LONDON
RENEWABLES

London Energy Partnership

Towards Zero Carbon Developments: Supportive Information for Boroughs

Centre for Sustainable Energy
London Borough of Merton

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Foreword

Ken Livingstone
Mayor of London

The way London's buildings are built has huge implications for our environment, our economy and our society. Tackling the carbon footprint of our buildings is vital. The reason is straight forward – tackling climate change is now humanity's single most important task. London's buildings are responsible for over 70 per cent of London's carbon dioxide emissions. Globally more people now live in cities than in rural areas.

The development of zero carbon developments across London will accelerate innovation, creating shared knowledge on how to design and build the kind of buildings that will be essential to the long-term challenge of fighting climate change in urban areas. A major world city like London can play a decisive role in setting an example for the rest of the world to follow. And in the process London can become a key player in the new technologies and services that will drive the 'sustainable economy' of the coming decades.

My target for at least one zero carbon development in every borough by 2010 is challenging, which is why we need to act now to build on the work that has already taken place in this area. Early this year I announced plans for a new zero carbon development to be taken forward by the London Development Agency working together with Arup and Greenpeace.

Zero carbon developments are part of a suite of projects and policies to deliver sustainable energy in London. The London Plan, and it's review, includes policies to tackle the energy consumption of major developments. Many involve collaboration of a number of organizations, including the pilot Energy Action Areas – which act as exemplar low carbon developments in London, the Green Homes Service Company and work looking at financing London's low carbon future.

This report developed by the London Energy Partnership aims to support boroughs in taking forward zero carbon developments in their areas. There however many others who also have a role to play. Landowners, developers, architects, builders, central government and unitary development authorities can also help London forge a lead in this growing area.

Executive Summary

The target in the Mayor's Energy Strategy, and referred to in the London Plan, of at least one zero carbon development in every borough by 2010 will, in most cases, require action by boroughs. In order to assist boroughs with this task, the London Energy Partnership commissioned the Centre for Sustainable Energy, in partnership with the London Borough of Merton Planning Officers, to provide supportive information for boroughs.

The main project aims were to develop a robust, broadly accepted working definition of zero carbon developments and, if possible, low carbon developments and to produce supportive information for London boroughs to aid them in the identification of suitable sites. Another main aim was to encourage use of the boroughs' powers as landowners and in forming partnerships with others to bring about zero carbon development. The study involved a stakeholder consultation exercise followed by a peer review meeting to further discuss the scope and content of the supportive information.

The supportive information is targeted principally at borough officers, including planners, and therefore includes practical advice around how local authorities can use their powers to encourage zero carbon developments, an overview of key arguments they can use in discussion with developers, and lessons to be learnt and pitfalls to avoid when taking forward proposed developments. Also included is a checklist summarising the issues when holding discussions with developers and the identification of key stakeholders to compare their information needs. A number of specific areas are covered within the information which include relevant current planning policy issues and the introduction of Local Development Frameworks.

A general overview is given of the characteristics of a development or site which may be suited to zero carbon developments. These include locational characteristics such as areas with specific planning designation and certain geographical variables relating to renewable energy resources. The scale, type and land-use of a development are also assessed and how these relate to low carbon measures.

A discussion around choice of technology is included and covers general issues relating to community energy networks, combined heat and power, energy efficiency and renewables. Detailed technical advice is not within the scope of this document and the text therefore makes reference to other more in-depth guidance, such as the London Renewables Toolkit, where appropriate. A list of relevant case studies and a summary of the key characteristics of each is included in Appendix B.

The supportive information suggests that, through new planning guidance and policy development, there exists a significant opportunity to set new standards for built

development to help address the challenges of climate change. A range of viable technologies for zero carbon developments are available, all of which can also be applied to low carbon developments. An increasing number of case studies can now be referenced.

There is a need for a coordinated approach across borough departments in enabling zero carbon developments and officers from a variety of departments can contribute to the process. Opportunities available to boroughs include the facilitation of multi-sector partnerships to oversee projects and the potential to apply conditions to the sale of public land to ensure zero carbon development.

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1 Introduction

1.1 Who has prepared this guidance?

In order to assist boroughs with facilitating and implementing zero carbon developments, the London Energy Partnership has commissioned the Centre for Sustainable Energy, in partnership with the London Borough of Merton Planning Officers, to provide supportive information for boroughs. This work aims to develop definitions of both zero and low carbon developments and supportive information in implementing these within the London boroughs. The work is jointly funded by the Department of Trade and Industry and the Greater London Authority.

1.2 Why is guidance needed in London for zero carbon development?

In 1997, London used more energy than the whole of Ireland. London's boroughs have a particularly important role in helping to tackle London's contribution to climate change. In a large urban area like London, with huge development pressures and changes underway, there is a unique opportunity to reduce carbon emissions through the planning system and other borough activities. The new spatial planning system encourages planners to have regard to a broad range of climate change issues including energy.

The GLA Housing Requirements Study estimated that some 35,400 new homes are needed every year (see the Further Alterations to the London Plan for details). In addition some 847,000 new jobs are forecast for London by 2006-2026. These pressures will create demand for major new developments to provide new places of work, shopping and related social and cultural facilities. The Mayor's Energy Strategy identifies that 44% of London's carbon emissions are from housing, 29% from commercial buildings and 21% from transport. Therefore, by influencing built development, there is significant potential to reduce London's carbon emissions.

Through new planning guidance and policies there is an opportunity to set new standards for built development to help address the challenges of climate change. Zero carbon development guidance is one significant way that boroughs can contribute to designing and building climate-neutral buildings in London.

The target in the Mayor's Energy Strategy, and referred to in the London Plan, of at least one zero carbon development in every borough by 2010 will, in most cases, require action by boroughs. There is, at present, a lack of clear guidance available to boroughs on how to achieve this. This supportive information aims to address the following issues and has been developed primarily to assist boroughs in realising zero carbon developments in their borough:

- What constitutes zero carbon developments?
- What sort of planning policies might be appropriate and enforceable?

- How may suitable sites be identified?
- What other mechanisms, processes and arguments can be used to help bring about development of such sites?

1.3 How can this guidance help boroughs meet the challenge of climate change?

This guidance provides a focus for boroughs wishing to encourage zero or low carbon development in London. It is not concerned with wider aspects of climate change policy, some of which are covered by other publications (see Section 1.6), but is concerned only with the energy-use aspects of zero or low carbon buildings within the proposed definitions. Section 2 provides more detail on definitions of this form of development.

This guidance is therefore one contribution to assist boroughs to help mitigate climate change in London. Borough officers, including planners, will need to link this guidance to other policies and initiatives that may apply to sustainability aspects of all development. This will encourage an integrated approach that may include, for example, promoting sustainable design and construction, renewable energy in London, car free development and development that reduces carbon emissions from transport. Flooding and water use are also related.

Note – one of the principal aims of this work is to make it easier for borough to enable zero and low carbon developments in their areas and to identify at least one suitable site for zero carbon development in their borough and facilitate its development. Therefore, although the main focus is on zero carbon development, many of the issues discussed also apply to low carbon development and will also serve to help boroughs in enabling these.

1.4 What are the Greater London Authority and Mayor doing to take a leadership role?

'*..climate change is the most important issue affecting humanity'*
Mayor of London, 6 March 2006

The London Plan refers to the Mayor's Energy Strategy[1] target of at least one zero carbon development in every London borough by 2010. Policies 4A.7 and 4A.8 set out guidance on energy efficiency and renewable energy. Policies 4A.9 and 4A.10 provide further guidance for both building-integrated and stand-alone renewable energy. Policies such as 4A.15 are also included to tackle impacts of climate change[2], and the first review of the London Plan is underway. The *Draft Further*

[1] The Government proposes to make it a statutory duty for the Mayor to produce a Climate Change and Energy Strategy (It is expected that the existing Energy Strategy fulfils this duty, which will add weight to the existing strategy.) See: *The Greater London Authority: The Government's Final Proposals for Additional Powers and Responsibilities for the Mayor and Assembly*, (DCLG) July 2006.
[2] See also Section 1.6 (London Guidance) *'Adapting to Climate Change: a checklist for development'*

Alterations to the London Plan (see Section 1.6) states that the "Mayor will and boroughs should in their DPDs [Development Plan Documents] require developments to make the fullest possible contribution to the mitigation of and adaptation to climate change and, in particular, to reduce emissions of carbon dioxide" (4A.15 Tackling climate change) and it includes a number of revised policies.

The construction of zero carbon developments across London would increase the pace with which both the planning system and the construction industry embrace sustainability as a fundamental design criterion. The Mayor's Sustainable Design and Construction Supplementary Planning Guidance, May 2006, also includes zero carbon developments as part of the Mayor's preferred standard for energy.

In order to help achieve the target of one zero carbon development in each borough, the Mayor's Energy Strategy calls on all boroughs to identify at least one suitable site for such development, use their powers as landowners or partners with others to bring about its development, and include the site(s) identified in their local development documents. A number of boroughs have already taken some action in this area.

1.5 How is the Government supporting zero carbon development in London?

'Climate change is the most severe problem we are facing today'
Sir David King, UK Government Chief Scientific Adviser, 2004.

There is '*no bigger long-term question facing the global community'* than the threat of climate change, said Prime Minister Tony Blair at the launch of the Climate Group, an international campaign aimed at speeding up greenhouse gas emission reductions. April 2004

'Our long term ambition should be zero carbon development. We do not know yet how fast we can get there, but the development industry should be clear about our aims and should start planning now for new investment and innovation to meet our goals. …..... Our aspirations should be for a Carbon Neutral Gateway. We need to know whether and how fast we can deliver first low carbon development, but ultimately carbon neutral development, in which we reduce the carbon emissions from existing homes at the same time as building low cost, low carbon developments on new sites too. We want the Thames Gateway to lead the way towards our long term national target of 60% reduction in emissions by 2050' Yvette Cooper, Minister for Housing and Planning, 8 June 2006

The new UK Sustainable Development Strategy: *Securing the Future* and the UK Government's Climate Change Programme 2006 reinforce the urgency of tackling climate change and the Government has set or agreed a number of targets to reduce releases of greenhouse gases. They include:

- Reduction of greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012 (Kyoto Protocol). Additionally, the Government's manifesto made a commitment to reduce carbon dioxide emissions by 20% below 1990 levels by 2010
- Putting us on the pathway to reduce carbon dioxide emissions 'by some 60% by about 2050 with real progress by 2020', as recommended by the Royal Commission on Environmental Pollution, and as accepted as a Government goal in The Energy White Paper (2003)
- Producing 10% of electricity from renewable sources by 2010 and 15% by 2015, with an aspiration of 20% by 2020 (Renewables Obligation).

As well as setting targets, the Government has sought to address climate change through a number of planning policy initiatives and has committed to a planning policy statement on climate change. In particular, tackling climate change is identified as a priority in Planning Policy Statement (PPS) 1: Delivering Sustainable Development, and Planning Policy Statement 22: Renewable Energy. PPS 1 states:

'Local planning authorities should ensure that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change' (paragraph 13 ii).

In addition to the general requirement in PPS 1 for planning bodies to deal with climate change the Government also gives standing to the UK Sustainable Development Strategy as material to the planning process. Paragraph 13 (i) of PPS 1 states,

'Development plans should ensure that sustainable development is pursued in an integrated manner, in line with the principles for sustainable development set out in the UK strategy.'

PPS 22: Renewable Energy, also aims to address climate change by the application of renewable energy. This includes a list of key principles to which regional planning bodies and local planning authorities should adhere in their approach to planning for renewable energy, an example of which states:

'Regional spatial strategies and local development documents should contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources.

Yvette Cooper's statement indicates the government's commitment to such policies:

> '*We now need all local authorities to set requirements for on site renewables in their local plans. Today we have set out a Parliamentary Statement to support*

Planning Policy Statement 22 making clear Government's expectations that all local authorities should set requirements for on site renewables in developments, and encouraging them to learn from other local authorities too on how far they can go. ……. As you will know we are already working towards a new planning policy statement on climate change. That is our opportunity to embed even stronger consideration of carbon emissions in all aspects of the planning process' , 8 June 2006

1.6 Where can I find out more information?

National Guidance

- *UK Sustainable Development Strategy* (DEFRA). Includes guidance on a range of carbon reduction targets and renewable energy targets. Chapter 4 reproduces the full range of the UK Government's international and domestic carbon reduction and renewable energy generation targets. www.sustainable-development.gov.uk/publications/uk-strategy/uk-strategy-2005.htm
- *Government Energy White Paper* (DTI 2003). Reduce carbon by 20% by 2010, to 60% by 2050. The Energy White Paper 'Our energy policy – creating a low carbon policy' (DTI, 2003) Page 4, Section 1.10. www.dti.gov.uk/energy/whitepaper/index.shtml
- *The Energy Challenge, Energy Review Report* (DTI, 2006) www.dti.gov.uk/energy/review/
- *Government Planning Policy Statements on sustainability and energy*; PPS1, PPS12, PPS22. Promote the use of renewable energy and energy efficiency to help meet Government carbon reduction targets. A PPS on climate change is to be developed: www.communities.gov.uk/planning.
- *Strategic Environmental Assessment (SEA) and Sustainability Appraisal (SA)* 2004. Allows climate change to be considered in all planning policies and decisions.
- *Building Regulations 2006 Part L*. Covers the conservation of fuel and power in both dwellings and buildings that are not dwellings. www.communities.gov.uk/index.asp?id=1501258
- *Government Planning Policy Statement on regional spatial strategies*; PPS11. Includes guidance on climate change and energy. (2004). www.communities.gov.uk/planning.
- Regional Spatial Strategies (RSS). These should also include guidance on climate change and sustainable energy. Procedural policy is given in PPS 11.
- *Beating the heat: keeping UK buildings cool in a warming climate*, 2005. www.ukcip.org.uk/resources/publications/pub_dets.asp?ID=69 For more detailed information see: *Chartered Institution of Buildings Service Engineers*

(CIBSE): Climate Change and the Indoor Environment: Impacts and Adaptation (CIBSE TM36)

- Code for Sustainable Homes. Formerly the Code for Sustainable Buildings, this aims to introduce a system of sustainable building standards based on voluntary compliance. The Code as proposed will have five performance levels from a basic entry level to an aspirational carbon-neutral 'five star' development. www.communities.gov.uk/index.asp?id=1162094
- Energy Saving Trust standards. These predefined standards for energy efficiency in domestic housing are intended for use on new developments and range from slightly better than building regulation (Good practice), to extremely efficient exemplar housing (Advanced). The main standard (Best Practice) sets a target of 25% lower CO2 emissions than building regulations (2006).

London Guidance

- *The London Plan, Spatial Development Strategy for Greater London*. Policies 4A.7-4A.9 require energy efficiency, efficient supply of energy and renewable energy in schemes. February, 2004. www.london.gov.uk (see also *Draft Further Alterations*)
- *Draft Further Alterations to the London Plan* - Initial draft of London Plan Review document for consultation *with* the London Assembly and GLA functional bodies. Includes draft policies to ensure boroughs make the fullest possible contribution to the mitigation of and adaptation to climate change. Minimum reduction targets of carbon dioxide emissions for London against a 1990 baseline for 2010, 2015, 2020 and 20205 are also included. May 2006. www.london.gov.uk/mayor/strategies/sds/further-alts/docs/further-alts-all.pdf
- *Mayor's Energy Strategy*. Proposals 2 & 9 seek one zero carbon development in each borough by 2010 and includes regional energy and climate change targets. www.london.gov.uk/mayor/strategies/energy/index.jsp
- *Integrating Renewable Energy into New Developments: Toolkit for Planners, developers and consultants*, *London Renewables*. Sep 2004 www.london.gov.uk/mayor/environment/energy/london_renew.jsp
- The *Mayor's Supplementary Planning Guidance on Sustainable Design and Construction* – sets out what can be done in the current policy framework to design and construct new developments in ways that contribute to sustainable development. May 2006. www.london.gov.uk/mayor/strategies/sds/sustainable_design.jsp
- *Low Carbon Designer* – a Zero and Low Carbon Design Electronic Toolkit being developed by the London Energy Partnership in 2006. It is expected to comprise a suite of calculation engines and data tables for use by designers,

developers and others seeking to incorporate all elements of building-integrated sustainable energy and design into their designs, proposals, developments, specification and other work.

- *Adapting to Climate Change: a checklist for development*. Guidance on designing developments in a changing climate, published by GLA on behalf of South East Climate Change Partnership, Sustainable Development Round Table for the East of England and London Climate Change Partnership. Nov 2005. www.london.gov.uk/climatechangepartnership/development.jsp. See also *Beating the Heat* (above).

  For, *London's Warming*, see london.gov.uk/gla/publications/environment.jsp

- *Renewable Energy in London: The Role of Planners*. This initiative aims to support planners in their implementation of the policies set out in the London Energy Strategy *and* London Plan, therefore helping planners to work towards achieving policy targets for renewables. Sept 2004. www.london.gov.uk/mayor/environment/energy/docs/renew_planners.pdf

- *Financing London's Low Carbon Future* includes 5 carbon scenarios to 2026. To be published on LEP web pages.

- *Making ESCOs work: Guidance and Advice on setting up and delivering an ESCO in London, with specific relevance to the Pilot Energy Action Areas.* To be published on LEP web pages.

- *Planning policy: making it happen.* To be published on LEP web pages.

- *Attitudes to renewable energy in London: public and stakeholder opinion and the scope for progress*. Dec 2003. See www.london.gov.uk

Local Guidance

- Community Plans and targets to reduce carbon and build low carbon developments

- Borough climate change/ sustainable energy strategies (see also Section 11)

General Guidance

- Friends of the Earth briefing: *Tackling Climate change at the local level*. Useful guidance on LDF *role* to deliver low carbon development. (2005). www.foe.co.uk/resource/briefings/ldf_climate_brbriefing.pdf

- *The 40% House*; Environmental Change Institute, University of Oxford. Useful research report into low carbon buildings with data. www.eci.ox.ac.uk

- *Leading the Way: how local authorities can meet the challenge of climate change* (LGA, 2005). www.lga.gov.uk

- The Energy Saving Trust. *Many* useful guides. www.est.co.uk

- WWF various useful reports including:

- *Enabling One Planet Living in the Thames Gateway* (BioRegional and WWF, 2004). www.wwf.org.uk/filelibrary/pdf/z-squared2004.pdf

- *One Million Sustainable Homes Brief* (WWF, 2004). www.wwf.org.uk/filelibrary/pdf/OMSHbrief.pdf

- Energy Efficiency Best *Practice* in Housing – examples include:
  - *Benefits of Best Practice: Heating and Insulation*
  - *Energy Efficiency Standards – For New and Existing Dwellings* (GIL72) www.est.org.uk/housingbuildings/specifiers

2 Definitions of Zero Carbon Developments

The Mayor's Energy Strategy currently refers to zero carbon developments[3] as "highly energy-efficient developments, powered and heated by renewables with zero net carbon emissions". In order to develop these, it is necessary that a more robust, broadly accepted working definition of zero carbon developments is first established. It is also recognised that an appropriate definition for low carbon developments would also be useful. (See Appendix A for further details.)

2.1 Zero Carbon Developments

Definition of Zero Carbon Development

A zero carbon development is one that achieves zero net carbon emissions from energy use on site, on an annual basis.

The definition is further clarified as follows:

a) Energy use on site relates to all energy uses of buildings and structures, and what goes on within them, excluding transport. These uses are (as given in the London Renewables Toolkit) heating, hot water, cooling, ventilation, lighting, cooking, appliances, computers, lifts, processes, floodlighting, etc. All non-building energy use on the site should also be included within the assessment, e.g. street lighting.
b) Fossil fuels may be used on site, as long as there is sufficient export of renewable heat, cooling and/or power to offset the resulting carbon emissions.
c) For multi-phase zero carbon developments, it will be agreed at the planning stage in which phase elements of zero carbon energy infrastructure are introduced. Furthermore, it will be required through appropriate planning conditions that all contributing technologies are installed prior to completion of the whole development. Where the infrastructure is not applied pro rata across each phase, adequate justification should be given in taking this approach and the delay of installation of zero carbon technologies to the final phase(s) should be avoided.
d) Zero carbon status of the development, and how this has been achieved, should be detailed in an Energy Assessment, which authorities may use to assess this status. Energy Assessments are included with planning applications for major developments. These should include the predicted energy use and associated carbon emissions and state any savings, against contemporaneous building regulations, through improved design, energy efficiency measures, efficient supply options and renewable energy technology. Further details are presently available in the London Plan and the London Renewables Toolkit. Readers should refer to the Further Alterations to the London Plan and the Low Carbon Designer when available (see Section 1.6).
e) Zero or low carbon energy may be imported from off-site sources in the form of heat (or cooling) from local networks, or in the form of electricity where this is connected by private wire and the development provides additionality,

[3] In some publications, zero carbon developments are also known as zero emission developments (ZEDs)

which may need to be adequately demonstrated. The carbon fraction of low carbon energy imported from off-site sources may be offset by the export of zero carbon energy.

f) Although the definition does not specifically cover climate change impact adaptation, waste, transport, embodied energy, water, noise, biodiversity, green space and air quality, the development should meet the Essential Standards given in the Mayor's Supplementary Planning Guidance on Sustainable Design and Construction, and any update to these in the Further Alterations to the London Plan, as a minimum and relevant local environmental and social standards that apply to new developments. It is expected that exemplar developments will seek to go beyond the essential standards in all areas of sustainability, particularly where they affect energy use.

g) Adequate infrastructure for post-construction monitoring of energy use in the development should be provided.

2.2 Low Carbon Developments

Definition of Low Carbon Development

A low carbon development is one that achieves a reduction in net carbon emissions of 50% or more from energy use on site, on an annual basis.

The items listed in points a) to g) for the zero carbon definition also apply to the low carbon definition.

In addition, the 50% reduction in carbon emissions will be in relation to those resulting from the 2002 Part L Building Regulations and, for carbon emissions relating to sources not covered therein, relevant Good Practice benchmarks such as those used in the London Renewables Toolkit. Further work will need to be undertaken to establish a percentage reduction in relation to the 2006 Building Regulations. See Appendix A for further details.

3 Areas of Planning Policy Which May Impact Zero Carbon Developments

The aim of this section is twofold. First, to identify other areas of planning policy that potentially conflict with taking forward a zero carbon development. These are highlighted in the hope that borough officers will then be able to foresee such conflicts, and modify the plans for the development accordingly at an early stage. The need for boroughs and the GLA to prepare Sustainability Appraisals as part of the new planning system should assist in the identification of potential policy conflicts and enable zero carbon development to be encouraged.

Second, this section aims to identify opportunities for synergy with other existing plans and policies, or potential ways in which those plans may be modified in future to facilitate zero carbon developments.

This section should be considered in conjunction with Section 11, which deals with key stakeholders, plans and strategies to influence.

This guidance has identified the need for new policies in the London Plan and Borough LDF to promote zero (and low) carbon development. Without strong policy support, opportunities will be limited. In addition to formal policy guidance as part of the development plan, boroughs in particular can prepare Supplementary Planning Documents to provide more detailed guidance on zero carbon development. This can take a variety of forms such as area specific masterplans or planning briefs. Alternatively, general guidance on climate change mitigation or sustainable design and construction should include guidance on zero carbon development.

3.1 Policies Relating to Development Characteristics

Examples of national, regional and local planning policy areas directly relevant to zero or low carbon development are given below, together with an indication of whether they may come into conflict with such developments, support them, or potentially do both.

Table 1: Relevant policies and their potential effect on zero or low carbon development

Policy	Support?	Conflict?
1. Energy efficiency – For example, see the Mayor's energy hierarchy and London Plan policy 4A.7. Some boroughs have similar policies.	✓	

2.	Renewable energy – expectation or requirement for a percentage (examples include 10% and 20%) on-site generation policy (For example, adopted in several London boroughs' Unitary Development Plans and the London Plan, with 20% in the Draft Further Alterations to the London Plan). Planning Policy Statement 22 and the London Plan support, or expect, positive policies and prescriptive policies that support the use of renewables in development. The London Plan and its Draft Further Alterations include guidance and several boroughs now have emerging policies.	✓	
3.	Sustainable design and construction – for example the type of materials used and their origin will determine the embodied energy of the building.	✓	
4.	Energy generation – this relates to facilities that produce renewable energy. There is an opportunity for policies to identify and promote the use of heat in new developments from local heat networks, including combined cooling (where needed) heat and power from, for example, biomass.	✓	
5.	Community heat and power policies - have the potential to enable low carbon development. In particular if linked to renewable energy supplies such as, from biomass For example, see *Draft Further Alterations to the London Plan*, New Policy 4A.5i.	✓	
6.	Waste - policies referring to the diversion of the organic components of waste from landfill which could then be used in Energy from Waste plant using new and emerging methods such as Mechanical Biological Treatment (See also point 4 and section 5.3).	✓	
7.	Affordable housing – see the London Plan Supplementary Planning Guidance on Housing, Nov 2005. The mix of housing types should also be considered. The higher the affordable housing requirement the more pressure there will be on reducing the build cost. However the potential to reduce energy bills and to help address fuel poverty concerns are potential benefits and address social concerns.	✓	✓
8.	Development density – low densities may conflict with making energy savings needed for a zero carbon development. In addition they may increase energy use from transport. However, low densities may make some forms of renewable energy more viable – such as wind power.	✓	✓
9.	Mixed-use policies - hold the potential to spread the heat load, provide additional summer cooling loads and increase the viability of combined heat and power (see Section 5.3).	✓	

10.	Local Air Quality standards/ Clean Air Act - potentially these may conflict with use of biomass heating and CHP, due to emissions of NO_x and particulates – although systems are designed to meet stringent European standards. This can be addressed by involving an Environmental Health Officer. Potential problems can also be mitigated by abatement equipment or increasing the stack height.		✓

3.2 Supplementary Planning Guidance/ Supplementary Planning Documents

There are areas of supplementary planning guidance at a local authority level that may also be relevant. These give further guidance to some of the above policy areas. The key point is that by providing appropriate "hooks" for carbon reduction in new development (as set out in Section 7) within Local Development Frameworks, then more detail can be provided within relevant supplementary planning documents. As these documents emerge, there is an opportunity to influence them so that they provide synergy and consistency in providing for zero and low carbon development.

The Mayor has produced Supplementary Planning Guidance on Sustainable Design and Construction (see Section 1.6) which should also be considered.

4 Site Characteristics Suited to Zero Carbon Developments

4.1 Overview

What actually makes a particular site more amenable to achieving zero carbon status?

While for most situations there are a number of common characteristics which may clearly help in this respect, it is also recognised that there is no 'one size fits all' set of criteria to apply, as there is no set way of achieving a zero carbon development. The characteristics that are potentially suitable for low carbon measures may relate to the proposed development in terms of the location of the site, such as area designation, availability of local renewable energy resources and proximity to energy networks. They may also relate to the development itself, for example in terms of density, scale, building type and function. Borough officers need to be aware of such issues when considering potential plots of land for development and when discussing proposals with developers.

Thus, the development and site characteristics of a zero carbon development that a local authority or developer would seek to incorporate will be largely influenced by the approach initially taken. For example, a local authority may look to an existing proven development within the UK and wish to replicate this within its borough. In this case a site would need to be identified to suit, as far as possible, the development's characteristics. Alternatively, a site may have been previously identified for regeneration and be a preferred option for a zero carbon development. The local authority or developer would then need to identify a set of development characteristics to suit the proposed site.

The main characteristics considered here are those relating to location, scale, type, technology and ownership/finance.

4.2 Location

4.2.1 Areas for Intensification, Areas for Regeneration and Opportunity Areas

As defined in the London Plan and sub-regional planning frameworks, these key areas may also offer opportunities to encourage zero carbon developments and could link to the Energy Action Areas mentioned below.

Areas of Intensification have significant potential for increases in residential, employment and other uses through the development of sites at higher densities with more mixed and intensive use. Access to good transport links and locally produced food are key criteria for a wider concept of zero carbon developments (if the transport carbon emissions footprint is factored in). Also potential residents of zero carbon developments may be more likely to minimise car use and require public transport and cycling facilities.

Residential units close to public transport hubs may potentially command higher values and as such may enable financial models for zero carbon developments to work. This will be particularly true if the location is highly sought after in terms of services, facilities and its general image.

Areas for Regeneration are clearly a focus for action, and will range from high profile, high value sites such as waterfront locations, to more deprived areas that may benefit from public funding through mechanisms like Neighbourhood Renewal initiatives. This injection of public funding can provide planning levers to deliver zero carbon developments.

Opportunity Areas comprise sites for accommodating large scale development to provide substantial numbers of new employment and housing, each typically more than 5,000 jobs and/or 2,500 homes, with a mixed and intensive use of land and assisted by good public transport accessibility. This potential for large scale, mixed use applications are again conducive to zero carbon developments (see Sections 4.3 and 5).

4.2.2 Energy Action Areas (EAAs)

The London Plan and Mayor's Energy Strategy refer to the creation of Energy Action Areas within London. The present pilots and future Energy Action Areas should be recognised as strong contenders for low and zero carbon development sites. An Energy Action Area is a geographical area that acts as a showcase low carbon community, successfully demonstrating a range of sustainable energy technologies and techniques across a number of applications throughout the area. It is suggested that concentrating activities in this way would add value and profile to projects, generate nodes of good practice, and provide a model for the rest of London and other urban areas to follow.

Four pilot areas, announced in July 2005, represent a mix of projects (new build and refurbishment) offering a range of responses to meeting the challenging targets set in the Energy Strategy. They are in New Wembley, Barking Town Centre, Merton and Southwark. The London Energy Partnership is responsible for developing and implementing the Energy Action Areas as a priority project and are working with developers and local authorities to explore ways of reducing carbon emissions at these sites.

Pilot EAAs are important due to their potential for larger scale developments and the resulting benefits from using community heating and combined heat and power (CHP) (see Sections 4.3 and 5.3). They also offer unique opportunities to create multi-partnerships, led in some cases by boroughs (for example Merton, Southwark and Barking & Dagenham), and the commercial sector in others (for example Quintain Estates/Brent Council for the New Wembley project).

One of the key remits of the EAA programme is to create replicable models for the rest of London. The fact that all four pilot EAAs are exploring a wide range of multi-partner and technological approaches will mean that valuable lessons will be learnt about different ways of progressing low carbon developments. These lessons will help in identifying future EAAs.

4.2.3 Land where any additional cost is unlikely to affect the overall viability of development

In the very short-term, the following may be a consideration. However, costs of sustainable energy solutions need to be established and worked in at the earliest stage and be part of both the site and building valuation.

A number of factors affect whether the requirements of zero carbon development may affect the overall viability of a development on a particular piece of land. These will range widely. Factors may include the original cost of the land, the systems and specifications the developer puts in place to ensure a zero carbon development, the experience and co-operation of the design team and other aspects of the development, the technologies that are feasible to achieve such a standard on that site and the value of the built development.

In the short term, where developers have not factored in any additional cost (due to policies not being in place) when purchasing land, an increase in land value may negate that lack of foresight and provide the financial buffer to cover additional cost.

4.2.4 Geographical Variables

These include climatological, geographical and geological factors that may need to be considered to assess if a site is suitable for a particular renewable/ sustainable technology. These may include:

- Wind resource – in urban areas the possibilities for higher wind speeds are perhaps greatest close to expanses of water, on high ground, exposed sites and on high buildings. However, the new generation of micro-turbines and roof-mounted devices now provides the opportunity for electricity generation on many high density urban buildings, which tend to experience lower wind speeds.
- The London Energy Partnership has recently completed a study into the potential for non building-integrated wind and biomass plants in London[4]. The wind study provides a set of guidelines detailing what renders a site suitable for installing wind turbines and from this, identifies a number of locations

[4] *Feasibility Study into the Potential for Non-Building Integrated Wind and Biomass Plants in London* available at www.london.gov.uk and www.lep.org.uk. Published by GLA on behalf of the London Energy Partnership.

across London which are potentially suitable for commercial-sized (medium to large, >100kW rated capacity) wind turbines.

- Biomass resource – the local availability of quality fuel is clearly a key factor for biomass energy plant. Transport and delivery costs will tend to limit the economically viable radius within which fuel can be sourced. If the fuel is a by-product from municipal management (for example, arboricultural wood residues) then associated carbon emissions will be less than with commercial energy crop cultivation for high-density urban developments. For a large population centre such as London, existing municipal and industrial waste streams hold potential for energy recovery from waste, where the biodegradable proportion of the waste can be classed as renewable under the Renewables Obligation. (For details on the most desirable technologies see section 5.3.) Space requirements for the storage of fuel and the impact of delivery vehicle movements on the locality will also need careful consideration. Good access to a site via nearby transport hubs, particularly rail and docks, will also facilitate the transportation of fuels. The London Energy Partnership's *Wind & Biomass Study* identifies potential sources of biomass fuel in London and recommends a number of options for establishing supply chains.
- Solar incidence – the topography of a site and its immediate surroundings will influence the potential for the passive solar design of a development as well as active solar technologies such as photovoltaics and solar water heating. Relevant factors may include overshading from adjacent tall buildings, particularly from the south-facing aspect of the site.
- Land area and geology – ground source heat pumps require access to land for either trenched or borehole ground loops. With trenching, land availability will restrict the size of the system. With boreholes, less land area is required but knowledge of the underlying geology and presence of groundwater is usually needed in order to properly design the ground loop – this is normally established from existing information or by a test bore. Other 'ground-coupling' technologies utilise aquifers for thermal energy storage in order to drive heating and cooling systems.
- Proximity to bodies of water – may create the potential for water source heat pumps.

The London Renewables Toolkit includes more detailed advice on assessing the suitability of locations for different renewable technologies.

4.2.5 Proximity to existing sources of low carbon heat

The London Community Heating Development Study published in May 2005 provides a detailed study of the potential for community heating in London and outlines some sources of low carbon heat.

4.3 Scale

The scale of the development, along with usage mix, will influence orientation options, thermal mass and passive solar design (PSD) techniques and the choice of technology. It is likely that one technology mix will be more appropriate than others at different scales of development. There are no rigid guidelines to this effect and each development will be case-specific, but economy of scale will mostly dictate feasibility. An obvious example is with combined heat and power (CHP) and district/community heating, where larger systems supplying stable levels of heat demand tend to be more viable than smaller ones.

Large-scale developments will tend to present more options for passive solar design and natural ventilation techniques as the interaction between adjacent buildings within the development can be controlled. Single-buildings or smaller developments, such as infill housing, are likely to be affected to a greater degree by existing buildings or obstacles around the site perimeter. Improved airflow and cooling effects can be achieved by reducing the ratio between the height and spacing of buildings (the H/W ratio), which can help to avoid the urban heat island effect (see Section 4.4).

Zero carbon is the Mayor's preferred energy standard for major developments, as stated in the Supplementary Planning Guidance on Sustainable Design and Construction. The Mayor's expectation of at least one zero carbon development in each borough by 2010 does not stipulate a minimum or maximum scale of development.

Small-scale development down to individual buildings can be designed as zero carbon developments through a range of technologies (see Case Study No 4 – BowZED), but the lack of economies of scale will normally favour the lower-cost option. Additional costs are normally accepted as part of the commission as these developments are more likely to be bespoke-built than a large-scale development, for example as private commissions. Small-scale developments will tend to be easier to monitor in terms of energy performance.

The advantage of large-scale developments is that they are likely to reach a certain size/density which makes zero carbon design more economically viable through economies of scale. This "critical mass" size will fluctuate according to issues such as the cost and sale value of grid electricity, the energy options available at that site and the potential for bulk purchase discounts of materials and equipment on larger orders.

For large developments where phasing over a period of time is more likely, an energy infrastructure 'masterplan' may need to incorporate a degree of modularity to systems. Modular systems, such as photovoltaic arrays, may then be added and

connected at each phase as developers are likely to find loading the cost of distribution all on the first phase to be onerous.

However, the cost and infrastructure of low carbon technologies[5] should not be left entirely to the final phases (see Section 2.1 Item C). For example, installation of pipework for a heat network extension to later-phase buildings should be installed before other infrastructure, such as roads, may cause future problems. The final plans for a site should be made clear to all stakeholders so that they are aware of future site installations.

For residential developments, a buoyant housing market may help units to be sold at a premium and therefore a smaller development area is required for the project to be commercially viable.

The influence of scale on technologies for non-residential zero carbon developments encompassing schools, hospitals, transport infrastructure, civic centres, waste management facilities (energy recovery from waste), retail, leisure, etc, will depend on the development mix. These are also likely to have different financial and partnership circumstances and hence different criteria in terms of economic viability.

As suggested in the Enabling One Planet report (see Section 1.6), a person's environmental impact is related to their portion of shared infrastructure and services – it is anticipated that by building larger developments of sustainable communities which are 2,500+ homes rather than the 100 units of BedZED (see Case Study No 1), the impact of these shared elements can be tackled more comprehensively.

4.4 Land Use and Form of Development

The site characteristics referred to here are concerned principally with the building type, land use, mix and form. The London Renewables Toolkit includes rough guide to where renewable energy technologies can be used and an indication of which of these technologies are most likely to be suitable in different single land use development scenarios such as retail, offices, industry, etc, and should also be consulted.

New build developments will tend to hold the most potential for low carbon technologies as there will be more options for measures such as passive solar design and building-integrated renewables. Although all types of refurbishment should consider energy demand and supply, it is major refurbishments that are more likely to deliver zero carbon.

[5] It should be noted that the term 'low carbon technologies' used in this guidance refers to the general range of technologies available, any of which could potentially contribute towards a zero carbon development or a low carbon development under the definitions proposed in Section 2

Density is a key characteristic when designing zero carbon developments and can influence the type of technologies employed. The Mayor's Supplementary Planning Guidance on Sustainable Design and Construction promotes making best use of all developable land by increasing density where accessibility to public transport is or will be high and the scale and character of the area will not be damaged. (Lower densities should be allowed where public transport accessibility and capacity is less.)[6]

Different densities may affect the suitability of the energy technology employed. For example, high density favours community heating, which could be supplied by biomass CHP, but may limit opportunities for solar technologies where roof space and shading are important issues.

With very high densities, the problem of urban heat island effects can be exacerbated, particularly where existing high concentrations of air conditioning outlets intensify the effect by dumping warm air and raising the temperature outside. This can be a particular problem in mixed-use or commercial developments where there may be a need for office cooling in the summer. In this case, natural ventilation systems and passive solar design can avoid adding to the problem (see Section 5.2), as well as lowering the carbon emissions of the development. Passive solar design needs careful consideration with regard to general building orientation, material choice and form, in order to optimise winter solar gain and summer cooling, and thus future-proof against climate change (see also Section 5.5).

The type of development and its resulting load profile (or energy demand over time) is important as the aim is to match this with appropriate on-site generation. For example, with combined heat and power plant, which may be part of the technology mix used in a zero carbon development, the most appropriate development will tend to be mixed-use developments that have a fairly flat heat load. In other words, a more constant, year-round, less 'peaky' heat demand (this may include unavoidable summer cooling needs that cannot be designed out) is preferable to one that greatly fluctuates over a period of time (see also Section 5.3).

An example of this would include a mixed residential development with a supermarket, swimming pool, hospital or 24 hour industrial commercial activity. Areas for Intensification as mentioned in Section 4.2.1 may facilitate zero carbon developments using this approach as they are more likely to be mixed-use areas.

4.5 Ownership and Occupancy

Land under public ownership provides a number of opportunities to enable zero carbon developments. Boroughs can apply conditions to the sale of council-owned land to ensure these developments occur and can facilitate partnerships to oversee

[6] The London Plan Supplementary Planning Guidance on Housing contains a Density Location Matrix which provides broad guidelines on density ranges for different development types and locations.

projects. This is explained further in Section 6. Boroughs can also look to their own corporate estate in developing zero carbon projects for both new build and major refurbishment. Energy or facilities managers and portfolio manager will have a key role here in identifying opportunities and should be encouraged to do so. (See also Section 6.5)

The type of organisation that may be attracted to a zero carbon development may include those with longer-term interests in the site, such as housing associations or health authorities, who may seek the low energy running costs, or low whole life costs, that such developments may offer.

Building end-users will also have a bearing on the type of low carbon technologies that may be suitable and care must be taken in making assumptions for heat and power loads associated with specific building types. It is the eventual occupants and their energy consumption behaviour that will largely govern load profiles.

4.6 Summary of Key Site Characteristics Suited to Zero Carbon Development

The following table summarises the key site characteristics that may be favourable in enabling a zero carbon development:

Table 2: Key site characteristics for zero carbon development

Characteristic	Feature
Location	• Existing areas earmarked for specific development • Areas of low land value • Appropriate geographical features, such as higher wind speeds, clear southerly aspect, close proximity to bodies of water or sources of biomass • Proximity to existing low carbon heat sources
Scale	• Large scale developments to facilitate: o Economy of scale o More control over building layout, such as passive solar design o Increased potential for mixed-use, shared infrastructure and shared services • Small scale developments to facilitate: o Less complex delivery and less need for phasing o Easier post-construction monitoring
Land use and form of development	• High density development for shared infrastructure and shared services, for example for heat networks • Mixed-use development requiring constant energy demand facilitates technology such as CHP • New build or major refurbishment projects – more scope for low carbon measures
Ownership and occupancy	• Land under public ownership o Conditions of sale that may be imposed by borough o Opportunities for multi-sector partnerships o Opportunities on borough corporate estate o Organisations with particular interest in whole life costs

5 Technology Options Suited to Zero Carbon Developments

5.1 Overview

A broad range of technologies can be employed in implementing energy efficiency and on-site generation capacity, with various combinations of these used to facilitate zero carbon developments. Although it may not be a specific role of the borough to make technology choices for developments, a basic understanding of the different types and their applications is useful when considering proposals.

The choice of technologies used in achieving a zero carbon development needs to be based on an informed, logical procedure which encompasses a holistic view of the costs and benefits. There is information available from a number of sources, including the London Renewables Toolkit, the Low Carbon Designer (under development – see Section 1.6) and supplementary planning guidance such as that on Sustainable Design and Construction and the forthcoming guidance on renewables.

The London Plan also includes an order of preference for heating and cooling systems. This has been updated in the *Draft Further Alterations to the London Plan*[7], which currently states that the "Mayor will expect all major developments to demonstrate that the proposed heating and cooling systems have been selected with the following order of preference:

- passive design;
- connection to existing CCHP [combined cooling heat and power]/CHP [combined heat and power] distribution networks;
- CCHP/CHP powered by renewable energy
- gas-fired CCHP/CHP;
- communal heating and cooling powered by renewable energy;
- gas fired communal heating and cooling;
- solar hot water
- ground coupled heating and cooling
- gas condensing boilers."

Boroughs are expected to apply the same criteria to major developments.

The range of renewable technologies available in helping to achieve zero carbon development is covered in the London Renewables Toolkit. Other important concepts for consideration are described below.

5.2 Energy Efficiency

To a certain extent, there will be a trade-off between maximising energy efficiency over and above the minimum requirements and using on-site renewable generation

[7] See Section 1.6

to achieve zero carbon status. The Mayor's Energy Hierarchy highlights that energy efficiency should be maximised in the first instance:

1. Use less energy (Be Lean)
2. Use renewable energy (Be Green)
3. Supply energy efficiently (Be Clean)

By maximising the energy efficiency of a site, total energy demand will be less and hence a greater percentage of this can then be met using a fixed on-site generation capacity. However, this is most likely to be determined by economics, once the feasibility of various scenarios has been assessed.

Passive Solar Design (PSD) can minimize dependence on artificial heating, cooling and lighting by careful orientation of buildings, choice of materials, nearby vegetation and the appropriate design of elevations. Maximising the use of natural ventilation and shading can compliment PSD. (See also the Mayor's SPG on Sustainable Design and Construction).

The energy efficiency of buildings can also be improved by increasing the insulation and air-tightness in order to reduce heat losses, and Building Regulations specify minimum standards in this respect. A range of options can be considered such as 'super' insulation, high thermal mass construction and triple glazing – the use of which may enable the zero-heating concept to be employed when combined with passive solar design. However, the risk of summer overheating and the effects of mechanical ventilation and/or cooling systems, especially considering the expectations of future climate change (see Section 5.5), also need to be considered. Options for designing a building to cope with peak summer temperatures, which by 2080 may be 7°C higher than peak temperatures today, include vegetation or other alternatives for shading, reflective surfaces, high thermal mass and controllable ventilation (see *Beating the heat*, Section 1.6 for details). It is also important to ensure that building management is in line with building design, to ensure the management does not make the energy system ineffective. For example, inappropriately placed internal walls may significantly reduce the effectiveness of a passive stake ventilation system.

Where developments include appliances and power requiring technologies, such as housing association sites, there is an opportunity to review and influence the resulting energy demand. Consideration should be given to energy efficient lighting throughout and top-rated[8] white goods and other products. Energy use from other sources has increased in recent years from the use of the stand-by power facility on many appliances and the general increase in use of electronic accessories such as chargers and computers. These developments may also present an opportunity to

[8] The top rating is A, A+ or A++ depending on the type of product. For example, the top rated fridges are presently A++. The most energy efficient products can be found on the list of approved energy saving recommended products available at www.est.org.uk/recommended.

encourage behavioural change amongst users through raising awareness of efficient energy use and ensuring consumption data is easily accessible, and even "real time".

Community energy networks are often referred to as district heat and power, community heating, district heating, etc, and are an important part of London's long-term energy future. Their development is one of the core ambitions of the London Energy Partnership and the London Climate Change Agency. All four of the pilot Energy Action Areas (see Section 4.2.2) are exploring their feasibility. Additionally, the Draft Further Alterations to the London Plan includes policy that priorities connection to existing networks (see 5.1). As mentioned above, the move towards higher density, mixed-use developments will facilitate the successful implementation of these networks.

A key site criteria for maximising zero carbon developments is that the design and construction is compatible with available energy systems. As energy networks expand, the opportunities for zero carbon developments to feed off them will increase. For example, 22,000 of Southwark's 52,000 dwellings are connected to community heating systems[9].

For this reason the feasibility of installing appropriate site energy infrastructure in anticipation of future developments should be assessed (see also Section 5.5).

The use of combined heat and power plant is often included under energy efficiency but may also be classed as renewable in certain cases – see below.

5.3 Combined Heat and Power (CHP)

Combined Heat and Power (CHP) is an important element of many zero carbon developments – particularly for those on a larger scale. If powered by fossil fuels it is often categorised under energy efficiency, whereas use of renewable fuels would then qualify as renewable energy. The Mayor's Energy Strategy expects London to maximise its contribution to meeting the national target for CHP by at least doubling its 2000 CHP capacity by 2010. CHP offers an efficient way to generate zero or low carbon heat and electricity and the potential to link up to existing or proposed community energy networks. Trigeneration systems which comprise combined cooling, heat and power (CCHP) are also available.

Energy recovery from waste can include anaerobic digestion, gasification, pyrolysis the manufacture of refuse-derived fuel and combustion of waste with direct or indirect use of the energy produced. All of these technologies have the potential to supply low carbon energy via CHP for individual developments or to supply community energy networks. However, some are more desirable than others, as explained below.

[9] Source: London Community Heating Development Study – www.london.gov.uk/mayor/environment/energy/docs/comm-heating-summary.pdf

The technologies link to long-term regional and local waste disposal strategies, which are exploring the feasibility of extracting energy from waste. The Mayor's Municipal Waste Strategy[10] sets out policies on the recovery of energy from waste and states that, where waste cannot be reused, recycled or composted, value should be recovered in the form of materials and energy. In the case of energy, this should be done using a process that is eligible for Renewables Obligation Certificates, maximises the efficiency by using both the heat and the electric power generated, and minimises emissions of pollutants to all media. The Mayor supports new and emerging methods such as Mechanical Biological Treatment in preference to any increase in conventional incineration capacity. There are benefits to considering the following order of preference of technologies for biomass: anaerobic digestion (which produces biogas), then gasification / pyrolysis (which produces syngas), then incineration of biomass waste. The added benefit of biogas and syngas is that they can be reformed to be used in fuel cells and so have greater flexibility for the future. As indicated above the Mayor has a strong preference for these technologies over any increase in conventional incineration capacity, but recognises that each application has to be considered on its individual merits.

CHP using wood or other sources of biomass can be used at various scales, depending on the establishment of a reliable supply of quality fuel. In order to move toward this reliable supply, the wind and biomass study mentioned in Section 4.2.5 includes an overview of the current total biomass resource in and around London, an assessment of the quality of the resource and specific proposals for utilising the resource.

Achieving zero carbon status without CHP, through the extensive use of a range of other measures and technologies should be achievable depending on the size, type and location of the development. For example, the concept of zero-heating has been implemented in some developments - see Case Study No 8: Hockerton Housing (Appendix B), which avoids the use of space heating by relying on sufficient building insulation and internal heat gains to achieve required temperatures. The heat load will then be greatly reduced and avoid the need for boiler or CHP plant. In this case, solar water heating is employed for domestic hot water, backed up by renewable electricity from photovoltaics and wind power. Case Study 15 provides and example where biomass heating, solar water heating and ground sourced cooling is used with a number of renewable electricity technologies.

As mentioned in Section 4.4, in order to enable CHP plant to be more economically sized and to operate efficiently, the plant should ideally supply a fairly constant load and run to an industry recommended minimum of 4500 hours a year. The larger the load fluctuations the greater the additional boiler capacity required to meet peak

[10] Available at: www.london.gov.uk/mayor/environment/waste

demands (incurring additional capital cost). CHP sized to meet more than the summer base load may result in 'heat dumping' in summer months.

5.4 Technology Mix

By considering the energy hierarchy and by assessing the feasibility of the various options in terms of technical viability, cost and performance, an appropriate mix of technologies can maximise carbon reductions and also increase security of energy supply. All on-site renewable generation technologies and energy efficiency measures can potentially be components of zero carbon developments. The choice of single or multiple technically-viable technologies will largely depend on their overall cost and carbon savings achieved.

In most cases where space heating is required, the use of renewables such as biomass CHP will be needed to achieve zero carbon status as this makes up a large proportion of the site energy use. Within the definition proposed in Section 2, exceptions to this may be where fossil fuel usage is offset by the export of zero carbon energy. An example could be where carbon emissions from the non-renewable elements of heat from an existing power plant (that may presently be dumping this heat) supplied to the site are offset by electricity exported from a wind turbine.

There are occasional tensions between technologies that need careful consideration. For example, combining solar water heating with CHP will reduce the summer heat load for CHP and potentially affect its economic viability (see Section 5.3). If the CHP unit is then down-sized to compensate, the electricity produced will also decrease and may result in the requirement for additional power with a higher carbon weighting to be imported from elsewhere.

Some sustainable building techniques can have positive interactions with low carbon measures. For example, there is some evidence that a flat 'green' (vegetated) roof incorporating an angled solar photovoltaic array can cause moisture to cool the panels. This can help avoid a decrease in efficiency experience by some photovoltaic materials at excessively high temperatures. However, consideration should be give to maintenance of the green roof, which should be achievable with the panels in place.

5.5 Future-proofing

For London, climate change is expected to result in hotter, drier summers exacerbated by the urban heat island effect in certain areas, with wetter winters and a significant increase in flooding risk through heavy winter rainfall. There are significant implications for the built environment, specifically on heating and cooling requirements (see the London's Warming Report, London Climate Change Partnership, 2002).

Climate change - both adaptation and mitigation - is one of the most extensive areas of policy development in the review of the London Plan (see Section 1.6). As explained in the Mayor's Supplementary Planning Guidance on Sustainable Design and Construction, buildings and infrastructure should be designed for the climate change that they will experience over their design lifetime, or be capable of being adapted as climate change progresses. This clearly also applies to zero carbon developments, of which summer overheating is a key issue regarding building energy use. This can lead to retrofit installations of energy-intensive air conditioning. Alongside solar passive design, a balance needs to be struck between ventilation to improve air quality indoors versus air tightness to improve energy efficiency performance.

Future local availability of zero or low carbon energy sources not currently available should also be considered as potential modular add-ons or as a complete new energy system. For existing district heating systems, it is relatively easy to replace fossil fuel plant with a renewable alternative, such as biomass.

Costs and feasibility of existing and future heat network connections to and from end users should also be investigated. Where possible, future connections should be anticipated and provision for these made, avoiding potentially greater cost and/or disruption at a later date.

Such future-proofing may be appropriate for technologies currently uneconomic or technically unproven. For example, the Mayor's Preferred Standard for energy states that all gas services (pipes) laid or renewed on site should be capable of carrying hydrogen. Future generation of biogas (for example from domestic sewage and waste) could be used in combination with emerging hydrogen fuel cell technology to produce hydrogen gas to use to generate electricity or stored and used as fuel for transport fleets. Fuel cell technologies provide a highly efficient means of heat and electrical energy generation, with very low levels of harmful atmospheric emissions.

Ground-coupling is the general term used where heat is transferred to or from the ground, as occurs with ground sourced heating. One form of this is Interseasonal Thermal Storage (or ITS) in the ground or ground water as a way to meet a site's space heating and cooling requirements. The report 'Enabling One Planet Living in the Thames Gateway' (BioRegional and WWF, 2004) considers this in further detail. A form of Interseasonal Thermal Storage known as Aquifer Thermal Energy Storage has also been used in Holland to balance winter cold and summer heat gains by storing heat and cooling capacity between the seasons.

5.6 Summary of Key Technology Options Suited to Zero Carbon Development

Table 3: Key technology options for zero carbon development

Technology Area	Feature
Energy efficiency	• First in energy hierarchy • Passive solar design • High levels of insulation, appropriate thermal mass and air tightness (whilst avoiding summer overheating) • Potential for zero heating concept • Use of high levels of natural light (while avoiding overheating), energy efficient lighting and appliances where fitted • Establishing or linking to community heating networks
Combined (cooling,) heat and power (CHP) and communal / district heating	• Fossil fuel or renewables • Renewable CHP (using biomass) may be necessary to achieve zero carbon status in large scale developments requiring space heating • CHP is especially suited to development types with constant heat load (such as mixed-use)
On-site renewable energy generation	• Includes Solar photovoltaics (also called solar power or solar electric), solar water heating, ground sourced heat pumps or cooling (includes boreholes), biomass, wind power • Can be used to avoid, replace or off-set fossil fuel use on site – see London Renewables Toolkit
New or evolving technologies	• Fuel cells – potential to drive CHP • Latest developments in technologies such as, ground-coupling using Interseasonal Thermal Storage, combined PV and solar water heating, more efficient systems.

6 Opportunities for Boroughs to Use Their Powers

This section examines powers and actions that boroughs can use and take to implement zero carbon developments. It does not assess planning policies, briefs and masterplans as these are considered in Section 7.

6.1 Planning Conditions

Planning conditions should be used to require design and format of developments to deliver low carbon development. Conditions must relate to development plan policies (London Plan or UDP/LDF). However, when outline applications are made there is likely to be a need for Section 106 agreements to ensure that detailed schemes can be properly enforced. Also care is needed to ensure that outline permissions are fully covered by planning conditions because these cannot be added later.

Planning conditions should refer to energy assessments required and related policies that need to be complied with. They could also make provision for future monitoring if not covered in Section 106 agreements - this is a relatively new area and further work is needed on how to ensure post-construction zero or low carbon compliance in relation to the original proposal.

The following are examples of planning conditions that have been used by the London Borough of Merton in relation to their 10% on-site generation policy:

Dover House (05/P2405) and Ravensbury Park (06/P0320 and 0377)

Before the development hereby approved commences the applicant shall have submitted to and approved details of renewable energy production equipment to provide at least 10% of predicated energy requirements for the commercial development. The development shall be constructed in accordance with such details as are approved and shall be retained and maintained so as to meet this requirement for as long as the development remains.

Winsor Avenue (05/P1357)

No works in relation to the proposed development shall commence on site pursuant to the planning permission hereby granted until details of a renewable energy generation system for the proposed B1 and B8 development which provides at least 10% of the predicted energy requirements have been submitted to and approved by the Local Planning Authority and suitably installed and operational to the satisfaction of the Local Planning Authority prior to the occupation of the accommodation.

6.2 Section 106 Agreements

On large development in particular, and where infrastructure is needed off-site, the development may need to be controlled by Section 106 agreements. As defined in

the London Plan, planning agreements or planning obligations as authorised by Section 106 of the Town and Country Planning Act 1990 are contractual agreements between local planning authorities and applicants for planning consent.

They are negotiated as part of the process of considering and approving planning applications. They have to relate to the proposed development, take account of the commercial viability of each scheme, and strike a balance between obtaining a reasonable level of community benefit and not undermining the commercial rationale for the development.

Section 106 could, for example, allow a development to pay for connections to a district heat and power system. In addition the need to provide for annual energy monitoring and appraisal of energy performance could be covered to ensure compliance. Where the developer retains an interest in the development then provision for an annual energy appraisal can be required.

Developers may generally be able to provide fairly significant community benefits, including those of a financial nature, depending on the size of the proposed development. However any community benefits need to relate to policies in the development plan.

6.3 Phasing of Development

In larger developments there may be a need for phased development. At the initial stages, when the whole scheme is considered, provision for the phased introduction of energy infrastructure will be required to ensure that each phase is co-ordinated and that temporary provision is made where necessary (see Section 2.1 Item C).

6.4 Energy Assessments

The Supplementary Planning Guidance on Sustainable Design and Construction provides detail on the requirements of an Energy Assessment. The London Energy Partnership *Low Carbon Designer* aims to provide a process in the form of an electronic toolkit for providing such information (see Section 1.6 - London Guidance).

The assessment should be referred to in any planning condition as the mechanism to validate target levels of carbon emissions on an annual basis. In general it is for the developer to prepare this assessment to ensure that the design delivers specified outputs. However council officers need to understand this process and have the ability to undertake their own assessments as well as to validate those from the developer.

Potentially, boroughs can introduce within corporate policy a requirement for these assessments in relation to their own building work, whether new build or retrofit. This could also be extended to include on-site generation policies within the

corporate estate. For example, Kirklees Council, West Yorkshire, is implementing a policy where new council buildings incorporate a proportion of on-site renewable energy generation: at least 10% in 2005/6, rising by 5% each year, to at least 30% by 2010/11.

6.5 Ownership, Finance and Incentive

Publicly-owned land provides an opportunity for boroughs to support and develop zero carbon projects. This can be through council corporate development on council-owned land or by the sale of council-owned land with conditions requiring zero carbon development. However, a key barrier to these developments is the additional build cost that may be associated with low carbon measures. The magnitude of any additional build cost will be dependant on a number of factors, including scale and choice of technology. For boroughs, as well as the private sector, additional build cost will potentially lower land values. Sutton, for example, sold land at below commercial value for the BedZED development (see Case Study No 1 – Appendix B).

One way of countering this can be through a local Energy Services Company (ESCo)[11]. There are many models, but the advantage for zero carbon developments is that any additional cost for the low carbon energy infrastructure need not all be carried by the developer, thus freeing up capital for the other elements that may be required such as sustainable urban drainage or renewable energy installations, if not included in the ESCo's service. (see also Section 8).

Partnerships can include the main developer and involve venture capital investors as well as local businesses. Particularly relevant to Energy Action Areas, these partnerships may provide a unique opportunity to bring together developers, architects, engineers, investors and the boroughs to ensure that there is an integrated approach. A well-known example of an ESCo is Thameswey Energy Ltd established by Woking Borough Council in 1999, which developed the first town centre private wire trigeneration community energy network in the UK. The London Climate Change Agency has taken a similar approach in developing the London ESCo.

The Woking approach illustrates how new technologies such as fuel cells and solar energy can be factored into projects where costs can be diluted into budgets of larger commercial energy generation applications such as CHP using a holistic approach to project development.

Private Finance Initiative (PFI) schemes for schools and other applications can also present opportunities for zero or low carbon developments. Requirements could potentially be embedded into the contracts in response to policy drivers such as PPS1 or the Power of Wellbeing (Local Government Act 2000), which requires local

[11] See *Making ESCos work: guidance and advice on setting up and delivering an ESCo in London with specific relevant to the pilot energy action areas*, see Section 1.6.

authorities to consider the environmental, social and economic well-being of residents in the planning process.

Other publicly financed or co-ordinated projects that could use similar rationales for encouraging zero carbon developments might include those involving:

- Strategic Health Authorities
- Community/voluntary groups such as Community Development Trusts
- Central government and EU funded regeneration schemes

Such projects are likely to be actioned through the community planning process and provide opportunities for boroughs to form partnerships. Lower running costs usually inherent in zero or low carbon projects may be attractive to public bodies, which may place more emphasis on lifetime costs rather than capital.

Grant funding for microgeneration technologies, whether new build or retrofit, is available for householders, community organisations, schools, the public sector and businesses through the government's Low Carbon Buildings Programme (part of the new Microgeneration Strategy)[12].

Other sources of funding available to boroughs and others for community-based projects may potentially come from Utility Green Funds such as EDF's Green Energy Fund (for renewables), or the BIG Lottery Fund's Bio-energy Capital Grants Scheme[13].

[12] See www.est.org.uk/housingbuildings/funding/lowcarbonbuildings/
[13] See www.biglotteryfund.org.uk/programmes/renewable/index.htm

7 Example Text for Inclusion Within Local Development Frameworks (LDF) to Encourage Zero or Low Carbon Developments

7.1 Approach

In the new planning system Local Development Frameworks will comprise a number of separate Development Plan Documents (DPD). A strategic climate change policy for inclusion within the Core Strategy DPD should be prepared to provide the context for more detailed guidance on zero or low carbon development. This could set targets to reduce carbon and support the principle of zero and low carbon development to deliver agreed targets. In addition many boroughs are preparing Development Control Policy DPD. These could go into more detail about sustainable design and construction and low carbon development. These DPD could be supplemented by site specific DPD and area specific Area Action Plans where particular proposals for zero and low carbon development could be identified.

These policies and proposals will rely on a range of government planning guidance and other advice and research. This policy justification needs to be clearly set out. It will include guidance in Planning Policy Statement 1 (PPS1), PPS12 and PPS22 in particular. In addition, guidance is provided in the DTI Energy White Paper and DEFRA Sustainable Development Strategy. Friends of the Earth have also prepared a briefing note on the background to climate change policies in LDF (see links in Section 1.6). The Government has announced proposals to prepare a new Planning Policy Statement on Climate Change in 2007.

For London Boroughs to make significant progress on zero and low carbon development the leadership role of the GLA is particularly crucial to establish a regional policy framework. The current review of the London Plan is the opportunity to put in place a new stronger planning policy framework climate change and zero and low carbon developments. The Mayor is currently preparing a climate change adaptation strategy that will inform the London Plan review. The Mayor's five Sub-regional Development Frameworks for London, published in May 2006, also contain more localised advice relating to sustainable design, construction and energy.

GLA guidance on zero carbon development is at present mainly included within the Mayor's Energy Strategy. Revised planning policies in the London Plan would provide borough planning departments with the stronger regional lead they require.

For boroughs to ensure that they have maximum support for zero and low carbon policies in their LDF they should undertake the following steps:

- Seek to ensure support for zero and low carbon development in their Community Plan and that targets are set for local carbon reductions, zero

carbon development, low carbon development, renewable energy generation and, where appropriate, local heat networks. Boroughs should coordinate their Community Plan with their LDF, and if targets are set in one then they should also be included within the other.

- Ensure that the LDF vision and objectives include guidance on climate change mitigation and set challenging targets to reduce carbon emissions. Boroughs can draw on an evidence base to justify such targets by referring to national and regional guidance as set out in Section 1.6. They may also use regional documents and attitude studies as a basis for this along with other activities that may have already been carried out in their area, for example under LA21 or local environmental consultation or action groups.
- Ensure that LDF Sustainability Appraisals scoping reports identify climate change and carbon emissions as key issues. Objectives, targets and indicators should be set.
- Ensure that Annual Monitor Reports include climate change objectives and carbon reduction targets/indicators.
- If possible prepare a corporate Climate Change Strategy. This could enable zero or low carbon development on council owned property. Shropshire, Woking and Camden councils provide three examples and the London Borough of Barking and Dagenham have a sustainable energy strategy. Information on other local authority activity in this area should be available from EST's Practical Help resource.[14]
- Seek public support for zero and low carbon development through Community Plan and Local Development Framework community engagement to legitimise policies and meet the test of 'soundness'.

7.2 Policy Options for Zero and Low Carbon Developments

Examples of policy and guidance relating to energy and carbon can be found in the London Plan, its SPG on Sustainable Design and Construction, the Draft Further Alterations to the London Plan, the London Renewables Toolkit and the Sustainable Energy Policy Advice Note. The latter two include local policies and specific considerations. Woking Council has prepared a Climate Neutral Practice Guide as SPG. In addition a number of Boroughs are preparing similar policies to seek renewable energy and energy efficiency. Links to these sources are set out in Section 1.6.

Precise wording of planning policies will depend on the scope of policy. For example:

- Does policy apply to all types of development or only selected uses and sizes?
- Will policies be linked to other guidance, for example links to sustainable design and construction, or will they stand alone?

[14] See www.est.org.uk/housingbuildings/localauthorities

- Will policies only apply to buildings and other structures as part of the development or should they include related transport impacts? For example car free development reduces carbon emissions from transport.

Depending on these considerations and the evidence base to justify zero and low carbon development, a range of policy options can be developed. These can be tested through community and stakeholder engagement when preparing borough LDF. The following example policies relate specifically to zero and low carbon built developments. The GLA and boroughs should include appropriate policies to encourage these forms of development in their development plan.

7.3 Core Strategy Options

Core policies in LDF need to reflect guidance in PPS1 and PPS22 that requires policies for climate change and specifically renewable energy. Policies in London will also need to have regard to the Mayor's alterations to the London Plan (see reference in Section 1.6). Policies should seek to reflect local targets and opportunities, and to establish decentralised power and provision of district heat and power networks where possible. Policies should also specifically refer to climate change as the driving force and include policies both for mitigation and adaptation.

Option 1: Climate change policy to meet energy white paper targets

The LDF will seek to mitigate the effects of climate change locally and will promote zero and low carbon development to contribute to the council's target to reduce carbon dioxide emissions by 25% by 2020 from 1990 baseline. Where appropriate new developments are expected to be zero or low carbon buildings.

[It should be noted that boroughs may have carbon or carbon dioxide targets based on a different base year. Those in the Draft Further Alterations to the London Plan have been included above. Borough targets should contribute appropriately, and may exceed the regional target.]

Option 2: General climate change policy

The LDF will seek to ensure that all new development is adapted to and contributes to reducing its impact on climate change and it will encourage/ seek zero and low carbon development.

Option 3. Policy linked to community plan

The council will have regard to community plan objectives to promote sustainability and to mitigate the effects of climate change. It will encourage/require/expect zero and low carbon developments in appropriate locations.

7.4 Development Control Policies

Option 1: Zero carbon developments The council expects zero emission developments on suitable sites and where this form of development is feasible.
Option 2: Low carbon developments All large mixed use developments should be designed as low carbon developments (size criteria to be defined)

7.5 Site Specific and Area Action Plan Policies

Option 1: Energy Action Areas Within the areas identified on the proposals map as Energy Action Areas, the council will require all development to be integrated with the CHP (or community heating) network to provide low carbon developments.[15]
Option 2: Zero carbon developments The following sites have been identified for zero carbon developments: (boroughs to select/justify based on local circumstances).

A specific example of a site-specific supplementary planning document that incorporates consideration of energy is that for the Guinness Brewery Site in Brent. The London Energy Partnership is producing a case study on the energy aspects of this.

[15] this could also apply to regeneration and opportunity areas, etc

8 Overview of Key Arguments for Boroughs to use in Discussion with Developers

Local authorities have leverage to progress zero carbon developments through the planning application process and a key driver for developers is securing planning approval as quickly as possible. If objections occur and delays ensue then this may compromise profit margins. Therefore, seeking a collaborative approach is most likely to deliver success, and therefore it is essential that the developer or landowner engages with the local authority at the earliest opportunity. Zero carbon developments are not usually delivered through a retrofit approach and if a proposal is to succeed it will need to be conceived, designed and constructed in close collaboration with the local authority and most likely in partnership with other organisations and practitioners.

There are two fundamental issues around which discussions are likely to centre. The first is on the legality of having a policy which requires a zero or low carbon development on a site. The second is around the additional build cost that a developer may incur in meeting such a requirement. Each is explored in turn below, together with the key arguments that can be used by a local authority in discussions with developers.

Issues regarding incentives around developers are also discussed in Sections 10 and 11.

8.1 Legality

The issue here is whether or not a policy requirement to have a zero or low carbon development places an "undue burden" on a developer, primarily in terms of additional build cost. The local authority will need to feel that they have a secure legal footing for placing such a requirement on a site that would be sufficiently robust to defend should planning permission be refused and a developer go to appeal.

This security must not only come from policies and statements, but also in the form of assurances by regional and national politicians and inspectors that, in determining planning applications, carbon reduction issues are paramount. To justify these policies, boroughs will need to refer to the evidence base that supports them and to relevant government guidance. This guidance is continually evolving and strengthening. Currently, key documents to refer to in this regard include the London Plan, The Mayor's Energy Strategy, PPS1, PPS22, SPG on Sustainable Design and Construction and the London Renewables Toolkit (see Section 1.6).

The new Local Development Framework, with its specific focus on Statements of Community Involvement and the community planning approach means that public perception and support should be a key issue in formulating planning policies. Any

consultation results such as questionnaire returns should give legitimacy to prescriptive policies. The consultation audience could potentially include a range of stakeholders such as developers interested in zero or low carbon projects, or local NGO's. Supportive guidance in planning briefs that have been subject to consultation can also help the developer through the process.

8.2 Additional Build Cost

There are several arguments and issues that can be explored with developers on this issue, as set out below.

1. Can any additional build cost be passed on to the end-user, and/or purchaser of a building?
    - There are increasing examples where developers are often able to market zero or low carbon developments at a premium. An example of this is seen in the mindset of developers committed to respond to planning policies requiring a proportion of energy demand to be met through on-site renewable energy. Many developers have viewed this as an opportunity to lead the field in the designing, constructing and marketing of low carbon buildings – with the opportunity to sell them at above market rate. Examples of this are the Fairview Homes development in Croydon (312 units), where the developer has recognised the benefits of installing renewables, and Chancerygate, who are proceeding with three developments in Merton which will incorporate 10% renewables.
    - Potentially, this "marketability" aspect may increase in the future, as end-users become more aware of the energy performance of new buildings through the energy labelling measures that will come into force in the UK in 2007-08 from the EU Energy Performance in Buildings Directive. For housing this is expected to be introduced in June 2007.
    - Local authorities can also assist in this process by liaising with economic development and regeneration officers to identify businesses in the borough that would have an interest in locating to a zero or low carbon development. An example might be a potential commercial end user prepared to pay a premium for a development because they are able to factor the relatively long pay back timeframe into a long term business plan. It may also serve to demonstrate their long term sustainability strategy in some way.
    - This economic intelligence can be used in discussions with a developer as evidence of demand for zero or low carbon buildings at a particular site. Similarly, boroughs can make use of satisfaction surveys from occupiers of such developments as proof of demand (eg see Case Study 7 – Appendix B).
    - The WWF report 'One Planet Living in the Thames Gateway' claims that the cost of developing to 'Z-squared' standards would be comparable to, or even cheaper than, the cost of developing to current building regulations. The reasoning behind this suggests that any additional build costs have the

potential to be partly offset by planning gain and by higher property values. A local authority may wish to adjust its Section 106 'hierarchy' so that priority is given to realising these developments over other activities (see also Section 6.2).

2. Does the developer have an interest in lower building running costs?

This is linked to the above point. On sites that are not speculative, the developer may also be the building occupant, or, in the case of a housing association, will have an interest in reducing the running costs for tenants as well as their own management costs for energy services, and energy for communal areas, etc. Where the developer is planning to provide commercial rents, they may also have an interest in reducing energy costs for communal areas. Other developer occupiers include public sector clients such as hospitals, schools, etc.

Zero carbon development incorporating renewable energy, along with energy efficiency measures and shared infrastructure such as community heating, can potentially offer savings in running costs in relation to alternatives such as individual boilers, and may offer attractive whole life costs.

3. Can any additional build cost be factored into the land value?

If the potential additional build cost for a zero or low carbon development, which is likely to depend on the scale of development along with a number of other factors, can be factored into the residual land value paid by a developer, then the developer would not face an additional burden. As planning policies change, to give greater weight to climate change mitigation and adaptation, the practices of developers and quantity surveyors, the value that they attribute to land and the ability to meet such policies on it, will change.

4. Will additional build cost represent an undue burden?

This is a grey area, and it is not possible to set hard and fast guidelines on what is or isn't an undue burden, as this will vary from site to site, and development to development. The cost of sustainable energy solutions should be established and worked in at the earliest stage and be part of the site valuation as is the case with meeting other planning policies. However, in the short term, in situations where the developer has bought the land before the policy existed and so was unable to take account of any additional build cost, there are aspects of a development which may affect the "overall viability" of a development, these include many factors – the original cost of the land and the value of the built development are just two of these.

5. Can additional build costs be minimised by working with developers more familiar with such approaches?

Developers can reduce the additional build cost by factoring the low carbon measures into their general approach. Once they do this then much of the cost is

down to the infrastructure itself - and economies of scale for producing these technologies should mean that these costs will in time fall

There are also specialist "Green" architects, engineers and services engineers, who may be interested in exploring innovative ways of progressing these developments in a way that minimises the additional build cost.

It should be stressed that the earlier that a development team commits to a zero or low carbon design, the less this aspect of the development is likely to cost.

6. Can any additional build costs be shared with an ESCo, or other funding partners?

As mentioned in Section 6.5, there are new opportunities for co-financing zero or low carbon developments through Private Finance Initiative schemes and partnerships with local Energy Services Companies (ESCo), where some of the infrastructure costs can be covered as part of a commercial arrangement. An obvious example of this is where a development is delivered through a CHP-driven community heat and power scheme, where the ESCo pays for the energy plant infrastructure and recoups its investment over time through the sale of heat and power. Leasing arrangements can also be made by the local authority or ESCo to deliver the energy plant component with a similar economic payback model.

7. Can any additional build costs be offset through other savings in conventional energy infrastructure?

Examples of this include the avoidance or reduction of the cost of heating and/or cooling systems for buildings through the use of zero heating or cooling approaches, or by using communal heating and cooling systems to avoid the cost of individual units. Another example is the potential to reduce electricity grid, and mains gas connection and upgrade costs by the use of energy efficiency measures, peak demand reduction, and embedded energy generation.

8.3 Other Supportive Arguments

Other possible arguments include:

- Rising energy costs and risks of disrupted supply are expected in the future. Developers and building occupiers will benefit from on-site generation/community heating through reduced risk and security of supply.
- Association with zero carbon developments could meet a company's corporate commitment to combating climate change. This can also be beneficial for business image and public relations with local communities and can contribute to corporate social responsibility objectives. Many large companies now have these policies.
- There is an incentive for developers to plan ahead and gain an advantage over their competitors in terms of being fully equipped to meet planning

policies and in gaining a good track record of delivering zero or low carbon projects.

- If there is widespread community and council support for zero or low carbon initiatives then the developer is more likely to win planning approval.

Note – further information on issues around developers and renewable energy can be found in the London Renewables document - *The Role of Developers*. See: www.london.gov.uk/mayor/environment/energy/docs/renew_developers.rtf

9 Check List of Issues for Boroughs to Discuss with Developers

The following table aims to provide a quick reference list for council officers in the process of taking steps to realise a zero carbon development in their borough and may be particularly useful in preparing for discussions with developers.

Table 4: Check list of issues for boroughs to discuss with developers

Area		Issue	Points to Raise	
1	Background information	Has all the relevant guidance and supportive information been fully considered?	1.1	Awareness of the potential for increased value of the development by virtue of its zero or low carbon status
			1.2	Awareness of the likely additional costs of zero carbon developments based on case studies and ways to deal with these
			1.3	Awareness of the availability of grants
			1.4	Awareness of the advantages of demonstrable public support
2	Objective (see Section 2)	In terms of zero or low carbon, is the overall objective of the development clear?	2.1	Low carbon or zero carbon as per definitions?
			2.2	How does this fit with multi-phased developments?
3	Planning policy (see Section 3)	Have other areas of planning policy that can affect energy been addressed?	3.1	Local Planning policies relating to development characteristics, such as affordable housing, fuel poverty, development density
			3.2	Local Planning policies relating to location, for example employment land, transport
			3.3	London Plan policies and reference to national policies, including PPS1 and PPS22

(continued)

Area		Issue	Points to Raise	
4	Site characteristics (see Section 4)	What general characteristics of the proposed development and/or site are particularly suited to achieving zero or low carbon status?	4.1	Is the site in any way favourably designated by virtue of its location? For example, pilot Energy Action Areas, Areas of Intensification or Regeneration
			4.2	Do the geographical factors of the site lend any advantage to particular low carbon measures? Including, for example, high windspeed which is often found on high or exposed ground (wind power), unobstructed southern aspect (solar).
			4.3	Is the scale of the development appropriate to the low carbon measures proposed?
			4.4	How do the type, form and use of buildings impact on the choice of low carbon measures?
			4.5	Is the density of the development compatible with the choice of low carbon measures?
			4.6	Has the orientation of buildings been given due consideration in relation to solar energy issues? Is this compatible with point 4.8 below?
			4.7	Has the proposal considered any existing or future-planned energy systems or infrastructure that may be located near the site? Such as district heating, wood recycling station or combined heat and power plant
			4.8	Is the development adequately 'future-proofed' against climate change? For example, allowing for higher ambient temperatures. (Increased risk of flooding and reduced water availability should also be considered.).
			4.9	Has the comfort and convenience of site users been compromised or improved in any way to achieve zero or low carbon status?
			4.10	Have the implications of site ownership been fully explored? For example, use of partnerships, incentives and financing and potential for ESCo involvement (continued)

Area		Issue	Points to Raise	
5	Low carbon technologies (see Section 5)	Is the most appropriate technology mix being proposed to achieve the aim?	5.1	Has an adequate options appraisal/ feasibility study been undertaken?
			5.2	Has the Mayor's Energy Hierarchy been addressed? Has this been adequately justified where not adopted?
			5.3	Have supply chains been fully considered? For example biomass fuel supply or for technologies that are not normally standard in the UK, such as triple glazing, have these been sourced and delivery been taken account of in build times so these aren't adversely affected?
			5.4	What are the aims regarding energy efficiency – how far do these exceed minimum standards?
			5.5	Is the anticipated load profile suitably matched with any proposed on-site generation? For example, a linear load profile matched to CHP or what are the export opportunities?
			5.6	What monitoring systems are proposed to evaluate zero or low carbon status post-construction and how will this be reported?
6	Consultation	Is a stakeholder consultation process appropriate?	6.1	Which stakeholders should be consulted, when and to what level?
7	Marketability & promotion	How will the development be marketed and promoted?	7.1	What are the expectations regarding market demand for the development? For example, have any potential end-users been identified?
			7.2	What specific aspects of the development will be promoted and how?

10 Lessons and Pitfalls to Avoid when Taking Forward Zero Carbon Developments

The aim of this section is to highlight some of the lessons learnt by other local authorities and other stakeholders in attempting to take forward zero carbon developments. It is hoped that this will avoid some of these lessons needing to be re-learnt, and help to smooth the path for future developments in London boroughs.

Many of the lessons relate to securing agreement and buy-in from key stakeholders to the concept of a zero carbon development, as well as influencing key plans and strategies. Therefore, this section should be read in conjunction with Sections 8 and 11.

There are currently many issues which can hinder or prevent zero carbon developments at various stages of development. Most council officers, developers, architects and landowners have little or no experience of such developments and there is scant information on which they can draw.

The majority of existing zero carbon developments have been developed through a visionary approach by committed individuals or organisations wishing to create exemplars. However, the need for boroughs to actively progress zero carbon developments is likely to introduce barriers where resources to overcome these may be more limited. A different approach thus needs to be taken to identify the obstacles and implement solutions. Part of this approach is inevitably concerned with learning from experiences of existing zero carbon projects and disseminating the resulting advice to stakeholders.

The following sections list some of the more common barriers and lessons associated with zero carbon developments as raised through the questionnaire consultation and other work.

Lesson 1: Accentuate the positive.

"A dream is just a dream. A goal is a dream with a plan and a deadline." (Harvey Mackay)

Clearly, taking forward a zero carbon development is unlikely to be a straightforward process, and it will require a strong vision and commitment from borough officers and members to bring about the necessary partnerships and engagement required. The positive outcomes, such as community benefits, mitigating climate change, meeting local, regional, national targets, etc, should be reinforced to stakeholders as necessary throughout the project.

The strong vision will also need to be backed up by a realistic delivery plan, building on the other lessons set out below.

Lesson 2: If the council owns the land, and depending on the additional costs which may be associated (see Section 8.2), council unwillingness to release land at less than standard price could impair the potential for a zero carbon development. Therefore, it is important to try and secure a commitment to this at an early stage.

Lesson 3: Developers will be concerned about any "undue" economic burden being placed on them. Legally, they have a right to challenge requirements if they can prove there is an undue burden (for example see PPS 22). Ways of avoiding this may involve:

- Factoring in the requirement for zero carbon at the earliest possible stage, so it can be factored into the residual land value
- Working in partnership with developers, so they buy-in to the concept from an early stage
- Identifying opportunities where the developer may not be solely concerned with capital cost but has an interest in whole life cycle costs, such as public sector developments, developer occupiers and social housing.
- Having clear information on what the additional build cost might be, through feasibility studies, quotations from suppliers and use of existing information including relevant toolkits (see Section 1.6).
- Identifying additional sources of funding that can reduce the impact on build cost (see also lesson 6)
- Working with ESCos, and/or multi-utility providers who can install and manage energy infrastructure, cover some or all of the upfront capital cost, and take a return from energy sales.

Lesson 4: Strong policy is needed, with specific targets, which will require, rather than encourage developers to meet zero and low carbon requirements. Experience suggests that most developers do not undertake this voluntarily.

Lesson 5: Zero carbon developments are more likely to proceed if there is a strong commitment and a prioritization to climate change mitigation from boroughs (and councillors). This will provide an overarching policy imperative within a local authority to ensure that zero carbon developments can be taken forward.

Lesson 6: A lack of council resources & time in partnering and liaising with developers, architects and consultants and preparing funding bids can prevent successful delivery of such developments. Ways of preventing this may include:

- Being realistic about how much local authority time and resource is likely to be available and planning and partnering accordingly
- Linking up as much as possible with existing support agencies and mechanisms, such as London Energy Agencies, Community Renewables

Initiative, the Low Carbon Building Programme, ESCos such as the London ESCo (see *Making ESCos work*, Section 1.6), the Carbon Trust Design Advice Service and information from Energy Action Area Programme
- Choosing sites where additional funding may be available for such initiatives, such as regeneration areas
- Securing engagement and support from other departments and staff within the council, to help "spread the load" (see Section 11)
- Securing commitment from within the local authority to ensure that sufficient resources are put in place. This could be in the form of agreements from councillors and senior management, or from formal documents such as Barking And Dagenham's Energy Strategy[16]
- Working with and selecting developers and construction professionals who have a commitment to the zero carbon objective, and are therefore prepared to take it forward as a key part of their approach

Lesson 7: It can be very difficult for local authorities to take forward zero carbon developments when the council does not own the land, due to the lack of leverage over developers/other land owners. Possible ways to address this are:

- to focus the development of such projects on council or public sector sites – either partially or fully owned, where the council or public sector has additional bargaining power
- for non-council owned sites, ensure a strong policy and allocated sites in the Local Development Framework (LDF), backed up by community consultation. This will mean that the local authority will have the refusal of planning consent as the final bargaining tool. If a specific site is not in the LDF (such as a windfall site) but falls within a general area identified for these types of developments, then a Supplementary Planning Document (SPD) could be used to facilitate a zero or low carbon development for the site.
- to maximise leverage from other sources, wherever possible, for example if regeneration funds are being used.

Lesson 8: The need for flexibility over means of compliance.

- Sustainable energy and climate change issues are cross-cutting themes across many policies, guidance and standards, and may not always link up in a logical, integrated manner.
- Therefore, local authorities should avoid being too prescriptive initially as to how zero carbon development can be provided. This places the onus on developers and construction professionals to put forward proposals that will match development types, sizes and characteristics to appropriate low carbon measures, including the balance between the use of energy efficiency

[16] www.barking-dagenham.gov.uk/6-living/envir-protect/pdf/energy-strategy-summary.pdf

and the use of renewable energy. This is also in line with PPS 22, which states that as far as renewable energy is concerned, local authorities should not make assumptions about the technical and commercial feasibility of renewable energy projects.

Lesson 9: Consider energy networks

- The potential for zero carbon developments may be enhanced by considering the potential for different developments on the same site to share a common energy infrastructure; for example, district heat and power (see also Section 5). This may extend beyond new developments to also include the potential for connecting up existing buildings around or on a site to the same network. This can also involve the utilisation of heat and power from existing or proposed energy generation facilities such as energy recovery from waste, which is off-site, but in close proximity to a proposed development
- Therefore, there is an important role for local authorities, and other officers, to play in identifying strategic opportunities such as these, and to encourage a site-wide approach to this issue. This may mean working with a number of developers and developments, rather than a single development. As an example, see the *Barking Town Centre Energy Action Area Implementation Plan*, due to be published in summer 2006.

11 Key Stakeholders and Information Needs

The aim of this section is to enable borough officers responsible for taking forward a zero carbon development to be able to do the following:

- Identify key stakeholders, both within and external to the borough, who potentially need to be involved and engaged with to facilitate the development
- Identify motivations and issues of interest to different stakeholders and key arguments that may be used to engage their support
- Identify key strategies and plans to influence and facilitate such development in the future.

Table 5: Borough stakeholder information needs

Key stakeholders to be Involved	**At what Stage?**	**Main Areas of Interest (what information will they be interested in?)**	**Motivational Factors (what will influence them?)**
Planning – development/ building control and policy	• Design brief • Application For building control, • Post-consent • Post-construction	• Can the requirements in the design brief be enforced? • Are the requirements in the design brief consistent with borough, regional and national policy? • What will be the planning impacts of any proposed zero carbon systems?	• Policy requirement to do this, in local plan/ LDF, and London Plan (if such policies are included) • Response to feedback from stakeholders • Response to the wider remit of local or government sustainable development agenda • Working in partnership and influencing others

Energy management	• Design brief
	• Application
	
	If have role in management of energy services:
	
	• Post-consent
	• Post-construction
		• If council buildings are involved:
		  • will the energy supply be secure and reliable?
		  • running costs – both in terms of fuel use, as well as maintenance
		  • who will be responsible for operating and maintaining the building energy services?
		• Will it help to meet any carbon reduction/ energy efficiency/CHP /community heating / renewable energy targets for the department, council or whole borough?
		• Is there potential to link supply of renewable heat and/or electricity to existing council buildings?
			• Possible economic benefits
			  o Lower running costs for council/ department
			  o Potential to lever in additional funding, for example from developer, Housing Corp
			• Assist in meeting borough targets
			  o May have targets for carbon reduction on new/ refurbished developments, in council buildings or for all buildings and activity in the borough
			• Personal interest – most energy managers, as engineers and technicians, have a high degree of personal interest in low carbon technologies

(continued)

HECA and housing (only relevant if housing involved)	• Design brief • Application If have role in management of energy services: • Post-consent • Post-construction	• Does it fit with or help to meet council's housing and HECA targets and strategy? • Does it fit with or help to meet council's affordable warmth/ fuel poverty strategy (if they have one)? • If there is a council housing element, what would be impact on tenants? • Will there be any conflict with targets for social and affordable housing on a development?	• Possible economic benefits o Will there be savings in running costs for tenants? o Will there be savings in running costs for the housing department, eg lower running costs for communal areas, and/ or lower access, servicing and maintenance costs. Zero heating or use of heat pumps will avoid the use of boilers. • Meeting targets
Elected members (particularly relevant portfolio holders, Development Control Committee, Housing Committee, Environment Committee and Green members)	• Design brief • Application Subject to protocols around probity with regard to councillors on Development Control Committee	• Will it provide good/ bad publicity for council and my party? • Does it meet requests and priorities of local community? • For relevant portfolio holders – will it assist in the delivery of their targets? • Will it contribute to meeting council Performance Assessment targets? • For Development Control members, will they be subject to legal challenge by a developer over policies? • For Development Control members, will there be planning issues for any proposed renewable energy systems?	• Potential for positive publicity and raised profile • Visual statement of what council is doing to tackle climate change and pollution • Potential for development to meet different council objectives as set out above, for example relating to regeneration, housing, economic development. • Benefits in relation to mitigating climate change, energy security, local economic benefits from lower running costs and harnessing local renewable resources • Proof of local community's views on climate change from consultation exercises • Additional job creation in the area • Meeting publicly announced targets
Regeneration and economic development	• Design brief • Application If have interest in local benefits: • Post-consent • Post-construction	• Will it conflict or add value to regeneration priorities? • Can concept be "sold" to regeneration partners? • Will it assist in delivery of targets? For example, may have own standards and targets for energy efficiency in new build • What additional local economic benefits could there be, such as lower running costs, local ESCO and local skills development / job creation?	• Social aspects, such as enhanced sense of pride in place • Evidence of support from local community • Potential for levering in additional funding, for example to support low carbon technologies • Evidence of local benefits, such as revenue for a local ESCO, lower running costs and local skills / jobs. (continued)

Finance/ Asset management	• Design brief • Application	• If Council own land, may need to sell land at lower than market price – may need agreement of finance department to do this	• Viable whole life costs • Potential to add value to an asset through zero or low carbon measures • Need justification for selling land at "less than best price" – namely: o lower running costs o fulfilment of other Council objectives, such as environmental well-being
Other: eg Education, Waste Management and Parks/ Green Spaces/ biodiversity departments	• Design brief • Application If have role in management of energy services: • Post-consent • Post-construction	Various interests, such as: • For schools – responsibility and practicality of operating and maintaining the building energy services along with associated costs; educational opportunities and links with the curriculum; • For waste management / parks – potential to save on cost of disposing waste by diverting existing waste products from landfill to be used to supply heat and power • Parks / Green spaces – resources to manage previously coppiced woodland	• Potential for lower site running costs (council buildings) • Potential savings from use of resources that may otherwise incur costs through disposal, such as tree waste or municipal solid waste

For boroughs, the relevant strategies and plans to influence, and the stakeholders they may motivate are shown in the table below:

Table 6: Borough strategies/plans and relevant stakeholders

Strategy and Plan to Influence	Relevant Borough Stakeholders	Comments
Local Development Framework (LDF) (or old Unitary Development Plan)	Cuts across all departments, with officers and members responsible for different actions.	• Opportunity to incorporate policy on zero or low carbon developments in LDF, either in core strategy or other development plan documents, and in supplementary planning documents • Potential ability to identify specific sites (also locations for wood recycling and areas of high potential for community heat networks.)

(continued)

Corporate plan/business plan	Cuts across all departments, with officers and members responsible for different actions.	• Likely to have targets relating to housing and regeneration as well as environment • May also have specific targets relating to cutting energy use and carbon emissions, with responsibility for these allocated to relevant departments
HECA/ Housing Strategy	Housing and HECA Officers	• All London boroughs should have a HECA strategy and annual reports containing targets for reducing carbon emissions in existing housing
Energy strategy for Council, or similar – such as Climate Change Strategy, Renewable Energy Strategy	Cuts across a number of departments, including energy management, housing and planning	• More useful if detailed, tangible aims (with targets) are stated alongside any broad aspirations
Regeneration/ Neighbourhood Renewal	Housing and Regeneration department	• Can access public funds through neighbourhood renewal initiatives, which may create planning levers to facilitate zero carbon developments
Community Strategy	Cuts across a number of departments	• Although strategy is "owned" by Local Strategic Partnership, local authority will be responsible for delivery of many actions in it, which is likely to involve elements of community consultation
Waste management strategy	Waste Management Officers	• Potential to divert organic wastes towards heat and power supply for developments, for example use of untreated, recycled wood waste • Potential for linking location of waste management/ energy recovery from waste facilities to supply of heat to zero carbon developments
Education strategy	Education Officers	• Energy use in schools is often the responsibility of energy managers. • Building programme may link to asset management department • Potential to incorporate zero carbon development with new school building programmes, for example as part of Government's Building Schools for the Future programme to rebuild or refurbish every secondary school in England
Parks and Green Spaces	Woodland/ Tree Officers, Park Rangers	• Possible link to supply of woodland and arboricultural residues to biomass facilities, such as Croydon Tree Station

Table 7: Non- borough stakeholder information needs

Key Stakeholders to Involve	At what Stage?	Main Areas of Interest (what information will they be interested in?)	Motivational Factors (what will influence them?)
Local Strategic Partnership	• Design brief • Application (Also when developing or consulting on a strategy)	• How does it help meet community priorities set out in Community Strategy? • Is there conflict with any of these priorities?	• Clearly identify how development can meet different priorities in Community Strategy • Identify any support from local community for development, for example through residents' groups or Citizens' Panels.
Developers	• Design brief • Application If specific planning conditions relate to monitoring of energy performance or there is a general interest in gaining knowledge: • Post-consent • Post-construction	• How much will it add to build cost, and can it be factored in to residual land value? • What effect will it have on saleability of property, for example, is there evidence of a 'green premium' and how will mainstream and 'niche' customers view it and what is the market share of the 'niche'? • Potential to lever in additional funding and grants • Securing planning consent – can this be "fast-tracked" if requirements are met? • Will it provide an opportunity for positive PR and marketing? • Does the company have the expertise and resources to do this and will it help to meet future regulation?	• See Section 8

Construction professionals (e.g. architects, M&E consultants)	• Design brief • Application If specific planning conditions relate to monitoring of energy performance or there is a general interest in gaining knowledge: • Post-consent • Post-construction	• What are technical options, and is it technically viable? • Is compliance with requirements clearly measurable using standard industry tools? • How much will it add to build cost? • What impact will it have on integrity and security of building services? • What impact will it have on building aesthetic, form, and other factors? • Does the company have the expertise to do this?	• A clear expectation of what is required for the design, that is clear policy and supporting information • Strong design brief • Factoring in zero design from day one so an integral part of design concept • Possible marketing/ PR benefits that help o Raise profile o Win competitive edge and future business • Ethical benefits o Environmental improvement o Social responsibility
RSLs/ Housing Associations (only relevant if housing involved)	• Design brief • Application If have role in management of energy services: • Post-consent • Post-construction	• Potential to contribute to meeting Housing Corporation requirements for new build, such as Ecohomes Very Good from March 2006 • Impact on tenants o Running costs o Ease of use of heating systems o Comfort o Provision of reliable energy services • Impact on RSL. Differences in o Running costs o Management of energy services (for example, compared to individual boilers) • Marketability of properties	• Possible economic benefits o Lower running costs for tenants o Lower running costs for landlord o Potential to lever in additional funding, for example from Housing Corp or in some cases regeneration funding • Possible marketing/ PR benefits that help o Raise profile o Obtain competitive edge • Assist in meeting targets o Such as requirement for Ecohomes Very Good o May have own targets for carbon reduction • Ethical benefits o Environmental improvement o Social responsibility

(continued)

English Partnerships/ Regeneration partnerships, LDA	• Design brief • Application If have interest in local benefits: • Post-consent • Post-construction	• Will it conflict or add value to regeneration priorities? • Can concept be "sold" to regeneration partners? • Will it assist in delivery of targets (both energy/climate change and non-energy/climate change)? For example, may have own standards and targets for energy efficiency in new build • What additional local economic benefits could there be – such as lower running costs, local ESCO or local skills and jobs?	• Social aspects, for example enhanced sense of pride in place • Evidence of support from local community • Potential for levering in additional funding, eg to support community heating • Evidence of local benefits, such as revenue for a local ESCO, lower running costs and local jobs
Facilities management, Utility provider, ESCO	• Ideally, involve expertise as early as design stage • But issue around possible need to tender contract for provision of energy services	• Will the provision of energy services to the development represent a commercial opportunity? • What is the potential for long-term energy supply contracts on the site?	• Size of non-domestic energy loads on site • Firm guarantees of supply contracts or long-term supply contracts, for example from public sector/ large commercial clients • Potential for joint venture with local authority partner

Glossary of Terms

More detailed descriptions of some of these terms are available in other publications, including the London Renewables Toolkit, relevant Energy Action Area reports, the Wind and Biomass study and the Low Carbon Designer.

Biomass	Biomass is a collective term for all plant and animal material. A number of different forms of biomass can be burned or digested to produce energy. Examples include wood, straw, poultry litter, putrescibles (kitchen and garden waste) and energy crops such as willow and poplar grown on short rotation coppice and miscanthus
BREEAM	Building Research Establishment Environmental Assessment Method – independent appraisal method to certify environmental performance of a building. This does not have minimum requirements for any one environmental area, so it is not appropriate as an indication, for example, of meeting energy policy.
Combined Cooling Heat and Power (CHP)	In some locations there is a need for cooling during the summer months. Heat from aCHP plant (see below) can be used to produce cooling, via absorption cycles. (Also called trigeneration.)
Combined Heat and Power (CHP)	A plant designed to produce both heat and electricity from a single source. This is more efficient as normally by-product heat is wasted. CHP can increase the overall efficiency of fuel use to more than 75%. CHP systems can vary from dwelling scale units (not yet commercially available) to large industrial plant linked to district heating systems. Fuel cells are CHP units which provide a high electricity to heat ratio. Because CHP units supply heat (so must be locally sited) CHP can also avoid transmission and distribution losses. (Also previously called 'cogeneration'.)
Community heating systems	Community or District heating uses a central boiler or building based systems, to provide heat to homes and other buildings via insulated underground water mains. The boiler(s) can be CHP plant.
Condensing boilers	Condensing boilers are the most energy efficient central heating boilers on the market today. They achieve this high level of efficiency with an extra heat exchanger which extracts heat from the hot exhaust gases and pre-heats the water feeding the boiler. When working at peak efficiency, water vapour in the exhaust gases condenses to liquid (an outlet is required).
Daylighting	Daylighting is the controlled admission of natural light into a space through windows to reduce or eliminate electric lighting.
Development Plan Documents (DPD)	Development Plan Documents are prepared by local planning authorities and outline the key development goals of the local development framework. They include the core strategy, site-specific allocations of land and, where needed, area action plans.

District heat and power	See 'CHP' and 'Community heating systems'
Ecohomes	EcoHomes is the domestic version of BREEAM. It provides an environmental rating for new, converted or renovated homes, and covers both houses and apartments.
Embodied Energy	The total life cycle energy used in the collection, manufacture, transportation, assembly, recycling and disposal of a given material or product.
Energy Services Company (ESCo)	It is difficult to provide a standard definition of an ESCO as they are seen in different ways. An ESCO is an entity that provides energy services. This may be: - Delivering energy efficiency, energy savings and/or sustainable energy (warmth, cooling and/or power), whether through a variety of different initiatives or through a particular initiative, such as a CHP scheme. - Designing, building, operating and managing an individual facility, often for a public body - Providing services (to the public/private sector or householders) guaranteeing (for example, through an energy performance contract or a shared-savings agreement) or otherwise underwriting energy savings or emissions reductions to be achieved by those services. This can include a reduction in costs. The ESCo could be a company, a trust, an industrial and provident society, or even an unincorporated body. Examples or organisations involved in ESCos include the London Climate Change Agency, Thamsewey Ltd, EDF Energy (such as Barkentine Heat and Power) and EcoCentrogen.
Grey water	Water that has already been used in washbasins, showers, baths and the like, and can be filtered and disinfected before being used again in toilet flushing and other non-potable activities, such as gardening.
Heat pumps	A heat pump is a device which transfers heat energy from one place to another and from a lower to a higher temperature. So a ground sourced heat pump (or cooling system) recovers the heat (or 'coolth') in the ground by circulating a fluid through a long buried pipe. (A domestic refrigerator is a heat pump.) Heat is removed from the contents (the source) and discharged elsewhere (the sink).
HECA strategy	The Home Energy Conservation Act 1995 addresses the issue of energy efficiency within the residential housing stock. The Act requires relevant authorities (in London this means London boroughs) to prepare a report setting out measures, which will lead to 30% improvement in energy efficiency in residential accommodation throughout their districts. In London the boroughs must report progress to DEFRA on an annual basis.
Interseasonal thermal storage	A process by which heat energy is collected and balanced between periods of supply and demand. Heat energy from the sun is collected during the summer and stored for use in the winter. Energy for cooling is collected during the winter and stored for summertime use.

Lifecycle or Whole Life Impacts	Assesses the impacts of a product or operation on the environment throughout its life e.g. from production and manufacture, operational and maintenance, through to final disposal/demolition.
Local Development Framework (LDF)	The Local Development Framework is the name given to the new system of Development Plans introduced by the Planning and Compulsory Purchase Act 2004.
Low Emissivity Coating	A coating on glass that reduces radiation exchange and improves the U-value
Mayor's Energy Hierarchy	The Mayor of London has defined an energy hierarchy to help guide decisions about energy measures: 1. Use less energy (Be Lean) 2. Use renewable energy (Be Green) 3. Supply energy efficiently (Be Clean)
Passive solar design	The technology of heating and cooling a building naturally without the use of mechanical equipment. The orientation of the building, site selection, materials, and design features allow the home to collect, store and distribute the sun's heat in winter, block the sun during the summer, and provide for air circulation and natural day lighting.
Photovoltaic (PV)	The process of converting solar energy into electricity. Interconnected solar cells are encapsulated into a sealed module that produces a voltage. PV modules can be applied and integrated into buildings as large panels, such as on roofs, cladding, roof tiles and integrated into glass to provide shading.
Planning gain	Mitigation of the impact of proposed new development. The legal basis is Section 106 (s106) of the 1990 Town & Country Planning Act in relation to planning obligations.
Renewable energy	Energy generated from sources that do not require the use of exhaustible materials.
Solar Preheating of Ventilation Air	Solar air heating systems use air as the working fluid for absorbing and transferring solar energy. Solar air collectors (devices to heat air using solar energy) can directly heat individual rooms or can potentially pre-heat the air passing into a heat recovery ventilator or through the air coil of an air-source heat pump.
Solar water heating	A system for heating water using energy from the sun. Solar energy is collected by a panel, which is connected by pipes to a hot water storage device such as a hot water cylinder. Systems can be installed for domestic hot water, swimming pools, caravans and similar applications.
Super insulation	Super insulation means insulation that is good enough to allow buildings to be occupied comfortably in winter with little or no heating.
Thermal mass	A term used to describe the ability of building materials to store heat (thermal storage capacity). The basic characteristic of materials with thermal mass is their ability to absorb heat,

	store it, and release it at a later time.
Trigeneration	This is also know as combined heat, cooling and power (CHCP / CCHP). The production of useful power, heat and cooling from an energy plant. Where cooling is required CHP plant can be used to produce cooling, via absorption cycles.
Trombe Wall	A sun-facing wall built from material that can act as a thermal mass (such as stone, concrete, adobe or water tanks), combined with an air space, insulated glazing and vents to form a large solar thermal collector.
U-Value	The U-value (or heat loss factor) is the measurement used to express the thermal performance of a material. The lower the U-value, the less heat is transmitted through the material, so if this is a wall, window, roof or external floor the less heat lost from the building.

Appendix A – Further Notes on Definitions

The definitions of zero carbon developments presented in Section 2 have been developed partly through the stakeholder consultation exercise undertaken during this study and partly through discussions within the Project Steering Group. Whilst the intention is to produce robust and broadly accepted working definitions, it is acknowledged that they should be kept under review and updated as regulations and policies develop and practices progress.

Furthermore, the limited availability of detailed costing information from relevant case studies places constraints on identifying the range of applications likely to be enabled under the definitions. However, a zero carbon design electronic toolkit (the *Low Carbon Designer*) commissioned by the London Energy Partnership in commissioning and its use, will help to address this and assist in gauging these definitions.

Importing Energy

The requirements under the definitions regarding the importing of energy are designed to encourage an appropriate mix of on-site generation, whilst allowing a certain degree of flexibility in sourcing zero or low carbon energy. It is expected that community energy networks will increasingly feature in urban environments and that zero or low carbon heat or cooling will become more accessible to future developments. Importing from such local networks is therefore permitted under the definition.

The case of zero or low carbon electricity imports, however, creates different issues and the following should only be used to improve a development that is already low carbon. The definition precludes 'green' tariff arrangements on the grounds of their temporary nature, but allows 'private wire' arrangements where a generating plant supplies a dedicated local network and where the development also demonstrates 'additionality'. That is where the plant provides additional generation from local renewable sources than would otherwise have occurred had the development not come about.

Low Carbon Definition

The benchmark of 50% or more is given in relation to the carbon reduction required for a development under this definition. This is with reference to Part L of the 2002 Building Regulations and to other appropriate Best Practice benchmarks for carbon emission sources not covered under the Building Regulations.

The 2006 Building Regulations, published in April 2006, will result in an overall reduction in carbon emissions from those associated with the 2002 Building

Regulations, of between 20% and 28% depending on the type of building[17]. Further work will therefore need to be undertaken to establish an appropriate percentage in relation to the 2006 Regulations. This should take into account:

- The Energy Saving Trust Energy Efficiency Standards for housing, particularly the advanced practice standard based on the European PassivHaus standard. This sets a limit on the space heating and cooling energy demand of 15 kWh/m^2 per year
- The upper levels of the Code for Sustainable Homes and the minimum requirements for energy
- The Planning Guidance on Sustainable Design and Construction supplementary to the London Plan and
- The Review of the London Plan.

[17] For dwellings, the technical provisions will mean that higher fabric, heating, ventilation and lighting systems designs will be necessary, delivering an overall improvement of on average 20%. For non-dwellings that are naturally ventilated and heated the improvement will be around 23%. For non-dwellings that are air-conditioned buildings the improvement will be around 28%.

Appendix B – A Case Study of Developments Incorporating Sustainable Energy Concepts

The following case studies give details of a selection of developments which have been designed using sustainable energy as a key concept. Information is given under a range of headings in order to highlight the issues of interest for planners and developers.

Although many of the projects include the address of the building, please respect the privacy of owners and occupiers and do not visit any buildings without seeking permission first.

It should be noted that the date of design, planning approval and completion affects how innovative developments are now considered. For example, certain energy efficiency measures noted in older buildings, such as condensing boilers, are now standard under the Building Regulations. Similarly some of the U-values noted in the older buildings are higher than the **maximum** U-values required to the achieve the Energy Saving Trusts Good, Best and Advance Practice Energy Efficiency Standards for Housing. These are summarised below, however please refer to these standards directly with regard to meeting them as the values provided below only represent the worst acceptable U-values, and do not describe all of the requirements of the standards which require additional items to be complied with, such as airtightness and low-energy lighting.

	Good	Best	Advanced
Roofs	0.16	0.13	0.15
Walls	0.3	0.25	0.15
Exposed floors	0.22	0.2	0.15
Windows	BFRC band D or better	BFRC band C or better	0.8 (Including roof windows)
Doors	2.2 W/m^2k	Glazed doors: 1.5 W/m^2k Solid doors: 1.0	External doors: 0.8

Something like: at present many buildings use more energy than the original designed expected them to. This makes build quality, user behaviour, maintenance and energy monitoring all very important. Wherever possible stakeholders should be encouraged to include these matters in their work.

Other examples.

A number of the developments listed in the following case studies can be found on the EcoDatabase, which contains over 150 residential projects from across the UK and some from the continent which aim to be ecological and environment friendly. The database builds up experience involving houses, flats and bungalows designed

and developed since the mid 1990s to have a reduced environmental impact. The projects have been compiled through a survey of housing associations, architects, energy and environmental consultants, builders, local councils and individuals. For further information visit: www.sustainablehomes.co.uk

Detailed information is also available from the ZEDHomes website - www.zedhomes.com, which lists details of both developments in the planning process, those that have been granted planning permission and those that haven't. The following case studies include some of these.

Location	Development Name	Completion Date	Type	Reference No.
London	Beddington Zero Energy Development	2000	Mixed use	**1**
	St Matthews Key Worker Homes	2003	Residential	**2**
	BowZED	2004	Residential	**3**
	Karma House	Construction has not started	Hotel & Apart hotel	**4**
	Packet Boat House	Construction has not started	Mixed use	**5**
	Gallions Ecopark	2002	Residential	**6**
Other UK	Warkworth Close, Gateshead	1995	Residential	**7**
	Nelson Street, Perth, Scotland	1997	Residential	**8**
	Amersham Road, Reading, Berkshire	1998	Residential	**9**
	The Hockerton Housing Project, Nottinghamshire	1998	Residential	**10**
	Millenium Mews, Liverpool	1999	Residential	**11**
	Slateford Green, Edinburgh	2000	Residential	**12**
	Harlow Foyer, Harlow, Essex	2001	Mixed use	**13**
	Millenium Green, Collingham, Nottinghamshire	2002	Residential	**14**
	Beaufortcourt Zero Emissions Building, Hertfordshire	2003	Commercial	**15**
	Oak Meadow, South Molton, N.Devon	2004	Residential	**16**
	Christopher Taylor Court, Bournville Solar Village, Nr Birmingham	2005	Mixed use	**17**
	Great Bow Yard, Langport, Somerset	2005	Residential	**18**
	The Wintles, Bishops Castle, Shropshire	2005	Residential	**19**
	Stamford Brooks, Cheshire	*2009*	Residential	**20**
	Sherwood Energy Village, Nottinghamshire	*2010*	Residential	**21**
	Ashford Zed Homes, Ashford, Kent	Planning	Residential	**22**
Non - UK	Ecolonia, Alphen Aan Den Rijn, Netherlands	1993	Residential	**23**
	Solarsiedlung Auf Dem Kruge, Bremen Germany	2001	Mixed use	**24**
	Kronsberg District Germany	*2008*	Residential	**25**

1. BedZed - Beddington Zero Energy Development, London

Location of development	Beddington, London Borough of Sutton
Status	Completed 2002
Developer / further information	Peabody Trust www.bedzed.org.uk 0208 404 1380 (Bill Dunster Architects) EST General Information Report 89
Aims of project	To make it easy for residents to be green. To build a community. To be Carbon neutral. Partners combined aims; commitment to innovation in construction (Peabody Housing Association), local sustainability (BioRegional), promoting sustainability in the borough (London Borough of Sutton)
Energy efficiency measures	Passive solar design, super insulation, reduced embodied energy, energy efficient design & appliances. Building materials from within 35 mile radius.
On-site generation measures	Photovoltaic modules on the roofs and integrated into glazing of conservatories. Communal CHP fuelled by woodchip provided from the BioRegional urban tree station, taking tree waste from the London boroughs of Croydon and Sutton and waste timber from local tree surgery (tree waste had conventionally been disposed of in a landfill.) For more information please see the London Renewables Toolkit for planners, developers and consultants, p 70-71. www.london.gov.uk/mayor/environment/energy/docs/renewables_toolkit.pdf
Other details	100 properties for sale and rent

User feedback on energy systems and their management, and related lessons learnt	Lifestyle officers were employed when residents first moved into the development to explain features of the site to everybody. This option will not be available for future residents, but it is hoped that people will pick up on the ideas. A manual is provided to "induct" residents. Also, BioRegional are based at BedZED to offer advice. Healthy living is built in, and residents are able to monitor their use of water and power via meters installed in kitchens. A survey (46% response rate) carried out as part of a Ph.D. revealed that residents are overall highly satisfied living at BedZED. Features such as the design of homes, gardens, and the sense of community were positively commented on. Negative views were expressed about problems with the heating system (CHP) or noise between properties.
Information regarding validation of the building performance and post-construction monitoring	Monitoring utilities usage, a PhD student collating data, effects on residents (questionnaires) The development has met its targets. The development achieves water savings of 20% and a saving of 40% for energy required to heat hot water. Space heating requirements are on average 88% below the national average and 73% below homes built to 2000 building regulations. (Bioregional monitoring programme www.bioregional.com).
Local Authority facilitation role	Where a LA owns the land, community heating can be required through a legacy clause in the contract with the developer. Bed Zed (London Borough of Sutton) is an example. The land was sold at below market value with reference to the 'Power of Wellbeing' provision in the Local Government Act 2000.
Key stakeholders involved and main lessons learnt	Joint initiative of the Peabody Trust & BioRegional Development Group. Bioregional have produced a 'Carbon Neutral Toolkit' (www.bioregional.com) Need very good use of space for high density development. Problems have been reported with the effective use of the CHP, and the site is currently being powered by the national grid. Solutions are being sought to re-establish the use of the CHP.

2. St Matthews Key Worker Homes, London Borough of Lambeth.

Name and location of development	St Matthews Key Worker Homes, 11 Water Lane, Brixton, SW2 1NU, London Borough of Lambeth
Status	First phase completed 2003
Developer / further information	PRP ZedFactor. www.prparchitects.co.uk
Aims of project	Low carbon, low cost housing for key workers
Energy efficiency measures	Super energy efficient scheme: High building insulation, low energy lighting, large south facing windows, external sunroom. Airtight with heat recovery extractor fans for ventilation.
On-site generation measures	Solar hot water and wood pellet boiler communal heating system
Other details	12 flats
User feedback on energy systems and their management, and related lessons learnt	Unknown
Information regarding validation of the building performance and post-construction monitoring	Unknown
Local Authority facilitation role	Council owned site, sold at below market value in order to buffer developers' perceived higher costs. Key criteria to have a low carbon development. Local Authority's (St Matthews) sustainability team met with consultants during design and development.
Key stakeholders involved and main lessons learnt	Based on experiences at BedZED.

3. BowZED, London Borough of Tower Hamlets.

Name and location of development	BowZED, London Bow E3.
Status	Completed 2004
Developer / further information	Yorklake: www.yorklake.com
Aims of project	To be Zero (fossil) Energy Development specification, meaning the development will produce as much energy from renewable sources over the course of a year as it imports from the mains, see www.zedfactory.com/bowzed/bowzed.html Design to exceed EcoHomes 'excellent' rating.
Energy efficiency measures	Insulation and thermal mass designed to make space heating redundant. Background heating is generated by occupants, solar gain and incidental gains from cooking and electrical items.
On-site generation measures	15kW wood pellet boiler to supply hot water and backup space heating. Photovoltaic modules mounted in angled conservatory roof from first floor to roof. 1.5kW$_p$ Swift roof-mounted wind turbine.
Other details	BowZed was built on a small plot, on the corner of two roads. The development consists of a studio flat on the third floor with one one-bed flat and two two-bed flats.
User feedback on energy systems and their management, and related lessons learnt	No information available.
Information regarding validation of the building performance and post-construction monitoring	No information available.
Local Authority facilitation role	No information available.
Key stakeholders involved and main lessons learnt	Bill Dunster Architects: www.zedfactory.com London Borough of Tower Hamlets: www.towerhamlets.gov.uk

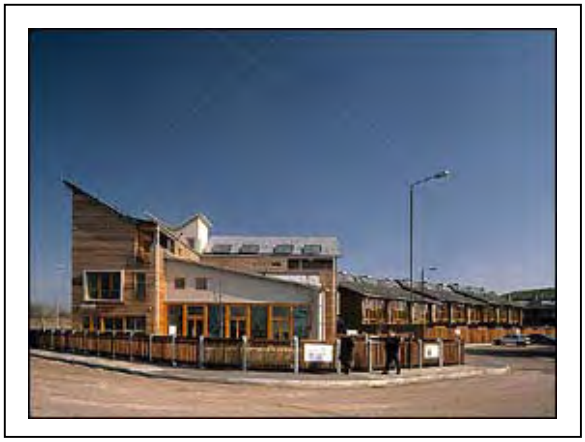
4. Karma House, London Borough of Brent

Name and location of development	Karma House, in the London Borough of Brent, is at 575 Northend Road, Wembley
Status	Planning permission granted
Developer & further information	ZEDhomes Ltd, see www.zedhomes.com/
Aims of project	Energy efficient hotel designed to exceed eco excellent rating.
Energy efficiency measures	Energy efficient design including triple glazing (north facing) and double glazing (south facing), natural ventilation wherever possible, zonal heating system, low energy lighting, key card electricity supply to rooms and time share (so all electrical items are switched off on leaving). Other: Bicycle storage, 'pedestrian first' policy – good lighting and drop kerbs & road layout that keeps vehicles to walking speed, car pool for residents and hotel guests linked to an established car club, water efficient appliances and highly visible water meters in time share apartments, low volume baths, water-saving flow restrictors on taps, dual flush toilets.
On-site generation measures	Biomass heating for space and water heating. Photovoltaic panels to power electric vehicles.
Other details	New 17-storey building for a 120 room hotel (on the first 5 floors), 108 short term apartment lets or 'timeshare or apartment-hotel units' (on floors 6-15) and a public viewing gallery and restaurant on the top floor.
As construction has not yet begun information on user experience, facilities management, validation of building performance and monitoring is not yet available	
Key stakeholders involved and main lessons learnt	Key stakeholders: ZedHomes Ltd, Seabrook Architects, London Borough of Brent

5. Packet Boat House, London Borough of Hillingdon

Name and location of development	Packet Boat House, in the London Borough of Hillingdon, is on the south side of Packet Boat Lane, Cowley, approximately 900 metres from Yiewsley town centre and 2.5 km from Uxbridge town centre.
Status	Planning consent granted (Nov 2005)
Developer & further information	ZEDHomes Ltd, see www.zedhomes.com/
Aims of project	To convert an old office block into energy efficient homes for local residents and key workers.
Energy efficiency measures	Minimise space-heating requirements so that biomass CHP unit only needs to provide hot water for domestic use and for heating the flats. Measures include: low energy lighting, triple (north facing) and double (south facing) glazing, work spaces with mechanically controlled windows, high thermal mass and green roofs. Other: Generous bicycle storage, development of local cycle networks, drop kerbs for prams, road layout that keeps vehicles to walking speed, car pool for residents, recycled materials for example for external cladding, water saving devices, water efficient appliances, highly visible water meters in the kitchen.
On-site generation measures	Bio-fuelled combined heat and power unit with hot water storage in each dwelling / work space. Over a typical year, the development has been designed so that overall carbon emissions are zero (it is expected that the biomass CHP unit may at times export electricity and that at peak times electricity from the grid will be used. Photovoltaic panels (to power electric vehicles).
Other details	Extension and refurbishment of existing building to develop 32 new and affordable studio, one and two-bedroom flats and 6,781 sq. ft of work space to house a medical practice and self-contained offices
As construction has not yet begun information on user experience, facilities management, validation of building performance and monitoring is not yet available	
Key stakeholders involved and main lessons learnt	ZEDHomes Ltd, London Borough of Hillingdon

6. Gallions Ecopark, London Borough of Greenwich



Name and location of development	Gallions Ecopark, Gallions Reach Urban Village Thamesmead, London
Status	Completion October 2002
Developer / further information	Gallions Housing Association www.gallionsecopark.co.uk Main contractor: Willmott Dixon www.willmottdixon.co.uk
Aims of project	Ecopark is a housing development to show how replicable, sustainable, low energy, development can become a practical, economical reality. Built on formerly contaminated land.
Energy efficiency measures.	Water conservation devices, cellulose insulation, condensing boiler, daylighting maximised, high performance facades/windows, low energy lighting, night cooling, passive solar orientation, roof U-value <0.25, stack ventilation, waste heat recovery, windows U-value <2.0[18], solar preheating of ventilation air. Also: fresh air design maximised, greywater recycling, HCFC free, sustainable managed sourcing of materials.
On-site generation measures	Solar preheating of water
Other details	39 houses, 8 flats, occupied since Jan 2002. Building cost information service: Average for 2 storey houses in Greater London: £1,029 /m^2 Gallions Ecopark Ecohomes: £1,165 £/m^2 (Including special site features)
User feedback on energy systems and their management, and related lessons learnt	Tenant satisfaction - in general the tenants are happy with their homes. Most have experienced significant reductions in energy bills compared to their previous properties. All have expressed an improvement in quality of life. Gallions did not supply secondary heating systems. Visits to the property have shown that none of the tenants have since purchased these. However, some households had purchased fans to help with cooling.

[18] Please note date of build and maximum U-values in current Good, Best and Advanced Practice Energy Efficiency Standards for Housing

Information regarding validation of the building performance and post-construction monitoring	The houses achieved Ecohomes 'Excellent' ratings and a SAP rating of 100. When low energy houses are designed and constructed, the energy savings can only be estimated. Monitoring is therefore an essential process if actual energy savings are to be identified and quantified. Monitoring of the Ecopark scheme covered the following aspects: • Airtightness • Water use • Energy use – and associated carbon emissions • Solar hot water system effectiveness • Occupants' comfort Monitoring available at; http://www.gallionsecopark.co.uk/home.htm
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Gallions Housing Association The Housing Corporation www.thehousingcorp.co.uk London Borough of Greenwich www.greenwich.gov.uk The project focused on features which could be replicated in future developments, to exclude any feature which could not be seen to be cost effective within the next decade but, where possible, making provision for its future inclusion or adaptation

7. Warkworth Close, Gateshead Council

Name and location of development	Warkworth Close, Balmoral Drive, Felling, Gateshead
Status	Completed 1995
Developer / further information	www.sustainablehomes.co.uk
Aims of project	Low carbon
Energy efficiency measures	Energy efficient appliances, low energy lighting, solar preheating of ventilation air, Trombe wall, windows - Low emissivity coating, occupant controlled environment, water conservation devices. Also: Urea Formaldehyde foam excluded, tropical timber excluded, timber from managed sustainable sources.
On-site generation measures	Solar hot water systems are shared, with one collector per 4-5 dwellings
Other details	A development of 44 highly insulated dwellings with care taken to provide air tight details with a heat recovery system to the exhaust air. The design also includes a solar wall, K glass, insulated doors, aerated water to reduce water flows, showers rather than baths & low energy lighting.
User feedback on energy systems and their management, and related lessons learnt	Low energy bills have been achieved for tenants with knowledge & experience gained for the Housing Association. Heat recovery ventilation was found to be successful but depends on tenant co-operation.
Information regarding validation of the building performance and post-construction monitoring	Solar domestic hot water heating was found to be of marginal benefit.
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Unknown

8. Nelson Street, Perth & Kinross Council

Name and location of development	Nelson Street, Perth, Scotland
Status	Completed 1997
Developer / further information	Built by Perthshire Housing Association. For further information contact Scottish Homes: Communications Officer, Tel: 0131 479 5059 e-mail: mahoneya@scot-homes.gov.uk, www.sustainablehomes.co.uk
Aims of project	Low carbon. Scottish Homes North and East hope that the project will become a model for future housing developments across the country.
Energy efficiency measures	Passive solar scheme designed to achieve high levels of energy efficiency within a traditional solid masonry structure. Passive solar orientation - optimised for solar gains: south facing sunspaces supply warm air to the rest of the dwelling, sunshades prevent overheating in the sunspaces, education of occupants, high performance facades: increased insulation (walls 80mm styrofoam, roof 200mm mineral fibre, floor 35mm styrofoam), thermal mass, double glazed argon filled windows & low emissivity glass: U-value 1.24. [19]
On-site generation	n/a
Other details	27 flats built on a brownfield site at relatively high density (117 dwelling per hectare). 27 dwellings occupied (rented) since Aug 97.
User feedback on energy systems and their management, and related lessons learnt	The sun spaces are integral to the building & ventilate into living rooms & bedrooms. Residents have found the flats very cheap to heat, rarely requiring the use of the central heating.
Information regarding validation of the building performance and post-construction monitoring	Prediction is that annual energy costs for Nelson Street could be half the Scottish average. The housing association and the agency agreed to jointly fund a research programme to quantify the benefits of the scheme in detail.
Local Authority facilitation role	Unknown
Key stakeholders involved	Built with more than £1.3 million in grant aid from Scottish Homes.

[19] Please note date of build and U-values in current Good, Best and Advanced Practice Energy Efficiency Standards for Housing

9. Amersham Road, Reading Borough Council

Name and location of development	Amersham Road, Reading, Berkshire
Status	Completed August 1998
Developer & further information	Ealing Family Housing Association (client) and Willmott Dixon (main contractor) For further information see EcoDatabase at www.sustainablehomes.co.uk and www.learn.londonmet.ac.uk/packages/cdres/projects/p5/en/over/over_1.html
Aims of project	The project was developed to reduce the environmental impact of 50 new homes, in terms of materials used and energy consumption. It was part of a European project to promote solar design in housing called SUNH (Solar Urban New Housing network). The project aimed to test and develop ideas for reliable energy sources to be adapted and used in future European developments. The project was part funded by a THERMIE grant.
Energy efficiency measures	Condensing boiler, low energy lighting, stack ventilation, cellulose insulation, education of occupants on control use, feedback on user comfort, handbook for how to use the house. Also: CFC & HCFC free, construction waste recycling, 6 litre or less WCs, water butts.
On-site generation measures	Solar water heating in 24 of the houses
Other details	50 Houses built to a very high level of environmental performance in a larger development of 190 houses: 2, 3 & 4 bed houses for social housing with some bungalows for the disabled; & a range of community facilities including a Community Centre
User feedback on energy systems and their management, and related lessons learnt	Detailed tenant survey shows a 92% tenant satisfaction rate.
Information regarding validation of the building performance and post-construction monitoring	Various sensors & information loggers were installed. Detailed 12 month monitoring exercise, completed in 2000, shows: Energy reduction - 31% due to solar initiative. Average solar contribution is 57% (range 35%- 82%). Average saving per household - £5.76 per week.

Local Authority facilitation role	Planning permission had been obtained for the solar collector panels to be located on the roofs of the 24 houses. Site visits were carried out by Reading Borough Council as a project partner
Key stakeholders involved in project and main lessons learnt	"A Sustainable Social Housing Development in the United Kingdom – A SUNH/THERMIE Demonstration Project". The development team included the client and main contractor (see above) Broadway Malyan Architects, Churchill HUI and ECD Energy and Environment. It was built in partnership with Reading Borough Council and Sovereign Housing Associations. Amersham Road has been selected as a Construction Best Practice Programme Case Study demonstrating the achievement of sustainable construction and respect for people.

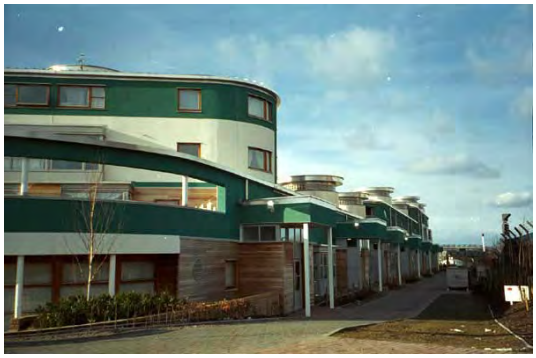
10. The Hockerton Housing Project, Nottinghamshire County Council

Name and location	The Hockerton Housing Project, Nottinghamshire County Council
Status	Completed 1998
Developer & further information	www.hockerton.demon.co.uk Nick White 01636 816902 email: hhp@hockerton.demon.co.uk Energy Efficiency Best Practice in Housing: The Hockerton Housing Project – New Practice Profile 119 www.est.org.uk/uploads/documents/housingbuildings/ce15.pdf
Aims of project	Aim was to be autonomous, net zero carbon, low embodied energy. No space heating, reduced hot water use, able to afford renewables.
Energy efficiency measures	No space heating Also: self-sufficient water supply.
On-site generation	On site wind turbine, PV, solar hot water
Other details	5 houses forming a self-build co-operative.
User feedback on energy systems and their management, and related lessons learnt	The residents of the five houses generate their own clean energy, harvest their own water and recycle waste materials causing no pollution or carbon dioxide emissions. The houses are amongst the most energy efficient, purpose built dwellings in Europe.
Information regarding validation of the building performance and post-construction monitoring	Monitored by BRE 1998/99, with quarterly data collection, the houses were found to have an average energy consumption of approximately 11kWh per day (Source: The Hockerton Housing Project – New Practice Profile 119) This equates to around 25% of that of a typical conventional house built to 1995 building regulations, as defined in Building a Sustainable Future: homes for an Autonomous Community – General Information Report 53 – www.action21.co.uk/sustainable_construction/pdf/GIR0053.pdf
Local Authority facilitation role	It was difficult to get planning permission because of rural area- otherwise council very supportive of project.
Key stakeholders involved in project and main lessons learnt	Nick Martin built the 'Autonomous House'. Nick Martin commissioned Dr Robert Vale (green architect) to design them. Insulation is easiest and most cost effective way of reducing energy use. Also very good at keeping out the heat in summer. Needed employment on site to stop people travelling far for work.

11. Millennium Mews, Liverpool City Council

Name and location of development	Millennium Mews, Liverpool
Status	Completed 1999
Developer & further information	Riverside Housing Association (client) and Carillion (main contractor). For further information see case study in Green Housing for the Future www.sustainablehomes.co.uk/pdf/Green%20Alliance%20Report.pdf
Aims of project	Low carbon demonstration project
Energy efficiency measures	Super insulation. (With 13 of the 14 homes achieving an NHER rating of 10) Also: water & waste recycling, recycled/ sustainable building materials. 20% increase in building costs
On-site generation measures	Photovoltaics with rating of 1.4 kWp, covering area of 16 m^2, and generating 835 kWh/yr, solar hot water
Other details	A new-build development of 14 houses and cottages, semi-detached and terraced houses completed in 1999.
User feedback on energy systems and their management, and related lessons learnt	"One young mother is convinced that the heat recovery and ventilation system in her house has had a very beneficial affect on her 4-year old son's asthma."
Information regarding validation of the building performance and post-construction monitoring	All fourteen houses have smart technology which enables their fuel and water consumption to be monitored remotely.
Local Authority facilitation role	Unknown
Key stakeholders involved in project and main lessons learnt	Model collaboration between the Riverside Housing Association (the developer) and the University of Liverpool

12. Slateford Green, City of Edinburgh Council



Name and location of development	Slateford Green, Gorgie Park Close, City of Edinburgh Council
Status	Completed 2000
Developer & further information	Canmore Housing Association (client), Hackland and Dore (architect) and Hart Builders. For further information see www.dunedincanmore.org.uk (includes independent review) and. www.sustainablehomes.co.uk
Aims of project	The development was initiated in 1995, designed to be a high profile, sustainable community to be completed for the millennium. Canmore's aim was for a development that was a "uniquely blended application of leading innovative ideas, market products, new technology, energy efficiency and ecologically sound concepts and practices".
Energy efficiency measures	Energy efficient appliances, exposed floor U-value <0.25, external wall U-value <0.35, fresh air design maximised, occupant controlled environment, passive solar orientation, pre-fabricated/modular construction, roof U-value <0.25, safe stack ventilation, timber frame[20].
On-site generation measures	District heating & cooling
Other details	It consists of 120 units of mixed tenure, including social rent, shared ownership and outright sale. The first flats were occupied in November in 1999 and the site was formally opened in June 2000.
User feedback on energy systems and their management, and related lessons learnt	Living in a community with minimal fuel bills & reducing car usage & congestion. All the residents have been extremely happy with their properties and no complaints have been received by Canmore regarding either the design or characteristics of the development. Formal evaluation of the technical aspects of the development has not been carried out. However, including evaluation of the tenants' experience of sustainable energy and energy efficiency features is a possibility in future satisfaction surveys in order to quantify the effect of the development on quality of life and expenditure on fuel.

[20] Please note date of build and U-values in current Good, Best and Advanced Practice Energy Efficiency Standards for Housing.

Information regarding validation of the building performance and post-construction monitoring	The association calculated that the design of the properties would result in savings of £250 per year in heating and hot water for residents. Although no formal evaluation has confirmed this, it is thought that these savings have been realised.
Local Authority facilitation role	Support from planners was very important in ensuring the smooth progress of the development. A delay in securing planning permission was due to legal complications around the Section 75 agreement on car-free developments, despite the development being driven by Edinburgh Council policy.
Key stakeholders involved and main lessons learnt	Some of the innovations are now considered part of an environmentally conscious approach (although costs can still be inhibitive) such as: the use of recycled materials (the joist system, warmcell insulation); natural and low tech processes rather than energy consuming systems (passive stack ventilation), and the use of non-toxic materials. Although these involved additional capital costs they were justified on the basis of either reduced energy consumption or lower maintenance costs. Construction system & the use of district heating would be used on similar future projects. The experience at Slateford Green has resulted in a number of lessons that can be shared: • Choosing the right partners is critical • Sticking to the brief and having a joint vision of the outcome is important and acts as a driver • Having the design team locally based helps communication with the client • Involving the main contractor at as early a stage as possible does help with buildability • The main contractor has to share the vision (not simply be seen as the deliverer of someone else's vision) and their expertise needs to be recognised by the rest of the partnership • Having support from planners is extremely important if the development design is to pass smoothly through the planning control process • Value for money assessment procedures need to be used for innovative projects.

13. Harlow Foyer, Harlow District Council

Name and location of development	Harlow Foyer, Occasio House, Playhouse Square, Harlow District Council, Essex
Status	Completed 2001
Developer / further information	See EcoDatabase at www.sustainablehomes.co.uk
Aims of project	The scheme is a Housing Demonstration Project.
Energy efficiency measures	Daylight designed, education of occupants, feedback on user comfort, energy efficient appliances, embodied energy calculated, embodied energy reduced, green roof. Also: Brownfield site, car free housing, environmental purchasing policy - construction, maintenance reduced materials
On-site generation measures	N/A
Other details	116 dwellings which have been occupied since June 2001.
User feedback on energy systems and their management, and related lessons learnt	Unknown
Information regarding validation of the building performance and post-construction monitoring	BREEAM Assessment
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	The scheme achieved reduced cost, integrated design, enhanced predictability & quality & time savings. It also reused a brownfield site & was built to high energy efficiency standards. A similar development – Redbridge Foyer – has benefited from some of the lessons learnt at Harlow.

14. Millennium Green, Collingham, Nottinghamshire County Council

Name and location of development	Millennium Green, Collingham, (Newark and Sherwood District Council) Nottinghamshire
Status	Completed 2002
Developer / further information	Gusto Homes (client) and Gusto Construction Ltd (contractor and architect) http://gustohomes.co.uk Gusto Construction Ltd.: 01636 894900
Aims of project	Low carbon. It is a demonstration project for the Housing Forum 'Traditional' homes but with innovative features and huge running cost savings
Energy efficiency measures	Triple insulation, solar gain & heat recovery, condensing boilers, energy efficient appliances.
On-site generation measures	Solar hot water
Other details	Privately built development of 24 two to six bed houses, and a business centre.
User feedback on energy systems and their management, and related lessons learnt	All properties on Millennium Green have been sold to a wide variety of purchasers ranging from young families to retired couples. Around half of the purchasers have bought specifically because of the sustainable features, whilst the remainder have principally been concerned with location and quality.
Information regarding validation of the building performance and post-construction monitoring	The properties save over 60% in carbon outputs compared to a typical house built to 1995 regulations and approx 50% mains water use, which in turn is saving money for the householders (Information from Gusto Homes; http://gustohomes.co.uk). The water use of the project has been monitored by the Environment Agency. It was also the class and overall winner of the Environment Agency's Water Efficiency Awards in 2003.
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	10% increase in building cost, SAP rating > 100

15. Beaufort Court Zero Emissions Building, Hertfordshire County Council

Name and location of development	Renewable Energy Systems (RES), Beaufort Court Zero Emissions Building, Hertfordshire County Council
Status	Completed November 2003
Developer / further information	Renewable Energy Systems (client), Willmott Dixon (main contractor), Studio E Architects www.studioe.co.uk (see office projects) Max Fordham LLP: www.maxfordham.com/ (see office projects) and Esbensen Consulting Engineers. For further information see: www.beaufortcourt.com/rec/default.htm
Aims of project	To have zero net carbon emissions, whilst only meeting the 2000 building regulations U values for wall and roof insulation. Provide a fully operational head office which meets the commercial needs and conditions of the property market. Deliver a building whose energy consumption is provided entirely from on-site renewable energy sources.
Energy efficiency measures	The construction work was undertaken on the basis of minimising waste and using materials and components with low embodied energy from readily available resources.
On-site generation measures	Energy for the site is generated from: Wind turbine – 225kW (Vestas V29) to generate approx 250MWh annually with excess exported to grid. Biomass – 100 kW biomass boiler (Talbott Heating) fuelled by 5 hectares Miscanthus adjacent to building. Ground water cooling – Ground water is used to cool the buildings during the summer. Water is extracted from the local aquifer at 12°C via an 80m borehole, passed through building air handling units then chilled beams Solar array – The 170m^2 solar array comprises 54m^2 of PVT panels (generate electricity and hot water) and 116m^2 of solar thermal panels. Heat store - 1400m^3 water heated by the solar array is stored and then

	used to heat incoming air to building in winter.
Other details	Redevelopment of existing buildings to provide 2,665 m^2 of headquarters office accommodation for RES including exhibition, catering, conference, meeting, and main plant spaces.
User feedback on energy systems and their management, and related lessons learnt	Wind turbine – Lower than expected wind speed and output approx 175MWh per year 09/04 to 09/05. Covers requirements of offices. Biomass – Poorly prepared ground low first crop yield. Boiler feeder creates noise and dust. PVT array - PV units sealed to thermal units. Heating of panels causes PV cells to slide off at 140°C. Only 5 PVT panels in use. Heat store – Water at less than 30°C at end of summer, 55°C expected
Information regarding validation of the building performance and post-construction monitoring	Various sensors & information loggers were installed.
Local Authority facilitation role	Local planning authority required that the views of the outside of the building must remain largely unchanged.
Key stakeholders involved and main lessons learnt	£699,970 from the EC Framework 5 Programme. This funding was conditional on the adoption of a radically innovative approach to resolving sustainable issues and the involvement of a pan-European design and development team. • Shell Solar Energy B.V. www.shell.com/solar • Green Energy (UK): Electricity supplier who buys the surplus renewable electricity: www.greenenergy.uk.com • Biorenewables/ADAS Consulting: Advised on, and planted, the Miscanthus energy crop. www.adas.co.uk • Talbott's Heating Ltd: Manufacturers of the biomass boiler www.talbotts.co.uk • Jardim Vista Lda: Heat store design www.jardimvista.com • DWEC Europe: Controls specialists and energy monitoring www.dweceurope.com • Vestas: Danish manufacturer and supplier of wind turbine www.vestas.com PVT array intended for use in constrained urban sites with limited area.

16. Oak Meadow, North Devon District Council

Photo courtesy of Gale & Snowden Architects

Name and location of development	Oak Meadow (originally Livarot Walk), South Molton, North Devon
Status	Completion 2004
Developer / further information	Joint initiative between Midas Homes Ltd, Gale & Snowden Architects, North Devon District Council and Devon & Cornwall Housing Association Somerset Trust for Sustainable Development Case Study www.northdevon.gov.uk/environment/livupdate.pdf
Aims of project	Low carbon, hope the development will become the benchmark against which all future housing will be measured.
Energy efficiency measures	Timber frame as lowest embodied energy, energy efficiency, triple glazed, terraced. Also: Rainwater recycling, sustainable & non-toxic building materials, sustainable transport options, room in roof style
On-site generation measures	Solar water heaters
Other details	35 Eco-homes excellent (23 houses, 12 flats) for rent. Built in partnership between council, housing association & construction companies.
User feedback on energy systems and their management, and related lessons learnt	The residents have been involved all the way through the project.
Information regarding validation of the building performance and post-construction monitoring	The scheme has an important research element and the residents are helping monitor the effects the homes are having on the environment
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	The development won a Mail on Sunday National HomeBuilder Design Award 2005. The award for Best Social Housing Development follows two previous awards given to the project – the 'Green Apple Award' and a Devon Environmental Business Initiative (DEBI) award in the category of Sustainable Construction.

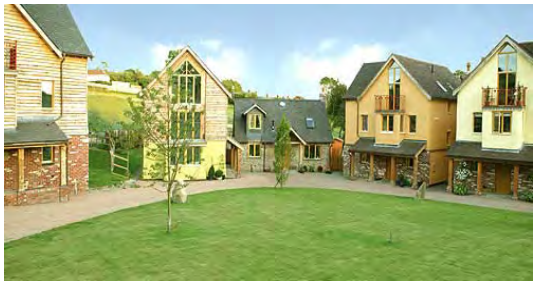
17. Christopher Taylor Court, Birmingham City Council

Name and location of development	Christopher Taylor Court, Bournville Solar Village, Nr Birmingham
Status	Complete December 2005
Developer / further information	For further information see EcoDatabase at www.sustainablehomes.co.uk
Aims of project	Low energy
Energy efficiency measures	Orientation optimised for solar gains, highly insulated structure with double glazed & draught stripped windows. Trombe wall and thermal mass: almost every flat has a large single glazed mass wall & windows & glazed door on the south facade to exploit passive solar gains & natural ventilation. Dual purpose internal sliding shutters reduce heat transfer from the mass wall to the room in summer & insulate the glazing & expose the mass wall in winter.
On-site generation measures	n/a
Other details	The development provides sheltered housing, comprising of 42 south facing flats south & insulated corridors to the north. All corridors are lit by daylight.
User feedback on energy systems and their management, and related lessons learnt	An energy management system controls the central heating to ensure maximum use of solar gains.
Information regarding validation of the building performance and post-construction monitoring	Monitoring showed an overall 10.5% contribution to the space heating demand, a useful contribution bearing in mind that the heating was supplied all day and night, providing an internal temperature of 23^{O}C
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Unknown

18. Great Bow Yard, South Somerset District Council

Name and location of development	Great Bow Yard, Langport, South Somerset District Council
Status	Complete December 2005
Developer / further information	South West Eco-Homes Ltd (part of Somerset Trust for Sustainable Development)
Aims of project	Low carbon: 75% reduction in proposed carbon emissions from current norms. 50% reduction in water use.
Energy efficiency measures	Natural and locally sourced materials such as timber frame with high levels of eco friendly insulation, and a variety of optional energy saving features. Used energy efficient design to reduce future running costs and make the most of natural daylight and solar energy. Also: used water saving devices such as rainwater harvesting and dual flush toilets. Recycled materials were used & sustainably sourced.
On-site generation measures	n/a
Other details	12 dwellings in a waterfront development.
User feedback on energy systems and their management	n/a
Information regarding validation of the building performance and post-construction monitoring	Not available at time of writing.
Local Authority facilitation role	South Somerset DC granted full planning permission without going to planning committee on the basis of substantial public support.
Key stakeholders involved and main lessons learnt	Unknown

19. The Wintles, Shropshire County Council



Name and location of development	The Wintles, Bishops Castle, Shropshire County Council
Status	Phase 1 Complete 2005
Developer / further information	Living Villages Limited: www.livingvillage.com
Aims of project	Low carbon and sustainable community life style
Energy efficiency measures	Super insulated, passive solar gain, air extraction & heat exchangers, timber frame, internal thermal heat mass store, triple glazing, condensing boilers, underfloor heating, grey water recycling, low energy appliances & lighting. Also: natural materials, encouraged to work from home,
On-site generation measures	Solar hot water
Other details	Phase 2 consists of 9 individual houses amongst 15 acres of gardens, orchards & woodlands
User feedback on energy systems and their management	n/a
Information regarding validation of the building performance and post-construction monitoring	Under construction
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Unknown

20. Stamford Brooks, Cheshire County Council

Name and location of development	Stamford Brooks, Cheshire County Council
Status	Construction 2004-2009
Developer / further information	A joint partnership project between the National Trust, Redrow Homes (North West) and Taylor Woodrow Homes. www.stamfordbrook.co.uk provides background & sales info, press releases
Aims of project	Low carbon, sustainability
Energy efficiency measures	Passive solar design, water efficiency & energy efficiency, high levels of insulation. Positioning of buildings to maximise daylighting and minimise over-shadowing even in mid winter. Also: Priority given to walking/ cycling/ public transport, recycling facilities
On-site generation measures	n/a
Other details	710 homes to be built in total, at least 10 per cent will be designated affordable housing.
User feedback on energy systems and their management.	Development currently under construction. The project is taking place over a five year period, building works having commenced in 2004 and completion of the final homes is scheduled for 2008/09.
Information regarding validation of the building performance and post-construction monitoring	Most homes achieve an Ecohomes 'Excellent' rating
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Big interest in purchasing the properties.

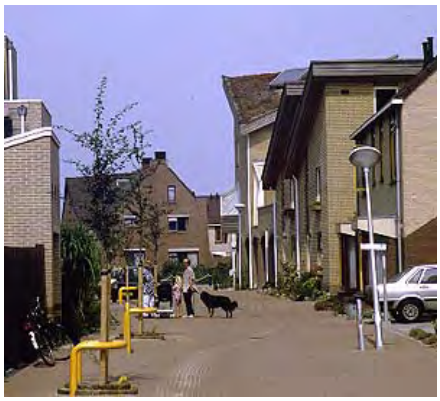
21. Sherwood Energy Village, Nottinghamshire

Name and location of development	Sherwood Energy Village, Ollerton, Newark and Sherwood District Council, Nottinghamshire County Council
Status	Construction 2005
Developer / further information	The site is owned and being developed by a social enterprise rather than a traditional commercial developer or local authority. www.emra.gov.uk/s_d_success/sherwood_energy_village.asp & www.sherwoodenergyvillage.co.uk/
Aims of project	Low carbon. The concept was to make the former colliery site special. Key issues were: ownership, mixed use, an environmental overlay, including energy efficiency, promotion of renewable energy and biodiversity and application of profit to further regeneration / site development.
Energy efficiency measures	Strong emphasis on energy efficiency. Also: Best practice methods in design & construction. Has UK's largest system of sustainable urban drainage – conserving surface waters & improving biodiversity.
On-site generation measures	Renewable energy sources will also feature
Other details	The Energy Village is the transformation of a former colliery site into a mixed-use development of housing, industry & commerce, leisure, recreation & education. 186 dwellings are to be constructed. These range from single dwelling bungalows and apartments through to terraced, semi-detached and detached housing
User feedback on energy systems and their management.	n/a
Information regarding validation of the building performance and post-construction monitoring	Under construction
Local Authority facilitation role	Unknown
Key stakeholders involved	Unknown

22. Ashford Zed Homes, Kent County Council

Name and location of development	Ashford Zed Homes, Ashford, Kent County Council
Status	Planning stage
Developer / further information	www.zedhomes.com/html/ashford 0845 1228656 ameeta.sharma@zedhomes.com and dan.layton@zedhomes.com
Aims of project	- To be carbon neutral, exceed EcoHomes 'excellent' rating. - To deliver an innovative and high quality design to meet the requirements of Ashford and it's future as a growth town creating a vibrant community
Energy efficiency measures	Energy efficient technologies will be integrated into the building fabric.
On-site generation	Bio-fuelled combined heat and power plant on-site and solar panels.
Other details	Ashford Zed will be an environmentally sustainable community of up to 1,000 new homes, working spaces, retail and leisure facilities, built on a brownfield site, within easy reach of Ashford town centre and International Station. In addition to the residential, commercial and leisure buildings, a "learning institute" will show all technologies used at Ashford ZED.
User feedback on energy systems	Not applicable - development still in planning phase.
Validation of building performance and post-construction monitoring	No solid monitoring plans as yet (Wembley and Hillingdon are their next developments to be built). They are working closely with ARUP (Chris Twin) on this.
Local Authority facilitation role	Ashford Zed Homes is a very large site and will be the first development that visitors will see when they arrive via Eurostar. ZEDHomes believes it should be iconic and set the standard for future development in Ashford. ZEDHomes held 2 public consultations where their proposals were unveiled to the local community and stakeholders. In May 2006, in conjunction with Ashford Borough Council, ZEDHomes held an Enquiry by Design to discuss the Ashford ZED proposals further. See www.zedhomes.com for full details. The development will significantly exceed the council's standards for energy saving and water recycling.
Key stakeholders involved	ZEDHomes Ltd and Ashford Borough Council

23. Ecolonia, Alphen aan den Rijn City Council



Name and location of development	Ecolonia, Alphen Aan Den Rijn, Netherlands
Status	Completed 1993
Developer / further information	Urban plan / Masterplan: Lucien Kroll Architects: All Dutch/Belgian, chosen for environmental credentials - BEAR Architects, Albert & Van Huut, Hopman bv, J P Moehrlein, Bakker / Boots / Van Haaren / Van der Donk, Peter van Gerwen, Archi Service and Vakgroep FAGO. (See: www.riba.org/fileLibrary/pdf/RIBA_response_to_Egan_Skills_Review.pdf) Further information is available at: www.eaue.de/winuwd/57.htm and http://home.hetnet.nl/~perronas/ecolonia.english.html
Aims of project	Commissioned by the Dutch national Environmental Agency in order to gain experience in the field of ecological town planning as well as in the area of ecological architecture.
Energy efficiency measures	Micro climatic design, energy efficient appliances, orientation optimised for solar gains, passive solar orientation, super insulated structure, timber frame. 61 of the total 101 buildings have heat recovery controlled ventilation systems. 32 have mechanical ventilation without heat recovery, and the remaining 8 dwellings are naturally ventilated. Also: recycled materials, flexibility of design, rainwater recycling, water butts
On-site generation measures	Solar hot water systems have been installed on nearly 80 south facing dwellings. The east-west oriented buildings had not been equipped with solar collectors as the energy savings proved to be too low. Photovoltaics were rejected at the time on financial grounds.
Other details	101 sustainable housing units built 1991-93.
User feedback on energy systems and their management, and related lessons learnt	Many residents stated their environmental awareness has increased since moving to Ecolonia. The behaviour of residents was monitored within a research framework at the Erasmus University of Rotterdam.

Information regarding validation of the building performance and post-construction monitoring	A resource measurement programme was carried out in 1993 with the following results (although it is not clear what these savings were compared to): • 40% reduction in gas consumption • 20% reduction in water consumption • 10% reduction in electricity consumption (see RIBA web link above)
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Modern energy efficient developments such as Ecolonia may be more expensive at the outset than traditional designs, but the operating costs of these homes are significantly lower than those built in the surrounding community following normal practices. In order to disseminate the acquired know-how on sustainable methods of town planning, an information centre was established.

24. Solarsiedlung Auf Dem Kruge Bremen City Council

Name and location of development	Solarsiedlung Auf Dem Kruge, Gropelingen, Bremen, Germany
Status	Completed 2001
Developer / further information	Solarinitiative Bremen http://solarserver.hs-bremen.de/index7.php See EcoDatabase at www.sustainablehomes.co.uk
Aims of project	A housing estate that supplies surplus energy to the local grid.
Energy efficiency measures	Energy efficient appliances, green electricity, low energy lighting, orientation optimised for solar gains, super insulated structure.
On-site generation measures	Photovoltaic panels - Grid Connection, Photovoltaic street lighting
Other details	80 terraced houses & 72 flats
User feedback on energy systems and their management, and related lessons learnt	All occupants are educated on control use. Apartment owners become "sellers" of electricity and thus have a monthly "income" up to €500[21]
Information regarding validation of the building performance and post-construction monitoring	One the biggest projects in Europe whereby PV modules were integrated into roofs of newly built housing. 960 modules were installed with a total rating of 200kW. The system generates 150,000 kWh per year, leading to a reduction of 130t of carbon dioxide per year. The apartments require only 1/10 of the energy used by normal homes.
Local Authority facilitation role	Unknown
Key stakeholders involved and main lessons learnt	Unknown

[21] In Germany, the Renewable Energy Act of 2000 gives citizens a guaranteed price when feeding excess energy back into the power grid (this is sometimes known as net metering). British households would be unlikely to benefit as much financially as these arrangements don't exist in the UK.

25. Kronsberg District, Hanover City Council

Name and location of development	Kronsberg District (Hanover Programme 2001), Germany
Status	Completion 2008
Developer / further information	World Exposition on Kronsberg District www.sibart.org/pdf/kronsberg.pdf
Aims of project	Demonstration project of a 'sustainable district'.
Energy efficiency measures	Energy efficient appliances, Also: water & waste management. Streets favour cyclists & pedestrians.
On-site generation	District heating,
Other details	Kronsberg will provide 6000 dwellings for a population of 15,000
User feedback on energy systems and their management, and related lessons learnt	All people moving into Kronsberg received a "Kronsberg-Binder" which is a collection of information relevant to the energy and water saving programmes, as well as other aspects of local sustainability. A number of events were organized to inform residents and motivate them to act more sustainably. Information has been offered through the neighbourhood centre and in the local schools and day care centres. An 'Energy Counsellor' worked with individual people in their homes or at the schools and other local institutions. A Kronsberg environmental magazine has been published to keep people updated on new projects such as improvements in the public transport system or the introduction of projects such as car sharing and barter rings. As Kronsberg's high goals for energy conservation can only be met through a combination of sustainable building technologies and corresponding lifestyles, the new residents have been informed about alternative practices for heating and ventilating their dwellings.
Information regarding validation of the building performance and post-construction monitoring	Each residential building requires a maximum heating energy requirement of 55kWh/m^2/yr. This has been verified by monitoring.
Local Authority and stakeholder involvement	Unknown

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Working as an independent body, the London Energy Partnership uses the power of partnership to enable London to respond to the challenges of climate change, security of energy supply and fuel poverty. The London Energy Partnership steering group members and observers include representatives from Argent Group Plc, Business Councils for Sustainable Energy UK, Carbon Trust, EDF Energy, Energy Saving Trust, RBC Capital Markets, Mayor of London, Government Office for London, London Borough's Energy Group, London Climate Change Agency, London Development Agency, London Sustainability Exchange, Renewable Energy Association, London South Bank University and Thames Gateway London Partnership.