FINAL REPORT

# Planning and Climate Change in Crawley

**A report for Crawley Borough Council by the Energy Centre for Sustainable Communities**

ecsc
ENERGY CENTRE FOR SUSTAINABLE COMMUNITIES

October 2007

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# 1 Introduction

> ***"Regional planning bodies, and all planning authorities should prepare and deliver spatial strategies that…make a full contribution to delivering the Government's Climate Change Programme and energy policies, and in doing so contribute to global sustainability"***
>
> **Draft Planning Policy Statement on Planning and Climate Change (December, 2006)**

Climate Change is widely recognised as one of the most fundamental challenges affecting our future, the effects of which are being seen in changes to weather patterns, rising sea levels and an increased frequency and intensity of extreme weather events. The main human influence on global climate is the emission of the key greenhouse gases - carbon dioxide ($CO_2$), methane and nitrous oxide.

Climate Change is at the forefront of both national and international agendas and is being reflected in major shifts in policy. The Government's approach to tackle Climate Change is two-pronged:

- *Mitigation* i.e. the reduction of greenhouse gas emissions that cause Climate Change, and
- *Adaptation* i.e. accepting that some changes in climate are inevitable and that we must adapt to these changes.

## 1.1 Study Objectives

The UK Government has recognised the key role that spatial planning will have to play in addressing climate change issues and this is indicated in the forthcoming Planning Policy Statement on Planning and Climate Change (expected late 2007). Crawley Borough Council has commissioned this study to:

- **Provide a robust evidence base for development of an SPD on Planning and Climate Change**
  The Council understands the need to promote best practice in the delivery of new developments that are sustainable, minimising emissions of Greenhouse Gases and having built-in adaptability and resilience to future changes in Climate. This will be delivered through a range of policies in its Local Development Framework; primarily through the adoption of an SPD on Planning and Climate Change, and hence an objective of this study is to provide robust evidence for development of the SPD.

- **Identify options for corporate policies and initiatives to reduce the impact of new development on Climate Change**
  The Council appreciates that to effectively reduce the impact that new development has on Climate Change (and vice versa) it will need to consider corporate policies and initiatives. This study, therefore, aims to identify options for corporate polices and initiatives to reduce the impact of new development on Climate Change.

## 1.2 Climate Change in Crawley

According to data published by Defra, Crawley Borough emitted 781,000 tonnes of $CO_2$, the main greenhouse gas, in 2004, with the sectoral split shown in Figure 1. It can be seen that the majority of

emissions, 81%, are from the built environment (combining domestic, industrial and commercial emissions) and hence this forms the scope of the study. It should be noted that the data below does not include emissions from aviation.

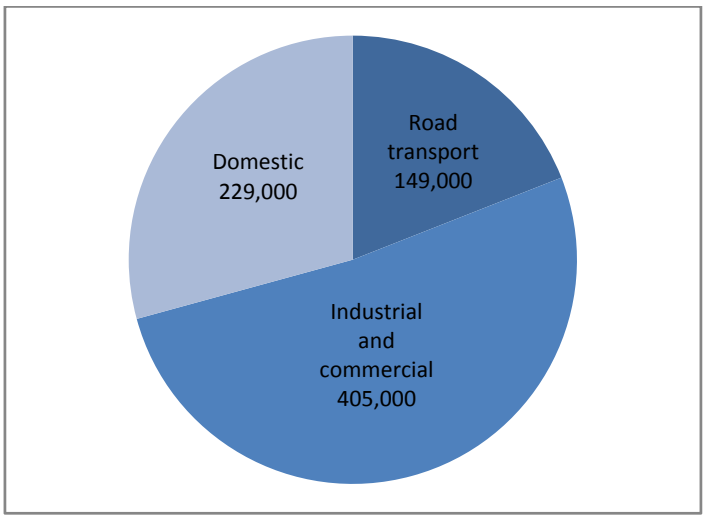



Figure 1 Tonnes of $CO_2$ by Sector. (Defra, November 2006. End user summary 2004).

The impacts of Climate Change in Crawley are likely to be felt through an increase in extreme weather events such as flooding, droughts, heat waves, severe storms and winds. There is already some evidence of such events with severe flooding in 2000: over 600 homes were flooded in Maidenbower and Pound Hill when the Gatwick Stream overflowed due to increased flows and surface run off. Conversely, in 2003 and again in 2006, the town suffered severe droughts with record low levels being experienced at supply reservoirs. Crawley normally receives its water from Weirwood Reservoir, but in 2006, water had to be pumped from Portsmouth to prevent standpipes from being used. The 2003 heat wave that affected northern Europe affected Crawley's infrastructure with local train lines beginning to buckle and the melting of local road surfaces.

## 1.3 Where Crawley is now

### 1.3.1 Key initiatives

The Council responded to the Climate Change challenge by signing the Nottingham Declaration on Climate Change[1] in 2003. As a signatory, the Council has acknowledged that Climate Change is occurring and has pledged to take action. Some areas where the council has already taken action are shown below:

- Participation in the Carbon Trust's Local Authority Carbon Management Programme[2] that aims to reduce carbon emissions from the Council's own buildings. This included development of an action plan to reduce energy use on all of the Council's main sites
- The Council has an Environmental Management System, which is verified through EMAS (Eco Management and Audit Scheme) and has achieved ISO 14001 standard
- The Council is involved in wide ranging partnerships at County, Regional and National level taking forward climate change issues including mentoring other authorities and organisations

[1] http://www.nottinghamdeclaration.org.uk
[2] http://www.carbontrust.co.uk/carbon/la/

- One of the Council's sites, the K2 leisure centre, has a CHP unit installed to provide heat and power and a rain water harvesting system is being considered for the site
- The town has a number of developments that have biomass systems installed and are in operation including the Buchan Park Environment Centre
- Biomass (woodchip) boilers are being considered for a retrofit to St. John's Church, Ifield Care Home, a new library and St. Wilfred's Secondary School.
- In terms of planning guidance, the Council has adopted SPGs on 'Sustainable Design' and 'Landscaping and Greening the Environment' that aim to provide guidance to architects, planners, designers and developers for achieving designs that conserve energy, water and non-renewable resources
- In its own housing stock, the council has fitted all hostels and sheltered accommodation with Solar Water Heating (25 installations) and Carey House (the largest sheltered housing unit) has been fitted with a major PV array (23kWp)
- The Council has installed solar thermal panels to public toilets and the turtle pond at Tilgate Nature Centre. A Micro wind turbine is also to be installed on the 'GreenZone' in the near future
- The Council has sponsored Sussex Solar, a Private Solar Water Discount Scheme. There has been twelve installations in the 2.5 years it has been running

### 1.3.2 Planning Policy

As a Local Planning Authority, the Council is responsible for decisions relating to development of Crawley Borough. This is principally through the spatial planning strategy known as the Local Development Framework.

As part of its Local Development Framework, the Council submitted its Core Strategy for examination in May 2006. The Submission Core Strategy included policies S1 and S2 on Sustainable Development. Following the Inspector's Report in August 2007, the Core Strategy was found to be sound, subject to a number of changes. One of these was related to S1 and S2.

The Inspector felt that policies S1 and S2 were not Crawley-specific and merely summarised national and emerging regional policy on sustainable development. He concluded that policies S1 and S2 should be removed from the adopted core strategy. Any local specific aspects of sustainability should then be brought forward and justified in a future review of the Core Strategy or (if appropriate) in other documents included in the Council's Local Development Scheme such as the Planning and Climate Change SPD.

From discussion with officers at the Council, ecsc understands that the Council is planning to bring forward local specific policy through its SPD on Planning and Climate Change and use national policy (in the form of the forthcoming PPS on Planning and Climate Change), regional policy (in the form of the South East Plan) and local policy (in the form of the forthcoming Development Control Policies DPD) as hooks for policy included within this SPD.

The Planning and Climate Change SPD will consider all aspects that contribute to or are affected by Climate Change. However, the scope of this report is primarily Climate Change and the built environment. The Council will need to address separately, other issues including: sustainable transport initiatives, waste management, biodiversity, emergency planning and health impacts.

# 2 The policy context for Climate Change and Planning

The government has recognised the important role that spatial planning has to play in effective action to tackle climate change. Spatial planners can use their role of facilitating the provision of new houses, jobs and infrastructure to shape places that have lower carbon emissions and are resilient to changes in climate.

Although building regulations will inevitably play a large part in reducing the emissions from individual dwellings, the Department for Communities and Local Government is increasingly looking to local planning authorities to provide the framework to integrate new development within other programmes that can influence the nature of places and how they function.

Below is a review of current policy that will need to be considered by Crawley in preparation of its SPD on Planning and Climate Change.

## 2.1 National Policy

### 2.1.1 PPS 1: Delivering Sustainable Development (2005)

PPS 1 sets out the overarching planning policies on the delivery of sustainable development through the planning system. It emphasises that Sustainable Development - ensuring a better quality of life for everyone, now and for future generations - should be the core principle underpinning planning.

It states that "Development plan policies should take account of environmental issues such as: mitigation of the effects of, and adaptation to, climate change through the reduction of greenhouse gas emissions and the use of renewable energy…"

### 2.1.2 Draft supplement to PPS 1: Planning and Climate Change (2006) *(N.B. This PPS is currently only available in draft form and therefore the details below relate to the draft PPS)*

In December 2006 the Government published a draft PPS on Planning and Climate Change, that, when adopted in late 2007, will become a supplement to PPS 1: Delivering Sustainable Development.

The draft PPS on Planning and Climate Change sets out Key Planning Objectives that planning authorities should deliver through their spatial strategies, including making "…a full contribution to delivering the Government's Climate Change Programme and energy policies, and in doing so contribute to global sustainability".

The draft PPS states that when identifying land for development, LPAs will have to ensure that the areas are consistent with policies in the PPS. The criteria that a site will have to perform well against are set out in paragraph 19 of the draft PPS, below:

"Planning authorities should take into account:

- the location and whether there is, or the potential for, a realistic choice of access by means other than the private car and for opportunities to service the site through sustainable transport;
- the capacity of existing and potential infrastructure (including for energy supply, waste management, water and sewerage, and community infrastructure such as schools and

hospitals) to service the site or area in ways consistent with cutting carbon emissions and successfully adapting to likely changes in the local climate;
- the ability to build and sustain socially cohesive communities with appropriate community infrastructure so as to avoid social exclusion, having regard to the full range of local environmental impacts that could arise as a result of likely changes to the climate;
- the effect of development on biodiversity and the capacity for adaptation, having regard to likely changes in the local climate;
- the contribution to be made from existing and new opportunities for open space to urban cooling; and,
- known physical and environmental constraints on the development of land such as sealevel rises, flood risk and stability, and take a precautionary approach to increases in risk that could arise as a result of likely changes to the climate."

The draft PPS states that when considering development of small sites e.g. windfall sites, it should be considered how they can contribute to specific climate change policies in a Council's core strategy.

In terms of renewable energy and low carbon technologies, a planning authority should assess the potential in their area. The draft PPS also "expect(s) substantial new development to gain a significant proportion of its energy supply on-site and renewably and/or connect to a decentralised, renewable or lowcarbon, energy supply". Until a "significant proportion" has been tested and defined through a development plan document this should be a standard 10 per cent.

The draft PPS acknowledges that as LPAs are concerned with the environmental performance of new development they should have regard for the environmental performance of individual buildings. However, the PPS states that "Planning authorities should not need, however, to devise their own standards for the environmental performance of individual buildings as these are set out nationally through the Building Regulations".

The draft PPS goes on to state that planning authorities should not set out specific requirements across broad areas but to focus on specific development opportunities for demanding higher levels of performance of nationally described standards e.g. the Code for Sustainable Homes (see below).

### 2.1.3 PPS 3: Housing (2006)

PPS 3 on housing underpins the delivery of the Government's strategic housing policy objectives and the goal to ensure that everyone has the opportunity to live in a decent home, which they can afford, in a community where they want to live.

It has a principle aim of delivering a step change in housing delivery through a new, more responsive approach to land supply at the local level. The PPS makes reference to the Draft PPS on Planning and Climate Change and states that the impact of, and on, Climate Change should be taken into account when considering a new development.

### 2.1.4 PPS 6: Planning for Town Centres (2005)

PPS 6 sets out the Government's policy on planning for the future of town centres. The Government's objective for town centres is to promote their vitality and viability. This is linked to a wider objective of ensuring that development is sustainable through high-density, mixed-use

development and promoting sustainable transport choices, including reducing the need to travel and providing alternatives to car use.

### 2.1.5 PPS 7: Sustainable Development in Rural Areas (2004)

PPS 7 sets out the Government's planning policies for rural areas. A Government objective for rural areas is to promote more sustainable patterns of development by:

- focusing most development in, or next to, existing towns and villages
- preventing urban sprawl
- discouraging the development of 'greenfield' land, and, where such land must be used, ensuring it is not used wastefully
- promoting a range of uses to maximise the potential benefits of the countryside fringing urban areas
- providing appropriate leisure opportunities to enable urban and rural dwellers to enjoy the wider countryside.

### 2.1.6 PPS 9: Biodiversity and Geological Conservation (2005)

PPS 9 sets out planning policies on protection of biodiversity and geological conservation through the planning system. A government objective is to promote sustainable development by ensuring that it is promoted through the conservation and enhancement of biological and geological diversity.

It recognises that over time the distribution of habitats and species, and geomorphological processes and features, will be affected by climate change and such change will be need to be taken into account in the development of planning policy.

### 2.1.7 PPS 10: Planning for Sustainable Waste Management (2005)

PPS 10 sets out the Government's policy to be taken into account by waste planning authorities and forms part of the national waste management plan for the UK. The overall objective, as set out in the UK Government's Sustainable Development Strategy, is to protect human health and the environment by producing less waste and by using it as a resource wherever possible.

Planning authorities have a role in delivering this objective through providing a framework in which communities are able to take more responsibility for their own waste and enabling sufficient and timely provision of waste management facilities to meet the needs of their communities.

### 2.1.8 PPS 12: Local Development Frameworks (2004)

PPS 12 sets out the procedural policy on the preparation of Local Development Documents that comprise the local development framework. It states that "In preparing local development documents, local planning authorities should seek first to avoid, or where this is not possible seek to reduce, the effects of development on climate change and vice versa. Local development documents should therefore include policy on:

I. the need, where possible, to avoid major new development in areas that are likely to be at greater risk now, or over the lifetime of the development (for example, those in areas of significant erosion or flood risk, or where water resources are limited);
II. the physical and environmental constraints on development of land, including, for example, the level of contamination, stability/subsidence, erosion and flood risk, given that any such risks may increase with climate change;

III. the likely increase in pressure on resources with climate change;
IV. the way that the distribution of nationally or regionally significant species and habitats may alter with climate change, and the effects of biodiversity and nationally or internationally designated areas;
V. the need to consider possible adaptation options for vulnerable areas, while understanding the uncertainties inherent in projections of the impacts of climate change. In the longer term, these may include managed realignment of the coast in some locations in the face of forecast rises in sea-level; and
VI. the need to revise strategies in the light of developing information on climate change, and its impact on flood risk in particular."

### 2.1.9 PPS 22: Renewable Energy (2004)

PPS 22 sets out the Government's policies for renewable energy. It states that:

- Local development documents should contain policies that promote and encourage, rather than restrict, the development of renewable energy sources;
- LPAs should set out criteria that will be applied in assessing applications for planning permission for renewable energy projects;
- LPAs should foster community involvement in renewable energy projects. Developers of renewable energy projects should engage in active consultation with the community early in the planning process;
- LPAs may include a policy that requires a percentage of the energy in new residential, commercial or industrial developments to come from on-site renewable energy developments

### 2.1.10 PPS 23: Planning and Pollution Control (2004)

PPS 23 on Planning and Pollution Control complements the pollution control framework under the Pollution Prevention and Control Act 1999 and the PPC Regulations 2000. It acknowledges that there is a need to limit and where possible reduce greenhouse gas emissions and take account of potential effects of climate change in the preparation of development plan documents and also it may be a material consideration of individual planning applications where pollution considerations arise.

### 2.1.11 PPS 25: Development and Flood Risk (2006)

PPS 25 sets out policies that ensure that flood risk is taken into account in all stages of the planning process. With flooding from both rivers and tidal water expected to increase in frequency and intensity due to climate change, it will be important for effective adaptation through spatial planning policies. The aims of the planning policy are "to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall".

The sequential risk-based approach should be followed that demonstrates that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

The following principles should be adhered to by Local Planning Authorities when preparing their local development framework:

- LPAs should prepare Local Development Documents (LDDs) that set out policies for the allocation of sites and the control of development which avoid flood risk to people and property where possible and manage it elsewhere, reflecting the approach to managing flood risk in this PPS and in the RSS for their region
- Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, LPAs should consider whether there are opportunities in the preparation of LDDs to facilitate the relocation of development, including housing to more sustainable locations at less risk from flooding.

### 2.1.12 Securing the future - UK Government Sustainable Development Strategy (March 2005)

In 1999 the government set out a strategy to deliver a better quality of life through sustainable development. The 2005 strategy takes account of developments since the 1999 Strategy, both domestically and internationally; the changed structure of government in the UK with devolution to Scotland, Wales and Northern Ireland; greater emphasis on delivery at regional level and the new relationship between government and local authorities.

It highlights the renewed international push for sustainable development from the World Summit on Sustainable Development in Johannesburg in 2002. The lead Department, Defra, chairs a Programme Board to oversee delivery of the Strategy, but all UK Departments share responsibility for making sustainable development a reality.

A key commitment of the strategy is to "plac[e] sustainable development at the heart of the land use planning system and at the core of new planning guidance".

### 2.1.13 Strong and Prosperous Communities, the Local Government White Paper (October 2006)

The Local Government White Paper has an annex on Climate Change that acknowledges that Local Government has a pivotal role in achieving sustainable development and mitigating and adapting to climate change. This role is not just in the way local authorities run their own estates and services but also as community leaders.

The proposals for how the White Paper will meet this challenge are:

- Through the Local Government Performance Framework. The new Performance Framework will have an appropriate focus on climate change, with the Comprehensive Spending Review making decisions on national outcomes, indicators and any national targets
- Use of Local Area Agreements to encourage partnership working
- Use of Local Strategic Partnerships
- Encouraging parish and town councils to use their powers in relation to energy saving measures e.g. microgeneration (as granted in the Climate Change and Sustainable Energy Act, 2006)
- Encouraging local authorities to reduce emissions on their own estates (additional funding was provided to the Salix Finance programme)

- Through the spatial planning system supporting low carbon living
- Establishment of a Climate Change Commission to consider how local leadership can drive change

### 2.1.14 Meeting the Energy Challenge. A White Paper on Energy (May 2007)

The Energy White Paper sets out a framework for action to address the challenges that face the UK regarding Climate Change and the need to ensure security of energy supplies. It acknowledges the role that the planning system has to play, particularly in delivering the necessary energy infrastructure. The UK requires 30-35GW of new generating capacity over the next two decades, with two thirds of this by 2020. An existing challenge to this is the planning system: taking too long; creating uncertainty and being difficult and costly to local government. It emphasises immediate improvements through the Draft PPS on Climate Change where applications for renewable energy will no longer have to demonstrate the overall need for renewable energy and new development will need to include a significant proportion of its energy supply from renewable sources.

On CHP, the White Paper seeks to promote good quality CHP and emphasises the obligation on developers of large power stations to consider opportunities for CHP.

The White Paper sees local authorities as having a growing role to play in meeting energy policy goals by leading to lower carbon emissions in their communities. This will be through the measures identified in the Local Government White Paper.

### 2.1.15 Planning for a Sustainable Future, White Paper (May, 2007)

The Planning White Paper has a chapter on Sustainable Development that covers Climate Change. The Town and Country Planning System will help to address Climate Change by:

- Finalising the Planning Policy Statement on Climate Change
- Permitting a range of types of householder microgeneration without the need to apply for planning permission
- Reviewing and where possible extending permitted development rights on microgeneration to other types of land use including commercial and agricultural development
- Working with industry to set in place a timetable and action plan to deliver substantial reductions in carbon emissions from new commercial building within the next 10 years.

The government expects that development plans should be tested on their carbon ambition, including how they integrate sustainable transport to reduce the need to travel.

Significant reference is made to the draft PPS on Planning and Climate Change.

## 2.2 Regional Policy

### 2.2.1 Regional Spatial Strategy (The South East Plan)

The South East plan was submitted to government in March 2006 and following extensive examination in public, the inspector's report was published in August 2007. It is hoped that following changes, the South East Plan will be adopted in late 2008.

The Submission South East Plan has a specific policy on climate change and a number of other policies that are relevant. These are detailed below.

### Policy CC2 Climate Change

This policy states that the strategy and policies of the South East Plan will promote measures to mitigate and adapt to climate change through the application of local planning policy. It states that LPAs should include policies and proposals in their plans, strategies and investment programmes that help to reduce the region's carbon dioxide emissions at least 20% below 1990 levels by 2010 and by at least 25% below 1990 levels by 2015.

### Policy CC3 Resource use

The regional assembly will promote measures that seek to stabilise the South East's ecological footprint by 2016 and to reduce the ecological footprint during the second half of the Plan period. This will include adaptation of existing development to reduce its use of energy, water and other resources.

### Policy CC4 Sustainable Construction

Construction of new buildings, and the redevelopment and refurbishment of existing building stock, will be expected to adopt and incorporate sustainable construction standards and techniques.

### Policy NRM3 Sustainable Flood Risk Management

This policy states that the sequential approach of PPS 25 (Development and flood risk) will be followed, that aims to ensure that new development is steered to the areas of lowest probability of flooding.

### Policy EN1 Development and design for energy efficiency and renewable energy

This policy states that local development documents should encourage the incorporation of high standards of energy efficiency in all development, subject to economic viability considerations. Design, layout and orientation should be used to achieve this. LPAs should use design briefs and/or Supplementary Planning Documents to promote development design for energy efficiency and renewable energy.

This policy states that LPAs may implement this policy through encouraging developers to submit an assessment of a development's energy demand and provide at least 10% of the development's energy demand from renewable sources for housing schemes of over 10 dwellings and commercial schemes over 1000$m^2$.

The policy recognises that areas where there is large scale development e.g. regional growth areas, may offer an opportunity for the active promotion of energy efficiency and use of renewable energy.

### Policy EN2 Combined Heat and Power

This policy states that local development documents and other policies should encourage the integration of CHP in all developments. This includes mini and micro-CHP and district heating infrastructure in large scale developments in mixed use. Biomass fuel should also be investigated and promoted where possible.

### Policy EN3 Regional Renewable Energy targets

The South East Plan sets out targets for electricity generation from renewable sources. These are shown in table 1.

Table 1 South East Regional Renewable Energy Targets (The South East Plan)

| Year/ Timescale | Installed Capacity (MW) | (%) Electricity Generation Capacity |
|---|---|---|
| 2010 | 620 | 5.5 |
| 2016 | 895 | 8.0 |
| 2020 | 1,130 | 10.0 |
| 2026 | 1,750 | 16.0 |

## Policy EN4 Sub-regional targets

The sub regional target for electricity generation from renewable sources is in table 2.

Table 2 South East Sub Regional Targets (The South East Plan)

| Sub-region | 2010 Target (MW) | 2016 Target (MW) | Champion |
|---|---|---|---|
| Thames Valley & Surrey | 140 | 209 | TV Energy |
| East Sussex & West Sussex | 57 | 68 | ECSC |
| Hampshire & Isle of Wight | 115 | 122 | Hampshire CC & Isle of Wight Council |
| Kent | 111 | 154 | Kent Energy Centre |

Local Development Documents should seek to contribute to the achievement of these targets. This should include:

1. Undertaking more detailed assessments of local potential
2. Encouraging small scale community-based schemes
3. Encouraging development of local supply chains, especially for biomass
4. Raising awareness, ownership and understanding of renewable energy

## Policy EN5 Location of Renewable Energy Development

This policy states that renewable energy, particularly wind and biomass, should be located and designed to minimise adverse impacts on landscape, wildlife and amenity.

## Policy EN6 Development Criteria

LDFs should support in principle the development of renewable energy. Local Development Documents should therefore include criteria-based policies that, in addition to general criteria applicable to all development, should consider the following issues:

1. The contribution the development will make towards achieving national, regional and sub-regional renewable energy targets and carbon dioxide savings
2. The potential to integrate the proposal with existing or new development
3. The potential benefits to host communities and opportunities for environmental enhancement

4. The proximity of biomass combustion plant to fuel source and the adequacy of local transport networks
5. The availability of a suitable connection to the electricity transmission and distribution network.

## 2.3 Sub regional Policy

### 2.3.1 West Sussex Structure Plan

The West Sussex Structure Plan (2001-2016) provides the strategic context for land use planning and transport for West Sussex. It provides the framework for local development frameworks developed by all local planning authorities in West Sussex.

Policy DEV1 states that "Development should not be permitted unless the construction, layout, scale, appearance and landscaping are of high quality taking into account the need to:

…ensure energy efficiency, minimise the use of non-renewable energy, and maximise the use of renewable energy sources"

Policy ERA4 relates to flood risk and states that "Local plans will include policies to:

(1) ensure that the integrity of functional floodplains is maintained and that a risk-based sequential approach is adopted which guides specified categories of development away from flood risk areas;

(2) secure the provision of measures to manage surface water run-off in new development which will help to reduce flood risk including, where appropriate, sustainable drainage systems (SuDS)"

## 2.4 Other documents

### 2.4.1 The Code for Sustainable Homes

The Code for Sustainable Homes (CSH) was published in December 2006 with the aim of driving a step change in sustainable home building practice. It will become the single national standard by which the sustainability of new homes is to be assessed and is already in use by home designers and builders as a guide to development, and by home buyers to assist in their choice of home.

The CSH will form the basis for future updates of the building regulations (see Building a Greener Future: Towards Zero Carbon Development). Level 1 of the Code is set above current building regulations and it is intended that the code will signal the future direction of building regulations in relation to carbon emissions from, and energy use in, homes, providing greater regulatory certainty for the homebuilding industry.

Currently, the code is mandatory for all new publically funded housing. The government is encouraging its use on a voluntary basis for commercially funded development and is consulting on proposal to making a rating against it mandatory for all new housing[3].

The Code measures the sustainability of a home against design categories, rating the 'whole home' as a complete package. The design categories are as follows:

[3] http://www.communities.gov.uk/publications/planningandbuilding/futurecodeconsultation

- Energy/$CO_2$
- Water
- Materials
- Surface water run-off
- Waste
- Pollution
- Health and well-being
- Management
- Ecology

The Code uses a sustainability rating system from level 1 to level 6. Level 1 (or one star) is the entry level (set above building regulations) and level 6 (or six stars) is the highest level reflecting exemplar development in sustainability terms.

The code offers a degree of flexibility in how developers can meet each level. However, minimum standards exist for a number of the categories as shown in table 3.

**Table 3: Flexibility the Code for Sustainable Homes (The Code for Sustainable Homes)**

| Flexibility of the Code | |
|---|---|
| **Categories** | **Flexibility** |
| Energy/$CO_2$ | Minimum standards at each level of the Code |
| Water | |
| Materials | Minimum standard at Code entry level |
| Surface water run-off | |
| Waste | |
| Pollution | No minimum standards |
| Health and well-being | |
| Management | |
| Ecology | |

### 2.4.2 Building a Greener Future: Towards Zero Carbon Development

The government held a consultation from December 2006 until March 2007 entitled 'Building a Greener Future: Towards Zero Carbon Development'.

The consultation document proposed that zero carbon housing should be possible within ten years. This would be through developers complying with the targets shown in table 4:

**Table 4 Proposed levels of improved energy/carbon performance over time (Building a Greener Future: Towards Zero Carbon Development)**

| Date | 2010 | 2013 | 2016 |
|---|---|---|---|
| Energy/carbon improvement as compared to Part L (Building Regulations 2006) | 25% | 44% | zero carbon |
| Equivalent energy/carbon standard in the Code | **Code level 3** | **Code level 4** | **Code level 6** |

To achieve these ambitious targets the government acknowledges that there are three main policy levers that can be used:

1. The planning system
2. The Code for Sustainable Homes
3. Building Regulations

It acknowledges that the planning system sets out the overall framework for development and building regulations can determine the environmental performance of individual buildings.

The proposals in table 4 were confirmed in a Policy Statement called Building a Greener Future[4] released in July 2007.

It is worth noting that the zero carbon targets apply to housing only. The Government has yet to describe how it intends to reduce carbon emissions from the non-residential sector.

## 2.5 Conclusion

The forthcoming PPS on Planning and Climate Change, expected in late 2007, will help to clarify the position of government expectations of LPAs with regards to Climate Change. At present there is no clear guidance as to what LPAs can demand in terms of maximum and minimum energy efficiency and renewable energy standards in new development. The draft PPS states that "planning authorities should…expect substantial new development to gain a significant proportion of its energy supply on-site and renewably and/or connect to a decentralised, renewable or lowcarbon, energy supply…" and "in the interim period before "a significant proportion" is tested and defined through the preparation and adoption of a development plan document a standard of 10 per cent should be required". If adopted in its current form, LPAs will therefore be able to demand 10 per cent renewable energy on substantial new development.

However, there has been much speculation, including in the national media, on what may change from the draft PPS[5] when adopted. Whilst this is speculation, it appears that the Government wants to discourage the adoption of a 'blanket' Merton rule policy (securing 10% of a development's energy demand through renewable sources on site) across a whole borough, by requiring local policies to be set out in DPDs and focusing on local development or site specific opportunities for demanding higher levels of carbon reduction. The draft PPS on Climate Change also welcomes the use of nationally described standards e.g. the Code for Sustainable Homes in spatial planning policies to demand higher levels of sustainability in residential development.

The contribution to be made by planning in achieving significant reductions in carbon emissions has been emphasised by Government. In a Policy Statement[6] in July 2007, CLG confirmed the position that they will expect new homes to be zero carbon by 2016, with interim steps of a 25% reduction of Carbon emissions on current building regulations by 2010 and a 44% reduction by 2013. This will be

[4] http://www.communities.gov.uk/documents/planningandbuilding/pdf/building-greener
[5] http://www.guardian.co.uk/environment/2007/aug/20/energy
http://www.planningresource.co.uk/bulletins/Planning-Resource-Daily-Bulletin/News/732574/Government-denies-Merton-Rule-abolition-claim/
http://www.planningresource.co.uk/bulletins/Planning-Resource-Daily-Bulletin/News/733293/Leaked-document-casts-doubt-Merton-Rule-denials/
[6] http://www.communities.gov.uk/documents/planningandbuilding/pdf/building-greener

achieved through a combination of both building regulations and the planning system and LPAs should prepare policy accordingly. At present, there is no guidance relating to the non-domestic sector but the government has aspirations to publish such guidance.

Finally, it is also evident that planning is encouraged to give greater consideration to the inclusion of measures in the design of new development that provide resilience to predicted changes in our climate.

# 3 Implementation of Climate Change Planning Policy by local planning authorities

Telephone interviews were conducted with officers at six leading local planning authorities to critique currently adopted policies on climate change mitigation and adaptation. To establish a thorough understanding about how the polices work in practice along with any possible pitfalls, each officer was asked about his or her experiences regarding:

- Compliance assessment
- Resource implications of policy implementation
- Expertise required to implement the policy
- How developers have reacted to the policy and what negotiations have been required
- Outcomes of the policy
- Monitoring of the policy

The findings from the interviews along with further information on policies from neighbouring authorities are in appendix 1. A summary of the findings is detailed below:

## 3.1 Current policy

Of those councils that were actively reducing carbon of new development and ensuring that it adapts to climate change, all were doing it through their planning policy. However, many had strong corporate polices and the response to climate change was a priority for the Council.

A range of planning policy mechanisms is currently being used. The Surrey authorities are able to use a structure plan policy before adoption of their LDF core strategies. Other authorities have adopted policy through an SPD and Croydon has adopted a policy through its UDP. As yet, none of the councils interviewed have adopted a policy through their LDFs.

A summary of the adopted policies is shown below in table 5.

**Table 5 Adopted policies of the Councils interviewed**

| Council | Policy |
|---|---|
| Croydon | 10% reduction in carbon emissions from the incorporation from renewable energy for non-residential developments exceeding 1,000 square metres gross floorspace, and new residential developments comprising 10 or more units. |
| Milton Keynes | Carbon neutrality or financial contributions to a carbon offset fund for all new development exceeding 5 new dwellings (in residential) and exceeding 1000 sq m (in the case of other development) |
| Waverley | 10% energy reduction from renewable energy in all new development |
| Reading | 20% carbon reduction from renewable energy in all new development |
| Woking | 10% energy reduction from renewable energy in all new development |
| Tandridge | 10% energy reduction from renewable energy in all new development |

## 3.2 Compliance Assessment

The LPAs surveyed for this report all require the submission of an energy statement by the applicant. In most authorities, the DC case officers refer the energy statement to another officer within the Council for verification; this was usually the person who had been involved in the development of the policy, whether this be senior policy officer, Environment and Sustainability manager or in one case building control. In some councils it was hoped that as knowledge and experience is gained, DC officers would be able to deal with energy statements without assistance.

In addition to the interviews, ecsc has reviewed a large amount of compliance data attached to planning applications in London and the South East, and has identified a number of issues for both developers and planners that commonly arise. These are:

- A difficulty for planners in obtaining the right compliance data in a consistent format
- A lack of clarity on the part of developers about how to comply and what to submit
- A difficulty for planners in verifying performance data
- A need for data re-entry by developers and planners
- A difficulty in updating the compliance checking process to reflect changes in technology and best practice
- A difficulty in keeping track of and reporting on all compliance data in order to be able to monitor the overall impact of policy

## 3.3 Resource implications

Most of the authorities interviewed said that the policy had not put an undue burden on DC case officers, although the majority of DC case officers had been required to attend a training session which was usually held in-house. This was because energy statements were typically processed by another officer within the local authority. The time taken for implementation varied between authorities as shown below:

- “Small time implication” per application for the DC Case Officer
- 20% of Environment and Sustainability Manager’s time
- 20% of Principal Policy Officer’s time
- 50% of Senior Planning Officer’s time
- 80% of Urban Design Officer’s time
- “Majority” of Planning Policy Officer’s time

## 3.4 Expertise required

All of the authorities that were spoken to required some sort of internal expertise for development and implementation of the policy i.e. external to the planning department, and this tended to be by using resources from the environment or sustainability departments within the Council. In Croydon, the Environment and Sustainability Manager is used to review energy statements submitted by developers.

External expertise was also required to provide the necessary training to DC officers in most cases, and some of the officers interviewed had used their local Energy Efficiency Advice Centre to provide assistance.

Milton Keynes had used external consultants in development of their policy to assess the viability and cost of meeting it. Woking also uses external consultants in complex cases to provide modelling assistance to assist with tests of viability.

In many cases, external consultants were used by developers to assist in preparation of their energy statement.

## 3.5 Negotiation with developers

The general consensus from the councils interviewed was that some developers were more cooperative than others with compliance of climate change policy. A common theme that came up was that developers had a lack of knowledge and required assistance; this could lead to resentment of the policy by the Developer. Most of the authorities spoken to overcame this by referring them onto an external consultant. Once they had been through the first development, most developers found that it was "just part of the process".

Croydon has had cases where the developer tried to offset the renewable energy policy against affordable housing but in these cases the Council did not relax the policy.

Milton Keynes' Carbon neutral policy is only implemented where it does not deem the development unviable. In most cases, developers have used this clause to prove that the development would be unviable if implemented in full and therefore the policy has been relaxed.

Tandridge has had two cases where the developer has appealed against the policy, both have which have been dismissed. There is further information in appendix 1.

## 3.6 Monitoring and Reporting

Even those authorities that are seen as 'leaders' with regards to planning policy and climate change tended to have an ad hoc approach to monitoring and reporting on the outcome of their policies, with all but two not compiling any data. Milton Keynes and Tandridge compiled data in a spreadsheet and database respectively, and found this approach time consuming. In Milton Keynes' case this has carbon dioxide reduction assigned to each measure.

## 3.7 Conclusion

Having reviewed good practice from other authorities it can be seen that there is a considerable range across both the policy criteria and also how policy is being implemented. As the majority of Climate Change policy is relatively new and innovative, this is not surprising. However, there are a number of clear conclusions that can be drawn:

- Implementation of a Climate Change policy will have a resource implication for the Council. This may be in the planning department but expertise is likely to be required from other departments in the council or external consultants
- It is probable that developers will require assistance in preparation of an energy statement to demonstrate compliance with Climate Change policy. The Council may refer the developer to external consultants who are able to provide this service
- There is a lack of structure for planning authorities to monitor and report on Climate Change policy in even the leading authorities

# 4 Sustainable Energy and Climate Change Adaptation options

To reduce carbon emissions from new development it is recommended that the energy hierarchy shown in Figure 2 is followed.

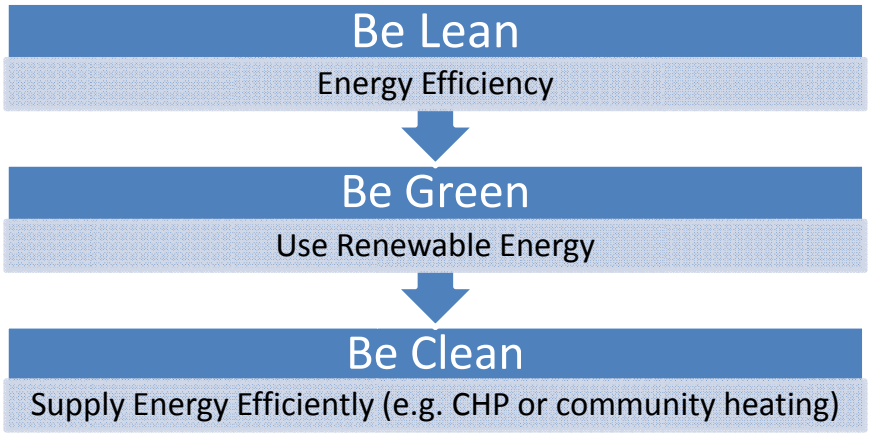



Figure 2: The Energy Hierarchy

'Be Clean' relates to Sustainable Energy technologies such as CHP and community heating that, while reducing carbon, still have carbon dioxide emissions associated with them. Renewable energy on the other hand is deemed to be carbon free.

The review of technologies in this chapter covers energy efficiency, renewable and sustainable energy technologies and adaptation design measures listed below in table 6.

Table 6 Overview of technologies included in review

| | |
|---|---|
| **Energy Efficiency** | • Reducing energy demand through energy efficiency technologies<br>• Energy efficient design |
| **Renewable Energy Technologies** | • Wind<br>• Solar Photovoltaics<br>• Solar Thermal<br>• Ground Source Heat Pumps (Proportion of renewable energy)<br>• Air Source Heat Pumps (Proportion of renewable energy)<br>• Biomass |
| **Sustainable Energy Technologies** | • CHP<br>- Micro CHP<br>- Stand alone commercial CHP<br>- CHP combined with district heating and private wire<br>• Community Heating |
| **Climate Change Adaptation Options** | • Natural Ventilation and Cooling<br>• Sustainable Drainage Systems (SUDS)<br>• Green Roofs<br>• Flood Resilient Construction<br>• Water Conservation Measures<br>• Rainwater harvesting and storage systems<br>• Greywater re-use |

It should be noted that the technologies covered are those that are deemed viable or appropriate for Crawley to promote to developers at this time. Unproven technologies, inappropriate technologies and those not commercially available have been excluded from the analysis and include Tidal, Geothermal, Mini-hydro, Micro CHP, Air Source Heat Recovery Pump Systems and Hydrogen fuel cells, with further detail of rationale for exclusion shown in table 8 on page 50.

## 4.1 Energy Efficiency

Energy efficiency gains are best achieved by considering the opportunities at the earliest stage in the design process. Designing in energy efficiency at the outset is more cost effective and yields higher savings than changing the design at a later stage. The Building Regulations (England and Wales) 2006 set the national standards that must be met for new and refurbished buildings in terms of heating, cooling and lighting. This does not include energy used in appliances and processes within the building. The key technologies are identified below.

Energy efficiency technologies include:

- Automatic controls
- Condensing boilers (although these are now mandatory in domestic application)
- A-rated appliances – for example refrigerators, clothes washers and dryers, dishwashers and IT equipment are the greatest energy use appliances
- Airtight building design
- Energy efficient lighting and controls
- Building Energy Management Systems (BEMS)
- Enhanced insulation
- High performance glazing
- Variable speed pumps and fans
- Mechanical ventilation with heat recovery

Energy Efficient Design includes:

- Passive solar design
- Natural ventilation
- Natural daylighting

## 4.2 Renewable Energy Technologies

Using renewable energy sources ensures that no net carbon dioxide is released when energy is produced and helps to mitigate the effects of climate change. Renewable energy sources can be available on-site (such as wind and solar energy) or produced locally (such as biomass). Where renewable energy is produced locally, its use ensures increased security of supply and can result in greater energy price stability, making it easier to predict future energy costs.

The presence of renewable energy generating equipment such as solar panels or wind turbines also provides a strong visual link between energy generation and consumption. This can increase awareness among consumers to help to encourage greater commitment to more efficient use of energy.

The costs included below are guideline figures and are taken from ecsc's CPlan software. Grants for renewable energy installations are available for householders, community organisations, schools, the public, the not-for-profit sector and private businesses.

### 4.2.1 Wind

Wind will turn the blades on a turbine and this turns a rotor, which generates electricity. There are two main types of turbine: horizontal (shown in Figure 3) and vertical axis.

Figure 3: A 2.5kW wind turbine at Ringmer Community College, East Sussex (ecsc)

#### *4.2.1.1 Benefits*

The average annual output of a 1.5kW turbine is approximately 2,200kWh/yr, assuming windspeed of 4.5m/s. This sized system would provide annual energy savings of approximately 2,200kWh/yr. The energy produced by a wind turbine would replace electricity, so the $CO_2$ savings of a 1.5kW turbine are approximately 946 kg.

#### *4.2.1.2 Potential Problems*

There are potential visual impacts, noise and conservation issues associated with wind turbines. It is also necessary to consider if a site is within or adjacent to a conservation area or an Area of Outstanding Natural Beauty. The structural strength of the building also needs to be considered if a roof mounted wind turbine is to be installed.

#### *4.2.1.3 Economic Impacts*

Systems of 1.5kW (building mounted) and 6kW cost approximately £5,000 and £33,000 respectively. This includes all components and installation. There is an additional cost associated with servicing and maintaining a wind turbine, which can vary depending on the size of the turbine. The average lifetime of a wind turbine is approximately 20-25 years. Excess electricity can be sold back to the grid, but a contract with an electricity provider is required.

#### 4.2.1.4 Opportunities

Wind turbines are most effective at constant wind speeds above 6 m/s. The amount of electricity generated by a wind turbine is dependent on the direction and speed of the wind. The wind speed is influenced by the location within the UK, nearby buildings, trees or other structures and the height of the turbine above ground level. Professionals can conduct an assessment of the wind speed in the area to ascertain if there is a sufficient wind speed.

### 4.2.2 Solar Photovoltaics

Figure 4: Solar Photovoltaic Panels (www.solarcentury.co.uk)

Solar photovoltaic (PV) panels convert solar radiation into electricity. PV panels can be mounted directly onto a building or can be building integrated in the form of solar PV tiles or transparent PV panels where the PV is integrated into glass.

#### 4.2.2.1 Benefits

An array of 8-10 $m^2$ or 1kW peak[7] produces approximately 850kWh during a year, offsetting approximately 365 kg of $CO_2$ per year. $CO_2$ savings are based on the solar PV panels displacing electricity[8].

#### 4.2.2.2 Potential Problems

The visual impact of solar PV panels, especially on pitched roofs needs to be considered. Planning permission is not normally required if the PV panels do not project significantly beyond the roof slope. However, exceptions may apply for systems on listed buildings, in conservation areas or in Areas of Outstanding Natural Beauty.

It must be ensured that shade from surrounding obstructions such as trees or nearby buildings does not become a problem and that the roof is strong enough to withstand the weight of the Solar PV panels.

Ancillary equipment required includes an inverter that converts the DC current generated by the PV into AC that can be used in buildings to power lights and appliances.

#### 4.2.2.3 Economic Impacts

A solar PV system that produces 1kW peak will cost approximately £6,000. Solar PV panels will last approximately 20 to 25 years and the associated maintenance costs are relatively low.

#### 4.2.2.4 Opportunities

Solar PV panels need to be installed on an unshaded South-East to South-West facing roof for optimal performance. Panels can be installed on pitched roofs or mounted at an angle onto flat roofs. Solar PV tends to be best suited for sites with a high daytime demand for electricity e.g. schools, offices, retail stores.

[7] Solar PV panels are rated at the peak output i.e. the instantaneous maximum output that could be achieved with maximum sunlight.
[8] Electricity generation is more carbon intensive per kWh than gas.

### 4.2.3 Solar Thermal

Solar thermal panels use the heat of the sun to generate hot water. There are two main types of solar thermal panels: flat plate collectors and evacuated tube collectors.

Evacuated tube collectors tend to be more efficient, but they also tend to be more expensive. A solar thermal system usually includes a collector/panel, a pump to circulate the heat and a large cylinder/tank, where the heated water is stored.

Figure 5: Evacuated tube collectors (www.metaefficient.com)

Figure 6: Flat plate collectors (www.cat.org.uk)

#### *4.2.3.1 Benefits*

On average the annual output of an evacuated tube collector is approximately 550kWh/$m^2$, saving approximately 105 kg/$m^2$ of $CO_2$ per year. $CO_2$ savings are based on the solar thermal panels displacing gas-heated hot water. If displacing hot water heated using electricity then the $CO_2$ savings will be higher.

#### *4.2.3.2 Potential Problems*

As with solar PV panels, the visual impact of solar thermal panels, especially on pitched roofs need to be considered. Planning permission is not normally required if the solar collectors do not project significantly beyond the roof slope. However, exceptions may apply for systems on listed buildings or in Areas of Outstanding Natural Beauty.

It must be ensured that shade from surrounding obstructions such as trees or nearby buildings does not become a problem and that the roof is strong enough to withstand the weight of the solar thermal panels.

#### *4.2.3.3 Economic Impacts*

A solar thermal evacuated tube size of 3$m^2$ (suitable for a typical domestic installation) costs approximately £3,000, which includes the capital cost and installation cost. The lifespan of an evacuated tube is approximately 20 to 25 years. The maintenance costs associated with solar thermal panels are low, as they only need to be cleaned and checked by the householder annually.

#### 4.2.3.4 *Opportunities*

Solar thermal collectors need to be installed on an unshaded South East to South West facing roof for optimal performance. Collectors can be installed on pitched roofs, vertically or mounted at an angle onto flat roofs. It is recommended that the cylinder be located as close to the collectors as possible to reduce heat loss. As solar thermal collectors provide hot water they are more suitable for buildings with a significant hot water demand e.g. residential buildings and catering and leisure facilities

### 4.2.4 Ground Source Heat Pumps

A ground source heat pump (GSHP) extracts low grade heat from the ground (via coils buried in the ground) and the heat is pumped around a building to provide space heating. A heat pump raises the temperature to the point where it can provide space heating or hot water. GSHPs require an input of electrical energy to drive the pumps. The difference between the energy input and heat output is expressed at the heat pump's coefficient of performance (COP).

There are three types of closed loop system:

- Horizontal
- Vertical
- Lake/Pond

These are illustrated in Figure 7.

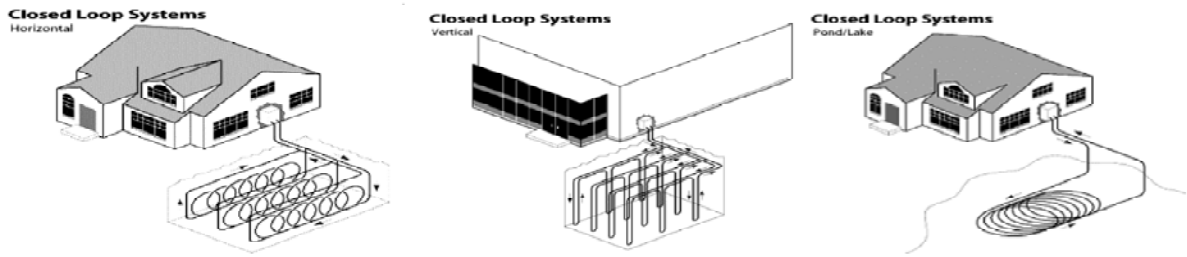



Figure 7: Ground Source Heat Pumps (www.eere.energy.gov)

Some Heat pumps can use a reverse cycle system that does both heating in winter and cooling in summer. This can be one of the most cost effective options in non-domestic buildings such as offices.

#### 4.2.4.1 *Benefits*

The average annual output of an 8kW GSHP is approximately 14,000kWh of heat. The associated net annual $CO_2$ savings of a GSHP is 1,300kg, which is based on the GSHP replacing a gas heating system and also considers the electricity used by the GSH unit to power the pump. For each kW of electricity used to power the pump, 3-4 kWs of heat is typically produced.

Visual impact of a GSHP is minimal as the coils are underground. Horizontal systems can be installed under gardens, playing field, car parks or any open land.

#### 4.2.4.2 *Potential Problems*

In horizontal systems, large quantities of adjacent land are required involving considerable excavation. If vertical boreholes are drilled then a licence may need to be issued by development control and the Environment Agency should be consulted.

GSHPs produce about the same amount of noise as a fridge (approximately 50 decibels) and it may be preferable to install them in a utility room or at the back of a garage in a residential property or a plant room if they are installed in a commercial property.

In order to install the coils, the soil needs to be free of rocks, tree roots and other obstructions, such as pipes, sewers and cables. An 8kW heat pump requires around 300m$^2$ of space for the excavation of two 50 m long trenches which contain horizontal heat absorption coils.

If a development only proposes a minimum standard of energy efficiency, lacks under floor heating, and proposes to use the heat pump to supply domestic hot water as well as space heating, the efficiency of the system will be greatly reduced. This may lead to higher carbon emissions and fuel costs than an equivalent high performance condensing boiler. Domestic installed GSHPs are most cost effective when installed in well insulated properties located off the gas network (often in rural settings) where oil or electricity is being displaced.

#### *4.2.4.3 Economic Impacts*

An 8kW GSHP could service a property that is approximately 160m$^2$ (a large house) and would cost in the region of £13,000 fully installed. This does not include the cost of the heating system, for example underfloor heating or low temperature radiators. Service and maintenance costs associated with GSHPs are similar to a conventional boiler. The pump will use some electricity to operate, so this should be taken in to consideration in any calculation of potential cost savings. GSHPs have a life span of 20 to 25 years.

#### *4.2.4.4 Opportunities*

The GSHP coils are usually installed horizontally and the length and amount of trenches required varies depending on the size of the GSHP. An average detached house would need two trenches approximately 40-50 metres long and 1-3 metres deep, and therefore this type of system is most suited to buildings with a large area of adjacent open space and is rarely suitable for town centre locations. If ground area is limited, boreholes can be drilled to install coils vertically, but this may be more costly.

GSHPs operate most effectively when used in conjunction with a low temperature distribution heating system, such as underfloor heating or low temperature radiators. GSHPs are primarily suited to off-gas network new build properties (either residential or commercial).

### 4.2.5 Air Source Heat Pumps


Figure 8: Air Source Heat Pump (www.solheat.co.uk)

The principle of an Air Source Heat Pump (ASHP) is similar to that of a ground source heat pump except that it converts the energy from the air rather than the ground.

#### *4.2.5.1 Benefits*

The average annual output of an 8kW ASHP is approximately 15,000 kWh. This has associated $CO_2$ savings of 1770kg assuming that it is displacing a gas heating system and also takes into account the electricity used by the pump. For each kW of electricity used to

power the pump, three to four kW of heat is produced.

#### 4.2.5.2 Potential Problems

An ASHP has a maximum noise level of 63.8 decibels (slightly louder than normal conversation) therefore it is preferable that they are located in an area that is not frequently occupied, such as outside. In housing developments, care must be taken in positioning ASHP to avoid noise disturbance to neighbouring properties.

Although this technology has the advantage of being easier and cheaper to install when compared to GSHPs as they require no excavation, the efficiency of air source heat pumps varies with external air temperature which fluctuates more widely than ground temperature.

#### 4.2.5.3 Economic Impacts

An 8kW ASHP has a capital cost of approximately £13,000 fully installed, and would be suitable for a large house. There are minimal maintenance costs associated with it.

#### 4.2.5.4 Opportunities

As with GSHPs, ASHPs are primarily suited to:

- Off gas network properties
- Properties with underfloor heating

### 4.2.6 Biomass

Biomass refers to the use of a wide variety of organic material such as wood, straw, dedicated energy crops, sewage sludge and animal litter for the generation of heat, electricity or motive power. Biomass is a low carbon fuel source because the carbon dioxide released when biomass is converted for energy purposes is largely offset by that absorbed by the organic material during its growth. With appropriate management this can be recaptured with new growth.

Figure 9: A biomass boiler fuel feed system (ecsc)

Biomass heating plants can come in a wide range of sizes from a few kWs to many MW of heat. For biomass CHP, sizes tend to range from around 1MW to many MW of electrical generation capacity. At the smaller sizes, fuel is usually supplied as wood pellets or wood chips.

#### 4.2.6.1 Benefits

A 20kW boiler has an average annual output of approximately 26,400 kWh of heat and would save approximately 13,860 kg of $CO_2$. The $CO_2$ savings are based on the heat generated by the biomass boiler displacing heat generated via a gas-fired boiler and a boiler efficiency of 80%.

#### 4.2.6.2 Potential Problems

It is likely a flue will be required when installing a biomass boiler and planning permission is often required. The frequency of biomass fuel delivery needs to be considered, as this can lead to increased transport movements. Consideration needs to be given if the biomass boiler is to be installed is in a listed building or in an Area of Outstanding Natural Beauty.

It is necessary to comply with the Clean Air Act (1993), which states that wood can only be burnt on exempted appliances. There are also some other regulations that relate to the installation of solid fuel heating systems that would require compliance including BS EN 303 Part 5 (1999).

Ash disposal and de coking arrangements need to be considered and there needs to be a reliable supply of wood fuel in the area. If an automatic wood fuel feeding system is not being used, it is necessary to consider how the wood fuel will be fed into the boiler.

#### *4.2.6.3 Economic Impacts*

The cost of biomass boilers varies depending upon the type of fuel used in the boiler i.e. wood chip, pellet or logs but would be in the region of £6,500. The cost includes the installation, flue and commissioning and is based upon an automatic feeding boiler. A boiler with a manual log feeder would be slightly cheaper, but the logs would need to be hand fed into the boiler. Woodfuel has to be bought to generate heat from the boiler, so there is a cost implication over the lifetime of the boiler. The cost of biomass fuel varies depending upon the supplier and the delivery costs. A biomass boiler usually requires an annual service and the cost is dependent upon the size of the boiler. Biomass boilers have a life span of approximately 15 to 20 years.

#### *4.2.6.4 Opportunities*

Biomass boilers can be installed in virtually any sort of development as long as the following key considerations are taken into account:

- Space for fuel storage
- Space for the boiler
- Access to a good quality supply of fuel
- Access to fuel storage for deliveries
- Space for thermal storage

## 4.3 Sustainable Energy Technologies

Sustainable energy technologies provide very efficient use of fuels to generate energy with lower levels of carbon emissions when compared with conventional national grid supplied gas and electricity.

### 4.3.1 Combined Heat and Power

In a traditional power station, a generator is used to produce electricity with heat as a by-product which is released to the atmosphere via cooling towers. In a combined heat and power unit, the heat released by the generation of electricity is used effectively, to provide hot water that can be utilised in central heating (and in some cases the excess heat in used to provide comfort cooling via absorption chillers[9]). As CHP is an efficient process making use of what would otherwise be waste heat, it has lower $CO_2$ emissions associated with it and is therefore a sustainable energy technology.

CHP units can be fuelled by:

- fossil fuels including natural gas or oil
- biofuels (meaning the technology is renewable as well as sustainable)

CHP units can be installed at a number of scales:

- Micro CHP – Primarily aimed at the domestic market, micro CHP units are a new technology that range in size from 0.5kW upwards. At present, micro-CHP units are not available for purchase in the UK and are expected to be launched in 2008-2009.
- Stand alone commercial CHP – CHP units for commercial buildings are a tried and tested technology and vary in output depending upon the size of the building.
- District CHP– Commercial sized CHP units can be used in conjunction with district heating and private wire networks[10] where they provide heat and power locally usually to a mixed use development. Associated infrastructure in the form of pipes to carry hot water and private wires networks are required. A typical system suitable for district heating is shown in Figures 10 and 11.

CHP is a tried and tested technology, with many schemes operating in the UK as well as on the continent. The latest figures available relate to 2005 where CHP generated approximately 28,000 GWh, nearly 7% of the total UK electricity generation. The majority of CHP units are fuelled by natural gas (67% in 2005) but new developments have opened up opportunities for other fuels including biomass[11].

Greenwich Millennium Village in London was one of the first major private housing developments in the UK to utilise CHP for heating and power, providing a reduction of primary energy use of approximately 65%[12].

[9] If there is a low heat demand in summer months, excess heat can be used in an absorption chiller to provide cooling. This therefore evens out heat demand over the year. This is often referred to as trigeneration or Combined Cooling Heat and Power (CCHP) i.e. heat, power and cooling.
[10] Private wire is a dedicated network of wires i.e. not part of the national grid.
[11] http://www.chpa.co.uk/
[12] http://www.greenwich-village.co.uk/pdfs/GMV_FS4a.pdf

Further detailed information on CHP is shown below. Please note, as Micro CHP units are not yet currently available in the UK the details below relate to commercial sized CHP units.

Figure 11 Flue from the CHP unit shown in Figure 11 (ecsc)

Figure 10 A 1.3MW CHP unit in Woking (ecsc)

#### 4.3.1.1 Benefits

The higher efficiency of a CHP unit means that there are lower carbon dioxide emissions from a CHP unit than the alternative of supplying heat from a gas-fired boiler and electricity from the national grid. Generating electricity near its use also reduces the loss of power which can occur from transmitting electricity over the national grid from a power station located a long way from the point of electricity use. If biomass is used as a fuel source, it is classified as carbon neutral.

#### 4.3.1.2 Potential Problems

A flue will be required when installing a CHP unit and planning permission is often required and it is necessary to comply with the Clean Air Act (1993). For larger units, there may also be noise and vibration issues that will require consideration.

Back up boilers and connection to the national grid electricity is also necessary in order to provide uninterrupted energy supply during periods of planned maintenance.

If CHP is used in combination with district heating and private wire networks, then considerable investment will be required for associated infrastructure. A network of pipes to carry hot water and underground wires to transmit electricity would need to be fitted to connect to each building on the network. This may cause inconvenience where existing infrastructure e.g. roads is already in place.

#### 4.3.1.3 Economic Impacts

A 5.5 kWe electrical output / 12.5 kWe heat output CHP unit would be suitable for a small commercial installation. Current market prices are in the region of £10,000-15,000 and it is expected that annual savings due to the production of electricity are approximately £1,000-1,500[13].

[13] Data based upon the Baxi DACHS mini CHP http://www.baxi.co.uk/products/combined-heat.html

#### 4.3.1.4 Opportunities

CHP systems are most feasible where there is a significant and constant demand for heat. If used in combination with district heating networks, compact mixed use developments are preferable so that there is a balanced heat demand over the day and there are minimal transition losses. Where biomass CHP is used there must be an efficient supply of biomass, preferably locally sourced.

### 4.3.2 District Heating

District heating (sometimes referred to as community heating) uses a centralised boiler and a system of pipes that can be used to distribute heat within a localised region – be this a block of flats, development of houses or a mixed use development including commercial. By distributing the heat from a centralised boiler, district heating provides higher efficiencies than generating heat from individual boilers.

#### 4.3.2.1 Benefits

District heating should not have any adverse effect on the occupants of a building. Occupants will still be able to use a conventional radiator or under floor heating system to keep their home/office/etc warm. The conventional controls (i.e. programmer/timer, room thermostat and thermostatic radiator valves) will allow the occupants to control the times when the heating turns on and off and the temperature to which the home is heated. Hot water supplied by the district heating system will be supplied on demand, so turning a hot tap on will draw heat from the system and the occupant will therefore be able to get as much instant hot water as they want when they want it. In fact, the only noticeable difference in a dwelling heated by a district heating system is that there is no conventional boiler. Depending on the size and type of the development there may be a heat exchanger in each dwelling/office/etc., or there may simply be a heat meter. This has the benefit for the occupant of there being no need for a boiler and hot water cylinder, negating annual maintenance costs and health and safety risks, as well as providing more room for storage.

If used in conjunction with a private wire network, occupants will not notice any difference in the electricity supplied to their building compared to supply from the national grid. It will be at the same voltage (240 Volts) and frequency (50Hz) as the National Grid. In residential units, each individual dwelling or unit will still have an electricity meter, which will be used to monitor how much electricity is used and to calculate bills.

#### 4.3.2.2 Economic impacts

District heating is often used in conjunction with private wires that distribute the heat and electricity respectively from a CHP unit. This requires considerable capital investment and maintenance; the Woking CHP plant pictured in Figures 9 and 10 costs in the region of £4.2 million.

#### 4.3.2.3 Opportunities

To minimise distribution losses from private wire and community heating networks it is preferable that the development is as compact as possible and therefore new high density urban and town centre locations are ideal.

## 4.4 Climate Change Adaptation Options

A major consequence of Climate Change will be more extreme weather events; this study identifies three likely key scenarios which will require adaptive design in new developments in Crawley:

1. Elevated summer temperatures and an increased likelihood and severity of heatwaves;
2. Increased levels of winter rainfall and year round increased rainfall intensity leading to increased risk of localised flooding;
3. Reduced summer rainfall and risk of increased severity and duration of drought.

It is imperative that the planning system recognises these likely impacts and creates a built environment that is resilient to both our present and future climate. A review of adaptation methods is below.

### 4.4.1 Natural Ventilation and Cooling

With expected higher summer temperatures, buildings should be designed to reduce the need for active cooling (air conditioning) by reducing internal heat loads and utilising passive cooling measures such as solar shading, thermal mass and effective natural ventilation systems.

Figure 12: External shading to reduce internal heat loads (Woking BC)

Measures include:

- Shading devices such as blinds and external shading (often referred to as brise soleil), as shown in figure 12
- Surface treatments that reflect heat in the summer such as light coloured paints
- Regulating ventilation through the day and night in an intelligent way to maximise cooling potential
- Using materials with a high thermal mass such as concrete, stones and tiled floors that can soak up unwanted heat during the day

More detailed information can be found in the Adapting to Climate Change: a checklist for development document[14]

#### *4.4.1.1 Planning considerations*

Planners should consider the following:

- use of brise soleil can provide an attractive facade treatment as well as being functional
- passive ventilation is generally not well suited for deep plan buildings where through-ventilation of air is difficult to achieve

14 http://www.climatesoutheast.org.uk/downloads/TRCCG%20Checklist%20for%20Development%20Nov%202005.pdf

- in residential schemes, internal layout considerations can influence cooling e.g. placing bedrooms on cooler side of shallow plan buildings. However, there are limitations to the use of natural ventilation in urban areas e.g. crime/noise/air quality issues regarding open windows, especially at night

#### *4.4.1.2 Economic Impacts*

If an integral part of the design, the use of natural ventilation should be no- or low-cost to the development. There are likely to be savings to the occupant as the need for active air conditioning can be negated.

#### *4.4.1.3 Environmental Impacts*

Natural ventilation and cooling can negate the need for mechanical air conditioning and therefore save the capital cost, energy and $CO_2$ emissions associated with this.

#### *4.4.1.4 Technological Considerations*

If active cooling through air conditioning is required, care should be taken that the excess heat is not dumped where it will cause problems for other people or the environment. It might be possible that this excess heat could be used as an energy source. Where viable, air conditioning units should be powered from local renewable energy sources.

#### *4.4.1.5 Broad assessment of feasibility*

As the natural ventilation and cooling measures described above are by and large internal features of a building they are likely to be feasible in the majority of developments. They should be designed into the development as early as possible to keep costs minimal.

### 4.4.2 Flood abatement - Sustainable Drainage Systems (SUDS)

Sustainable Drainage Systems (SUDS) act to mimic natural drainage patterns and aim to manage and slow down surface water run off and release it to the natural water cycle. For larger developments this will involve managing flood risk at the catchment scale and considering storage areas for water such as balancing ponds as well as considering permeable pavements, or areas of gravel or grass to allow rainwater to infiltrate, which should be standard for all development.

#### *4.4.2.1 Planning considerations*

Developers should consider the use of existing natural features such as ditches and ponds to form part of the SUDS system, and minimise costs.

**Figure 13: Balancing ponds at Holmes Close, Woking. These also act as an amenity asset. (Woking BC).**

Maintenance of the SUDS will need to be discussed with the developer early on in the planning process. The Environment Agency recommends that maintenance should be the responsibility of a publicly accountable body. This will require a legal agreement and may require a payment by the developer. The adopting body should be involved in the design process of the SUDS.

SUDS should be carefully considered for brownfield sites as there may be a risk of environmental

damage from land contamination through the mobilisation of contaminants.

#### *4.4.2.2 Economic Impacts*

The market value of homes can be increased if there is open water, such as a balancing pond in the vicinity, see figure 13. They may lead to cost savings to the developer for example by avoiding or reducing the need for gully pots or piped connections to distant outfalls. By managing the risk of flooding downstream in a catchment, savings can be made on associated flood defence costs.

#### *4.4.2.3 Environmental Impacts*

SUDS can have multi use benefits such as public amenity and wildlife improvements as well as dealing with wider water catchment issues such as flooding, water quality and resource risks.

#### *4.4.2.4 Technological Considerations*

Siltation of the SUDS should be considered and appropriate measures will need to be taken during construction and during use. The soil permeability and hydrology of a development will need to be assessed to determine which SUDS techniques are appropriate. In areas where the soils are highly permeable consideration should be given to the lining of wet ponds. In areas where the soil is of particularly low permeability infiltration techniques may be less effective.

#### *4.4.2.5 Broad assessment of feasibility*

The choice of appropriate SUDS for a development will be dependent upon a number of factors:

- Pollutants that are present in run-off
- The size of and drainage strategy for the catchment area
- The hydrology of the area and infiltration rate of the soil
- Groundwater Source Protection Zones
- Contaminated land

For sites larger than 5 hectares, large scale ponds and wetlands are generally more feasible with infiltration trenches, swales, filter strips and porous pavements being appropriate for all sites. An effective SUDS usually incorporates a mix of mechanisms.

### 4.4.3 Flood abatement – Green Roofs

Figure 14: A green roof (www.inhabitat.com)

Green roofs are roofs that comprise of vegetated material, or roofs that have vegetated spaces. The most commonly used vegetation is sedum.

There are two types of green roof:

1. Extensive – these have fewer drainage layers and a simpler construction, meaning they are cheaper and more suitable for larger roofs where weight is a greater consideration
2. Intensive – these are more traditionally regarded as roof gardens and are primarily designed for aesthetic rather than economical value. It has a more complex drainage system than an extensive green roof.

#### 4.4.3.1 Planning Considerations

There are some maintenance issues associated with green roofs, especially in the early stages of establishment. For new developments, it should be clear who the maintenance responsibility lies with and where possible this should not be passed on to the homeowner (in the case of residential). Unless a manicured appearance is required, there will be very little maintenance after years one and two[15].

As with all technologies, green roofs should be considered as early as possible in the design of a building.

#### 4.4.3.2 Economic Impacts

A whole life cost analysis of green roofs[16] concluded that green roofs are more cost effective than traditional exposed roofs. Although capital and maintenance costs were higher, savings were made through energy reduction costs for the properties.

#### 4.4.3.3 Environmental Impacts

Green roofs have multiple environmental benefits:

- Reducing flow rates and stormwater runoff, reducing flood risk
- Providing habitat, improving biodiversity
- Providing an outdoor living space in warmer weather
- Improving the water quality of rainwater runoff
- Improving the insulation of a building, regulating building temperature and saving $CO_2$. It is estimated that a 1000$m^2$ green roof can save 245 tonnes over its lifetime[17]
- Increasing the lifespan of a roof
- Converting carbon dioxide to oxygen through photosynthesis

#### 4.4.3.4 Technological Considerations

In should be ensured that the roof of the building is strong enough to take the extra weight associated with a green roof. The load values for a saturated intensive green roof can be as much as 500kg/$m^2$.[18]

[15] http://www.livingroofs.org/livingpages/barmaintenance.html
[16] http://www.livingroofs.org/NewFiles/Living%20roof%20Bridgewater%20003.pdf
[17] http://www.livingroofs.org/NewFiles/Living%20roof%20Bridgewater%20003.pdf
[18] http://www.livingroofs.org/livingpages/barstructural.html

### 4.4.4 Flood Resilient Construction

Where development is required on floodplains it is important that construction is as resilient as possible to the flooding that may occur. The Association of British Insurers has published guidance on flood resilient construction techniques[19] that works on the principle of limiting damage caused by floodwater once it enters a property; this is most practical approach as it is difficult to keep water out of a property for more than a few hours.

The simplest approach is to move the functional parts of the property above the likely level of flooding and use the lower levels for uses such as car parking.

If the ground level needs to be used as functional living space then there are a number of low-cost measures that can be designed into the building such as:

- Tiled concrete floors instead of wood
- Plastic or ceramic kitchen and bathroom units instead of chipboard
- Lime-based or waterproof render on walls instead of gypsum plaster
- Service meters, boiler, and electrics well above likely flood level
- One-way valves in pipes to prevent sewage back-up into property

#### *4.4.4.1 Planning considerations*

There are unlikely to be any planning considerations associated with the measures above.

#### *4.4.4.2 Economic Impacts*

Many of the measures to make a building flood resilient are no or low cost such as ensuring that electrics are above likely flood level. However, they should be designed in early to the development as they are expensive to retrofit.

If a property is subject to a flood then it is likely that it will be significantly cheaper to 'make right' if there are flood resilient measures installed than if not.

#### *4.4.4.3 Environmental Impacts*

Flood resilient measures will ensure that a property is able to cope better with the increased flooding that is likely to increase as a result of Climate Change.

#### *4.4.4.4 Technological Considerations*

The technological considerations depend upon the measure being installed. It should be ensured that all measures are appropriate for the use of the building.

#### *4.4.4.5 Broad assessment of feasibility*

As the flood resilient measures described above are by and large internal features of a building they are likely to be feasible in the majority of developments. They should be designed into the development as early as possible to keep costs minimal.

### 4.4.5 Water Efficiency

When considering water efficiency measures, there is a simple hierarchy that can be followed to ensure maximum benefit for the investment. This is illustrated in Figure 15 15.

[19] https://www.abi.org.uk/display/File/Child/554/Strategic_Planning_for_Flood_Risk_thamesgateway.pdf

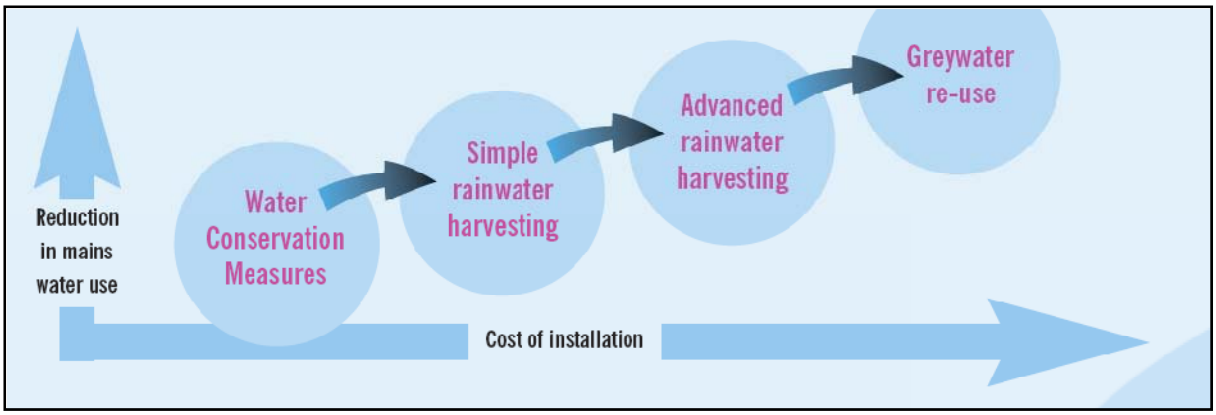



Figure 15: Investment sequence for water conservation and recycling measures (Woking BC).

The components of the water efficiency hierarchy are analysed in more details below.

### 4.4.6 Water Conservation Measures

Water efficient fittings in new development can be low-cost and save significant quantities of water. The Environment Agency has published a series of fact cards on Conserving Water in Buildings[20].

Consideration should be given to:

Water efficient toilets – dual-flush and low-flush toilets can save more than half of the water used in flushing toilets. The most effective retrofit solution is to use a cistern displacement device such as a 'water hippo' that lowers the water volume of the cistern.

Domestic appliances – washing machines typically account for 14 per cent of water use in the home and therefore a water efficient model should be fitted as standard

Taps – spray taps on handbasins can typically save up to 80 per cent of the water and energy used with standard pillar taps. Aerated taps can also be used to reduce water usage.

Urinals – waterless urinals that use no water, other than for daily cleaning, are now widely available and should be installed as standard.

Waterless toilets –the most common form of a waterless toilet is the composting toilet. It is unlikely that a waterless toilet would be economic purely as a water saving measure but they are ideal for rural new-build projects where the prices become comparable with conventional systems that would require on-site drainage.

Showers and baths – although showers generally use less water than having a bath, power showers can use more water than a bath in less than five minutes. Thermostatic mixer valves have a calibrated dial that allows temperature to be set from experience and therefore reduces the time taken to achieve the correct temperature with a mixer on simple hot and cold tap controls. Water saver shower heads can also be used that create finer drops by introducing air into the flow.

Plumbing and heating design and management – water appliances in a building do not operate in isolation and by considering a building's plumbing as a whole, there is scope for further water and

[20] http://www.environment-agency.gov.uk/subjects/waterres/286587/286911/548861/?version=1&lang=_e

energy savings. Ideally all water fittings should be grouped around the hot water source, with the most frequently used fittings being the nearest. This minimises the 'dead-leg' i.e. the amount of cold water that has to be drawn off each time a tap or shower is used. When designing pipe layout, hot water pipes should be placed above cold water pipes to reduce heat transfer.

#### *4.4.6.1 Planning Considerations*

There are few planning considerations associated with water conservation measures.

#### *4.4.6.2 Economic Impacts*

The cost of water conservation measures varies depending upon the measure being installed. Some of the measures described above are no-cost for example, plumbing and heating design and management. Others, such as water efficient toilets, have a very low marginal cost.

Cost savings will be made through water savings in buildings that have water meters installed.

#### *4.4.6.3 Environmental Impacts*

For minimal investment the associated savings are high. Fitting spray taps for example can save up to 80% of the water and energy used in filling hand basins and installing dual-flush and low-flush toilets can save more than half of the water used for flushing toilets.

#### *4.4.6.4 Technological Considerations*

The technological considerations depend upon the measure being installed. It should be ensured that all measures are suitable for the use of the appliance e.g. spray taps will be less effective if they are used in sinks which are filled regularly such as the kitchen sink if it is used for washing up dishes.

#### *4.4.6.5 Broad assessment of feasibility*

As water conservation measures are by and large an internal feature of a building, all of the measures listed above should be feasible in the majority of developments. They should be designed into the development as early as possible to keep costs minimal.

### 4.4.7 Rainwater harvesting and storage systems

A rainwater harvesting system typically collects water from the roof of a building and holds it in storage tanks for uses such as toilet flushing, irrigation or car washing (i.e. non-potable uses).

**Figure 16: Linked rain barrels storing rain water (www.harvesth2o.com)**

#### *4.4.7.1 Planning Considerations*

Planning permission is not required for a rainwater harvesting system, but as with all technologies it is preferable that they are built into the design of a building as early as possible.

#### *4.4.7.2 Economic Impacts*

Using a case study from Southampton University[21], a system that has an estimated usage of 1690 litres/day has a capital cost of £4,325. Using Southern Water 2006 tariffs this gives a payback period of 5.3 years.

[21] http://www.rainharvesting.co.uk/pages/case_studs/cs_studs3.html

#### 4.4.7.3 Environmental Impacts

Rainwater harvesting systems reduce water demand and therefore ease pressure on water supply. They can also reduce the risk of flooding in storms by storing and buffering run off to the drainage system. A 100m$^2$ roof can catch 500 litres of water from rainfall of just 5mm[22].

#### 4.4.7.4 Technological Considerations

A rainwater harvesting system will require some maintenance including cleaning of the filter. This should not be an onerous task.

#### 4.4.7.5 Broad assessment of feasibility

Rainwater harvesting systems are most economical when they are being integrated into new build developments, particularly commercial developments or schools that have large roofs, a high non-potable water demand and a metered supply[23].

### 4.4.8 Greywater re-use

Greywater includes water from baths, sinks and washing machines that can be reused for toilet flushing (after filtration and disinfection).

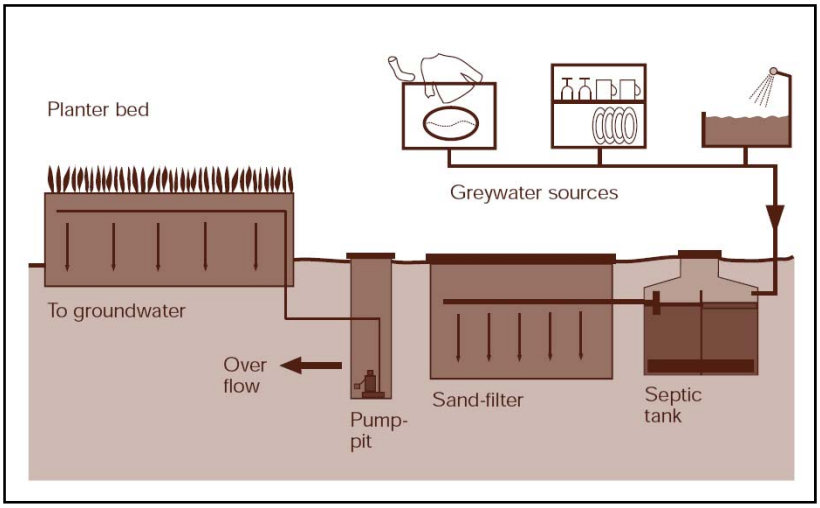



Figure 17: Advanced greywater treatment (www.tcpa.org.uk)

#### 4.4.8.1 Planning Considerations

For a simple residential system, there are few planning considerations. For advanced greywater treatment such as shown in figure 17, planning permission may be required for the septic tank.

#### 4.4.8.2 Economic Impacts

For a medium sized house (with a room area of 90m$^2$ and assuming four person occupancy) a greywater recycling unit would cost approximately £1,900[24]. There will also be maintenance costs associated with the system. If the property is on a water meter this cost can be offset by using less water from the utility company.

[22] http://www.tcpa.org.uk/downloads/20070523_CCA_lowres.pdf

[23] http://www.cat.org.uk/information/catinfo.tmpl?command=search&db=catinfo.db&eqSKUdatarq=20020925160005

[24] http://www.water.support.co.uk

#### 4.4.8.3 Environmental Impacts

The use of a greywater system reduces the use of potable water and the energy and environmental costs associated with its treatment. For a medium sized house with a roof area of 90m$^2$, it is expected that the volume of greywater that would be available for recycling is approximately 50,000 litres annually, which would meet the total demand for W.C. flushing[25].

#### 4.4.8.4 Technological Considerations

Greywater recycling systems require significant treatment to avoid bacteria build up, and maintenance to the system will be required to ensure the filtration and disinfection systems are working correctly.

#### 4.4.8.5 Broad assessment of feasibility

As with rainwater harvesting systems, greywater recycling systems are most economical when they are being integrated into new build developments, particularly commercial developments or schools that have large roofs, a high non-potable water demand and a metered supply.

## 4.5 Conclusion

Every development has unique demand characteristics that will influence the range of sustainable energy and climate change adaptation technologies suited to it. Whilst a sustainable energy feasibility study should be completed for each development on a case-by-case basis, an overview of the feasibility issues associated with a number of development types is shown below in table 7. In addition, the feasibility of CHP and community heating and private wire should also be considered in mixed use developments and larger scale single use schemes.

**Table 7: Broad feasibility of sustainable energy and Climate Change adaptation options by development type**

| |
|---|
| **Offices and Industrial Buildings**<br><br>– **High daytime electricity demand**<br>– **Summer cooling and winter heating demand**<br>– **Relatively low water demand for offices, some industrial buildings may have significant water demand** |
| • Energy efficiency measures to reduce the electricity demand should be considered such as energy efficient lighting and appliances<br>• Ground source heating and cooling is likely to be appropriate to meet the annual heating and cooling demand of the buildings<br>• Wind turbines or Solar photovoltaic panels are suitable for contributing towards the daytime electricity demands of the buildings<br>• Solar Thermal is unlikely to be appropriate as hot water demand is likely to be low<br>• Water conservation measures such as water efficient toilets and spray taps should be considered<br>• If there is a large flat roof, rainwater harvesting or a green roof may be feasible |
| **Single dwelling domestic**<br><br>– **Peak heating and electricity demand in early morning and evening**<br>– **Domestic hot water demand** |

[25] http://www.water-support.co.uk

| |
|---|
| • Energy efficiency measures to reduce the electricity demand should be considered such as energy efficient lighting and appliances<br>• Solar Thermal is likely to be appropriate to meet a proportion of the hot water demand<br>• Biomass boilers or ground source heat pumps to meet heating demand are likely to be feasible<br>• As the daytime electricity demand is low, solar photovoltaics are likely to be less feasible<br>• Where sufficient wind resource exists, wind turbines can generate useful amounts of electricity during times of peak electricity demand<br>• Water conservation measures such as water efficient toilets and spray taps should be considered |
| **Larger scale development of flats and houses**<br><br>– **Peak heating and electricity demand in early morning and evening**<br>– **Domestic hot water demand**<br>– **Constant power requirement for communal and outside areas**<br>– **Significant demand for water** |
| • Energy efficiency measures to reduce the electricity demand should be considered such as energy efficient lighting and appliances<br>• For larger developments there is the opportunity to use shared infrastructure and consider communal heating and powering solutions e.g. solar thermal or biomass. However if this is not appropriate individual solutions suggested for single dwellings still apply. If communal solutions are considered, ownership of equipment and payment mechanisms for heat and power need to be properly resolved<br>• Water conservation measures such as water efficient toilets and spray taps should be considered<br>• SUDS with balancing ponds is likely to be appropriate in a larger development |

# 5 Delivery mechanisms

The Nottingham Declaration Action Pack[26] is an online resource that was developed to support local authorities in action on Climate Change from starting to address the challenges through to reviewing implemented plans. The Action Pack identifies three main roles of a local authority in responding to Climate Change, namely as:

- An estate manager – direct action on a Council's own estate to reduce emissions and make sure that the estate has Climate Change adaptation measures in place. This also includes a Council's role as a major employer, which it can use to influence change
- A service provider – by providing services such as waste and planning with climate change in mind, a Council can have a significant impact on Climate Change mitigation and adaptation
- A community leader – working in partnership with the community, a Council can use its influence to facilitate wider change in the community.

For action in all of these areas there are mechanisms in place that can assist a Council in delivery. These are detailed below.

## 5.1 Energy Services Companies (ESCOs)

It is not possible to provide a standard definition of an ESCO; as described by the London Energy Partnership's report *Making ESCOs Work*[27], they "can be whatever those desiring such an entity want it to be". In terms of local authority operation of an ESCO perhaps the most significant benefit of ESCO creation is that the company is outside of the authority's revenue budget and therefore provides the council with an opportunity to take a more commercial approach to providing energy services without the statutory framework that it is generally subject to.

A fundamental feature of an ESCO is that it has a defined purpose, be this to facilitate the supply chain for biomass or a mechanism for supplying householders with energy efficiency measures. A common way ESCOs are used is to provide the structure for community energy projects such as CHP private wire and community heating schemes. The main issue when planning any community energy project (typically defined as the supply of energy to more than one building via a centralised system) is the high capital cost associated with setting up such a project and installing equipment. This is particularly true of projects that incorporate Combined Heat and Power (CHP) to serve a district heating and private wire system, due to the high costs associated with the energy centre and distribution infrastructure. These issues can be addressed and managed with the use of an ESCO.

### 5.1.1 ESCO Operation

Financing a project through an ESCO can allow the transfer of capital costs and risk of the project to a third party. An ESCO can typically carry out some or all of the following services:

- Design
- Finance
- Installation
- Operation & Maintenance

[26] http://www.nottinghamdeclaration.org.uk
[27] http://www.london.gov.uk/mayor/environment/energy/partnership-steering-group/docs/making-escos-work.pdf

- Monitoring and Emissions Reporting
- Customer Services and Billing

The setting up of an ESCO specifically for the delivery of an individual project can allow investment from interested parties (e.g. the developers or Council) and provide an associated return on investment for these parties. Alternatively the ESCO provider can have full ownership of the project and thus take on all of the financial risks.

An ESCO will typically consider a community energy scheme over the course of 20-30 years to allow capital costs of setting up the community energy scheme to be recouped and profit accrued. The ESCO can do this by running the community energy scheme, providing operation and maintenance to the project and selling energy to customers. The ESCO will purchase the fuel required to run any CHP or boilers servicing the project and will sell heat and electricity to the customers of the scheme. The prices of heat and electricity to consumers are usually guaranteed to be below the comparative prices charged by the leading energy suppliers in the area.

Where CHP is incorporated into the community energy scheme it will typically be used to provide the base energy demand of the scheme, with boilers and electricity from the national grid being used to provide top up and back up when required. At times when the electricity produced by the CHP engine is not required by the customers, it will be exported back to the national grid and will generate an additional income for the ESCO.

The benefits to customers of buying heat and electricity from a community energy scheme supplied by an ESCO are:

- No maintenance costs associated with individual boilers
- Dwellings do not have discrete boilers
- Prices of heat and power are guaranteed to be lower than the cost of supply from other local suppliers for the term of the project

### 5.1.2 How ESCOs work

The basic function of an ESCO is managing outsourced energy services which guarantee client agreed energy savings and qualitatively enhanced plant performance. The basic function can be extended to offering energy costs on par or below that of the clients existing energy supplier.

When contracted ESCOs nominally agree to be paid annually out of the savings amassed and only if the savings are made. ESCOs share the risks involved in capital spend through third party finance on energy service or energy efficiency measures by aggregating risk (cash flow, overheads etc.) over a number of long-term projects (costs subsumed into clients bill; projects refinanced by lower energy costs) and asset financing.

They are organisations with a strong combination of technical and financial expertise, and because incentivised, offer a unique vehicle for overcoming barriers associated with the cost and the application of systems led energy technologies. The ESCO retains ownership of the energy services equipment.

### 5.1.3 Opportunities

When considering the opportunities for setting up an ESCO the Council will need to consider the following issues:

- The overall purpose and objectives of the ESCO
- Type(s) of technology to invest in i.e. renewable energy, energy efficiency, sustainable energy or a combination of technologies
- Preferred Company form e.g. Limited Company, Limited Liability Partnership, Community Interest Company etc.
- Investment size dependant on the budget that the Council can allocate to the ESCO
- Financial investment criteria i.e. rates of return or payback periods
- The level of involvement the Council wants in the running of the ESCO

ESCOs for large scale projects e.g. combined heat and power can be set up as public/private joint ventures with equity finance from a financial partner or energy supplier or local authority equity (up to 20%) and loan finance. The Local Government Act (2000) allows local authorities to set-up suitable joint ventures as a basis for delivering asset and energy plan savings. This requires strong political leadership and consensus, as well as interdisciplinary and cross-departmental support.

Profits derived can be recycled (ring-fenced in a revenue and capital fund) into further energy efficiency measures, including bulk buying measures, or into the supply of site specific renewable energy; increasing local distributed energy capacity.

Additionally, an ESCO may provide the opportunity to improve the energy efficiency of existing housing stock through investment of profits generated through the supply of energy. For example, Woking's ESCO Thameswey has reinvested some of its profit from the generation and sale of renewable and low carbon energy in improving insulation standards of properties owned by older people. This has enabled both a reduction in the number of homeowners experiencing fuel poverty and reduced carbon emissions from the Borough's existing housing stock.

## 5.2 Section 106 agreements

Section 106 of the Town and Country Planning Act 1990 allows a local planning authority to enter into a legally-binding agreement or planning obligation, with a land developer over a related issue. Councils can use Section 106 agreements for a wide range of purposes, including: securing higher levels of energy efficiency, renewable energy and climate change adaptation measures; obtaining financial contributions to decentralised (e.g. CHP) energy infrastructure; setting up arrangements for monitoring the performance of renewable energy technologies; securing funding for local carbon offset schemes and contributing towards the LPAs costs of resourcing the assessment the energy/carbon implications of a scheme.

Section 106 agreements are often regarded as a catch all solution to ensure sustainable energy is properly implemented. However, the Council is likely to require skilled legal, financial and technical expertise to properly daft and negotiate the energy components of the agreements with prospective developers.

## 5.3 Heads of Terms in Land and Asset disposal agreements

Where the Council is selling land for development it is reasonable to use this as an opportunity to negotiate with the prospective developer with a view to obligating them to implement sustainable energy or climate change adaptation measures as part of the land sales agreement.

An example would be, in the case of CHP, requiring a developer to ensure that the development will be designed with the necessary infrastructure for a community heating and/or power network. This also provides the design team with an excellent opportunity to engage with potential ESCO providers at the beginning of the design process rather than part way through or at later stages.

This approach may ultimately result in lower receipts for the Council for sale of the land but will guarantee that a sustainable energy solution for the development occurs.

## 5.4 Funding streams for sustainable energy measures

The Energy Saving Trust holds a funding database[28] that can be used to identify potential funding streams. The following funding streams may be of particular relevance to local authorities:

### 5.4.1 Low Carbon Buildings Programme[29]

Run by the Department for Business, Enterprise and Regulatory Reform, the Low Carbon Buildings Programme provides grants for microgeneration technologies to householders, community organisations, schools, the public and not-for-profit sector and private businesses.

### 5.4.2 Salix Finance[30]

Salix is an independent, publicly funded company that provides interest-free match funding to the public sector to invest in energy efficiency measures and technologies that will reduce carbon emissions.

### 5.4.3 Grants for householders

As well as the Low Carbon Buildings Programme described above, householders may be eligible for grants for energy efficiency measures such as cavity wall and loft insulation. Through the Energy Efficiency Commitment (EEC) the governments requires utility suppliers to deliver carbon savings targets through supplementing the cost of energy efficiency measure to householders. The Council sponsors Sussex Solar, which provides householder with the opportunity to install Solar Thermal panels at a discounted rate.

## 5.5 Innovative financial models for sustainable energy measures

As well as accessing external funding streams directly, the Council can develop its own financial models to provide funding for sustainable energy measures, particularly where large scale capital investment is required.

Types of financial model include:

- Investing to save cash
- Investing to generate cash

[28] http://www.energysavingtrust.org.uk/housingbuildings/funding/database/
[29] http://www.lowcarbonbuildings.org.uk
[30] http://www.salixfinance.co.uk/

With both models upfront cash (or equity) is required. The source of this equity can be either from the Council's own capital, prudential borrowing, grants or a combination of all three sources. In invest-to-save models the capital funding is generally put into energy efficiency measures to *save* cash. In invest-to-generate models the capital investment is put into renewable energy and/or CHP projects to *generate* cash. Both types of model can be combined to maximise the return on the investment.

The Council needs to consider the circumstances under which it may invest in sustainable energy measures either on its own estate or on developments within the Borough. By taking this approach the Council can establish financial criteria (such as payback times or rates of return) to appraise opportunities and the risks involved.

## 5.6 Conclusion

Local authorities have a wide remit to deliver action on Climate Change mitigation and adaptation, and there are a number of mechanisms that can be used to assist. It is important that the Council decides which delivery mechanisms are appropriate to its own objectives and capabilities. For example, with ESCO development, some local authorities may have the expertise and resource available to establish and run an ESCO. In other cases, the local authority may partner the private sector in a joint venture ESCO.

In the case of Crawley, the Council has an opportunity to consider contributing towards the capital costs of the energy solutions on new developments and is likely to be able to justify a lower return on this investment than a purely commercial private sector investor. The Council is recommended to carry out further work to determine an optimal solution based on the current policy agenda of the council and its attitude to risk and financing sustainable energy within the Borough.

In practice, the delivery mechanisms employed by any local authority are likely to be a combination of those described in this chapter, with no 'one size fits all' solution.

# 6 Opportunities for Crawley

Crawley Borough covers 4,497 hectares and is situated in the north eastern part of the County of West Sussex. Horsham District abuts the town on the western side, Mid Sussex District is to the south and east whilst the County of Surrey abuts the town to the north.

Mainly urban in character, Crawley is surrounded by countryside and a small part of the southern area is within the High Weald Area of Outstanding Natural Beauty. It lies adjacent to the M23 and close to the M25 and is on the main railway line linking London to the coast. Gatwick Airport, one of the world's major international airports, is located within the Borough.

Crawley has its origins in the Middle Ages or even earlier. However, the majority of its growth and its character is derived from its designation as a New Town in 1947. Crawley was one of eight new towns established by the Government after the war to stem the increasing congestion and outward sprawl of London and to provide a better quality of life for Londoners living in the inner, overcrowded areas of the city. The New Town was to provide employment and good quality housing in a green environment.

The basic design concept of Crawley New Town is a series of residential neighbourhoods, each with its own facilities, located around a town centre with a separate industrial area located to the north.

As with any borough, Crawley has unique characteristics that affect the viability of sustainable energy technologies in the borough. Each renewable energy type is taken in turn in table 8 along with a statement on its broad feasibility.

**Table 8: Broad feasibility of sustainable and renewable energy technologies in Crawley**

| Technology | Broad feasibility for Crawley |
|---|---|
| Wind | Radar from Gatwick airport may pose a constraint for large scale wind turbines |
| Solar Thermal | With high irradiance in the South East, solar thermal is likely to be viable in Crawley |
| Solar PV | With high irradiance in the South East, solar PV is likely to be viable in Crawley |
| Biomass | Although there is limited countryside within Crawley borough for growing biomass, the surrounding counties are heavily wooded and there are already existing supply networks in place[31], therefore biomass is a feasible technology in Crawley |
| GSHP | There are no constraints in Crawley that are likely to make GSHPs unviable |
| ASHP | There are no constraints in Crawley that are likely to make ASHPs unviable |
| Community Heating | Community heating networks are likely to be feasible in Crawley due to its compact, urban nature |
| CHP – with community heating and | Crawley is ideal for CHP combined with community heating and private wire networks due to its compact, urban nature |

[31] For example, the Surrey Hills Wood Fuel group.

| | |
|---|---|
| private wire | |
| CHP – standalone units | There are no constraints in Crawley that are likely to make standalone CHP units unviable |
| Micro CHP | As this technology is not currently commercially available it is not appropriate at this time |
| Air Source Heat Recovery Pump Systems | At the present time, this technology is unproven and is unlikely to be viable on a large scale in Crawley. However, a number of small scale units are commercially available and may be particularly suited to non-residential developments |
| Tidal | With no coastline tidal technologies will not be possible in Crawley |
| Geothermal | The geology in Crawley is unlikely to be suitable for geothermal technologies |
| Mini Hydro | Limited resource exists in Crawley, and therefore mini hydro is not likely to be viable on a large scale |
| Hydrogen fuel cell | At the present time, this technology is not commercially viable |

Crawley's submission core strategy identified eight key areas when considering the borough spatially. Each spatial area is taken in turn below and the general opportunities for sustainable energy identified.

## 6.1 Gatwick Airport

### 6.1.1 Key characteristics

Gatwick is a single runway, two terminal Airport, with 32 million passengers per annum. Although the Council generally supports growth of the airport to maximise its use, it does not support an additional runway. However, it has been required to safeguard land to the South of the airport boundary in accordance with the Aviation White Paper.

An objective within the submission core strategy is to "ensure that the growth in business at the airport is associated with measures which limit its impact on the surrounding area".

Gatwick Airport is linked to a Sustainable Development Strategy and associated legal agreement. These documents include environmental measures that must be undertaken by BAA to minimise adverse environmental impacts to air quality, air noise and traffic congestion during expansion.

The Council is currently working on a revised SPD for Gatwick Airport development, to be adopted in 2008. This will be accompanied by an agreement with BAA and the surrounding Gatwick Local Authorities to adopt a set of environmental commitments and legal obligations.

### 6.1.2 Options for securing a more sustainable energy supply

The Council has a strong policy basis to demand strict environmental measures from BAA on the Gatwick Airport site. The current Sustainable Development Strategy includes an objective for reduction in energy use on site[32] and in new development[33].

With the airport being a twenty-four hour operation with a constant heat and electricity demand, it is likely that CHP is a viable technology and its feasibility should be assessed, particularly with relation to new development on site. It may be possible to use biomass as a fuel for the CHP as the site is potentially large enough to incorporate a storage area for fuel.

In terms of renewable energy, there are likely to be issues associated with large scale wind turbines located near radar at the airport and consultation with the relevant authorities is essential. Radar works by detecting Doppler frequency of a moving object such as an aircraft. The motions of wind turbines lie in similar velocity bands to aircraft and if the blades rotate in the area visible to the radar they cannot be distinguished from a moving aircraft. It is possible that more sophisticated types of radar can differentiate between the Doppler of higher speed aircraft and wind turbines, but currently no Air Traffic Control radars have this capability[34]. The National Air Traffic Service (NATS) runs a service known as NATS En Route Plc (NERL) that is responsible for the safe and expeditious movement in the en-route phase of flight for aircraft operating in controlled airspace in the UK. NERL has published maps that represent areas where wind turbines will, or may, affect NERL operation, depending on the blade tip height of the wind turbine[35]. The data they publish for 20m height blade tips (which is the smallest tip height published) clearly shows that any area around Crawley would require further pre-planning consultation, see Figure 18.

Other forms of renewable energy may be appropriate for the Gatwick spatial area. The airport will have both a significant daytime hot water and electricity demand with large catering facilities and shopping facilities. The airport should therefore consider solar energy through both solar thermal and solar photovoltaic panels.

[32] to achieve a reduction in $CO_2$ emissions associated with airport site energy consumption of 51% per passenger by 2010 on 1990 to increase the use of renewable energy through a renewable energy demonstration project

[33] Identify the costs and benefits of energy saving measures on a lifecycle basis and include $CO_2$ reduction targets in the project process.

[34] http://www.bwea.com/aviation/ams_report.html

[35] http://www.bwea.com/aviation/nats.html

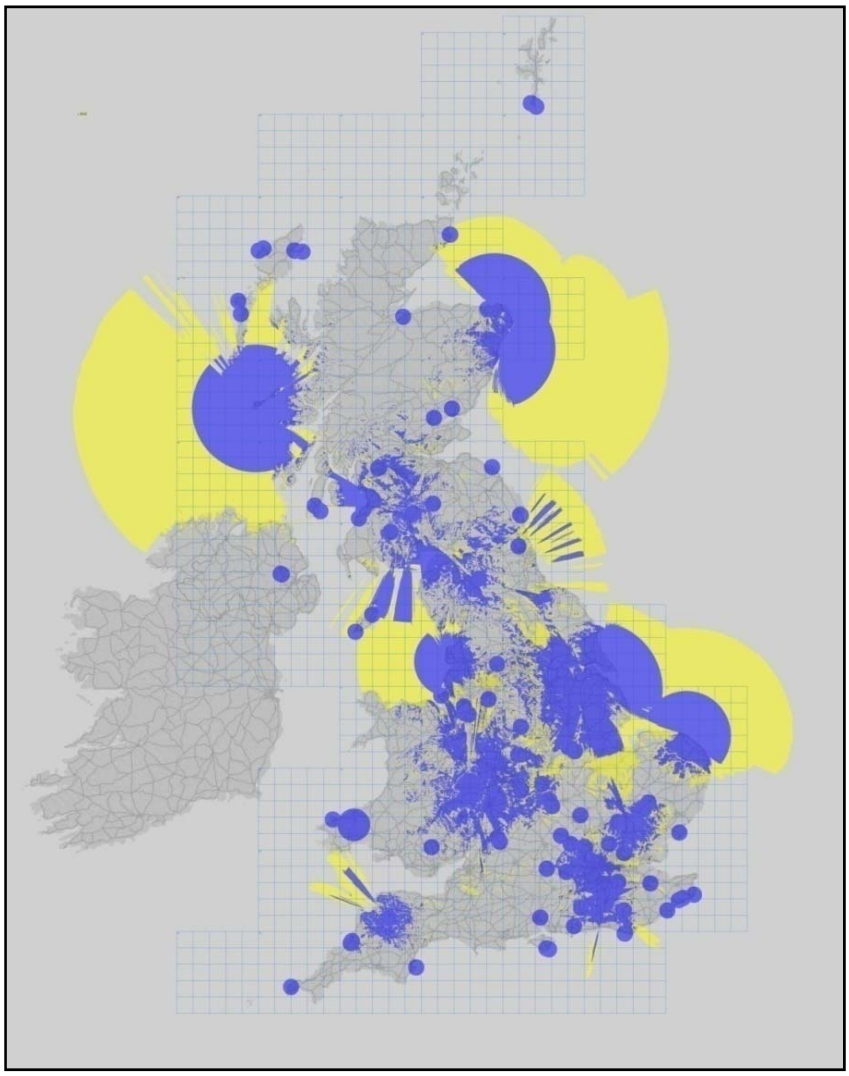


Figure 18: Image showing areas where a wind turbine of 20m or above tip height may affect NERL (National Air Traffic Service En Route Plc) radar signals. Blue areas are those where wind farm developments are likely to interfere with the operational infrastructure of NERL. Yellow areas are those where there remains a potential to interfere with this infrastructure. (http://www.bwea.com/aviation/nats.html)

## 6.2 Manor Royal and County Oak

### 6.2.1 Key characteristics

Manor Royal and County Oak are large employment areas; including both business and industrial. The areas are critical for Crawley's current economic buoyancy and the continued success of these areas is a key factor in ensuring the growth of a diverse economy.

There is redevelopment and intensification anticipated within the areas to encourage high quality additional floorspace. The submission core strategy also identifies this as an opportunity to deliver environmental improvements and improvements to methods of sustainable transport.

Two areas directly north of Manor Royal have been identified as Employment Opportunity Areas, to accommodate the borough's employment floorspace requirement. Both sites are Greenfield, and the Council has recognised that any development should utilise the land to its full potential including high quality design and sustainable development methods.

### 6.2.2 Options for securing a more sustainable energy supply

With redevelopment and intensification within Manor Royal and County Oak, the opportunity for CHP should be investigated. It is unlikely that there will be a significant all year round heat and hot water demand for office space but some of the industry in the area may have a heat or hot water demand, meaning CHP becomes more feasible. With much of the industry being airport related, there is likely to be a twenty four hour, seven day demand, which is optimal for CHP. If the airport is extended into the safeguarded land at a later date it may be possible to have CHP on a community network incorporating both the airport and Manor Royal and County Oak.

Rather than large scale redevelopment at one time, Manor Royal and County Oak are undergoing incremental change as plots come forward. As there is no one developer that is likely to take the lead on the development of an ESCO, this would provide an opportunity for the involvement of the Council to promote CHP and assess the viability of setting up an ESCO.

Manor Royal and County Oak should become subject to an SPD that details the required levels of sustainable energy. The Council should consider using the Building Research Establishment's Environmental Assessment Method (BREAAM) that assesses the environmental performance of any building, giving a rating of either Pass, Good, Very Good or Excellent. BREAAM considers environmental impacts in eight broad areas, one of which is energy. Ideally all new development in the area should be rated as BREAAM Excellent for energy.

Renewable energy should be incorporated into new development; the amount will be dependent upon the policies adopted by the Council through its SPDs. As with all of Crawley, large scale wind turbines are likely to affect the radar signals at Gatwick Airport, and therefore it is likely that any wind power would need to be building integrated and on a small scale. Office space has a high daytime electricity demand and therefore solar photovoltaic panels are likely to be feasible depending on the orientation of the building. With new development, solar PV can be designed in at an early stage and can be used as cladding, and with potential for the costs to be offset against other building materials.

With the two Employment Opportunity Areas being located on Greenfield land, the Council has significant scope to demand high levels of sustainable energy technologies and carbon reduction in these areas; with Crawley being predominantly urban, Greenfield land is at a premium. The Council should consider the viability of zero-carbon exemplar developments at these sites.

## 6.3 Land West and North West of Crawley

### 6.3.1 Key characteristics

The Land West and North West of Crawley has been identified as an area to accommodate a strategic development of 2,500 dwellings up to 2016 in the Adopted West Sussex Structure Plan. This will include a new neighbourhood with subsidised housing, high quality employment land and other uses associated with residential neighbourhoods.

The development will primarily occur beyond Crawley's administrative boundary, in Horsham. However, the development will have direct implications for Crawley and therefore a Joint Area Action Plan for the area is being developed and preferred options are due to be published in 2007.

Paragraph 6.10 and 6.11 of the Issues and Options for the Joint Area Action Plan are concerned with Sustainable Housing. This includes "implementing environmental measures, including employing sustainable construction methods, providing 10% on site renewables and securing efficient use of water resources".

The Submission Core Strategy has an objective for the area that "development should be based on maximising the opportunities for the use of sustainable construction methods". The area will include a high quality mixed use neighbourhood that will comprise of up to 2,500 dwellings, a new neighbourhood centre (potentially including shops, employment floorspace, a community hall, a primary school, a doctor's surgery, a library, a public house, public open space) and employment provision.

### 6.3.2 Options for securing a more sustainable energy supply

Although not in Crawley's administrative boundary, the Council can still have a significant influence over the sustainability credentials of development in this area through the Joint Area Action Plan. The development of a new neighbourhood provides a once in a generation opportunity to incorporate significant sustainable energy measures.

With the new neighbourhood incorporating mixed use development, the viability of CHP should be considered. As the new neighbourhood is being developed on Greenfield, the concept of a private wire network is more likely to be viewed favourably.

The Council has utilised the Code for Sustainable Homes in a number of SPDs it has produced through demanding all residential elements to meet code level 4. In terms of carbon dioxide reductions this equates to approximately a 44% reduction in energy/carbon compared to Part L (Building Regulations 2006)[36]. This is a significant reduction and the Council should consider implementing a similar policy through the Joint Area Action Plan to apply to all residential development in the Land West and North West of Crawley. All other development types should be subject to BREEAM assessment and achieve an Excellent rating for energy.

## 6.4 North East Sector

### 6.4.1 Key characteristics

The North East Sector was originally identified as an area to accommodate up to 2,700 dwellings and other uses (in the adopted Local Plan and adopted West Sussex Structure Plan). The Council submitted a planning application for a new neighbourhood in 1998. However, due to the then forthcoming Aviation White Paper, the Secretary of State issued an Article 14 Direction preventing the Council granting planning permission without his authority in March 1999.

Due to the uncertainty regarding a second runway at Gatwick Airport, the Council has to have regard to the potential noise contours. As a consequence of this uncertainty, it is essential the Council acknowledges the inability and uncertainties of delivering the North East Sector in the short and medium term. Partial delivery of the sector would not be in accordance with the neighbourhood principle, and therefore would not be permitted.

36 http://www.communities.gov.uk/pub/173/BuildingaGreenerFutureTowardsZeroCarbonDevelopment_id1505173.pdf

### 6.4.2 Options for securing a more sustainable energy supply

As there will be no development in the North East sector in the period of the Core Strategy, there is little scope to incorporate sustainable energy technologies at this time.

## 6.5 Neighbourhood structure and neighbourhood centres

### 6.5.1 Key characteristics

Crawley Borough consists of 12 neighbourhood centres, each with good access to its own centre offering local shops, services and community facilities. They are a key feature of planning and development of Crawley and represent a sustainable form of development as reflected in current government guidance. This is achieved by locating the majority of uses within an area so that the majority of local trips can be by foot.

New development is planned in some centres; Langley Green, Bewbush and Furnace Green in particular. Draft SPDs have been written for Langley Green and Bewbush, both containing similar paragraphs on sustainability. For community buildings consideration should be given to energy efficiency, water saving devices, recycling facilities, creating opportunities for wildlife and there is a requirement for 10% on site renewable energy. Residential elements of the development should meet level 4 of the Code for Sustainable Homes.

### 6.5.2 Options for securing a more sustainable energy supply

In keeping with the neighbourhood principle, redevelopment of the neighbourhood centres will be mixed use, giving a constant heat and electricity demand. The viability of CHP and private wire networks should therefore be investigated for Langley Green and Bewbush redevelopment. The Council has been proactive in demanding Code for Sustainable Homes level 4 for residential units in the SPDs for Langley Green and Bewbush.

In the Langley Green regeneration area, Crawley Borough Council and West Sussex County Council are both major landowners. The Council should therefore set itself strict limits on environmental performance and set an example to other developers. The Council should assess the feasibility of adopting Langley Green as a zero-carbon neighbourhood where all residential units are built to code 6 of the Code for Sustainable Homes and commercial development is also zero carbon. Planned development in Langley Green includes a new primary school. If Crawley Borough Council were to work with the County Council to develop this as a 'zero-carbon' school, not only would it highlight the Council's commitment to Climate Change, it could act as a educational tool with links to the national curriculum and also act as a beacon of sustainability for other local schools. Technologies such as biomass or ground source heat to meet the space heating requirements of the school should be considered and a renewable energy feasibility study should be completed.

As with all of Crawley, it is unlikely that large scale wind power would be feasible in these areas due to the issues associated with radar and Gatwick airport. Solar thermal and solar photovoltaic panels are likely to be suitable to be building integrated depending on other feasibility criteria such as orientation of the building.

## 6.6 Transport corridor between the Town Centre and Three Bridges

### 6.6.1 Key characteristics

This area is a key transport corridor linking Three Bridges Station to the Town Centre. It is a mixed use area of primarily residential and employment and has already undergone some redevelopment. Due to its sustainable location (near public transport networks) it is hoped to be able to redevelop older and outdated premises to secure quality mixed development at higher density. An objective for the area within the Submission Core Strategy is to "ensure new development makes efficient use of land and is high environmental and design quality".

There are major opportunities in redevelopment to secure highly accessible developments due to the close location to the Town Centre, Three Bridges Station and the Fastway.

### 6.6.2 Options for securing a more sustainable energy supply

As with other mixed use redevelopment in Crawley, CHP coupled with district heating and cooling is likely to be viable in the transport corridor between the Town Centre and Three Bridges, and its feasibility should be assessed.

The spatial area is not subject to an SPD. The Council should consider adopting an SPD that demands higher levels of sustainability for the area: a minimum of Code for Sustainable Homes level 4 and BREEAM Excellent rating for energy in commercial buildings.

## 6.7 The Countryside

### 6.7.1 Key characteristics

Although surrounded by countryside, there is very little countryside within Crawley Borough boundaries and the Submission Core Strategy sees it as a valuable asset that requires protection and enhancement wherever possible.

### 6.7.2 Options for securing a more sustainable energy supply

The countryside could be used to grow and harvest biomass sustainably to be used as a renewable fuel source. This would require an assessment of the amount of land available in Crawley borough, but this is unlikely to be on a significant scale due to the small area of countryside.

## 6.8 The Town Centre

### 6.8.1 Key characteristics

The town centre is a sustainable location for major developments, as it attracts large numbers of people for a mix of uses including houses. The Submission Core Strategy seeks to promote and facilitate a major new mixed use development in the town centre including new retail, leisure and residential opportunities, and to ensure that the vitality and viability of the Town Centre is enhanced.

The "Town Centre North" site has been identified as a site for considerable redevelopment (including residential). It is subject to an SPD that is currently in draft form that has a chapter on sustainable development. This states that consideration must be given to a range of sustainable options including water conservation and that 10% of energy requirements should be from on-site renewable energy. It acknowledges that CHP may be a possibility for the redevelopment and that

the feasibility of CHP and ESCOs should be examined by the developer. Residential elements of the redevelopment will be expected to reach level 4 of the Code for Sustainable Homes.

In addition to Town Centre North, there are a number of other mixed use development opportunities identified in the town centre.

The Council commissioned a report by ICE (UK) Ltd. in 2005 to assess feasibility of CHP in Crawley. This focussed on the Town Centre redevelopment and found that "a Community Energy scheme serving the Town Centre North development would be viable, based around a 525kWe gas fired CHP engine potentially with the addition of a back-up biomass boiler and an extensive solar thermal array. All heat and the majority of electricity generated by the CHP engine would be supplied directly into the development maximising efficiency by reducing transmission losses. Thermal storage vessels are also proposed to increase the operating hours of the CHP engine during the summer".

### 6.8.2 Options for securing a more sustainable energy supply

The Council has been proactive in assessing CHP feasibility for the Town Centre North redevelopment. As it has been found that CHP with a community energy scheme would be feasible, the Council should work with the developer to integrate CHP, possibly procuring this through an ESCO.

As the Town Centre North is being championed in the area as a landmark development, it provides the opportunity to demand higher levels of sustainable energy. The Draft SPD states that residential elements of the scheme should reach Code for Sustainable Homes level 4; the Council should assess the viability of attaining Code for Sustainable Homes level 6 for residential elements. Although this may seem demanding now, building will not commence until 2010, by which time it is likely that Code level 3 for energy will be mandatory. All commercial building should achieve BREEAM Excellent rating for energy.

The Town Hall is an outward facing representation of the Council and therefore when building a new Town Hall as part of the Town Centre North redevelopment, it will be important to ensure it is to the highest environmental standards, incorporating visible renewable energy technologies. Feasibility of a zero carbon town hall as an exemplar building should be investigated.

## 6.9 Conclusion

Although a broad assessment of feasibility for sustainable energy technologies for each spatial area has been covered in this chapter, each development site is likely to have unique circumstances that will affect the viability of technologies.

Building on the broad recommendations, further work should be carried out for each spatial area, particularly Town Centre North, to provide a more detailed feasibility assessment. This work should incorporate an estimate of the available sustainable energy resource and identify specific development sites e.g. the new Town Hall, where the Council has an opportunity to lead by example or has the ability to influence key stakeholders.

# 7 Opportunities and the way forward

Chapter 5 considers the roles that a local authority has in delivery on Climate Change, namely as:

- An Estate Manager
- A Service Provider
- A Community leader

It is imperative that the Council considers its responsibilities under all of these roles and makes a choice on appropriate delivery mechanisms. Delivery will involve having a strong foundation of both Corporate and Planning policy. Recommendations in these areas are shown below.

## 7.1 Corporate Policy

A workshop was held with officers in July 2007 to consider actions that the Council could take corporately to impact on Climate Change. Following the workshop, some suggestions for action are outlined below that will allow Climate Change to be incorporated into corporate policies and initiatives.

### 7.1.1 A clear strategic framework is required

For effective delivery on Climate Change programmes in Crawley, the Council must ensure that it has a clear strategic framework in place. Any polices and programmes it has on climate change will need to be underpinned by strong corporate support.

It was clear from the workshop that the Council needs to develop a vision for action on Climate Change. This should include both mitigation and adaptation strands and should be long term, looking twenty to thirty years ahead.

Corporate support must come from the 'top' and will necessitate a "Climate Change Champion" to be nominated at both Director level and Member level. Their roles would be to ensure that Climate Change is included in corporate decisions taken forward by the Council. This buy-in should be filtered down throughout the Council through awareness raising and training for both officers and members.

The current corporate plan could be more robust regarding Climate Change matters. When a new corporate plan is being developed to run from 2009, this should consider how the Council can ensure Climate Change is a priority within Crawley. The current Community Strategy has the Local Environment as a key theme but within this Climate Change could be emphasised as a priority when the Community Strategy is updated. Linkages between any polices should be identified to reinforce this priority corporately.

Crawley does not have a Climate Change Strategy, although the Environment Unit has undertaken a scoping study that considers the impacts and opportunities for preparing for Climate Change. This provides a good basis for the development of a Climate Change Strategy and associated action plan. This may require the establishment of a Climate Change Working Group to manage projects and share information between departments. Resource implications were discussed at the workshop and it was felt that extra resources would be required for the implementation of actions relating to a Climate Change strategy. This may be in the form of a Climate Change Officer whose purpose would be to coordinate activities and projects within the Council.

The Council has an environmental management system in place and was only the twelfth local authority in the UK to receive the prestigious EMAS accreditation. The environmental management system evaluates, manages and monitors the Council's environmental performance and should therefore be integral to any action on Climate Change.

### 7.1.2 Partnership working

Where appropriate, partnerships should be formed with relevant organisations such as the Local Strategic Partnership, Local Agenda 21 group, other local authorities, Chamber of Trade and Commerce and the private sector. Suitable partnerships have the potential to bring in additional funding for projects and allow the effective sharing of knowledge and expertise. There is already good practice in this area:

The planning department has a good working relationship with Horsham District Council, as demonstrated by the Joint Area Action Plan currently being developed for the West and North West of Crawley. Crawley's Building Control functions are operated by Horsham District Council through the partnership of 'Sussex Building Control'.

The Environment Unit has been working with the community and local businesses through the Defra funded Climate Challenge programme[37].

The Council should form close working relationships with the other West Sussex District and Borough Councils and the County Council to identify areas for partnership working on Climate Change. This may be in the form of a joint Climate Change Strategy or action plan.

There are a number of energy related businesses in Crawley, such as Utilicom and Ceres Power; the Council should capitalise on this opportunity to learn from leading companies within the energy sector.

Local Area Agreements are a key driver in action at a local level and Crawley should work with West Sussex County Council to use the Local Area Agreement to deliver on Climate Change initiatives, working in partnership with neighbouring local authorities. The West Sussex Local Area Agreement includes a target to reduce total $CO_2$ emissions from energy use (excluding energy from transport) and the lead partners to deliver on this indicator are the District and Borough Councils in West Sussex.

### 7.1.3 Financial Structures

The use of innovative financial structures and take-up of available funding streams would ensure that Crawley can deliver effectively on climate change projects.

This may include:

- Examining the possibility of using ESCO solutions for development in Crawley to provide heat and power for Council owned buildings
- Ensuring grants are utilised where possible (e.g. Salix funding[38] and the Low Carbon Buildings Programme[39]) towards measures implemented on the Council's Estate.

[37] http://www.crawleyclimatechallenge.co.uk/
[38] www.salixfinance.co.uk

### 7.1.4 Development on Council owned property

As part of the Town Centre North redevelopment, the Council will be moving to a new Town Hall. The new Town Hall should be an exemplar of Sustainable Construction to demonstrate the Council's commitment to the Climate Change Agenda.

Where the Council is a landowner it has considerable influence on the environmental performance of new development on its land. The Council's Procurement Policy should reflect that Climate Change issues will be addressed when drawing up Heads of Terms with Developers to ensure that significant sustainability measures are incorporated into new developments.

## 7.2 Planning Policy

An objective of this study is to provide guidance and evidence for policy development for inclusion in the Council's SPD on Planning and Climate Change.

### 7.2.1 Setting targets for Development Control

The SPD should include targets for Carbon Reduction in new development. As discussed in Chapter two, there is no clear guidance available for where these targets should be set; it is hoped the forthcoming PPS on Planning and Climate Change will provide clarification in this area.

From the draft PPS on Planning and Climate Change it is likely that:

- Clear, numerical targets will be required
- Policy will need to be adopted through a DPD
- Policy will need to be tested and an evidence base provided

### 7.2.2 Policy considerations

There are a number of issues that the Council should consider in selection of its target. The main issues are outlined in table 9.

**Table 9 Overview of issues for consideration in policy development**

| **ISSUE: Energy vs. $CO_2$ reduction** |
|---|
| Merton style policies are generally based on demanding either a percentage of energy needs of a development to be met from renewable sources or a percentage reduction in $CO_2$ from renewable sources. Although they are often used interchangeably, they provide differing results.<br><br>It is recommended that a policy demanding a reduction of $CO_2$ emissions is adopted, with the rationale shown below:<br><br>• It is a reduction in carbon dioxide emissions (a greenhouse gas) that will contribute toward the mitigation of climate change. Energy consumption and $CO_2$ emissions are not equivalent due to the varying carbon emissions factors of fossil fuels.<br>• Energy reduction can be achieved without reducing carbon emissions (an energy use reduction can even increase emissions if fuel sources are switched).<br>• Energy targets may discourage the use of Combined Heat and Power, which is potentially a low |

[39] www.lowcarbonbuildings.org.uk. The Council would be eligible for funding through stream 2A of the Low Carbon Buildings Programme that is for medium and large microgeneration projects by public, not for profit and commercial organisations.

carbon technology. CHP systems can actually increase overall delivered energy use while still reducing carbon emissions.

- Energy targets might encourage the use of electric rather than gas fired plant which would increase carbon dioxide emissions.
- An energy target may encourage ground and air source heat pumps over electricity generating technologies such as PV. Heat pumps are most appropriate in buildings with high levels of energy efficiency and low temperature distribution systems located off the gas network (often in rural settings). Compared with a conventional building with an efficient gas boiler, heat pumps can sometimes increase emissions.
- The national calculation methodologies for assessing building performance are based on carbon rather than energy.
- Benchmarks based on Energy Efficiency Best Practice for Housing, Code for Sustainable Homes and Econ 19 are based on carbon measurements rather than energy.

**ISSUE: Broad-brush target vs. differential targets according to size, type and location of development.**

The draft PPS on Planning and Climate Change has indicated that "In considering and justifying a local approach, planning authorities should:

- avoid setting out for application across broad areas requirements for specific construction techniques, particular building fabrics, fittings or finishes, or performance measures for buildings;
- focus on specific development opportunities and securing an earlier application of higher levels of performance of nationally described standards, for example by expecting identified development proposals to be delivered at higher levels of the Code for Sustainable Homes"

It is therefore recommended that a policy demanding differential targets according to size, type and location of development is adopted, with the rationale shown below:

- Larger scale (especially non-domestic) developments have more options available to them for reducing energy demand through a wider range of design parameters. Carbon savings from energy efficiency measures in office developments, for example, can be achieved at around a quarter of the price of renewables.
- However, there is a limit to which energy efficiency can reduce demand especially in conventional domestic developments. Some of the Code for Sustainable Homes targets cannot be met through energy efficiency alone. Energy efficiency improvements above the improved building regulations are actually more expensive than renewables in some conventional residential developments. More innovative demand reducing designs using passive techniques and exposed thermal mass for example should be encouraged.
- Large scale developments (including residential) which have the potential for shared infrastructure and evenly spread demand can also realise greater savings than small scale or individual dwelling developments. Wind turbines are most cost effective in residential developments where the supplied electricity can be shared between dwelling units.
- The most cost effective opportunity for carbon reduction is to outsource energy production to an energy services company. Where an ESCO network can be connected to, the capital cost is effectively transferred to a third party which is contracted to provide energy services to occupants.
- Wind and biomass have been shown to provide cost effective renewable energy solutions. However, the feasibility of these technologies varies considerably from development to development. A small increase or decrease in predicted site wind speed results in a big change in energy generation. Ground source heat pumps were less cost effective at reducing carbon emissions than in residential developments but when used in conjunction with ground coupled

cooling and used for pre-heating and cooling were more cost effective in non-domestic buildings.

- There may sometimes be conflicts between low carbon technologies. For example, solar thermal hot water collectors may not be appropriate if hot water is being supplied from CHP.

### 7.2.3 Evidence base

To test specific options for policy development, it is recommended that the Council undertakes a modelling exercise to test policy scenarios with a range of developments to see how a particular policy may play out in practice. This will also act as an evidence base for the chosen policy. The modelling exercise should consider the cost impact (both capital and life cycle analysis), technical feasibility and environmental impact.

### 7.2.4 Policy implementation

Once a policy is adopted, there will be a number of considerations for implementation of the policy. These are covered in appendix 2.

## 7.3 Conclusion

Through signing the Nottingham Declaration on Climate Change, Crawley Borough Council is committed to take action in Climate Change. This action is required across all services within the Council. Although the Council has taken the first step by signing the declaration, further commitment and a clear strategic framework from director level is required. This should filter down to all services to ensure that Climate Change is integral to service delivery by the Council.

As Crawley is currently undergoing considerable redevelopment, both in the Town Centre and wider borough, it has a “once in a generation” opportunity to integrate sustainable and renewable energy measures into new development and also ensure that new development will be able to withstand future changes in climate. This will require a huge step change by the Council to ensure that this unique opportunity is used to its full advantage. It is necessary for the Council to carry out further feasibility assessment in the form of modelling exercise to test policy scenarios for planning policy development.

As highlighted in chapter 3, there will be resource implications attached to some of these actions and the Council needs to understand what these resource implications are likely to be so that it can prioritise which actions to take forward and form an action plan with a time line and allocated resources.

# 8 Appendix 1: Learning from others - Climate Change Planning Policy

## 8.1 Best Practice

### 8.1.1 Croydon

(Interview with Eddy Taylor, Environment and Sustainability Manager)

#### *8.1.1.1 Current Policy*

The Council will encourage all developments to incorporate renewable energy, but will require proposals for non-residential developments exceeding 1,000 square metres gross floorspace, and new residential developments comprising 10 or more units, whether new build or conversion, to incorporate renewable energy production equipment to off-set at least 10% of predicted carbon emissions, except where:

- the technology would be inappropriate;
- it would have an adverse visual or amenity impact that would clearly outweigh the benefits of the technology;
- renewable energy cannot be incorporated to achieve the full 10%.

Where the 10% requirement cannot be achieved on major developments, a planning obligation will be sought to secure savings through the implementation of other local renewable energy schemes.

#### *8.1.1.2 Compliance assessment*

For compliance with the policy the developer submits an energy statement to development control. This is sent to the Environment and Sustainability Manager who comments on the energy statement, which is then sent back to the development control officer. The energy statement includes:

- Eco-homes (to change to code for sustainable homes from 1st September)/BREEAM pre-assessment
- Other sustainability features
- Siting, size and location of renewable technologies
- SAP ratings and Building regulations Part L 2006 compliance is recommended to be addressed at this stage

In terms of checking compliance with the policy from a practical perspective, temporary staff have been used at times to liaise with developers to ensure that renewable technologies have actually been installed.

#### *8.1.1.3 Resource implications*

The policy has taken about 20% of the Environment and Sustainability Manager's time. It has not taken a huge amount of the development control officers' time and for this reason they have been favourable for the policy.

All DC officers have been trained in renewable energy using external consultants.

#### 8.1.1.4 Expertise required

Internal expertise in the form of the Environment and Sustainability Manager has been required to implement the policy through the review of developer energy statements.

External consultants have not been required for implementation of the policy per se but have been used to provide training for DC officers.

#### 8.1.1.5 Negotiations with developers

Developers are now generally on board. They have found that cost has not really been the issue but that 'know-how' is the initial problem. Once they have completed the first development with renewable energy it tends to become just part of the process. Developers are referred to external consultants to prepare the energy statement if they require assistance. There have been cases where the developer has tried to trade the policy off against other policies e.g. affordable housing but the DC officers have not relaxed any policies and have ensured compliance.

#### 8.1.1.6 Outcomes of policy

130+ planning applications have required renewable energy

#### 8.1.1.7 Monitoring of policy

There is no formal process for monitoring the policy. The Environment and Sustainability Manager knows how many planning applications have required renewable energy but this information is not kept in a database. No information on carbon savings or type of technologies installed is available.

### 8.1.2 Milton Keynes

(Interview with Martin Davies, Senior Planning Officer)

#### 8.1.2.1 Current Policy

All new development exceeding 5 dwellings (in the case of residential development) or incorporating gross floorspace in excess of 1000 sq m (in the case of other development) will be required to include the following:

- Energy efficiency by siting, design, layout and buildings' orientation to maximise sunlighting and daylighting, avoidance of overshadowing, passive ventilation;
- Grouped building forms in order to minimise external wall surface extent and exposure;
- Landscape or planting design to optimise screening and individual building's thermal performance;
- Renewable energy production e.g. external solar collectors, wind turbines or photovoltaic devices;
- Sustainable urban drainage systems, including rainwater and waste water collection and recycling;
- Significant use of building materials that are renewable or recycled;
- Waste reduction and recycling measures;
- Carbon neutrality or financial contributions to a carbon offset fund to enable carbon emissions to be offset elsewhere.

#### 8.1.2.2 Compliance assessment

All information regarding compliance for the policy (including mitigation i.e. carbon neutral) and adaptation (e.g. Sustainable Urban Drainage Systems) is submitted to the development control

officer in a report. For the energy statement this includes SBEM (Simplified Building Energy Model) or SAP (Standard Assessment Procedure) calculations along with how the 10% renewables policy will be met (including feasibility of technologies to be used).

This is submitted to Development Control. The DC case officer will read the report and then refer it to the Senior Planning Officer to comment.

#### *8.1.2.3 Resource implications*

The Senior Planning Officer spends approximately 50% of his time on implementation of this policy. The DC officers are required to look at a report of compliance assessment for each planning application.

#### *8.1.2.4 Expertise required*

The majority of expertise has been from internal resources however external consultants have been required in some instances. All development control officers attended a one day workshop by external consultants to assist with implementation of the policy. External consultants were used in 2004 to carry out a feasibility study in to the viability of expecting carbon neutral developments. Another report was completed in 2006 that looked at the cost of the meeting the policy.

#### *8.1.2.5 Negotiations with developers*

Initially some developers have been negative towards the policy but they have tended to come to terms with it, although there are still some that are less cooperative. If they do not know how to meet the target, the Council provides the developer with a list of consultants.

There have been some cases where there developer has been able to demonstrate that if the policy is implemented in full it will mean that the development is no longer financially viable. Where this is the case, the policy has been relaxed.

#### *8.1.2.6 Outcomes of policy*

In 2006, there were 50 planning applications in all that the policy was applicable to. Of those that received planning permission, 78% met the carbon neutrality policy.

#### *8.1.2.7 Monitoring of policy*

The policy is monitored by the Senior Planning Officer. An excel spreadsheet is kept that has the percentage reduction in carbon dioxide emissions from renewable energy.

### 8.1.3 Waverley

(Interview with Sarah Wells, Urban Design Officer)

#### *8.1.3.1 Current Policy*

Waverley is implementing Surrey Structure Plan policy SE2:

Development for the generation of energy from renewable resources of wind, sun and biomass as a contribution to the regional target will be encouraged. Small scale proposals to serve individual buildings, or small groups of buildings, are becoming practicable and will be supported. In areas such as the AONBs, landscape considerations may preclude larger schemes, but small scale schemes may be acceptable.

Commercial and residential development should be designed such that a minimum of 10% of the energy requirement is provided by renewable resources. The use of combined heat and power or similar technology will be encouraged, and for all developments in excess of 5,000 sq m floorspace should be regarded as the norm.

All types of development should incorporate energy efficiency best practice measures in their design, layout and orientation.

Waverley is implementing this policy in all new developments and conversions and is in the process of moving towards asking for a 10% reduction in carbon dioxide emissions through the provision of renewable energy rather than asking for 10% of energy requirements. In terms of policy documents, the Council is currently preparing a practice note for policy SE2 and will create an SPD once the Core Strategy has been adopted.

#### *8.1.3.2 Compliance assessment*

For assessment of compliance, the developer submits an energy statement to the DC case officer. The case officer passes the energy statement on to the Urban Design Officer who checks the energy statement to ensure it complies with the policy.

Developers are referred to consultants for assistance with preparation of the energy statement.

#### *8.1.3.3 Resource implications*

The Urban Design Officer spends 80% of her time on implementation of the policy. All development control officers have attended training on renewable energy but their time spent on the policy is minimal.

Funding has been sought through the government office to train planners but there have been direct costs for attendance and conferences to enable knowledge growth within the authority.

#### *8.1.3.4 Expertise required*

All expertise that has been used is internal. The Urban Design Officer has built up her knowledge of the subject through reading publication and attending conferences. Developers are referred to external consultants for assistance with preparation of their energy statements.

#### *8.1.3.5 Negotiations with developers*

Most developers are now aware of the policy and accept that they will have to comply with it, but many hold resentment as there is nothing in place to help them prepare their energy statement. There have not been any cases so far where the developer has tried to offset the renewable energy policy against other policies.

#### *8.1.3.6 Outcomes of policy*

There has been no monitoring of the policy so the Council is unaware of the outcomes.

#### *8.1.3.7 Monitoring of policy*

The Council is currently looking in to ways of monitoring the policy.

### 8.1.4 Reading

(Interview with Phil Moule, Planning Policy Officer)

#### 8.1.4.1 Current Policy

The Council adopted an SPD on Sustainable Design and Construction[40] in March 07. This has a number of policies related to climate change including:

- Energy Efficiency - All housing should meet ecohomes 'very good' (or Code for Sustainable Homes level 3) and commercial properties should meet BREAAM 'very good'. For major developments 50% of properties should meet excellent standards in ecohomes or BREAAM. Passive solar energy should also be considered.
- Renewable Energy - Where viable major developments should incorporate renewable energy production to off-set at least 20% of predicted carbon emissions
- Water Resources and Flooding - Developments should incorporate water saving devices; harvesting and re-use of rainwater; collection, treatment and re-use of grey water; Sustainable Drainage Systems (SUDS)

#### 8.1.4.2 Compliance assessment

The SPD incorporates a Sustainable Design Checklist with 18 questions related to the policies included in the SPD e.g. How has the development been designed to optimise the use of energy from the sun?

For each planning application a sustainable design statement is required that takes each question in turn. The renewable energy policy (question 5) also requires SAP or SBEM calculations to be submitted. These calculations are sent to building control to assess compliance with the policy. The sustainable design statement is assessed by the Sustainability Manager for major applications and the planning policy officer for the smaller applications. It is hoped that in time the development control case officer will be able to assess smaller applications as their knowledge base increases.

#### 8.1.4.3 Resource implications

When developing the SPD, the planning officer spent the majority of his time on the project along with significant input from the Sustainability Manager. Some external expertise was sought through the local Energy Efficiency Advice Centre. The Planning Policy Officer still spends the majority of his time on the implementation of the SPD including meetings with developers etc.

All DC officers have attended an internal seminar on renewable energy.

#### 8.1.4.4 Expertise required

Internal expertise in the form of the sustainability team and building control team has been necessary for both the development and implementation of the policy.

External expertise from the Energy Efficiency Advice Centre has also been required.

#### 8.1.4.5 Negotiations with developers

The Developers' reaction to the SPD has been more positive than expected. However, they are still using the "where viable" clause in the renewable energy policy to try not to install renewable technologies. This is often because they are unsure of which technologies to use and some have said that the policy is inflexible as it does not include sustainable technologies such as CHP.

[40] http://www.reading.gov.uk/Documents/servingyou/planning/local_development_framework/Adopted_Sustainable_Design&Const_SPD_0307.pdf

During the consultation stage for the SPD the issue was raised about negotiating the polices in the SPD with other deliverables such as affordable housing, however this has not been raised since the SPD was adopted.

The adaptation policies in the report e.g. water resources and flooding are generally accepted by the developers as they feel more confident with these technologies.

#### *8.1.4.6 Outcomes of policy*

At the time of the interview (four months after adoption) there has not yet been a development that has met the full 20% reduction in $CO_2$ emissions as there have been viability issues.

#### *8.1.4.7 Monitoring of policy*

There is currently no coordinated monitoring of the policy but the Council is looking in to this.

### 8.1.5 Woking

(Interview with Sean Rendall, Principal Policy Officer)

#### *8.1.5.1 Current Policy*

The Council has been actively implementing Surrey Structure plan policy SE2 since March 2005. The policy requires best practice energy efficiency measures and a minimum of 10% predicted energy consumption to be generated on site. It also expects CHP to be provided for all developments of over 5000sqm. Woking is applying the policy to all development including single house units, listed buildings and buildings in conservation areas. The Council has also adopted planning guidance seeking climate neutral development. This includes measures for water conservation, Sustainable Drainage Systems, and thermal comfort.

Work is now underway on developing a strategic approach to community heat and power network and infrastructure development. This has been instrumental in securing a number of large scale developments committing to connect to the network in recent months. In addition this work is being brought into the Council's Planning GIS to identify a CHP development area as a planning constraint in order to enable earlier identification of opportunities to connect to community energy networks.

#### *8.1.5.2 Compliance assessment*

A five step approach has been adopted for setting out energy statements. This is explained on the Council's website[41] and guidance is provided in pre-application discussions.

In more complex cases external advice has been sought from the Council's ESCO, Thameswey Ltd. Energy statements are checked against the Thameswey renewable energy assessment tool.

A climate neutral checklist is also required to be submitted for all major applications[42].

#### *8.1.5.3 Resource implications*

Initially all energy statements were referred to the Principal Policy Officer. Now some DC Officers are able to handle energy statements for all but the more complex developments. Approx 20% of his time is spent on dealing with applications.

[41] http://www.woking.gov.uk/council/planningservice/planningapplications/energy
[42] http://www.woking.gov.uk/council/planning/publications/climateneutral2/checklist.pdf

Woking is working with Thameswey to rollout the new C Plan system[43] for online energy statement submission and anticipates this will make a major improvement in efficiencies.

#### 8.1.5.4 Expertise required

The Principal Policy Officer acts as lead on the policy and has received training. All DC staff have received training in renewable energy, low carbon development and the principles of climate neutral development. A forum for applicants has been used to raise awareness of the policy and compliance requirements. Some DC Officers are now competent to make their own assessments of energy statements. In complex cases advice is sought from the Council's ESCO.

#### 8.1.5.5 Negotiations with developers

Efforts to raise awareness among developers now means there is a generally good level of awareness of the need to generate 10% from renewable sources, and very few developers have objected. The greatest concern tends to be lack of knowledge and some uncertainty about terms and units of measurement that are used in the assessment of energy statements. There is also generally lower understanding of the need to achieve best practice energy efficiency and there remains widespread reluctance to connect to CHP due to very low levels of knowledge and fear of delays/risk in securing energy supplies, price structures, customer/end user uncertainty etc.

#### 8.1.5.6 Outcomes of policy

No figures are currently available for the number of applications where the policy has been applied. However, since implanting SE2 a number of major schemes have now been built with RE installed.

#### 8.1.5.7 Monitoring of policy

Work is underway on updating the Council's monitoring procedures. Once rolled out C plan[44] will be used to monitor effectiveness of the policy.

### 8.1.6 Tandridge

(Interview with Matthew Chapman, Planning Policy Officer)

#### 8.1.6.1 Current Policy

Tandridge is currently implementing policy SE2 of the Surrey Structure Plan on all new residential development and commercial development over 500m$^2$. This is a requirement that 10% of energy requirement is from renewable sources.

Currently, the Council is not implementing any specific climate change adaptation policies but there will be policies included in the core strategy when adopted.

#### 8.1.6.2 Compliance assessment

The Council has put the onus on the developer to demonstrate compliance with the policy. The Council refers the developer to an energy consultancy[45] to obtain an energy statement that has to be submitted with the planning application; this will show how the policy will be complied with. This is submitted to the DC case officer, who will examine the figures and liaise with the developer.

[43] www.carbonplanner.co.uk
[44] www.carbonplanner.co.uk
[45] http://www.tandridge.gov.uk/Planenviron/PlanningApplications/Renewableenergy.htm

#### 8.1.6.3 Resource implications

As the policy is a County policy there was no resource implication in policy development. However, the planning policy officer has spent approximately 5 days to put together briefing notes and introduce the policy. All DC officers have attended a day training session and have a small time implication with each planning application.

#### 8.1.6.4 Expertise required

In the early days of implementation an officer at the County Council would be used for verification of compliance and technical advice. However, as the DC officers are becoming more confident this service is no longer used.

#### 8.1.6.5 Negotiations with developers

Developers have generally reacted well to the policy. There have been two appeals by Developers, both of which have been dismissed for the following reasons:

McCarthy and Stone (Developments) Ltd against the decision of Tandridge District Council, 19th April 2006. The inspectorate refused to grant planning permission for the erection of 31 sheltered apartments (category II) and manager's accommodation, for three main reasons, one of which was the insufficiency of the provision for energy from renewable resources. The report states "I have been given no indication as to whether it would be possible to go any way towards complying with the policy", and therefore concludes that "the proposal fails to provide energy from renewable resources and would be contrary to SP policy SE2 and the thrust of regional and national policy"

Ian Warrener against the decision of Tandridge District Council, 31st January 2006. The inspectorate dismissed the appeal and refused to grant planning permission for the erection of three dwellings. One of the main issues was whether the proposed houses had been designed so that a sufficient level of energy requirement is provided by renewable resources. Within his report he stated that "Policy SE2 of the adopted Surrey Structure Plan requires residential development to be designed so that a minimum of 10% of the energy requirement is provided by renewable resources. Early consideration of this matter should prevent this requirement being in conflict with other design issues whereas the imposition of conditions could lead to problems at the implementation stage. There was no evidence before me that this matter had been addressed within the design of the proposed dwellings. I therefore conclude that the scheme fails to comply with the structure plan policy"

#### 8.1.6.6 Outcomes of policy

There have not yet been any commercial schemes that have been subject to the policy (due to low levels of commercial development in Tandridge) but all housing schemes that have been granted planning permission since policy adoption have complied.

#### 8.1.6.7 Monitoring of policy

Monitoring of the policy is completed by the planning policy officer who has an access database of all schemes that have been subject to the policy. This is updated using housing completions data.

## 8.2 Practice of neighbouring authorities

As well as learning from authorities that are considered leaders through implementation of climate change policies, there is good practice in neighbouring authorities that Crawley should be aware of.

A full list of planning authorities that are implementing renewable energy polices can be found on the Merton Rule Website[46]

### 8.2.1 Surrey Local Planning Authorities

Crawley borders the Surrey Local Authorities of Mole Valley, Reigate and Banstead and Tandridge to the North. All Surrey Local Authorities are subject to the Surrey Structure Plan policy SE2 that states that development should be designed such that "a minimum of 10% of the energy requirement is provided by renewable resources. The use of combined heat and power or similar technology will be encouraged, and for all developments in excess of 5,000 sq m floorspace should be regarded as the norm. All types of development should incorporate energy efficiency best practice measures in their design, layout and orientation."

### 8.2.2 Mid Sussex

Mid Sussex's current Local Plan has a number of policies relating to Climate Change such as encouraging renewable energy, energy efficiency and water conservation. These are complemented by an SPD on Sustainable Construction. Although a small number of developers have proactively taken sustainable construction on board the majority still do not implement measures as the policies are lacking 'teeth' (being 'encourage' rather than 'require').

The Council is due to submit its Preferred Options for its Core Strategy towards the end of 2007. This is likely to include prescriptive policies relating to climate change. Mitigation polices include a ramping renewable energy requirement for new development as shown in table 10.

Table 10 Mid Sussex's ramping policy

| Percentage carbon dioxide reduction required from renewable energy technologies | Dates |
|---|---|
| 10% | Adoption until 2010 |
| 15% | 2011 – 2015 |
| 20% | 2016 – 2020 |
| 25% | 2021 – plan end |

The Preferred Options Core Strategy will build on the Sustainable Construction SPD and will require a sustainable construction statement that demonstrates how compliance to be submitted with all new developments.

It is also likely to include adaptation polices that consider biodiversity networks and migration of organisms.

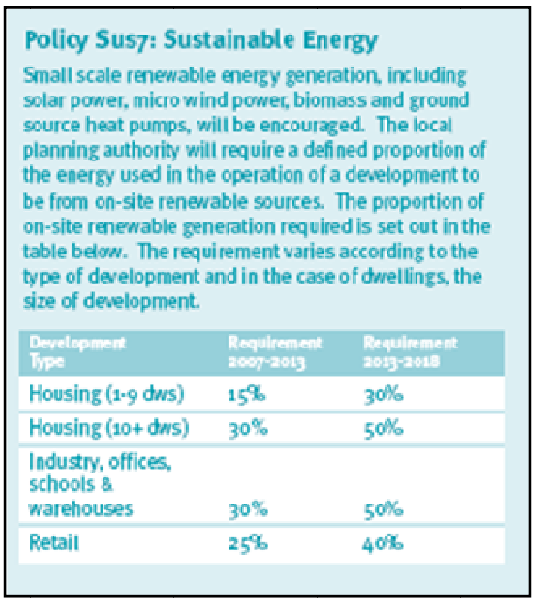
### 8.2.3 Horsham

Horsham District Council adopted its Core Strategy in February 2007. Policy CP2 on Environmental Quality states that new development should take account of the potential to utilise renewable energy sources and utilise sustainable construction technologies. There are no prescriptive targets relating to Climate Change.

[46] http://www.themertonrule.org/list-of-boroughs

### 8.2.4 Chichester

Chichester District Council's Submission Core Strategy contained policy Sus7 on Sustainable Energy. It required a percentage of energy requirements of a new development to be met from on-site renewables. This requirement varies depending upon the development type and size of development and is to be ramped up over time.



**Policy Sus7: Sustainable Energy**

Small scale renewable energy generation, including solar power, micro wind power, biomass and ground source heat pumps, will be encouraged. The local planning authority will require a defined proportion of the energy used in the operation of a development to be from on-site renewable sources. The proportion of on-site renewable generation required is set out in the table below. The requirement varies according to the type of development and in the case of dwellings, the size of development.

| Development Type | Requirement 2007-2013 | Requirement 2013-2018 |
|---|---|---|
| Housing (1-9 dws) | 15% | 30% |
| Housing (10+ dws) | 30% | 50% |
| Industry, offices, schools & warehouses | 30% | 50% |
| Retail | 25% | 40% |

Figure 19: Policy Sus7 from Chichester's Submission Core Strategy (now withdrawn)

The inspector's report on the Core Strategy was published in June 2007 and unfortunately led to the withdrawal of the Core Strategy. The three main issues that led to the withdrawal are the absence of a clear indication as to the location for large-scale greenfield development at Chichester;

the relationship between the provision for greenfield development and its timing, and the need for improvement works to the A27; and the evidence base for the housing distribution across the District.

However, with regards to Sus7, the inspector found the policy to be sound as long as a proviso was added to the policy that acknowledges that the targets would not be applied in full if the developer could show that this would lead to the development being unviable. More information is available from Chichester's website[47]

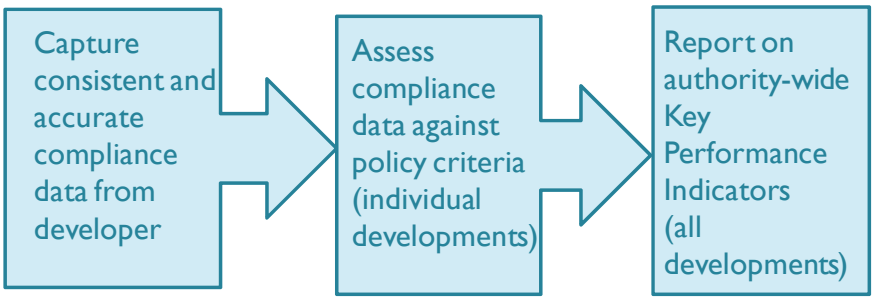
[47] http://www.chichester.gov.uk/index.cfm?articleid=5079

# 9 Appendix 2: Policy implementation

## 9.1 Policy implementation methodology

Once a sustainable energy policy and targets for new developments have been put in place, a mechanism for ensuring successful implementation needs to be established. This requires a methodology defined by the Council for developers to measure the performance of proposed developments and demonstrate compliance. This methodology should help to overcome the issues associated with compliance assessment and implementation that are discussed in Chapter 0.

Any implementation methodology needs to address the following three areas:




### 9.1.1 Capture consistent and accurate compliance data from the developer – the Energy Statement

The energy statement is the most widely deployed method of submitting evidence of compliance and is normally based on the standard methodologies such as SAP and SBEM. Policy should stipulate that an energy statement is a mandatory part of the planning application and that it should include the following:

- A description of the development with gross internal floor area for each TCPA planning use class
- An estimate of predicted energy consumption and carbon dioxide emissions from the operation of the proposed building if constructed to 2006 Part L minimum requirements (using the national calculation methodology Target Emissions Rate or TER). This is often referred to as the *Baseline Emissions*
- An estimate of total predicted energy consumption and carbon dioxide emissions from the operation of the proposed building if enhanced energy efficiency measures are incorporated. This figure is calculated using the Building Emissions Rate (BER) in the national calculation methodology and is often referred to as the *Adjusted Baseline Emissions*
- A target proportion of carbon dioxide or energy savings to be derived either from renewable measures or from a combination of sustainable energy measures
- An appraisal of the feasibility of renewable energy measures with total predicted energy and carbon dioxide savings
- An appraisal of the feasibility and energy / emissions from Combined Heat and Power and District Heating /Community Energy with total predicted energy and carbon dioxide savings

When demonstrating the feasibility of design options, developers also need to provide evidence that they have considered the following:

- That there is sufficient energy demand to utilise the energy produced from sustainable energy sources. For example, there is little point in putting three solar thermal panels on a small house which will provide hot water in excess of that likely to be used by the occupants.
- That there is sufficient space to locate sustainable energy installations. For example, sufficient South facing roof area to locate solar panels or sufficient land area to locate ground source heat pumps.
- That here are sufficient resources in terms of wind, sun (unshaded areas) or biomass fuel supply available.
- That the visual, noise and transport impacts have been taken into account. For example the noise created by wind turbines or the amount of lorry loads of biomass fuel that need to be delivered.

### 9.1.2 The Compliance Process

It is recommended that the compliance process follow a two stage submission of energy statement data. Stage 1 should provide a provisional estimate of carbon emissions based on benchmarks of typical performance of similar building types. This can be conducted very early in the design process before detailed energy calculations have been undertaken. The commitments made at this stage can be recorded in a planning condition and discharged once more detailed designs and building control Part L calculations are available which prove that the early undertakings have been followed through.

The rationale for a two stage process is that carbon emissions data for building control purposes based on the national calculation methodology is not usually available until quite late in the design process. The advantage of a two stage process is that it enables targets to be set early in the design process. The potential to influence the impact of a design is greatest at the early stages of concept development. The effectiveness of sustainable energy or low carbon design decisions declines as project time elapses. It becomes increasingly difficult and more expensive to alter a design based on the feedback from environmental performance predictions and therefore less viable to incorporate energy efficient components.

The two stage compliance assessment process is represented in figure 20.

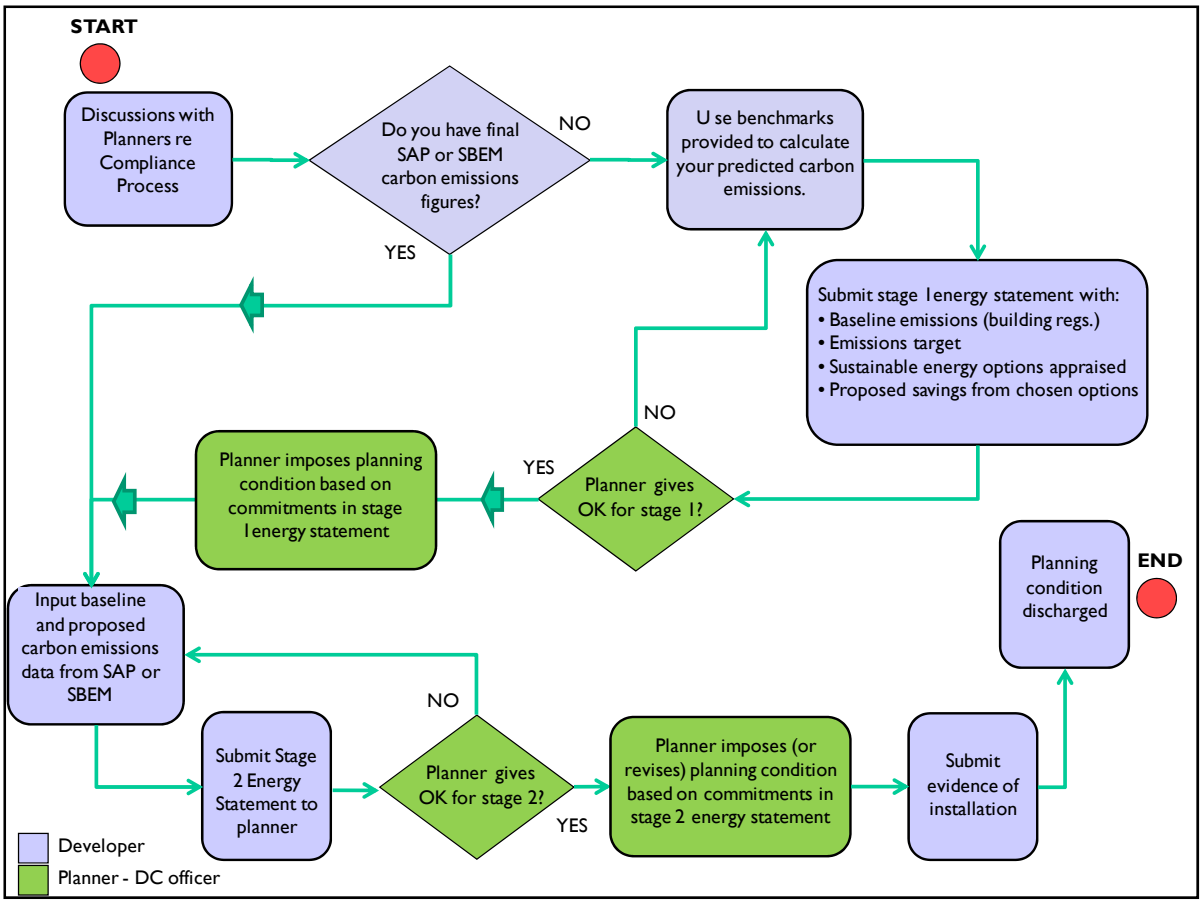



Figure 20: Compliance Process for Carbon Emissions Assessment

#### *9.1.2.1 Post Construction Proof of Compliance*

The compliance assessment process needs to incorporate mechanisms for ensuring that the constructed building actually delivers the agreed carbon reductions over baseline. This could take the form of requiring proof of purchase such as invoices for renewable energy equipment. Section 106 agreements could be used to ensure on-going energy monitoring.

### 9.1.3 Reporting on authority wide Key Performance Indicators (KPIs)

LPAs need to be able to aggregate compliance data from multiple planning applications to give a strategic picture of the overall impact of policy against KPIs. It is likely that CLG KPIs will emerge that require reporting on how much renewable energy is available in an LPA area, for example. A mechanism that enables planners and other local authority strategic managers to generate management reports on overall performance against key performance indicators such as number of targets met across the entire authority, total carbon emissions, number of solar installations etc. is highly desirable. Other indicators such as number of energy statements submitted and length of time to process energy statements should also be monitored.

### 9.1.4 Compliance Checking Software tools

There are number of software tools available to assist with energy statement submission and checking. These include:

#### 9.1.4.1 The Low Carbon Designer

The Low Carbon Designer developed by the London Energy Partnership has been designed to assist developers, architects, and planners with all the key energy aspects of their site. It includes a software implementation of the London Renewables Toolkit. A full energy, $CO_2$, and cost analysis is used to produce a report which can be used as a key part of the energy assessment for planning applications. The tool enables users to calculate the site energy demands for residential, non domestic and all other land uses. The user can then assess the performance of a number of different energy efficiency measures, efficient energy supply technologies (such as CHP) and renewable energy technologies. A full set of calculation engines are included to allow a detailed analysis of performance.

#### 9.1.4.2 The Low Carbon Mixer

The low carbon mixer is a simple software package which was developed in partnership with One North East and The North East Assembly. The toolkit will automatically calculate the 10% requirement for developments based on existing benchmarked developments. It will also project the potential:

- CO2 Emissions
- Capital Cost Increase
- Savings
- Payback Periods

#### 9.1.4.3 C-Plan

Working in partnership with Woking Borough Council and London South Bank University, ecsc has developed the C-Plan Web portal which manages the processing of the carbon impact aspects of planning applications. C-Plan achieves this by linking together planners, developers and strategic managers providing them with tools for compliance checking, tracking and reporting and managing the flow of information between them. Developers are provided with the tools to calculate building carbon dioxide emissions, produce energy statements for planning applications and submit these within a managed process. Local Authorities are provided with a robust process for assessing whether developments meet planning policy requirements as well as rich reporting features to illustrate key performance indicators. An output screen from C-Plan can be seen in figure 21.

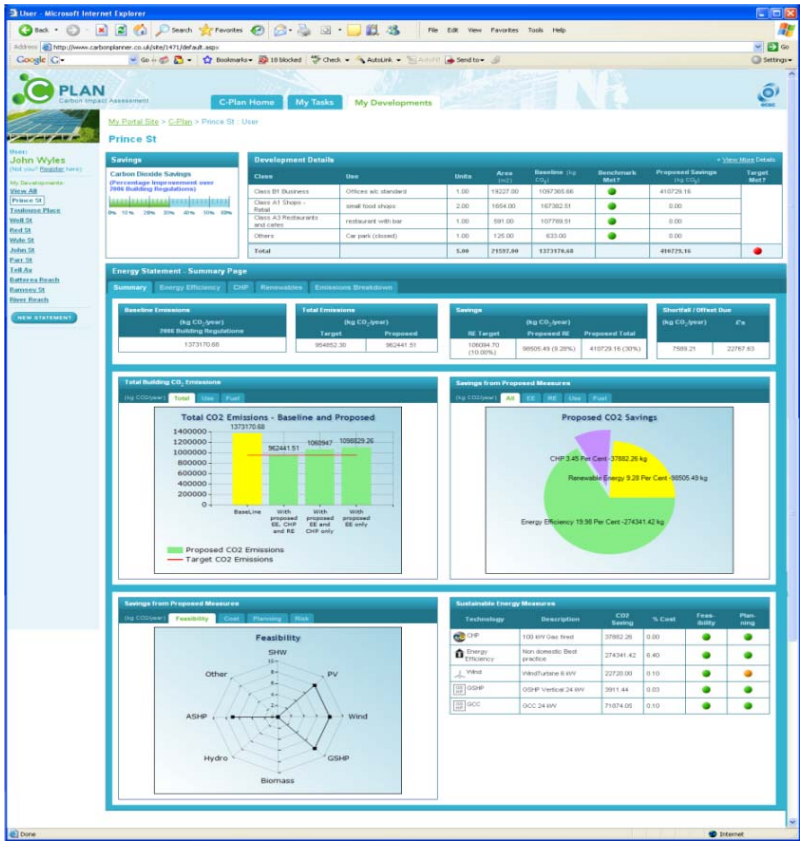



Figure 21: A demonstration of an output screen from CPlan (ecsc)

### 9.1.5 Training

Development control officers will need training to help them successfully implement policy. Officers need to understand the process and have the ability to undertake their own assessments as well as validate those of the developer. Training should be in-house and be relevant to the local policy and environmental context. It should be practically based and include relevant case studies and worked examples. It should include:

- A general understanding of climate change and its implications
- Key energy efficiency, low and zero carbon technologies, measures and their respective cost and benefits
- How to apply European Union, national and regional level guidance and policy in the planning application process
- Key arguments to use in negotiations
- Tools to assist in decision making
- Wider support programmes available
- A software tool which can be used to demonstrate compliance should be used to underpin the compliance process.

### 9.1.6 List of approved consultants

As noted in chapter 3, in many cases developers were lacking the necessary knowledge and required assistance to develop an energy statement. The Council should therefore compile a list of approved consultants who can assist developers.

## 9.2 Summary of recommendations for implementation of a policy

Table 11 Summary of recommendation for implementation of a policy

| Issue | Recommendations |
|---|---|
| Low skill level and experience within DC officers leading to low confidence when implementing policy. | A training course for development control officers should be specified. Training should be tailored to be relevant to the local policy and environmental context. It should be practically based and include relevant case studies and worked examples.<br><br>Training for DC officers should include visits to sustainable energy and renewable energy installations.<br><br>The Council should explore collaborative training and working practices with neighbouring authorities. |
| Low awareness within elected councillors | Provide workshop for councillors looking at implications of the policy.<br><br>Identify energy and carbon implications of a planning proposal under specific heading in committee reports.<br><br>Produce an annual monitoring report on implementation of the policy. |
| Applicant's uncertainty about how to respond to the policy | The Council to provide guidance clearly setting out precisely what targets are to be met and how compliance is to be assessed. Guidance could include:<br><br>• Web based information<br>• Press releases<br>• A seminar for agents and applicants<br>• Pre application guidance leaflets |
| Data needs to be captured in a consistent format from applicants. | A template energy statement needs to be defined. Ideally, this should be an electronic web based form to facilitate capturing of compliance data. |
| Energy / carbon performance data is not available at outline design stage. | A two stage process is recommended where an initial estimate of predicted performance is undertaken based on typical performance benchmarks for the proposed building type. A planning condition should be applied to ensure that further evidence to confirm the performance at detailed design stage. These should be based on the national calculation methodology SAP/SBEM carbon calculations. |
| Applicant unable or unwilling to provide detailed energy | Encourage the use of recognised benchmark data in the submission of energy statements. |

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| modelling data (e.g. SAP information) at planning stage | |
| The national calculation methodology used i.e. SAP/SBEM does not include all the energy loads such as all lighting and equipment. | It is recommended that the national calculation methodology based benchmarks be supplemented by estimates of full lighting and equipment consumption These additional loads could be based on benchmarks such as ECON 19 for offices. |
| Compiling and checking energy statements against benchmarks is a complex process that needs standardisation. | Providing a software tool that implements the compliance process should be considered. This tool should then underpin training for development control officers. Resources need to be identified for training of officers and information provided for elected members on planning committee. |
| Feasibility of proposed sustainable energy design options needs to be clearly demonstrated. | Applicant should provide evidence of the feasibility of sustainable energy options in terms of:<br>• Availability of sufficient energy demand where technologies are located<br>• Availability of sufficient space and renewable resource<br>• Visual impact and planning considerations<br>A graphical "traffic light" system to make it easier for planners to assess feasibility is recommended. |
| Applicants may seek to trade compliance with the policy against provision of the Council's other planning objectives (e.g. affordable housing). | Adopt use of compliance software that provides data on cost impact for schemes in order to be able to negotiate with developers on viability on tradability of the policy's requirements. |
| Applicant claims that the compliance with the policy is neither practical nor viable | Use of software tools to provide cost information and viability.<br>Ensure proposals for meeting policy are included at an early stage in the design of a scheme and addressed in pre application discussions. |
| Potential conflict between policy and other design objectives e.g. visual impact of renewable energy in conservation areas | Ensure early engagement in pre application discussions.<br>Include conservation officers in training on renewable energy.<br>Consider options for meeting policy with low visual impact e.g. use of solar tiles integrated with slate roofs.<br>Agree justification for making exceptions to policy. |
| Council's doubt over compliance in practice | Use planning conditions to ensure evidence of compliance provided by applicant. Conditions could include evidence of information provided by the developer for building occupiers on the use and operation of renewable energy equipment.<br>Include enforcement officers in the Council's training programme. On larger schemes, require the applicant to provide monitoring statistics for energy |

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| | consumption post application |
| LPAs need to report against authority-wide KPIs and national indicators including COIs (Core Output Indicators). | A central database of energy statements containing aggregated compliance data should be implemented and a set of management reports defined. |
| Emerging national policy guidance encourages LPAs to promote Community Energy schemes. | The compliance assessment methodology should include a way of demonstrating opportunities and benefits of Community energy schemes where heat and electricity demand can be balanced across the network.<br><br>An audit of existing decentralised energy infrastructure in Crawley should be carried out, including location, type, ownership and capacity. This information should be made available to planning officers in order to identify opportunities for new development to connect to it. |

# 10 Glossary

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|---|---|
| **Air Source Heat Pump (ASHP)** | A pump system that transfers heat from outdoor air to indoor air during the winter, and can work in reverse during the summer. |
| **Array** | Collection of panels (either solar thermal or PV) |
| **Biomass boiler** | A boiler that burns fuels such as wood chips, straw and agricultural residues. |
| **Building-mounted wind turbine** | A small wind turbine that is mounted on a building, usually attached to the building roof. |
| **Evacuated tube** | A type of solar collector for a solar thermal system. |
| **Feasibility study** | A study undertaken to determine the technical, economic and environmental viability of a project. |
| **Ground-source heat pump (GSHP)** | A pump system that takes the low-level heat occurring naturally underground and raises its temperature to a level that is sufficient to heat a building. |
| **Payback period** | The length of time taken to recover the cost of an investment through the returns attributable to it. |
| **Photovoltaic cells (PV)** | A silicon-based material that uses the energy in sunlight to create an electrical current. |
| **Renewable energy (RE)** | Energy that occurs naturally and repeatedly in the environment. |
| **Renewables obligation** | A Government initiative requiring electricity suppliers to source an annually increasing specified percentage of electricity from renewables. |
| **Solar thermal (aka Solar hot water)** | A method of heating water using the sun's thermal energy. |
| **Thermal Mass** | A measure of the extent to which a building can absorb heat. |
| **Wood Chip** | Wood reduced to small pieces. |
| **Wood Pellet** | Sawdust compressed into uniform diameter pellets to be burned in a heating stove. |

# 11 List of abbreviations

| | |
|---|---|
| **ASHP** | Air Source Heat Pump |
| **CHP** | Combined Heat and Power |
| **CLG** | Communities and Local Government |
| **$CO_2$** | Carbon Dioxide |
| **CSH** | The Code for Sustainable Homes |
| **DC** | Development Control |
| **DPD** | Development Plan Document |
| **EE** | Energy Efficiency |
| **EEBPH** | Energy Efficiency Best Practice in Housing (an EST Programme) |
| **ESCO** | Energy Services Company |
| **EST** | Energy Saving Trust |
| **GCC** | Ground Coupled Cooling |
| **GIFA** | Gross Internal Floor Area |
| **GSHP** | Ground Source Heat Pump |
| **GWh** | Gigawatt hours |
| **HVAC** | Heating, Ventilation and Air Conditioning |
| **kWh** | Kilowatt hour |
| **kWh/yr** | Kilowatt hours per year |
| **LDF** | Local Development Framework |
| **LPA** | Local Planning Authority |
| **m/s** | Metres per second |
| **PPS** | Planning Policy Statement |
| **PV** | Solar Photovoltaic |
| **RE** | Renewable Energy |
| **SAP** | Standard Assessment Procedure |
| **SBEM** | Simplified Building Energy Model |

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|---|---|
| **SHW** | Solar Hot Water (aka Solar Thermal) |
| **SPD** | Supplementary Planning Document |
| **SPG** | Supplementary Planning Guidance |
| **SUDS** | Sustainable Drainage Systems |
| **TER** | Target Emission Rate |
| **UDP** | Unitary Development Plan |