What makes an eco-town?

A report from BioRegional and CABE inspired by the eco-towns challenge panel

CABE

BioRegional

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Front cover image: Great Bow Yard housing scheme © Design for homes/ Richard Mullane

BioRegional is an entrepreneurial charity which invents and delivers practical solutions for sustainability. We develop sustainable products, services and production systems – and set up new enterprises and companies to deliver them; initiate and guide the development of sustainable communities; and seek to replicate our approach through consultancy, communications and training. Our aim is to lead the way to sustainable living – through practical demonstration.

CABE is the government's advisor on architecture, urban design and public space. As a public body, we encourage policymakers to create places that work for people. We help local planners apply national design policy and advise developers and architects, persuading them to put people's needs first. We show public sector clients how to commission projects that meet the needs of their users. And we seek to inspire the public to demand more from their buildings and spaces. Advising, influencing and inspiring, we work to create well designed, welcoming places.

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Contents

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‘These real-life projects should advance industry best practice and government policy. More than that, we hope they will speak to all of us as individuals, showing us what a sustainable future could look like: nothing to be afraid of, but something to embrace’

In May 2008, as a member of the government’s eco-towns challenge panel, I listened to proposers from across England setting out their vision for each of the shortlisted eco-towns. The minister, Caroline Flint, had asked us to challenge and encourage the eco-towns proposers. It wasn’t going to be our job to decide which ones were chosen, but we all felt a sense of responsibility. We all wanted them to be trailblazing projects which would be worthy of the name eco-town.

I was asked to join the panel because BioRegional is the organisation that initiated the Peabody Trust’s BedZED eco-village in south London. Living and working in an eco-community as I do, it’s sometimes easy to forget that most people don’t! Whilst BedZED isn’t perfect, it shows how we can reduce our impacts and create a place where people know their neighbours and have a better quality of life.

BioRegional is working with partners to build on and apply what we have learnt at BedZED to larger new and existing communities in the UK and around the world as part of what we call ‘one planet living’. The first of these communities are now being established in the UK and USA, with projects in development in Portugal, South Africa, Abu Dhabi, Canada and China. We have found that these projects do not need to cost more, but rather a different design approach is required that can lead to savings which offset any additional expense. As with BedZED, it is our intention that these real-life projects will advance industry best practice and government policy. More than that, we hope they will speak to all of us as individuals, showing us what a sustainable future could look like: nothing to be afraid of, but something to embrace.

This is a role which eco-towns, if they are to live up to their name, should be able to fulfil. They could inspire with what is possible and speed progress to sustainability across the UK and internationally.

With all of this in mind, I wrote this report in collaboration with CABE to share our experience with the eco-towns proposers and the government. Our aim is to outline the scope of what needs to be tackled if we are to live sustainably and to provide some targets and advice as to how it can be achieved. I am delighted to have worked with CABE on this report; they have brought to it not only the benefit of their experience on design but also their reputation and influence. I am also grateful to our fellow eco-towns challenge panel members and the chair, John Walker , who encouraged and welcomed the production of this document. Many thanks are due to colleagues at BioRegional, including Amy Hammond, Jane Hersey, Ben Gill, Pooran Desai, Ronan Leyden and Nicole Lazarus for reviewing, commenting and adding to the report and to panel members who contributed including Stephen Joseph, Better Transport; Lynda Addision, Liz Reason, Sir Peter Hall, University College London and Sunand Prasad, president, Royal Institute of British Architects (RIBA).

Richard Simmons
Chief executive, CABE

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‘New ideas and new technologies are being developed which will increase our capacity to tackle climate change and create more sustainable places. The pace of climate change, and the response of other nations to it, will affect the targets for which we have to aim’

The government’s eco-towns initiative has started a number of debates – about the choice of locations, about the sustainability of smaller towns, about what makes an eco-town special, about the ability of new towns to enable lessons to be learnt which might apply to the existing built environment. One of the hottest topics of debate has been how to judge whether a place, old or new, can be described as ‘sustainable’.

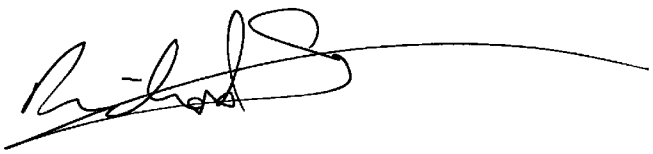
This isn’t an easy judgement to make. Lifestyles within a household can vary considerably. Extend this to a neighbourhood, village or town and the potential for variations makes it almost impossible to predict how many individuals will behave ‘sustainably’ even if they are given the opportunity to do so. An alternative is to set benchmarks for the performance of buildings and places in average use. This will give a proxy for how sustainable a building or place is designed to be; and how it may perform if behaviour is as expected.

BioRegional has been developing new thinking about how to create sustainable settlements since 1997 and has originated the idea of ‘one planet living’. It was natural to apply this thinking to eco-towns to see if measures could be developed to test whether or not the ambition of the promoters is sufficiently high.

CABE has always been interested in how the design of buildings and places can improve people’s quality of life. That includes how they can be designed to be more sustainable – not only through reducing carbon emissions, but by making them more adaptable to the impact of climate change, and encouraging biodiversity and the use of multi-functional green infrastructure.

It was natural for the two organisations to join their thinking and apply it to eco-towns. The idea was to come up with some criteria that would be testing for the proposers. Staff from both organisations took part in the eco-towns challenge panel. The approach of the panel has informed these criteria, although BioRegional with CABE are responsible for their expression in this document. The government will shortly consult on minimum standards with a consultation paper on a planning policy statement on eco-towns. In response, our criteria are, in places, a little more challenging, for example requiring all development to achieve the Building for Life gold standard, but all such criteria have to be seen as works in progress.

New ideas and new technologies are being developed that will increase our capacity to tackle climate change and create more sustainable places. The pace of climate change, and the response of other nations to it, will affect the targets for which we have to aim. The criteria in this document are a contribution to the debate. They cannot be an absolute or final statement of what an eco-town should aim for. If eco-towns are to have a fundamental purpose, it must be to show us how we can all achieve one planet living.



1 Introduction

‘We hope the standards and criteria outlined will be useful when considering developing all new neighbourhoods or urban extensions, not just eco-towns’

This report was written in answer to the question ‘what makes an eco-town?’. Across the world, there have already been a number of trailblazing initiatives, including exemplary European sustainable communities such as Vauban in Freiburg and Hammarby Sjöstad. We can also learn from smaller eco-communities in the UK like BedZED and Great Bow Yard. These projects are great examples, but eco-towns should be the next step forward, building on what has been learnt. The need for settlements which show what our towns and our daily lives will be like if we live sustainably has never been more urgent. Eco-towns must therefore demonstrate real and measurable sustainable living. They should encourage and allow people to live within ecological limits whilst enjoying a high quality of life in an attractive environment.

The report has been prepared by BioRegional and CABE in response to the eco-towns proposals, as guiding principles to help achieve these quality aspirations. This is particularly to assist the consortia involved in the development of those schemes and provide more detailed information for government, which is charged with delivering the policy. We hope the standards and criteria outlined will be useful when considering the development of all new neighbourhoods or urban extensions, not just eco-towns. We think they will also be useful to anyone who wants to understand more about how we might live more sustainably and still have a high quality of life.

Eco-towns should be places where it is easy for residents to adopt sustainable lifestyles. This means that the choices offered across all aspects of living and working need to be sustainable ones. Developers need to put in place the foundations to enable this. These will include energy efficient buildings, renewable energy, resource efficient infrastructure and proximity to employment and services. It should also include access to sustainable lifestyle options, services and information to make it the everyday ‘default’ for residents to choose a more sustainable way of living in the eco-town.

Hammarby Sjöstad, Stockholm, masterplan by Stockholm City Planning Bureau with Jan Inghe-Hagström as lead architect. Here, it is easy for residents to adopt sustainable lifestyles

Whilst the focus of this report is on environmental sustainability, eco-towns must also address social and economic factors if they are to be successful. Sustainability is about more than resource efficiency: sustainable communities will be well designed and will foster social and economic sustainability. Often the issues are interwoven. For example, sustainable transport options such as cycling and walking reduce environmental impact but also bring benefits for personal health and well-being; walkable communities encourage social connection; car clubs are a new service industry that create sustainable jobs and reduce transport impacts. It is vital that the eco-towns work well as places. This means in social and economic terms as well as environmental.

Our aim is to provide a clear illustration of the core issues that will affect whether a proposal is good enough to be an eco-town, and the criteria against which this can be measured.

What we are presenting here is not a prescriptive list of required methodologies, but the strategic decisions which have fundamental consequences for a sustainable settlement’s development. Each consortium should investigate these and deliberate on them, so that they achieve the highest-quality outcome.

Finally, it should be noted that this document provides our perspective on the early stage of the proposals. The advice and recommendations should be read with this in mind.

2 What is sustainable? Living within our ecological limits

Ecological footprint and CO_2 emissions

Our current way of life in the UK, in common with other developed countries, is unsustainable. Globally, population is rising rapidly and ecological footprinting[1] shows we are consuming 25 per cent more renewable resources every year than the planet can replenish. Different countries are consuming at different rates. If everyone in the world consumed as much as we do in the UK, we would need three planets to support us. Of course we only have one. Therefore, we need to reduce our ecological footprint in the UK by two thirds.

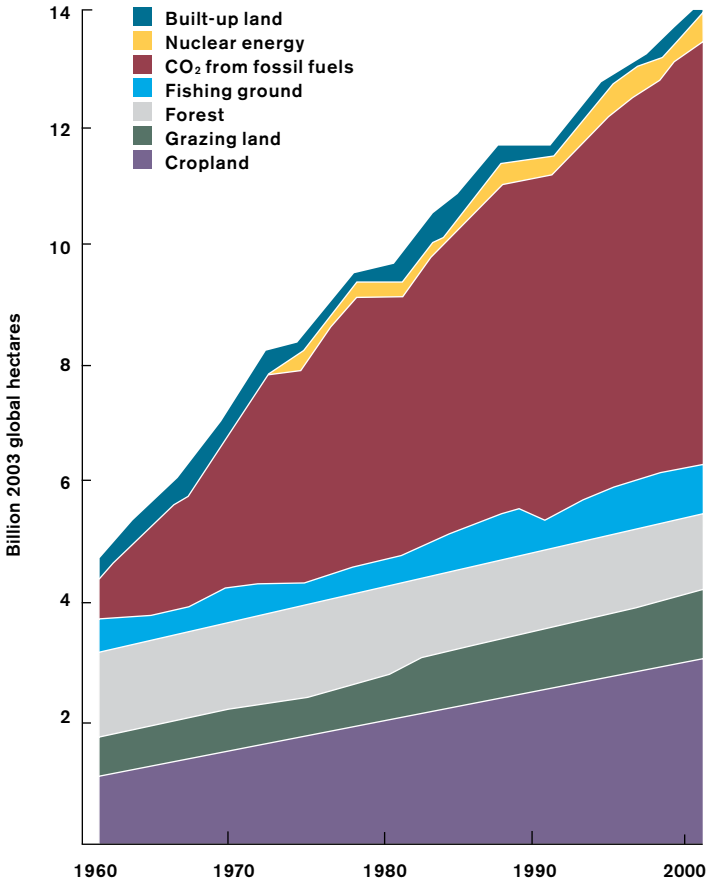
Carbon dioxide (CO_2) emissions are a major part of our ecological footprint. Figure 1 shows how CO_2 emissions from fossil fuels have risen nine-fold since 1963[2], resulting in dangerous climate change.

The UK Climate Change Bill, which is expected to receive royal assent in autumn 2008, sets a target for the UK to reduce carbon dioxide emissions by 60 per cent below 1990 levels by 2050. However, the 60 per cent target was based on a report by the Royal Commission on Environmental Pollution from 2000. Since this time developments in climate change science show that this target is insufficient. Various organisations, such as WWF and Friends of the Earth, are lobbying for the government to increase the CO_2 reduction target in its Climate Change Bill to at least 80 per cent, and to include emissions from international aviation and shipping. The prime minister has acknowledged that the target may have to rise to 80 per cent. As eco-towns will be exemplary, the design of the eco-towns should enable residents to reduce their CO_2 emissions by at least 80 per cent below 1990 levels by the time of full occupation.

1 For a definition of ecological footprinting see appendix
2 *Living Planet Report*, (WWF, Global Footprint Network, Zoological Society of London; 2006)

The impact of flooding in Boscastle, Cornwall. Climate change is having a detrimental effect on our way of life

Figure 1: World ecological footprint by component 1961–2003



Reducing carbon emissions and ecological footprint is not just about protecting our environment. It is about adjusting to a world where an increasing population and increasing consumption are leading to higher demand for resources. These issues are starting to impact on people in the UK in terms of high oil and food prices. As Sir Nicholas Stern noted in his influential 2006 Treasury review, *The economics of climate change* 'tackling this now will cost less than addressing it later; we need to future-proof our way of life'. How will average households manage when oil prices reach $300/barrel and food is in short supply?

This gives us our first overarching criteria for what is sustainable and what an eco-town means: a place that is designed to make it possible and easy for residents to reduce their ecological footprint by two thirds and reduce their carbon dioxide emissions by 80 per cent below 1990 levels. This is what will make eco-towns truly exemplary, going beyond existing exemplary projects. Eco-towns should show us, in a real and measured way, what our sustainable future will look like.

Where do impacts arise?

So how can we live within our ecological limits? Figure 2 illustrates where the ecological footprint, carbon dioxide emissions and greenhouse gas (GHG) emissions arise in an average UK resident's life. The key areas are home, energy, transport, food and consumables. The consumption figures include the impact of imported goods. The figures are modelled using the Resource and Energy Analysis Programme (REAP) and are based on 'material flow accounting' for the whole of the UK. (See the appendix for further information on why we use a consumption model such as REAP).

Considering the data in Figure 2, we are able to review how eco-towns can enable sustainable levels of resource use and CO_2 emissions. Firstly, we need to split the impacts into two areas of responsibility: personal responsibility and UK-wide government and business responsibility.

Personal responsibility

Well-designed and well-built eco-towns can directly assist residents in achieving reductions in:

- 75 per cent of their total carbon dioxide emissions impacts
- 76 per cent of their total greenhouse gas emissions impacts; and
- 78 per cent of their ecological footprint

by putting in place sustainable solutions for housing/construction, home energy, transport, food and goods – all areas in which people make personal choices.

UK-wide government and business responsibility

The remainder of an individual's ecological footprint represents a proportion of UK-wide infrastructure (shown in purple in figure 3). Individuals are not able to reduce this aspect themselves and it is not readily measurable on a local basis.

This proportion of each UK citizen's impact accounts for:

- 25 per cent of their carbon dioxide emissions impacts
- 24 per cent of their total greenhouse gas emissions impacts; and
- 22 per cent of their ecological footprint.

and is the responsibility of government and business as it arises directly from the operation of the services provided for all of us.

How can eco-towns provide sustainable solutions?

Eco-town developers can most directly and simply enable ecological footprint and CO_2 reductions in the areas of housing and construction and home energy, which together account for 31 per cent of a person's CO_2 emissions and 26 per cent of a person's ecological footprint.

However, eco-towns must also tackle the infrastructure and services for daily lifestyle choices around transport, food and goods that account for 44 per cent of CO_2 emissions and 52 per cent of the ecological footprint. Of course, the actual impact in practice will depend on personal choices by residents. This shows the importance of making everyday sustainable lifestyle choices attractive and accessible, and providing appropriate education and support, so that they become the 'default'.

Government and business infrastructure and services on site should also be built and operated to eco-town standards to reduce the 25 per cent of our UK-wide CO_2 emissions and 22 per cent UK wide ecological footprint.

Figure 2: Average ecological footprint, CO_2 emissions & GHG emissions of a UK resident[3]

	Ecological footprint		Carbon dioxide emissions		Greenhouse gas emissions (in CO_2 equivalents)	
	Gha/cap	Per cent	Tonnes/cap	Per cent	Tonnes/cap	Per cent
Housing	0.46	8%	0.97	8%	1.04	8%
Home energy	1.01	18%	2.78	23%	2.94	22%
Transport	0.83	15%	2.73	23%	2.86	21%
Food	1.23	23%	0.99	8%	1.64	12%
Consumer goods	0.75	14%	1.48	13%	1.70	13%
Private services	0.48	9%	1.18	10%	1.34	10%
Government	0.37	7%	0.93	8%	1.07	8%
Capital assets	0.31	6%	0.80	7%	0.84	6%
Total	**5.45**	**100%**	**11.87**	**100%**	**13.43**	**100%**

3 Ecological footprinting and carbon emissions data modelled by BioRegional using REAP, provided by Stockholm Environment Institute. Definitions of these categories are shown in the appendix.

Three planet living: if everyone in the world consumed as much as we do in the UK, we would need three planets to support us

Figure 3: Ecological footprint of average UK resident

Figure 4: CO_2 emissions of average UK resident

3 Eco-towns: reducing CO_2 emissions and ecological footprint

Eco-town developers should use the measures of ecological footprint and CO_2 emissions to assist in designing the eco-towns and then use ecological footprint and CO_2 emissions of individual residents as headline monitoring criteria.

The headline sustainability criteria and targets for individual residents of eco-towns are:

- an ecological footprint two thirds lower than the national average; and
- CO_2 emissions 80 per cent lower than 1990 levels.

Figure 5: Summary of required CO_2 emissions and ecological footprint reduction

		Ecological footprint		CO_2 emissions	
	Categories	Current	Target 66% saving	Current	Target 80% saving
Total Average per person		5.4 gha	1.8 gha	11.87 tonnes/ capita	2.37 tonnes/ capita
Personal responsibility influenced by eco-town	Housing, home energy, transport, food, donsumer goods	4.28 gha	1.42 gha	8.95 tonnes/ capita	1.79 tonnes/ capita
National responsibility not directly influenced by eco-towns	Private services, government, capital investment	1.17 gha	0.39 gha	2.92 tonnes/ capita	0.58 tonnes/ capita
Total Reductions in personal responsibility categories only			2.59gha (53% saving) 1.4 planet living		4.71 tonnes/ capita (60% saving)
Total With reductions in both personal responsibility and national responsibility categories.			1.8 gha (66% saving) One planet living		2.37 tonnes/ capita (80% saving)

3.1 Reducing environmental impact by category

The headline criteria can then be broken down into their component parts to review how reductions can and have been achieved in each area in order to meet the overall targets for sustainable levels of resource use.

Carbon dioxide emissions

In the UK CO_2 emissions per person per year are 11.87 tonnes (tpa) as calculated by levels of consumption using REAP. An 80 per cent reduction on 1990 levels is required[4]. However, 2.9 tonnes of CO_2 emissions are accounted for by government and business services, and so the amount of CO_2 emissions an individual can personally be responsible for reducing is 9 tonnes per year (75 per cent of their total CO_2 emissions). An eco-town needs to offer sustainable infrastructure and choices that will allow residents to reduce the CO_2 emissions of their homes, home energy use, transport, food and consumer goods by 80 per cent from 9 tpa to 1.8 tpa. It will take time to reduce the proportion of CO_2 emissions for which government and business are responsible and if these emissions have not been reduced, then this means a target of total CO_2 emissions of 4.71tpa (Figure 5) for each person living in the eco-town.

Ecological footprint

Ecological footprint per person per year in the UK is 5.4 global hectares (gha) (See appendix for definition). This needs to be reduced to 1.8gha, a two thirds reduction. This would be 'one planet living'[5]. The proportion of an individual's ecological footprint which is their personal responsibility is 4.3gha, or about 75 per cent of a person's total ecological footprint. Eco-towns should enable residents to reduce their personal proportion by two thirds from 4.3gha to 1.4gha. Achieving this target would mean that if the UK-wide services proportion of a person's ecological footprint did not alter, an individual's ecological footprint in an eco-town will be 2.6Gha or one and a third planet living.

Resources

The Living Planet report (WWF, Global Footprint Network, Zoological Society of London, 2006).
Stockholm Environment Institute, www.sei.se
Best Foot Forward, www.bestfootforward.com
BioRegional, www.bioregional.com
'One Planet Living' footprint calculator, http://calculator.bioregional.com

4 Curret levels of UK CO_2 emissions are similar to 1990 levels. Details of UK's carbon emissions since 1990 baseline at tinyurl.com/5nhw4d
5 'One planet living' is a global initaitive based on 10 principles of sustainability developed by BioRegional and WWF, www.oneplanetliving.org

1 **Housing, construction and maintenance**

2 **Home energy**

3 **Transport**

4 **Food**

5 **Consumer goods**

6 **Government and business services and infrastructure**

7 **Waste**

'An eco-town needs to offer sustainable infrastructure and choices that will allow residents to reduce the CO_2 emissions of their homes, home energy use, transport, food and consumer goods'

1 Housing

8%	Ecological footprint of average UK resident
8%	CO_2 emissions of average UK resident

Housing construction and maintenance includes the impacts of the construction industry, the building and maintenance of our homes, and services relating to our homes such as rentals and mortgages

The national impact from constructing new buildings and infrastructure needs to be reduced in line with the overarching 80 per cent reduction in CO_2 emissions. CO_2 emissions for construction and maintenance of UK housing are about 1tpa per person. This is 8 per cent of an average individual's CO_2 emissions. This needs to be reduced by 80 per cent to 0.2tpa of CO_2 per person and 0.09gha per person. Meeting this solely through lower embodied energy of materials will be very challenging and a combination is required:

- lower embodied energy of materials
- durable buildings with an increased design life
- design for deconstruction so the materials can be reused at the end of the building's life.

It will be very challenging to meet the 80 per cent reduction target in a new build project. Therefore refurbishing buildings would also assist in reducing the impacts.

Building houses will not be the only construction impact of the eco-towns; all other buildings, including offices and community buildings, should also aim for this 80 per cent reduction. Similarly the onsite infrastructure needs to be minimised, such as roads (covered in transport), drainage systems and electrical sub-stations. The infrastructure impact of a new town will stretch far beyond the edge of the town, and an eco-town must make sure that it maximises the use of existing infrastructure and minimises the impact of any new infrastructure.

Monitoring

The impact of construction can be measured as:

- embodied CO_2/m^2 and per 100 homes. This ranges from best practice of 300 to worst practice of 1000 $kgCO_2/m^2$ for domestic dwellings[6]
- embodied CO_2 of all infrastructure works. A similar range in embodied carbon exists, depending on the approach taken.

Resources

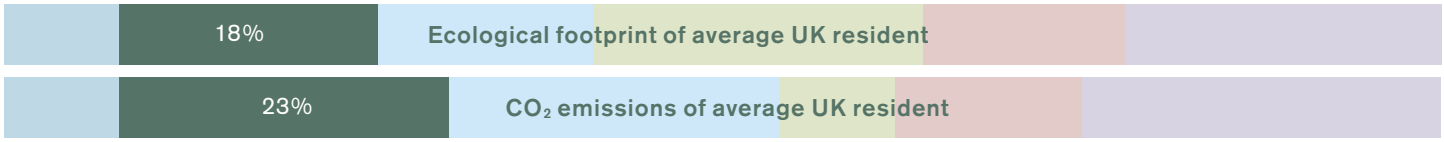
The potential to reduce the environmental impact of construction materials (BioRegional, 2005). The report shows how 60 per cent CO_2 emission reductions are possible through greater resource efficiency, such as increased recycled and reclaimed content, reduced wastage and also including a 5 per cent reduction in built infrastructure. The report concludes that, to achieve the required 80 per cent reduction, there is a need to reduce further infrastructure and retro-fit existing buildings.

BioRegional Quintain © Greg King, Construction News

Green concrete at One Brighton by Crest Nicholson BioRegional Quintain – 100% recycle aggregate and 50% cement replacement reduces the embodied carbon by a third

6 Movement for Innovation, Sustainability Working Group Report – Environmental Performance Indicators for Sustainable Construction. 2002.

2 Home energy



Home energy includes all gas and electricity consumption in the home, plus other fuels such as coal and oil

Eco-town developers can help residents to reduce the impact of home energy use – which accounts for 23 per cent of an individual's CO_2 emissions – by creating zero carbon buildings. The target is to reduce CO_2 emissions in this sector by 100 per cent, from 2.78tpa per person to zero tpa. The ecological footprint of home energy use should be reduced by 75 per cent from 1.01 to 0.25gha. By maximising the CO_2 emission reductions from homes, smaller reductions can be made elsewhere.

As a minimum:

- buildings should be energy efficient and built to Code for Sustainable Homes level 4, AECB Silver or BREEAM excellent – for whole building energy use and CO_2 emissions targets. Passivhaus could also be considered.
- buildings to be fitted with super efficient appliances.
- eco-towns will need to operate on 100 per cent renewable energy[7], or as close to 100 per cent as possible; for example, on-site gas back up may be necessary for periods of maintenance work.
- at least 50 per cent on-site renewable energy generation should be possible. Decentralised energy generation has an important role to play in the future energy mix but the technical and economic feasibility depends on the renewable resources available in each location and the cost and availability of technology. Ongoing management of the energy supply is also a consideration. Given their status as demonstrations of sustainability, 100 per cent on site renewable energy generation is widely considered appropriate for eco-towns. To achieve the necessary carbon reductions the UK needs a grid supply of 100 per cent renewables, but in the interim, if the site cannot support 100 per cent on site renewable energy generation, then any off-site energy supply should be new capacity and certified as from a renewable source. (This advice is based on BioRegional's experience and differs from the government definition).
- energy supply should be delivered efficiently. Whatever the percentage of on-site renewables, the resource efficiency of the renewable energy supply needs to be considered carefully and maximised. An eco-town offers mixed development which may lend itself to the installation of a district-wide combined heat and power scheme (capturing and using heat from electricity generation that might otherwise be wasted).
- visible real-time energy consumption figures should be provided for each dwelling to help with behaviour change.

7 for heating, cooling and electrical demand

© David Wilson Homes South Midlands

Aspect Upton Way, Northampton. This award-winning new development shows what an eco-town could look like. Built to EcoHomes Excellent standard, it incorporates glazed passive solar design and photovoltaic panels on the roof.

Monitoring

This should include as a minimum:

- kWh and CO_2 per person/per dwelling/ per m^2 of space against national and local average and project baseline targets;
- energy consumption data covering:
  - gas
  - electricity
  - other fuel types such as wood
  - renewable energy technologies
  - hot water (if measured by meters) and
- thermographic imaging on a selection of properties.

Monitoring could also include:

- residents' thermal comfort and air quality
- percentage of units to be air tightness tested after two years
- renewable energy generated on site and exported to the grid.

Resources

Eco-towns prospectus, (CLG, 2007)
BedZED Monitoring Report (BioRegional, 2007)
Town and Country Planning Association eco-towns energy worksheet (TCPA, forthcoming)
AECB CarbonLite programme, www.carbonlite.net
Centre for Alternative Technology, www.cat.org.uk
Energy Saving Trust, www.energysavingtrust.org.uk
Carbon Trust, www.carbontrust.co.uk
Renewable Energy Association, www.r-e-a.net

3 Transport

Transport impacts arise from fuel consumption, car ownership, public transport, flying and construction and maintenance of the transport networks

Personal transport and the construction and maintenance of the associated infrastructure account for 23 per cent of an individual's CO_2 emissions. As a guideline, to achieve ecological sustainability targets this needs to be reduced by around 80 per cent. This means reducing personal transport CO_2 emissions from 2.7tpa per person to 0.55tpa. The ecological footprint of 0.83gha needs to be cut by 75 per cent to 0.21gha.

It is vitally important that eco-towns dramatically reduce the need to travel and provide sustainable mobility options. Community facilities and workplaces need to be within easy walking and cycling distance. This may have an impact on the density of developments. A suggested average density of no less than 50 dwellings per hectare, preferably closer to 100 dwellings per hectare in central built-up areas, will enable easy walking or cycling to key local facilities. Home zones can reduce the dominance of the car and allow the local community to get to know each other.

Local employment opportunities can reduce the need to travel. A suggested target could be at least 66 per cent (ideally 80 per cent) of employment within the eco-town or within walking, cycling or public transport distance, with one local job or workspace for each household.

Eco-towns will ideally entirely avoid the use of fossil fuels as an energy source for both homes and transport. Whilst theoretically a renewable resource, bio-fuels have an ecological footprint and a carbon impact, so their use needs to be considered carefully.

As a minimum, eco-towns should have a transport strategy with a range of elements.

- a modal split developed to be consistent with delivering an 80 per cent cut in CO_2 emissions associated with personal transport
- a travel plan showing how 80 per cent cuts in personal transport related CO_2 emissions can be achieved (against the UK and local average). This should be prepared for the whole town and supplemented by activity/building based travel plans. It should cover not only internal town movements but also external networks – not corridors
- average walking time to shops, primary schools, post offices and other key local facilities of no more than 10–15 minutes
- filtered permeability, eg making access to and through developments easier on foot or by bike than by car and providing safe and attractive walking and cycle routes to schools and other facilities

BedZED, Surrey. A green transport plan at BedZED eco-village in south London included public transport within 10 minutes' walk; incentives for bicycle use and storage for them inside dwellings; London's first car club; home zones and reduced car parking and road space; a charge for car parking spaces and a car parking permit system. Three sets of monitoring data over six years of occupation indicate a 50–65 per cent reduction in private car fossil fuel miles travelled compared to the local average. Just 17 per cent of residents travel to work by car, although the local average is 42 per cent. Residents' air travel, however, does add to their environmental impact. (BRE, 2002; tinyurl.com/5sgg2, BioRegional www.bioregional.com)

© Anne Woods/CABE

Vauban, Freiburg, Germany. A significant charge (of up to £14,000) for a car parking space and a green transport plan have led to 60–80 per cent of commuting journeys being made by bike, and 15–25 per cent by public transport. For those who own a car, on average just 21–28 per cent of commuting and total journeys are made by car. (Building for Life: tinyurl.com/5hvuhq)

© Stephen McLaren

Blackett Street and Quayside, Newcastle. Public realm improvements by Newcastle City Council and Gillespies has enhanced the environment for shoppers and encouraged walking.

- provision of low carbon public transport options to enable car free travel within the eco-towns and reduce the need for car travel outside it
- a public transport network that is quickly accessible, frequent and reliable, linking all business and residential areas and with links to the wider network. A frequency of 10–15 minutes in the daytime is normally necessary to avert the tendency to use the car. The service should operate from around 6am to midnight
- real-time displays showing public transport departure times and actual running information
- reduced road infrastructure and car parking spaces with a maximum of one car parking space per household, and ideally 0.6 or less. Car ownership at BedZED shows that this is possible in the suburbs. Car clubs offer a possible solution here. A reduction of 75 per cent against the local average for commercial car parking.
- a target of at least a 75 per cent reduction in miles travelled by private car against the local average
- incentives for non-fossil fuel and super efficient personal transport alternatives
- links with local authorities, transport providers and local off-site employers to work together to reduce travel impacts
- travel advisors to help people and businesses with sustainable travel. General awareness raising about the impact of personal transport and flying. Information about more low carbon travel options.

Monitoring

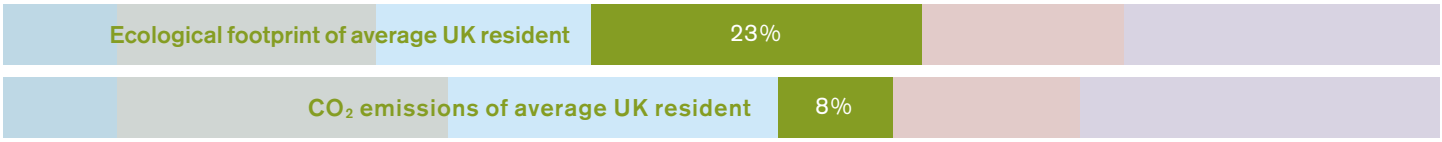
Monitoring of transport should take place against:

- CO_2 emissions from personal transport per person per year
- miles travelled by private car and use of public transport and bicycles
- passenger km/litre and freight tonne km/litre as a measure of efficiency on use of fuel in transport. Alternatively, passenger (tonne) km per vehicle km. This will help to understand how efficiently people and goods are moved (eg how full vehicles are)
- modal split of commuting journeys, leisure journeys and shopping journeys
- number of cars registered within the town
- Residents' public transport satisfaction survey
- Comparison of cost and convenience of public transport to car use (unless a car club/car share arrangement).

Resources

Town and Country Planning Association eco-towns transport worksheet, (TCPA, 2008; tinyurl.com/5wlzc6)
Building sustainable transport into new developments: a menu of options for growth points and eco-towns, (Department for Transport (DfT), 2008; tinyurl.com/3nxl4p)
Manual for Streets, (DfT, 2007; tinyurl.com/36hnds)
Z-squared; the impact of transport, (BioRegional, 2007; tinyurl.com/5zxdec)
Sustainability and safety group, University of Huddersfield.

4 Food



Food and drink includes food consumed at home or out at restaurants or other catering establishments

The food we eat is responsible for 8 per cent of our total individual CO_2 emissions, and as food requires a lot of land, a significant 21 per cent of our individual ecological footprint. Food is also responsible for 12 per cent of our greenhouse gas emissions, mainly due to nitrous oxide emissions and methane emissions associated with meat production.

Studies have shown that it is possible to reduce the ecological footprint of food by around 60 per cent by significantly reduced meat and dairy consumption (meat and dairy accounts for 50 per cent of the ecological footprint of our food), by eating local, seasonal food, through improved efficiency of farming and by reducing food waste. Between 25 per cent and 40 per cent of all food is wasted in the supply chain or by consumers. Just by eating a healthy diet according to government guidelines, an individual can reduce the ecological footprint of their food consumption by 15 per cent.

The UK average impact of food consumption is 1tpa and 1.23gha per person per annum. The target for sustainability in eco-towns is a 60 per cent reduction in ecological footprint to 0.5gha per person per year and a 60 per cent cut in CO_2 emissions embodied in food to 0.4tpa.

Bluebell allotments, Norwich. Allotments offer sustainable and locally grown food, but also healthy living and outdoor activity. The increasing cost of living is pushing up the popularity of cheaper, more environmentally friendly food sources

As a minimum, eco-town developers should assist residents in reducing their food impacts by:

- providing information on sustainable and healthy diets and highlighting where residents can purchase or grow lower impact food within the eco-town
- making links with local farms to supply food
- encouraging local farms to adopt the eco-town's spirit and reduce the embodied impact of their farming practices
- fostering on-site businesses which provide space and service staff for local and sustainable food producers to sell their produce in a modern and convenient way
- actively seeking retailers on site who will commit to supporting residents in reducing the ecological footprint of their food consumption, in particular providing a wide variety of healthy, low meat and dairy options and encouraging lower impact meat and dairy choice, eg sourcing grazing animals rather than grain fed animals
- ensuring that shopping facilities are conveniently located for 'just-in-time' food purchase by residents to reduce the food wastage associated with one weekly food shop; and
- providing convenient and attractive space for food growing within and around the development in locations that have been assessed for sunlight, irrigation, soil quality and ways to maintain soil fertility.

Monitoring

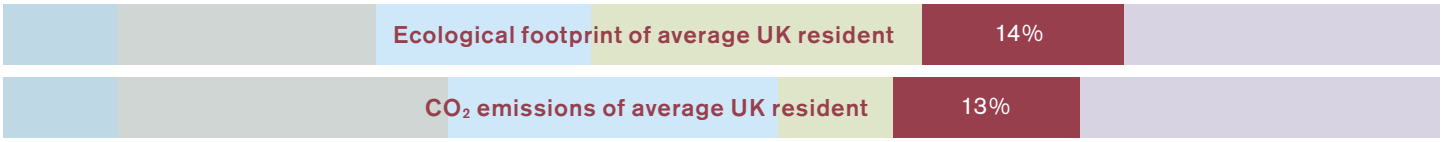
This could include:

- amount of produce supplied by farms less than 50–100km radius of the site
- amount of food waste arising from retailers on site
- ecological footprint of the diet of 100 randomly selected residents
- number of shops selling local produce
- number of cafes and restaurants offering sustainable and local food
- amount of food grown on exchanged through allotment or garden produce swaps.

Resources

Footprint of Scotland's diet, (Stockholm Environment Institute, 2007; tinyurl.com/628k3n)
Z-squared: the impact of food, (BioRegional, 2005; tinyurl.com/6bn7c3)
The food we waste, (WRAP, 2008; tinyurl.com/5emjx2).

5 Consumer goods



Consumer goods means any products we purchase, including durable large household objects such as furniture and appliances and smaller products such as newspapers, clothing and electronics

Consumer goods account for 14 per cent of an individual's ecological footprint and 13 per cent of CO_2 emissions. As a society we are buying a lot of products that we do not need and that are quickly thrown away. The target for sustainability in eco-towns would be a reduction of 50–55 per cent in the impact of consumer goods purchased by eco-town residents, reducing ecological footprint to 0.38gha and CO_2 emissions to 0.66 tonnes.

As a minimum, eco-town developers should:

- set a new trend by designing an environment which favours quality of life, community and healthy activities over shopping as a leisure activity
- market retail space to responsible retailers who commit to the eco-town philosophy and who will work to provide sustainable retailing
- work with tenants and retailers to include space for re-use and repair of consumer goods, charity shops and swap shops
- foster and encourage local sustainable goods and services; this could include facilitating new enterprises making the goods that people need.

Monitoring

This could include:

- analysis of the ecological footprint of the sales of consumer goods as part of regular eco-towns monitoring
- sales through re-use or charity shops
- new enterprises manufacturing local sustainable goods

Liverpool Hope Street. Public realm improvements by Camlin Lonsdale and Mouchel Parkman for Liverpool 20/20 have re-invigorated Hope Street. Eco-towns need a pro-active approach to retail management to encourage responsible retailing and opportunities for local recycling and repair of consumer goods

'The target for sustainability in eco-towns would be a reduction of 50–55 per cent in the impact of consumer goods'

6 Government and business services and infrastructure

Government and business services includes the administration of central and local government, plus services that they manage such as social services, waste management, schools and universities

Each of us has to accept a proportion of the UK-wide footprint generated as a result of the services and infrastructure provided by government and businesses on our behalf. This is the proportion of an individual's impact described as national responsibility (Figure 2). It includes all infrastructure not relating to construction, the home, energy, transport, food and consumer goods. Individuals are not able to reduce it themselves and it is not readily measurable on a local basis.

The proportion allocated to each UK citizen equates to:

- 25 per cent of an individual's CO_2 emissions
- 22 per cent of an individual's ecological footprint.

Reducing these impacts is the responsibility of government and business, as it arises directly from the operation of services provided nationally. But where the eco-town provides such public infrastructure, there is an opportunity to work with government or business to apply eco-town criteria. This local infrastructure should also be monitored and reported upon. However, in monitoring residents of the eco-towns, this aspect of a resident's impact will, at least initially, remain high.

'There is an opportunity to work with government or business to apply eco-town criteria'

Bournemouth Library. This winner of the Better Public Building Award in 2003, uses natural light to reduce the need for artificial lighting and cooling, exposed concrete slabs to absorb heat and a structure that acts as a heat sink. All ensure that energy costs are minimised

7 Waste

Waste itself does not show up as a category when calculating CO_2 emissions and ecological footprint in REAP because the impact is absorbed across all sectors. However, waste is an important area to be tackled

Eco-town proposers should consider the waste created by the town as a resource to be reprocessed into something useful, or treated to recover value or energy from it, rather than something to be disposed of.

Eco-town developers will need to work with the local authority to identify solutions for the treatment of any residual waste. Recycling needs to be made easy for the residents, for example through integrating refuse/recycling facilities into street design.

Developers will also need to work with the local authority on the creation of a communication strategy and an ongoing campaign promoting waste reduction and recycling and treating waste onsite where possible, for example through composting.

Developers should put in place strategies and targets to achieve zero waste to landfill. This will involve minimising waste generation by working with businesses and retailers to ensure that they are committed to reducing their own waste.

As a minimum, eco-town developers should:

- produce waste minimisation strategies to reduce waste arising by between 25 per cent and 50 per cent
- target a 70 per cent recycling rate
- compost 66–90 per cent organic waste on site
- achieve less than 3 per cent waste to landfill.

Monitoring

Against the waste targets above.

Resources

Z-squared concept community waste studies, (BioRegional; tinyurl.com/6ppzmu)
Hammarby, Sweden

Paper recycling in Nechells, Birmingham. Eco-towns need to make provision for waste minimisation, recycling and re-use to achieve zero waste to landfill

‘Eco-town developers will need to work with the local authority to identify solutions for the treatment of any residual waste’

How does it all add up?

In the previous pages, we have considered where CO_2 emissions and ecological footprint impacts arise and what reductions are needed.

Figure 6: CO_2 emissions and ecological footprint reduction scenario

	Ecological footprint			CO_2 emissions		
	Current	Target	Target	Current	Target	Target
	Gha /cap	reduction	Gha /cap	tonnes/cap	reduction	tonnes/cap
Current average UK individual's impact	5.45	66%	1.8	11.87	80%	2.37
Personal responsibility Reductions in eco-town						
Housing construction	0.46	80%	0.09	0.97	80%	0.19
Home energy	1.01	75%	0.25	2.78	100%	0.00
Transport	0.83	75%	0.21	2.73	80%	0.54
Food	1.23	60%	0.49	0.99	60%	0.40
Consumer goods	0.75	50%	0.38	1.48	55%	0.66
Sub-total	**4.28**	**66%**	**1.42**	**8.95**	**80%**	**1.79**
UK wide government and business responsibility Assumes no change						
Private services	0.48	0%	0.48	1.18	0%	1.18
Government	0.37	0%	0.37	0.93	0%	0.93
Capital investment	0.32	0%	0.32	0.81	0%	0.81
Sub-total	**1.17**	**0%**	**1.17**	**2.92**	**0%**	**2.92**
Total impact in eco town in this scenario		**53% reduction**	**2.59**		**60% reduction**	**4.71**
Overall sustainability target		**66% reduction**	**1.8**		**80% reduction**	**2.37**

All figures have been calculated using REAP (see apendix for more information).

If we take the suggested reductions in each of the categories, we arrive at the total reduction of CO_2 emissions and ecological footprint required for the 'personal responsibility' aspect of an individual's impact (Figure 6). Eco-town developers are encouraged to explore different CO_2 emissions and ecological footprint reduction scenarios and develop their own approach to enabling sustainable lifestyles.

These figures are indicative of how our carbon footprint breaks down; and the scale of reductions that are needed in each area to meet the 80 per cent reduction target for CO_2 and the 66 per cent reduction target for ecological footprint.

It is worth noting that these two indicators do not always follow each other exactly. For example some measures to reduce the impact of transport – such as the use of bio-fuels – may halve carbon emissions but not significantly reduce the ecological footprint, due to the amount of land required to grow the fuel source.

Figure 6 shows the importance of reducing the impact of the services provided by government and business. Eco-town residents cannot achieve sustainability in isolation. The whole country, government and business will have to follow the eco-towns lead.

In summary, the following reductions are needed.

Ecological footprint reduction target

- total reduction needed is from 5.4 global hectares (gha) to 1.8gha, a two thirds reduction. This would be 'one planet living'.
- personal responsibility level is 4.28 gha. This needs to be reduced by two thirds to 1.43gha/person/year.

CO_2 emissions reduction target

- total reduction down from 11.87 to 2.37 tonnes per person per year (80 per cent).
- personal responsibility level is from 9 tonnes and needs to be reduced to 1.8 tonnes.

'Eco-town residents cannot achieve sustainability in isolation. The whole country, government and business will have to follow the eco-towns lead'

3.2 Eco-towns: masterplanning issues

Eco-towns need to be based on exemplary placemaking, masterplanning and architecture as the overarching principles that affect and define the settlement and its form. Masterplanning and engineering should focus on delivering the sustainability criteria for eco-towns. This will involve working with the landscape and the resources particular to the site.

Design preparation

As a minimum, developers of eco-towns should:

- conduct a place-based analysis of the sub-region and the specific site, in terms of natural, built and historic environments
- undertake an assessment of functional networks of the sub-region – for example travel patterns and labour markets – to inform the proposed development.

Design development

Developers of eco-towns should observe the following for the overall development of their design:

Masterplanning

- approach the masterplan by planning the whole settlement rather than individual buildings. The key issues of layout, density and scale should be directly related to passive design approaches (in terms of orientation, aspect, and thermal mass) and to issues of connectivity and community inclusion.
- design the masterplan to allow for change throughout its phasing and implementation. For example, community energy strategies can allow for relatively simple upgrading without having to retrofit individual buildings at a future date
- graded density should be considered in relation to transport nodes, based on a guide range of 50 to 100 dwellings per hectare within the town centre and 50 to 65 dwellings per hectare along transport corridors
- factor the site's physical features and resources into the design, considering the wind direction and solar orientation when designing streets and buildings in order to minimise energy demand. Building depth and massing is crucial to allow for adaptation and the future use of natural ventilation
- ensure community facilities can be conveniently accessed by all members of the community without the need for a car journey
- put in place a clear long-term programme and strategy for delivery and implementation.

'Design the masterplan to allow for change throughout its phasing and implementation'

Energy and resources

- address the resource issue by examining how what is available on-site and locally and deciding how that can be utilised to help achieve the sustainability objectives. Waste, sewage, wind, sun and woodland can all be considered as sources of energy
- calculate the total energy demand for the site, include non-residential buildings, and how the demand could be met using renewable technologies
- ensure the community energy strategy correlates to the layout and density of development.

Landscape

- design the landscape to conserve and enhance valuable natural features (such as water and biodiversity), manage water efficiently, and create green corridors and useful green infrastructure
- link mixed neighbourhoods to a green infrastructure strategy.

Design criteria

- Building for Life gold standard should be a requirement for all residential developments.
- the development and implementation process should be designed for future adaptation based on the climate change predictions from UKCIP08
- all residential dwellings should adhere to English Partnerships quality and space standards.

‘To ensure the success of eco-towns, the development and delivery of designs should be closely monitored by the local planning authority’

Monitoring

To ensure the success of eco-towns, the development and delivery of designs should be closely monitored by the local planning authority. The consortia should be able to provide government with evidence of a masterplanned analysis-led approach. This should, for example, include passive design principles, a character appraisal, strategic environmental assessment, and an environmental impact assessment.

The developers are also responsible for ensuring that the urban designer and masterplanner are retained throughout the design process and development to maintain continuity of vision.

CABE’s design review panel should monitor and review schemes as the masterplanning process progresses.

After completion of the development, government and local authorities should conduct ongoing GIS mapping to understand and monitor how the settlement is functioning.

Resources

One Planet Living: Information for Developers, (BioRegional, tinyurl.com/5afh96)
Sustainable Project Appraisal Routine (SPeAR) (Arup, tinyurl.com/yqnvgh)
The principles of inclusive design. (They include you.)(CABE, 2006; tinyurl.com/5q4hax)
Creating successful masterplans: a guide for clients, (CABE, 2008; tinyurl.com/665tpn)
Actions for Housing Growth: Creating a legacy of great places, (CABE, 2007; tinyurl.com/6g9knk)
*Eco-towns worksheets, (*Town and Country Planning Association, 2008, www.tcpa.org.uk/ecotowns.asp)
Building for Life case study: Scharnhauser Park, Tubingen, (www.buildingforlife.org; tinyurl.com/62nxeh)
www.sustainablecities.org.uk: a shortcut to authoritative knowledge on the social, economic and environmental dimensions of creating sustainable cities. The content is being tested by the English core cities and will be launched in early 2009.

1 Water

Most treated water is delivered to customers at high environmental and economic costs and is used for non-potable purposes, whilst storm water, which is capable of reducing the need for treated water, is managed in a wasteful way. An eco-town will need to address these issues.

Sustainable urban drainage systems (SUDS) should be a standard feature of all eco-towns. A SUDS plan should indicate the types of measures to be used and should include:

- evidence of sub-soil porosity and suitability for use of infiltration SUDS
- pre- and estimated post-development run-off calculations to be undertaken to determine the scale of SUDS required
- assessment of flood risk where this is deemed appropriate
- proposals for integrating the drainage system into the landscape or public open space
- demonstration of good ecological practice including habitat enhancement
- estimates of land take for different drainage options based on initial calculations of any significant drainage structures.

As a minimum, developers of eco-towns should:

- achieve net water neutrality by reducing use in surrounding existing settlements in order to compensate for water required by the new settlement
- provide rainwater collection devices for every property – domestic and non-domestic
- meet Code for Sustainable Homes level 4 water efficiency measures, and equivalent for non-domestic buildings.

Flood risk management

Locations in Environment Agency-determined 'flood zone 3' should not be considered suitable areas for eco-town developments. Assessments of flood risk should be undertaken to provide a technical assessment of all forms of flood risk to an eco-town and its surrounding area. An eco-town-wide flood risk assessment is essential. Where there are potential risks associated with surface water drainage and/or sewer flooding, they should be dealt with as part of the development or town-wide masterplan. tinyurl.com/5du4xd

Sutcliffe Park, Lewisham. The flood relief scheme for south London's River Quaggy returned the river to a more natural setting. During periods of high water, a flood alleviation system allows the park to slowly fill with water, reducing the risk of flooding downstream.

Monitoring

Continual monitoring of the use of water resources is critical if eco-towns are to fulfil the rigorous sustainability criteria. All water use should be metered and local authorities and utilities companies should monitor levels of consumption. Post-occupancy evaluations commissioned by government should examine water resources and behaviour change.

Resources

BRE Innovation Park: tinyurl.com/5ff99c
CIRIA sustainable urban drainage website, www.ciria.org/suds
CLG practice guide on development and flood risk/PPS25: tinyurl.com/2zq86r
Environment Agency, Introduction to sustainable drainage systems, tinyurl.com/5gf6bc
Green infrastructure example: East London Green Grid at tinyurl.com/5r2821
International example: *Water sensitive planning guide for the Sydney region* www.wsud.org

2 Design of healthy neighbourhoods

In eco-towns, the spaces between buildings must be designed as carefully and deliberately as the buildings themselves. The two should work together to create a network of safe and attractive places, capable of supporting a variety of activities, enabling all residents to be physically active as a routine part of their daily life.

Streets should be designed as places and not just as traffic circulation routes. The needs of people should be prioritised over the requirements of motorised transport. This has the additional benefit of quiet, pollution-free streets, which will allow for opening windows so buildings can be naturally ventilated, thus reducing energy demand.

Street networks should be clear and well connected and public and private spaces should be well defined. Streets and squares should be designed to create local distinctiveness and identity and be safe to use by a wide range of people. Careful attention must be paid to the relationship of scale of space and the activities it may support.

The design of eco-towns should include:

- the promotion of walking and cycling for functional as well as recreational journeys
- shared spaces, shared surfaces and home zones in appropriate contexts
- streets and squares designed as social places with a clear relationship to surrounding buildings
- safe and accessible cycle parking
- car parking provision that is well-integrated into a high-quality public realm
- streets designed for extreme weather conditions such as flooding (for example with SUDS);
- active street frontages wherever possible
- passive supervision of public space with housing and other buildings arranged to overlook the public realm
- an assessment of the impact the proposal is likely to have on activity levels of the town's residents
- accessible routes to schools, shops and community facilities which are attractive and safe for all users, in particular children, elderly and mobility impaired people
- the creation of sports facilities and green gyms, where groups are organised to maintain and improve a green space as a form of keeping fit
- high-quality play spaces to encourage young people to enjoy the outdoors, including spaces for teenagers.

Children playing at Southey Owlerton, Sheffield. This community-led regeneration provided facilities for young people and children including this bike and skate park

Monitoring

Planning authorities should monitor the design process to ensure that developers of eco-towns provide evidence of levels of proposed footfall along routes and levels of proposed activity. Post-occupancy management should use a range of measures to monitor the quality of neighbourhoods:

- Manual for Streets – quality audits for streets
- PERS – pedestrian environment review system
- European Common Indicators: availability of local public open areas and services; percentage of citizens living 300m from public spaces.

References

Manual for Streets, (DfT, 2007; tinyurl.com/36hnds)
Civilised Streets, (CABE Space, 2008; tinyurl.com/4yl82c)
Making contracts work for wildlife, (CABE Space, 2006; tinyurl.com/6xfvfr)
AUNT SUE: access/mobility and journey environment toolkit, (www.londonmet.ac.uk/aunt-sue)
Right Trees for a Changing Climate, (Mayor of London, 2007; www.right-trees.org.uk)
Parks, People & Nature, (Mayor of London, Natural England, 2008: tinyurl.com/6fdb2f)
Fair Play: a consultation on the national play strategy, (DCSF, 2008; tinyurl.com/6lvtep)
Space Syntax: an organisation specialising in the production of strategic design concepts for buildings and urban areas (www.spacesyntax.com)

3 Green infrastructure and biodiversity

‘Green infrastructure is a strategically planned and delivered network comprising the broadest range of high quality greenspaces and other environmental features. It should be designed and managed as a multi-functional resource capable of delivering the landscape, ecological services and quality of life benefits required by the communities it serves and needed to underpin sustainability. Its design and management should also protect and enhance the character and distinctiveness of an area with regard to habitats and landscape types.’ (TCPA Green Infrastructure worksheet for eco-towns, 2008)

A network of high-quality open spaces, greenspaces and green corridors should comprise publicly accessible spaces such as parks, semi-public spaces such as school grounds, and private spaces such as residential gardens. A high proportion of the ‘effective living area’, ideally 40 per cent, should be green.

A green infrastructure network should be fully integrated into the design of an eco-town. Such networks can include:

- parks and gardens – urban parks, country parks, regional parks, formal gardens (including designed landscapes)
- amenity greenspace – informal recreation spaces, housing green spaces, domestic gardens, village greens, urban commons, other incidental space;
- green roofs
- allotments, community gardens and city farms
- cemeteries and churchyards
- natural and semi-natural urban green spaces, including: woodland and scrub, grassland, heath or moor, wetlands, open and running water, wastelands and bare rock habitats like cliffs and quarries
- green corridors – rivers and canals, including their banks; road and rail corridors including roadside trees; cycling routes; pedestrian paths; rights of way and permissive paths.

Green space and open space should be multifunctional, providing for recreation, amenity, pedestrian and cycling connections in addition to delivering wide environmental benefits. These benefits may include:

- mitigation of the urban heat island effect by providing shade, shelter and moisture release
- air and water pollution control by filtering contaminants
- noise reduction and reduced visual intrusion of traffic

The Academy of St Francis of Assisi, Liverpool. Green roofs can be considered for all types of building, such as this school

- flood management, sustainable drainage and surface water storage
- local food production on allotments;
- woodland or crops for energy production; and
- the creation of wildlife habitats or corridors and the encouragement of biodiversity.

Green roofs and green walls can form part of a green infrastructure network and provide the following benefits:

- reduction in rooftop temperatures. On hot sunny days, rooftop temperatures may be up to 40°c cooler with a green roof than with a conventional flat dark coloured roof (London’s Urban Heat Island – a summary for decision makers, Mayor of London, 2006)

- reduction of rainwater runoff by absorbing and slowly releasing large amounts of water
- reduction of noise for occupants, especially on upper floors
- increased urban biodiversity by providing habitat space for birds and small animals
- increased evaporative cooling effect by the retention of storm water in roofs and vegetation.

Street trees and trees in public spaces (especially large, broad-leaved trees) help to alleviate the effects of climate change. For example, trees provide shade in the summer reducing the need for mechanical air conditioning (depending on their proximity to buildings). Trees also provide natural cooling systems as they consume large amounts of available energy in the atmosphere through the process of evapotranspiration.

It is important to ensure that the right trees are planted to cope with present and future local conditions.

- trees (when large enough) provide shade – surface peak temperature reductions of between 5°c and 20°c may be possible
- evapotranspiration through trees and vegetation can result in the reduction of peak summer temperatures by between 1°c and 5°c.

For guidance on local standards set for the eco town site locality, developers could refer to:

- local greenspace and open space strategies
- regional green infrastructure strategies
- regional green grids.

There should be well considered and deliverable proposals for the long term management of greenspace and for funding to ensure such management .

As a minimum, developers of eco-towns should:

- produce a biodiversity action plan identifying the key species and presenting strategies designed to improve and increase habitat for selected species and increase their numbers.
- provide a green infrastructure plan demonstrating how the development proposal will feature an interconnected network of multifunctional greenspace with:
  - public green space representing at least 20 per cent of the overall development footprint (excluding private gardens)
  - a canopy cover of at least 25 per cent in residential areas and 15 per cent in mixed-use or commercial areas ; and
  - provision for bicycle and walking connection within the development and towards neighbouring communities.

Milton Keynes floodplain forest. Green infrastructure should be designed to be multi-functional, such as providing open space and floodwater storage areas

Monitoring

Once an eco-town has set its standards in biodiversity and green infrastructure, it is essential that they are adhered to. Government should continue to monitor the delivery of the commitments made throughout development and post-occupancy.

Resources

Paying for parks, (CABE, 2006; tinyurl.com/5u5dub): guidance on management and revenue

Green space strategies – a good practice guide, (CABE, 2004; tinyurl.com/6yrw5n)

London's Urban Heat Island – a summary for decision makers, (Mayor of London, 2006; tinyurl.com/6jsfrv)

LEED for Neighborhood Development Rating System, (US Green Building Council, 2008, tinyurl.com/2c4g9c): a set of evaluation criteria intended to help assess and reward environmentally superior practices

Green Flag Awards: criteria for public parks, (www.greenflagaward.org.uk)

Accessible natural green space in towns and cities, (English Nature, 1995; tinyurl.com/6otfoe)

Putting it all in place

We suggest that eco-town developers need to establish the following:

1 A clear **framework and metrics for their sustainability criteria**, drawing on the government's eco-towns criteria and the criteria set out by the ecological limits and design principles described in this report. These limits and criteria then inform the design, construction and occupation of the eco-town and can be used for monitoring post-occupation.

2 **A shared vision** for the eco-town. Workshops should take place at a very early stage to review how the project's sustainability targets can be achieved, how local employment opportunities can be generated and how a place can be created where people will be happy to live and work. They should be attended by key people from the project team (the eco-town promoter, developers, architects, engineers, and masterplanners) and other project stakeholders including government contacts, relevant local authority officers and members, transport and utilities companies, local environmentalists, local employers and other local representatives such as local parish councillors. The shared vision and ideas developed can inform the eco-town vision and form the basis of the town's sustainability action plan (see point 5).

3 **Good masterplanning** and engineering at the earliest stages with a focus on delivering the eco-town sustainability criteria through high standards of design. It is important to work with the landscape and resources on site, understanding the physical assets of a place. The masterplan should consider and integrate all spatial issues including transport, health, landscape and the local economy.

4 A clear idea of a **'day in the life' in 2020** of a range of residents and business occupants. This should reflect the eco-town's sustainability criteria and shared vision, and demonstrably deliver the CO_2 emissions and ecological footprint reductions required for each individual resident to live a sustainable life.

5 **A sustainability action plan** for the eco-town, developed using and including the framework, metrics, shared vision, masterplanning and 'day in the life'. The framework and metrics should be used to set out clearly how the sustainability criteria will be achieved for the range of residents and business occupants. **It should include targets, timescales and milestones, and be updated and audited as plans develop or at least annually**. The sustainability action plan should be used as a guide as the project develops.

6 **A local employment and local economy strategy**. Eco-towns should be as much about creating employment and a local economy as they are about building homes. This will assist in delivering the transport targets as well as improving social and economic outcomes. Ideally 80 per cent of employment should be within the eco-town or within walking, cycling or public transport distance. There should be one local job or workspace for each household. The strategy should aim to foster entrepreneurship and the creation of sustainable jobs and businesses through the provision of workspace and opportunities suitable for the demographic mix of expected residents.

7 The inclusion of **eco-towns criteria in contracts** with third parties. Training should be provided for these third parties in order for the initial vision to be maintained as the project advances.

8 Workable plans for **facilities management** developed before commencing work on site and a long-term management and resource generation plan for maintenance.

9 **All the necessary elements to enable sustainable lifestyles** should be ready and waiting when the first residents move in, especially those elements that reduce the need to travel and reduce energy demand. Good publicity and information – supplied in advance of people and businesses moving in – will be critical to ensuring required changes in behaviour.

10 Once the eco-town is occupied, the sustainability criteria and targets should be used for **monitoring, dissemination and continuous improvement**. Statistically representative sample sizes should be used.

Eco-towns as a learning process

'It is in all of our interests that the eco-towns are as successful as possible. Whilst eco-town developers may be taking the lead, they need the support and involvement of key stakeholders.

It is in all of our interests that the eco-towns that make it through the selection process are as successful as possible, both in providing communities to live and work in and in providing valuable learning about how we can live sustainable lives in the future. Whilst eco-town developers may be taking the lead, they need the support and involvement of key stakeholders.

As this is a learning process for all, we suggest that the government takes a relatively non-prescriptive, flexible, partnership approach to working with eco-town promoters. However, we also recommend that eco-town status should be removed if the eco-town promoters are not genuinely attempting to deliver on their sustainability action plan. Therefore we suggest that the government ensures that expert advisors are on hand to support all successful eco-town teams in achieving their vision, and independent evaluators to assess and monitor progress annually.

Local authorities and regional development agencies also have a key role to play and will need to enable and support the eco-towns in a partnership role. We further suggest that the government requests that transport and energy infrastructure providers work with eco-town developers in a similarly constructive and helpful manner.

As the proposals progress, there will be many issues to consider, not least how to influence and change the behaviour of those moving to an eco-town. The governance, management and maintenance of the town will require innovative models to enable those living there to achieve the aims of the town's initial vision. These models will need to make it easy for residents to adopt a sustainable way of life, achieving the carbon and ecological footprints set out in this report. Without clear strategies for management and subsequent maintenance of the town's assets, an eco-town will fall short of its exemplar aims.

It is important that everyone involved learns from both the successes and the failures of eco-towns. The measurable criteria detailed in this document can be used as a starting point to monitor, disseminate and deliver continuous improvement, including additional criteria. This will be important to determine whether the town is meeting the targets set out at the design stage, enabling the town to assess and adapt if necessary to achieve these initial targets.

ECD Architects © Paul Tyagi

Coopers Road, Southwark. This social housing scheme is designed to allow solar collectors to be retro-fitted on south-facing roofs in future. Future adaptability needs to be built in to the initial design process and lessons learned and incorporated into later phases of development

The lessons learned from eco-towns should be publicised widely, to influence government policy and industry best practice. The government has the responsibility to ensure there is sufficient monitoring. We hope that the forthcoming eco-towns planning policy statement will go beyond the demanding criteria for the development to include methods of measuring success – through monitoring and evaluation – as the eco-towns' proposals move forward.

Appendix

Using a consumption model

Ecological footprint

Ecological footprinting measures how much biologically productive land and water an individual, population or activity requires to produce all the renewable resources it consumes and to absorb the waste it generates. Biologically productive land and water is the area that produces materials useful to humans (forests, farmland, fishing areas and built up areas) but doesn't include marginal land such as deserts, mountains and the open ocean.

If we take the total area of biologically productive land in the world (11.2 billion hectares) and divide it by the 6.3 billion people living on the planet we can calculate the area available per person on the planet. If everyone in the world used the same amount of resources we would each have 1.8 global hectares (gha). This includes allowing just 10 per cent for other species.

An ecological footprint is measured in global hectares – this is an area measure normalized to the area-weighted average productivity of biologically productive land and water in a given year. Because different land types have different productivity, a global hectare of, for example, cropland, would occupy a smaller physical area than the much less biologically productive pasture land, as more pasture would be needed to provide the same biocapacity as one hectare of cropland.

Direct and indirect, or production and consumption carbon emissions

The emissions data that the government publishes are based on direct emissions (or by a production method, ie what is actually emitted within our country). This presents a problem as there are some areas of the total emissions that are not covered, such as shipping and aviation. These are not required in the Kyoto protocol and have also been left out of the government's Climate Change Bill. This is due to complications of allocation over international boundaries but it does leave a gap in the carbon footprint, especially given that aviation is the fastest growing source of carbon dioxide emissions.

An alternative model for assessing emissions is to look at a consumption model. This means that international trade is also taken into account. For example, if products are being consumed in the UK but are produced in China, some of the UK burden is shifted to China under typical methodologies. Using a consumption model, the UK consumers take responsibility for those emissions.

The consumption model of carbon emissions means that flows of materials and energy through the economy are taken into account enabling us to examine the impacts of embedded carbon within the products we consume. The energy used to manufacture and transport goods is built into the impact of those goods.

The Resource and Energy Analysis Programme

(REAP) is a model based on consumption methodology that has been developed by the Stockholm Environment Institute (York) as part of the Ecological Budget UK project.

It is based on 'material flow accounting' for the whole of the UK. This establishes the total material flows in the UK economy and uses economic data to track the flows of material and provides a full account of the UK.

The main data source for REAP is PRODCOM, which is a survey compiled by the Office for National Statistics on Products of the European Union, a harmonised system across the European Union for the collection and publication of product statistics. The data is then organised by final consumption patterns that follow both SIC and the COICOP classifications[8]. The data used is from 2001.

REAP can produce data by CO_2 emissions, greenhouse gas emissions and ecological footprint.

8 SIC is the UK Standard Industrial Classification of Economic Activities and COICOP is the international Classification of Individual Consumption According to Purpose

Definitions of categories used in REAP

- **Housing, construction and maintenance** includes the impacts of the construction industry, the building and maintenance of our homes, and services relating to our homes such as rentals and mortgages.

- **Home energy** includes all gas and electricity consumption in the home, plus other fuels such as coal and oil.

- **Transport** is due to fuel consumption, car ownership, public transport, flying and construction and maintenance of the transport networks

- **Food and drink** includes food consumed at home or out at restaurants or other catering establishments.

- **Consumer goods** means any products we purchase, including durable large household objects such as furniture and appliances and smaller products such as newspapers, clothing and electronics.

- **Private services** means any service we consume such as recreation, financial, telephone, insurance, private schools and medical care.

- **Government** includes the administration of central and local government, plus services that they manage such as social services, waste management, schools and universities.

- **Capital assets** covers investment in capital assets such as factories, machinery, transport equipment, and other buildings and structures. Some of the capital assets however are included in the other categories, for example dwellings come under housing, and building r oads and railways would come under transport. This section includes the other remaining sectors such as machinery, the wholesale trade and the chemical industry.

This report, produced jointly by the BioRegional Development Group and CABE, offers timely advice to the agencies involved in developing proposals for England's eco-towns. Drawing on BioRegional's work on building sustainable settlements, and CABE's understanding of what it takes to create workable and sustainable places, What makes an eco town? challenges the eco-town proposers to be as ambitious as they can. It sets out clear sustainability criteria against which the proposers can judge their plans, and offers ways to monitor progress. The report is inspired by the government-appointed eco-towns advisory panel, as well as by BioRegional's 'one planet living' approach. It seeks to show how all developers, not just the eco-town proposers, can build in sustainability.

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