BUILDING PRIDE IN OUR CITY

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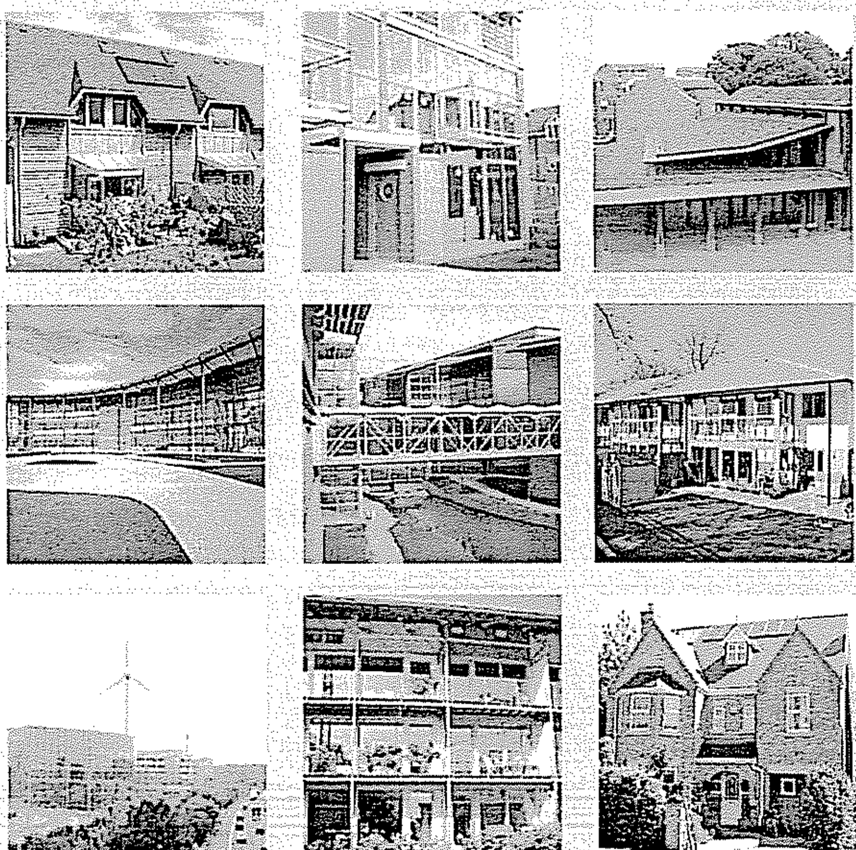
OXFORD CITY COUNCIL

Local Development Framework

Natural Resource Impact Analysis

Supplementary Planning Document

Adopted July 2006



19 JULY 2006
EXECUTIVE BOARD ITEM 21 APPENDIX A

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1. Eco homes at Oak Medow, South Molton, Devon (Gale and Snowden Architects/photo by Karen Taylor)
2. BedZed project, Sutton, Surrey (www.buildingforlife.org)
3. Arbroath Abbey, Angus Council (Bauder/photo from LivingRoofs – www.livingroofs.org)
4. Red Kite House, Wallingford (Scott Brownrigg Architects - www.scottbrownrigg.com)
5. Vodafone Headquarters, Newbury, Berks (www.vodafone.co.uk)
6. Beaufighter Road development,West Malling, Kent (Fry Drew Knight Creamer Architects/photo by Paul Dixon)
7. Green Park, Reading (photo from ecotricity – www.ecotricity.co.uk)
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9. Navigation Way, Oxford (photo by Oxford City Council)

CONTENTS

SECTION 1: INTRODUCTION

Context

1. In recent years more has become known about the impact people are having on the natural resources and the world around us. It is now widely recognised, for example, that the levels of Carbon Dioxide (CO^2) released into the atmosphere as a result of our ever-increasing demand for energy are harming the environment, and weather patterns are changing as a result. Alongside this, our demand for materials, both natural and man-made, is depleting resources at an increasing rate.

2. This document~~SPD~~ has been produced at a time when the debate on these issues is being held at the highest levels; government policy at European, national and regional levels is being updated and strengthened in an attempt to control our demand for energy and natural resources and the impact we have on the environment. The impact of the built environment, in terms of its demand for resources and the levels of energy it uses, is currently a focus for this debate.

3. ~~To do what it can to address these issues at a local level,~~ Oxford City Council has a longstanding commitment to making Oxford more sustainable, to do what it can to address these issues at a local level. Incorporating sustainable design and building principles in developments is one important way that this commitment can be realised. These principles must be considered from the start of the design process and not seen as an additional bolt-on at a later stage.

Benefits of sustainable building

4. The wider environmental benefits of building sustainably are well known: lowering demand for energy, the emission of greenhouse gases and the use of natural resources for example. But it also has more local and immediate benefits. High quality, sustainable building design and construction creates pleasant living and working environments. Studies have shown that sustainable building also prevents sick building syndrome, raises workplace morale and increases people's satisfaction with the environment they live and work in. Recent and projected rises in energy[1] and water prices mean that buildings are getting more expensive to run, so incorporating measures to reduce the demand for energy has financial benefits too. A recent survey by CABE and the Halifax indicated that house buyers were prepared to pay a financial premium for homes designed on principles of sustainability[2]. The role of corporate responsibility in decision making within commercial companies also makes sustainable buildings an attractive proposition.

Purpose of the SPD

5. The purpose of this document is to supplement those policies of the adopted Oxford Local Plan 2001–2016 that address the issue of resource-efficient buildings, namely policies CP.15 (Energy Efficiency), CP.16 (Renewable Energy), CP.17 (Recycled Materials) and CP.18 (Natural Resource Impact Analysis). Policies CP.15 – 18 are quoted in full in Appendix 1 of this document.

6. This document is mainly concerned with environmental sustainability and in particular resource-efficient buildings. Other policies of the Oxford Local Plan address issues of social and economic sustainability and indeed other aspects of environmental sustainability (such as Policy NE.17 on Biodiversity). Together the whole raft of Local Plan policies will ensure that development in Oxford is sustainable in the wider sense of the word. The scope of this document only covers resource-efficient buildings; this allows a discussion of more depth and detail, focused on a specific aspect of the sustainability debate.

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[1] Ofgem estimate that over the winter of 2004/5 alone, customers in the UK paid £5.2 billion more for their gas and electricity than they had in the previous year. "Rising Energy Prices", Energywatch, page 1

[2] 87% of housebuyers want to know whether their homes are environmentally friendly and 84% would be prepared to pay for a more ecofriendly home. CABE, Halifax and WWF (in Guardian July 26th 2004)

7. This document aims to provide detailed advice and guidance and to set out how the planning authority will be seeking to apply Policies CP.15–18 when determining planning applications. It provides examples of measures and technologies that can be used in the development of proposals to ensure that they minimise energy use and use of natural resources, therefore complying with the policies of the Local Plan.

8. This document will be adopted as a Supplementary Planning Document (SPD) and will form part of the Local Development Framework. That status will allow it to be used in the determination of planning applications and will acquire the weight of a 'material consideration' under Section 38(6) of the Planning and Compulsory Purchase Act 2004.

9. The SPD addresses each of the key policy areas in turn. Section 2 addresses the issue of Energy Efficiency, Section 3: Renewable Energy, Section 4: Choice of Materials and Embodied Energy, Section 5: Recycled Materials and Section 6: Water Resources. Each section is introduced with the background and forces for change in that policy area; poses a series of key questions on the issue the issue is discussed; and suggests possible measures and technologies that could form part of the design solution in proposed schemes are suggested. Each section ends with a list of the questions posed in the NRIA template and checklist as explained below.

10. The SPD addresses a wide range of measures and technologies but is not exhaustive; links and references to organisations where more detail can be found on particular issues are provided at Appendix 2. It will not be appropriate for a development to incorporate all the measures set out here. There will always be a need to balance the benefits of these measures against the wider design policies of the Local Plan. Different measures will be more appropriate in different locations and for different uses. The SPD is therefore worded in general terms with some additional considerations for residential and commercial proposals with advice and requirements that will apply in the majority of cases.

What is an NRIA?

11. A Natural Resource Impact Analysis (NRIA) should evaluate the use of natural resources and the environmental impacts and benefits arising from a proposed development, both at the construction phase and through the subsequent day-to-day running of the buildings. Where an NRIA is required, it must demonstrate how the building is designed to minimise the use of natural resources over its lifetime.

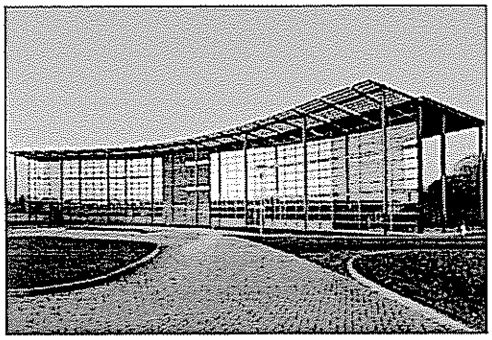
12. Appendix 4 sets out a suggested template for an NRIA. This template follows the format of the SPD, addressing each of the topics covered. It is set out as a series of questions which developers are asked to answer in regard to their proposal. Having answered yes, no or partly to each of the questions, developers should explain how each question has been addressed in their scheme or explain why it has not been addressed. Please note that where developers answer 'no' to a significant number of questions, it would be advisable to amend the proposals before submitting an application for planning permission. An NRIA completed in sufficient detail and structured in the format of the template will provide the information required to support a planning application; of course this in itself does not prove would not mean that the proposed scheme meets the requirements of the Local Plan policies.

13. Developers are advised to use this template, but may use their own format if they prefer. However in this such cases the planning authority will consider whether it meets the requirements of the policies and may seek further information. Developers should always discuss their proposals with planning officers before submitting an application; and officers will be happy to advise on whether an NRIA gives the information they need in order to determine the application.

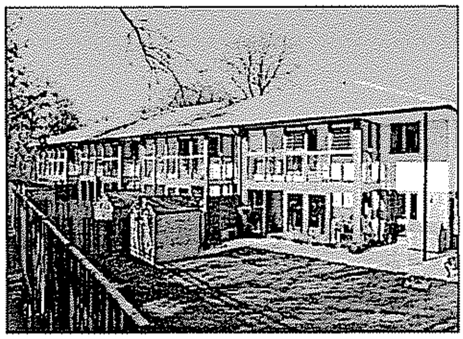
14. The final section of any NRIA must be in the form of the checklist (Appendix 4). This checklist gives developers an indication of the City Council's requirements, and gives officers a set of measures to use, alongside the details already provided in the NRIA, to determine an application. The checklist comprises a series of measurable questions and sets out the City Council's "minimum", "preferred" and "target" standards for each of these. The checklist is included at Appendix 6. The current standards were written in 2006. The City Council intends to review them in 2010 to take into account improvements in best practice.

15. There are nationally recognised systems that ~~address~~ measure the ~~issue of resource efficient~~ sustainability of buildings (for example BREEAM, Ecohomes and the forthcoming government Code for Sustainable ~~Buildings~~Homes). Such systems are often helpful in assessing the sustainability of a building in the wider sense. ~~H~~however the template and checklist in this document are specially designed to address the ~~key~~ issues in this field that are most important to Oxford City Council. ~~Such systems are often helpful in assessing the sustainability of a building in the wider sense.~~ Should a developer wish to use one of these other schemes they should submit the rating achieved with a completed NRIA. This will enable the City Council to ensure that the key aspects of energy efficiency, renewable energy, the choice of materials, recycled materials and water resources are addressed in full.

16. The SPD, its parent policies in the Local Plan, ~~and~~ the template format and accompanying checklist, are intended to provide sufficient information to make ~~clear to potential developers~~ the intentions of the planning authority in this area clear to potential developers. Information submitted in an NRIA will be used to assess a scheme's compliance with the policies of the Local Plan. Where appropriate the City Council will use conditions and / or legal agreements to secure the commitments made in an NRIA.



Environment Agency Offices,
Red Kite House, Howbery Park, Wallingford
(Scott Brownrigg Architects - www.scottbrownrigg.com)



Beaufighter Road development,
West Malling, Kent
(Fry Drew Knight Creamer Architects/photo by Paul Dixon)

Do I need to submit an NRIA?

17. As set out in Policy CP.18 of the Local Plan, an NRIA is required for all major developments. For the purpose of this policy a major development is defined as 10 or more dwellings or 2,000 m^2 or more of floorspace. For mixed-use developments of residential and non-residential uses, the proposals will be assessed on a pro-rata basis to decide if an NRIA is required. Planning applications for developments over this threshold will be expected to include an NRIA at submission.

18. On proposals below the threshold, applicants should also incorporate the design principles and concepts outlined in this SPD, and although not required to do so, are encouraged to submit an NRIA. Please note that Policy CP.15 in particular, applies to all development, without any threshold, therefore all developments must be designed to optimise energy efficiency.

19. Developers are required to submit an NRIA with outline applications over the threshold. Whilst not all the information may be available to fully complete an NRIA at the outline stage, an interim statement covering the key issues must be submitted. This will help planning officers in the determination of the application, and will also help in the preparation of detailed matters for the next stage of the planning process when a full NRIA will need to be submitted.

20. The City Council is here to assist in these matters and discussion on NRIA matters at the pre-application stage is encouraged. If you have any doubts, or if you would like further advice on this matter, please contact the planning department. Please note that all applicants are also welcome to contact the Sustainable Energy Officer and Building Control Officers at Oxford City Council for help and advice.

The financial implications of resource efficiency

21. Alongside the environmental benefits of the measures and technologies addressed in this document, there is also great potential for financial benefits. Many of the measures addressed in this document can be included at nominal or zero cost to the developer. Many of these can be cost neutral or positive, if discussed with the design team and included at the earliest stages, and are often cheaper to run in the long term.

22. Energy and water efficiency measures and renewable energy technologies can greatly reduce the operational costs of a building. Improving the energy efficiency of a scheme will reduce the energy requirements and therefore the fuel costs of operation. With rising fuel prices it is therefore wise to reduce the energy requirements of a building. ~~It is also beneficial to reduce dependence on the national grid by p~~Producing a proportion of energy requirements on-site from renewable sources can also reduce dependence on the national grid. It should be recognised that in the future, changes to legislation will require more stringent measures in building design and building services. Alongside these legislative changes expectations of building performance are also likely to rise. Measures to improve energy and water efficiency, or generate on-site renewable energy, cost far more to add to a building after completion (including the potential cost of closing it for the works to take place) than if they were included at the design and construction stages. It therefore makes financial sense to secure the future performance of a scheme in its design.

23. This document does not refer to specific products or their costs, as such information inevitably dates very quickly. However as technology develops, markets mature, and demand increases with tightened legislation, technologies and systems will become more affordable. This process has already begun with many of the technologies described in this document, and particularly when bought in bulk for a large scheme or multiple schemes, they can be procured for a relatively small proportion of total build costs.

24. A number of grant-making bodies can offer help with the cost of including renewable energy technologies in a scheme. Whilst grant schemes can be reviewed with time, there is a clear commitment from the government to maintain such support. Locally, help is available to locate funding sources from the Sustainable Energy Officer of the City Council and from bodies such as Thames Valley Energy; see Appendix 2 for further sources of assistance.

SECTION 2: ENERGY EFFICIENCY

Background and forces for change

25. Buildings account for 45% of primary energy use in the UK and approximately 20% of that energy is thought to be wasted. Clearly this ~~area~~ can be targeted with the aim of reducing the demand for energy produced using fossil fuels and thereby reducing carbon emissions. The new EU directive on the Energy Performance of Buildings is intended to substantially improve energy efficiency in buildings. Key aspects of that directive are for member states to apply a common method for assessing the energy performance of a building and then set minimum standards and to establish a system of building certification along the same lines as those produced for electrical white goods. This will be implemented into UK law through measures including a revision of Part L (Conservation of fuel and power) of the Building Regulations ~~that is due to come into effect on 6~~ (April 2006), and the development of a National Calculation Methodology (SBEM) on the energy performance of non-residential buildings.

26. As well as the legislative aspect, there is a financial aspect to energy efficiency. Recent years have seen significant increases in the cost of utility bills; for example Energywatch estimate that the average domestic gas bill has increased by 38% and the average domestic electricity bill by 30% since October 2003. The incorporation of energy-saving measures in the initial design and construction of a building can significantly affect the levels of energy consumed and thus the running costs of the building after completion.

How will the design and layout ensure that energy is used efficiently in the scheme?

27. It is very important that energy efficiency is considered from the earliest stages of the design process as several of the measures described below are most effective if considered before detailed plans are drawn up. A thorough analysis of the site and its potential is key to designing a scheme which maximises energy efficiency.

28. *Solar gain*
~~Passive and active s~~Solar gain can provide a significant contribution towards the heating, lighting (daylighting can offset the requirements for electric lighting), ~~heating~~ and ventilation (via passive stack ventilation) in a building. Solar gain should be controlled so as to avoid excessive demand for cooling. Different approaches to maximising ~~passive and active~~ solar gain are needed depending on the size and use of buildings, ~~. For greatest solar access, buildings should have main elevations~~but elevations that face within 30° of due south (either to the east to make the best use of morning sunlight or to the west for afternoon sunlight) are likely to maximise access to the sun (excluding other factors). In terms of heating from solar gain, p~~P~~lanning the layout of individual buildings to ensure that the main living (or working) spaces are on the southerly-facing elevations can also have~~s~~ a beneficial effect. The rooms where people will spend most time should have priority for such locations over rooms with a lower occupancy such as the circulatory or servicing spaces of a building, which require less heating. Rooms that contain machinery or equipment that generates heat should be on the northern sides of a building. To minimise the need for additional space heating, elevations to the south should have larger areas of glazing than those facing north. Glazing ~~is~~has an important role maximising the levels of natural daylight penetrating the building, so reducing dependency on artificial lighting. It is also important, however, that occupants don't feel the need to use blinds for privacy, as these can cut out around 20% of passive-solar energy.

29. *Shelter and shading*
Some shade or shelter may be beneficial in the summer months particularly at the start and end of the day and on the south and west elevations. Buildings may also need shelter from prevailing winds. Trees in shelterbelts that protect a scheme from the prevailing south or southwest winds should be spaced at least 3 or 4 times their mature height from south-facing elevations so that they do not block out sunlight. Opportunities for such shelterbelts may be more limited in urban areas like Oxford but they may be appropriate in some circumstances and should be considered. Deciduous planting can provide shading from glare and overheating during the summer but still allow sunlight from the low level sun in the winter through the bare branches. In the UK, the sun's

low winter altitude means it may be difficult to achieve much in the way of ~~passive-~~solar gain and daylight penetration, particularly in cities where adjacent buildings may obscure the winter sun. Ideally buildings should be positioned to avoid any such obstructions. In mixed-height developments, taller buildings should generally be sited to the north.

Residential: Solar gain

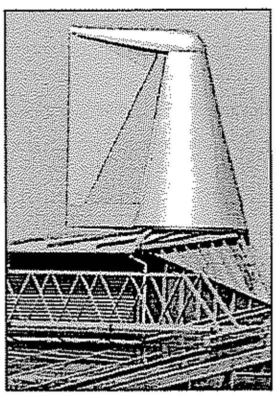
The design of residential properties should maximise the use of solar gain. Residential layouts should seek to make the most of a southerly orientation, with main habitable rooms located on southerly elevations and incorporating proportionally higher levels of glazing. Obstructions such as projecting garages and porches and staggered plans on south sides should be avoided to prevent overshadowing. Care should be taken however, that layouts are also designed to meet the requirements of the design policies of the Local Plan (CP.6 – 13), for example with clear street patterns, active frontages and passive surveillance.

Commercial: Shading

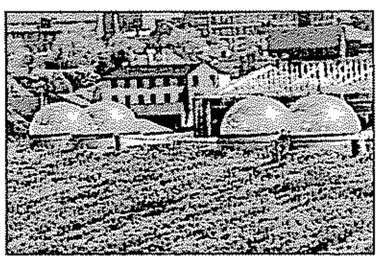
Whilst the principles of solar gain should also be taken into account in the design of commercial properties, developments such as offices will require a controlled approach to prevent overheating. Too much sunlight (particularly in office buildings for example) can add to the heat generated and increase demands for cooling. Louvres, external blinds and roof overhangs can provide shade in the high summer but still allow maximum daylight.

30. *Building form*
Detached buildings can be inefficient compared to linked buildings, which reduce heat loss through the walls. To minimise the heat lost through external walls, the smallest possible ratio of the external wall and roof area to volume will maximise energy efficiency. If they are not heated, conservatories, lobbies and porches can provide buffer zones between the internal spaces and the external environment. They can add to ~~passive-~~solar gain if glazed, provide an additional insulation layer, preheat air drawn into the building and prevent cold air entering.

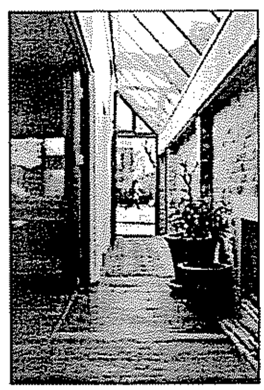
31. *Green and brown roofs*
The use of green and brown roofs can also increase energy efficiency. A green roof is one that has been surfaced with a growing medium, with vegetation on top of an impermeable membrane; brown roofs work on the same concept but with a broken substrate replacing the organic growing medium. Intensive roofs have a deep layer of soil, and can grow and support lawns and shrubs and are designed for people to use; extensive roofs have a shallower layer of soil, are generally planted with mosses and sedums and are not designed for such use. Green and brown roofs can provide buildings with more thermal mass (see below), prolong the life of the roof, reduce sound transmission, moderate surface water run-off, provide green space for wildlife and people, and look attractive. The average weight of a fully saturated extensive roof is comparable to the weight of a gravel ballast conventional roof.



Natural ventilation wind cowl, Jubilee Campus, Nottingham (photo from BRE)



Green roof with light pipes, Jubilee Campus, Nottingham (photo from BRE)



Passive solar space, Oxford (photo by Oxford City Council)

How will the construction of the buildings ensure efficient use of energy and reduce overall energy use?

32. *Thermal mass*
The use of thermally massive materials and construction can have beneficial effects through their ability to store heat through the warmer parts of the day and release that heat through the cooler parts of the day and night. Generally heavy materials such as stone and concrete have a high specific heat capacity whilst more lightweight materials such as soft wood have a lower specific heat capacity. To exploit the potential of heavy materials with such capacity, the proportion of that material exposed to the internal spaces should be maximised, for example a floor which receives direct ~~passive~~ solar gain could be constructed in a heavy material so that it can store as much heat as possible for use during the cooler parts of the day. It should be recognised that thermally massive buildings can involve the use of materials with relatively high embodied energy (see paragraph 52), the costs and benefits of such an approach should be considered when making design decisions.

33. *Insulation and air tightness*
To maximise energy efficiency the heat lost from the building must be kept to a minimum. This can be achieved through effective use of insulation. Building Regulations represent a legal minimum but do not reflect best practice. Insulating roofs, walls and floors beyond Building Regulation standards will minimise heat lost and save on energy bills. Superinsulation is the use of very thick layers of insulation to minimise heat flow. Superinsulation requires a high standard of air tightness and the use of trickle or maybe mechanical ventilation. Other innovative insulation measures and technologies (such as vacuum insulation) are becoming available. Sustainable insulation materials that are now available on the market such as recycled newspaper and sheep's wool should be considered. Besides good levels of insulation, buildings should be constructed for air tightness to minimise air infiltration. Windows and doors must be well fitted to cut draughts; however it is important to use controlled ventilation to ensure good internal air quality.

34. *Glazing*
Poor-quality glazing can allow heat to escape and cause condensation and draughts, leading to excessive heating costs. In contrast, high-specification glazing can improve thermal comfort, improve the energy rating of the property and bring additional benefits such as increased security and sound insulation. Building regulations require the use of double-glazing with low emissivity (but triple glazing should also be considered).

Residential: SAP energy ratings
The Standard Assessment Procedure (SAP) is the government's method for calculating the energy performance of residential properties. This calculation takes into account a range of factors that contribute to energy efficiency; including the materials used, insulation, ventilation, heating systems, solar gain, fuel and renewable energy technologies.

Commercial: Energy Ratings
~~There is currently a choice of compliance checklists for building regulations.~~ In response to the Energy Performance of Buildings Directive, ~~ODPM are currently working on~~ DCLG have developed the National Calculation Method for non-residential buildings~~;~~ and a calculation engine called Simplified Building Energy Method (SBEM) ~~is being developed. This is expected to work in a similar manner to the SAP rating.~~ This method uses factors such as CO^2 emissions, U-values and building services in the calculation.

How will the mechanical and electrical systems of the buildings ensure efficient use of energy and reduce overall energy use?

35. The systems incorporated into buildings can also have a significant effect on energy efficiency. There is little value in incorporating the design and layout measures outlined above unless the systems introduced into the building also minimise the use of energy. ~~H~~Mechanised heating, lighting and ventilation systems should only be mechanised where ~~absolutely~~ necessary. Good design can mean there is no need for heating or mechanical ventilation and minimal need for lighting. Mechanical systems should not be sized larger than necessary. There are great benefits to producing a building services handbook for the benefit of future occupants. A manual can

explain why the mechanical and electrical systems were chosen for the building, and show occupants how to use them most efficiently.

36. *Heating*
The heating of a development is a significant factor in the level of energy demanded. Building regulations now specify that only boilers with an efficiency rating of A or B can be fitted; currently only condensing boilers are able to meet this requirement. Condensing boilers increase efficiency by recovering the heat that is normally wasted in the hot flue gases given off by a conventional boiler. The flue gas from a conventional boiler will be at a temperature of about 150°C, but a condensing boiler can reclaim most of this heat (and the latent heat of the water vapour in the flue gases) and give off flue gases at about 50°C. The controls of any heating system are key to its efficient operation. Zoning can be used to maximise efficiency by allowing different parts of a building to be heated to different levels to reflect their uses.

37. *Combined Heat and Power*
Combined Heat and Power (CHP) units generate electricity through an engine and capture the by-product, combustion heat, for use in heating and hot water systems. CHP units can use and be adapted to a variety of fuel sources including premium fuels such as natural gas and renewable fuels such as biomass. CHP is an efficient way of generating power as it captures the heat produced that is lost in other generating methods, including at the power station, consideration should always be had as to the appropriateness of a CHP unit in a development. CHP is most cost effective when the demand is balanced over the day, so sharing systems between buildings (district heating) can be beneficial. CHP is also most cost effective when the demand is balanced over the year. ~~Also t~~The demand for the generated heat should be consistent throughout the periods in which the plant operates (as, if the heat is not required, CHP would rank as an inefficient method of generating electricity). ~~Transmission distances should be kept short;~~ CHP is most efficient when users are close to the plant ~~power source~~. Individual micro-CHP will produce significantly less CO^2 emissions than condensing boilers but more than district CHP would.

Residential: CHP
CHP technology has been around for some time at the large scale, but recently several companies have released micro-CHP systems, suitable for individual dwellings, that can achieve significantly reduced levels of CO^2 emissions. Residential units as part of mixed-use developments and, possibly, larger residential developments may also be suitable for a district heating system run from a larger CHP plant.

Commercial: CHP
CHP units can ~~are~~ also be well suited to large buildings such as offices, factories and shopping centres and to district heating systems in mixed-use developments where the timing of demand differs between uses or buildings.

38. *Ventilation*
Maximum use of natural ventilation is appropriate in most circumstances. The simplest method of natural ventilation is to create opportunities for cross ventilation. Openings on opposite walls (or even adjacent walls) can draw air through a space. Windows should be openable and trickle vents and other such devices should be installed to provide continuous background ventilation. ~~T~~As a general guideline, to maximise cross-ventilation, the building depth should be no more than five times the floor-to-ceiling height. For single-sided ventilation, depth should be limited to around 2.5 times the floor to ceiling height. In non-residential buildings ~~m~~Mechanical ventilation may be required to supplement the natural ventilation. Mechanical ventilation can be very energy efficient, running on only small levels of energy yet achieving significant benefits in a development; careful specification is key. Plant should be specified to ensure that noise nuisance both for building users and for neighbours is minimised. Heat exchange technology can be used in both passive and mechanical ventilation systems to increase efficiency. Air conditioning plant will not generally be required to achieve comfort in Oxford's climate.

39. *Lighting*
Around a third of the energy used by a building goes into lighting. Energy-efficient buildings should therefore use the naturally available light as much as possible. The main factors influencing the levels of daylight in a building are the orientation and size of windows, obstructions blocking the light and reflectivity of surrounding surfaces. Daylight normally penetrates about 4–6 metres from a window into a room, and adequate daylight levels can be achieved up to a depth of about 2.5 times the window head height. The daylighting benefits of large areas of glazing need to be considered

against the thermal and other properties of glazing. Even where the design capitalises on natural light, it is important to carefully select the artificial lighting system that is installed. Automatic lighting controls for example can be effective in areas such as corridors and toilets. An efficient and easily controllable system can make significant benefits in terms of energy efficiency and therefore running costs.

Commercial: building services

Commercial properties often require more in terms of building services and more complicated systems to control and regulate the internal environment. In addition to the general points identified above, proposals for commercial properties should also give consideration to the following:

Ventilation: The use of atria and thermal chimneys to increase the opportunities for natural ventilation. Low-pressure mechanical systems can assist ventilation. This involves increasing airflow through and out of a building using fans and supply / extract ducts. Such mechanically assisted ventilation will probably be sufficient in our climate for all except a few hours each year. An example of such a system is displacement ventilation, which introduces air at low velocity at floor level, and extracts warm stale air at the ceiling: a good ceiling height is required for this to work (minimum 2.75m, but the more the better).

Lighting: Rooflights can provide a wider distribution of light, which is especially useful in deep-plan buildings; they can provide three times the benefit of an equivalently sized vertical window. In non-domestic buildings the window area should be about 20% of the floor area to provide sufficient light to a depth of about 1.5 times the height of the room. The use of atria, light shelves or sun pipes can also increase the levels of daylighting deeper into rooms. Sun pipes use a tube with mirrors to deflect and direct light to where it is required, and can be useful in some domestic properties too. Where artificial lighting systems are specified, those that generate least heat and therefore reduce the need for cooling and ventilation should be chosen.

Residential: appliances

As the energy efficiency of a building is improved, the impact that appliances have on the total energy consumption becomes more significant. White goods such as refrigerators, freezers, washing machines and tumble dryers can add significantly to the energy load of a household, for example. It is important therefore to ensure that the appliances chosen to fit out a new building are as efficient in their use of energy as possible so as not to undo the good work done in improving the energy efficiency of the building envelope. However, simply stating that a new building will be fitted with energy-efficient appliances will not be sufficient to make that building acceptable without the corresponding efficiency measures to the envelope, as specification of appliances is inherently a short-term measure in the life-span of a building.

Commercial: Building Energy Management Systems

Building Management Systems and Building Energy Management Systems are used to manage and control the environment within buildings. They can operate and control the heating, ventilation, air conditioning and lighting and even be designed to control window opening and blinds. These systems can have benefits in terms of optimising energy use. However, using them to control windows and blinds, for example, can remove control from the occupants over their local environment, which can be frustrating.

Energy efficiency questions to be addressed in an NRIA

How will the design and layout ensure that energy is used efficiently in the scheme?

1. Has an energy strategy been prepared?
2. How is the development designed to maximise beneficial solar gain? (through orientation, spatial layout and systems design)
3. How will the design of the building make efficient use of energy? (linked buildings, buffer zones, thermal mass etc)

How will the construction of the buildings ensure efficient use of energy and reduce overall energy use?

4. What insulation standard will the development be built to?

5. How is the development designed to minimise unwanted air infiltration?
6. What glazing standard will the development be built to?

How will the mechanical and electrical systems of the buildings ensure efficient use of energy and reduce overall energy use?

7. ~~Will the development incorporate high-efficiency boilers?~~What efficiency standard will boilers be specified to?
8. Will the development be linked to a combined heat and power plant or to a district heating system?
9. How has the development been designed to maximise controlled natural ventilation?
10. Will any mechanical ventilation to be incorporated be of high efficiency?
11. How has the development been designed to maximise natural daylighting?
12. ~~W~~How will the development incorporate ~~a~~ high-efficiency lighting ~~system~~?
13. ~~W~~How will the development incorporate high-efficiency appliances (where installed)?
14. How will the heating, lighting and ventilation systems be controlled?

Checklist question for energy efficiency

	Minimum standard		Preferred standard		Target standard	
Residential uses: What is the SAP rating?	SAP "good"	1 pt	SAP "best"	2 pts	SAP "advanced"	3 pts
Non-residential uses: What is the relationship of the Building Emissions Rating (BER) to the Target Emissions Rating (TER)?	BER = TER	1 pt	BER is 2% better than TER	2 pts	BER is 5% better than TER	3 pts

SECTION 3: RENEWABLE ENERGY

Background and forces for change

40. Energy production is one of the chief sources of carbon emissions in the UK. ~~Some 37% of UK carbon emissions originate from energy production.~~ By using energy from renewable sources such as solar, hydro, wind and biomass, demand can be reduced for energy ~~electricity~~ generated in traditional non-renewable ways. This will help to reduce non-renewable energy use and greenhouse gas emissions.

41. The government is seeking to encourage the development of renewable energy production and has set a target to reduce carbon dioxide emissions by 60% by 2050 and to generate 20% of UK electricity ~~energy~~ from renewable energy sources by 2020 (which includes 10% by 2010). The recent PPS22: Renewable Energy indicates the Government's intentions by making a significant step forward from the previous PPG22 of 1993, which it replaces. Regional targets have been set for renewable energy generation: by 2010 the South East should generate at least 5.5% of its electricity from renewable sources and by 2026 at least 16%. The Thames Valley and Surrey sub-region has been set the target of producing 140MW of renewable energy by 2010 and 209 MW by 2016. Oxford City Council will encourage development of renewable technologies on appropriate sites to contribute to meeting these targets.

42. Renewable sources can be used to produce both electricity and heat. Whilst energy can be produced using renewable sources at a national level through windfarms and biomass electricity plants for example, micro-generation technologies can be incorporated into the design of buildings and can provide significant levels of energy to run them and even export to the national grid to provide an income source. The government see micro-generation as having "the potential to play a significant role in moving towards the government's objective of sustainable, reliable and affordable energy for all" [3]. Whilst much of the government focus is on the generation of electricity from renewable sources, it is important to recognise that renewable sources can also be used to produce heat.

43. As indicated below the NRIA checklist sets a required percentage of energy to be produced from on-site renewables. In terms of meeting these standards, low-carbon technologies can be included in the calculation, for example: CHP and heat pumps. As an illustration, in some circumstances district heating may be available and may be the best choice of technology for generating energy for a scheme. In such cases this will be taken into account as if it were produced from an on-site renewable energy source. This would require a planning / legal commitment to ensure that the development was connected to the system in the long term. In order to satisfy this policy, it will not be sufficient to state that energy will be purchased from a "green" supplier.

44. Various grant-making bodies offer financial support to developments that incorporate the use of renewable energy technologies see Appendix 2 for sources of further information.

How will the design incorporate the use of energy from renewable sources?

45. *Biomass*
Biomass is organic matter of recent origin; this does not include fossil fuels, which have taken millions of years to evolve. The CO_2 released when energy is generated from biomass is balanced by that absorbed during the fuel's production; hence this is termed a carbon-neutral process. Producing energy from biomass is most cost-effective when a local fuel source is used, which results in local investment and employment. It can lead to improved bio-diversity, open up previously closed areas of woodland for amenity value and can contribute to waste management by harnessing energy from products that are often disposed of at landfill sites. Biomass is produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. Biofuels fall into two main categories: woody biomass (which includes forest products, untreated wood products and short rotation coppice (SRC), e.g. willow that has

[3] DTI Micro-generation strategy and low carbon buildings programme consultation page 7

been sustainably produced) and non-woody biomass (which includes animal waste, industrial and biodegradable wastes from food processing, and high energy crops, e.g. rape, sugar cane, maize). For building-related applications biomass fuel usually takes the form of wood pellets, wood chips or logs burned in modern appliances, ~~often computer-controlled and~~ requiring little manual input and management. Fuel storage can be in the form of underground bunkers, hoppers, or, in the case of wood pellets, in bags; and frequency of delivery depends on storage available. ~~Wood chip systems are best suited to buildings with a consistent heat load throughout the heating system, such as hospitals, halls of residence, hotels etc. as the heating systems are not as responsive as traditional fossil fuel-based designs. Wood pellets are more flexible and responsive and heating options range from large-scale boilers, down to individual room heaters.~~ The current focus of this market is towards providing heat only, either for individual buildings, or as part of a district heating system.~~,~~ ~~as CHP is only feasible where base loads of 150kW heat and 100kW electricity (minimum) are required.~~ Fuel supply is plentiful and not a problem regionally, with prices for chips ~~which are cheapest,~~ and pellets rapidly converging with the cost of ~~gas~~gas, it is anticipated that chips and pellets will become cheaper than gas in the near future. All modern biomass combustion equipment meets strict EU emissions regulations.

46. *Heat pumps*
The ground, air and water all contain heat that can be harnessed for use in a development. The heat from these sources can be pumped into the heating systems of buildings, reducing the need for heat generation on site. Whilst not totally renewable (as a small level of power is needed to run the pump element of a system, although this could be provided from a renewable source), heat pump systems can provide significant levels of heat from a renewable source. Other benefits of heat pumps are that they can be maintenance free, don't require annual inspections as gas-fuelled systems do, and don't require storage of fuel as in oil or LPG systems. The most common use of heat pumps is for ground-source heating; air-source heat pumps can be cheaper to install but the heat source is less consistent compared with the stable temperature of the ground. Ground-source heat pumps (GSHPs) can be used to efficiently heat a building by drawing heat from the ground (either through buried horizontal loops or through boreholes), concentrating it and delivering it to the building. ~~There are three main elements to a GSHP system: a ground loop, a heat pump and a heat distribution system. The system works in a similar manner to a refrigerator: a closed loop system of plastic pipes filled with water and antifreeze is buried in the ground and pumped around the loop, the pump evaporates, compresses and condenses the heat and delivers it into the heating distribution system of the building. This process exploits the stable temperature of the earth for both heating and cooling. The principle is that heat is not created but merely transferred from one area to another. The system removes heat from one side of the circuit and ejects heat to the other side.~~ Heat pumps are particularly suitable for buildings with under-floor heating or blown-air systems and some can be reversed to provide cooling in summer. Where buildings need pile foundations the closed-loop system of pipes can be integrated into the foundations.

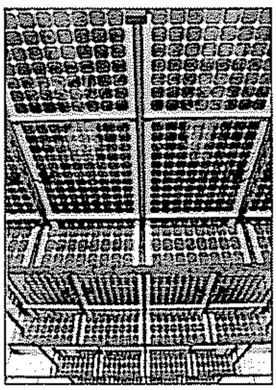
47. *Solar water heating*
Solar water-heating systems are very reliable and (apart from the plumbing system) have no moving parts and are durable. Solar collectors or panels containing fluid absorb the sun's heat and, once hot, the water passes through a coil in a hot-water cylinder and transfers the heat to the water in the cylinder. There are two main types of solar water-heating collectors: flat plate collectors in a box which is glazed and insulated behind; and evacuated tubes where vacuum glass tubes enclose each pipe and its associated absorber plate, acting as the insulation. Evacuated tubes are generally more efficient per square metre but the efficiency of flat plate collectors can be improved through installing a larger solar collector. Solar collectors can be installed at low level or on the roof of a building or incorporated into the roof finish. The ~~optimum~~ best location is facing towards the south ~~slightly west of due south~~ and at a tilt of 30-40°, although a collector set anywhere between east and west and at a tilt of between 10 and 60° will perform at 90% of the optimum performance. As an indication of the performance of solar water-heating systems, they can be expected to provide 60% of the hot water requirements of a home over a year.

48. *Photovoltaic (PV) arrays*
Solar energy can be turned into electricity via the use of photovoltaic (PV) cells. These cells convert solar energy into electrical energy using a cell consisting of one or two layers of a semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. Linked cells are encapsulated into modular panels, interconnected to provide electrical power which can be harmonised with grid electricity and fed

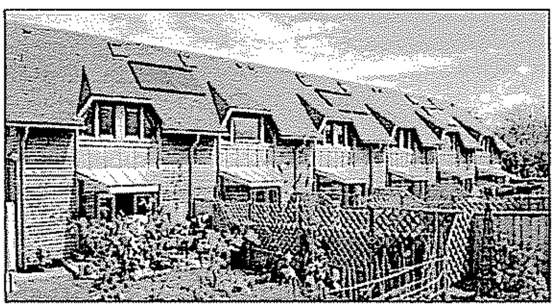
back into the network. ~~PV electricity supply can be isolated from the grid supply and so provide a reliable back-up at periods of grid failure.~~ The panels are very durable, as they have no moving parts. This is one of the easiest renewable energy systems to install in the urban environment as PV panels can be fixed to or form an integral part of the roof covering or the façade of appropriate buildings. ~~(it is worth considering that the cost of PV cells may be partially off-set when compared to high-spec functionless façade materials in prestigious developments).~~ Also, PV panels need not take up any additional land space, and do not require the specific topographical features that other forms of renewable energy do. PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles, to panels and transparent cells that can be used on conservatories and glass to provide shading as well as generate electricity. It is important to recognise that a PV system does not have to be designed to meet all the electricity requirements of a development but would prove very valuable in off-setting a proportion of those requirements.

49. *Small-scale wind energy*
The generation of energy from wind power is generally associated with large-scale wind farms in remote and exposed areas of the countryside. There is potential, however, for wind energy to be captured at the local level on a small scale. Small, stand-alone turbines have hub heights of anything from 6 to 30m and power ratings of anything from 2.5 to 20kW. Depending how much wind there is, the power generated by such machines can serve anything from one house to a larger housing or commercial development. Noise levels tend to be lower than most background sources of noise; radio/TV/telephone reception is rarely impeded; and birds are unaffected at this scale of technology. It is important to site the turbines at a reasonable distance from physical obstructions, such as buildings and trees, so as to fully utilise the wind available. Smaller turbines of the 1 – 1.5kW size are now being marketed for attachment to buildings. Costs are currently high, but expected to fall as economies of scale in production occur. It is important to understand the characteristics of the wind around the building proposed for the installation as the wind may not be flowing freely, which would radically alter the suggested output of the turbine. It is also important to be sure that the structure of the building will tolerate any vibration the turbine may cause. Turbines need to be positioned above the roof line. A wind energy installation of any type will almost certainly require planning permission.

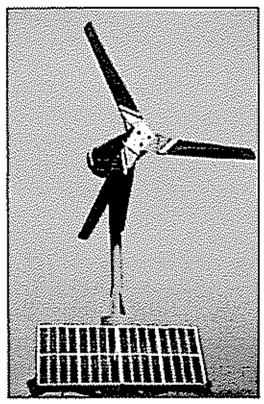
50. *Micro hydro*
There is limited potential to use hydro technology for electricity generation within the Oxford City boundaries. The potential for such schemes depends on the volume of water flow and the level of head (vertical drop of water)~~, which needs to be a minimum of 1.5m~~. Locations that might be suitable are old mill sites and river weir structures.



Photovoltaic, Jubilee Campus, Nottingham (photo from BRE)



Eco homes at Oak Meadow, South Molton, Devon (Gale and Snowden Architects/photo by Karen Taylor)



Sainsbury, Greenwich (photo from BRE)

Renewable energy questions to be addressed in an NRIA

How will the design incorporate the use of energy from renewable sources on-site?
15. Will the development incorporate the use of biomass as a fuel?
16. Will the development incorporate the use of ~~ground-source~~ heat pumps?
17. Will the development incorporate active solar water-heating systems?

18. Will the development incorporate solar electricity generation?
19. Will the development incorporate wind-energy electricity generation?
20. Will the development incorporate a micro-hydro scheme?

Checklist question for renewable energy

	Minimum standard		Preferred standard		Target standard	
What percentage of energy requirements will be produced by on-site renewables?	20%	1 pt	30%	2 pts	40%	3 pts

SECTION 4: CHOICE OF MATERIALS AND EMBODIED ENERGY

Background and forces for change

51. When selecting the materials for a scheme it is important to consider the environmental impact of those choices over time, including their manufacture, construction, finishing, operation (cleaning and maintenance), demolition and disposal. Specification of materials should consider their longevity, maintenance requirements, the levels of processing they have been through, and where they are sourced.

How will the materials specified minimise embodied energy and environmental impact?

52. *Embodied energy*
Energy is used in the extraction, production and transportation of materials, and as such an energy-efficient project will minimise the levels of embodied energy in the materials selected. The total amount of embodied energy can be high; for an average office building life-span of 15 to 20 years, about 7% of total energy consumption is embodied in materials. As the operation of buildings becomes more energy efficient, the levels of embodied energy will have an increasingly important part in the overall efficiency of a scheme. Different building methods use differing amounts of materials, so it is a matter of balancing the benefits of a particular building method against its impact. For instance, a design to maximise solar gain might require a solid concrete floor to store solar energy and the energy gain from this may outweigh the impact of the materials.

53. *Low environmental impact*
Re-used and recycled materials should usually have preference (see chapter 5); materials from a renewable source should always be chosen above those from a non-renewable source. Care should be taken to source materials from suppliers and manufacturers that have a proven environmental management record (some manufacturers have ISO 14001 environmental management systems in place) or those that publish environmental data.

54. *Locally sourced materials*
Sourcing materials from near a site has several benefits. The main environmental benefit is the reduced distance for transportation. Reducing the distance that materials have to travel, in particular heavy construction materials, has a significant impact on the demand for road transport and the energy that that requires. Other benefits include the enhancing the link between the new building and the area, preserving local character and supporting the local economy.

55. *Good internal air quality*
Sick building syndrome is officially recognised as an illness by the World Health Organisation and includes a wide range of symptoms triggered by the presence of chemical, allergens, microorganisms etc in buildings, as part of the artificial nature of many internal environments (including artificial lighting and the lack of connection with the diurnal cycle that can be offered by natural light and outside views). The careful specification of materials and internal finishes and decorating materials can help to minimise the incidence of sick building syndrome and contribute to the creation of good internal air quality. For example, paints and varnishes should have a natural finish or have a low solvent content and avoid the toxic volatile organic compounds (VOCs) that are found in many high gloss paints and varnishes. Alternatives include natural resin emulsions that are solvent-free and biodegradable.

56. *Responsible use of timber*
The use of timber is significant in the building industry and the consumption of timber is increasing. Whilst timber has many environmental benefits as a building material (being natural and renewable with low embodied energy) it is important that it is specified and used responsibly. Less than 15% of the total wood and wood products consumed in Britain comes from British woodlands; most construction timber is sourced from temperate forests in North America, Scandinavia and Russia, with tropical hardwood imported mainly from the Far East. The management of forestry is key to the sustainability of using timber. The Forest Stewardship Council (FSC) is an independent body that has an international labelling scheme for timber and timber products. This scheme certifies

forestry that is managed in an environmentally appropriate way, respects the interests of local people and is economically viable. Engineered boards such as plywood should also be FSC certified. Threatened imported species, especially hardwoods, should be avoided at all times. As far as possible, the use of timber preservative treatments should be avoided as the chemical formulations of many preservatives mean that treated timber is classed as toxic waste. Careful detailing and specification of durable timber can avoid much use of preservatives.

Choice of materials and embodied energy questions to be addressed in an NRIA

How will the materials specified minimise embodied energy and environmental impact?

21. ~~W~~How will the materials be specified to ensure a low level of embodied energy?
22. ~~W~~How will the materials be specified to prioritise those with minimal environmental impact?
23. Will the materials be sourced locally?
24. ~~W~~How will the materials and systems be specified to ensure a good quality internal environment?
25. ~~W~~How will the timber be specified to ensure it is from the most sustainable sources?
26. Will contractors and suppliers be chosen with regard to their environmental management record?

Checklist question for choice of materials and embodied energy

	Minimum standard		Preferred standard		Target standard	
What score is achieved in table 2?	4	1 pt	5-7	2 pts	8-11	3 pts

Table 2:

	Minimum standard	Score	Preferred standard	Score	Target standard	Score
Aggregates use	Some recycled aggregate used on site.	1	Recycled aggregate from off – site sources used for >60% of all aggregate consumed on site	2	Recycled aggregate from on-site demolition used for >60% of all aggregate consumed on site	3
Timber use	Softwoods from temperate managed forests used. No tropical hardwood from non certified sustainable sources	1	FSC or equivalent certified timber. and / or recycled or reclaimed timber used in <90% of the timber uses on site (by volume). Rest of timber from temperate managed forests	2	FSC certified timber (or equivalent) and/or reclaimed timber used in 90% of timber uses (by volume)	3
Insulation materials	From fossil fuel sources, with no ozone depleting blowing agents	1	From recycled materials	2	From naturally occurring sources	3
Sourcing strategy			Average distance travelled by materials (by weight) to be <100 miles (Industry average)	1	>50% of materials (by weight) to be sourced from within 35 miles (achieved by BedZed)	2

SECTION 5: RECYCLED MATERIALS

Background and forces for change

57. In 2002-03, England produced about 280 million tonnes of waste. This included 91 million tonnes of construction and demolition waste, 30% more than in 1999. Around half of the construction and demolition waste generated in 2003 was recycled as aggregate or soil; 18% was spread on land at registered "exempt" sites; 22% was used for landfill engineering or restoration; and 10% was disposed of at licensed landfill sites. Around 13 millions tonnes of construction waste comprises material delivered to site and thrown away unused. The government has sought to reduce the amount of waste sent to landfill and increase the amount of material recycled through changes in the waste management licensing regulations, the Landfill and Hazardous Waste Directive, and the landfill tax.

58. Waste production of course continues throughout the occupation of the development. In 2003-04, local authorities collected an estimated 29.1 million tonnes of waste in England. Around 87% of this municipal waste came from households, a total of 25.4 million tonnes. The rest came from sources such as shops and small trading estates, council office waste and local parks and gardens. Between 1998 and 2004, the proportion of municipal waste sent to landfill declined from 82% to 72%. ~~Oxfordshire households in 2003 — 2004, produced 483 kg~~Households in Oxford produced 335 kg of waste per person per year. In 2004-05, Oxford City Council collected 46,000 tonnes of refuse from householders, and recycled 14.8% of this.

How will the buildings be re-used and / or demolition waste be responsibly dealt with?

59. *Re-use / conversion of existing buildings*
Existing buildings can often be refurbished or extended, involving a much lower demand for new resources and materials than would be needed for demolition and construction. Re-use and conversions can offer opportunities to retain the existing embodied energy of buildings and to reduce the waste generated through demolition and the new resources and materials required. Existing properties can be successfully re-used through the conversion of basements and roof spaces and the creation of additional floors and extensions. However, existing buildings may not be orientated and laid out in the most energy-efficient manner (as set out in section 2) and may require significant improvements in terms of insulation, for example. There may be opportunities to improve passive solar design through changes in the layout and glazing patterns for example. Ideally, developers should only build new when all possibilities of refurbishing and re-using existing buildings have been exhausted.

60. *Strategy for re-use / disposal of waste*
Where demolition is appropriate and necessary, a clear strategy should be formulated for the handling and re-use or disposal of demolition waste. An audit of the demolition works will identify the materials to be released and their potential future uses and form the basis of a strategy for the handling of waste. Contractors should also be required to implement a waste strategy. This will include a waste audit, identifying the waste streams with proposals for dealing with them which could include on-site recycling or the use of waste reclamation firms.

How will waste be minimised and the materials and construction methods used in the development make best use of recycling?

61. *Reclaimed / recycled materials*
The use of reclaimed and recycled materials in construction can reduce environmental impacts in terms of less demand for new materials and in terms of less waste to be disposed of in landfill sites. Such materials can be sourced from demolition (e.g. reclaimed steel and timber elements and recycled masonry for use as aggregate either generated on site or elsewhere); from construction waste (e.g. broken bricks and tiles) and from waste from the manufacture of materials and components or other industries. The balance of energy saved from recycling needs to be considered where recycled elements are transported in from other sites or require significant levels

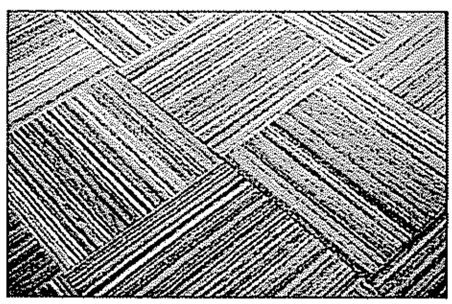
of reprocessing; however, on-site recycling of demolition and construction waste is nearly always preferable to its removal and disposal. There is a healthy and growing market for some re-used construction components such as bricks, roof slates, hardwood flooring, timber beams and architectural features. Such components are often sought at a premium and can provide a good income source if they are carefully removed during demolition and are not required on site. In addition, many mainstream construction products now include a significant percentage of recycled materials, for example recycled glass in glass wool. When specifying materials, manufacturers data should be examined in order to give preference to those with a higher percentage of recycled elements.

62. *Aggregates and soils*
Over 90% of non-energy minerals extracted in Great Britain are used to supply the construction industry with materials. The sourcing and transportation of new sand, gravel and crushed rock has significant environmental impact and as such the government has introduced the Aggregates Levy. This levy and the Landfill Tax on the disposal of waste, are designed to encourage the recycling of aggregates. 18% of UK aggregates now come from recycled sources. On larger sites, on-site crushing and re-use is the best option, although recycled aggregates are widely available and increasingly local contractors are interested in removing waste for off-site crushing. Where extra soil (top soil or sub soil) is required in landscaped areas, this should be screened soil reclaimed from other developments. Where soil is superfluous to requirements on a development, this soil should be carefully handled to protect its quality.

63. *Ease of construction in design*
The design of buildings should be reviewed from the viewpoint of ease of construction and managing waste at an early stage. Prefabrication, the off-site construction of aspects or modules of buildings, offers many benefits including quality, health and safety, handling of materials and quick build times on site and can also reduce waste. Prefabrication in a controlled factory environment can mean less waste from ordering surplus materials or through damaging materials on-site. The waste that is generated under factory conditions can also be re-used and recycled more easily. The logistics of maintenance and replacement should be factored into the decision to use modules, as set out below, and the future deconstruction of buildings should also be considered. Prefabrication in a controlled factory environment can mean less waste from ordering surplus materials or through damaging materials on site. The waste that is generated under factory conditions can also be re-used and recycled more easily.

64. *Future deconstruction*
Designing buildings and their details with deconstruction in mind enables the building at the end of its useful life-span to become the resource for future developments and complete the resource cycle. Designing buildings with their deconstruction in mind will help minimise the future costs involved in sending waste to landfill, provide materials for the replacement of the building or resale if appropriate when the building reaches the end of its life-span. This responsible outlook can also help avoid financial penalties in the future due to changing legislation as legislation in this area is likely to be tightened over time. A deconstruction plan and product / material index can be produced to document the areas addressed in the design and assist with deconstruction in the future. Examples of ways to ensure materials are recycled rather than wasted in the future include: avoiding composite materials; using lime-bases rather than Portland cement for mortar and renders to enable easier recycling of bricks; using mechanical fixings rather than adhesives; and using dry construction techniques where possible.

Recycling facilities (photo from BRE)



Recycled tiles (photo from BRE)

How will domestic / commercial waste generated in the development be dealt with?

65. *Storage and access to facilities / collection*
Storage facilities should be provided and be accessible, safely and conveniently, by building occupants. Internal layouts should include space to store waste conveniently before it is taken outside for recycling or composting. <u>Oxford City Council provides both recycling and waste collection services; advice should be sought from council officers in the City Works Business Unit.</u> ~~A similar scheme is available for commercial properties and advice should be sought from council officers in the City Works Business Unit.~~

66. *Composting*
Land-filled organic waste imposes burdens on the environment out of proportion to its volume; during decomposition it creates methane, which is a greenhouse gas with 30 times the global warming potential of CO^2. Composting organic waste addresses this problem and turns a waste into a valuable resource for use in gardens and landscaping schemes. Home composting significantly reduces waste for disposal and can raise awareness among users of the wider waste issue. A green waste recycling scheme also operates in the city; advice should be sought from officers in the City Works Business Unit.

Residential: recycling
~~All h~~<u>H</u>ouses and flats in Oxford are included in the City Council's kerbside recycling collection. This scheme involves the collection of materials including glass, tins, paper and clothes. Storage space for the separation of materials should be provided in any development.

Commercial: recycling
The City Council ~~operate a collection scheme~~ <u>offers a recycling service</u> for commercial properties<u>.</u> ~~where materials for recycling are collected from the kerbside.~~ For more details on this scheme contact <u>the Trade Waste Officer at</u> City Works Business Unit.

Recycled materials questions to be addressed in an NRIA

How will the buildings be re-used and / or demolition waste be responsibly dealt with?

27. ~~W~~<u>How w</u>ill the development make efficient use of all material resources on site (for example existing buildings, services, infrastructure and topsoil)?
28. ~~Will~~<u>Has</u> a strategy for the minimisation and handling of waste be prepared?

How will <u>waste be minimised and</u> the materials and construction methods used in the development make best use of recycling ~~and minimise waste generation~~?

29. ~~W~~<u>How w</u>ill the development make maximum use of recycled materials?
30. ~~W~~<u>How w</u>ill the development make maximum use of construction and demolition waste arisings?
31. How is the development designed to incorporate materials / elements that will be simple to re-use / recycle at the end of the building's life?

How will domestic / commercial waste generated in the development be dealt with?

32. How will provision be made for the storage / collection of waste generated in the development?
33. How will the development provide opportunities and facilities for home / community composting?

<u>Checklist question for recycled materials</u>

<u>Incorporated into question for choice of materials and embodied energy.</u>

SECTION 6: WATER RESOURCES

Background and forces for change

67. Water consumption in the South East has grown significantly in recent years and is the highest per capita in the UK. As well as being a precious resource in its own right, the treatment of water through the sewage system requires large resources and energy. Minimising the amount of mains water that is used within a building is inherently good for the environment but also reduces running costs (where metered). Research for the Office of the Deputy Prime Minister has shown that new buildings could be designed to use 25% less water than current designs typically consume, and this has been adopted as a target in the government's Sustainable Communities programme. Reducing overall mains water usage has another benefit in that sewerage costs are related to mains water consumption. The Thames region is among the driest in the UK, receiving an average of 690mm rainfall per year compared with an annual national average of 897mm. Extraction of water is having a severe impact on parts of the south east region.

How will water resources be conserved and recycled?

68. *Water-saving devices*
On average 150 litres of water is used per person per day. 34% of water used at home is in baths and showers, 29% in toilets and 4% in gardens. Installing water-saving devices can reduce these levels considerably. Low flush toilets, aerating taps, low flow shower heads and water-efficient appliances are examples of devices that can reduce water consumption. The installation of water meters has been shown to significantly affect the levels of water consumption by encouraging changes in behaviour among occupants. Landscaping can be designed to minimise the level of water needed for its maintenance; this can include careful choice of planting and the use of wood chips.

69. *Rainwater collection / harvesting*
On average about 200 litres of rainwater fall on the roof of a $100m^2$ house each day in the UK. Enough rainwater can be collected from the average house to meet all its potable water requirements, which is approximately half the annual average total consumption of water. Simple uses of harvested rainwater are garden irrigation and car washing, but it can also be used to flush toilets and for washing machines if treated through filtration. Rainwater can be easily collected at the domestic scale in a water butt and the water can be used elsewhere in the property. At a slightly larger scale, rain can be collected from the roof, travelling via a drainpipe into a storage tank (usually underground). A control unit monitors the water level in the storage tank and can display this information. If levels drop too low, the system switches to the mains water supply; and if it gets too high, an overflow trap allows the excess to be skimmed off to a storm drain. ~~Enough rainwater can be collected from the average house to meet all its potable water requirements, which is approximately half the annual average total consumption of water.~~

70. *Grey water recycling*
Grey water is the term given to water that has already been used in washbasins, showers, baths and washing machines. This water can also be collected and reused. Depending on the cleaning products used, straightforward settlement may be all that is required before grey water can be reused in the garden. There are grey water reuse systems available on the market that will filter and chemically treat grey water and make it suitable for toilet flushing and car washing. The plumbing in a building can even be designed so as to connect the waste outlet of a washbasin with a toilet cistern. This will cut down on the amount of clean water that is simply flushed away, although care must be taken to avoid cross-contamination.

Residential: water collection

On a domestic scale the simplest method of water recycling is to collect rainwater in water butts and use it elsewhere on the property, for example watering the garden and washing the car. A water butt can be installed for a minimal outlay but is more likely to be

Commercial: water collection

On a larger scale it becomes more appropriate to collect rainwater for storage in an underground tank that can be used in place of or to supplement

used by the residents if installed before occupation.	mains water for a variety of uses.

Water resources questions to be addressed in an NRIA

How will water resources be conserved and recycled~~reused~~?
34. How will the development incorporate the use of water-saving devices?
35. How will the landscaping be designed to minimise water consumption?
36. How will the development incorporate the harvesting and re-use of rainwater?
37. How will the development incorporate the collection, treatment and recycling~~re-use~~ of grey water?

Checklist question for water resources

	Minimum standard		Preferred standard	
What score is achieved in table 3?	1	1 pt	2	2 pts

Table 3:

	Minimum standard	Score	Target standard	Score
Residential	54m³/bedspace/year	1 pt	37.5m³/bedspace/year	2 pts
Offices	9.3m³/person/year	1 pt	6.4m³/person/year	2 pts
Schools	3.9m³/pupil/year	1 pt	2.7m³/pupil/year	2 pts
Hospitals	1.66m³/m²floorspace/year	1 pt	1.38m³/m²floorspace/year	2 pts
Further & Higher Education	0.62m³/m²floorspace/year	1 pt	0.4m³/m²floorspace/year	2 pts

Residential standards taken from BRE figures for average consumption and 30% reduction of average
Non-residential standards taken from the OGC Watermark project (see Appendix 2)

GLOSSARY

Local Development Framework (LDF)
The Local Development Framework is replacing the previous development plan system and contains the detailed policies and proposals to guide development in Oxford.

Natural Resources Impact Analysis (NRIA)
Natural Resources Impact Analysis evaluates the use of natural resources and the environmental impacts and benefits arising from a proposed development, at the construction phase and through the subsequent day-to-day running of the buildings.

NRIA checklist
The final section of an NRIA must be in the form of the checklist as set out at Appendix ~~5~~4. This details a set of measures and the City Council's "minimum", "preferred" and "target" standards that will be used in determining applications.

NRIA template
The template provides a structure for the completion of an NRIA. It follows the format of the supplementary planning document, addressing each of the topics covered. It consists of a series of questions which developers are asked to answer in regard to their proposal.

Standard Assessment Procedure (SAP)
The government's preferred method for calculating the energy performance of residential buildings.

Simplified Building Energy Method (SBEM)
A calculation engine the government ~~is developing that will be~~ has developed that is used to measure the energy performance of non-residential buildings.

Supplementary Planning Document (SPD)
A document that supplements and elaborates on policies and proposals in development plan documents.

APPENDIX 1: OXFORD LOCAL PLAN 2001 – 2016

Environmental Opportunities

2.15 Energy Efficiency

2.15.1 Energy conservation and renewable energy are central to the principles of sustainable development, and are a fundamental part of design. Developers should demonstrate how the schemes have been designed to help to conserve energy by means of layout, orientation, construction, materials and landscaping of buildings.

2.15.2 Part L of the Building Regulations covers some aspects of energy efficiency and sets some minimum standards. However, the City Council will seek good design which covers all aspects of energy efficiency.

2.15.3 The City Council attaches importance to the efficient use of natural resources in new developments and the re-use of existing buildings.

POLICY CP.15 - ENERGY EFFICIENCY

Planning permission will only be granted for developments which are designed to optimise energy efficiency. Developments will be assessed against the following criteria:

a. **the use of appropriate materials, siting, form, orientation and layout of buildings to maximise the benefits of passive solar (or natural) heating, cooling, lighting and natural ventilation;**

b. **the use of soft landscaping, including tree planting, to increase summer shading and reduce heat loss in winter; and**

c. **the use of energy-efficient, renewable-energy technology, whether new or traditional, for heating, cooling, power and lighting.**

2.16 Use of Renewable Energy

2.16.1 Renewable energy is the term used to describe the energy flows that occur naturally and repeatedly in the environment, for example from the sun, wind, oceans, plants and water.

2.16.2 The Government has planned a range of legislative and commercial incentives to achieve the target of generating 10% of electricity supplies from renewable resources by 2010. Government policy is to stimulate the development of new renewable energy sources, wherever they may be economically attractive and environmentally acceptable, to contribute to:

- diverse, secure and sustainable energy sources;
- a reduction in the emission of pollutants;
- the encouragement of competitive renewable industries.

2.16.3 The City Council will in particular encourage the use of solar panels, photovoltaics and, where appropriate, wind generators on all developments (both new and existing), and on residential and non-residential buildings.

POLICY CP.16 - RENEWABLE ENERGY

Planning permission will be granted for renewable energy schemes in appropriate locations.

2.17 Recycling Facilities and Use of Recycled Materials

2.17.1 One of the key aims for 'sustainability' is to minimise waste. The principle is based on reducing the quantity of waste produced, recycling the waste which is produced, and re-using recycled or reclaimed materials.

2.17.2 All new developments that attract a large number of people should include recycling facilities. They should provide enough space for small recycling areas suitable for facilities, such as bottle banks, and paper and plastic recycling bins.

2.17.3 One of the problems of home recycling is that internal residential layouts are not normally large enough for separation and recycling at home. The short-term storage of glass, paper and plastics can require specific consideration in the kitchen layout. In new residential development space should be allowed for the home recycling boxes collected by the City Council.

2.17.4 The City Council will encourage the re-use of re-claimed building materials and the use of secondary aggregates, screened soil and other re-cycled materials in all developments. Developments of 10 or more dwellings, or more than 2,000 m^2 of floorspace, must demonstrate how the design will incorporate the use of secondary materials. Examples of this could be the use of reclaimed bricks, tiles and timbers, the use of screened soil and wood chips in landscaping areas, or the use of secondary aggregates in the construction of roads.

2.17.5 Developments, where the design does not incorporate the use of recycled or reclaimed materials, will be refused planning permission, as they would not help the City Council in achieving the Government's targets on minimising waste. Policy CP.18 requires developments above certain thresholds to submit a Natural Resource Impact Analysis (NRIA) which would include recycled materials.

POLICY CP.17 - RECYCLED MATERIALS

Planning permission will only be granted for developments of 10 or more dwellings, or non-residential development of 2,000m^2 or greater, where the design includes the use of recycled or reclaimed materials. This may form part of the Natural Resource Impact Analysis (NRIA).

2.18 Natural Resource Impact Analysis

2.18.1 The City Council will encourage all developments to combine resource efficiency and renewable energy into their design. The sensible use of construction materials, energy-efficient systems, and high technology appliances can improve living standards and reduce running costs. Examples include the following facilities:

- grey water recycling systems;
- recycled paper insulation;
- energy management systems;
- natural ventilation;
- solar orientation;
- solar water heating;
- avoidance of air conditioning;
- combined heat and power (CHP) facilities.

2.18.2 Proposed development should use fewer non-renewable resources, re-use materials, use less energy, and give more consideration to life cycle costs (i.e. the environmental costs of materials, source, transport, construction method and running costs). It is important that building materials are not toxic.

2.18.3 Developments of 10 or more dwellings or non-residential developments of 2,000 m^2 or greater must submit a Natural Resource Impact Analysis (NRIA). The NRIA should explain how the use of natural resources has been minimised in the project through energy efficiency, use of renewable energy, recycling and use of recycled materials. Large- scale developments which do not adequately address the NRIA in their design will be refused planning permission.

2.18.4 The City Council will, from time to time, publish Supplementary Planning Documents on the requirement for, and content of, a Natural Resource Impact Analysis (NRIA), and give examples of good practice in applying the above principles to different types of development proposals.

POLICY CP.18 - NATURAL RESOURCE IMPACT ANALYSIS

Developments of 10 or more dwellings or non-residential developments of 2,000 m^2 or more will be expected to submit a Natural Resource Impact Analysis (NRIA), as detailed in a Supplementary Planning Document. Planning permission will only be granted for developments, if through the NRIA, the proposal demonstrates careful attention to, and exploitation of:

a. opportunities for the reduction in energy use;
b. efficiency in the use of energy;
c. the generation of energy from renewable energy sources;
d. the use of renewable resources in general; and
e. the use of recycled or reclaimed materials in their construction.

APPENDIX 2: SOURCES OF FURTHER INFORMATION

Section 2: Energy Efficiency
Sustainable Energy Officer, Environmental Health Business Unit, Oxford City Council
Building Research Establishment: www.bre.co.uk
The Carbon Trust: www.carbontrust.co.uk
Chartered Institute of Building Services Engineers: www.cibse.org
Energy Saving Trust: www.est.org.uk
~~Office of the Deputy Prime Minister~~Department for Communities and Local Government (Building Regulations): www.~~odpm~~dclg.gov.uk/buildingregs

Section 3: Renewable Energy
Sustainable Energy Officer, Environmental Health Business Unit, Oxford City Council
The Carbon Trust: www.carbontrust.co.uk
Clear Skies: www.clear-skies.org
Department of Trade and Industry: www.dti.gov.uk/renewables
Energy Saving Trust: www.est.org.uk
National Energy Foundation: www.nef.org.uk/greenenergy
Thames Valley Energy: www.tvenergy.org
Various Trade Bodies

Section 4: Choice of Materials and Embodied Energy
Association for Environment Conscious Buildings: www.aecb.net
Building Research Establishment: www.bre.co.uk
Considerate Constructors Scheme: www.ccscheme.org.uk
Construct Sustainably: www.constructsustainably.com
Construction Resources: www.constructionresources.com
Constructing Excellence: www. constructingexcellence.org.uk
Forestry Stewardship Council: www.fsc.org
Timber Recycling Information Centre: www.recycle-it.org

Section 5: Recycled Materials
Aggregain: www.aggregain.org.uk
Department for Environment, Food and Rural Affairs (Waste Strategy 2000):
www.defra.gov.uk/environment/waste
Department for Environment, Food and Rural Affairs: Review of England's Waste Strategy; a consultation document: http://www.defra.gov.uk/corporate/consult/wastestratreview/review-consult.pdf
Lets Recycle: www.letsrecycle.com
Oxfordshire County Council: www.oxfordshire.gov.uk
Recycled Products Guide: www.recycledproducts.org.uk
Recycle Wood: recyclewood.org.uk
Royal Institution of Chartered Surveyors: www.rics.org
Salvo (architectural salvage directory): www.salvo.co.uk
Smart Waste (BRE): www.smartwaste.co.uk
Waste and Resources Action Programme: www.wrap.org.uk
Waste Watch: www.wastewatch.org.uk

Section 6: Water Resources
Environment Agency: www.environment-agency.gov.uk
Thames Water: www.thameswater.co.uk
UK Climate Impacts Programme: www.ukcip.org.uk
Water UK: www.water.org.uk
Water benchmarks (Watermark project):
www.ogcbuyingsolutions.gov.uk/energy/services/services_conservation_water_benchmarking.asp

APPENDIX 3: OXFORD CLIMATE DATA

Average temperature (° C)

Lat 51 Lon -2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual average
10-year average	2.52	2.88	5.62	7.76	11.5	14.2	17.0	16.4	13.7	9.99	5.63	3.72	9.30

- Units: degrees Celsius
- Note: 10 metres above the earth's surface

Average wind speed at 50m (m/s)

Lat 51 Lon -2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual average
10-year average	8.38	7.74	7.93	6.76	6.18	5.83	5.76	5.79	6.62	7.26	7.87	8.19	7.02

- Units: metres per second (m/s) and percent (difference)
- Notes:
  - 50 metres above the earth's surface;
  - Percent difference minimum and maximum.

- All height measurements are from the soil, water, or ice/snow surface instead of "effective surface", which is usually taken to be near the tops of vegetated canopies.

Average wind speed at 10m (m/s)

Lat 51 Lon -2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual average
10-year average	6.62	6.11	6.26	5.34	4.88	4.61	4.55	4.57	5.23	5.74	6.22	6.47	5.54

- Units: metres per second (m/s)
- Notes:
  - 10 metres above the earth's surface
  - For terrain similar to airports

- The effects of terrain and/or vegetation height has been taken into account. These values are for terrain similar to airports.

Average daily radiation on horizontal surface (kWh/m^2/day)

Lat 51 Lon -2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10-year average	0.73	1.27	2.23	3.49	4.51	4.80	4.83	4.07	2.91	1.66	0.95	0.57

- Average daily radiation on horizontal surface (definition) - amount of electromagnetic energy (solar radiation) incident on the surface of the earth
- Units: kWh/m^2/day

Further information on climate can be found at: www.retscreen.net and: http://www.dti.gov.uk/renewables/technologies/windspeed/online.html

~~APPENDIX 5: SUSTAINABILITY OBJECTIVES OF THE NRIA SPD~~

~~NRIA SPD objectives~~	
~~**Objective a**~~	~~To ensure that all new developments are designed to maximise energy efficiency~~
~~**Objective b**~~	~~To secure more developments that incorporate the use of renewable energy~~
~~**Objective c**~~	~~To ensure that all large-scale developments incorporate the use of recycled or reclaimed materials in their design~~
~~**Objective d**~~	~~To ensure that new developments avoid, where possible, the use of non-renewable resources and that consideration is given to the wider environmental impact of the materials and resources utilised~~
~~**Objective e**~~	~~To provide guidance to developers on what will be expected in the Natural Resource Impact Analysis documents that are to be submitted with applications for planning permission for large-scale developments.~~

APPENDIX 4: ~~SUGGESTED~~ NRIA TEMPLATE AND CHECKLIST

Please answer each question with ~~"yes", "partially" or "no" and provide~~ supplying as much detail as is available to support that answer. Where the answer to the question is "partially" or "no" please provide reasons for this stance. All NRIAs must be submitted with a completed checklist, whether the NRIA template has been used or not. This information will be used to supplement the details submitted in the earlier sections of the NRIA.

Energy Efficiency:

How will the design and layout ensure that energy is used efficiently in the scheme? *(page 8)*		
1	Has an energy strategy been prepared?	
2	How is the development designed to maximise beneficial solar gain? (through orientation, spatial layout and systems design)	
3	How will the design of the building make efficient use of energy? (linked buildings, buffer zones, thermal mass etc)	

How will the construction of the buildings ensure efficient use of energy and reduce overall energy use? *(page 10)*		
4	What insulation standard will the development be built to?	
5	How is the development designed to minimise unwanted air infiltration?	
6	What glazing standard will the development be built to?	

How will the mechanical and electrical systems of the buildings ensure efficient use of energy and reduce overall energy use? (page 10)		
7	~~Will the development incorporate high-efficiency boilers?~~What efficiency standard will boilers be specified to?	
8	Will the development be linked to a combined heat and power plant or to a district heating system? (please provide details)	
9	How has the development been designed to maximise controlled natural ventilation?	
10	Will any mechanical ventilation to be incorporated be of high efficiency?	
11	How has the development been designed to maximise natural daylighting?	
12	~~W~~How will the development incorporate a high-efficiency lighting ~~system~~?	
13	~~W~~how will the development incorporate high-efficiency appliances (where installed)?	
14	How will the heating, lighting and ventilation systems be controlled?	

Renewable Energy:

How will the design incorporate the use of energy from renewable sources on-site? *(page 14)*		
15	Will the development incorporate the use of biomass as a fuel? (please provide details)	
16	Will the development incorporate the use of heat pumps? (please provide details)	
17	Will the development incorporate active solar water-heating systems? (please provide details)	
18	Will the development incorporate solar electricity generation? (please provide details)	
19	Will the development incorporate a micro-hydro scheme? (please provide details)	
20	Will the development incorporate wind-energy electricity generation? (please provide details)	

Choice of Materials and Embodied Energy:

How will the materials specified minimise embodied energy and environmental impact? *(page 17)*		
21	~~W~~How will the materials be specified to ensure a low level of embodied energy?	

22	~~W~~How will the materials be specified to prioritise those with minimal environmental impact?	

23	Will the materials be sourced locally?	
24	WHow will the materials and systems be specified to ensure a good quality internal environment?	
25	WHow will the timber be specified to ensure it is from the most sustainable sources?	
26	Will contractors and suppliers be chosen with regard to their environmental management record? (please provide details)	

Recycled Materials:

How will the buildings be re-used and / or demolition waste be responsibly dealt with? *(page 19)*		
27	WHow will the development make efficient use of all material resources on site (for example existing buildings, services, infrastructure and topsoil?	
28	WillHas a strategy for the minimisation and handling of waste be prepared? (please provide details)	

How will waste be minimised and the materials and construction methods used in the development make best use of recycling and minimise waste generation? (page 19)		
29	WHow will the development make maximum use of recycled materials?	
30	WHow will the development make maximum use of construction and demolition waste arisings?	
31	How is the development designed to incorporate materials / elements that will be simple to re-use / recycle at the end of the buildings life?	

How will domestic / commercial waste generated in the development be dealt with? (page 21)		
32	How will provision be made for the storage / collection of waste generated in the development?	
33	How will the development provide opportunities and facilities for home / community composting?	

Water Resources:

How will water resources be conserved and recycledused? (page 22)		
34	How will the development incorporate the use of water-saving devices?	
35	How will the landscaping be designed to minimise water consumption?	

36	How will the development incorporate the harvesting and re-use of rainwater?
37	How will the development incorporate the collection, treatment and re-use-recycling of grey water?

APPENDIX 5: NRIA CHECKLIST

All NRIAs must be submitted with a completed checklist, whether the NRIA template in Appendix 4 has been used or not. This information will be used to supplement the details submitted in the earlier sections of the NRIA. Tables 1–3 should be used to calculate the value for questions C1, C3 and C45 and must be submitted as part of the NRIA.

In order to pass the NRIA checklist, a score of at least 6 must be achieved which includes at least the "minimum" standard in each section.

			Minimum standard		Preferred standard		Target standard		Score achieved
Energy efficiency	C1	Residential uses: What is the SAP rating? (See table 1)	SAP "good" (GS1)	1 pt	SAP "best" (BS1)	2 pts	SAP "advanced" (AS1)	3 pts	
		Non-residential uses: Under criterion 1 of SBEM: what is the relationship of the Building Emissions Rating (BER) to the Target Emissions Rating (TER)?What is the SBEM rating?	BER = TER	1 pt	BER is 2% better than TER	2 pts	BER is 5% better than TER	3 pts	
Renewable energy	C2	What percentage of energy requirements will be produced by on-site renewables?	20%	1 pt	30%	2 pts	40%	3 pts	
Materials	C3	What score is achieved in table 2?	4	1 pt	5-7	2 pts	8-11	3 pts	
Water resources	C4	What score is achieved in table 3?	1	1 pt	2	2 pts	3	3 pts	
							Total checklist score:		/112

Table 1 – SAP ratings

Dwelling Type	"Good" (GS1)			"Best" (BS1)			"Advanced" (AS1)		
	Cost Saving (£/yr)	CO2 Saving (kg CO2/yr)	SAP	Cost Saving (£/yr)	CO2 Saving (kg CO2/yr)	SAP	Cost Saving (£/yr)	CO2 Saving (kg CO2/yr)	SAP
Flat	19	94	102	42	375	108	>58	>569	128
Detached Bungalow	36	331	100	55	554	106	>73	>782	124
Semi-detached Bungalow	34	300	100	50	487	106	>67	>700	124
Mid-terraced	28	161	102	56	502	108	>78	>769	128
End-Terraced	35	261	100	61	570	107	>84	>851	127
Semi-detached	41	331	100	66	614	107	>90	>910	126
Detached	55	513	101	83	823	107	>108	>1137	125

SAP table based upon EST Best Practice Guide CE12

~~Note: When the SBEM ratings have been established by the government, they will be inserted into the checklist in the same format as the SAP ratings.~~

Table 2 - Choice of materials (Total the highest score in each row and use this to calculate the points achieved in the main checklist table)

	Minimum standard	Score	Preferred standard	Score	Target standard	Score	Score achieved
Aggregates use	Some recycled aggregate used on site.	1	Recycled aggregate from off – site sources used for >60% of all aggregate consumed on site	2	Recycled aggregate from on-site demolition used for >60% of all aggregate consumed on site	3	
Timber use	Softwoods from temperate managed forests used. No tropical hardwood from non certified sustainable sources	1	FSC or equivalent certified timber, and / or recycled or reclaimed timber used in <90% of the timber uses on site (by volume). Rest of timber from temperate managed forests	2	FSC certified timber (or equivalent) and/or reclaimed timber used in 90% of timber uses (by volume)	3	
Insulation materials	From fossil fuel sources, with no ozone depleting blowing agents	1	From recycled materials	2	From naturally occurring sources	3	
Sourcing strategy			Average distance travelled by materials (by weight) to be <100 miles (Industry average)	1	>50% of materials (by weight) to be sourced from within 35 miles (achieved by BedZed)	2	
							/11

Table 3 - Water Resources (Use the score achieved to calculate the points achieved in the main checklist table)

	Minimum standard	Score	Preferred standard	Score	Score achieved
Residential	$54m^3$/bedspace/year	1	$37.5m^3$/bedspace/year	2	
Offices	$9.3m^3$/person/year	1	$6.4m^3$/person/year	2	
Schools	$3.9m^3$/pupil/year	1	$2.7m^3$/pupil/year	2	
Hospitals	$1.66m^3/m^2$floorspace/year	1	$1.38m^3/m^2$floorspace/year	2	
Further & Higher Education	$0.62m^3/m^2$floorspace/year	1	$0.4m^3/m^2$floorspace/year	2	
					/2

Residential standards taken from BRE figures for average consumption and 30% reduction of average
Non-residential standards taken from the OGC Watermark project (see Appendix 2)

	Minimum standard	Score	Preferred standard	Score	Target standard	Score	Score achieved
Water use	Rainwater harvesting system to provide water for gardens, planting, car washing.	1	Less than 150 litres per person per day predicted use per dwelling	2	30% reduction on UK average home consumption (achieved by Gallions Housing Association)	3	
							/3

(average UK water consumption = 150 litres per person per day – Source: BRE)