ATKINS

Trafford Low Carbon and Energy Evidence Study Phase 1

Final Revised Draft Report

April 2011

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1. Introduction

Study Purpose

1.1 Atkins was appointed by Trafford Council in March 2010 to prepare a Low Carbon Energy Evidence study.

1.2 The study will be used to provide a sound evidence base for the formulation of Trafford's Core Strategy Policy L5, and a supporting Supplementary Planning Document. The study seeks to build on the findings of, and demonstrates how to implement, the carbon emission reductions targets detailed in the AGMA Decentralised and Zero Energy Planning Study (January 2010).

1.3 The purpose of the study is to:

- Inform work on Trafford's Core Strategy, particularly Policy L5;
- Demonstrate how Trafford will implement the carbon (CO_2) emissions reduction targets as detailed in Policy L5;
- Detail the feasibility and viability of introducing new energy infrastructure to meet carbon emission reduction targets;
- Provide guidance to assist Development Management Officers to implement Policy L5; and
- Provide an evidence base to enable the production of a Supplementary Planning Document (SPD) that will assist developers in Trafford in delivering the most appropriate technologies.

Approach

1.4 A blended team undertook the study including energy specialists from Atkins Carbon Management team and Town planners from Atkins Planning Team.

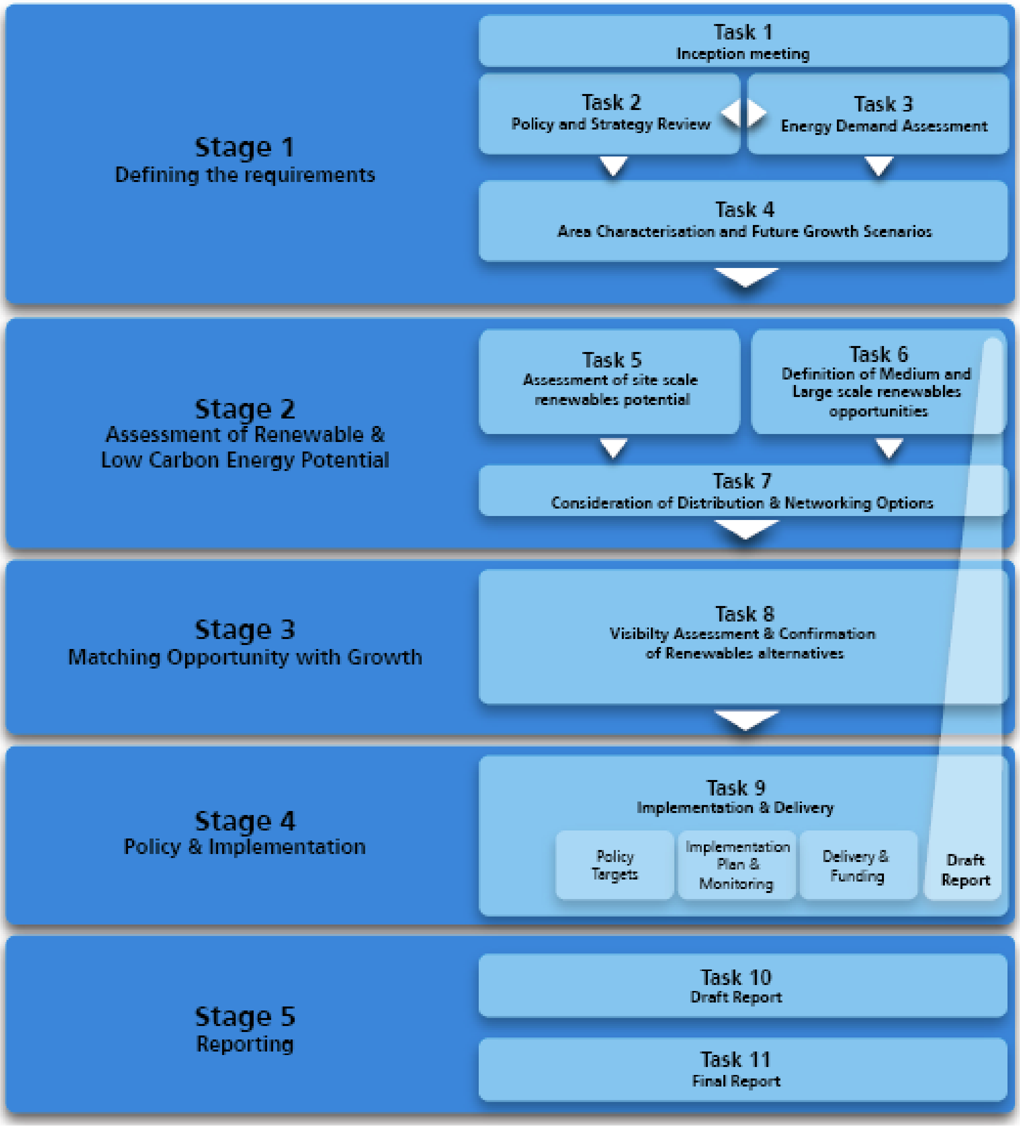
1.5 Figure 1.1 sets out the approach which was taken to completing the study including the key study stages and tasks.

1.6 This report summarises the key findings from the study. The remaining sections of the report follow sequentially through the stages identified at Figure 1.1.

- Section 2 provides a review of the legislative background underpinning the study including national planning policy guidance, the requirements of the regional and sub-regional policy and strategies, current and emerging local planning policies and other guidance, research reports and consultation documents which are relevant to the study.
- Section 3 identifies a number of high level scenarios which identify a range of assumptions regarding energy demand and CO2 emission reduction over the life of the Core Strategy to 2025/26. These scenarios help to establish the boundaries for the assessment of area and site level opportunities associated with new development.
- Section 4 provides an assessment of the Borough to accommodate renewable energy potential in connection with development. The assessment considers the potential for large and medium scale facilities which have the potential to anchor the development of local energy networks. It also considers the approach which should be taken to identify appropriate solutions for smaller sites.
- Section 5 provides an assessment of the economic viability of renewables options through a series of development case studies. The assessment considers the interaction with other policy goals including affordable housing, planning obligations and the relationship between renewable energy targets and Code for Sustainable Homes targets.

- Section 6 draws together the conclusions of the study. It recommends the approach which should be taken within the Core Strategy with regard to targets for on site and near site renewable energy generation. The chapter recommends how the policy requirements should be integrated with the development management process including guidance on how renewables options should be considered at pre-application stage and during the consideration of planning applications.

Figure 1.1 - Study Approach



Further Viability Case Studies

1.7 A final draft of the report was issued in December 2010. However, in order to provide further certainty around the viability of development schemes within Trafford Park, and in response to comments made by the Planning Inspector during the formal hearing session for Core Strategy Policy L5 in March 2011, additional case studies were undertaken to test a major residential-led mixed use scheme and a commercial scheme.

1.8 The outcomes of the further viability case studies are reported in chapter 5.

2. Policy Context

Introduction

2.1 This section provides a review of the national, regional and local policies and strategies that influence and guide the Renewable Energy (RE) and low carbon energy generation options.

2.2 The purpose of the policy review is to establish the requirements for the provision of low carbon energy within the current policy and regulatory framework, in order to establish the role planning policy can play in encouraging low carbon energy generation in the borough. The policy review informs the understanding of how the decision making process reflects objectives, targets and relevant standards. The Council should draw on baseline evidence and local circumstances to determine options for intervention where they are most appropriate.

2.3 The drafting of future policies should take an integrated approach and should be drawn so they enable measurements to be taken that satisfy both national and local targets (such as Defra National Indicator targets NI 185 and the Council's own 'Adapting to Climate Change in Trafford'.

Background: Legislative, Regulatory and other Drivers

2.4 At the national level minimum targets are defined in the Climate Change Act 2008 (CCA 2008) and other government policy. The Planning and Energy Act 2008 enables local authorities to exercise a power to adopt the policy in the Planning and Climate Change supplement to Planning Policy Statement (PPS) 1, although it is a discretionary.

2.5 Carbon reduction targets are tied to statutory targets and are subject to regular review. There is a duty on the Secretary of State to ensure that legally binding targets are met and this includes green house gas emission reductions through action in the UK and abroad of at least 80% by 2050, and reductions in CO_2 emissions of at least 26% by 2020, against a 1990 baseline. Planning authorities should help to achieve the national timetable for reducing carbon emissions from domestic and non-domestic buildings.

2.6 In particular the Low Carbon Transition Plan and the Renewable Energy Strategy (July 2009) set out how the UK will achieve dramatic reductions in emissions and meet targets on renewables whilst the Household Energy Management Strategy (March 2010) placed a greater emphasis on district heating schemes. The April 2010 budget outlined the Government's commitment to tackle climate change. Measures outlined include a commitment to reduce government department's carbon emissions by at least 30 per cent by 2020 through the production of departmental carbon reduction plans; a commitment to reform the energy market to provide clean, secure and affordable energy, and the establishment of a Green Investment Bank with a mandate to invest in the low-carbon sector to address the gap in the provision of equity capital to large, complex low carbon infrastructure projects

2.7 Commitment to reduce government carbon emissions by 30% by 2020

National Planning Policy

2.8 The requirement for local authorities to develop low carbon and renewable energy policies in their Development Plan Documents (DPD's) comes from PPS 22: Renewable Energy (2004) and the PPS 1 Supplement, Planning & Climate Change (2007). Local Planning Authorities should provide a framework to encourage low carbon and renewable energy in DPD's and can explicitly adopt higher standards than the Building Regulations in policy.

Planning Policy Statement 1: Delivering Sustainable Development (PPS1)

2.9 Sustainable development is the core principle underpinning planning. Development plans are required to address climate change through policies which reduce energy use and emissions, promote the development of renewable energy resources, and take climate change impacts into account in the location and design of development.

2.10 Development plan policies should seek to help secure more efficient use or reuse of existing resources, rather than making new demands on the environment; and encourage, rather than restrict, the use of renewable resources. Authorities should promote resource and energy efficient buildings; community heating schemes, the use of combined heat and power, small scale renewable and low carbon energy schemes in developments.

PPS 1 Supplement.

2.11 The PPS Supplement sets out a series of principles for the decision-making framework designed to ensure that new development, its spatial distribution, location and design should be planned to limit carbon dioxide emissions; make good use of opportunities for decentralised and renewable or low carbon energy and ensure new development should be planned to minimise future vulnerability in a changing climate.

2.12 Paragraph 33 states that in testing out local requirements planning authorities should ensure that what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including costs of necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities. The evidence base should be tested before an Inspector. LPAs should set out how they intend to advise potential developers on the implementation of the local requirements and how these will be monitored and enforced.

2.13 Paragraph 18 states planning authorities should consider the opportunities for the core strategy to add to the proposals and policies of the RSS where local circumstances will allow to further progress in achieving the Key Planning Objectives.

2.14 The Key Planning Objectives (Paragraph 9) relate to sustainable development. The broad based criteria can be used to justify reasons for decision making and briefly require LPAs to:

- contribute to delivering the Government's Climate Change Programme and energy policies;
- provide for homes, jobs, services and infrastructure by securing the highest viable resource and energy efficiency and reduction in emissions;
- deliver patterns of urban growth which reduce the need to travel, especially by car;
- secure new development and shape places that minimise vulnerability, and provide resilience to climate change in ways consistent with social cohesion and inclusion;
- conserve and enhance biodiversity;
- reflect the development needs and interests of communities; respond to the concerns of business and encourage competitiveness and technological innovation in mitigating and adapting to climate change.

2.15 If these objectives cannot be met then consideration should be given to how proposals could be amended to make them acceptable, or where this is not practicable, to whether planning permission should be refused. In the context of this Study the first, fourth and sixth Objectives are the most relevant.

2.16 Policies within DPDs should expect a proportion of energy to be supplied from low carbon or renewable sources and policies should promote this through supporting infrastructure (Paragraph 19).

2.17 Strategic targets are also defined in the RSS but they should be used as a strategic tool for shaping policies and for annual monitoring and 'should not be applied directly to individual planning applications' (Paragraph 16), although consistent underperformance by an authority would prompt action by the Secretary of State at the RSS level and with implementation.

2.18 The ability to contribute to targets will vary according to a site's size, resources and the rate and nature of new developments coming forward and judgement may also be partly informed by this evidence base. There are also local requirements for sustainable buildings (Paragraphs 30-32).

Renewable and Low-Carbon Energy Generation

2.19 Planning authorities should (Paragraphs 19-20):

- not require applicants for energy development to demonstrate either the overall need for renewable energy and its distribution, nor question the energy justification for why a proposal for such development must be sited in a particular location;
- ensure any local approach to protecting landscape and townscape is consistent with PPS22 and does not preclude the supply of any type of renewable energy other than in the most exceptional circumstances;

2.20 Alongside any criteria-based policy developed in line with PPS22, consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, support innovation and expect a proportion of the energy supply of new development to be secured from decentralised and renewable or low-carbon energy sources.

Selecting Land for Development

2.21 In deciding which areas and sites are suitable, and for what type and intensity of development, planning authorities should take into account:

- the extent to which existing or planned opportunities for decentralised and renewable or low-carbon energy could contribute to the energy supply of development;
- the means to reduce the private car and opportunities to service sites through sustainable transport;
- the capacity of existing and potential infrastructure to reduce carbon dioxide emissions and successfully adapt to likely changes in the local climate;
- the ability to build and sustain socially cohesive communities with appropriate community infrastructure, taking into account local impacts that could arise as a result of likely changes to the climate;
- the effect of development on biodiversity;
- the contribution to be made from existing and new opportunities for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity; and adapt to known constraints on such as flood risk and stability, taking a precautionary approach.

2.22 In deciding on areas and sites to identify for development, priority should be given to those that will perform well against the criteria in paragraph 24 of the PPS (summarised above). Where areas and sites perform poorly, planning authorities should consider whether their performance could be improved.

Local Requirements for Decentralised Energy to Supply New Development

2.23 Paragraphs 26-29 address local requirements for decentralised energy to supply new development drawing on the evidence-base.

2.24 Authorities should pay attention to opportunities for utilising existing decentralising and renewable or low carbon energy supply systems. Proposed development should connect to an identified system or be designed to connect to be able to connect in the future. A specific requirement to facilitate connection must be fair and reasonable and not unduly restrictive.

2.25 Planning Authorities should set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable and bring forward development area or site specific targets to secure this potential. In bringing forward targets, planning authorities should set out the type and size of development to which the target will be applied and ensure there is a clear rationale for the target and it is properly tested. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured. Planning authorities can set out how the proposed development would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

2.26 New opportunities to supply proposed and existing development could include co-locating potential heat customers and heat suppliers.

2.27 Planning policies should support innovation and investment in sustainable buildings.

2.28 Where appropriate planning authorities can improve upon national policy. Authorities must be able to demonstrate clearly the local circumstances that warrant and allow this and include opportunities for significant use of decentralised and renewable or low carbon energy. Planning authorities should ensure what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities.

2.29 In the case of housing development the proposed approach should be consistent with securing the expected supply and pace of housing development shown in the housing trajectory required by PPS3 and not inhibit the provision of affordable housing. Local authorities should also set out how they intend to advise potential developers on the implementation of the local requirements, and how these will be monitored and enforced.

Monitoring and Review

2.30 Paragraphs 34-37 of PPS1 Supplement state that where monitoring suggests that implementation is not being achieved in line with an agreed strategy or that the strategy is not delivering the expected outcomes, it is essential to respond promptly and effectively and update assumptions on which the spatial strategy is based (which can be tested against the Key Planning Objectives). Annual monitoring reports should describe performance and, as necessary, the action intended to improve implementation or to update the strategy. PPS 22

2.31 Some of the context for the approach in PPS 22 on Renewable Energy (2004) has changed in the context of more recent policy and legislative drivers. Planning applications for renewable energy projects should be assessed against specific criteria set out in regional spatial strategies (the Regional Spatial Strategy for the North West) and local development documents. This includes a requirement for a percentage of the energy to be used in new residential, commercial or industrial development to come from on-site renewable energy developments.

2.32 Policies should set out the criteria that will be applied in assessing applications for planning permission for renewable energy projects.

2.33 The wider environmental and economic benefits of all proposals for renewable energy projects, whatever their scale, are material considerations that should be given significant weight in determining whether proposals should be granted planning permission. The Council must determine the degree to which it is reasonable to support a renewable energy scheme in the context of any adverse impact on the local environment or community which may outweigh the local and wider benefits they offer in producing energy or reducing pollution to land, air or water for example.

2.34 Planning applications should not be rejected because output is anticipated to be small. Developers of renewable energy projects should engage in active consultation and discussion with local communities at an early stage and before any planning application is formally submitted.

2.35 Planning authorities should only allocate specific sites for renewable energy in plans where a developer has already indicated an interest in the site, has confirmed that the site is viable, and that it will be brought forward during the plan period. This provision should not be interpreted too restrictively in the light of recent policy changes. However, specific sites that are allocated for RE or Low Carbon generation should realistically be deliverable during the life of the development plan. The issue of viability should be determined on a case by case basis.

Locational Considerations

2.36 As most renewable energy resources can only be developed where the resource exists and where economically feasible, planning authorities should not use a sequential approach in the consideration of renewable energy projects.

Small Scale Renewable Energy Developments

2.37 Small scale renewable energy schemes utilising technologies such as solar panels, Biomass heating, small scale wind turbines, photovoltaic cells and combined heat and power schemes can be incorporated both into new developments and some existing buildings and should be encouraged through positively expressed policies in local development documents.

Landscape and Visual Effects of Renewable Energy Developments

2.38 The landscape and visual effects of renewable energy developments vary according to type of development, its location and landscape setting. Some of these effects may be minimised through appropriate siting, design and landscaping schemes. Policies in LDDs should seek to minimise visual effects. Assessing the impact of turbines on the landscape is unlikely to affect Trafford. However, if used for the purpose of micro-generation the Council should consider the need for guidance on the cumulative impact of small turbines on 'small scale' development.

Noise

2.39 Renewable energy developments should be located and designed in such a way to minimise increases in ambient noise levels. Plans may include criteria that set out the minimum separation distances between different types of renewable energy projects and existing developments. This is particularly important for housing. Typically ambient noise levels at night time for example are between 35-40 db and can be marginally higher if a neighbour nearby has an interest in the development. Trafford is unlikely to promote wind energy development on anything but a small scale but technical standards should refer to the need to comply with best practice in the ETSU guide 1997.

Odour

2.40 In handling planning applications for anaerobic digestion, local planning authorities should consider carefully the potential impacts of odour and the proposals for its control. In cases where odour would have an impact, such plants should not be located in close proximity to existing residential areas.

Biomass Projects and Energy Crops

2.41 Local planning authorities should make sure that the potential for an increase in traffic effects are minimised by ensuring that generation plants are located in as close proximity as possible to the sources of fuel that have been identified. But in determining planning applications, planning authorities should recognise that other considerations (such as Grid connection and use of heat generated from a development) may influence the choice of the most suitable locations.

Wind Turbines

2.42 LDDs should not include policies in relation to separation distances from power lines, roads, and railways. It is the responsibility of developers to address any potential impacts, and legislative requirements on separation distances, before planning applications are submitted.

Consultation on a Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate

2.43 There have been significant developments in legislation and planning policy support for renewable energy that has changed the context of the guidance contained in the PPS1 Supplement and PPS22. The consultation PPS combines and updates these policy documents and will become a consolidated supplement to PPS1. The draft PPS sets out how planning should help to achieve lower carbon emissions and greater resilience to the impacts on climate change.

2.44 Key features of the new PPS1 supplement are that targets for renewable energy should be set in the Regional Strategy and LDFs should generally not set separate District-wide targets but may set out local requirements relating to specific development areas and must take account of decentralised energy opportunities when allocating sites. The PPS1 supplement also gives more power to LPAs in determining applications on climate change grounds in expecting planning proposals to demonstrate how they reduce greenhouse gas emissions.

2.45 There are concerns that there is a the lack of support for addressing energy efficiency in existing buildings and the extent to which it is reasonable to discount all sites for allocation purely on the grounds that they might perform poorly in terms of their scope to provide for decentralised energy.

Reference to Other National Policy Guidance

2.46 There are a number of other national policies that are relevant to the adoption of new policies and their implementation, some of which are particularly relevant from an environmental point of view.

2.47 They can be summarised as follows:

- PPS 3 Housing;
- PPS4 Planning for Sustainable Growth;
- PPS 10 Waste;
- PPS 12 Local Spatial Planning 2008 – the approach to good infrastructure planning;
- PPG 13 Transport;
- PPS 5 Heritage –
- PPG 24 Noise; and
- PPG 25 on Development and Flood Risk – flood protection and mitigation measures.

Building Regulations, Standards & Certificates

2.48 The requirements to meet Building Regulations should not be addressed in planning conditions but policy can promote standards that exceed Building Regulations (PPS1) and reference can be made to that. Energy efficiency standards can exceed the energy requirements of building regulations and so lower emissions rates for buildings.

2.49 Part L of the Building Regulations sets the mandatory minimum thresholds of reduction in CO2 emissions for all types of buildings and requires new residential development’s dwelling emission rate (DER) to reduce periodically. Building regulations that cover DER are measured by exceeding Target Emission Rates (TER) in certain percentages, reflecting energy improvements over TER.

Domestic Buildings – Code for Sustainable Homes

2.50 The requirement to produce new housing as a minimum at Code level 3 in the Code for Sustainable Homes (2008) (CfSH) is now mandatory for public housing and voluntary for private sector housing. The Government's policy is for all new homes to be zero carbon from 2016 which will be achieved by incorporating the CfSH standards into the Building Regulations. It is proposed to incorporate the energy / carbon standards in three steps. The following Codes will apply to the Building Regulations and the energy improvements over TER relative to the 2002 Building Regulations are:

- 2010 –Code Level 3 – 25% improvement
- 2013 – Code Level 4 – 44% improvement
- 2016 - Code Level 6 – zero carbon

2.51 The Government is working on a definition of zero carbon for the purpose of meeting the 2016 target. The Standard Assessment Procedure (SAP) is also being reviewed. These target levels are likely to reduce carbon emissions by a further 10-20% and that reduction should be reviewed post 2016. Non-mandatory standards cover other sustainable design issues. Owing to the planned programme of changes to update the CfSH up to 2020, it is unlikely that many developers will want to voluntarily exceed current requirements in terms of targets given the demands, costs and technological challenges satisfying the criteria raises. Guidance on how to comply with the Code can be found in these publications on the DCLG website:

- The Code for Sustainable Homes: Setting the Sustainability Standards for New Homes - which sets out the assessment process and the performance standards required for the Code; and
- The Code for Sustainable Homes: Technical guide (May 2009 Version 2) - which sets out the requirements for the Code, and the process by which a Code assessment is reached.

Non-Domestic Buildings - BREEAM

2.52 The Building Research Establishment Environmental Assessment Standard (BREEAM) addresses similar topics for non-residential buildings, but the ratings are pass, good, very good, excellent and outstanding. There are some variations in the credits used for different versions of BREEAM although many are the same for all versions. Except for central government estates, agencies and a few others, it is a voluntary standard unlike CfSH. BREEAM is an environmental assessment method used throughout the world for reviewing, assessing and improving the environmental performance of the following types of projects:

- Whole new buildings;
- Major refurbishment of existing buildings;
- New build extensions to existing buildings;
- A combination of new build and existing building refurbishment;
- New build or refurbishments which are part of a larger mixed use building; and
- Existing building fit-out.

2.53 The Department for Children, Schools and Families (DCSF) currently requires the following new build and refurbishment projects to achieve at least a BREEAM rating of 'Very Good' for:

- Primary school projects costing £500,000 or more;
- Secondary school projects costing £2 million or more; and

- All projects involving remodelling or complete refurbishment of more than 10% of the total gross internal floor area of a school.

2.54 However, smaller scale projects are also encouraged to achieve a BREEAM rating, where feasible. The BREEAM rating is a way that planning authorities can set targets for sustainable design. BREEAM should be considered for all the projects listed above and adopted where feasible.

Energy Performance Certificates

2.55 The Energy Performance Buildings Directive has seen the final roll- out of Energy Performance Certificates to all building sectors with the introduction of EPCs to rented homes and the extension of EPCs to include all commercial buildings when bought, sold or rented. All large public buildings have to have on public view a Display Energy Certificate showing the building's energy efficiency rating from 1 October 2009. In November 2009 agreement was reached on the revisions to the Directive. The revisions have strengthened and extended the scope of the current directive by setting a legal framework to upgrade national building codes and by launching an ambitious policy of nearly zero-energy buildings, so that all new buildings in the European Union (EU) will be nearly zero-energy as of 2020

The Low Carbon Transition Plan

2.56 The Low Carbon Transition Plan sets out a route-map for the UK's transition to a low-carbon economy by 2020. The plan suggests that through the provision of 'carbon budgets', energy will be produced and used more efficiently by all parties. The objective is to make the appropriate changes to a low carbon economy and reduce the dependency on declining resources which make the economy subject to market disturbances. The plan shows the potential emission savings on a sector-by-sector basis, in which the aims are:

- Protecting the public from immediate risk;
- Preparing for the future;
- Limiting the severity of future climate change through a new international climate agreement;
- Building a low carbon UK, through the legally binding 'carbon budgets'; and
- Supporting individuals, communities and businesses to play their part.

Transforming Existing Homes and Communities

2.57 Central government aims to source 15% of energy demand from renewable energy throughout the heat, electricity and transport sectors by 2020. The Transition Plan document states that currently 13% of UK's greenhouse emissions come from heating rooms and the water supply in homes. The plan, along with wider policies, aims to cut emissions from homes by 29% on 2008 levels by producing more heat and electricity through low carbon technologies, such as solar power and heat pumps. Essentially the analysis on least-cost technologies suggests that the delivery of these targets would depend on RE providing around 30% of the electricity supply (including 2% from small-scale sources) and 12% of the heat supply.

2.58 The UK Renewable Energy Strategy aspires to make sufficient progress each year to achieve the 2020 target. Under the Renewable Energy Directive, the UK has interim targets to achieve the following shares of renewables:

- 4.0% in 2011-12;
- 5.4% in 2013-14;
- 7.5% in 2015-16;
- 10.2% in 2017-18.

2.59 The most recent analysis suggests the level of RE leading to 2020 will be sufficient to meet these interim targets, if future demand is on the low side of the government projections. However, the government is less confident about meeting the first three interim targets if energy demand is high. In this case the need to generate RE across the UK will be greater, in order to compensate for future energy demands.

2.60 The Transition Plan identifies ways of helping households to make energy savings of 20%, reaching the Carbon Emissions Reduction Target, between April 2008 and March 2011. There is a commitment to insulate six million homes and ensure that energy suppliers are maintained to the end of 2012, through efficient use of the energy and the grid.

2.61 To deliver energy savings in the longer term, the plan aims to install smart readers in every home by the end of 2020 and encourage the provision of smart displays now for existing meters benefiting between two and three million households.

2.62 The Community Energy Saving Programme will deliver treatments to housing in low-income areas in order to raise the overall standards of the housing stock. The Transition Plan also targets the most vulnerable sections of society, e.g. pensioners, and fuel poor households in ensuring that these homes are provided with adequate insulation and that energy costs are reduced.

2.63 The plan is supportive of a local approach to reducing energy consumption, where communities can install RE and low carbon energy generating technologies independently. The Transition Plan will provide an online “How to” guide for communities looking to produce low carbon energy at a community level, as well as unlock greater action by local authorities to identify the best potential for low carbon community scale solutions in their areas.

Heat and Energy Saving Strategy Consultation

2.64 The consultation document, which was launched in February 2009, sets out an aim for emissions from existing buildings to be approaching zero by 2050. This means increasing the scope and ambition of our energy saving measures, as well as decarbonising the generation and supply of heat. Key policy proposals include:

- Consideration of whether a new delivery model is needed, to allow a more coordinated approach to rolling out improvements to homes and communities, house-by-house and street-by-street.
- Consideration of widening requirements under Building Regulations to carry out energy saving measures alongside certain types of building work, and consideration of a new voluntary code of practice with the building trade on energy efficiency and low carbon energy.
- A new focus on district heating in suitable communities, and removing barriers to their development.
- Encouragement of combined heat and power and better use of surplus heat through carbon pricing mechanisms.

Regional and Local Policy Context

Regional Spatial Strategy for the North West

2.65 Planning policies and new development should contribute to the reduction in the Region's carbon dioxide emissions; take into account future changes to national targets for carbon dioxide and other greenhouse gas emissions; and identify, assess and apply measures to ensure effective adaptation to likely environmental, social and economic impacts of climate change. New development should meet at least the minimum standards in the North West Sustainability Checklist for Developments (Policy DP9).

2.66 The RSS requires a commitment to support sustainable energy production and consumption, especially from public authority schemes. This includes the greater use of CHP in plans and strategies (Policy EM15).

2.67 Policy EM16 requires Distribution Network Operators and Local Planning Authorities to make effective provision for any required energy network upgrades to minimising consumption and demand, and maximise an efficient approach to energy. Robust policies should be included to support reductions in emissions in order to actively facilitate reductions in energy requirements and improvements in energy efficiency.

2.68 Indicative capacity targets for the development of renewable energy technologies are provided in Tables 9.6 and 9.7a-c to demonstrate the way in which the 10% regional target as stipulated in Policy EM17 for electricity to be supplied from renewable energy sources by 2010 may be achieved.

2.69 Local authorities should work with stakeholders in the preparation of sub regional studies of renewable energy resources so as to gain a thorough understanding of the supplies available and network improvements, and how they can best be used to meet national, regional and local targets. These studies should form the basis for:

- informing a future review of RSS to identify broad locations where development of particular types of renewable energy may be considered appropriate; and
- establishing local strategies for dealing with renewable resources, setting targets for their use which can replace existing sub regional targets for the relevant authorities.

2.70 RSS reflects Government targets in policy EM18 requiring development over 10 units or 1000sqm to meet 10% of its energy needs from decentralised and renewable or low carbon sources. Thresholds below this level maybe applicable if demonstrated to be viable in more local studies identified in the Sustainability SPD. Targets for the percentage of energy to be use in new development to come from decentralised and renewable or low-carbon energy sources should be set out and tested in Development Plan Documents to ensure they are evidence-based, viable and consistent with ensuring housing and affordable housing supply is not inhibited.

AGMA Decentralised and Zero Carbon Energy Planning

2.71 The AGMA study was undertaken to provide a strategic framework and evidence base to enable the Core Strategies to set minimum targets for low and zero carbon energy. The study aims to identify opportunities to link new development with the supporting energy infrastructure, and identify the most appropriate energy mix for delivering new growth aspirations across the area.

2.72 The study identifies a series of strategic recommendations in the planning and delivery of low carbon energy. These include creation of an energy planning framework and specific strategic infrastructure planning to overcome future constraints in meeting carbon reduction targets, creation of a spatial energy plan for the City Region which identifies strategic projects to be taken forward; high level objectives such as the identification of character areas should be incorporated into Core Strategy; and City Region spatial energy plan should form basis for DPD supported by an SPD to ensure consistent energy plan preparation.

2.73 The key outcome from the AGMA study is the identification of higher carbon reduction targets than the Regional Spatial Strategy and the introduction of a shift in emphasis from energy use to CO_2 emissions.

Trafford Core Strategy: Further Consultation on the Vision, Strategic Objectives and Delivery Strategy

2.74 Consultation on the Preferred Options of the Core Strategy began in 2008 to progress Core Policies. The latest round of consultation undertaken in March 2010 addresses the delivery of the

Vision for Trafford, explaining how the Vision and Objectives will be achieved over the lifetime of the plan.

2.75 By 2026 the Core Strategy seeks to create vibrant, prosperous and sustainable communities with economic and housing growth focused in the urban area. It identifies 5 strategic locations for areas if change, namely Pomona Island; Trafford Wharfside; Lancashire County Cricket Club Quarter; Trafford Centre Rectangle and Carrington. In particular substantial areas of brownfield land at Carrington will be transformed into a new sustainable mixed use neighbourhood.

2.76 To achieve this vision and the strategic objectives, the consultation document outlines a series of policies to guide future development. Of importance to the Trafford Low Carbon study are policies L1, L2 and W1 which set out the scale and nature of growth in Trafford, whilst more specifically Policy L5 explains how the climate change targets will be implemented in new development.

2.77 In terms of guiding the location and scale of new growth, Policy L1 requires 11800 new dwellings to be accommodated in the plan period. 30% of this will be directed to the Regional Centre and Inner Areas, and of the remaining 70% within the South City Region area, half will support key regeneration priorities set out in Policy L3 and will strengthen Trafford's 4 town centres.

2.78 Policy W1 seeks to direct B1 office use mainly in the Regional Centre (Pomona and Wharfside) and the Town Centres. Trafford Park Core is identified as a key location for industry and business activity whilst Carrington has been identified as accommodating large-scale employment development. Policy L5 – Climate Change (consultation draft, November 2009)

2.79 Core Policy L5 states that all new development will be required to minimise contributions to and mitigate the effects of climate change and maximise its sustainability by adopting measures that reduce carbon emissions. Development will be required to contribute to national, regional and local carbon reduction targets throughout both the development process and the life of the development to deliver benefits to both future occupants of the development and residents of the borough.

Sustainable Construction

2.80 The government has made a commitment through Code for Sustainable Homes in-line with Part L Building Regulations to make all homes zero carbon from 2016, and 2019 for non-residential uses. In order to achieve this, Policy L5 requires developers to take action to ensure that the following is achieved:

- Year 2010 – Code Level 3;
- Year 2013 - Code Level 4; and
- Year 2016 - Code Level 6.

2.81 By 2019 these provisions will also apply to all new non-domestic buildings.

2.82 They will also need to demonstrate best practice in commercial developments, through the application of the BREEAM (Building Research Establishment Environmental Assessment Method) standards; and provide an assessment with all planning applications to show how they meet at least the minimum standards in the North West Sustainability Checklist for Developments.

CO2 Emissions Reductions Target Framework

2.83 All development proposals above 10 residential units or 1,000m^2 thresholds will be required to submit an Energy / Carbon Budget Statement with each planning application that demonstrates the specific measures to be implemented as part of the development to reduce gross carbon emissions. A gross emission reduction target framework is set out in table L.5.1 which sets the targets to reduce carbon emissions for all developments which meet the stated threshold. This study has been developed based on the assessments undertaken in the AGMA study.

TableL.5.1 - Gross Emission Reduction Target Framework

Target Areas	Minimum CO2 reduction targets				Proposed Allowable Solutions
	2010-2015		2016-2021		
	% of regulatory* target	Unregulated** target %	% of regulatory* target	Unregulated** target %	
Area 1: Network expansion	80	80	35	Balance % (regulated) 80 (unregulated)	Developer contribution towards network expansion linking existing buildings
Area 2: Electricity intense	60	42	100	80	Developer contribution either to local installations or to City Region investment fund once established
Area 3: Micro-generation	60	34	80	80	Developer contribution either to local installations or to City Region investment fund once established

* Regulated Emissions i.e. space heating, ventilation, hot water and fixed lighting.
** Unregulated Emissions i.e. energy use within the building including IT equipment, fridges.

2.84 Definitions of target areas in Table L5:

- Target Area 1 - Network expansion area: Locations where the proximity of new and existing buildings creates sufficient density to support district heating and cooling.
- Target Area 2 - Electricity intense area: Locations where the predominant building type has an all electric fit-out, creating high associated CO2 emissions.
- Target Area 3 - Micro-generation area: Locations where lower densities and a fragmented mix of uses mean that only building scale solutions area possible.

2.85 Developments smaller than the above threshold, but involving the erection of a building or substantial improvement to an existing building will be expected to incorporate appropriate micro-generation technologies.

2.86 An Energy / Carbon Budget Statement is to be submitted for all developments that meet the threshold. The statement will set out the projected energy demand profile and associated gross CO_2 emissions (both regulated and unregulated) for all phases of the development. The statement will need to set out how the developer will meet the appropriate target set out in the framework above. The statement will need to be submitted at the outset of any proposed development (outline or before). The methodology for this statement will be set out in a planned Sustainability SPD.

2.87 If particular circumstances of the development suggest these requirements are not viable the applicant must provide information consistent with the Trafford Economic Viability Study to demonstrate this.

2.88 Proposals for new sources of energy generation will be encouraged except where they would have an unacceptable impact on the local environment and suitable mitigation measures are not proposed.

2.89 The justification to the policy provides further guidance on the standards adopted for new development confirming that the principles of the Code for Sustainable Homes is also applicable to proposals for householder alterations and extensions.

2.90 Trafford Council's recently adopted Sustainability Strategy sets out the desire for the early implementation of the Governments Code for Sustainable Homes and a minimum requirement for on-site renewable energy generation in new developments of 10% as well as improvements in energy efficiency of existing dwellings in the Borough. The BREEAM accreditation of 'excellent' is to be applied to all new Council buildings and 'very good' to all new non-residential developments.

2.91 In terms of the carbon emissions reduction targets framework, the justification to the policy explains how the targets have been achieved. The regulatory carbon reduction targets are national requirements measured against Building Regulations Part L 2006. The unregulated energy use is estimated using the national calculation methodology for building types. Whilst residential development will need to be zero carbon by 2016, it is recognised that this may be costly and difficult to achieve. Therefore, Target Area 1 applies a 35% regulatory emissions target with the remaining 65% carbon emissions reduction being achieved through 'allowable solutions' such as linking into an expanding district heating network.

Adapting to Climate Change in Trafford

2.92 In 2009, Trafford Council published its first Sustainability Strategy, designed to tackle the issues of climate change mitigation, energy security, and fuel poverty. The Sustainability Strategy together with the Energy and Water Management Plan aims to address a number of new sustainability indicators which include reducing carbon emissions from Council operations; achieving a reduction in per capita carbon emissions in the Local Authority area from domestic housing, Business and industry and Transport.

2.93 Trafford Council developed a strategy to identify and deal with the new risks and challenges posed by Climate Change. The most appropriate options for Trafford were selected following consultation and an action plan was developed to ensure that the Council is fully prepared to deal with all future climate scenarios.

2.94 The strategy makes a commitment to carbon reduction, renewable energy generation and energy efficiency which is to be implemented through LDF policies. The strategy recognises that the Core strategy will be the key document for implementing sustainable development in Trafford. The location and amount of development identified in the Core Strategy will take into account the constraints and opportunities resulting from climate change.

3. Energy Baseline and Requirements

3.1 This section identifies the existing energy requirements for Trafford in terms of demand for electricity and gas, and the projected energy requirements of the four case studies areas. The existing energy requirements were determined from data supplied by the Office for National Statistics. Energy trajectories for the four case study areas were devised from Trafford Council's current growth trajectory.

3.2 The high level energy trajectories, one for each case study area, help to define the boundaries of what may be technically feasible options for renewable energy generation at a more local level and help provide a benchmark to measure performance of alternative renewable energy options.

Existing Energy Requirements

3.3 The table below lists Census data and energy consumption data for Trafford in 2007. It can be seen that the energy consumption for electricity is 6.05 kWh/m^2 and 35.7 kWh/m^2 for gas. It can also be estimated that the average energy consumed per household in Trafford in 2007 was 4774 kWh of electricity and 19,987 kWh of gas. The data is sourced from the Office for National Statistics[1].

Table 3.1 - Energy Consumption for Trafford 2007

2001 Census data	Trafford	Population	210,145
		Area (hectares)	10,605
		Households	89,313
Breakdown of Energy Consumption (kWh)	Electricity	Ordinary domestic	362,138,046
		Economy domestic	64,317,467
		Industrial/Commercial	216,080,323
	Gas	Domestic	1,785,102,068
		Industrial/Commercial	2,001,996,892
Total energy consumption (electricity and gas)	Consumption (kWh)	Electricity	642,535,836
		Gas	3,787,098,960
	Number of meters	Electricity	104,557
		Gas	91,290
	Consumption (kWh)	Domestic	2,211,557,581
		Industrial/Commercial	2,218,077,215
		Total	4,429,634,796

Existing Low Carbon and Renewable Energy Generation Facilities in Trafford

3.4 A number of low carbon and energy generation facilities have been put forward for consideration by Trafford Council. These are set out in Table 3.2 below, and have been considered as part of this study.

[1] Office for National Statistics, http://www.statistics.gov.uk/default.asp

Table 3.2 - Low Carbon Facilities in Trafford

Table: Provides an indication of the type of low carbon faciities which have been proposed within Trafford - please note not all have been developed.

Planning Application Ref	Year	Decision	Address	Proposal details
74838/Full	2010	Awaiting	United Utilities, Rivers Lane, Urmston	Erection of 5 no. control buildings associated with the provision of facilities to export biogas to the gas supply grid.
74681/Full	2010	Awaiting	Land adjacent to the M60 high level bridge & Davyhulme WWTW & to south of Trafford Soccer Dome.	Construction of site exploration, production testing & extraction of coal bed methane, transmission of gas & generation of electricity including CHP facility. Erction of temporary 34m high drilling rig, formation of two boreholes, installation wells, storage containers and ancillary plant and equipment. Restoration of site following cessation of use.
H/70807	2009	Approved with conditions	Tenax Circle, Trafford Park	3 megawatt wood fuelled renewable energy biomass power plant.
74169/FULL	2009	Approved With Conditions	Cheshire Cheese Hotel 181 Manchester Road Altrincham WA14 5NT	Removal of brick chimney stacks above roof level to front and rear elevations, alterations to windows to rear elevation, installation of solar panels to rear elevation and demolition of single storey outbuilding to rear of main building.
H/70123	2008	Approved with conditions	United Utilities, Rivers Lane, Urmston	Advanced sludge treatment facility & CHP plant.
H/63181	2005	Approved With Conditions	Cerestar, Guinness Road, Trafford Park.	Alterations and expansion of existing plant comprising erection of a combined heat and power plant, wheat plant and building, bulk outloading building and pellet store, carbon furnace building and control facility. Extension to existing cooling towers.
H/63041	2005	Approved With Conditions	Kellogg Co of GB Ltd, Park Road, Stretford	Installation of a 4.9 MWe combined heat and power plant with 42 metre high chimney stack.
H/CIR/51129	2001	Deemed Consent		Consultation under the Electricty Act 1989 re: the erection of a Combined Heat and Power Scheme of 62 MWe output.
H/50503	2000	Approved With Conditions	Kellogg Co Of Gb Ltd, Park Road, Stretford, Manchester, Trafford, M32 8RA	Application under S.36 of the Electricity Act 1989 for the erection of a 62 MW natural gas fired Combined Heat and Power Generating Plant
H/50373	2000	Approved With Conditions	David Lloyd Leisure Club, Barton Embankment, Trafford Park, Manchester	Installation of a combined heat and power unit within an external acoustic enclosure.
H40286	1995	Approved	TENAX ROAD -FMC PROCESS ADDITIVES-TRAFFORD PARK	ERECTION OF A NEW UTILITIES BUILDING TO ACCOMMODATE A NEW COMBINED HEAT AND POWER (CHP) SYSTEM
Pre-planning application discussions.	2009		Site adjacent to Manchester Ship Canal & Barton High Level Bridge (M60). To the NE of Davyhulme STW and SW of Dumplington STW.	Barton Biomass Plant - Peel Energy
Reported in Annual Monitoring Report Dec 2008		Microgeneration	Sale Grammar, Marsland Road, Sale	Photovoltaic Panels
Reported in Annual Monitoring Report Dec 2008		Microgeneration	Woodheys Primary School, Meadway, Sale	Photovoltaic Panels

Energy Requirements of the Case Study Areas

3.5 The existing energy requirements for each of the local energy network case study areas outlined in section 4 of this report are illustrated in the following tables. The breakdown of energy consumption was determined from Middle Layer Super Output Area (MLSOA) data available from the Office for National Statistics. There are 28 MLSOA in total within the borough of Trafford.

Table 3.3 - Energy Consumption for Carrington Case Study 2007

2001 Census data	Carrington	MLSOA	017
		Population	7,723
		Area (hectares)	1,202
		Households	3,357
Breakdown of Energy Consumption (kWh)	Electricity	Ordinary domestic	12,502,982
		Economy domestic	1,960,579
		Industrial/Commercial	3,809,537
	Gas	Domestic	50,865,863
		Industrial/Commercial	88,585,567

Table 3.4 - Energy Consumption for Altrincham Town Centre Case Study 2007

2001 Census data	Altrincham Town Centre	LLSOA	024E, 025B
		Population	3,284
		Area (hectares)	527
		Households	1,448
Breakdown of Energy Consumption (kWh)	Electricity	Ordinary domestic	6,639,017
		Economy domestic	4,263,439
		Industrial/Commercial	7,821,581
	Gas	Domestic	32,945,359
		Industrial/Commercial	14,385,883

3.6 It should be noted that the figures shown for Altrincham are based on a pro-rata estimation of the MLSOA data. Altrincham crosses two MLSOAs and Lower Level Super Output Area (LLSOA) data has, therefore, been used from LLSOA 024E and 025B. This existing number of households within these areas was given as 732 and 716 respectively. These figures were used to pro-rata the MLSOA data for the 024 and 025.

Table 3.5 - Energy consumption for Trafford Park Case Study 2007

2001 Census data	Trafford Park	MLSOA	002, 006
		Population	15,530
		Area (hectares)	1,071
		Households	6,196
Breakdown of Energy Consumption (kWh)	Electricity	Ordinary domestic	24,103,013
		Economy domestic	2,758,457
		Industrial/Commercial	50,000,651
	Gas	Domestic	126,026,726
		Industrial/Commercial	1,526,122,515

Table 3.6 - Energy Consumption for Old Trafford Case Study 2007

2001 Census data	Old Trafford	MLSOA	001, 003, 004
		Population	23,113
		Area (hectares)	553
		Households	9,659
Breakdown of Energy Consumption (kWh)	Electricity	Ordinary domestic	35,568,488
		Economy domestic	6,794,029
		Industrial/Commercial	27,634,504
	Gas	Domestic	181,885,003
		Industrial/Commercial	73,197,221

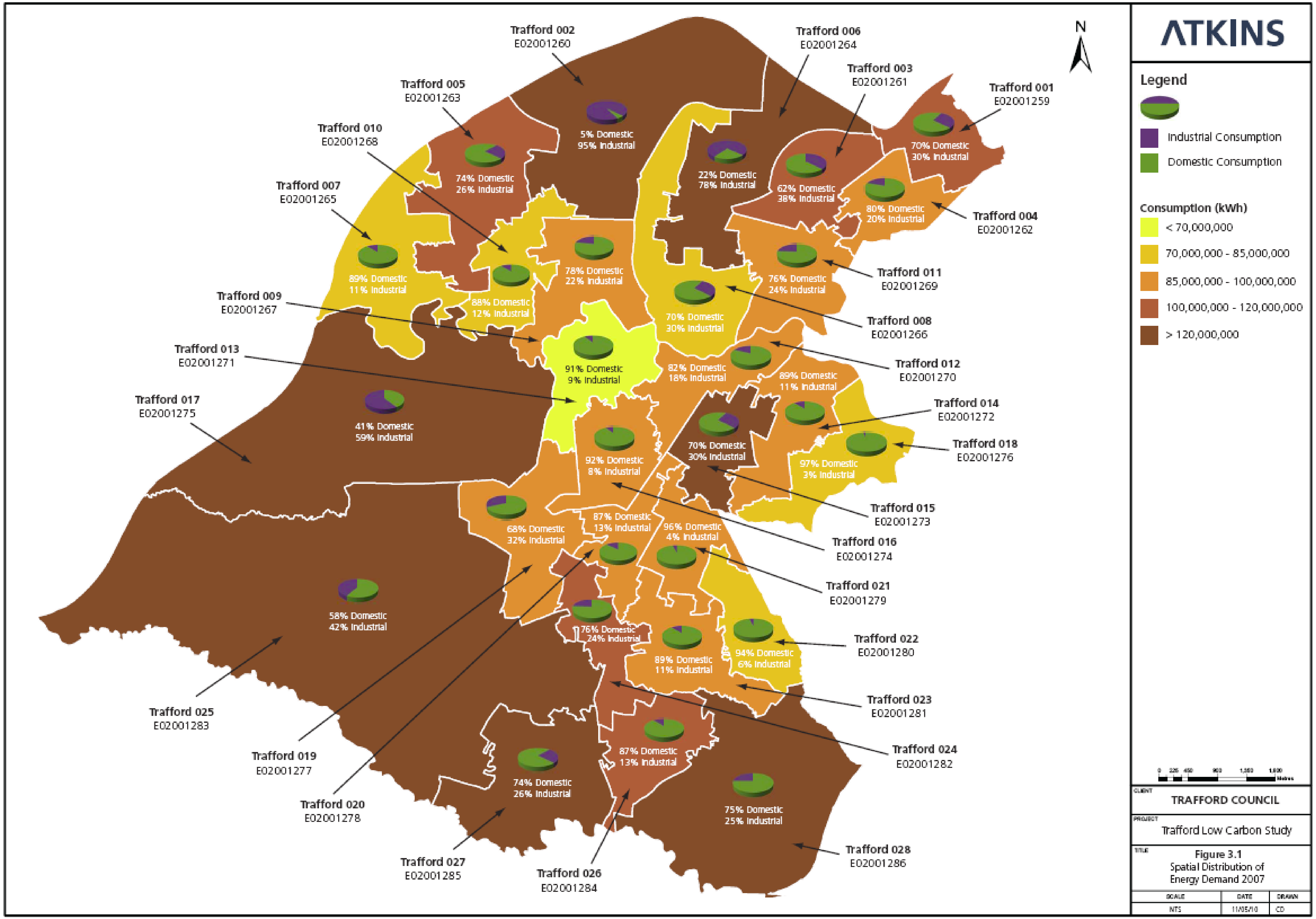
Spatial Distribution of Demand

3.7 Figure 3.1 graphically displays the spatial distribution of energy demand including domestic, industrial and commercial electricity and gas consumption (represented by the pie charts). The map shows how energy consumption in the Borough varies at middle layer super output area (MLSOA) level.

3.8 Those areas with the most significant concentrations of existing energy consumption are around the northern parts of the borough (Trafford Park) and to the west (Carrington). These areas accommodate the greatest concentrations of commercial/industrial development which has a large influence on overall consumption. Elsewhere existing consumption is predominantly domestic.

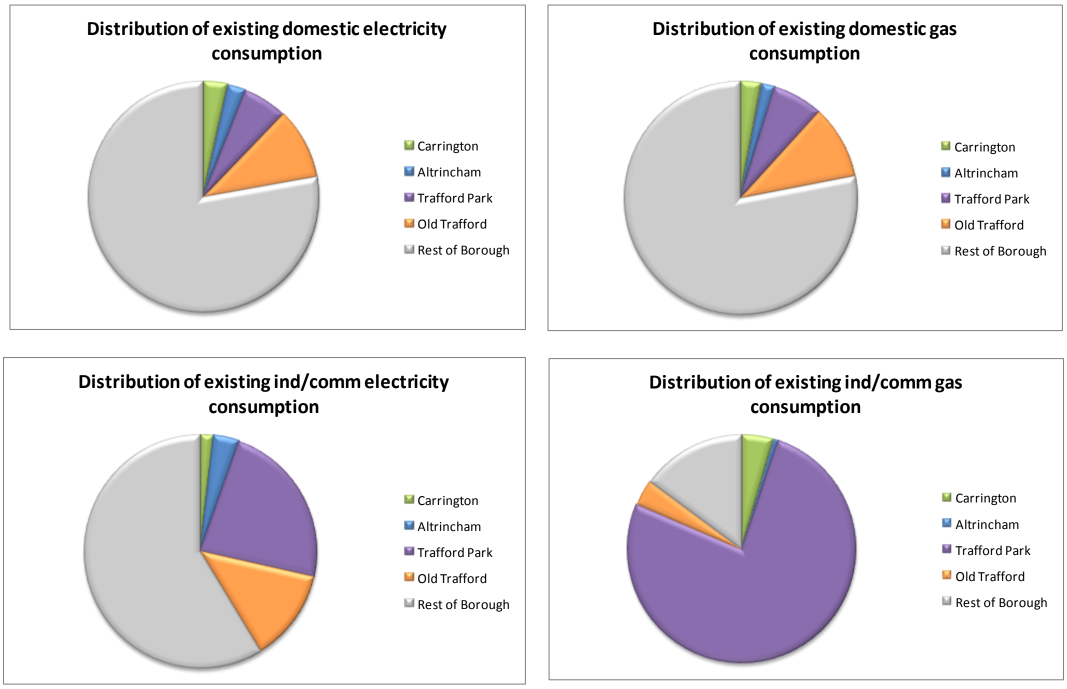
3.9 Existing concentrations of energy consumption provide a guide to the density of energy consumption and therefore a guide to the suitability of areas to be retrofitted to be served by area CHP networks. However, other factors including the scale of new development are also important and considered further in section 4.

Figure 3.1 - Spatial Distribution of Energy Demand



3.10 Figure 3.2 shows the spatial distribution of energy demand including domestic, industrial and commercial electricity and gas consumption across the case study areas and the rest of the borough.

Figure 3.2 - Graphical Distribution of Existing Energy Consumption



3.11 As can clearly be seen from the pie charts, Trafford Park has the largest consumption of gas in the commercial/industrial sector and represents over 75% of the gas consumed within this sector for the entire borough. Trafford Park is also a significant consumer of electrical energy. The next largest consumer of gas and electricity is the Old Trafford area.

Comparison with Other North West Authorities

3.12 This section briefly discusses and comments on Trafford's electricity and gas consumption in comparison to the other 43 North West authorities.

3.13 In order to compare the gas and electricity consumption for the borough, domestic and industrial/commercial consumptions have been split out and all the North West authorities ranked in order of highest consumption. This information provides an understanding of how consumption in Trafford compares with other North West local authority areas. **Error! Reference source not found.** and Figure 3.4 display the electricity consumption in the Domestic and Industrial/Commercial sectors respectively. Figure 3.5 and Figure 3.6 display the Domestic and Industrial/Commercial gas consumption respectively.

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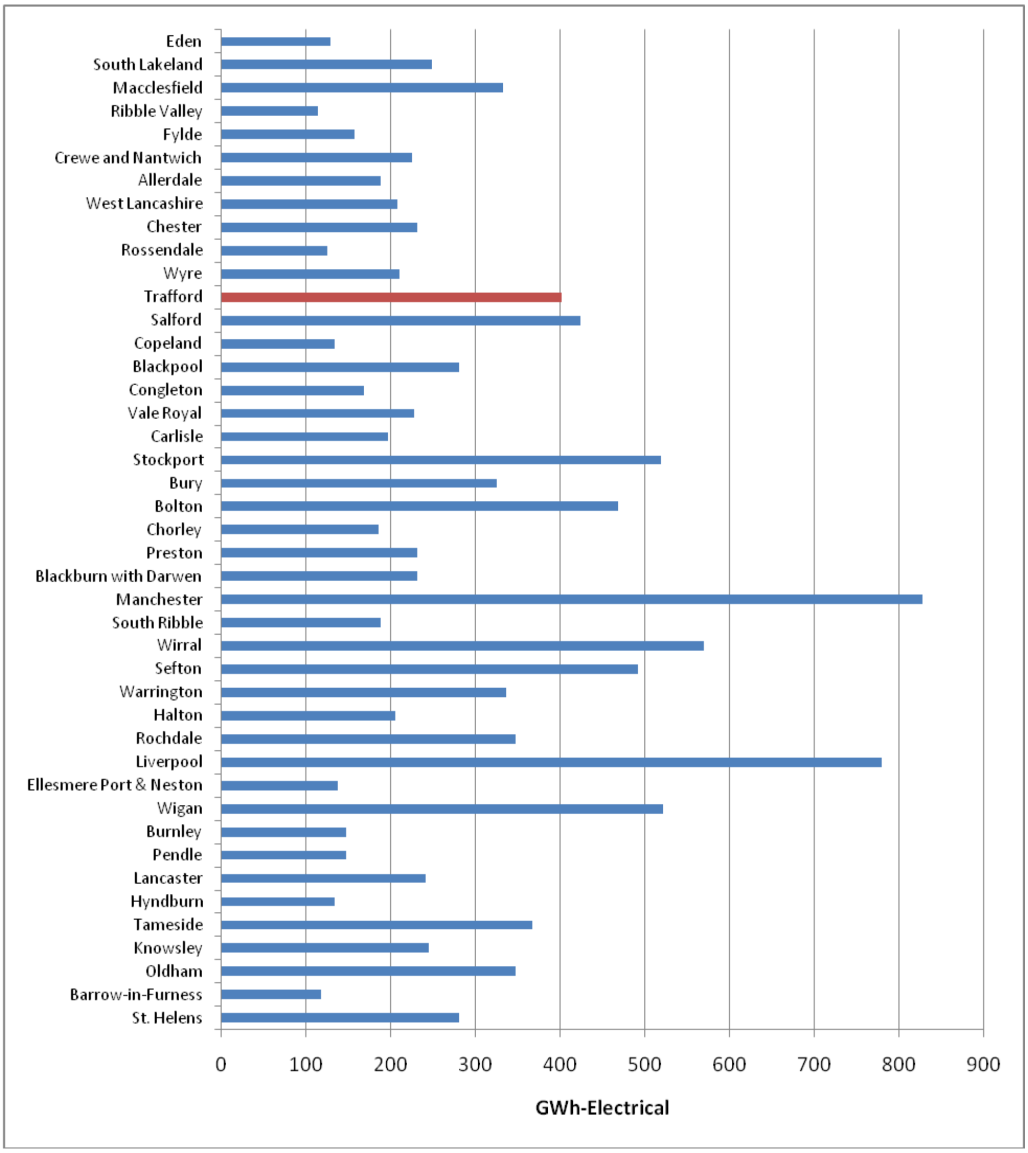
Figure 3.3 - Domestic Electricity Consumption for all North West Authorities 2008

Electricity Sales at regional and local authority level 2008			
	Domestic consumers	Sales per household	All consumers
NUTS4 Area	Sales 2008 - GWh	Average domestic consumption kWh	Sales 2008 - GWh
St. Helens	281.7	3,756	798.0
Barrow-in-Furness	118.3	3,815	541.8
Oldham	348.3	3,870	833.6
Knowsley	244.9	3,887	756.4
Tameside	367.7	3,954	906.2
Hyndburn	134.6	3,957	327.9
Lancaster	241.5	3,959	583.0
Pendle	147.8	3,995	397.0
Burnley	147.8	3,996	369.5
Wigan	522.0	4,016	1,229.2
Ellesmere Port & Neston	138.1	4,061	962.1
Liverpool	780.5	4,065	2,062.9
Rochdale	347.6	4,089	880.0
Halton	205.4	4,108	762.7
Warrington	336.6	4,156	1,005.9
Sefton	492.2	4,171	1,024.3
Wirral	569.9	4,190	1,290.6
South Ribble	188.8	4,195	480.7
Manchester	827.9	4,203	2,759.7
Blackburn with Darwen	231.2	4,204	731.5
Preston	232.1	4,221	697.1
Chorley	185.7	4,221	392.9
Bolton	469.5	4,229	1,082.6
Bury	326.1	4,235	738.3
Stockport	519.3	4,257	1,235.4
Carlisle	197.1	4,285	627.6
Vale Royal	227.5	4,293	572.6
Congleton	168.5	4,320	422.0
Blackpool	281.0	4,323	633.1
Copeland	134.7	4,347	249.4
Salford	423.9	4,370	1,096.5
Trafford	402.8	4,378	1,671.6
Wyre	211.4	4,405	494.5
Rossendale	125.6	4,486	379.8
Chester	231.4	4,538	940.7
West Lancashire	208.9	4,542	548.7
Allerdale	188.4	4,596	671.6
Crewe and Nantwich	225.7	4,606	639.8
Fylde	158.3	4,655	485.9
Ribble Valley	114.7	4,778	436.1
Macclesfield	332.8	5,043	849.0
South Lakeland	249.1	5,415	589.6
Eden	129.6	5,636	410.6
TOTAL NORTH WEST	12,417.1	4,236	34,568.5

Source: DECC MLSOA Electricity and Gas estimates 2008

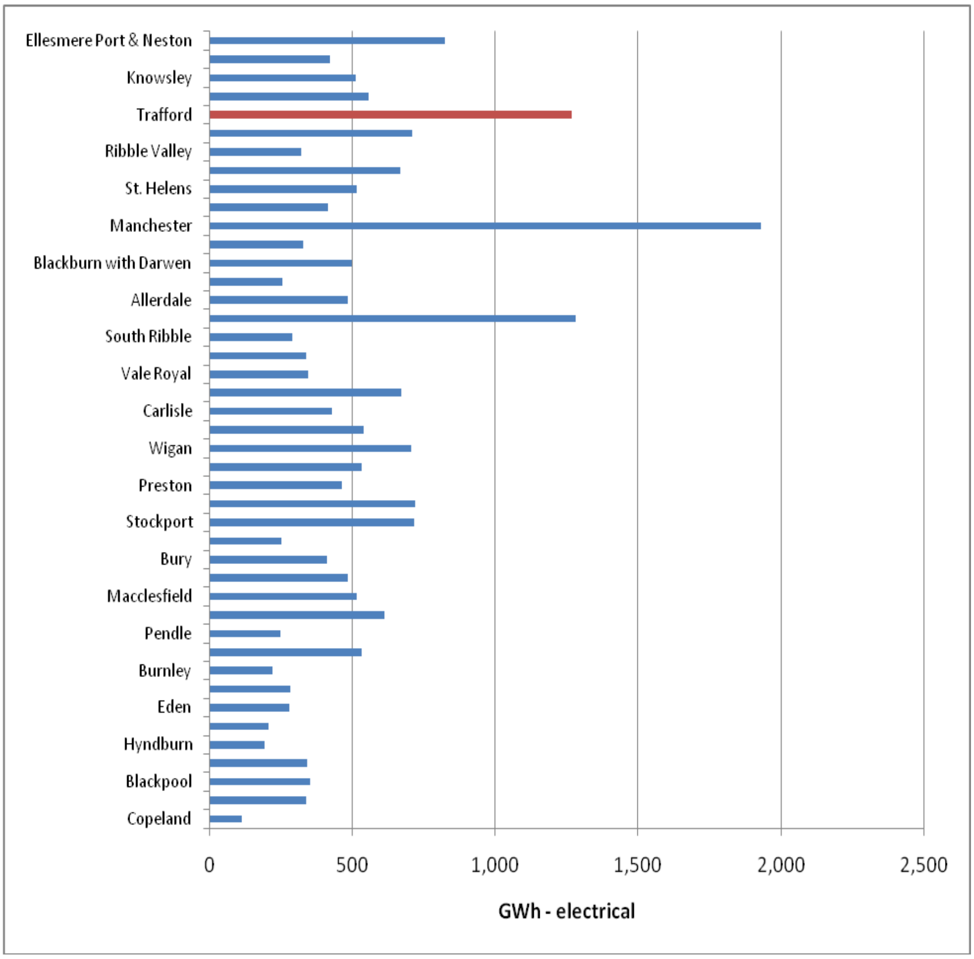


3.14 From **Error! Reference source not found.** it can be seen that Trafford is ranked 9/43 for total domestic consumption of electricity.

3.15 In Figure 3.4 it can be seen that electrical consumption for commercial and industrial users puts Trafford at the higher end of the table being 3rd from top in terms of highest consumers with 5.7% of the North West's commercial electrical consumption. When ranked in order of average consumption, Trafford is fifth from the top of the league table with 157,517 kWh. This indicates that the commercial and industrial activity in the Borough is higher compared with most other Boroughs and that there are more energy intensive commercial and industrial users than other boroughs.

Figure 3.4 - Industrial/Commercial Electricity consumption for all North West authorities 2008
Source: DECC MLSOA Electricity and gas estimates 2008

Electricity sales at regional and local authority level 2008			
	Commercial and industrial consumers	Sales per consumer	All consumers
NUTS4 Area	Sales 2008 - GWh	Average commercial and industrial consumption kWh	Sales 2008 - GWh
Copeland	114.7	41,251	249.4
South Lakeland	340.5	46,693	589.6
Blackpool	352.1	51,483	633.1
Lancaster	341.5	60,966	583.0
Hyndburn	193.3	63,474	327.9
Chorley	207.2	64,054	392.9
Eden	280.9	65,578	410.6
Wyre	283.1	67,869	494.5
Burnley	221.6	68,426	369.5
Sefton	532.1	69,350	1,024.3
Pendle	249.2	75,923	397.0
Bolton	613.1	77,676	1,082.6
Macclesfield	516.2	78,044	849.0
Oldham	485.3	78,402	833.6
Bury	412.2	79,687	738.3
Congleton	253.5	80,436	422.0
Stockport	716.1	81,920	1,235.4
Wirral	720.7	84,410	1,290.6
Preston	465.0	84,450	697.1
Rochdale	532.4	84,798	880.0
Wigan	707.2	85,289	1,229.2
Tameside	538.5	85,901	906.2
Carlisle	430.5	86,820	627.6
Salford	672.6	88,253	1,096.5
Vale Royal	345.1	89,937	572.6
West Lancashire	339.8	90,611	548.7
South Ribble	291.9	91,710	480.7
Liverpool	1,282.4	91,746	2,062.9
Allerdale	483.2	91,756	671.6
Rossendale	254.2	97,969	379.8
Blackburn with Darwen	500.2	99,664	731.5
Fylde	327.6	104,363	485.9
Manchester	1,931.8	109,653	2,759.7
Crewe and Nantwich	414.1	113,092	639.8
St. Helens	516.4	115,725	798.0
Warrington	669.3	116,676	1,005.9
Ribble Valley	321.5	117,842	436.1
Chester	709.2	142,873	940.7
Trafford	1,268.8	157,517	1,671.6
Halton	557.3	164,390	762.7
Knowsley	511.5	190,017	756.4
Barrow-in-Furness	423.5	193,192	541.8
Ellesmere Port & Neston	824.0	368,178	962.1
TOTAL NORTH WEST	22,151.3	94,192	34,568.5



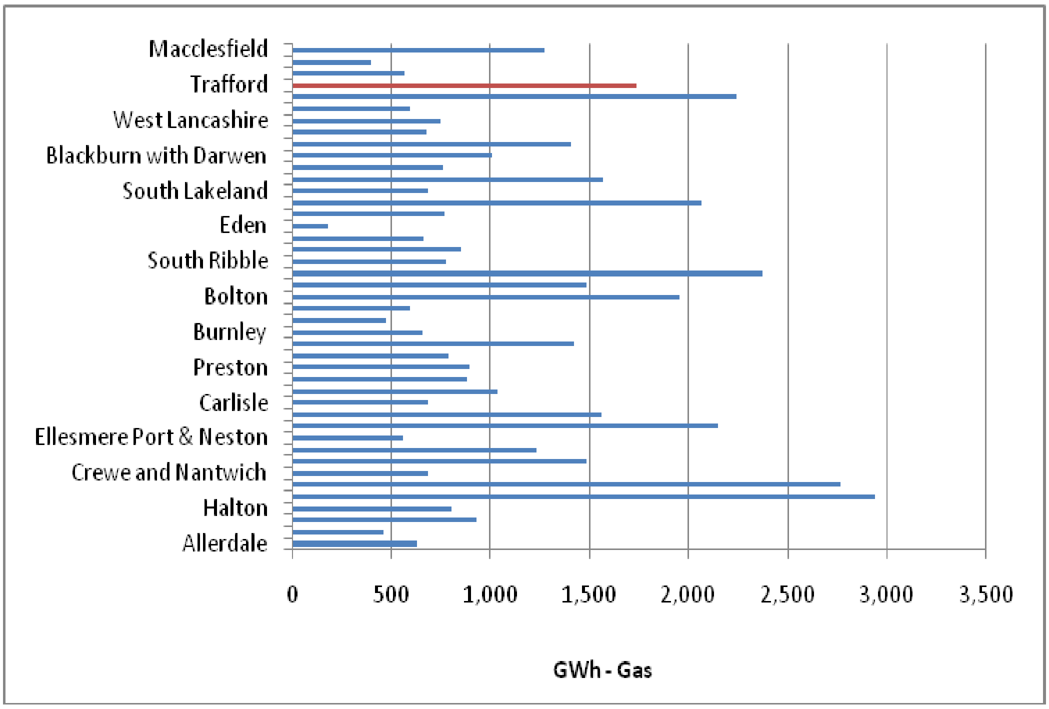
3.16 Figure 3.5 displays the table and graphs containing the comparison data for domestic gas usage in the Borough.

Figure 3.5 - Domestic gas consumption for all North West authorities 2008

Source: DECC MLSOA Electricity and Gas estimates 2008

Gas sales at local authority level 2008			
	Domestic consumers	Sales per consumer (kWh)	All consumers
LAU1 Area (2)	Sales 2008 - GWh	Average domestic consumption	Sales 2008 - GWh
Allerdale	631.8	17,664	1,232.2
Barrow-in-Furness	463.5	14,749	979.7
Knowsley	932.6	15,222	1,566.4
Halton	804.4	15,507	1,331.5
Liverpool	2,938.6	15,546	4,820.1
Manchester	2,768.1	15,897	4,769.6
Crewe and Nantwich	685.1	16,210	1,045.4
Salford	1,486.5	16,227	2,197.1
St. Helens	1,230.5	16,252	2,470.7
Ellesmere Port & Neston	556.9	16,354	1,389.3
Wigan	2,145.5	16,374	3,163.2

Tameside	1,561.6	16,641	2,131.4
Carlisle	682.8	16,724	1,249.9
Blackpool	1,037.0	16,804	1,423.2
Lancaster	883.2	16,864	1,383.3
Preston	897.0	16,912	1,289.8
Chester	786.8	17,030	1,091.2
Warrington	1,420.6	17,040	2,627.6
Burnley	656.8	17,043	928.2
Copeland	475.5	17,178	574.3
Hyndburn	594.4	17,205	857.4
Bolton	1,949.5	17,361	2,574.3
Rochdale	1,483.3	17,379	2,105.9
Wirral	2,371.3	17,389	3,220.0
South Ribble	777.5	17,446	1,115.5
Vale Royal	854.4	17,704	1,097.3
Pendle	664.9	17,714	928.6
Eden	179.4	17,783	536.9
Wyre	772.2	17,846	1,193.7
Sefton	2,063.6	17,857	2,579.4
South Lakeland	681.9	17,922	1,493.8
Oldham	1,570.4	17,926	2,078.0
Chorley	759.6	18,051	978.4
Blackburn with Darwen	1,010.4	18,202	1,732.5
Bury	1,407.8	18,427	1,937.0
Congleton	677.9	18,572	1,330.3
West Lancashire	745.3	18,661	1,149.2
Fylde	594.0	19,106	1,051.5
Stockport	2,240.9	19,360	2,988.6
Trafford	1,736.7	19,385	3,623.6
Rossendale	567.5	19,445	906.7
Ribble Valley	399.6	20,229	633.8
Macclesfield	1,272.6	20,920	1,978.0
TOTAL NORTH WEST	**48,419.8**	**17,257**	**75,754.8**



3.17 Trafford consumes approximately 3.5% of North West total domestic gas consumption which ranks it as the 8th largest consuming local authority area. Trafford is ranked 40th out of 44 for lowest average domestic gas consumption. A similar position is taken in relation to the domestic electrical consumption (32nd).

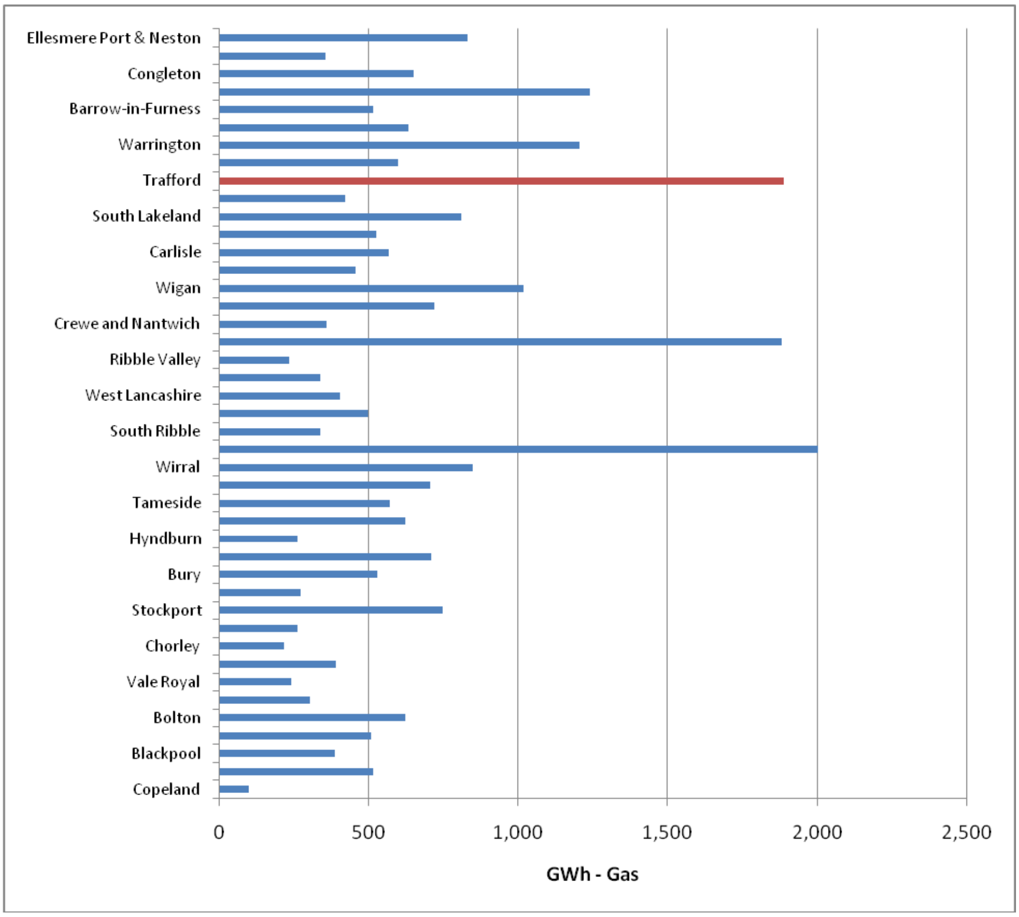
3.18 A review of the commercial gas usage in the Borough is shown in Figure 3.6. In terms of average commercial gas consumption, Trafford is ranked lower down the table at 35th out of 43 authorities. This reflects the fact that Trafford has more commercial and industrial activity primarily because it consumes approximately 7% of the total consumption for the North West, placing it 2nd in terms of total consumption behind Manchester which comes top.

Figure 3.6 - Industrial/Commercial Gas consumption for all North West authorities 2008

Source: DECC MLSOA Electricity and Gas estimates 2008

Gas sales at local authority level 2008			
	Commercial and industrial consumers	Sales per consumer	All consumers
LAU1 Area (2)	Sales 2008 - GWh	Average commercial and industrial consumption	Sales 2008 - GWh
Copeland	98.8	319,823	574.3
Sefton	515.8	331,677	2,579.4
Blackpool	386.3	370,686	1,423.2
Oldham	507.7	385,776	2,078.0
Bolton	624.9	406,548	2,574.3
Chester	304.4	419,297	1,091.2
Vale Royal	242.9	427,623	1,097.3
Preston	392.8	431,148	1,289.8
Chorley	218.8	447,532	978.4
Pendle	263.7	463,379	928.6

Stockport	747.7	464,968	2,988.6
Burnley	271.5	491,765	928.2
Bury	529.2	494,611	1,937.0
Salford	710.6	497,254	2,197.1
Hyndburn	263.0	509,696	857.4
Rochdale	622.6	515,858	2,105.9
Tameside	569.8	526,110	2,131.4
Macclesfield	705.4	533,595	1,978.0
Wirral	848.7	568,063	3,220.0
Manchester	2,001.5	619,269	4,769.6
South Ribble	338.0	665,357	1,115.5
Lancaster	500.1	675,843	1,383.3
West Lancashire	404.0	684,676	1,149.2
Rossendale	339.2	692,269	906.7
Ribble Valley	234.3	699,259	633.8
Liverpool	1,881.5	710,264	4,820.1
Crewe and Nantwich	360.3	717,704	1,045.4
Blackburn with Darwen	722.1	721,386	1,732.5
Wigan	1,017.7	763,467	3,163.2
Fylde	457.5	784,750	1,051.5
Carlisle	567.1	868,501	1,249.9
Halton	527.1	884,459	1,331.5
South Lakeland	811.9	902,101	1,493.8
Wyre	421.4	926,263	1,193.7
Trafford	1,886.9	1,087,561	3,623.6
Allerdale	600.4	1,087,753	1,232.2
Warrington	1,207.0	1,130,126	2,627.6
Knowsley	633.8	1,160,782	1,566.4
Barrow-in-Furness	516.2	1,453,951	979.7
St. Helens	1,240.2	1,488,849	2,470.7
Congleton	652.4	1,685,801	1,330.3
Eden	357.5	1,814,677	536.9
Ellesmere Port & Neston	832.5	2,522,645	1,389.3
TOTAL NORTH WEST	**27,335.0**	**685,552**	**75,754.8**



3.19 In summary, Trafford compares poorly in terms of average consumption of domestic and commercial gas when considered against other North West local authorities.

Assessing Future Energy Requirements

Approach

3.20 In order to evaluate the proposed policy targets, the future energy requirements of existing and proposed development for the period to 2025 have been modelled. Reducing carbon emissions are key elements of UK policy, consequently there are many assumptions and corresponding future scenarios that could affect the proposed future energy requirements for Trafford, particularly with regard to future carbon emissions from the existing building stock. Consequently, to enable a planned energy and CO_2 emission trajectory to 2025, key assumptions have to be defined.

3.21 The key assumptions made are based on the Government's recent Heat and Energy Saving Strategy Consultation, for existing building stock. These assumptions take into account the impact of sustainable construction, energy efficiency and low and zero carbon technology energy sources, but not the specific opportunities relating to renewable energy generation linked with new development in Trafford.

3.22 In addition, two key reports have been reviewed to determine other possible future energy scenarios that may affect the energy trajectory assumptions used in this document. These are the:

DECC report, Updated Energy and Carbon Emissions Projections[2], November 2008; and

- URS/4NW report, Assessment of Potential Carbon Savings Achievable in the North West Region by 2020[3], March 2009.

DECC – Updated Energy and Carbon Emissions Projections

3.23 The report provides robust updated emission projections up to 2020, where data has been updated to reflect changes in the key assumptions of: fossil fuel prices; economic growth; population; and energy data. The projections are regarded to be of a high standard and used by government to develop policy.

3.24 The report states that, taking into account current policy at the time of the report, UK carbon emissions are projected to fall to about 26% below 1990 levels by 2020. The report also details that emissions from the residential sector are estimated to be reduced by 28%, from 74 Mt CO_2 to 53 Mt CO_2.

3.25 The report also provides a renewed projection of the composition of UK electricity generation by fuel, where the main changes that will affect emissions are: a 27.5% reduction in the proportion of coal generation; a 16% increase in the use of gas; a 50% reduction in the proportion of nuclear generated electricity; and a 70% increase in the use of renewable energy technologies.

URS/4NW - Assessment of Potential Carbon Savings Achievable in the North West Region by 2020

3.26 With regards to carbon reductions in Trafford and the North West, a study has been carried out by URS Corporation Ltd, on behalf of the North West Climate Change Partnership, commissioned by 4NW: An assessment of potential carbon savings achievable in the North West Region by 2020.

3.27 The report conducted a high level assessment of the potential carbon savings in the North West and its sub regions, taking into account a range of potential savings achievable through the implementation of regional, national and international policies, along with possible additional measures outside of current and planned policies and initiatives.

3.28 The key findings of the report found that the range of potential carbon savings achievable in the North West by 2020 were from 12.6 – 22.7 Mt CO_2, equating to estimated CO_2 percentage reductions of 29-45% by 2020.

3.29 In addition, the report makes reference to the North West Greenhouse Gas Emissions Inventory (NWEI)[4]. This inventory provided: estimates of regional GHG emissions in 1990; quantification of regional emissions in 2005; and projections of regional estimates up to 2010 and 2020 under a business as usual scenario. With regard to the Greater Manchester region the NWEI inventory stated CO_2 emissions (Mt CO_2/year) of: 1990 – 19.1, 2005 – 17.5 and a 2020 baseline projection of 18; this projection equates to a reduction in CO_2 emissions of only 5.8%.

Conclusions

3.30 Analysis of the reports discussed above show that there are many contributing factors that can affect future energy demand and carbon emission projections. Specific assumptions have been made for electrical and gas energy in the domestic, commercial/industrial sectors. The assumptions used in the chosen energy trajectory scenario are deemed to be satisfactory when taking into account the scenarios discussed in the reports studied, particularly when considering

[2] Department of Energy and Climate Change, "Updated Energy and Carbon Emissions Projections", November 2008, DECC
[3] URS Corporation Limited (URS) – Prepared for 4NW, "Assessment of Potential Carbon Savings Achievable in the North West Region by 2020", Final Update 1.1, 31st March 2009
[4] AEA Energy and Environment, on behalf of 4NW, "North West Greenhouse Gas Emissions Inventory (NWEI)", final version July 2008

the proposed higher CO_2 reduction figures of 34% by 2020 and 80% by 2050. The specific assumptions are outlined in the following sections.

Energy Assumptions Associated with New Developments

New Dwellings

3.31 It was assumed that between 2006 and 2007 all new dwellings were built in line with Part L1A of Building Regulations (Conservation of fuel and power in new dwellings). Thereafter, relevant Code for Sustainable Homes (CfSH) levels were applied; these are detailed in Table 3.7. It has been assumed that CfSH Level 3 (which incidentally has the same CO_2 emission reduction as planned changes to Part L of Building regulations in 2010) can typically be achieved through energy efficiency improvements.

Table 3.7 - Code for Sustainable Homes

Mandatory Building Standard	Date	$C0_2$ emissions reduction
2006 Part L1A	2006-2009	"Baseline"
CfSH Level 3	2010-2011	-25%
CfSH Level 4	2015-2016	-44%
CfSH Level 6	2020-2021	-100% (Zero Carbon)

3.32 The trajectory of CO_2 emissions reduction outlined in the previous table is the percentage improvement of Dwelling Emission Rate (DER) over Target Emission Rate (TER). For CfSH Levels 3 and 4 the emission rates are calculated from space heating, domestic hot water heating, and lighting for a building. Emissions attributed to cooking and appliances are exempt. CfSH Level 5 and 6 emission rates are calculated from space heating, domestic hot water heating, lighting, cooking, and appliances.

3.33 It was assumed that the energy consumed by CfSH Levels 5 and 6 were the same as CfSH Level 4; the only difference being the quantity of renewable energy required to offset carbon emissions. The assumption was based on the premise that the reduction in energy consumption attributed to energy efficiency measures will be maximised at CfSH Level 4 house. Further reductions in energy consumption will be very difficult to achieve.

3.34 A detailed breakdown of the energy consumption and CO_2 emissions associated with different CfSH levels (Baseline, CfSH Level 3, CfSH Level 4 and CfSH Level 6) is given in Appendix A. A summary of the assumptions is tabulated in Table 3.8. The "Baseline" energy consumption is for a typical three bedroom house built to current (2006) building regulation standards. This data was sourced from the Energy Saving Trust[5].

Table 3.8 - Energy Assumptions for New Build Dwellings

Building Standard	Electrical kWh/yr	Gas kWh/yr	Total kWh/yr	Total kg CO2/yr
"Baseline"	3,100	9,150	12,250	2,309
CfSH Level 3	3,020	6,249	9,269	1,732
CfSH Level 4	2,620	5,047	7,667	1,293
CfSH Level 5/6	2,620	5,047	7,667	1,293

N.B. The energy consumption figures quoted above (kWh/yr) include the consumption of gas fired cooking and appliances, but the CO_2 and consumption reductions exclude these parameters, as per Code for Sustainable Homes guidance[6]

[5] Energy Saving Trust, Personal communication to Atkins CM&R team, 23-Mar-2009
[6] Communities & Local Government, "Code for Sustainable Homes: Technical Guide", October 2008, Dept. for Communities and Local Government

Non-Residential Development

3.35 At the time of writing, the Code for Sustainable Buildings had not been finalised. It is anticipated this Code, like the Code for Sustainable Homes, will assign points scores (and therefore the Level attained) for percentage emissions reductions beyond the 2006 baseline.

3.36 Details of the proposed buildings were also not available, and thus estimating the carbon emissions reductions for future commercial/industrial buildings was not possible. As such, a high level estimation of the energy consumption of the future commercial/industrial buildings was carried out, but assumptions as to the carbon reductions that these could achieve were not devised. The estimated energy consumption for each of the proposed developments was calculated from the floor area supplied, the building Use Class, and Cibse Guide F energy benchmarks.

Energy Assumptions Associated with Existing Building Stock

3.37 As part of the Government's ambitious target of cutting CO_2 below 1990 levels by 80% by 2050, the Government's aim is for all existing buildings to be approaching zero carbon by 2050, as defined in the consultation document, the Heat and Energy Saving Strategy (launched February 2009).

3.38 The energy demand of the existing building stock represents a significant proportion of energy use in comparison with the future energy demands of new development. Consequently, energy efficiency improvements to existing buildings is seen as a major opportunity to reduce carbon emissions, whilst also being regarded as a more cost-effective means of making savings. The Government has highlighted the requirement for low and zero carbon energy sources to be introduced, following the completion of more cost effective energy efficiency measures, such as heating system (boiler) upgrades and solid wall insulation, to make further contributions.

Existing Dwellings

3.39 The Government's Heat and Energy Saving Strategy Consultation suggests an equivalent of a 30% reduction in CO_2 from households by 2020 compared to 2006 (refer to Table 3.9), which would reduce annual emissions by up to 44 MtCO2 by 2020.

3.40 To enable this target it is proposed that all cavity walls and lofts will be insulated, where practical by 2015. Further to this it is suggested that more substantial improvements will be needed, incorporating small-scale energy generation and solid wall insulation, with an aim of delivering these substantial changes to seven million homes by 2020. It is also proposed that all homes are to receive a 'whole house' package incorporating cost-effective energy saving measures by 2030.

3.41 The Government has indicated that new policies will be required to deliver these ambitious targets. It is proposed that the Carbon Emissions Reduction Target (CERT) programme may run to December 2012 and from this point, new community based schemes will be required. The Government is currently piloting a programme entitled the Community Energy Savings Programme (CESP) to trial this approach.

3.42 Table 3.9 illustrates the interpolated emissions reductions to 2025 commensurate with the 30% by 2020 target for existing housing.

Table 3.9 - CO_2 Reductions of Existing Housing Stock

Year	$C0_2$ emissions reduction
2011	10%
2016	20%
2021	30%
2025	44%

Existing Buildings other than Dwellings

3.43 Information sourced from The Carbon Trust suggests that a reasonable scenario for reductions in CO_2 levels in commercial buildings is 20% by 2020. To support the delivery of these savings the Government's Heat and Energy Saving Strategy Consultation sets out the objective that all dwellings and other buildings will receive a package incorporating all of the cost-effective energy saving measures by 2030. Similar to Table 3.9, the assumed CO_2 reductions have been interpolated for existing buildings other than dwellings, shown in Table 3.10.

Table 3.10 - CO_2 Reductions of Existing Buildings Other Than Dwellings

Year	$C0_2$ emissions reduction
2011	5%
2016	10%
2021	20%
2025	32%

3.44 The reductions outlined above were also applied to the energy consumption of the existing stock. The results of the energy and CO_2 trajectories are given in the next section.

Energy Demand Trajectory

3.45 The following tables summarise the projected energy consumed and CO_2 emissions up to and including 2025 for the four case study areas (as defined above):

- Table 3.11 - Carrington;
- Table 3.12 - Altrincham Town Centre;
- Table 3.13 – Trafford Park; and
- Table 3.14 – Old Trafford.

3.46 The energy demand trajectory is based on the assumption that actions to improve the energy efficiency of the existing building stock are implemented by owners supported by regulation and incentives from Government.

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Table 3.11 - Energy Trajectory to 2025 for Carrington

Carrington - existing stock		Unit	2007	2011	2016	2021	2025
Domestic - energy trajectory	Households (2001 census)	No.	3357				
	CO_2 reduction target	%		10%	20%	30%	44%
	Electricity	GWh	14.46	13.02	11.57	10.12	8.10
	Natural gas	GWh	50.87	45.78	40.69	35.61	28.48
	Electricity	Mt CO_2	7.87	7.08	6.29	5.51	4.41
	Natural gas	Mt CO_2	9.36	8.42	7.49	6.55	5.24
	Sub total	*Mt CO_2*	*17.23*	*15.50*	*13.78*	*12.06*	*9.65*
Ind/Comm - energy trajectory	CO_2 reduction target	%		5%	10%	20%	32%
	Electricity	GWh	3.81	3.62	3.43	3.05	2.59
	Natural gas	GWh	88.59	84.16	79.73	70.87	60.24
	Electricity	Mt CO_2	2.07	1.97	1.87	1.66	1.41
	Natural gas	Mt CO_2	16.30	15.48	14.67	13.04	11.08
	Sub total	*Mt CO_2*	*18.37*	*17.45*	*16.53*	*14.70*	*12.49*
Total	**CO_2 total**	**Mt CO_2**	**36**	**33**	**30**	**27**	**22**
Carrington - future stock		**Unit**	**2007**	**2011**	**2016**	**2021**	**2025**
Future Housing - energy trajectory	Future households	No.		0	360	600	600
	CfSH	Level		3	4	6	6
		Implementation year		2010	2013	2016	
		% reduction DER/TER		25%	44%	100%	100%
	Electricity	GWh		0.00	0.94	1.57	1.57
	Natural gas	GWh		0.00	1.82	3.03	3.03
	Sub total	GWh		0.00	2.76	4.60	4.60
	Electricity	Mt CO_2		0.00	0.51	0.86	0.86
	Natural gas	Mt CO_2		0.00	0.33	0.56	0.56
	Sub total	Mt CO_2		0.00	0.85	1.41	1.41
Future Ind/Comm - energy trajectory	Future Ind/Comm	sq. m					384,622
	Electricity	GWh					19.56
	Natural gas	GWh					64.08
	Sub total	GWh					83.63
	Electricity	Mt CO_2					10.64
	Natural gas	Mt CO_2					11.79
	Sub total	Mt CO_2					22.43
Total	**CO_2 total**	**Mt CO_2**					**23.84**
Carrington - summary		**Unit**					**2025**
Energy consumption	Electricity	GWh					34.33
	Natural Gas	GWh					160.67
	Total						195.01
CO_2 Emissions	Electricity	Mt CO_2					18.68
	Natural Gas	Mt CO_2					29.56
	Total						48.24

Table 3.12 - Energy Trajectory to 2025 for Altrincham

Altrincham - existing stock		Unit	2007	2011	2016	2021	2025
Domestic - energy trajectory	Households (2001 census)	No.	1448				
	CO2 reduction target	%		10%	20%	30%	44%
	Electricity	GWh	10.9	9.8	8.7	7.6	6.1
	Natural gas	GWh	32.9	29.7	26.4	23.1	18.4
	Electricity	Mt CO2	5.9	5.3	4.7	4.2	3.3
	Natural gas	Mt CO2	6.1	5.5	4.8	4.2	3.4
	Sub total	*Mt CO2*	*12.0*	*10.8*	*9.6*	*8.4*	*6.7*
Ind/Comm - energy trajectory	CO2 reduction target	%		5%	10%	20%	32%
	Electricity	GWh	7.8	7.4	7.0	6.3	5.3
	Natural gas	GWh	14.4	13.7	12.9	11.5	9.8
	Electricity	Mt CO2	4.3	4.0	3.8	3.4	2.9
	Natural gas	Mt CO2	2.6	2.5	2.4	2.1	1.8
	Sub total	*Mt CO2*	*6.9*	*6.6*	*6.2*	*5.5*	*4.7*
Total	**CO2 total**	**Mt CO2**	**19**	**17**	**16**	**14**	**11**
Altricham - future stock		**Unit**	**2007**	**2011**	**2016**	**2021**	**2025**
Future Housing - energy trajectory	Future households	No.			126	126	126
	CfSH	Level		3	4	6	6
		Implementation year		2010	2013	2016	
		% reduction DER/TER		25%	44%	100%	100%
	Electricity	GWh		0.00	0.33	0.33	0.33
	Natural gas	GWh		0.00	0.64	0.64	0.64
	Sub total	GWh		0.00	0.97	0.97	0.97
	Electricity	Mt CO2		0.00	0.18	0.18	0.18
	Natural gas	Mt CO2		0.00	0.12	0.12	0.12
	Sub total	Mt CO2		0.00	0.30	0.30	0.30
Future Ind/Comm - energy trajectory	Future Ind/Comm	sq. m					49,356
	Electricity	GWh					8.06
	Natural gas	GWh					6.46
	Sub total	GWh					14.52
	Electricity	Mt CO2					4.38
	Natural gas	Mt CO2					1.19
	Sub total	Mt CO2					5.57
Total	**CO2 total**	**Mt CO2**					**5.87**
Altrincham - summary		**Unit**					**2025**
Energy consumption	Electricity	GWh					20.47
	Natural Gas	GWh					36.61
	Total						57.08
CO2 Emissions	Electricity	Mt CO2					11.14
	Natural Gas	Mt CO2					6.74
	Total						17.87

Table 3.13 - Energy Trajectory to 2025 for Trafford Park

Trafford Park - existing stock		Unit	2007	2011	2016	2021	2025
Domestic - energy trajectory	Households (2001 census)	No.	6196				
	CO2 reduction target	%		10%	20%	30%	44%
	Electricity	GWh	26.86	24.18	21.49	18.80	15.04
	Natural gas	GWh	126.03	113.42	100.82	88.22	70.57
	Electricity	Mt CO2	14.61	13.15	11.69	10.23	8.18
	Natural gas	Mt CO2	23.19	20.87	18.55	16.23	12.99
	Sub total	*Mt CO2*	*37.80*	*34.02*	*30.24*	*26.46*	*21.17*
Ind/Comm - energy trajectory	CO2 reduction target	%		5%	10%	20%	32%
	Electricity	GWh	50.00	47.50	45.00	40.00	34.00
	Natural gas	GWh	1526.12	1449.82	1373.51	1220.90	1037.76
	Electricity	Mt CO2	27.20	25.84	24.48	21.76	18.50
	Natural gas	Mt CO2	280.81	266.77	252.73	224.65	190.95
	Sub total	*Mt CO2*	*308.01*	*292.61*	*277.21*	*246.41*	*209.44*
Total	**CO2 total**	**Mt CO2**	**346**	**327**	**307**	**273**	**231**
Trafford Park - future stock		**Unit**	**2007**	**2011**	**2016**	**2021**	**2025**
Future Housing - energy trajectory	Future households	No.		0	650	550	750
	CfSH	Level		3	4	6	6
		Implementation year		2010	2013	2016	
		% reduction DER/TER		25%	44%	100%	100%
	Electricity	GWh		0.00	1.70	1.44	1.97
	Natural gas	GWh		0.00	3.28	2.78	3.79
	Sub total	GWh		0.00	4.98	4.22	5.75
	Electricity	Mt CO2		0.00	0.93	0.78	1.07
	Natural gas	Mt CO2		0.00	0.60	0.51	0.70
	Sub total	Mt CO2		0.00	1.53	1.29	1.77
Future Ind/Comm - energy trajectory	Future Ind/Comm	sq. m					424,311
	Electricity	GWh					41.22
	Natural gas	GWh					61.87
	Sub total	GWh					103.10
	Electricity	Mt CO2					22.42
	Natural gas	Mt CO2					11.38
	Sub total	Mt CO2					33.81
Total	**CO2 total**	**Mt CO2**					**35.58**
Trafford Park - summary		**Unit**					**2025**
Energy consumption	Electricity	GWh					95.37
	Natural Gas	GWh					1180.05
	Total						1275.43
CO2 Emissions	Electricity	Mt CO2					51.88
	Natural Gas	Mt CO2					217.13
	Total						269.01

Table 3.14 - Energy Trajectory to 2025 for Old Trafford

Old Trafford - existing stock		**Unit**	**2007**	**2011**	**2016**	**2021**	**2025**
Domestic - energy trajectory	Households (2001 census)	No.	9659				
	CO2 reduction target	%		10%	20%	30%	44%
	Electricity	GWh	42.36	38.13	33.89	29.65	23.72
	Natural gas	GWh	181.89	163.70	145.51	127.32	101.86
	Electricity	Mt CO2	23.05	20.74	18.44	16.13	12.91
	Natural gas	Mt CO2	33.47	30.12	26.77	23.43	18.74
	Sub total	*Mt CO2*	*56.51*	*50.86*	*45.21*	*39.56*	*31.65*
Ind/Comm - energy trajectory	CO2 reduction target	%		5%	10%	20%	32%
	Electricity	GWh	27.63	26.25	24.87	22.11	18.79
	Natural gas	GWh	73.20	69.54	65.88	58.56	49.77
	Electricity	Mt CO2	15.03	14.28	13.53	12.03	10.22
	Natural gas	Mt CO2	13.47	12.79	12.12	10.77	9.16
	Sub total	*Mt CO2*	*28.50*	*27.08*	*25.65*	*22.80*	*19.38*
Total	**CO2 total**	**Mt CO2**	**85**	**78**	**71**	**62**	**51**
Old Trafford - future stock		**Unit**	**2007**	**2011**	**2016**	**2021**	**2025**
Future Housing - energy trajectory	Future households	No.		0	745	745	745
	CfSH	Level		3	4	6	6
		Implementation year		2010	2013	2016	
		% reduction DER/TER		25%	44%	100%	100%
	Electricity	GWh		0.00	1.95	1.95	1.95
	Natural gas	GWh		0.00	3.76	3.76	3.76
	Sub total	GWh		0.00	5.71	5.71	5.71
	Electricity	Mt CO2		0.00	1.06	1.06	1.06
	Natural gas	Mt CO2		0.00	0.69	0.69	0.69
	Sub total	Mt CO2		0.00	1.75	1.75	1.75
Future Ind/Comm - energy trajectory	Future Ind/Comm	sq. m					206,275
	Electricity	GWh					27.07
	Natural gas	GWh					19.94
	Sub total	GWh					47.01
	Electricity	Mt CO2					14.72
	Natural gas	Mt CO2					3.67
	Sub total	Mt CO2					18.39
Total	**CO2 total**	**Mt CO2**					**20.15**
Old Trafford - summary		**Unit**					**2025**
Energy consumption	Electricity	GWh					75.44
	Natural Gas	GWh					182.85
	Total						258.29
CO2 Emissions	Electricity	Mt CO2					41.04
	Natural Gas	Mt CO2					33.64
	Total						74.68

3.47 Projections were based on Middle Layer Super Output Area (MLSOA) 2007 electricity and gas estimates[7]. This data has been used as the starting point and the declared adjustments and assumptions have been derived from this data. From the tables above it can be seen that the overall projected energy consumption and CO_2 emissions for the existing stock in the case study areas follow a downward trend based on the reduction targets previously discussed. The figures on the next page provide a graphical representation of the reduction in energy consumption and CO_2 emissions for the existing stock. The net energy consumption and CO_2 emissions for the study areas will increase as a whole due to the increased building stock up to 2025.

[7] Dept. of Energy & Climate Change, "Middle Layer Super Output Area (MLSOA) electricity and gas estimates 2007: North West Government Office Region", 2007, BERR

3.48 It should be noted that the reductions in electricity and gas consumption shown are contingent on some existing energy consumption from the national grid being displaced by decentralised renewable sources in Trafford and energy efficiency savings being realised.

3.49 The figures above display a general downward trend in energy consumption and CO_2 emissions in both domestic and industrial/commercial sectors. These downward trends are achievable based on the assumptions made previously (i.e. implementation of Code for Sustainable Homes and the future proposed Code for Sustainable Buildings).

3.50 Realisation of these energy consumption reductions assumes that CfSH measures are fully implemented within new development and that funding and incentives referred to in Government strategies are implemented.

4. Renewable and Low Carbon Energy Potential Linked to New Development

Approach

4.1 This section summarises the approach that has been taken in assessing renewable energy potential in Trafford and outlines the key findings. The greatest potential to embed new medium and large scale renewable energy facilities is in association with new development within the case study areas.

4.2 This section considers the development pipeline which influences the scale and type of renewable energy opportunities which will exist in conjunction with new development, the scale of the resource available in Trafford and the feasibility of realising this resource. The potential for local energy networks is considered first, followed by the feasibility of other renewable resources.

4.3 The study sought to establish the potential for renewable potential linked to new development within the four case study areas through the following approach:

- Step 1 – Review of development trajectory to identify those areas which may have potential for local energy networks;
- Step 2 - Review of major large scale renewable energy opportunities and their fit with new development;
- Step 3 – Establish technical pre-feasibility and cost of larger scale facilities; and
- Step 4 – Establish smaller scale opportunities and technical feasibility and costs.

4.4 Although this study focuses on the potential for renewable and low carbon energy within the case study areas, the Council's approach should be to maximise renewable energy opportunities in conjunction with:

- seeking to reduce overall CO_2 emissions through reducing energy consumption;
- improving energy efficiency in new development through application of the Code for Sustainable Homes (CfSH); and
- deployment of other low and zero carbon technologies.

4.5 The costs of meeting CfSH and BREEAM targets have featured in the assessment of viability in Section 6.

Review of Development Trajectory and Locations for Future Growth

4.6 The nature and scale of development growth within Trafford is set out in the 'Trafford Core Strategy: Further Consultation on the Vision, Strategic Objectives and Delivery Strategy' (March 2010). Core Strategy policies L1 (Land for New Homes), W1 (Economy) and W2 (Town Centres and Retail) shape the development trajectory and outline a number of strategic locations where the majority of the growth will be focussed.

4.7 These Core Strategy policies have guided the review of Trafford's development trajectory, supplemented by additional strands of research undertaken by Trafford Council in order to establish an evidence base of development requirements in the Borough up to 2025/26. Key research includes:

- Strategic Housing Land Availability Assessment (SHLAA) and Housing Land Schedule which establishes the likely scale, location and phasing of residential development within the Borough; and
- Employment Land Study (ELS) and Employment Land Schedule which establishes the potential scale of employment development, including those employment sites where there is potential for redevelopment for mixed uses.

4.8 A number of masterplans and strategic frameworks have also been prepared that contribute towards shaping the development trajectory in key strategic locations. These include:

- Old Trafford Masterplanning Report - which explores development and regeneration / housing renewal potential in the Old Trafford part of the Borough;
- Trafford Park Vision and Implementation Report - which outlines the strategic vision for Trafford Park and the key development opportunities;
- Shell, Carrington Delivery Statement - which outlines comprehensive redevelopment proposals for a major new mixed use settlement in former brownfield land at Carrington; and
- Trafford Quays Delivery report - outlining proposals for a residential-led mixed use development of the Trafford Quays site in Trafford Park.

Residential Development

4.9 Policy L1 (Land for New Homes) and W2 (Town Centres and Retail) contained within Trafford's Core Strategy (dated March 2010), set out the scale and distribution of housing provision for the borough to 2025/26.

4.10 A total allocation of 11,860 dwellings was identified for the plan period in this draft of the Core Strategy. This was subsequently revised to a slightly increased figure of 11,906 in the Core Strategy Publication draft (dated September 2010)

4.11 The majority of new housing is proposed to be delivered from 2011/12 onwards in reasonably even phases. This growth is distributed in key strategic locations across the Borough. These strategic locations are shown on Figure 4.1 in relation to the spatial distribution of energy demand.

4.12 The residential growth is phased as follows:

- 2008/09 to 2010/11 - 1,400 dwellings;
- 2011/12 to 2015/16 - 3,810 dwellings;
- 2016/17 to 2020/21 – 3,656 dwellings; and
- 2021/22 to 2025/26 – 3,040 dwellings.

4.13 The majority of growth is focussed within the South City Region Area, where the Strategic Locations are the Trafford Centre Rectangle (SL4), Carrington (SL5), Regeneration / Town Centre schemes and other South City Region sites.

4.14 The Borough's Inner Area is centred mainly on the Old Trafford area, with the Lancashire County Cricket Club Quarter (SL3) and Other Inner Area sites. The Regional Centre consists of Strategic Locations at Trafford Wharfside (SL2) and Pomona Island (SL1). The SL1 allocation was originally removed as a result of PSS25 Sequential Testing, but has now been included based on the extant planning permission.

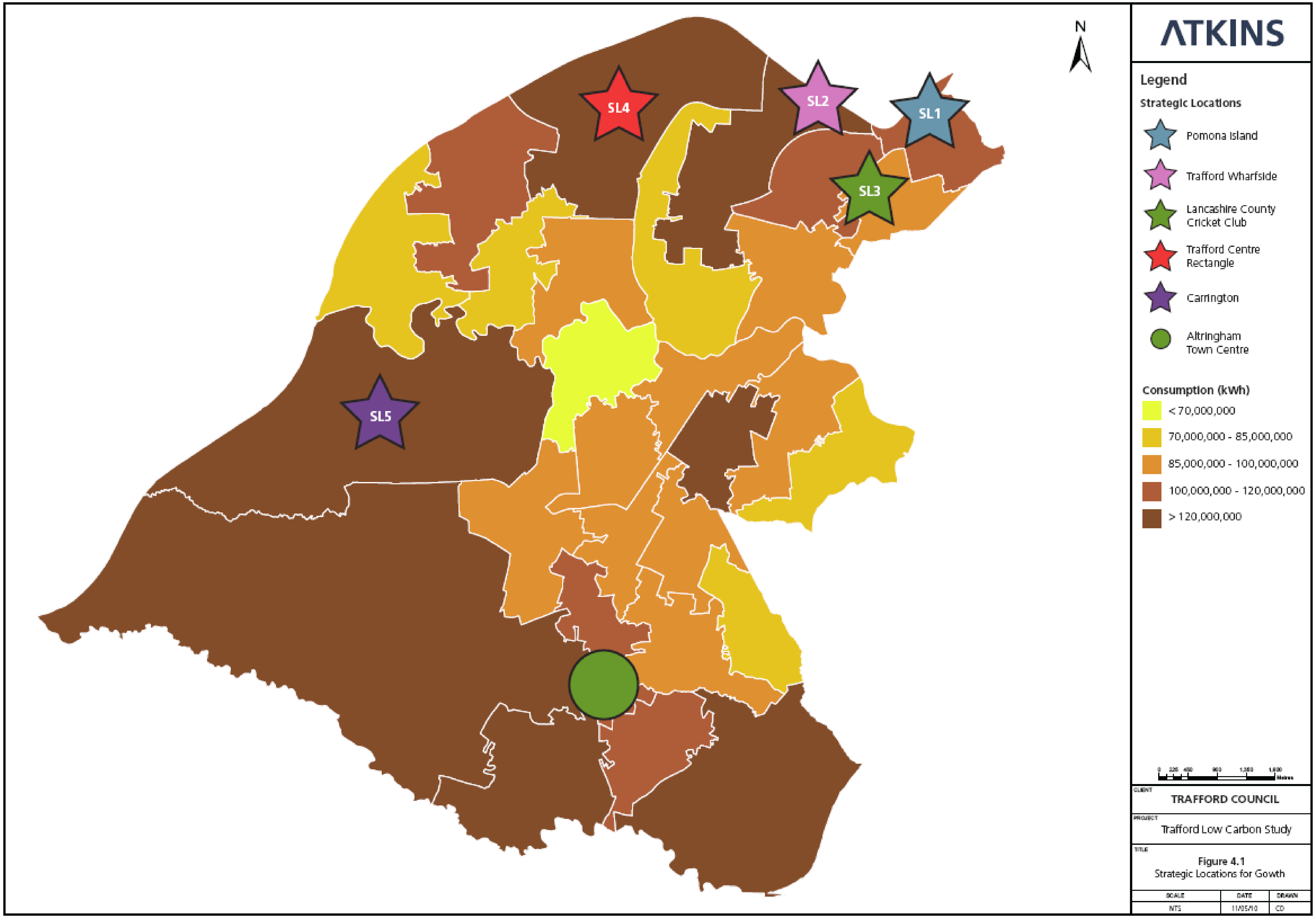
4.15 A review of all residential sites was undertaken using the growth trajectory outlined in the March 2010 draft of policy L1. This informed the establishment of renewables portfolios and energy network case studies, and all large sites in excess of 10 dwellings are identified in **Error! Reference source not found.**.

Table 4.1 Trafford Residential Growth

Core Strategy Strategic Locations	SHLAA Ref.	Site	Residential Units	TOTALS
Regional Centre Area				
SL1 Pomona Island	-		-	
SL2 Trafford Wharfside	1609	Wharfside, Trafford Park	500	
	1609	Southbank		
	1450	Victoria Warehouses, Trafford Park Rd	400	
Regional Centre Area Totals				**900**
Inner Area				
SL3 Lancashire County Cricket Club Quarter	1601	Old Trafford Cricket Ground	900	
Other Inner Area Sites (>10 units)	1430	1 – 5 Ayres Rd, M16	45	
	1447	Land at Warwick Rd South	24	
	1458	Land at 355 City Rd	58	
	1463	Browning St	25	
	1502	Works Adjacent to Mitton Rd	14	
	1565	Tamworth Court and Chorlton Rd	112	
	1596	Chester Rd / Cornbrook Rd Park / Virgil St	30	
	1429	Empress Mill, Empress Street, Old Trafford	100	
	1698	St Alma Court, Moss Lane West	17	
	1703	Carriage St / Cornbrook St / Chorlton Rd	62	
	1763	Warwick House, Warwick Road	17	
	1427	Land at Northumberland Road	193	
	1438	Former Petrol Station, Warwick Rd South / Kings Rd	15	
	1442	Thrifty Site, Warwick Rd / Montague Rd	70	
	1455	Trafford Press Site, Chester Road	116	
	1469	Petrol Station and Adjacent Land, 499 Chester Rd	95	
	1503	Stretford Memorial Hospital, Seymour Grove	33	
	1504	Land South of White City Retail Park	25	
	1625	Land at Talbot Rd, Stretford	17	
	1671	Vacant retail unit, Chester Rd	59	
	1705	Office Car Park, Chester Rd / Boyer St	17	
	1708	Land Opposite Kings Rd Primary School	34	
	1717	Nansen Close	19	
	1721	Kings Rd TA Barracks	19	
	1732	Avondale Rd Car Park	35	
	1428	Land at Kendal Rd, Stretford	17	
Remaining Other Inner Area Sites		Sites < 10 units (in case study area 4)	67	

		Sites < 10 units (not in case study area 4)	265	
Other Inner Area Sites Totals			**1,600**	
Inner Area Totals				**2,500**
South City Region				
SL4 Trafford Centre Rectangle Strategic Location	1614	Trafford Centre Rectangle	1,050	
SL5 Carrington Strategic Location		Carrington	1,560	
Other South City region Sites (>10 units)	1289	92 & 94 Manchester Road, Carrington	16	
	1290	Carrington House, Manchester Road, Carrington	10	
	1563	Crampton Lane, Carrington	76	
	1664	Ackers Lane	32	
	1689	Crampton Rd, Manchester Rd	14	
	1704	Stone Meadows Caravan Park, Manchester Rd	25	
	1718	Carrington Lane / Manchester Rd	15	
	1292	The Greyhound Public House, Manchester Road, Partington	24	
	1507	Land at Partington Millbank County Junior School, Partington	47	
	1510	Land East of Partington Shopping Centre, off Central Rd, Partington	47	
	1533	Gypsy Caravan Park	34	
	1541	4 Lock Lane, Partington	31	
	1551	Former Depot, Manchester Rd	13	
	1561	Orton Brook School Site, Oak Rd	75	
	1610	Partington Canalside, Lock Lane	550	
	1639	Red Brook Public House, Partington	51	
	1540	Millbank Hall Farm	80	
	1588	Industrial Unit, Oakfield Rd, Altrincham	10	
	1696	Oakfield Rd, Altair Site, Altrincham	150	
	1627	47-67 George St, 3-15 Cross St, 48-50 Stamford New Rd, Altrincham	10	
	1584	Station Buildings, Stamford New Rd, Altrincham	23	
	1546	Central Way, Altrincham	30	
	1582	Regent Rd / New St, Altrincham	22	
		Other Town Centre Sites (<10 resi. units)	22	
	1585	Oakfield / Balmoral Rd, Altrincham	45	
	1586	Mayors Rd / Manor Rd, Altrincham	17	
	1680	Townfield Gardens	13	
	1589	Highbank Adult Training Centre, Albert Place, Altrincham	15	
		Other Case Study Sites <10	22	
Remaining Other South City region Sites			4,331	
South City Region Area Totals				**8,460**
Policy L1 Total Allocation				**11,860**

Figure 4.1 - Strategic Locations for Growth



Employment Land

4.16 Core Strategy policy W1 (Economy) and W2 (Town Centres and Retail) set out the scale and distribution of employment land supply (B Class uses) for the Borough to 2025/26. A total land supply of 190 hectares is identified for the plan period, phased as follows:

- Up to 2015/16 – 59 hectares;
- 2016/17 to 2020/21 – 68 hectares; and
- 2021/22 to 2025/26 – 63 hectares.

4.17 As illustrated above, the supply of employment land is evenly phased over the plan period. As with the residential trajectory, this growth is distributed in key strategic locations across the Borough.

4.18 The majority of the supply (145 hectares) is focussed within the Trafford Park and Carrington strategic locations. Land in and around the Regional Centre will provide 20 hectares of employment supply, with the balance split between Broadheath, the town centres and other locations in the Borough.

4.19 A breakdown of the supply of employment land set out in policy W1 is provided at Table 4.2 below.

4.20 A review of all employment land has been undertaken in order to inform the establishment of energy network case studies.

Table 4.2 - Core Strategy Policy W1 Employment Land Supply

	Up to 2015/16	2016/17 – 2020/21	2021/22 – 2025/26	Total Land Supply for B uses (Ha)
W1a Pomona Island	4	4	2	10
W1b Trafford Wharfside	3	3	4	10
W1c Trafford Park Core	18	22	15	55
W1d Trafford Centre Rectangle	2	6	7	15
W1e Carrington	25	25	25	75
W1d Broadheath	3	3	4	10
W1d Town Centres	1	2	2	5
W1e Elsewhere	3	3	4	10
Core Strategy Policy W1 Allocation Total	**59**	**68**	**63**	**190**

Other Land Uses

4.21 Within the scope of this study we have not identified the renewables potential associated with other types of development which may come forward within the Borough up to 2025/26. At present the location and scale of development and energy requirements are not known in any comprehensive detail. Furthermore, such development which includes A-Class retail uses not combined with mixed use schemes, residential and non residential Institutions such as schools, hospitals and leisure uses also have highly specific energy consumption profiles which it is difficult to derive assumptions.

4.22 Although the scale of opportunity cannot be determined there are several programmes where there are significant opportunities for integrating renewable energy generation such as:

- Proposed Waste Management Facilities
- Building Schools for the Future programme to upgrade secondary schools;
- New and refurbished Primary School provision;
- New Further and higher education facilities; and
- Trafford Leisure Trust on-going building maintenance and investment programme

Establishing Renewables Portfolios and Development Typologies

4.23 An analysis of the development trajectory was undertaken in order to identify the likely size and type of developments which are likely to come forward up to 2025/26. As **Error! Reference source not found.** illustrates, the residential development trajectory is composed of range of development sizes and types, from single dwellings and housing conversions, small developments up to 10 dwellings and medium and larger sized schemes, including major mixed use development sites.

4.24 In addition to the scale of development identified in the development pipeline another significant determinant is the scale and density of development and the relationship with the threshold sizes for different types of renewable and low carbon energy provision.

4.25 Some technologies are scalable on a continuum whilst the technical feasibility of other technologies are ‘staircased’ with thresholds between different scales of technology. These are summarised below:

- Easily scalable: Photovoltaic, Solar Water Heating, Small Hydro, Biomass Boiler, Ground Source Heat Pump (2 main technologies with choice dependent on density and land available), Air Source Heat Pump.
- Staircased: Combined Heat and Power and Biomass Combine Heat and Power, Wind (although range of sizes and capacities available provides flexibility).

4.26 Taking into account these considerations, the following typology of developments was derived to capture the development pipeline and both key technological thresholds:

- Individual dwelling Detached/Semi detached;
- Individual dwelling terrace;
- Individual house conversion;
- Small scale development between 10 and 50 dwellings;
- Housing led mixed use 50-200 dwellings;
- Housing led mixed use 200-500 dwellings; and
- Housing led mixed use 500 units+.

4.27 These development categories have been specifically tailored to reflect the nature of development coming forward within Trafford.

4.28 A number of assumptions were made in order to derive approximate levels of new floorspace that were result from the proposed growth. These were based on density / mix assumptions set out in the Affordable Housing Economic Viability Study (prepared by GVA Grimley) for housing schemes

(40 dwellings per hectare (dph)), mixed apartment / housing schemes (50 dph) and apartment schemes (140 dph).

4.29 Typical internal floorspace for a range of property types were also assumed:

House Type	M^2
2 bed apartment	60
3 bed apartment	70
2 bed terrace	75
3 bed terrace	85
3 bed semi	95
4 bed semi	110
4 bed detached	125
5 bed detached	140

Scoping of Renewable Energy Options Appropriate to Trafford

4.30 The integration of renewable energy technologies into development proposals should take place during project concept and scoping stages rather than seen as an 'add on' which is bolted on to a development at the later stages of scheme design.

4.31 A high level, general, knowledge of all renewable energy technologies is required to understand their suitability to any particular development type, size and location.

4.32 Several renewable and/or Low-Zero Carbon generation types have been considered for their applicability to the Trafford case study areas given their urban/brownfield characteristics and previous successful projects in the Trafford MBC area. These are:

- Wind turbines
- Photovoltaics
- Solar water heating
- Biomass heating
- Biomass power plants
- Biomass Combined Heat and Power
- Energy from Waste Combined Heat and Power
- Ground Source Heat Pumps

4.33 Table 4.3 identifies the most important aspects of each technology, typical installed capacity and approximate investment costs.

4.34 For each of the technologies considered, Table 4.3 highlights specific aspects which are relevant to their application to the development typologies which have been defined. These features include general suitability, typical output, primary advantages and disadvantages.

4.35 Appendix B provides a review and assessment of each technology and its suitability within the Trafford context. This further develops work undertaken at the regional and sub regional level to assess renewable energy resources.

4.36 Although it appears that average wind speeds within Trafford are able to support wind facilities it is unlikely that wind power will make a major contribution towards meeting overall renewable energy targets in the borough in most situations for a number of reasons:

- Local microclimate issues coupled with the presence of multi storey buildings are likely to affect local wind conditions significantly which will affect the efficiency of equipment.
- Development of freestanding wind turbines will also need to be compatible with adjoining land uses and not harm residential amenity with respect to visual impact, noise and shadow flicker issues which may be difficult to achieve in many locations within Trafford.

4.37 The most suitable locations may be within employment locations and on education sites as well as micro generation opportunities linked with residential and householder development. Despite the limited opportunities which may exist this does not preclude wind from consideration as a potential resource where appropriate conditions exist and it is compatible with planning policy.

4.38 The potential for biomass heating and CHP also requires careful consideration as its potential as a resource is influenced by establishing a sustainable feedstock resource and a sustainable means of transporting the resource into the Borough. In addition, it is important that the provision of biomass heating or biomass CHP does not have a significant adverse effect on local air quality or compromise local air quality management strategies. If these considerations can be addressed then it represents a useful renewable resource. These issues are likely to be optimised in connection with medium and larger scale facilities where the technology tends to be more efficient and emissions can be managed more effectively.

Table 4.3 - Renewable Energy Technologies Scoping for the Trafford Case Study Areas

Generation class	Renewable/LZC generation type	Advantage(s)	Primary disadvantage(s)	Trafford resource	Cost per kW installed	Suitability to Trafford
Electricity	Solar PV	Unlimited resource- FiT will ensure payback against electricity ~ 15 years	High investment compared to energy yield	~950 kWh/m² per year solar irradiation	£4,000 - £7,000	Many opportunities for building integration
	Wind power	Unlimited resource	Can be difficult to achieve planning consents; intermittent energy source	5.4 - 5.8 m/sec average wind speed; this will not apply inside the conurbation	~£1,000 (2MW); ~£3,000 (6kW)	Turbines can sometimes be situated in urban areas
	Biomass power	Treated as carbon neutral; fuel may be free if waste wood is used	Efficiency will be below 40%	Unknown- depends on allocation of virgin biomass resources and sources available for waste wood supply	£280 - £300	Suitable for non-residential areas
Combined Heat and Power	Biomass CHP	High efficiencies	Usually necessary to secure long term heat contracts from multiple users	Unknown- depends on allocation of virgin biomass resources and sources available for waste wood supply	£2,500 - £5,000; this does not include heat main and DH network links to buildings	Needs to be situated as near as possible to heat customers
	Energy from waste CHP	Low-carbon energy source compared to landfill	Often limited to export of electricity	Depends on catchment area for waste contract and composition of wastes	£3,500 - £5,000 (whole facility)	Sites are available in Trafford
Heat	Solar thermal (SHW)	Unlimited resource; RHI will ensure ~10 year payback against gas	Lower amount of heat generated during the winter	~950 kWh/m² per year solar irradiation	£1,200 - £1,800	Many opportunities for building integration
	Biomass boilers	Fuel is carbon neutral if from a sustainable source; fuel is often cheaper per kWh than gas; payback period very short if existing boiler is due for replacement	Higher capital cost than fossil fuel boilers	Unknown- depends on allocation of virgin biomass resources and sources available for waste wood supply	£450 - £900	Many opportunities for building integration- boilers should be sized as large as possible to achieve economies of scale
	Wood stoves	Fuel is carbon neutral if from a sustainable source; fuel can sometimes be acquired at very low cost	Manual handling of fuel; not suitable or safe in some building contexts	Unknown- depends on allocation of virgin biomass resources and sources available for waste wood supply	£300 - £ 700	Most applications are at the domestic scale. The technology is suitable for retrofit
	Ground Source Heat Pumps (GSHP)	High efficiency (~300%)	High investment cost with longer paybacks than other renewables	Depends on suitability of a particular area to accept boreholes or trenches	£700 - £950 (domestic)	Suitable at small or large scale but needs land available for excavation or appropriate geophysical conditions

Guidance on the Selection of Appropriate Technologies

4.39 Guidance set out in PPS 22 Renewable Energy is clear that local planning authorities should not make assumptions about the technical and commercial feasibility of renewable energy projects which are proposed for development. Technological change can mean that sites excluded as locations for particular types of renewable energy development may in future be suitable.

4.40 PPS 1 Supplement identifies that applicants for energy development should not need to demonstrate either the overall need for renewable energy or its distribution, nor question the energy justification for why a proposal for such development must be sited in a particular location.

4.41 However, paragraph 33 of PPS1 Supplement is clear in identifying that in establishing appropriate local and site level targets local authorities should ensure:

- What is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities;
- In the case of housing development and when setting development area or site-specific expectations, demonstrate that the proposed approach is consistent with securing the expected supply and pace of housing development shown in the housing trajectory required by PPS3, and does not inhibit the provision of affordable housing.

4.42 Particularly in the case of renewable energy projects proposed in conjunction with residential development it is appropriate for the Council to give proper consideration to what has been proposed including verifying the appropriateness of technical solutions.

Identification of Potential Opportunities for Local Energy Networks

4.43 To establish the potential for the establishment of local energy networks in the Borough (extending beyond a single land ownership) an assessment was made of those areas within the Borough which had the potential to either host a medium or large scale CHP facility or where it was possible to link sites to form a network either served by a single central facility or a small number of “seedpod” facilities.

4.44 District wide systems are constituted by one or a few centralised plants, normally cogeneration plants (CHP) and high efficiency boilers, which feed the network. This approach reduces the air pollutant emissions and resource depletion with respect to private thermal generation. Heat and power is distributed within each building as normal, but buildings are served by an underground insulated pipe network. This ensures the distribution water and electrical circuit (primary circuits) are isolated from the consumer’s internal network (secondary circuits).

4.45 There are a number of parameters that should be considered to assist the achievement of sound and cost-effective district wide energy networks. Densely populated areas optimise the efficiency of these networks in terms of thermal losses and minimize the initial capital investment, for economy of scale reasons.

4.46 The Energy Saving Trust Guide (CE55 Community Heating) specifically states ‘Most new build will be constructed by private developers, and assuming a project lifetime of 20 years with a discount rate of 12 per cent, new developments of 55 or more dwellings per hectare are, prima facie, likely to be cost effective’.

4.47 While this is a general rule of thumb there are several other criteria which are also important in establishing potential. A suitable model needs to exist or can be established for long term funding, management and maintenance. In addition sufficient critical mass is needed to underpin a business case especially given that, under EU competition rules, future occupiers cannot be tied in to taking energy suppliers from any particular supplier.

4.48 A number of criteria were used to identify those areas which had the greatest potential for a wider CHP network. These were:

- Scale of development and associated energy demand;
- Phasing of development in order that there is potential for close alignment between the development of the heat network and development in order to overcome cash flow and payback limitations;
- Presence of anchor facilities, such as institutional or commercial uses which are larger heat users and could underpin demand for heat especially during the summer months when demand is low for domestic users;
- Proximity of developments to maximise efficiency and reduce the need for pumping;
- Presence of suitable heat corridors and routes which do not require major works to railway or strategic road corridors; and
- Potential to influence the shape of proposals through the planning process (planning permission has not yet been granted or S106 agreement signed, or outstanding conditions relating to renewable energy strategy not yet discharged).

4.49 It should also be noted that district energy networks are normally to be designed with a degree of redundancy in the sizing of pipes and equipment to provide a degree of future proofing to take account of future extension and intensification of use and revision of construction coefficients. These considerations are reflected within the specification of pipelines and cables which are installed from the outset.

4.50 To optimise the network, routing should also be minimised, i.e. the distributed generation station (heat and/or power) should be sited as close as possible to the thermal consumers. The generation plant should function over long annual periods with a thermal load close to the technical nominated one, for increased energy efficiency to be achieved.

4.51 The AGMA study highlighted several opportunities for local energy networks in Trafford which have potential for development. These opportunities were reviewed with the Council and a range of other opportunities were considered taking account of local renewable resources and the location of major development in the Borough up to 2026.

4.52 A systematic analysis was also undertaken of the distribution of the pattern of new development within the Borough to identify whether sufficient critical mass existed to underpin the demand of medium and large scale CHP facilities. The opportunities with the most potential were identified for four areas within the borough. Termed Low Carbon Growth Areas in the Core Strategy Policy, these areas relate to the areas where major growth is planned as detailed in the Core Strategy Policy L1 and which is justified and supported through the phasing plan for development up to 2026. Further detail on these areas is provided at the start of this chapter under Review of Development Trajectory and Locations for Future Growth. They are highlighted spatially in Figure 4.1, with boundaries illustrated in Appendix H. These are referred to as Old Trafford, Trafford Park, and Carrington and Altrincham area case studies. The potential renewable options to serve these areas are assessed below.

4.53 In order to provide a consistent approach to determining energy baseline data, Middle Layer Super Output Area boundaries were used, as energy data is recorded at this scale. The exception was the Altrincham case study, where the size of the relevant MLSOAs would have resulted in a skewing of energy data in contrast to the town centre location of that particular study. Therefore, Lower Layer Super Output Areas were used, with energy data aggregated using ‘per household’ calculations.

4.54 This report has not considered the opportunities for retrofit of existing residential or commercial properties in identifying potential heat networks, other than in connection with development or redevelopment.

4.55 At present the costs of adapting and connecting existing properties would be prohibitive due to the costs involved. Inclusion of such properties would undermine the potential business case of a local energy network if it was dependent on retrofitting existing properties.

4.56 Despite this, once a network is established, there is potential for it to serve existing properties as they are developed or refurbished. In addition, an Energy Service Company (ESCO) could be tasked with social and regeneration objectives which may use the profits generated from its energy generation and distribution activities to fund energy efficiency improvements to the existing stock. This is discussed further in Appendix D.

Options Appraisal for Potential Local Energy Networks

4.57 Each of the four identified case study areas offers differing pre-existing constraints and opportunities for the deployment of renewable energy and LZC energy systems. This options appraisal considers a selection of area wide options presented by the renewable energy technologies summarized in Table 4.3 - Renewable Energy Technologies Scoping for the Trafford Case Study Areas as applied to the general spatial and built environment characteristics of each case study area.

4.58 To assess opportunities to secure CO_2 emissions reductions using an area wide approach without complete, detailed site-by-site feasibility studies there remains the possibility that certain opportunities for technology deployment may be missed. However, deployment of site specific opportunities is considered later in this chapter.

4.59 The purpose of the appraisal of local energy networks and area solutions is to establish their technical feasibility and cost of deployment and to explore overarching concepts for delivery. Therefore, in the interests of ensuring the usefulness of the results, and to incorporate optimal up-take of renewables and LZC systems through the planning process, the approach taken here is to:

- City Regional scale - Develop further opportunities which have been highlighted in the AGMA Decentralised and Zero Carbon Energy report. This is limited to the development of the proposal to adapt the future Carrington CCGT power station to CCGT/CHP operation which presents various opportunities for district heat solutions in Trafford. The implications of this have been incorporated into the options for each case study area, where applicable. There are also other examples of energy generation projects at various stages that will impact on Trafford emissions. Only one of these has been incorporated into the options, because the majority of the projects are allocated to existing industrial facilities and it is not clear what carbon emissions savings will be produced. The Barton Biomass Power Plant which was estimated to have a 20MWe capacity has been included in the Trafford Park case study LZC options as this is believed to be a “stand alone” facility able to generate “zero carbon” electricity to the grid;
- District scale – highlight further district heat/CHP solutions where opportunities are believed to exist. These solutions have been incorporated into case study area options where applicable; and
- Site scale – at this stage it is not possible to address the renewables/LZC potentials for individual sites but, following from the methodology used in the energy demand assessment and future energy trajectories, the case study areas have been reduced to generic building types with each type’s potential for micro-renewables scaled to the building resource in the particular case study area.

Explanation of the Case Study Options Tables

4.60 There are two rows presenting CO_2 data in the options tables. In all instances, the upper row expresses CO_2 savings as a percentage attributable to LZC generation compared to “business as usual” – these are the estimated CO_2 savings for existing development plus new development the case study area can expect once LZC generation has been added. However, this value does not depict absolute changes in emissions. The lowest row expresses these; this is expressed as a percentage change in emissions levels in comparison to the original emissions for the area before additional development is added.

4.61 When the value depicted on the lowest row is positive, this represents a net increase over the original baseline emissions despite the addition of LZC technologies. When the value is negative, this represents a net reduction over the original emissions.

4.62 Only four of the options from the total of twelve from the four case study areas show a net reduction in absolute levels of CO_2 emissions. The remainder show increases in emissions since the LZC generation decreases the emissions from a proportion of the additional demand added by the projected new developments.

4.63 A fuller explanation of each row in the case study tables is provided in Table 4.4.

Table 4.4 - Explanation of Case Study Area Options Tables

		Option 1	Option 2	Option 3
Explanation of each row in the case study options table. All values depict demand/emissions/savings **per year.**	**Options generation potential and emissions**			
This is the percentage of the case study area's thermal demand satisfied by the portfolio heat-generating LZC technologies selected for this option.	% of area MWh (thermal)			
The percentage of the case study area's elctrical demand satisfied by the portfolio of LZC technologies which generate electricity selected for this option.	% of area MWh (electric)			
Initial capital investment required to purchase and install the LZC technologies for the particular option. Under some circumstances, the burden of the capital cost may be shifted to an ESCO or spread between public and private entities.	Capital Cost (£million)			
This represents an estimate of the sum total of regulated and unregulated CO2 emissions from existing buildings for the case study area in 2025, not including anticipated development growth or emissions savings from LZC technologies. Therefore, energy efficiency improvements for the existing building stock are incorporated into this value.	Baseline emissions (t/CO2/a)			
This represents an estimate of the sum total of regulated and unregulated CO2 emissions from existing and future projected emissions from new development to 2025 **not including** emissions savings from LZC technologies.	Baseline+future projected emissions (t/CO2/a)			
This value is an estimate of CO2 emissions savings attributable to thermal and electrical LZC generation from the portfolio of LZC technologies selected for each option.	CO2 emissions savings from LZC inputs (t/CO2/a)			
Baseline+future projected emissions (t/CO2/a) **minus** CO2 emissions savings from LZC inputs (t/CO2/a).	Adjusted emissions after LZC inputs			
Estimate of percentage CO2 reductions possible over emissions from existing plus future development in the case study area after deployment of the portfolio of LZC technologies.	**% CO2 reduction over baseline+future emissions**			
This percentage value is an estimate of the change in CO2 emissions for the particular option once the total emissions from existing and new development has been added together, and the emissions savings from the portfolio of LZC technologies has been subtracted from this value. If the percentage is a positive value, this means total emissions under this option for the case study area have increased. If the percentage value is negative, this means that despite new development taking place, total emissions for this option have decreased.	**% CO2 change from baseline emissions after new development & LZC inputs**			

Factors Affecting LZC Technology Selection and Technology Limitations

4.64 Table 4.5 below identifies a summary of some of criteria which have been used to identify appropriate technical solutions. If we consider residential uses, ground source heat pumps (GSHP) compares least favourably, since in an urban environment this technology, though very efficient, can be very difficult to install because of the necessary groundworks which add considerably to costs. Solar thermal (SHW), by contrast, is simpler and cheaper to install.

4.65 Wind power at a larger scale (>400kW – 2MW per turbine) is relatively cost effective, but it is recognised that there may be few opportunities in and around Trafford to deploy this technology, even outside of the urban area. An exclusion zone is depicted in the wind energy resource spatial plans in the AGMA *Decentralized and zero carbon energy planning* (2010, p.91) report which extends nearly as far as (but not including) the Carrington site from the vicinity of Wilmslow and

Manchester airport. Therefore, wind power has been included in terms of small scale opportunities.

4.66 Biomass power, which in the UK usually utilises virgin biomass (not waste wood) can generate very significant amounts of zero carbon electricity, but does not utilise the heat generated, as with CHP. It has been included because there is a proposal for a facility of this kind to be constructed in Trafford.

4.67 The AGMA report (2010, p.94) indicates that the sub-region, of which Trafford is a part, may have just over 10,000 odt (oven-dried tonnes) per year of biomass available. One biomass CHP plant serving a portion of Trafford could use in excess of this amount. Therefore, unless imported biomass is considered acceptable, any biomass plant (either CHP, electricity only, or heat only) incorporated into the planning process above 500kW[8] will necessitate close attention to the feasibility of access to the biomass supply chain. There are indications that larger projects like this may fail to secure investment unless long-term fuel contracts can be guaranteed.[9]

4.68 Biomass needs to be treated as a special case, as its constant need for fuel indicates that projects should not be encouraged unless the fuel supply can be organized well in advance of the construction and infrastructure arrangements.

Table 4.5 - Comparative Selection Criteria for Building Integrated Renewables/LZC Systems

Building integrated renewables/LZC systems selection criteria

Generation type		Deployability	Utility	Resilience	Capital cost	ROI
Electricity	Solar PV	Easy to install and retro-fit	Electricity - highly flexible energy carrier	Panels are robust but inverters need replacing	High	Very good with FiT
Heat	Solar thermal (SHW)	Additional tanks and plumbing required	Usually only used for hot water (DHW)	Panels are robust	Reasonable	Competitive with electric DHW heating before RHI
	Biomass boilers	Initial install & retro-fit may need new buildings	Can provide space heating and DHW	Modern units are low-maintenance	Additional build may add to costs	RHI enables good ROI against fossil fuels
	Biomass/pellet stoves	More complex if retro-fitted to DHW system	Can satisfy space heating and DHW demands	Reliable and robust	Install costs similar to fossil fuel equivalents	RHI enables good ROI against fossil fuels
	GSHP	Problematic in urban areas	Efficiency affected if used for DHW	Reasonable	High	Reasonable with RHI

Red indicates concern, amber – average concern, green – not problematicCase Study Area 1: Carrington

Rationale behind Choice of LZC Solutions for the Case Study Area Options

4.69 The choice of technologies chosen for each Case Study area option depended on a number of factors. These are listed below:

- If there is the potential for a large LZC energy export project in the Case Study area, this has to be incorporated first, as this probably represents the most viable solution, since larger facilities can produce economies of scale;
- Larger LZC energy export facilities will generate heat, electricity or both heat and electricity (CHP). In the case of heat export from a large facility (such as Carrington CCGT), other LZC generation was sought which could produce electricity (wind power) followed by micro-renewables. The preference here being for solar PV, since renewable electricity is more valuable than renewable heat. In the case of a major LZC electricity exporter (Peel Energy

[8] Smaller projects may have less difficulty in arranging fuel contracts, but the surge in interest and deployment of these technologies implies the possibility of a biomass supply "bottleneck" in the near future.
[9] John Clegg consulting Ltd (2010) *Wood fibre availability and demand in Britain 2007 – 2025.* This report indicates that it is very difficult to secure indigenous long-term biomass contracts

biomass power plant), the next choice will be a source of heat generation followed by micro-renewables and

- The viability assessment (see chapter 5) has brought into question the deployment of solar PV for many of the options on the grounds of initial investment costs. Solar PV commands undoubtedly high initial costs, but the Feed-in-Tariff (FiT) has been introduced for the purposes of significantly shortening the time required to achieve a return on investment. There are already signs that initial investment costs for solar PV will be shifted from a developer to another entity (such as a bank or ESCO), guaranteeing this entity a revenue and possibly cheaper electricity to the user through a variety of financial mechanisms, though this cannot be guaranteed.

Reconciliation of Policy L5 and Allowable Solutions

4.70 The Gross Emission Reduction Target Framework (Development Plan Document- Core Strategy: Further Consultation on Core Policies L2, L4, L5, W1 and R5, November 2009) incorporates a table (p.22) indicating that if a developer is not capable of meeting emissions requirements as demanded by the Building Regulations, then contributions must be made to Allowable Solutions.

4.71 The Renewables Case Study Options in this report were drafted with the assumption that Building Regulations would be met by developers and that additional provision would be provided to realise further reductions in emissions.

4.72 Where it is not appropriate to meet the emissions reductions on site due to site or space constraints which limit the deployment of renewable technologies, then an equivalent planning obligation to secure contributions towards equivalent allowable solutions in the Borough would be permissible. Allowable solutions should be limited to emissions saving measures such as improved energy efficiency or further deployment of LZC systems.

4.73 In the event that viability issues preclude or reduce the targets which can be achieved for specific sites then the emissions reductions identified within the case studies may not be secured. As Policy L5 stands, there is no guarantee any emissions targets for the Borough will be met.

Choice of Renewable LZC Systems for Inclusion in the Case Study Area Options

4.74 The choice of technologies covers those with the highest probability of successful deployment within an urban area. Wind power was included because it is one of the cheapest solutions per kWh of electricity produced and has been installed at industrial sites in the UK and on the fringe of urban areas at low capacities. For this reason no more than two 2MW wind turbines were modelled in the options, as this scale of deployment in no way represents a “wind farm”.

4.75 Air-Source Heat Pumps (ASHP) has not been included in the options because it has few applications in energy efficient housing beyond Code for Sustainable Homes Level 4 (as the space heating demand would be too low), and under many conditions it does not, in practice, have emissions lower than natural gas heating. Therefore, it is best deployed where gas mains are not present. It is sometimes incorporated into Mechanical Ventilation Heat Recovery (MVHR) systems in energy efficient housing, but in this case it performs an *energy efficiency* function and is therefore should not be defined as a true LZC or renewable energy system.

Case Study 1: Carrington Area

4.76 The Carrington Area case study area presents very specific opportunities for low carbon generation, being the proposed site for two large infrastructure projects, namely a new 860MW high efficiency CCGT power station and a possible waste processing facility. Table 4.6 accounts for estimated demand from the proposed development of residential, general industrial (B2) and storage and distribution facilities (B8) in the area.

4.77 The CCGT power station has been specified as a case study opportunity in the AGMA Decentralised and zero carbon energy planning study. The developers of the proposed CCGT power plant are required by the Secretary of State to assess the feasibility of utilising the large quantities of waste heat available from a plant of this kind, although pursuing this method of increasing the efficiency of the proposed plant may result in its electrical efficiency dropping slightly.

4.78 If the heat were to be utilised from the CCGT plant, the AGMA study identifies the opportunity to distribute this through a heat main to the north east following the Manchester ship canal, serving areas such as Trafford Park, Old Trafford, Eccles and central Manchester, along with Carrington refinery and the proposed Partington Wharfside paper recycling mill (see Figure 4.2)

4.79 However, since it is usually more viable to send heat through a district heat main as short a distance as possible, and the total amount of heat available would be considerable, Option 1 below proposes to serve the Carrington growth area via an additional local loop.

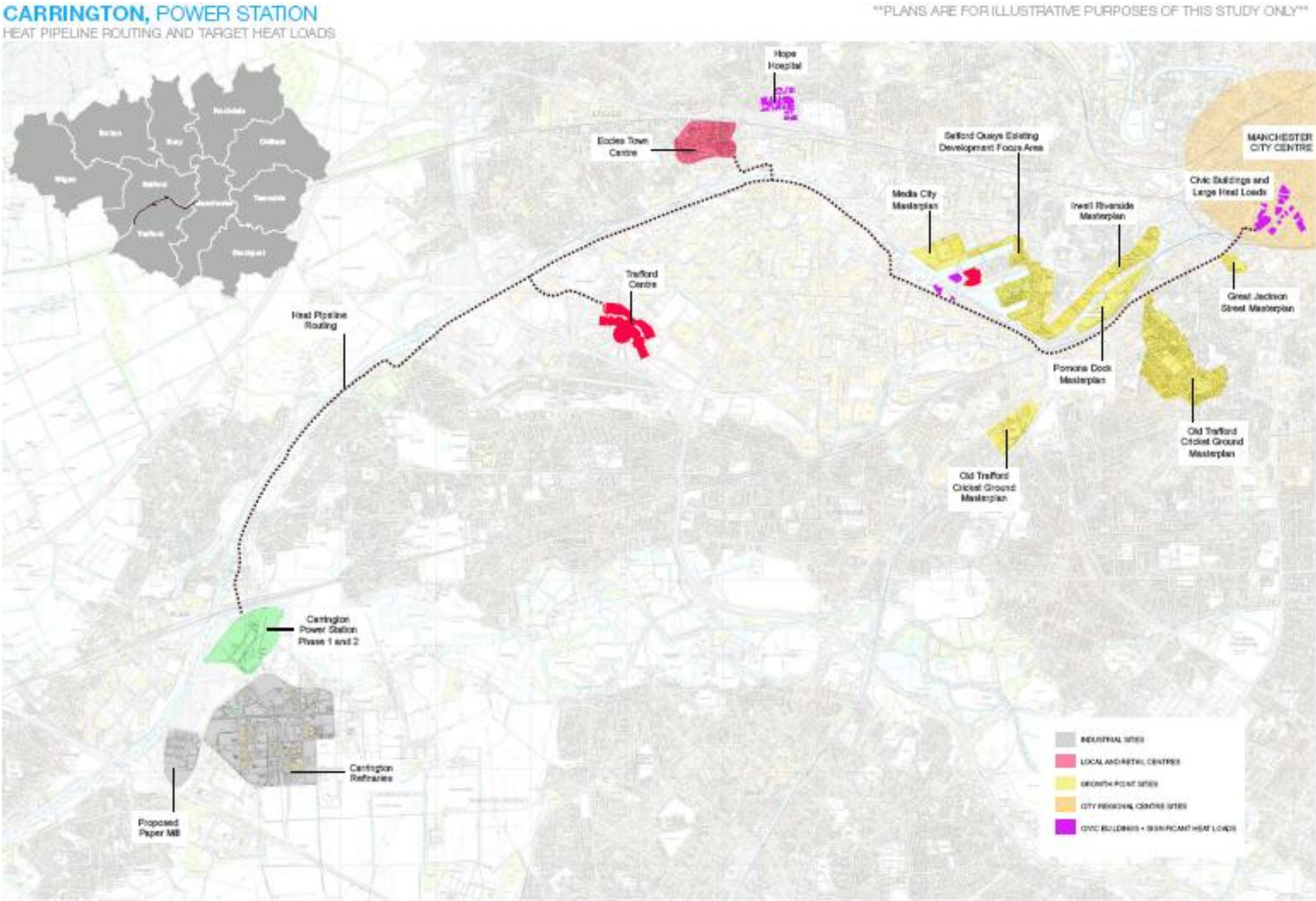
4.80 **Option 1** considers the possibility of diverting a proportion of the heat to the Carrington development area with the effect of otherwise displacing emissions from natural gas[10] used for the purposes of space heating and domestic hot water. This would result in emissions savings of 17.27% over the baseline.

4.81 **Option 2** assumes a small-medium sized waste facility generating excess electricity (but not heat, as this is assumed to be used for process purposes on site) dedicated to the new development at Carrington accompanied with building integrated solar thermal hot water (SHW) systems installed only in the houses. This results in CO_2 savings of 77.74%. This is a high figure due to the displacement of grid electricity and landfill emissions.

4.82 **Option 3** envisages a renewable heat-only district heat system for the development which could be provided by biomass boilers, with 7.5% (grid electricity) emissions abatement from solar PV attributed to non-domestic buildings, and a notional 2kWp system fitted to each house in the development. This results in CO_2 savings of 28.46% over the baseline.

[10] A heat main servicing the Carrington development could displace emissions from electricity if it were used to generate heat in the new development, resulting in higher emissions savings, but this quantity cannot be forecasted accurately at this stage, so it has been omitted from the calculations.

Figure 4.2 - Proposed Heat Pipeline



Source: AGMA Decentralised and Zero Carbon Energy Planning Study for Character Area 1.

Table 4.6 - LZC/infrastructure Options for Carrington Area (Case Study 1)

	Option 1	Option 2	Option 3
Options generation potential and emissions	**DH network from Carrington CCGT+grid electricity**	**Private wire electricity support from local EfW CHP+SHW**	**Biomass District Heat system+PV**
% of area MWh (thermal)	30%	6%	30%
% of area MWh (electric)	0%	105%	26%
Capital Cost (£million)	1.79	42.46	99.83
Baseline emissions (t/CO2/a)	17,815	17,815	17,815
Baseline+future projected emissions (t/CO2/a)	43,919	43,919	43,919
CO2 emissions savings from LZC inputs (t/CO2/a)	7,586	34,145	12,498
Adjusted emissions after LZC inputs	36,333	9,774	31,421
% CO2 reduction over baseline+future emissions	**17%**	**78%**	**28%**
% CO2 change from baseline emissions after new development & LZC inputs	**104%**	**-45%**	**76%**

4.83 The capital cost for Option 1 does not include an estimated cost of £500m for the Carrington power station (this would be funded and financed as a separate project). The cost does include an estimate for a 1.2 km heat main based on a heat main cost of £1,400/metre.

4.84 The capital cost for option 2 includes an estimate for the CHP component only of an EfW facility. Option one is likely to be the preferred approach to serve this area due to the cost effectiveness of this solution. This may be combined with deployment of micro-renewables to improve upon emissions reduction as viability allows at the time of delivery.

Case Study 2: Altrincham

4.85 **Option 1** assumes new build housing will have space heating provided by GSHP. The emissions savings in this case are not large, given the relatively low numbers of new housing completions expected in the period to 2026 coupled with their low space heating requirements in comparison to existing dwellings. New build houses are allocated 2kWp each of solar PV, whilst half the households from the existing building stock are considered to adopt a retrofit solar PV solution. 10% of industrial electricity demand is treated as provided for by solar PV.

4.86 **Option 2** is as above, but space heating for new build housing is provided for by either biomass boilers on small heat networks, or by modern wood-fuel stoves on a house-by-house basis.

4.87 **Option 3** is as Option 2 but with 10% of non-domestic building space heating demand met by biomass boilers. This could be met by major buildings in the centre of Altrincham being linked by a district heat network.

Table 4.7 - LZC/infrastructure Options for Altrincham (Case Study 2)

	Option 1	Option 2	Option 3
Options generation potential and emissions	**New build housing GSHP+PV, house retrofit PV, new Ind./Comm.+retrofit PV**	**New build housing biomass heat+PV, house retrofit PV, new Ind/Comm+retrofit PV.**	**Major+public buildings+new housing biomass heat, new build PV+PV retrofit to existing buildings**
% of area MWh (thermal)	2%	2%	6%
% of area MWh (electric)	13%	13%	13%
Capital Cost	22.37	22.25	24.21
Baseline emissions (t/CO2/a)	12,277	12,277	12,277
Baseline+future projected emissions	18,741	18,741	18,741
CO2 emissions savings from LZC inputs (t/CO2/a)	1,684	1,707	2,006
Adjusted emissions after LZC inputs	17,057	17,033	16,734
% CO2 reduction over baseline+future emissions	**8.98%**	**9.11%**	**10.71%**
% CO2 change from baseline emissions after new development & LZC inputs	**39%**	**39%**	**36%**

Case Study 3: Trafford Park

4.88 **Option 1** considers the possibility of a biomass power plant contributing significantly to emissions savings for this area. However, in order for the emissions savings to be counted locally, the power plant would need to be treated as a local asset contributing to local emissions savings for Trafford, and not as a strategic asset. Wind Power would need to be either off site or subject to planning permission within the industrial area. It is envisaged in this case study area as two 2MW turbines. Solar PV is allocated to all new buildings and as a retrofit to existing buildings.

4.89 **Option 2** considers the possibility of a spur from the proposed heat main from the Carrington CCGT plant satisfying some of the heat demands of Trafford Park and specifically the Trafford Centre, as considered by the AGMA Decentralised and Zero Carbon Energy Planning study. Solar PV is treated by the same method as Option 1

4.90 **Option 3** allocates solar PV by the same method as the first two options, but is accompanied by SHW systems where possible, resulting in a relatively small contribution to thermal demands

Table 4.8 - LZC/infrastructure Options for Trafford Park (Case Study 3)

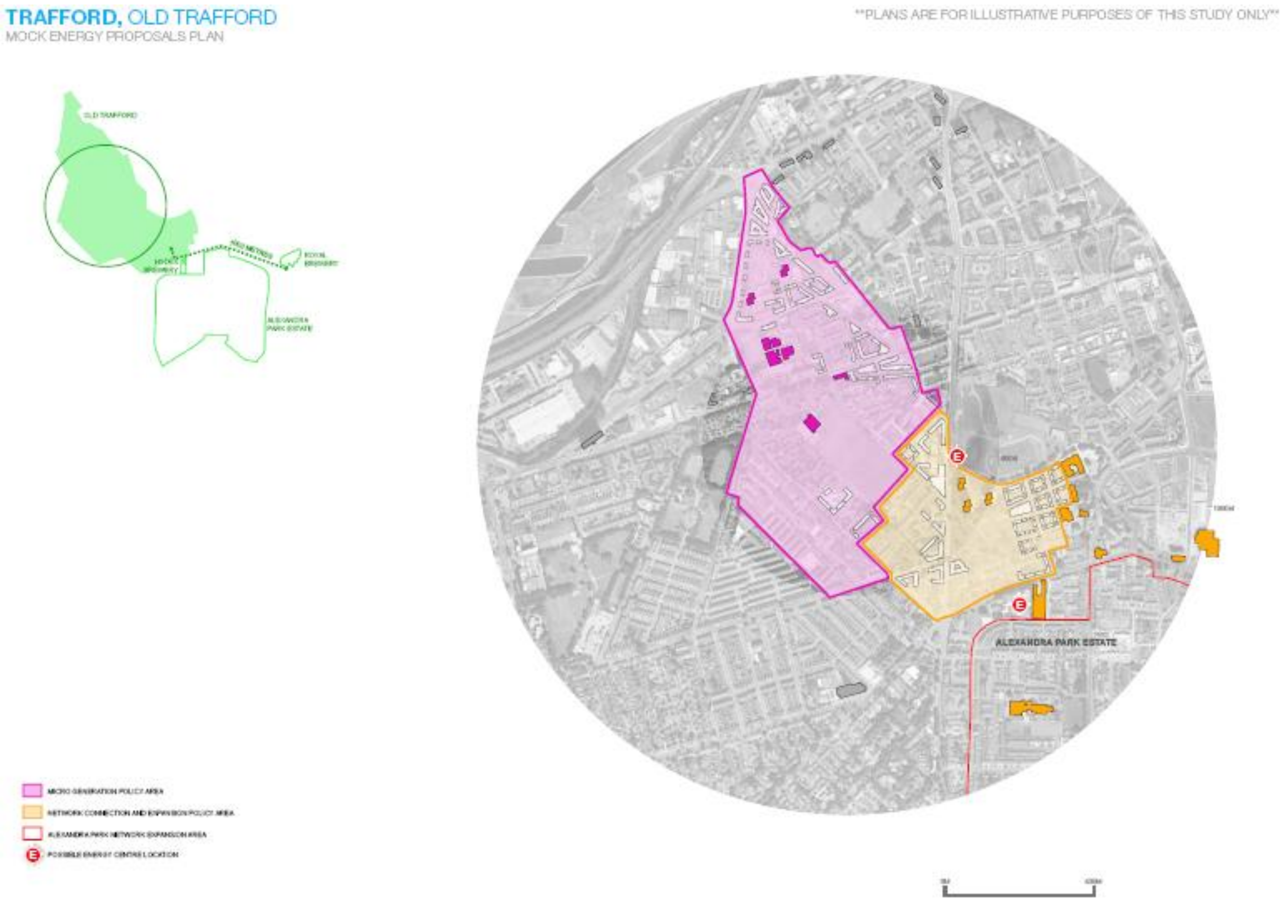
	Option 1	**Option 2**	**Option 3**
Options generation potential and emissions	**Wind power+solar PV+biomass power**	**Biomass power+CCGT heat main+solar PV**	**SHW+solar PV**
% of area MWh (thermal)	0%	19%	4%
% of area MWh (electric)	181%	173%	15%
Capital Cost	115.37	120.32	207.30
Baseline emissions (t/CO2/a)	230,610	230,610	230,610
Baseline+future projected emissions	268,161	268,161	268,161
CO2 emissions savings from LZC inputs (t/CO2/a)	92,641	129,261	15,568
Adjusted emissions after LZC inputs	175,520	138,900	252,593
% CO2 reduction over baseline+future emissions	**34.55%**	**48.20%**	**5.81%**
% CO2 change from baseline emissions after new development & LZC inputs	**-24%**	**-40%**	**10%**

Case Study 4: Old Trafford

4.91 The Old Trafford case study is an inner city area characterised by a mix of low-rise terraced housing, high-rise residential tower blocks and a number of prominent sites, including public buildings such as Trafford Town Hall, Manchester United football stadium and Lancashire County Cricket Club. The area is subject to a masterplan where it has been highlighted as a gateway to the Regional Centre.

4.92 This area was selected as one of the case study character areas in the AGMA Decentralised and zero carbon energy planning study. The AGMA study divides the framework area into two energy planning areas (see Figure 4.3), due to the timescales associated with the regeneration in the area.

Figure 4.3 - Proposed Energy Planning Areas



Source: AGMA Decentralised and zero carbon energy planning study for Character area 5.

4.93 The AGMA study proposed that the two energy planning areas should be based on: micro-generation installations for Area 1 (purple highlighted area) and a biomass CHP district heating scheme for Area 2 (orange highlighted area); where the Biomass CHP scheme could potentially be linked with an existing district heating network in the nearby Alexandra Park Estate (not part of Trafford).

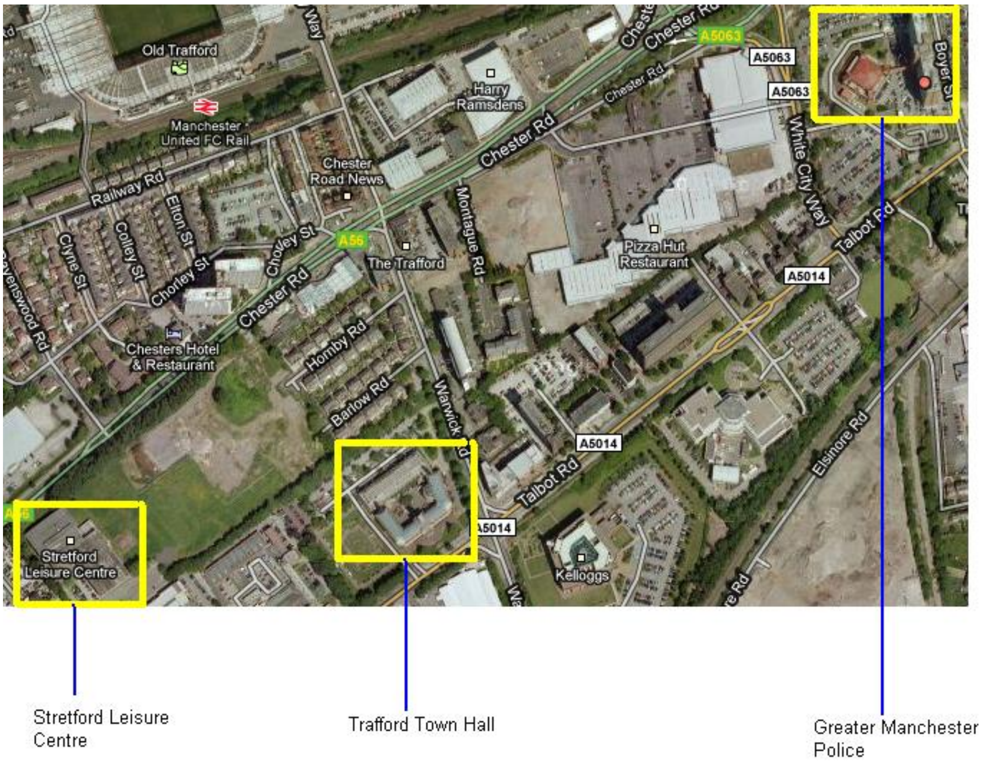
4.94 Our assessment of the potential energy options for Old Trafford concludes with the AGMA study; where a district heating scheme, serving locations within the Old Trafford development area, is detailed as Option 2.

4.95 With regard to Option 2, our analysis has shown that the district heating network could feed numerous existing public buildings: Trafford Town Hall, Stretford Leisure Centre and Greater Manchester Police HQ. There may also be future opportunities to extend the network more widely to serve other public buildings, Trafford College and Stretford Police Station. Historical energy consumption figures have been provided for the 3 public buildings and are detailed in the table below.

Table 4.9 - Energy Consumption for Existing Public Buildings

Site	Estimated Floor area (sqm)	Data Period & Source	Annual Electricity Use (kWh)	Annual Gas Use (kWh)
Trafford Town Hall	10,340	2009 to 2010 (Trafford Council)	1,560,564	1,194,763
Stretford Leisure Centre	5,401	Dec 2008 to Nov 2009 (DEC)	386,353	2,525,067
Greater Manchester Police	15,811	Sep 2008 to Oct 2009	6,262,991	2,517,028

4.96 In addition to serving the existing named public buildings, it is proposed that the district heating network will also serve the future development within the area. For the purpose of this study, it has been assumed that the area to be served will equate for 50% of the known future development, consequently the energy demand figure used equates to 50% of the calculated energy growth trajectory for the case study area.



4.97 **Option 1** considers the possibility of a spur from the proposed Carrington CCGT heat main to Areas “1” and “2” in addition to the “Talbot Road” sites, contributing significantly to the case study area heat demand. This is accompanied by solar PV installations where appropriate to new buildings and a proportion to existing buildings.

4.98 **Option 2** replaces the existing (predominantly natural gas fuelled) plant providing heat to the Alexandra Park estate with a biomass CHP plant to supply the existing estate and major heat customers in area “2”. Area “1” is allocated solar PV and SHW to new and existing buildings.

4.99 **Option 3** has been created to reflect emissions savings possible if area LZC solutions are not available, with solar PV and SHW allocated to new and existing buildings augmented by two 2MW off-site wind turbines.

Table 4.10 - LZC/infrastructure Options for Old Trafford (Case Study 4)

	Option 1	Option 2	Option 3
Options generation potential and emissions	**Carrington CCGT heat main to Areas 1,2+"Talbot Road"+solar PV to Area 1**	**Biomass CHP to Area 2+"Talbot Road"& AP estate+solar PV, SHW to Area 1**	**Solar PV+SHW to Areas 1&2+off-site wind power**
% of area MWh (thermal)	100%	14%	2%
% of area MWh (electric)	1%	11%	11%
Capital Cost £ million	11.62	16.13	22.98
Baseline emissions (t/CO2/a)	56,639	56,639	56,639
Baseline+future emissions (t/CO2/a)	76,960	76,960	76,960
CO2 emissions savings from LZC inputs (t/CO2/a)	34,279	4,715	6,676
Adjusted emissions after LZC inputs	42,681	72,245	70,284
% CO2 reduction over baseline+future emissions	**44.54%**	**6.13%**	**8.67%**
% CO2 change from baseline emissions after new development & LZC inputs	**-25%**	**28%**	**24%**

Modelling of Costs and Potential Renewable Energy Target Levels

4.100 The provision of on-site renewable energy technologies has been investigated for seven development typologies representative of all residential development in the Borough.

4.101 A series of scoping tables have been devised which provide a basis to establish the most appropriate renewable energy technologies that should be considered for proposed sites in terms of scale and suitability and establish the likely capital cost of provision and level of Carbon dioxide savings.

4.102 To establish the costs the following steps were taken:

- Step 1 – Establish estimated annual energy demand for each category of development assuming conventional supply from the grid;
- Step 2 – Calculate baseline carbon emissions of the development;
- Step 3 – Calculate the potential contribution of each renewable energy technology;
- Step 4 – Calculate the costs of each technology
- Step 5 – Calculate the reduction in carbon emissions of the development and subtract from the baseline.

4.103 Tables have been prepared for different levels of renewable energy generation linked with a target reduction in carbon dioxide compared with baseline CO2 emissions (As set out in Part L of 2006 Building Regulations). The contribution of renewable energy as a % of total energy required has also been derived.

4.104 The CO_2 reduction identified in the tables relates only to the renewable energy generation aspect. Further reductions may also be realised through meeting other requirements relating to the Code for Sustainable Homes.

4.105 Requirements have been established for the renewables component to provide a 10%, 20%, 30%, 40%, or 50% reduction in CO_2 emissions through the deployment of renewable compared with the base case. The energy generation produced and associated level of CO_2 linked to each renewable technology is provided in Appendix C.

4.106 To assess each of the seven identified generic development typologies for the provision of renewable energy, assumptions were made on development area and energy consumption.

Energy Benchmarks

4.107 Table 4.11 shows the energy benchmarks assumed for residential and for non-residential use. The residential energy assumptions consider that all new homes will be built to at least Level 4 of the Code for Sustainable Homes. As the type of commercial facilities that may be integrated into the mixed use sites is not known at the early stages of planning an average energy consumption figure for non residential uses has been derived based upon consideration of uses commonly included within residential mixed use schemes in the Borough and using energy benchmarks available from CIBSE.

4.108 The average was taken across the following building types: general office; high street agency, general retail; large non-food shop; small food store; large food store; restaurant; bar; cultural activities; fitness centre; public building; school; clinic; and workshop. It is recognised that not all of these buildings will be integrated into every development, but in the absence of specific information a mean represents an appropriate approach.

Table 4.11 - Energy Benchmarks Assumed for On-site Provision Options

Type	kWh/m2 yr	kg CO2/m2 yr
Residential – electrical	44	24
Residential – thermal	84	15
Non-residential – electrical	128	69
Non-residential – thermal	171	32

4.109 The typical typologies and their respective floor area and energy assumptions used in the analysis are shown in Table 4.12.

Table 4.12 - Assumed Energy Consumption for Generic Typologies

Generic Typology	Gross Floor Area m^2	Total kWh/yr	Total tCO_2/yr
Individual dwelling Detached/semi-detached	160	20,445	6.28
Individual dwelling Terrace	105	13,417	4.12
Individual dwelling Flat conversion	65	8,305	2.55
Development of dwellings 10-50 flats	930	118,839	36.49
Housing/Mixed use site >50-200 units	5,065	952,286	254.84
Housing/Mixed use site >200-500 units	16,355	2,106,251	641.64

Generic Typology	Gross Floor Area m^2	Total kWh/yr	Total tCO_2/yr
Housing/Mixed use site >500 units (excluding CHP)	100,300	15,726,137	4,987.76

Cost Estimates

4.110 The estimates of energy consumption for each typology were used to approximate the capital cost necessary to meet various carbon dioxide targets by deploying low carbon/renewable energy technologies. The costs are based on a cost per kW installed for each renewable energy technology. The assumed costs per kW are set out in Table 4.13 and shows low, high and average costs per kW. The three levels of cost relate to the economy of scale realised when installing these technologies.

4.111 In considering appropriate assumptions lower, average or high assumptions have been selected based upon the scale of development served.

Table 4.13 - Assumed Costs per kW Installed for Each Technology

Technology	Average (£/kW)	High (£/kW)	Low (£/kW)
Solar PV	6500	8000	5000
Wind Power	2000	3000	1000
Small Scale Hydro	5500	8000	3000
Solar Thermal	1445	1714	1176
Biomass Boiler	600	800	400
GSHP[11]	1000	1200	800
ASHP	850	1200	500
Micro CHP	1500	1800	1200
Biomass CHP	5500	7000	4000

4.112 The quoted figures are typical but site conditions can add lead to significant variability the level of investment required. The costs used have reflected typical conditions likely to be experienced in the Borough.

4.113 The specific cost components included for each technology are:

- Solar PV (PV): collectors, roof brackets, inverter, cabling, installation
- Wind Power: turbine, generator set, tower, installation
- Small scale Hydro (SHP): turbine, generator set, weir, civil works, powerhouse, installation,
- Solar thermal or solar hot water (SHW): collectors, roof brackets, connection piping, hot water tank, installation
- Biomass boiler (BB): boiler, accumulator tank, fuel train, storage, installation
- Ground Source Heat Pump (GSHP): heat pump only
- Air Source Heat Pump (ASHP): heat pump, hot water tank, installation
- Micro Combined Heat and Power (CHP): CHP unit, installation
- Biomass CHP (BCHP): CHP unit, fuel train, storage, civil works, installation

[11] Note: GSHP cost per kW excludes the costs of the heat collector system (slinky or borehole) as this can vary greatly from site to site.

4.114 The assumed costs should be taken as guide for considering general feasibility issues. A developer would be expected to carry out a detailed site assessment to determine renewable energy investment costs for a particular site.

Selection of Possible Renewables Portfolio

4.115 The matrices in Table 4.14 to Table 4.18 show the possible renewables technologies which may be considered for different development typologies reflecting the findings of Table 4.3 and Appendix C.

4.116 The different components have been colour coded according to primary and secondary suitability. Technologies highlighted in green have been identified as the primary solutions which are likely be the most suitable renewable energy technology for that particular development typology at that particular % level of renewable energy contribution.

4.117 Secondary technologies, highlighted in yellow, would also be suitable either combined with or as an alternative to the primary recommendation. The third type of recommendation is colour coded into white cells and these solutions may also be suitable for a particular typology, but it would be very much dependent on local site conditions. Finally, there are a number of blank cells in the tables and these indicate technologies which would not normally generally suitable for that particular development typology.

4.118 Further information for each of the typologies and the contribution of renewable energy technologies can be found in 0. The tables shown in that appendix include details such as: the recommended capacity for each solution; the maximum kWh produced by the system; the percentage of renewable energy provided by each system to each typology; and the tonnes and percentage of carbon emissions saved per annum.

Using the Cost Tables

4.119 The matrices can be used to investigate the capital required to integrate renewable energy technologies with development. Different tables may be referred to depending on the % of energy requirements to be met from on site renewable or to meet a specific carbon reduction target.

4.120 The user firstly decides what renewable energy contribution is required/desired, i.e. 10%, 20%, 30%, 40% or 50% and or target reduction in Carbon dioxide emissions. The user then selects which typology of development is being investigated, e.g. “Housing/Mixed use site >50-200 units”. The approximate investment cost for each technology under the specified typology and floor area is shown in the adjacent cells.

Technology Recommendations Key

	Primary technologies - typically suitable for this portfolio
	Secondary technologies - alternative solutions that would be suitable for this portfolio but combined with other solutions
£9,999	This technology solution may be suitable for this portfolio depending on site conditions.
	This type of technology is typically unsuitable for this portfolio
	SHW should only be selected if **CHP/BCHP** is discarded from the chosen portfolio mix

Table 4.14 - Renewable Energy Scoping: 10% Contribution

10% Contribution from Renewables

						10%								
						Power			Heat				CHP	
Use Class	Generic Typologies		Development example (m2)	Total kWh/yr	RE contribution (kWh)	PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached	Energy Contribution	160	22,788	2,279	£24,307	£3,902		£3,751			£3,600		
C3	Individual dwelling detached/semi-detached	CO_2 savings tonnes per annum				1.25	1.22		0.44			1.94		
C3	Individual dwelling terrace	Energy Contribution	105	14,955	1,495	£15,952			£2,462			£3,600		
C3	Individual dwelling terrace	CO_2 savings tonnes per annum				0.81			0.26			1.42		
C3	Individual dwelling flat conversion	Energy Contribution	65	9,258	926							£3,600		
C3	Individual dwelling flat conversion	CO_2 savings tonnes per annum										0.88		
	Indicative Potential by Dwelling													
C3	Development of dwellings 10-50 flats	Energy Contribution	930	132,456	13,246	£114,795	£15,120	£15,120	£17,261	£13,699	£11,214	£17,467		
C3	Development of dwellings 10-50 flats	CO_2 savings tonnes per annum				7.17	7.11	7.11	2.46	11.10	7.27	12.56		
C3	Housing/Mixed use site >50-200 units	Energy Contribution	5065	1,145,969	114,597	£993,173	£130,818	£130,818	£149,339	£88,892	£97,020	£151,117	£42,974	
C3	Housing/Mixed use site >50-200 units	CO_2 savings tonnes per annum				62.10	61.54	61.54	21.18	96.04	62.89	115.25	34.65	
C3	Housing/Mixed use site >200-500 units	Energy Contribution	16355	2,345,721	234,572	£1,563,814	£133,888	£146,060	£225,243	£121,304	£158,876	£181,956	£70,372	£250,210
C3	Housing/Mixed use site >200-500 units	CO_2 savings tonnes per annum				127.17	125.97	125.97	43.41	196.59	128.74	220.83	70.92	70.92
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	Energy Contribution	100,300	16,945,816	1,694,582	£11,297,211	£967,227	£1,055,157	£1,627,189	£876,319	£1,147,739	£1,314,478		
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	CO_2 savings tonnes per annum				918.70	910.02	910.02	313.54	1,420.16	930.01	1,661.66		

Table 4.15 - Renewable Energy Scoping: 20% Contribution

20% Contribution from Renewables

						20%								
						Power			Heat				CHP	
Use Class	Generic Typologies		Development example (m2)	Total kWh/yr	RE contribution (kWh)	PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached	Energy Contribution	160	22,788	4,558	£48,615	£7,804		£7,502			£8,485		
C3	Individual dwelling detached/semi-detached	CO_2 savings tonnes per annum				2.45	2.45		0.88			2.16		
C3	Individual dwelling terrace	Energy Contribution	105	14,955	2,991	£31,903			£4,923			£5,568		
C3	Individual dwelling terrace	CO_2 savings tonnes per annum				1.59			0.53			1.42		
C3	Individual dwelling flat conversion	Energy Contribution	65	9,258	1,852	£19,750			£3,048			£3,447		
C3	Individual dwelling flat conversion	CO_2 savings tonnes per annum				1.02			0.35			0.88		
	Indicative Potential by Dwelling													
C3	Development of dwellings 10-50 flats	Energy Contribution	930	132,456	26,491	£229,590	£30,241	£30,241	£34,522	£27,399	£22,428	£34,933		
C3	Development of dwellings 10-50 flats	CO_2 savings tonnes per annum				14.34	14.23	14.23	4.92	12.56	12.56	12.56		
C3	Housing/Mixed use site >50-200 units	Energy Contribution	5065	1,145,969	229,194	£1,986,346	£261,637	£261,637	£298,678	£237,046	£194,041	£302,233	£85,948	
C3	Housing/Mixed use site >50-200 units	CO_2 savings tonnes per annum				124.27	123.08	123.08	42.44	146.94	125.79	146.94	69.29	
C3	Housing/Mixed use site >200-500 units	Energy Contribution	16355	2,345,721	469,144	£3,127,628	£267,776	£292,120	£450,487	£242,609	£317,751	£363,913	£140,743	£500,421
C3	Housing/Mixed use site >200-500 units	CO_2 savings tonnes per annum				254.34	251.94	251.94	86.82	220.83	220.83	220.83	141.84	141.84
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	Energy Contribution	100,300	16,945,816	3,389,163	£22,594,421	£1,934,454	£2,110,313	£3,254,378	£1,752,638	£2,295,478	£2,628,957		
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	CO_2 savings tonnes per annum				1,837.40	1,820.05	1,820.05	626.99	1,661.66	1,661.66	1,661.66		

Table 4.16 - Renewable Energy Scoping: 30% Contribution

30% Contribution from Renewables

						30%								
						Power			Heat				CHP	
Use Class	Generic Typologies		Development example (m2)	Total kWh/yr	RE contribution (kWh)	PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached	Energy Contribution	160	22,788	6,836	£72,922	£11,706		£11,253	£8,000		£12,727		
C3	Individual dwelling detached/semi-detached	CO_2 savings tonnes per annum				3.70	3.67		1.23	2.16		2.16		
C3	Individual dwelling terrace	Energy Contribution	105	14,955	4,486	£47,855			£7,386			£8,352		
C3	Individual dwelling terrace	CO_2 savings tonnes per annum				2.45			0.79			1.42		
C3	Individual dwelling flat conversion	Energy Contribution	65	9,258	2,777	£29,624						£5,170		
C3	Individual dwelling flat conversion	CO_2 savings tonnes per annum				1.48						0.88		
	Indicative Potential by Dwelling													
C3	Development of dwellings 10-50 flats	Energy Contribution	930	132,456	39,737	£344,384	£45,361	£45,361	£51,784	£41,098	£33,642	£52,400		
C3	Development of dwellings 10-50 flats	CO2 savings tonnes per annum				21.52	21.34	21.34	7.38	12.56	12.56	12.56		
C3	Housing/Mixed use site >50-200 units	Energy Contribution	5065	1,145,969	343,791	£2,979,519	£392,455	£392,455	£448,018	£266,677	£291,061	£453,350	£128,921	
C3	Housing/Mixed use site >50-200 units	CO2 savings tonnes per annum				186.37	184.62	184.62	63.62	146.94	146.94	146.94	103.94	
C3	Housing/Mixed use site >200-500 units	Energy Contribution	16355	2,345,721	703,716	£4,691,443	£401,665	£436,180	£675,730	£363,913	£476,627	£545,869	£211,115	£750,631
C3	Housing/Mixed use site >200-500 units	CO2 savings tonnes per annum				381.51	377.91	377.91	130.23	130.19	130.19	130.19	212.76	212.76
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	Energy Contribution	100,300	16,945,816	5,083,745	£33,891,632	£2,901,681	£3,165,470	£4,881,567	£2,628,957	£3,443,217	£3,943,435		
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	CO2 savings tonnes per annum				2,756.10	2,730.07	2,730.07	940.53	1,661.66	1,661.66	1,661.66		

Table 4.17 - Renewable Energy Scoping: 40% Contribution

40% Contribution from Renewables

						40%								
						Power			Heat				CHP	
Use Class	Generic Typologies		Development example (m2)	Total kWh/yr	RE contribution (kWh)	PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached	Energy Contribution	160	22,788	9,115	£97,229	£15,608		£15,005	£9,428		£16,970		
C3	Individual dwelling detached/semi-detached	CO_2 savings tonnes per annum				4.95	4.90		1.67	2.16		2.16		
C3	Individual dwelling terrace	Energy Contribution	105	14,955	5,982	£63,807			£9,847			£11,136		
C3	Individual dwelling terrace	CO_2 savings tonnes per annum				3.24			1.14			1.42		
C3	Individual dwelling flat conversion	Energy Contribution	65	9,258	3,703							£6,894		
C3	Individual dwelling flat conversion	CO_2 savings tonnes per annum										0.88		
	Indicative Potential by Dwelling													
C3	Development of dwellings 10-50 flats	Energy Contribution	930	132,456	52,982	£459,179	£60,482	£60,482	£69,046	£54,797	£44,856	£69,867		
C3	Development of dwellings 10-50 flats	CO2 savings tonnes per annum				28.75	28.45	28.45	9.84	12.56	12.56	12.56		
C3	Housing/Mixed use site >50-200 units	Energy Contribution	5065	1,145,969	458,387	£3,972,691	£523,273	£523,273	£597,357	£474,092	£388,082	£604,467	£171,895	
C3	Housing/Mixed use site >50-200 units	CO2 savings tonnes per annum				248.53	246.16	246.16	84.80	146.94	146.94	146.94	138.59	
C3	Housing/Mixed use site >200-500 units	Energy Contribution	16355	2,345,721	938,289	£6,255,257	£535,553	£584,239	£900,973	£485,217	£635,502	£727,826	£281,487	£1,000,841
C3	Housing/Mixed use site >200-500 units	CO2 savings tonnes per annum				508.67	503.88	503.88	173.55	173.58	173.58	173.58	283.68	283.68
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	Energy Contribution	100,300	16,945,816	6,778,326	£45,188,843	£3,868,908	£4,220,627	£6,508,756	£3,505,275	£4,590,956	£5,257,913		
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	CO2 savings tonnes per annum				3,674.74	3,640.10	3,640.10	1,253.98	1,661.66	1,661.66	1,661.66		

Table 4.18 - Renewable Energy Scoping: 50% Contribution

50% Contribution from Renewables

						50%								
						Power			Heat				CHP	
Use Class	Generic Typologies		Development example (m2)	Total kWh/yr	RE contribution (kWh)	PV	Wind[1]	SHP[2]	SHW[3]	BB	GSHP[4]	ASHP	CHP	BCHP
C3	Individual dwelling detached/semi-detached	Energy Contribution	160	22,788	11,394	£121,536	£19,510		£18,756	£11,784	£11,576	£21,212		
C3	Individual dwelling detached/semi-detached	CO_2 savings tonnes per annum				6.20	6.12		2.11	2.16	2.16	2.16		
C3	Individual dwelling terrace	Energy Contribution	105	14,955	7,477	£79,758			£12,309		£7,597	£13,920		
C3	Individual dwelling terrace	CO_2 savings tonnes per annum				4.04			1.41		1.42	1.42		
C3	Individual dwelling flat conversion	Energy Contribution	65	9,258	4,629							£8,517		
C3	Individual dwelling flat conversion	CO_2 savings tonnes per annum										0.88		
					-									
	Indicative Potential by Dwelling				-									
C3	Development of dwellings 10-50 flats	Energy Contribution	930	132,456	66,228	£573,974	£75,602	£75,602	£86,306	£68,497	£56,070	£87,333		
C3	Development of dwellings 10-50 flats	CO2 savings tonnes per annum				35.92	35.57	35.57	12.21	12.56	12.56	12.56		
C3	Housing/Mixed use site >50-200 units	Energy Contribution	5065	1,145,969	572,984	£4,965,864	£654,092	£654,092	£746,696	£444,461	£485,102	£755,584	£214,869	
C3	Housing/Mixed use site >50-200 units	CO2 savings tonnes per annum				310.63	307.70	307.70	105.98	146.94	146.94	146.94	173.24	
C3	Housing/Mixed use site >200-500 units	Energy Contribution	16355	2,345,721	1,172,861	£7,819,071	£669,441	£730,299	£1,126,217	£606,521	£794,378	£909,782	£351,858	£1,251,051
C3	Housing/Mixed use site >200-500 units	CO2 savings tonnes per annum				635.84	629.85	629.85	216.96	216.98	216.98	216.98	354.60	354.60
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	Energy Contribution	100,300	16,945,816	8,472,908	£56,486,053	£4,836,135	£5,276,783	£8,135,945	£4,381,594	£5,738,695	£6,572,391		
C3 & Mixed	Housing/Mixed use site >500 units (excluding CHP)	CO2 savings tonnes per annum				4,593.43	4,550.12	4,550.12	1,567.51	1,661.66	1,661.66	1,661.66		

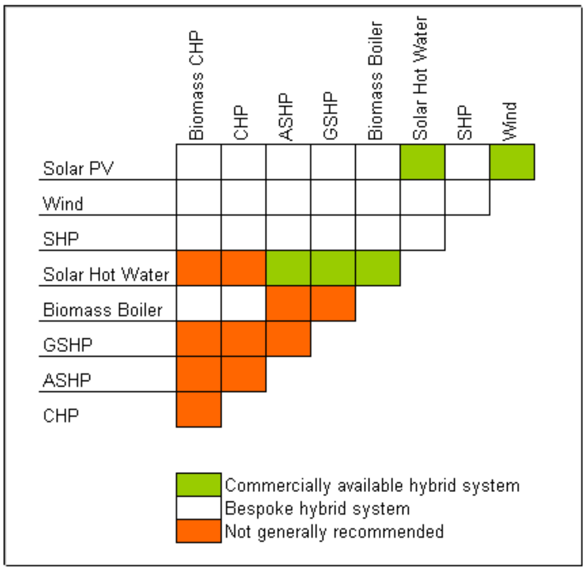
Consideration of Multiple Technologies

4.121 The contribution of renewable energy solutions to various typologies has been provided in Table 4.14 through to Table 4.18. Each technology has been appraised on its own merits and the contribution it could make without considering the integration of another renewable energy technology. In many situations it is likely that a development would employ more than one technology to meet a particular CO_2 reduction target (especially for higher targets). Combined renewable energy technologies are termed hybrid renewable energy systems and these have a number of advantages including:

- Increased contribution of clean energy to the site/development; and
- Hybrid systems can overcome limitations inherent in either technology when deployed individually in terms of fuel flexibility, efficiency, reliability, emissions and/or economics.

4.122 It is important to note that not all renewable technologies are compatible with each other. Figure 4.4 - Hybrid Renewable Energy Systems identifies potential hybrid combinations applicable to developments within the Borough. The matrix has been colour coded into: commercially available combinations; bespoke combinations; and hybrid solutions that would generally not be recommended from a technical or financial perspective.

Figure 4.4 - Hybrid Renewable Energy Systems



4.123 The most common examples of hybrid systems in the UK involve solar thermal systems integrated with other heating technologies such as biomass boilers or heat pumps. These solutions complement each other as the solar thermal largely satisfies the domestic hot water demand during the summer months which eliminates/minimises the requirement to operate the boiler or heat pump. These combinations require the installation of a hot water tank (or sometimes a larger buffer tank) which can increase the space required within a plant room.

4.124 Other common combinations include solar PV with a renewable energy heating solution such as solar thermal or biomass boiler. These technologies effectively operate separately, one contributing to the electrical supply and the other to the heating supply, but their combined contributions are considered when calculating total renewable energy supplied to a particular site.

Implementation Considerations

Scale of Potential Energy Generation

4.125 As previously outlined the biomass CHP systems should be sized to meet baseload thermal demand for the development. Scaling to this parameter eliminates any thermal energy being unnecessarily wasted. Unwanted electrical generation can be spilled onto the local grid. The cost of the energy centre, cost of the district heating pipe network and electrical connections, and the additional generation from renewable energy technologies determine the contribution from the developer;

Distribution and Networking Options

4.126 Electrical distribution can be done via smart grids or micro-grids networks for example.

4.127 Thermal distribution is delivered via underground pre-insulated district heating pipe networks. Optimal location of the plant is essential to minimise costs and maximise efficiency. The area to be served by the plant can be divided into zones, each including one or more buildings. Routes of existing and proposed services within the site should be considered and incorporated where appropriate.

Business and Delivery Models

4.128 Area wide sustainable generation requires the technical capability to generate, and the commercial capability to utilise the renewable energy and distribute the power and/or heat to ensure that all available incentives and grants are effectively utilised. Energy efficiency projects require the ability to capitalise the equipment cost and then to demonstrate the efficiencies and typically to charge the business unit on a revenue basis over time. In addition, there must be an emphasis on the identification of opportunities for existing industrial and waste processes to contribute to meeting renewable energy and carbon emissions reduction targets. There must also be an emphasis on the opportunities for linking new or extended development and its supporting energy infrastructure with existing communities. Thus, a suitable business model is necessary for the successful implementation and operation of sustainable energy projects.

4.129 There are a number of business models applicable for the implementation of area wide renewable energy solutions. One effective model that is gaining popularity is an Energy service company (ESCO). The purpose of an ESCO is to identify and drive energy efficiencies and sustainable generation on behalf of an interest group. The mechanism translates the uncertainty of managing an efficiency project or sustainable generation project into a business risk that can be quantified, operated and managed over time. The ESCO model was developed originally to drive energy efficiencies at the point of use ("end-user") – using capital to install the energy saving device and recovering the as a small revenue charge to on the end users. The scope of the ESCO operations has widened to include examples of small-scale sustainable generation, local distribution, energy efficiencies initiatives, monitoring and building management – and combinations of these. It has been common for CHP plants to be installed on a 'supply and operate' basis and it is apparent that large city centre biomass installations are likely to be operated by an ESCO[12]. Further details relating to business and delivery models are provided in Appendix D.

Project Costs

4.130 Low or Zero carbon technologies tend to have higher capital costs than competing fossil fuelled technologies. Capital costs of renewable energy projects are generally site specific, and this is especially true for Biomass boilers, Biomass CHP, Ground Source heat pumps, and Small scale hydropower. This is largely due to the varying level of civil works required for these systems depending on the site conditions.

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[12] CIBSE, "CIBSE Knowledge Series Biomass Heating", September 2007, London

4.131 For biomass systems a value engineering analysis should be undertaken to determine the optimum duty in terms of capital cost, running cost, and CO_2 savings. This should take into account the size of the fuel and thermal stores required and the value of the plant space. Although wood chips may be available at a lower cost per kWh than other fuels, a biomass installation is rarely justified in strictly financial terms. However for areas where heating makes up a large proportion of total energy demand, they offer an effective means of reducing CO_2 emissions using a sustainable fuel.

Funding

4.132 Over the last five years renewable energy has primarily been encouraged by the Renewables Obligation and, to a lesser extent, through an exemption from the Climate Change Levy. Additional support is provided through Research & Development (R&D) funding and capital grants. These have been worth approximately £500 million between 2002 and 2008. Several further financial mechanisms and incentives are now available to further support the take up of renewables.

4.133 The **Environmental Transformation Fund (ETF)** is a new initiative to bring forward the development of new low carbon energy and energy efficiency technologies in the UK. The fund formally began operation on 1 April 2008, and is now administered by DECC. Funds within the UK element of the Fund will total £400 million during the period 2008/09 to 2010/11. The UK element of the Fund aims to accelerate the commercialisation of low carbon energy and energy efficiency technologies in the UK. In doing so, it will help reduce the carbon intensity of energy production as well as reduce energy demand. The fund will therefore contribute towards the UK's climate change and renewable energy goals for 2020 and beyond and will specifically focus on the demonstration and deployment phases of bringing low carbon technologies to market. It is not possible to apply directly for ETF funding. Instead, it will be necessary to apply to schemes funded by it, some of which are listed below[13].

4.134 **Low Carbon Buildings Programme** (LCBP) is a £86m grant programme for micro-generation technologies, launched in April 2006, offering capital grants over 3 years to successful applicants. The main objectives are to assist the application of both energy-efficiency and micro-generation technologies in a range of buildings, driving down costs in the process, and making the micro-generation market more viable. LCBP Phase 1 is relevant to householders and has been extended from July 2010 to April 2011. This timeline is possibly intended to provide funding support until a renewable heat incentive/feed in tariff is instigated. Grants for the installation of micro-generation technologies are available to public sector buildings (including schools, hospitals, housing associations and local authorities) and charitable bodies. Applications are being accepted now until April 2011. There is an upper limit of 300kW for heat applications and the maximum funding available is £200,000 for a single project. An extra £45 million has been provided for the LCBP as a whole from the 2009 budget, but new applicants for solar PV funding will experience a delay in finding out whether or not they have been successful due to the volume of applications[14]. LCBP Phase 2 is part of the UK Environmental Transformation Fund (ETF) to bring forward the demonstration and deployment of low carbon energy and energy efficiency technologies. Organisations can apply for 50% of the cost of installing approved micro-generation technologies, supplied and installed by Framework Suppliers.

4.135 **Salix**: is an independent publicly funded company that provides interest free conditional grants to the public sector to "…improve energy efficiency, attain targets, reduce energy bills and raise

[13] Further details about the ETF are available from: http://www.berr.gov.uk/energy/environment/etf/page41652.html

[14] http://www.lowcarbonbuildingsphase2.org.uk/index.jsp

green credentials"[15]. Salix is mainly concerned with funding energy efficiency projects with a short payback period (5 years), but will consider funding renewable energy projects with a payback period up to 7.5 years under certain conditions. Until additional feed-in tariffs are available, this stipulation may make some of the more capital intensive technologies such as solar PV fall outside of its funding scope. Public bodies should, however, consider applying for Salix funding when considering any renewable energy project, as guidance is available for the purposes of checking funding availability without undertaking extensive preparatory work.

4.136 **Intelligent Energy Europe (IEE)** was launched in June 2003 to offer a more integrated and coherent approach towards the area of non-technological support in the field of energy efficiency and renewable energy sources. From 2007 Intelligent Energy Europe will be part of the Competitiveness and Innovation Framework Programme (CIP). Projects fall under four types of action, General, Creation of New Energy Agencies, Events, and Concerted Actions. Applications cannot exceed €40,000. The CIP aims to encourage the competitiveness of European small and medium-sized enterprises (SME's) and will assist better access to finance and deliver business support services in the European regions.

4.137 **Bio-energy Capital Grants Scheme** is currently closed but £12 million should be available to 2011. An announcement on the next phase of the scheme is expected to be made during 2009. It is targeted at supporting biomass heat, CHP and Anaerobic Digestion projects in the community, industrial and commercial sectors. It is not available to individual householders. The grants available fund up to 40% of the difference in capital costs between the project and its fossil-fuelled equivalent with a maximum of £500,000 available for a single project[16].

4.138 The **Carbon Trust Renewable Energy Interest free loans** are available for renewable energy projects that also help to reduce the energy consumption on site. Projects that purely generate renewable energy for export to the grid would not be eligible. Small or medium-sized enterprises (SMEs) in England and Scotland, or all businesses in Wales that have been trading for at least 12 months can borrow from £5,000 to £200,000 – with the repayments based on the savings.

4.139 The **Energy Crop Scheme**[17] provides establishment grants for approved energy crops. Approved crops include short rotation coppice (SRC) and Miscanthus. The crops must be used for heat, CHP or power generation. Establishment grants are one-off payments, designed to cover a percentage of the standard costs of establishing approved energy crops, 40% for Miscanthus and SRC. This includes activities such as ground preparation, fencing, purchase of planting stock, planting, weed control and first year cutback. The level of funding depends on the area of land under agreement and the crop grown. Grant funding to help establish producer groups are also available. These must be legal entities and 50% funding will be provided or a maximum of £200,000 per group.

4.140 **Enhanced Capital Allowances** (ECA) scheme is for businesses who wish to install plant or LZC generation equipment that fit energy efficiency or renewable energy criteria. Under this scheme businesses can write off 100% of the capital cost of the equipment against their taxable profits during the period the investment was made[18].

4.141 The **Renewables Obligation** requires power suppliers to supply a certain proportion of their electricity production from renewable energy. If they cannot provide some or all of this themselves, they can buy Renewable Obligation Certificates (ROCs) from other parties, including generation from on-site renewables. A ROC is issued for each MWh of power generated. Certain renewable energy technologies and technical configurations/standards qualify for two ROCs per

[15] http://www.salixfinance.co.uk/thecompany.html details of renewable energy funding available at: http://www.salixfinance.co.uk/laprojects.html

[16] http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,20166&_dad=portal&_schema=PORTAL

[17] http://www.defra.gov.uk/corporate/regulat/forms/erdp/generic/ecs.pdf

[18] http://www.eca.gov.uk/etl/default.htm

MWh, such as solar PV. ROCs are issued for power generated, not just for surplus power exported to the grid. To give certainty to the industry, ROCs have been guaranteed to 2037 by the Government. As the obligation increases, this indicates a stable or rising price for ROC's.

4.142 **Renewable Heat Obligation** is presently a provision within the Energy Act for the roll-out of the Renewable Heat Obligation. This will function in a similar way to ROC's, but for renewable heat, such as that which is generated by biomass boilers. The details of this scheme have not as yet been finalised; projects instigated now and in the next few years should benefit from it.

4.143 The **Carbon Reduction Commitment** (CRC) is a complex, mandatory UK wide emissions trading scheme introduced as part of the Climate Change Act. It will directly affect around 5,000 large private and public sector organisations.

4.144 Participating organisations will have to buy carbon allowances based on their emissions. Their performance will be compared with the other participants and they will appear on a published CRC league table, and dependent on performance they will either receive a bonus or pay a penalty.

4.145 Powers within the Energy Act 2008 allowed the government set up a **Feed-in Tariff scheme**, which recognised that the RO was a relatively complex mechanism. The Feed-in Tariff scheme (FITs) is a recently launched environmental programme introduced by the government to promote widespread uptake of a range of renewable and low-carbon electricity generation technologies. The scheme is applicable to a number of technologies up to a maximum capacity of 5MW; the technologies are: solar PV, wind power, hydropower, anaerobic digestion, and Micro CHP (<2kW).

4.146 The scheme requires Licensed Electricity Suppliers (FIT licensees) to pay a generation tariff to owners of these renewable or low-carbon generators for electricity generated (regardless of whether or not that electricity is exported to the national grid) and an export tariff to them where such electricity is exported to the grid. Thus, suppliers will play the main customer facing role for the scheme, registering eligible installations, processing generation data and making payments. Ofgem will administer the scheme behind the scenes.

4.147 Wind, solar PV or hydropower technologies which are less than 50kW in capacity must have the installations accredited by the Microgeneration Certification Scheme (MCS) to be eligible for FITs. Micro-CHP schemes are only eligible for FITs if their capacity is less than 2kW and they are accredited through MCS. For installations between 50kW and 5MW in capacity (and anaerobic digestion units of any capacity) must apply to Ofgem for accreditation through their Renewable and CHP Register.

4.148 The rates that customers receive under the FIT programme have been set by the Department of Energy and Climate Change (DECC). Once registered for FITs, the generation tariff received will last for the tariff lifetime (expected to be 20 years) and will be adjusted annually according to inflation.

4.149 Similarly to FITs, the Energy Act 2008 provides the statutory powers for a **renewable heat incentive** (RHI) scheme. The goal of the scheme is to enable the UK meet its 2020 15% renewable energy target; the government is aware that without some form of financial assistance the impact of renewable heat on this target will be marginal. On 1st February 2010 a public consultation was published on the proposed design of the RHI scheme, which it aims to introduce in April 2011. It is being termed "clean cash back for renewable heat"[19].

4.150 It is proposed that the scheme supports a range of heat generating technologies including air, water and ground source heat pumps, solar thermal, biomass boilers, renewable CHP, biogas, bio-liquids and the bio-methane. The scheme will be open to individuals, community groups, and businesses. In general the scheme will only apply to the installation of new equipment; i.e.

[19] DECC, "Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme", Feb 2010

refurbishment, repair or conversion of equipment would not create any RHI entitlement with the exception of conversion of domestic heating oil boilers to use bio-liquids. Furthermore, heat used for generating electricity would not be eligible for RHI support.

4.151 Site where multiple technologies are in use (for example a biomass boiler and solar thermal panels) each will be eligible for the relevant RHI tariffs, provided that the technologies meet the individual eligibility criteria. In small to medium scale installations tariffs it is proposed at this stage that tariffs are paid on a "deemed" number of kWh that a building is expected to consume. This eliminates excess heat being generated and dumped by operators to avail of larger revenue from the scheme. For larger and process systems the heat will be paid on a metered basis.

4.152 **Climate Change Levy Exemption** Certificates allows renewable generators to benefit from Levy Exemption Certificates (LEC's). The Climate Change Levy (CCL), a tax on the industrial use of energy, is applied by suppliers to non-domestic consumers of 'non-exempt' electricity currently at a rate of £4.56/MWh, and gas at a rate of £1.5/MWh. Renewable energy is exempt from the CCL, therefore an organisation with significant renewable energy portfolios or generation assets will benefit financially from this. Generators who produce renewable energy and are accredited by Ofgem receive LEC's which they can sell, via suppliers, to customers who are exposed to the CCL. The value to the generator is therefore a negotiated percentage (up to 85%) of the £4.56/MWh that the customer will save through purchasing renewable output.

Deliverability

4.153 Developers should undertake further detailed technical feasibility studies once initial options (whether on-site or area wide) have been appraised.

4.154 For Biomass CHP for example this will include further demand assessments, pipe-work design for the heat distribution systems detailing the exact course, layout and flow requirements for the system for example. If a dedicated energy centre is necessary the site's ability to receive and handle the volumes of biomass assessed. The distribution of electricity to the grid will need to be negotiated with the Distribution Network operator.

4.155 For medium and larger scale facilities where a developer may require funding or technical support from an energy supply partner a detailed Business Plan Modelling is usually required, as is the securing of the requisite capital financing. Business Plan Modelling should take into account full operation and maintenance issues from technical operation of the plant through to billing and metering arrangements. The delivery options for providing the service may range from bespoke structures such as community or cooperative ownership, to co-opting the resources of a utility company, to the formation of an ESCO, or any combination thereof[20]. An ESCO may be non-profit making in order to control costs to the end user.

[20] NHBC Foundation *Community Heating Combined Heat and power* [online] http://www.nhbcfoundation.org/LinkClick.aspx?fileticket=Ev%2f%2bSNIFrK4%3d&tabid=339&mid=774&language=en-GB

5. Viability Testing

Approach

5.1 PPS1 Supplement requires that local targets are tested based on evidence of local feasibility and potential for renewable and low carbon technologies to supply new development. Any targets set by the Council should be evidence based and viable, having regard to overall site development costs. The approach should be consistent with securing the supply and pace of housing and not inhibit the provision of affordable housing.

5.2 This chapter considers these issues by testing the costs of different renewable technologies which may be deployed within the Council, including on site solutions and local energy networks.

5.3 To test the impact of different policy thresholds on viability there is a need to consider the cost of renewable technology options in the context of other site development costs in the borough. This has been carried out using a number of development appraisal case studies.

Development Appraisal Framework and Assumptions

5.4 The development appraisal framework has been developed to be consistent with other studies being undertaken by the Council. The primary appraisal tool used has been developed by the consultant, using affordable housing guidelines set out in Trafford's Core Strategy and sales value and Planning Obligation assumptions from an Economic Viability Study prepared by GVA for the Council in May 2009. The case studies, in accordance to the Core Strategy, were located in areas with varying market conditions. These were identified as "hot", "moderate" and "cold" areas, and were each assigned a specific provision of affordable housing contribution based on the provisions contained with Core Strategy Policy L2 – Meeting Housing Needs. These provisions are shown in Table 5.1.

Table 5.1 - Affordable Housing Provision in Different Locations

Market Condition	Areas	Affordable Housing Provision
Cold	Old Trafford, Carrington and Partington	5%
Moderate	Urmston, Stretford and Sale (and Carrington, for the purposes of this study).	20%
Hot	Altrincham, Mersey Valley and Rural Communities	40%

5.5 The location of the case study is a key influence on viability as it informs the potential development value produced and the related level of affordable housing which may be secured. The Carrington Area case study is located on a former brownfield site at the edge of the urban area. Given its size and characteristics it can more than likely command values similar to the moderate market areas. Therefore, an affordable housing target of 20% has been assumed for the purposes of this study and the viability testing exercise for this area. This is in line with the provisions within Core Strategy Policy L2, but it should be acknowledged that affordable housing requirements for development schemes coming forward in Carrington will be determined through a site specific viability study but will not normally exceed 40%.

Construction Costs

5.6 The construction costs used in the viability model were taken from the Building Cost Information Service (BCIS). The BCIS provides a range of costs per square metre (sqm) for the different housing typologies portrayed in the case studies, e.g. flats, terrace housing, semi-detached housing etc. Therefore the type of housing constructed would also have an effect on the viability of a case study. The BCIS also provided the construction costs per square metre for non-residential developments. These were incorporated into the mixed-use Carrington case study. The construction cost rates are identified in Table 5.2 and Table 5.3.

Table 5.2 - Residential Construction Cost Rates

Residential Construction		BCIS based on GIA. Residential GIA = 95% of GEA
BCIS rate flats:	£831 /sqm	BCIS: North West Region - Median Construction Cost; Flats, 2nd Quarter 2010
BCIS rate Housing terraced:	£643 /sqm	BCIS: North West Region - Median Construction Cost; 2-storey Terraced Housing, 2nd Quarter 2010
BCIS rate Housing semi detached:	£626 /sqm	BCIS: North West Region - Median Construction Cost; 2-storey Semi-detached Housing, 2nd Quarter 2010
BCIS rate Housing detached:	£684 /sqm	BCIS: North West Region - Median Construction Cost; Detached Housing, 2nd Quarter 2010

Table 5.3 - Non-Residential Construction Cost Rates

Non-Residential Construction		BCIS based on GIA. Commercial GIA = 90% of GEA
A1	£587 /sqm	BCIS: North West Region - Median Construction Cost; General Shop, 2nd Quarter 2010
B1	£1,012 /sqm	BCIS: North West Region - Median Construction Cost; Air-conditioned 1-2 storey Office, 2nd Quarter 2010
B2	£575 /sqm	BCIS: North West Region - Median Construction Cost; Advance Factories up to 500 m2, 2nd Quarter 2010
B8	£444 /sqm	BCIS: North West Region - Median Construction Cost; Retail Warehouse, 1000 - 7,000 m2, 2nd Quarter 2010
D2	£947 /sqm	BCIS: North West Region - Median Construction Cost; 500 - 2,000 m2 General Purpose Hall, 2nd Quarter 2010

5.7 The costs used in the consultant's viability model were adjusted to reflect the costs in the north-west region, during the second quarter of 2010. Furthermore, floorspace figures of the case studies were provided as gross internal areas (GIA), which are directly applied to the sales rates of a development. However, costs must be applied to the gross external area (GEA) in order to portray the cost of the entire development. As such, the consultant has assumed the residential GIA floorspaces to be 95% of their GEA, and the non-residential GIA to be 90% of their GEA.

Relationship with Code for Sustainable Homes

5.8 The Construction costs in the case studies were adjusted to also reflect the costs associated with the Codes for Sustainable Homes. The case studies were tested at Level 4, but the model enables the user to assess the viability based on CfSH Levels 1 to 6.

5.9 Information on the costs associated with Code for Sustainable Homes have been drawn from the 'A Cost Review of the Code for Sustainable Homes' (Cyril Sweett, Feb. 2007) and 'Cost Analysis of The Code for Sustainable Homes' (Communities and Local Government, Jul. 2008). These two documents provided cost estimates associated with different dwellings types for each level of the code. Table 5.4 provides a summary of the overall costs of Code for Sustainable Homes. The construction and infrastructure costs in the code not linked to renewables were separated from to avoid double counting and to enable the modelling of costs specific to Trafford, rather than national defaults.

Table 5.4 - Costs of Implementing Code for Sustainable Homes

	Flat £/ Unit	Flat Average Size 65.5 m2	Terrace £/ Unit	House Average Size 85.0 m2
Code 1	£460 / Unit	£7 / m2	£275 / Unit	£3 / m2
Code 2	£1,648 / Unit	£25 / m2	£1,713 / Unit	£20 / m2
Code 3	£2,622 / Unit	£40 / m2	£2,899 / Unit	£34 / m2
Code 4	£4,318 / Unit	£66 / m2	£4,545 / Unit	£53 / m2
Code 5	£6,672 / Unit	£102 / m2	£6,936 / Unit	£82 / m2
Code 6	£12,003 / Unit	£183 / m2	£20,771 / Unit	£244 / m2

5.10 The costs per square metre were used as additional costs to the residential constructions of each case study in order to portray a realistic assessment of viability.

Planning Obligations Assumptions

5.11 The Planning Obligation assumptions made in the consultant's model is based on GVA's Economic Viability Study of Trafford. The Planning Obligations relate to the policies of:

- SPD1: Developer Contributions to Highway and Public Transport Schemes;
- SPG: Informal / Children's Playing Space and Outdoor Sports Facilities Provision and Commuted Sums; and
- SPG: Developer Contributions towards Red Rose Forest.

5.12 The costs associated with the Planning Obligation requirements above vary by location and, where applicable, they are calculated on an occupancy per unit basis.

5.13 For affordable housing, different assumptions were established for case studies based on their locations with respect to the housing market areas. Some locations were considered to have better market conditions than others, and were identified as being "hot" areas. As these areas have a greater potential of producing higher returns their affordable housing is set accordingly to optimise the delivery of affordable housing. Where market values are lower, a lower proportion of affordable housing can be secured without having an effect on scheme viability. Affordable housing provision for each area type is shown in Table 5.1 above.

Other Costs

5.14 Other costs relating to land purchase and fees have been incorporated into the model. These are identified in Appendix C.

Case Studies

5.15 To consider the effect of the increased development costs associated with different CO_2 reduction targets through the deployment of renewable and low carbon technologies, five case studies representative of the range of different residential and residential led mixed use developments within the Councils housing supply trajectory were selected. They were tested to consider the marginal and overall effect of the potential costs associated with different policy thresholds and their effect on the viability of development and housing delivery. The case study results are indicative of other similar sized developments which may come forward in the Borough and link with the typologies and potential Microgeneration and area wide renewable and low carbon technology portfolios described in this report.

5.16 The case studies assessed were identified from the Trafford development trajectory, which identified a list of developments both proposed and underway. They vary in terms of the type and scale of development to illustrate the effects of policy targets in different contexts in the Borough. The details of the five case studies are set out below:

- 15 terraced houses (2 and 3 bedroom) on Crampton Road on previously developed land, in a “cold” market area;
- 30 semi-detached / detached houses (4 and 3 bedrooms) on Central Way in Altrincham, in a “hot” market area;
- 112 flats (2 and 3 bedrooms) on Tamworth Court in Old Trafford in a “cold” market area;
- 175 dwellings, comprising of a hypothetical scheme of flats and terraced houses, within the Urmston/ Stretford/ Sale area, a “moderate” market area; and
- A development comprising of 1,560 dwellings and 539,212 sqm of commercial floorspace at a brownfield site in Carrington, a “moderate” area with a 20% affordable housing provision.

5.17 These details were inserted into the consultant’s model to determine the levels of their viability. The appraisal showed that scheme returns varied significantly between the case studies. In some cases in current market conditions schemes were identified as not being viable or being marginally viable without considering the additional marginal development costs associated with policy targets. In these situations the improvement in market circumstances was modelled to identify if targets may be achievable later in the plan period.

Further Case Studies

5.18 In order to provide further certainty around the viability of development schemes within Trafford Park, and in response to comments made by the Planning Inspector during the formal hearing session for Core Strategy Policy L5 in March 2011, additional case studies were undertaken to test a major residential-led mixed use scheme and a commercial scheme.

5.19 The outcomes of the further viability case studies are reported at the end of this chapter.

Renewable Energy Technology Costs

5.20 The costs for each renewable technology which were applied were drawn from the tables included within Appendix C and summarised in Chapter 4.

5.21 Technology costs were modelled for a carbon dioxide reduction of 10%, 20%, 30%, 40% and 50% compared with a baseline linked to Part L of the 2006 Building regulations delivered through the deployment of low carbon and renewable energy technologies. Other saving which may be secured through compliance with other aspects of the Code for Sustainable homes would be additional to this. The cost of meeting Code for Sustainable Homes Level 4 and BREEAM Very Good was accounted for in the assessment of development costs.

5.22 For the purpose of sensitivity testing, it is appropriate to model individual technologies separately to explore potential limits. Should technologies be combined then costs will lie within the limits of the renewables costs identified.

5.23 The individual technologies which were tested included:

- Photovoltaic (PV);
- Wind energy (turbines, freestanding towers);
- Small hydro plant (SHP);
- Solar thermal hot water (SHW);
- Biomass boiler (BB);
- Ground source heat pumps (GSHP);
- Air source heat pumps (ASHP);

- Micro Combined heat and power systems (CHP); and
- Biomass combined heat and power systems (BCHP)

5.24 The viability of local or area wide energy network proposals was considered separately for the three of the case studies where these were identified as potential options. The following section highlights the significant differences the identified technologies have on the viability of the development typology case studies.

On Site Options

5.25 For each of the development typologies, Appendix C shows the range of cost assumptions. The two indicators (the cost per dwelling unit and the cost per sq.m) provide a basis of comparing costs between different development typologies and policy targets.

5.26 In general, it can be seen that for all technologies the cost per sqm and the cost per unit gradually decrease as the size of the development increases when comparing within the same policy targets.

5.27 On a cost per sq.m basis, Photovoltaic (PV) technologies are significantly more expensive than the other technologies at present compared with the other technologies. For an individual semi detached house to reduce carbon emissions by 20% through PV technology, the cost is £304 per square metre compared with other technologies ranging between £13 and £53 per square metre. Ground source heat pumps (GSHP) and gas CHP have lower costs than this at approximately £29 and £13 square metre respectively.

Local Energy Networks

5.28 The costs of area wide options for specific areas in Trafford were tested against the viability of case studies within the respective jurisdictions. These costs are summarised in Table 5.5, below. Of the centralised local energy networks, Carrington's Area Wide Option has the widest cost range per sq.m, which extends from £4 to £220.6. This is an exceptional difference in cost between options; the choice of which will have a significant impact on the overall viability of a development.

5.29 The cost ranges in Altrincham and Old Trafford were more subtle. In Altrincham, the range of cost per sq.m between options was approximately £6 and for Old Trafford it was around £35. The effect the below costs have on the viability of case studies within these areas, is stipulated further on in this section.

Table 5.5 - Local Energy Networks Establishment Costs/ sq.m

Local energy Network	Option 1	Option2	Option 3
Carrington AWO	£4.0	£93.8	£220.6
Altrincham AWO	£78.4	£78.0	£84.9
Old Trafford AWO	£36.1	£50.0	£71.3

Current and Future Viability

5.30 The additional costs of the individual renewable technologies were added to the outputs of the viability appraisal of each case study, in order to derive the impact of each renewables option on viability. Table 5.6 shows the initial developer's return for each case study, without the added costs of individual renewable energy technology. For the purpose of this exercise, it has been assumed that a developer's return must be above 15% for a scheme to be viable.

Table 5.6 - Scenario 1 Viability Summary

Case Study	Area Type	Scheme Viability	Developer's Return without Renewables
Central Way, Altrincham	HOT	YES	27.4%

1 site in Urmston, Stretford	MODERATE	NO	3.0%
15 units Crampton Road PDL	COLD	NO	-5%%
Tamworth Court	COLD	NO	-19.0%
CL5 Carrington	MODERATE	YES	21.7%

5.31 Table 5.6 shows that three case studies, namely the ones Tamworth Court, Crampton Road and Urmston / Stretford, produce unviable initial returns. The Carrington case study is viable, the effect of the policy targets will increase development costs and reduce viability of those schemes which are not viable further.

5.32 The results show that a 15 dwelling development in a “hot” area and a large mixed used development, comprising of over 1,500 dwellings, in a “moderate” area are viable. A residential development of 112 units in a “cold” area is the least viable development typology.

Sensitivity Testing

5.33 The prevailing market conditions are poor compared with an average of what may be expected over the life of the LDF. In order consider the effect of an improvement in market conditions increases in sales values of 10% and 20% were considered and incorporated into the appraisal. Furthermore, a slight reduction in construction costs which could also occur compared with the present situation have been assumed to test whether potential policy targets may be realised over the life of the plan as a whole.

5.34 The testing found that viable results can be expected for the majority of the schemes in the situation of an improvement of 20% in sales values a decrease in construction costs of 15%. The affects these alterations had on the schemes are identified in the below tables:

Table 5.7 - Scenario 1 Viability Summary

Case Study	Area Type	Scheme Viability	Developer's Return without Renewables
1 site in Urmston, Stretford	MODERATE	YES	24.1%
15 units Crampton Road PDL	COLD	YES	15.4%
Tamworth Court	COLD	NO	0.4%
CL5 Carrington	MODERATE	YES	28.1%

5.35 These outcomes would have the effect of strengthening the viability of all the case studies. However, the Tamworth Court case study is still not viable, with a 0.4% return. Furthermore the Crampton Road case study is marginal at only 0.4% above the established 15% return which is the minimum the development sector would normally accept to bring forward a scheme.

5.36 No improvement in market conditions is needed to deliver CO2 reduction target in Hot market areas including the Central Way case study and some schemes within moderate market areas.

Variations between the On-Site Renewable Technologies Selected

5.37 The following is a summary of the effect that the different policy targets (% of carbon dioxide emission reduction delivered through deployment of onsite individual renewable technologies) would have on the viability of the different development typologies. Each technology has been considered separately assuming that it could adequately reduce the amount of carbon emissions required from renewable sources and meet the reduction target.

Reduction in CO_2 Emissions by 10% at Code for Sustainable Homes Level 4

5.38 In current market circumstances the Crampton and Tamworth case studies would not be viable to start with and could not deliver a reduction in CO_2 emissions without having an effect on housing supply. All other case studies would be viable with a 10% reduction in emissions from on site renewables.

Table 5.8 - Reducing 10% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Central Way, Altrincham	YES	YES	YES	YES	YES	YES	YES	YES	YES
1 site in Urmston, Stretford	YES	YES	YES	YES	YES	YES	YES	YES	YES
15 units Crampton Road PDL	NO	NO	NO	NO	YES	NO	NO	NO	NO
Tamworth Court	NO	NO	NO	NO	NO	NO	NO	NO	NO
CL5 Carrington	YES	YES	YES	YES	YES	YES	YES	YES	YES

Reduction in CO_2 Emissions by 20% at Code for Sustainable Homes Level 4

5.39 With a 20% policy target there remains one or more viable technology for the remaining 3 case studies although relying solely on PV would not be achievable for the Urmston and Carrington cases studies.

Table 5.9 - Reducing 20% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Central Way, Altrincham	YES	YES	YES	YES	YES	YES	YES	YES	YES
1 site in Urmston, Stretford	NO	YES	YES	YES	YES	YES	YES	YES	YES
15 units Crampton Road PDL	NO	NO	NO	NO	NO	NO	NO	NO	NO
Tamworth Court	NO	NO	NO	NO	NO	NO	NO	NO	NO
CL5 Carrington	YES	YES	YES	YES	YES	YES	YES	YES	YES

Reduction in CO_2 Emissions by 30% at Code for Sustainable Homes Level 4

5.40 With a 30% policy target there remains one or more viable technology for the remaining 3 case studies although relying solely on PV would also not be viable for the Central Way case study.

Table 5.10 - Reducing 30% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Central Way, Altrincham	NO	YES	YES	YES	YES	YES	YES	YES	YES
1 site in Urmston, Stretford	NO	YES	YES	YES	YES	YES	YES	YES	YES
15 units Crampton Road PDL	NO	NO	NO	NO	NO	NO	NO	NO	NO
Tamworth Court	NO	NO	NO	NO	NO	NO	NO	NO	NO
CL5 Carrington	NO	YES	YES	YES	YES	YES	YES	YES	YES

Reduction in CO_2 Emissions by 30% at Code for Sustainable Homes Level 4

5.41 The same schemes are viable at a 40% reduction in emissions as a 30% reduction.

Table 5.11 - Reducing 40% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Central Way, Altrincham	NO	YES	YES	YES	YES	YES	YES	YES	YES
1 site in Urmston, Stretford	NO	YES	YES	YES	YES	YES	YES	YES	YES
15 units Crampton Road PDL	NO	NO	NO	NO	NO	NO	NO	NO	ON
Tamworth Court	NO	NO	NO	NO	NO	NO	NO	NO	NO
CL5 Carrington	NO	YES	YES	YES	YES	YES	YES	YES	YES

Reduction in CO_2 Emissions by 50% at Code for Sustainable Homes Level 4

5.42 At a reduction of 50%, the Urmston and Carrington case studies become unviable if the targets are delivered solely through adoption of SHW technology. In addition the Urmston and the Central Way case study are unviable with the ASHP technology. Deployment of one or a mix of the other technologies would not have an effect on scheme viability.

Table 5.12 - Reducing 50% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Central Way, Altrincham	NO	YES	YES	YES	YES	YES	NO	YES	YES
1 site in Urmston, Stretford	NO	YES	YES	NO	YES	YES	NO	YES	YES

15 units Crampton Road PDL	NO	NO	NO	NO	NO	NO	NO	NO	NO
Tamworth Court	NO	NO	NO	NO	NO	NO	NO	NO	NO
CL5 Carrington	NO	YES	YES	NO	YES	YES	YES	YES	YES

5.43 The figures show that the PV technology is by far the most expensive of the renewable technologies, as it renders all case studies unviable at a reduction target of 30%. Subsequently, the ASHP and SHW technologies may also detrimentally affect the viability of some of the case studies at the higher targets. Despite the 2 currently unviable schemes in the cold market areas, the above tables show that the majority of renewable technologies can be incorporated into developments to reduce emissions by up to 50%, without significantly reducing the financial return of the project below the minimum return normally expected by developers and investors.

5.44 The Crampton and Tamworth case studies were unviable throughout all provisions, as their initial viability was quite low, even with a hypothetical 20% increase in sales and a 15% reduction in costs.

Implications for Different Reduction Targets – Area Wide Options

5.45 The following is a summary of the impacts that the different policy targets (% of carbon emission reduction caused by area wide options) would have on the viability of the different development typologies. This was tested on three development typologies; 30 semi-detached houses in a “hot” area, 112 flats in a “cold” area and a large mixed use development in a “moderate” area. Each option has been considered separately. The tables below show which options were viable:

Table 5.13 - Central Way Area Wide Options

Central Way, Altrincham - "HOT" Area - 30 Semi-detached Houses	Option 1	Option 2	Option 3
Scheme Viability	YES	YES	YES

Table 5.14 - Tamworth Court Area Wide Options

Tamworth Court - "COLD" Area - 112 Flats	Option 1	Option 2	Option 3
Scheme Viability	NO	NO	NO

Table 5.15 - Carrington Area Wide Options

CL5 Carrington - "MODERATE" Area - Large Mixed Use Developments	Option 1	Option 2	Option 3
Scheme Viability	YES	YES	NO

5.46 The above tables show that each option for the Central Way case study is viable. This is due to the case study’s high initial level of profit returns, which are a result of the area being designated as a “hot” market area. There may be scope to secure greater reductions in emissions in this area through the use of allowable solutions.

5.47 The results reveal that none of the options for the Tamworth case study are viable. Unlike the other two typologies, Tamworth Court is a development of a smaller scale in an area with poor market conditions. With the assumed improvements in market conditions, the initial return from the Tamworth Court development is still 0%, rendering unviable before undergoing the further costs of the area wide options.

Effect of Alternative Affordable Housing targets

5.48 The Crampton and Tamworth case studies are the least viable of the case studies tested in this exercise. They are both in “cold” areas, which imply that the sales values are relatively lower. To counter this, an affordable housing provision of 5% has been assumed consistent with current

Council policies. However, this produced initial returns of -5% and -19%, respectively in current market conditions (see Table 5.6). As such the schemes would not be deliverable (without subsidy) before the addition of additional development costs linked to deployment of renewable technologies.

5.49 Sales values and construction costs were subsequently tested to assess the circumstances when development may be viable and the limits required to deliver viability. A 20% increase in sales values with a 15% decrease in development costs was assumed. These assumptions lifted the returns for the Crampton case study to 15.4%, just above the established viability threshold. However, the assumptions only managed to have the Tamworth case study break even, producing a return of 0%.

5.50 It is important that renewable energy targets do not impact on the pace of housing delivery or the provision of affordable housing which may be achieved. However, planning obligations and appropriate renewable energy infrastructure is part of the package of infrastructure which is required to make development acceptable. The marginal cost of renewable energy infrastructure for schemes is relatively small in terms of the impact on viability (for example typically a 0- 2% on overall costs for targets up to 20% for most technologies).

5.51 The effect of reducing affordable housing to 0% was considered, in order to determine the extent to which renewable technology can be incorporated into the developments, without negatively effecting viability in situations where delivering affordable housing without subsidy is not practicable.

Table 5.16 - Comparison of 35% and 50% Affordable Housing Provision

	Developer's Return				
	5% Affordable Housing		0% Affordable Housing		
Typology	Return (£)	Return (%)	Return (£)	Return (%)	Difference in Return
Tamworth Court	£48,633	0.4%	£238,069	1.9%	1.5%
Crampton Road	£282,805	15.4%	£314,957	17.0%	1.6%

5.52 Providing no affordable housing has had a very small effect on the overall viability. The above table shows that the viability of both case studies has increased by circa 1.5%. This is not sufficient to justify a carbon reduction target for such schemes under the market conditions described. In reality schemes will not normally come forward in the present market circumstances or may require subsidy and interest from a Housing Association.

Effect of Potential Electricity and Heat Generation Revenue Linked to the Feed in Tariff and Renewable Heat Incentive

5.53 A significant element affecting the potential uptake and viability of renewable energy technologies is the effect of the introduction of the Feed in Tariff (FIT) and Renewable Heat Incentive (RHI) in April 2010. For renewables which are installed for to formal introduction of the scheme tariff payments will be back dated to July 15 2009 to avoid a delay in uptake.

5.54 The design of these incentives is intended to remove uncertainty and risk regarding the potential return on investment in renewables by:

- Simplifying grid connection;
- Guaranteeing a market for electricity generated by developments and fixing a price offered by electricity suppliers;
- Providing an additional tariff for electricity/heat exported to the grid

5.55 Energy suppliers who operate the grid (United Utilities in Trafford) will be establishing their administration structures to reflect the new system.

5.56 The effect of these incentives will be to reduce the payback periods for renewable energy installations to between 5 and 10 years for most technologies and some 20-25 years for Solar PV.

This improves the business case for investing in renewables and may encourage developers to optimise opportunities relating to sites.

5.57 The Feed in Tariff has been designed to offer a 6-8% return on the initial investment to encourage take up. This is similar to tariffs operating in other European countries.

5.58 The tariffs have the potential to provide an additional revenue stream once the initial capital outlay has been paid off. The tariff is to be payable based on the amount of heat and electricity actually supplied and would represent a revenue stream to the developer rather than a cost. In this situation, a discounted cash flow approach would be appropriate for considering the viability for renewables and carbon reduction targets rather than treating establishment of renewables as an up-front cost.

5.59 In addition many developers may not wish to diversify their business to administer the supply of electricity and receipt of tariffs and may opt to transfer the rights to receive generation and export tariffs (in the case of electricity generation) to a third party. Several firms, including for example Eaga, have adopted this business model to deploy and manage renewable installations on behalf of others. The third party could be an owner occupier or RSL following completion and installation and commissioning of equipment. In this case the benefits accruing to the occupier or owner of the equipment would be reflected in the sales price of the dwelling (with the cost of installation passed on to the occupier/RSL). The operating costs associated with maintenance would also be transferred in this case. This option is likely to prove attractive due to the tax allowances which are currently attracted for renewables installation.

5.60 With medium and high density developments with a high proportion of leasehold properties the rights may be transferred to a management company or landlord following completion of the development who would take on responsibility for the benefits and costs associated with renewables. In this situation, the developer could make a one off charge for the transfer of the right to generate at the time of construction. Alternatively, the benefits of generation could be offset from the overall service and maintenance charged once the initial capital costs have been paid off.

5.61 A third model would be a partnering approach whereby a developer partners with a renewable energy provider prior to construction of the development. The renewables partner would build, operate and manage the renewables elements of the scheme so the effect of the costs and benefits of installing renewables is neutral. Again the owner would be paid by the renewables company for the right to generate. Such a model could work equally well for dwellings of a single unit as well as larger schemes.

5.62 A final model would be that the renewable energy project would be feasible in its own right being viewed as a separate project without it being delivered in conjunction with a real estate/development project.

5.63 Given the limited life of the FIT tariff, which will last only to 2020, it is possible that landowners will seek to install renewables technologies on vacant or unoccupied sites and premises on a temporary basis in advance of development, especially as the credit crunch may delay the start of development.

5.64 In all of these situations the delivery model chosen in connection with the Feed in Tariff/Renewable Heat Incentive would have the effect of overcoming of reducing the additional development costs associated with higher carbon dioxide targets. Either through subsidising the costs (FIT/RHI), by shortening the payback period or by separating the renewable project from the development project to meet investment criteria/improve deliverability.

5.65 The consultants recommendations on how the carbon reduction target should be applied through development management and agreed for any given development, is set out in chapter 6.

Further Viability Case Studies

5.66 This section summarises the outcomes of further viability testing that was undertaken in March 2011 in order to provide certainty around potential CO_2 reduction targets for development schemes in the Trafford Park Low Carbon Growth Area.

5.67 The approach and conditions outlined in this chapter were applied to the following additional two schemes:

- Trafford Centre Rectangle - residential-led mixed use scheme consisting of 1,050 residential units and 78,180 m2 of B1 uses (27,780m2 landmark office building on the Kratos site – outline planning permission for 6/7 storey BCO Grade A office accommodation and 43,400m2 office accommodation); and
- Kratos Site – commercial scheme consisting of 27,780m2 landmark office building – outline planning permission for 6/7 storey BCO Grade A office accommodation.

Trafford Centre Rectangle Scheme

5.68 The assumptions for the Trafford Centre Rectangle case study are similar to the ones used for the CL5 Carrington case study earlier in the chapter. However, there was a variation made to include the development of a Grade A office component. Where the CL5 Carrington case study assumed one rent for B1 use which lied in the middle ground of high end development and regular new build, the Trafford Centre Rectangle case study split the office rent and construction costs into a Grade A office component and a regular office component. Table 5.17 reveals the rents and constructions costs of the office, as well as the variations caused by the assumed increase in rent potential and decrease in construction cost.

Table 5.17 - Trafford Centre Rectangle: Rents & Construction Costs

Rents	
B1 BCO GRADE A	£188/ sqm
B1 BCO GRADE A Rent up 10%	£207/ sqm
B1 BCO GRADE A Rent up 20%	£266/ sqm
Construction Costs	
B1 BCO GRADE A	£1,253/ sqm
B1 BCO GRADE A Cost down 5%	£1,190/ sqm
B1 BCO GRADE A Cost down 15%	£1,065/ sqm

5.69 Table 5.18 identifies the costs per sqm used for each on site renewable technology, under each carbon emissions reduction target. The figures apply to mixed use schemes that provide over 500 units.

Table 5.18 - Trafford Cente Rectangle: Cost per M_2 for On Site Renewable Technology

Target	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
10%	£72.8	£6.3	£6.9	£30.7	£3.7	£7.3	£4.7	£5.9	£20.9
20%	£145.6	£12.6	£13.7	£61.5	£12.5	£16.4	£18.7	£11.7	£41.8
30%	£218.4	£18.9	£20.6	£92.2	£28.1	£36.8	£42.2	£17.6	£62.7
40%	£291.2	£25.2	£27.5	£122.9	£50.0	£65.4	£74.9	£23.5	£83.6
50%	£364.0	£31.5	£34.3	£153.7	£78.1	£102.2	£117.1	£29.4	£104.4

5.70 The Trafford Centre Rectangle development will be subject to the Trafford Park Area Wide Option. Table 5.19 shows the costs per sqm for residential and non-residential developments for that AWO. In order to provide further sensitivity analysis, an additional AWO 2A was developed which did not include any provision for Solar PV. As Table 5.19 illustrates, this significantly reduced the cost per m^2 for the AWO, whilst having a minimal impact on the level of CO_2 reduction achievable through the application of that AWO (reducing the saving by approximately 1% of baseline and future emissions).

Table 5.19 - Trafford Centre Rectangle: Costs per M_2 for Trafford Park AWO

Local energy Network	Option 1	Option2	Option2A	Option 3
Trafford Park AWO Residential	£63.8	£66.5	£38.3	£114.6
Trafford Park AWO Commercial	£230.6	£240.5	£138.3	£414.4

5.71 Table 5.20 reveals the different developer returns for the Trafford Centre Rectangle case study, in accordance to varying assumptions on sales and costs values, without the added costs of individual renewable energy technology. It has been assumed that a developer's return must be above 15% for a scheme to be viable.

Table 5.20 – Trafford Centre Rectangle: Scenario 1 Viability Sensitivity Summary

	20% Sales Increase	10% Sales Increase	GVA Sales
BCIS Costs	21.1%	15.4%	9.2%
5% Construction Cost Decrease	24.3%	18.6%	12.3%
15% Construction Cost Decrease	31.3%	25.5%	19.2%

5.72 In the medium-long term, given the type and location of the scheme, sales are liable to increase by 20% to reflect an anticipated expansion in the property market. However, it is unlikely for construction costs to decrease by much. As such, the scenario most apt for the Trafford Centre Rectangle case study entails a sales increase of 20% with constant BCIS costs. This scenario was applied to the viability model when testing the costs of renewable technologies.

Variations Between the On-Site Renewable Technologies Selected

5.73 The following is a summary of the effect that the different policy targets (% of carbon dioxide emission reduction delivered through deployment of onsite individual renewable technologies) would have on the viability of the Trafford Centre Rectangle scheme.

5.74 The case study would be viable with a 10% reduction in emissions from each individual on site renewable technologies.

Table 5.21 - Trafford Centre Rectangle: Reduction in CO2 emissions by 10% at Code for sustainable homes level 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Trafford Centre Rectangle	YES	YES	YES	YES	YES	YES	YES	YES	YES

5.75 The case study would be unviable with a 20% reduction in emissions from PV (14.3% return). All other individual on site renewable technologies produce viable scheme with a 20% reduction target.

Table 5.22 - Trafford Centre Rectangle: Reducing 20% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Trafford Centre Rectangle	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.76 The case study would be unviable with a 30% reduction in emissions from PV (10.9% return). All other individual on site renewable technologies produce viable scheme with a 30% reduction target.

Table 5.23 - Trafford Centre Rectangle: Reducing 30% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Trafford Centre Rectangle	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.77 The case study would be unviable with a 40% reduction in emissions from PV (7.5% return). All other individual on site renewable technologies produce viable scheme with a 40% reduction target.

Table 5.24 - Trafford Centre Rectangle: Reducing 40% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Trafford Centre Rectangle	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.78 The case study would be unviable with a 50% reduction in emissions from PV (4.1% return) and SHW (13.9%). All other individual on site renewable technologies produce viable scheme with a 50% reduction target.

Table 5.25 - Trafford Centre Rectangle: Reducing 50% of Carbon Emissions at Code 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Trafford Centre Rectangle	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.79 The tables above illustrate that the Trafford Centre Rectangle scheme remains viable with a 50% reduction in CO_2 emissions for all but one of the on site renewable technologies, whilst applying reasonably pessimistic assumptions in relation to construction costs.

Implications for Different Reduction Targets – Area Wide Options

5.80 The following is a summary of the impacts that the different policy targets (% of carbon emission reduction caused by area wide options) would have on the viability of the Trafford Centre Rectangle case study.

Table 5.26 - Trafford Centre Rectangle Area Wide Options

Trafford Centre Rectangle - "MODERATE" Area - Large Mixed Use Development	Option 1	Option 2	Option 2A	Option 3
Scheme Viability	NO	NO	YES	NO

5.81 Table 5.26 shows that all Area Wide Options 1, 2 and 3 are unviable, although AWO's 1 and 2 are only marginally unviable (a deficit of 0.5% and 0.8% respectively). However, the additional AWO 2A, with solar PV renewable technology removed, is viable. The list below highlights the details of the results:

- AWO 1 provides 14.5% developer's return, and a carbon emissions reduction of 35%
- AWO 2 provides 14.2% developer's return, and a carbon emissions reduction of 48%
- AWO 2A provides 17.2% developer's return, and a carbon emissions reduction of 47%
- AWO 3 provides 9.2% developer's return, and a carbon emissions reduction of 6%

5.82 The results illustrate that AWO 2A would result in a reduction in CO_2 emissions of 47%, whilst still providing the developer with a return of 17.2% for the Trafford Centre Rectangle scheme.

Kratos Site Scheme

5.83 The Kratos case study examines the viability of a standalone Grade A 6 storey office, using relevant assumptions from the overarching Trafford Centre Rectangle case study. As such, the case study will focus solely on the office component and all assumptions that correspond to it. Table 5.27 reveals the rents and constructions costs of the office, as well as the variations caused by the assumed increase in rent potential and decrease in construction cost.

Table 5.27 - Kratos Site: Rents & Construction Costs

Rents	
B1 BCO GRADE A Rent	£188/ sqm
B1 BCO GRADE A Rent up 20%	£226/ sqm
Construction Costs	
B1 BCO GRADE A	£1,253/ sqm
B1 BCO GRADE A Cost down 15%	£1,065/ sqm

5.84 Table 5.28 identifies the costs per sqm used for each renewable technology, under each carbon emissions reduction target. The figures apply to mixed use schemes that provide over 500 units, which Kratos falls under.

Table 5.28 - Kratos Site: Cost per M2 for On Site Renewable Technology

Target	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
10%	£72.8	£6.3	£6.9	£30.7	£3.7	£7.3	£4.7	£5.9	£20.9
20%	£145.6	£12.6	£13.7	£61.5	£12.5	£16.4	£18.7	£11.7	£41.8
30%	£218.4	£18.9	£20.6	£92.2	£28.1	£36.8	£42.2	£17.6	£62.7
40%	£291.2	£25.2	£27.5	£122.9	£50.0	£65.4	£74.9	£23.5	£83.6
50%	£364.0	£31.5	£34.3	£153.7	£78.1	£102.2	£117.1	£29.4	£104.4

5.85 The Kratos development will be subject to the Trafford Park Area Wide Option. However, the viability assessment of the scheme will only incorporate the commercial costs of the Area Wide Options. These are shown in Table 5.29.

Table 5.29 - Kratos Site: Costs per M2 for Trafford Park AWO

Local energy Network	Option 1	Option2	Option2A	Option 3
Trafford Park AWO Commercial	£230.6	£240.5	£138.3	£414.4

5.86 Table 5.30 shows the initial developer's return for the Kratos case study, without the added costs of individual renewable energy technology. It has been assumed that a developer's return must be above 15% for a scheme to be viable.

Table 5.30 - Kratos Site: Scenario 1 Viability Summary

Case Study	Area Type	Scheme Viability	Developer's Return without Renewables
Kratos	MODERATE	NO	13.3%

5.87 The testing found that viable results can be expected for the scheme in the situation of an improvement of 20% in sales values and a decrease in construction costs of 15%. The affects of these alterations are identified in Table 5.31.

Table 5.31 - Kratos Site: Scenario 2 Viability Summary

Case Study	Area Type	Scheme Viability	Developer's Return without Renewables
Kratos	MODERATE	YES	36.1%

Variations Between the On-Site Renewable Technologies Selected

5.88 The following is a summary of the effect that the different policy targets (% of carbon dioxide emission reduction delivered through deployment of onsite individual renewable technologies) would have on the viability of the Kratos Site scheme.

5.89 The case study would be viable with a 10% reduction in emissions from each individual on site renewable technologies.

Table 5.32 - Kratos Site: Reduction in CO2 emissions by 10% at Code for sustainable homes level 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Kratos	YES	YES	YES	YES	YES	YES	YES	YES	YES

5.90 The case study would be viable with a 20% reduction in emissions from each individual on site renewable technologies.

Table 5.33 - Kratos Site: Reduction in CO2 emissions by 20% at Code for sustainable homes level 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Kratos	YES	YES	YES	YES	YES	YES	YES	YES	YES

5.91 Relying on PV technology to produce a 30% emissions reduction would render the case study unviable (14.5% return). The other renewable provisions are feasible.

Table 5.34 - Kratos Site: Reduction in CO2 emissions by 30% at Code for sustainable homes level 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Kratos	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.92 Relying on PV technology to produce a 40% emissions reduction would render the case study unviable (7.2% return). The other renewable provisions are feasible.

Table 5.35 - Kratos Site: Reduction in CO2 emissions by 40% at Code for sustainable homes level 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Kratos	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.93 Relying on PV technology to produce a 50% emissions reduction would render the scheme very unviable (0.0% return). The other renewable provisions are feasible.

Table 5.36 - Kratos Site: Reduction in CO2 emissions by 50% at Code for sustainable homes level 4

Typology	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Kratos	NO	YES	YES	YES	YES	YES	YES	YES	YES

5.94 The tables above illustrate that the kratos Site scheme remains viable with a 50% reduction in CO_2 emissions for all but one of the on site renewable technologies.

Implications for Different Reduction Targets – Area Wide Options

5.95 The following is a summary of the impacts that the different policy targets (% of carbon emission reduction caused by area wide options) would have on the viability of the Kratos case study.

Kratos Site - "MODERATE" Area – Commecial Development	Option 1	Option 2	Option 2A	Option 3
Scheme Viability	NO	NO	YES	NO

5.96 Table 5.36 shows that only Area Wide Option 2A is viable. The list below highlights the details of each AWO:

- AWO 1 provides 13.2% developer's return, and a carbon emissions reduction of 35%
- AWO 2 provides 12.3% developer's return, and a carbon emissions reduction of 48%
- AWO 2A provides 22.4% developer's return and a carbon emissions reduction of 47%
- AWO 3 provides -5% developer's return, and a carbon emissions reduction of 6%

5.97 The results illustrate that AWO 2A would result in a reduction in CO_2 emissions of 47%, whilst still providing the developer with a return of 22.4% for the Trafford Centre Rectangle scheme.

Summary

5.98 The further viability case studies for both the Trafford Centre Rectangle and the Kratos Site demonstrate that both schemes remain viable when meeting a CO2 reduction target of 40%, through either onsite renewables or through an AWO.

6. Policy Recommendations and Targets

Introduction

6.1 The introduction of the Government's Renewable Energy Strategy and associated package of incentives is likely to impact on the market for renewable energy and improve the attractiveness of incorporating renewable energy facilities within new development and to smaller electricity and heat suppliers.

6.2 It will be important that the policy approach to be adopted in Trafford's Core Strategy is sensitive to these changes. Targets should be flexible enough to avoid the upfront capital investment costs of installing renewables impacting on overall scheme viability or the delivery of affordable housing whilst encouraging developers to 'try harder' to maximise the percentage of energy generation which is generated from renewable sources. Such an approach will facilitate lower per capita carbon dioxide emissions from the domestic sector in the future and ensure that carbon reduction targets can be met.

6.3 Whilst this study has considered the potential for renewable energy, the Council's approach is linked to the wider sub-regional goals relating to reducing overall CO_2 emissions (as set out in the AGMA Decentralised and Zero Carbon Energy Planning report). This can be achieved through utilisation of low and zero carbon technologies within new development, delivering energy efficiently, including use of decentralised energy networks, as well as delivering renewable low and zero carbon energy.

6.4 There is a clear inter-relationship between renewable energy policy targets and wider polices relating to CO_2 emissions reduction and the requirements of the Code for Sustainable Homes, which include energy as an integral component. This study has modelled the effect of carbon reduction targets and renewable energy generation in relation to other policy requirements (refer to Section 6).

6.5 Within Trafford the potential for integration of renewable energy generation is influenced by the scale of renewable energy resources in the Borough and, critically, the viability and deliverability of development where facilities are to be provided in conjunction with development.

6.6 Consistent with guidance outlined in PPS1 Supplement and the consultation Planning Policy Statement 'Planning for a Low Carbon Future in a Changing Climate', requirements for renewable energy provision and carbon reduction should not impact on the supply of new homes or the provision of affordable housing and the requirements for other infrastructure necessary to make development acceptable. Notwithstanding the feed in tariffs available for renewable energy generation, these issues affect the financial viability of development. This is influenced by the percentage of overall energy requirements which are provided on site as installation and connection needs to take place at the time of development and represents an "up front" cost. There is significant variation in the establishment cost of different types of renewable energy technologies.

6.7 These considerations set out within the evidence base have influenced the emerging approach to establishing appropriate policy targets for carbon reduction.

6.8 Trafford Council set out an approach to CO_2 emissions reduction targets, and issues of sustainable construction, pollution and water, in the draft Core Strategy Policy L5 – Climate Change (dated November 2009). The CO_2 emissions reduction targets component of this draft policy is set out at Figure 6.1 below. The draft policy has since been revised, taking account of consultation responses and the findings of this study. Further detail is on the revised policy is included later in this section.

Figure 6.1 - Extract from Draft Trafford Core Strategy, Policy L5 – Climate Change (November 2009)

TRAFFORD DRAFT CORE STRATEGY - POLICY L5: CLIMATE CHANGE (NOVEMBER 2009)

L5.1 All new development will be required to minimise contributions to and mitigate the effects of climate change and maximise its sustainability by adopting measures that reduce carbon emissions. Development will be required to contribute to national, regional and local carbon reduction targets throughout both the development process and the life of the development to deliver benefits to both future occupants of the development and residents of the borough.

CO2 Emissions Reductions Target Framework

L5.5 All development proposals above 10 residential units or 1,000m² thresholds are required (until such time that all development is required by the Code for Sustainable Homes and Buildings to achieve zero carbon) to submit an Energy / Carbon Budget Statement with each planning application that demonstrates specific measures are to be implemented as part of the development to reduce gross carbon emissions. The targets to reduce carbon emissions are detailed in Table L5.1, which are to be applied to all developments which meet the stated threshold. These targets are derived from the AGMA Decentralised Energy Study, which has identified the potential for achieving decentralised and renewable energy and significant levels of CO2 reduction.

Table L5.1 CO2 Gross Emission Reduction Target Framework

Target Areas	Minimum CO2 reduction targets				Proposed Allowable Solutions
	2010-2015		2016-2021		
	% of regulatory* target	Unregulated** target %	% of regulatory* target	Unregulated** target %	
Area 1: Network expansion	80	80	35	Balance % (regulated) 80 (unregulated)	Developer contribution towards network expansion linking existing buildings
Area 2: Electricity intense	60	42	100	80	Developer contribution either to local installations or to City Region investment fund once established
Area 3: Micro-generation	60	34	80	80	Developer contribution either to local installations or to City Region investment fund once established

* Regulated Emissions i.e. space heating, ventilation, hot water and fixed lighting.
** Unregulated Emissions i.e. energy use within the building including IT equipment, fridges.

Definitions of target areas in Table L5:

- Target Area 1 - Network expansion area: Locations where the proximity of new and existing buildings creates sufficient density to support district heating and cooling.
- Target Area 2 - Electricity intense area: Locations where the predominant building type has an all electric fit-out, creating high associated CO2 emissions.
- Target Area 3 - Micro-generation area: Locations where lower densities and a fragmented mix of uses mean that only building scale solutions area possible.

L5.6 Developments smaller than the above threshold, but involving the erection of a building or substantial improvement to an existing building will be expected to incorporate appropriate micro-generation technologies.

L5.7 An Energy / Carbon Budget Statement is to be submitted for all developments that meet the threshold. The statement will set out the projected energy demand profile and associated gross CO2 emissions (both regulated and unregulated) for all phases of the development. The statement will need to set out how the developer will meet the appropriate target set out in the framework above. The statement will need to be submitted at the outset of any proposed development (outline or before). The methodology for this statement will be set out in the Sustainability SPD.

L5.8 If particular circumstances of the development suggest these requirements are not viable the applicant must provide information consistent with the Trafford Economic Viability Study to demonstrate this.

L5.9 Proposals for new sources of energy generation will be encouraged except where they would have an unacceptable impact on the local environment and suitable mitigation measures are not proposed.

Policy Framework and Supporting Justification

6.9 Section 2 of this report provides a summary of national, regional and local policies and guidance relating to renewable energy. This section demonstrates how the Council's emerging policy approach relates to guidance within national planning policy guidance and regional guidance / strategies.

6.10 It is important that Planning Policies are in general conformity with national and regional planning policy, unless other evidence supports a different policy approach.

PPS1 Supplement

6.11 PPS 1 identifies that planning authorities should provide a framework that promotes and encourages renewable and low carbon energy generation and that policies should be designed to promote and not restrict renewable and low-carbon energy and supporting infrastructure.

6.12 Planning authorities are expected to have an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies to supply new development in their area.

6.13 Consideration should also be given to the new consultation PPS1 supplement, which stipulates that targets for renewable energy should be set in the Regional Strategy, although local authorities may set out local requirements relating to specific development areas and must take account of decentralised energy opportunities when allocating sites. This is in line with the current approach for Greater Manchester, in terms of a sub-regional framework for CO2 emissions reduction target areas and targets, and interpretation at the local level.

6.14 This study (Chapter 4) has considered the potential renewable resources in Trafford which have the potential to make a significant contribution towards meeting the objectives of national planning policy guidance and the sub-regional approach to carbon energy planning set out in the AGMA report.

6.15 It is appropriate for planning authorities to:

- set out a target percentage of carbon reduction for new development, including the indicative component to come from decentralised and renewable or low-carbon energy sources where it is viable. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured;
- where there are particular and demonstrable opportunities for greater use of decentralised and renewable or low-carbon energy than the target percentage, bring forward development areas or site-specific targets to secure this potential;
- In bringing forward targets there is a need to set out the type and size of development to which the target will be applied; and
- ensure there is a clear rationale for the target and it is properly tested.

6.16 In considering a development area or site-specific target, this study has paid particular attention to opportunities for utilising potential area wide decentralised and renewable or low-carbon energy supply systems to supply proposed and existing development.

6.17 Where there are existing decentralised energy supply systems, or firm proposals, planning authorities can expect proposed development to connect to an identified system, or be designed to be able to connect in future.

6.18 When specifying requirements for new development to secure energy from decentralised and renewable or low-carbon energy sources, it is appropriate for the Council to set specific requirements to facilitate connection.

6.19 Well-founded development area and site-specific targets drawn up in line with PPS 1 Supplement should facilitate significant proportions of the energy supply of new development to be secured from decentralised and renewable or low-carbon energy sources.

6.20 Policies are required to demonstrate that what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities.

6.21 This study has considered the technical feasibility, costs of bringing sites to market and potential options for implementation of both decentralised energy networks and the portfolio of onsite renewables options which can be deployed in the Borough. The assessment of viability included in Section 6 has also accounted for other potential planning obligations required to address the impact of development and the other development needs of the Borough.

6.22 The study has considered how carbon reduction policies within the Core Strategy could interact with other policies in order that the expected supply and pace of housing development shown in the housing trajectory and the provision of affordable housing is not inhibited.

6.23 This chapter sets out how potential developers should be advised on the implementation of the local requirements.

AGMA Decentralised and Zero Carbon Energy Planning

6.24 The AGMA study was undertaken to provide a strategic framework and evidence base to enable the Core Strategies to set minimum targets for low and zero carbon energy. The study aims to identify opportunities to link new development with the supporting energy infrastructure, and identify the most appropriate energy mix for delivering new growth aspirations across the area.

6.25 The key outcome from the AGMA study is the identification of higher carbon reduction targets than the Regional Spatial Strategy and the introduction of a shift in emphasis from energy use to CO_2 emissions. The study proposed a target framework for carbon reductions, related to three spatial areas:

- 1. Network expansion area;
- 2. Electricity intense area; and
- 3. Micro-generation level.

6.26 Minimum and maximum targets are proposed for carbon reductions overall, based on reductions against Part L of the Building Regulations. The minimum target is based on the Regional Spatial Strategy policy EM18 or a district heating network connection requirement. The maximum target is based on a sliding scale of costs, with the maximum being location specific depending upon the cost and availability of renewable technology solutions.

6.27 This AGMA study establishes this framework of maximum and minimum targets in order to '…future proof the ability of districts to set higher targets based on local opportunities for decentralised and zero carbon energy generation…'.

Trafford's Core Strategy, Policy L5 – Climate Change

6.28 Trafford's current Core Strategy draft Policy L5 (dated September 2010) contains carbon reduction targets that have been derived from the AGMA study, and informed through consultation and findings of this study. The current policy text is set out in Figure 6.2.

6.29 Policy L5 incorporates a set of questions, devised in the AGMA study, which could be used to identify which target would apply to any given development.

Figure 6.2 - Extract from Trafford's Core Strategy, Policy L5 – Climate Change (Sept. 2010)

CO_2 Emissions Reductions Target Framework

L5.2 The CO2 emissions reduction targets are:

- All non-residential developments above a threshold of 1,000m2 and all residential developments in the Borough need to comply with the targets detailed in Table L5.1, this is supported by a explanatory 'target area' identification flow chart provided in Figure 3. The CO2 reductions emissions are to be detailed within the Carbon Budget Statement;
- For residential developments comprising of 10 units or more and non-residential developments above a threshold of 1,000m2 located within Trafford's Low Carbon Growth Areas (LCGAs) of Altrincham, Carrington, Old Trafford and Trafford Park, a minimum 40% regulated CO2 emissions reduction target is applied. Where higher targets are viable, reductions in unregulated CO2 emissions will also be considered as part of the Carbon Budget Statement. Further guidance on how to achieve these higher targets will be provided in the SPD(s).
- Non-residential developments smaller than the above threshold, but involving the erection of a building or substantial improvement to an existing building will be expected to incorporate appropriate micro-generation technologies; and
- Where it can be demonstrated that provision cannot be delivered on site, contributions towards an allowable solutions fund will be sought, to introduce a carbon offset scheme to fund schemes and required infrastructure.

L5.3 All residential developments and non-residential developments above a 1,000m² thresholds are required to submit a Carbon Budget Statement, detailing the measures to be implemented to reduce gross CO2 emissions.

Table L5.1 - Energy Infrastructure Target Framework[1]

	Target Area 1	Target Area 2	Target Area 3
Minimum CO2 reduction requirements	Connect to a Combined Heat & Power / districting heating network	+17% increase on part L for domestic and +10% for non-domestic buildings.	+ 15% increase on Part L for domestic and +15% for non domestic buildings.
Maximum CO2 reduction requirements	Up to 73%	Up to 56% for domestic buildings. Up to 28% for non-domestic buildings.	Up to 49% for domestic; and Up to 42% for non domestic buildings.

[1]Reductions in CO2 emissions will be calculated based on gross emissions i.e. estimated regulated and unregulated emissions weighted to reflect the proportion of electricity use.

Target Area Definitions:

Target Area 1 - Network development area: Mixed use and high density residential developments in areas with networks will be expected to connect to existing networks.
Target Area 2 - Electricity intense buildings: Buildings using electrical heating/cooling that are not connected to decentralised energy networks will be expected to mitigate a proportion of their emissions using low or zero carbon technologies.
Target Area 3 – Micro generation area: Medium to low density developments will be expected to mitigate a proportion of their emissions, using low or zero carbon technologies.

6.30 The policy currently makes provision for contributions towards an allowable solutions fund, where it can be demonstrated that provision cannot be delivered on site. The aim is to introduce a carbon offset scheme to fund schemes and required infrastructure.

6.31 However, after opportunities for energy reduction have been considered, it is recommended that the policy approach in the Borough gives priority to on site generation where facilities can be accommodated in physical terms and take account of other policy considerations (i.e. Carbon Compliance rather than allowable solutions).

6.32 The viability assessment has identified that, in cost terms, up to 50% of overall CO_2 emissions reduction requirements have the potential to be accommodated on site without recourse to Allowable Solutions for the majority of areas within the borough. This is subject to compatibility with other planning policy objectives and space requirements. Only in situations where there are other physical or development constraints which preclude the use of onsite renewables should allowable solutions be acceptable.

6.33 Within the four case study areas within the Borough, the viability assessment has indicated that they all have the potential to be served by decentralised energy networks. The Council have prioritised these within the policy.

6.34 Based on the evidence provided in this study we have identified policy options which provided a sound basis for refining the CO_2 emissions reduction target framework within the Core Strategy Policy L5. As Figure 6.2 now illustrates, this is now reflected in the draft policy.

Recommended Approach to Defining CO_2 Emissions Reduction Targets

6.35 Based on the evidence provided within this report, we have recommended that a borough wide target is established for CO_2 emissions reduction. This would provide a benchmark against which proposals for development should be assessed using a case by case, open book approach to scheme assessment.

6.36 We recommend that all development proposals above 10 residential units or 1,000m^2 should meet a target comprising of a percentage component based on CfSH standards for building performance and percentage to be achieved through deployment of renewable energy technologies. The % proportions would be based on the following:

- A building performance target linked to relevant national Code for Sustainable Homes standard (escalating to 2016); and
- A renewable component, recommended to be a minimum of 30% CO_2 saving for residential-led developments (compared with Part L Building Regulations 2006).

6.37 The policy aims to strikes a balance between cold, medium and hot market areas in the Borough. An alternative approach would be to set area targets of 15% for cold market areas and (micro-generation level) 40% for all other areas. This target would relate predominantly to those areas within Target Area 3, as outlined in the AGMA report.

6.38 The CO_2 savings are based solely on regulated emissions, which is a more simplified approach compared with the one set out in the AGMA study.

6.39 We also recommend the establishment of higher targets for development located within three of the AWO boundaries. The emissions reduction target relating to renewable within the locations for these Area Wide Options (AWO) is recommended as follows:

- Altrincham - Minimum 40% CO_2 reduction target
- Trafford Park - Minimum 40% CO_2 reduction target
- Carrington - Minimum 40% CO_2 reduction target

6.40 These areas could be designated as ‘Low Energy Zones. It is suggested that an ESCO, or other suitable mechanism, is established as the delivery vehicle for the “Trafford Park” and the “Rest of the Borough" (including Carrington and Altrincham). These would relate directly to the AGMA Study's Target Area 1 (network expansion area).

6.41 Given the issues around current scheme viability that emerged through testing of the Old Trafford AWO, it is suggested that viability should be considered as part of a future review of the Core Strategy. Opportunities in this area could also be explored further and addressed in the forthcoming 'Sustainable Trafford 2011-2020' Strategy. A local authority-led ESCO, or other suitable mechanism, could also be established for "Old Trafford", relating to the AGMA Study's Target Area 1 (network expansion).

6.42 The exact percentage for each development should be established though a development appraisal on a case by case basis. A step by step checklist explaining information and requirements that applicants should fulfil will need to be provided. This should include an energy / carbon budget statement to demonstrate specific measures to be implemented as part of the development scheme.

6.43 As these targets set minimum levels of CO_2 reduction, the need to test on a case by case basis is important in negotiating the most beneficial and suitable package of renewable technologies that can deliver the optimum level of CO_2 reduction on site. This is of particular importance given the results of the viability assessment in cold market locations (such as Old Trafford), where current scheme viability is marginal even without the inclusion of costs for renewable technologies.

6.44 For non residential development outside of areas covered by the proposed Area Wide Options, the policy should not set specific targets but seek to maximise savings. Specific opportunities could relate to waste, institutional and education uses (as referred to in the report).

6.45 Allowable solutions should only be allowed were physical site constraints preclude the deployment of a suitable technology. The equivalent value / saving should be directed towards home energy improvement programmes in the Borough.

Justification for Recommendations

Renewable Technology Resource

6.46 An assessment of renewable and low carbon energy resources available in Trafford has been undertaken. This is described in Section 4 of the report and further detail is provided in Appendix B.

6.47 The main technologies which have potential for widespread application in the Borough for sites of all sizes are:

- Wind turbines;
- Solar water heating;
- Biomass heating;
- Biomass combined heat and power;
- Ground Source heat pumps;
- Air source heat pumps; and
- Small scale hydro power.

6.48 In addition, there is significant potential for the establishment of local decentralised energy networks whereby, heat is supplied via CHP networks rather than on site. The greatest opportunities for deployment in the Borough exist within the four case study areas. Smaller opportunities may also exist within future estate renewal programmes and in connection with major commercial and retail development, waste management facilities, major health projects, and secondary and tertiary education projects.

6.49 In most situations there are likely to be a choice of renewable energy technologies which can be deployed to meet the targets. However, not all of the technologies which have been proven viable in financial terms will be suitable in every location. The deployment of biomass heating and CHP is dependent on having a sustainable feedstock source and strategy and transportation strategy. In addition, it is important that emissions from biomass heating/CHP facilities do not have a significant impact on air quality.

6.50 A suggested approach for Development Management in assessing the incorporation of renewable technologies into development proposals is included in Appendix G. This should only be used as a general guide, with a rigorously tested approach being developed and in place through an adopted SPD.

The CO_2 Emissions Reduction Target Recommendations

6.51 This study has modelled the effect of several potential targets relating to 10%, 20%, 30%, 40% and 50% reduction in CO_2 emissions for the following types of residential schemes, which capture the range of developments represented within Trafford's project development growth. These include:

- Individual dwelling Detached/Semi detached;
- Individual dwelling terrace;
- Individual house conversion;
- Small scale development between 10 and 50 dwellings;
- Housing led mixed use 50-200 dwellings;
- Housing led mixed use 200-500 dwellings; and
- Housing led mixed use 500 units+.

6.52 Through examining a range of case studies an assessment was made of the potential renewable energy and associated CO_2 savings which could be provided by different technologies in relation to each typology. In addition, the cost of installing each solution was established using recognised cost benchmarks (refer to Section 4 and associated Appendix C).

6.53 The costs were then examined within the context of a development appraisal framework which was used to assess the impact on development viability. This included sensitivity testing of:

- Improvement in the local property market;
- Variations in construction costs; and
- Affordable housing targets.

6.54 The outcomes of the assessment demonstrated that although the recommended minimum target is set at 30% for the renewable and low and zero carbon energy component of total CO2 emissions reductions, it is likely that higher levels of CO_2 emissions reduction could be secured over the life of the Core Strategy, especially given the potential impact of Feed in Tariff and Renewable Heat Incentive, and likely improvement in property market conditions.

Cost and Viability Issues

6.55 With reference to chapter 5, assuming implementation of CfSH Level 4 and securing the range of affordable housing provision across the defined market areas in line with the Core Strategy Policy L2, a range of renewable technologies could be secured which could provide up to 50% CO_2 emissions reduction which would not have an impact on development viability.

6.56 The only exception is in cold market areas, where development viability was shown to be difficult to achieve even without the inclusion of renewable technology costs. Further, the only technology which would not prove viable is solar photovoltaic (PV), which renders all case studies unviable at a CO_2 emissions reduction target of 30%.

6.57 It is not recommended that a target greater than a 30% reduction in CO_2 emissions is established in policy at this time, due to the viability issues in cold market areas. An open book approach, on a case by case basis, would enable a target greater than the 30% minimum to be secured in circumstances when it is viable to do so.

Development Types

6.58 The assessment has shown that, although there are variations in the cost of implementing CO_2 emissions reduction targets depending on scheme sizes (average cost per m^2), the 30% target can apply to schemes of all sizes, and in most locations within the Borough, without having a significant effect on viability. The exception is in cold market areas, where the application of case by case development appraisals is particularly important in establishing deliverable levels of CO_2 reduction and scheme viability.

6.59 Although it is viable to apply CO_2 emissions reduction targets to smaller residential/mixed use schemes (less than 10 units) in moderate and hot market areas, the policy should be applied to schemes over this size. Trafford Council should promote and encourage renewable energy generation in connection with smaller schemes, but should not require it. This is because of the administrative and resource requirements of administering the target, and because of the additional costs placed on development proponents in terms of the likely need to prepare a development appraisal/energy statement and obtain professional advice regarding the application of the targets and identification of appropriate renewables technologies.

Allowable Solutions

6.60 The analysis of the costs on installing different renewables technologies has demonstrated that it is possible to meet the requirement on site without recourse to allowable solutions for all development sizes.

6.61 However, other policy objectives may preclude the installation of some renewables technologies due to site conditions, or where installation would cause significant effects. The circumstances where this may arise are:

- Where the site is located within a Conservation area or its setting;
- Where the site has an effect on a listed building;
- In relation to stand alone wind turbines, this may due to inappropriate site conditions and effects relating to noise, visual impact and residential amenity;
- In relation to biomass boilers and Biomass CHP where it is not possible to secure a sustainable feedstock source and method of transportation or where the proposed equipment to be installed would have a significant effect on local air quality; and
- Where there is insufficient space to install ground source heat pumps and other solutions are not appropriate.

6.62 In these circumstances it is appropriate to meeting the shortfall in energy demand and associated CO_2 reductions through an offsite allowable solution. These should either be an alternative off site renewables solution where a firm proposal is identified and delivery is certain, or a commuted sum payment which can be pooled to support specific carbon reduction projects in the Borough (for example, the City Region Investment Fund referred to in Policy L5).

Open Book Approach

6.63 It is recommended that an open book appraisal is undertaken for developments of over 10 dwellings. The appraisal, in combination with preparation of a Carbon / Energy Statement, can be used to establish whether a higher target can be achieved. An open book development appraisal can address the parameters which need to be considered to demonstrate financial viability and be used to model the (beneficial) effect of the Feed in Tariffs and the Renewable Heat Incentive through examining their effect over the course of the project.

Carbon / Energy Budget Statement

6.64 Appendix F outlines the key requirements for a carbon budget statement which should be completed by applicants to establish the likely energy generation, and associated CO_2 emissions reduction for a range of renewables technologies, for a proposed development.

Consideration of Local Energy Networks

6.65 The evidence base considered locations within the Borough where the establishment of renewable energy networks should be prioritised. The major opportunities correlate with the planned areas of growth that are set out in Core Strategy policy L1, W1 and W2.

6.66 Chapter 4 demonstrates that the establishment of local energy networks in the four case study areas is feasible and commercially viable, through a range of low and zero carbon network options.

6.67 Compared with on site solutions, a major benefit associated with these options is that they offer a much lower cost solution. Furthermore, in improved market conditions there may be potential for the CO_2 emissions reduction here to be complemented by the addition of further on site renewables to increase generation capacity further, if there is a sufficient business case and there would be no significant effect on viability.

6.68 The Carbon / Energy Budget Statement process should be used to establish and compare opportunities for decentralised energy and renewables for individual sites in conjunction with opportunities for carbon reduction. Where it is demonstrated that local energy networks can make a contribution this should be prioritised to help underpin investment in network infrastructure.

Circumstances When Higher Targets May Be Sought

6.69 The consideration of onsite renewables options, and the potential for local energy networks, has shown that the potential contribution of renewable technologies to CO_2 emissions reduction does vary across the Borough in relation to development viability. Development viability in the cold market areas has been shown to be difficult to achieve, without prior to any inclusion of renewable technology costs.

6.70 Despite the viability issues with cold market areas, it is recommended that there is currently the potential to achieve a minimum of 30% CO_2 emissions reduction from renewable or low carbon sources across the borough. This is on the basis of information contained within the proposed Energy / Carbon Budget Statement and open book financial appraisals, with the CO_2 emissions reduction which should be sought from renewables for individual proposals reflecting the level of Code for Sustainable homes to be achieved, the level of affordable housing and other planning obligations which have a significant influence on overall development viability.

Other Types of Development

6.71 For other types of development, the specific opportunities for onsite renewables generation and possible CO_2 emissions reductions are influenced very much by specific user requirements. This study has not considered these specific opportunities, given that details regarding the opportunities and the energy profile of future users are not yet known.

6.72 The recommended approach is that the Council should seek contributions for non residential proposals of more than 1,000 m^2 of floorspace.

6.73 Major opportunities exist in relation to major institutional users such as Trafford Town Hall, Trafford Leisure Trust and education establishments. In addition, larger scale A, B and D -class uses also have the potential to accommodate significant renewable energy generation capacity and, therefore, CO_2 emissions reduction.

6.74 Applicants should establish the likely energy usage profiles at the outset of development and agree with the Council appropriate options to be considered.

6.75 The policy should identify that the Council is seeking to maximise the potential for development to deliver CO_2 emissions reduction requirements through the establishment of onsite renewable energy generation.

6.76 The package of regulation and incentives included within the Government's Renewable Energy Strategy, particularly the Renewables Obligation, Carbon Reduction Commitment, Feed in Tariff and Renewable Heat Incentive, provide a significant incentive for commercial, retail, industrial, and institutional users to actively consider renewable energy generation. Non- residential users normally have greater energy requirements, so any opportunity for occupiers and users to make cost savings has the potential to improve their competitive advantage.

Other LDF Documents

6.77 Whilst the Core Strategy is the appropriate document to include policies identifying opportunities for renewable energy and CO_2 emissions reduction, including locational or site specific targets for onsite generation, it is appropriate for renewable energy and CO_2 emissions reduction issues to also be addressed within other DPDs and SPDs in order to establish how policies should be applied and implemented.

Sustainability SPD

6.78 Trafford Council intend to prepare a Sustainability SPD that will address the requirements for renewable energy and low carbon technologies, guidance on the selection of renewable options for particular sites, guidance on integration of renewable sand carbon reduction requirements into financial appraisals, detail the requirement to submit an Energy / Sustainable Design Statement alongside planning applications, provide guidance on allowable solutions and connection to decentralised energy networks.

6.79 The content and findings of this report should inform the preparation of the SPD.

Land Allocations Plan DPD

6.80 The proposed Land Allocations Plan DPD should refer to renewable energy policies and CO_2 emissions reduction targets identified within the Core Strategy, including any opportunities relating to particular sites.

Development Management

Requirements for Inclusion in Design and Access Statements

6.81 Design and access statements when they are required should identify how renewable energy facilities will be successfully integrated with development. Key issues for consideration include:

- Location and siting of renewable energy facilities;
- Space requirements of proposed renewables portfolio;
- Conservation areas and listed buildings;
- Siting and screening of plant;
- Access arrangements for maintenance and servicing;

- Connections to local energy networks; and
- Design guide sustainable design and construction.

Use of Conditions and Planning Obligations

6.82 PPS1 Supplement advises that ‘Planning conditions or planning obligations can be used to secure the provision and longer-term management and maintenance of those aspects of a development required to ensure compliance with the policies in this PPS. Where there are existing decentralised energy supply systems, or firm proposals, planning authorities can expect proposed development to connect to an identified system, or be designed to be able to connect in future. In such instances, and in allocating land for development, planning authorities can set out how the proposed development would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

6.83 The Council should continue to require the establishment of appropriate renewable energy infrastructure through the use of conditions linked to the policy target, and justified by a Sustainability Statement and Design and Access Statement for larger schemes.

6.84 The Council should consider contributions towards renewable energy infrastructure on a case-by-case basis.

6.85 To secure energy and CO_2 emissions reduction from decentralised and renewable / low carbon energy sources, the Council may see to set specific requirements from developers. In advance of any move towards a Community Infrastructure Levy it would not be appropriate to establish a standard charge for most development. However, it would be feasible to include Planning Obligations in certain situations linked with the opportunities identified within this study:

Establishment

6.86 In the case study areas, and in other locations where the need arises, there could be a requirement for contributions towards the establishment of energy generation infrastructure. It is suggested that applicants for planning permission could discuss with the Council how the proposals would be expected to contribute to securing the decentralised energy supply system from which it would benefit.

6.87 Landowners and developers should be made aware of the requirement to connect with decentralised energy networks during pre application discussions which take place with the Council.

6.88 Planning Obligations could be required towards establishment of facilities where centralised renewable energy generation facilities serving the site are provided off site.

Connection

6.89 This will require installation of pipe work on site and potentially across public highways to serve individual buildings and provision of equipment (or capability for equipment to be provided). Planning Obligations may be required for the provision of offsite infrastructure and connections.

6.90 Before obligations of this type are required it would be important that further feasibility work is carried out to develop the proposals and associated business case.

Operation

6.91 Normally this aspect will be addressed through conditions. However, it is important that there is a clearly identified strategy for the operation and long term management of renewable energy equipment. This will include:

- Consideration of appropriate connection costs including related electricity or heat distribution infrastructure;

- Proof of a business plan and demonstrating the viability of the preferred approach towards meeting targets including consideration of costs, revenue and the effect of incentives (major development);
- An identified supplier and agreement in principle (Power Purchase Agreement, CEM, ESCO) (Major development);
- Identification of how maintenance of renewables infrastructure will be dealt with (i.e. service charge etc.). The Council may also wish to seek contributions to secure the provision and longer-term management and maintenance of those aspects of a development required to ensure compliance with the policies set out in PPS 1 and Trafford's Core Strategy;
- Where it is proposed that biomass boilers should contribute towards meeting CO_2 emissions reduction targets these facilities should comply with environmental regulations. Where the residual impact of such facilities would have a significant impact on air quality, then developers could be required to make developer contributions towards appropriate mitigation;
- Renewable energy facilities and associated infrastructure should be brought into use before first occupation; and
- Planning Obligations could be sought for the costs associated with monitoring of renewable energy facilities.

6.92 Any requirement should be fair and reasonable and, in particular, not restrict those with responsibility for providing energy to new development, or the occupiers, to any one energy provider in perpetuity.

Decommissioning

6.93 In certain situations, such as installation of temporary renewable energy infrastructure, it may be appropriate to include a condition requiring decommissioning and removal of infrastructure and facilities.

Allowable Solutions

6.94 In certain circumstances where a site is not suitable for hosting on site renewables or to be served by connected heat facilities then it may be appropriate for Planning Obligations to secure Allowable Solutions. The solutions could be referred to specifically within the S106 agreement and potentially linked to a commuted sum.

Potential for Local Development Orders

6.95 Where there are proposals to establish local energy networks the Council should give positive consideration to the use of local development orders (LDO) to secure renewable and low-carbon energy supply systems.

6.96 The order could in effect provide planning permission for certain categories of development required to deliver the network which are not covered by existing permitted development rights. It is likely that the main generation facilities would not be included within the order and that the LDO would focus on pipe work and ancillary equipment.

6.97 The LDO should be complemented by appropriate guidance relating to siting and design in order to ensure that local energy networks are delivered successfully.

Framework for Implementation and Monitoring

6.98 Government Guidance identifies that effective monitoring and review is essential in securing responsive action to tackle climate change. The successful implementation of policies on climate change depends on active stewardship. Where monitoring suggests that implementation is not being achieved in line with an agreed strategy or that the strategy is not delivering the expected outcomes, it is essential to respond promptly and effectively.

6.99 The Annual Monitoring report should collate information on renewable energy matters. Indicators should be linked to those which are monitored through national and regional databases which are to be established. The criteria which should be considered for monitoring are:

- Installed capacity of renewable energy infrastructure;
- Annual electricity generation from renewable sources;
- Annual heat generated from renewable sources; and,
- Carbon dioxide emissions displaced by in-Borough renewable energy generation.

6.100 Information relating to the first 3 indicators will be available to be sourced from the register of renewable energy installations to be established by the Office for Renewables Deployment.

6.101 The Annual Monitoring report should assess progress against the policy objectives by type and size of development in order that it is effective in shaping future policy and the relationship between establishment of renewables facilities and the relationship with housing delivery.

Delivery Mechanisms

6.102 To take forward the findings of this study, further work is required to further define the detailed feasibility and business case of the local decentralised energy networks identified in the case studies. Possible delivery mechanisms are highlighted within Appendix D.

Appendix A - Code for Sustainable Homes Energy Consumption Assumptions

Typical 2006 building regs 3-bed semi-detached dwelling

			CO2 factors (kg CO2)		
			natural gas	grid electricity	
Single house unit model (90m²)	Gas (kWh)	Grid elec (kWh)	0.184	0.544	
Space heating	3,900		718		
DHW	3,920		721		
Lights		1,600		870	
Appliances		1,500			
Cooking	1,330				
TOTAL	**9,150**	**3,100**	1,439	870	**2,309**

Code for Sustainable Homes Level 3 assumption

			CO2 factors (kg CO2)		
			natural gas	grid electricity	
Single house unit model (90m²)	Gas (kWh)	Grid elec (kWh)	0.184	0.544	
Space heating	2,453		451		
DHW	2,466		454		
Lights		1,520		827	
Appliances		1,500			
Cooking	1,330				
TOTAL	**6,249**	**3,020**	905	827	**1,732**

Code for Sustainable Homes Level 4 assumption

			CO2 factors (kg CO2)		
			natural gas	grid electricity	
Single house unit model (90m²)	Gas (kWh)	Grid elec (kWh)	0.184	0.544	
Space heating	1,251		230		
DHW	2,466		454		
Lights		1,120		609	
Appliances		1,500			
Cooking	1,330				
TOTAL	**5,047**	**2,620**	684	609	**1,293**

Code for Sustainable Homes Level 6 assumption

			CO2 factors (kg CO2)		
			natural gas	grid electricity	
Single house unit model (90m²)	Gas (kWh)	Grid elec (kWh)	0.184	0.544	
Space heating	1,251		230		
DHW	2,466		454		
Lights		1,120		609	
Appliances		1,500			
Cooking	1,330				
TOTAL	**5,047**	**2,620**	684	609	**1,293**

Appendix B - Assessment of Trafford Renewable Energy Resources

Assessment of Trafford Renewable Energy Resources

This section provides an assessment of the Trafford Renewable energy resource. This review supplements the wider consideration of regional opportunities within the AGMA and 4NW studies.

Wind Power

Wind turbines are designed to harness the kinetic energy of moving air, thus, the most important initial aspect to consider is wind resource. If a significant wind resource is not available in an area, the feasibility of installing wind power technology is greatly affected. However, if a substantial annual wind resource is available then this technology is commonly the most effective method for developers to meet their energy targets.

Electricity generated from a wind turbine can be integrated in similar ways to solar PV technology. For very large systems, as mentioned earlier, they are usually connected to the transmission networks. Medium sized units, or single turbines, are connected into the distribution network, and very small urban turbines are generally connected directly into the building electrical systems. Also, turbines can be integrated into battery systems to provide electricity in remote locations or to work alongside a large electrical network. Key concerns when planning wind turbine installations are noise emissions and visual impacts.

The most cost-effective, reliable, and useful method is to erect one or more medium scale turbines which would be capable of generating enough electricity to supply base load demand during peak winds. The alternative would be to install multiple small scale turbines (either standalone or building mounted) but this leads to cumulatively higher installation costs, maintenance costs and it is likely the cumulative energy yield would be smaller than from a single medium scale unit.

Trafford case study areas wind resource: three sites have been sampled using the DECC wind speed database. To represent the Trafford Park and Old Trafford case study areas, only one sample was made because relative to the resolution of the wind speed database, the two areas are very unlikely to have any significant difference in their resource. For Altrincham, the railway station was chosen as a central location, whilst for Carrington, the location of Carrington Business Park was referenced. Wind Resource at 25m agl for Trafford Case Study Areas displays the wind speeds at these locations.

Wind Resource at 25m agl for Trafford Case Study Areas

5.7	5.6	5.5
5.9	5.8	5.6
5.7	5.8	5.7

Altrincham case study area
(Altrincham railway station: WA14 1EN)

5.4	5.3	5.3
5.4	5.4	5.4
5.4	5.4	5.4

Old Trafford and Trafford Park case study areas
(The Trafford Centre: M17 8AA)

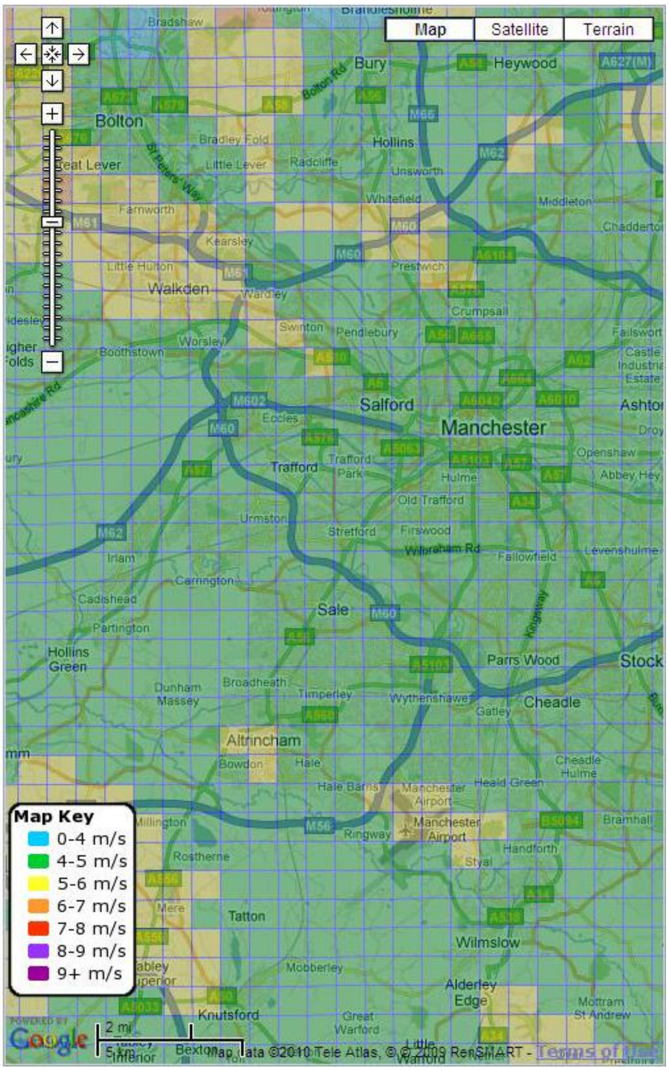
5.4	5.4	5.4
5.4	5.5	5.5
5.5	5.5	5.5

Carrington case study area
(Carrington Business Park: M31 4DD)

Using the same database as used for derive the figures outlined in the figure above, a mapped version is available online[21] and is shown on the wind speed resource map below. Though the source database lacks resolution, we can see from the colour coding on the map that of the Trafford case study areas, the Altrincham area shows a marginally better resource than the other areas.

[21] NOABL wind map [online] available from http://www.rensmart.com/Weather/BERR

Wind Speed Resource Map of the Trafford and Manchester Area



Relevance to the Trafford case study areas: from the above we can surmise there is a viable wind resource at Trafford (around 5.5m/sec is the lower viable limit), but if it were not an area dominated by urban development, it would be very unlikely to attract interest from wind farm developers because there are areas nearby further west, and at higher altitudes, with a much improved wind resource. Moreover, the urban environment is often ill-suited to the installation of wind turbines of any size, because buildings and other obstructions to elevations from ground level up to the height of the tallest building or structure break up the “laminar” flow of air useful to turbines, replacing it with turbulent air which has a detrimental effect on wind turbine performance and often negating their cost-effectiveness. There are some instances of successful wind turbine installations in or very near urban environments due to locally favourable conditions, though since these conditions are impossible to predict in advance. Therefore a wind survey lasting up to twelve months at a favoured site needs to take place.

Electricity generated from a wind turbine can be integrated in similar ways to solar PV technology. For very large systems, as mentioned earlier, they are usually connected to the transmission networks. Medium sized units, or single turbines, are connected into the distribution network, and very small urban turbines are generally connected directly into the building electrical systems. Also, turbines can be integrated into battery systems to provide electricity in remote locations or to work alongside a large electrical network. Key concerns when planning wind turbine installations are noise emissions and visual impacts.

The most cost-effective, reliable, and useful method is to erect one or more medium scale turbines which would be capable of generating enough electricity to supply base load demand during peak winds. The alternative would be to install multiple small scale turbines (either standalone or building mounted) but this leads to cumulatively higher installation costs, maintenance costs and it is likely the cumulative energy yield would be smaller than from a single medium scale unit.

Photovoltaics (Solar PV)

Solar photovoltaic (PV) systems convert solar radiation into direct current electricity in a semiconductor device or cell. The potential energy produced through the utilisation of PV modules is dependent on the amount of sunshine hours. PV performs better in colder conditions, all other factors being equal. However, it is naturally inefficient in low sun and cloudy conditions, with efficiency likely to be reduced to 5-20% of its full solar output.

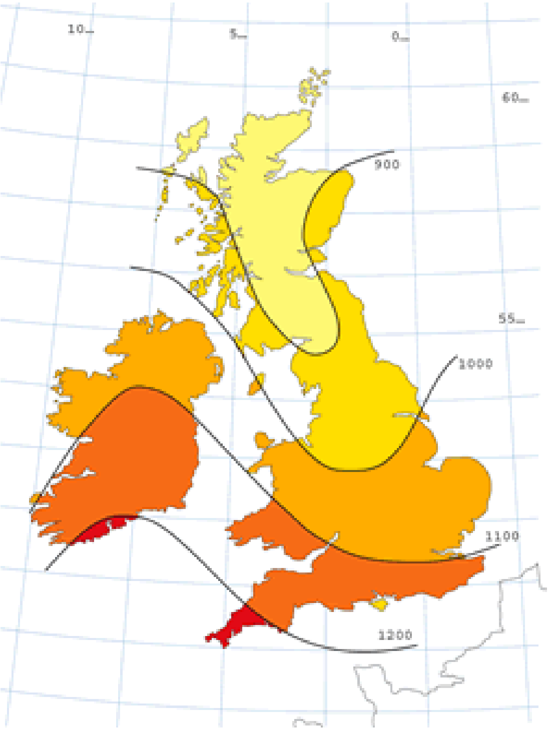
Three main types of PV system are commercially available: amorphous silicon, poly-crystalline silicon and mono-crystalline silicon. The former is the cheaper, less efficient type of system; while the other two are progressively more efficient and expensive. Each can be used to provide electricity in the same manner:

1. Connected directly to the electrical grid network;
2. Connected to a battery system for stand-alone power supply;
3. A combination of 1 and 2 above.

This has led to PV systems being used worldwide, from small solar powered calculators to large solar arrays covering hectares of ground supplying electricity to a large electrical transmission system.

Trafford case study areas solar resource: The solar PV resource is shown below in the UK Solar Resource illustration below. The value shown on the map is not the quantity of energy delivered by a solar PV system. Industry average for solar PV system efficiencies range between 12 and 18 per cent although higher efficiency units are also available. As can be seen from figure 4-2, the south of England has a significantly higher solar resource than Scotland and the north of England, but solar PV is a viable technology in the north of England if sited correctly and sized proportionately to the demand.

UK Solar Resource



Relevance to the Trafford case study areas: Due to the versatile nature of PV panels, their relative ease of integration into electrical systems and potential revenue source, PV technology is being considered more frequently for UK developments, both for new buildings and retrofits. Planning permission is not normally required for small scale systems except for special circumstances such as listed buildings.

The UK solar PV market is still relatively small, with paybacks generally in the region of 17-20 years with the Feed-in-Tariff (from April 2010) without a grant-based on current grid electricity prices This is due to both the high capital cost of the equipment, and the relatively low annual hours of direct sunlight. Site specific constraints provide further barriers to implementation and revolve around the amount of suitable roof space available for the installation of solar PV panels.

However, it is a well established method of electricity generation and usually requires little maintenance when integrated into a larger network. The systems are very well suited to buildings with a daytime demand (offices, retail, etc.) and a summer load, though the FiT will reward generation regardless of the daily match to demand. With the introduction of the FiT, solar PV installations should be metered separately to monitor the amount of electricity generated, and smart metering will need to be in place to account for exported electricity.

When assessing the feasibility of installing Solar PV in urban areas, shading from other structures lying in between the sun's path and the installation must be considered, as must the possibility of additional construction post-installation obscuring the panels at any point during the installation's life-cycle.

Solar hot water (SHW) - solar thermal generation

Solar thermal systems harness the heating potential of solar energy by capturing energy from the sun. In the simplest solar thermal application, a discrete solar collector gathers solar energy to provide hot water to temperatures exceeding 50ºC for domestic, commercial or industrial use. The heated water can be used for space heating, domestic water heating, agricultural and commercial use and for the heating of swimming pools.

There are two main types of solar thermal collector - flat plate and evacuated tubes. Passive systems rely on natural convection to circulate the water through the collectors. An active system uses pumps and valves to control the circulation of the heat absorbing liquid. Active systems are more complex but provide greater flexibility of system layout and can operate all year without the risk of freezing.

Flat plate collectors use a black absorber plate with a specially developed coating to maximise the collection of solar energy whilst simultaneously limiting re-radiation of energy back to the atmosphere. The collector is usually covered with a transparent material, such as glass, and insulated behind to prevent heat losses. Heat is transferred to the water via pipes lying along the plate or through channels within the collector. They tend to be a simpler and cheaper form of panel.

Evacuated tube collectors use a series of evacuated glass tubes to enclose each absorber plate. Convection losses are almost entirely eliminated by the vacuum in the tube, making this type of collector more efficient than the flat plate, especially in marginal weather conditions. However, flat plate collectors are more robust and more suitable in areas which may be prone to vandalism.

SHW systems are more efficient than solar PV systems in that they can generate around four times more energy per unit area than solar PV systems can. This has been reflected in simple pay-back times which were considerably shorter for SHW before the introduction of FiT or Renewable Heat Incentive (RHI- to be introduced in April 2011).

Trafford case study area resource: This is also applicable to solar thermal systems, yet these systems may have an advantage over some forms of PV under some climatic conditions such as cloudy weather because SHW is not purely dependent on solar radiation from the visible spectrum.

Relevance to the Trafford case study areas: urban development's often contain a mixture of residential, commercial and leisure facilities and solar thermal systems are well suited to contributing to thermal energy generation. Planning permission is not normally required for small scale solar thermal systems except for special circumstances such as listed buildings, and solar thermal is seen as a prime technology for Town Councils and private developers wishing to meet their renewable energy targets.

Domestic water heating is perhaps the best overall potential application for active solar heating in the UK. Domestic water heating demand continues all year round and still needs to be satisfied in the summer when the solar resource is at its peak. Solar thermal systems can also be used for space heating but the seasonal pattern of solar radiation for space heating applications shows that there is a mismatch between availability of solar radiation and the demand for heat.

Commercial systems have not received much attention in terms of solar water heating but hotels, beauty salons, bars and restaurants all have high demands for hot water and are well suited to the integration of this technology. Furthermore, swimming pools and leisure centres also have high hot water demand.

The major advantages of solar thermal systems are their reliability and long life span (20-25 years if maintained). The systems are versatile and can be installed on a single building serving a single set of occupants or an entire multi-unit building serving multiple units via a central storage tank.

Biomass Power Plants

This term in effect describes a "biomass power station", where, as with most of the UK's grid electricity, a thermal power plant is used to generate only electricity. In the UK, although the technology allows a biomass power plant to use a gas or reciprocating engine, as with biomass CHP (see below), allowing generation capacities to be below 1MW, the economics of power-only plants (where most or all of the heat is wasted) usually necessitates larger capacities above 10MW. A good example of this type of electricity generation is exemplified by the Steven's Croft biomass power plant in Lockerbie, Scotland. This is sized at 44MW and at the time of commissioning (2008) more than doubled the amount of electricity generated from biomass in Scotland. The preferred technology is usually fluidised-bed combustion with a steam turbine used to generate the electricity. Electrical efficiencies for biomass power plants are usually as low as coal power stations (which do not use combined cycle systems unlike natural gas-fuelled power stations) at less than 35%.

Trafford case study areas resource: biomass power plants can utilise the waste wood or virgin wood resource (see below).

Relevance to the Trafford case study areas: Peel Energy is currently involved in pre-planning discussions with a view to constructing a 20MWe waste wood-fuelled biomass power plant near the Barton High Level Bridge (M60). There is also a smaller 3MWe biomass power plant with planning approval at Tenax Circle, Trafford Park. If the former is approved and constructed, it will have a major impact on carbon emissions savings in Trafford.

Biomass Heating – Biomass Boilers and Wood Fuel Stoves

Biomass refers to any plant or animal derived matter. Biomass used for fuel falls into two main categories:

1. Woody biomass, including:
    a. Forest residues, e.g. from wood thinnings;
    b. Untreated wood waste, e.g. from sawmills;
    c. Crop residues, e.g. straw;
    d. Short Rotation Coppice (SRC), e.g. willow, miscanthus
2. Non-woody biomass, including:
    a. Animal wastes, e.g. slurry from cows, pigs, chickens
    b. Industrial and municipal waste
    c. High energy crops, e.g. rape, sugar, cane.

The most common biomass boiler fuel in the UK is wood biomass fuel including wood chip and pellet, both of which can be considered environmentally friendly fuels.

The combustion of biomass in a boiler is the simplest and most widely practiced technique to convert biomass to heat. Upon combustion, heat energy is released and is used to heat water. The by-products of combustion include carbon dioxide and water, plus other impurities, which are released in a flue gas.

The use of biomass is generally classed as a “carbon neutral” process because the carbon dioxide released during combustion to produce energy is taken up by plants during their growth and the cycle continues. Energy is required for the foresting, (including fertilisation), harvesting, any pre-treatment process (e.g. chipping) and transport, which results in carbon emissions. Hence energy from biomass is better described as “almost carbon neutral” or as a Low Carbon Technology.

Wood chip is made from trees, branch-wood or coppice products which are mechanically shredded by a chipping machine and then air dried. Wood chip is a bulky fuel so storage and delivery access need to be considered. Transport costs can be high for distances over 20 miles, and therefore wood chip is most cost effective if locally sourced.

Pellets are made of compressed sawdust or wood shavings, giving a more concentrated form of fuel than wood chips. Pellets are cylindrical in shape, ranging in diameter from 6-8mm and approximately 20mm long. Consequently they can be transported further, need less storage space and are easier to handle, but are more expensive than chips due to production costs.

Biomass heating is one of the few renewable technologies that require the regular delivery of fuel for input into the system. Regular deliveries of logs, wood chips or pellets need to be received, transported to boiler and stored on site, which requires space for storage and easy access for long vehicles to the site.

With the introduction of the RHI, a tariff per kWh will be paid to the asset owner. Its value will be proportionate to the estimated heat demand of the building in question. It also decreases in value as the generation plant increases in size in order that small systems can be compensated for lower economies of scale, as with the FiT rates.

Trafford case study areas resource: the National Community Wood Recycling Project (NCWRP) is believed to have instigated a feasibility study to assess the waste wood and municipal arisings (tree surgery) potential around Trafford, but the results of this study have not been located in the public domain. There is already a materials recycling facility operated by Biffa and opened in 2010, though it is not known what quantities of wood could be recovered at this facility. There is also a 3MWe biomass (wood) power plant approved for a site at Tenax Circle, Trafford Park. This facility will require significant quantities of wood fuel. Therefore any strategic plan to facilitate further biomass use in Trafford at any scale will necessitate a detailed study of existing biomass resources within the Metropolitan Borough, whether these can be developed further along with the necessary supply chains, and whether any regional biomass resource can be developed in future from both waste streams and managed woodland/virgin timber or Short Rotation Forestry (SRF)[22]. Alternatively each site or development area could arrange its biomass supply independently on an *ad hoc* basis, though this runs the risk of functioning up to the point where spare capacity is exhausted from the system and imports become necessary.[23]

Relevance to the Trafford case study areas: the *Sustainable Trafford* report, produced for Trafford MBC (no date supplied)[24], describes the Old Trafford Renewables Project. This was a small pilot project, but its success demonstrates what is possible and it could serve as an indicator to guide future renewable technology measures in existing and hard-to-treat housing. Six households are reported to have received SHW systems and wood stoves at zero cost to the householder with the aim of reducing fuel poverty and deriving heat for hot water and space heating from more sustainable sources.

Biomass heating utilising boilers with capacities from the tens of kilowatts range through to 500kW - 1MW and above may become more widespread in the UK serving district heating (DH) networks either for retrofit purposes or new developments may become more prevalent in the UK in the near future. This is a consequence of the potential for lifetime efficiency and CO_2 savings and tightening Building Regulations and Code for Sustainable Homes requirements. Biomass DH networks can be compatible with phased developments since if they are designed correctly, smaller networks can be linked to larger networks as the build progresses.

Biomass Combined Heat and Power (CHP)

Biomass-fired CHP technology is less established than natural gas-fired systems in the UK, but there are commercial units available on the market. In mainland Europe, biomass CHP utilising

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[22] The Forestry Commission holds the position that the North West region has “under managed” its woodlands and that there are potentially 181,000 tonnes per year of spare capacity, or 100MW (thermal) spare capacity going forward [online] http://www.forestry.gov.uk/forestry/infd-7baj7k

[23] Presently there are permissions for large biomass power plants, and some already operating in the UK, which together will use millions of tonnes of biomass every year, an increasing proportion of which will need to be imported. The sustainability of this resource is already under question, but there remains the opportunity for smaller wood-fuel users to set up more localised supply chains that could, in theory remain separate from those set up by the much larger facilities.

[24] This report mentions the National Community Wood Recycling Project (NCWRP). It is believed to have instigated a feasibility study to assess the waste wood and municipal arisings (tree surgery) potential around Trafford, but the results of this study have not been located in the public domain.

wood chip and/or wood waste feedstocks is a very successful technology, but tends to be situated in or near highly forested areas than most of the UK. In order to make this technology relevant to UK needs, there have been designs created in general at a smaller scale (200kWe-2MWe) with mixed success. The most well-established, commercially available technology options include a gasifier plus reciprocating engine or a boiler/combustion chamber with a steam turbine. For most biomass applications in the UK, the gasification technology with reciprocating engine option appears to be the most promising in the 500kWe – 4MWe range as these have a high ratio of electricity to heat, with steam turbines appearing to be more applicable to Energy from Waste (EfW) plants at higher generation capacities (see below).

A relatively new, but proven technology is biomass CHP utilising the organic Rankine cycle. This uses a steam turbine, but instead of using water in the steam cycle, an organic medium such as a refrigerant or hydrocarbon is used. Since the system requires a lower boiling point, it is regarded as safer (lower pressure than conventional steam), cheaper at a small scale, and more efficient overall than conventional steam plant.

A downdraught gasifier with reciprocating engine tends to be the most common small-scale biomass CHP technology. In the UK, this technology has recently reached commercial operation, but it is well proven in Scandinavia and Austria. The most significant technical challenge with this particular technology is in "refining" the gas produced in the gasifier to a standard that can be combusted in a gas reciprocating engine.

Any small-scale biomass CHP system would be more expensive to install and run than an equivalent size gas CHP system and would require more maintenance than gas CHP plants, particularly for the solids handling components and filters. A biomass CHP system also requires considerably more space for the plant equipment and biomass storage bunker.

The smaller the differential between electricity and gas or biomass prices, the less economically attractive a CHP system can be. This is known as the "spark spread." It is vital that the lifecycle costs of a CHP system are closely examined and this requires forecasts of gas and electricity prices, which are difficult to determine. Economic viability of a CHP scheme requires high annual running hours and full utilisation of the heat and power either on-site or exported locally, which in the case of electricity means exported to the grid. Biomass CHP systems do not currently qualify for the FiT (as this has a 50kWe maximum limit), but they will qualify for the RHI, further increasing their lifetime financial viability.

Trafford case study area resource: the same resource issues apply to biomass CHP as biomass heating (see 4.39 above), as the fuels are usually the same, though there are UK manufacturers who produce biomass CHP systems which can utilise waste wood of varying quality which is not so widespread a practice as a fuel for biomass boilers.

Relevance to the Trafford case study areas: since there are few examples of biomass CHP working commercially or technically below 500kWe and systems are predominantly larger than this in mainland Europe, it is not safe to recommend systems below this capacity. Economically viable biomass CHP will also utilise the low-grade heat produced from the gas engine for a DH network[25]. Unlike biomass heating, which could have, for example, as few as 5-10 houses linked by a small heat main to a single biomass boiler of around 200kW, a single biomass CHP unit would ideally be sized to the baseload heat demand; if it were serving a new housing development built to high efficiency standards, one system would need to service several hundred houses. This may pose a problem for returns on investment if only small packets of a development were built at a time. However, if the demand originated from a large development to be completed in one step, or pre-existing large public or residential blocks, then the minimum size of the biomass CHP system would not be an issue.

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[25] This is usually a requirement for "Good Quality CHP" which is eligible for RHI, ROC's and CCL exemption (renewables LE C's).

Energy from Waste (EfW) CHP

In order to meet the increasingly stringent UK landfill diversion targets, as much as 8.9 million tonnes of additional annual processing capacity for Municipal Solid Wastes will be needed to 2020. Of this amount, around 25% is expected to be combusted in EfW plants[26]. This technology is distinct from landfill gas combustion, which is not capable of capturing a high proportion of the methane produced and it does not involve direct gasification and/or combustion of mechanically-handled wastes. As commercial, industrial and domestic wastes demand a certain size of facility to render them logistically and commercially viable, they are usually large in size (typically designed to handle more than 50,000 tonnes of waste annually) and are situated away from the immediate proximity of residential areas. Additionally, any on-site CHP is likely to allocate some or all of its heat for process purposes, thereby limiting the potential for feeding into a DH network. The scale and technical format of EfW plants also defines the type of CHP suitable. Steam turbines with a lower electrical efficiency than gas engines are most commonly specified instead of gas engines, though the size of the plants indicates that significant quantities of electricity can be exported to the grid or apportioned to a particular site. Although this method of generation is not carbon neutral, as non-biological wastes are usually combusted with organically-derived wastes, when compared to landfill and grid electricity, carbon emissions savings are made and this is reflected in the bespoke ROC allocation for a generation plant. ROC's are allocated according to the biomass fraction combusted at the site and it will qualify for CCL exemption on fuel inputs and electricity generation.

Trafford case study area resource: the resource is difficult to quantify because waste contracts and catchment areas may change.

Relevance to the Trafford case study areas: An estimate of electricity generation available for export from the proposed EfW facility at Carrington has been provided in the Carrington case study area options (see section 4.72). The precise configuration and location for this facility is not known at present.

Ground Source Heat Pumps (GSHP)

Heat Pumps utilise the principle of the third law of thermodynamics to 'pump' heat from one medium to another. The concept for the heat pump was discovered in the 1850s and found its first commercially practical application in the refrigerator in the 1930s. Heat pumps to provide heating rather than cooling have been steadily developed since the mid 1900s and have become widespread in use in the USA and Europe since the 1990s. Heat pumps generally use electricity to drive compressors, evaporators and pumps to 'pump' the heat from a low grade heat source to a higher grade heat output. For every 1 unit of electricity used they can typically pump between 2 and 5 units of useful heat. A heat pump uses a heat collector which can draw heat from a number of sources, including the ground, the air or from a suitable water source. The most common types used in heating systems are:

- Ground Source Heat Pump (GSHP)
- Air Source Heat Pump (ASHP)
- Water Source Heat Pump (WSHP)

WSHP can be highly efficient as the heat transfer from water to the heat collector is significant, but because suitable nearby water sources, such as a lake, are required these systems are fairly rare. The next most efficient is the GSHP which draws heat from either vertical (via boreholes) or horizontal ground collectors. The least efficient but cheapest to install is the ASHP which resembles a large air conditioning unit and draws heat from external air.

[26] UK Trade & Investment (2008, p. 2-5) [online] available from: http://ukinspain.fco.gov.uk/resources/en/pdf/14529904/energy-from-waste

Trafford case study area resource: this will be similar to any urban area – feasibility will need to be ascertained on a case by case basis.

Relevance to the Trafford case study areas: Heat pumps are more efficient when required to provide a low temperature heat output. Heat pump based heating systems therefore require larger heat emitters than conventional systems and work well with under floor heating or possibly oversized radiators. For these reasons heat pumps are ideally suited to either new builds or major refurbishments where under floor heating can be installed. Heat pump systems can have even higher efficiencies if there is both a cooling and heating requirement in the same vicinity, where heat can be pumped from one area, providing cooling and directed to another area to provide heating. Supermarkets and leisure centres may provide such sources. Large heat pump systems can also share common collector and distribution systems to further increase the economic benefits.

In urban areas, GSHP utilising ground loops may be difficult to deploy because there is not always enough space available to dig trenches or wide excavations to lay the ground loop. The technique often used in this case (or it may be the preferred solution) is to drill boreholes which draw their heat from the ground or an underground water source. These boreholes can exceed 100m in depth, so a geophysical survey will be necessary to ascertain whether there are any natural or artificial obstacles which may interfere with this option.

Appendix C - Renewable Energy Generation and Costings by Typology, Technology and % Contribution

C.1 Renewable Energy Technology Detailed Costs

1 Individual dwelling detached/semi-detached

Declared Assumptions from RE Scoping worksheet		
Development size m²	160	m2
Total kWh for development	22788	kWh/yr
kWh thermal	11678	kWh/yr
Carbon Emissions/yr	8.1	tonnes
RE Contribution %	10%	
RE required kWh	2279	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	3.04	1.30	0.47	3.13	10.00	1.93	3.00	0.57	0.61
RE m2 required	22.00			5.00					
Max kWh from system	2332	2279	2279	2375	11678	6760	10512	2279	2279
% RE provided of total energy	10%	10%	10%	10%	51%	30%	46%	10%	10%
tCO2 saved per annum	1.3	1.2	1.2	0.4	2.2	1.3	1.9	0.7	0.7
% CO2 saved per annum	15%	15%	15%	5%	27%	15%	24%	8%	8%
Install Cost	£24,307	£3,902	£3,784	£3,751	£8,000	£2,315	£3,600	£1,025	£4,254
cost m² building	£151.92	£24.39	£23.65	£23.44	£50.00	£14.47	£22.50	£6.41	£26.59
cost per tCO2	£6.388.09	£2.451.45	£6.537.21	£2.731.15	£370.30	£959.51	£617.06	£2.612.58	£10.160.04

Individual dwelling detached/semi-detached

RE Contribution % 20%
RE required kWh 4558 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	6.08	2.60	0.95	6.25	10.00	3.86	7.07	1.14	1.22
RE m2 required	43.00			10.00					
Max kWh from system	4558	4558	4558	4750	11678	11678	11678	4558	4558
% RE provided of total energy	20%	20%	20%	21%	51%	51%	51%	20%	20%
tCO2 saved per annum	2.4	2.4	2.4	0.9	2.2	2.2	2.2	1.4	1.4
% CO2 saved per annum	30%	30%	30%	11%	27%	27%	27%	17%	17%
Install Cost	£48,615	£7,804	£7,568	£7,502	£8,000	£4,630	£8,485	£2,051	£8,508
cost m² building	£303.84	£48.78	£47.30	£46.89	£50.00	£28.94	£53.03	£12.82	£53.17
cost per tCO2	£3.268.32	£1.225.73	£3.268.60	£1.365.58	£370.30	£555.45	£555.45	£1.306.29	£5.080.02

Individual dwelling detached/semi-detached

RE Contribution % 30%
RE required kWh 6836 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	9.12	3.90	1.42	9.38	10.00	5.79	10.61	0.57	0.61
RE m2 required	65.00			14.00					
Max kWh from system	6890	6836	6836	6650	11678	11678	11678	2279	2279
% RE provided of total energy	30%	30%	30%	29%	51%	51%	51%	10%	10%
tCO2 saved per annum	3.7	3.7	3.7	1.2	2.2	2.2	2.2	0.7	0.7
% CO2 saved per annum	46%	45%	45%	15%	27%	27%	27%	8%	8%
Install Cost	£72,922	£11,706	£11,351	£11,253	£8,000	£6,945	£12,727	£1,025	£4,254
cost m² building	£455.76	£73.16	£70.95	£70.33	£50.00	£43.41	£79.54	£6.41	£26.59
cost per tCO2	£2.162.12	£817.15	£2.179.07	£975.41	£370.30	£555.45	£555.45	£2.612.58	£10.160.04

Individual dwelling detached/semi-detached

RE Contribution % 40%
RE required kWh 9115 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	12.15	5.20	1.89	12.50	11.78	7.72	14.14	2.28	2.43
RE m2 required	87.00			19.00					
Max kWh from system	9222	9115	9115	9025	11678	11678	11678	9115	9115
% RE provided of total energy	40%	40%	40%	40%	51%	51%	51%	40%	40%
tCO2 saved per annum	5.0	4.9	4.9	1.7	2.2	2.2	2.2	2.8	2.8
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£97,229	£15,608	£15,135	£15,005	£9,428	£9,261	£16,970	£4,102	£17,015
cost m² building	£607.68	£97.55	£94.60	£93.78	£58.92	£57.88	£106.06	£25.64	£106.34
cost per tCO2	£1.615.38	£612.86	£1.634.30	£718.72	£370.30	£555.45	£555.45	£653.15	£2.540.01

Individual dwelling detached/semi-detached

RE Contribution % 50%
RE required kWh 11394 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8,000	£3,000	£8,000	£1,200	£800	£1,200	£1,200	£1,800	£7,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	15.19	6.50	2.36	15.63	14.73	9.65	17.68	2.85	3.04
RE m2 required	109.00			24.00					
Max kWh from system	11554	11394	11394	11400	11678	11678	11678	11394	11394
% RE provided of total energy	51%	50%	50%	50%	51%	51%	51%	50%	50%
tCO2 saved per annum	6.2	6.1	6.1	2.1	2.2	2.2	2.2	3.4	3.4
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£121,536	£19,510	£18,919	£18,756	£11,784	£11,576	£21,212	£5,127	£21,269
cost m² building	£759.60	£121.94	£118.24	£117.22	£73.65	£72.35	£132.57	£32.05	£132.93
cost per tCO2	£1.289.34	£490.29	£1.307.44	£568.99	£370.30	£555.45	£555.45	£522.52	£2.032.01

2 Individual dwelling terrace

Declared Assumptions from RE Scoping worksheet

Development size m²	105	m2
Total kWh for development	14955	kWh
kWh thermal	7664	kWh/yr
Carbon Emissions/yr	5.3	tonnes
RE Contribution %	10%	
RE required kWh	1495	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1.99	0.85	0.31	2.05	1.93	1.27	3.00	0.37	0.40
RE m2 required	14.24			3.00					
Max kWh from system	1510	1495	1495	1425	6775	4436	7664	1495	1495
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	0.8	0.8	0.8	0.3	1.3	0.8	1.4	0.5	0.5
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£15.952	£2.561	£2.483	£2.462	£1.547	£1.519	£3.600	£673	£2.792
cost m² building	£151.92	£24.39	£23.65	£23.44	£14.73	£14.47	£34.29	£6.41	£26.59
cost per tCO2	£9,867.48	£3,735.55	£9,961.46	£4,551.92	£638.32	£1,462.10	£846.40	£3,981.07	£15,481.96

Individual dwelling terrace

RE Contribution % 20%
RE required kWh 2991 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	3.99	1.71	0.62	4.10	3.87	2.53	4.64	0.75	0.80
RE m2 required	28.00			6.00					
Max kWh from system	2968	2991	2991	2850	7664	7664	7664	2991	2991
% RE provided of total energy	20%	20%	20%	19%	51%	51%	51%	20%	20%
tCO2 saved per annum	1.6	1.6	1.6	0.5	1.4	1.4	1.4	0.9	0.9
% CO2 saved per annum	30%	30%	30%	10%	27%	27%	27%	17%	17%
Install Cost	£31.903	£5.121	£4.966	£4.923	£3.093	£3.039	£5.568	£1.346	£5.583
cost m² building	£303.84	£48.78	£47.30	£46.89	£29.46	£28.94	£53.03	£12.82	£53.17
cost per tCO2	£5,019.21	£1,867.77	£4,980.73	£2,275.96	£564.27	£846.40	£846.40	£1,990.54	£7,740.98

Individual dwelling terrace

RE Contribution % 30%
RE required kWh 4486 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	5.98	2.56	0.93	6.15	5.80	3.80	6.96	1.12	1.20
RE m2 required	43.00			9.00					
Max kWh from system	4558	4486	4486	4275	7664	7664	7664	4486	4486
% RE provided of total energy	30%	30%	30%	29%	51%	51%	51%	30%	30%
tCO2 saved per annum	2.4	2.4	2.4	0.8	1.4	1.4	1.4	1.4	1.4
% CO2 saved per annum	46%	45%	45%	15%	27%	27%	27%	25%	25%
Install Cost	£47.855	£7.682	£7.449	£7.385	£4.640	£4.558	£8.352	£2.019	£8.375
cost m² building	£455.76	£73.16	£70.95	£70.33	£44.19	£43.41	£79.54	£19.23	£79.76
cost per tCO2	£3,268.32	£1,245.18	£3,320.49	£1,517.31	£564.27	£846.40	£846.40	£1,327.02	£5,160.65

Individual dwelling terrace

RE Contribution % 40%
RE required kWh 5982 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	7.98	3.41	1.24	8.21	7.73	5.06	9.28	1.50	1.60
RE m2 required	57.00			13.00					
Max kWh from system	6042	5982	5982	6175	7664	7664	7664	5982	5982
% RE provided of total energy	40%	40%	40%	41%	51%	51%	51%	40%	40%
tCO2 saved per annum	3.2	3.2	3.2	1.1	1.4	1.4	1.4	1.8	1.8
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£63.807	£10.243	£9.933	£9.847	£6.187	£6.077	£11.136	£2.692	£11.166
cost m² building	£607.68	£97.55	£94.60	£93.78	£58.92	£57.88	£106.06	£25.64	£106.34
cost per tCO2	£2,465.58	£933.89	£2,490.36	£1,050.44	£564.27	£846.40	£846.40	£995.27	£3,870.49

Individual dwelling terrace

RE Contribution % 50%
RE required kWh 7477 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	9.97	4.27	1.55	10.26	9.67	6.33	11.60	1.87	1.99
RE m2 required	71.00			16.00					
Max kWh from system	7526	7477	7477	7600	7664	7664	7664	7477	7477
% RE provided of total energy	50%	50%	50%	51%	51%	51%	51%	50%	50%
tCO2 saved per annum	4.0	4.0	4.0	1.4	1.4	1.4	1.4	2.3	2.3
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£79.758	£12.804	£12.416	£12.309	£7.734	£7.597	£13.920	£3.365	£13.958
cost m² building	£759.60	£121.94	£118.24	£117.22	£73.65	£72.35	£132.57	£32.05	£132.93
cost per tCO2	£1,979.41	£747.11	£1,992.29	£853.49	£564.27	£846.40	£846.40	£796.21	£3,096.39

3 Individual dwelling flat conversion

Declared Assumptions from RE Scoping worksheet

Development size m²	65	m2
Total kWh for development	9258	kWh
kWh thermal	4744	kWh/yr
Carbon Emissions/yr	3.3	tonnes
RE Contribution %	10%	
RE required kWh	926	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1.23	0.53	0.19	1.27	1.20	0.78	3.00	0.23	0.25
RE m2 required	9.00			2.00					
Max kWh from system	954	926	926	950	4194	2746	4744	926	926
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	0.5	0.5	0.5	0.2	0.8	0.5	0.9	0.3	0.3
% CO2 saved per annum	16%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£9,875	£1,585	£1,537	£1,524	£957	£941	£3,600	£417	£1,728
cost m² building	£151.92	£24.39	£23.65	£23.44	£14.73	£14.47	£55.38	£6.41	£26.59
cost per tCO2	£15.615.33	£6.034.35	£16.091.59	£6.827.88	£1.031.13	£2.361.86	£1.367.26	£6.430.97	£25.009.32

Individual dwelling flat conversion

RE Contribution %	20%	
RE required kWh	1852	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	2.47	1.06	0.38	2.54	2.39	1.57	2.87	0.46	0.49
RE m2 required	18.00			4.00					
Max kWh from system	1908	1852	1852	1900	4744	4744	4744	1852	1852
% RE provided of total energy	21%	20%	20%	21%	51%	51%	51%	20%	20%
tCO2 saved per annum	1.0	1.0	1.0	0.4	0.9	0.9	0.9	0.6	0.6
% CO2 saved per annum	31%	30%	30%	11%	27%	27%	27%	17%	17%
Install Cost	£19,750	£3,170	£3,074	£3,048	£1,915	£1,881	£3,447	£833	£3,456
cost m² building	£303.84	£48.78	£47.30	£46.89	£29.46	£28.94	£53.03	£12.82	£53.17
cost per tCO2	£7.807.66	£3.017.17	£8.045.79	£3.413.94	£911.51	£1.367.26	£1.367.26	£3.215.48	£12.504.66

Individual dwelling flat conversion

RE Contribution %	30%	
RE required kWh	2777	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	3.70	1.59	0.58	3.81	3.59	2.35	4.31	0.69	0.74
RE m2 required	26.00			6.00					
Max kWh from system	2756	2777	2777	2850	4744	4744	4744	2777	2777
% RE provided of total energy	30%	30%	30%	31%	51%	51%	51%	30%	30%
tCO2 saved per annum	1.5	1.5	1.5	0.5	0.9	0.9	0.9	0.8	0.8
% CO2 saved per annum	45%	45%	45%	16%	27%	27%	27%	25%	25%
Install Cost	£29,624	£4,756	£4,612	£4,572	£2,872	£2,822	£5,170	£1,250	£5,184
cost m² building	£455.76	£73.16	£70.95	£70.33	£44.19	£43.41	£79.54	£19.23	£79.76
cost per tCO2	£5.405.31	£2.011.45	£5.363.86	£2.275.96	£911.51	£1.367.26	£1.367.26	£2.143.66	£8.336.44

Individual dwelling flat conversion

RE Contribution % 40%
RE required kWh 3703 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	4.94	2.11	0.77	5.08	4.79	3.14	5.74	0.93	0.99
RE m2 required	35.00			6.00					
Max kWh from system	3710	3703	3703	3800	4744	4744	4744	3703	3703
% RE provided of total energy	40%	40%	40%	41%	51%	51%	51%	40%	40%
tCO2 saved per annum	2.0	2.0	2.0	0.7	0.9	0.9	0.9	1.1	1.1
% CO2 saved per annum	60%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£39,499	£6,341	£6,149	£6,096	£3,830	£3,762	£6,894	£1,666	£6,912
cost m² building	£607.68	£97.55	£94.60	£93.78	£58.92	£57.88	£106.06	£25.64	£106.34
cost per tCO2	£4.015.37	£1.508.59	£4.022.90	£1.706.97	£911.51	£1.367.26	£1.367.26	£1.607.74	£6.252.33

Individual dwelling flat conversion

RE Contribution % 50%
RE required kWh 4629 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£8.000	£3.000	£8.000	£1.200	£800	£1.200	£1.200	£1.800	£7.000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	6.17	2.64	0.96	6.35	5.98	3.92	7.18	1.16	1.23
RE m2 required	44.00			10.00					
Max kWh from system	4664	4629	4629	4744	4744	4744	4744	4629	4629
% RE provided of total energy	50%	50%	50%	51%	51%	51%	51%	50%	50%
tCO2 saved per annum	2.5	2.5	2.5	0.9	0.9	0.9	0.9	1.4	1.4
% CO2 saved per annum	76%	75%	75%	27%	27%	27%	27%	42%	42%
Install Cost	£49,374	£7,926	£7,686	£7,620	£4,787	£4,703	£8,617	£2,083	£8,640
cost m² building	£759.60	£121.94	£118.24	£117.22	£73.65	£72.35	£132.57	£32.05	£132.93
cost per tCO2	£3.194.04	£1.206.87	£3.218.32	£1.367.26	£911.51	£1.367.26	£1.367.26	£1.286.19	£5.001.86

4 Development of dwellings 10-50 flats

Declared Assumptions from RE Scoping worksheet

Development size m²	930	m2
Total kWh for development	132456	kWh
kWh thermal	67878	kWh/yr
Carbon Emissions/yr	47.2	tonnes
RE Contribution %	10%	
RE required kWh	13246	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	17.66	7.56	2.75	18.17	17.12	11.21	20.55	3.31	3.53
RE m2 required	126.00			28.00					
Max kWh from system	13356	13246	13246	13300	60003	39294	67878	13246	13246
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	7.2	7.1	7.1	2.5	11.1	7.3	12.6	4.0	4.0
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	27%	8%	8%
Install Cost	£114.795	£15.120	£15.120	£17.261	£13.699	£11.214	£17.467	£4.967	£19.427
cost m² building	£123.44	£16.26	£16.26	£18.56	£14.73	£12.06	£18.78	£5.34	£20.89
cost per tCO2	£906.25	£281.17	£773.22	£386.10	£72.07	£137.56	£67.69	£374.56	£1,373.40

Development of dwellings 10-50 flats

RE Contribution %	20%	
RE required kWh	26491	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	35.32	15.12	5.50	36.34	34.25	22.43	41.10	6.62	7.06
RE m2 required	252.00			56.00					
Max kWh from system	26712	26491	26491	26600	67878	67878	67878	26491	26491
% RE provided of total energy	20%	20%	20%	20%	51%	51%	51%	20%	20%
tCO2 saved per annum	14.3	14.2	14.2	4.9	12.6	12.6	12.6	8.0	8.0
% CO2 saved per annum	30%	30%	30%	10%	27%	27%	27%	17%	17%
Install Cost	£229.590	£30.241	£30.241	£34.522	£27.399	£22.428	£34.933	£9.934	£38.854
cost m² building	£246.87	£32.52	£32.52	£37.12	£29.46	£24.12	£37.56	£10.68	£41.78
cost per tCO2	£453.12	£140.59	£386.61	£193.05	£63.71	£79.63	£67.69	£187.28	£686.70

Development of dwellings 10-50 flats

RE Contribution %	30%	
RE required kWh	39737	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	52.98	22.68	8.25	54.51	51.37	33.64	61.65	9.93	10.60
RE m2 required	378.00			84.00					
Max kWh from system	40068	39737	39737	39900	67878	67878	67878	39737	39737
% RE provided of total energy	30%	30%	30%	30%	51%	51%	51%	30%	30%
tCO2 saved per annum	21.5	21.3	21.3	7.4	12.6	12.6	12.6	12.0	12.0
% CO2 saved per annum	46%	45%	45%	16%	27%	27%	27%	25%	25%
Install Cost	£344.384	£45.361	£45.361	£51.784	£41.098	£33.642	£52.400	£14.901	£58.280
cost m² building	£370.31	£48.78	£48.78	£55.68	£44.19	£36.17	£56.34	£16.02	£62.67
cost per tCO2	£302.08	£93.72	£257.74	£128.70	£63.71	£79.63	£67.69	£124.85	£457.80

Development of dwellings 10-50 flats

RE Contribution % 40%
RE required kWh 52982 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	70.64	30.24	11.00	72.68	68.50	44.86	82.20	13.25	14.13
RE m2 required	505.00			112.00					
Max kWh from system	53530	52982	52982	53200	67878	67878	67878	52982	52982
% RE provided of total energy	40%	40%	40%	40%	51%	51%	51%	40%	40%
tCO2 saved per annum	28.7	28.5	28.5	9.8	12.6	12.6	12.6	16.0	16.0
% CO2 saved per annum	61%	60%	60%	21%	27%	27%	27%	34%	34%
Install Cost	£459.179	£60.482	£60.482	£69.045	£54.797	£44.856	£69.867	£19.868	£77.707
cost m^2 building	£493.74	£65.03	£65.03	£74.24	£58.92	£48.23	£75.13	£21.36	£83.56
cost per tCO2	£226.11	£70.29	£193.30	£96.53	£63.71	£79.63	£67.69	£93.64	£343.35

Development of dwellings 10-50 flats

RE Contribution % 50%
RE required kWh 66228 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6,500	£2,000	£5,500	£950	£800	£1,000	£850	£1,500	£5,500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	88.30	37.80	13.75	90.85	85.62	56.07	102.75	16.56	17.66
RE m2 required	631.00			139.00					
Max kWh from system	66886	66228	66228	66025	67878	67878	67878	66228	66228
% RE provided of total energy	50%	50%	50%	50%	51%	51%	51%	50%	50%
tCO2 saved per annum	35.9	35.6	35.6	12.2	12.6	12.6	12.6	20.0	20.0
% CO2 saved per annum	76%	75%	75%	26%	27%	27%	27%	42%	42%
Install Cost	£573.974	£75.602	£75.602	£86.306	£68.497	£56.070	£87.333	£24.835	£97.134
cost m^2 building	£617.18	£81.29	£81.29	£92.80	£73.65	£60.29	£93.91	£26.70	£104.45
cost per tCO2	£180.96	£56.23	£154.64	£77.78	£63.71	£79.63	£67.69	£74.91	£274.68

5 Housing/Mixed use site >50-200 units

Declared Assumptions from RE Scoping worksheet

Development size m²	5065	m2
Total kWh for development	1145969	kWh
kWh thermal	794262	kWh/yr
Carbon Emissions/yr	335.8	tonnes
RE Contribution %	10%	
RE required kWh	114597	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.500	£2.000	£5.500	£950	£600	£1.000	£850	£1.500	£5.500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	152.80	65.41	23.79	157.20	148.15	97.02	177.78	28.65	30.56
RE m2 required	1.091.00			241.00					
Max kWh from system	115646	114597	114597	114475	519130	339960	622957	114597	114597
% RE provided of total energy	10%	10%	10%	10%	45%	30%	54%	10%	10%
tCO2 saved per annum	62.1	61.5	61.5	21.2	96.0	62.9	115.2	34.6	34.6
% CO2 saved per annum	18%	18%	18%	6%	29%	19%	34%	10%	10%
Install Cost	£993,173	£130,818	£130,818	£149,339	£88,892	£97,020	£151,117	£42,974	£168,075
cost m² building	£196.09	£25.83	£25.83	£29.48	£17.55	£19.16	£29.84	£8.48	£33.18

Housing/Mixed use site >50-200 units

RE Contribution % 20%
RE required kWh 229194 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.500	£2.000	£5.500	£950	£800	£1.000	£850	£1.500	£5.500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	305.59	130.82	47.57	314.40	296.31	194.04	355.57	57.30	61.12
RE m2 required	2.183.00			483.00					
Max kWh from system	231398	229194	229194	229425	794262	679920	794262	229194	229194
% RE provided of total energy	20%	20%	20%	20%	69%	59%	69%	20%	20%
tCO2 saved per annum	124.3	123.1	123.1	42.4	146.9	125.8	146.9	69.3	69.3
% CO2 saved per annum	37%	37%	37%	13%	44%	37%	44%	21%	21%
Install Cost	£1,986,346	£261,637	£261,637	£298,678	£237,046	£194,041	£302,233	£85,948	£336,151
cost m² building	£392.17	£51.66	£51.66	£58.97	£46.80	£38.31	£59.67	£16.97	£66.37

Housing/Mixed use site >50-200 units

RE Contribution % 30%
RE required kWh 343791 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.500	£2.000	£5.500	£950	£600	£1.000	£850	£1.500	£5.500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	458.39	196.23	71.36	471.60	444.46	291.06	533.35	85.95	91.68
RE m2 required	3.274.00			724.00					
Max kWh from system	347044	343791	343791	343900	794262	794262	794262	343791	343791
% RE provided of total energy	30%	30%	30%	30%	69%	69%	69%	30%	30%
tCO2 saved per annum	186.4	184.6	184.6	63.6	146.9	146.9	146.9	103.9	103.9
% CO2 saved per annum	55%	55%	55%	19%	44%	44%	44%	31%	31%
Install Cost	£2,979,519	£392,455	£392,455	£448,018	£266,677	£291,061	£453,350	£128,921	£504,226
cost m² building	£588.26	£77.48	£77.48	£88.45	£52.65	£57.47	£89.51	£25.45	£99.55

Housing/Mixed use site >50-200 units

RE Contribution % 40%
RE required kWh 458387 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.500	£2.000	£5.500	£950	£800	£1.000	£850	£1.500	£5.500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	611.18	261.64	95.14	628.80	592.61	388.08	711.14	114.60	122.24
RE m2 required	4.366.00			965.00					
Max kWh from system	462796	458387	458387	458375	794262	794262	794262	458387	458387
% RE provided of total energy	40%	40%	40%	40%	69%	69%	69%	40%	40%
tCO2 saved per annum	248.5	246.2	246.2	84.8	146.9	146.9	146.9	138.6	138.6
% CO2 saved per annum	74%	73%	73%	25%	44%	44%	44%	41%	41%
Install Cost	£3,972,691	£523,273	£523,273	£597,357	£474,092	£388,082	£604,467	£171,895	£672,302
cost m² building	£784.34	£103.31	£103.31	£117.94	£93.60	£76.62	£119.34	£33.94	£132.73

Housing/Mixed use site >50-200 units

RE Contribution % 50%
RE required kWh 572984 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£6.500	£2.000	£5.500	£950	£600	£1.000	£850	£1.500	£5.500
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	763.98	327.05	118.93	786.00	740.77	485.10	888.92	143.25	152.80
RE m2 required	5.457.00			1.206.00					
Max kWh from system	578442	572984	572984	572850	794262	794262	794262	572984	572984
% RE provided of total energy	50%	50%	50%	50%	69%	69%	69%	50%	50%
tCO2 saved per annum	310.6	307.7	307.7	106.0	146.9	146.9	146.9	173.2	173.2
% CO2 saved per annum	93%	92%	92%	32%	44%	44%	44%	52%	52%
Install Cost	£4,965,864	£654,092	£654,092	£746,696	£444,461	£485,102	£755,584	£214,869	£840,377
cost m² building	£980.43	£129.14	£129.14	£147.42	£87.75	£95.78	£149.18	£42.42	£165.92

6 Housing/Mixed use site >200-500 units

Declared Assumptions from RE Scoping worksheet

Development size m²	16355	m2
Total kWh for development	2345721	kWh
kWh thermal	1193697	kWh/yr
Carbon Emissions/yr	839.5	tonnes
RE Contribution %	10%	
RE required kWh	234572	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	312.76	133.89	48.69	321.78	303.26	198.59	363.91	58.64	62.55
RE m2 required	2,234.00			494.00					
Max kWh from system	236804	234572	234572	234650	1062625	695875	1193697	234572	234572
% RE provided of total energy	10%	10%	10%	10%	45%	30%	51%	10%	10%
tCO2 saved per annum	127.2	126.0	126.0	43.4	196.6	128.7	220.8	70.9	70.9
% CO2 saved per annum	15%	15%	15%	5%	23%	15%	26%	8%	8%
Install Cost	£1,563,814	£133,888	£146,060	£225,243	£121,304	£158,876	£181,956	£70,372	£250,210
cost m² building	£95.62	£8.19	£8.93	£13.77	£7.42	£9.71	£11.13	£4.30	£15.30

Housing/Mixed use site >200-500 units

RE Contribution %	20%	
RE required kWh	469144	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	625.53	267.78	97.37	643.55	606.52	397.19	727.83	117.29	125.11
RE m2 required	4,468.00			988.00					
Max kWh from system	473608	469144	469144	469300	1193697	1193697	1193697	469144	469144
% RE provided of total energy	20%	20%	20%	20%	51%	51%	51%	20%	20%
tCO2 saved per annum	254.3	251.9	251.9	86.8	220.8	220.8	220.8	141.8	141.8
% CO2 saved per annum	30%	30%	30%	10%	26%	26%	26%	17%	17%
Install Cost	£3,127,628	£267,776	£292,120	£450,487	£242,609	£317,751	£363,913	£140,743	£500,421
cost m² building	£191.23	£16.37	£17.86	£27.54	£14.83	£19.43	£22.25	£8.61	£30.60

Housing/Mixed use site >200-500 units

RE Contribution %	30%	
RE required kWh	703716	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	938.29	401.66	146.06	965.33	909.78	595.78	1,091.74	175.93	187.66
RE m2 required	6,702.00			1,482.00					
Max kWh from system	710412	703716	703716	703950	703716	703716	703716	703716	703716
% RE provided of total energy	30%	30%	30%	30%	30%	30%	30%	30%	30%
tCO2 saved per annum	381.5	377.9	377.9	130.2	130.2	130.2	130.2	212.8	212.8
% CO2 saved per annum	45%	45%	45%	16%	16%	16%	16%	25%	25%
Install Cost	£4,691,443	£401,665	£438,180	£675,730	£363,913	£476,627	£545,869	£211,115	£750,631
cost m² building	£286.85	£24.56	£26.79	£41.32	£22.25	£29.14	£33.38	£12.91	£45.90

Housing/Mixed use site >200-500 units

RE Contribution %	40%	
RE required kWh	938289	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1,251.05	535.55	194.75	1,287.10	1,213.04	794.38	1,455.65	234.57	250.21
RE m2 required	8,936.00			1,975.00					
Max kWh from system	947216	938289	938289	938125	938289	938289	938289	938289	938289
% RE provided of total energy	40%	40%	40%	40%	40%	40%	40%	40%	40%
tCO2 saved per annum	508.7	503.9	503.9	173.6	173.6	173.6	173.6	283.7	283.7
% CO2 saved per annum	61%	60%	60%	21%	21%	21%	21%	34%	34%
Install Cost	£6,255,257	£535,553	£584,239	£900,973	£485,217	£635,502	£727,826	£281,487	£1,000,841
cost m² building	£382.47	£32.75	£35.72	£55.09	£29.67	£38.86	£44.50	£17.21	£61.19

Housing/Mixed use site >200-500 units

RE Contribution %	50%	
RE required kWh	1172861	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required	1,563.81	669.44	243.43	1,608.88	1,516.30	992.97	1,819.56	293.22	312.76
RE m2 required	11,170.00			2,469.00					
Max kWh from system	1184020	1172861	1172861	1172775	1172861	1172861	1172861	1172861	1172861
% RE provided of total energy	50%	50%	50%	50%	50%	50%	50%	50%	50%
tCO2 saved per annum	635.8	629.8	629.8	217.0	217.0	217.0	217.0	354.6	354.6
% CO2 saved per annum	76%	75%	75%	26%	26%	26%	26%	42%	42%
Install Cost	£7,819,071	£669,441	£730,299	£1,126,217	£606,521	£794,378	£909,782	£351,858	£1,251,051
cost m² building	£478.08	£40.93	£44.65	£68.86	£37.08	£48.57	£55.63	£21.51	£76.49

7 Housing/Mixed use site >500 units (excluding CHP)

Declared Assumptions from RE Scoping worksheet

Development size m²	100300	m2
Total kWh for development	16945816	kWh
Total kWh thermal	8981932	kWh/yr
Carbon Emissions/yr	5938.4	tonnes
RE Contribution %	10%	
RE required kWh	1694582	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	2.259	967	352	2.325	2.191	1.435	2.629	424	452
RE m2 required total	16,139			3,568					
Max kWh from system	1710734	1694582	1694582	1694800	7676553	5027097	8981932	1694582	1694582
% RE provided of total energy	10%	10%	10%	10%	45%	30%	53%	10%	10%
tCO2 saved per annum	918.7	910.0	910.0	313.5	1420.2	930.0	1661.7	512.3	512.3
% CO2 saved per annum	15%	15%	15%	5%	24%	16%	28%	9%	9%
Install Cost	£11,297,211	£967,227	£1,055,157	£1,627,189	£876,319	£1,147,739	£1,314,478	£508,374	£1,807,554
cost m² building	£112.63	£9.64	£10.52	£16.22	£8.74	£11.44	£13.11	£5.07	£18.02
cost per tCO2	£5.44	£1.10	£3.30	£2.23	£0.28	£0.86	£0.30	£2.34	£7.81

Housing/Mixed use site >500 units (excluding CHP)

RE Contribution %	20%	
RE required kWh	3389163	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	4.519	1.934	703	4.649	4.382	2.869	5.258	847	904
RE m2 required total	32,278			7,135					
Max kWh from system	3421468	3389163	3389163	3389125	8981932	8981932	8981932	3389163	3389163
% RE provided of total energy	20%	20%	20%	20%	53%	53%	53%	20%	20%
tCO2 saved per annum	1837.4	1820.0	1820.0	627.0	1661.7	1661.7	1661.7	1024.7	1024.7
% CO2 saved per annum	31%	31%	31%	11%	28%	28%	28%	17%	17%
Install Cost	£22,594,421	£1,934,454	£2,110,313	£3,254,378	£1,752,638	£2,295,478	£2,628,957	£1,016,749	£3,615,107
cost m² building	£225.27	£19.29	£21.04	£32.45	£17.47	£22.89	£26.21	£10.14	£36.04
cost per tCO2	£2.72	£0.55	£1.65	£1.12	£0.24	£0.48	£0.30	£1.17	£3.90

Housing/Mixed use site >500 units (excluding CHP)

RE Contribution %	30%	
RE required kWh	5083745	kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	6.778	2.902	1.055	6.974	6.572	4.304	7.887	1.271	1.356
RE m2 required total	48,417			10,703					
Max kWh from system	5132202	5083745	5083745	5083925	8981932	8981932	8981932	5083745	5083745
% RE provided of total energy	30%	30%	30%	30%	53%	53%	53%	30%	30%
tCO2 saved per annum	2756.1	2730.1	2730.1	940.5	1661.7	1661.7	1661.7	1537.0	1537.0
% CO2 saved per annum	46%	46%	46%	16%	28%	28%	28%	26%	26%
Install Cost	£33,891,632	£2,901,681	£3,165,470	£4,881,567	£2,628,957	£3,443,217	£3,943,435	£1,525,123	£5,422,661
cost m² building	£337.90	£28.93	£31.56	£48.67	£26.21	£34.33	£39.32	£15.21	£54.06
cost per tCO2	£1.81	£0.37	£1.10	£0.74	£0.24	£0.48	£0.30	£0.78	£2.60

Housing/Mixed use site >500 units (excluding CHP)

RE Contribution % 40%
RE required kWh 6778326 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW Install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	9,038	3,869	1,407	9,298	8,763	5,739	10,516	1,695	1,808
RE m2 required total	64,555			14,270					
Max kWh from system	6842830	6778326	6778326	6778250	8981932	8981932	8981932	6778326	6778326
% RE provided of total energy	40%	40%	40%	40%	53%	53%	53%	40%	40%
tCO2 saved per annum	3674.7	3640.1	3640.1	1254.0	1661.7	1661.7	1661.7	2049.4	2049.4
% CO2 saved per annum	62%	61%	61%	21%	28%	28%	28%	35%	35%
Install Cost	£45,188,843	£3,868,908	£4,220,627	£6,508,756	£3,505,275	£4,590,956	£5,257,913	£2,033,498	£7,230,215
cost m² building	£450.54	£38.57	£42.08	£64.89	£34.95	£45.77	£52.42	£20.27	£72.09
cost per tCO2	£1.36	£0.27	£0.82	£0.56	£0.24	£0.48	£0.30	£0.59	£1.95

Housing/Mixed use site >500 units (excluding CHP)

RE Contribution % 50%
RE required kWh 8472908 kWh

	PV	Wind	SHP	SHW	BB	GSHP	ASHP	CHP	BCHP
Cost/unit	£5,000	£1,000	£3,000	£700	£400	£800	£500	£1,200	£4,000
Average kWh per kW Install	750	1752	4818	729	773.5	1181	645	4000	3750
RE kW required Total	11,297	4,836	1,759	11,623	10,954	7,173	13,145	2,118	2,259
RE m2 required total	80,694			17,838					
Max kWh from system	8553564	8472908	8472908	8473050	8981932	8981932	8981932	8472908	8472908
% RE provided of total energy	50%	50%	50%	50%	53%	53%	53%	50%	50%
tCO2 saved per annum	4593.4	4550.1	4550.1	1567.5	1661.7	1661.7	1661.7	2561.7	2561.7
% CO2 saved per annum	77%	77%	77%	26%	28%	28%	28%	43%	43%
Install Cost	£56,486,053	£4,836,135	£5,275,783	£8,135,945	£4,381,594	£5,738,695	£6,572,391	£2,541,872	£9,037,769
cost m² building	£563.17	£48.22	£52.60	£81.12	£43.68	£57.22	£65.53	£25.34	£90.11
cost per tCO2	£1.09	£0.22	£0.66	£0.45	£0.24	£0.48	£0.30	£0.47	£1.56

C.2 Viability Assessment Assumptions and Findings

Carrington Case Study Summary Sheet

Appraisal Summary	
Case Study	**SL5 Carrington**
Total number of units:	**1560**
Tenure Balance	
Market Housing	80%
Affordable Housing	20%
Social Rented	50%
Equity Share	50%
Market Housing	**£331,344,000**
Social Rent	**£26,921,700**
Shared Equity	**£16,567,200**
Commercial Value	**£845,393,551**
Gross Development Value	**£1,220,226,451**
Code for Sustainable Housing	**Code 4**
Construction Costs	**£434,740,213**
Total Fees	**£71,459,603**
Abnormals & S106	**£14,084,363**
Construction Contingency	**£5,261,063**
Land Cost	**£427,079,258**
TOTAL OUTGOINGS	**£952,624,500**
Net Present Value (2010)	**£267,601,951**
Developer's Return	28.1%

Sensitivity Analysis

Cost / **GDV**	**-10%**	**-5%**	**0**	**5%**	**10%**
10%	£484,887,046	£437,255,821	£389,624,596	£341,993,371	£294,362,146
5%	£423,875,724	£376,244,499	£328,613,274	£280,982,049	£233,350,824
0	£362,864,401	£315,233,176	**£267,601,951**	£219,970,726	£172,339,501
-5%	£301,853,079	£254,221,854	£206,590,629	£158,959,404	£111,328,179
-10%	£240,841,756	£193,210,531	£145,579,306	£97,948,081	£50,316,856

Carrington Case Study Area – Renewable Energy Technology Working Example: 20% Reduction in Carbon Emissions from SHW Technology Area Wide Option 2

SL5 Carrington **20%** **Code 4** **£1,220,226,451** **£952,624,500**	**EXPLANATORY TEXT FOR TABLE** Affordable Housing Provision – 20% Code for Sustainable Homes Level 4 Gross Development Value - £1.2B Total Development Costs - £952M
£267,601,951 **28%**	Residual Value (GDV less TDC) - £267M Developer's Return – 28%
20 percent	This is the % target of CO_2 reduction tested. The model tests targets of 10%, 20%, 30%, 40%, 50%. For each target, costs are linked to each RE technology

Power	Heat	CHP
PV	**SHW**	**CHP**
OFF	ON	OFF
-	£43,232,707	-
Wind1	**BB**	**BCHP**
OFF	OFF	OFF
-	-	-
SHP	**GSHP**	
OFF	OFF	
-	-	
	ASHP	
	OFF	
	-	
£0	**£43,232,707**	**£0**

The CO_2 reduction targets are linked to their associated costs for each RE technology. The RE technology costs are incorporated into the appraisal by turning the individual RE technologies ON or OFF. Once the individual RE technology, or technologies, are selected, the sum total of their costs (based on the CO_2 reduction target selected) is applied to the Residual Value.

£224,369,244 **23.6%**	Residual Value with RE Costs Applied (£267,601,951 less £43,232,707) The change in Residual Value will provide a new Developer's Return – 23.6%.
OPTION 2	This line indicates the Area Wide Option selected, as referenced in the main report.
Resi £61,943,538 34,145 t/yr 78%	The total cost associated of the option - based on rate of the AWO capitol cost per case study unit. This is to ensure that the correct cost amount of the specific AWO is assessed in our case study
£162,425,706 **17.1%**	The sum total of the AWO cost per unit is applied to the Residual Value, after the individual RE technology/ technologies are selected (£224,369,244 less £61,943,538). The change in this Residual Value will provide a new Developer's Return – 17.1% (just viable).

Tamworth Court Case Study Summary Sheet

Appraisal Summary	
Case Study	**Tamworth Court**
Total number of units:	**112**
Tenure Balance	
Market Housing	95%
Affordable Housing	5%
Social Rented	50%
Equity Share	50%
Market Housing	**£12,123,900**
Social Rent	**£207,383**
Shared Equity	**£127,620**
Commercial Value	**£0**
Gross Development Value	**£12,458,903**
Code for Sustainable Housing	**Code 4**
Construction Costs	**£5,755,218**
Total Fees	**£1,289,860**
Abnormals & S106	**£716,815**
Construction Contingency	**£287,761**
Land Cost	**£4,360,616**
TOTAL OUTGOINGS	**£12,410,269**
Net Present Value (2010)	**£48,633**
Developer's Return	0.4%

Sensitivity Analysis

GDV \ Cost	-10%	-5%	0	5%	10%
10%	£2,535,551	£1,915,037	£1,294,524	£674,010	£53,497
5%	£1,912,605	£1,292,092	£671,578	£51,065	(£569,448)
0	£1,289,660	£669,147	**£48,633**	(£571,880)	(£1,192,394)
-5%	£666,715	£46,202	(£574,312)	(£1,194,825)	(£1,815,339)
-10%	£43,770	(£576,743)	(£1,197,257)	(£1,817,770)	(£2,438,284)

Tamworth Court Case Study Area – Renewable Energy Technology Working Example:
10% Reduction in Carbon Emissions from CHP Technology
Area Wide Option 3

Tamworth Court

Affordable Housing	5%
CfSH	Code 4
GDV	£12,458,903
COST	£12,410,269
RESIDUAL VALUE	£48,634
RETURNS	0%

10 percent

Power	Heat	CHP
PV	**SHW**	**CHP**
OFF	OFF	ON
-	-	£44,666
Wind1	**BB**	**BCHP**
OFF	OFF	OFF
-	-	-
SHP	**GSHP**	
OFF	OFF	
-	-	
	ASHP	
	OFF	
	-	
£0	**£0**	**£44,666**

£3,968

0.0%

OPTION 3

Resi

£598,845

174 t/yr

5%

-£594,877

-4.8%

Central Way Case Study Summary Sheet

Appraisal Summary	
Case Study	**Central Way**
Total number of units:	**30**
Tenure Balance	
Market Housing	60%
Affordable Housing	40%
Social Rented	50%
Equity Share	50%
Market Housing	**£6,868,800**
Social Rent	**£1,488,240**
Shared Equity	**£915,840**
Commercial Value	**£0**
Gross Development Value	**£9,272,880**
Code for Sustainable Housing	**Code 4**
Construction Costs	**£2,017,874**
Total Fees	**£574,861**
Abnormals & S106	**£280,375**
Construction Contingency	**£100,894**
Land Cost	**£3,245,508**
TOTAL OUTGOINGS	**£6,219,512**
Net Present Value (2010)	**£3,053,368**
Developer's Return	49.1%

Sensitivity Analysis

GDV \ Cost	-10%	-5%	0	5%	10%
10%	£4,602,608	£4,291,632	£3,980,656	£3,669,681	£3,358,705
5%	£4,138,964	£3,827,988	£3,517,012	£3,206,037	£2,895,061
0	£3,675,320	£3,364,344	**£3,053,368**	£2,742,393	£2,431,417
-5%	£3,211,676	£2,900,700	£2,589,724	£2,278,749	£1,967,773
-10%	£2,748,032	£2,437,056	£2,126,080	£1,815,105	£1,504,129

Central Way Case Study Area – Renewable Energy Technology Working Example: 30% Reduction in Carbon Emissions from SHP Technology Area Wide Option 1

Central Way

Affordable Housing	40%
CfSH	Code 4
GDV	£7,727,400
COSTS	£6,064,960
RESIDUAL VALUE	£1,662,440
RETURNS	27%

30 percent

Power	Heat	CHP
PV	SHW	CHP
OFF	OFF	OFF
-	-	-
Wind1	BB	BCHP
OFF	OFF	OFF
-	-	-
SHP	GSHP	
ON	OFF	
£153,357	-	
	ASHP	
	OFF	
	-	
£153,357	**£0**	**£0**

£1,509,083

24.9%

OPTION 1

Resi

£850,836

64 t/yr

4%

£658,247

10.9%

Urmston / Stretford Case Study Summary Sheet

Appraisal Summary	
Case Study	**Urmston, Stretford**
Total number of units:	**175**
Tenure Balance	
Market Housing	80%
Affordable Housing	20%
Social Rented	50%
Equity Share	50%
Market Housing	**£25,243,200**
Social Rent	**£2,051,010**
Shared Equity	**£1,262,160**
Commercial Value	**£0**
Gross Development Value	**£28,556,370**
Code for Sustainable Housing	**Code 4**
Construction Costs	**£9,092,363**
Total Fees	**£2,259,611**
Abnormals & S106	**£1,201,078**
Construction Contingency	**£454,618**
Land Cost	**£9,994,730**
TOTAL OUTGOINGS	**£23,002,399**
Net Present Value (2010)	**£5,553,971**
Developer's Return	24.1%

Sensitivity Analysis

GDV \ Cost	-10%	-5%	0	5%	10%
10%	£10,709,848	£9,559,728	£8,409,608	£7,259,488	£6,109,368
5%	£9,282,030	£8,131,910	£6,981,790	£5,831,670	£4,681,550
0	£7,854,211	£6,704,091	**£5,553,971**	£4,403,851	£3,253,731
-5%	£6,426,393	£5,276,273	£4,126,153	£2,976,033	£1,825,913
-10%	£4,998,574	£3,848,454	£2,698,334	£1,548,214	£398,094

Crampton Road Case Study Summary Sheet

Appraisal Summary	
Case Study	**Crampton Road**
Total number of units:	**15**
Tenure Balance	
Market Housing	95%
Affordable Housing	5%
Social Rented	50%
Equity Share	50%
Market Housing	**£2,057,700**
Social Rent	**£35,198**
Shared Equity	**£21,660**
Commercial Value	**£0**
Gross Development Value	**£2,114,558**
Code for Sustainable Housing	**Code 4**
Construction Costs	**£761,431**
Total Fees	**£182,307**
Abnormals & S106	**£109,848**
Construction Contingency	**£38,072**
Land Cost	**£740,095**
TOTAL OUTGOINGS	**£1,831,752**
Net Present Value (2010)	**£282,805**
Developer's Return	15.4%

Sensitivity Analysis

GDV \ Cost	-10%	-5%	0	5%	10%
10%	£677,436	£585,849	£494,261	£402,673	£311,086
5%	£571,708	£480,121	£388,533	£296,945	£205,358
0	£465,980	£374,393	**£282,805**	£191,218	£99,630
-5%	£360,253	£268,665	£177,077	£85,490	(£6,098)
-10%	£254,525	£162,937	£71,349	(£20,238)	(£111,826)

Appendix D - Renewable Energy Delivery Vehicles

DELIVERY VEHICLES: COMMERCIAL AND TECHNICAL CONSIDERATIONS – ENERGY SERVICE COMPANIES (ESCO) AND CONTRACT ENERGY MANAGEMENT (CEM) COMPANIES

INTRODUCTION

Sustainability is at the heart of each project and each project will need a detailed technical review and assessment of the appropriate commercial, operational and technical structure to deliver that sustainability and to manage the associated risk. It is possible that different business and technical models will be required for different developments, which will have varying risk profiles, rewards and potentially different technical solutions

There are a number of business models that might be applicable for the implementation of area-wide renewable energy solution – and each is ultimately about managing business risk and capital investment.

Each if the traditional commercial models (e.g. not-for–profit, co-operative, limited liability, guaranteed) maybe fitted into the Energy Services Company ("ESCO") that typically delivers energy efficiencies and the Contract Energy Management Company ("CEM") that typically generates heat and power. Both models are undergoing resurgence throughout Europe [source: *Energy End-Use Efficiency and Energy Services* ("Energy Services Directive")].

DEFINITION OF AN ESCO & CEM COMPANY

The European Parliament Directive 2006/32/EC and the report for the Council entitled *Energy End-Use Efficiency and Energy Services* ("Energy Services Directive") define the energy service companies as follows:

> **"Energy Service Company"** ("ESCO"): a natural or legal person that delivers energy services and/or energy efficiency improvements measures in the end-user facility or premises and accepts some degree of the financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements.
>
> **"Contract Energy Management"** ("CEM"): a service provided under a legal contract to the end-user which includes generation of electricity and useful heat for use at the end-user facility or premises.

The report identifies that the investment of the ESCO or CEM is in the upfront provision of more effective capital which delivers the energy efficiencies and savings to the client. The ESCO or CEM receives the reward over the lifetime of the contract usually in the form of a share of the savings generated – which may be guaranteed. The essence of the business model is the management of the risk and uncertainty.

The report comments that both ESCO's and CEM's are seen as tools to enhance the sustainable use of energy through promoting energy efficiency and very efficient renewable energy generation. The corporate structure translates the uncertainty of managing an efficiency or sustainable generation project into a defined business risk that can be quantified, operated and managed over the long term.

COMPANY STRUCTURE

The company structure of both an ESCO and CEM is determined by the benefits to be delivered and the risks to be mitigated and designed to serve the long-term aspirations of the stakeholders. Organisations can be formed as co-operatives, not-for-profit and limited by guarantee or as a company limited by shareholder equity and third party debt. In all cases the corporate entity will have stakeholders and will require access to funding, and are typically owned by the parties taking the initial risk. The corporate structure may affect the sources and types of funding available.

ESCO's and CEM's help to overcome financial constraints to investment in the energy sectors and typically seek to repay initial costs, at least in part, by taking their reward directly from the financial savings from the energy efficiencies or delivery of the power and heat for on-site use. The benefit to the end user is the immediate investment, reduced costs and CO_2 whilst the ESCO and CEM can utilise market drivers to realise the value of the efficiencies.

PURPOSE OF AN ESCO and CEM

Traditionally the purpose of the ESCO is to identify and drive energy efficiencies at the point of use on behalf of an interest group. The mechanism translates the uncertainty of managing an energy efficiency initiative into a business risk that can be quantified, operated and managed over time. Typically the ESCO funds the capital investment in the efficiency measures and recovers the investment by a revenue charge usually based on the savings achieved over time.

Traditionally in the UK the purpose of the CEM is to build, manage and operate an energy centre that generates high-efficiency sustainable electricity and heat for use at the end-user site. The heart of the Energy Centre can be the Combined Heat and Power generator (CHP) which generates electricity and heat at the same time in a predetermined ratio. The CEM also requires complex distribution controls and a connection to the point of use and potentially the distribution grid: thus the CEM requires: capital, connections to distribute the power and heat and the commercial capability to realise the benefits of the renewable energy and heat. There is an additional technical constraint that the available heat is directly linked to the type of generator and the amount of power generated.

SOURCES OF FUNDS

The financing options for the Combined Heat and Power (CHP) generating equipment can be divided into two key groups.

Possible Funding Methods for CHP Projects	
Capital Purchase or 'on balance sheet' financing	Operating Lease or 'off balance sheet' financing
Financed by: • Internal funds • Debt finance • Leasing	Financed by: • Equipment supplier • Energy services company (ESCO) • Other sources of funding

Source: DECC CHP Focus; http://chp.defra.gov.uk/cms/

Internal Funds

- CEM retains full ownership of the assets and bears the full technical, financial and commercial risk – which can vary with the type of installation chosen and the contract structure.

Debt Financing

- CEM matches appropriate source of capital to a specific project and timescale, repayment schedule being from the CEM cash flow – the cost of the finance depends on the trade off between the perceived risk and returns.

Leasing

- Two main types of arrangement:
  - hire purchase; the CEM becomes the legal owner of the assets once all payments have been made
  - finance lease ('full payout'); the CEM does not own the asset although it appears on the balance sheet whilst the rental payments are made – at the end of the primary period the asset is sold or a new lease is sought

Equipment Supplier Finance

- Leasing package as an alternative to outright purchase where the supplier designs, installs, maintains, and operates the CHP, the technical risk is transferred into the equipment supplier, the price risk is with the CEM – typically the supplier will purchase the fuel, account for the CO2, buy the heat and power and may supply the CEM at a discounted energy price.

Energy Services Company (ESCO)

- Wide varieties of contracts where the ESCO typically design, install, finance, operate and maintain a CHP plant on the end-user site. The entire risk including the CHP plant capital and operating costs, together with all technical and operating risks of the CHP is transferred into the ESCO. The CEM savings will normally be less than under a capital purchase arrangement – unless the plant is "oversized" for the immediate end-user allowing the surplus electricity and heat to be sold to other end-users.

Other Sources of Funds

- There may be opportunities to meet the capital cost through a combination of funding types, access to which may depend on the leading beneficial owner and the corporate structure – for example interest-free short-term loans maybe available to statutory bodies through DECC Salix funding or through CESP finance initiatives.

INDICATIVE CAPITAL COSTS

Capital costs for the CEM will be determined by the feasibility study and refined by the project development process. Indicative capital costs for bio-fuel generation; are in the order of:

CHP reciprocating gas	£ 1,000 per kW of electricity
Bio-fuel wood premium	£ 500 per kW of electricity

Other site specific charges such as corporate & legal & professional fees, way-leaves, civil engineering, electricity grid connection, way-leaves, metering at the houses and regulatory charges, heat main and network are all excluded from the examples given below

Source: CHPA: July 2009

CONSIDERATIONS AND BENEFICIARIES OF WIDE AREA DEVELOPMENTS WITHIN OLD TRAFFORD

The proposed development areas within Old Trafford are predominantly larger-scale commercial or government sites within a localised geographical area. Adjacent to Old Trafford development there is a domestic heat main in the Alexandra Park and a major residential redevelopment of flats.

Area wide sustainable generation requires the technical capability to generate, alongside the commercial capability to utilise the renewable energy and distribute the power and/or heat to ensure that all available incentives and grants are effectively realised.

Within the Old Trafford developments it is likely that sustainable power generation will be connected directly to the existing grid whilst the heat will require a newly built dedicated local heat distribution network, which may be limited to the individual development of Trafford Town Hall or be connected to other additional commercial users such as leisure centres and local colleges by local heat mains and has the potential to be connected into the larger Heat Main Spur as proposed by the AGMA study.

ESCOs and CEMs require the ability to capitalise the equipment cost, quantify the savings and charge the business unit over time: in addition, there may be an incentive to identify and realise new savings opportunities. The three typical benefits of an ESCO or CEM to the energy users are as follows:

- The energy user takes delivery of the new equipment and makes the efficiency savings at the point of use which are quantified in some way and for which the ESCO receives a share of the savings;
- The energy user receives the high-quality or sustainable electricity through the existing distribution grid under a standard electricity supply contract, measured by an electricity meter and is invoiced – the CEM is rewarded through the sale of the sustainable electricity into the electricity distribution grid;
- The energy user receives the sustainable heat through a new heat distribution network and receives the benefit at the point of use. Typically the heat displaces a fossil fuel (e.g. natural gas) as a heating fuel and may investment in different boilers and controls.

The primary role of the ESCO or CEM is to:

- Identify and quantify energy efficiencies and carbon and cost savings opportunities
- Source the capital to procure and deploy the equipment
- Deliver and commission the equipment
- Realise the savings and receive reward
- Operate in accordance with BS ISO 15900

The opportunities may be in a new build or in a retro-fit environment. There is a possibility to add other opportunities such as heat networks and efficiency projects either to existing or new ESCO's; for example a "tie-in" with *Building Schools for the Future and the Code for Sustainable Homes* alongside the potential to integrate local iconic sites such as Lancashire County Cricket Club, Trafford Town Hall, Stretford Leisure Centre and the Greater Manchester Police Station and exploit the potential to link into other proposed heat mains in the future.

Technical and Operational considerations for a CEM or ESCO are the requirements to:

- Generate from a local energy management plant

- Distribute and charge the end-users for the heat, which requires a new heat distribution network with heat meters at the point of use and a contract to charge for the benefit of the heat.
- Deliver the power into the local grid and, within the Old Trafford developments, this will be a connection to the local grid governed by the Distribution Network Operator ("DNO") and an industry-standard electricity meter.
- Contract with and invoice a licensed electricity supplier to receive the sustainable electricity delivered into the grid – it is for the licensed electricity supplier to offer to supply the local occupiers under their standard end-user electricity supply contract.
- Build and access the new local heat distribution network and initially it is envisaged that the CEM will be physically located within a new development area – potentially on the Trafford Town Hall site.
- Access the electricity distribution grid through a substation which could be physically located within the development area and will be under the control of the local Distribution Network Operator ("DNO").

There is a potential role for both classes of enterprises within the area where:

- the new development areas will require the energy infrastructure such as the heat network and the electricity grid wires and metering to the residential and commercial end-users
- the new developments will receive the benefits of green energy alongside the opportunity to offer sustainable electricity to existing residential and commercial end-users in Old Trafford (or indeed elsewhere in England and Wales)
- energy efficiencies can be used to reduce energy demand in existing homes and businesses and maybe delivered by an ESCO

Old Trafford Option

Each of the following options has been examined using the publically available estimates of energy use data and has not assessed potential generation technologies, controls or fuels. It is assumed that some, but not all of the sites in the vicinity of Trafford Town Hall will participate in the ESCO.

It is envisaged that the delivery of one of the following options will require a body to adopt a co-ordinating role to bring diverse parties and stakeholders with differing interests into the project scheme and to help manage the initial risks associated with the creation of the ESCO. Once established the ESCO will have a viable income stream, a long-term CO2 reduction potential and a long-term value.

The generating capability of the ESCO, the investment requirements and sources of funding, phasing of developments and the surrounding contract structures will require a detailed Feasibility Study and Environmental Impact Assessment.

Option 1
Centralised biomass CHP electricity and heat generation with additional heat network, supplying the local Old Trafford development zone

A single reciprocating-engine CHP generating high-quality electricity from a sustainable feedstock fuel. The electrical output feed into the on-site consumer and any excess exported into the national grid at a location to be determined (potentially Trafford Town Hall)> This option requires a direct connection into the local on-site heating systems and offers the potential to extend the export of heat to adjacent commercial and leisure facilities.

The electricity and heat is exported from the CEM to the ESCO at an agreed transfer price, the feedstock fuel is purchased under a long-term procurement contract and stored on-site.

The profits attributable to the ESCO and CEM will be distributed in line with the corporate structure and any agreements between the stakeholders. The CEM may sell the power either directly to the local end-users or to a licensed supplier at a grid connection point and receiving a share of the sustainable power benefits.

Finance for the generation equipment may be separated finance of the heat network and metering and invoices consumers – although it should be noted that the ability to export usable heat is critical to achieve the high efficiencies required to achieve high-quality CHP status.

This option allows for expansion and a potential connection to larger Old Trafford Heat Main spur or to other local heat mains through a heat main extension, linking the development areas along the route of the Manchester Ship Canal or alternative continuous routes as proposed by the AGMA study.

Option 2
Single CHP with solar PV and solar thermal

The centralised CHP generates electricity and usable heat for distribution into the on-site heat user and exports any excess electricity into the local grid. The heat and electricity output is supplemented by solar PV and solar thermal installations on the new build housing and smaller commercial projects adjacent to Old Trafford.

This option is particularly attractive to the Community Energy Saving Programme ('CESP') financing scheme where the suppliers adopt a "whole house" approach "in areas with high levels of low incomes" in order reduce CO2 emissions using measures which specifically includes district heating as an option.

The use of solar thermal allows localised sustainable heating sources without connecting into a local heat main.

Finance for the generation equipment can be separated from the finances for the heat network, metering, invoices consumers. An additional ESCO might be required to deliver and manage the solar PV and the solar thermal installations.

Option 3
Multiple CHP units- cumulative value of 2.8MWe and heat network

This option proposes a number of smaller CHP units each scaled for the heat demand on each commercial site and residential re-development and maybe connected to existing heat mains or new heat mains when required.

The series of smaller CHP plants simplifies the connection to the grid, requires a much smaller engine and storage footprint and reduces the number of road deliveries of bio-fuel feedstock to each site and allows different feedstock fuels to be adopted depending on the availability of fuels and the occupancy of each site. The number of CHP engines/gasifiers and Energy Centres will increase the total costs as there are multiple connections to the grid and to the heat network.

This option is scalable and will provide a robust network and the ability to plan maintenance and offer multiple bio-fuel feedstocks such as oil and wood chip.

Finance for the CHP maybe through a single CEM with many centres or a CEM per energy centre. The ESCO finances the heat network and metering and invoices consumers. The heat network and biomass option are facilitated by the close proximity of the commercial users and high-density residential re-developments.

Option 4
Large CHPs units generating more heat and power than required by the on-site consumers and exporting the excess heat into a connected major heat main network and to the national electricity grid.

This option proposes a number of CHP units each scaled for the maximum heat demand on each new development and connected by a heat main between the new development areas.

The series of smaller CHP plants simplifies the connection to the grid, requires a much smaller engine and storage footprint and reduces the number of road deliveries of bio-fuel feedstock. The number of CHP engines and Energy Centres will increase the total costs as there are multiple connections to the grid and to the heat network.

The direct export of heat allows significant amounts of electricity to be generated – in excess of the requirements of the local users – which, subject to the availability of the locally-sourced sustainable fuels, will maintain the high-quality CHP status and provide an increased long-term revenue stream to the ESCO.

This option is scalable and will provide a robust network and the ability to plan maintenance and support multiple bio-fuel feedstocks such as corn oil and wood chip.

Finance for each energy centre and heat network maybe on an individual basis or as a large project or both. This option allows for a phased development and combination of sources of finance.

OTHER POTENTIAL DEVELOPMENT OPPORTUNITIES – Potential for Partnerships

There is a potential leadership and partnership role for both a CEM and an ESCO within the wider Old Trafford area to promote energy efficiencies and sustainable generation at iconic sites and developments. Significant savings in CO2 emissions and fuel costs are available from improving existing housing stock. The ESCO and CEM can be established with a remit to source the available funds and deliver those savings through retro-fitting efficiency measures and making sustainable local electricity available as a realistic option. Key iconic sites might include:

Trafford Centre

Altringham Town Centre

Existing Leisure Centres with Swimming Pools

Partington / Carrington redevelopment

Appendix E - Glossary

ATKINS

A

Anaerobic Digestion (AD)
A treatment process breaking down biodegradable, particularly waste, material in the absence of oxygen. Produces a methane-rich biogas that can be used as a substitute for fossil fuels.

Achievable Emissions Intensity
The minimum average annual emissions intensity that could be achieved in a given year, given the installed capacity, projected demand and the projected profile of that demand.

B

Best Available Technology
The latest stage of development of a particular technology (e.g. a process or operating method) that is practically suitable for deployment.

Biofuel
A fuel derived from recently dead biological material and used to power vehicles (can be liquid or gas). Biofuels are commonly derived from cereal crops but can also be derived from dead animals, trees and even algae. Blended with petrol and diesel biofuels can be used in conventional vehicles.

Biogas
A fuel derived from recently dead biological material which can be burned in a generator or a CHP plant, or upgraded to biomethane for injection into the gas grid.

Biomass
Biological material that can be used as fuel or for industrial production. Includes solid biomass such as wood and plant and animal products, gases and liquids derived from biomass, industrial waste and municipal waste.

C

Cap and trade schemes
Cap and trade schemes establish binding controls on the overall amount of emissions from participants. Within this quantity ceiling, participants in the scheme can choose where best to deliver emission reductions by trading units which correspond to quantities of abatement.

Carbon dioxide equivalent (CO_2e) concentration
The concentration of carbon dioxide that would give rise to the same level of radiative forcing as a given mixture of greenhouse gases.

Carbon dioxide equivalent (CO_2e) emission
The amount of carbon dioxide emission that would give rise to the same level of radiative forcing, integrated over a given time period, as a given amount of well-mixed greenhouse gas emission. For an individual greenhouse gas species, carbon dioxide equivalent is calculated by multiplying the mass emitted by the Global Warming Potential over the given time period for that species. Standard international reporting processes use the time period of 100 years.

Carbon Emissions Reductions Target (CERT)
CERT is an obligation on energy supply companies to implement measures in homes that will reduce emissions (such as insulation, efficient lightbulbs and appliances, etc). (See Supplier obligation).

Carbon sink
An absorber of carbon (usually in the form of carbon dioxide). Natural carbon sinks include forests and oceans.

Central Heating (Gas)

A central heating system provides warmth to the whole interior of a building (or portion of a building) from one point to multiple rooms. When combined with other systems in order to control the building climate, the whole system may be a HVAC (heating, ventilation and air conditioning) system.

Climate
The climate can be described simply as the ‘average weather’, typically taken over a period of 30 years. More rigorously, it is the statistical description of variables such as temperature, rainfall, snow cover, or any other property of the climate system.

Carbon Change Levy (CCL)
A levy charged on the industrial and commercial supply of electricity, natural gas, coal and coke for lighting, heating and power.

Climate sensitivity
The response of global mean temperatures to increased concentrations of carbon dioxide in the atmosphere. It is typically defined as the temperature increase that would occur at equilibrium after a doubling of carbon dioxide concentration above pre-industrial levels.

Combined Cycle Gas Turbine
A gas turbine generator that generates electricity. Waste heat is used to make steam to generate additional electricity via a steam turbine, thereby increasing the efficiency of the plant.

Combined Heat and Power (CHP) The simultaneous generation of heat and power, putting to use heat that would normally be wasted. This results in a highly efficient way to use both fossil and renewable fuels. Technologies range from small units similar to domestic gas boilers, to large scale CCGT or biomass plants which supply heat for major industrial processes.

D

Display Energy Certificate (DEC)
The certificate shows the actual energy usage of a building and must be produced every year for public buildings larger than 1,000m^2.

E

Electricity production
The total amount of electricity generated by a power plant. It includes own-use electricity and transmission and distribution losses.

Energy Performance Certificate (EPC)
The certificate provides a rating for residential and commercial buildings, showing their energy efficiency based on the performance of the building itself and its services (such as heating and lighting). EPC's are required whenever a building is built, sold or rented out.

Emissions Performance Standard
A CO_2emissions performance standard that would entail regulation to set a limit on emissions per unit of energy output. This limit could be applied at plant level, or to the average emissions intensity of a power company's output.

Energy Intensity
A measure of total primary energy use per unit of gross domestic product.

Energy Efficiency Commitment (EEC)
The predecessor of CERT, and a type of supplier obligation.

European Union Allowance (EU A)
Units corresponding to one tonne of CO_2 which can be traded in the EU ETS.

European Union Emissions Trading Scheme (EU ETS)
Cap and trade system covering the power sector and energy intensive industry in the EU.

F

Feed-in-tariffs
A type of support scheme for electricity generation, whereby renewable generators obtain a long-term guaranteed price for the output they deliver to the grid.

Fuel poverty
A fuel-poor household is one that needs to spend in excess of 10% of household income on all fuel use in order to maintain a satisfactory heating regime.

G

Gas Condensing Boiler

Condensing boilers get their name because they enter what is called "condensing mode" periodically. In other words, they start to extract heat from the exhaust gases that would otherwise escape through the flue, in the process turning water vapour from the gas back into liquid water or condensate.

Global Warming Potential
A metric for comparing the climate effect of different greenhouse gases, all of which have different lifetimes in the atmosphere and differing abilities to absorb radiation. The GWP is calculated as the integrated radiative forcing of a given gas over a given time period, relative to that of carbon dioxide. Standard international reporting processes use a time period of 100 years.

Greenhouse gas (GHG)
Any atmospheric gas (either natural or anthropogenic in origin) which absorbs thermal radiation emitted by the Earth's surface. This traps heat in the atmosphere and keeps the surface at a warmer temperature than would otherwise be possible, hence it is commonly called the Greenhouse Effect.

Gross Domestic Product (GDP)
A measure of the total economic activity occurring in the UK.

Gross Value Added (GVA)
The difference between output and *intermediate consumption* for any given sector/industry.

GWh (Gigawatt hour)
A measure of energy equal to 1000MWh.

H

Heat pumps
Can be an air source or ground source heat pump to provide heating for buildings. Working like a 'fridge in reverse', heat pumps use compression and expansion of gases or liquid to draw heat from the natural energy stored in the ground or air.

Heavy good vehicle (HGV)
A truck over 3.5 tonnes (articulated or rigid).

I

Infrastructure Planning Commission
A new body established by the Planning Act (2008) to take decisions on planning applications for major infrastructure projects.

Integrated Gasification Combined-Cycle (IGCC)
A technology in which a solid or liquid fuel (coal, heavy oil or biomass) is gasified, followed by use for electricity generation in a combined-cycle power plant. It is widely considered a promising electricity generation technology, due to its potential to achieve high efficiencies and low emissions.

K

kWh (Kilowatt hour)
A measure of energy equal to 1000 Watt hours. A convenient unit for consumption at the household level.

kWp (Kilowatt peak)
A measure of the peak output of a photovoltaic system under test conditions.

L

Levelised Cost
Lifetime costs and output of electricity generation technologies are discounted back to their present values to produce estimates of cost per unit of output (e.g. p/kWh).

Life-cycle
Life-cycle assessment tracks emissions generated and materials consumed for a product system over its entire life-cycle, from cradle to grave, including material production, product manufacture, product use, product maintenance and disposal at end of life. This includes biomass, where the CO_2 released on combustion was absorbed by the plant matter during its growing lifetime.

Light Goods Vehicle
A van (weight up to 3.5 tonnes; classification N1 vehicle).

M

Mitigation
Action to reduce the sources (or enhance the sinks) of factors causing climate change, such as greenhouse gases.

$MtCO_2$
Million tonnes of carbon dioxide (CO_2).

MWh (Megawatt hour)
A measure of energy equal to 1000 kWh.

O

Ofgem (Office of Gas and Electricity Markets)
The regulator for electricity and downstream gas markets.

P

Passive Design

Passive design is design that does not require mechanical heating or cooling. Homes that are passively designed take advantage of natural climate to maintain thermal comfort.

R

Renewables
Energy resources, where energy is derived from natural processes that are replenished constantly. They include geothermal, solar, wind, tide, wave, hydropower, biomass and biofuels.

Renewable Energy Strategy (RES)
Government strategy aiming to increase the use of renewable energy in the UK, as part of the overall strategy for tackling climate change and to meet the UK's share of the EU target to source 20% of the EU's energy from renewable sources by 2020. Draft strategy was published for consultation in 2008.

Renewable Heat Incentive (RHI)
Will provide financial assistance to producers (households and businesses) of renewable heat when implemented in April 2011.

Renewables Obligation Certificate (ROC)
A certificate issued to an accredited electricity generator for eligible renewable electricity generated within the UK. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated.

Retrofit

Retrofitting refers to the addition of new technology or features to older systems.

S

Smart meters
Advanced metering technology that allows suppliers to remotely record customers' gas and electricity use. Customers can be provided with real-time information that could encourage them to use less energy (e.g. through display units).

Smarter Choices
Smarter Choices are techniques to influence people's travel behaviour towards less carbon intensive alternatives to the car such as public transport, cycling and walking by providing targeted information and opportunities to consider alternative modes.

Social tariff
An energy tariff where vulnerable or poorer customers pay a lower rate.

Solar photovoltaics (PV)
Solar technology which use the sun's energy to create electricity.

Solar Thermal
Solar technology which uses the warmth of the sun to heat water to supply hot water to buildings.

Solar water heating
Solar technology which uses the warmth of the sun to heat water to supply hot water in buildings.

Standard Assessment Procedure
UK Government's recommended method for measuring the energy rating of residential dwellings. The rating is on a scale of 1 to 120.

Supplier Obligation
An obligation that the Government places on energy suppliers, to help householders reduce their carbon footprint. The current policy is the Carbon Emissions Reductions Commitment (CERT) running from April 2008 to 2011.

T

Technical potential
The theoretical maximum amount of emissions reduction that is possible from a particular technology (e.g. What would be achieved if every cavity wall were filled). This measure ignores constraints on delivery and barriers to firms and consumers
that may prevent up take.

Total final consumption (TFC)
The sum of consumption by the different end use-sectors.TFC is broken down into energy demand in the following sectors:

- Industry, transport, other (includes agriculture, residential, commercial and public services) and non-energy uses.
- Industry includes manufacturing, construction and mining industries. In final consumption, petrochemical feedstocks appear under industry use. Other non-energy uses are shown under non-energy use.

TWh (Terawatt hour)
A measure of energy equal to 1000 GWh or 1 billion kWh. Suitable for measuring very large quantities of energy – e.g. annual UK electricity generation.

Appendix F - Carbon / Energy Budget Statement

REQUIREMENTS FOR CARBON BUDGET STATEMENT

Consistent with Core Strategy Policy L5 Climate Change, all residential developments and non-residential development above a 1,000m² thresholds are required to submit a Carbon Budget Statement.

This study has identified that there are opportunities to secure on site renewable energy generation from small developments including those less than 10 units in size. The current draft Policy L5 makes provision for a Carbon Budget Statement to be prepared for all residential developments in the Borough. Provision should be made in a Supplementary Planning Document to provide guidance on how the policy should be applied so that the process of preparing a Carbon Budget Statement for this scale of development is not too onerous.

The Carbon Budget Statement would establish the potential for renewable energy provision and carbon emissions reductions linked to building performance. The strategy to deliver carbon emissions savings should:

- Consider how potential on and near site renewables generation can be maximised;
- Consider how improved building performance and sustainable construction can secure emissions savings;
- Demonstrate that costs and potential benefits have been considered including interaction with other policy requirements; and
- Demonstrate that full consideration has been given to the potential delivery options

The key steps to be followed in preparing a Carbon Budget Statement are outlined below. These steps refer to worked examples contained in this report of the cost and contribution (as at 2010) of on-site renewable technologies, scaled by size of the specific project. For example: once the appropriate geographical location is identified, the relevant project scale is identified and carbon reduction contribution is calculated and agreed. The appropriate contribution to the total project energy demand to be met from renewable technology is calculated and expressed as a percentage of the expected energy demand the tables in Appendix C “Renewable Energy Technology Detailed Costs” (“RE Tables”) and offer an indicative cost and technology options to meet the carbon reduction target for heat and for power, adjusted by the economies of scale.

Further step by step guidance and worked examples in support of the specific project and associated Carbon Budget Statement should be provided with the Sustainability SPD.

- **Step 1**: Calculate the predicted annual energy demand of the project using the latest benchmarks provided in this report. The energy and carbon dioxide benchmarks are calculated using the expected energy demand split between heating and electricity and adjusted for the building efficiencies and phased over the period of development, reflecting the appropriate building regulations alongside the national and regional targets.
- **Step 2**: Calculate the baseline carbon dioxide for the entire development phased by the year that each building project is completed using the National Calculation Methodology and the latest carbon emissions factors (benchmarks included in this report as at 2010).
- **Step 3**: Draw up a shortlist of renewable technologies for consideration that are appropriate to the development. Applications may consult the latest and relevant SPD and the tables within this report to identify and determine the relevant, preferred and applicable renewable technologies to meet the carbon reduction and energy demand targets. Proven energy efficiency measures are excluded from this section of the report but maybe relevant within the Carbon Budget Statement.
- **Step 4**: Calculate the contribution of each proposed renewable energy technology. The calculated energy demand and the associated carbon dioxide target of each phase of the

project can be met in a through the deployment of a variety of energy-saving and renewable technologies and would be proposed in the Carbon Budget Statement for the specific project.

- **Step 5**: Calculate the costs of the technically feasible renewable technologies including establishment, connection and finance costs, The benchmarking tables within this report provide indicatives costs and benchmarks as at 2010 all scaled by project size and reflecting expected economies of scale. The cost per tonne of displaced carbon dioxide is used to inform the baseline economic cost of the proposal.
- **Step 6**: Calculate the revenue to be received through the Renewable Obligations Certificates (ROCs), Feed-In Tariffs (FITs), Renewable Heat Initiatives (RHI) and other relevant Government incentives alongside the support available from targeted initiatives to reduce fuel poverty. The expected heat and power output, an indicative technical solution and the associated assumptions are contained within the tables. Other assumptions must be stated within the Carbon Budget Statement.
- **Step 7**: Demonstrate that consideration has been given to the business case and Power Purchase Agreement with an Electrical Supplier; the Carbon Budget Statement requires that:
  - Renewable power is used safely and effectively, which may mean exporting to and importing from the national power grid and should demonstrate that the required agreements with the stakeholders (such as Meter Owner and Operator, the Distribution Network Operator and a properly Licensed Electricity Supplier) are in place;
  - Renewable Heat is used safely and effectively, which may mean the use and sale of heat into a heat network on one or many properties or commercial sites or into the local Heat Main; and
  - The source of the feedstock fuel to be identified and purchase options in place including hedging the feedstock fuel, power and heat prices.
- **Step 8**: Assess the benefits of technically feasible renewable technologies including end-user benefits considering whole life costs, developer benefits, local benefits and global benefits: a high level business case to demonstrate the long-term commercial viability of the proposed technologies over the project period demonstrating total indicative revenues and other benefits derived from the agreements and informed by the tables as appropriate.
- **Step 9**: Calculate the reduction of baseline carbon dioxide emissions for the development or the project.
- **Step 10**: Calculate the annual amount of electricity (kWhe) and/or heating kWhth which will be met by on-site and near-site renewables taking into account the amount of delivered energy, end-use demand, energy efficiency, Co-efficient of Performance ("COP"): individual technologies provide either electric or thermal (heat) energy, with the exception of Combined Heat and Power ("CHP") plants which provide a combination of both heat and electricity.
- **Step 11**: Within the development appraisal show the effect of the costs of renewable energy generation options with other planning obligations including affordable housing, the relevant Code for Sustainable Homes and cost of compliance with Building Regulations. The tables in this report provide indicative costs and impacts both in kWhe and kWhth of the technology combinations by the proportion of the energy demand to be met by renewable generation.
- **Step 12**: Identify the approach to be taken for the operation and long term maintenance of the installation including demonstrating the long term safe, secure and viable operational.
- **Step 13**: Provide justification for the preferred approach to meet the requirements of the current Core Strategy policy.
- **Step 14**: Provide justification for inclusion in the Planning Application; and

- **Step 15**: Derive the requirements to be included within a Planning Obligation where appropriate.

The Carbon Budget Statement should be prepared in conjunction with the preparation of development proposals and be considered during pre-application discussions in order to scope out potential renewables options prior to the detailed design of proposals in order that the range of options are not narrowed prematurely and that opportunities for renewables are incorporated early on.

Appendix G - Suggested Approach for Assessing Renewable Technologies

ASSESSING THE INCORPORATION OF RENEWABLE TECHNOLOGIES INTO NEW DEVELOPMENT PROPOSALS: SUGGESTED APPROACH FOR DEVELOPMENT MANAGEMENT

This approach should be guided in greater detail by the proposed SPD and be run in tandem with the steps outlined in Appendix F.1 of the Trafford Low Carbon and Energy Evidence Study for the preparation of a Carbon Budget Statement.

This process should only be introduced once a sound, and rigorously tested evidence base for renewable technologies, development types and locations in Trafford is in place through an adopted SPD.

1. Undertake pre-application discussions as early as possible with the applicant / developer and their agent in order to raise awareness of the requirements for a Carbon / Energy Budget Statement and how it will be used in determining a planning application.

2. Determine the relevant CO_2 reduction target and relevant Target Area for the proposed development by referring to Core Strategy Policy L5. This should be confirmed with the applicant / developer during initial pre-application discussions.

3. Consider feasibility for connection to existing / proposed low and zero carbon networks, if located within Trafford's Low Carbon Growth Areas.

4. Consider feasibility of decentralised low and zero carbon technologies. Guidelines on suitable locations for each technology are set out below.

   N.B Where possible, run this exercise with the developer during pre-application discussions and include the relevant technical officer in these discussions. This will aid transparency and assist the developer in gaining a greater appreciation of the pros and cons of each technology.

5. Having determined which renewable technologies are feasible, the developer should now follow steps 2 to 10 (in Appendix F.1 of the Trafford Low Carbon and Energy Evidence Study) in order to complete a carbon budget statement for the development proposals to provide an indication of what percentage reduction in CO_2 emissions and the costs associated with the renewable technologies that will deliver those reductions.

6. If no renewable technologies are viable, consider contributions through allowable solutions into an established mechanism that delivers CO_2 reductions in a consistent and transparent manner across the Borough.

7. Incorporate the costs of the renewable energy technologies / allowable solutions contributions into the development appraisal and assess the cost implications against other priorities, such as affordable housing contributions.

8. Depending upon the outcome of 6, liaise and negotiate with the developer in line with key policy requirements, such as CO_2 reduction and affordable housing, and scheme viability.

9. Should on site renewable technologies be feasible, ensure proposals are incorporated into the planning application to enable the delivery of necessary renewable technologies.

10. Prepare and complete legal agreement to ensure commitment to delivery of renewable technologies and agreed CO_2 reduction targets / allowable solutions.

GUIDELINES ON SUITABLE LOCATIONS FOR RENEWABLE TECHNOLOGIES

Wind Turbines - Stand Alone

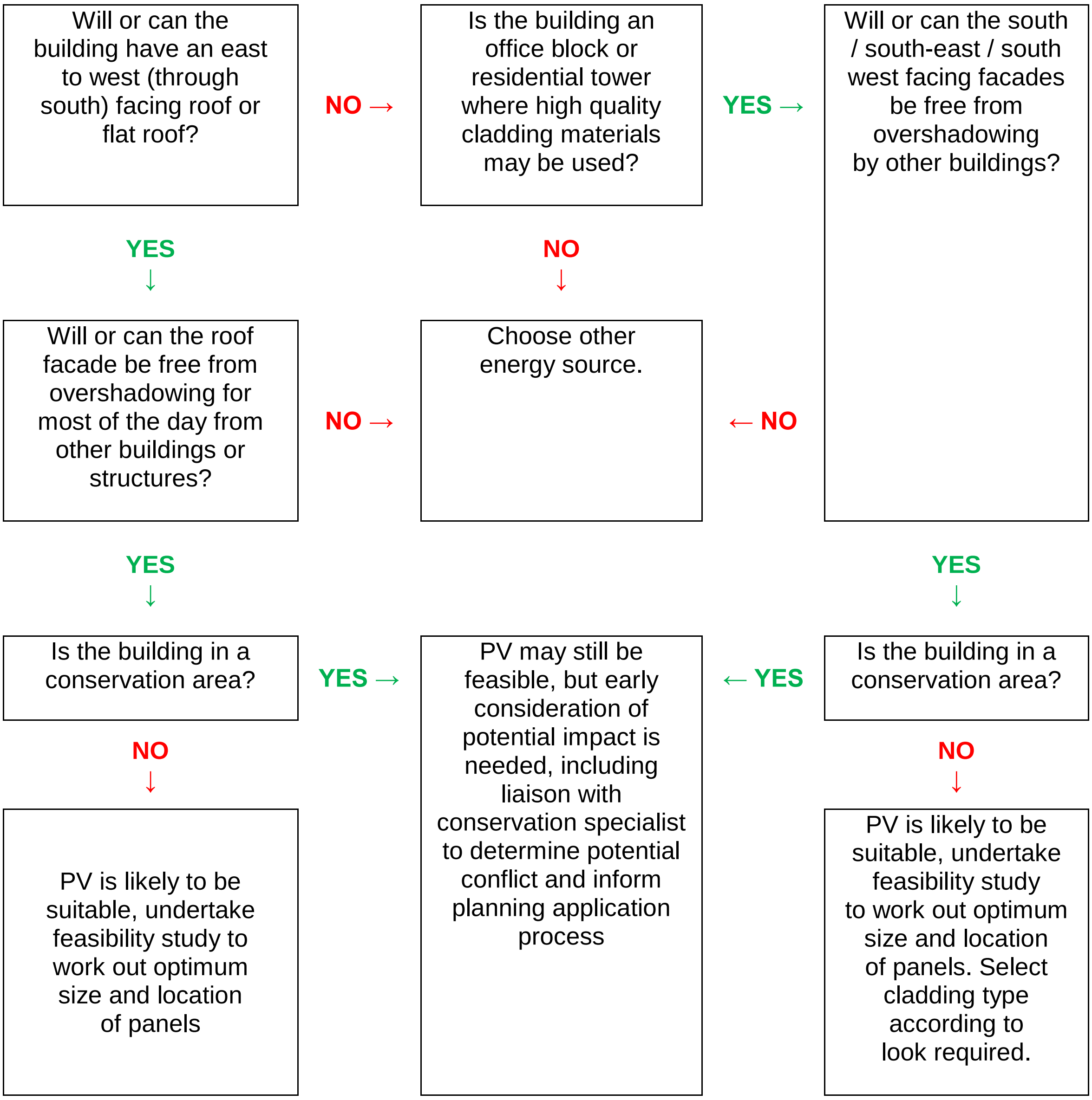
Is there an average wind speed of at least 6 m/s on site?	NO →	Choose other renewable energy option
YES ↓		
Is the area free from obstructions that could cause turbulence, such as tall buildings, other structures, trees?	NO →	Check how turbulence will affect turbine performance before pursuing as an option
YES ↓		
Is there sufficient land on the development to allow the placement of the turbine(s) away from residential areas? The distance is dependent upon turbine size	NO →	Choose other renewable energy option
YES ↓		
Is the site in or near a conservation area or area of historic interest, listed building or in the Green Belt?	YES →	Wind could be a feasible option but early consideration of potential impact is needed, including liaison with conservation specialist (and existing local residents) to determine potential conflict and inform planning application process. N.B. Demonstration of 'very special circumstances' would be required for Green Belt land.
NO ↓		
Wind power is likely to be a feasible option. Carry out detailed site analysis.		

Wind Turbines - Roof Mounted

Roof mounted wind turbines have not been widely demonstrated, but are currently under trial by a number of manufacturers. The criteria for mounting a small (1.5kW) turbine on a roof are minimal - as they are designed to fit any roof design and are mounted on the wall.

They have been designed to work in turbulent wind conditions (as might be experienced on roof tops) and have been designed to minimize vibrations through use of damping systems. The turbines will work in lower wind speeds than larger turbines, estimated at 3.5m/s.

Photovoltaics



Solar Thermal Systems – Office, Retail, Industrial and Apartment Development

Will the building have a year round hot water demand? For example, canteen, washrooms, showers, industrial process.	NO →	Choose other renewable energy source
YES ↓		
Will the building have an open aspect south-east to south-west facing roof (or flat roof)? If not, can it be reoriented so it will?	NO →	Choose other renewable energy source
YES ↓		
Is there space for a hot water cylinder(s) close to the panels? If not, can the design be altered to provide suitable space?	NO →	Longer, more complicated / expensive pipe work might be required but still possible. Carry out study of roof and roof space.
YES ↓		
Is the building in a conservation area?	YES →	Consider potential impact, obtain early specialist conservation advice and ensure the system is located as unobtrusively as possible. Systems have been installed in conservation areas.
NO ↓		
Solar water heating is likely to be suitable for this site. Confirm whether planning permission is required and ensure the system design is discreet. Carry out more detailed survey to work out size of panels required.		

Solar Thermal Systems – Homes or Small Apartment Development

Will or can any of the dwellings have an open aspect south-east to south-west facing roof (or flat roof) and area of at least $4m^2$?

NO → Choose other renewable energy source

YES ↓

Is there space for a hot water cylinder(s) near the panels? If not, can it be altered so there is?

NO → Carry out study of roof and roof space

YES ↓

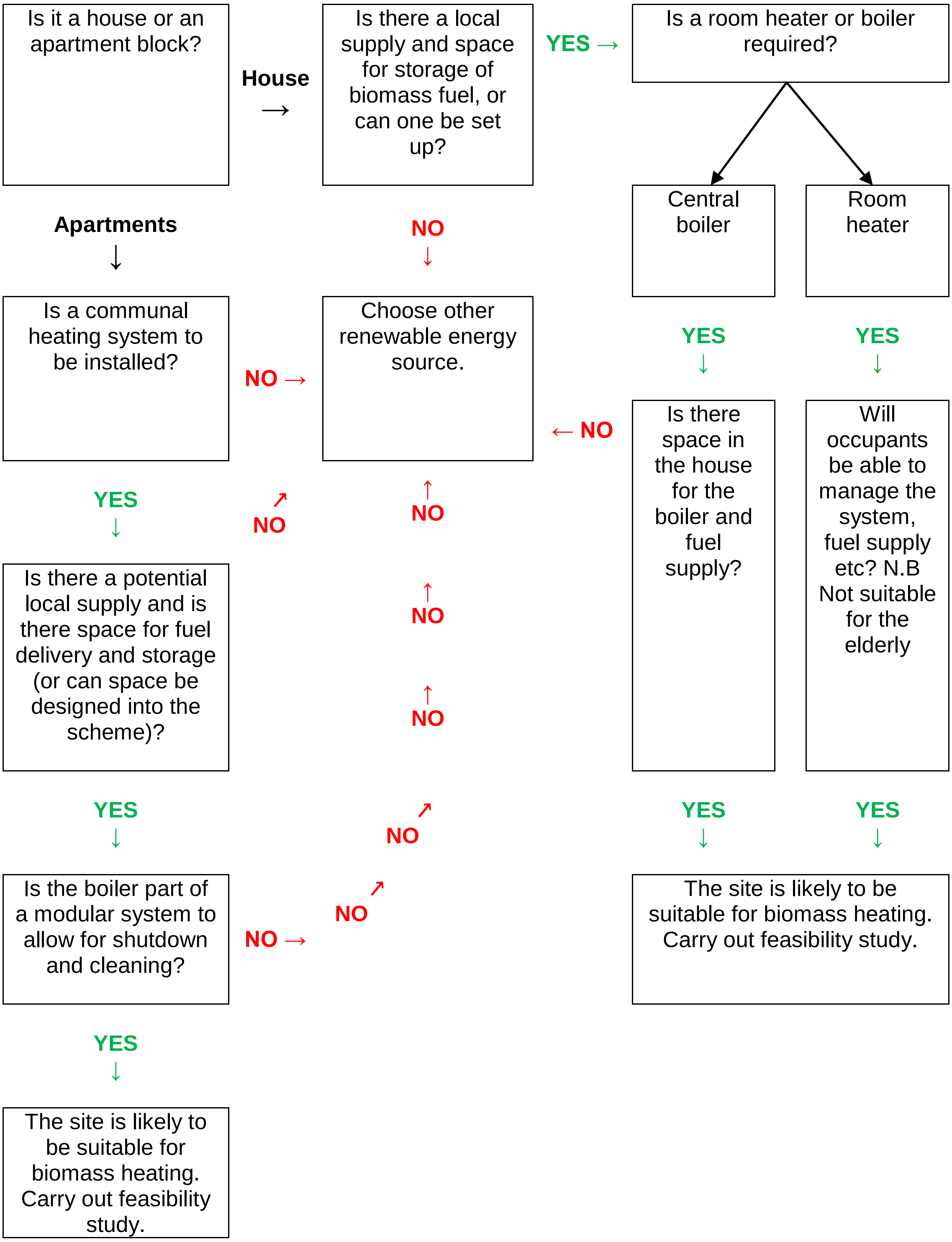
Is the building in a conservation area?

YES → Consider potential impact, obtain early specialist conservation advice and ensure the system is located as unobtrusively as possible. Systems have been installed in conservation areas.

NO ↓

Solar water heating is likely to be suitable for this site. Confirm whether planning permission is required and ensure the system design is discreet. Carry out more detailed survey to work out size of panels required.

Domestic Biomass Heating



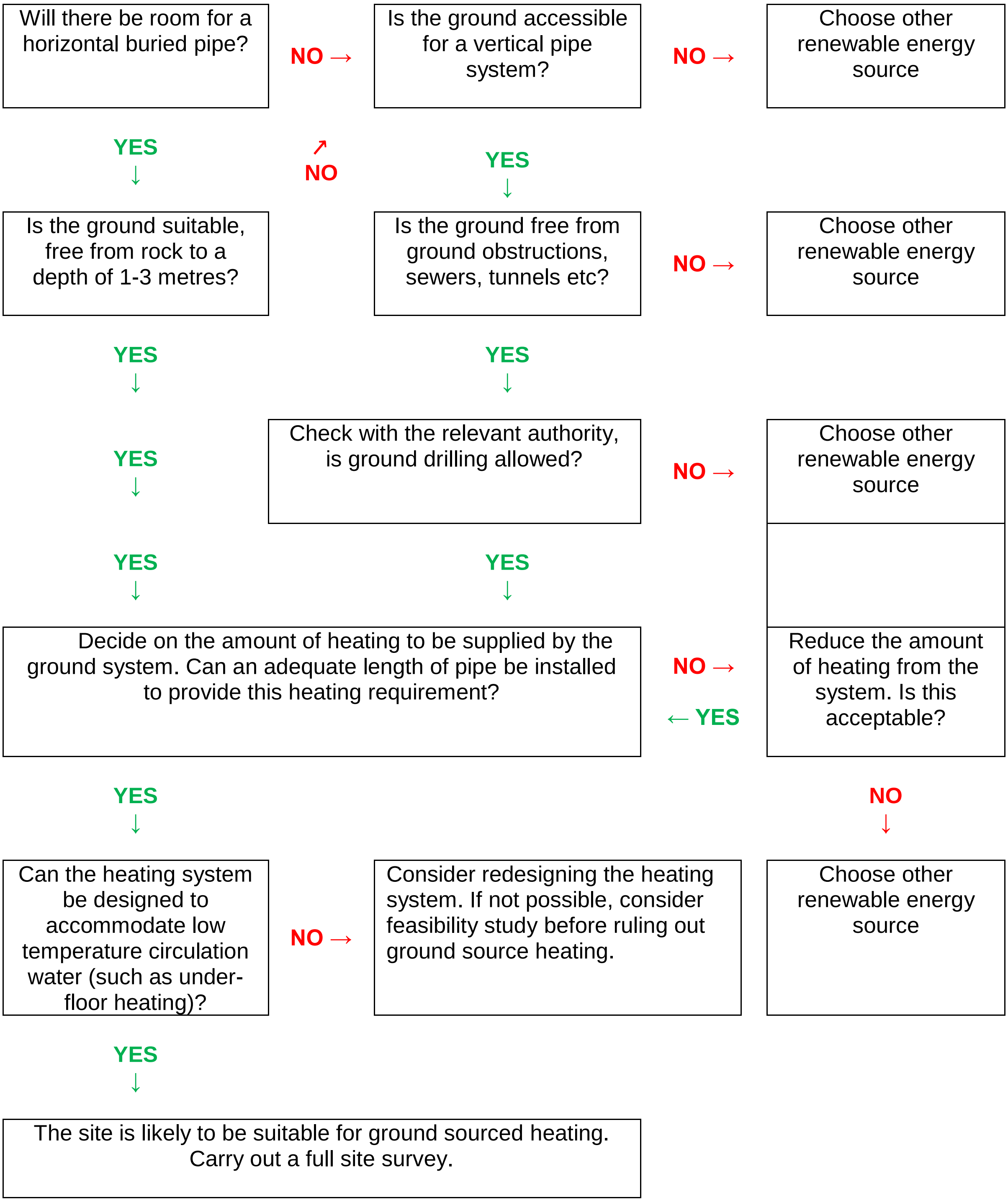
Non-domestic Biomass Heating

Is there the potential for a local supply, delivery and storage for biomass fuel?	NO →	Choose other renewable energy source, only if it is not possible to set up a fuel supply chain.
YES ↓		
Can the boiler house be located so it is suitable for biomass supply, with sufficient storage capacity?	NO →	Check other renewable energy source, only if there is no scope to design-in storage capacity in the scheme.
YES ↓		
Will boiler be part of a modular system to allow for shut down and cleaning?	NO →	Redesign to be part of a modular design, if not possible, choose another renewable energy source.
YES ↓		
The site is likely to be suitable for biomass heating. Carry out feasibility study.		

Biomass CHP

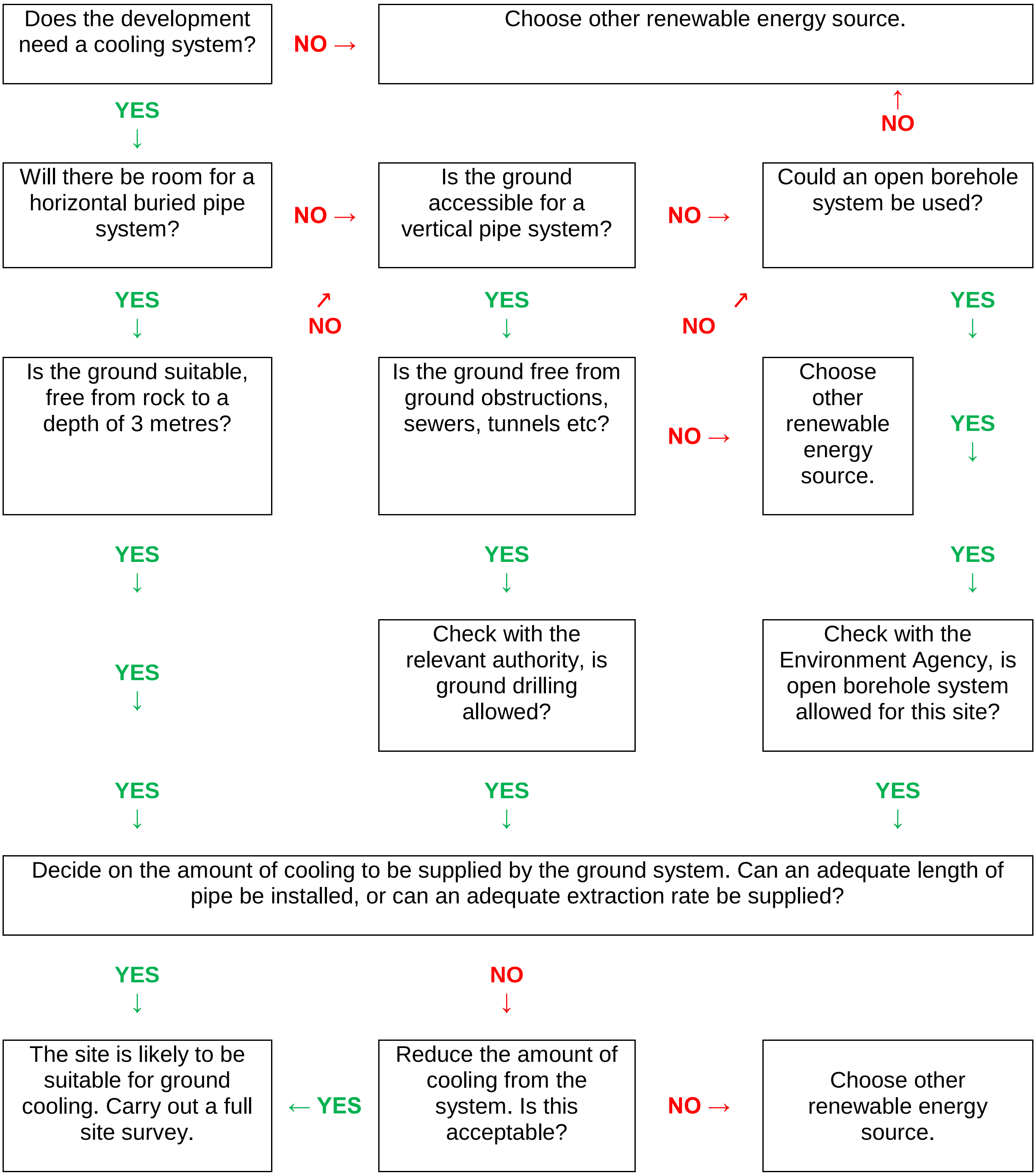
Question		If NO
Will the development have a year-round demand for heat, and a communal heating system?	NO →	Choose other renewable energy source
YES ↓		
Is a reliable guaranteed CHP system available at the appropriate size?	NO →	Is it possible to re-size the CHP plant? If not, choose other renewable energy source.
YES ↓		
Is there potential for a local supply, delivery and storage for biomass fuel?	NO →	Choose other renewable energy source, only if it is not possible to set up a supply chain.
YES ↓		
Can a reliable CHP repair and maintenance system be put in place in the completed development?	NO →	Choose other renewable energy source
YES ↓		
The site is likely to be suitable for biomass CHP. Carry out feasibility study.		

Ground Source Heating



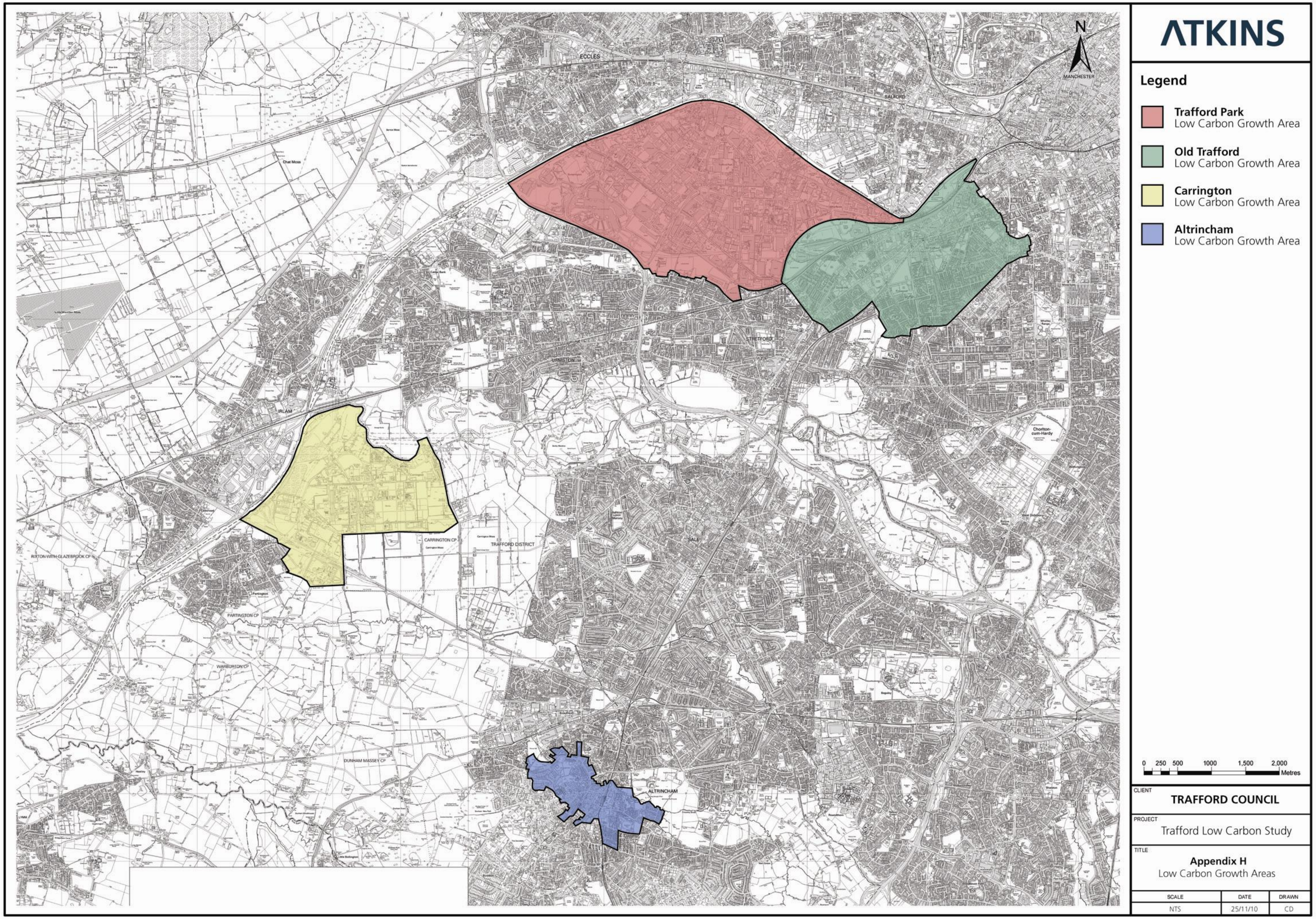
N.B The same equipment may be used for cooling.

Ground Cooling Systems



N.B The same equipment may be used for heating.

Appendix H - Trafford Low Carbon Growth Areas


ATKINS
Legend
Trafford Park
Low Carbon Growth Area
Old Trafford
Low Carbon Growth Area
Carrington
Low Carbon Growth Area
Altrincham
Low Carbon Growth Area
N
0 250 500 1000 1,500 2,000 Metres
CLIENT
TRAFFORD COUNCIL
PROJECT
Trafford Low Carbon Study
TITLE
Appendix H
Low Carbon Growth Areas
SCALE NTS
DATE 25/11/10
DRAWN CD
ECCLES
SALFORD
STRETFORD
URMSTON
IRLAM
CARRINGTON CP
TRAFFORD DISTRICT
PARTINGTON CP
WARBURTON CP
DUNHAM MASSEY CP
ALTRINCHAM
RIXTON-WITH-GLAZEBROOK CP
Chat Moss