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Ipswich Renewable Energy and Sustainable Construction Viability and Resource Assessment

climatechangesolutions

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Housing growth plans for Ipswich

Ipswich has been identified as a growth point in the East of England plan and approximately 10,000 homes, 35,000 sq m of retail and 55 hectares of employment land are expected to be built between now and 2026. This development will be captured by the proposed sustainability policies DC1 and DC2 in the Core Strategy which set Code for Sustainable Homes standards for new housing and BREEAM standards for new non-domestic development, and a 15% renewable energy contribution from new development.

This study has undertaken an assessment of the available renewable energy resource within Ipswich Borough and has also investigated the potential impact of the proposed Core Strategy sustainability policies DC1 and DC2 on development viability in Ipswich. In assessing the viability of the proposed sustainability policies it has considered indicative energy supply strategies for a sample of development sites so as to assess the carbon benefits and financial costs of suitable low carbon solutions and requirements for different development types.

Current and Future Energy Consumption

The overall energy consumption within Ipswich is currently approximately 1,780 GWh per annum creating 559,122 tonnes of CO2 per annum.

Energy use in housing is dominated by heat consumption, whereas in non-residential buildings energy use is evenly spread between heat and electricity. However, due to the higher carbon intensity of electricity, CO_2 emissions are evenly distributed between heat and electricity in housing and are dominated by electricity consumption in non-residential buildings. Based on historical trends, energy consumption would be likely to increase over the coming years but the Government's 2009 Low Carbon Transition Plan sets out a number of policies that are expected to encourage lower energy consumption over the next decade.

Future energy consumption has been estimated based on Department of Energy and Climate Change (DECC) methodology which derives energy demand projections in the existing built environment, and from the planned housing and non-residential building growth. This analysis suggests that energy consumption within Ipswich will have fallen to approximately 1,560 GWhs per annum by 2026 even taking into account the planned growth in buildings.

Renewable Energy Resource within Ipswich Borough

As shown in Table 1, there is the practical potential to generate approximately 8.1% of Ipswich's projected total energy consumption in 2020 from renewable sources.

Energy recovery from biomass waste would make the largest contribution to overall renewable energy generation by 2020, with the potential to supply 45.5 GWh (21.8 GWh thermal, 23.7 GWh electrical) or 3.1% of total projected energy demand in Ipswich.

Is should be noted that technologies integrated within both existing buildings and new developments will play a significant role. Based on the assumed renewable energy strategies for future developments, by 2020, a total of 32.8 GWh (19.8 GWh thermal, 13.0 GWh electrical) of renewable energy could be generated from the new build in Ipswich, representing 2.2% of total projected energy demand. Under current national policy, it has been estimated that retrofit to existing buildings could deliver approximately 24.3GWh (21.8 GWh thermal, 2.5 GWh electrical).

Despite Ipswich being a predominantly urban district, the constraints analysis carried out to identify unconstrained areas for wind energy development showed three small sites that could (technically) accommodate one large-scale turbine each. If developed, with a total installed capacity of 7.5 MW, these three turbines could generate approximately 15.6 GWh of electricity (just over 1% of projected total energy demand by 2020).

Table 1: Potential renewable energy resource in Ipswich Borough

Renewable energy category	Total potential energy generation (GWh)	Proportion of total renewable energy potential	Proportion of Ipswich's total energy demand
Decentralised wind	15.60	13.15%	1.06%
Decentralised biomass	45.47	38.32%	3.10%
Decentralised hydro	0.52	0.44%	0.04%
New build	32.77	27.62%	2.23%
Existing build	24.30	20.47%	1.66%
Total	**118.7**	**100.00%**	**8.08%**

Overview of viability assessment of policies DC1 and DC2

The impact of Code for Sustainable Homes Standards on development viability has been assessed by building on the study carried out by Fordham Research Group[1] which derived residual land values[2] for different sites in Ipswich under different affordable housing levels. The Fordham analysis showed that most town centre sites are not viable for development under general market conditions, and therefore will also struggle with the costs of building to both the Government's improving carbon standards as well as Ipswich Borough Council's additional sustainability requirements. However, our analysis suggests that the economically healthier development sites in the Northern Fringe could cope with the costs of meeting most of the sustainability requirements under DC1 and DC2 if developers secure ESCo finance to cover some of the costs, and could potentially cope with the costs of meeting all requirements if the housing market picks up in the coming years.

In addition, policies DC1 and DC2 incorporate the Government's policy requirement of a sequential improvement in the Building Regulation carbon standards, and in fact the majority of the cost of achieving policies DC1 and DC2, consists of the cost of meeting these Building Regulation carbon requirements. The specific impact of policies DC1 and DC2 on development viability in Ipswich is therefore less than the Code for Sustainable Homes cost analysis suggests. In proposing policy DC1, Ipswich Borough Council has set a robust environmental planning policy which seeks to ensure that high standards are set for all environmental issues in addition to carbon emissions.

General viability of development in Ipswich

The study carried out by Fordham Research Group assessed the viability of sites in Ipswich, Babergh and Mid Suffolk & Suffolk Coastal sites through incorporating costs of achieving Code Level 3 and different affordable housing levels. Out of the 8 Ipswich sites that were analysed, 3 of them were in IP-One area (Waterfront, Ipswich Cent E edge and Ipswich

[1] Affordable Housing Site Viability Study by Fordham Research Group, June 2009.
[2] Residual land value is defined as the value of the site after taking out the costs of development and developer's profit from the likely income from sales and/or rents.

Cent W edge), 3 of them in Northern Fringe (N of Valley Road, W of Westerfield Road, Ipswich North Sub) and 2 other sites were located in other various locations in Ipswich.

The results presented in the study show that development viability in the Ipswich area is in general marginal. **Out of the 8 Ipswich sites considered in the Fordham study, 3 of them were considered not viable for development at standard build costs (assuming no affordable housing but including Code level 3 costs). As the affordable housing levels increased to 25% two other Ipswich sites became unviable, and at 40% affordable housing only one site was found to be viable (located in the Northern Fringe).** The sites in IP-One struggle to achieve the viability test in general, and none of the sites are viable when affordable housing requirements are introduced (without grant support). Viability in the Northern Fringe is generally healthier which indicates that Northern Fringe sites are best suited to absorbing the costs of building to higher sustainability standards.

Policy CS12 of the Proposed Submission Core Strategy and Policies of the Ipswich Local Development Framework (September 2009) requires (a) 40% affordable housing provision in schemes of 15 or more dwellings or 0.5ha or more; and (b) 20% affordable housing provision in schemes of between 10 and 14 dwellings or 0.3 to 0.49 ha.

However it is important to note that these targets will be subject to viability testing. The targets will guide the requirement for affordable housing on allocated sites and windfall sites, but actual provision on each site will be determined through negotiation having regard to:

- development size
- site development costs
- the requirement to deliver new housing
- scheme viability including the the availability of Social Housing Grant; and
- costs associated with other planning objectives such as planning to reduce carbon emissions.

Effect on site viability of building to CSH Levels 4, 5 and 6 (at 2008 market prices and without ESCo finance)

The Fordham study analysed a number of variables under a 30% affordable housing policy, and we have used these figures in our analysis of the impact of building to Code levels 4, 5 and 6. The analysis suggests that under 2008 market prices and without access to ESCo finance, imposing higher levels of the Code for Sustainable Homes on housing developments will reduce the residual land values even further on Ipswich development sites. The results are summarised in the table below where green cells indicate viability, amber cells indicate marginal sites, and red ones indicate unviable sites. The tables show two figures under the alternative use values: the alternative use value itself and the alternative use value plus a 15% cushion.

At 30% affordable housing under normal build costs (based on Code Level 3 as shown in the table below), only two sites were viable (North of Valley Road and West of Westerfield Road; both located in the Northern Fringe area) and one site was marginal. Our modelling results showed that **adding on the costs of Code level 4 would push one of these sites**

out of viability, leaving one site as 'viable' and one site as 'marginal'. Increasing the costs to achieve Code levels 5 and 6 left no viable sites in the Ipswich area.

VIABILITY RESULTS WITH TOTAL COSTS OF ACHIEVING DIFFERENT CODE LEVELS								
Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
3	-65	-2130	223	142	-470	211	-34	-2
4	-126	-2,095	131	63	-837	165	-279	-83
5	-283	-2,614	24	-28	-1,237	46	-391	-181
6	-364	-2,838	-34	-77	-1,402	-15	-474	-264

Effect on site viability of building to CSH Levels 4, 5 and 6 with increased market prices (compared to 2008 market prices) and ESCo finance

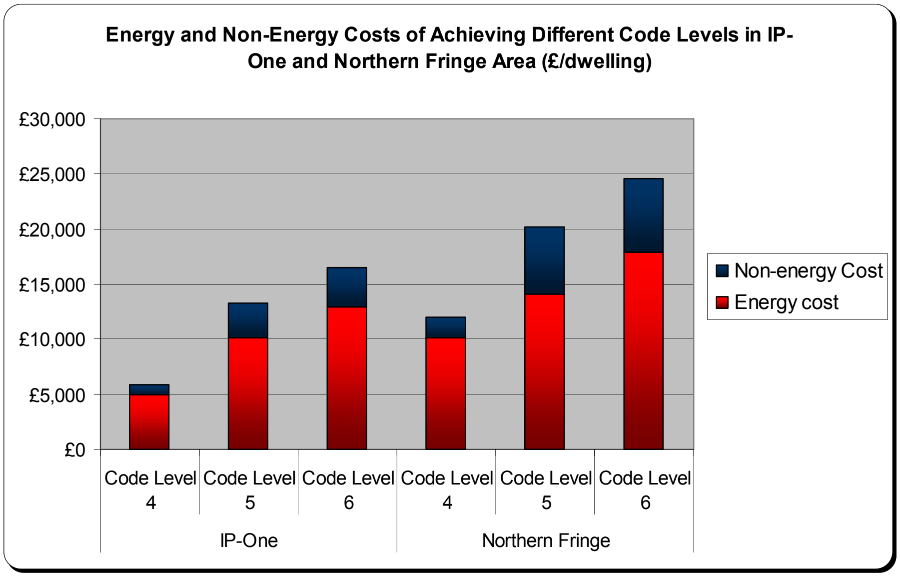
An ESCo is a specialist energy services company that can finance, design, build and operate communal energy infrastructure such as biomass heating systems or combined heat and power systems in return for the revenue streams from selling low carbon heat to customers. Across the UK in recent years, ESCo companies have formed partnerships with housing developers on a number of low carbon housing projects that are installing communal boilers and site-wide heat distribution infrastructure in the development. ESCo finance potentially has an important role in improving the viability of the sites through contributing to the capital costs of renewable energy technologies and reducing the burden on the developers. **When ESCo finance is included, viability in three of the sites located in Northern Fringe area improved and are viable up to Code Level 5. When we assessed the combination of ESCo finance with a 7.5% increase in housing prices (compared to 2008 prices) we found that the Northern Fringe sites were viable up to Code Level 6.** These results are summarised in the table below.

VIABILITY RESULTS WITH INCREASED PRICES AND ESCO FINANCE								
Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-2	-1,537	236	176	-477	280	-68	119
5	-148	-1,951	179	127	-896	169	-215	-3
6	-208	-2,143	129	85	-1,030	124	-282	-70

The modelling of communal heating systems for the Northern Fringe sites enabled by the size of the development also helped the viability of these sites through lower costs of energy compliance. This was further reinforced by the larger initial residual land values that these sites had. If specific site conditions were found not to suit communal heating systems at these sites, then the costs associated with the energy requirements of the code could be higher which might affect the viability status of these sites.

High cost of carbon compliance within the Code

It is important to note that the majority of the costs of building to the Code are the carbon compliance costs which will be borne by developers regardless of Ipswich's policies due to government's ambition to make all new housing developments zero carbon by 2016. Therefore, the additional costs that DC1 brings about in relation to government's policy would just be the costs associated with the non-energy requirements of the Code for Sustainable Homes. In order to support this point, we have also modelled viability with only the energy costs of different code levels which reflects the impact of government's policy of carbon neutrality by 2016.The figure below shows the ratio of the typical energy costs associated with meeting different Code levels compared to the cost of meeting the other environmental aspects of the Code, with the energy costs three to four times the size of the cost of the other elements.



Source: Zero Carbon Homes Consultation and Davis Langdon & Element Energy study

Assessing Impact of the proposed Core Strategy policies DC1 and DC2 on Development Viability

We have assessed the impact of the energy costs of the Code on the viability of the sites, leaving out the costs of achieving the other environmental requirements, and found that the results on viability were almost the same. In other words**, the impact on development viability of the cost of the non-energy of the Code is very small**. The table below illustrates that for the base case scenario (no ESCo contribution) when the non-energy costs are removed and only the energy costs are incorporated into the viability testing, the impact on the viability results are very small. For example, under Code Level 4, viability of the North of Valley Road site was improved to 'viable' from marginal and Ipswich North Sub site was upgraded to being 'marginal' from a previous status of having a residual land value that is slightly lower than the alternative use value. For Code Level 5, the only change was on the West of Westerfield Road where the site became 'marginal'. Under Code Level 6, there was no difference on viability between DC1 and the government's policy: with all sites unviable.

VIABILITY RESULTS WITH ONLY ENERGY COSTS OF ACHIEVING CODE FOR SUSTAINABLE HOMES								
Residual land values (£k/acre)	**Co op Depot**	**Waterfront**	**N of Valley Road**	**W of Westerfield road**	**Ipswich Cent E edge**	**Ipswich North sub**	**Ipswich SE**	**Ipswich Cent W edge**
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-106	-2,031	155	84	-788	180	-255	-58
5	-191	-2,396	105	41	-1,108	115	-327	-117
6	-251	-2,589	55	-1	-1,242	70	-394	-184

Impact of DC1 BREEAM Requirement on the Viability of Non-Domestic Buildings

In the absence of general viability data for non-domestic development sites, a different approach was followed for assessing the capacity of commercial developments to absorb the costs of achieving BREEAM standards. We have compared employment land values in

Ipswich with the regional and national average in order to provide an indication of its ability to cope with the BREEAM costs. A study by Cyril Sweett in 2005 demonstrated that achieving BREEAM Excellent can add up to 7% onto the build costs of a new office building. The commercial land values in Ipswich are lower than the regional and national average and therefore Ipswich has slightly below average capacity in terms of absorbing the costs of building to higher BREEAM standards.

Although there is greater variability in non-domestic buildings, and there isn't the same level of detail of cost data as for the Code, energy costs are also likely to be the most substantial costs within BREEAM. Therefore, in the same way as for the Code requirements of DC1, the **government's timetable for all new non- domestic developments to be zero carbon from 2019 will constitute the main costs of the DC1 requirement for non-domestic buildings**.

Renewable Energy Policy - DC 2

In order to assess the impact of policy DC2 on development viability, the relationship between 15% and 20% on-site renewable energy generation and the carbon requirements in Code Levels 3 & 4 has been assessed, and the additional compliance costs associated with the policy identified. The requirement for 15% of energy to be generated from renewable energy equates nearly exactly to the carbon reduction target for Code for Sustainable Homes Level 3. **The 15% renewable energy policy in combination with a Code Level 3 requirement will not therefore lead to any additional carbon reductions but it will increase the cost of delivering these carbon reductions.**

The impact of the 15% Renewable Energy Policy on the viability of the development sites is essentially that of slightly increasing the cost of compliance for Code Level 3. The increase in cost may be only small where site characteristics allow the lower cost renewable energy technologies to meet the majority of the target, but the cost impact could be fairly substantial if higher cost technologies are needed. Policy DC2 would also have the perverse effect of encouraging developers to install renewable energy at the expense of energy efficiency fabric improvements which have a longer lifespan in terms of carbon savings

If the renewable energy requirement were increased to 20% it would equate to a carbon reduction requirement of 33% for heating and lighting emissions, which lies approximately halfway between the requirements of Code Levels 3 and 4.

The impact of a 20% Renewable Energy Policy on the viability of the development sites would be that of placing a requirement on developers similar in cost to meeting Code Level 4 carbon requirements. However, a 20% renewables policy would have little effect when applied in combination with a Code Level 4 requirement as a renewable energy contribution of greater than 20% is required to deliver the mandatory carbon reductions under Code Level 4.

Need for flexibility in application

The analysis undertaken demonstrates that the impact on viability of Code for Sustainable Homes compliance varies between sites depending on their location. It will therefore be important for the Council, whatever affordable housing policy and approach to sustainable housing policies is adopted, to be flexible in their application and to take into account scheme specific circumstances where this is justified. Both Policy DC 1 and DC2 contain the provision for flexibility in policy application dependent on matters of feasibility and viability.

Assumptions on price

It should be recognised that we have assumed that building more sustainable homes would increase costs but that there would be no premium on price and that consumers would not be willing to pay more for a home built to a higher Code. Our analysis may therefore be considered conservative but we have no evidence to suggest that the increase in costs would be, to any significant extent, offset by an increase in market value.

Monitoring Compliance with the proposed sustainability policies

Development Control officers may benefit from training to help in assessing sustainability and energy strategies. The Council could require suitable on-site carbon monitoring to be installed in the larger new development sites, such as the Northern Fringe, to enable assessment of long-term (carbon) performance compliance.

Wider Policy Mechanisms for Promoting Low Carbon Development

Planning policy is a core plank of local strategies for delivering decentralised energy generation and low carbon development, however, to maximise the chances of success it has to be married with a range of non-planning measures that should attempt to create local delivery leadership, promote demand for low carbon solutions and the supply of services required to deliver and facilitate the delivery of the key solutions, particularly:

- Low carbon infrastructure (communal heating networks), to enable connections between new development, the existing built environment, sources of surplus heat and waste-to-energy opportunities (incineration and aneorobic digestion of municipal waste)
- Provide or facilitate financing mechanisms that support delivery of local Allowable Solutions that enable zero carbon development to be achieved, whilst supporting priority carbon measures, e.g. communal heating infrastructure, civic renewable energy projects and carbon reduction measures in the existing built environment
- Provide or facilitate financing measures that facilitate access to capitalisation of the future revenues from energy generation or energy saving, e.g. Energy Services Company solutions, Renewable Tariff capitalisation and low interest loans, to minimise direct cost for land development.

2 Housing growth and Non-domestic Development in Ipswich

2.1 Overview of key housing growth areas

Ipswich has been identified as a growth point in the East of England plan and is expected to accommodate growth amounting to approximately 19,500 homes and around 18,000 jobs (30,000 divided between Ipswich, Suffolk Coastal and Babergh) between 2001 and 2026. The East of England plan also identifies Ipswich as a regional centre for retail and other town centre purposes, and a key centre for development and change.

9,641 homes have already been built since 2001 or already have planning permissions subject to Section 106 agreements being agreed, but approximately 10,000 homes are still to be granted planning consent and built between now and 2026. Most of these 10,000 properties would be captured by the adopted Core Strategy, and would need to meet the sustainability requirements in the Core Strategy. There are a total of 70 potential development sites in Ipswich but there are three general areas of development within the borough; the IP-One (town centre) area, the Northern Fringe Greenfield sites and a mix of other sites across the rest of the borough. In addition to the allocated sites outlined in the Core Strategy and the Strategic Housing Land Availability Assessment Draft Report (SHLAA), there is also the prospect of windfall sites becoming available in the period 2021 to 2026, and these have been estimated and split between IP-One and the rest of the Borough. Table 2 provides an overview of the total projected number of new housing units from 2010 to 2026 that have not yet gained planning consent. The key characteristics of the strategic areas of growth are considered in more detail below.

Table 2: Ipswich Borough Housing Growth Numbers from 2010 to 2026 (and have yet to obtain planning permission)[3]

IP-One (Waterfront)	Northern Fringe	Rest of Borough	Total
3,335	3,500 to 4,000	2,567	9,902

The phasing of the development is split into 4 periods - period 1 is 2010 to 2015, period 2 is 2015 to 2020 and period 3 is 2020 to 2025. There is also expected to be a fourth period of development post 2025 during which the Northern Fringe sites will be further developed with additional housing units, and this could bring an additional 750 homes taking the overall total to almost 10,500 units between now and 2030. As illustrated in Table 3 the projected phasing of this development would be mostly post 2016 and so most would be captured by the zero carbon homes requirement (although planning consents could be issued earlier in 2013/14 as soon as the SPD is in place).

Therefore the advanced energy/ carbon standards in Policy DC 1 for housing developments over 250 units would not affect the Northern Fringe which constitutes a significant proportion of housing development in Ipswich over the next 15 years, but the requirement for the non-energy aspects of the Code for Sustainable Homes would capture all the 10,650 planned new homes.

[3] Strategic Housing Land Availability Assessment Draft Report (SHLAA), Ipswich Borough Council, September 2009, revised table 2 in the schedule of proposed amendments to the Core Strategy, March 2010 and figures from Sarah Barker and Robert Hobbs (March 2010)

Table 3: Phasing of Housing Growth in Ipswich Borough from 2010 to 2030[4]

2010 to 2015	2015 to 2021	2021 to 2026	2026 to 2030	Total
1,500	4,500	3,900	750	10,650

2.2 IP-One Area

The IP-One area broadly equates to the central part of Ipswich and includes:

- Town centre, where the central shopping area and retail is the dominant use;
- Waterfront, with a mix of commercial, port-related and residential uses;
- Ipswich Village where leisure (such as Ipswich Town Football Club) and office uses predominate; and,
- Education Quarter where the new University Campus Suffolk and Suffolk New College are the main land uses.

The population of the IP-One area is approximately 28,000 and contains the borough's most economically deprived households.

Key characteristics of IP-One are:

- Planning for the effects of climate change and the risk of flooding – areas of IP-One along the River fall within flood risk zones 2 and 3;
- Potential for 3,335 new homes;
- 34 potential housing sites, ranging from in size from 10 dwellings to 330 dwellings. Six sites at approximately 100 or more dwellings and eighteen sites under 50 dwellings.

Key sites in the IP-One area are:

- Island Site which has the potential for 330 housing units. It lies in the heart of Ipswich docks and is identified for housing development from 2016 to 2020.
- Shed 8 – potential for 200 units, identified for development between 2010 and 2015.

2.3 Northern Fringe

The tight urban boundary to Ipswich Borough means that there is only one area of extensive greenfield land still available on the periphery of the town and within the Borough. The land, which is located on the northern edge of the urban area and is known as the Northern Fringe, will constitute the main development area for Ipswich after 2021. However due to the limited availability of previously developed land in the rest of the town, the delivery of up to 1,000 dwellings will be expected to commence during the plan's second phase (i.e. 2015-2021) on land to the east of Henley Road and south of the railway line.

[4] *Strategic Housing Land Availability Assessment Draft Report (SHLAA), Ipswich Borough Council, September 2009 and Fifteen Year Dwelling Trajectory from Ipswich Borough Council, March 2010*

POLICY CS10: IPSWICH NORTHERN FRINGE

Land at the Northern Fringe of Ipswich, north of Valley Road/Colchester Road and between Henley Road in the west and Tuddenham Road in the east, will form the main source of supply of housing land in Ipswich after 2021.

Table 4 illustrates that there is the potential for approximately 4,750 housing units in the Northern Fringe, with 3,500 up to 2025 and the remaining up to 2030. There are 2 large sites in the Northern Fringe over 1,000 housing units, and one over 2,000 units, and these large sites will have the flexibility to install a range of different energy supply solutions and in particular the opportunity to install communal energy systems which can help deliver substantial onsite carbon reductions.

Table 4: Three key sites in the Northern Fringe with number of housing units up to 2030

Land to east of Henley Road, north of railway line (IP180)	Land west of Westerfield Road (IP181) and Ipswich School Playing Field (IP185)	Land to the east of Westerfield Road (IP182)	Total
2,044	1,461	1,242	4,747

2.4 Density of housing development across the borough

The densities of housing development outlined in Table 5 highlight the higher densities within the town centre and the lower densities in the more rural areas. These densities can have an impact on what energy supply technologies are suitable for particular developments, and for lower density sites the cost of installing communal heating networks for biomass heating and combined heat and power can be a lot higher.

Table 5: General development densities for the key growth areas in Ipswich[5]

IP-One (Waterfront)	Rest of IP-One	Within 800 metres of a district centre	Rest of Borough
High density – 165 dwellings per hectare	High density – 110 dwellings per hectare	Medium density – 45 dwellings per Hectare	Low density – 35 dwellings per hectare

2.5 Non-Residential Development in Ipswich

The key non-domestic development in Ipswich relates to office and industrial development on employment land and retail development in the town centre. The areas of employment land identified in the Core Strategy up to 2025 include:

- 35,000 sq m of additional/ new retail
- 55 hectares of employment land (office & industrial).

[5] *From the Strategic Housing Land Availability Assessment Draft Report (SHLAA), Ipswich Borough Council, September 2009*

These are the key developments that would be captured by the proposed BREEAM policies outlined in the Core Strategy (see below).

3 National and Regional Policy Context for Sustainability and Planning

3.1 Planning Policy Statement 1 (PPS1): Delivering Sustainable Development

PPS1 expects new development to be planned to make good use of opportunities for decentralised and renewable or low-carbon energy. The supplement to Planning Policy Statement 1 'Planning and Climate Change' highlights situations where it could be appropriate for planning authorities to anticipate levels of building sustainability in advance of those set nationally. This could include where:

- there are clear opportunities for significant use of decentralised and renewable or low carbon-energy; or
- without the requirement, for example on water efficiency, the envisaged development would be unacceptable for its proposed location.

Most importantly PPS 1 requires local planning authorities to develop planning policies for new developments that are based on:

"….an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies, including microgeneration".

The PPS1 supplement also states that:

"….alongside any criteria-based policy developed in line with PPS22, consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources, but in doing so take care to avoid stifling innovation including by rejecting proposals solely because they are outside areas identified for energy generation".

3.2 Definition of Zero Carbon Homes for 2016 and Allowable Solutions

The Government has set out its aspirations for improving the carbon performance of new developments into the future with its announcement of the tightening of Building Regulations for new homes along the following lines:

- 2010 – a 25% carbon reduction beyond current (2006) requirements;
- 2013 – a 44% carbon reduction beyond current (2006) requirements; and,
- 2016 – a 100% carbon reduction beyond current (2006) requirements.

In the March 2008 budget Government also announced its intentions for all non-domestic buildings to be zero carbon by 2019. Therefore, the various phases of development in the borough will face stricter and stricter mandatory requirements, and all residential development after 2016 is likely to need to be zero carbon. However, the aspiration for zero carbon development by 2016 is very challenging and will require innovative approaches from both the public sector as well as the development industry.

The government is proposing to introduce a more flexible definition of 'zero carbon' to guide building policy. The Zero Carbon consultation document published at the end of 2008 outlines various options that could potentially be used by house builders to ensure new homes are 'Zero Carbon' from 2016. It suggests that on-site requirements are capped at somewhere between the current Code for Sustainable Homes (CSH) Level 4 and 5 requirements with a minimum requirement for energy efficiency, and a set of off-site 'allowable solutions' developed to allow the residual emissions to be offset. The allowable measures have yet to be fully defined but could include large scale off-site renewable energy infrastructure, investment in energy efficiency measures for existing building stock, energy efficient white goods and building controls, or S106 contributions.

Government has proposed that a maximum cost of the 'Allowable Solutions' be set out. If costs stay high, more flexibility will be allowed in the future. The 'allowable solutions' will not be fully defined until 2012 so the total cost of carbon is likely to be capped at somewhere between £100 -£200 per tonne of CO_2 (every year for 30 years) to provide some cost certainty in the meantime.

In policy terms, currently, there is a high level of uncertainty with regard to both the level of on-site compliance required, anywhere between 44% and 100% of regulated emissions, as well as likely costs for allowable solutions to offset the remainder. Analysis of the technology options for on-site compliance presented in the consultation document suggests biomass based technologies are integral to achieving on-site carbon reduction targets at the higher end of this suggested range, and such a target cannot be achieved through micro-renewables alone.

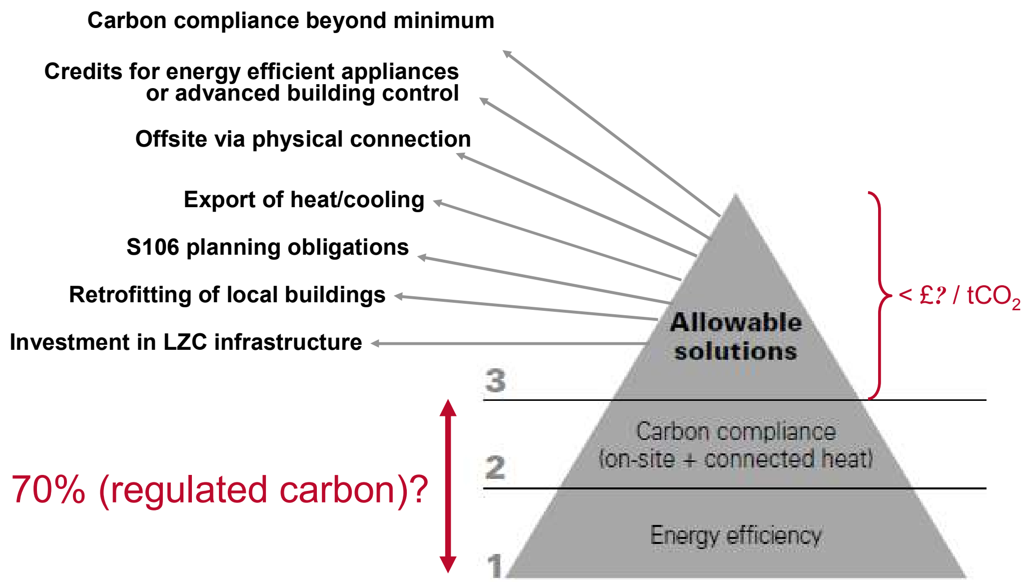


Figure 1: Schematic of zero carbon policy options under consideration

Estimates based on published data[6] suggest a cost range of £10.5k – £15k per dwelling for 100% reduction in regulated emissions on-site depending on the dwelling type. Biomass CHP is a key technology in delivering this target along with energy efficiency measures and PVs. Based on the guideline figure of £100/tonne over 30 years in the consultation document, the total estimated costs for allowable solutions adds another £2,400 - £4,000 to the total for the different dwelling types. At £200/tonne, the costs will be double that indicative range. As a guideline, at the median figure of £150/tonne, the total c.ost of compliance with zero carbon including both on-site and off-site measures is £14.1-£21k per dwelling.

Alternatively, given the significant cost of putting in the district heating infrastructure for such schemes, it can be argued that if the entire carbon reduction target was to be achieved solely through on-site measures, the cost of delivering the remainder of the carbon emission on-site will be marginal.

[6] *Costs and Benefits of Alternative Definitions of Zero Carbon Homes: Project report' published as an update to the '*Definition of Zero Carbon Homes and Non-Domestic Buildings*' consultation stage Impact Assessment*

The cost range for compliance with 70% on-site carbon reduction target using micro-renewables is estimated at £8.7k – £11.6k depending on dwelling type. At the median figure of £150/tonne over 30 years, the cost of allowable solutions to achieve the remainder off-site ranges between £5.4k- £9.2k. This also suggests the total cost of compliance to be between £14.1- £20.8k as with the 100% on-site scenario above. However, this option would additionally require gas distribution infrastructure and gas boilers to be put in place, and therefore where these costs are taken into account, the total cost per dwelling would be significant higher for the overall delivery of low carbon energy.

Zero carbon developments will therefore need to achieve minimum fabric standards and some onsite renewable energy generation, with financial contributions for investment in allowable solutions to offset the residual emissions. For any specific development site, developers will need to assess the prospects for different technical solutions including combined heat and power, biomass, medium to large scale wind turbines, heat pumps, PV and solar water heating before determining the contribution of allowable solutions in offsetting the residual carbon emissions.

3.3 Zero Carbon Agenda for Non Domestic Buildings

The timetable for zero carbon non-domestic buildings lags slightly behind the housing timetable with all non-domestic development set to be zero carbon from 2019. The broad framework for zero carbon that has been developed for homes will be adapted to reflect the variability in different types of non domestic buildings. The other key differences between non-domestic buildings and homes are the greater complexity and larger scale of non-domestic buildings and the proportionally greater electricity demand compared to heating needs in non-domestic buildings. The Government is thinking of introducing the allowable solutions for non-domestic buildings in advance of the zero carbon standard date of 2019, so that it can contribute to the development of the general allowable solutions market place and the build-up of district heating infrastructure for which non-domestic buildings can act as key anchor loads.

3.4 Regional Planning Policy

Policy ENG1 within the East of England Plan[7] recommends carbon reduction and renewable energy standards for new development. These policies have been incorporated within the Development Plan for the GNDP authorities. It requires a minimum of 10% of energy to be supplied from decentralised renewable or low-carbon energy sources above a threshold of 10 dwellings or 1000m² for non-residential development. This is considered an interim measure, ahead of local policies being set through Local Development Frameworks.

POLICY ENG1: Carbon Dioxide Emissions and Energy Performance

To meet regional and national targets for reducing climate change emissions, new development should be located and designed to optimise its carbon performance. Local authorities should:

- encourage the supply of energy from decentralised, renewable and low carbon energy sources and through Development Plan Documents set ambitious but viable proportions of the energy supply of new development to be secured from such sources and the development thresholds to which such targets would apply. In the interim, before targets are set in Development Plan Documents, new development of more than 10 dwellings or 1000m2 of non-residential floorspace should secure at least 10% of their energy from decentralised and renewable or low-carbon sources, unless this is not feasible or viable; and

[7] *East of England Plan - The Revision to the Regional Spatial Strategy for the East of England, May 2008*

- promote innovation through incentivisation, master planning and development briefs which, particularly in key centres for development and change, seek to maximise opportunities for developments to achieve, and where possible exceed national targets for the consumption of energy. To help realise higher levels of ambition local authorities should encourage energy service companies (ESCos) and similar energy saving initiatives.

Policy ENG2 within the East of England Plan outlines the renewable energy targets for the East of England. Although the renewable energy generation for the new developments will help in contributing towards these overall renewable energy targets, the housing growth within the GNDP area will add to the existing energy demand of the area and therefore increase the amount of renewable energy that is needed in order to achieve the overall target.

POLICY ENG2: Renewable Energy Targets

The development of new facilities for renewable power generation should be supported, with the aim that by 2010 10% of the region's energy and by 2020 17% of the region's energy should to come from renewable sources. These targets exclude energy from offshore wind, and are subject to meeting European and international obligations to protect wildlife, including migratory birds, and to revision and development through the review of this RSS.

3.5 Code for Sustainable Homes

The carbon standards outlined above are taken from the **Code for Sustainable Homes (CSH)** which specifies tightening carbon reduction standards up to Level 6 which corresponds with a zero carbon development. However, carbon standards are only one element of the Code, which also covers water, materials, ecology, waste as well as a few other issues. The Code for Sustainable Homes was published by the Government (DCLG) in December 2006. It is intended as a single national standard to guide the industry in the design and construction of sustainable homes, and a means of driving continuous improvement, greater innovation and exemplary achievement in sustainable home building. The CSH assesses the overall sustainability of the home using a star rating system from 1 to 6 with the minimum level being more onerous than Building Regulation requirements. It also lays down minimum requirements for specific sustainability issues that must be met before certificate for compliance with a particular code level can be awarded. The requisite percentage scores and minimum requirements for energy and water consumption are set out in Table 6 below:

Table 6: Requirements under different levels of the Code for Sustainable Homes

Code Level	Percentage Score Required	Energy TER Improvement (%)	Water Consumption target (litres/person/day)
★	36	10	120
★★	48	18	120
★★★	57	25	105
★★★★	68	44	105
★★★★★	84	100	80
★★★★★★	90	Carbon neutral	80

In addition to the above, the Code stipulates a base requirement across all Code levels for embodied impacts of construction materials, surface water run-off, construction site waste management plan and household waste storage.

The credits achieved in each category are multiplied by an environmental weighting factor to determine the overall points scored in that category. These weighting factors reflect the relative importance of each of the issues covered in the Code and have been determined after extensive consultation with different stakeholder groups within the construction industry. The Category points scored are then summed to give an overall percentage score for the dwelling.

Therefore the carbon requirements that will be assessed for the different Code Level costings are:

- CSH Level 4 – 44% carbon reduction on heating and lighting
- CSH Level 5 – 100% carbon reduction on heating and lighting
- CSH Level 6 – zero carbon development for ALL energy use including appliances as well as heating and lighting.

3.6 BREEAM Standards

The Building Research Establishment Environmental Assessment Method (BREEAM) is a sustainability standard for non-domestic buildings. The Government is currently in the process of developing a Code for Non-Domestic Buildings which will replace BREEAM as the main tool for assessing the environmental performance of non domestic buildings.

Due to the significant variability of types of non-domestic buildings, there are six BREEAM versions covering different building types:

- BREEAM Office;
- BREEAM Industrial;
- BREEAM Retail;
- BREEAM Educational;
- BREEAM Healthcare;
- BREEAM Other Buildings;

BREEAM Office, Industrial and Retail are the key versions of interest for the non-domestic development in Ipswich, as these represent the main development types in Ipswich.

There are 4 BREEAM ratings ranging from Good to Very Good to Excellent and Outstanding. The carbon requirement for BREEAM Excellent is typically a 25% improvement on 2006 Building Regulations whereas for Outstanding it is typically 50% (the exact standard is based on a minimum Energy Performance Certificate performance and varies from building type to building type even within the different BREEAM versions). The core elements and standards for these ratings have increased over time in line with the improvements in Building Regulations so that BREEAM always keeps ahead of general industry standards. In the same way as the Code for Sustainable Homes, BREEAM covers all environmental aspects of a development from energy and carbon to water consumption to impact of materials to local ecology and transport.

3.7 Renewable energy support mechanisms – FIT & RHI

A feed-in-tariff (FiT) for renewable electricity generation under 5MWe capacity has been introduced in April 2010. This will improve the financial case for small-scale renewable generation in the UK. Importantly, unlike the Renewable Obligation Certificate (ROC) scheme for large renewable generation, the FiT can be claimed whilst counting the carbon reduction for achievement of Code for Sustainable Homes credits, and is therefore open to new developments. A similar support mechanism for renewable heat called the Renewable Heat Incentive is set to follow in April 2011 which will provide an income stream for renewable heat equipment such as heat pumps, biomass boilers or solar water heating.

These financial support mechanisms for small scale renewable energy systems have the potential to assist developers in covering the cost of renewable energy infrastructure in new development, and could assist in improving the viability of development built to higher carbon standards. Although both of these mechanisms will provide an income stream to owners of renewable energy technologies, they could also stimulate the marketplace to provide a business offering of upfront capital for investment in these technologies so that the long term FIT and RHI income streams can be claimed by these companies. Housing developers could form a partnership with a FIT/ RHI investment company, a new type of ESCo, and secure finance to cover some, or all, of the costs of installing microgeneration technologies. The rights to the FIT and RHI income stream from the installations would however need to be signed over to the investment company rather than the householder who eventually lives in the home, and this is an issue that needs further consideration.

4 Proposed Sustainability Policies in the Core Strategy

4.1 Policy DC1 - Code for Sustainable Homes and BREEAM standards

Policy DC1 within Ipswich's proposed Core Strategy promotes Code for Sustainable Homes and BREEAM compliance for development within Ipswich:

Policy DC1 – Sustainable Development

All new residential and non-residential buildings shall be required to achieve a high standard of environmental sustainability. In this regard, all developments exceeding the thresholds set out below shall achieve the following standards as a minimum unless, in exceptional circumstances, it can be clearly demonstrated that this is either not feasible or not viable:

Timescales (grant of planning permission)	Developments of between 1 and 249 dwellings	Developments of 250 dwellings or more	All other residential and non-residential development with a gross external floorspace of 500 sq. m or more
From 2010	Level 3 of the CfSH	Level 4 of the CfSH	BREEAM "Very Good"
From 2013	Level 4 of the CfSH	Level 5 of the CfSH	BREEAM "Excellent"
From 2016	Level 6 of the CfSH	Level 6 of the CfSH	BREEAM "Excellent"

As outlined above, Government policy will require all housing development to follow the carbon requirements in the Code up to zero carbon compliance from 2016 through sequence improvements in the Building Regulations. Government policy will also require all non-domestic development to adopt zero carbon standards from 2019. Policy DC 1 goes beyond national policy requirements in 3 key ways:

- Low carbon standards – requires developments of 250 or more to achieve carbon standards at a level 3 years in advance of the national requirements. From the analysis of the phasing of Ipswich development in section 2 above, the advanced carbon standards for developments over 250 dwellings would only capture the St Clement's Hospital Grounds development site (IP116) as all other sites over 250 units are not scheduled until post 2016;
- Code standards – Government policy does not require Code compliance and therefore this policy requires Ipswich housing development to achieve higher sustainability standards than in general;
- BREEAM standards - Government policy does not require BREEAM compliance and therefore this policy requires Ipswich non-domestic development to achieve higher sustainability standards than in general.

Although the analysis below will assess the overall cost of the Code and BREEAM on the viability of Ipswich developments, the actual impact of Policy DC1 on the costs faced by developers only relates to the non-carbon elements of the Code and BREEAM - as the carbon standards are mandatory anyway under Building Regulation requirements other than for those sites larger than 250 units which apply for planning permission before 2016.

4.2 Policy DC2 - Renewable Energy Requirement

Ipswich Borough Council's proposed Core Strategy contains the following policy related to Decentralised Renewable or Low Carbon Energy:

POLICY DC2: Decentralised Renewable or Low Carbon Energy

All new build development of 10 or more dwellings or in excess of 1000 sq. m of other residential or non-residential floor space shall provide at least 15% of their energy from decentralised and renewable or low-carbon sources. If it can be clearly demonstrated that this is not either feasible or viable, the alternative of reduced provision and/or equivalent carbon reduction in the form of additional energy efficiency measures will be expected. The design of development should allow for the development of feed in tariffs.

This renewable energy policy requires developers to install onsite renewable energy infrastructure that reduces carbon emissions from the development by 15%. DC2 responds to policy ENG1 in the East of England Plan which requests a 10% contribution from renewable energy for all new development above 10 dwellings or 1000m² for non-residential.

However, policy DC2 has a very close interaction with the energy requirements within the Code for Sustainable Homes and BREEAM, and therefore the Government's programme of improving the carbon requirements within Building Regulations out to zero carbon development in 2016 and 2019. The key question is whether the proposed 15% renewable energy requirement would provide any additionality to policy DC1 and the tightening of the Building Regulations. It is clear that the zero carbon requirement for 2016 and 2019 will render DC2 a redundant policy, but could it have an impact up until 2016 for housing and 2019 for non-domestic?

The Code Level 3 requirement of a 25% reduction in carbon emissions from heating and lighting is a mandatory part of Building Regulations from April 2010. To test the impact of DC2 over the next 3 years, it is necessary to assess whether a 15% reduction of total carbon emissions through renewables would have any additional effect to Code Level 3 carbon requirements. The carbon reduction requirements within the Code only apply to regulated carbon emissions (e.g. from heating and lighting), whereas the 15% renewables requirement applies to carbon emissions from all energy use, which includes electricity consumption by appliances. A comparison of the overall carbon and cost impact of Code Level 3 versus 15% renewables policy is undertaken in section 5. We also assess the carbon and cost impact of a 20% renewable energy policy compared to the various carbon requirements of the different Code levels.

5 Assessing the Impact of the Proposed Sustainability Policies on Development Viability in Ipswich

5.1 Overview of Approach

5.1.1 Impact of Code for Sustainable Homes Standards on Development Viability

Viability of the sustainability policies on residential developments have been assessed through building on the residual land values[8] calculated for a range of Ipswich sites in the 'Affordable Housing Site Viability Study' published by Fordham Research Group in June 2009. The basic requirement for viability in this study is that the residual land value must exceed the alternative use value by a pre-determined margin which will be explained in more detail below.

The study undertaken by Fordham Research Group derives the residual land values based on Code Level 3 costs and a range of affordable housing scenarios. For the purpose of this study, Camco used these residual land values and deducted the additional costs of achieving Code Levels 4, 5 and 6 to derive a new residual land value that would reflect the costs of achieving higher levels of the Code. These new residual land values were then compared with the alternative use values identified by the Fordham study to understand whether the residual land values would be able to absorb the additional costs on the developments brought by Policy DC1.

Figure 2 illustrates the methodology that was followed for the viability testing of different Code levels. The costs of achieving different Code levels were sought from 'Code for Sustainable Homes: Cost Review' published by Element Energy and Davis Langdon in March 2010[9].

As the recent report published by Element Energy and Davis Langdon did not incorporate the possibility of achieving energy targets through allowable solutions in their study and provided costs of energy compliance which was achieved all 'on-site', it was anticipated that the study would over-estimate the energy costs of achieving different code levels. Consequently, costs of code compliance were categorised into energy and non-energy costs where the energy costs were sourced from the Zero Carbon Consultation[10] and the non-energy costs were sourced from the Element Energy and Davis Langdon report. These costs differed on a site-by-site basis depending on the type of development and the optimal energy package chosen for different code levels. These are explained in further detail in Section 5.4 and 6.1.3

Once the costs of code compliance were incorporated into the residual land values, a similar approach to the Fordham study was followed where the new values were compared to the alternative use values in order to conclude on the viability of the sites. As Fordham study suggests, a surplus that the residual land value produces over the alternative use value is not considered as a sufficient requirement to lead on to a viability conclusion. The surplus needs to be large enough to provide the incentives for the landowner to release the site for residential development. Therefore a 'cushion' was added on to the alternative use value where by the viability depends on whether the residual land value is higher than the alternative use value plus the cushion. We have used the same cushion value that is used in the Fordham study which is £40k/acre for all sites, constituting around 15% mark-up over the industrial benchmark land value for Ipswich. In cases where the new residual land value did produce a surplus over the

[8] Residual land value is defined as the value of the site after taking out the costs of development and developer's profit from the likely income from sales and/or rents.
[9] Code for Sustainable Homes: Cost Review by Element Energy and Davis Langdon available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/1501290.pdf
[10] The energy costs in the consultation were based on a study carried out by Cyril Sweett and Faber Maunsell to assess the costs and benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development.

alternative use value but this surplus was lower than the determined cushion, the viability was regarded as ‘marginal’.

5.1.2 Impact of BREEAM and Renewable Energy Targets on Viability

In the absence of general viability data for commercial development sites, a different approach was followed for assessing the capacity of commercial developments to absorb the costs of achieving BREEAM standards. We have compared employment land values in Ipswich with the regional and national average in order to assess the ability to cope with the BREEAM costs. In order to assess the impact of policy DC2 on development viability, the relationship between 15% and 20% on-site renewable energy generation and the carbon requirements in Code Levels 3 & 4 has been assessed, and the additional compliance costs associated with the policy identified. The methodologies are explained in more detail in the following sections.

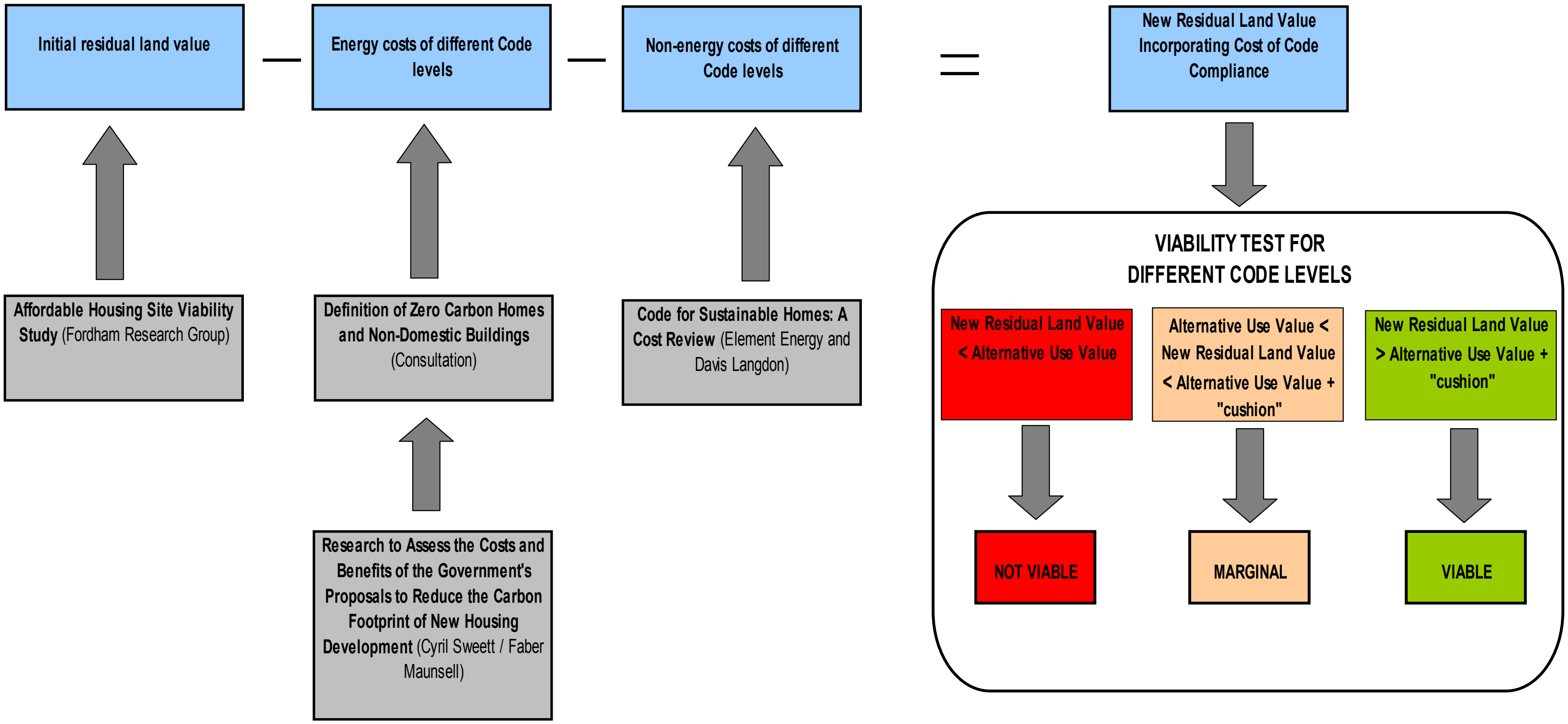


Figure 2 Methodology of testing the viability of different Code levels in Ipswich

5.2 General Viability of Development in Ipswich

The study carried out by Fordham Research Group assessed the viability of sites in Ipswich, Babergh and Mid Suffolk & Suffolk Coastal sites through incorporating costs of achieving Code Level 3 and different affordable housing levels. The results presented in the study shows that the viability in Ipswich area is generally difficult to achieve. Out of the 8 Ipswich sites considered in the study, 3 of them were already not viable assuming no affordable housing and Code level 3 costs. As the affordable housing levels increased to 25% two other Ipswich sites became unviable. The results of the study for Ipswich area is summarised in Table 7 categorised in three locations, two of which are the key housing growth areas.

Table 7 Viability Summary in Ipswich based on Fordham Study

Site areas	No aff	25% aff	30% aff	35% aff	40%aff
IP-One	1 viable 2 unviable	0 viable 3 unviable	0 viable 3 unviable	0 viable 3 unviable	0 viable 3 unviable
Northern Fringe	3 viable 0unviable	3 viable 0unviable	2 viable 1 marginal	2 viable 1 unviable	1 viable 1 marginal 1 unviable
Other	1 viable 1 unviable	0 viable 2 unviable	0 viable 2 unviable	0 viable 2 unviable	0 viable 2 unviable
Total	5 viable 3 unviable	3 viable 5 unviable	2 viable 1 marginal 5 unviable	2 viable 6 unviable	1 viable 1 marginal 6 unviable

The table above clearly shows that the viability in Northern Fringe area is healthier compared to the other sites which indicates that these sites would have scope for absorbing some of the additional costs of achieving better sustainability levels. For sites in IP-One and other areas, affordable housing levels over 30% and higher sustainability levels would have to be incentivised through access to grants.

In this context it is important to note that the Council intend to require 40% affordable housing provision in schemes of 15 or more dwellings or 0.5ha. or more; and 20% affordable housing provision in schemes of between 10 and 14 dwellings or 0.3 tp 0.49 ha. However these targets will be subject to viability testing. The targets will guide the requirement for affordable housing on allocated sites and windfall sites, but actual provision on each site will be determined through negotiation having regard to:

- development size
- site development costs
- the requirement to deliver new housing
- scheme viability including the the availability of Social Housing Grant; and
- costs associated with other planning objectives such as planning to reduce carbon emissions.

5.3 Key inputs to the Affordable Housing viability model

As we have based our viability study on the residual land values derived by the Fordham study, it is important to outline the key inputs to this study to get a clear understanding of the assumptions behind the model that we have developed. Any variation in the assumptions of the Fordham model would alter the residual land value outputs which form the basis of our study. Therefore, even if the inputs of the Fordham study do not reflect the local conditions of Ipswich, it was not possible to incorporate these differences into the residual land values without altering or adapting their work.

- Section 106 contributions – the Fordham model used a figure for typical s106 contribution per dwelling specific to each site. Their approach was based on pulling the available data on District and County contributions where information was available and combining this with the data on the contributions required by recently agreed schemes and their experience in order to arrive at figures which would reflect the typical contributions that would be required from the sites under consideration.
- Price fluctuation – The average house prices and residential land values in the study are taken from 2007. As the study was carried out in 2008 when the housing market downturn was under way, different price scenarios have also been analysed with 30% affordable housing in order to understand the impacts of further price decrease in the market or potential price recoveries in the future on the viability testing.

- Build costs – The build costs used in deriving the residual land values were sourced from a base date of 2008. In order to account for the impact of Code's Level 3 on build costs, the Fordham study has assumed an additional average cost increase of 4.2%. In addition, cost adjustments for significantly smaller sites have also been made where one site in Ipswich with 10 dwellings (Ipswich North Sub) have been added a cost premium of 6% to account for economies of scale.

- Affordable housing component – the Fordham study derives the residual land values for a range of affordable housing component scenario, however tests the impacts of price fluctuations on residual land values and therefore the viability of the sites only with a 30% affordable housing scenario. Therefore, in order to be able to assess the impacts of different price scenarios in our model, we have mostly used the 30% affordable housing. We did use the 40% scenario as well but it was not possible to model the possible price changes in the market in the absence of data relating to this issue in the Fordham study.

- 'Cushion' value – As it was outlined in our methodology, we have used the cushion value initially determined by the Fordham study to assess the viability of each site. The cushion value is to reflect the size of the surplus that is needed over the alternative use value to create the incentives for the landowner to release the site as a housing development. As this figure would be based on several variables and differ from case to case, Fordham has used an average figure of £40k/acre for each site as a threshold for their testing (equating to around a 15% increase over the industrial benchmark land value for Ipswich).

- Social Housing Grant – Fordham study assumes zero availability for Social Housing Grant and derives the residual land values based on this which also formed the basis of our modelling.

5.4 Characteristics of the Sites Tested

The 8 sites we have used in our modelling are taken from the Fordham study and we have tried to assess these specific sites within the context of two key housing growth areas, namely IP-One and Northern Fringe in addition to sites classified as 'other areas'. The main characteristics of the sites are presented in Table 8.

In order to be able to use the data provided in the Cyril Sweett/Faber Maunsell report where the costs were given based on the type of development, Camco studied the characteristics of the 8 sites and correlated it with the development type that would be best reflecting these. The development form defined in the Fordham study together with the size, location and the density of the sites mostly formed the basis of this matching

Table 8 Characteristics of the Sites Tested

Site name	Area in Ipswich	Number of dwellings	Dwellings/ Gross Area (ha)	Development type	Developm ent form	Residual Land Value with Code 3 (£k/acre)*
Co op Depot	Other	227	44	Market town/terraced	Base	-65
Waterfront	IP-One	131	172	Urban regeneration/flats	Very high	-2130
N of Valley Road	Northern Fringe	395	32	Market town/detached	Rural/edge	223
W of Westerfield road	Northern Fringe	1200	28	Market town/detached	Rural/edge	142
Ipswich Cent E edge	IP-One	18	120	City infill/flats	High	-470
Ipswich North sub	Northern Fringe	10	33	Small scale/terraced	Base	211
Ipswich SE	Other	42	60	Market town/flats	High	-34
Ipswich Cent W edge	IP-One	60	60	Market town/flats	High	-2

* Sourced from Ipswich et al. Affordable Housing Viability Study (assuming 30% affordable housing component and Code

Table 8 also illustrates that the sites in IP-One area where the higher density developments were located had negative residual land values even with costs of achieving Code level 3 and 30% affordable housing component. The lower residual land values in IP-One area was due to the high density nature of the developments. As the land value is the main source of developer subsidy which constitutes a lower proportion of the total value for high density developments, it erodes much more quickly with higher affordable housing levels which results in significantly lower levels of residual land values in a 30% affordable housing case. In other words, when a low (houses) versus a high density (apartments) development is considered in a land of a particular size, the land value will be able to buy a higher proportion of the houses when compared with the apartments[11].

Right at the start of our study, this clearly indicated that these sites would not be able to absorb any additional costs of development without access to public sector grants or other funding streams such as ESCo[12] finance (see section 7.2).

5.5 Using Residual Land Values to Test Viability of Sustainability Requirements

The residual land values calculated in the study carried out by the Fordham Research Group was used as an input in our study to test the viability of achieving higher code levels on Ipswich sites. Our methodology as outlined earlier was to deduct the additional costs of achieving higher code levels from the residual land value to derive new residual land values and follow a similar approach to that of Fordham study where these new residual land values are compared to the alternative use values to decide on the viability of the sustainability requirements. For testing the viability of BREEAM and the Merton Rule, a slightly different approach was taken in the absence of robust data both relating to residual land values (in the case of DC2) and the costs of achieving different levels of BREEAM (in the case of commercial developments under DC1).

[11] Affordable Housing Site Viability Study by Fordham Research Group, June 2009.
[12] An ESCO is an energy services company which finances the capital cost of low or zero carbon technologies in return for the revenue stream secured from sales of heat and power.

6 Compliance Costs of the Code for Sustainable Homes, BREEAM and Renewable Energy Target

6.1 Compliance Costs of the Code for Sustainable Homes

6.1.1 Identifying energy costs and other costs in the Code

Our analysis of the costs of achieving Levels 4, 5 & 6 of the Code for Sustainable Homes is based upon the analysis undertaken by Element Energy in March 2010.[13] The energy components of the code costs have come from the Zero Carbon Consultation as these included the possibility of meeting the energy requirements through allowable solutions.

The development types defined in the Element Energy/Davis Langdon report and the Zero Carbon Consultation were considered and associated with the specific sites being studied, based on the site specific information we had from the Fordham study. This was necessary as the costs were broken down in both of the reports based on the type of the development. The next step before identifying the costs was to choose a suitable energy package for each site which is explained further in Section 6.1.3.

Associated costs of each identified energy package were taken from Annex E of the Zero Carbon Consultation. As explained previously, this was considered to be a better approach in order to allow the impact of allowable solutions in the energy costs which was not factored in within the Element Energy/Davis Langdon report where the non-energy costs of the code was sourced from.

One other adjustment we had to make was to work out the marginal costs of achieving Levels 4, 5 & 6 over Code 3 in order to add on to the costs that were estimated by the Fordham Research Group which had already included the Code Level 3 costs. Since all the costs in the Zero Carbon Consultation and the Element Energy/Davis Langdon report were presented as additional costs over the Building Regulations, we deducted the total cost of achieving Code Level 3 from these figures in order to avoid double-counting of Code 3 costs when adding on the costs. The overall cost of achieving Code 3 was sourced from the Cyril Sweett report[14] in order to keep it consistent with the Fordham study with the assumption that costs of achieving Code Level 3 has remained relatively constant since the study was carried out in 2007. Table 9 illustrates the non-energy derived from the Element Energy/Davis Langdon report which was used in our viability modelling.

Table 9 Costs sourced from Element Energy/Davis Langdon report

[13] Code for Sustainable Homes: Cost Review by Element Energy and Davis Langdon available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/1501290.pdf
[14] A Cost Review of the Code for Sustainable Homes, Report for English Partnerships and the Housing Corporation, Feb 2007

House type	CODE 4 NON-ENERGY COSTS	CODE 5 NON-ENERGY COSTS	CODE 6 NON-ENERGY COSTS
Small brownfield/Terraced	£1,120	£5,120	£6,355
Strategic Development/Detache	£1,866	£6,125	£6,776
Strategic Development/Flats	£920	£3,121	£3,570
Small Brownfield/Flats	£1,000	£2,650	£3,300

The approach we followed in identifying the suitable energy packages for each site is explained in Section 6.1.3. The costs we have taken from the Zero Carbon Consultation is summarised in the table below. Where the same energy package has different costs for the same site, this is due to higher carbon reductions achieved through the technologies based on the requirements of the different code levels.

In addition, the table also illustrates that the energy costs make up the majority of the overall code costs when compared with the non-energy costs. This means that when the government regulation of zero carbon homes is implemented in 2016, the additional costs caused by Ipswich's Code policy will not be significantly higher than the impact of the government's policy. The table also shows that Code levels 5 and 6 have the same energy packages and costs assuming that the remainder of the carbon reductions required by Code level 6 would be provided through allowable solutions. This is explained in more detail in the following section.

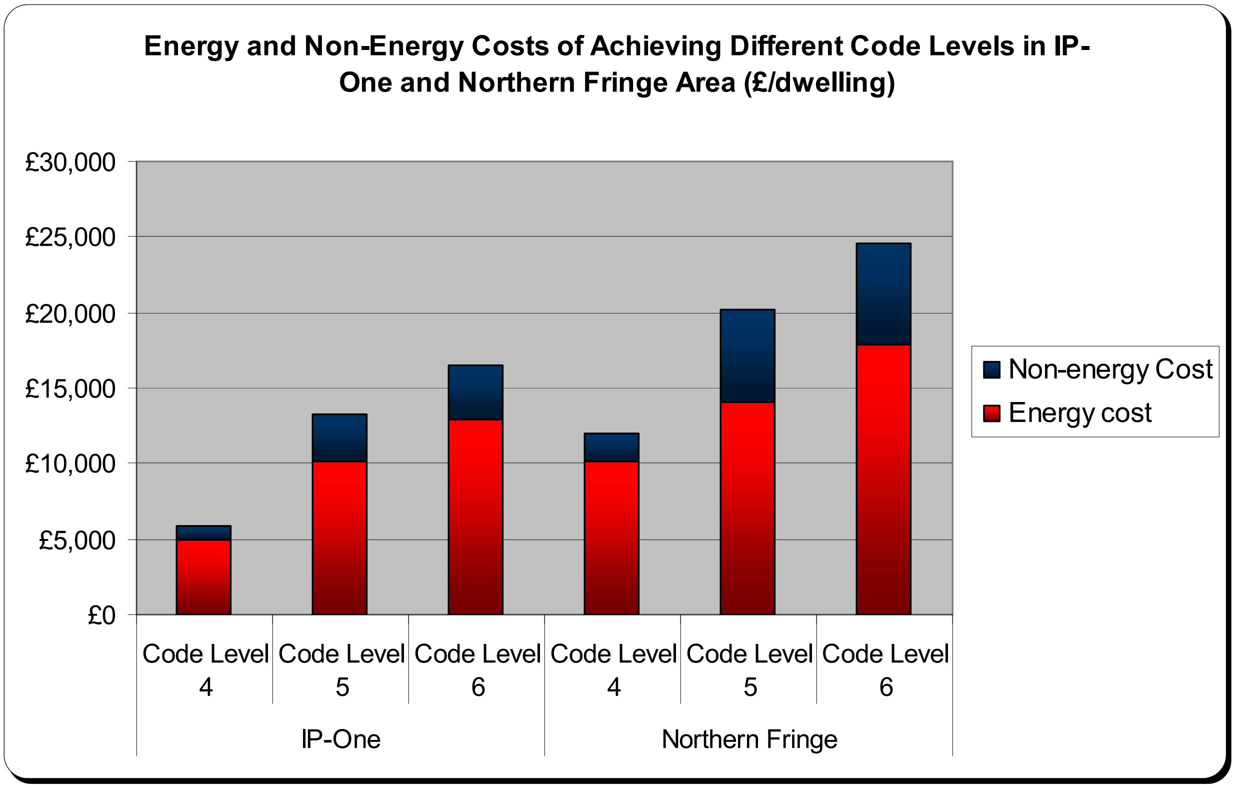
Table 10 Costs associated with different code packages

Site	Location	Code Level	Energy technology*	Energy cost of Code** (£/dwelling)	Non-energy cost of Code (£/dwelling)	Total cost (£/dwelling)
Co op Depot	Other	4	PV+BPEE	£7,346	£1,120	£8,466
		5	PV+BPEE	£12,145	£5,120	£17,265
		6	PV+BPEE	£13,080	£6,355	£19,435
Waterfront	IP-One	4	Biomass heating + BPEE	£4,938	£920	£5,858
		5	Gas CHP + PV+ BPEE	£10,169	£3,121	£13,290
		6	Gas CHP + PV+ BPEE	£12,929	£3,570	£16,499
N of Valley Road	Northern Fringe	4	PV+BPEE	£10,180	£1,866	£12,046
		5	Biomass heating + PV+ BPEE	£14,057	£6,125	£20,182
		6	Biomass heating + PV+ BPEE	£17,837	£6,776	£24,613
W of Westerfield road	Northern Fringe	4	PV+BPEE	£10,180	£1,866	£12,046
		5	Biomass heating +PV+BPEE	£14,057	£6,125	£20,182
		6	Biomass heating +PV+BPEE	£17,837	£6,776	£24,613
Ipswich Cent E edge	IP-One	4	mixture of GSHP +BPEE and PV+APEE	£9,940	£1,000	£10,940
		5	GSHP+PV+BPEE	£16,521	£2,650	£19,171
		6	GSHP+PV+BPEE	£19,281	£3,300	£22,581
Ipswich North Sub	Northern Fringe	4	PV+BPEE	£7,346	£1,120	£8,466
		5	PV+BPEE	£12,145	£5,120	£17,265
		6	PV+BPEE	£15,475	£6,355	£21,830
Ipswich SE	Other	4	mixture of GSHP +BPEE and PV+APEE	£12,466	£1,000	£13,466
		5	GSHP+PV+BPEE	£15,448	£2,650	£18,098
		6	GSHP+PV+BPEE	£18,208	£3,300	£21,508
Ipswich Cent W Edge	IP-One	4	Biomass heating + BPEE	£5,712	£1,000	£6,712
		5	Biomass heating+PV+BPEE	£8,117	£2,650	£10,767
		6	Biomass heating+PV+BPEE	£10,877	£3,300	£14,177

* BPEE: Best Practice Energy Efficiency APEE: Advanced Practice Energy Efficiency ** Including cost of allowable solutions.

Figure 3 further stresses the point that majority of costs associated with achieving different code levels come from energy compliance and the non-energy costs are significantly lower when compared with the energy costs. The figure also shows that the total costs of code compliance in IP-One area is lower than that of Northern Fringe sites caused by the notional allocation of district heating systems to IP-One sites and the lower costs associated with this technology in high density areas.

Figure 3 Energy and Non-Energy Costs of Achieving Different Code Levels in IP-One and Northern Fringe Area



6.1.2 Definition of zero carbon and allowable solutions

Government has announced that all new homes built from 2016 would have to be zero carbon after taking into account the emissions from space heating, ventilation, hot water and fixed lighting (e.g. regulated emissions), exports and imports of energy from the development (and directly connected energy installations) to and from centralised energy networks, and expected energy use from cooking and appliances (e.g. unregulated emissions).

The zero carbon consultation proposes to meet the zero carbon homes standard through high levels of energy efficiency, on-site low and zero carbon technologies and a range of mainly offsite solutions for tackling the remaining emissions referred to as the allowable solutions. The need for allowable solutions became evident through the study done by Cyril Sweett and Faber Maunsell where none of the technology combinations managed to eliminate the regulated and unregulated emissions for flats. Allowable solutions give the flexibility to the developers to meet the required targets through off-site solutions and facilitate the process by ensuring that the targets are viable to achieve both technically and financially.

Currently, the portion of the reductions to be met by allowable solutions is under consultation and the following options are being considered:

- Carbon compliance level of 44% on-site and allowable solutions
- Carbon compliance level of 70% on-site and allowable solutions

- Carbon compliance level of 100% on-site and allowable solutions

In our modelling, we have used the second option where 70% of the carbon reductions are realised on-site with the remainder of the emissions being covered by the allowable solutions. We believe that this is the option most likely to be imposed by the government as it is an ambitious but a realistic target which would bring momentum to onsite renewable solutions in new developments without putting an unrealistic burden on the developers. Therefore, while choosing the energy packages for our model, we have aimed at technologies that would bring around 70% reduction on carbon emissions onsite for Code Levels 5 and 6. This is also supported by a ministerial statement during summer 2009.

Another key issue in estimating the costs for achieving zero carbon homes standard was the costs associated with the allowable solutions. As it is not possible to predict with certainty the relative amounts of the different types of allowable solutions that will be taken up from 2016, it is difficult to estimate the costs that would be associated with these offsite solutions. Therefore we took a similar approach to that of the Consultation where the price of allowable solutions is capped at £100/tonne of CO2. We have also incorporated £50 and 150£ per tonne of CO2 for allowable solutions in our modelling, however as this did not have a significant impact on the viability testing, we have not included the results of this sensitivity analysis.

6.1.3 Developing optimum energy packages for the different sites

Before identifying the costs of achieving different code levels, an optimum energy package was identified for each site based on their characteristics. There were different variables which had an impact on the output of this exercise ranging from the density of the development, location, size and the comparative costs between different options.

For Code level 4, a combination of PV and best practice energy efficiency to achieve reductions of 44% on regulated emissions seemed to be the best option for a majority of the sites located outside the IP-One area due to lower costs provided in Annex E of the Zero Carbon Consultation.

Waterfront and Ipswich Cent W edge which are sites located in the IP-One area and have ‘very high’ and ‘high’ densities respectively based on Fordham study’s definition, were allocated with a combination of biomass boilers and best practice energy efficiency measures based on the lower prices per dwelling in return for high carbon reductions offered by this technology. This is due to low amounts of piping work that would be required in high density developments. Even though this energy package was identified as the optimum option for these sites, the caveat under this choice is the fact that biomass boilers could become an issue for planning permission in city centres due to air quality requirements.

A mixture of ground source heat pumps (GSHP), PVs and energy efficiency measures were chosen for Ipswich Cent E Edge and Ipswich SE site which were identified as ‘city infill/flats’ and ‘market town/flats’ respectively. Despite the higher costs of the GSHPs, there were limited options for these two sites where the development size was relatively small and the application of PVs would be limited due to smaller roof areas and over-shading issues. Therefore, we have decided to go with the option of backing up the PVs with GSHP to achieve the required levels of carbon reduction.

For Code Level 5 and 6 a similar approach was followed where the density and the size of the developments together with the costs of different options informed the choice of the energy packages that were notionally allocated to each site. Based on the percentage savings that these energy packages achieved, the remaining reductions were assumed to be covered by allowable solutions.

Biomass boilers together with PV and best practice energy efficiency measures were the best available package for N of Valley Road and W of Westerfield Road which have relatively low densities and are based in Northern Fringe. Two other technologies that were considered for these developments were PV or GSHP on their own. Allocating only PV to these sites were considered risky in terms of hitting the carbon reduction targets due to the uncertainty relating to the orientation and size of the roofs as well as the overshading factor. Given that GSHP was a significantly more expensive option which made the biomass backed up by PV option the most attractive package for these sites. Solar water heating was not chosen as the CO_2 reductions are limited and a secondary heating system (either GSHP or biomass boilers) would still be needed leading to greater expenditure.

Despite the fact that Ipswich SE and Ipswich Cent W edge sites had similar characteristics in terms of development size and density, different packages have been allocated to these sites to understand what impact different technologies would have on the costs of hitting the required targets. In addition, since Ipswich Cent W edge site is located in the IP-One area, it was assumed that there would be a higher potential that the developments in this area can link in to a communal heating network. Based on the same rationale of the potential of communal heating networks, Waterfront was allocated with a gas CHP combined with PVs. The higher density and the size of this development also contributed to the choice of this energy package. The Code 5 energy package for the Co-op Depot site remained the same as the Code 4 package with a combination of best practice energy efficiency measures and PV. The Code 6 energy packages are the same as the Code 5 packages with a greater contribution from allowable solutions which are used to offset the carbon emissions arising from the energy used by appliances in the home.

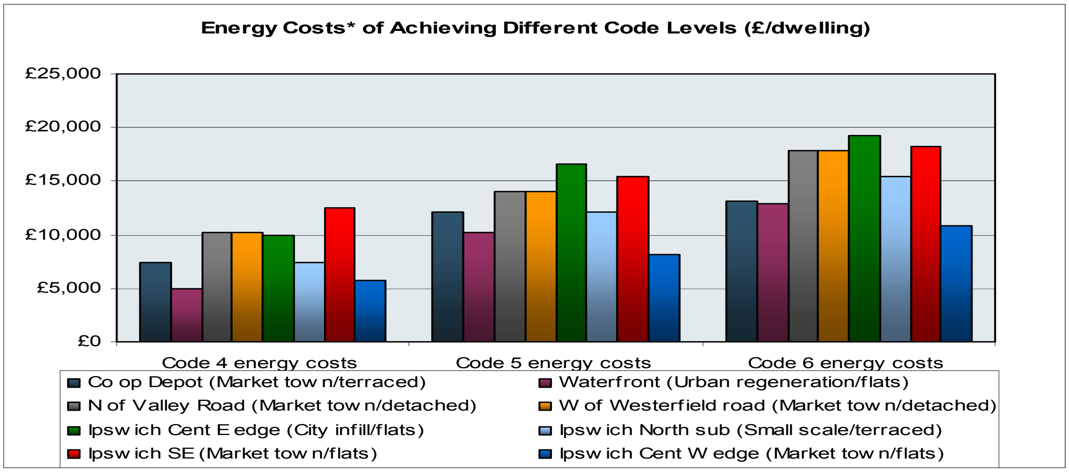
The identified packages for each site are presented in Table 11. The proportion of allowable solutions for each package is based on the carbon reductions achieved for each site which is dependant on the chosen technology and the associated reductions achieved within the specific house type.

Table 11 Energy packages identified for each site

Site name	Code 4 energy package	Code 5 energy package	Code 6 energy package
Co op Depot	PV+BPEE	PV+BPEE (30% allowable solutions)	PV+BPEE (60% allowable solutions)
Waterfront	Biomass heating + BPEE	Gas CHP + PV+ BPEE (30% allowable solutions)	Gas CHP + PV+ BPEE (58% allowable solutions)
N of Valley Road	PV+BPEE	Biomass heating + PV+ BPEE (24% allowable solutions)	Biomass heating + PV+ BPEE (49% allowable solutions)
W of Westerfield road	PV+BPEE	Biomass heating +PV+BPEE (24% allowable solutions)	Biomass heating +PV+BPEE (49% allowable solutions)
Ipswich Cent E edge	mixture of GSHP +BPEE and PV+APEE	GSHP+PV+BPEE (27% allowable solutions)	GSHP+PV+BPEE (57% allowable solutions)
Ipswich North sub	PV+BPEE	PV+BPEE (30% allowable solutions)	PV+BPEE (60% allowable solutions)
Ipswich SE	mixture of GSHP +BPEE and PV+APEE	GSHP+PV+BPEE (38% allowable solutions)	GSHP+PV+BPEE (63% allowable solutions)
Ipswich Cent W edge	Biomass heating + BPEE	Biomass heating+PV+BPEE (19% allowable solutions)	Biomass heating+PV+BPEE (52% allowable solutions)

Figure 4 shows that packages with ground source heat pumps had higher associated costs when compared with other technologies. Communal heating systems on the other hand had considerably lower costs as illustrated in the table.

Figure 4 Energy Costs of Achieving Different Code Levels



Site name	Code 4 energy package	Code 5 energy package	Code 6 energy package
Co op Depot	PV+BPEE	PV+BPEE (30% allowable solutions)	PV+BPEE (60% allowable solutions)
Waterfront	Biomass heating + BPEE	Gas CHP + PV+ BPEE (30% allowable solutions)	Gas CHP + PV+ BPEE (58% allowable solutions)
N of Valley Road	PV+BPEE	Biomass heating + PV+ BPEE (24% allowable solutions)	Biomass heating + PV+ BPEE (49% allowable solutions)
W of Westerfield road	PV+BPEE	Biomass heating +PV+BPEE (24% allowable solutions)	Biomass heating +PV+BPEE (32% allowable solutions)
Ipswich Cent E edge	mixture of GSHP +BPEE and PV+APEE	GSHP+PV+BPEE (27% allowable solutions)	GSHP+PV+BPEE (57% allowable solutions)
Ipswich North sub	PV+BPEE	PV+BPEE (30% allowable solutions)	PV+BPEE (60% allowable solutions)
Ipswich SE	mixture of GSHP +BPEE and PV+APEE	GSHP+PV+BPEE (38% allowable solutions)	GSHP+PV+BPEE (63% allowable solutions)
Ipswich Cent W edge	Biomass heating + BPEE	Biomass heating+PV+BPEE (19% allowable solutions)	Biomass heating+PV+BPEE (52% allowable solutions)

*Excluding costs of allowable solutions

6.2 Compliance Costs of BREEAM

Currently there is limited data available regarding the compliance costs of the different versions of BREEAM, although a large study by Cyril Sweett will be published later this summer. The only published data currently available is from a study undertaken in 2005 that investigated the costs of meeting Eco-homes and BREEAM.[15] However, a lot has changed since 2005 with substantial improvements in the Building Regulations and

[15] *Costing Sustainability: How much does it cost to achieve BREEAM and EcoHomes ratings?, IP4/05, BRE and Cyril Sweett, 2005*

subsequent alterations to BREEAM requirements. The number of different versions of BREEAM has also increased and a new rating of BREEAM Outstanding has been added to the rating system.

Table 12 below outlines the costs of building to BREEAM Very Good and BREEAM Excellent for air conditioned and naturally ventilated offices. However, the costs of the current versions of BREEAM will differ due to a number of reasons:

- Building Regulation improvements in 2006 have now superseded the energy requirements in earlier BREEAM standards;

- Carbon reductions are greater for the current versions of BREEAM, with a 25% carbon reduction mandatory for BREEAM Office Excellent for naturally ventilated (and a higher carbon reduction for air conditioned offices), as opposed to it being a voluntary option under the earlier versions.

The location of a development has a substantial impact on the credits awarded under BREEAM for proximity to public transport and local amenities, and therefore on the cost of achieving different BREEAM ratings. A town centre location will typically enable a development to pick-up these credits at no cost and therefore town centre developments have a lower cost of achieving BREEAM ratings. Compliance costs for developments outside urban areas or away from transport hubs will therefore be higher.

Table 12: Percentage increase in office build costs under BREEAM Very Good and Excellent

BREEAM rating	Air-Conditioned Office		Naturally Ventilated Office	
	Typical Location	Good Location	Typical Location	Good Location
Very Good	0.2%	0.1%	0.3%	0.4%
Excellent	7%	3.3%	3.4%	2.5%

This illustrates that BREEAM Excellent can add 7% to build costs for an air conditioned office and 3.4% for a naturally ventilated office. We do not have cost data for the impact of BREEAM on retail and light industrial buildings, but the BREEAM office costs can be used as a proxy for these other non-domestic uses.

6.3 Compliance Costs of the Merton Rule (proposed policy DC2)

6.3.1 Comparing the renewable energy requirement of Policy DC2 to the Code for Sustainable Homes energy carbon requirement

The requirement for 15% of energy to be generated from renewable energy equates nearly exactly to the carbon reduction target for Code for Sustainable Homes Level 3. The 15% renewable energy policy needs to be measured in terms of carbon reductions in order to ensure consistency and ease of monitoring across different developments. Ipswich will need to be clear to developers that carbon emissions from the development should be reduced by 15% below Building Regulation requirements through the use of onsite renewable energy.

The 15% renewable energy policy applies to all energy use and carbon emissions from a development whereas the carbon reductions in the Code only apply to carbon emissions from heating and lighting as these are controlled by Building Regulations whereas appliances energy use is not (these are referred to 'regulated emissions'). Table 13 shows that 15% of carbon emissions from ALL energy use equates to 25% of emissions from heating & lighting which exactly corresponds to the carbon reduction within Code Level 3. A 20% reduction in ALL emissions would equate to a 33% reduction in heating and lighting emissions for flats, and a 31% reduction for houses (as heating is responsible for a slightly larger proportion of energy use in houses than it is in flats).

Table 13: Relationship between 15% and 20% target for ALL emissions, and the Code for Sustainable Homes carbon target for emissions from heating and lighting only

Building type	Proportion of regulated emissions to total	Reduction in ALL emissions	Corresponding reduction in REGULATED emissions
Flat	60%	15%	25%
House	65%	15%	24%
Flat	60%	20%	33%
House	65%	20%	31%

Table 13 above shows that the 15% renewable energy requirement will have no effect upon the carbon emission reductions of housing developments as developers will need to deliver the same carbon reductions in order to comply with the requirement for Code Level 3.

6.3.2 Comparing the cost of achieving Code Level 3 through energy efficiency and renewables versus through renewables only

In complying with both the DC1 and the DC2 policies, developers will therefore seek to meet the carbon reduction requirement under the Code for Sustainable Homes through the use of renewable energy only as opposed to a combination of energy efficiency and renewable energy. Table 14 shows the impact of this approach on compliance costs for developments by highlighting the cost of achieving a 25% reduction in regulated carbon emissions for each of the viability test development sites through a combination of energy efficiency and renewable energy (which is the cheapest approach to meeting Code carbon reductions), and through renewable energy only.

Table 14: Comparing the cost of achieving Code Level 3 through energy efficiency and renewables versus through renewables only[16]

Site name	Energy costs for Code Level 3 – Energy efficiency & renewables	15% renewables cost - PV	15% renewables cost – biomass heating	15% renewables cost – GSHP & PV
	ALL OPTIONS DELIVER 25% REDUCTION IN REGULATED EMISSIONS			
Co op Depot (Market town/terraced)	£5,000	£5,100		£12,300
Waterfront (Urban regeneration/flats)	£3,400	£4,500	£4,000	
N of Valley Road (Market town/detached)	£6,000	£8,000		£12,300
W of Westerfield road (Market town/detached)	£6,000	£8,000		£12,300
Ipswich Cent E edge (City infill/flats)	£3,400	£4,600		£10,400
Ipswich North sub (Small scale/terraced)	£5,000	£5,100		£12,500
Ipswich SE (Market town/flats)	£3,400	£4,500	£4,000	
Ipswich Cent W edge (Market town/flats)	£3,400	£4,500	£4,000	

It can be seen the by setting the renewable energy target, this raises the cost of achieving the same CO2 reductions as required for Code level 3. Whilst this may achieve certain policy ambitions such stimulating the renewable energy industry it could lead to a reduction in the energy efficiency of new developments, thereby leading to undesirable outcomes such as greater running costs, greater use of (biomass) resources and the lost opportunity to ‘lock in’ energy efficiency measures that would generally last for much longer than renewable energy technologies.

[16] *Data from Annex E, Definition of Zero Carbon Homes and Non-domestic Buildings: Consultation, 2009*

6.3.3 Considering the impact of a 20% renewable energy policy

If the renewable energy requirement were increased to 20% it would equate to a carbon reduction requirement of 33% for heating and lighting emissions, which lies approximately halfway between the requirements of Code Levels 3 and 4. Table 15 compares the cost of meeting a 20% renewable energy requirement with a 15% renewable energy requirement and with code levels 3 & 4.

Table 15: Comparing the cost of achieving 20% renewables policy with Code Level 4 carbon standards[17]

Site name	Energy costs for Code Level 4	20% renewables cost - PV	20% renewables cost – GSHP & PV
	44% reduction in regulated emissions	31/ 33% reduction in regulated emissions	
Co op Depot (Market town/terraced)	£7,346	£6,000	£15,500
Waterfront (Urban regeneration/flats)	£4,938 (e.e. & biomass boilers)	£3,938 – cost of biomass boilers	£10,000
N of Valley Road (Market town/detached)	£10,180	£9,200	£22,200
W of Westerfield road (Market town/detached)	£10,180	£9,200	£22,200
Ipswich Cent E edge (City infill/flats)	£9,940 (mixture of PV & GSHP)	£5,000	£12,500
Ipswich North sub (Small scale/terraced)	£7,346	£6,000	£13,500
Ipswich SE (Market town/flats)	£12,466	£4,700	£11,000
Ipswich Cent W edge (Market town/flats)	£5,712 (e.e. & biomass heating)	£4,700	£11,000

[17] *Data from Annex E, Definition of Zero Carbon Homes and Non-domestic Buildings: Consultation, 2009*

6.3.4 Impact of the DC2 policy on non-domestic buildings

In the same way as the 15% renewable energy requirement equates to the same level of carbon reductions as Code Level 3 for housing, it also roughly equates to the carbon reductions required under BREEAM Excellent. BREEAM Excellent requires a minimum Energy Performance Certificate score that typically corresponds to a 25% improvement in carbon performance over Building Regulations (although the precise value varies from building type to building type). This analysis shows that a 20% renewable energy target would increase cost further against a Code Level 3 requirement and would lead to a high proportion of a Code Level 4 target being met through renewables which, again, could be at the expense of energy efficiency measures.

7 Testing the Viability of the Proposed Sustainability Policies

7.1 Outputs of the Viability Testing

Table 16 and Table 17 show the viability of housing development across the 8 Ipswich sites at Code for Sustainable Homes Levels 4 and 5. The viability results present the base case scenario of 2008 market prices with an affordable housing level of 30%. We were limited to using the 30% affordable housing level as the base case since this was the level at which the Fordham study carried out appraisals to test the impact of different market price scenarios on viability. We do test the combination of a 40% affordable housing target with Code Levels 4, 5 & 6 at the end of this section, however this does not include sensitivity analysis of different price scenarios in the absence of required data. As mentioned previously, the viability of the sites are assessed against an alternative use value plus the cushion value which reflects the amount of surplus needed over the alternative use value to create the incentives for the landowner to release the site for housing development. The alternative use value with and without the cushion figure are presented under the Alternative Use Value column in Table 16 below.

Table 16 Viability Testing for Code Level 4 at 30% affordable housing and 2008 house market prices

Assumptions

Code Level	4
Affordable housing levels	30%
Price scenario	Base case

Site	Location	Energy Package	ESCO Finance and/or FIT/RHI revenue	Total Code 4 costs (£k/acre)	Residual Land Value based on Code 3 Costs (£k/acre)	New Residual Land Value Incorporating Costs of Code 4 (£k/acre)	Alternative Use Value (£k/acre)	Viable with Code 4?	Viable with Code 3?
Co op Depot	Other	PV+BPEE	0%	£61	-65	-126	245/285	not viable	not viable
Waterfront	IP-One	Biomass heating + BPEE	0%	-£35	-2130	-2,095	370/410	not viable	not viable
N of Valley Road	Northern Fringe	PV+BPEE	0%	£92	223	131	110/150	marginal	viable
W of Westerfield road	Northern Fringe	PV+BPEE	0%	£79	142	63	20/60	viable	viable
Ipswich Cent E edge	IP-One	mixture of GSHP +BPEE and PV+APEE	0%	£367	-470	-837	245/285	not viable	not viable
Ipswich North Sub	Northern Fringe	PV+BPEE	0%	£46	211	165	178/218	not viable	marginal
Ipswich SE	Other	mixture of GSHP +BPEE and PV+APEE	0%	£245	-34	-279	170/210	not viable	not viable
Ipswich Cent W Edge	IP-One	Biomass heating + BPEE	0%	£81	-2	-83	245/285	not viable	not viable

Table 17 Viability Testing for Code Level 5

Assumptions	
Code Level	5
Affordable housing levels	30%
Price scenario	Base case
Cost of allowable solutions (£/tonne of CO_2)	100

Site	Location	Energy Package	ESCO finance and/or FIT/RHI revenue	Total Code 5 costs (£k/acre)	Residual Land value based on Code 3 costs (£k/acre)	New Residual Land value incorporating costs of Code 5 (£k/acre)	Alternative Use Value (£k/acre)	Viable?
Co op Depot	Other	PV+BPEE	0%	£234	-65	-£299	245/285	not viab
Waterfront	IP-One	Gas CHP + PV+ BPEE	0%	£476	-2130	-£2,606	370/410	not viab
N of Valley Road	Northern Fringe	Biomass heating + PV+ BPEE	0%	£194	223	£29	110/150	not viab
W of Westerfield road	Northern Fringe	Biomass heating +PV+BPEE	0%	£147	142	-£5	20/60	not viab
Ipswich Cent E edge	IP-One	GSHP+PV+BPEE	0%	£838	-470	-£1,308	245/285	not viab
Ipswich North Sub	Northern Fringe	PV+BPEE	0%	£177	211	£34	178/218	not viab
Ipswich SE	Other	GSHP+PV+BPEE	0%	£393	-34	-£427	170/210	not viab
Ipswich Cent W Edge	IP-One	Biomass heating+PV+BPEE	0%	£215	-2	-£217	245/285	not viab

The figures above illustrate that out of the eight sites considered, only one site was viable and one site marginal within Code Level 4 costs, 2008 market prices and no ESCo finance contributions. Compared with Code Level 3 viability results shown on Table 16, it can be seen that additional costs associated with Code 4 impacted the viability of only two sites. The remaining sites were unviable under both cases with the exception of one site in Northern Fringe. Code Levels 5 and 6 left none of the sites viable.

The results of Code Levels 4, 5 and 6 with 2008 market prices, no ESC/FIT/RHI contribution and 30% affordable housing component is summarised in the table below. In the following sections, these conditions will be referred to as the 'base case' scenario. The table also includes the results of the Fordham Study looking at Code Level 3.

Table 18 Summary results of viability analysis with base case

Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
3	-65	-2130	223	142	-470	211	-34	-2
4	-126	-2,095	131	63	-837	165	-279	-83
5	-283	-2,614	24	-28	-1,237	46	-391	-181
6	-364	-2,838	-34	-77	-1,402	-15	-474	-264

not viable
marginal
viable

7.2 Comparison of the Impacts of Government's Policy and DC1 on Viability

It was mentioned in Section 3.2 that the Government has set out its aspirations for improving the carbon performance of new developments in the future and has announced that all new developments would be required to be zero carbon by 2016. This means that Ipswich's DC1 policy only brings on the non-energy costs of the Code when compared with the government's policy. In order to understand the impact of government's policy on viability in Ipswich, we have re-designed our model so that it incorporates only the energy costs of the code. The results are shown in Table 19.

Table 19 Viability results with only energy costs of the Code incorporated

Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-106	-2,031	155	84	-788	180	-255	-58
5	-191	-2,396	105	41	-1,108	115	-327	-117
6	-251	-2,589	55	-1	-1,242	70	-394	-184

The table above shows that when the non-energy costs are removed and only the energy costs are incorporated into the viability testing, illustrating the impacts of government's policies, the changes on the viability results are only marginal when compared with the viability results of DC1 showed under Table 18. Under Code Level 4, viability of N of Valley Road was improved to 'viable' from marginal and Ipswich North Sub site was upgraded to being 'marginal' from a previous status of having a residual land value that is slightly lower than the alternative use value. For Code Level 5, the only change was on W of Westerfield Road where the site became 'marginal'. Under Code Level 6, there was no difference on viability between DC1 and the government's policy: all sites were unviable.

Therefore, it should be noted that even if the residual land values are adversely affected by additional costs of DC1, a majority of these costs would be imposed on the developers anyway due to the Government's policy of making all new developments zero carbon by 2016. In addition, although we have modelled the theoretical impact of different code targets on all the housing developments, in practice all but one of the larger sites will come forward after 2016 and therefore all developments would have to achieve the zero carbon standards of the code targets anyhow under the Building Regulations.

7.3 Investigating Impact of Key Variables on Viability

The viability of the development sites improves with increasing market house prices and with a contribution from Energy Services Companies who can contribute financial investment to energy infrastructure within new developments in return for an income stream from the operation of the infrastructure in the future. We have tested the impact of these key variables on viability along with the impact of a 40% affordable housing case. The scenarios we looked at are listed in the table below.

Table 20 Description of different scenarios tested for viability analysis

Scenarios	Description

Base Case	2008 market prices, no ESCo/FIT/RHI finance, 30% affordable housing, no grants
Scenario 1	ESCo finance: 2008 market prices, 25% ESCo/FIT/RHI on PV, 50% ESCo/FIT/RHI on communal heating systems, 30% affordable housing
Scenario 2	Market price increase: 7.5% increase from 2008 market prices, no ESCo/FIT/RHI, 30% affordable housing
Scenario 3	ESCo & market price increase: 7.5% increase in market prices, 25% ESCo/FIT/RHI on PV, 50% ESCo/FIT/RHI on communal heating systems, 30% affordable housing
Scenario 4	ESCo& 40% affordable housing: 2008 Market prices, 25% ESCo/FIT/RHI on PV, 50% ESCo/FIT/RHI on communal heating systems, 40% affordable housing

7.3.1 ESCo Contribution (Scenario 1)

ESCos

An ESCo is a specialist energy services company that can design, build and operate communal energy infrastructure such as biomass heating systems or combined heat and power systems. ESCo companies have formed partnerships with housing developers on a number of low carbon housing projects that are installing communal boilers and site-wide heat distribution infrastructure in the development. Although the precise arrangements vary from case to case, these ESCos typically provide a proportion of the capital for covering the costs of the energy infrastructure and then own and operate the plant, including selling the heat to residents. The terms of reference for the heat sales to residents are carefully determined so to safeguard resident energy costs (and are often linked to general market prices) and usually involve the local authority.

In our analysis of the potential impact that ESCo involvement could have on viability, we have assumed that ESCo contributions could amount to 50% of the cost of the plant for communal energy networks (biomass heating, biomass combined heat and power and gas combined heat and power). ESCos would not make any contribution to the costs of energy efficiency improvements as there are no future revenues streams associated with this investment (unlike selling heat from a biomass boiler).

Feed-In Tariffs and Renewable Heat Incentives

ESCos have not historically contributed to the investment costs of individual microgeneration technologies such as photovoltaics and solar water heating. However, as outlined above, the Government is about to introduce two renewable energy support mechanisms;

- the Feed-In Tariffs (FIT) will provide an annual income stream for renewable electricity such as from photovoltaics from April 2010; and,
- the Renewable Heat Incentive (RHI) will provide an annual income stream for renewable heat such as biomass heating, solar water heating and heat pumps from April 2011.

Although both of these mechanisms will provide an income stream to owners of renewable energy technologies, they could also stimulate the marketplace to provide a business offering of upfront capital for investment in these technologies so that the long term FIT and RHI income streams can be claimed by these companies. Housing developers could form a partnership with a FIT/ RHI investment company, a new type of ESCo, and secure finance to cover some, or all, of the costs of installing microgeneration technologies. The rights to the FIT and RHI income stream from the installations would however need to be signed over to the investment company rather than the householder who eventually lives in the home, and this is an issue that needs further consideration.

As the FIT and RHI have not yet entered the market place, and there is some uncertainty over how the sector will respond, we have used a conservative figure of a 25% contribution to the energy costs for microgeneration technologies (PV, solar water heating and heat pumps) in the viability analysis.

Impact of ESCo/FIT/RHI on The ESCo contribution in Scenario 1 is therefore set at 50% for those developments with an energy package that includes biomass heating or gas CHP, and 25% for those with an energy package of PV or heat pumps.

The results of the modelling with ESCo/FIT/RHI contribution is presented in Table 21.

Table 21 Scenario 1 Results (Base case + ESCo)

Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-93	-1,923	164	92	-716	190	-203	-13
5	-235	-2,301	105	42	-1,049	83	-307	-92
6	-316	-2,525	47	-8	-1,215	21	-390	-175

The results show that ESCo finance had an important role in improving the viability of the sites through contributing to the capital costs of renewable energy technologies and reducing the burden on the developers. Our modelling illustrated that through ESCo finance, viability in three of the sites located in Northern Fringe area improved. No sites were viable under Code Level 6, however we have shown that viability would remain the same under the government's policy of zero carbon homes where only energy costs would be imposed on the developers. The results are summarised in the table below.

7.3.2 Market prices in Ipswich (Scenario 2 & 3)

The base case scenario of our analysis had assumed 2008 market prices based. As the downturn of the market had already started during this time, we have also modelled a scenario with an increase of 7.5% in the market prices compared to 2008 through working with the residual land values derived by the Fordham study under such conditions. The results are shown in the table below.

Table 22 Scenario 2 Results (Base case + market price increase)

Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-35	-1,709	203	148	-598	255	-144	49
5	-196	-2,263	98	58	-1,083	133	-299	-92
6	-256	-2,456	48	16	-1,217	88	-366	-159

Increase in market prices had a similar affect on viability as ESCo finance, where viability in three sites located in Northern Fringe improved. However, when the market price increase was combined with an ESCo contribution, the results improved significantly. Under Code Level 5 two out of three of the Northern Fringe sites were viable and under Code Level 6, one of these sites became marginal with the other one remaining viable. The results are shown in Table 23.

Table 23 Scenario 3 Results (Market price increase & ESCo)

Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-2	-1,537	236	176	-477	280	-68	119
5	-148	-1,951	179	127	-896	169	-215	-3
6	-208	-2,143	129	85	-1,030	124	-282	-70

7.3.3 Affordable Housing proportion (Scenario 4)

The impact of an increase in the affordable housing component from 30% was also investigated through modelling viability with a 40% case scenario. The results showed that this changed viability of the sites significantly and none of the sites were viable even in the existence of ESCo finance, leading on to the conclusion that 40% affordable housing levels would be difficult to deliver without any access to grants. The results are shown in the table below.

Table 24 Scenario 4 Results (ESCo + 40% affordable housing)

Residual land values (£k/acre)	Co op Depot	Waterfront	N of Valley Road	W of Westerfield road	Ipswich Cent E edge	Ipswich North sub	Ipswich SE	Ipswich Cent W edge
Alt use value	245/285	370/410	110/150	20/60	245/285	178/218	170/210	245/285
Code Level								
4	-191	-2,243	95	6	-943	86	-315	-127
5	-333	-2,621	36	-44	-1,276	-21	-419	-206
6	-414	-2,845	-22	-94	-1,442	-83	-502	-289

7.4 Lessons for Key Sites in IP-One and the Northern Fringe

The viability testing of the specific and notional sites from the Fordham study provides us with an indication of the general viability of the sustainability policies within the Borough's main development areas.

It is clear from the modelling results that viability in IP-One area is difficult to achieve as none of the scenarios that were modelled showed viability for any of the three IP-One sites. This is mainly due to the high density nature of the developments in this area where the land value is a lower proportion of the total value of the developments. As land value is the main source of developer subsidy, this means that there is less potential to absorb additional costs of sustainability even if these costs were less than the Northern Fringe sites due to the notional allocation of district heating technologies. On the other hand, there was more potential for the viability in the Northern Fringe areas which followed from the high residual land values these sites had.

It is worth noting that the cost associated with Code for Sustainable Homes is expected to reduce over time due to the growth in demand for the services and products enabling the achievement of higher code levels. However, it is currently not possible to quantify the magnitude of this cost reduction and therefore the viability testing we undertook does not incorporate this issue and could therefore be considered as conservative from this perspective.

7.5 Viability of the DC1 BREEAM Policy for Non-Domestic Buildings

Without a development viability study for employment land in Ipswich it is extremely difficult to assess the impact of the BREEAM compliance costs on the viability of development. Nonetheless, the BREEAM costs outlined in section 6 can be evaluated in the context of employment land values in the Ipswich area to provide an indication of the ability of development within Ipswich to absorb the costs associated with higher sustainability standards. Table 25 presents employment land values in Ipswich, the Eastern Region and England & Wales for July 2009 which highlight that land values in Ipswich are slightly below the national average, and less than half of that of the average within the Eastern Region. These land values would suggest that Ipswich has significantly less capacity than other areas in the Eastern Region, and slightly less capacity than national average, to absorb the costs of building to higher sustainability levels.

Table 25: Employment Land Values for England & Wales, Eastern Region and Ipswich, Valuation Office Agency[18]

	National Average (excluding London)	Eastern Region	Ipswich
Office	£710,000 per ha	£1,136,000 per ha	Not available
Industrial	£600,000 per ha	£936,000 per ha	£475,000 per ha

Although the costs of achieving BREEAM Very Good and Excellent are likely to be somewhat higher than the figures from the 2005 study presented in section 6, they are not likely to be as high as the costs of achieving Code for Sustainable Homes Levels 5 & 6, as they do not require zero carbon standards (this is required in BREEAM Outstanding). The burden of building to BREEAM Very Good and Excellent is therefore not as great as building to the highest Code levels.

7.6 Viability of DC2 Renewable Energy Policy

7.6.1 Impact of 15% Renewable Energy Requirement on Development Viability

In

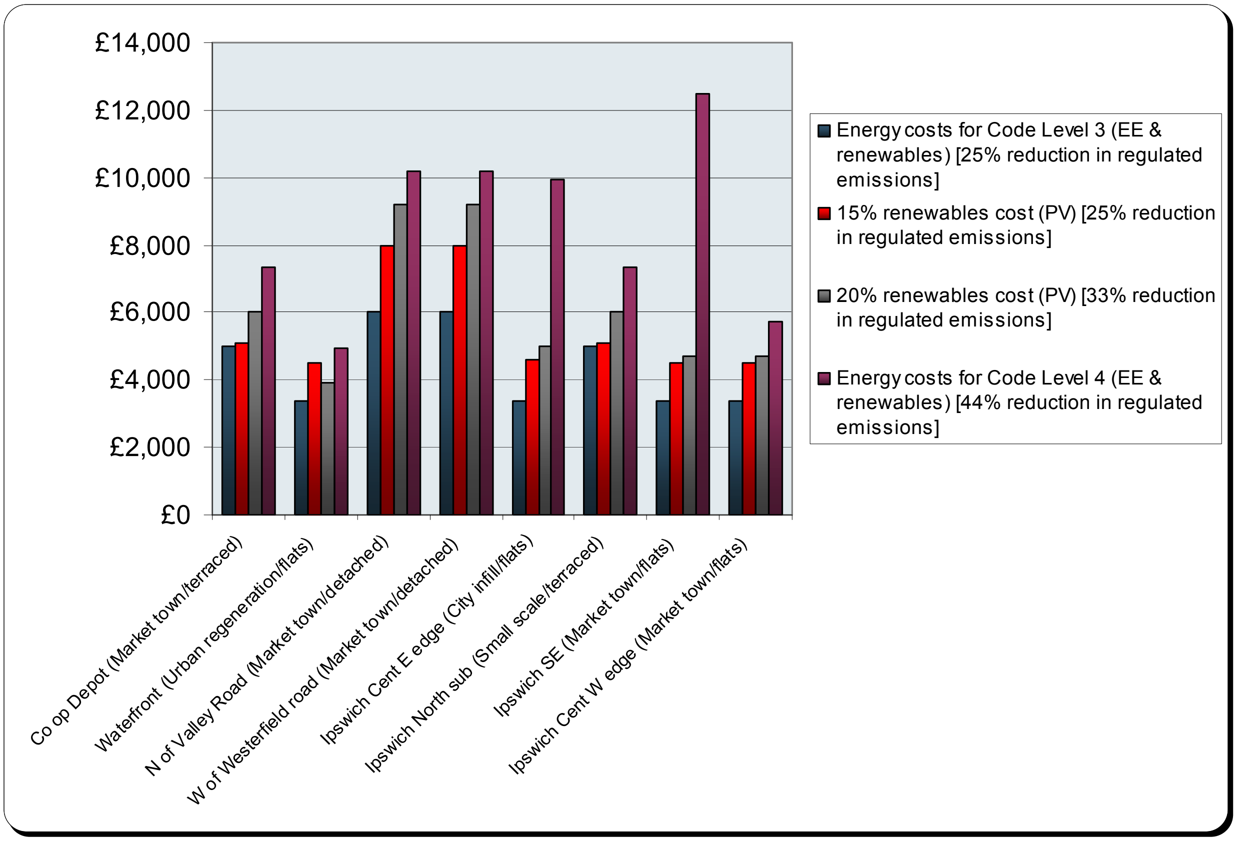
[18] *Valuation Office Agency, Property Market Report July 2009*

Figure 5 below the purple bars show the cost of meeting the carbon requirements of Code Level 3 through a combination of energy efficiency and renewable energy for the tested development sites and the other bars outline the costs of compliance through the use of different renewable energy technologies only. Although biomass heating is the cheapest renewable energy option it is only applicable to sites of a certain scale and density, and is only appropriate for 3 of the test sites as indicated. The heat pumps are the more expensive renewable energy technology as represented by the light blue bars, but they may be a required technology where for example overshading affects the deployment of photovoltaics.

Figure 5 demonstrates that it is more cost effective to reduce emissions through a combination of energy efficiency and renewable energy than through renewable energy alone in delivering the 25% carbon reduction in regulated emissions required for Code Level 3. The 15% renewable energy policy in combination with a Code Level 3 requirement will not therefore lead to any additional carbon reductions but it will increase the cost of delivering these carbon reductions and have the perverse effect of encouraging developers to install renewable energy at the expense of energy efficiency fabric improvements which have a longer lifespan in terms of carbon savings.

The impact of the 15% Renewable Energy Policy on the viability of the development sites is essentially that of slightly increasing the cost of compliance for Code Level 3. The increase in cost may be only small where site characteristics allow the lower cost renewable energy technologies to meet the majority of the target, but the cost impact could be fairly substantial if higher cost technologies are needed.

Figure 5: Impact of 15% Renewable Energy Policy on the Cost of Achieving Carbon Requirements within Code Level 3



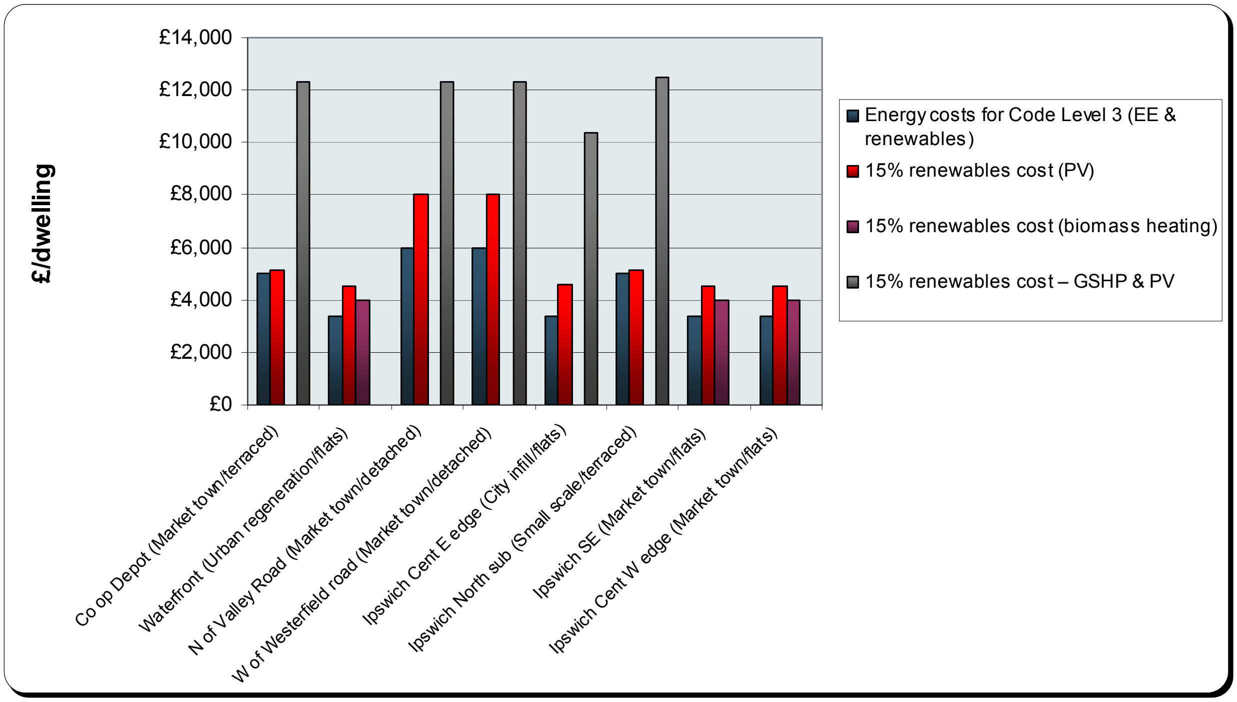
The 15% renewable energy policy has no effect when applied in combination with a Code Level 4 requirement as a renewable energy contribution of greater than 15% is required to deliver the mandatory carbon reductions under Code Level 4.

7.6.2 Impact of a 20% Renewable Energy Requirement on Development Viability

Figure 6 compares the cost of meeting a 20% renewable energy requirement with a 15% renewable energy requirement and with code levels 3 & 4. This demonstrates that the cost of meeting a 20% renewable energy policy lies approximately half-way between the cost of meeting the carbon requirements of Code Level 3 and Code Level 4 – which is not surprising considering that it equates to a 33% reduction in regulated emissions which is approximately half-way between the two Code Level requirements. The analysis in Figure 5 has the effect of slightly down-playing the costs of a 20% renewable policy and up-playing the costs of Code Level 4 as, in order to simplify the analysis, a higher cost heat pump solution has been included in the Code costs but omitted from the 20% renewables costs.

The impact of a 20% Renewable Energy Policy on the viability of the development sites would be that of placing a requirement on developers similar in cost to meeting Code Level 4 carbon requirements. However, a 20% renewables policy would have little effect when applied in combination with a Code Level 4 requirement as a renewable energy contribution of greater than 20% is required to deliver the mandatory carbon reductions under Code Level 4.

Figure 6: Comparing the costs of achieving Code Level 3, 15% renewable energy, 20% renewable energy and Code Level 4



7.7 What does the analysis tell us about the viability of the proposed sustainability policies?

7.7.1 Impact of DC1 will vary from site to site

The analysis in this report has focused on the implications for the development economics of mixed tenure residential schemes with levels 4, 5 and 6 of the Code for Sustainable Homes. The analysis has taken the earlier affordable housing viability study and assessed how scheme viability might be affected by requirements for Code for Sustainable Homes standards (following the same assumptions and methodology used in the Fordham Research study).

We recognise that we have assumed that building more sustainable homes would increase costs but that there would be no premium on price and that consumers would not be willing to pay more for a home build to a higher Code. Our analysis may therefore be considered conservative but we have no evidence to indicate that the increase in costs would be, to any significant extent, offset by an increase in market value.

The analysis we have undertaken also demonstrates that the impact on viability of Code for Sustainable Homes compliance varies between sites depending on their location. It will therefore be important for the Council, whatever affordable housing policy and approach to sustainability policies is adopted, to be flexible in their application and to take into account scheme specific circumstances where this is justified.

7.7.2 ESCo finance and role of FIT/ RHI has a critical role in enabling viability

Our analysis suggests that the economically healthier development sites in the Northern Fringe could cope with the costs of meeting most of the sustainability requirements under DC1 and DC2 if developers secure ESCo finance to cover some of the costs (deliver levels 4 & 5 of the Code), and could potentially cope with the costs of meeting all requirements if the housing market picks up in the coming years (ie achieve Code level 6 as well).

ESCo finance for communal energy infrastructure and FIT and RHI finance for renewable energy technologies, potentially has an important role in improving the viability of the sites through contributing to the capital costs of renewable energy technologies and reducing the burden on developers. When ESCo finance is included, the viability of three of the sites located in the Northern Fringe are viable up to Code Level 5. When ESCo finance is combined with a 7.5% increase in housing prices we found that all the Northern Fringe sites were viable up to Code Level 6.

7.7.3 Alternative approaches for carbon & sustainability planning in LDFs

In general local planning authorities can adopt a range of different approaches in progressing sustainable and low carbon development within their area. The Government has set out its timetable for requiring zero carbon development by 2016 (for housing) and planning authorities have the option of following this programme or developing policy requirements in advance of the Government’s programme. In proposing policy DC1, Ipswich Borough Council has set a robust environmental planning policy which seeks to ensure that high standards are set for all environmental issues in addition to carbon emissions.

Appendix 1 - Energy Consumption and Carbon Emissions

It is essential to firstly understand current and future energy consumption and carbon emissions of Ipswich. Emissions are measured in terms of “tonnes of carbon dioxide emitted per year”, or tCO_2/yr. Energy consumption is shown in Megawatt hours (MWh). This study concentrates its analysis on the existing and new built environment.

Current energy consumption

Figure 7 illustrates the annual energy consumption for Ipswich broken down my commercial & industrial and dwelling use, as provided by the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department for Energy and Climate Change (DECC). This shows that electricity makes up a higher proportion in the commercial and industrial buildings when compared to dwellings however thermal demand is still larger in both of the cases. This is not uncommon, and is evidence as to why national government is beginning to focus its efforts on heat

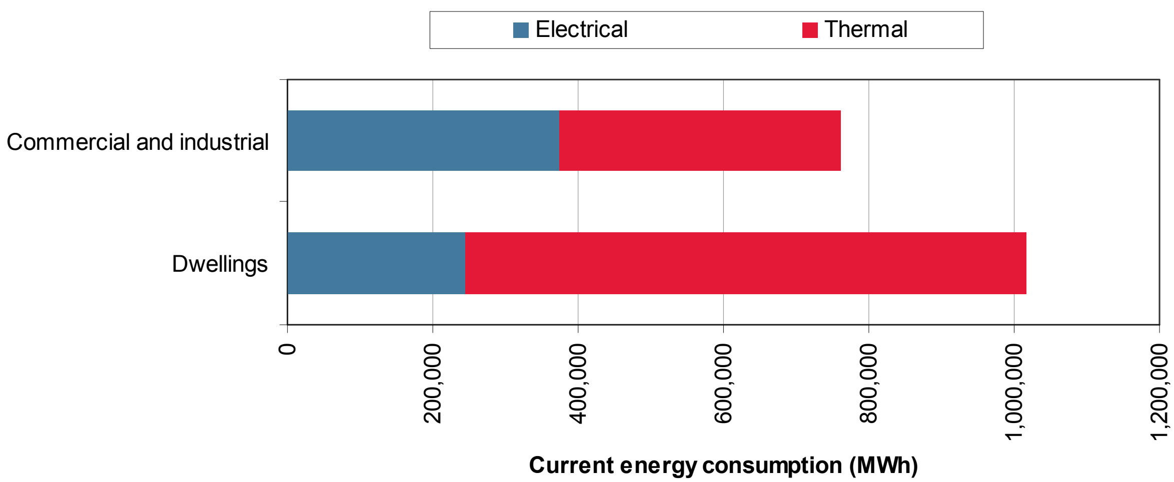


Figure 7: Estimated energy consumption for 2007 (Sources: BERR and DECC)

Translated carbon emissions of the energy consumption presented in Figure 7 is illustrated in Figure 8. The carbon emitted by every unit of energy differs between energy sources, hence the results do not directly mirror the energy graph above. Electricity’s proportional representation has increased due to its higher intensity of carbon per unit energy.

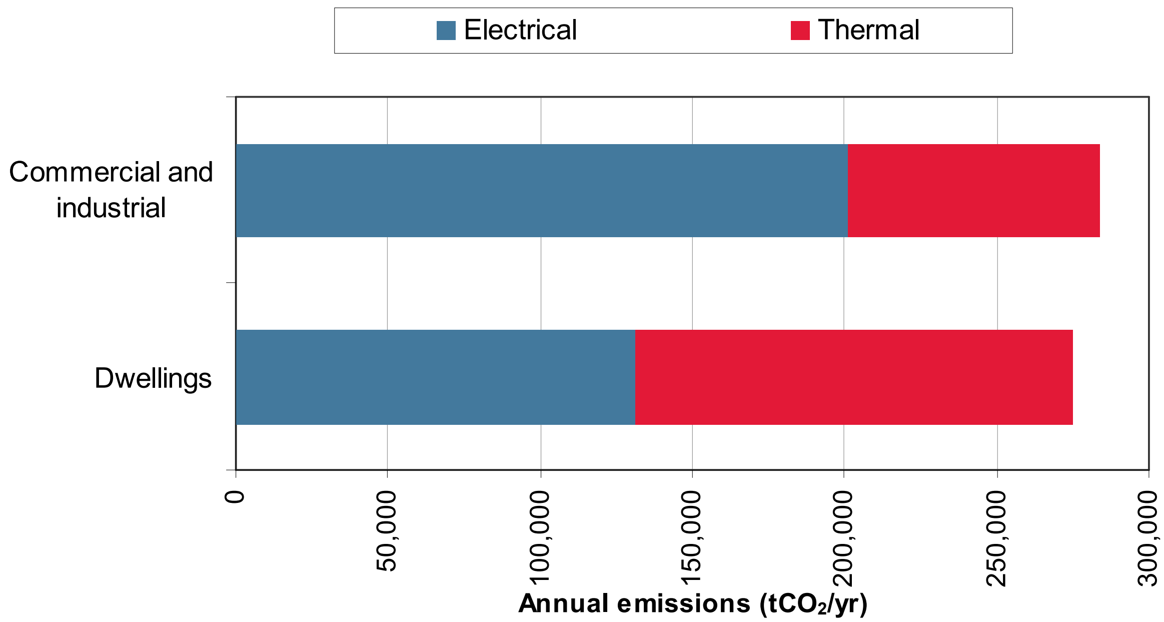


Figure 8: CO_2 emissions for 2007 (Sources: BERR and DECC)

Breakdown of 2007 emissions baseline by fuel type and sector

It is important to consider carbon emissions arising from the built environment of Ipswich, as this is the key focus of the study. Energy statistics available from BERR demonstrate the electrical and thermal (coal, oil and gas) energy consumption for each Authority. This data is illustrated for commercial & industrial and domestic sources (Figure 9). Initial observations include:

- Electricity is the major source of emissions for commercial & industrial (C&I), whereas it is a more even split between electricity and gas in the domestic setting.
- There is relatively little coal and oil consumption in domestic properties.
- Ipswich C&I emissions come from electricity at a higher magnitude than the national average, whilst emissions from oil, coal and gas are less than the national average.
- Distribution of emissions from the domestic sector are more in line with the national average compared to C&I sector where electricity and gas emissions are of similar magnitude to the national average. Emissions from coal and oil on the other hand are significantly lower than the national average.

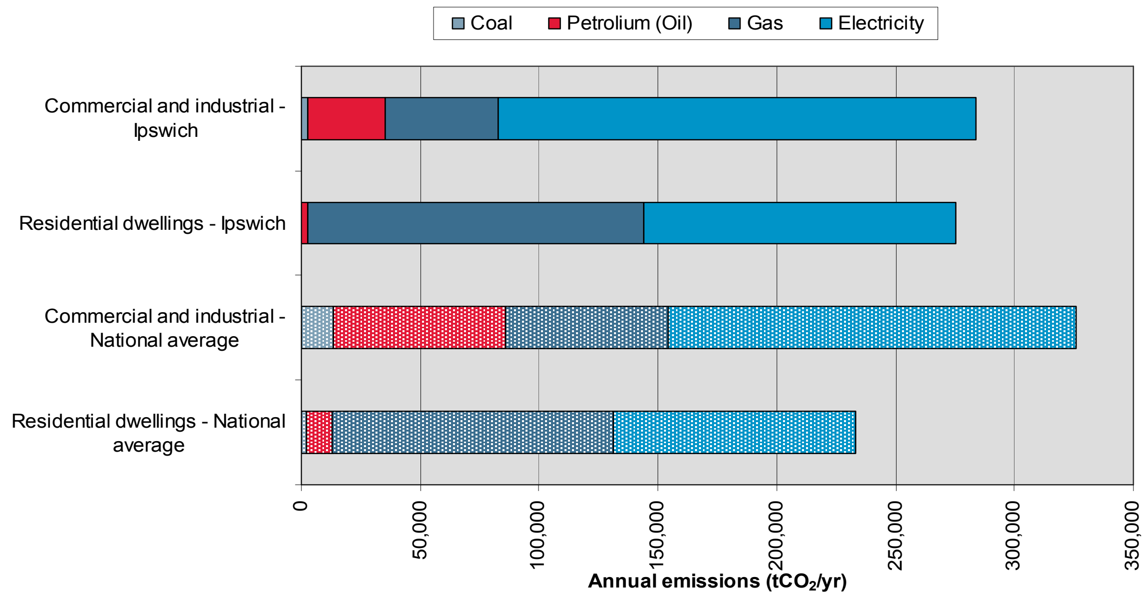


Figure 9: Source of thermal and electrical energy from C&I and domestic sources

Projected energy consumption

It is necessary to project forward energy demands, since national and regional targets are measured in terms of the proportion of energy demand delivered by renewable technologies in a given year. The scale of energy consumption in that year is a major factor which will influence whether a target will be met. Reducing consumption is as equally important to meeting the targets as installing renewable energy systems.

Baseline consumption is likely to increase in the absence of policy levers. However, the Low Carbon Transition Plan sets a path for lower consumption as a result of a series of binding and non-binding policy levers, leading to the deployment of energy efficiency technologies and systems and the better management of energy through behavioural change and careful use of controls.

It is not possible to accurately predict energy trends over an extended period, particularly during the current climate of policy changes and fluctuating energy prices. However, the Department for Energy and Climate Change (DECC) have released a set of scenarios which model energy consumption for combinations of three critical factors:

- Energy prices
- Policy impact
- Expected growth

The central scenarios for each of these factors are taken to derive projections of growth for electrical and thermal demand in the existing and new built environment, The energy demand for 2007 (as presented previously in Figure 7) was then extrapolated forward using the scaling factors. The results are illustrated in Figure 10 and Table 26.

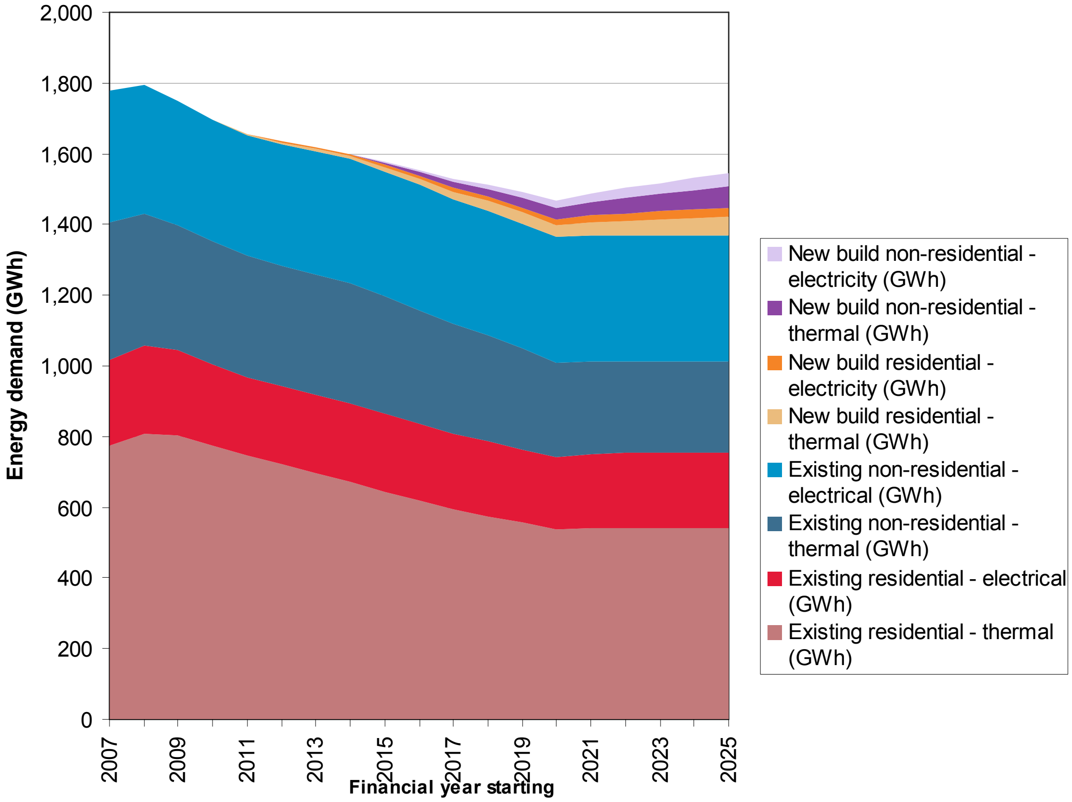


Figure 10: Future energy demand for domestic and C&I sectors (Source: DECC)

Table 26 Future energy demand predictions for domestic and C&I sectors (Source: DECC)

Energy Demand

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Residential energy projections - thermal	4.54%	-0.67%	-3.28%	-3.68%	-3.08%	-3.02%	-3.29%	-3.30%	-3.43%	-3.38%	-2.33%	-2.64%	-2.92%	1.61%	0.91%	0.00%	0.00%	0.00%	0.00%
Residentail energy projections - electrical	1.81%	-3.59%	-3.75%	-2.37%	0.00%	0.06%	-0.30%	-0.17%	-0.22%	-0.31%	-0.11%	-0.26%	-0.32%	2.51%	2.00%	0.00%	0.00%	0.00%	0.00%
Non-residential projections - thermal	-3.72%	-4.54%	-2.39%	-1.40%	-0.40%	-0.09%	-0.18%	-0.67%	-1.37%	-1.72%	-2.20%	-3.15%	-3.79%	0.17%	0.31%	0.00%	0.00%	0.00%	0.00%
Non-residential projections - electrical	-2.10%	-4.39%	-2.31%	-0.47%	0.75%	1.40%	1.45%	1.17%	0.87%	0.90%	0.99%	1.05%	1.10%	1.53%	1.41%	0.00%	0.00%	0.00%	0.00%

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Existing residential - thermal (GWh)	773	809	803	775	745	720	697	672	645	619	593	575	556	535	540	541	541	541	541	541
Existing residential - electrical (GWh)	244	249	240	230	224	223	222	221	219	216	213	211	208	206	209	212	212	212	212	212
Existing non-residential - thermal (GWh)	387	373	356	347	342	341	341	340	332	322	311	299	284	268	263	258	258	258	258	258
Existing non-residential - electrical (GWh)	375	367	351	343	341	344	348	353	354	354	354	354	354	355	357	358	358	358	358	358
New build residential - thermal (GWh)	0.0	0.0	0.0	1.8	3.5	5.3	7.1	8.8	13.3	17.7	22.1	26.5	31.0	35.4	39.2	43.0	46.9	50.7	54.5	58.4
New build residential - electricity (GWh)	0.0	0.0	0.0	0.8	1.6	2.4	3.3	4.1	6.1	8.2	10.2	12.2	14.3	16.3	18.1	19.8	21.6	23.4	25.1	26.9
New build non-residential - thermal (GWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	10.9	16.4	21.8	27.3	32.8	38.2	43.7	49.1	54.6	60.1	65.5
New build non-residential - electricity (GWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	6.8	10.2	13.7	17.1	20.5	23.9	27.3	30.7	34.1	37.5	41.0
Thermal energy (GWh/yr)	1,160	1,181	1,159	1,124	1,091	1,066	1,044	1,021	996	970	943	922	898	871	880	886	895	904	913	923
Electrical energy (GWh/yr)	619	616	591	574	567	569	574	578	582	585	587	591	594	597	608	617	622	627	632	638
Total (GWh/yr)	1,780	1,797	1,750	1,698	1,657	1,635	1,618	1,599	1,578	1,554	1,530	1,513	1,492	1,468	1,488	1,502	1,517	1,531	1,546	1,560

Figure 10 highlights the magnitude of the energy demand of the existing building stock as opposed to the new build and emphasises the importance of focusing efforts on improving the efficiency of the existing buildings alongside with building new developments to high energy efficiency and low carbon standards.

Predicted Growth in LZC Energy Generation from New Developments

7.7.4 Areas of Growth within Ipswich

As it was outlined in the main text of this report, Ipswich has been identified as a growth point in the draft East of England plan and is expected to accommodate growth amounting to approximately 19,500 homes and around 18,000 jobs (30,000 divided between Ipswich, Suffolk Coastal and Babergh) between 2001 and 2026. The three main areas of residential development is planned within IP-One, Northern Fringe and the rest of the borough. The predicted growth numbers are presented in the table below.

Table 27 Ipswich Borough Housing Growth Numbers from 2010 to 2026

IP-One (Waterfront)	Northern Fringe	Rest of Borough	Total
3,335	3,500 to 4,000	2,567	9,902

The key non-domestic development in Ipswich relates to office and industrial development on employment land and retail development in the town centre. The areas of employment land identified in the Core Strategy up to 2025 include:

- 35,000 sq m of additional/ new retail
- 55 hectares of employment land (office & industrial).

These growth figures have been used to forecast the renewable energy production and energy consumption associated with Ipswich's new development.

7.7.5 Characterising the Main Developments and Choosing Indicative Energy Supply Strategies

A similar approach to the viability testing was taken whilst choosing the energy strategies for the different sites in order to predict the renewable energy that will be generated within Ipswich. The smaller developments that constitute urban and rural infill are typically not appropriate for communal systems and therefore the optimum energy strategy will consist of highly energy efficient buildings with individual building integrated technologies. However, it was anticipated that the large developments within IP-One area may enable the implementation of communal heating systems and therefore the developments that will be built after 2016 to zero carbon standards were allocated communal biomass heating systems.

The urban extensions are at the larger size and density necessary to support a communal system in some or all of their development areas, and are large enough to potentially establish a long term power purchase agreement with a wind turbine developer or justify the creation of a local community owned ESCo on behalf of the future development.

Future building Regulations for non-residential buildings are not yet set, besides the intention to make all such buildings zero carbon as of 2019. Therefore it was assumed that there would be a 25% target set on emissions reductions between 2013 and 2016 and a 44% reduction target between 2016 and 2019. All new non-residential developments were assumed to be zero carbon after 2019.

The energy strategies allocated to sites were all rule of thumb categorizations and there will often be an overlap between these development types within the characteristics of any specific development site. The specific characteristics of the site will also determine the technical and financial suitability of CHP and district heating systems. Therefore the energy strategies presented in Table 28 are indicative only.

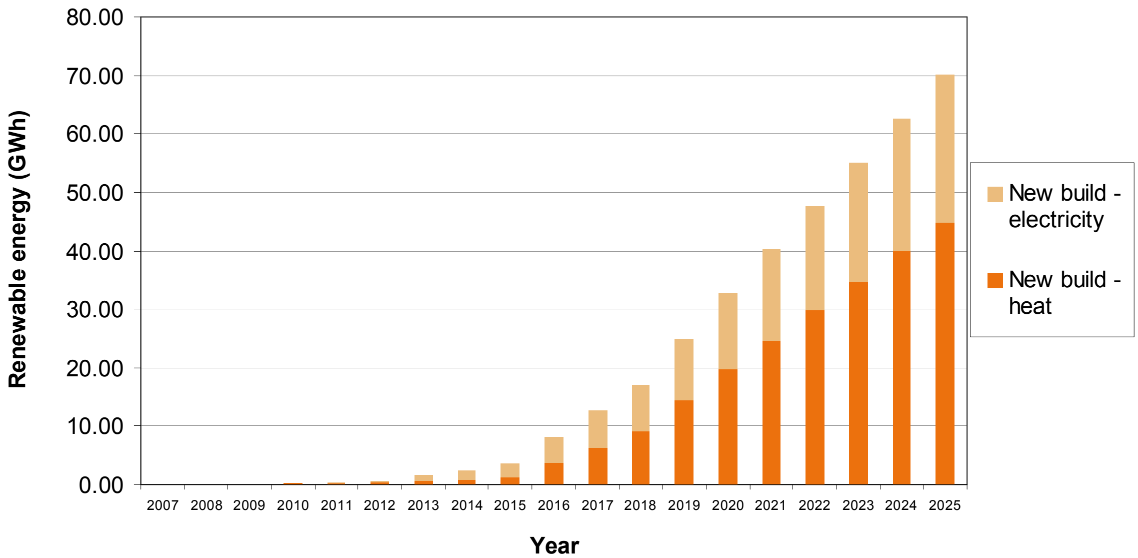
Table 28: Defining suitable energy strategies for development areas in Ipswich

Development	Time frame built	General Development Characteristics	Renewable Energy Strategy
IP-One & Rest of Borough (until 2013)	2010-2013	Urban infill	PV + Solar thermal
	2013-2016		PV + Solar thermal
	2016-		Communal biomass heating + PV + allowable solutions
Northern Fringe	2013-2016	Urban extension	Small wind + individual biomass heating
	2016-		CHP (biomass, AD or EfW)+ PV + allowable solutions
Non-Residential	2010-2013	Non-residential	none
	2013-2019		PV
	2019-		GSHP + PV

7.7.6 Modelling renewable energy generation in Ipswich's new development

We have modelled the renewable energy generation associated with the growth plans for residential and non-residential development over the next 15 years, which is presented in Figure 11. According to our predictions, by 2025, a total of 70 GWh (45 GWh thermal, 25 GWh electrical) of renewable energy will be generated from the new buildings in Ipswich. These predictions were also fed into the renewable energy assessment of the area which is discussed in Appendix 2.

Figure 11 Predicted Renewable Energy Generated from New Developments in Ipswich



Heat Mapping across Ipswich Borough

Understanding the spatial distribution of heat consumption can help to identify suitable areas for district heating and combined heat and power (CHP). By overlaying the potential pattern of new development we can begin to identify areas of opportunity to link new build community energy infrastructure with high energy consuming existing settlements.

Figure 12 presents the spatial distribution of gas consumption on a Medium Super Output Area (LSOA) basis. In light of the extensive coverage of the gas distribution network within the district and the high proportion of households connected to the gas grid (approx 95%), actual heat demand can be expected to be very similar to gas demand. The granularity of data at MSOA level does not enable specific sites of heat demand to be identified; rather, it begins to identify 'areas of search' for a more detailed study.

District heating viability

District heating requires significant infrastructural investment to enable heat to be distributed over a given area. To enable this investment to be recouped at a rate attractive to a developer or Energy Service Company (ESCO), schemes are optimised by connecting to:

- large heat consumers;
- a number of consumers whose summed heat demands produce a constant heat load; and
- consumers whose locations are tightly clustered (reducing pipe distances).

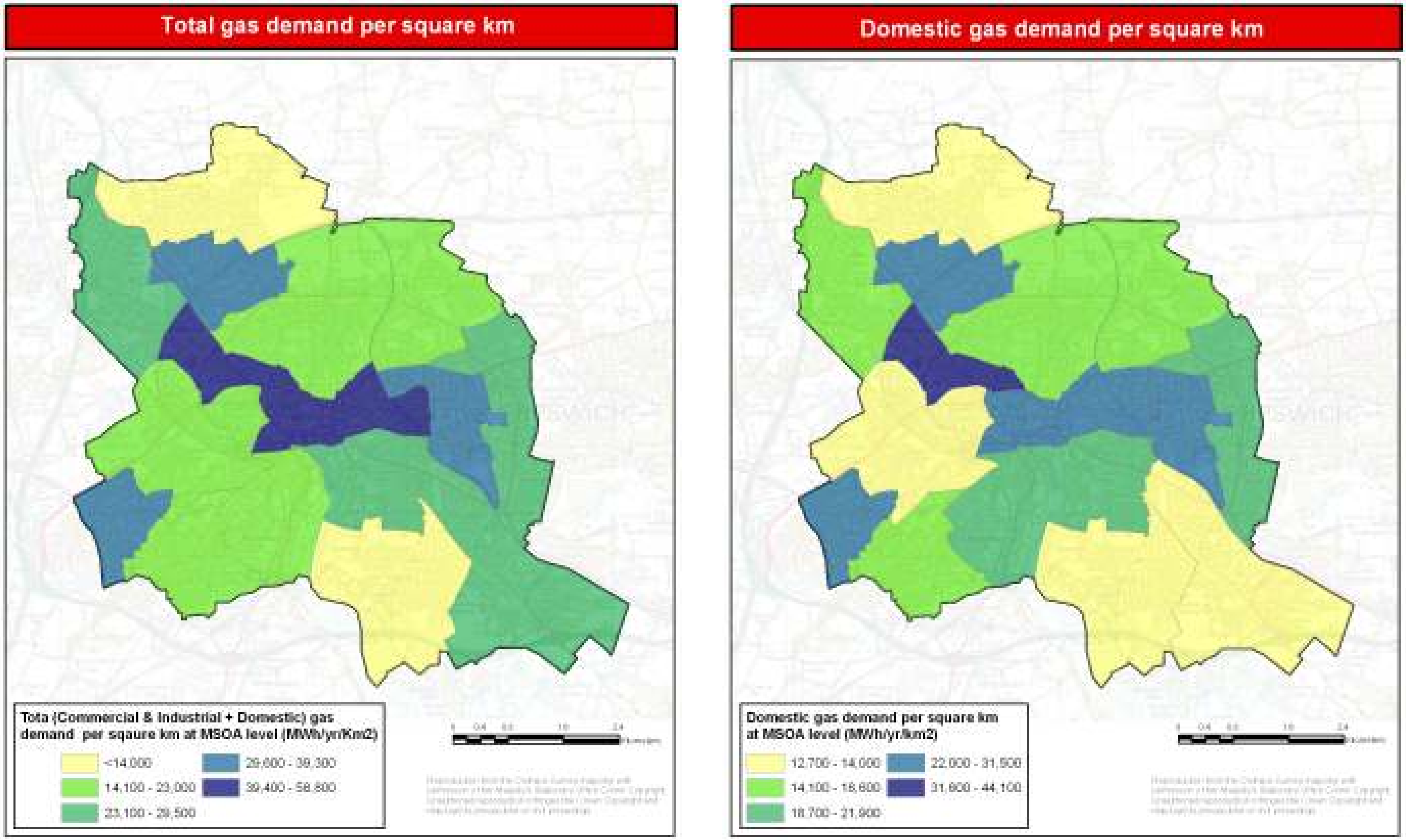
A recent DECC study provides a methodology to assess the technical viability of district heating based on heat densities. This infers that areas with a heat density exceeding 3,000 kW/km2 are more viable for district heating. Figure 12 replicates this methodology on a MSOA basis for gas demands of the existing built environment (it does not include future developments). As mentioned above, gas demand patterns can be assumed a good proxy for heat demand patters in the district. This kind of analysis can identify areas for further and more detailed analysis in subsequent studies.

Figure 12 indicates that, based upon existing domestic and commercial heat demands, the most technically viable locations for district heating correlate closely with spatial distribution of heat consumption.

Figure 13 shows the intensity of current gas consumption and plots the location of new development to help identify areas of synergy for building district heating schemes across both existing and new development. MLSOA areas in Green exceed the DECC threshold of 3,000 kW/km2, and areas in Blue represent zones which provide a particularly favourable conditions for district heating. The map shows a number of instances where favourable district heating conditions coincide with future development pressures.

It is recommended that further examination of those specific areas where high heat density and large new development coincide is conducted to explore the potential for district heating and interconnection between the two, particularly where each on their own would not justify investment

Figure 12: Intensity of gas consumption across Ipswich in MWh/yr/km^2 (includes total gas consumption and domestic sector gas consumption)



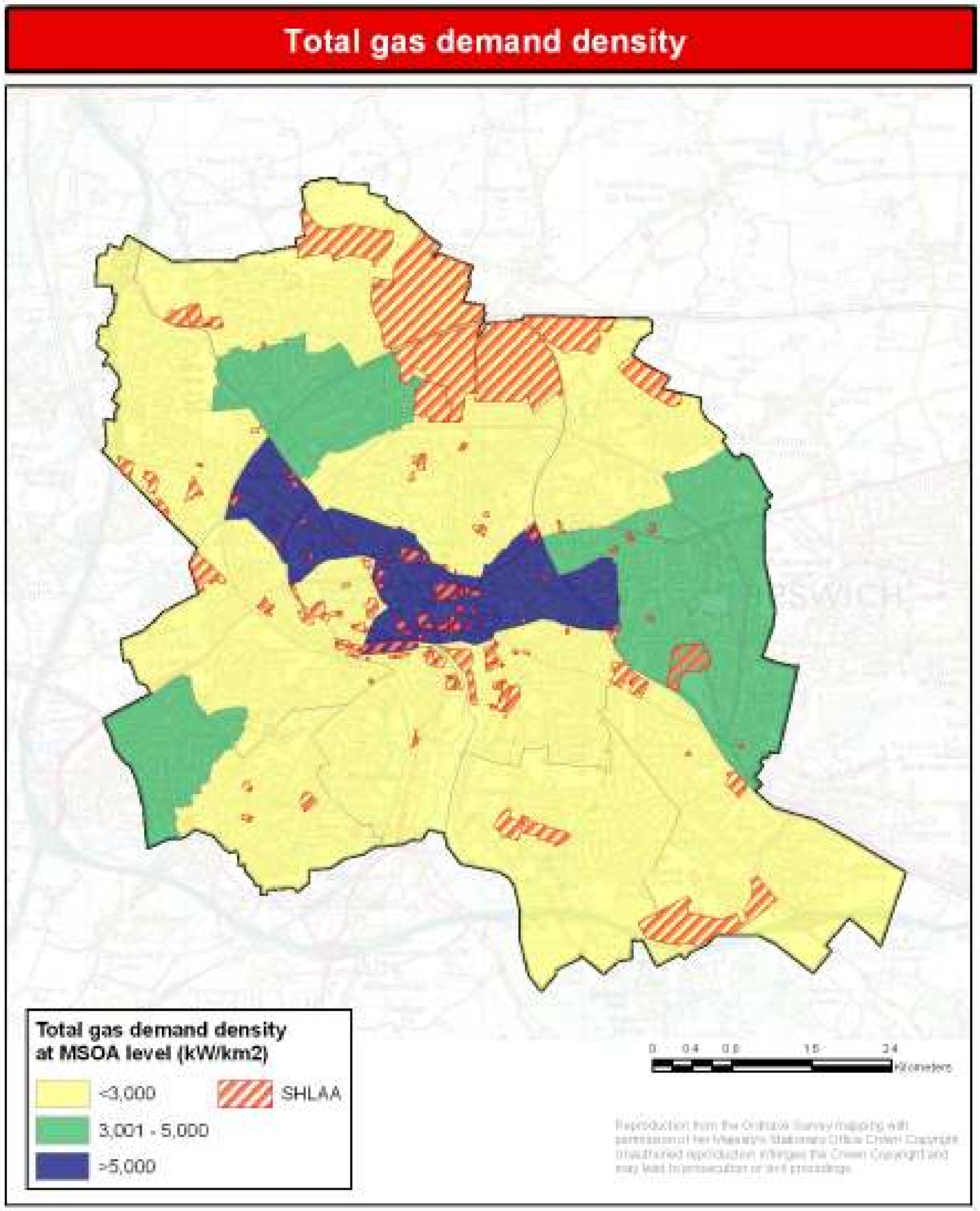


Figure 13: Intensity of current gas consumption and the locations of new development

Appendix 2 – Renewable Energy Potential in Ipswich

This Appendix presents the results of the assessment of renewable energy potential in Ipswich.

Scope

The scope of the assessment covers all locally relevant existing and emerging land-based renewable energy technologies directly or indirectly linked to the built environment. Therefore, transport biofuels, tidal and off-shore wind energy are excluded. The potential for renewable energy projects has been considered in three categories:

- **Stand-alone generation** – comprising commercial-scale wind and biomass energy projects.
- **New buildings -** low carbon technologies integrated within new buildings or associated with new development. This category includes offsite allowable solutions to meet a proportion of a zero carbon target, regardless of specific location of the offsite project. Technologies include solar thermal, solar PV, ground source and air source heat pumps, biomass boilers, biomass CHP, micro wind and large wind.
- **Existing buildings** - micro generation heat and power projects integrated within existing buildings. This will include solar thermal, solar PV, ground source and air source heat pumps and small scale biomass boilers.

Stand-alone

7.7.7 Overview of approach

The overall approach to assessing the potential for renewable energy technology deployment within Ipswich has been to identify the technically available resource and then systematically apply layers of analysis to progressively reduce the technical potential to what is realistically available and achievable.

The Department for Energy and Climate Change (DECC) has recently published a methodology[19] to standardise renewable energy assessments on a regional basis. One general limitation of this methodology is that it only considers approaches to assessing the technical potential and does not provide guidance on how to identify economic and supply chain constraints that will ultimately determine the potential uptake over a period of time. The technical potential can be defined as the fraction of the naturally available resource that is technically accessible and is not constrained by the physical environment or planning/regulatory limitations of high priority.

For those stand-alone generation technologies covered by DECC's methodology, the technical potential has been assessed in line with the methodological approach and criteria provided by DECC. Further analysis to account for economic and supply chain

[19] The Renewable and Low-carbon Energy Capacity Methodology for the English Regions.

constraints not covered by DECC methodology has then been carried out to determine the fraction of the technical potential that could be realistically deployed.

7.7.8 Wind energy assessment

Spatial analysis using Geographic Information Systems (GIS) has been conducted to identify sites suitable for commercial scale wind development. Two scales of wind turbine have been assessed as detailed in Table 29 below. Although large wind turbines are favoured commercially due to their significantly greater power output, we have also provided an assessment of medium scale turbines because the predominately urban nature of the borough means that the capacity for large turbines is fairly small.

Table 29: Wind turbine scales

Scale	Capacity	Hub height	Rotor diameter
Large	2.5 MW	85m	100m
Medium	~ 200 kW	31m	27m

Table 30 below shows the GIS layers and buffer distances applied (where appropriate) to identify sites where developments of commercial scale wind would not be limited by high priority physical environment or planning/regulatory constraints. The parameters and criteria used for this assessment of large-scale turbine siting potential are consistent with those recommended by DECC's methodology. DECC methodology does not provide parameters for medium scale wind turbines, the parameters used in this study are based on Camco's experience and are consistent with the guidance set out in PPS22.

Table 30: Parameters for assessing technical potential - absolute constraints to commercial-scale wind development

Criteria	GIS Layers - Large-scale turbines (2.5MW)		GIS Layers - Medium-scale turbines (~ 250 kW)	
	Layer	Buffer	Layer	Buffer
Wind speed	Average wind speed @ 45m above ground level < 5m/s	-	Average wind speed @ 25m above ground level < 5m/s	-
Non accessible areas	Open water	-	Open water	-
			Woodland areas	-
Environmental/ landscape impact	Ancient woodland	-	Ancient woodland	-
Noise and residential amenity	Built-up areas (settlement polygons)	600m	Dwellings	300m
			Commercial buildings	50m
Transport infrastructure	Motorways	150m	Motorways	50m
	A, B and primary routes	150m	A, B and primary routes	50m
	Railways	150m	Railways	50m
Air safeguarding from MOD and civil aviation interests	Civil airports	5km	Civil airports	5km
	MoD airbases	5km	MoD airbases	5km
	Small civil airfields	5km	Small civil airfields	5km
Sites of historic interest	Scheduled Ancient Monuments	-	Scheduled Ancient Monuments	-
	Registered Parks & Gardens		Registered Parks & Gardens	-
	World Heritage Sites	-	World Heritage Sites	-
	Registered Historic battlefields	-	Registered Historic battlefields	-
	Conservation Areas	-	Conservation Areas	-

Based on the absolute constraints listed above in Table 30, the areas with technical potential for large and medium scale wind turbines are shown in Figure 14 and Figure 15 respectively.

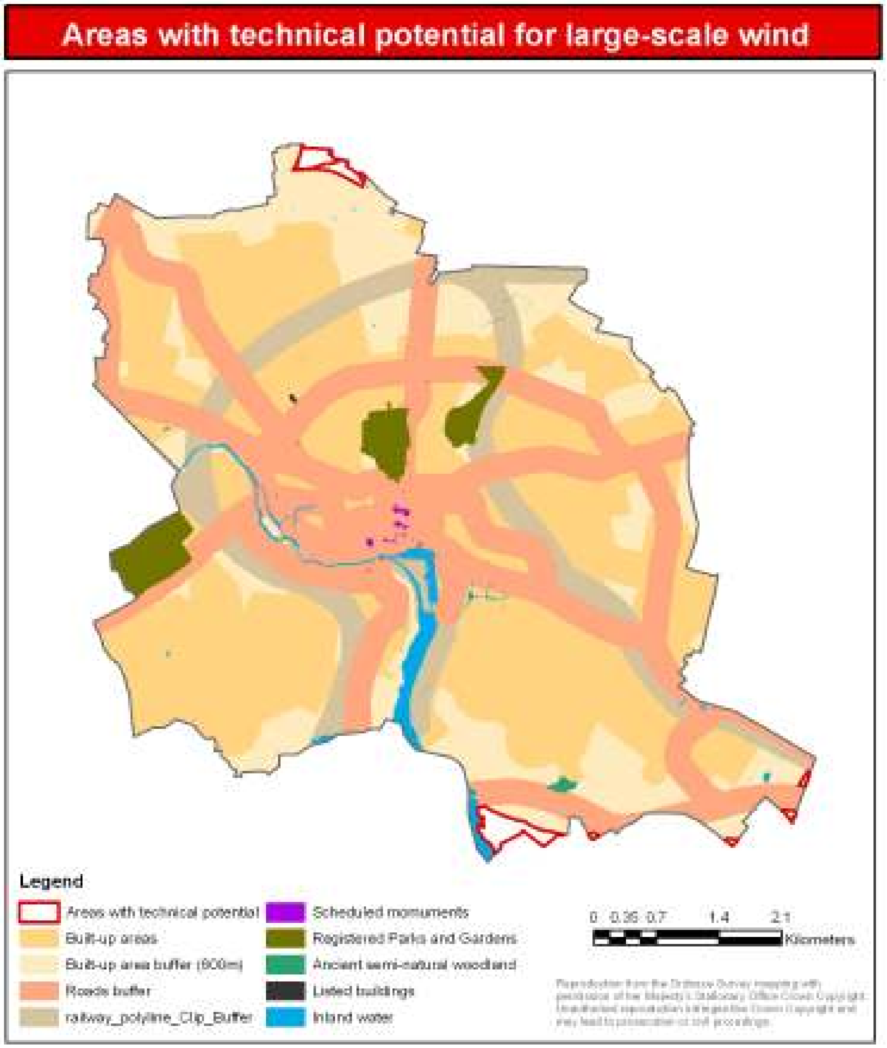


Figure 14. Areas with technical potential for large-scale wind.

Figure 15. Areas with technical potential for medium-scale wind.

7.7.9 Comments on land-use constraints for wind energy

Proximity to buildings / settlements

Residents of dwellings in close proximity to wind turbines may potentially be affected by mechanical and aerodynamic noise and shadow flicker from wind turbines. An interim draft of the DECC methodology discussed different approaches to take account of proximity to buildings, particularly housing, stating that 600m should be the distance applied for larger turbines (circa 2.5MW). The final version of DECC methodology, however, prescribes that the buffer should be applied to "built-up areas[20]" rather than to individual buildings. The latter significantly limits the land identified as suitable for wind energy. Although it reflects the fact that owners of all properties, even isolated rural properties, can raise objections and there is reasonable likelihood that if a development is closer than a stated 'rule of thumb' (600m in this case) will not achieve planning permission, this approach would ignore the fact that large-scale wind economics might allow in some cases negotiated settlement between the developer and property owner. The assessment of technical potential for large scale wind has been carried out in line with DECC methodology i.e. applying buffers around built-up areas as opposed to individual buildings.

DECC methodology does not provide criteria or parameters to assess the technical potential for medium-scale wind. In this study, it has been considered appropriate to apply buffers around individual buildings when assessing the potential for turbines this size. There can be locations in urban areas where the distance to the nearest building is greater than the minimum required to ensure that these are not affected by noise and shadow flicker. Besides, economics of medium-scale wind are not likely to allow a negotiated settlement between the developer and owners of isolated properties. The minimum distance from housing has been taken as 250m, whilst 50m has been taken as the minimum allowable distance from commercial buildings. The analysis has been conducted using LLPG and OS MasterMap data, which identifies all buildings, with the appropriate buffer being applied to each building.

The Local Land and Property Gazetteer (LLPG) was used to differentiate between residential and commercial buildings in OS MasterMap to the n apply the appropriate buffer.

The constraint associated with future proposed housing and proposed mixed development has been explored creating buffers around the sites identified as deliverable in the SHLAA, 500m for large wind and 200m for medium wind. The buffers applied to future developments are slightly lower than those applied to existing buildings, since only a proportion of the site's footprint will be developed and it is assumed that there would be certain flexibility to determine the location of housing in a way that noise and shadow flicker impact is avoided. The figures below show the sites suitable for wind development once future development has been factored into the constraints analysis.

Historic Environment settings

[20] In the context of DECC methodology, "built-up areas" are equivalent to settlement polygons as represented in OS Strategi data.

The setting of certain assets, particularly historic environment assets, can prove to be a constraint but these need to be considered on a site by site basis and hence, in line with DECC's methodology, no buffers have been applied.

Wind speed

The average annual wind speed layers have been derived from the NOABLE wind speed database. DECC's methodology recommends that the assessment of technical potential for large wind should take the threshold as 5m/s at 45m above ground. This only reflects the fact that wind turbines do not operate below the wind speed referred to as the cut-in speed (usually around 4.5m/s or 5m/s). In the current market, however, wind developers will typically look for sites with an average wind spped of no less than 6 m/s, and ideally over 6.5m/s.

It should be noted that all the sites identified as suitable for large-scale wind turbines, once the constraints associated with new developments have also been taken into account, present an average wind speed at 45m above ground level of 6m/s or over.

Air safeguarding and Radar

'Air safeguarding' zones around MOD and civil aviation interests are consultation zones, i.e. local planning authorities are required to consult the Civil Aviation Authority (CAA) upon any proposed developments with tall structures that would fall within safeguarding map-covered areas.

There are no known operating civilian or military airports or airfields within 5km of the study area (buffer recommended by DECC). However, data published by NATS En Route (NERL, the company responsible for the safe movement of in-flight aircraft operating in the UK) indicates that wind developments of large scale in most parts of Ipswich would have the potential to interfere with radar.

The British Wind Energy Association's 'Wind energy and aviation guide' points out that the aviation community has "procedures in place to assess the potential effects … and identify mitigation measures". Furthermore, the guide states that while both wind energy and aviation are important to UK national interests, the 'overall national context' will be taken into account when assessing the potential impacts of a wind development upon aviation operations.

Despite air safeguarding zones (outside the aforementioned 5km buffer) not being included as an absolute constraint, they need to be addressed by developers early in the process of wind energy site development. It is worth noting that there are developing technical solutions to potential radar interference, for example, 'stealth' treatments to the key elements of the wind turbine structure. Moreover, the fact that there are numerous examples of development in close proximity to airports, such as Prestwick in Scotland and Schipol in The Netherlands, suggests that wind turbines can be compatible with airport locations.

National designated landscapes[21] and international and national nature conservation areas[22]

Table 31 below shows other factors that can limit the development of large and medium-scale wind but that should not be automatically considered as absolute constraints. The level of constraint imposed by these factors needs to be assessed on a site-by-site basis, since the impact and the possibilities for mitigation may be lower or higher for differing sites and different scales of development. This is further discussed below.

Table 31: Other potential constraints to wind development

Criteria	GIS Layers - Large-scale turbines (2.5MW)	GIS Layers - Medium-scale turbines (~ 250 kW)
International and national designations for landscape	Areas of Outstanding Natural Beauty	Areas of Outstanding Natural Beauty
	National Parks	National Parks
	Heritage Coast	Heritage Coast
International and national nature conservation designations	Sites of Special Scientific Interest	Sites of Special Scientific Interest
	Special Areas of Conservation	Special Areas of Conservation
	Special Protection Areas	Special Protection Areas
	National Nature reserve	National Nature reserve
	Ramsar Sites	Ramsar Sites
Wind speed	Average wind speed @ 45m above ground level < 6m/s	Average wind speed @ 25m above ground level < 6m/s
Other	Steep terrain > 20°	
	Intertidal zones	

Whilst the DECC methodology recognises sensitivity around these protected areas, it states that these designations should not be automatically considered as an absolute constraint to wind development. The methodology recommends that, in the absence of local studies to draw upon, high level assessment are carried out to identify the type and level of renewable energy infrastructure that could be accommodated within areas protected under these designations.

Covering part of the south of Ipswich, the Stour and Orwell estuaries are designated as a Special Protected Area (SPA), a Site of Special Scientific Interest (SSSI),and a Ramsar site (for wetland habitats). The estuaries are included in the schedule of Natura 2000 European Marine Sites, a Europe-wide network of the most important sites for nature conservation. Part of the area with technical potential identified by the assessment is within the estuaries. While wind turbine development is not formally prohibited within these areas, it is very unlikely to go ahead given the threat posed to important bird

[21] National designated landscapes include: National Parks, Areas of Outstanding Natural Beauty and Heritage Coasts.
[22] International and national nature conservation areas include: Special Protection Area (SPA), Special Areas of conservation (SAC), RAMSAR convention site, Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR)

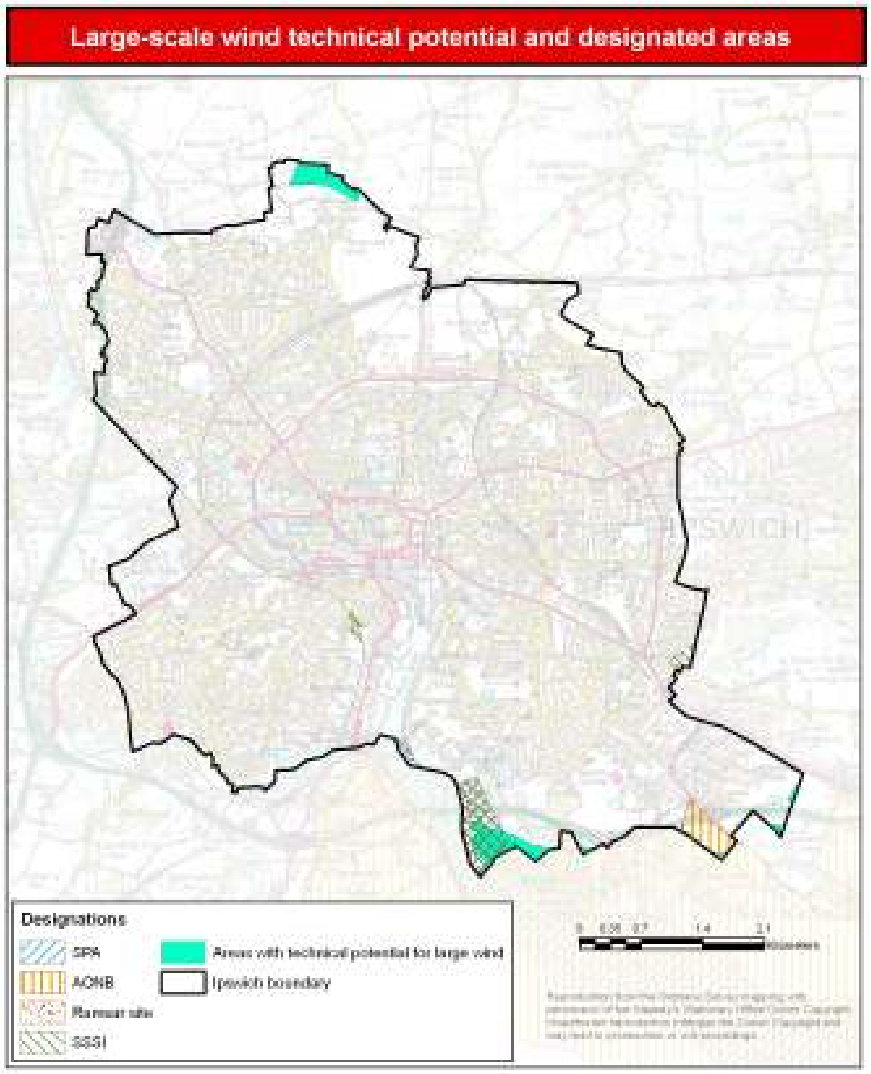
species present in the estuaries. Besides, the majority of this area is an intertidal zone where installation costs would be prohibitive

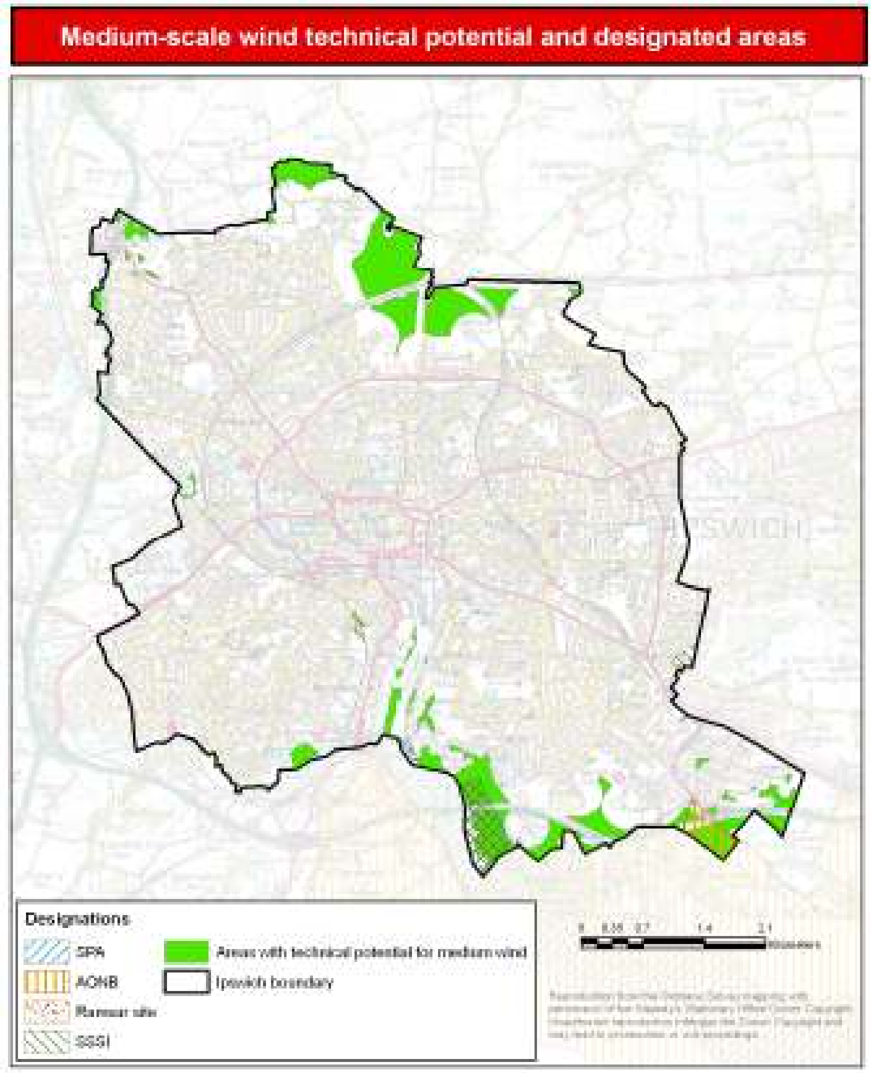
Development of commercial-scale wind turbines is also unlikely within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty. The AONB management plan emphasises that "all forms of large power generation within the AONB are likely to create significant adverse impacts on the landscape". Development of commercial-scale wind turbines would add to the impact caused by the existing nuclear power plant.

7.7.10 Impact of SHLAA sites on wind technical potential

Figure 17 and Figure 18 show the impact of the SHLAA sites on the technical potential for large and medium scale wind, and the reduction in the number of locations available for turbines.

Figure 16: Designated areas and large and medium scale wind turbine potential





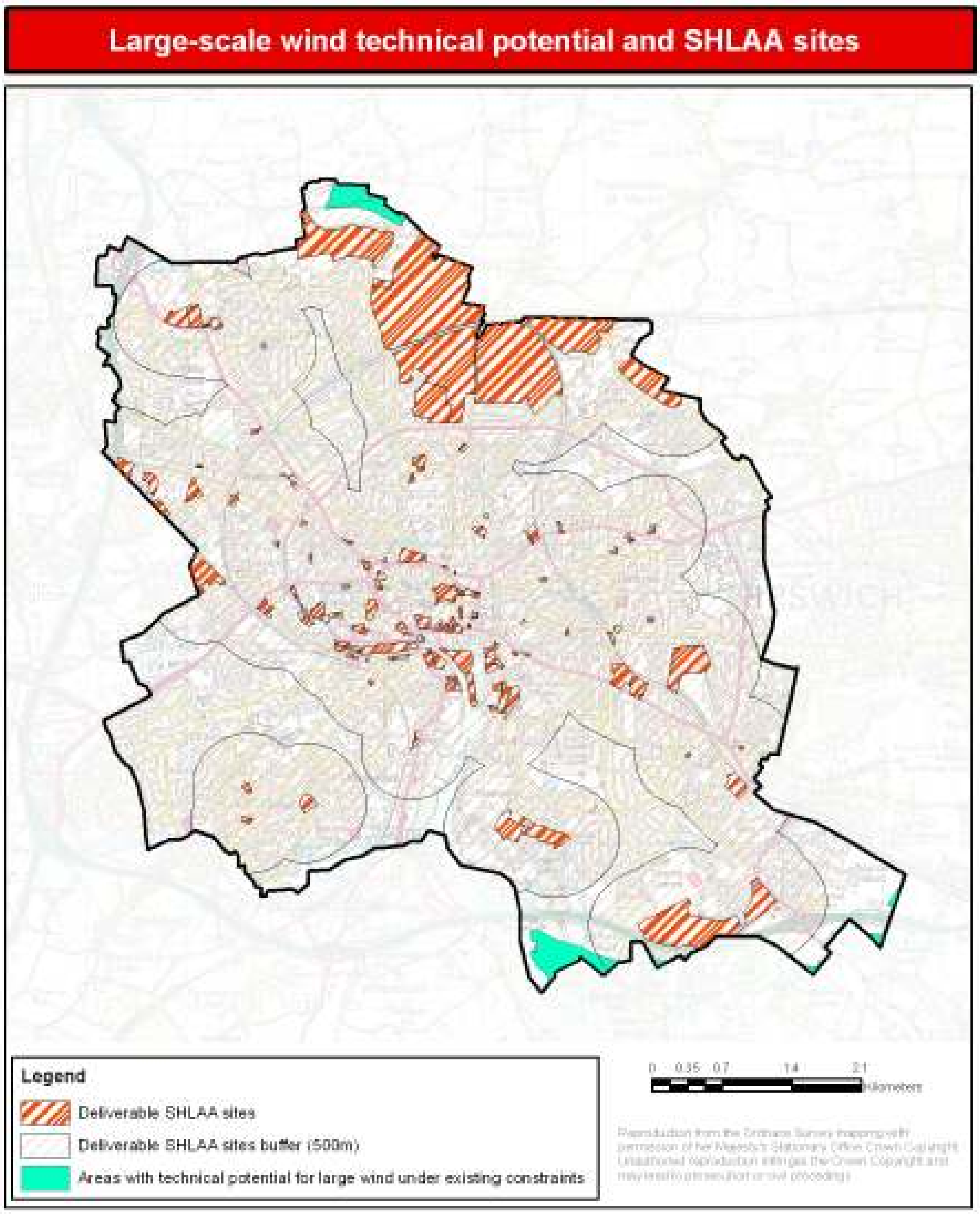


Figure 17: Impact of SHLAA sites on large scale wind potential

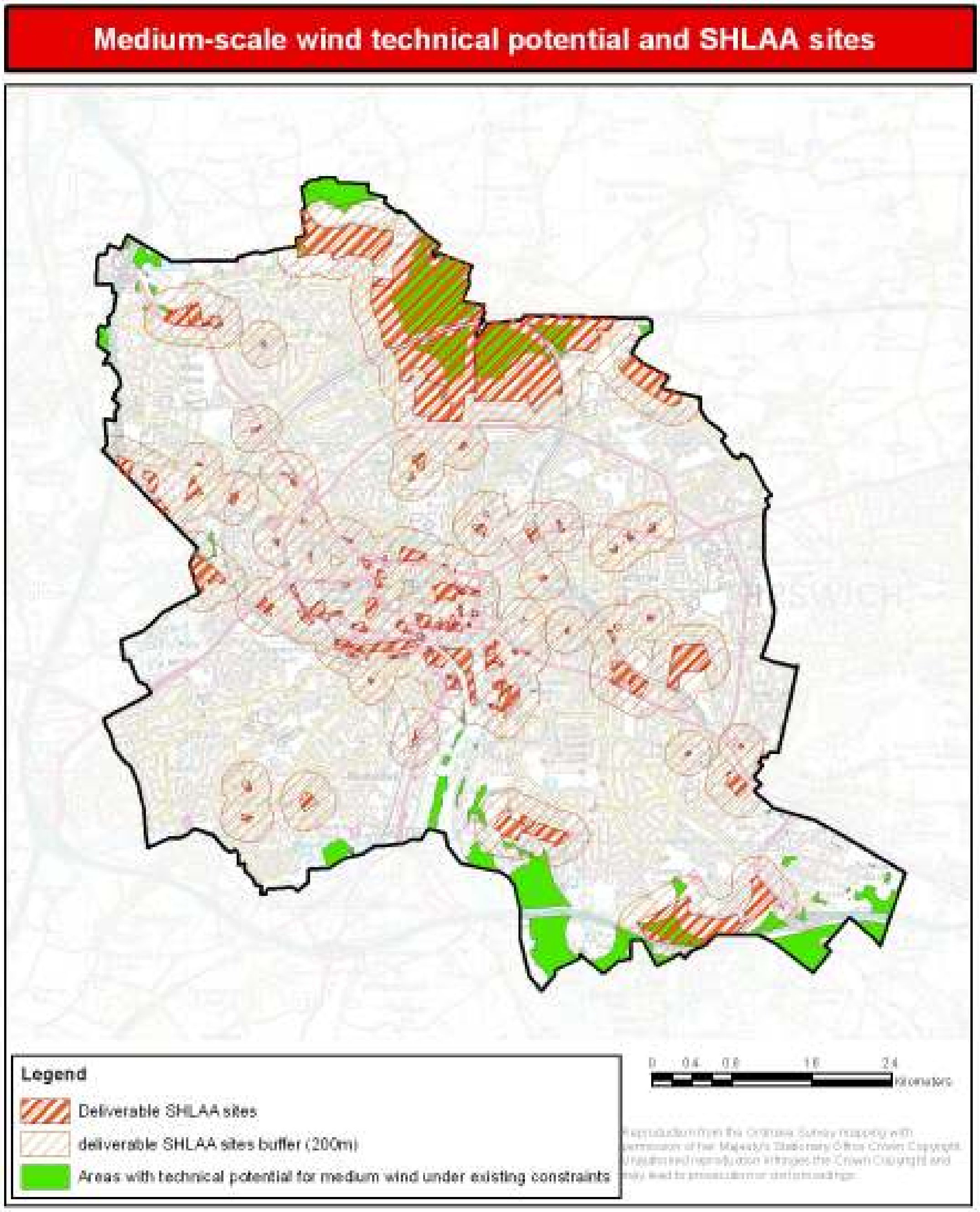


Figure 18: Impact of SHLAA sites on medium scale wind potential

Other parameters not accounted for

The spatial analysis presents a view of the potential sites for wind energy development, based upon the constraints considered. It does not directly take account of the ease of connection to the electrical distribution network which is largely an economic issue, i.e. larger projects will be able to carry larger capital costs for connection to the network or for network upgrades. In practice sections of power networks may have inherent load or power quality constraints, particularly at lower voltage levels. The study also does not consider landscape / visual amenity constraints (other than by excluding certain designations of land) which would need to be considered on a project-by-project basis. Additionally, telecommunications masts have been excluded from the analysis due to a lack of relevant GIS data, and again this should be considered on a project-by-project basis.

The study identifies the key constraints that are likely to rule out wind turbine developments but there are a number of additional local issues and preferences that could constrain any specific wind turbine location. These include local landscape considerations, site access (for construction), contamination and private airstrips.

Potential cumulative landscape impact of multiple turbines has not been considered. The DECC methodology specifically recommends not to account for the cumulative impact of wind energy when assessing resource capacity because of its subjective nature and the fact that views around this issue may change over time. It does, however, also identify that accounting for landscape impact could providing supporting analysis of the targets for a local authority area.

Potential energy supply from identified wind energy sites

This section provides a brief overview of the methodology to convert technically viable sites identified from the GIS analysis, into an estimate of the number of wind turbines and quantity of electricity delivered from these. The number of wind turbines is determined by assessing separation distances between turbines. With consideration of guidance from the Danish Wind Energy Association[23] we have assumed a separation of distance of five rotor diameters, which is consistent with the DECC methodology. This separation allows for adequate spacing between turbine blades to prevent air stream interference to the operational detriment of the turbines.

The size of the wind turbine is proportional to its energy output, and onshore wind developers will look to install the largest turbines viable for a given site. The current market for large scale wind turbines is largely focused on 2.5 MW turbines (approximately 135m to the tip of the blade at the top of its swept area) and this has been used as a default size across the study period (up to 2026), although it should be recognised that the wind turbines will be selected to suit each specific location. A simple method to quickly understand the likely electricity generated from a wind turbine is to apply a capacity factor (or load factor): actual annual generation as a percentage of a turbine's theoretical maximum output. The 10-year UK average annual capacity factor (for all large-wind energy projects) as reported by DECC in 2009 is 28%, however we have assumed a more conservative view of 25% to account for the low wind speeds within the study area. A capacity factor of 20% has been assumed for medium-scale wind turbines. In addition to the capacity factor, it is assumed that any wind turbine will be taken off line for maintenance for 5% of the time. The calculation below sets out how these factors are combined to estimate the energy generation from a single 2.5 MW large scale wind turbine.

2.5 MW x 8,760 hrs/yr x 95% availability x 25% capacity factor = 5,201 MWh/yr

Table 32 and Table 33below show the land area available to turbines under different scenarios of landscape constraints across the study area. The tables also translate these land areas into potential installed capacities and energy yields calculated as outlined above.

Table 32. Technical potential under existing constraints.

Scale of wind	Wind potential when absolute constraints only are applied	Wind potential when absolute constraints and land designation constraints are applied

[23] *www.windpower.org*

turbines	Area (ha)	No. of turbines	Capacity (MW)	Generation (GWh/year)	Area (ha)	No. of turbines	Capacity (MW)	Generation (GWh/year)
Large	37.4	7	17.5	36.4	22.7	6	15.0	31.2
Medium	234.0	149	37.3	77.5	194.3	127	31.8	66.0

Table 33. Technical potential under existing constraints and those associated with future developments (SHLAA deliverable sites).

Scale of wind turbines	Wind potential when absolute constraints and SHLAA site constraints are applied				Wind potential when ALL constraints (absolute and potential) are applied			
	Area (ha)	No. of turbines	Capacity (MW)	Generation (GWh/year)	Area (ha)	No. of turbines	Capacity (MW)	Generation (GWh/year)
Large	18.2	4	10.0	20.8	3.7	3	7.5	15.6
Medium	114.0	87	22	45.2	75.6	65	16	33.8

Table 32 illustrates that if absolute constraints only are applied then there would be areas in the borough to site up to 7 large turbines and 149 medium sized turbines. However, if all potential constraints in Table 33 are applied (ie absolute constraints and potential constraints) then there would be remaining space in the borough to only site 3 large turbines OR 65 medium sized turbines. The resource potential of 3 large turbines has been included in the overall assessment of renewable energy potential in Ipswich Borough which is outlined below.

Biomass energy

7.7.11 Overview of approach

The overall approach to assessing the biomass resource potential has been to quantify the total biomass available for energy generation from the existing streams within the district and then apply resource uptake curves to project potential achievable rollout of generation capacity over the study period. Due to the urban characteristics of the district, the resource is limited to following bio-energy feedstocks:

- Biogenic components of Municipal Solid Waste (MSW) currently landfilled (i.e. wood waste, food/kitchen waste, green waste, paper and card)
- Green waste currently diverted
- Commercial & Industrial wood waste
- Commercial & Industrial food waste

Ipswich has currently declared three areas as Air Quality Management Areas (AQMA) and due to this, if biomass is to be taken forward in Ipswich area, the boilers should comply with the specific air quality requirements particularly in the designated AQMAs.

The procedure followed for this assessment is outlined below:

1. **Quantification of the resource available** from each of the biomass streams considered. MSW primary data has been taken from WasteDataFlow, whilst Commercial and Industrial waste figures have been scaled down from national figures as explained below. The analysis follows through a number of stages in order to arrive at a reasonable estimate of the available potential resource:

   1.1. Estimate theoretical potential i.e. the total quantity of feedstock generated in the study area.

   1.2. Estimate technical potential. This is the fraction of the theoretical potential that is not limited by absolute technical and environmental constraints, e.g. maximum proportion of food waste that can be recovered.

   1.3. Estimate available potential. This is the technical potential minus “competing demands” for the resource that is assumed need to be met before resources can be diverted for purpose of energy generation Energy recovery from waste must be considered in the context of the waste hierarchy as established in the UK Waste Strategy for England 2007, this is: reduce, re-use, recycle, recover, dispose.

2. **Define uptake curves for each feedstock considered**. The fraction of the available resource that can be realistically recovered now is estimated based on current capabilities and practices. This is then increased gradually over time up to the full available resource, taking into consideration the rate at which each sector could develop. The principles upon which the uptake curves have been defined are drawn from a recent study commissioned by DECC[24], as well as previous experience in other EU countries. Resource uptake curves for each feedstock are then

[24] *To inform the government’s Renewable Energy strategy, the Department of Energy and Climate Change (DECC) [24] commissioned research to forecast the likely roll-out / uptake of generation capacity across the UK. E4tech, 2009, Biomass supply curves for the UK, available at http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/res/res.aspx*

converted into primary energy curves using calorific values specific to each feedstock[25].

3. **Group primary energy curves for each feedstock** in accordance to the suitability for use within three broad categories of conversion technologies: 'clean biomass' combustion, energy from waste plants and anaerobic digestion plants.

4. **Estimate useful energy generation potential** based on typical efficiencies of the conversion technologies considered and assumed proportions of the resource dedicated to cogeneration, heat generation only or electricity generation only.

The main assumptions regarding resource potential for the fuel types considered are outlined below.

Municipal Solid Waste currently land-filled

- For this study, a slow growth in waste arisings has been assumed (0.75% annually over current levels). It is acknowledged by a number of sources (Waste Strategy for England 2007[26], ERM[27] and E4Tech reports) that there is great uncertainty regarding future arisings. E4tech assumes static, waste strategy suggests four scenarios (one of them no growth, 3 of them little growth with maximum of 2% a year).
- For paper and card a 50% recycling rate is assumed. Overall recycling targets in the waste strategy for household waste have been assumed to be applicable to individual waste components. This is supported by EU directive that sets specific recycling targets for 2020 of 50% for glass, plastic, paper and metals.
- The Waste Strategy for England and Wales 2007 sets actions to stimulate energy recovery of wood waste rather than recycling. Wood has relatively low embodied energy (energy consumed in extraction) but high calorific value. Though for some kinds of wood waste re-use or recycling are better options, use as a fuel generally conveys a greater greenhouse gas benefit than recovering the material as a resource (and avoiding primary production). Given the likelihood of the majority of the wood component MSW being contaminated, it is assumed that all collectable wood waste within this stream would be available for energy generation in Energy from Waste plant.
- Maximum recovery levels are set based on best performance across Europe, under the basis that if it has been achieved elsewhere in Europe, it can theoretically be achieved in the study area. These are taken from Table B1.2 of the ERM report.
- Separability of waste will increase linearly to reach maximum recovery levels in 2025/26.
- Initial recovery potential = 5% over recycling rate.
- Alternative disposal routes for kitchen waste and green waste e.g. composting are not considered as competing demand.

Green waste currently diverted

- Composting is not considered a competing demand and therefore it's assumed that all green waste currently composted would be available for energy generation. However, an uptake period of 5 years is assumed.

[25] It should be noted that for anaerobic digestion feedstocks, the energy content of the biogas yield expected has been used rather than the calorific value of the feedstock.
[26] Waste strategy for England 2007. http://www.defra.gov.uk/environment/waste/strategy/strategy07/index.htm
[27] Carbon Balances and Energy Impacts of the Management of UK Wastes (ERM 2006). Available from http://randd.defra.gov.uk/Document.aspx?Document=WR0602_4746_FRA.pdf

Commercial and Industrial and Construction and Demolition wood waste

- Figures on C&I wood waste arisings at national level, taken from the Waste Strategy for England and Wales 2007, have been scaled down based on number of business.
- C&D arisings over time have been derived using national data and disaggregated on the basis of new housing allocations.
- It has been assumed that, once the panel board industry needs are covered, the remaining collectable wood waste from these streams is available for energy generation. It is assumed that 25% of arisings will be used to supply the panel board industry. This is 10% over current recycling rates.
- Maximum recovery level 90% (ERM).
- Separability of waste will increase linearly to reach maximun recovery levels in 2020. Initial recovery potential is assumed to be 5% over current recovery rate.

Commercial food waste

- Arisings has been calculated assuming that the ratio of commercial food waste to municipal food waste arisings in the study area is equivalent to that observed national level.
- Composting is not considered a competing demand.

7.7.12 Local biomass resource and potential useful energy generation

Table 34 below shows the total quantity of feedstock currently generated within Ipswich's boundaries (i.e. the total theoretical resource) expressed in oven dried tonnes and energy content.

Table 34. Biomass theoretical resource.

Waste stream		Theoretical resource	
		ODT/yr	GWh/yr
Municipal Solid Waste currently landfilled	Paper and card	7,297	22.3
	Green waste	1,740	3.9
	Food waste	936	4.6
	Wood waste	1,154	5.4
Green waste currently diverted		1,909	4.3
Wood waste (C&I and C&D)		11,137	52.0
Food waste (Commercial)		537	2.6
Total		**24,712**	**95**

Figure 19 and Table 35 show potential useful energy generation over the study period, based on the fraction of the theoretical resource available for bioenergy, market uptake curves and efficiency of the relevant conversion technologies as outlined in *Section 2.3.1 Overview of Approach*. As it can be noted, there is limited potential for energy generation using only the local resource, with just over 3% of energy needs potentially met from biomass by 2020. This is equivalent to around 23.7 GWh_e of biomass power generation and 21.8 GWh_h of heat generation from biomass boilers.

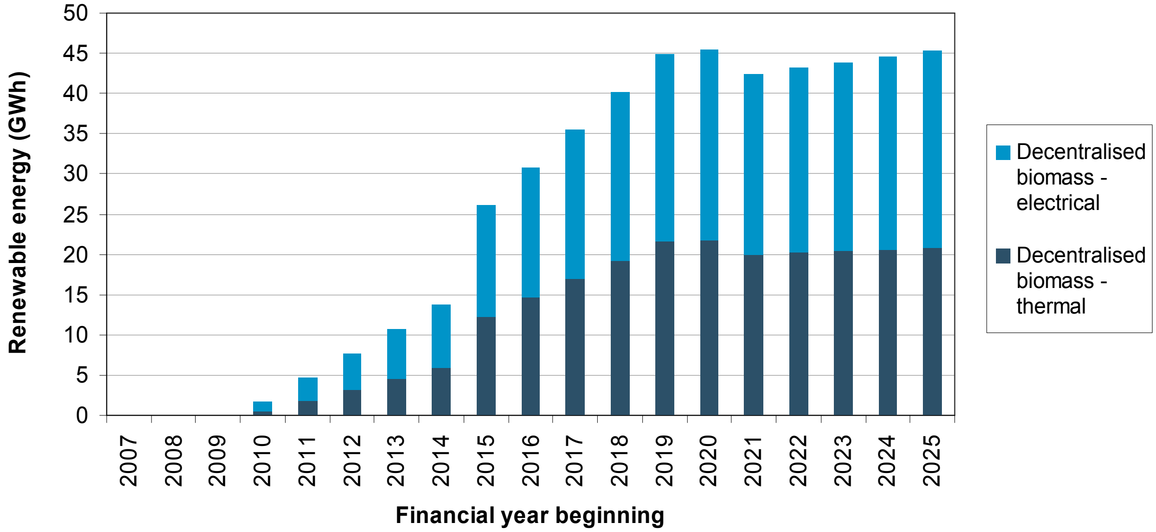


Figure 19. Potential biomass uptake.

Table 35. Potential biomass uptake

Year	2015	2020	2025
Thermal energy (GWh)	12.3	21.8	20.8
Electrical energy (GWh)	13.9	23.7	24.5
Total (cumulative GWh)	26.1	45.5	45.3
Proportion of demand - thermal	1.23%	2.50%	2.27%
Proportion of demand - electrical	2.38%	3.97%	3.87%
Proportion of demand - total	1.66%	3.10%	2.93%

7.7.13 Delivering biomass energy

Developing biomass as a renewable energy resource is notoriously difficult because, unlike other technologies such as wind energy, it is necessary to resolve the twin problems of fuel supply and demand simultaneously. Without sufficient demand the supply market is not stimulated and vice versa. Hence, biomass is a prime area for public sector intervention to overcome the market discontinuities that exist. There are some good examples of this in Europe such as in Austria, but also emerging examples in the East of England, in Yorkshire and Humber and in the North West of England, with growing amounts of investment for infrastructure projects.

For the study area to support the development of the biomass sector and maximise uptake, the following are suggested actions:

- Develop a comprehensive medium term (say 5 year) strategy
- Raise awareness of bio-energy among key stakeholders, including the development industry, waste managers, retail and hospitality industry.

- General education and advocacy on the opportunities presented by bio-energy to overcome any public concerns.
- Review funding opportunities, e.g. Defra Bio-energy Capital Grants Scheme, the Bio-energy Infrastructure Grants Scheme and the Regional Development Agency, and co-ordinate strategic applications, learning from actions/best practice elsewhere.
- Review specific opportunities around the estates of the partner authorities, e.g. anchor for community heating or fuel switching within council buildings.
- Take advantage of existing resources/expertise of UK-wide bodies and UK-wide schemes (e.g. the Carbon Trust's Biomass Heat Accelerator Scheme, the National Non Food Crop Centre and the Biomass Energy Centre).
- Consider access and costs issues for bio-energy power plants seeking to connect to the grid.
- Consider opportunities to increase the use of bio-energy through planning guidance and building regulations.
- Consider local air quality of emissions from bio-energy heat and power plants to ensure that bio-energy plants meet air quality legislation.
- Develop funding scheme for pilot projects. Support a limited number of representative projects in each sector with good dissemination potential.
- Consider potential for the Anaerobic Digestion plant not just wood based projects.
- Develop an understanding of the market potential of the existing feed stocks and seek to quantify potential, as an initial step to developing the business case for strategic investment, and encourage prime movers.

Hydro power

The hydropower assessment below has been derived from the recently published Environment Agency report ‘Mapping Hydropower Opportunities in England and Wales’ (2009). The report identified four potential sites within Ipswich where micro-scale hydropower schemes with a fish pass could deliver an improvement in the local environment as well as renewable electricity (Figure 20). With a total overall capacity of just 62 kW, and assuming and availability factor of 95%, these sites could generate approximately 522 MWh/year.

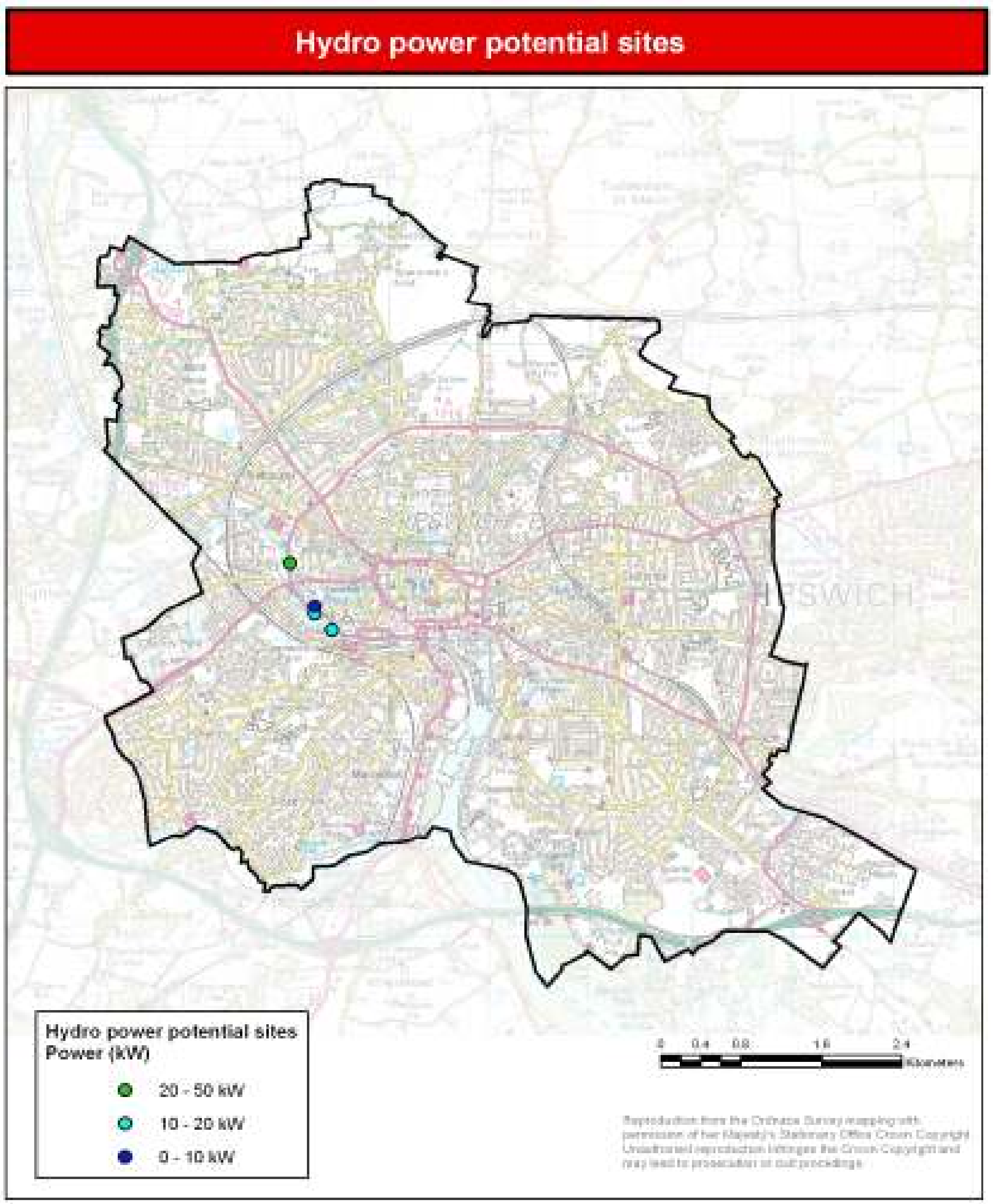
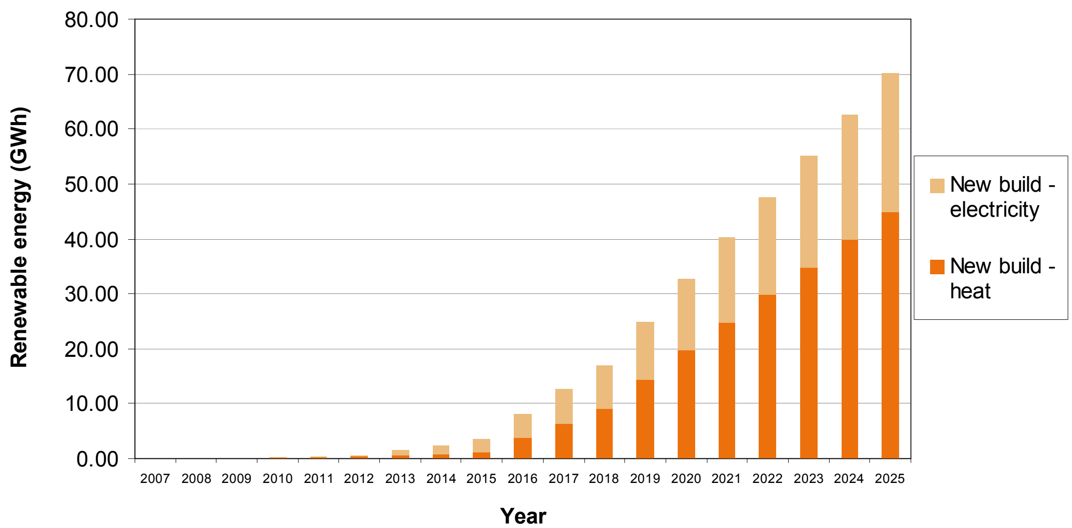


Figure 20. Hydro power potential sites.

Renewable energy generation associated with new development

We have modelled the renewable energy generation associated with the growth plans for residential and non-residential development over the next 15 years, which is presented in Figure 21. Our modelling suggests that by 2025, a total of 70 GWh (45 GWh thermal, 25 GWh electrical) of renewable energy will be generated from the new buildings in Ipswich. The methodology used to estimate renewable energy uptake in new developments is outlined in Appendix I.

Figure 21 Predicted Renewable Energy Generated from New Developments in Ipswich



Existing Buildings

7.7.14 Methodology

Prior to reviewing the approach taken to assess the potential role for low and zero carbon technologies in the existing built environment, it is worth reflecting on the fact that local planning policy can not significantly influence the uptake in this area, except where major refurbishment or extensions are involved. In the majority of cases planning permission is not required. Most domestic microgeneration, for example, is classed as Permitted Development, with even micro-scale wind energy being considered for re-classification as such in the future.

A recent study commissioned by a range of regional and central government bodies investigated the uptake of microgeneration within Great Britain[28]. This provides scenarios for the energy delivered by renewable sources for Great Britain as a whole, and a number of individual regions. This study presents a range of uptake scenarios and we contend that the scenario that best fits current policy for renewable energy generation is that which considered the implementation of the renewable power and heat tariffs, which have subsequently be announced as government policy. The scenario models uptake of microgeneration based upon technologies receiving 2p/kWh for heat and 40p/kWh for electricity. Support is assumed to run for 10 years at a 3.5% discount rate, with the level of support for future installations being digressed[29]. It is considered that this is the closest match to the current feed-in tariff for electricity, and Renewable Heat Incentive for thermal systems.

[28] *Element Energy, 2008, The growth potential for microgeneration in England, Scotland and Wales*
[29] *The annual payment is set for 20 years but the value reduces depending on the year of commencement of the project*

The study provides overall energy generation for Great Britain. We have calculated the proportion of national uptake that will occur within Ipswich by basing it on the percentage of the national housing stock that is located in Ipswich, as shown in Table 36.

Table 36. Estimating the proportion of national uptake of renewable energy technologies that will occur in Ipswich

Estimating the percentage of national housing stock that is located in Ipswich		
	Number of dwellings[30]	Proportion
UK (excl. NI)	24,730,887	100%
Ipswich	51,729	0.21%

The study's results include new build uptake of microgeneration technologies. It is not possible to disaggregate the existing build component from the results, hence an assumption has been made that 2/3^{rds} of the delivered energy is generated on/in existing buildings. The remaining 1/3rd is ignored to avoid double counting with the new build analysis.

The estimated uptake scenario of the renewable energy potential in existing buildings within Ipswich is 1.66% of the projected energy demand[31] in 2021. This equates to a renewable energy potential of 24.4 GWh/year for existing buildings. The overall results of the existing buildings uptake scenario are presented in Table 37 and Figure 22 below.

Table 37. Existing buildings uptake scenario.

Year		2020/2021
Microgeneration energy generated (GWh)	Thermal	21.9
	Electrical	2.5
	Total[32]	24.4
Proportion of projected demand	Thermal*	2.51%
	Electrical	0.42%
	Total[32]	1.66%

[30] Wales, England and Monmouthshire figures: National Statistics, 2009, ONS Neighbourhood Statistics, Housing, Accommodation Type - Household Spaces (UV56), data from most recent census in 2001; Scotland figures: Scottish Neighbourhood Statistics, Housing, Total number of households
[31] Estimated growth in energy demand is based on 'Energy projections for the UK, DTI'
[32] Rounding applies

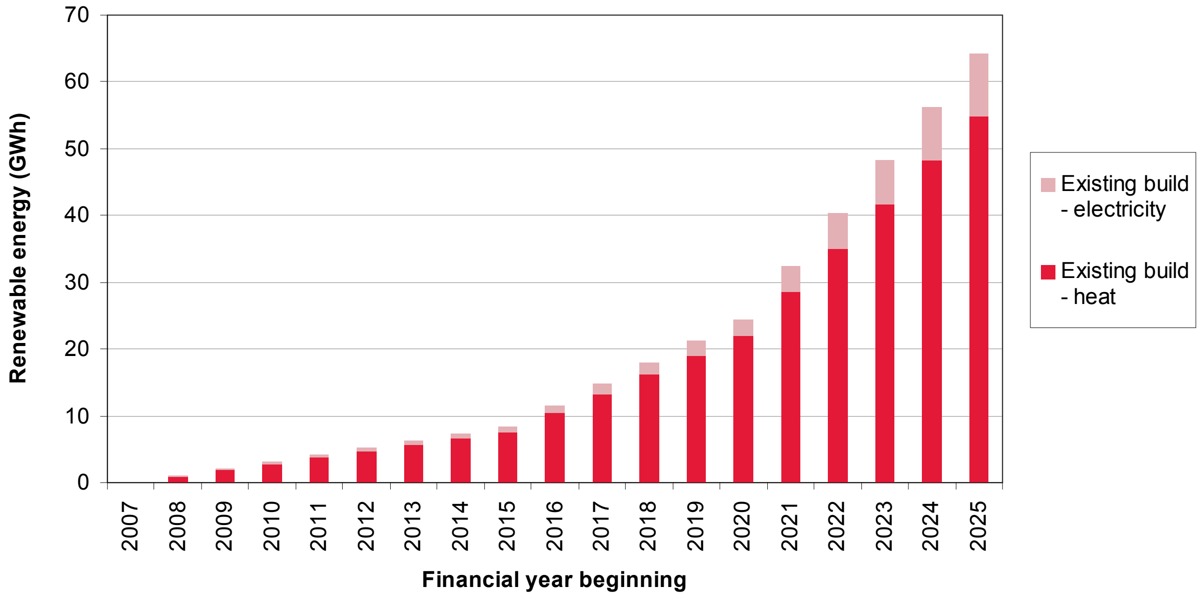


Figure 22. Existing buildings uptake scenario

Summary of Renewable Energy Potential

This section summarises the results of the renewable energy assessment, illustrating the overall renewable energy potential uptake up to 2025.

As shown in

Table 38, there is the practical potential to generate approximately 8.1% of Ipswich's projected total energy consumption in 2020 from renewable sources.

Energy recovery from biomass waste would make the largest contribution to overall renewable energy generation by 2020, with the potential to supply 45.5 GWh (21.8 GWh thermal, 23.7 GWh electrical) or 3.1% of total projected energy demand in Ipswich.

Is should be noted that technologies integrated within both existing buildings and new developments will play a significant role. Based on the assumed renewable energy strategies for future developments, by 2020, a total of 32.8 GWh (19.8 GWh thermal, 13.0 GWh electrical) of renewable energy could be generated from the new build in Ipswich, representing 2.2% of total projected energy demand. Under current national policy, it has been estimated that retrofit to existing buildings could deliver approximately 24.3GWh (21.8 GWh thermal, 2.5 GWh electrical).

Despite Ipswich being a predominantly urban district, the constraints analysis carried out to identify unconstrained areas for wind energy development showed three small sites that could (technically) accommodate one large-scale turbine each. If developed, with a total installed capacity of 7.5 MW, these three turbines could generate approximately 15.6 GWh of electricity (just over 1% of projected total energy demand by 2020).

Table 38. Summary of renewable energy potential uptake in Ipswich.

Renewable energy category	Potential electricity generation		Potential heat generation		Total potential generation Electricity + Heat		
	GWh	Proportion of Ipswich's projected electrical demand	GWh	Proportion of Ipswich's projected thermal demand	GWh	Proportion of Ipswich's total energy demand	Proportion of total renewable energy potential
Decentralised wind	15.60	2.61%	-	0%	15.60	1.06%	13.15%
Decentralised biomass	23.71	3.97%	21.76	2.50%	45.47	3.10%	38.32%
Decentralised hydro	0.52	0.09%	-	0%	0.52	0.04%	0.44%
New build	13.00	2.18%	19.77	2.27%	32.77	2.23%	27.62%
Existing build	2.53	0.42%	21.76	2.50%	24.30	1.66%	20.47%
Total	**55.37**	**9.27%**	**63.30**	**7.27%**	**118.7**	**8.08%**	**100.00%**

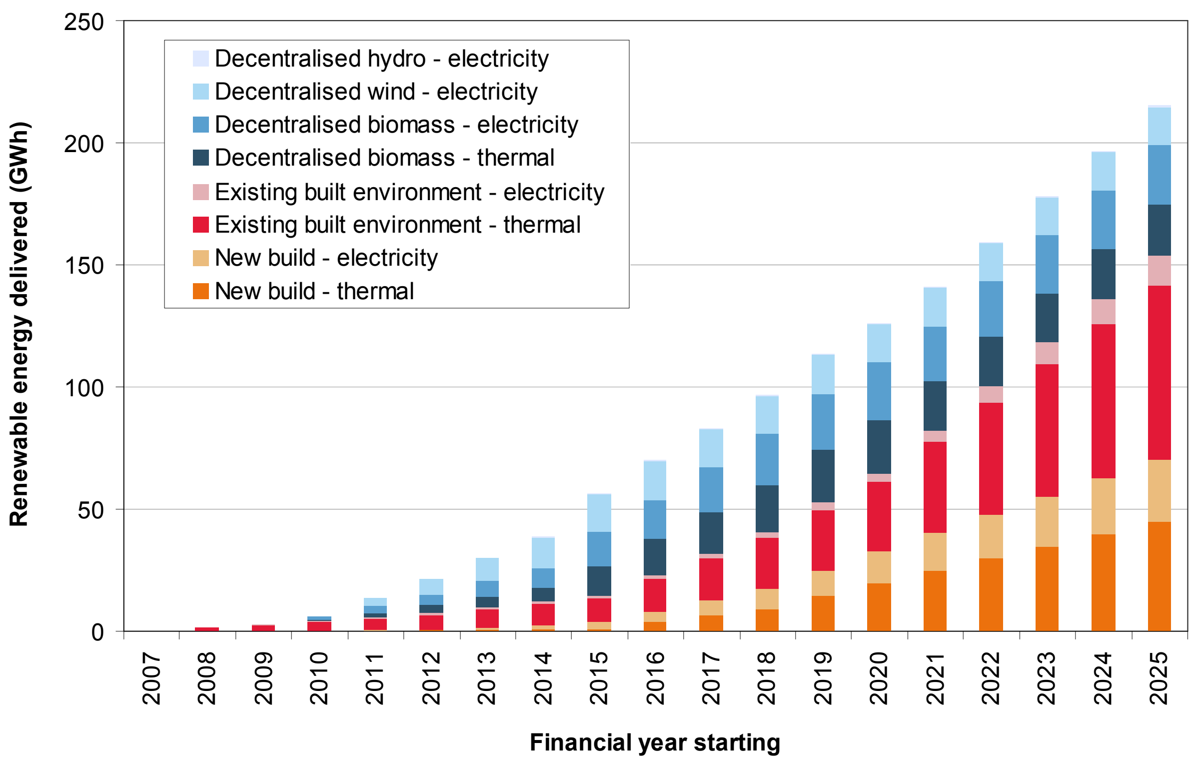


Figure 23. Summary of renewable energy potential uptake in Ipswich.

Appendix 3 – Existing Housing, Monitoring Compliance and Wider Policies for Promoting Low Carbon Development

Mechanisms to upgrade existing housing stock

7.7.15 Funding available from the 'Allowable Solutions' mechanism

The new development has the potential to bring significant benefits to the existing built environment, and there is substantial scope for synergies between the new and existing built environment. The heat mapping assessment demonstrates the potential for anchoring heat networks in new developments and then rolling them out into existing buildings. The 'allowable solutions' within the definition of zero carbon development will also provide funding for improving the energy performance of existing buildings and .

Ipswich Borough Council could consider establishing a Carbon Offset Fund to coordinate allowable solution payments from developers and to channel that investment into carefully chosen projects in Ipswich. Milton Keynes Council has already set a precedent for a carbon offset fund and requires developers to pay money into an offset fund to offset all residual emissions from new developments (in effect, it already has a zero carbon development definition in line with the Government's emerging definition on zero carbon). The Council would need to establish a 'carbon offset fund' into which these payments are deposited, and then distributed to energy saving schemes within the district, such as insulation, renewable energy projects or district heating infrastructure. Milton Keynes Council has set a cost per tonne of carbon that it requires developers to pay which is based on the cost of delivering carbon savings through loft and cavity wall insulation in existing homes. If this money is invested in loft and cavity wall insulation then it will exactly offset the carbon emissions from the new build, which could then be viewed as a 'carbon neutral' development. However, in order to claim that the new developments are carbon neutral, it is essential that these carbon reductions in existing housing are 'additional' savings – ie that they wouldn't have happened unless they were financed by the carbon offset fund.

Ipswich Borough's growth plans could potentially make available £50 Million of investment in 'allowable solutions' in Ipswich's existing built environment.[33] This funding could be spent on energy efficiency measures in housing or on low carbon infrastructure such as combined heat and power and district heating all channelled through a carbon offset fund.

7.7.16 Key mechanisms for improving energy efficiency in housing

The main Government instrument for delivering energy efficiency in housing is the Supplier Obligation, previously known as EEC and CERT. This provides support to households to make energy savings through subsidised insulation measures. Over the next 10 years the government intends to establish proactive advice services and roll-out the installation of smart meters to provide information to encourager action, pilot new financing mechanisms (such as PAYS), co-ordinate support and explore new delivery approaches, such as mandating local authorities to take enforcement action to improve the condition of rented housing.

[33] This estimate is based on the assumption that all development built post 2016 will adopt the maximum level of allowable solutions of 30% of emissions from heating & lighting and 100% of emissions from appliances, and will pay £100 per tonne of carbon dioxide to offset all these emissions.

7.7.17 Supplier obligation

Between 2002 and 2009, the CERT scheme has helped over 6 million homes to be more energy efficient. The CERT scheme is now being extended until the end of 2012, servicing another 1.5million homes. The government intends for all lofts and cavity walls to be insulated where practicable and where households want it by 2015. Nationwide carbon savings from the scheme are predicted to be 185 million tonnes to 2011. There is a role for local authorities to work in partnership with the energy suppliers to establish area-based programmes that direct effort into a town or city in order to maximise potential economies of scale and build momentum, leading to greater uptake. This includes the Community Energy Saving Programme (CESP – another obligation on energy suppliers) designed to focus on areas of low income, where the incidence of fuel poverty tends to be highest. CESP is intended to be implemented through partnerships between energy supply companies, local authorities and other community representative organisations.

7.7.18 Other sources of energy efficiency finance

The Department of Energy and Climate Change's recently published Household Energy Management Strategy stated the need for more substantial improvements to existing homes, such as solid wall insulation and new low carbon sources of heat supply and electricity. In order to finance the scale of investment required (estimated at £5-15bn per annum nationwide), three principle mechanisms are proposed:

1. **Renewable Heat Incentive** – effectively a mechanism for households, communities and businesses to be paid a tariff for generating renewable heat. The details of this scheme will be published for consultation early in January 2010 and support will be available from April 2011.
2. **Feed-in Tariffs** – financial rewards for small scale renewable electricity generation, available from April 2010
3. **Pay-As-You-Save** – this scheme is only at pilot stage but is intended to spread the upfront costs into the future with costs of improvements offset be energy bill savings. This could cover both energy efficiency and renewable energy measures, with envisaged costs of around £10,000, repayable over a term of up to 25 years with the repayment schedule linked to the property.

All of the above mechanisms potentially have a role for Local Authorities in co-ordinating the available support and potentially leading programmes of delivery, centralising funding mechanisms, drawing down programmatic finance from public and private sources and establishing networks of installers and contractors to tackle towns, perhaps on a street-by-street basis. In particular, LAs may have an important role to play in levying a 'PAYS Local Authority Land Charge'. Further details will be published in the final Heat and Energy Saving Strategy in early 2010.

7.7.19 Additional Local Authority Action

In addition to the above funding and delivery mechanisms, government wants to see local authorities empowered to take additional action in tackling climate change. The government is consulting on the role that local authorities can play in meeting national carbon budgets and new powers that local authorities may need to do this. To support this, £3m has been provided under the Best Practice Programme and funding is available for community projects under the Low Carbon Communities Challenge.

Recommendations for monitoring compliance

Ipswich Borough Council's Core Strategy sets sustainability standards for new development and this study has identified targets for borough-wide renewable energy implementation. Clearly, Ipswich will need to have the necessary capability and resource to enforce and monitor performance against these policies. Planning Authorities are required, through Annual Monitoring Reports, to report the development of renewable energy on an annual basis and government is presently considering the inclusion of a National Indicator for renewable energy, which will firm up and extend the requirements placed upon the authority to report in the future.

7.7.20 Renewable energy installations on existing buildings

When dealing with urban development Planning Authorities can significantly influence the uptake of Low and Zero Carbon technologies by setting policy and ensuring that carbon standards are achieved through effective development control. With respect to renewable energy on existing buildings, Planning Authorities are effectively not in a position to encourage uptake other than through demonstrating support. For existing buildings (other than major refurbishment) planning permission is not required, particularly with existing and proposed Permitted Development rules. For decentralised generation, the Planning Authority can establish the planning framework, with stretching targets, clear criteria based policies and some degree of spatial identification of areas of suitability, where relevant, which can encourage delivery of projects. However, the many commercial factors affecting the individual projects are also key determinants of whether schemes will come forward.

As outlined above, Planning Authorities have greater influence over the implementation of decentralised generation and existing building schemes, where they opt to establish direct links between new-build and so-called 'allowable solutions', by presenting local solutions. Ipswich, in addition to its planning role, should also take a leading role in the development of renewable energy initiatives, which will support delivery against the region's targets.

Monitoring of larger renewable energy generation is straight forward since installations require formal consent, e.g. planning and power connection, and they are therefore highly traceable. However, there is an extremely small likelihood of renewable energy developments of this size within Ipswich and therefore smaller renewable energy installations which have permitted development rights are the most likely for Ipswich. Monitoring uptake of these smaller installation is far the more difficult. For example solar thermal panels or heat pumps on homes do not require planning permission, whereas wind turbines in school grounds through to an anaerobic digestion plant on a farm might (if captured by flue height). For electrical installations, data from electricity network companies (Distribution Network Operators) is useful since all such systems need to obtain a formal licence for connecting to the network. Thereafter, thermal-based energy systems rely upon existing market data, expert opinion from stakeholders, and suppliers.

7.7.21 Monitoring compliance with Policies DC1 and DC2

Enforcing carbon standards on new-build development is crucial and difficult. The actual energy consumption within buildings is notoriously difficult to assess, because of the many dynamic components of buildings. Standardised tools such SAP and SBEM have been developed to support more consistent assessment of the energy consumption, but it remains complex. In addition, the analysis of the energy supply from Low and Zero Carbon technologies can be hard to assess; some technologies are greatly influenced by local specific circumstances, whilst for others, long term performance has tended to have been overstated, e.g. micro-wind and Air Sourced Heat Pumps. Hence, it has proved problematic for developers to clearly represent how they will meet set standards, and in turn it is difficult for Development Control officers to interpret these standards.

Clarity in the planning policy / guidance is critical, in the first instance. The key operational terms need to be well defined and described in sufficient detail. Also planning policy needs to call for standardised data, in a format that the Planning Authority can readily interpret. This will be useful to also ensure the authority is able simply to report and monitor performance. Development Control officers should rely on on-site built information, and not just design information, ensuring that site inspection staff are adequately included within the compliance checking process. Clearly the authority needs to be prepared to 'call-in' poor performance and to take appropriate action to ensure that local developers understand that these standards are a key feature of building compliance.

In addition, Ipswich should consider requiring the installation of on-site monitoring equipment capable of capturing sufficient data to assess long-term building (carbon) performance against the stated claims during the development phase. This is particularly relevant to the major development at the Northern Fringe. This would help to inform future changes to compliance and assessment and future evolution of planning policy, e.g. through Supplementary Planning Guidance. The requirement to provide on-going monitoring could also be coupled with a financial bond requirement, which would be returned if the development achieves the long term performance standards proposed. Whilst this is not commonplace and the mechanics of delivery would need to be resolved, it offers a clear proposition of monitoring and managing performance over time, which is ultimately what is sought through increasing carbon standards on buildings. The move towards zero carbon buildings will inevitably move towards the operational performance of buildings as standards continue to improve in design and construction. Therefore investigating how such a mechanism might be established in practice, e.g. resolving metering solutions, establishing and legally testing the financial mechanism, and negotiating its application in a development, would be useful preparatory work. Moreover, it would also demonstrate, to the development community, the level of aspiration to tackle the difficult issue of poor operational performance.

Development Control officers could be provided with training to help them assess energy and carbon reduction strategies. Ipswich could also require suitable on-site carbon monitoring to be installed in major new development to enable assessment of long-term (carbon) performance compliance.

Table 39 and Table 40 summarise key elements of good performance for monitoring and compliance against policies DC1 and DC2.

Enforcement	
New-build	***Existing build***
• Very clear planning policy & guidance • Require standardised data for compliance • DC officers should rely on on-site built information, and not just design information. • Ensure building inspectors adequately include LZC investigation • Ensure DC staff are adequately trained or provide external expert service • Authority willing to call-in poor performance (avoiding local perception that this aspect of	• Establish strong planning framework (ambitious targets, clear criteria based policies and some degree of spatial identification of areas of suitability) • Developing local 'allowable solutions' measures • Ipswich Borough Council may be able to take a leading role in the development of renewable energy initiatives.

compliance is less important). • Require long-term performance monitoring (perhaps with financial bond arrangement)	

Table 39: Key features of effective enforcement

Monitoring		
New-build	***Existing build***	***Large renewable energy projects***
• Use standard compliance data, from planning permission & Building Control processes • Require on-site monitoring, particularly for major development	• Monitoring of existing buildings is the most difficult area. • Collate data associated to those projects requiring planning permission, e.g. for small wind turbines and biomass boilers (with certain height flues) • Collate data for electrical installation which require power connection agreements (from Distribution Network Operators) • For remaining thermal-based energy systems collate market data from stakeholders, e.g. Natural England for biomass systems, and suppliers.	• Collate planning application information • Could be supplemented power network connection agreement data from Distribution Network Operators • Easy to collate on an annual basis and to then account for large proportion of the overall implementation
• *Conduct a detailed survey of renewable energy uptake, collating the information from planning applications (stand-alone generation, new build development and those small-scale projects in the existing built environment that are not classed as Permitted Development)* • *Data can be collated from a number of key data sources: regional studies, RESTATS, ROC register, databases operated by renewable energy agencies such as the British Wind Energy Association and the Renewable Energy Association* • *It is anticipated that information covering small-scale projects, in particular, will be difficult to collate directly and hence it is recommend that an annual external survey is conducted, asking local active stakeholders to provide information on existing or planned systems. This in particular should seek to gain insight on the areas for which is it hard to gain information with any degree of confidence, e.g. thermal installations in existing build applications and installations on new developments where insufficient data has been provided by the developer or reported by Development Control. As this will be a survey (of a sample) the results will need to be statistically interpreted to provide results for the entire authority. In the future the introduction of the Feed-in-tariff and the Renewable Heat Incentive may make data collection easier for smaller scale projects.*		

Table 40: Key features of effective monitoring

Non-Planning Delivery Mechanisms for Low Carbon Energy

7.7.22 Introduction

Planning policy is a core plank of local strategies for delivering decentralised energy generation and low carbon development, however, to maximise the chances of success it has to be married with a range of non-planning measures that should attempt to:

- Create local delivery leadership
- Promote demand for low carbon solutions and the supply of services required to deliver these
- Facilitate the delivery of the key solutions, particularly:
    - Low carbon infrastructure (communal heating networks), to enable connections between new development, the existing built environment, sources of surplus heat and waste-to-energy opportunities (incineration and anaerobic digestion of municipal waste)
    - Provide or facilitate financing mechanisms that support delivery of local Allowable Solutions that enable zero carbon development to be achieved, whilst supporting priority carbon measures, e.g. communal heating infrastructure, civic renewable energy projects and carbon reduction measures in the existing built environment
    - Provide or facilitate financing measures that facilitate access to capitalisation of the future revenues from energy generation or energy saving, e.g. Energy Services Company solutions, Renewable Tariff capitalisation and low interest loans, to minimise direct cost for land development
    - Capture external grants such as innovation funding and structural funds. Examples of this include European Regional Development Funds (that have been used to support the development of biomass CHP in the East of England), European Investment Bank investment (such as being sought for low carbon refurbishment of existing buildings in the South East), development and planning funding for Ecotowns, and Housing Growth Funds from CLG that may be able to support the development of low carbon infrastructure projects in support of growth.

Local Authorities are in a prime position to see the “big picture” of development in their area and would be well placed to coordinate the establishment of low carbon delivery solutions. Given the challenges of meeting the various milestones along the zero carbon roadmap whether the targets are accelerated ahead of the national plan or not, the development industry will need both carrots and sticks to achieve quite radical standards (compared to current construction practice).

Finally, councils should continue to demonstrate leadership by developing low carbon projects with their own estate, e.g. providing public buildings to be anchor projects for low carbon district heating schemes or developing council-managed renewable energy generation or energy efficiency programmes.

7.7.23 Coordinating the development of low carbon infrastructure

Managing and financing energy infrastructure for long term, phased development projects is extremely challenging. Large combined heat and power systems are a very cost effective low carbon strategy but they are difficult to establish in phased development. Ipswich Borough Council needs to encourage developers to engage with expert entities in order to most effectively progress energy infrastructure within their developments. Key steps include:

- Planning & delivery of low carbon infrastructure should be carried out by an entity with long term interest in assets, such as an Energy Services Company (ESCO);

- Developers should be encouraged to engage early with ESCOs to facilitate a more effective approach to rolling out low carbon infrastructure;
- A Special Purpose Vehicle could be established to lead early client negotiation and mitigate risk before bringing proposals to market.

7.7.24 Financing low carbon infrastructure

Addressing investment challenges for communal infrastructure

A 'carbon investment fund' could help overcome the high upfront costs of energy infrastructure with the public sector providing the initial investment which is then repaid through developer's energy contributions. It would also provide a proactive response to the government's aspiration to support future carbon reductions through a variety of 'off-site' means, and ensure greater local control of delivery. A council (or joint council) operated ring fenced carbon investment fund could provide the upfront capital needed for financing large scale low carbon infrastructure such as CHP/district heating networks that can supply phased developments. The carbon investment fund would bring forward the value of staged developer contributions to early stage investment and would be reimbursed through payments from private sector developers as their developments are rolled out. Provisions such as this should be incorporated into LDF infrastructure planning and could also be linked to Section 106 (or Community Infrastructure Levy) arrangements as an alternative to a discrete carbon investment fund, although it would be important for the incomes to be hypothecated

Key actions to support investment shortages:

- A ring fenced carbon investment fund may be needed to bring forward value of staged developer contribution to early stage investment (initially financed by the public sector, but reimbursed through payments from private sector developers);
- Contractual complexities & residual uncertainties need to be managed through secured rights to sell energy & carbon benefits to customers into the future (ESCOs need to know the size of market for heat & power, timing of development, & price of future energy);
- Housing developer investment needs to be channelled towards shared off-site renewable developments and carbon investment fund could manage this role.
- Additional measures needed to mitigate early stage infrastructure development risk;
- Increased support for renewable energy development with mechanisms to contractually link off-site renewable energy infrastructure to new developments.

There are numerous contractual complexities which Ipswich Council could seek to mitigate through:

- working with developers and ESCOs to help secure rights to sell energy & carbon benefits to customers into the future
- ensuring that developers commit their buildings to the energy network with long term energy power & heat purchase contracts
- committing to long term power and heat purchase contracts with ESCOs for their own buildings so as to help establish low carbon networks

Special purpose vehicles / ESCOs

Ipswich Borough Council could seek to establish a municipal Energy Services Company (ESCO) as others, such as Woking and Sheffield Council, have previously done. This would work to develop / install sustainable energy systems within both the new development and existing buildings. A special purpose vehicle could particularly help in rolling out CHP and district heating to existing communities, and thereby help realise the substantial carbon reductions that CHP can deliver to existing buildings.

The term 'Energy Services Company' is applied to many different types of initiatives and delivery vehicles that seek to implement energy efficiency measures or local energy generation projects. ESCOs are established in order to take forward projects that the general energy market place is failing to deliver – and in this way ESCOs are designed to overcome the market and policy failures that affect local sustainable energy projects. There are a number of commercial ESCOs in existence which can support developers in designing, installing and operating a communal energy system for a new development. These ESCOs may either operate the energy system entirely themselves or enter into an arrangement with the developer and other entities in order to establish a new ESCO specifically designed to operate the energy infrastructure of the new development. These development-specific ESCOs can be structured so that they are part, or wholly, owned by the residents of the development, and are therefore often referred to as 'community ESCOs'.

An ESCO can take many forms and be designed to progress small energy projects or large projects. Different ESCO applications include:

- Low carbon energy supply for a new development
- District heating or CHP scheme for social housing and / or other community and private sector customers
- Community renewables projects
- Retrofitting energy efficiency measures into buildings or energy management in buildings
- Pre-commercial energy development / projects and small bespoke projects.

Local authority ESCO activity would be controlled by the rules governing Local Authority borrowing, trading and charging for services and public procurement legislation. Key relevant legislation concerns the supply of utilities, and particularly electricity which is heavily regulated with complex licensing arrangements. Although a Local Authority-led ESCO might be entirely public sector owned and operate as a public body or quasi-public body, it may deliver its services through contracting private sector companies.

An ESCO or special purpose vehicle led by a public sector organisation may be needed if a low carbon project is not being taken forward by the market place due to financial or technological risks. An ESCO can be designed so as to manage these risks and enable a project to proceed. Nonetheless, a Local Authority or community group will only want to go down the path of establishing an ESCO if the energy project they wish to pursue is of no interest to an existing ESCO or if certain market risks cannot be reduced through other actions by the public sector, such as guaranteeing revenue streams for the heat or electricity generated by a renewable energy installation. Establishing an ESCO is not a simple short term task and there are risks involved so it is important the need for an ESCO is fully established at the outset. When developing the plans for a low carbon project, it is sensible to test the business case with energy experts and existing commercial ESCOs that have implemented similar projects.

7.7.25 Ipswich Borough Council leading by example

Ipswich Borough Council has a great opportunity to directly progress renewable energy installations and decentralised energy generation by taking forward projects on its own buildings and land. As outlined earlier, the council could establish a local ESCO to help implement these low carbon energy projects.

The council also has opportunities in terms of using its public buildings as an anchor heat load around which to establish CHP and a district heating network, establishing renewable energy installations on its buildings, such as PV and solar water heating, and even a power supply agreement with a wind turbine located within the district. Key actions include:

- Public sector buildings to provide ‘anchor loads’ for district heating and low carbon infrastructure networks so as to lead the way in installing CHP and developing heat networks;
- Renewable energy installations on council buildings, including PV, solar water heating and small to medium wind turbines;
- Identify a number of public sector demonstration projects across the district;
- Develop an action plan for implementing these demonstration projects.

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