009 that they believe that they have the most accurate demand forecasting of all UK water authorities. The Yorkshire Water growth scenarios for AMP5 have been based on the following data sets, which have subsequently been submitted to Ofwat.

- Population data purchased from Experian including existing households & population, obtained from the Office of National Statistics and estimates & projections for population growth prepared by the Department for Communities and Local Government.[11]
- Sites previously proposed for allocated in the emerging LDF.
- GIS mapping linked to Experian data and LDF sites, and taking into account sites already developed.

The Yorkshire Water Draft Water Resources Management Plan – Periodic Review 2009 also sets out how Yorkshire Water plans to balance supply and demand for a 25 year period between 2010/11 and 2034/35 incorporating predicted changes to the climate and changes to the Yorkshire Population in its housing and future water use and metering trends. The approved plan is due to be implemented shortly after consultation with Ofwat.

The Draft Water Resources Management Plan also identifies in more detail how the 25 year demand forecast has been produced, taking into consideration factors which result in either an increase or decrease in demand. The key considerations are

- Yorkshire Water has stated its intention to maintain a customer demand led approach to metering. A forecast of 30,000 domestic optants per annum has been calculated with support from industry experts.
- Yorkshire Water have assumed that, in line with the Government initiative to build sustainable homes, all new domestic properties from 2010 will have a

[11] Yorkshire Water – Reconciling Population totals and components 2008

per capita consumption of 120 litres/head/day (equivalent to Code for Sustainable Homes level 1 – the lowest code level).

- Population growth has been estimated in line with regional spatial strategies. The population is set to increase over the period, while commercial demand forecast has been prepared by industry experts Experian and this reflects an expected decline over the 25 year period for the Yorkshire Water region. This is currently being reviewed for the preparation of the final Water Resources Management Plan to reflect the sharp decline in demand that has been exhibited over the past two years.
- Yorkshire Water also believe that the impact of Climate Change is predicted to lead to behavioural change which will increase demand by 0.6 Ml/d in 2007/08, rising to an increase of 22.49 Ml/d by 2034/35.

5.1.1.1 Water Efficiency Technologies

Water efficiency technologies can be retrofitted to existing properties and easily included in new buildings. These technologies include:

- Water meters
- Low flow taps
- Dual or low flush WCs.
- Flow restrictors in showers.
- Water efficient dishwashers and washing machines.

The minimum requirements for water efficiency are currently provided in the Building Regulations 2009 G. This document has been updated in line with Code for Sustainable Homes Levels 1 and 2, which equates to a maximum daily water usage of 120l/person/day. It is anticipated that the permitted daily water usage limits will reduce in line with the CSH standards in a similar vein to that of the energy efficiency.

5.1.1.2 Domestic Water Reuse/Recycling

Water demand can be reduced by water harvesting, and the easiest method is the installation of water butts to intercept water from the downpipes. In the Building Regulations 5

litres/person/day has been assumed to be used for garden use and water butts can replace most or all of that water, which does not need to be treated to potable standards.

A further development of this technique is rainwater harvesting, with large tanks installed, either in the roof space or in large tanks underground, fed directly from roofs and other impermeable areas. This water reservoir can then be used for non-potable uses in the home, such as in washing machines, WCs, showers etc. This water can be treated if required by UV treatments for use in higher risk areas such as schools and hospitals.

Grey water is the water discharged from showers, baths, washing machines etc that is traditionally discharged into the sewerage system. This grey water can be stored in tanks and reused in the irrigation of gardens and also used in WCs. Grey water has the dual benefit in reducing potable water usage and reducing the amount of sewage that needs to be treated.

Water butts are cheap and easily installed in both new and existing properties to provide an instant saving in water use, however, both rainwater harvesting and grey water recycling require a significant capital cost in both installation and integration to a developments water system so are mainly applicable in new developments.

5.1.2 Gas

The National Grid Gas Long Term Development Plan 2008 sets out how National Grid Gas estimates population growth to 2017\18.

National Grid Gas demand forecast are not based specifically on growth identified within the LDF, but are based upon an extensive range of planning assumptions and from their own market observations including the advice from specialist consultancies and data collected from UK Transmission's Transporting Britain's Energy consultation process. The consultation involves a broad cross section of market participants including consumers and consumer groups, and provides important feedback on the impact of market developments, such as initiatives to reduce the consumption of fossil fuels to combat global warming, and data relating to the consumption of new and existing loads.

National Grid Gas demand forecasts indicate a 4% increase in annual gas demand by 2017/18, with forecast peak demand flat over the period. It is estimated that demand over this period is projected to be significantly lower than previously forecast by National Grid Gas due to a combination of factors, including the various initiatives that are underway to combat climate change, the impact of higher fuel prices and weaker economic growth.[12]

5.1.2.3 Reducing Energy Demand

The process for reducing the demand for a finite or environmentally costly resource – often referred to as Demand Side Management (DSM) may reduce the need for improved infrastructure (reduced CAPEX) and simultaneously can alter the character of a demand profile to align it with the supply profile, reduce waste and therefore improve sustainability.

5.1.2.4 Energy Efficiency

Energy efficiency is a form DSM. For the existing housing stock, energy efficiency will be carried out on an ad hoc basis by the lease/free-holders or landlords of individual properties. As a result, management of this demand will be variable at best. This can be overcome with financial incentives, such as grants, to encourage the inclusion of retrofitted energy efficient measures, which include, for domestic properties:

- Replacing old boiler with high efficiency, condensing boiler
- Installation of thermostats
- Install cavity wall and roof insulation
- Upgrade double glazing

Additional measures can be included in commercial properties to improve energy efficiency and these include:

- Install low energy lighting
- Installation of Building Management Systems

[12] National Grid Gas Long Term Development Plan 2008

For new developments, there is a greater flexibility of methods available to increase the energy efficiency and a greater opportunity for Sheffield City Council to influence the energy efficiency requirements of new developments.

The minimum requirements for residential energy efficiency are currently provided in the Building Regulations 2006 L1A[13]. This document is due to be updated in 2010 with an anticipated step change in line with Code for Sustainable Homes Level 3, which equates to a 25% reduction in carbon emissions over the current Building Regulations. It is then anticipated that in 2013 the Building Regulations will require further reductions in line with the current Code for Sustainable Homes Level 4, which involves a 44% reduction of carbon emissions. In order to meet these requirements energy efficiency will be required as a cost effective method of reducing the carbon emissions of a development and reduce the energy demand. The main methods for improving energy efficiency are mentioned below:

- Basic passive solar design, subject to site limitations with buildings designed to maximise day lighting and displace the need for artificial lighting.
- Improved thermal performance at junctions.
- Improved levels of insulation and air tightness.
- Improved windows and building fabric specifications to reduce heat loss (U Values).
- Mechanical Ventilation with Heat Recovery (MVHR) or Mechanical Extract Ventilation (MEV).
- Effective heating controls.
- Dedicated light fittings to be high-energy efficiency with electrical appliances specified as A-Rated or better.
- Improving the efficiency of the heat source.

The energy efficiency requirements as laid out in the Building Regulations are the minimum requirements for any new development; Local Authorities have required increased specifications with the use of local planning policy, this can be done effectively with the requirements that developments attain certain BREEAM or CSH scores, or can be dictated directly with a minimum specification that is required. It should be considered that an increase in energy efficiency

[13] http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADL1A_2006.pdf

requirements may come with a larger cost implication that will have to be borne by the developer.

Recent studies completed as part of the Zero Carbon hubs investigation into defining a fabric efficiency standard for Zero Carbon homes indicated the costs of achieving very high standards of energy efficiency in new homes, such as the passive haus standard, could represent a 18% increase in capital costs of construction for a detached house compared to current 2006 Part L construction costs[14].

In addition to Local Authority policies, energy efficiency can be influenced by other programmes such as the 'Decent Homes Standard' which aims to ensure that homes have a reasonable degree of thermal comfort. This standard is defined as having an efficient heating system and effective insulation.

5.1.3 Electricity

Both YEDL (the Distribution Network Operator owned by CE Electric) and Central Networks (owned by E.ON) publish a Long Term Development Statement. This statement contains information on all strategic assets, capacity and forecast demands and is a good indicator whether works are planned that will benefit developers. Standard population growth funding attributed to each Long Term Development Plan is calculated from an extrapolation of actual demands on each of the primary networks over a number of preceding years and does not actively capture new development projects allocated in Local Plans or Local Development Frameworks. Effectively demand forecasting by the DNO's is very unsophisticated. Energy generators and suppliers have much more sophisticated methods.

5.1.4 Smart Grids

The effect of the decentralising of energy generation could be mitigated, without the need to fundamentally upgrade the network, with the use of Smart Grids.

Smart Grids are systems where the supply, demand and grid elements are managed through an intelligent communication system. This allows the Distribution Network Operator (DNO) to manage the existing infrastructure in the most efficient way possible. It would allow the energy

generated by renewable sources (generally erratic and intermittent) to be used more efficiently by routing the supply to where the demand need is. This would allow the central generators to reduce output until required. The consumers would have a better understanding of the energy usage patterns, as would the DNO, so energy could be priced according to demand thereby acting as an incentive to reduce the peaks, prolonging the life of the existing grid and enable future expansion of the system.

The take up of Smart Grids has been slow, with only a small number of schemes in the USA and Italy. The reason is the amount of investment needed to upgrade the meters on the demand-side and install the infrastructure required to manage the system. YEDL are currently reviewing the use of smart meters, which may improve the accuracy of forecasting energy usage. It is currently up to the DNOs to install smart grid into their system and with the current disconnect between generation and network operation there is currently not the incentives necessary to install a smart grid.

The Department for Energy and Climate Change (DECC) has recently announced that all UK homes will have smart meters by 2020 as part of the UK's plans to move towards smart grids. DECC have also recently published 'Smart Grids: The Opportunity', which is a discussion paper aimed at promoting the implementation of smart grids. Additionally an EU Smart Grid Task Force has been set up, with the intention to produce a vision for the implementation of smart grids. This is expected to be published during 2010 with a roadmap identifying key milestones published by 2011. The government, DNO's and Ofgem are expected to play a vital part in the realisation of this vision.

YEDL are sponsoring products to improve the efficiency of the current network, such as dynamically assessing and adjusting the network voltage to improve generation export capability. Applications such as this may not be widespread in the short-term, but may become integral to the standard installations in the long-term.

It is anticipated that the role out of smart meters will be led by energy suppliers in taking responsibility for the supply and installation of new meters.

[14] http://www.zerocarbonhub.org/building.aspx?news=5

5.1.5 Micro-generation

The use of micro-generation can reduce the reliance of individual home owners on the carbon-intensive national grid for their electricity needs or natural gas for heating needs. The micro-generation of heat is the easiest to manage, in that all the heat generated is consumed on site and there is a reduction of the heating demand of the property from the gas network. Forms of micro-generated heat include:

- Solar Thermal Hot Water.
- Ground Source Heat Pumps
- Biomass boilers
- Micro Gas CHP

The micro-generation of electricity is more problematic as this is more dependent on the climatic conditions to provide the power, which will create the problem of electricity generated when there is little demand on the property. During such times the electricity is exported to the grid to be used elsewhere. Forms of micro-generated electricity include:

- Photo voltaic cells.
- Gas CHP
- Micro Wind turbines
- Micro Gas CHP
- Micro-hydro

The Low Carbon Building Programme provides grants for the installation of micro-generators on existing property, however the relatively high capital cost and long payback period of micro-generators has meant that the take up of these technologies has been slow to build. Sheffield City Council could enter discussions with local suppliers to provide preferential rates to residents in Sheffield.

There are some community projects in Sheffield, where the community is banding together to create larger schemes of micro-generation. Sheffield Renewables are one such group, which is looking to fund a micro hydro project at Kelham Island. This model, of a community led project, is beneficial as it allows residents to band together to invest in larger scale micro-generation that would not otherwise be feasible. There is an opportunity to utilise Sheffield's industrial heritage, as is the case with the Kelham Island scheme, with a number of water mill sites that provide an opportunity to install micro-hydro power utilising the existing weirs and mill races.

For new developments there is an obligation to provide a minimum of 10% of the development's energy from renewable sources and a further requirement to reduce the carbon emissions of the development by 20%[15]. There is also a greater flexibility of micro-generation technologies that can be integrated into the fabric of the building during construction and offer considerable savings over those that are retrofitted. Micro-generation is more suited to small developments where the scale is insufficient for the installation of a large scale low carbon or renewable energy solutions.

5.1.6 District Heating

The principal benefit of utilising district heating, is the potential for carbon savings and long term fuel flexibility. Whilst heat can be generated from decentralised plant and distributed via district heating at lower costs than conventional systems, the investment need of heat distribution networks can be very high. They typically require two special highly insulated pipes and sufficient space to accommodate their installation.

Evidence suggests that district heating can be more expensive over its lifetime than individual gas condensing boilers and electric heating, predominantly due to the high cost of distribution networks[16]. Once the infrastructure is in place however heat can be generated at a comparable or lower cost to conventional supply systems. Sheffield city centre is a dense urban area with concentrated housing; commercial properties and public sector buildings (including leisure facilities, hospitals and university campuses) which are particularly good for district heating networks as they offer a relatively high and consistent demand for heat.

[15] Sheffield Core Strategy, Policy CS 65
[16] Heat Call for Evidence 71 DECC

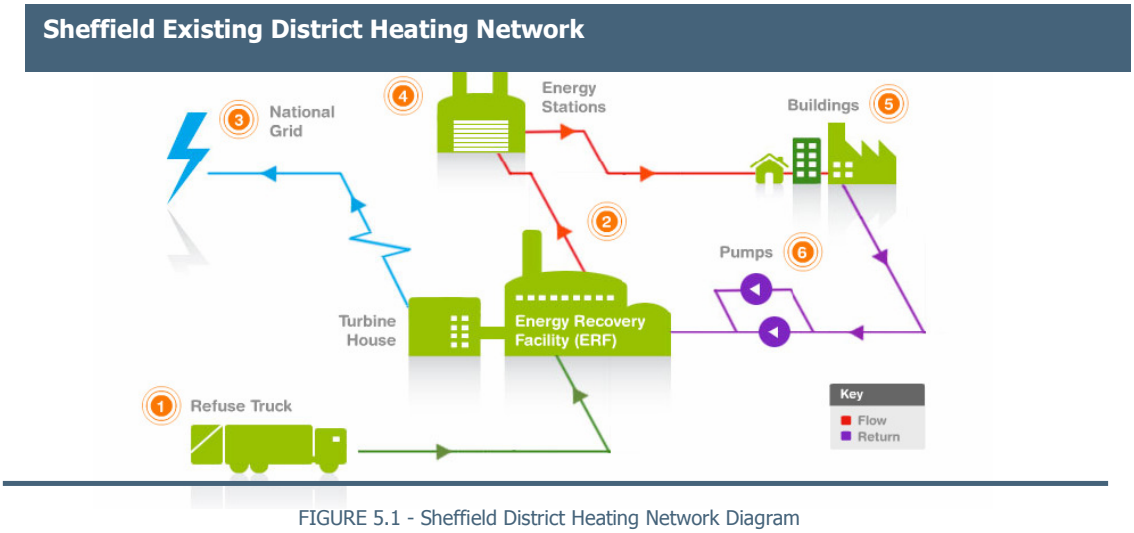

FIGURE 5.1 - Sheffield District Heating Network Diagram

Image ©Veolia Environmental Services (UK) Plc 2009

Sheffield City Centre already has one of the largest and most successful district heating networks in the UK, which has supplied heat to domestic, commercial and public sector buildings in Sheffield since 1988.

This district energy plant recovers energy from municipal waste and is located at Bernard Road; this facility was originally built in the 1970s and later upgraded in 1996, with a waste throughput capacity of approximately 225,000 tonnes of municipal solid waste (28 tonnes of waste per hour). A condensing GE Thermodyn steam turbine produces a maximum peak electricity output of 19.8MW that is exported directly to the Attercliffe Bulk Supply Point Substation via a HV 11kV circuit, the plant also generates 43MW of peak thermal energy that is exported to the district heating network supplying heat to over 140 buildings in the city.

The network is also supported by an Intermediate Pressure (IP) gas supply at the ERF facility and by three peaking energy stations that include:

- 48MW gas fired boiler at Bernard Road
- 8MW oil fired boiler at Park Hill
- 30MW oil fed boiler at Newcastle Street.

The Network has been operated by Veolia (ES) Sheffield Ltd since 2001 and reaches many areas of Sheffield including Netherthorpe, Western Bank, the Heart of the City, Moorfoot and Western Park Hospital.

Veolia (ES) Sheffield Ltd is a wholly owned subsidiary of Veolia Environmental Services and operate all assets (ERF, Energy Centres and Heat Distribution Network) over a fixed term contract with Sheffield City Council until 2036, this includes all service connections up to control valves on the network side of the heat exchanger.

Heat exchangers are owned by the consumer but are typically designed and built by Veolia as are all new assets and network extensions. The network currently does not extend beyond the boundary of the inner ring road with the exception of connection to Sheffield University.

Veolia have not provided information on how they calculate growth, however analysis recently undertaken by Veolia has confirmed that a peak load of 45.5MW is expected from existing and known future connections.

Sheffield City Council has approved planning permission for the development of a 25MW waste wood biomass plant at Blackburn Meadows by E.ON. This plant is to be located in the Lower Don Valley area of Sheffield at E.ON's existing land holding, previously occupied by Blackburn Meadows Power Station.

It was originally intended that construction of the plant would commence in 2009 with it being fully operational during 2011, however the current programme for construction commencement and operational completion is not known.[17]

The proposed Blackburn Meadows Renewable Energy Plant will produce sufficient electricity to meet the needs of approximately 40,000 homes and will reduce emissions of CO2 by approximately 80,000 tonnes per annum.

[17] Blackburn Meadows Renewable Energy Plant, Environmental Statement – Non Technical Summary, March 2008

Blackburn Meadows Biomass Power Facility

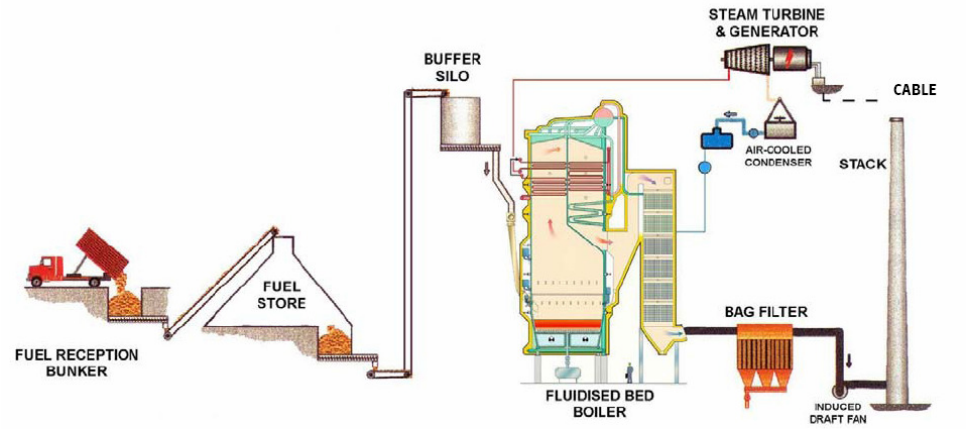

FIGURE 5.2 - Blackburn Meadows Biomass Power Station Diagram

E.ON are currently working to identify opportunities to utilise the heat produced in the generation of renewable electricity. Whilst electricity produced will be exported to the local distribution network operated by YEDL, it is intended that new district heating infrastructure will be able to supply heat to neighbouring commercial and industrial establishments (new build or otherwise).

5.1.7 Telecommunications

BT Openreach have been unwilling to contribute to the Sheffield Energy and Water Infrastructure Study due to perceived concerns over the confidentially of their planned capital investment programme. This is in the context of significant investment by Digital Region Limited who will utilise Openreach \ Virgin Media optical fibre assets where possible. The information contained within this report is wholly based on information which is available in the public domain and via Ofcom.

BT Openreach will generally not install infrastructure to accommodate new development until such times as the development has received planning approval and is due to commence onsite. Typically BT Openreach will contribute £3,600 per unit capital contribution to cover the cost of any offsite reinforcement. In nearly all cases this is sufficient to enable a zero contribution from developers. Therefore allocation of sites within the SDF will not have any bearing on whether BT

Openreach would forward fund infrastructure to accommodate growth. It will be dealt with as and when a formal application is received for new development infrastructure, however allocation will encourage the development of sites and can be a catalyst for planning applications and assist in the delivery of development.

BT Openreach have plans to roll out a new fibre to the street cabinet infrastructure, which will provide superfast broadband capability to 40% of UK homes by 2012, although it is noted that the telephone exchange or cabinets within Sheffield are not included within the current rollout. This may be linked to the fact that BT are aware of the proposals by Digital Region to undertake a similar investment programme.

Digital Region currently have a capital investment programme to install a new physical network between a new regional hub at Doncaster and Primary Connection Points (PCP – above ground GRP cabinets – typically green and located at most street corners) via BT's existing telephone exchanges. This will be a fibre to the cabinet network, and except where there is a specific need, will negate the need for fibre to the premises. Digital Region plan to connect all PCP cabinets within the Sheffield study area between February 2010 and April 2012.[18]

[18] Dates taken from 'cluster available dates' spreadsheet received from Thales dated 28th September 2009.

Digital Region Network

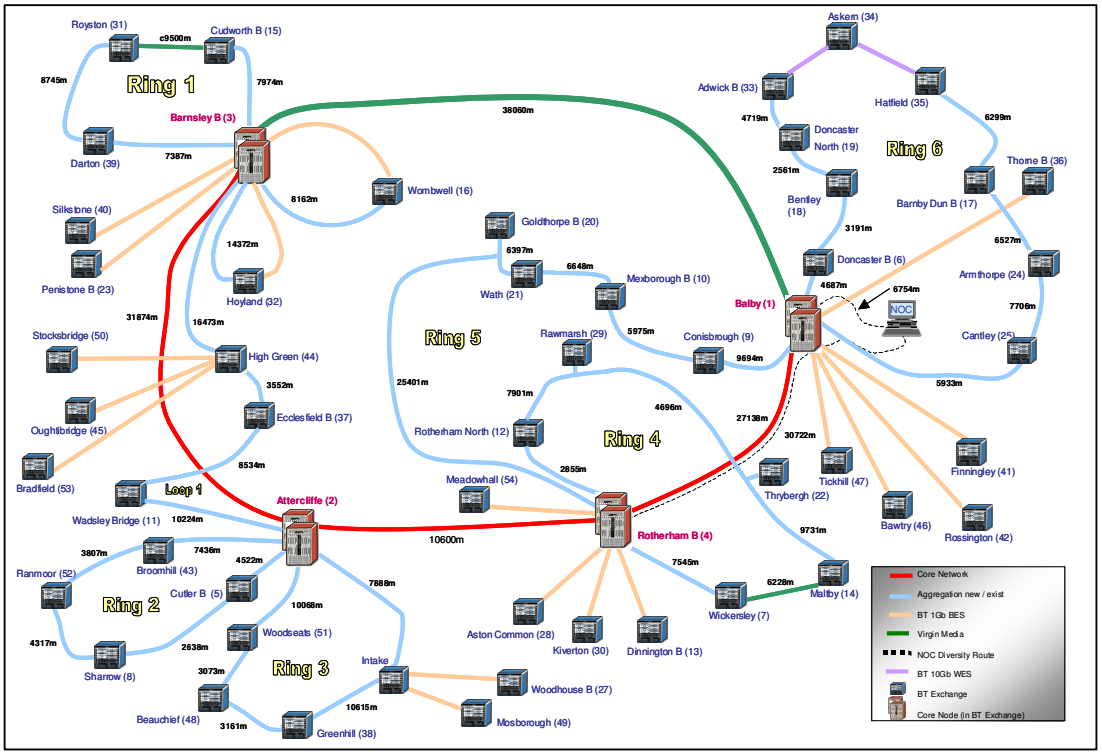

FIGURE 5.3 – Digital Region Schematic

5.1.8 Alternative Supply-Side Management and Technologies

In Sheffield the main forms of energy supply are electricity, gas and district heating including energy from waste. There are alternative fuel sources available for use in Sheffield and Future Energy Yorkshire (FEY) has been formed to make the most of any new energy technologies and fuel types available. FEY has been setting up a regional supply chain for biomass fuels[19] as well as providing information and advice on the use of biomass. FEY is also involved in the promotion of other renewable energy sources such as waste heat recovery, anaerobic digestion and hydro electric as well as providing funding for community schemes, emerging technologies and flagship projects.

[19] http://www.fey.org.uk/site/WIPBiomass/Support/tabid/314/Default.aspx

As Sheffield is a predominately urban environment, there is limited opportunity for the integration of wind power into the national grid within the city boundary and the available sites have been identified in the Renewable Energy Scoping and Feasibility Study for Sheffield.

A significant opportunity for an increase in renewable energy within Sheffield is the extension of the district heating network and the introduction of new systems, either with biomass CHP or purely biomass heating.

There is a national movement away from centralised power generation e.g. large scale power plants producing hundreds of megawatts in a single location toward decentralised power generation. Decentralised Energy (DE) is defined as power produced at or near the point of consumption and has many advantages over the standard centralised model that has historically been employed.

Comparison of Centralised Energy with Decentralised Energy			
Centralised Energy		Decentralised Energy	
Pros	Cons	Pros	Cons
Established method of energy delivery for the UK. Can utilise established national top down approach to electricity infrastructure distribution. Modern plant electrical efficiencies are very high and many power plants can utilise co-firing and there is the future potential of carbon capture and storage.	Generation plant is typically located long distances from urban areas and there are limited opportunities to utilise the heat generated productively and improve overall plant efficiency. Large land take of generation plant and necessary infrastructure for generation and distribution. Significant distribution losses given large distances between supply and demand.	Improved Efficiency through thermal utilisation and reduced electricity distribution losses. Energy supply benefits from increased diversification, reliability and security. There are opportunities to improve environmental performance through improved efficiency and use of low carbon or renewable energy sources giving reduced CO2. Government incentives and initiatives to promote decentralised and renewable energy. Reduced land take of large power generation facilities.	Barriers to DE have historically been primarily regulatory and financing. The UK has a robust and secure gas supply network that can discourage the use of district heating networks. Another barrier to DE can be technology. CHP or renewable generators can be restricted by a number of technical parameters including energy demand profiles, fuel supply sourcing and local emissions control.

TABLE 5.1 – Comparison of Centralised Energy with Decentralised Energy

The water industry is a large user of energy, using up to 2% of the country's power use[20], therefore any efficiencies in water supply will reduce the amount of energy used to process the water. Aside from water efficiency measures described above, there are improvements that can be made to the water network.

In 2008-2009 Yorkshire Water posted a total loss of water to leakage of 295 million litres/day[21] and is predicting a water supply deficit by the end of 2034/2035 of 65 million litres/day[22] due to due to climate change increasing water usage and static supply availability. Yorkshire Water have advised that this deficit can be reduced by introducing a series of measures such as:

- Leakage Control
- Mains Replacement
- Pressure Control

Yorkshire Water has also identified additional sources of water in their plan such as:

- Reservoir dam height raising
- Increased ground water/river abstraction
- New/refurbished water treatment works.

Additional sources of water, specifically to provide non-potable water, could be the utilisation of grey water for industrial processes diverted from the sewer system or the use of treated sewage. These solutions would require significant investment to provide the infrastructure for the non-potable water and has been labelled unfeasible in the Yorkshire Water Resources Plan.

[20] http://www.yorkshirewater.com/our-environment/carbon-management.aspx
[21] Yorkshire Water published June Return.
http://www.ofwat.gov.uk/regulating/junereturn/jrlatestdata/sub_jr09_yky_datatables2.xls
[22] Yorkshire Water Periodic Plan 2009 Draft Water Resources Plan
http://www.yorkshirewater.com/medialibrary/PDF%20files/Draft%20Water%20Resources%

5.2 SDF Energy and Water Demand Forecast

The demand forecast for Sheffield has been calculated based on the methodology set out in section 10.1 of this report. The table below identifies the electricity, gas, water and wastewater demands that will be generated if all sites within the SDF are developed between 2009 and 2026.

SHEFFIELD LOAD GROWTH TOTAL AT 2026	**Peak Electricity** (kVA)	**Annual Gas** (kWh / yr)	**Daily Water** (m3 / Day)	**Daily Wastewater** (m3 / Day)
	191,312	**519,820,039**	**13,920**	**13,920**

TABLE 5.2 – Sheffield Utility Loading to 2026

Figure 5.4 below identifies the residential and non residential growth generated by the SDF to 2026, from which the load growth in this study is calculated. It can be seen from the graph that the estimated development timeframe proposed within the SFD slows after 2020, however it should be highlighted that less desirable market conditions at the time of writing may change this assumed programme.

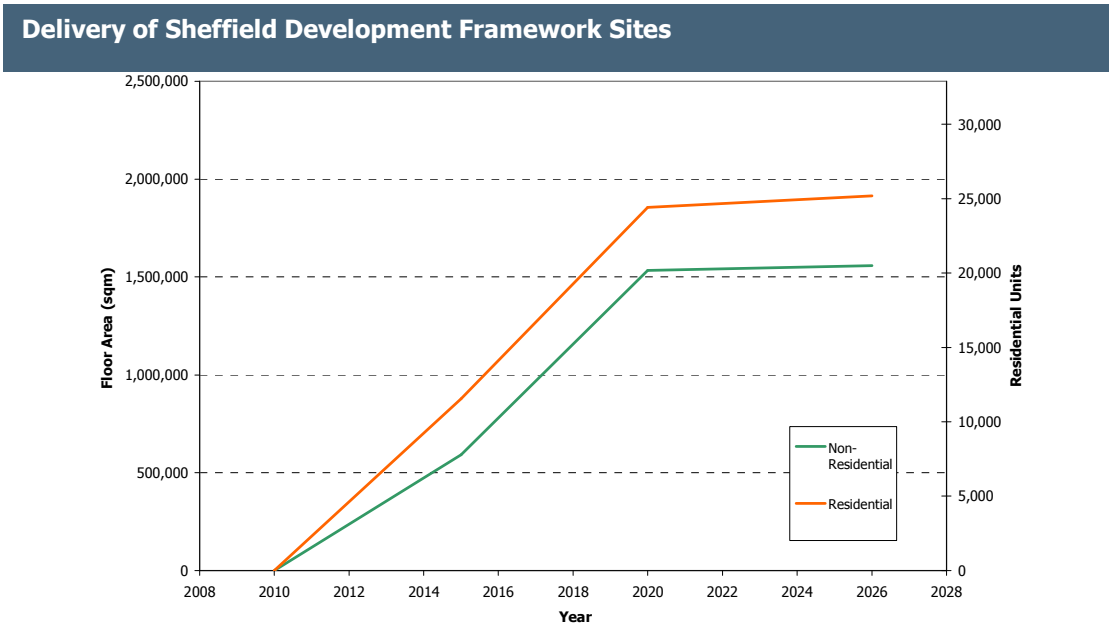

FIGURE 5.4 – Delivery of Sheffield Development Framework Sites

6 Capacity Shortfall, Physical Constraints and Investment Need

6.1 Sheffield Wide Issues And Risks

6.1.1 Water Supply and Distribution

Yorkshire Water Services (YWS) and Severn Trent Water have both confirmed that there are no strategic shortfalls in water abstraction, water treatment or water distribution which currently affect Sheffield or would affect the delivery of the Sheffield Development Framework to 2026.

The are a few local site-specific network extensions, a small number of which may involve some local network reinforcement in order to mitigate the effects of pressure loss to existing customers. These have broadly been identified as within the South East Community Assembly Area and the Waverley sites which are located within the Rotherham Council area. These costs are identified in Part III of this report and the cumulative costs are considered within the abnormal investment need.

Site No	Community Assembly Area	Site Name
P00366	South East	Deepwell Avenue
P00376	South East	Mosborough Wood Business Park
P00380	South East	Owlthorpe C
P00381	South East	Owlthorpe D
P00382	South East	Owlthorpe E
P00384	South East	Oxclose Farm
P00500	Waverley	Waverley - UK Coal Site
P00501	Waverley	Waverley Business Park
P00502	Waverley	Waverley Advanced Manufacturing Park

TABLE 6.1 – Development Sites Where Offsite Water Reinforcement May Be Required

The table below identifies the likely abnormal investment need for new water connection activities for each community assembly area, and highlights that abnormal connection costs have only been identified for the Waverley and South East Community Assembly Areas.

Community Assembly Area	Abnormal Utility Connection Costs
Central	£ -
East	£ -
North	£ -
North East	£ -
South	£ -
South East	£ 425,100
South West	£ -
Waverley	£ 450,000
Total	**£ 875,100**

TABLE 6.2 – Water Abnormal Connection Costs

6.1.2 Sewerage

Yorkshire Water Services has advised that significant growth in the catchment of Woodhouse Mill Sewage Treatment Works would require investment to increase the treatment capacity. Although YWS investment for this activity should be forthcoming between 2010 and 2015 (AMP5) this may only capture the growth required at the time of the 2009 periodic review, i.e. sites contained within the 'City Sites Preferred Options Document' or those committed by December 2008. Therefore should all development in this catchment come forward before investment in the AMP6 (2015 – 2020) CAPEX programme there will likely be Sewage Treatment Capacity shortfalls and potentially planning objections from Yorkshire Water.

The Woodhouse Mill Sewage Treatment Works serves sites within the South East Community Assembly Area and part of the East Community Assembly Area. The sites within the Woodhouse Mill Sewage Treatment Works are identified in the table below;

Site No.	Site Name
P00155	Former Asda site Orgreave Place 1
P00156	Scaffold Yard, Orgreave Place
P00362	Land at Crossland Drive, Gleadless
P00365	TA Centre, Hurlfield Road Manor Top
P00366	Deepwell Avenue
P00367	Beighton Road, Woodhouse
P00368	Drakehouse Crescent
P00370	New Street, Longacre Way
P00371	Alport Drive
P00373	Meadowbrook Park
P00375	Birley Moor Road
P00376	Mosborough Wood Business Park
P00377	New Street, Holbrook
P00379	Newstead Estate
P00380	Owlthorpe C
P00381	Owlthorpe D
P00382	Owlthorpe E
P00383	Rother Valley Way, Owlthorpe Greenway
P00384	Oxclose Farm
P00386	Rotheham Road, Beighton
P00387	Scowerdons Estate
P00390	Waterthorpe Greenway [Ex Playing Field]
P00391	Waterthorpe Greenway [Peaks Mount]
P00392	Waterthorpe Greenway [Playing Fields]
P00393	Weaklands Estate
P00394	Former Westfield School Site

TABLE 6.3 – Development Sites within Woodhouse Mill Sewage Treatment Works Catchment

It should also be noted that parts of Rotherham and North East Derbyshire drain into Woodhouse Mill Sewage Treatment Works and therefore additional capacity could potentially be utilised by sites developed in neighbouring Districts.

Yorkshire Water Services has advised that there is only limited capacity for further housing growth in Stocksbridge as a result of limiting capacity at Stocksbridge Sewage Treatment Works and the redevelopment of the 3 former industrial sites in the East Stocksbridge cluster. Currently there is no investment planned in AMP5 (2010 – 2015) and therefore the development of these sites might be considered after 2015 providing they are adopted in the SDF allocations significantly in advance of this.

A new sewage treatment facility may be constructed close to Morehall Bridge Water Treatment Works – to support Stocksbridge - but the procurement of this facility is dependent on commercial agreement with the developer of the former industrial site off Station Road, which is not currently forthcoming.

The following sites within the North Community Assembly Area are served by the Stocksbridge Sewage Treatment Works and are all at risk of development in advance of appropriate investment in sewage treatment capacity.

Site No.	Site Name
P00263	Balfour House, Horner Close, Stocksbridge
P00266	Ernest Thorpe's Lorry Park, Station Road, Deepcar
P00271	Former Steins Tip 'Deepcar Site' Station Road, Deepcar
P00280	Site A Stocksbridge Steelworks, off Manchester Road, Stocksbridge
P00284	Site G, Stocksbridge Steelworks, Stocksbridge
P00290	Stocksbridge Steelworks (Eastern End)
P00291	Stocksbridge Steelworks Trailer Park
P00292	Sweeney House, Alpine Close, Stocksbridge
P00437	Newton Grange, Manchester Road, Stocksbridge

TABLE 6.4 – Development Sites within Stocksbridge Sewage Treatment Works Catchment

Yorkshire Water Services has committed some investment to Blackburn Meadows Sewage Treatment Works in AMP5 (2010-2015) but this is based only on the development of those sites included in the City Sites Preferred Options document or those committed in December 2008. However, Yorkshire Water has suggested that Blackburn Meadows should be able to accommodate the development planned within its catchment.

Yorkshire Water Services has advised that there are no strategic shortfalls in foul sewerage capacity in the City and all sites can be connected to local sewers. Unfortunately Waverley, which is located outside of the Sheffield Metropolitan Authority boundary, cannot be drained into the existing foul sewerage network and there is not capacity at the Sewage Treatment Works to accommodate its foul flows.

Yorkshire Water Services are currently in discussion with Rotherham Council in order to identify a solution for Waverley. The sooner the site becomes adopted in a Local Plan or Development Framework the sooner investment in Sewage Treatment Capacity will be considered. A further £4,000,000 of abnormal costs should be included for the procurement of a new foul pumping station and rising main to the Treatment Works.

The following development clusters and Community Assembly Areas have issues regarding Sewage Treatment Capacity over the period of the SDF.

Cluster	Community Assembly Area	Comments
East Stocksbridge	North	Insufficient Capacity at Stocksbridge Sewage Treatment Works
Handsworth and Woodhouse	South East and East	Risk of insufficient Sewage Treatment Capacity at Blackburn Meadows Sewage Treatment Works
Gleadless Valley	South, East and South East	Risk of insufficient Sewage Treatment Capacity at Blackburn Meadows Sewage Treatment Works
Beighton and Mosborough	South East	Risk of insufficient Sewage Treatment Capacity at Woodhouse Mill Sewage Treatment Works
Hackenthorpe Cluster	East and South East	Risk of insufficient Sewage Treatment Capacity at Woodhouse Mill Sewage Treatment Works

TABLE 6.5 – Development Clusters where Sewage Treatment Capacity is limited or at Risk

6.1.3 Surface or Stormwater Sewerage

Yorkshire Water have advised that surface water discharge from brownfield sites should be limited to their former discharge rate (EA advise a reduction of 30% below existing discharge rate) and any increase above this (and the discharge from any greenfield site) must be discharged in accordance with the widely recognised sustainable drainage hierarchy including infiltration and limited discharges during storm events.

This may involve modest to substantial onsite stormwater attenuation but this is not considered an abnormal investment need, and would be considered a normal developer cost.

6.1.4 Gas Distribution

The segregation of the gas wholesale, transmission and retailing markets from the gas distribution market means that developer led activities do not impact upon the national, regional or local supply of gas. Therefore this study only considers gas distribution network capacity as it is only distribution network investments that are developer funded.

National Grid Gas (UK Distribution) has confirmed that there is no strategic gas shortfall currently affecting Sheffield or which would affect the development of the Sheffield Development Framework to 2026. The intermediate-pressure (IP) gas network which forms a ring-main

around central Sheffield is securely supported from the national and regional high-pressure (HP) network. The IP network supports a medium-pressure and low-pressure network across the City.

National Grid Gas has committed to a strategic investment programme which will improve security of supply to Northern Sheffield; this project (known as the Barnsley Network Reinforcement Programme) will be delivered in 2011 and 2012.

There are a small number of development sites that would require connection directly from the intermediate-pressure or medium-pressure network and are located such that network extensions or local reinforcement might cost more than £100,000 per site. These sites are identified in the table below;

Site No	Community Assembly Area	Site Name
P00014	East	Land between 434-652 Grimesthorpe Road
P00083	Central	Nelson Mandela Building, Pond Street
P00121	Central	West Bar Triangle
P00165	East	Former Tinsley Marshalling Yards, Europa Link
P00191	East	Sheffield Business Park (Blues Skies)
P00212	East	Manor Boot Houses
P00290	North	Stocksbridge Steelworks (Eastern End)
P00291	North	Stocksbridge Steelworks Trailer Park
P00309	North East	Foxhill Masterplan Area (main site)
P00382	South East	Owlthorpe E
P00387	South East	Scowerdons Estate

TABLE 6.6 – Sites Requiring Significant Network Extensions for Gas

The table below identifies the likely abnormal investment need for new gas connection activities for each Community Assembly Area.

CAA	Abnormal Utility Connection Costs
Central	£ 909,700
East	£ 959,500
North	£ 529,500
North East	£ 935,300
South	£ -
South East	£ 717,300
South West	£ 56,000
Waverley	£ 48,700
Total	**£ 4,156,000**

TABLE 6.7 – Gas Abnormal Connection Costs

6.1.5 Electricity Distribution

The segregation of the electricity generation, wholesaling and retailing markets from the transmission and distribution markets means that developer led activities do not impact upon the supply of electricity. In this study only electricity distribution network capacity is considered as it is only distribution network investments that are developer funded.

A review of YEDL and Central Networks' Long Term Development Statement and a comprehensive consultation with YEDL has determined that there are currently network capacity shortfalls at Ellin Street, Claywheels Lane, Wheatacre Road, Dronfield and Stanley Street 33/11kV Primary Substations.

The demand required to accommodate the estimated SDF growth within the Dronfield Primary Substation catchment is very small (86kVA) and therefore YEDL have advised that capacity should not be an issue when a formal developer application is made.

The Wheatacre Road Primary Substation is a single transformer installation backed up by a private steelworks Primary Substation. Although YEDL have advised that the demand generated by the SDF sites within the Wheatacre Road Primary Substation catchment can be accommodated

from the current arrangement, there is a risk of supply becoming insecure if the private steelworks supply is lost.

The costs identified in this section exclude any additional land costs associated with upgrading of the Primary Substation.

YEDL have advised that they will continue to review the situation, however there is a risk of circa £3,000,000 of developer funded reinforcement being necessary if upgrading of Wheatacre Road Primary Substation is required to accommodate the following sites within the North Community Assembly Area.

Primary Substation Reinforcement	Site No.	Community Assembly Area	Site Name
Wheatacre Road	P00263	North	Balfour House, Horner Close, Stocksbridge
	P00266	North	Ernest Thorpe's Lorry Park, Station Road, Deepcar
	P00271	North	Former Steins Tip 'Deepcar Site' Station Road, Deepcar
	P00280	North	Site A Stocksbridge Steelworks, off Manchester Road, Stocksbridge
	P00284	North	Site G, Stocksbridge Steelworks, Stocksbridge
	P00290	North	Stocksbridge Steelworks (Eastern End)
	P00291	North	Stocksbridge Steelworks Trailer Park
	P00292	North	Sweeney House, Alpine Close, Stocksbridge
	P00437	North	Newton Grange, Manchester Road, Stocksbridge

TABLE 6.8 – Wheatacre Road Primary Substation

YEDL have confirmed that transformer replacement at Claywheels Lane Primary Substation is to be carried out in 2011 as part of their asset replacement programme. This asset replacement will create a further 6MVA of firm capacity at the Primary Substation, and therefore developer funding for these works is unlikely to be required provided that the following sites are developed after 2011.

Primary Substation Reinforcement	Site No.	Community Assembly Area	Site Name
Claywheels Lane – Transformer replacement by YEDL in 2011 as part of their asset replacement programme	P00233	East	Airflow Site, Claywheels Lane
	P00241	Central	Land at Claywheels Lane
	P00258	Central	Ucar Site, Claywheels Lane
	P00259	Central	United Cranes Site, Claywheels Lane
	P00267	North	Farrar Precision Engineering, Oughtibridge Lane, Oughtibridge, Sheffield, S35 0HN
	P00301	North East	Chaucer School Site - Parson Cross Masterplan Area
	P00309	North East	Foxhill Masterplan Area (main site)
	P00310	North East	Foxhill Masterplan Area (Recreation Ground)
	P00314	North East	Lytton Road / Buchanan Road / Wordsworth Ave (B2) Parson Cross Masterplan Area
	P00322	North East	Parson Cross Hotel
	P00428	North East	Buchanan Road/Deerlands Avenue PCT site

TABLE 6.9 – Claywheels Lane Primary Substation

Further development local to Stanley Street Primary Substation within the 2010 to 2015 period may trigger new transformer upgrades (circa £3,000,000) in order to create a further 6MVA of firm capacity at the Primary Substation. The Primary Substation at Stanley Street is not currently within the YEDL asset replacement programme and therefore upgrading of this Primary Substation would likely be wholly funded by all sites benefiting from this upgrade including;

Primary Substation Reinforcement	Site No.	Community Assembly Area	Site Name
Stanley Street – Transformer replacement (developer attributable cost)	P00013	North East	Hartwell's site, Savile Street
	P00021	North East	Somerset Road
	P00040	Central	Blonk Street, adj. 28 Wicker
	P00110	Central	Spitalfields/ Brunswick Road
	P00114	Central	Stanley Street / Stanley Lane
	P00121	Central	West Bar Triangle
	P00151	East	Effingham Street Gasworks, Sussex Street

TABLE 6.10 – Stanley Street Primary Substation

Depending on the timing of applications, there is a risk that available capacity within the upgraded Stanley Street Primary Substation could be fully utilised, and the development within

the West Bar Triangle may trigger a further circa £3,000,000 of investment to upgrade transformers at Blue Boy Street to create an additional 6MVA of supply capacity.

There is supply capacity issue at Ellin Street 33/11kV Primary Substation where a contemporary developer application for the New Retail Quarter cannot be supported without major investment at this primary asset. YEDL are already in discussions regarding a new Primary Substation adjacent to the existing Ellin Street Primary Substation. The cost of this Primary Substation would be developer funded, and the following developments within the Central Community Assembly Area will likely be required to pay an apportioned cost of the estimated £4,000,000 of the new Primary Substation.

Primary Substation Reinforcement	Site No.	Community Assembly Area	Site Name
Ellin Street – New Primary Substation in 2015 (developer attributable cost)	P00036	Central	75 Milton St, 83 Headford St, etc.
	P00038	Central	Industry Works Site B, Sylvester Gardens
	P00047	Central	Charter Row/Rockingham Gate/The Moor
	P00055	Central	Moorfoot/NBD South
	P00060	Central	Egerton Street / Hanover Way
	P00065	Central	Furnival Square / Matilda Way
	P00068	Central	Hallam Lane
	P00069	Central	Headford Street / Egerton Street
	P00081	Central	Moore Street / Fitzwilliam Street
	P00109	Central	Site of Universe Works, 97 Mary Street, Sheffield, S1 4RT

TABLE 6.11 – Ellin Street Primary Substation

Once Ellin Street Primary Substation is upgraded, YEDL have stated that some of the load on the Arundel Street Primary Substation will be transferred to Ellin Street therefore creating sufficient additional capacity at Arundel Street to meet the predicted SDF load growth to 2026.

The following sites local to Arundel Street within the Central Community Assembly Area may incur developer funded reinforcement costs if they are developed before the load transfer has taken place in 2017.

Primary Substation Reinforcement	Site No.	Community Assembly Area	Site Name
Arundel Street – De-load to Ellin Street in 2017 as part of YEDL capital investment programme	P00032	Central	Pinstone Street / Union Street
	P00039	Central	Shoreham St/Sidney St
	P00041	Central	Car park at Arundel St/Charles St
	P00054	Central	Cross Turner St/Fornham St
	P00063	Central	Eyre Lane/ Matilda Street/ Arundel Street/ Furnival Street
	P00080	Central	Matilda Street/ Arundel Street/ Newton Lane
	P00111	Central	St Mary's Road / Suffolk Road / Fornham Street

TABLE 6.12 – Arundel Street Primary Substation

Applying the cumulative loads from all developments would potentially trigger a shortfall of capacity at the 132/33kV Sheffield City Bulk Supply Point Primary Substation; however the application of a City-wide diversity factor by YEDL (which YEDL will consider automatically as not all new dwellings within the SDF will have a peak demand at the same time) should mitigate this theoretical investment need.

The table below identifies the likely abnormal investment need for new electricity connection activities for each community assembly area.

Community Assembly Area	Abnormal Utility Connection Costs
Central	£12,165,578
East	£3,576,950
North	£834,500
North East	£ 4,031,271
South	£ -
South East	£771,650
South West	£ -
Waverley	£168,450
Total	**£21,548,398**

TABLE 6.13 – Electricity Abnormal Connection Costs

6.2 Summary Of Key (Physical) Development Constraints

The costs of diverting and altering existing strategic (trunk) utility services over the duration of the Sheffield Development Framework will be substantial at circa £12,168,125. (NOT including an estimated £2,800,000 to £12,000,000 for BT Openreach trunk networks).

This indicative budget cost does not include the cost of diverting high-pressure gas mains, 275/400kV electricity assets, very large/deep trunk sewers or stormwater culverts – these assets would be retained in-situ with existing Wayleaves or Deeds of Easement and in some cases a significant buffer for safety and environmental health purposes (up to 300m for high-pressure gas mains and 60m for overhead 275/400kV power lines). The following sites contain infrastructure which should be retained;

Site No.	Site Name	Community Assembly Area	Development Constraints Likely to Remain Insitu
P00015	Oakham Drive	North East	275kV cable
P00017	Prospect Business Park, Carlisle Street East	North East	275kV cable
P00028	West of Crown Hill, Petre Street	North East	275kV cable
P00029	Woodside	North East	275kV cable

TABLE 6.14 – Sites within North East Community Assembly Area with constraints likely to remain insitu

Creative Sheffield and Sheffield City Council have advised that all strategic diversionary works required to accommodate the New Retail Quarter have been carried out, and any remaining services have been retained insitu.

Site No.	Site Name	Community Assembly Area	Development Constraints Likely to Remain Insitu
P00032	Pinstone Street / Union Street	Central	BT Openreach
P00044	Castle Markets	Central	BT Openreach
P00046	Charles St/Arundel Gate/Brown Lane/Froggatt Lane	Central	BT Openreach
P00047	Charter Row/Rockingham Gate/The Moor	Central	BT Openreach
P00050	Corporation St/Spring St	Central	BT Openreach
P00054	Cross Turner St/Fornham St	Central	BT Openreach
P00055	Moorfoot/NBD South	Central	275kV cable & Combined Sewer & BT Openreach
P00069	Headford Street / Egerton Street	Central	Surface Water Culvert & Combined Sewer
P00071	'Jessop East', Former Jessop Hospital, Leavygreave Road	Central	BT Openreach
P00074	Land At Acorn Street, Green Lane And Dunfields	Central	Combined Sewer
P00080	Matilda Street/ Arundel Street/ Newton Lane	Central	BT Openreach
P00081	Moore Street / Fitzwilliam Street	Central	Combined Sewer & BT Openreach
P00084	New Retail Quarter **– Advised by SCC that these have been diverted**	Central	275kV cable & Combined Sewer & BT Openreach
P00089	Pitsmoor Road/Chatham Street/Swinton Street	Central	275kV cable & BT Openreach
P00094	Rockingham Street / Bailey Lane / Boden Lane	Central	BT Openreach
P00096	Rockingham Street / Portobello Street	Central	BT Openreach
P00098	Russell Street / Bower Street	Central	Combined Sewer & BT Openreach
P00105	Site Of Cornish Steel Works Land Between Dun Street And Dunfields Green Lane Sheffield	Central	Combined Sewer
P00110	Spitalfields/ Brunswick Road	Central	Combined Sewer
P00111	St Mary's Road / Suffolk Road / Fornham Street	Central	BT Openreach
P00121	West Bar Triangle	Central	275kV cable & Combined Sewer & BT Openreach
P00125	Wharncliffe Works	Central	Combined Sewer & BT Openreach
P00239	Herries Road, Herries Road South / Penistone Road North	Central	BT Openreach
P00247	Land at Wardsend Road	Central	400kV cable
P00248	Land at Wardsend Road North	Central	400kV cable
P00250	Livesey Street / Penistone Road	Central	Combined Sewer
P00253	Site at Old Penistone Road	Central	BT Openreach
P00257	Site of Hillfoot Steels, Pensitone Road North	Central	400kV cable & BT Openreach
P00426	Footprint Tools & Synters	Central	BT Openreach
P00446	Heart of the City, Offices No. 3, Norfolk Street / Charles Street	Central	BT Openreach

TABLE 6.15 – Sites within Central Community Assembly Area with constraints likely to remain insitu

Site No.	Site Name	Community Assembly Area	Development Constraints Likely to Remain Insitu
P00129	Alsing Road	East	Combined Sewer
P00134	Attercliffe Canalside, Ripon St	East	Combined Sewer
P00136	Rear of Davy McKee	East	Combined Sewer
P00139	Brightside Lane/Upwell St	East	Combined Sewer
P00141	Broadlands, Lumley St	East	Surface Water Culvert
P00157	Former Brightside Works, Weedon St (River Don District plot 1)	East	Combined Sewer
P00158	Former Cooper & Turner Works, Weedon St (River Don District plot 2)	East	Combined Sewer
P00164	Former Sheffield Tipper's site, Sheffield Road	East	BT Openreach
P00166	Halfpenny vehicular link, between Meadowhall	East	275kV cable
P00171	Meadowhall Way (excl River Don District plot 5)	East	BT Openreach
P00174	Lumley Street	East	Surface Water Culvert
P00176	Scania site, Fell Street	East	Combined Sewer
P00182	Outokumpu, Shepcote Lane	East	BT Openreach
P00184	Pinfold Works, Staniforth Road	East	BT Openreach
P00194	Adj Fitzalan Work, Attercliffe Rd	East	BT Openreach
P00195	Spartan Works, Attercliffe	East	BT Openreach
P00202	Westaways, Attercliffe	East	Combined Sewer
P00204	Castle College North Site, Granville Road	East	BT Openreach
P00208	The Circle / Fretson Road, Manor	East	Surface Water Sewer
P00218	Nunnery Sidings - Dixons Site Phase 3 (Park and ride)	East	Surface Water Culvert
P00219	Nunnery Sidings (East)	East	Surface Water Culvert
P00220	Off Parkway Avenue	East	BT Openreach
P00223	Phase D, Stonecliffe Road, Manor	East	BT Openreach
P00334	Olive GroveRd/Charlotte Rd	East	BT Openreach
P00433	Errington Crescent/Errington Rd	East	BT Openreach

TABLE 6.16 – Sites within East Community Assembly Area with constraints likely to remain insitu

Site No.	Site Name	Community Assembly Area	Development Constraints Likely to Remain Insitu
P00368	Drakehouse Crescent	South East	275kV cable
P00375	Birley Moor Road	South East	BT Openreach
P00380	Owlthorpe C	South East	Surface Water Sewer
P00384	Oxclose Farm	South East	Surface Water Culvert
P00390	Waterthorpe Greenway [Ex Playing Field]	South East	275kV cable & HP gas main
P00391	Waterthorpe Greenway [Peaks Mount]	South East	HP gas main
P00392	Waterthorpe Greenway [Playing Fields]	South East	275kV cable & HP gas main

TABLE 6.17 – Sites within South East Community Assembly Area with constraints likely to remain insitu

There are four city centre sites that have existing district heating network within the site boundary:

Site No.	Site Name	Community Assembly Area	length of pipe	Indicative Diversion Cost
P00222	Park Hill Flats	Central	270m	£286,250
P00084	New Retail Quarter **– Advised by SCC that these assets have already been diverted**	Central	204m	£228,500
P00205	Claywood Tower Blocks	Central	135m	£168,125
P00204	Castle College North Site	Central	140m	£162,500

TABLE 6.18 – Sites with existing district heating network within the site boundary

These may be connecting existing buildings on site. We are currently awaiting confirmation from Veolia regarding arrangements and typical costs for diversion of existing DH infrastructure.

The diversion or alteration of non-strategic distribution mains and services is NOT included in this study as they are considered to be standard developer activities.

The following figure identifies the trunk service alteration costs for each category of strategic utility infrastructure on a Community Assembly Area basis. It can be seen from the graph that the most significant alteration activities are required in the Central and East Community Infrastructure Areas at c.£4M for each area.

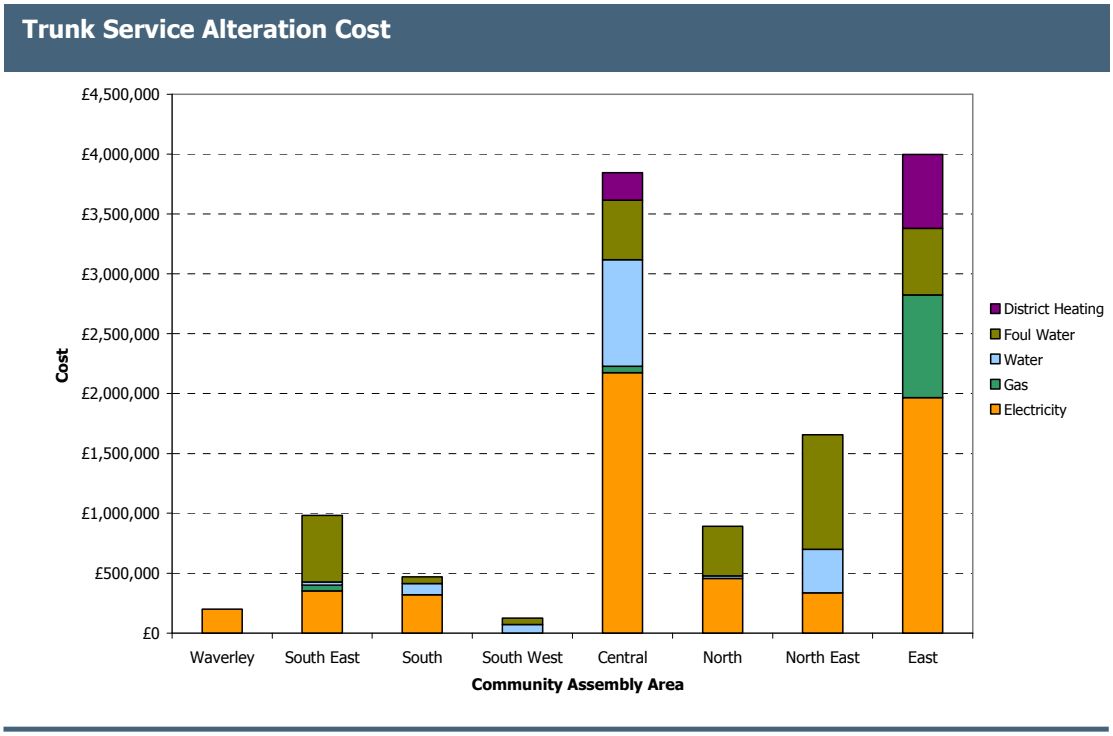

FIGURE 6.1 – Trunk Service Diversion / Alteration Cost (Community Assembly Areas)

6.3 Summary Of Abnormal New Connection and Alteration Need

All new connection costs presented in this study are considered 'abnormal', i.e. these are costs associated with non-standard infrastructure procurement. For example the costs associated with onsite distribution mains, cables and sewers, secondary substations, medium to low pressure gas governors, metered service connections, internal risers, local off-site network connections, and standard water and sewerage infrastructure charges are not included in the costs presented here.

The projected abnormal new connection and alteration utility investment need to deliver the SDF to 2026 is estimated to be £30,579,498. This does not include the costs associated with diverting any trunk telecommunications infrastructure which is estimated at £2.8m to £12m.

CAA	Total Abnormal Connection Cost
Central	£13,075,278
East	£ 4,536,450
North	£ 1,364,000
North East	£ 4,966,571
South	£ -
South East	£ 1,914,050
South West	£ 56,000
Waverley	£ 4,667,150
Total	**£30,579,498**

TABLE 6.19 –Community Assembly Area Total Abnormal Costs

Consultation with Yorkshire Water Services has determined that the only foul water pumping station that will likely be required is Waverley where a budget figure of £4,000,000 for pumping stations and rising mains should be included. Further foul water pumping stations may be required as a result of the elevation of an individual site but these costs are NOT included as they are not required to support a network incapacity issue.

The figure below identifies the abnormal utility connection costs on a Community Assembly Area basis and clearly shows that the Central Community Assembly Area has new connection costs far in excess of the other Community Assembly areas.

This significant difference in cost is largely due to the electricity reinforcement required at Ellin Street and Stanley Street, together with the larger number of sites with an electricity demand in excess of 0.5MVA which may require new 11kV circuits to be installed back to the local Primary Substation.

Abnormal Utility Connection Costs

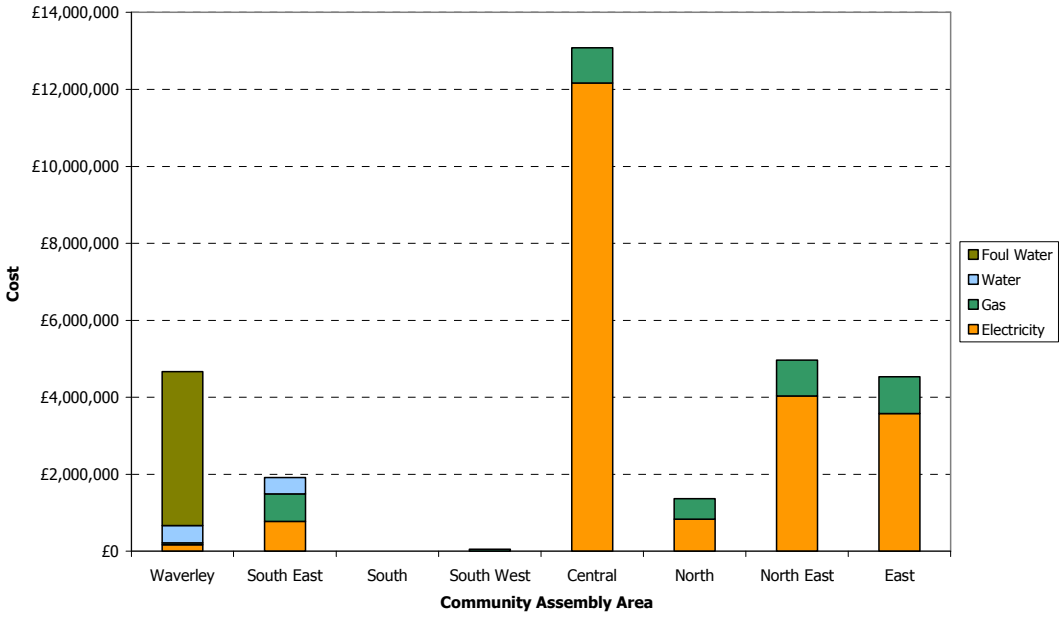

FIGURE 6.2 – Abnormal Utility Connection (Utility Assembly Areas)

Phased Total Abnormal Utility Connection Costs

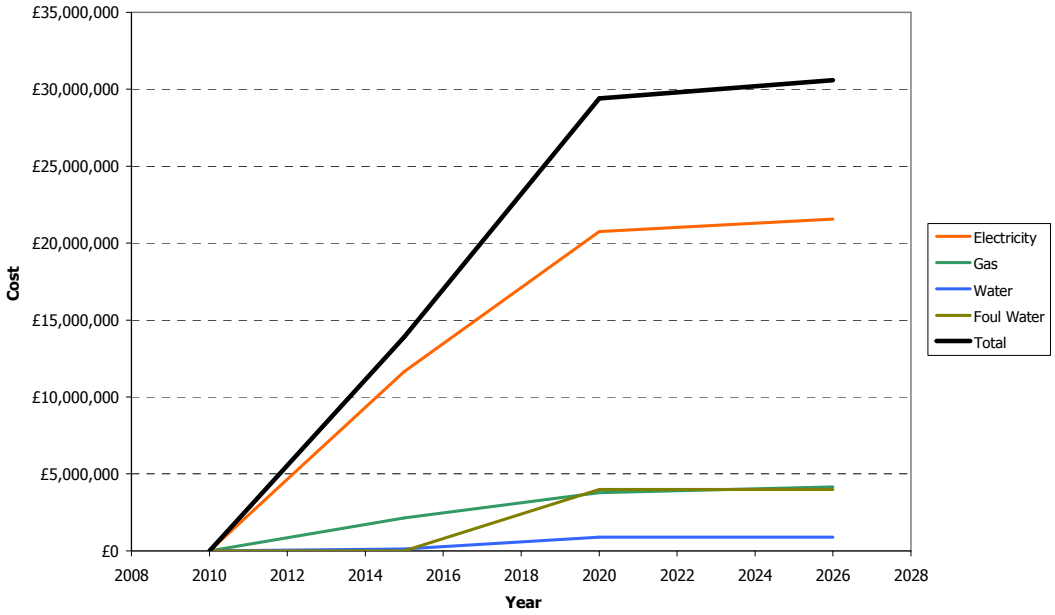

FIGURE 6.3 – Abnormal Utility Connection (Total)

6.4 Summary Of Total Infrastructure Need

6.4.1 Traditional Infrastructure

The total projected utility investment need to deliver the SDF to 2026 is £42,747,623 (NOT including an estimated £2,800,000 to £12,000,000 for BT Openreach trunk networks).

A full summary spreadsheet identifying the abnormal connection costs, diversion / alteration costs and any strategic infrastructure that is recommended to be retained insitu for each site within the SDF is included within Part III of this report alongside the individual site specific data sheets, however the tables below summarise the water, sewerage, gas, electricity and district heating abnormal new connection and alteration costs for each community assembly area.

Community Assembly Area	Electricity	Gas	Water	Foul Water	Total
Central	£12,165,578	£909,700	£-	£-	£13,075,278
East	£3,576,950	£959,500	£-	£	£4,536,450
North	£834,500	£529,500	£-	£-	£1,364,000
North East	£4,031,271	£935,300	£-	£-	£4,966,571
South	£-	£-	£-	£-	£-
South East	£771,650	£717,300	£425,100	£-	£1,914,050
South West	£ -	£56,000	£-	£-	£56,000
Waverley	£168,450	£48,700	£450,000	£4,000,000	£4,667,150
Total	**£21,548,398**	**£4,156,000**	**£875,100**	**£4,000,000**	**£30,579,498**

TABLE 6.20 –Abnormal New Connection Costs by Community Assembly Area

Community Assembly Area	Electricity	Gas	Water	Foul Water	District Heating	Total
Central	£2,174,500	£52,500	£889,500	£500,000	£228,500	£3,845,000
East	£1,965,500	£859,750	£-	£555,000	£616,875	£3,997,125
North	£457,000	£-	£20,000	£415,000	£-	£892,000
North East	£335,000	£-	£363,000	£960,000	£-	£1,658,000
South	£ 321,000	£ -	£93,000	£55,000	£ -	£469,000
South East	£352,500	£46,000	£27,500	£557,000	£-	£983,000
South West	£-	£-	£70,000	£55,000	£-	£125,000
Waverley	£199,000	£-	£-	£-	£-	£199,000
Total	**£5,804,500**	**£958,250**	**£1,463,000**	**£3,097,000**	**£845,375**	**£12,168,125**

TABLE 6.21 –Diversion \ Alteration Costs by Community Assembly Area

Community Assembly Area	Electricity Total	Gas Total	Water Total	Foul Water Total	District Heating (Diversions only) Total	Grand Total
Central	£14,340,078	£962,200	£889,500	£500,000	£228,500	£16,920,278
East	£5,542,450	£1,819,250	£-	£555,000	£616,875	£8,533,575
North	£1,291,500	£ 529,500	£20,000	£415,000	£-	£2,256,000
North East	£4,366,271	£935,300	£363,000	£960,000	£-	£6,624,571
South	£321,000	£-	£93,000	£55,000	£-	£469,000
South East	£1,124,150	£763,300	£452,600	£557,000	£-	£2,897,050
South West	£-	£56,000	£70,000	£55,000	£-	£181,000
Waverley	£367,450	£48,700	£450,000	£4,000,000	£-	£4,866,150
Total	**£27,352,898**	**£5,114,250**	**£2,338,100**	**£7,097,000**	**£845,375**	**£42,747,623**

TABLE 6.22 –Total Abnormal New Connection and Diversion \ Alteration Costs by Community Assembly Area

Cumulative Utility Investment Need

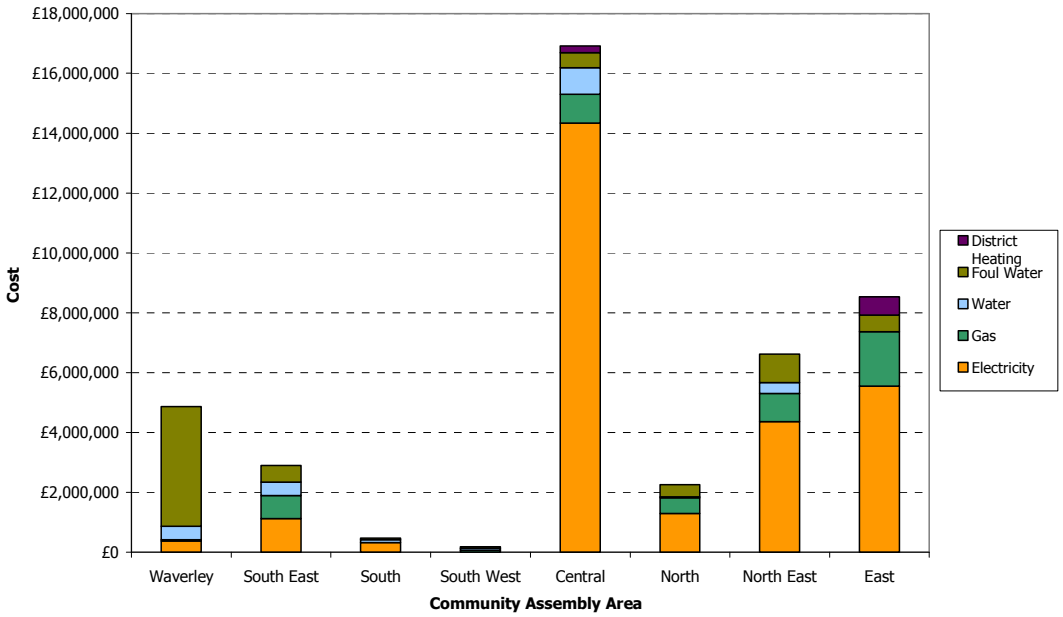

FIGURE 6.4 – Cumulative Investment Need (Community Assembly Area)

Cumulative Total Abnormal Utility Investment Need

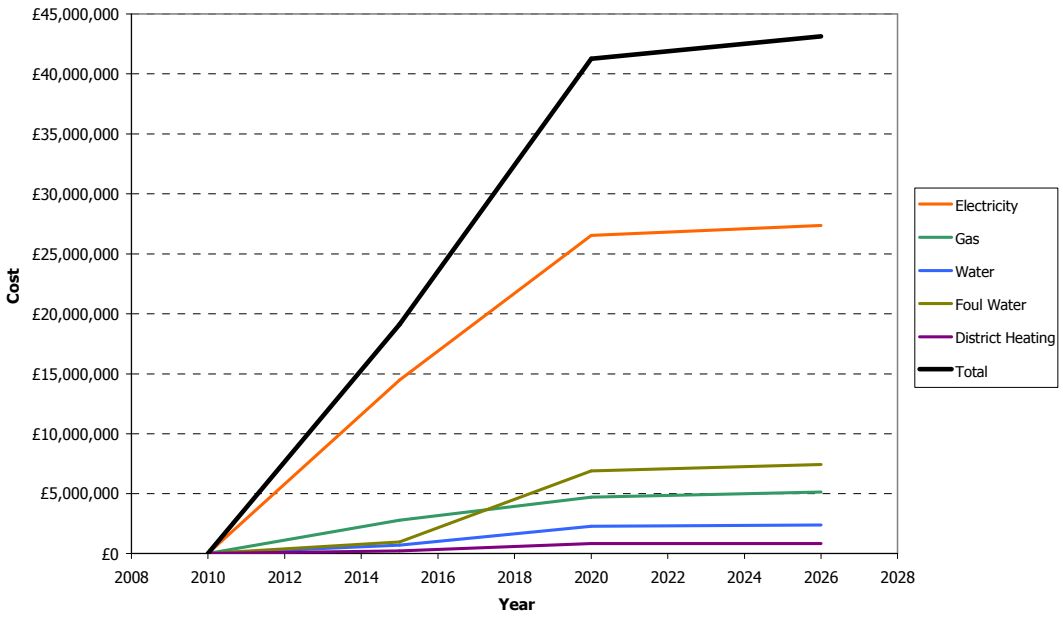

FIGURE 6.5 – Cumulative Investment Need (Total)

6.4.2 Unit Cost per Square Meter

The table below identifies sites which have cumulative diversion and abnormal utility connection costs above £50 per square meter of gross developable area; however the costs for all 319 sites within the SDF have been identified in the site specific datasheets contained within Part III of this report. Full reference should also be made to the data sheets within Part III of this report when considering the new connection and diversion / alteration activities associated with the site.

The mean average for cumulative new connection and diversion costs is £11.84 per m^2 of gross developable area. The sites identified in the table below may, therefore, be typically more expensive to develop, however this is something that would need to be considered by potential developers once more detailed development aspirations and masterplans are available.

Site No.	Site Name	Community Assembly Area	Total Cost	Total Unit Cost/Developable Area
P00250	Livesey Street / Penistone Road	Central	£ 754,000	£1,168.99
P00185	Prince of Wales Road	East	£ 370,000	£ 462.50
P00290	Stocksbridge Steelworks (Eastern End)	North	£ 150,000	£ 228.66
P00391	Waterthorpe Greenway [Peaks Mount]	South East	£ 131,000	£ 218.33
P00291	Stocksbridge Steelworks Trailer Park	North	£ 152,200	£ 120.41
P00110	Spitalfields/ Brunswick Road	Central	£ 1,573,550	£ 104.90
P00416	Concord JI School	North East	£ 115,000	£ 95.83
P00273	G Fishers Transport Yard, Green Lane, Ecclesfield	North	£ 120,000	£ 92.59
P00326	Wordsworth Ave/ Buchanan Road	North East	£ 457,500	£ 86.42
P00001	Upwell Street/Colliery Road	North East	£ 831,250	£ 84.82
P00384	Oxclose Farm	South East	£ 924,300	£ 70.71
P00020	Skinnerthorpe Road/Owler Lane (commercial)	North East	£ 252,500	£ 70.14
P00301	Chaucer School Site - Parson Cross Masterplan Area	North East	£ 410,750	£ 68.69
P00114	Stanley Street / Stanley Lane	Central	£ 428,200	£ 67.97
P00013	Hartwells site, Savile Street	North East	£ 998,571	£ 66.38
P00370	New Street, Longacre Way	South East	£ 52,000	£ 65.00
P00501	Waverley Business Park	Waverley	£ 1,538,883	£ 64.12
P00041	Car park at Arundel St/Charles St	Central	£ 45,000	£ 62.50
P00138	Betafence, Sheffield Road	East	£ 513,450	£ 62.31
P00028	West of Crown Hill, Petre Street	North East	£ 110,500	£ 57.55
P00200	Vantage Riverside	East	£ 533,500	£ 57.43
P00308	Former 354-384 (Evens) Deerlands Avenue	North East	£ 80,000	£ 55.40
P00279	Next to Arthur Lee Works, Loicher Lane, Ecclesfield	North	£ 80,000	£ 54.95
P00239	Herries Road, Herries Road South / Penistone Road North	Central	£ 184,000	£ 54.81
P00392	Waterthorpe Greenway [Playing Fields]	South East	£ 420,000	£ 52.50

TABLE 6.23 – Sites with unit cost above £50/m^2

6.4.3 Decentralised Energy

Sheffield has the largest district heating network in the UK with 44km of district heating distribution pipes beneath its streets. These pipes and the Energy Recovery Facility, which generates 43MW of heat and up to 19.8MW of power from municipal waste, are operated by Veolia (ES) Sheffield Ltd (part of the Veolia Group) until 2036.

At this stage Veolia has not confirmed how much supply capacity (headroom) is available without the need for further investment in generation assets. However the possibility that 85 out of the 319 potential new development sites might physically be connected into this district heating network strongly suggests that further generation assets will certainly be required in addition to network extensions and possible network reinforcement (especially as the waste stream in Sheffield will reduce over time in accordance with the Waste Management Plan).

Veolia has not declared the scale of investment needed in energy generation facilities and network reinforcement activities to meet the anticipated SDF growth nor have they provided a mechanism of capital apportionment. It is likely that the additional generation capacity could be combined heat and power (CHP) led by gas or biomass or biomass boilers and unless these facilities are located at the existing Energy Recovery Facility there will be a spatial implication to this investment need. It is also understood that there has been some discussion between Eon and Veolia in regard to the connection of heat between the Energy Recovery Facility and the proposed Biomass Power Station at Blackburn Meadows; this would potentially mitigate the need for further generation assets in the City Centre.

The possibility exists that Veolia could investigate the feasibility of utilising surplus heat from other buildings within Sheffield, however Veolia have not declared any discussions with interested parties. Due to limited legislation in place for the export and transportation of heat, the feasibility would also be dependant on whether commercial terms of agreement could be reached between Veolia and any third party, including the consideration of items such as security of supply, length of contract. Each opportunity would need to be reviewed and evaluated on a case by case basis.

The capital cost of connection to the Energy Recovery Facility is provided for each of the 85 sites that are located within a reasonable distance from the existing district heating network. The combined cost of each of these extensions, not including the capital cost of additional generation facilities and reinforcing existing energy network assets is approximately **£12,670,000**.

Should these 85 sites be served from the Energy Recovery Facility then it is unlikely that traditional gas connections would be required, thereby potentially reducing the demand on grid gas, however as previously highlighted within this report all forms of District Energy are typically backed up by grid supplies.

Alternatively some of these sites might use building integrated microgeneration, a standalone energy facility, or might connect to an alternative district energy network should investment in an alternative facility be forthcoming.

District Energy Connection Potential

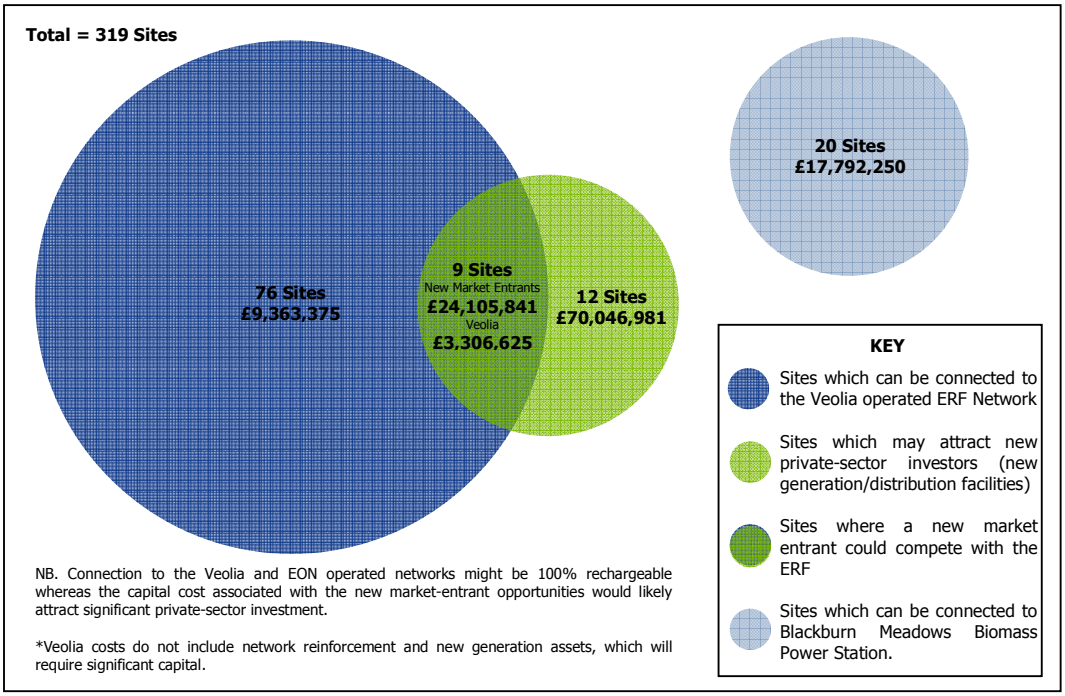

FIGURE 6.6 – District Heating Connection Potential

A number of the sites that might be connected into the existing energy network operated by Veolia might also be connected into a new District Energy facility perhaps using private-sector investment from an Energy Services Company (ESCo) under a Design, Build, Fund, Operate and Maintain model.

In total 21 out of the 319 development sites are located close to an existing large energy user or another development site (or are sufficiently large in themselves) to consider the procurement of a new district energy facility.

District Energy Opportunities

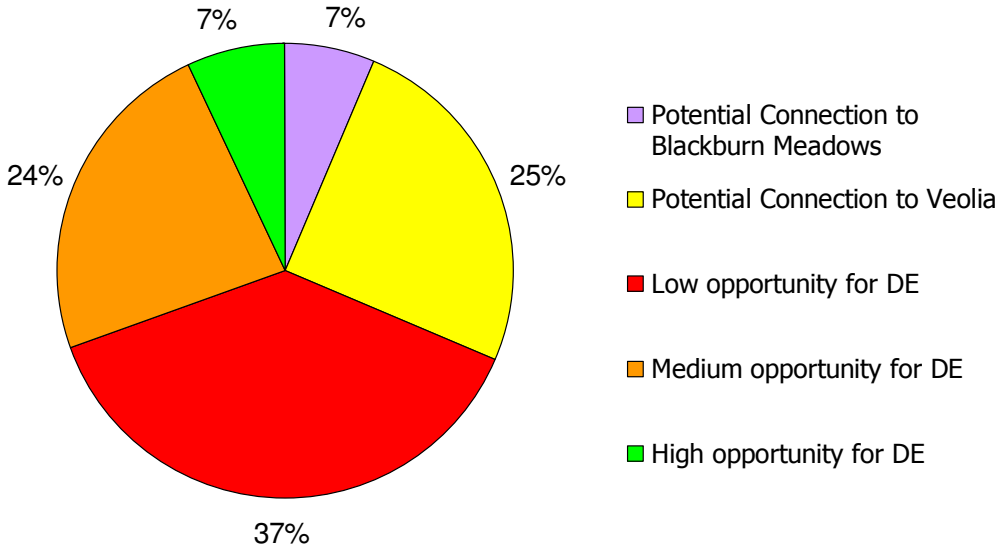

FIGURE 6.7 – District Energy Opportunity Breakdown

In addition to those sites that might be economically connected to the existing district energy network operated by Veolia, or might attract a investment from a new market-entrant, there are a further 20 out of the 319 sites that might be connected to the biomass power station to be owned and operated by Eon at Blackburn Meadows. All sites with District Energy potential are identified in Part III of this report.

If all new developments where there is a good commercial and technical opportunity to develop a new district energy facility were able to attract investment the investment need might be somewhere approaching £94M (including generation and distribution assets).

It is recommended that a feasibility study is carried out to understand the feasibility of extending the District Heating Network within Sheffield either in conjunction with Veolia, the introduction of other market entrants or a combination of both.

7 Utilities CAPEX Programmes for Sheffield

7.1 Water

Yorkshire Water and STW have both identified that there are no specific strategic schemes planned for the Sheffield region which will directly affect the SDF sites identified within this study, however ongoing improvements in network security, pressure improvement and leakage control will benefit the SDF sites.

7.2 Sewerage

Yorkshire Water have advised that there are plans to upgrade the Sewage Treatment Works at Blackburn Meadows, Woodhouse Mill and Stocksbridge within AMP5 (2010 – 2015), however this will only take account of sites that were allocated within the Development Plan at December 2008.

Although WYG have commenced dialogue with Yorkshire Water in respect of the SDF development to 2026, it is vital that this dialogue is maintained. It will therefore be necessary for Sheffield City Council or their appointed representatives to work closely with Yorkshire Water to ensure that any development within the SDF is included within Yorkshire Water plans for AMP 6, 7 and 8. New development will be affected by Yorkshire Water's planned capital investment programme over the duration of the SDF.

7.3 Gas

National Grid Gas (NG) review local plans as they are released in order to influence longer term strategic planning of their network (5 year Development Price Control Review - DPCR), however specific development led strategic infrastructure will not be designed and constructed until triggered by the development itself. NG have confirmed that the Barnsley network reinforcement scheme due to be undertaken in 2011 \ 2012 will benefit the northern part of Sheffield[23], while ongoing mains replacement programmes will also create additional network capacity to accommodate organic growth within Sheffield.

[23] National Grid Gas – Long Term Development Plan 2008.

In each 5 year DPCR, an element of development growth is added, however unless a specific capital investment project or major development comes on-stream, the model is likely to remain fairly stable over the 5 year period. NG review a revenue stream over a 10 year period, and the slow rate of occupation of business parks can often mean that developers are liable for 75% of the total capital cost of upstream reinforcement. However this mechanism is only triggered for larger applications where a design study and economic test is required. Breaking down larger sites into smaller parcels often mitigates this activity.

7.4 Electricity

The most recent YEDL prepared DPCR (Development and Planning Control Review) submission was prepared towards the end of 2008, although this will not be formally released into the public domain until the end of 2009 once the final determination has been published by Ofgem.

In advance of this information being formally published, YEDL have identified the following network reinforcement schemes that are included within the DPCR, and these can be summarised as follows:[24]

- New Central Sheffield 33/11kV Primary Substation to commence construction in 2015.
- 11kV network reinforcement scheme to transfer load from Silver Street Primary Substation to Blue Boy Street Primary Substation in 2016.
- 11kV network reinforcement scheme to transfer load from Arundel Street Primary Substation to Ellin Street Primary Substation in 2017 creating a further 5MVA capacity at Arundel Street Primary Substation.
- Dronfield available capacity will increase in 2010 by up to 7MVA due to the transfer of a large 11kV customer to a dedicated single transformer substation.

In addition to the capital investment schemes identified above, YEDL are undertaking ongoing condition assessments of assets which are approaching their 40 year life expectancy in order to identify which assets should be considered for replacement as part of YEDL's ongoing asset replacement programme. The condition assessments generally only look forward a maximum 10

[24] Letter from David Van Kesteren of YEDL to WYG dated 22nd September 2009

year period (currently to 2018), and the current asset replacement schemes that are planned by YEDL within this horizon are as follows:

- Claywheels Lane 33/11kV Primary Substation transformer replacement commencing in 2011 – This will create a further 6MVA of firm capacity at the Primary Substation.
- Blackburn Valley 33/11kV Primary Substation transformer and 11kV switchgear replacement commencing in 2013 – This will create a further 6MVA of firm capacity at the Primary Substation.
- Saxon Road 33kV switchgear replacement commencing in 2016 – No additional capacity created

While YEDL can forecast beyond 10 years to identify the general condition of assets across the network, the information does not allow a decision to be taken on which assets need to be included for asset replacement beyond this 10 year horizon. Therefore YEDL and WYG are unable to assess which asset replacement schemes will be implemented between 2018 and 2026 including the replacement of any existing Primary Substations.

As a consequence of the YEDL asset replacement programme, additional network capacity will be created during the asset replacement process (this will continue to happen beyond 2018 but cannot be identified at this time). As equipment is replaced at urban Primary Substations, YEDL will install infrastructure to increase the firm capacity at the Primary Substation from 24MVA to 30MVA. This additional capacity is also considered when the replacement of any cable and overhead line circuits are carried out so that these assets do not restrict capacity of other downstream assets (such as Primary Substations) which have or will be upgraded. YEDL have advised that in rural areas capacities of 12MVA and 24MVA will be considered rather than installing 30MVA assets.

YEDL have advised that the Sheffield 11kV network does not cause many issues and have stated that it is the most robust of our YEDL city centre 11kV networks. That said, YEDL have made some general comments:

- YEDL are carrying out some 11kV reinforcement and installing remote control in the Ecclesfield area to resolve some poor performance within the 11kV network

- Copper theft at substations has become more of an issue in recent years and YEDL are suffering a higher than average level of theft in the Sheffield area. This can sometimes result in customer interruptions.
- YEDL have an asset replacement programme for 11kV substations throughout the YEDL area; the replacement level in the Sheffield area is slightly higher than the average for the region, but there isn't a specific part of Sheffield that gives YEDL cause for concern.

In addition to capital replacement works planned by YEDL, National Grid have an ongoing capital replacement programme which includes replacement of transformers of 275/33kV transformers at their Grid Supply Points (GSP's) with 120MVA transformers. The only currently planned capital replacement works planned for the GSP's serving Sheffield, is Pitsmoor A Grid Supply Point, however this provides a dedicated supply to Sheffield Forgemasters in the Brightside area of Sheffield, and will therefore not directly affect the sites contained within the SDF.

7.5 Telecommunications

Although BT Openreach will not share their capital investment plans, it is known via Ofcom that BT, in consultation with the UK telecommunications industry, and with input from Ofcom, is currently upgrading its physical infrastructure using DSL technologies including an ADSL2+ programme (21st Century Networks) and a more contemporary VDSL fibre to the cabinet network (superfast broadband); the latter is a national £1.5bn investment programme but Sheffield telephone exchanges will not be enabled, possibly due to the Digital Region Ltd programme.

BT are currently in the process of formulating their new 21st century network (21CN) which according to BT will provide advanced communications for the future and will establish a platform supported by common standards and interfaces, for all BT communication services – whether voice, data, video or internet.

21CN will be based on Internet Protocol (IP) technology, alongside similar technologies. IP is more flexible than traditional circuit switched networks and can handle communications previously carried by multiple, bespoke networks. In simplistic terms, 21CN will replace BT's currently complex tradition system made up of various methods of communication, and replace these with a more streamlined number of operating facilities, with the added improvement of increasing the reliability for those services provided across the BT network.

BT has advised that in order to introduce 21CN, it will be necessary to migrate some 30 million existing telephone lines onto the new infrastructure. This will require BT to closely work with all of the UK's communications and network providers. It is understood that this work is currently underway, and BT aim to have this migration completed by 2011.

BT Openreach have plans to roll out a new fibre to the street cabinet infrastructure, which will provide superfast broadband capability to 40% of UK homes by 2012, although it is noted that the telephone exchange or cabinets within Sheffield are not included within the current rollout. This may be linked to the fact that BT are aware of the proposals by Digital Region to undertake a similar investment programme.

Digital Region Ltd (a procurement vehicle funded by Yorkshire Forward, South Yorkshire local authorities and European funding) has now appointed a design and build contractor and operator. Thales will build a new fibre to the cabinet network across south Yorkshire, enabling all telephone exchanges and street cabinets over the next three years. This will provide superior telephony, internet and television capabilities within Sheffield.

7.6 Decentralised Energy

The existing energy recovery facility and district heating network within Sheffield is operated by Veolia (ES) Sheffield Limited. Veolia does not currently have a programme for capital investment or a model for forward funding of network improvements, and therefore any extensions to the network or reinforcement of the network will likely be developer led.

In July 2008 E.ON received planning permission to build a £60m biomass power station at Blackburn Meadows. It is expected that the Blackburn Meadows Biomass Power Station will be generating circa 25MW power onto the local distribution network in 2011 and will simultaneously generate renewable heat that might be utilised in the Don Valley area.

It is understood that there have been preliminary discussions between Veolia and E.ON regarding the potential to link the respective district heating networks together. However these discussions did not progress beyond preliminary stages as both E.ON and Veolia were unable to agree commercial terms for the generation and distribution of heat.

8 Utility Regulation and Investment Funding For New Development

8.1 Water Supply And Distribution

There are ten water and sewerage undertakers in England and Wales and sixteen water only undertakers. Sheffield is located largely in the area operated under license by Yorkshire Water Services although a small part of the study area to the South of Sheffield is operated by Severn Trent Water. These undertakers are licensed to treat and distribute water and wastewater under regulation however it is primary legislation in the from of the Water Industry Act 1991 and Water Act 2003 which provides much of the framework for developer related activities including new connections and the alteration/diversion of existing assets.

In recent times a small number of new undertakers have been granted a Water Supply Licence through the Water Supply Licensing regime created within the Water Act 2003; these new licensed operators can purchase water wholesale for resale to new and large users. Similarly a mechanism – known as 'Inset Appointments' - exists whereby a licensed water undertaker can own and operate distribution assets in another undertaker's incumbency in order to provide new connections (in both instances the demand must exceed 50Ml/year, which is approximately equivalent to 375 new residential dwellings). It is generally acknowledged that the Water Supply Licensing and Inset Licensing regime is not delivering much increased competition as very few large water users have switched water supplier and only a handful of inset licenses have been awarded. Although there is currently no reason why some of the larger new development sites within the SDF cannot utilise more competitive forms of water connection the water resource itself will ultimately be derived from the incumbent Water Undertaker – Yorkshire Water Services.

Section 45 of the Water Industry Act 1991 mandates all Water Undertakers to provide a water connection for all domestic purposes upon application. New water service pipes and meters should be designed and installed at cost, but this process is typically provided using standard charges that reflect actual costs. Where there is no water main or a water main of sufficient size (within the adjoining public highway) a water main should be requisitioned under section 41 of the Water Industry Act 1991.

Under section 42 of the Water Industry Act 1991 a Water Undertaker must provide a financial contribution toward the capital cost of a new water main if this water main creates new billing revenue. The Water Act 2003 provides an additional model for cost sharing; the Discounted Aggregate Deficit contribution (DADS). Under both the Relevant Deficit (section 42 of the Water Industry Act 1991) and DADS models the sooner the new development occupancy is fully realised the sooner the water undertaker maximises its new revenue and therefore the greater the level of capital contribution from the water undertaker. Under the DADS model a capital lump-sum payment is made by the water undertaker in advance of the installation works (this is typically deducted from the capital project cost).

Whether a new connection application is through the incumbent Water Undertaker, a non-incumbent Water Undertaker or a new entrant (Water Supply Undertaker) all new connection activities can be broken into 'contestable' and 'non-contestable' operations;

Contestable Activities	Non Contestable Activities
Activities that can be designed and built by any accredited organisation (accredited through the Water Industry Regulation Scheme)	Activities can only be undertaken by the incumbent undertaker
Works are those that tend to be downstream of a point of connection to the existing network	

TABLE 8.1 – Water Contestable and Non Contestable Activities

A capital [DADS] contribution toward any new water main must still be provided whoever designs and builds the asset as defined in the Water Industry Act 1991.

Water and sewerage undertakers can also levy an 'infrastructure charge' against new water and sewerage connections to support strategic infrastructure projects that are triggered by organic small scale demand growth. Effectively Infrastructure Charges are levied against all new build and flat conversion projects where there is a net increase in water demand (Yorkshire Water Services' 2009 infrastructure charge is circa £300 per domestic water connection and circa £300 per domestic sewerage connection). This process was introduced behind the WIA 1991 such that small property developers and builders whom do not trigger new water main extensions will contribute to the overall network growth capital investment need such that this does not need to be captured in annual consumer price rises.

A water undertaker is mandated to alter (divert or protect) any asset to accommodate new development activities however all costs will be borne by the developer (except for Major

Transportation Schemes where the Utility Undertaker must always contribute at least 18% of the costs under the New Roads and Streetworks Act). Clearly in many circumstances the cost of diverting large or strategic utility apparatus will be prohibitive to development.

Water and Sewerage Undertakers submit a five-year Asset Management Plan (AMP) proposal that is determined by Ofwat. This Asset Management Plan (AMP5 – 2010 to 2015 – has just been determined) balances the level of consumer price rises that can be implemented to support capital programmes relating to network security, growth, pressure improvement, leakage, sewer flooding, water quality, odour and environmental improvement. Clearly there is political pressure to keep consumer price rises to a minimum and therefore once this 5-year plan is approved Water Companies cannot easily derive additional capital funding other than through third parties – developer funding is a significant contributor. It might be argued that there is pressure for Water and Sewerage Undertakers to maximise developer contributions but developers can only be recharged for costs associated with new water mains and service pipes plus any off-site infrastructure that will mitigate pressure losses or diminished security of supply to existing customers whom would otherwise be adversely affected by a specific development (as demonstrated through network modelling).

Water Undertakers occasionally align parts of their capital investment programme with major areas of new development for example a Sustainable Urban Extension (although not necessarily those allocated in a Local Plan or Development Framework as this does not carry any development – hence revenue - certainty). In this circumstance a water undertaker would typically recharge much of their initial investment to each developer that benefits from this new investment through a capital 'claw-back'; a form of roof tax to supplement the existing 'infrastructure charge' (which is a more indeterminate roof tax).

Once a capital scheme has been derived a **Water Undertaker** must contribute to the cost of the network improvement through the DADS or relevant deficit model (based on the value of the predicted new billing revenue) whether onsite, off-site or remote from site.

8.2 Sewerage And Sewage Treatment

Under Section 94(1) (a) of the Water Industry Act 1991, it is the duty of every sewerage undertaker "to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere)…as to ensure that the area is and continues to be effectively drained". This duty under Section 94 is supplemented by Regulation 4 of the Urban Waste Water Treatment Regulations 1994.

Under Section 98 of the Water Industry Act 1991, a sewerage undertaker is under a duty to provide a public sewer for the drainage of domestic sewage from a premise where a notice is served – commonly referred to as a requisition - by an owner or occupier or Local Authority. Where a requisition notice is served upon a sewerage undertaker the sewerage undertaker has, in effect, a period of six months from the day upon which any financial conditions which may be set are satisfied before it will be considered to be in default. The points of connection with the public sewer should be agreed between the parties, i.e. those making the requisition and the sewerage undertaker. The sewerage undertaker will likely identify a position that has the capacity to accommodate the new flows, which may not be the nearest sewer. In some instances the point of connection might be the Sewage Treatment Works itself however under a s98 'requisition' the Sewerage Undertaker must consider – in exactly the same way as a Water Undertaker – the new billing revenue and provide a capital contribution on the basis of a Relevant Deficit calculation (the detail of such conditions is set out in Section 99 of the 1991 Act). The duty to part-fund the 'requisitioned' sewer by the Undertaker should ensure that the proposal provides reasonable value. Unfortunately the developer tends to have little control over the process of sewer requisitions.

Alternatively a developer may elect to self-lay a new sewer and have it adopted by the Sewerage Undertaker under s104 of the Water Industry Act 1991. Under this act, a sewerage undertaker may agree with any person who is constructing or proposing to construct a sewer or sewage disposal works that, providing the sewer, etc. is constructed in the manner specified in the agreement, the undertaker will make a vesting declaration on completion of the work, or on some specified date or the happening of some future event.

The time-period for the vesting and adoption is typically 12 months from partial completion provided at least 50% of the design flow-rate is realised. A sewer that discharges to an un-

adopted sewer will not be adopted. Defects must be corrected by the developer or organisation who entered into the s104 agreement with the adopting authority. The point of connection to the existing sewerage network under a s104 application is determined by the sewerage undertaker and downstream network reinforcement may still be required by the sewerage undertaker once a new sewer is commissioned and vested.

The s104 'Adoption' process approximately follows the new process for the self-laying of water mains however a lump-sum capital contribution based on a Relevant Deficit or DADS contribution is not payable for sewers adopted under s104 of the Water Industry Act; the entire cost of the design and construction of the sewer is typically covered by the developer. Additionally both YWS and STW will charge 2.5% of the value of the works for approval of the system and supervision. Where a bond is required (typically private sector projects) this will be 10% of the value of the works to be adopted.

If pumping stations are required for adoption both YWS and STW will require 2.5% of the value of the works for approval and supervision and a 15% bond will be required.

Where a sewer must cross third party land the undertaker would serve notice on the relevant landowner(s). The sewer would be laid at cost price (taken by the developer) and YWS and STW would require 4.5% of the capital value of the drain for approval and supervision. In this case there may be a need to pay compensation to the 3rd party affected and any on-costs generated. Water and Sewerage Undertakers have rights to cross third-party land for all regulated activities unlike gas and electricity network operators who have no third party rights of access for new connection activities. The process for third party land access is an established procedure requiring a minimum 3-month notice and payment of all costs.

Under s185 of the Water Industry Act a Sewerage Undertaker has a duty to divert sewers to accommodate new development activities. The developer is expected to cover the full cost of moving the sewer. Sewers diverted in the horizontal plane must still be able to convey flows in the vertical plane to the gradients specified under Sewers for Adoption. YWS and STW will request 6% of the value of works for approval, supervision and adoption. There may be a need to pay compensation to 3rd parties depending on the works undertaken.

It is possible in some circumstances to agree build-over Agreements with the Sewerage Undertaker but there is no statutory duty governing this activity.

New primary legislation (the Flood and Water Management Bill) will shortly be introduced requiring the adoption of private sewers and other sewerage assets by the incumbent Sewerage Undertaker.

Sewerage Undertakers are mandated to invest in new infrastructure resulting from a development that has previously been allocated in a Local Plan. The allocated sites within a Local Plan (or Local Development Framework) should therefore be captured within the undertakers capital investment programme (currently AMP5 – 2010 to 2015) and therefore a Local Plan (or adopted Local Development Framework/Core Strategy) should be forwarded to the Sewerage Undertaker at the earliest opportunity to ensure that suitable investment is programmed within the next 5-year [AMP] programme.

Sewerage Undertakers will not contribute to new infrastructure that is being designed and built by a third party and adopted under s104 of the Water Industry Act but they will contribute to the capital cost of sewers that are requisitioned under s98 of the Act. The level of contribution is dependant on the number of properties within the development and the programme for construction and occupation.

The Sewerage Undertaker is not responsible for the surface water culvert network within Sheffield, instead this is the responsibility of the riparian land owner though which the culvert passes. Sheffield City Council does not operate any formal or regular inspection system on ordinary watercourses and culverts, except for those where the Council is responsible as the Highway Authority or riparian land owner. Where reports of blockage/debris are received, the Council will take appropriate action to try and ensure rectification by the relevant riparian owner. Where necessary, the Council will use its enforcement powers to ensure adequate maintenance of watercourses. The Council using the Land Drainage Act 1991 powers, may occasionally undertake such maintenance work, if there is an urgent reason to do.

8.3 Electricity Generation, Transmission And Distribution

The electricity industry in the UK is sub-divided into Retailing, Generation, Transmission and Distribution. The generation and retailing of electricity is market led at a national level and is largely disconnected from the process of new development or physical regeneration at a Regional, Sub-regional or Local level. Electricity generation investment needs are therefore excluded from this study. The exception to this rule is the decentralised generation and distribution of low to zero-carbon and renewable electricity, which is sometimes referred to as Distributed Energy but more commonly referred to as Decentralised Energy.

There is no mechanism for developer funding (or regional/sub-regional public sector support) at the national electricity transmission level however the licensed national electricity Transmission Network Operator - National Grid - is a stakeholder in this study in that their planned capital investment programmes may directly relate to Sheffield such that any modifications to their committed investment programme that might improve overall value for National Grid or increase development opportunities within Sheffield should be encouraged. National Grid own and operate transmission assets largely at 400kV and 275kV where it is transformed down to 132kV or below at Grid Supply Points.

It is the responsibility of the fourteen licensed Distribution Network Operators (DNOs) to maintain and operate distribution networks to support population growth and economic growth to ensure suitable and secure connections (under section 16 of the Electricity Act 1989 a DNO also has a duty to connect – for import or export purposes - any premises that requires electricity for domestic purposes). In order to meet their requirement to provide fit for purpose new electricity connections, and maintain a fit for purpose, safe and secure network for existing electricity consumers each DNO will frequently require major investment from the developer supply chain. This reliance on developer funding to meet population and employment growth often has a cumulative impact on Sub-regional and Local Authority planning and development strategies, which can be very substantial.

The incumbent or 'host' DNO for nearly all of Sheffield is YEDL, owned by CE Electric. A small area to the South is operated by Central Networks, owned by E.ON. Each of these operators has an inherited network aligned to the former UK's Regional Electricity Companies. Each of these operators has been consulted extensively in this study.

Recently the distribution market has been opened up to *independent* Distribution Network Operators (iDNOs); Ofgem has granted licences to Connect, GTC and Energetics amongst others. Now it is possible for non-incumbent and independent network operators (both referred to as iDNOs) to design, build, own and operate new distribution networks to support new development within another operator's geographical area – this mechanism is commonly referred to as an *Embedded Network*. Although relatively immature this market appears to be delivering a reasonable level of competition.

Irrespective of whether the host DNO or an iDNO are elected to own and operate (adopt) a new electricity distribution network, the design and build of new connection works and all works downstream of a connection to an existing network can be undertaken by any accredited contractor - often referred to as an *Infrastructure Connections Provider* (ICP) – this is similar to the water and gas new connections market whereby all new connection activities are classified as 'contestable' and 'non-contestable'. Contestable works are those that can be undertaken by an ICP but non-contestable works can only be undertaken by the host DNO (live connections and all upstream reinforcement).

Distribution Network Operators and Transmission Network Operators receipt revenue through an agreed percentage of consumer bills (a Distribution Use of System – DUOS - charge appears on each of our bills).

If a developer wants to ensure that sufficient capacity is available on a network for a future date (or development site) an 'Availability Charge' might be paid, typically a monthly payment to the host DNO (currently circa £0.45\kVA per annum) until all new connections are completed. Availability charges are typically paid by landowners where previously a large electrical demand existed and they wish to retain this capacity for a future development and is typically reserved via an Availability Charge at a specific meter point. Should a developer want to reserve supply capacity (for example when it is known that there is only limited capacity at an existing Primary Substation) then applying for new infrastructure on a speculative basis is not sufficient to secure capacity indefinitely (a standard Connection Agreement often stipulates that the agreed capacity has a finite time-line of typically 5 years, occasionally less). The Availability Charge is considered equitable by Ofgem because a DNO should not have to operate and maintain assets where they will receipt zero revenue.

Frequently a new developer will be required to purchase infrastructure – such as a Primary Substation or new extra-high voltage (EHV) circuits/cables – which delivers much more additional capacity than is required, in this case the DNO should fund the element not directly attributable to the new development. This 'apportionment' activity is usually achieved on a pro-rata basis, i.e. a developer requiring 10MVA would have to pay for 1/3 of a 30MVA Primary Substation. Occasionally if a DNO believes that they will not recover their 2/3 share investment they may try to recharge the whole investment need to the principal developer and trust that the developer recovers some of their investment via the 'Apportionment Rule'; the 'Apportionment Rule' allows a developer to recover their initial investment on a pro-rate basis for a period of only 5-years.

For example if Developer A invests £5m in a 30MVA Primary Substation and Developer B requests a 15MVA application within 5-years of the Primary Substation being commissioned then the DNO will reimburse Developer A on receipt of a lump-sum from Developer B. Most importantly any developer should only consider the supply capacity needed within a 5-year window – any investment beyond this is typically at risk (because of the 5-year Apportionment Rule and the likely 5-year limitation on Authorised Supply Capacity in a standard Connection Agreement).

If an Availability Charge is not paid but a large lump-sum payment is paid to secure off-site reinforcement to support a multi-phase (or speculative) development and during this development another of the developers requests a new connection on the same network there will be a risk that the second developer may utilise the spare capacity created such that the first developer may have to fund further network reinforcement. However, this practise should in part be mitigated by the 'Apportionment Rule' that has been operating since 2005.

When an independent or non-incumbent DNO is requested to provide an embedded network this non-incumbent network operator may be encouraged to contribute to the design and build costs of the new mains and services. This 'asset value' contribution is often viable because the embedded network will generate a new revenue stream based on the distribution of electricity to an end-user.

All electricity Distribution Network Operators submit a 5-yearly Development and Price Control Review (DPCR) to Ofgem for approval in exactly the same way as Water and Sewerage Undertakers submit their proposed 5-year capital investment programme to Ofwat such that DPCR5 matches AMP5 in the water industry, i.e. 2010 to 2015. Ofgem's 5-yearly determination

limits the capital investment programme to minimise consumer price rises but should allow for investment to meet organic growth (usually an extrapolation of actual load growth on each of the primary networks during the preceding 5 years NOT development projects allocated in Local Plans or Local Development Frameworks - unless an 'Availability Charge' is being paid). A DNO does not usually invest in specific development projects unless this investment can be clawed-back through further developer applications – even then a DNO will not forward-fund network reinforcement attributable to new development until actually triggered by a formal new connection application.

The approved 5-yearly capital investment programme is published in a Long Term Development Statement (LTDS) which summarises the committed investment programme for the next 5-year period. The LTDS contains information on all strategic assets, capacity and forecast demands and is a good indicator whether planned works will benefit developers.

It might be noted that the industry consultation behind DPCR5 (2010-2015) had an extended discussion on the level of price rises that could be accommodated in order to deliver network investment to meet an anticipated very significant increase in applications from Distributed Generators (decentralised energy operators).

8.3.1 Decentralised Electricity Distribution Regulation

Operators of Decentralised Energy systems that generate electricity such as Combined Heat and Power plants often seek to utilise a 'private wire' network as a means of distributing electricity for maximum revenue rather that exporting electricity to the local distribution network at a much lower wholesale price. It should be noted however that these plants are often backed up by traditional grid energy connections in order to provide security of supply.

The electricity market allows for exemptions from the requirements to hold generation, transmission, distribution and supply licenses. Sale of electricity to end consumers by an unlicensed supply company through an unlicensed distribution network is known as "private wire". On these networks customers are unable to change. Many ESCos operating decentralised heat and power networks preferred model for electricity distribution has historically been to utilise the exempt licensing regime and establish 'private wire' networks.

The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001 governs the exempt licensing regime, which enables exempt generators, distributors and suppliers to supply electricity that they generate and distribute themselves directly to customers rather than to a licensed supplier (the grid).

- The Electricity Act 1989 authorises the Secretary of State for Trade and Industry to make Orders under the exempt licensing regime.
- Amendments to this Order do not require primary legislation.
- Amendments to this Order can be enacted at any time by the Secretary of State
- for Trade and Industry.
- Since 1995 the Secretary of State for Trade and Industry has enacted three Orders, the 1995, 1997 and 2001 Orders progressively relaxing the exempt licensing regime and the barriers to sustainable energy.

8.3.2 Existing Exempt Licensing Limits

The existing exempt licensing limits are, as follows:

- An exempt generator can generate up to 50MW of electricity per site without Secretary of State approval and up to 100MW per site with Secretary of State approval.
- An exempt generator can distribute and supply exempt electricity from each generating site directly to customers, on site and over private wire up to 50MW (or up to 100MW) of which no more than 1MW (1,000 households) can be supplied to domestic customers. For example, up to 49MW can be supplied to non domestic customers but only 1MW can be supplied to domestic customers per site. Hence generally schemes above 1MW would need separate private wire networks to be installed; this is commercially prohibitive for developers and not in the consumers' best interest.
- An exempt generator can distribute and supply exempt electricity directly to customers over public wires up to 5MW in aggregate of which no more than 2.5MW (2,500 householders) can be supplied to domestic customers.

Private wire networks result in the consumer being locked into the private wire operator for their electricity supply restricting their freedom of choice in appointing a nominated supplier and benefiting from the competitive 'switching' market. Private Wire contracts can be linked to RPI or local network distribution supply prices.

Private wire contracts are typically index linked such that they represent a competitive alternative supply arrangement for the consumer. This is typically negotiated on the basis of the alternative supply arrangements afforded to the consumer and the term of the supply contract.

8.3.3 Current Installed Decentralised Electricity Generation in Sheffield

A significant barrier to Decentralised Energy and the generation of low carbon and renewable electricity can be the ability of existing electricity infrastructure to accommodate the export of decentralised electricity production onto the grid without major network reinforcement.

The national electricity distribution networks are dominated by conventional generation that injects large amounts of power into the extra high voltage transmission network, where it is transported to localised distribution networks, and delivered to end consumers at a number of voltage levels.

Decentralised Energy generation can represent a number of technologies with varying operating patterns that may be very different to the traditional generators and will likely be connected at every level of the distribution network.

Integration of these new resources into all aspects of the power system will be the key to ensuring the evolution of an economically efficient and effective system based on sustainable generation sources.

- Capital investment to accommodate export
- Current proposals to address and facilitate export
- Cost burden is with the generator although this may typically be levied by the generator to the developer or consumer

Currently the YEDL 2007 LTDS identifies 70.4MW of Decentralised generation that is connected to the YEDL network at Bulk Supply Points within Sheffield. This does not include small micro generators.

There are enquiries for connection of up to 108MVA of generation listed in the 2007 LTDS which includes the Blackburn Meadows Biomass Power Station.

Grid Supply Point	Bulk Supply Point	Primary s/s	Connection Voltage (kV)	Installed Capacity (MW)
Sheffield City	Sheffield City	Victoria Street	11	2.0
Thurcroft	Thurcroft	Beighton 1&2	11	1.0
		Costhorpe	11	0.3
		Edlington	11	8.4
		Harworth 11kV	33	31.6
West Melton 66kV	West Melton	Houghton Main	11	5.2
West Melton/Thorpe Marsh	Attercliffe	Bernard Road	11	21.0
	Blackburn Meadows 132kV	Blackburn Meadows 11kV	11	1.0
Total Sheffield Grid Connected Distributed Generation				**70.4**

TABLE 8.2 – Sheffield embedded generation data connected to YEDL network[25]

Source Substation	Status	Total No	Capacity (kVA)	MVA
Blackburn Meadows B	Budget estimates provided	2	63200	63.2
Neepsend	Current connection applications	1	5800	5.8
Thurcroft	Budget estimates provided	3	39200	39.2
Total Sheffield Enquiries for Connection to the YEDL network				**108.2**

TABLE 8.3 – Sheffield enquiries received for connections to the YEDL network[26]

[25] Embedded Generation data is based on YEDL Long-term development statement October 2007 Appendix 7: Distributed Generation Data

[26] Future Connection enquiries is based on YEDL Long-term development statement October 2007 Appendix 8: Table of Third Party Interest for a Connection

8.3.4 Renewable Obligation Certificates (ROC)

The Renewables Obligation is a Government initiative to encourage more renewable electricity generation and is an electronic certificate based scheme. One certificate, known as a Renewable Obligation Certificate (ROC), is issued for each megawatt hour (MWh) of renewable electricity generated.

Electricity suppliers need these certificates to meet their obligation under the scheme – which is to demonstrate that they have supplied a proportion of their electricity from renewable energy sources. Suppliers can obtain their certificates from different sources, for example traders, or direct from small generators.

The value and allocation of ROCs varies according to the source renewable of electricity production (i.e. wind turbines, PV, Biomass, Bio-gas etc.) and the scale of production (e.g. above or below 50kW) the weighting and value of ROCS is reviewed regularly. It is dictated by the market and could be as much as £40 or as little as £15.

8.3.5 Feed in Tariffs (FITs)

Feed-in tariffs are new measures introduced by the government to support the uptake of micro-generation technologies in the UK. The design and implementation of feed-in tariffs is currently being discussed as part of the government's 'Department of Energy & Climate Change website' and could be subject to change prior to their introduction in April 2010. FITs are a form of financial support to increase the uptake of small-scale renewable generation (<5MWe) to support delivery of the UK's 2020 renewable energy targets. The mechanism provides renewable micro-generators with a 20 year guaranteed per unit support payments (pence/kWh) for renewable electricity generation with current consultation suggesting that suppliers should offer customers a guaranteed minimum export payment of 5p/kWh.

8.4 Gas Supply, Transmission And Distribution

The gas connections market is the most liberalised of all of the three key utility services; possibly because this industry was privatised before water and electricity and possibly because the regulator has been arguably stronger in regard to Competition in Connections generally. Since the restructuring of National Grid Transco the national gas distribution network has been divided into four regional components (these regional distribution networks were always managed by Transco). Scotia Gas Networks acquired the gas transportation (GT) networks in the South of England and Scotland (since renamed Southern Gas Networks and Scottish Gas Network – SGN). Wales and West Utilities acquired the Welsh and West of England gas transportation network. Northern Gas Networks acquired the North of England. The four remaining gas transportation regions largely in the central parts of England were retained by National Grid - this includes Sheffield. National Grid also operates the National High-Pressure gas transportation network and the National Electricity Transmission System.

All infrastructure works downstream of a point of connection to an existing network are contestable (including the point of connection itself), and can be installed by an Independent Gas Transporter (iGT) or accredited (GIRS) contractor. Usually an iGT will contribute to the cost of this asset based on the revenue stream generated by the proposed masterplan. Again this maximum new revenue stream that can be generated is based on the rate of occupation of the new premises; the quicker the occupation the sooner iGT revenue will be maximised and therefore the larger the capital contribution will be.

The gas industry in Britain has evolved to a point where many alternative connection services are now available on a competitive basis, while National Grid Gas continue to offer connection services in line with their obligations under the Gas Act 1986 (as amended 1995). Operating under the Gas Act, National Grid Gas have an obligation to develop and maintain an efficient and economical pipeline system and, subject to that, to comply with any reasonable request to connect premises, provided that it is economic to do so.

A developer can request a new connection via National Grid Gas (operator of the regional distribution network containing Sheffield) or via an independent network operator (iGT – independent Gas Transporter). Typically domestic new connections will require low-pressure natural gas connections from low-pressure networks however medium-pressure connections are

frequently obtained for larger developments (an onsite pressure-reducing facility should be installed – this requires very modest land/rights of access for the operator). Gas networks are designed to convey specific volumes of gas therefore higher pressure networks will typically require smaller diameters to supply the same quantity of gas.

In many instances, specific system reinforcement may be required to maintain system pressures for the winter period after connecting a new supply or demand. Depending on scale, reinforcement projects may have significant planning, resourcing and construction lead-times and that as much notice as possible should be given. In particular, National Grid Gas will typically require two to four years' notice of any project requiring the construction of high pressure pipelines or plant, although in certain circumstances, project lead-times may exceed this period. This is unlikely to affect proposed developments contained within this study (national gas transmission is largely unaffected by developer activities unless existing high-pressure assets need protecting or diverting to accommodate new development). Developer activities may impact on Intermediate Pressure (IP) mains and certainly Medium Pressure (MP) mains and Low Pressure (LP) mains; a Pressure Reducing Station (PRS – also known as a Gas Governor) is used to reduce pressure for distribution purposes.

The demarcation between contestable and non-contestable works is again the point of connection to the network however the actual connection to the network is now a contestable activity therefore there is significantly fewer risks using self-lay, multi-utility and embedded networks in the gas industry.

Embedded networks in the gas industry are construed as normal practise with few risks. Most residential, commercial and mixed-use development in England, Scotland and Wales utilise independent gas transporters (iGTs) to design, build and operate gas networks on new development sites. The market is currently led by GTC Utility Networks and Connect Utilities.

The reason that iGT led Embedded Networks have become popular in the gas sector is that all iGTs typically offer a large capital contribution toward the contestable works (and the non-contestable works are mostly funded by the incumbent GT). The level of contribution is based on the number of properties being constructed and the occupancy programme. In some instances developers pay no contribution for new gas mains and services.

Gas Distribution Network Operators review local plans as they are released in order to influence longer term strategic planning of their network (5 year Development Price Control Review - DPCR), however specific development led strategic infrastructure will not be designed and constructed until triggered by the development itself. National Grid have confirmed that the Barnsley network reinforcement scheme due to be undertaken in 2011 \ 2012 will benefit Sheffield, while ongoing mains replacement programmes will also create additional network capacity to accommodate organic growth within Sheffield.

In each 5 year DPCR programme a **Gas Distribution Network Operator** will consider the need for development led growth, however unless a specific project or major development comes on-stream, the model is likely to remain fairly stable over the 5 year period.

Gas connection applications for large sites, or large energy users, will trigger a Design Study which may in turn trigger an Economic Test to understand what levels of off-site network reinforcement are triggered by a specific application and what capital contribution will be forthcoming from National Grid. This is commented upon in Chapter 6 but in most instances – and certainly where the application for gas is more modest – National Grid will entirely fund all upstream gas distribution and transmission investment needs. Where a contribution is required from a developer this might be shared with an independent Gas Transporter (iGT) such that the developer does not contribute significantly. It has been suggested that very large sites be broken into phased applications to reduce this risk further.

8.5 Heat Distribution Regulation

There is currently no separately regulated market for heat in the UK, unlike electricity or gas. Direct sales of heat, for example by district heating or CHP operators, take place within the economy's general regulatory framework in regard to competition and consumer protection.

In the absence of such regulation consumers of district heating do not have the protection provided to gas and electricity consumers by the licensing framework administered by Ofgem; commercial heat customers do not operate in a market like gas markets with many alternative sellers in competition, published reference prices etc.

A district heating provider needs to establish contractual arrangements that, in the case of gas or electricity supply, would normally be subject to regulatory control, in particular:

- quality and continuity of service (including protections for consumers during supply outages)
- the basis for setting prices in the long term
- metering and billing
- dispute resolution

Energy Service Agreements (ESA) establish the arrangements for energy supply and charging as well as contract duration. These arrangements are currently typically negotiated on a case by case basis.

Once connected to a district heating network, customers are unlikely to be able to switch between suppliers and benefit from market competition to obtain lowest cost energy supply in the way that gas consumers can.

The Government recognises the importance of protecting district heating customers to ensure consumer confidence, good quality of service and reasonable prices (DECC 2009).

Whilst there has been some support for a regulatory framework to protect the interests of consumers it is widely felt that heavy regulation would prevent innovation in an undeveloped market and that any regulatory framework in the future should not be intrusive or heavy-handed although government recognises that in the future a more structured approach may be required as the industry develops[27] .

At present the Government therefore proposes a forum to monitor heat markets and to identify any necessary action. This forum will include representation from industry, consumer interests, including Consumer Focus, and regulators, including Ofgem. The proposed forum will look at all aspects of heat supply. Specifically, as its first task, the forum will be asked to provide advice on the consumer and other issues regarding district heating and to facilitate an industry code for district heating.

New development in Sheffield of sufficient size and scale including sites such as Waverley may consider utilising new District Energy (DE) infrastructure provision. This would likely be procured via an Energy Service Company (ESCo) or Multi Utility Service Company (MUSCo) and could be undertaken either in a partnership arrangement with local authority or via contracting the private sector.

8.5.1 Renewable Heat Incentive (RHI)

To meet the UK's 2020 15% renewable energy target, there is a need to develop new ways of generating renewable energy including heat. Heat generated from renewable sources accounts for only 0.6% of total heat demand at present and it is forecast this may need to rise to as much as 12% for the UK to achieve legally binding EU targets.

Expansion of renewable heat is anticipated to require some form of financial assistance because other forms of heat (such as gas) are currently cheaper. Such support will allow more people to afford renewable heat and, by expanding the market, help bring costs down more quickly. Common examples of renewable heat technologies include: air and ground-source heat pumps, biomass fuelled stoves and boilers, solar-thermal water heaters and combined heat and power (CHP) plants which use renewable fuels.

Powers in the Energy Act 2008 allow the setting up of a Renewable Heat Incentive (RHI) which is seen as important to delivering low carbon and renewable heat that is accessible, flexible and user-friendly as possible to encourage investment in renewable heat at all scales.

The Act allows the RHI to provide financial assistance to generators of renewable heat, and producers of renewable biogas and biomethane.

Details of the scheme have not yet been finalised, however, the following will be the likely key features:

- It is expected that the incentive will apply to generation of renewable heat at all scales, whether it is in households, communities or at industrial scale.
- The incentive should also cover a wide range of technologies including biomass, solar hot water, air- and ground-source heat pumps, biomass CHP,

[27] DECC 2009

biogas produced from anaerobic digestion, and biomethane injected into the gas grid.

- The incentive will apply across England, Scotland and Wales (Northern Ireland will need to develop their own legislation.)
- The RHI will be banded for example by size or technology (e.g. larger scale biomass heat may require less support per MWh than others).

The incentive payments will be funded by a levy on suppliers of fossil fuels for heat. These are mainly licensed gas suppliers but also include suppliers of coal, heating oil and LPG.

Through a consultative process, Government proposes to develop the detailed design of the RHI which will be set out in regulations to be approved by Parliament. It is proposed to have the RHI in place by April 2011.

8.5.2 Carbon Reduction Commitment (CRC)

CRC is a mandatory scheme and it places legal obligations on large organisations in both the public and private sector to disclose information in energy usage and to report on emissions and purchase allowances from Government. Any organisation that does not comply with its legal obligations under CRC will be subject to financial penalties.

Organisations must report their actual carbon emissions each year and surrender allowances to cover to their reported emissions. During the introductory phase, allowances are to be sold at a fixed price of £12 per tonne of CO_2. Following the initial sale period, participant organisations can buy or sell allowances by trading on the secondary market.

8.5.3 Climate Change Levy (CCL)

The Climate Change Levy (CCL) was introduced in April 2001 as an energy tax that adds approximately 15% to typical energy bills of UK businesses. The CCL is a key part of the UK government's strategy to promote energy efficiency and reduce greenhouse gas emissions. The CCL is applied to electricity, gas, coal and Liquid Petroleum Gas (LPG), but is not applied to any domestic supplies.

8.5.4 Energy Service Companies (ESCos)

An ESCo provides a flexible vehicle to assist in the delivery and operation of low carbon infrastructure such as CHP, district heating and the operation of renewable energy systems.

ESCos are private companies or partnerships (with the public sector or communities) who can deliver varying levels of input to District Heat and Power schemes including project design, capital finance, construction, management, fuel purchasing, billing, plant operation, maintenance, long-term replacement and risk management. ESCos typically provide capital finance to projects on the basis of long-term revenue derived from energy supply contracts with consumers.

The flexibility inherent in the ESCo concept can be used to create a structure which is aligned with the development partners and stakeholder's overall vision and strategy for developing low carbon infrastructure and infrastructure services. For example, a number of local authorities in the UK have established their own ESCos, whereas others have engaged with existing (private sector) ESCos through various contractual arrangements.

A specialist operator might be preferable when CHP or biomass plant is proposed given the need to ensure systems perform efficiently and are commercially viable. The use of biomass fuels requires dedicated short, medium and long term supply strategies and arrangements that maintain security of supply and competitively priced energy although partnerships with local biomass fuel suppliers may be explored to develop a secure long term renewable fuel supply.

Three indicative ESCo models are illustrated below.

MODEL 1: PUBLIC SECTOR DRIVEN ESCO

In this model, a public sector body establishes the ESCo, and retains a significant (and possibly controlling) interest in its ownership and/or management. This model is particularly useful where a market driven solution would not realise a developers or Local Authority's aspirations for the development. For example, if the local authority wishes CHP/district heating schemes to be implemented on small individual sites that in the short term are less commercially viable so as to be capable of subsequent integration, it will need to have sufficient control over the ESCo to ensure that outcome.

This model requires significant commitment and resources from developers/stakeholders. Professional advisers would normally be required in order to establish the ESCo, run a competitive procurement for the design and construction of the infrastructure (and possibly the subsequent operation and maintenance of the assets), and to negotiate the various agreements.

EXAMPLE

Woking – Revolving fund within Woking Council set up Thameswey Ltd to be the contractor and they in turn set up TW Energy private/public joint venture, private wire network.

MODEL 2: A PRIVATE SECTOR DRIVEN ESCO

In this model, the ESCo is established, controlled and managed entirely by the private sector. This model is appropriate where the developer/stakeholder is confident that a market driven solution will meet its objectives, or is keen to transfer responsibility and risk in its approach to engaging with the private sector.

The resource time and external costs would be much lower for this type of ESCo, in which the solution is principally driven by the private sector. Some in-house resources and technical support would be required, for tendering and appointing an appropriate private sector provider and ensuring best value for money. Where the developer or stakeholder (such as a Local Authority) wishes to take a supply from the ESCo for its own building(s), there will be an interface to be managed (similar to any other interface with a services provider).

EXAMPLE

Titanic Mill Private development set up Mill Energy Services Limited who will own, operate and maintain the heat and energy systems. Shares in the company will be transferred to residents on the development when the properties are sold.

MODEL 3: PUBLIC SECTOR AS FACILITATOR
In this model, a public sector body facilitates the establishment of, or engagement with, an ESCo, but does not play a significant role in its subsequent ownership or management. This represents a compromise between models 1 and 2 in terms of the resource implications for the Local Authority - and the control which it can exert over outcomes - but there is considerable room for manoeuvre based on what is being procured and the precise nature of the facilitation role that the local authority would adopt.
EXAMPLE
Southampton Company limited by shares owned and operated by Utilicom joint co-operation with City Council **Birmingham District Energy Company** **Barkantine** Company limited by shares - owned by EDF appointed by LB Tower Hamlets for 30 year term after tender process PFI for energy services

Where an ESCo is undertaking or funding significant capital works, the contract term will typically be 15, 20 or 25 years although examples of 125 year contracts in line with leasehold tenancy are available. The contract term will need to be sufficient to ensure any ESCo secures a return on its capital.

A flexible and adaptable approach to energy generation technology will benefit both the consumer and ESCO over the contract term as advances are made in the fields of renewable energy and plant efficiency.

ESCo Procurement Model

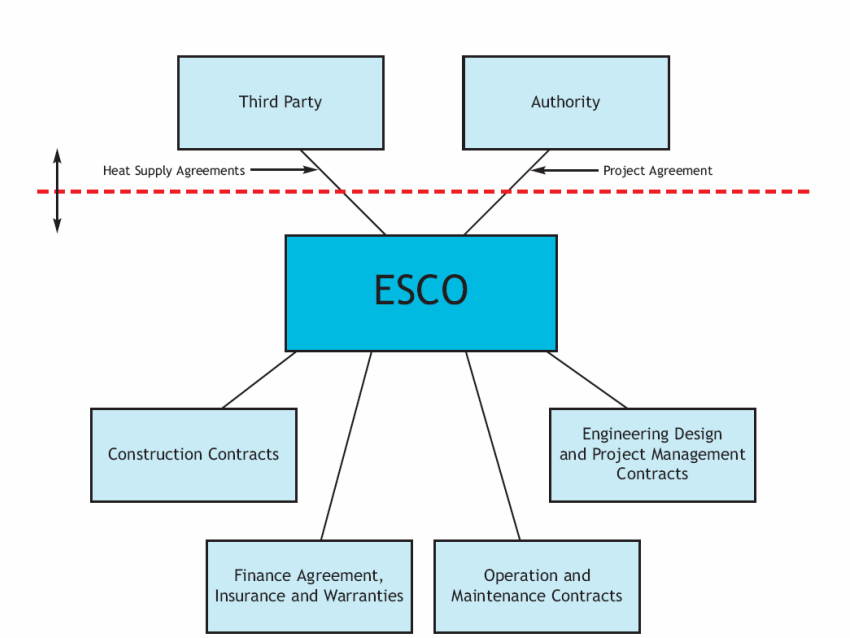

FIGURE 8.1 – ESCo Procurement Model[28]

8.5.5 Financial models and mechanisms

Contributions to capital design and build costs provided by an ESCO can vary significantly on the basis of the particular terms of contract and establishing a suitable capital repayment and energy charging framework for all stakeholders. Contracting an expert provider can enable a transfer of risk away from developers and landowners to the private sector and enable a preferential financing arrangement, however it will necessitate a long term commitment for the delivery of energy services (normally >10years).

Experience to date has been one of developers looking to Local Authorities (or other sources of funding, e.g. Regional Development Agencies) to fund the additional cost of new district heating

[28] GPG377 Good Practice Guide: Guidance on Procuring Energy Services to Deliver Community Heat and Power Schemes © March 2004

infrastructure over and above that which they would have had to incur in laying a conventional network.

It may be possible to achieve best value for money by using market competition to dictate the amount of capital contribution from potential ESCo providers. The extent and complexity of the required network, fuel supply sourcing and consumer arrangements will impact on the levels of capital contribution made by an ESCo, which is calculated based on the revenue stream generated by the sale of heat and power in relation to the operational and capital replacement costs. Upfront capital contributions will be significantly affected by phasing and programme of development as well as the particular terms and duration of the energy services contract. Contributions toward initial capital design and build costs might be made.

An alternative to the above procurement mechanisms is being considered for the London Thames Gateway Heat Network, and is a joint venture between the following parties to develop a network which will connect diverse sources of affordable low/zero carbon heat to existing and new development.

- London Development Agency
- Greater London Authority
- London Thames Gateway Development
- Corporation
- Department for Communities and Local
- Government
- London Energy Partnership
- Barking Power Ltd
- LB Newham
- LB Barking & Dagenham
- LB Havering
- Barking Riverside Ltd
- Combined Heat and Power Association

The first source of heat is intended to be Barking Power Station, whereby heat normally rejected during electricity production will be distributed to up to 120,000 homes via 23km of district

heating network. Aspirations for inclusion of additional heat sources from Biomass CHP, other existing power stations, waste to energy and surplus heat from industrial processes is currently being investigated.

The London Development Agency (LDA) are to use their existing capital to seed the initial funding for the project, and to leverage additional funding from EU and UK sources. In the Thames Gateway, the Economic Development Infrastructure Plan (EDIP) is seen as a mechanism to provide match funding through the Joint European Support for Sustainable Investment in City Areas (JESSICA) fund. This is an example of a funding stream the LDA hopes to access to develop this scheme.

8.5.6 Indicative costs of new DE Infrastructure

The capital investment need of Decentralised Energy is difficult to estimate at this stage with any degree of certainty. Variations in the specific requirements and arrangements for supply of heat and power including contract duration, ownership and operational models will have a significant impact on the actual costs of DE infrastructure. Cost associated with heat infrastructure is considered to represent the most significant investment need sometimes exceeding 60% of costs.

Benchmark costs for DE infrastructure of £5,800 per dwelling or £89 per m^2 for commercial development might be assumed.[29]

Item	Energy Centre	Electrical Connection	Heat Network	Internals	Consumer Connection	Total
Residential (£/dwelling)	£1,400	£100	£2,200	£1,900	£200	£5,800
Commercial (£/m^2)	£16.5	£1.75	£50	£17.5	£2.75	£89

TABLE 8.4 – Indicative costs for DE infrastructure

[29] Costs based on mid range value given in EST Community Heating and Planning for Developers.

Additional costs to reinforce any local utility (gas and electricity) networks may also be levied and are typically at the burden of the developer not the ESCo.

8.6 Telecommunications

The main statutory instrument governing telecommunications is the Telecommunication Act 1984. This Act was passed by the government in 1984 to licence British Telecom when it was split off from the Post Office and privatised, and to provide a framework for promoting competition. Since that time other telecommunications network and service providers have been licensed, and now there are over 300 licensed companies. These licenses are monitored and when necessary amended by OFCOM.

A recent addition to these licensed telecommunications operators is Digital Region Ltd, a partnership between Yorkshire Forward, Barnsley Metropolitan Borough Council, Doncaster Metropolitan Borough Council, Rotherham Borough Council, and Sheffield City Council to provide a new fibre communications network; wherein the framework to design, build and operate this network and undertake all retaining activity has been awarded to Thales.

Digital Region Ltd has a major capital investment programme which includes the installation of a new physical network between a new regional hub in Doncaster and all Principle Connection Points in Sheffield between February 2010 and April 2012. All BT Telephone Exchanges will be connected as part of this.

New connection activities in the telecommunications market are typically provided as a marketable commodity by most of the Tier 1 infrastructure providers such as Virgin Media, Cable and Wireless and therefore the cost of all new connection services, cables and ducting, plus any off-site works or upstream reinforcement is wholly rechargeable to the applicant.

BT Openreach will generally not install infrastructure to accommodate new development until such times as the development has received planning approval and is due to commence onsite. Typically BT Openreach will contribute £3,600 per unit capital contribution to cover the cost of any offsite reinforcement. Therefore whether development projects are allocated in Local Plans or Local Development Frameworks will not have any bearing on whether BT Openreach would

forward fun infrastructure to accommodate growth. It will be dealt with as and when a formal application is received for new development infrastructure.

Fibre to the Home or Fibre to the Unit can be installed by a number of independent providers (in addition to Openreach, Digital Region or Virgin Media) some of whom will contribute significantly to the capital cost of all off-site and onsite fibre cables and ducts, for example Independent Fibre Networks. Typically however these operators will not contribute significant capital if BT Openreach apparatus is also being installed into the same development site.

Digital Region Ltd has not defined how they will undertake new connections for developer led activity and how costs will be apportioned between themselves and the applicant.

8.7 Multi Utility Operations

Throughout this section – certainly within the water, gas and electricity sections – most new connection activities were divided into contestable and non-contestable works, i.e. those works that can be designed and installed by an accredited contractor and those works that can only be designed and installed by the incumbent undertaker. Many of the 'accredited' contractors are accredited to undertake contestable gas, water and electricity operations, i.e. they are accredited through the Gas Industry Regulation Scheme (GIRS), Water Industry Regulation Scheme (WIRS) or Lloyds [electricity connections] Scheme. These contractors will be accredited to undertake design and/or installation and/or project management. Each of these contractors can therefore be commissioned to design and/or install and/or project manage all water, gas and electricity new connections on new development sites. As part of this activity telecommunication ducts and jointing chambers can also be installed to a BT Openreach specification. Unfortunately the diversion or alteration of existing services is largely non-contestable as is most types of upstream network reinforcement.

Although this type of operation is not often significantly cheaper than traditional connections it might be argued that a developer has slightly more control over this type operation (or the multi-utility undertaker has a better relationship with the incumbent undertaker and can deliver new connections faster). There is no additional legislation or regulation governing this type of activity. Multi-utility installed networks can be adopted by incumbent or non-incumbent/independent operators providing the correct protocol is followed throughout.

9 Conclusions and Recommended Next Steps

9.1 Traditional Water, Sewerage, Gas And Electricity Infrastructure

The key risks associated with the provision of new utility services to meet the SDF are insufficient sewage treatment capacity and insufficient electricity distribution network capacity.

Although changes to planning policy will result in more energy efficient development taking place in the future, including the reduction in annual water and energy demands, peak demands will not reduce as significantly. Utility infrastructure design is generally undertaken based on peak demands rather than annual demand, and therefore infrastructure design (and therefore capital investment need) is unlikely to alter very significantly as a result of energy efficiency.

In both of these cases the relevant statutory undertakers (Yorkshire Water Services and YEDL) have committed to capital investment programmes either in 2010-2015 (AMP5/DPCR5) or 2015-2020 (AMP6/DPCR6) that will in-part mitigate the need for significant developer contributions; to benefit from these planned capital investment works the delivery timeline for a number of sites must be carefully considered.

This is particularly true for the extension of existing sewage treatment works as the very high capital costs associated with these activities would certainly not be fundable through the developer supply chain and therefore development will be effectively frozen until these improvement works are completed. Those sites that might be affected by lack of sewage treatment capacity are those located within the Handsworth and Woodhouse, Stocksbridge, Gleadless Valley, Beighton and Mosborough, and Hackenthorpe clusters. Full reference should be made to section 6 of this report which identifies the affected sites, sewage treatment works and catchments. Part III of this report provides site by site analysis.

It is important that any new allocated site gets adopted within the Sheffield Development Framework at the earliest opportunity as this effectively mandates the Sewerage Undertaker to invest in sewage treatment facilities. Adoption of the Sheffield Development Framework in 2013 should allow any further investment in Sewage Treatment facilities within AMP6 (2015 to 2020).

Those sites that are at risk of triggering substantial new investment in electricity distribution networks are highlighted in Section 6.1.5 together with the development sites that should benefit from YEDL's stated capital investment programmes.

As development of the sites listed in 6.1.5 may trigger a significant capital investment need, Creative Sheffield and Yorkshire Forward should consider how critical these sites are to the economic development of Sheffield to understand whether the economic benefit of early development outweighs the additional capital funding that will be required should early development be necessary.

If the critical development sites listed in 6.1.5 are to be brought forward then Creative Sheffield, developers or other agencies should ensure that the occupation schedule for each new development is fully understood. YEDL must be comfortable that a revenue stream will actually be generated otherwise any investment may be deemed speculative such that the capital Apportionment Rule may not be applied (i.e. a return on one parties' investment will not be considered where another party benefits from this investment). Further a speculative application may not securely ring-fence supply capacity for a particular development. Investment risks can still be mitigated by the primary investor entering into a Collaboration Agreement with other developers or through the payment of an Availability Charge but this mechanism for securing the claw-back of capital is much more onerous and expensive.

The most important activity is for Sheffield City Council Forward Planning to maintain a dialogue with each of the incumbent utility undertakers to share demand forecasting data, spatial planning data (including sites for new infrastructure) and to explore multi-stakeholder value engineering opportunities including joint forward investment initiatives within or outside current regulated frameworks – the latter might be considered an economic development activity and might be undertaken via Creative Sheffield or Yorkshire Forward.

Sheffield City Council should ensure that the GIS database supplied as part of this study is kept in a contemporary format.

9.2 Procuring District Energy Infrastructure

District Energy can potentially play a crucial role in the delivery of a low carbon Sheffield and the city has a valuable asset in its existing district heating network. It is recommended that further information from Veolia is ascertained in regard to supply versus demand headroom, capital investment need, capital apportionment and a protocol for alterations and Rights of Access to existing services (to ensure that Ransom situations are avoided).

There are numerous options for establishing and funding new district heating facilities and this study has identified opportunities within and outside the City Centre. It is recommended further investigation is undertaken to identify those opportunities highlighted in this study in consultation with landowners, developers and existing large energy users. This might ultimately determine district energy opportunities across the City that could attract substantial private-sector investment and keep Sheffield at the cutting-edge of decentralised energy provision in the UK.

The creation of a Sheffield Sustainability Hub, based on the model created by Sheffield Hallam University, could be of potential benefit and ensure that the two universities, Creative Sheffield and Sheffield City Council can work closely together. This comprehensive knowledge base might inform the city's development into the future. The hub can also be extended to developers and local renewable energy companies to increase the practical element of the group and help increase the commercial potential of, and help develop, new technologies and ideas.

9.3 Procuring Infrastructure in the City Centre

The procurement of new utility connections and diversionary works for City Centre development sites should be carefully considered in order to minimise costs and disruption of the public realm. The Sheffield City Centre's streetworks team might be informed about the importance of the public realm and might be given more transparency of the wider City Centre Masterplan. Individual Masterplans might also make consideration of existing trunk services in order to negate costly diversions.

Although there are no identified abnormal new connection costs associated with water, wastewater and relatively small abnormal costs have been identified for gas infrastructure, the significant £12M of abnormal new connection costs identified for electricity infrastructure for the

Central Community Assembly Area should be carefully co-ordinated, in accordance with the recommendations contained within section 9.1.

The graph below identifies that the abnormal new connection costs for the city centre sites are c£12M against costs for Non-City Centre Sites at c£15M. Although the city centre sites appear to trigger larger electricity abnormal costs, the non-city centre sites have greater abnormal connection costs for gas, water and foul water infrastructure.

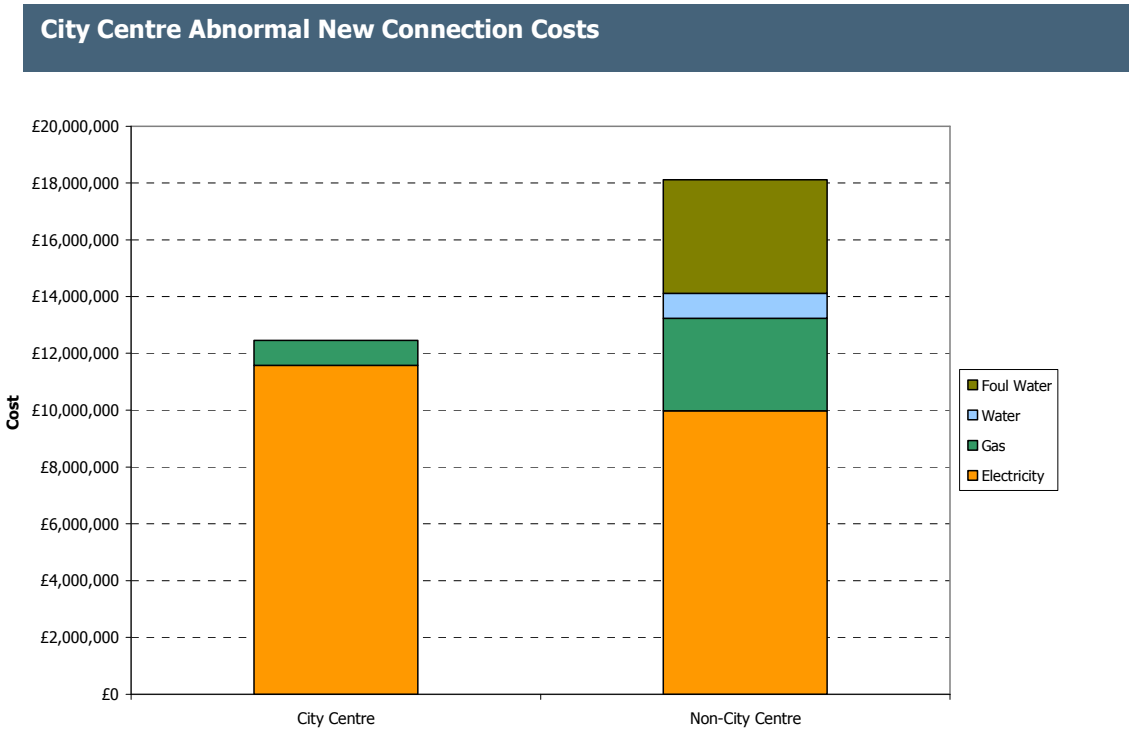

FIGURE 9.1 – Abnormal New Connection Costs (City Centre)

When considering the comparison of trunk diversion / alteration costs for city centre and non-city centre sites, the pendulum swings in the opposite direction and non-city centre sites trigger significantly greater costs with regard to electricity, gas and water, foul water and district heating diversions \ alterations (c£10M for non-city centre sites and c£3M for city centre sites.)

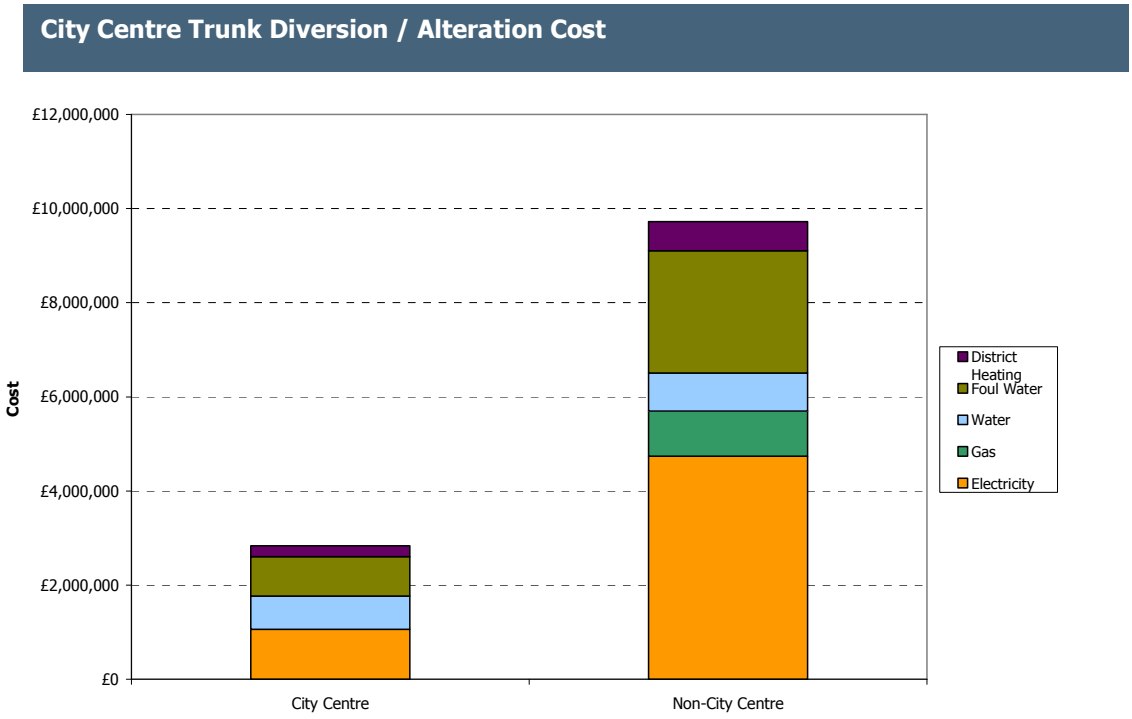

FIGURE 9.2 – Trunk Service Diversion / Alteration Costs (City Centre)

When combining the new connection abnormal costs and diversion / alteration costs, the total investment need for the development of the City Centre Sites is c£15M against an investment need for c28M for the non City Centre Sites. This large difference between these investment needs is primarily due to the greater diversionary / alteration activities associated with the non-city centre sites, however it should be borne in mind that there is no masterplan information data available for the non-city centre developments, and it may feasible for much of the infrastructure identified within this report to be retained insitu by masterplan design and adhering to the appropriate easements, thereby reducing these costs.

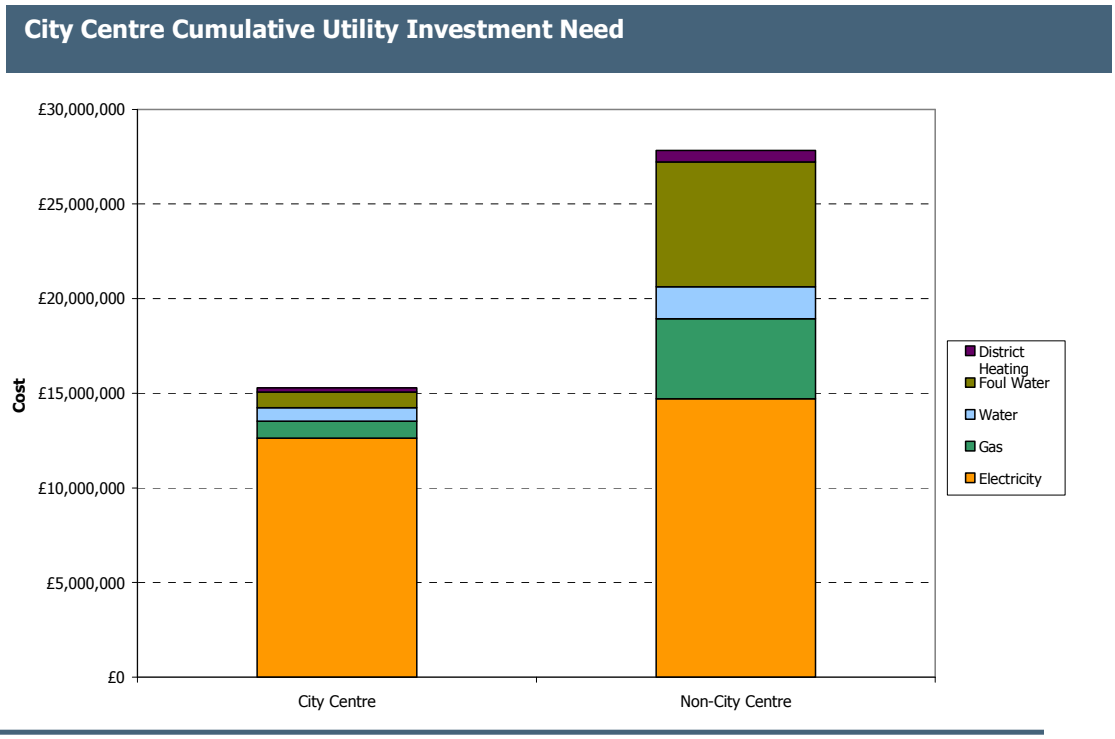

FIGURE 9.3 – Cumulative Investment Need (City Centre)

10 Methodology and Assumptions

10.1 Methodology

A key part of this study is understanding the location of all key strategic utility infrastructure. WYG therefore issued formal requests to statutory undertakers in order to obtain the asset location drawings covering all sites identified within the study area. A description of the GIS database together with its methodology is contained within section 3 of this report.

The details of all 319 sites to be considered within the study were received from Sheffield City Council and identified on excel spreadsheet 'Infrastructure Study Draft List of Sites 31st March 2009'. This spreadsheet identified key information including the site reference number, cluster name, site name, use class, site area, number of dwellings or floor area and the estimated scheme completion date.

The 319 sites were grouped into 52 new development cluster by Sheffield City Council based on geographical areas in order to reduce the amount network modelling that would need to be undertaken by each Statutory Undertaker.

The spatial location and boundary of each cluster and site within the study was provided by Sheffield City Council. This information was transferred to the GIS database and will be discussed further in section 14 of this report.

A utility loading schedule (water, gas, electricity, water and wastewater) for all sites within the study was prepared by WYG using the development base data contained within the 'Infrastructure Study List of Sites' provided by Sheffield Council and based on the following criteria:

Utility	Classification	Utility Demand Assessment Methodology
Electricity	Residential	BSRIA Rules of Thumb 4th edition. BG14/2003 including a diversity factor of 0.9.
	Commercial	
Gas	Residential	NExA AQ Values Average New Dwelling Consumption in the UK from May 2007.
	Commercial	CIBSE TM46:2008 Annual fossil fuel consumption good practice standard.
Water and Wastewater	Residential	Based on 148 litres/person/day (CIRIA 177) over a 16 hour day using a peaking factor of 3 where an average property contains 2.49 people.
	Commercial	Based on BS6700/BS EN 752 assuming 70 litres per person per day.

TABLE 10.1 – Utility Loading Methodology

WYG then prepared a consultation document containing the utility loading schedule and a GIS map identifying the boundaries of each site and cluster within the study. This consultation document was issued to YEDL, National Grid Gas, Yorkshire Water, Severn Trent Water, BT Openreach, Veolia and Digital Region in order to obtain an overview of the current strategic network capacity issues and constraints, and allow each statutory undertaker to consider the impact of the increased utility demands on their respective networks.

Following release of this consultation document meetings were held with each statutory undertaker in order to discuss;

- current strategic network capacity and constraints across Sheffield and at growth points and key economic development locations
- the scope of undertaker's current capital investment programme within Sheffield.
- possible limitations of study (utility network models are a snap-shot at a point in time with various scenarios identified).

It was agreed with Creative Sheffield and each statutory undertaker that the requirements for modelling the impact of each site on the existing utility infrastructure would be significantly time consuming and would be unlikely to be completed within the tight timeframe available for this

study. It was therefore agreed with all parties that the following methodology would be implemented so that each statutory undertaker could respond within the tight programme for completion of this study.

WYG would review the Primary Substation data in the YEDL Long Term Development Statement 2008 against planned Sheffield growth to identify any areas of potential capacity shortfalls. YEDL would then review this information and provide a commentary on the likely investment need.

National Grid Gas to carry out a network analysis on a cluster by cluster basis to identify a point of connection on the existing medium or intermediate pressure gas network with sufficient capacity to accommodate the demand required by each cluster.

Yorkshire Water agreed to provide a commentary on a site by site basis to identify water and wastewater capacity issues and site constraints. This exercise had been partially undertaken by Yorkshire Water during the Sheffield Development Framework Issues & Options and Preferred Options Consultation undertaken with Sheffield City Council.

Severn Trent Water to provide a commentary on a site by site basis to identify water capacity issues and site constraints

All utility information was separated into the various utility categories, e.g. strategic water mains, medium-pressure gas mains, intermediate-pressure gas mains, local high-pressure gas pipelines, national high-pressure gas transmission pipelines, high-voltage electricity mains, extra-high-voltage electricity transmission lines, telecommunication distribution services, telecommunication trunk services, foul/surface/combined gravity sewers, pumped mains and trunk sewers. Private power and district or community heating networks are not included as these are not currently adopted by regulated statutory undertakers. The district heating network from the Veolia (ES) Sheffield Energy Recovery Facility is also included.

It was agreed with Creative Sheffield and Sheffield City Council that any potential benefits from undertaking full utility mapping of Sheffield City Centre and the surrounding area may be outweighed by the cost of carrying out such an exercise. Therefore mapping of the key strategic infrastructure only was carried out, i.e. local distribution, low-voltage and low-pressure distribution mains and all individual services are not included on the database as these services

can typically be diverted more easily and inexpensively than key strategic infrastructure and would not likely constrain economic development in terms of utility capacity to meet economic (or population) growth.

On receipt of formal responses and modelling results from each statutory undertaker, WYG undertook a review of these formal responses in respect of scope, cost and programme for strategic network reinforcement and strategic diversionary works. The results of this review are detailed within the site specific data sheets contained part III of this report.

In addition WYG carried out a review of statutory undertakers' strategic asset plans to determine the likely extent of any strategic diversionary works required to accommodate the development predicted within the City Centre Masterplan (CCMP) and Economic Masterplan (EMP). A schedule of diversions, with programme risks and budgeting costs are contained within the site specific data sheets contained within part III of this report.

As a parallel exercise to the consultation with each statutory undertaker, WYG have carried out a review of the statutory undertakers' published long term investment planning strategies to understand the likely extent of any strategic network reinforcement – and particularly how this might be modified to capture the City's economic development potential in a more cost effective manner such that both the statutory undertaker and developer supply-chain might benefit (thus reducing the unit cost of developing employment land in the City). This information was supplemented by information provided by each statutory undertaker during the stakeholder meetings.

On Tuesday 17th November 2009, Creative Sheffield and Sheffield City Council provided details of the spatial boundaries of seven Community Assembly Areas, together with details of which sites fall within each Community Assembly Area. Creative Sheffield and Sheffield City Council advised WYG that the strategic infrastructure requirements for each Community Assembly Area were to be included within the report.

10.2 Key Stakeholders

Yorkshire Water Services (YWS) are the incumbent water statutory undertaker covering the majority of the Sheffield study area, however Severn Trent Water are the incumbent statutory

water undertaker for the Beighton and Mosborough cluster and also the Hackenthorpe cluster located to the south east of the study area.

National Grid Gas are the incumbent statutory gas undertaker for the Sheffield Study area.

YEDL are the host Distribution Network Operator (DNO) for the majority of the Sheffield study area, however Central Networks are the host DNO for a small area of the Beighton and Mosborough cluster located to the south east of the Sheffield study area, including sites at Deepwell Avenue, Oxclose Farm, Meadow Brook Park, Mosborough Wood Business Park, Former Westfield School Site.

BT Openreach are the regulated Tier 1 telecommunications provider for the Sheffield Study area, however senior representatives of BT Openreach have been reluctant to engage in the Sheffield study citing concerns regarding confidentiality of their existing network capability and planned capital investment programmes.

Digital Region Limited are the planned owner and operator of a new fibre communications network within Sheffield which is intended to provide super fast broadband. Digital Region is owned by Yorkshire Forward, Barnsley Metropolitan Borough Council, Doncaster Metropolitan Borough Council, Rotherham Borough Council, and Sheffield City Council. Thales has been appointed to design, build, own and operate this network.

Veolia (ES) Sheffield Limited operate the Sheffield Energy Recovery Facility and District Heating Network within Sheffield.

EON (SES) currently have plans to construct a biomass Power Station at Blackburn Meadows which will generate both electricity and heat, possibly for distribution via a new district heating network.

10.3 Assumptions, Risks And Exclusions

The following assumptions have been made when undertaking the Sheffield Energy and Water Infrastructure Study;

10.3.1 General Assumptions

The capacity assessment undertaken by each statutory undertaker and by WYG although intended to capture the growth of Sheffield to 2026, is a point in time assessment undertaken during 2009, and may be subject to change as development takes place, existing demands are relinquished and statutory undertaker capital investment and replacement programmes are implemented. The findings and strategies presented within this report are therefore subject to the changes associated with complex dynamic networks.

The utility loading figures prepared by WYG have been calculated using the methodology contained within section 10.1 of this report, however this has been without the benefit of detailed development accommodation schedules or accurate building services loading figures being available. These loading figures are therefore subject to change as the development design moves forward and more accurate information becomes available.

This study captures the likely abnormal offsite utility costs associated with each new development based on consultation with each statutory undertaker, however formal new connection applications have not been made for each site. Therefore the scope and costs presented in this report may be subject to change once formal developer applications are made.

BT Openreach has not been a willing participant in the process and therefore traditional fibre to the unit services are largely excluded from this report. Although Virgin Media operate significant trunk networks within the city, they have largely been excluded also.

BT Openreach rarely requires any developer capital however Virgin Media and other CATV operators consider their product a marketable product and may fully recharge developers.

Digital Region Limited has been consulted over the duration of the study but they have not fully designed or constructed their digital network and do not have a new connections protocol, so investment need is not captured.

All budget costs stated within this report exclude land costs associated with the construction of strategic assets such as electricity primary substations, or foul water pumping stations.

10.3.2 Water Assumptions

The results contained within this study are based on the formal consultation responses received from Yorkshire Water on 13th July 2009 and 13th September 2009 together with the minutes of the meeting held between Yorkshire Water and WYG on 9th July 2009.

It has been assumed that in instances where Yorkshire Water have identified that a water supply can be 'made available at reasonable cost', then the cost of any onsite and offsite mains would be in line within typical developer funded costs of £500 per unit, and no abnormal offsite reinforcement costs would be required.

In instances where Yorkshire Water have identified that some offsite reinforcement of the distribution network will be required to provide a water supply to the development, WYG have used budget figures provided by Yorkshire Water as part of their response to a development enquiry.

Main Size	Easement Width
<200mm diameter	6m easement (3m either side of the centre line of the pipeline)
>200mm but less than 600mm diameter	10m easement (5m either side of the centre line of the pipeline)
>600mm diameter	12m easement (6m either side of the centre line of the pipeline)

TABLE 10.2 – Typical Water Main Easement Widths[30]

10.3.3 Gas Assumptions

The results contained within this study were initially based on the formal consultation responses received from National Grid Gas on 10th September 2009 and the minutes of the meeting held between National Grid Gas and WYG on 17th June 2009.

The network modelling by National Grid Gas was undertaken on a cluster by cluster basis with National Grid Gas identifying a point of connection on the existing gas network with sufficient capacity to accommodate the cumulative load of all sites within the cluster. It was subsequently

identified by WYG however that this modelling method would provide a skewed infrastructure investment need in excess of what would be required were the sites to be considered on a site by site basis.

An additional assessment has therefore been undertaken by WYG based on National Grid Gas document 'T\SP\NP14\E – Specification for The Design Of System Extensions, Connections And Services To Below 7bar National Grid Systems'. The design tables contained within this document set out the maximum permissible demand that can be taken from a parent main of defined diameter without the need to undertake detailed network analysis. This document in conjunction with the modelling activities already undertaken by National Grid Gas have allowed WYG to identify a potentially closer low or medium pressure connection point for each site, thereby allowing a more accurate assessment of any abnormal offsite costs to be identified.

Although document T\SP\NP14\E identifies a point of connection on the gas distribution network that could be utilised without requiring developer funded network reinforcement, it is possible that network reinforcement carried out and funded by National Grid Gas may need to be carried out upstream of the point of connection. The need for this reinforcement could only be determined at the point of formal application and network assessment for each individual site within the SDF, and therefore any programme implications associated with this cannot be advised at this time.

The gas assessment assumes that traditional gas mains and services will be procured for each building on the SDF sites. Where large diameter single connections are required for energy centres or industrial processes, it should be highlighted that the results of this analysis could change significantly and a more remote connection point to a gas main with larger diameter or higher operating pressure may be required.

The diversion of high pressure gas mains can be very expensive and complex, and it has been recommended within this report that these assets are accommodated within the development masterplan.

[30] Information received in email from Matthew Naylor of Yorkshire Water 30th September 2009

Easement widths can vary from site to site and are dependant on the legal wayleave or easement documentation put in place at the time. This information is likely to be held by Sheffield City Council or the land owner, however for the purposes of this report the following easement widths have been assumed.

Gas Size	Easement Width
Medium Pressure	6m easement (3m either side of the centre line of the pipeline)
Intermediate Pressure	10m easement (5m either side of the centre line of the pipeline)
High Pressure	20m easement (10m either side of the centre line of the pipeline)

TABLE 10.3 – Typical Gas Main Easement Widths

10.3.4 Electricity Assumptions

The firm capacity and estimated current demand of each Primary Substation within Sheffield has been taken from the YEDL Long Term Development Statement 2008 and Central Networks Long Term Development Statement 2008.

A drawing identifying the approximate extent of the existing 11kV catchment area for each YEDL Primary Substation was provided by David Van Kesteren of YEDL.

Details of the YEDL capital investment and asset replacement programme was provided by YEDL and is identified in the letter from David Van Kesteren dated 22nd September 2009. This provides a 10 year look ahead at the YEDL asset replacement programme that is likely to be implemented.

In instances where the proposed demand for the site is less than 500kVA it has been assumed that connection to the local 11kV network or below will be sufficient to accommodate the development without triggering any network reinforcement of the 11kV network or above. This strategy has been agreed with YEDL.

In instances where the proposed site demand is greater than 500kVA, the suitability of the local 11kV network to accommodate the load is not known, and therefore it has been assumed that new 11kV circuits back to the local Primary Substation (or a Primary Substation with available capacity) will be required together with the provision of new 11kV circuit breakers at the Primary

Substation. A budget figure has been applied by WYG based on a unit rate of £185/m for twin 11kV circuits and £25,000 for each 11kV circuit breaker. The local 11kV capacity will only be modelled in response to a formal developer application for new connection.

Based on the YEDL LTDS and Primary Substation catchment data provided by David Van Kesteren, WYG carried out an analysis to identify which sites would likely be served by each Primary Substation. The estimated electricity demand for each site was then applied to the most likely Primary Substation that would serve the site in order to understand the cumulative effect of the electricity demand.

This analysis identified those Primary Substations which would have a capacity shortfall to accommodate the planned growth within Sheffield, and those which could easily accommodate the planned growth.

The likely programme for construction of a Primary Substation has been identified within the site specific data sheets as between 12-24 months. This should be treated as indicative only as there are a number of factors which could dictate the length of this programme including availability of transformers and third party land negotiations should these be required to either construct the Primary Substation or install offsite cabling.

The diversion of 275kV and 400kV electricity cables can be very expensive (c£12,000,000 per km), and therefore it has been recommended within this report that these cables are accommodated within the development masterplan.

Cable Voltage	Easement Width
33kV	4m easement (2m either side of the centre line of the cable)[31]
132kV	15m easement (7.5m either side of the centre line of the cable)
275\400kV	120m easement (60m either side of outer edge of the cables)[32]

TABLE 10.4 – Typical Electricity Cable Easement Widths

[31] Easement widths vary from site to site. Typical wayleave width provided by David Van Kesteren of YEDL on 20th November 2009.
[32] Recommended stand off distance between cables and new properties based on guidelines contained within Sage (Stakeholder Advisory Group on extremely low frequency electromagnetic fields)

10.3.5 Wastewater Assumptions

Stormwater and surface water new connections costs are excluded, however budget costs for diversion of surface water sewers have been provided where there is sufficient information available.

The consideration of flooding and flood defences is excluded.

SUDS is now considered a standard infrastructure requirement and typically onsite developer funded solutions will be required. Abnormal costs will likely only be triggered on sites where there is no infiltration potential, no watercourse or no local sewerage to the site, and the site has historically had very little surface water discharge.

For the purposes of this study it has been assumed that any net increase in surface water will be conveyed to ground via infiltration or to a local watercourse.

Strategic sewers that have been identified crossing the development site have been considered for diversion, and budget costs assigned where possible. For costing purposes, it has been assumed that the depth of the diverted sewer is the same as the original sewer, that there are lateral connections every 10 metres and that the original sewer pipe is left in-situ and grouted up.

It has also been assumed that the diversion route is within the boundary of the development site, and therefore no third-party land costs have been included.

For the purposes of this study, it has been assumed that where the diversion route is greater than twice the original length of the sewer, the hydraulic performance of the sewer will be significantly compromised and therefore not feasible to divert the sewer.

It has been assumed that specialist methods of pipe-laying would be required to divert sewers with a diameter greater than 2.1 metres or a depth to pipe invert greater than 6 metres. Costs associated with these specialist methods are beyond the scope of this study.

Sewer Diameter (mm)	<150	150 – 299	300 – 499	450 – 600	601 – 749	750 – 924	925 - 1000	1001 – 1124	1125 – 1399	>1400
Depth to Invert of Sewer (m)										
<3.0m	3.0m	3.0m	3.0m	3.5m	3.5m	4.0m	5.0m	5.0m	5.0m	5.0m
3-4m	3.0m	3.0m	3.0m	4.0m	4.0m	5.0m	5.0m	5.0m	5.0m	5.0m
4-5m	4.0m	4.0m	4.0m	5.0m	5.0m	5.0m	6.0m	6.0m	6.5m	6.5m
5-6m	5.0m	5.0m	5.0m	6.0m	6.0m	6.5m	6.5m	6.5m	6.5m	6.5m
6-7.5m	6.0m	6.0m	6.0m	6.0m	6.0m	6.5m	6.5m	6.5m	6.5m	6.5m
>7.5m	4.0m	4.0m	4.0m	4.0m	4.0m	5.0m	5.0m	5.0m	5.0m	6.0m

TABLE 10.5 – Typical Sewer Easement Widths[33]

10.3.6 Additional Assumptions

Consultation has taken place with Veolia ES Ltd and E-on Sustainable Energy Services in relation to the assessment of decentralised energy and district heating in Sheffield.

A high level analysis of the potential suitability of SPD sites for Decentralised Energy has been undertaken and WYG has defined a series of key criteria to assess the SPD sites potential based on:

1. **Scale and diversity of development:** The scale and diversity of each SPD site dictates the annual energy (heat and power) demand and ultimately the revenue that can be derived from any infrastructure installed to meet this demand.

2. **Proximity to existing Veolia DE Network:** Those SPD sites located in close proximity to the existing Veolia network have the opportunity to consider connection to the existing network. Those sites located closer to existing infrastructure are considered as likely to represent a lower cost burden in connecting to the network and are therefore more viable.

[33] Typical Sewer Easement Widths taken from Sewers for Adoption 6th Edition

3. **Proximity to Existing Large Energy Consumers:** Those SPD sites located in close proximity to existing large energy consumers (such as hospitals, hotels, leisure centres etc.) may have the opportunity to work as a collaborative approach to new DE infrastructure. The existing demand can act as an anchor load to attract private investment. This can be difficult to achieve and requires multiple parties to agree to long term energy service contracts.

Parameters for the queries as below:

Query 1	Cat 1	Cat 2	Cat 3
Proximity to nearest point on existing Veolia DE Network (metres)	>1,000m	500>1000	<500
Query 2	**Cat 1**	**Cat 2**	**Cat 3**
Proximity to nearest existing high heat demand users (metres)	>1000	500>1000	<500

TABLE 10.6 – DE Assessment Queries

Large heat demand users include the following:

1	Large Hospital
2	Medium Hospital
3	Small Hospital
4	Large Educational
5	Medium-Large Educational
6	Medium-Large Public Administration
7	Large and Medium Sports Arena
8	Large Hotel
9	Medium Hotel
10	Large Retail
11	Medium Retail
12	Steelworks

TABLE 10.7 – Existing large heat demand classification

	1 Poor	2 Fair	3 Good	Score	Weighting
Scale (Developable Area m^2)	<20,000	20,000-50,000	>50,000	2	4
Development Mix	1	2-4	>4	2	2
Proximity to existing DE Network (m)	>1000	500-1500	<500	1	2
Proximity to Existing High Heat Demand Users (m)	>1000	500-1000	<500	1	2

Poor	Fair	Good
11 to 14	**15 to 20**	**>20**

TABLE 10.8 – DE Potential Criteria

There are numerous complex technical and commercial factors which ultimately dictate the suitability of any development site for integrating Decentralised Energy.

This analysis has been followed by a qualitative analysis process based on the results of quantative findings using the Sheffield GIS database to identify development site clustering patterns and proximity to generation plant such as the planned E-on Blackburn Meadows biomass power plant and the existing Veolia district heating network.

Consultation with Veolia has also taken place to define any large energy consumers identified in quantative analysis that are already connected to the existing district heating network.

The cost of district heating network connection has been based on a figure of £875 per metre from the point of connection based on a mid range value from published heat network costs[34] and information provided to WYG regarding new connection applications.

Annual carbon emissions for the Sheffield SDF to 2026 have been derived based on annual energy consumption for 319 individual development parcels as defined in the energy and water loading schedule.

Annual carbon emissions have been converted from these electricity and gas consumption estimates using factors of 0.194 for gas and 0.422 for electricity[35].

Forecast annual carbon emission reduction has been based on current and proposed future building regulation standards including the government's revised 2009 Zero Carbon standard.

10.4 GIS Methodology

The ArcMap GIS platform was used to gather strategic utility data received from each statutory undertaker and display this on an Ordnance Survey base map. All data was requested in formats that would require as little re-processing/re-formatting as possible, such as: ESRI shapefile or GDB, other GIS formats or CAD/DWG formats, however this request was not complied with in the

[34] Community heating for planners and developers – Energy Saving Trust

majority of cases. The data is described according to the two separate elements of this stage of the project, with the New Business District South area requiring more detailed asset information below strategic level when compared to the wider study area for which only strategic utility infrastructure was identified.

Collated Sites refers to the individual allocated site polygons. These were supplied in ESRI shapefile format by Laurie Platt of Sheffield City Council (SCC) initially and later re-supplied by Chris Hanson (SCC) Forward Planning Unit. The polygons were joined to the allocated sites spreadsheet file using "site number" as the joining field.

Infrastructure Sub-areas are the "cluster" sites created and supplied in ESRI shapefile format by SCC. These were supplied once at project start.

NBD/NRQ areas are polygons showing the location of the New Business District and New Retail Quarter zones. They were supplied by SCC at project start in ESRI shapefile format.

Green Belt polygons show the areas around Sheffield designated as Green Belt land. These polygons were supplied in ESRI shapefile format by SCC at project start.

The Planning Authority Boundary polygon identifies the extent of the Sheffield Planning Authority Boundary. These polygons were supplied in ESRI shapefile format by SCC at project start.

The Study Area polygon identifies the extent of the Energy and Infrastructure Study. It was supplied in ESRI shapefile format by SCC at project start.

10.4.1 Severn Trent Water Data

Severn Trent Water data was received on 8th June 2009 in ESRI shapefile format.

Severn Trent requested that a confidentiality agreement was signed with regard to use of the data, and this confidentiality agreement was passed to Creative Sheffield for completion by representatives of Creative Sheffield and Sheffield City Council.

[35] Building Regulations Approved Document L1A Conservation of Fuel and Power in New Dwellings 2006 Edition

The data provided by Severn Trent Water included;

- Strategic Water Network comprising all pipes greater than 300mm diameter

10.4.2 Yorkshire Water Data

Yorkshire Water asset data was received on 8th May 2009 in MapInfo TAB format and therefore required translation to ESRI file formats.

The Yorkshire Water asset data included the following;

- The location of Water Treatment Works
- Strategic Water Network comprising all pipes greater than 250mm diameter
- Strategic Sewerage Network comprising all foul sewers greater than 250mm diameter, combined and surface water sewers greater than 400mm in diameter
- The location of all Sewerage Treatment Works and sewage pumping stations

10.4.3 National Grid Electricity Transmission

This data was taken from the National Grid website in April 2009; http://www.nationalgrid.com/uk/LandandDevelopment/DDC/GasElectricNW/undergroundcables/shape/ and this data is displayed as being current as of February 2008 and was made available in ESRI shapefile format. It is accurate spatially to 1:1250 scale.

The electricity data from National Grid comprises:-

- 275/400kV overhead and underground electricity transmission cables
- 275/400kV > 132kV Grid Supply Point Substations

10.4.4 YEDL Data

YEDL electricity network data was originally supplied in PDF format and was effectively schematic in nature. The data was not spatially accurate at scales more greater than 1:50,000.

After re-digitising from the re-scanned and geo-referenced PDFs it became apparent that the level of accuracy was not appropriate for the needs of the study and therefore further data was requested from YEDL.

The re-supplied data was accurate against 1:1250 scale mapping but again required re-scanning and re-digitising into the GIS.

The following features are identified:-

- 33kV underground and overhead cables
- 66kV underground and overhead cables
- 132kV underground and overhead cables
- 66kV>11kV and 33kV>11kV Primary Substations
- 132kV>66 or 33kV Bulk Supply Points

10.4.5 Central Network East (CNE) Data

Central Networks Energy data was supplied in PDF format and again was effectively schematic in nature. There is only one CNE substation that intersects with the study area and for this reason it was decided that the supplied data was of sufficient accuracy for the project.

This data was re-scanned, geo-referenced and re-digitised into GIS and comprised:-

- 33kV underground and overhead cables
- 66kV underground and overhead cables
- 132kV underground and overhead cables
- 66kV>11kV and 33kV>11kV Primary Substations
- 132kV>66 or 33kV Bulk Supply Points

10.4.6 National Grid Gas

The gas network in the study area was sourced from both the National Grid website (as per the National Grid administered electricity transmission network) and from National Grid GIS team.

The regional high pressure network was available in ESRI shapefile format from the National Grid website whereas the medium and intermediate pressure distribution network were provided in

PDF format. This PDF was accurate against 1:50,000 scale mapping and was supplied on 9th July 2009.

This data was re-scanned, geo-referenced and re-digitised against the OS 1:50,000 background map and comprised:-

- National Grid/Northern Gas Network Boundaries
- Regional High Pressure (HP) Gas Mains
- Intermediate Pressure (IP) Gas Mains
- IP to MP Regulators
- Above Ground Installations (AGI)
- Gas Holders

10.4.7 BT Openreach

Postcodes for telephone exchanges were taken from online source (samknows.com) in February 2009. These were geocoded against OS Address Point data. The exchanges are named and flagged according to whether they are SDSL enabled or not. 4 Km buffers were created around these sites for further analysis.

10.4.8 Distributed Energy Facilities

The district heating network for Sheffield is owned and operated by Veolia (ES Sheffield Limited). This data was supplied in a CAD format which was imported into ArcGIS. The data was positionally highly accurate to 1:1250 scale, however, the formatting of the DWG was not logical in that elements of the drawing were not split into logical layering convention. For example, duct labelling was not placed on a CAD layer called duct labelling. For this reason it was not a simple task to create an intelligent, simplified district heating layer for use in GIS. Instead the labelling and extraneous elements had to be manually (visually) stripped out of the GIS layer so that the route of the network remained. Instead of manually transposing attribute data from the CAD drawing to the GIS it was decided to include the original CAD data to provide graphical information.

This data was received in CAD/DWG format from Veolia on 10th September 2009. It was imported into ArcGIS and where possible the main route of the district heating network was

identified and transferred to the geodatabase. Because there was no attribute tagging or a distinct layering convention applied in the supplied drawing it was not possible to create proper GIS attribution. Instead, the original CAD data was imported along with any annotation to provide information to the user if needed regarding pipe diameters etc.

The supplied information is accurate against 1:1250 mapping and is current as of September 09.

10.4.9 Renewable Energy Sites

Renewable energy sites were sourced from http://www.co2sense.org.uk (previously Future Energy Yorkshire website) and were geocoded using OS Address Point.

10.4.10 New Business District South

This area required data to be supplied at much higher levels of accuracy and also demanded information beyond the strategic level information supplied for the main study area.

All data for this area was supplied on paper and required scanning, geo-referencing and re-digitising. All digitising was done against a 1:1250 scale OS Mastermap background.

Data Layer	Source
BT	BT Openreach
Electricity	YEDL/National Grid
Water/Wastewater	Yorkshire Water
Virgin Media	Virgin Media
Thus	Thus
KCOM	Kingston Communications
Easynet	Easynet
Masterplan (raster)	SCC/ Creative Sheffield
Gas	National Grid Gas

TABLE 10.9 – GIS Source Data

10.4.11 Methodology

For paper-based source data, paper maps were scanned at 300dpi and maintained in TIFF format. These were imported to GIS and geo-referenced visually against common points

between digital OS data and the source map. In this manner, multiple maps were "stitched" together to provide a source layer for heads-up digitising of utility data.

For PDF based data, PDFs were converted to TIFF using Adobe Acrobat (full version). In all cases the original resolution was maintained. The TIFFs were then imported and geo-referenced in ArcGIS as per normal.

For Digital Vector data, CAD (DWG or MGN format) data was imported into ArcGIS. Dependent upon CAD layering schema, data was logically reorganised into layers. GIS (non-ESRI format) data was translated to ESRI formats through the MapInfo Universal Translator and imported to ArcGIS.

All metadata has been written in ISO format suitable for SCC translation to Gemini formats via ESRI's Productivity Suite.

10.4.12 Users

The following users at Creative Sheffield and Sheffield City Council are intended to utilise the GIS database.

- Neil Burgin (Creative Sheffield)
- Andy Nolan (SCC)
- Cat Arnold (SCC)
- Richard Holmes (SCC)
- Chris Hanson (SCC)
- Simon Ogden (SCC)
- Yunus Ahmed (SCC)

11 Protection Of The Public Realm (During Infrastructure Delivery)

The public realm for the purpose of this study is defined as all areas, albeit mostly in the City Centre, that are maintained as public realm for general public use by Sheffield City Council. This includes public highway where non-standard highway finishes and-or street furniture are located and maintained at additional cost to Sheffield City Council.

Large investment has recently been carried out at Sheaf Square, Howard Street, Peace Gardens and Tudor Square with high quality finishes and aesthetics being introduced. Sheffield City Council are keen that protection of the public realm is considered at an early stage of any utility infrastructure planning, so that recently completed high quality finishes are not damaged during future utility works.

Much of the existing public realm contains buried utility services; water, sewerage, gas, electricity, district heating and telecommunications. A comprehensive list of all licensed statutory undertakers is available from 'Street Force', the streetworks department within Sheffield City Council Highways Division. Sheffield's Street Force Department currently has 28 statutory undertakers listed in the City.

All statutory undertakers (and their nominated agents) will be granted a streetworks licence upon application to the Highway Authority in accordance with the Code of Practice under the New Roads and Streetworks Act 1991 (NRSWA) as amended under the Traffic Management Act 2004 (TMA) to maintain and improve their existing assets. Where the public realm is operated as public highway then statutory undertakers also have a right to design, build, own and operate new apparatus.

The Code of Practice under NRSWA provides a framework for the issue of notices between the Highway Authority and all licensed statutory undertakers. Provided the correct notices are issued in accordance with the Code then statutory undertakers have a right to excavate and reinstate the public highway. Generally non-emergency and non-urgent works (including planned capital works, diversion works and new connection related works) will require a 3-month notice before commencement. All matters relating to traffic management have to be dealt with in advance of the notice.

Under NRSWA 1991 and TMA 2004 the permanent reinstatement of the public highway must be on a like for like basis within reason. Where higher quality finishes or higher quality street furniture is utilised then there is a risk that statutory undertakers will reinstate finishes using more economic materials.

'Street Force' meet quarterly to discuss all major highway works and statutory undertaker led projects (where a streetworks notice has been issued or is anticipated) in order to understand local, area-wide and city-wide traffic, performance and quality related issues and to enable each undertaker to have visibility of other undertakers' planned works. It is assumed that this process applies to works within the Public Realm.

Newly improved highways (and perhaps newly regenerated Public Realm) can be protected under Section 58 of the New Roads and Streetworks Act whereby a moratorium is served on any further streetwork activity by the Highway Authority or a Statutory Undertaker for a period of 2 years of completion of the improvement works. Section 58 of the NRSWA 1991 should be reviewed in terms of its ability to protect newly constructed or improved Public Realm within the City.

Buried utility services will largely be located within land adopted as public highway in which case all statutory undertakers will have rights of access to operate and maintain their apparatus in accordance with the Codes of Practise recognised under the New Roads and Streetworks Act 1991 as amended (as described above).

Where buried services are operated outside the public highway there should be a Right of Access (either a legal right under the Law of Property Act 1925 or an equitable agreement), between the owner or operator of the asset and the landowner in which the utility service is located. Typically these Rights of Access are generic Deeds of Easement (a right that operates in perpetuity) or a Wayleave (a right that can be terminated by the owner/operator of the asset usually by ceasing to continue an agreed payment to maintain that right). Sometimes there is no Right of Access and the statutory undertaker uses its statutory right of access – this is particularly true of water and sewerage assets as water and sewerage operators have arguably better statutory rights of entry into third party land (although compensation and a Wayleave is typically granted under this statutory mechanism). Where existing water or sewerage assets are located there is usually an overriding right to maintain these accesses as wastage and environmental health is given high priority.

If the Public Realm is to be truly protected from repeat excavation and reinstatement then it might be prudent to prevent any new services from being installed in the public realm; this can only be achieved if the public realm is not considered public highway and a statutory undertaker has no statutory right of access to third party land – this is unlikely. Irrespective of this matter most Public Realm already contains existing utility services operated under existing Rights of Access.

Further consideration should be given to the inclusion of service corridors within development masterplan design, whereby services could be located in soft landscaping areas that can be more easily reinstated to their former condition.

It is therefore considered more reasonable that the protection of the Public Realm is managed through the Street Force team where there is an existing mechanism for controlling streetwork activities and there is a mechanism for controlling the quality of temporary and permanent reinstatement. Perhaps the Street Force Team might be further trained in the importance of a first class Public Realm in attracting inward investment to the City of Sheffield and the subsequent regenerative affect that this can have to the quality of the life in the City. Utility services should support the built environment and not define the built environment.

There are three major utility programmes operating in Sheffield in the near future; the installation of a new Digital Region Ltd optic fibre broadband network, the replacement of metallic gas mains throughout the City and a new strategic gas main (the Barnsley Reinforcement Main). It might be prudent to advise these organisations that certain parts of the City cannot be utilised for streetwork activities. The Digital Region network will include new Primary Connection Points (PCPs) adjacent to every BT Openreach PCP in the City (effectively at the end of every street).

The following should be considered in relation to the protection of the public realm during utility works;

Strategy	Benefits	Risks
Co-ordinated Utility Procurement by Developers of Adjacent Land Parcels.	An overall lower cost procurement solution can often be implemented where a joined up strategy for network reinforcement is implemented.	Developers often have differing agendas and programmes making agreement on a strategy difficult to achieve.
Forward Funding of Strategic Reinforcement by the Public Sector to promote new development	Ensures offsite works are undertaken in a co-ordinated manor, limiting disruption to the existing public highway.	Statutory Undertakers are unlikely to be willing to install strategic reinforcement where development is considered speculative.
Consider the inclusion of dedicated service corridors with development masterplan design	Service corridors could be designed in soft landscaping areas which could be more easily reinstated to their former condition.	Statutory Undertakers will not allow tree planting within proximity to their assets and therefore any landscaping would need to be carefully designed.

12 SDF Carbon Emission Impact

Since 2003, Defra and subsequently DECC have published an annual inventory of emissions broken down to local authority level. These are sub-divided into emissions from the domestic, industrial & commercial and transport sectors.

The proposed development of the SDF (including SEM & CCMP) will also have a significant carbon impact associated with the energy consumed in new homes and buildings.

12.1 Sheffield Carbon Baseline

Sheffield's total carbon footprint is 3,442,903 tonnes per year. These emissions are broadly attributed to domestic **34%**, transport **17%**, industry and commercial **49%.**

LA Region Name	Year	Industry and Commercial (Tonnes CO2/yr)	Domestic (Tonnes CO2/yr)	Road Transport (Tonnes CO2/yr)	Total (Tonnes CO2/yr)
Sheffield	2005	1,728,000	1,244,000	600,000	3,572,000
	2006	1,732,000	1,239,000	587,000	3,558,000
	2007	1,675,000	1,181,000	588,000	3,443,000

TABLE 12.1 - Sheffield Carbon Emissions[36]

12.2 SDF Carbon Increase

The estimated carbon emissions attributable to energy consumed in buildings (residential, commercial and industrial) as part of the Sheffield Development Framework to 2026 (building energy use only) is estimated to represent a net increase of **189,603 tonnes** per year[37] by 2026, based on construction to current 2006 Part L building regulation compliance standards.

This represents a **5.5%** increase in carbon emissions compared to Sheffield's 2007 total carbon emission estimate (DECC 2007) or if compared to emissions attributed solely to domestic energy use a **16%** increase in emissions.

[36] Taken from Carbon Emissions Analysis Sheffield, February 2009 prepared by URSUS Consulting Limited for Sheffield City Council
[37] Based on annual electricity and gas consumption figures derived for the SDF to 2026 for the purposes of this study and carbon emission factors of 0.194 for gas and 0.422 for electricity. Assuming traditional gas and electricity connections.

12.2.1 Impact of Future Building Regulations

Building regulation steps changes in 2010, 2013 and 2016 are expected to legislate new development to significantly reduce annual regulated carbon emissions from this baseline condition.

Building Regulations	Onsite Regulated Carbon Reduction
2010	25%
2013	44%
2016	70%

TABLE 12.2 - Building Regulation step changes

The chart below illustrates how these different Building Regulation scenarios could reduce annual carbon emissions from the 2006 baseline scenario if applied from 2010 to 2026.

Sheffield SDF Carbon Reduction Impact

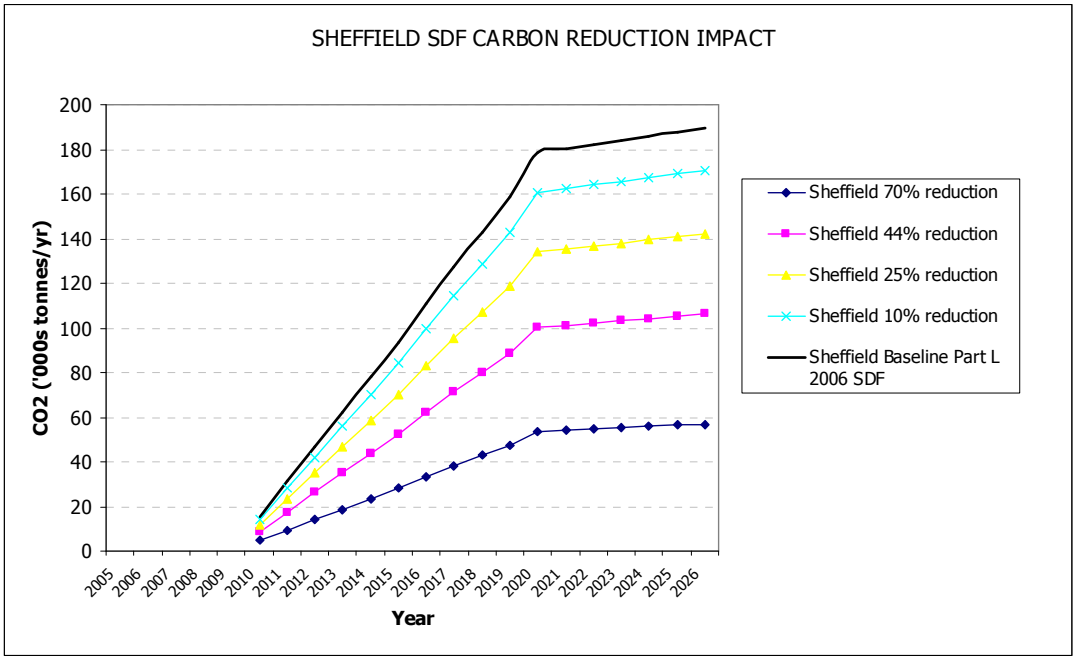

FIGURE 12.1 - Sheffield SDF Carbon Reduction Impact

If all development built as part of the Sheffield Core Strategy was built to the Government's revised Zero Carbon standard carbon emissions based on building energy is estimated to be reduced to **56,881 tonnes/yr** equal to a **1.65%** increase in Sheffield's 2007 emissions estimate (excluding carbon savings of any Allowable Solutions offset mechanism).

Application of a phased scenario of carbon reduction as enforced by these building regulation step changes being enforced over time is estimated to reduce emissions to **97,900 tonnes/yr** reduced delivering an overall **48%** reduction in annual carbon emissions compared to the 2006 SDF baseline emissions estimate equal to a carbon saving of **91,700 tonnes/yr** and resulting in a **2.84%** increase in carbon emissions compared to Sheffield's 2007 carbon emission estimate.

Sheffield SDF Carbon Reduction Impact

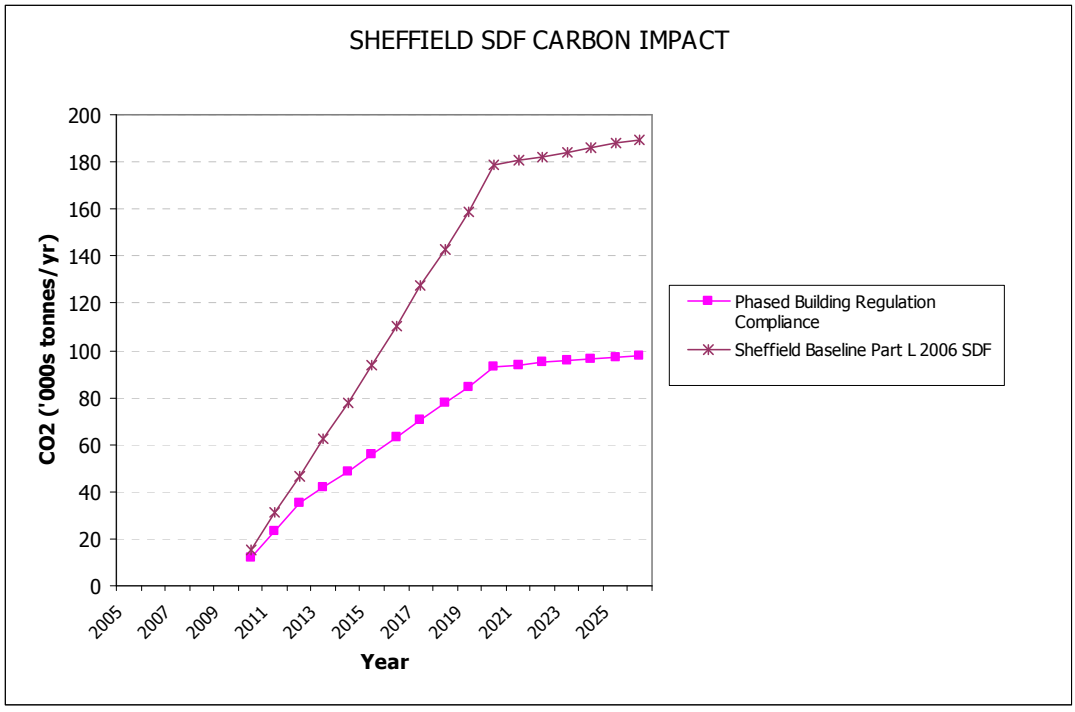

FIGURE 12.2 - Sheffield SDF Carbon Impact

12.2.2 Sheffield Carbon Reduction Targets and Policies

Sheffield has challenging targets to reduce the amount of carbon emitted by the city as defined in both the local area agreement and in the City Strategy.

% Carbon Reduction	Target Level	CO2 Reduction (Tonnes CO2/yr)
2% reduction on 2005 levels by 2009	LAA Targets	71,440
5% reduction on 2005 levels by 2010		178,600
10% reduction on 2005 levels by 2011		357,200
30% reduction on 2005 levels by 2020	City Strategy Targets	714,400
60% reduction on 2005 levels by 2050		2,143,200

TABLE 12.3 - Sheffield Carbon Reduction Targets and Policies

Local government planning policy can positively impact on the level of these emissions, in addition to the anticipated step changes in building regulations due in 2010, 2013 and 2016, and the introduction of **Policy CS 65** of the SDF Core Strategy Adopted in March 2009 sets a challenging objective for all new development in Sheffield to deliver a 20% reduction in annual carbon emissions above all future building regulations step change requirements.

As such it is interpreted that policy CS 65 obligates new development (domestic) to deliver the following carbon reduction standards:

Building Regulations	National Onsite Carbon Reduction (compared to 2006 compliance)	Sheffield Development Onsite Carbon Reduction
2006	N/A	N/A
2010	25%	45%
2013	44%	64%
2016	70%	90%

TABLE 12.4 - Impact of Sheffield Policy **CS 65**

The chart below illustrates the forecast positive impact of Policy CS 65 on carbon emissions of the SDF to 2026 and is estimated to deliver a further reduction of 19,900 tonnes/yr by 2026.

Application of 20% Policy

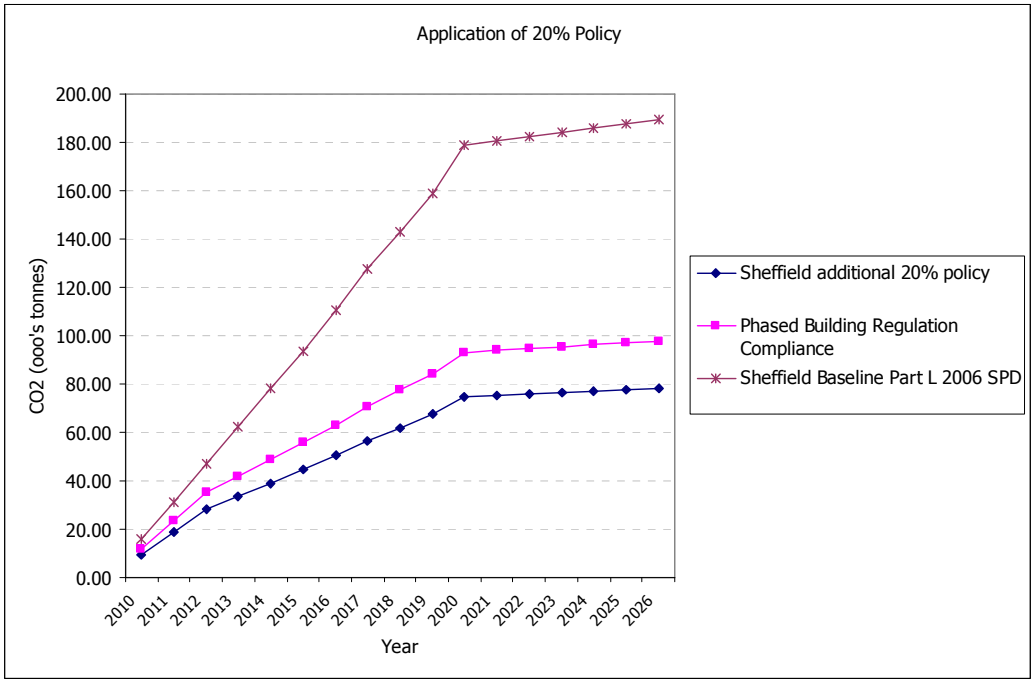

FIGURE 12.3 - Application of 20% Policy

The impact of forecast building regulation step changes combined with Policy CS 65 of the Sheffield Core Strategy are estimated to result in a net increase in carbon emissions from the SDF of **78,350tonnes/yr** by 2026, this is equal to a **2.27%** increase on Sheffield's 2007 emissions estimate (excluding carbon savings of any Allowable Solutions offset mechanism).

12.2.3 Zero Carbon Homes from 2016

From 2016 new homes built as part of Sheffield Development Framework will be required to meet the Government's revised Zero Carbon standard whereby net carbon emissions of the home will meet a minimum "carbon compliance" standard equal to 70% reduction of emissions from regulated energy use.

Any carbon not mitigated on site will likely need to be dealt with through a suitable "Allowable Solution" these might include energy efficient appliances, advanced forms of building control systems, export of low carbon or renewable heat to other developments, investments in low and zero carbon community heat infrastructure or further carbon reductions on site beyond the

regulatory standard. Such Allowable Solutions are anticipated at this stage to need to cover carbon emitted from the home for 30 years after construction.

It can be interpreted that Policy CS 65 will require residential development beyond 2016 to deliver a higher level of onsite carbon compliance equal to a 90% reduction of emissions from regulated energy use; this could be anticipated to reduce the carbon emission mitigation needed to be delivered through Allowable Solutions.

Whilst the wider policies and mechanisms for delivering Zero Carbon homes and Allowable Solutions develop over the coming years a guideline maximum price has been suggested by Government of £100 per tonne of carbon dioxide in implementing Allowable Solutions.

As an example if the Sheffield development framework were to be built out as forecast to 2026 residual emissions of the Sheffield Development Framework are estimated at in the region of 11,264tonnes/yr[38] this would represent a maximum carbon compliance cost to developers of £1,126,400 per annum.

Dependent on how the mechanisms for enforcing Allowable Solutions are defined in the future and the preferred approach adopted by developers this could represent a revenue source for Sheffield City Council to invest in other carbon reduction and renewable energy initiatives in the City.

An increase in building regulation standards can only go so far in reducing carbon emissions, and therefore needs to be considered alongside supply side measures and reductions in demand.

12.2.4 Diversifying And Decarbonising Supply

Diversification and decarbonisation of utility supply is a form of Supply Side Management (SSM). Matching demand and supply on a peak, daily and seasonal basis will provide a completely sustainable cycle, but is largely impossible, certainly in terms of power, which cannot currently be economically stored.

[38] This estimate is based on residual emissions of 10% after adoption of building regulation step changes and Policy CS65 of the Sheffield Core Strategy and is inclusive of all regulated and unregulated emissions of domestic and non-domestic development.

The conventional model of energy provision is that of very large central power generators exporting electricity onto the grid increasing supply to meet the demand with spare generating capacity to meet the predicted peaks of demand.

With the increase in decentralised energy and micro-generation, the model is being altered and as a result predicting the requirements of the peak demand is more difficult as communities and homeowners increase the amount of energy they generate, reducing their demand. The grid is also unable to meet the altering of the system from one way flow to a two way exchange. This may in-part be mitigated through the introduction of smart-grids and other major network investments but currently this level of investment will be captured by bill-payers and Ofgem has not approved this level of increase in energy network investments.

Decentralised Energy is simply generating energy near where it is to be used, effectively matching supply to demand. It can potentially lower carbon emissions, increase the diversity of energy supply and, in some cases, lower costs. Grid connection of renewables is currently being incentivised by a number of national measures including the Renewables Obligation and Feed in Tariffs. This is anticipated to stimulate a shift to Decentralised and Renewable electricity generation.

At a local level it will be important to identify physical export barriers to large generators, establish effective systems and processes for monitoring local area generators from concept and planning to operation and grid connection. Other climate change mitigation policies such as the Carbon Reduction Commitment (CRC) and Renewable Heat Incentive (RHI) may also promote the switch from traditional centralised supply to Decentralised Energy. Reference should be made to feed in tariffs detailed in section 8.3.5

13 Sustainable Energy Technology Research in Sheffield

Sheffield has two progressive universities both with a laudable track record of developing new energy efficient and renewable energy technologies. WYG has approached both universities for details of their current research and has carried out an appraisal of this research to understand the commercial opportunities and the benefits to SDF.

13.1.1 University Of Sheffield

The University of Sheffield is one of the leading universities in the UK and is a centre of world-class research in many disciplines. One of these disciplines is research into renewable energy and carbon reduction. The University of Sheffield is also committed to reducing its carbon footprint and energy bills and is participating in the Carbon Trust's Higher Education Carbon Management (HECM) programme and have implemented a Strategy and Implementation Plan (SIP) under the Carbon Management Programme.

13.1.2 University of Sheffield Research

The University of Sheffield has a breadth of research and innovation activity across different departments and disciplines. This covers technological advances, social consequences/acceptance, energy infrastructure developments and further scientific understanding of low carbon concepts. There are many individual projects related to the themes covered in this study but this report only includes those centres and clusters that host large projects funded by either a UK research council, European Framework funds or commerce and are therefore of the most relevance to this study. The two main areas of interest are renewable energy and energy demand reduction.

13.1.3 Renewable Energy

The University of Sheffield is at the forefront of cutting edge research into the renewable energy market including photovoltaic (PV) cells, renewable sources of hydrogen and energy from waste. These areas are explored in more detail on the following pages.

The Electronic and Photonic Molecular Materials Group is involved in researching the use of low cost light emitting diodes to improve device efficiency and ways to improve the efficiency

of low cost photovoltaic cells. A specific project being carried out within the group is *High-efficiency block copolymer solar cells: a scaleable prototype for low cost energy generation*. This is a project funded by the Engineering and Physical Science Research Council. This proposal assembles a consortium of chemists, physicists and materials scientists from Imperial College London and the universities of Manchester, Sheffield and Durham to produce new prototype polymer solar cells that have high power conversion efficiencies and could be mass produced cost effectively. The work will develop new polymer solar cell designs that integrate flexibility with inexpensive materials with solution based processing. This area of research is invaluable as currently the cost of generating electricity using photovoltaic cells is prohibitive and a step-change in the cost of photovoltaic power is required to allow widespread implementation of photovoltaic electricity to meet changing energy demands.
The EPSRC National Centre for III-V Technologies specialises in research in semi-conductor technologies. This includes investigating methods of improving the efficiency of solar cells, which feeds directly into a private company set up between University of Sheffield and Imperial College.
The Sheffield University Waste Incineration Centre (SUWIC) is a leading international research centre for thermal treatment of wastes. SUWIC played a key role in developing one of the UK's first, and still the largest, district heating system, with 150MWh currently connected; operated by Veolia, it uses heat generated by burning domestic, commercial and hospital wastes. The SIUWIC is at the cutting edge of research into improving efficiencies in energy from waste plants and should be integral in consulting with prior to any expansion of the district heating system or creation of new district heating systems in Sheffield.
Biological & Environmental Systems (BESG), and the EPSRC-funded Science and Innovation Award Centre, are interdisciplinary groups interested in understanding biological and environmental systems at the subcellular, cellular and systems levels. Current research includes developing a method of producing hydrogen as a fuel with the use of metabolically engineered micro-organisms.
The Ceramics and Composites Laboratory (CCL) is a major research group launched in September 2004 the research expertise includes ionically-conducting materials for lithium battery applications, self-sensing and self-healing composite materials with applications in wind turbines, oxide-based electroceramics applied to O_2/N_2 separation for oxyfuel combustion or in fuel cells and natural fibre composites and life cycle analysis and energy efficiency of biopolymers and biocomposites. An area of study: *Making wind turbines*

invisible to radar involves the development of composite materials that control the way microwave and radar signals pass through or rebound off of surfaces such as turbine blades.

13.1.4 Energy Efficiencies

The University of Sheffield is investigating several different mechanisms and areas of energy efficiency in processes and systems. These areas are explored in more detail below.

Electrical Machines & Drives (EMD) hosts the Rolls-Royce UTC in Advanced Electrical Machines and Drives (UTC AEMD) and the Research Chair in Power Electronic Systems which underpins research in power electronic devices and packaging technologies. In 2004, EMD secured renewal of its EPSRC Platform Grant on hybrid-electric and all-electric vehicles, high power density traction motors, exhaust gas energy recovery, novel electromagnetic force/torque transmission technologies with applications in wind and wave power generation, and 'more-electric' civil and military aero- engines. A current project *State-of-Charge modelling and State-of-Health determination of batteries for all-electric vehicles* aims to develop charging scenarios for car batteries, to prolong their life time.
The Advanced Manufacturing Research Centre (AMRC), researches manufacturing technologies directly related to the aerospace industry. Projects aim to reduce energy consumption in processing and transport of parts and equipment. A new initiative, the Composites and Advanced Materials Technology Centre (CAMTeC), is developing a world-class centre of excellence in low temperature cure composites and hybrid (composite/metal) structures, with applications in wind turbine systems and reducing the weight of aircraft to reduce fossil fuel demand.
The Environment and Structures Research Group (ESRG) addresses sustainable and environmental performance of the built environment, including reduced carbon emissions from buildings. ESRG has created *SaBRE*, a joint initiative between the University of Sheffield and the BRE to create a North of England centre for environmental profiling, certification, training, consultancy and research. ESRG works closely with Prof. Saul, a member of the Pennine Water Group that provided scientific advice to the House of Lords Science and Technology committee on water management, 2005-7 and collaborates with Yorkshire Water to reduce energy consumption in their water processing and distribution networks.
Within the ESRG is the SCORCHIO (Sustainable Cities: Options for Responding to Climate Change Impacts and Outcomes), which aims to develop tools that use the next generation of

UKCIP scenarios to help planners, designers, engineers and users to adapt urban areas. It will do so by developing a climate simulator for urban areas; modelling typical buildings and their surroundings in order to develop a new human comfort vulnerability index; estimating the heat from buildings, together with a set of energy-related air pollutant and greenhouse gas emissions, to understand different building adaptation options; developing GIS-based methods for examining adaptation in planning and design; and demonstrating the methods and tools developed through in depth case studies, working in partnership with practicing planners and designers in Manchester and Sheffield.

13.1.5 Knowledge Commercialisation

The University of Sheffield has not been slow to market the fruits of its labours and is pro-active in maximising the returns from its knowledge base. Fusion IP owns 100% of the rights to the University of Sheffield's Intellectual Property (IP) and is a mechanism to develop the emerging technologies and research into businesses that eventually become independent companies.

Current companies set up from the University of Sheffield Fusion IP model include:

- QuantaSol, set up in conjunction with Imperial College London, in order to market new, 3rd generation Photo Voltaic cells, which is working closely with the EPSRC National Centre to improve PV efficiencies
- BioHyrdogen Ltd, which is looking to use microbial fermentation methods to produce Hydrogen as an efficient, robust and economical fuel source.
- Magnomatics is another company set up by Fusion IP, which produces high-torque magnetic gearboxes for use in wind turbine to improve efficiencies and reduced maintenance issues.

13.1.6 University of Sheffield Infrastructure

The University of Sheffield is also committed to reducing directly the environmental impact its activities have and has set a target of reducing its emissions by 20% below the baseline year of 2005-2006 by 2016-2017 by a variety of methods as laid out in some detail in the Carbon Management Programme SIP. The University of Sheffield has connected over 50 buildings to the district heating network and is the single largest user of this facility.

13.1.7 Sheffield Hallam University

Sheffield Hallam University is one of the UK's most progressive and innovative universities with the emphasis on both fundamental and applied research to underpin the culture fostered at Sheffield Hallam. The university is committed to ensure sound, environmentally responsible operational practice in all its activities and the systematic incorporation of environmental concern in the decision making process. Sheffield Hallam University has adopted a sustainability policy to indicate its commitment to these actions.

13.1.8 Research

The Solar Energy Group, within the Materials and Engineering Research Institute at Sheffield Hallam University, is dedicated to the understanding of Semiconductor Material and Device technology for next generation Solar Cells and Light Emitting Devices. Research in the group focuses on the manufacturing and processing of semi conducting materials and multi layer structures using electrochemical deposition techniques, the fabrication of device structures and their characterisation.

The Sheffield Hallam University has set up a Sustainability Hub to act as a conduit for information exchange within the university. A number of academic and non-academic staff, across disciplines, feed into this internal online community and its forum meetings. The aim of the network is to showcase outputs of research and business development projects, promote information exchange, foster debate, and share insights into regional, national and international policy and practice.

13.1.9 Knowledge Commercialisation

Sheffield Hallam University has recently set up a consultancy called Hallam Energy in order to use the university's specialisms' in order to maximise the benefit of existing technologies and to develop technologies further. Hallam Energy has set up a link with North East Derbyshire District Council in order to provide its expertise on a consultancy basis and has been successful in work with several different clients to evaluate product performance, provide energy and waste options and advise on product development.

Sheffield Hallam University has also used this link with the commercial sector to place PhD students in local companies to gain experience and forge new links between the academic and commercial worlds.

13.1.10 Zero And Low Carbon Technology Companies

Sheffield has a long and distinguished link with industrial innovation and is developing a sustainable energy sector to be proud of. There are over 30 companies involved in renewable energies within Sheffield. Nearly a third of the renewable energy companies are involved in the installation and maintenance of more than one type of renewable energy. A quarter is involved in the manufacture, supply or installation of PV and Solar Thermal Hot Water systems. The renewable energy sector is well catered for in Sheffield with every major renewable energy type represented with a company, except hydro power. There is even a company developing tidal power. A list of the companies located in Sheffield can be found in the table below;

Technology	University	Programme/Group	Purpose	Commercialisation of University Knowledge	Sheffield Based Suppliers/Manufacturers
Solar Thermal	n/a	n/a	n/a	n/a	A E Solar Systems Bumford Heating Clifford Plumbing and Heating Prior Plumbing and Heating Pure Energy Solutions RDJ Plumbing and Solar Heating GT Plumbing and Heating
PV	University of Sheffield	ESPRC National Centre for III-V technologies Electronic and Photonic Molecular Efficiencies Group	Improve efficiencies Reducing construction costs	QuantaSol	RAI Systems Ltd Aspire Solar Renewable Energy Heavens Solar Technology SolarGen UK Solar Utilities Homeco Technologies Ltd
	Sheffield Hallam University	Solar Energy Group			
Energy from Waste	University of Sheffield	Sheffield University Waste Incineration Centre	Improve efficiencies Reducing construction costs	n/a	Veolia
Energy Efficiency	University of Sheffield	Advanced Electrical Machines and Drives Advanced Manufacturing Research Centre Environment and Structures Research Group SCORCHIO	Improve manufacturing processes Provide tools for energy management	n/a	Ecowarehouse Sheffield Insulation Energy Saving Technologies Miller Pattison
CHP	n/a	n/a	n/a	n/a	Disenco
Heat Pumps	Sheffield Hallam University	PhD students seconded to Danfoss Ltd	n/a	n/a	Danfoss Heat Pumps UK Ltd Trianco Bancroft Plumbing and Heating

Biomass\Biofuels	Sheffield University	Biological and Environmental Systems	Studies in applications of biological systems	Biohydrogen Ltd	n/a
Wind	Sheffield University	The Ceramics and Composites Laboratory	Use of composite materials	Magnomatics	Rotary Engineering AG Wind Power AW Electronics Ltd Breeze Renewable Energy Ltd
Tidal	n/a	n/a	n/a	n/a	Pulse Tidal

TABLE 13.1 – Sheffield Renewable Energy Technology Summary

The carbon benefit of these technologies is impossible to quantify without research, data capture and analysis. The renewable technologies that replace grid supplied electricity offer the biggest carbon savings and should be promoted more than those which provide alternative forms of heat and which offer a more modest form of carbon saving.

13.1.11 The Future

Both universities have set in place effective means of turning academic research into commercial enterprise and the systems are already producing companies, which aim to maximise the potential of the universities. There are opportunities for these fledgling technologies to provide Sheffield with a strong position in the renewable energy sector.

The University of Sheffield is at the cutting edge of research into photo voltaic cells and if the research develops would go a long way to making PV an affordable and cost effective method of electricity production. There is an opportunity that Sheffield could be at the vanguard of this new technology and close links between the council, developers and the University of Sheffield could be utilised in any trials, helping to meet the renewable energy targets of developments, providing real data for the university and raising the profile of Sheffield at the same time.

The University of Sheffield has been involved historically in the development of the District Heating Network, currently operated by Veolia, and is the single biggest user of the system. The Sheffield University Waste Incineration Centre (SUWIC) played a key role in the network's development and has built on this base to become one of the leading international research centres for the thermal treatment of waste. With the wealth of knowledge and practical experience within Sheffield, the city is well placed to look at opportunities to incorporate progressive technologies into any future district heating networks or even to improve and update the existing system.

The creation of a Sheffield Sustainability Hub, based on the model created by Sheffield Hallam University, could be of potential benefit and ensure that the two universities, Creative Sheffield and Sheffield City Council can work closely together. This comprehensive knowledge base might inform the city's development into the future. The hub can also be extended to developers and local renewable energy companies to increase the practical element of the group and help increase the commercial potential of, and help develop, new technologies and ideas.

14 The GIS Database

This report is supported by a Geographical Information System (GIS) database that has been derived from asset information provided by relevant statutory undertakers and other key consultees.

This GIS database has been derived by WYG to illustrate the existing strategic utility infrastructure within Sheffield, and will allow Creative Sheffield and Sheffield City Council to view the position of strategic utility infrastructure in relation to each development allocation within the emerging SDF, EMP and CCMP.

The methodology for identification of non strategic utility infrastructure is described in the GIS Methodology section of this report. Non strategic assets as those which could normally be expected to be moved as part of the development process.

Sheffield GIS Database

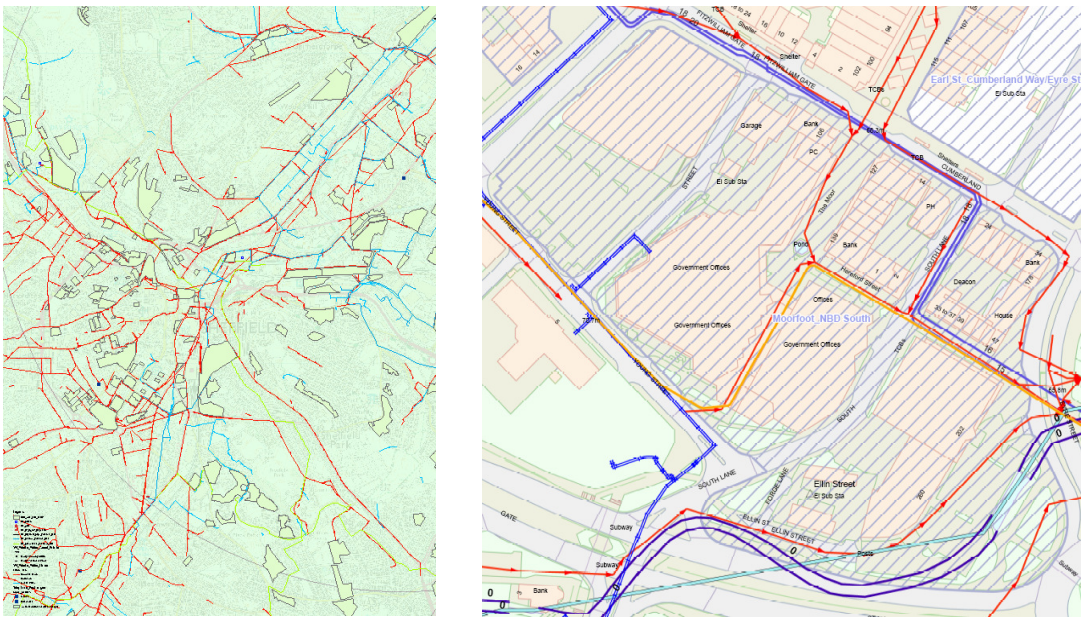

FIGURE 14.1 – Typical GIS Extracts

The GIS database contains;

CE Electric (YEDL),	Electricity distribution networks comprising 33kV and above
Central Networks	Electricity distribution networks comprising 33kV and above
National Grid	Electricity transmission infrastructure 275kV and 400kV
National Grid Gas	Medium, intermediate and high pressure gas infrastructure
Yorkshire Water	Potable water mains (strategic and distribution water mains above 250mm diameter) foul water sewers above 250mm diameter, and surface water / combined sewers above 400mm diameter.
Severn Trent Water	Potable water mains (strategic and distribution water mains above 250mm diameter) and foul water sewers above 250mm diameter, and surface water / combined sewers above 400mm diameter.
BT	The location of BT telephone exchanges.
Veolia (ES)	Sheffield Energy Recovery Facility and District Heating Network.
SDF sites	Development sites identified in the Sheffield Development Framework.
CAA boundaries	Community Assembly Areas provided by Sheffield City Council.
Large energy users	Existing developments believed to have high energy demand.

An outline of the tasks, data sources and outputs for the GIS elements of the Energy and Infrastructure Study for Sheffield City Council can be found in section 13 of this report.

BT Openreach were unwilling to provide the location of their strategic assets for the Sheffield wide area. Digital Region were unwilling to provide proposals for their new fibre network and its interconnection with BT PCP cabinets.

Glossary of Terms

Item	Description
AMP	Asset Management Period – A 5 year capital investment programme submitted by licensed Water and Sewerage Undertakers for final determination by Ofwat (AMP5 is 2010-2015)
Availability Charge	Availability charge is a monthly levy that is paid to an electricity distribution network operator (DNO) to reserve supply capacity at a site (meter point) in lieu of a metered revenue stream
Biomass	Biomass is biological material derived from living, or recently living organisms, such as wood, waste, and alcohol fuels and is classified as a renewable energy source. Biomass is commonly used to generate electricity or produce heat.
Bulk Supply Point	A facility which transforms electricity from 132kV to 33kV, and is typically a level above a Primary Substation.
CAPEX	Capital Expenditure
Capital Apportionment	The split of network reinforcement and other capital new connection costs between a regulated utility undertaker and a developer. An 'Apportionment Rule' exists in the electricity distribution regime
Capital Claw-back	A mechanism for recovering a capital investment – usually by Water Undertakers – by adding a unit cost (or additional unit 'infrastructure charge') onto individual new connection costs
Carbon Emissions	An abbreviation applied to carbon dioxide (CO_2) as the most significantly anthropologically affected greenhouse gas and a significant contributor to climate change
City Centre Masterplan (CCMP)	The Sheffield City Centre Masterplan 2008 looks 15 years ahead and builds upon the projects which have been progressed as a result of the 2000 Masterplan. The new Masterplan, incorporates these projects and identifies the next key stages of development and transformation of the City Centre
Collaboration Agreement	An agreement between two or more parties that could be used to apportion or claw-back an initial capital investment where this is not offered by a statutory undertaker
Covered Reservoir	A potable water reservoir, typically at ground level, that fully encloses and protects this water from external pollutants. May be covered with grass or have additional functionality.
Creative Sheffield	Creative Sheffield is the UK's first ever city development company, charged with delivering Sheffield's economic transformation.
Decentralised Energy	Energy generation that is not connected to a nationally strategic transmission network, more usually a local distribution network and typically utilises at a smaller scale and often using low-carbon or renewable energy. Decentralized energy may generate heat for local distribution (District Energy) and-or export power onto a local electricity network, or to end users via a private-wire.

Item	Description
Deed of Easement	An easement is a type of right which one person has over the land of another. Easements are legal interests under s1(2)(a) of the Law of Property Act 1925 (LPA 1925). They can be either legal or equitable.
DNO	Distribution Network Operator - The incumbent electricity operator for a region of the UK. There are fourteen DNO's operating in the UK
DPCR	Development Price Control Review – a 5-year capital investment programmed delivered by gas and electricity distribution network operators and approved by Ofgem (DPCR5 is 2010-2015)
Embedded Network	A network which is designed, built, owned and maintained by an independent operator wholly within another operator's region
Energy efficiency	The extent to which the use of energy is (or can be) reduced through good design, orientation, construction and operation
Energy from Waste	Is the process of creating energy in the form of electricity or heat from the incineration or thermal treatment of a waste source or the production of a combustible fuel commodity such as biogas.
Energy	Energy is a resource with the ability to do work or create change - energy is typically derived as thermal energy (for heating and cooling) and power. In Sheffield domestic thermal energy (space heating + hot water) is typically supplied by natural gas (and the Energy Recovery Facility), whilst power is mostly delivered from electricity generated at a central generating station from fossil fuels
ESCo	Energy Services Company – a company which is set up by a private or public sector organisation (or joint venture) for the purpose of delivering sustainable energy in the form of heat and/or power to an end user. ESCo commercial and procurement models are numerous
Feasibility	The viability of development in relation to economic and market conditions.
GIS	Geographical Information System is a ordnance survey based mapping system which is linked to a database of information
Greenhouse Gas (GHG)	A gas that can trap solar radiation that has penetrated earth's atmosphere and include carbon based gasses (CO_2 and methane etc.) plus nitrous oxide and ozone
iDNO	Independent Distribution Network Operator is an organisation who design, build, own and operate new distribution networks to support new development within another operator's geographical area – this mechanism is commonly referred to as an Embedded Network
Local Development Framework (LDF)	A Local Development Framework is a suite of local development design and planning framework documents describing spatial growth as defined under national Planning Policy Statement 12

Item	Description
Long Term Development Statement	A Long Term Development Statement is published by all gas and electricity distribution network operators (DNOs) to provide data to developers and other parties in regard to the development of a particular gas or electricity network (network specifications, constraints and capital investment programmes)
MUSCo	Multi Utility Services Company - an entity which has been set up by a suitably licensed organisation for the purpose of delivering combined utility services including energy, water, wastewater and telecommunications.
Non-Potable Water	Non-drinking quality water
PADHI	Planning and Development near Hazardous Installations (PADHI) is a policy document which provides guidance on development near hazardous installations such as high pressure gas mains.
Potable Water	Drinking quality water
Primary Substation	A facility which transforms extra-high-voltage/high-voltage electricity for transmission and distribution purposes – typically designed and built by the electricity undertaker and require > 3,000m^2
Private Wire	An electricity network that is operated NOT under license by a regulated operator. The operation of private-wire networks is governed under the Electricity (Class Exemptions from the Requirement for a Licence) Order 2001, which enables exempt generators, distributors and suppliers to supply electricity that they generate and distribute themselves directly to customers rather than to a licensed supplier (the grid).
Public realm	The part of the Urban Environment that is typically owned, operated and maintained by a local or municipal public authority (this includes the public highway in the case of this study)
Regional Economic Strategy (RES)	The Regional Economic Strategy (RES) is a plan for how Yorkshire & Humber will grow faster and better than its competitors by 2015.
Regional Spatial Strategy (RSS)	Regional Spatial Strategies bring together economic, social and environmental issues linked to planning in a coherent framework
SAGE	SAGE (Stakeholder Advisory Group on Extremely Low Frequency (ELF) Electromagnetic Fields
Sewage	The foul water discharged from domestic premises including lavatories, bathing, dishwashing and laundering facilities
Sewer	A pipe used to convey sewage

Item	Description
Sewerage	The network of sewer pipes and other network assets that enables the conveyance of sewage from a point of use to a sewage treatment works
Sheffield Development Framework (SDF)	The SDF is the Sheffield specific Local Development Framework (LDF) - a suite of local development design and planning framework documents that define the spatial growth of the City to 2026 - as defined under national Planning Policy Statement 12. The Core Strategy was adopted in March 2009.
Sheffield Economic Masterplan (SEM)	The Sheffield Economic Masterplan sets a broad agenda for the sustainable growth and improved performance of the Sheffield economy
Stormwater	Surface water resulting from rainfall
Street furniture	Structures in and adjacent to the highway which contribute to the street scene, such as bus shelters, litter bins, seating, lighting, railings and signs.
Supply-side Management	To manage the supply of a resource to a meet a specific demand in the most efficient way, typically to reduce wastage, increase diversity and improve security of supply
Surface Water	Water that collects on the surface of the earth usually following rainfall, which will 'runoff' towards a watercourse or stormwater drain, infiltrates into the ground, or evaporates
Sustainable development	Defined by the Brundtland Commission (1987, and quoted in PPG1) as 'Development which meets present needs without compromising the ability of future generations to achieve their own needs and aspirations'. The UK's strategy for sustainable development "A better quality of life" was published in May 1999 and highlights the need for environmental improvement, social justice and economic success to go hand-in-hand.
Treated Sewage Effluent (TSE)	The non-potable water resource that is reclaimed after primary, secondary and tertiary sewage treatment and should be in accordance with strict quality guidelines
Utility Undertakers	Those Authorities who are mandated through primary legislation or conditions of their operating license to provide a specific duty e.g. supply, distribute and retail water or electricity, convey and process sewage, or operate wireless or wire-line telecoms services
Wayleave	In law, the right to use the land of another for a specified purpose
Yorkshire Forward	Yorkshire Forward is the Regional Development Agency, charged with improving the Yorkshire & Humber economy.
Zero Carbon	The DCLG (Department of Communities and Local Government) consultation into the definition of "Zero Carbon" homes in July 2009 states that carbon reduction onsite is equal to 70 per cent of

	regulated carbon emissions

15 Appendix A – City Centre Masterplan Boundaries and GIS Extracts