
for Sustainable Building Products

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# Report into Future Opportunities for Sustainable Building Products

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# SCOPING STUDY INTO

# FUTURE OPPORTUNITIES FOR

# SUSTAINABLE BUILDING PRODUCTS

## ON BEHALF OF INVEST NORTHERN IRELAND

## FINAL REPORT

February 2009
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# SCOPING STUDY INTO FUTURE MARKET OPPORTUNITIES FOR SUSTAINABLE BUILDING PRODUCTS

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# EXECUTIVE SUMMARY

## 1. LEGISLATIVE DRIVERS

The legislation relating to sustainability, climate change and environmental issues is complex, wide ranging and constantly emerging. However, over recent years, there has been a wave of legislation and initiatives introduced at a national level which are directly relevant to the construction and refurbishment of sustainable buildings, and therefore to the market for sustainable building products.

Section 2 considers the key legislation and targets considered relevant, and these are summarised below.

**Kyoto Protocol**

Requires industrialised countries internationally to reduce their collective greenhouse gas emissions by 5.2% below 1990 levels, by the commitment period 2008-2012

Under Kyoto, the **EU** has committed to reduce its emissions by 8% by 2008-2012. In 2007, the heads of state set a further target to have reduced emissions by 20% by 2020.

Under Kyoto, the **UK** has committed that, by 2008-2012, it will have reduced its emissions to 12.5% below its 1990 levels.

Through the Climate Change Act in 2008, the UK set a further target of a 26%-32% reduction by 2020 and an 80% reduction by 2050

Under Kyoto, **Ireland** has committed that, by 2008-2012, its emissions will be no more than 13% above its 1990 levels.

A target has not yet been set for 2020.

**EU Energy Performance of Buildings Directive**

Requires member states to set minimum requirements on energy performance of buildings and introduce a system of energy performance certification for new and refurbished buildings.

Requires member states to develop plans for low or zero carbon buildings, with the public sector leading the way.

**UK**

The Energy Performance of Buildings Regulations 2008 requires all new buildings to have an Energy Performance Certificate or Display Energy Certificate

By 2016, all new homes must be zero carbon

An ambition that, from 2019, all new non-

**Ireland**

Energy Performance of Buildings Regulations 2008 and Amendment 2008 requires all new buildings to have a Building Energy Rating certificate.

By 2013 all new homes will be zero carbon

## 2. CONSTRUCTION TRENDS

The construction sector is one of the most severely impacted by the current economic crisis and recession. Section 3 of the report considers economic projections for the UK and Ireland, and provides a summary of construction output trends and projections in GB.

The statistics show the very tough market condition that the construction industry is facing, with a marked downturn in market demand and construction activity, and predictions that this downturn will continue for the next 2 years.

Coupled with the downturn in demand, the industry is faced with rising energy and running costs, and increasing legislative and compliance pressures, many of which add a requirement for further investment by the businesses. Amongst these pressures is the drive for construction companies and suppliers to develop more sustainable building practices and products.

The move towards sustainable building products and practices is an inevitable development, and will be essential for future suppliers to the construction industry. Companies need to be looking now to the introduction and development of these products. The challenge for the industry is to manage its costs and maintain business in the current very difficult trading conditions, whilst ensuring that it is in a position to meet the growing demand and move towards sustainable products.

## 3. PRODUCT OPPORTUNITIES AND MARKET DEMAND

### Market Demand

As part of the scoping study, we consulted with a number of contractors and purchasers of building products, in addition to a wide range of industry bodies and associations. All of the consultees confirmed that there is growing demand for sustainable building products, which will help them to meet the tightening regulations, higher levels of the Code for Sustainable Homes, and achieve improved energy efficiency ratings.

To date, the main area driving demand has been in public/government funded projects. However, as the Code for Sustainable Homes becomes more and more embedded into Building Regulations and EPCs start to influence the market value of properties, it is anticipated that the demand for sustainable building products will increase across all sectors of the construction industry. Indeed, consultees reported that energy conservation and the specified use of sustainable products is increasingly part of their clients' project briefs.

Most large scale contractors and builders already have, or are developing, policies and procurement procedures for the sourcing of sustainable products, although some are more informal around the design specifications and the requirement for a BREEAM Rating. These policies are mostly created by choice but, for those developers undertaking public-sector construction projects, there is clear pressure from public sector clients to introduce

sustainable purchasing policies. Many are now monitoring sustainability and have set internal targets and identified Key Performance Indicators (KPIs).

Adequate supply of sustainable products is an issue. In many instances the technology and products are available to satisfy Code Level 4 requirement, but not always in the volumes required to service the contractors' project requirements. Additionally, there are always opportunities to develop new products offering improvements over existing offerings, whether in terms of cost, technical capabilities or availability. Section 4.2 considers the product opportunities, and highlights the considerable opportunities for products suitable for the retrofit market.

Consultees also felt that there is limited awareness of, and information on, the sustainable building products available in the market. This situation is improving with involvement with Schemes like BREEAM Rating and also organisations such as the Natural Step, but there is still a need for greater promotion of the supply chain.

When considering a potential supplier of sustainable building products, the key factors taken into account were cited as:

- having a quality control system in place;
- certification of products;
- third party assessment of products, including proof of the product's suitability for the intended use as well as its 'sustainable' criteria;
- ability of the supplier to deliver product volume and maintain a solid presence in the market; and
- the provision of technical support, where necessary.

Consultees all anticipated that the market for sustainable building products would continue to accelerate, forced by government sustainability targets and potential world material shortages.

Over the short term it is anticipated that market demand will initially focus on envelope materials, such as concrete block with increasing recycled content, sustainable renders, and low (to zero) ozone depleting insulation.

**Product Opportunities**

Based on the primary consultations, it would appear that products are already available which enable developers and builders to construct to the Passiv Haus standard (Sustainable Code Level 4).

However, that is not to say that there are not opportunities to improve upon these products, whether in terms of cost, effectiveness or availability of supply. Indeed, some consultees commented that the products were not always available locally on an adequate scale and that they had to be imported from mainland Europe. If available, contractors would prefer to source from within the British Isles.

There are fewer product options available for manufacture to levels above Code Level 4 and this is a potential area of research and development, to find building products (in addition to renewable energy technologies) which will enable builders to reach Code Levels 5 and 6.

As sustainable building becomes more and more mainstream, and higher levels of the Code become engrained into Building Regulations, there will be a growing need for:

- Sustainable products which will enable builders to meet ***the higher levels of the Code***;
- At a ***cost*** which is attractive and non-prohibitive;
- In the ***volumes*** appropriate to a mainstream market; and
- From suppliers operating ***sustainable production policies***.

Therefore, the main growth opportunities are for:

- products which help builders achieve Code Level 4 (which will be the minimum building standard in the UK in 2013);
- products which help builders achieve Code Level 4, and which offer an improvement over the products currently available on the market (either in terms of availability of supply, effectiveness or cost);
- products which will help builders achieve Code Levels 5 and 6; and
- products attractive and suitable for retrofit and refurbishment, and which will help to achieve Code Levels 4 and above.

Section 4.2 considers:

- how the sustainability agenda is driving opportunities for off-site MMC;
- the under-exploited opportunity for retro-fit products to improve energy efficiency and emissions; and
- product areas which consultees highlighted as areas in which there are specific market opportunities; these included: insulation products, high performance window and glazing; cladding products; air tightness; ventilation products; thermal bridging elimination; controls and metering.

## 4. ECO-TOWNS

The UK Government has plans to develop 5 eco-towns in the UK by 2010, increasing to 10 by 2020, in response to the need for more sustainable living, coupled with continued housing shortages. These eco-towns will be:

- new settlements for 5,000 – 15,000 families;
- 30%-50% of the homes will be affordable housing;
- zero carbon rated; and
- equipped with green space, schools, health services, medium scale retail centre, business and leisure services.

The standards set for the eco-towns include:

- zero carbon emissions from buildings within the development;

- more than 50% of trips originating from the eco-towns should be by foot, bicycle or public transport;

- the homes should achieve 'Building for Life Silver Standard' and Level 4 of the Code for Sustainable Homes as a minimum, with set standards for waste recycling, construction waste, composting, water efficiency, energy and CO2, pollution and ecology;

- sustainable drainage systems and exemplars in water efficiency;

- 40% of the area allocated to green space; and

- sustainable waste management and recycling systems.

The Government is currently reviewing application from 12 possible locations for the development of the eco-towns, with a view to selecting the successful locations by the beginning of 2009.

## 5. CONCLUSIONS AND RECOMMENDATIONS

The market and demand for sustainable construction products is a very real and immediate opportunity, and one which construction companies cannot ignore – as sustainability criteria become essentials in the market's expectations and in legislative requirements.

The legislative drivers have been gathering momentum but, as sustainability ratings become increasingly influential on the market value of a building and energy costs rise, there is also growing demand from building owners to have houses and buildings with high sustainability ratings.

In the wake of recent increases in energy and raw material costs, and in the current economic climate, it might be tempting to think that product sustainability is a luxury that the industry and market can do without. But the reverse is true. These price increases are driven in part by increased pressure on resources, and they reinforce the need to find ways to reduce the resource intensity of product supply chains and make products themselves more efficient in their use of energy and natural resources.

We are not just talking about having a few more sustainable options. This is about making sustainability mainstream for all products. It's a huge challenge. But there are huge environmental and social gains to be made, and huge business opportunities available in redesigning, developing and marketing all of our products in a more sustainable way.

The challenge for manufacturers is to:

- Invest in developing sustainable construction products which will 'push the envelope' and help builders and developers to achieve higher levels of energy efficiency in their buildings, as well as meeting their sustainability and responsible sourcing policies, ensuring adequate production capacities and providing a commercial product attractive as a mainstream building material.

- Develop skills capability. There is a need for new skills set for the construction of low to zero carbon homes or passive houses. These skills could be developed through training schemes and an academy of excellence. An interesting comparison here is the Renewable Technology Installers Academy delivered by Action Renewables in response to a skills deficit being experienced in what is also a new and related sector. This could also fast track Northern Ireland into a centre of excellence for sustainable construction.

  Associated with knowledge development are the skills required to provide the ability to successfully deliver new innovative products through targeted R&D.

- Develop knowledge capability. There is a large amount of information available on potential sustainable building products, with such databases as GreenBOOK Live being updated in the last year and The Sustainable Energy in Buildings Network ("SEBNet") in Ireland (http://www.sei.ie/Your_Building/Low_Carbon_Homes_Programme/SEBNet_Products_Services)

It is recommended that, to assist the construction industry in responding to this market opportunity, intervention and support should be provided to:

- Support and encourage appropriate product and process R&D projects;

- Assist and encourage industry players to develop supply chain collaborations and partnerhips, both within Northern Ireland and internationally, to help to progress R&D projects and commercial exploitation;

- Support the development of industry skills and knowledge – technical skills and market knowledge;

- Assist industry players in identifying opportunities specific to their sector and capabilities, and develop action plans and partnerships for progressing these opportunities.

# 1. INTRODUCTION

## 1.1 Background and Context

1.1.1 Climate change and environmental pressures are now well established as major international issues, to which governments, businesses and consumers are having to respond through more environmentally friendly and aware practices, products and policies. The need to reduce greenhouse gas emissions, save energy, look to renewable energy sources and more renewable raw materials, and reduce waste are just some of the pressures impacting significantly on the construction industry. These pressures are driven by both legislation and commercial drivers such as the cost of energy and raw materials.

1.1.2 In meeting these challenges, there are considerable opportunities for the development and marketing of building products and services which will help to improve the energy efficiency and 'green rating' of a building, are commercially attractive, and are sustainable. The demand for sustainable building products is gradually moving from being aspirational and niche, to become more and more mainstream and a necessity in the construction trade.

1.1.3 In light of these market developments, Invest NI commissioned Kappa Consulting, in association with KESS Process Engineering, to undertake a scoping to study into the market opportunities and drivers for sustainable building products in Great Britain and the Republic of Ireland.

Kappa Consulting is a specialist management consultancy firm providing public and private sector clients with professional, practical and commercial advice, across a range of consultancy service, including:

- Strategy development and business planning;
- Marketing planning;
- Research and scoping studies;
- Performance reviews.
- Evaluations; and
- Sales planning.

KESS Process Engineering is a consultancy firm specialising in areas such as regulatory compliance and the application of new and emerging clean technologies to provide process solutions, material and resource efficiency and waste reduction.. KESS's main client base includes multinational companies in the pharmaceutical, aerospace, electronics and food sectors. KESS also provides Expert Evaluator and Rapporteur services to the European Commission for project applications to the Framework 7 in the thematic area of the Environment and Sustainable Development.

## 1.2 The Scoping Study

1.2.1 The key objectives of the scoping study were:

- To conduct research into the current drivers and trends for sustainable building/construction products;
- To identify the types of sustainable products and technologies which will be needed to fulfil the sustainability agenda in the UK and beyond; and
- To identify details of UK eco towns, and other developments where new sustainable building business can be won in the short/medium term.

1.2.2 The assignment was completed by conducting extensive desk research and primary consultations with trade associations, industry experts, research bodies, government, building contractors and promoters of sustainable developments. The consultees are detailed in Appendix I.

3.4.1 In addition, Kappa Consulting attended the 2008 Passive and Low Energy Architecture International Conference (PLEA) in Dublin at the end of October 2008. The theme of the conference was "***Towards Zero Rated Building***". Some of the pertinent sessions over the course of the conference are:

- Innovative Materials, Components and Systems;
- Construction and the Environment;
- Zero Energy Buildings;
- Zero Energy Building Regulations and Policy; and
- Passive and Low Carbon Design.

The main themes of the conference were:

- The drive towards more energy efficient and 'zero carbon' building is an international phenomenon, which needs to addressed by architects, builders, developers and suppliers of building materials. However, the challenges vary from country to country, according to different climatic conditions;
- Some of the targets set by government are very challenging and, if they are to be achieved, there needs to be considerable investment in new material and construction techniques; and
- There already is a wealth of research and development ongoing internationally into innovative materials and techniques, but these have yet to be mainstreamed and commercialised on an economic scale.

1.2.3 This report presents the findings of the scoping study, under the following headings:

| Section | Content |
|---|---|
| 2. Legislation and Environmental Drivers | Detail on the relevant legislation and targets set for Europe, the UK and Ireland. |
| 3. Trends in the Construction Sector | Summary of the trends in the construction sector in GB and ROI, and their influence on demand for sustainable building products. |
| 4. Product Opportunities and Market Demand | The types of building products needed to fulfil the sustainability agenda, and market demand for sustainable building products. |
| 5. Eco-Towns and Sustainable Developments | Profile of a number of up and coming eco-towns and sustainable building developments in GB and Ireland. |
| 6. Conclusions | The overall conclusions from the scoping study. |

## 1.3 Definition of Sustainable Building Products and Scope of the Assignment

For the purposes of this assignment, the focus was on sustainable building products, other than renewable energy technologies.

The pure definition of a sustainable building products would take into consideration a full life-cycle assessment 'cradle to grave' of the environmental impact of the product, its raw materials and the method of production.

However, for the purposes of this scoping study, we are considering opportunities for building products that will assist in the construction of more 'sustainable' buildings, and in achieving the growing legislation on the levels of energy efficiency and carbon emissions in buildings.

# 2. LEGISLATION AND ENVIRONMENTAL DRIVERS

2.1 This section of the scoping study considers the key legislation and targets driving demand for sustainable building products.

The section begins with an overview of the Kyoto Protocol and 1992 Earth Summit (Sub-section 2.2), which provided the global context and basis for much of the subsequent legislation and policies regarding climate change, sustainability and energy efficiency.

Sub-sections 2.3, 2.4 and 2.5 consider key policies and legislation at a European level - the European Sustainability Strategy, which was developed at a European level in response to the Earth Summit and Kyoto Protocol; the Thematic Strategy on the Sustainable Use of Natural Resources, which arose out of the European Sustainability Strategy; the EU Energy Performance of Buildings Directive; and the Intelligent Energy Europe Programme

Moving on from a Europe-wide level, the report then goes on to consider how these strategies have been translated into legislation and government policies at a national level in the UK and Ireland: Sections 2.6, 2.7 and 2.8 detail how the European Energy Performance of Buildings Directive and the Kyoto targets have been reflected in national legislation and policies regarding building regulations and the energy rating/construction of buildings.

| Section | |
|---|---|
| 2.2 | Kyoto Protocol and Targets |
| 2.3 | The European Strategy for Sustainable Development<br>Thematic Strategy on the Sustainable Use of Natural Resources |
| 2.4 | Intelligent Energy Europe Programme |
| 2.5 | The EU Energy Performance of Buildings Directive |
| 2.6 | UK Legislation and Initiatives:<br>- Building Regulations (current and future)<br>- Code for Sustainable Homes |
| 2.7 | Northern Ireland Legislation |
| 2.8 | Republic of Ireland Legislation |

## 2.2 Kyoto Objectives and Targets

2.2.1 The *Kyoto Protocol* is a protocol to the United Nations Framework Convention on Climate Change ("UNFCCC"), an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the *Earth Summit*, held in Rio de Janeiro, June 1992. The treaty is intended to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

The Kyoto Protocol establishes legally binding commitments for the reduction of four greenhouse gases (carbon dioxide, methane, nitrous oxide, sulfur hexafluoride), and two groups of gases (hydrofluorocarbons and perfluorocarbons) produced by "Annex I" (industrialised) nations, as well as general commitments for all member countries.

As of 2008, 183 parties had ratified the protocol, which was initially adopted for use on 11 December 1997 in Kyoto, Japan and which entered into force on 16 February 2005. Under Kyoto, industrialised countries agreed to reduce their collective greenhouse gas ("GHG") emissions by 5.2% compared to the year 1990, by the first commitment period 2008-2012. National limitations range from 8% reductions for the European Union and to 7% for the United States, 6% for Japan, and 0% for Russia. The treaty permitted GHG emission increases of 8% for Australia and 10% for Iceland.

2.2.2 Kyoto includes defined "flexible mechanisms" such as Emissions Trading, the Clean Development Mechanism ("CDM") and Joint Implementation to allow Annex I economies to meet their GHG emission limitations by purchasing GHG emission reductions credits from elsewhere, through financial exchanges, projects that reduce emissions in non-Annex I economies, from other Annex I countries, or from Annex I countries with excess allowances. In practice this means that Non-Annex I economies have no GHG emission restrictions, but have financial incentives to develop GHG emission reduction projects to receive "carbon credits" that can then be sold to Annex I buyers, encouraging sustainable development.

In addition, the flexible mechanisms allow Annex I nations with efficient, low GHG-emitting industries and high prevailing environmental standards to purchase carbon credits on the world market instead of reducing greenhouse gas emissions domestically. Annex I entities typically will want to acquire carbon credits as cheaply as possible, while Non-Annex I entities want to maximize the value of carbon credits generated from their domestic Greenhouse Gas Projects.

Among the Annex I signatories, all nations have established Designated National Authorities to manage their greenhouse gas portfolios; countries including Japan, Canada, Italy, the Netherlands, Germany, France, Spain and others are actively promoting government carbon funds, supporting multilateral carbon funds intent on purchasing Carbon Credits from Non-Annex I countries, and are working closely with their major utility, energy, oil & gas and chemicals conglomerates to acquire Greenhouse Gas Certificates as cheaply as possible. Virtually all of the non-Annex I countries have also established Designated National Authorities to manage the Kyoto process, specifically the "CDM process" that determines which GHG Projects they wish to propose for accreditation by the CDM Executive Board.

2.2.3 Below is a list of the change in greenhouse gas emissions from 1990 to 2004 for some countries that are part of the Climate Change Convention as reported by the United Nations.

| Country | Change in greenhouse gas Emissions (1990-2004) excluding LULUCF | Change in greenhouse gas Emissions (1990-2004) including LULUCF | EU Assigned Objective for 2012 | Treaty Obligation 2008-2012 |
|---|---|---|---|---|
| Germany | -17% | -18.2% | -21% | -8% |
| Canada | +27% | +26.6% | n/a | -6% |
| Australia | +25% | +5.2% | n/a | +8% |
| Spain | +49% | +50.4% | +15% | -8% |
| Norway | +10% | -18.7% | n/a | +1% |
| New Zealand | +21% | +17.9% | n/a | 0% |
| France | -0.8% | -6.1% | 0% | -8% |
| Greece | +27% | +25.3% | +25% | -8% |
| Ireland | +23% | +22.7% | +13% | -8% |
| Japan | +6.5% | +5.2% | n/a | -6% |
| United Kingdom | -14% | -58.8% | -12.5% | -8% |
| Portugal | +41% | +28.9% | +27% | -8% |
| EU-15 | -0.8% | -2.6% | n/a | -8% |

*(LULUCF = Land Use, Land Use Change and Forestry)*

Comparing total greenhouse gas emissions in 2004 to 1990 levels, the EU group of 23 (EU-23) Nations had reduced their emissions by 5%. In addition, the EU-15 group of nations (a large subset of EU-23) had reduced their emissions by 0.8%. However, by 2007, a Eurostat review concluded that there had been no favourable changes to report compared to 2000 and, following considerable progress made during the 1990s and a significant reduction between 2004 and 2005, the EU-15 trend had actually started to move away from its target. In 2005, EU-15 and EU-27 emissions respectively stood at 98% and 92% of their 1990 levels.

As of year-end 2006, the United Kingdom and Sweden were the only EU countries on pace to meet their Kyoto emission commitments by 2010. While UN statistics indicate that, as a group, the 36 Kyoto signatory countries can meet the 5% reduction target by 2012, most of the progress in greenhouse gas reduction has come from the stark decline in Eastern European countries' emissions after the fall of communism in the 1990s.

### 2.2.4 *Kyoto - The European Position*

On 31 May 2002, all fifteen then-members of the European Union deposited the relevant ratification paperwork at the UN. The EU produces around 22% of global greenhouse gas emissions, and has agreed to an ***overall reduction of 8% from 1990 emission levels, by the first commitment period 2008-2012***. On 10 January 2007, the European Commission announced further plans for a European Union energy policy that included ***a unilateral 20% reduction in GHG emissions by 2020***.

In December 2002, the EU created an emissions trading system in an effort to meet its targets; quotas were introduced in six key industries: energy, steel, cement, glass, brick making, and paper/cardboard; with fines for member nations who fail to meet their obligations starting at €40/ton of carbon dioxide in 2005, and rising to €100/ton in 2008. EU projections suggest that, by 2008, the EU will be at 4.7% below 1990 levels.

The position of the EU is not without controversy in Protocol negotiations. One criticism is that all the EU member countries should cut by 15%, as the EU insisted on a uniform target of 15% for other developed countries during the negotiations but allowed itself to share a big reduction in the former East Germany to meet the 15% goal for the entire EU. Also, emission levels of former Warsaw Pact countries who now are members of the EU have already been reduced as a result of their economic restructuring. This may mean that the region's 1990 baseline level is inflated compared to that of other developed countries, thus giving European economies a potential competitive advantage over the U.S.

### 2.2.5 *Kyoto - The UK*

The United Kingdom's Kyoto ***target for the commitment period 2008-2012 is to reduce emissions to 12.5% below 1990 levels***.

The energy policy of the United Kingdom fully endorses goals to reduce carbon dioxide emissions, and has committed to proportionate reduction in national emissions on a phased basis.

On 13 March 2007, a draft Climate Change Bill was published after cross-party pressure over several years, led by environmental groups. Informed by the Energy White Paper 2003, the Bill aimed to put in place a framework to achieve a mandatory 60% cut in the UK's carbon emissions by 2050 (compared to 1990 levels), with an intermediate target of between 26% and 32% by 2020.

However, the target of cutting carbon emissions by 60% had been a Government ambition for some years and environmental organisations and some political parties criticised the 60% target as being insufficient.

The Climate Change Act became law in the UK on 26 November 2008, and it makes it the duty of the Secretary of State to ensure that the ***net UK carbon account for all six Kyoto greenhouse gases for the year 2050 is at least 80% lower than the 1990 baseline,***

***and 26%-30% lower by 2020***. The first set of carbon budgets, covering the five year periods 2008-12, 2013-17 and 2018-22 will be published in Spring 2009.

The Act aims to enable the United Kingdom to become a low-carbon economy and gives ministers powers to introduce the measures necessary to achieve a range of greenhouse gas reduction targets. An independent Committee on Climate Change has been created under the Act to provide advice to UK Government on these targets and related policies.

2.2.6 ***Kyoto - Ireland***

Given the high levels of economic and demographic growth experienced by Ireland throughout the 1990s, and the inevitable impact that this growth will have had on greenhouse gas emissions, Ireland's Kyoto ***target for the commitment period 2008-2012 is set at 13% above the 1990 level***.

The most recent data shows that, in 2005, Ireland stood 25% above the 1990 emissions level and, in the 2008-2012 period, will need to achieve an average reduction of some 12 percentage points from the current level. This places Ireland in the mid-range of the EU-15 countries in terms of its distance to target.

However, Ireland remains committed to meeting its 2008-2012 climate change target and views the transition to a low-carbon world as unavoidable. Ireland's National Climate Change Strategy 2007-2012 is one of a number of interrelated Government initiatives to address energy and climate change issues; these include the White Paper on Energy, the Bio-Energy Action Plan and the Sustainable Transport Action Plan. Taken together, these measures support environmental sustainability, underpin competitive position and enable the meeting of global responsibilities.

Whilst achievement of the 2008-2012 commitment is a key objective of the Climate Change Strategy, Ireland is aware that it must be prepared for even greater challenges in the post-Kyoto period.

Ireland's precise target for 2020 is not yet known or set. However, as with the 2008-2012 target, the EU has committed itself to drawing up a burden-sharing agreement which takes account of differing national circumstances. 1990 will remain the base-year against which targets are set and Ireland's relative under-development in 1990 will continue to be a factor which must be taken into account in the burden-sharing agreement. However, there is no doubt that, whatever target is eventually agreed, Ireland will be required to greatly intensify emission reduction activities.

## 2.3 The European Strategy for Sustainable Development

2.3.1 The EU Sustainable Development Strategy was first developed in 2001, to deal with many of the challenges highlighted at the Rio de Janeiro Earth Summit:

- Climate change and clean energy;
- Sustainable transport;

- Sustainable consumption and production;
- Conservation and management of natural resources;
- Public health;
- Social inclusion, demography and migration; and
- Global poverty.

In February 2005, the European Commission took stock of the progress that had been made, and it was concluded that the situation had actually deteriorated. As a result, a 'renewed' Strategy was developed and adopted in June 2006.

The first specific long-term objective of the Strategy is to limit climate change, with the EU committing to put pressure on its member states to meet the Kyoto Protocol commitments they signed up to in 1997, and the most recent targets agreed between the heads of state in March 2007 - to reduce greenhouse gases by 20% by 2020.

The Strategy themes that will have the most direct impact on the opportunities for sustainable building products are;

- Climate change and clean energy;
- Sustainable consumption and production; and
- Conservation and management of natural resources.

Appendix II contains additional detail on the objectives and challenges in relation to these three themes; these include:

- An objective that, by 2010, 12% of energy consumption and 21% of electricity consumption will be met by renewable sources, and with the possibility that this target will be increased to 15% for 2015;

- An objective that, by 2010, the average level of Green Public Procurement across the EU as a whole will match that currently achieved by the best performing member states;

- An objective to promote greater use of, and production of, sustainable products;

- A note that, in terms of environmental impact, one of the most significant sectors in the UK is the consumption of materials for housing. Whilst there is greater recycling within the industry and less reliance on natural resources and raw material extraction, the overall levels of resource extraction are still increasing in absolute terms globally. This is unsustainable;

- A conclusion that the EU has actually been moving away from its Kyoto target for 2008-2012, and needs to put in place aggressive measures to achieve the necessary emissions reductions;

- A recommendation that the development of sustainable products and technologies will be essential if the necessary cuts in emissions are to be achieved, but that these products need to be both effective and price competitive; and

- A recommendation that policies and government interventions are needed to stimulate and encourage the use of, and production of, more sustainable products.

2.3.2 In 2005, the EU also launched its Thematic Strategy on the Sustainable Use of Natural Resources, to develop indicators and mechanisms for setting targets and accurately measuring the environmental impacts of specific products and processes. The objective of the Strategy is to develop one aggregated indicator, illustrating the environmental impacts related to resource use with a single score. Appendix III contains a summary of relevant aspects of the Strategy.

## 2.4 Intelligent Energy Europe Programme

2.4.1 The EU has introduced a number of other plans and policies to help to realise the Kyoto targets; these include the Energy Performance of Buildings Directive (which is discussed in the following sub-section) and increasing the funding available for sustainable energy support programmes, such as '***Intelligent Energy Europe***' ("IEE").

The first period of the IEE (IEE-1) programme ran from 2003 to December 2006, and had a budget of about €250 million. The second period of IEE-2 runs from 2007 until 2013, and has an increased budget of €730 million.

The objective of IEE-2 is to contribute to securing sustainable and competitively priced energy for Europe by providing for action to:

- Foster energy efficiency and the rational use of energy resources.
- Promote new and renewable energy sources and support energy diversification.
- Promote energy efficiency and the use of new and renewable energy sources in transport.

As a major consumer of energy, buildings are a priority of the IEE Programme.

2.4.2 The IEE-2 programme aims to assist stakeholders with implementing the Energy Performance of Buildings Directive and, under IEE's 2008 call, proposals were sought for following activities:

- To take action, including large scale awareness raising and public information campaigns, facilitating the creation of fully functional energy performance certification markets and ensuring the recommendations on certificates are followed by appropriate, practical application.

- To launch voluntary action/schemes for certification, in accordance with the Energy Performance of Buildings Directive, of buildings not for sale or rent and for buildings not covered by the Directive (e.g. smaller properties and renovation).

- To take targeted action related to retrofitting, in particular addressing specific categories of buildings and/or using specific technologies/strategies.

- To take targeted action, including retrofitting, for the take up of passive and very low-energy buildings and technologies, and for energy-neutral and energy-positive buildings which go well beyond the EPBD requirements.

- To take action concerning retrofitting of public buildings, to lead by example and promote adoption of new proven technologies and strategies, including renewable energy sources.

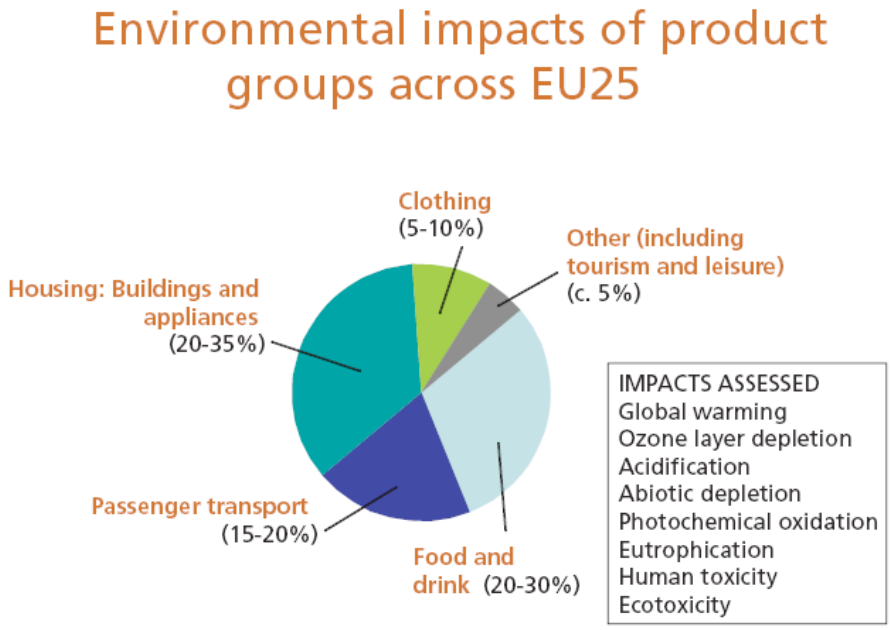
- To conduct large scale awareness-raising campaigns on behavioural aspects of the use of buildings.

- To launch large scale education and training schemes / activities in all member states to qualify the market for implementation of the EPBD: agreements with universities, associations of installers, chambers of commerce etc, to institutionalise the necessary education and training.

On the topic of construction techniques and materials, a number of IEE projects promote the market penetration of technologies and concepts which take the energy performance of buildings beyond current legislative requirements.

## 2.5 EU Energy Performance of Buildings Directive

2.5.1 The following pie chart shows the results of an EU study on the Environmental Impact of Products, which identifies those products consumed in the EU that have the greatest environmental impact throughout their lifecycle.




The study looked at the following key consumption areas, in both the private and public sectors: food and drink; clothing and footwear; housing, furniture, equipment and utility use; health; transport; communications; recreation and culture; education; restaurants/hotels; and miscellaneous.

The study found that housing (including buildings and appliances), along with food, drink and private transport, was consistently one of the areas causing the greatest environmental impact. Cumulatively, these sectors account for 70%–80% of the environmental impact created by private consumption and approximately 60% of total consumption expenditure.

EU research has also shown that buildings account for c40% of EU energy consumption, that approximately half of carbon dioxide emissions (the most significant greenhouse emission) comes from energy use in buildings, and that carbon dioxide emissions from buildings could be reduced by 22% through improved energy efficiencies.

Therefore, energy efficiency in the building sector is a top priority and, as a result, the EU Energy Performance of Buildings Directive ("EPBD") was developed and adopted on 16th December 2002, and came into force on 4th January 2003.

### 2.5.3 Requirements of the Directive

The EPBD is one of the EU's key legislative tools for meeting its Kyoto commitments and responding to issues raised in the Green Paper on energy supply security. Its two main objectives are: improved energy performance of buildings; and convergence of building energy standards towards those member states which already have ambitious targets.

The EPBD requires Member States to:

- develop and implement the general framework for a methodology to calculate the integrated energy performance of buildings;
- apply minimum requirements on the energy performance of new buildings;
- apply minimum requirements on the energy performance of large existing buildings that are subject to major renovation;
- implement a system of energy performance certification for buildings;
- implement a system of regular inspection of boilers and of air-conditioning systems in buildings and, in addition, an assessment of the heating installation if the boilers are more than 15 years old; and
- requirements for experts and inspectors for the certification of buildings, the drafting of accompanying recommendations and the inspection of boilers and air-conditioning systems.

Within these general principles and objectives, it is the individual responsibility of each EU Member State to choose measures that correspond best to its particular situation.

The Directive concerns a very broad spectrum of individuals: builders, designers, housing associations, architects, providers of building products and appliances, installation companies, building experts, owners, tenants… It will greatly affect awareness of energy use in buildings, and is intended to result in a substantial increase in investment in energy efficiency measures and in the use of renewable energy resources.

The 4th of January 2006 was the official deadline by which the 25 Member States had to transpose the Directive into national law, with a deadline of January 2007 set for the two new Member States, Bulgaria and Romania. However, member states were granted an extension of three years (to Jan 2009) to comply with the last two requirements (certifications and inspections), due to a lack of qualified and/or accredited experts.

### 2.5.4 Recast/Update to the Directive in 2008

Some Member States have made promising progress against the EPBD, but the majority still have enormous untapped potential for improvements. To this end, the Commission sees further room for strengthening the effectiveness and the impact of the Directive, and so it has been updated (or 'recast') in 2008, to introduce even tighter standards.

*Buildings are at the core of the European Union's prosperity. They are important to achieve EU's energy savings targets and to combat climate change whilst contributing to energy security. An enormous unrealised savings potential lies dormant in buildings. The recast of the Energy Performance of Buildings Directive (2002/91/EC) will activate this, also boosting sustainable investments and job creation, often in SMEs, across Europe. More energy efficient buildings provide better living conditions and save money to all citizens. The estimated impact of the recast is energy savings of 60-80 Mtoe in 2020 or the total EU energy consumption will be reduced by 5-6%.*

*(Press release MEMO/08/693, Brussels, 13 November 2008)*

The recast Directive helps citizens to improve the energy efficiency of their houses and encourages the construction industry to build better quality buildings. The estimated impacts are that 5-6% less energy will be used in EU in 2020 and about 5% less CO2 emissions will be emitted in the whole EU in 2020.

Some of the key points in the recast Directive are:

- energy performance certificates become a real, active energy label for houses. For instance, the certificate has to be included in all advertisements for sales or renting, and the certificate along with its energy saving recommendations has to be part of the sales and renting documents.

- inspections of heating and air conditioning systems will advise consumers to use better appliances or improve their operation, even replacing if necessary.

- concrete energy performance requirements will come from national or regional building codes, but their level of ambition should be improved and a specific benchmarking system should be used.

- the scope of the Directive is broadened and, for example, all existing buildings when they undergo a major renovation should meet certain efficiency levels and not only for those above 1000m2 as was in the current Directive.

- member states will develop plans for increased numbers of low or zero energy and carbon buildings, such as passive houses, and the public sector should show a leading example investing in such buildings.

In 2009, the Commission intends to launch a major “Build-up” initiative to increase the awareness throughout the whole supply chain from authorities to construction industry and citizens, and new financing schemes are to be introduced to overcome investment barriers.

In addition, the EC has proposed a new Regulation replacing the existing Construction Products Directive, to not only make the CE mark mandatory but also introduce a new indicator on the sustainable use of natural resources. As a result, the sustainability of products could be included in the CE marking assessment.

## 2.6 UK Legislation and Initiatives

2.6.1 The main vehicles through which the EPBD is translated into national legislation in the UK are through national Building Regulations, Energy Performance of Building Regulations, the introduction of the Code for Sustainable Homes and Government Procurement standards for sustainable products.

Wales and England share the same Building Regulations, whilst Scotland and Northern Ireland set their own building regulations. The Welsh Assembly has requested that responsibility for building regulations in Wales should be transferred to the Assembly, and this is currently under consideration.

Northern Ireland and Scotland are following a similar trajectory and targets as England.

2.6.2 ***Energy Performance of Buildings (Certificates and Inspections) (England and Wales) (Amendment No 2) Regulation 2008 (SI2008/2363)***

As of January 2008 all new dwellings in the UK are required to have an Energy Performance Certificate ("EPC"). Buildings which are not dwellings, such as public buildings, will require a Display Energy Certificate (DEC).

Energy Performance Certificates and Display Energy Certificates have to be produced using the relevant calculation tool specified in the National Calculation Methodology. This applies for all energy certificates whether on construction, sale or rent, or for public display.

2.6.3 ***Revisions to Part L of Building Regulations 2000 SI2000/2531***

To meet the requirements of Article 3 of the EPBD, the 2006 revision of Part L of the Building Regulations moved the basis of compliance from standards given for each construction element and building service to an overall $CO_2$ emissions target - the Target Emissions Rate (TER) for the whole building.

This target is based on a notional dwelling defined in terms of the elemental standards (U-values, area allowances, boiler efficiencies etc) that prevailed in the 2002 edition of Approved Document L1. The 2002 Approved Document was chosen as the datum because it gave a set of standards that the construction industry was familiar with in terms of construction specifications and real constructional products and materials. This enabled them to extrapolate the physical implications of the proposed higher standards.

In the 2006 revision to the Building Regulations, there was no prescription or specific guidance on how the overall $CO_2$ emissions performance of a building should be improved – whether through energy efficiency measures alone, the take-up of Low or Zero Carbon (LZC) systems, or a combination of the two. However design flexibility was limited in the Approved Documents, so that reasonable fabric performance had to be achieved, and it is expected that these limits will continue to be tightened. In addition, consideration will be given as to whether more specific guidance can be given to encourage the adoption of higher performance building fabric before selecting building

services systems including LZC systems.

### 2.6.4 *Future Building Regulations for New Buildings 2010 – 2016*

In 2006 the UK Government announced a 10-year timetable and a target stating that, ***by 2016, all new homes must be built to zero carbon standards***. A low or zero carbon design refers to a building that has a negligible or zero net energy consumption in one year. The UK Government has defined zero-carbon as:

**What Does A Zero Carbon Home Mean?**

From 2016, all new homes are to be built in a way that, after taking account of:

- Emissions from space heating, ventilation, hot water and fixed lighting;
- Expected energy use from appliances;
- Exports and imports of energy from the development (and directly connected energy installations) to and from centralised energy networks;

The building will have net zero carbon emissions over the course of the year.

Within the context of the UK target, the Welsh Assembly Government has a stated 'aspiration' to have all new homes zero carbon by 2011 and the UK Government is currently considering a request to transfer responsibility for Building Regulations to Wales (currently England and Wales are governed by the same Building Regulations).

In order to achieve these targets, there will be a step by step tightening of the Building Regulations. Carbon emissions from new homes and building are currently regulated by the Building Regulations. In 2006, Government consulted on proposals to make progressive changes to the energy efficiency and carbon requirements of building regulations, in 2010, 2103 and 2016, leading to regulations which would require new homes to be zero carbon by 2016. The Strategy for Sustainable Construction also includes a target that 25% of products used in construction projects should be from schemes recognised for responsible sourcing.

In the 2008 Budget, Government also announced its 'ambition' to make ***all new non-domestic buildings built from 2019 zero carbon*** and, if they are schools or other public buildings, they will have to be zero-carbon a year earlier (2018).

Until 2013 the building standards and regulations are expected to continue to be set with reference to those sources of emission (space, water heating and lighting) that are

contained in the 2006 regulations and to offer the option of adopting Low and Zero Carbon (LZC) technologies. However, the step to zero carbon in 2016 is likely to include emissions from other sources (principally electrical appliances), which would result in the need for significant renewable generation capacity as well as other LZC systems.

Planning legislation also has a significant role to play in the achievement of low carbon developments, and will be taken into consideration in advance of the anticipated 2010 amendments to the Building Regulations. Through the Climate Change Planning Policy Statement (PPS) there is the potential for changes to improve the contribution that, for instance, site layout, building orientation, shading etc can make in reducing demand on mechanical heating, cooling and ventilation systems.

### 2.6.5 *Code For Sustainable Homes*

The Code for Sustainable Homes ("the Code") will be a key tool in driving future energy efficiencies and demand for sustainable products within the house building sector. It provides a set of voluntary (in the case of private sector homes) energy, carbon and other sustainability standards for new homes.

The Code rates new houses on a scale of 1-6, according to their energy and water efficiency, sustainability features and carbon emissions. Code homes also encourage their owners to live a more sustainable lifestyle and are built in a more efficient way, using materials from sustainable sources. This creates less waste and also means that Code homes have lower running costs.

By setting a single national standard within which the home building industry can design and construct homes to higher environmental standards, the Code sets a framework for the future direction of regulations and offers a tool (the 1-6 star rating system) for developers to differentiate themselves within the market. Through mandatory ratings, the Code also gives new homebuyers better information about the environmental impact of their new home and its potential running costs.

There are nine categories within the Code:

- Energy and $CO_2$ Emissions;
- Pollution;
- Water;
- Health and Wellbeing;
- Materials;
- Management;
- Surface Water Run-off;
- Ecology; and
- Waste.

Points are assigned to each category and, when a builder chooses to incorporate a specific feature, they are awarded points which, when added together, form the basis of a hotel-

style star rating system. The standards set within each category and the points system are available on http://www.planningportal.gov.uk/uploads/code_for_sust_homes.pdf

As explained, the rating ranges from 1 to 6 stars:

- 1* homes will be 10% more energy efficient and 20% more water efficient than most new homes. They may also have some of the other features in the Code such as providing office work space with communication links within the home, secure cycle storage or greater security features.

- 3* homes will be 25% more energy efficient and have many more sustainable features than a 1* home.

- 6* homes will be highly sustainable and, over the course of the year, their net carbon emissions will be zero. This is a zero carbon house. Needing over 90% of the points available, a 6 home would include most of the sustainability features in the Code.

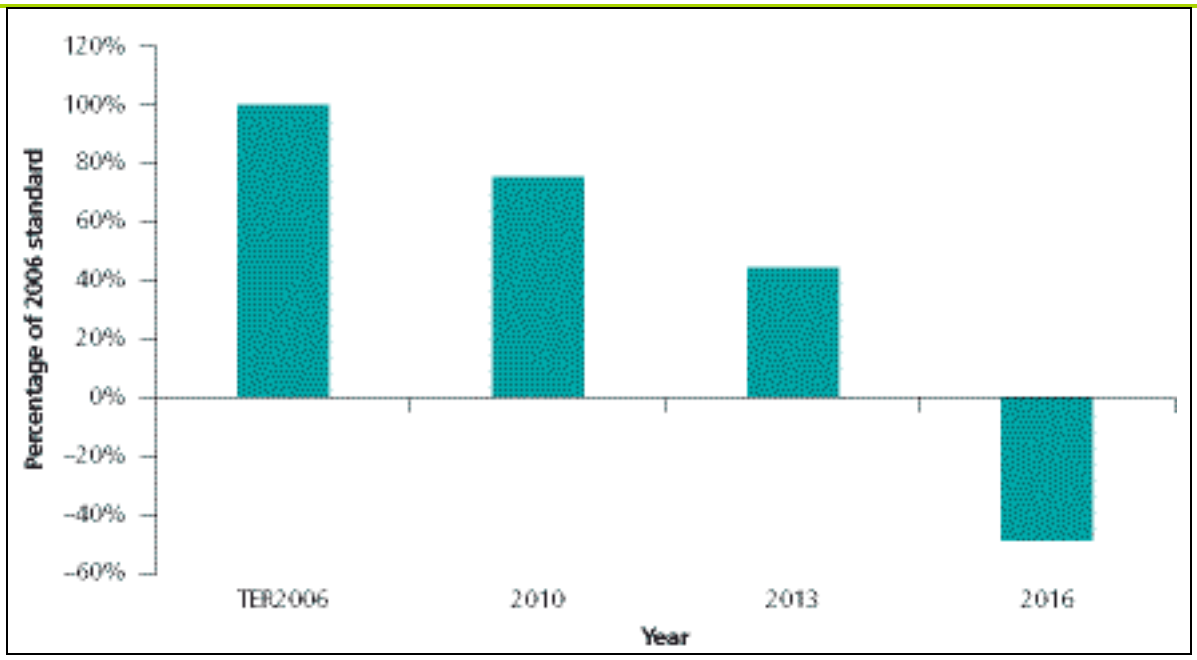
2.6.6 From April 2008, ***all new social housing must be built to a minimum of Code level 3*** and, whilst the Code is still voluntary for privately built housing, it will become an important influencer on the 'saleability' and market value of all houses (public and private). Homes built to, and assessed against, the Code must include the Code certificate within the HIP. Any homes not assessed against the Code must include a nil-rated certificate of non-assessment in the HIP

It is anticipated that ***the Code will become more and more engrained in building regulations***. In July 2007, the UK Government published a paper ("Building Regulations - Energy efficiency requirements for new dwellings - A forward look at what standards may be in 2010 and 2013"), which anticipated that the building regulations would reflect the Code within the following time frame:

| Date | 2010 | 2013 | 2016 |
|---|---|---|---|
| Building Regulations Minimum Code rating | Level 3<br><br>(i.e. 25% improvement on energy efficiency compared to 2006) | Level 4<br><br>(i.e. 44% improvement) | Level 6<br><br>(i.e. zero carbon) |

The following chart illustrates the equivalent improvements (against a 2006 baseline) in carbon emissions, achieved by the energy performance standards in the Code for Sustainable Homes Levels 3, 4 and 6.

**Figure 1: Percentage reduction in target carbon emissions (TER) required by each standard**
**(base = 2006 standard)**




Appendix V provides an illustration of the types of standards and measures which would be necessary to comply with a Code Level 3 (anticipated for 2010) and Code Level 4 (anticipated for 2013).

2.6.7 ***Government Procurement***

The UK Government has put in place a number of measures to 'lead by example' and ensure that government funded construction and government procurement promotes more sustainable construction and products:

- Within the UK, Government has committed that ***all Government-funded housing developments must achieve at least a 3 star rating under the Code*** for Sustainable Homes.

- The Housing Corporation has announced its intention that new homes funded under the National Affordable Homes Programme should meet zero carbon and level 6 of the Code for Sustainable Homes by 2015, of the technology needed to achieve this cost-effectively is available.

- Government has also committed to achieving ***BREEAM*** 'excellent' rating on all new buildings and BREEAM 'very good' rating on all refurbishments;

- Government-funded construction programmes, such as Building Schools for the Future and Health PFI, have adopted model procurement documentation setting out minimum and target performance standards for sustainability; and

- Government has published mandatory minimum environmental standards for procurement of a wide range of commonly purchased products, and Defra has

identified a number of "Buy Sustainable – Quick Wins" ***Government procurement specifications***. The current product specifications include:

- sustainable as well as environmental criteria;
- a wider range of product groups; and
- voluntary "best practice", as well as the mandatory minimum, specifications.

The EU Green Public Procurement criteria also include comprehensive criteria for construction products. The minimum requirements are based on the market average level for each product group and are aligned with European Green Public Procurement requirements where appropriate. Best practice specifications stipulate criteria for the better performing products and the market should aspire to reach these levels, as they will eventually become the minimum requirement.

The initial standards were updated and extended in 2007 to reflect new market average levels, and the standards are being reviewed on an ongoing basis.

The UK's plans are set out in the 2007 UK Government Sustainable Procurement Action Plan and similar plans published by the NHS and Local Government, whilst the Government response to the Commission on Environmental Markets and Economic Performance includes information on how public procurement will capture and stimulate innovation, including application of the 'forward commitment procurement' model.

## 2.7 Northern Ireland Legislation

2.7.1 In its Sustainable Development Strategy "First steps toward Sustainability", Northern Ireland committed to:

*"**Improve overall average energy efficiency of Northern Ireland households by 25% and that of NIHE housing stock by 40% by 2025 (base date 1990)***

*To reduce greenhouse gas emissions, principally by promoting energy efficiency and the use of renewable.*

*To establish Northern Ireland as a world class exemplar in the development and use of renewable energy.*

*To plan and prepare for climate change impacts in Northern Ireland."*

The main legislative tools by which Northern Ireland will encourage the development of more sustainable, lower carbon buildings are:

- the Building Regulations;
- the Energy Performance of Buildings Regulations; and
- the Code for Sustainable Homes.

The Code for Sustainable Homes has been introduced into Northern Ireland for social housing, and all new public sector housing now needs to reach Code Level 3.

The Northern Ireland Executive has also stated that it intends to improve the energy and carbon requirements of building regulations by 25% and 44% in 2010 and 2013 respectively, moving towards zero carbon thereafter – in line with the UK trajectory.

### 2.7.2 *Building Regulations (NI) 2000 Part F – Conservation of fuel and power*

Part F of the Building Regulations for Northern Ireland addresses the conservation of fuel and power in building work undertaken in Northern Ireland.

An amendment to Part F of the Building Regulations for Northern Ireland was effective from 30 November 2006, representing a step change in energy performance requirements and including aspirations to:

- Introduce a "Whole Building Approach" based on the calculated energy performance of buildings and using defined national calculation methodologies;
- Set energy performance requirements that achieve a reduction in carbon emissions of up to 40% on current standards;
- Introduce a requirement to consider the installation of alternative energy sources such as CHP and renewable energy systems in large buildings (over 1000m²);
- Require the upgrading of energy performance in large existing buildings (over 1000m²) undergoing major refurbishment; and
- Require the production of an Energy Performance Certificate (“EPC”) for all new buildings.

The 2006 amendment is split into 5 sections covering:

- FI: Application and Interpretation;
- F2: Conservation Measures;
- F3: Target Carbon Dioxide Emission Rates (TER);
- F4: Provision of Information;
- F5: Deemed-to-Satisfy Provisions.

In addition to the requirement to achieve the TER, the F2 Conservation Measures state that reasonable provision should be made for the conservation of fuel and power in buildings, by:

(a) limiting heat gains and losses, through thermal elements and other parts of the building fabric, and from pipes, ducts and storage vessels;

(b) providing energy efficient fixed building services with effective controls; and

(c) commissioning the energy efficient fixed building service prior to completion of the building work.

The 2006 amendment also encourages the use of low and zero carbon ("LZC) energy systems, including renewable energy systems such as solar thermal, photovoltaic, wind generation and CHP systems. The LZC benchmark for non-domestic buildings is 10% of the total carbon emissions. If the target is not met, further improvements in energy efficiency will have to be met in order to compensate and reduce emissions to an equivalent extent.

2.7.3 The regulations focus on carbon emissions for both new build and refurbishment projects, and are designed to implement aspects of the EPBD. Whereas the previous regulations specified standards for certain components of a building, the principle requirement under the new regulation is to meet the carbon emissions target for the building as a whole. As a result, the new regulations place greater emphasis on demonstrating the quality of construction and commissioning, and bring new responsibilities for architects, design teams and engineers.

For new buildings the only method for demonstrating compliance with PartF is to show that carbon dioxide emissions from the building meet the TER, measured in kgCO2/m2/year. Predicted emissions from the design are calculated for new buildings and may not exceed the TER, and designers must use a new National Calculation Methodology. In addition, new buildings must meet various minimum design limits, and limit solar gains to avoid overheating. Maximum U-Values are given for the fabric of new buildings, both in terms of an area weighted average for each element type (e.g. walls and roofs) and for any part of the individual elements.

Under the regulations, refurbishment projects are also required to account for the energy picture of the whole building. For work on existing buildings, there are minimum elemental standards for the building fabric and services. Whilst the standards for replacing individual elements in existing buildings are not as stringent as for new buildings (reflecting the practical constraints involved in the improvement of thermal elements during refurbishment) the fabric should be insulated to achieve specified U-values for walls, floors, pitched roofs with insulation on the ceiling, other roofs and windows.

For refurbishments or extensions over 1,000m2, or where a fixed building service is installed for the first time, or where the installed capacity of an existing fixed building service is increased, the further condition of 'consequential improvement' needs to be considered. This relates to heating, lighting, metering, building fabric and low/zero carbon energy generating systems. For example, an increase in the installed capacity of a heating or cooling plant could necessitate improvements to the insulation in the existing building, or the replacement of inferior windows and doors. This regulation does not require any work to be done that it not technically, functionally and economically feasible, where 'economic feasibility' is described as having a straight payback of up to 15 years.

2.7.4 ***The Energy Performance of Buildings (Certificates and Inspections) Regulations (Northern Ireland) 2008 (S.R. 2008 No. 170)***

The Energy Performance of Buildings Regulations (Northern Ireland) implement Articles 7 (energy performance certificate), 9 (inspection of air-conditioning systems) and 10 (independent experts) of EPBD.

The Regulations were made on 10 April 2008, coming into effect for sales of existing dwellings on 30 June 2008, for new buildings on 30 September 2008 and for the rental sector and for sales of non-domestic buildings on 31 December 2008.

The main provisions of the Regulation are:

- Energy Performance Certificates ("EPCs") should be produced and made available when buildings are constructed, sold or rented out;

- Display energy certificates ("DECs") should be displayed in large public buildings (over 1000 m2) providing a public service. These institutions must also obtain an advisory report containing recommendations for the improvement of the energy performance of the building. The advisory report is valid for a period of 7 years from the date it was issued. The DEC should be no more than 12 months old (regulation 12);

- Air-conditioning systems should be regularly inspected, at intervals not exceeding 5 years The commencement date for air-conditioning systems depends on when the system was first put into service - a five year period for systems put in place after 30 December 2008 and, for systems put in place before 30 December 2008, either 4 January 2010 (rated output more than 250 kW) or 4 January 2012 (rated output not more than 250 kW).

- Energy assessors who produce EPCs, DECs or who inspect air-conditioning systems shall be members of an accreditation scheme approved by the Department (regulation 19);

- A person responsible for having construction work carried out should make available an EPC to the owner of the building not more than five days after the work has been completed;

- EPCs should be accompanied by recommendation reports for the improvement of the energy performance of the building and should be no more than 10 years old (regulation 8); and

- Restrictions are imposed on the circumstances in which certificates and recommendation reports may be disclosed, and create an offence for unlawful disclosure.

2.7.5 The interrelationship between the building regulations and EPC regulations is a little complicated due to past changes to the building regulations involving SAP Energy Ratings, Energy Rating Notices and now Energy Performance Certificates. However, the requirements are explained in detail in the following table:

| **Dwellings subject to Part F 1999** |
|---|
| SAP Energy Ratings were first introduced from 1April 1999, by amendment 1998 No. 453 to the Building Regulations (Northern Ireland) 1994.<br><br>Any dwelling subject to these regulations requires a SAP Energy Rating to be submitted to district councils at design stage. A SAP Energy Rating of 60 or less triggers more onerous thermal standards than those for a dwelling having a design SAP rating of greater than 60.<br><br>When the building is constructed the SAP Energy Rating must be notified on completion to the district council not more than 5 days after completion. Anyone can produce the SAP Energy Rating.<br><br>Where a dwelling subject to the above regulations is completed after 30th September 2008, it also becomes subject to the Energy Performance of Buildings (Certificates and Inspections) Regulations (Northern Ireland) 2008 (EPB Regulations). Under these regulations, the dwelling requires an Energy Performance Certificate (EPC) on completion which must be given to the owner not more than 5 days after the work has been completed. The Energy Performance Certificate can only be produced by an Accredited Energy Assessor. Building Control has no role to play in this process. |
| **Buildings subject to Part F 2006** |
| Buildings subject to Part F 2006 and submitted for approval before 30th September 2008 must have a TER and DER submitted to district councils at design stage. The DER must not exceed the calculated TER.<br><br>When the building is completed the TER and DER must be submitted to building control not more than 5 days after completion to demonstrate that the target has been met. The TER and DER calculations can be done by anyone.<br><br>Where the completed building is a dwelling, an Energy Rating Notice must be produced for the dwelling and a copy submitted to the district council not more than 5 days after completion. This Energy Rating Notice is simply a statement of the SAP Energy Rating for the dwelling. The Energy Rating Notice will be superseded in SAP software from 30th September by an Energy Performance Certificate which can only be produced by an Accredited Energy Assessor. In these circumstances, building control may accept a SAP Energy Rating, which can be calculated by anyone, or an EPC produced by an Accredited Energy Assessor in lieu of the Energy Rating Notice.<br><br>Where a building subject to the above regulations is completed after 30th September 2008 it also becomes subject to the Energy Performance of Buildings (Certificates and Inspections) Regulations (Northern Ireland) 2008.<br><br>Under these regulations, the building requires an Energy Performance Certificate on completion which must be given to the owner not more than 5 days after the work has been completed. The Energy Performance Certificate can only be produced by an Accredited Energy Assessor. Building Control has no role to play in this process. |
| **Buildings subject to Part F 2006 and submitted for BC approval after 30th September 2006** |
| Buildings subject to Part F 2006 and submitted for approval after 30th September 2008 must have a TER and DER submitted to district councils at design stage. |

The DER must not exceed the calculated TER. When the building is completed the TER and DER on completion must be submitted to building control not more than 5 days after completion to demonstrate that the target has been met. The TER and DER calculations can be done by anyone.

The Building Regulations have been amended from 30th September 2008 by the EPB Regulations to require that, when a building is completed, an Energy Performance Certificate must be produced for the building and a copy given to the owner and to the district council not more than 5 days after completion. The Energy Performance Certificate can only be produced by an Accredited Energy Assessor.

## 2.8 Republic of Ireland Legislation

The main legislative tools by which the Republic of Ireland is encouraging the development of more sustainable, lower carbon buildings is through:

- the Building Regulations; and
- the Energy Performance of Buildings Regulations.

### 2.8.1 *Building (Amendment) Regulations 2008 (S.I. No. 259 of 2008)*

On 10th July 2008 an amendment to the Building Regulations in Ireland was brought into operation, which included requirements regarding conservation of fuel and energy (as detailed in Part L of the Amendment).

Part L applies to all new buildings and renewal works to existing buildings, including the replacement of external doors, windows and roof lights. However, Part L does not apply to works (including extensions) to an existing building which is a 'protected structure' or a 'proposed protected structure' within the meaning of the Planning and Development Act 2000 (No. 30 of 2000)

The main provisions of Part L are:

| **Conservation of Fuel and Energy** | |
|---|---|
| L1 | A dwelling shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the dwelling and the amount of $CO_2$ emissions associated with this energy use, insofar as is reasonably practicable. |
| L2 | For ***existing dwellings***, the requirements of L1 shall be met by:<br><br>a. limiting heat loss and, where appropriate, maximising heat gain through the fabric of the building;<br>b. controlling, as appropriate, the output of the space heating and hot water systems;<br>c. limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air; and<br>d. providing that all oil and gas fired boilers installed in existing dwellings shall meet a minimum seasonal efficiency of 86% where practicable. |

| | |
|---|---|
| L3 | For ***new dwellings***; the requirements of L1 shall be met by:<br><br>a. providing that the energy performance of the dwelling is such as to limit the calculated primary energy consumption and related CO2 emissions insofar as is reasonably practicable when both energy consumption and $CO_2$ emissions are calculated using the Dwelling Energy Assessment Procedure published by Sustainable Energy Ireland;<br>b. providing that, for new dwellings, a reasonable proportion of the energy consumption to meet the energy performance of a dwelling is provided by renewable energy sources;<br>c. limiting heat loss and, where appropriate, availing of heat gain through the fabric of the building;<br>d. providing and commissioning energy efficient space and water heating systems with efficient heat sources and effective controls;<br>e. providing that all oil and gas fired boilers shall meet a minimum seasonal net efficiency of 86%;<br>f. providing to the dwelling owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and energy than is reasonable |

| | |
|---|---|
| L4 | For ***buildings other than dwellings***, the requirements of L1 shall be met by:<br><br>a. providing that the energy performance of the new building is such as to limit the calculated primary energy consumption and related $CO_2$ emissions insofar as is reasonably practicable, when both energy consumption and CO2 emissions are calculated using the Non-domestic Energy Assessment Procedure published by Sustainable Energy Ireland;<br>b. limiting the heat loss and, where appropriate, maximising the heat gains through the fabric of the building;<br>c. providing energy efficient space and water heating services including adequate control of these services;<br>d. ensuring that the building is appropriately designed to limit need for cooling and, where air-conditioning or mechanical ventilation is installed, that installed systems are energy efficient, appropriately sized and adequately controlled;<br>e. limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air;<br>f. limiting the heat gains by chilled water and refrigerant vessels, and by pipes and ducts that serve air conditioning systems; and<br>g. providing energy efficient artificial lighting systems (other than emergency lighting, display lighting or specialist process lighting) and adequate control of these 'systems'. |

The Building Regulations in the Republic of Ireland already incorporate standards requiring new buildings to meet, as a minimum, standard equating to Level 3 of the Code for Sustainable Homes. In the Republic of Ireland, this reflects a 40% improvement on the standards required in the 2005 regulations. By 2010, the regulations will reflect Code level 4 and by 2013 code level 6 (zero carbon).

| Date | 2008 | 2010 | 2013 |
|---|---|---|---|
| Building Regulations Minimum Code rating | Level 3<br><br>(i.e. 40% improvement on energy efficiency compared to 2005) | Level 4<br><br>(i.e. 60% improvement) | Level 6<br><br>(i.e. zero carbon) |

Therefore, in the Republic of Ireland, it is anticipated that ***all new building will be zero carbon by 2013*** – earlier than the target set for the UK.

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### 2.8.2 *Building Regulations Technical Guidance – Conservation of Fuel and Energy*

For <u>new buildings</u> the key issues to be addressed in meeting the building regulations regarding energy and fuel conservation are:

- Primary energy consumption and related $CO_2$ emissions;
- Use of renewable energy sources;
- Fabric insulation;

- Air tightness;
- Boiler efficiency;
- Building services controls;
- Insulation of pipes ducts and vessels;
- Mechanical ventilation systems;
- Performance of completed dwelling; and
- User information.

For existing buildings the key issues to be addressed are:

- Fabric insulation;
- Air tightness;
- Boiler efficiency;
- Building services controls; and
- Insulation of pipes ducts and vessels.

Appendix VI summarises the technical requirements for the above five issues, which are common to both new build and refurbishment projects.

2.8.3 ***European Communities (Energy Performance of Buildings) Regulations 2006 (S.I. No 666); European Communities (Energy Performance of Buildings) (Amendment) Regulations 2008 (S.I. No 229)***

This regulation first came into effect in the Republic of Ireland in January 2007 and requires that, where planning permission is sought for large buildings (over 1000m$^2$), consideration must have been given to the technical, environmental and economic feasibility of installing alternative energy systems and that the use of such systems has been taken into account, as far as practicable, in the design of that building.

The alternative energy systems to be considered should include:

(a) decentralised energy supply systems based on renewable energy;
(b) combined heat and power systems;
(c) district or block heating or cooling, if available; and
(d) heat pumps.

The regulation also states that a ***Building Energy Rating (BER) certificate*** is required for the following classes of buildings with effect from the dates specified for each class of building:

(a) new dwellings commenced on or after 1 January 2007;
(b) new buildings, other than dwellings, commenced on or after 1 July 2008**;** and
(c) buildings of any class in existence at 1 January 2009 offered for sale or letting on or after 1 January 2009.

Examples of BER Certificates for a new dwelling and for a new building other than a dwelling are shown in Appendix VII.

# 3. TRENDS IN THE CONSTRUCTION SECTOR

3.1 The construction sector is one of the most severely impacted by the current economic crisis and recession. The following sub-sections consider economic projections for the UK and Ireland, and provide a summary of construction output trends and projections in GB.

However, we are in a relatively unique economic climate, without a general consensus of opinion on what the impacts of the credit crisis will be. As national governments work together to try to find solutions and put in place measures to try to boost market confidence and stabilise the financial system, we are in a state of uncertainty – it is unclear as to how effective these measures will be and when they could start to impact.

Within this context, this section attempts to give a picture as to the current state of the market, but with the proviso that it is at a volatile stage. However, one certainty is that businesses are in a period of tough trading, when competition will be fierce.

The statistics show the very tough market conditions that the construction industry is facing, with a marked downturn in market demand and construction activity, and predictions that this downturn will continue for the next 2 years. However, it also recognised that we need more new homes to meet the growing number of households. The UK's annual household growth projections point to 223,000 new households per annum to 2016.

Coupled with the downturn in demand, the industry is faced with rising running costs, and increasing legislative and compliance pressures, many of which add a requirement for further investment by businesses. Amongst these pressures is the drive for construction companies and suppliers to develop more sustainable building practices and products – we need to build more homes, but we need to minimize the impact on carbon emissions.

The move towards sustainable building products and practices is an inevitable development, and will be essential for future suppliers to the construction industry. Companies need to be looking now to the development of these products. The challenge for the industry is to manage its costs and maintain business in the current very difficult trading conditions, whilst ensuring that it is in a position to meet the growing demand and move towards sustainable products.

## 3.2 Overall Economic Trends

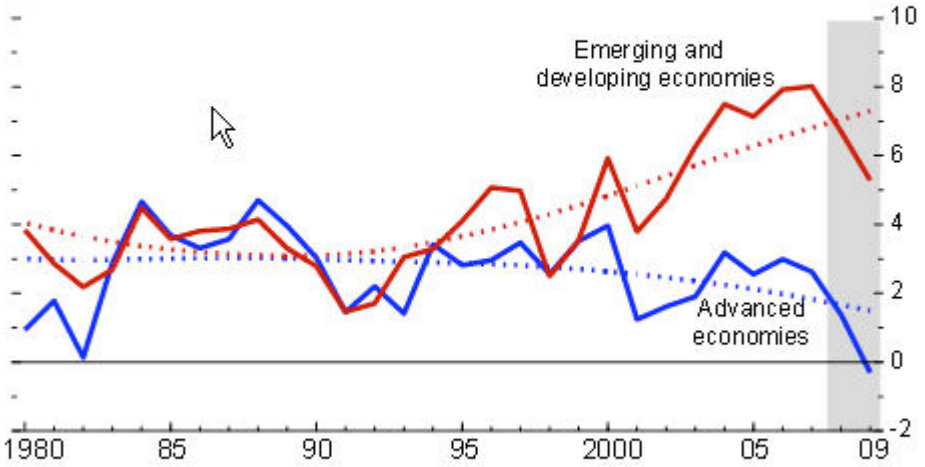
According to the International Monetary Fund:

- The current credit crisis has been described as the most dangerous financial crisis hitting global economies since the 1930s, with the International Monetary Fund stating that many global economies are close to or moving into recession.

- World growth is projected to slow from 5% in 2007 to 3¾ percent in 2008 and to just over 2% in 2009, with the downturn led by advanced economies. Latest predictions (November 2008) from the International Monetary Fund project that world output will grow by only 2.2% in 2009 – 0.75 percentage points lower than the prediction made a month previously (in October 2008).

- In advanced economies, output is forecast to contract on a full-year basis in 2009; the first such fall in the post-war period. In emerging economies, growth is projected to slow down appreciably, but still reach 5 % in 2009. However, these forecasts are based on current policies. Global action to support financial markets and provide further fiscal stimulus and monetary easing could limit the decline in world growth.

**Figure 1. Real GDP Growth and Trend**
*(Percent change)*




Source: IMF staff estimates.

- The *U.S.* economy will suffer, as households respond to depreciating real and financial assets and tightening financial conditions. Growth in the *euro area* will be hit hard by tightening financial conditions and falling confidence. In *Japan*, the support to growth from net exports is expected to decline.

- Weakening global demand is depressing commodity prices. Oil prices have declined by over 50% since their peak, falling to levels not seen since early 2007 - reflecting the major global downturn, the strengthening of the U.S. dollar and the financial crisis - despite the decision by the Organisation of Petroleum Exporting Countries to reduce production. In line with market developments, the International Monetary Fund's baseline petroleum price projection for 2009 has been revised down to $68 a barrel. Similarly, metals and food prices have fallen from their recent peaks. Whilst these trends ease the burden on households in advanced economies and emerging economies in Europe and Asia, they lower growth prospects in many other emerging economies.

  The combination of stabilising commodity prices and increasing economic slack should help to contain inflationary pressures. However, inflation risks are still significant, as higher commodity prices and continued pressure on local supply conditions affect wage demands and inflation expectations.

- Emerging markets are coming under pressure, with emerging equity markets losing about a third of their value in local currency terms and more than 40% of their value in U.S. dollar terms, owing to widespread currency depreciations.

- Business activity is increasingly being held back by slumping confidence. As the financial crisis has become more entrenched, households and firms are anticipating a prolonged period of poor prospects for jobs and profits. As a result, they are cutting back on consumption and investment.

- Policy actions are being implemented to address the financial stress and to support demand, but it will take time to reap their full benefits. The initiatives include programs to purchase distressed assets, use of public funds to recapitalise banks and provide comprehensive guarantees, and a coordinated reduction in policy rates by major central banks.

| Projected Annual Economic Growth | | | |
|---|---|---|---|
| | **2007** | **2008** | **2009** |
| **Advanced Economies** | **2.6%** | **1.4%** | **-0.3%** |
| US | 2% | 1.4% | -0.7% |
| Euro Area | 2.6% | 1.7% | -0.5% |
| Germany | 2.5% | 1.8% | -0.8% |
| France | 2.2% | 0.8% | -0.5% |
| Italy | 1.5% | -0.2% | -0.6% |
| Spain | 3.7% | 1.4% | -0.7% |
| ***UK*** | ***3.0%*** | ***0.8%*** | ***-1.3%*** |
| Canada | 2.7% | 0.6% | 0.3% |
| Japan | 2.1% | 0.5% | -0.2% |
| **Emerging and Developing Economies** | **8.0%** | **6.6%** | **5.1%** |
| Central and Eastern Europe | 5.7% | 4.2% | 2.5% |
| China | 11.9% | 9.7% | 8.5% |
| India | 9.3% | 7.8% | 6.3% |
| ASEAN-5 | 6.3% | 5.4% | 4.2% |
| Africa | 6.1% | 5.2% | 4.7% |
| Middle East | 6.0% | 6.1% | 5.3% |
| Commonwealth of Independent State | 8.6% | 6.9% | 3.2% |
| **World Output** | **5.0%** | **3.7%** | **2.2%** |

- However, the International Monetary Fund states that the economic outlook is still 'exceptionally' uncertain. Financial conditions continue to present serious downside risks and, in the current setting, upside risks are limited. Nonetheless, it is possible that the financial sector policy measures, once fully specified and implemented, could foster a more rapid-than-expected improvement in financial conditions. In the meantime, the relatively strong balance sheets of nonfinancial corporations might help forestall a major cutback of investment. Under such conditions, confidence could also recover rapidly and spending by households and firms quickly reaccelerate.

## 3.3 GB Construction and House building Market

### 3.3.1 *Overall Construction Output – Recent Trends*

The following table details the level of construction output in Great Britain over the five year period ending 2008.

**Construction Output in Great Britain, by Type, 2004-2008, (£ Million)**

| Description | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Public Housing | 2 605 | 2 659 | 3 437 | 4 222 | 4 172 |
| Private Housing | 16 818 | 18 384 | 19 572 | 20 064 | 17 323 |
| Public Non-Residential | 10 392 | 10 053 | 9 826 | 10 262 | 11 646 |
| Private Industrial | 3 978 | 4 290 | 4 888 | 5 022 | 4 364 |
| Private Commercial | 16 808 | 17 370 | 20 137 | 23 169 | 24 404 |
| Repair & Maintenance | 44 340 | 46 793 | 48 293 | 51 411 | 53 906 |
| **Total** | **94 941** | **99 549** | **106 153** | **114 150** | **115 815** |

*Note: Figures may not add up due to rounding; SOURCE: MBD analysis of ONS data and estimates*

As shown:

- In value terms, ***public/social housing*** construction output is expected to have declined by a modest 1% to £4.17 billion in 2008. This is in contrast to year-on-year growth recorded between 2004 and 2007, culminating in a significant increase of 62% in nominal terms. However, provision of social housing is still only one fifth of what it was 20 years ago.

  Construction output in the public housing sector has been buoyed during much of the review period by Government commitments which have focused upon the provision of increased levels of social housing. The moderate decline in social housing construction estimated for 2008 partly reflects the more uncertain economic climate.

  The Housing Corporation is the national Government agency that funds new affordable housing and regulates housing associations in England. From December 2008, the Housing Corporation was replaced by a new agency, the Tenant Services Authority (TSA). The Housing Corporation's principal investment fund is known as the National Affordable Housing Programme. In 2006-08, the Corporation invested £3.9 billion in 84 000 new affordable homes throughout England. In the period covering 2008/11, the plan is for the Corporation/TSA to invest a further £8.4 billion in affordable homes.

  Housing associations are not for profit companies which have built most of the social housing stock in recent decades. However, private developers have become more and more involved in social housing. In February 2008, the Housing Corporation announced £3.3 billion in grants for new social housing building; whilst most of the grants went to housing associations, the Corporation also handed out money directly to 14 developers compared with eight in the last round of grants. It is hoped that, by bringing in private developers, competition should be enhanced and capacity increased.

- ***Private housing*** output is expected to have declined by 14% in nominal terms in 2008, taking the value of output to £17.32 billion. Prior to that, output increased in each year between 2004 and 2007, although annual growth levels slowed from 26% to a moderate 3%.

The increase in private house building activity in the years prior to 2008 was due to a number of factors which include extended life expectancy, increasing number of single occupant households and the positive economic background facilitating home ownership (aided by historically low interest rates), all of which are resulting in an ever increasing trend where demand outstrips supply.

The decline in private house building activity during 2008 reflects the deteriorating market conditions. The economic downturn, global financial instability and reduced mortgage availability have resulted in a downturn in the housing market and in house builders cutting back on new build projects.

The following table analyses private new housing starts and completions over the five year review period:

**Private New Housing Starts and Completions in Great Britain, 2004-2008 (Units)**

| Year | Starts | % Change | Completions | % Change |
|---|---|---|---|---|
| 2004 | 194 127 | +9% | 166 844 | +5% |
| 2005 | 190 680 | -2% | 170 504 | +2% |
| 2006 | 192 388 | +1% | 168 411 | -1% |
| 2007 | 182 081 | -5% | 182 630 | +8% |
| 2008 | 133 098 | -27% | 146 960 | -20% |

*Note: 2008 based on quarterly data ; Historic data have been revised; SOURCE: MBD*

In 2007, the number of private new housing starts fell by 5%, and is expected to have fallen by a significant 27% during 2008, taking the number of starts to 133 098.

The South East of England has consistently been the most important region for private house building output, although the proportional importance of the region has declined over the five year period. This is an area of high demand, although the market is constrained by a lack of available land for development.

**Regional Private Housing Construction Output, 2004-2008 (% of Total)**

| Area | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| North East | 3.7% | 3.6% | 3.6% | 4.5% | 5.2% |
| Yorkshire & Humberside | 9.1% | 8.0% | 8.4% | 9.5% | 9.7% |
| East Midlands | 9.0% | 8.4% | 9.3% | 9.8% | 8.8% |
| East England | 9.5% | 9.3% | 9.1% | 8.7% | 8.8% |
| London | 6.4% | 6.5% | 7.2% | 7.6% | 8.3% |
| South East | 14.8% | 14.5% | 13.8% | 14.2% | 15.0% |
| South West | 9.5% | 11.0% | 11.2% | 11.0% | 10.7% |
| West Midlands | 10.5% | 10.2% | 9.2% | 8.1% | 7.6% |
| North West | 10.0% | 10.4% | 11.7% | 11.5% | 11.3% |
| Wales | 4.8% | 4.4% | 4.5% | 4.6% | 4.1% |
| Scotland | 12.8% | 13.8% | 12.0% | 10.6% | 10.5% |
| **Total** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

*Note: Percentages may not add up to 100% due to rounding*
*SOURCE: MBD*

- In the ***public non-residential*** sector, output increased by 4% in 2007, and is estimated to have been followed by an even stronger 13% increase in 2008. This is in contrast to a 5% decline recorded between 2004 and 2006, partly reflecting a marked decline in public sector investment. Growth in the latter part of the review period has mainly been driven by increased output levels in the education and health sectors. Investment in new prisons was also increased towards the end of the review period.

- ***Private industrial*** construction output is projected to have reached £4.36 billion in 2008, equating to a decline of 13% compared with the previous year. The decline is a partial reflection of the global financial crisis which has affected investment levels. Between 2004 and 2007, output in the sector increased year-on-year, driven by the increase in retail warehousing demand and the continued development of the distribution and logistics sectors. However, UK manufacturers are now faced with rising unit costs, raw material, fuel and energy costs which is depressing investment in new construction.

- ***Private commercial*** construction output is expected to have increased by 5% to £24.4 billion in 2008, representing overall growth of 45% compared with 2004. In 2008, the sector is estimated to have accounted for 21% of total construction output compared with 18% in 2004. Growth in private commercial construction output has mainly been driven by the health, offices and education sectors.

  Over 2008, the commercial sector has not been affected by the current economic downturn to the same extent as the house building sector, as many build projects in the commercial sector that were already in the pipeline went ahead. However, the

deteriorating economic conditions and the instability in the financial sector is expected to result in reduced private commercial construction activity in 2009 and 2010.

- Total ***repair & maintenance*** output is estimated to have increased by 5% in 2008, taking the value of output to £53.91 billion. Overall, the value of the sector has increased by 22% since 2004. The effects of the economic downturn on repair and maintenance activity is expected to be partly negated by strong growth in demand for home energy efficiency improvement work.

### 3.3.2 *House building Trends*

A number of factors have been encouraging growth within the house building sector during recent years:

- Demographic changes are placing an upward pressure on housing demand. Although the UK population is growing relatively slowly, immigration, divorce and longer life expectancy mean that there is a growing number of households to accommodate.

- Social trends have also tended to place an upward pressure on demand, including the long-term increase in single occupant households.

- Economic considerations, such as the increase in the proportion of the population sufficiently wealthy to afford house ownership, increases in consumer spending power, historically low interest rates and widespread credit availability. Further economic considerations have included a strengthening of house price inflation, partly reflecting low interest rates as well as demand criteria. However, the credit crunch and global financial instability have now resulted in a tightening of available credit, which has reduced mortgage availability and in turn has had a considerable impact on the housing market.

- House price increases have influenced the market by limiting the ability of first-time buyers to get onto the property ladder, and this has had a knock-on effect in increasing demand for rental accommodation. During the current downturn house prices have started to fall across all regions of Great Britain.

- Flats and apartments have accounted for an increasing proportion of new housing starts, accounting for 46% of total starts in 2007 compared with 36% in 2003. However, this share is unlikely to increase much further in the next few years, with some trade sources suggesting that it has reached a peak. This is due to Local Government planning authorities now refocusing on building family homes. Furthermore flats and apartments have been hit particularly hard by the downturn in the housing market, and by the significant slowdown in the buy-to-let market, which has been a major driving factor for the building of large-scale city-centre apartment developments.

- Self-build homes also account for a growing proportion of new houses. They are increasingly the choice of well-off households wanting a distinctive ‘designer’

property. However, planning restrictions and the economic downturn will have a downward pressure on this sector, which may become more and more niche.

### 3.3.3 *Construction Forecasts*

Whilst the need for additional housing, buildings and construction still exists, current economic conditions have depressed both the number of buildings being built and market confidence to buy, with builders and developers scaling back new build projects, mothballing developments and reducing overheads.

Total construction output in Great Britain is expected to decline by 5% in real terms in 2009 followed by a moderate 2% decline in 2010. This is largely a reflection of the strong downturn in the economy and construction activity, anticipated in the private housing, commercial and industrial sectors. The global financial crisis and the economic downturn, which is now projected to be more prolonged than previously expected, will exert a downward pressure on the construction market in 2009 and 2010.

**Forecast Construction Output in Great Britain, 2009-2013, (£ Million at 2008 Prices)**

| Year | Output | % Change |
|---|---|---|
| 2009 | 110 509 | -5% |
| 2010 | 108 305 | -2% |
| 2011 | 110 289 | +2% |
| 2012 | 113 167 | +3% |
| 2013 | 117 237 | +4% |

*SOURCE: MBD forecasts*

MBD forecasts that construction activity will return to growth in 2011, albeit at a moderate 2%, and this is expected to be followed by slightly stronger growth of 3% and 4% in 2012 and 2013 respectively.

Moderate growth is still expected to be maintained in the public housing and public non-residential sectors, driven by continued government investment in construction programmes, although this funding may come under threat due to the current strong increase in public borrowing.

Repair and maintenance activity is expected to decline moderately in 2009 and 2010, although modest growth is expected to be restored by 2011.

The prospects in the private construction sector are closely linked to economic conditions, thus the anticipated return to growth in 2011 is strongly dependent on an economic recovery. It is anticipated that, over the short to medium term, the main growth areas in new house building will be in affordable/social housing supported by Government intervention. Private house building will continue, but the rates of growth will be significantly lower than over past years.

3.3.3.1 House building Forecasts

The UK is still in a situation where there is an undersupply of housing stock. The Barker Review (2004) identified that there was a persistent inadequate housing supply in the UK, and argued that a further 17,000 new social housing homes would be needed each year to meet the demand from the flow of new households, and that up to 9000 a year above this rate was needed in order to make inroads into the backlog of need. As a result, the UK Government has placed house building as one of its key policy objectives.

The Government's Sustainable Communities Plan, announced in February 2003, was in response to the undersupply of housing and provided plans and funding for an additional 200,000 homes in London and the South East. The Sustainable Communities Plan also designated four areas as potential growth areas in the long term to 2031:

- Milton Keyes/South Midlands, where 370 000 homes are expected to be built;
- Ashford, 31,000 homes;
- 250 000 to 500 000 new homes in the London-Stansted-Cambridge-Peterborough corridor; and
- Thames Gateway.

Currently it is anticipated that, by 2016, these growth areas, along with London, will provide 200 000 additional homes above previously planned levels.

To complement the Sustainable Communities Plan, the New Growth Points initiative was announced in December 2005 to provide support to local communities who wish to pursue large scale and sustainable growth, including new housing, through a partnership with Government. So far, 29 areas have been named as New Growth Points across the East, South East, South West, East Midlands and West Midlands. If all of the proposed growth is realised, New Growth Points would contribute around 100 000 additional dwellings by 2016, an increase of around 32% on previous plans for housing supply in these areas. The new housing developments in each region will be supported by improvements to the social and transport infrastructure.

In July 2007, the Government announced its Green Housing Paper which introduced a set of measures to increase housing supply, including:

- an announcement that the New Growth Points Programme will be expanded, with further local authorities invited to bid to become part of the programme, including areas of the North for the first time.

- targets of 2 million new homes by 2016 and 3 million by 2020: an extra 250,000 new homes on top of the previous target by 2016.

- at least 70 000 affordable homes to be built per year - including a doubling to 45,000 new social homes a year.

- £8 billion to be invested in affordable housing over the three years of the next

comprehensive spending review.

- a new "housing and planning delivery grant" to direct extra resources to councils that build the most houses while penalising those who have not identified at least five years' worth of sites ready for development.

- expansion of the Open Market HomeBuy scheme with the Government set to launch a 17.5% equity loan product from July.

In September 2008, the Government announced a new housing package of measures, in response to the challenging conditions in the housing market. The £1 billion package is designed to help first time buyers struggling to get onto the housing ladder, support vulnerable homeowners at risk of repossession, and support the house-building industry. Measures in the package designed to help the house building industry include:

- bringing forward £400 million funding for social housing providers, including registered social landlords and councils, to deliver 5500 more social houses over the next 18 months.

- working with Regional Development Agencies to support the most critical regeneration schemes with the most potential to transform their communities.

- HomeBuy Direct, a £300 million scheme which will help up to 10 000 first time buyers into affordable homeownership over the next two years. According to the Government, this should help the house building industry weather difficult conditions so that, when the market recovers, they are ready to expand and continue building the new homes needed for the long term.

However, the Government's Housing Package has received criticism from the house building industry. Indeed industry participants commented that the measures, which contain no new money, are inadequate to tackle the scale of difficulties facing the house building industry following the credit crunch. Furthermore, the Government admitted that it may miss its 2011 target for affordable housing, despite the £1 billion rescue package.

*Private Housing*

As shown below, private housing output in GB is expected to decline by 13% and 5% in 2009 and 2010 respectively.

**Forecast Private Housing Output in Great Britain, 2009-2013 (£ Million at 2008 Prices and Completions)**

| Year | Output | % Change | Completions | % Change |
|---|---|---|---|---|
| 2009 | 15 012 | -13% | 126 092 | -14% |
| 2010 | 14 262 | -5% | 120 796 | -4% |
| 2011 | 14 647 | +3% | 123 357 | +2% |
| 2012 | 15 188 | +4% | 127 181 | +3% |

| | | | | |
|---|---|---|---|---|
| 2013 | 15 978 | +5% | 133 285 | +5% |

*SOURCE: MBD forecasts*

This is a reflection of the current economic climate and the difficult housing market conditions combined with reduced mortgage availability. However, output in the sector is expected to increase between 2011 and 2013, with annual growth levels anticipated to fluctuate between 3% and 5% in real terms. Anticipated growth in the medium term is expected to be driven by the continued housing shortage and rising population. However, as the future return to growth is strongly dependent on the economic recovery and upturn in the housing market, there is a high degree of uncertainty concerning the timing and level of output growth in the sector.

*Public Housing*

Social housing is also expected to be affected by the current economic climate, with the level of social housing built by private developers falling. However, on a more positive note, social housing should be positively affected by the building of the Olympic village which is projected to result in the construction of 3600 new social homes.

Furthermore, over the forecast period as a whole, construction activity in public housing is projected to be stimulated by continued investment by the Government in the provision of social housing. As highlighted by the Barker Review, the social housing supply needs to be increased if the Government is to cope with increased levels of demand.

**Forecast Public Housing Output in Great Britain, 2009-2013, (£ Million at 2008 Prices and Completions)**

| Year | Output | % Change | Completions | % Change |
|---|---|---|---|---|
| 2009 | 4 293 | +3% | 29 239 | +4% |
| 2010 | 4 579 | +7% | 31 578 | +8% |
| 2011 | 4 982 | +9% | 34 735 | +10% |
| 2012 | 5 530 | +11% | 38 313 | +10% |
| 2013 | 5 807 | +5% | 40 535 | +6% |

*SOURCE: MBD forecasts*

3.3.3.2Private Commercial Sector

**Forecast Private Commercial Construction Output in Great Britain, 2009-2013, (£ Million at 2008 Prices)**

| Year | Output | % Change |
|---|---|---|
| 2009 | 21 933 | -10% |
| 2010 | 20 618 | -6% |
| 2011 | 20 954 | +2% |
| 2012 | 21 551 | +3% |
| 2013 | 22 338 | +4% |

*SOURCE: MBD forecasts*

- Private commercial construction output is expected to decline by 10% and 6% in real terms in 2009 and 2010 respectively. This is largely a reflection of the economic downturn, which has a particularly negative impact on the offices, shops and entertainment sectors. Furthermore, the financial crisis is also anticipated to have a negative effect on PFI projects, as banks are more reluctant to underwrite projects and provide funding. Private construction output is expected to increase gradually between 2011 and 2013. However there is a degree of uncertainty concerning this forecast, as the timing of the return to growth in the private commercial sector is somewhat dependent on an economic recovery.

- A key trend in the private commercial construction market is the move towards developing sustainable buildings. By 2019, office buildings and shopping centres will have to be built to zero-carbon standards. Trade sources suggest that this new regulation will add 10% to the typical costs of a development.

3.3.3.3 Private Industrial Sector

**Forecast Private Industrial Construction Output in Great Britain, 2009-2013, (£ Million at 2008 Prices)**

| Year | Output | % Change |
|---|---|---|
| 2009 | 3 902 | -11% |
| 2010 | 3 704 | -3% |
| 2011 | 3 757 | -1% |
| 2012 | 3 755 | -3% |
| 2013 | 3 842 | neg |

*SOURCE: MBD forecasts*

Private industrial construction output is projected to decline during the majority of the five year forecast period ending 2013. The economic downturn, and the tighter lending criteria imposed by banks, is expected to exert a strong downward pressure on business investment levels. Furthermore, warehouse output has increased significantly in the five

years to 2008 to the extent that the market is now characterised by oversupply. Combined with the current economic downturn this is expected to result in reduced demand for warehouses and distribution centres over the next five years.

3.3.3.4 Public Non-Residential Sector

**Forecast Public Non-residential Construction Output in Great Britain, 2009-2013, (£ Million at 2008 Prices)**

| Year | Output | % Change |
|---|---|---|
| 2009 | 12 029 | +3% |
| 2010 | 12 543 | +4% |
| 2011 | 12 817 | +2% |
| 2012 | 13 203 | +3% |
| 2013 | 13 539 | +3% |

*SOURCE: MBD forecasts*

Public non-residential construction output is projected to increase throughout the five year forecast period up to 2013, with annual growth levels fluctuating between 2% and 3% in real terms. Overall, output in the sector is anticipated to increase by a cumulative 16% in real terms between 2008 and 2013. Although construction projects in the sector are likely to be affected by the current economic climate and the credit crunch will affect the funding of projects, a downturn is expected to be avoided. This is due to the Government remaining committed to increased investment in a number of sectors, most notably education and health. Furthermore, the Government announced in October 2008 that it will fast-track construction projects by bringing further funds from future budgets, in order to provide a stimulus to the economy. However some industry analysts have warned that projects may not get off the ground any quicker, due to complex planning applications, the lengthy tendering and audit process required for big public sector projects.

# 4. PRODUCT OPPORTUNITIES AND MARKET DEMAND

## 4.1 Market Demand

4.1.1 As part of the scoping study, we consulted with a number of contractors, building and purchasers of building products, in addition to a wide range of industry bodies and associations. All of the consultees confirmed that they had a growing demand for sustainable products, to help them meet the tightening regulations, higher levels of the Code, and achieve improved energy efficiency ratings.

4.1.2 To date, the main area driving demand has been in public/government funded projects. However, as the Code for Sustainable Homes becomes more and more embedded into Building Regulations and the EPCs start to influence the market value of properties, it is anticipated that the demand for sustainable building products will increase across all sectors of the construction industry. Indeed, consultees reported that energy conservation and the specified use of sustainable products is increasingly part of their clients' project briefs.

4.1.3 Most large scale contractors and builders already have, or are developing, policies and procurement procedures for the sourcing of sustainable products, although some are more informal around the design specifications requiring products with a BREEAM Rating. These sourcing policies are mostly created by choice but, for those developers undertaking public-sector construction projects, there is clear pressure from public sector clients to introduce sustainable purchasing policies. Many are now monitoring sustainability and have set internal targets and identified Key Performance Indicators (KPIs).

4.1.4 Consultees reported that, whilst products and technologies are available to meet some of the sustainability targets, they are not always available in the volumes required. Additionally, whilst sustainable products are available, there are opportunities to develop new products offering improvements over the existing offerings, whether in terms of cost, technical capabilities or availability. Section 4.2 considers the product opportunities, and highlights the considerable opportunities for products suitable for the retrofit market.

4.1.5 Consultees also felt that there is a need to raise awareness and understanding of the products available. This situation is improving with Schemes such as the BREEAM Rating and organisations such as Natural Step, but there is still a need for greater promotion of the supply chain.

4.1.6 When considering a potential supplier of sustainable building products, the key factors taken into account were cited as:

- having manufacturing and process quality control systems in place;

- having appropriate certification for the products, including third party assessment of the product's technical suitability for the intended use and of its 'sustainability'

criteria. Section 4.3 explains the BREEAM rating, Natural Step and other assessment schemes.

- ability of the supplier to meet the volume requirements, including the anticipated increase in demand for 'sustainable' building products;

- evidence of the suppliers financial stability and ability to maintain a solid presence in the market; and

- the provision of technical support, where necessary.

4.1.7 The consultees all anticipated that the market for sustainable building products would continue to accelerate, forced by government sustainability targets and potential world material shortages.

Over the short term it is anticipated that the market demand will initially focus on envelope materials, such as concrete block with increasing recycled content, sustainable renders, and low (to zero) ozone depleting insulation.

## 4.2 Product Opportunities

4.2.1 Based on the primary consultations, it would appear that products are already available which enable developers and builders to construct to the Passiv Haus standard (sustainable code level 4).

However, that is not say that there are not opportunities to improve upon these products, whether in terms of cost, effectiveness or availability of supply. Indeed, some consultees commented that the products were not always available locally on an adequate scale and that they had to be imported from mainland Europe. If available, they would prefer to source from within the British Isles.

4.2.2 There are fewer product options available for manufacture to the Code levels above Level 4, and this is an area of research and development - to find building products (in addition to renewable energy technologies) which will enable builders to reach Code Levels 5 and 6.

As sustainable building becomes more and more mainstream, and higher levels of the Code become engrained into Building Regulations, there will be a growing need for:

- Sustainable products which will enable builders to meet ***the higher levels of the Code***;
- At a ***cost*** which is attractive and non-prohibitive;
- In the ***volumes*** appropriate to a mainstream market; and
- From suppliers operating ***sustainable production policies***.

4.2.2 Therefore, the main growth opportunities are for:

- products which help builders achieve Code Level 4 (which will be the minimum building standard in the UK in 2013), in adequate volumes;

- products which help builders achieve Code Level 4, and which offer an improvement over the products currently available on the market (either in terms of availability of supply, effectiveness or cost);

- products which will help builders achieve Code Levels 5 and 6; and

- products attractive and suitable for retrofit and refurbishment, and which will help to achieve Code Levels 4 and above.

4.2.3 The following sub-sections consider:

- how the sustainability agenda is driving opportunities for off-site MMC;

- the under-exploited opportunity for retro-fit products to improve energy efficiency and emissions; and

- product areas within which there are specific market opportunities.

4.2.4 ***New Build – Prefabricated***

As the standards for sustainable construction rise and become more mainstream, there may be a continued move away from traditional on-site construction methods.

Consultees felt that it was more difficult to meet the sustainability standards through the traditional methods of on-site building, and so ***modern methods of construction*** ("MMC"), where all or part of a building is manufactured off-site in a factory, are increasingly seen as the way forward for the construction sector and particularly in meeting the sustainability agenda.

***Pre-fabricated timber frame*** and POD housing are emerging as the more popular options for complying with the standards, and also offer cost advantages in terms of speed of construction.

The following is an example of some different companies, cited as examples of companies developing construction techniques to meet the sustainability agenda:

***Mantle Panel Ltd*** www.mantlepanel.com

Mantle Panel Ltd is a company manufacturing green building systems consisting of wall and roofs with thermal shells boasting 0.10uValues. Mantel Panel claims that its system enables developers to achieve the highest Code for Sustainable Homes targets.

The Mantle Building System is an engineered hybrid between a Stressed Skin Panel (SSP's) and a Structural Insulated Panel (SIP's), fused as composite technologies to create a new frameless building panel.

**Weberhaus** (weberhaus.co.uk)

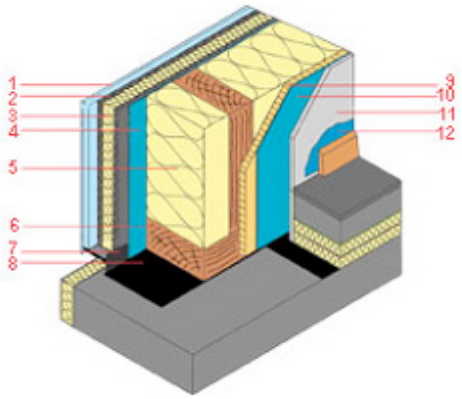
Weberhaus, based in Germany, is a manufacturer of pre-fabricated timber frame houses for the self build housing sector, but with a particular emphasis and specialism in sustainable environmentally friendly housing. The company supplies throughout Europe, including the UK and Ireland. The houses are manufactured in Germany and transported by truck to the site. The company uses a timber-frame structure with triple-glazed windows already inserted and sealed, and incorporating a number of smart energy options, including solar collectors for hot water generation and photovoltaic sensors generate electricity.

Weberhaus invests in ongoing research and development to identify innovative techniques and products which will improve the energy efficiency, sustainability and 'environmental' credentials of its houses.

Indeed, its range of standard designs includes the "Oevolution" range which is aimed at integrating homes into the cycles of nature. The Oevolution range includes the following technologies developed to optimise the efficiency and sustainability rating of the houses:

- Photovoltaic components generate electricity from sun energy and reduce consumption of supplier network power.
- Intelligent building technology ensures that all house functions such as heating, ventilation, blinds etc. can be controlled centrally.
- Solar collectors collect the energy provided by the sun and charge the water tanks for water supply and heating support, saving the energy for heating and hot water.
- Optimised thermal insulation of the wood frame structure reduces the heat conduction effect.
- Free rainwater can be used for toilet flushing, the washing machine or garden irrigation by means of a rainwater system.
- Seasonal storage system: Through the heat exchanger sun energy is conducted into a long term storage unit (a large water tank). It stores energy in summer to be available for use in winter.
- Controlled ventilation: WeberHaus buildings can be equipped with an automated ventilation system that employs the thermal energy in used air to heat the fresh air conducted into rooms.
- Passive use of solar energy: the windows facing south support a high yield rate in passive solar use, thereby reducing the need for heating system output.

In addition, the energy-saving wall "Ovolution" and Ovonature was developed by WeberHaus to encase the house and provide a perfect room climate, as well as minimised energy consumption:




1. Joint-free facing plaster
2. Joint-free cement mortar plaster
3. Acoustic and thermal insulating cement-bound plaster carrier
4. Steam diffusion-permeable foil
5. Mineral full thermal insulation
6. Solid wood half-timber construction
7. Aluminum profile
8. Moisture barrier
9. Wood panel
10. Steam diffusion barrier
11. Plaster panel
12. Wall covering

Finally, Weberhaus has designed and manufactures the 'Weberhaus Plus Energie' house which uses geothermal heating, photovoltaics and other unique building components to build a house that 'produces more energy than it consumes'.

***Eco Pod by EcoHab*** (ecohab.co.uk)

EcoHab, Manchester, designs and manufactures dome-shaped pods, as an energy efficient housing option.

As its name suggests EcoHab's aim is to provide a house that addresses issues of energy consumption and $CO_2$ emissions. The houses are small dome-shaped pods, using a wood-burning stove that also heats the water in a copper cylinder and provides underfloor heating. When rainwater pours down on the pod, it is harvested at a rate of about five litres per millimetre of rain. Only high-efficiency appliances and low-energy lighting are

used in the pods, and higher-end versions have solar panels and a wind turbine connected to four 12-volt batteries to provide electricity.

However, given their nature, appearance and size, the Ecopods are quite a niche market.

### 4.2.5 *Refurbishment and Refit*

It is anticipated that, by 2016, 70% of housing stock will be from current/existing buildings. Therefore, if Government is to meet its energy and $CO_2$emissions targets, it is essential that the existing housing stock can be refurbished economically to meet higher energy efficiency and sustainability standards. Indeed, given the levels of emissions and energy consumed by existing buildings, improvements to the existing housing stock will have a greater impact on sustainability targets than a focus on new construction, important though that is.

However, the development of targets, legislation, and products specific to improving the energy efficiency and emissions from existing buildings are much less advanced than for new buildings. Building regulations, although now requiring upgrading to new build standards, are still largely written for new build construction rather than upgrading contemporary construction.

To date, the main barriers to the development of the refit market have been:

- There has not been any binding legislation requiring owners of existing homes and buildings to undertake significant refurbishment to improve the 'sustainability' of their building;
- The costs of undertaking the refurbishment have been prohibitive; and
- The potential disruption necessary with the available refit options has been too significant.

Nevertheless, the following combination of events will drive growing demand for refit solutions to improve the energy efficiency of existing buildings:

- increasing fuel costs driving home and building owners to look for improvements which will increase their energy efficiency;

- the tightening housing market and recession will lead more people who may otherwise have been considering moving house to look to home improvements;

- the introduction of Energy Performance Certificates, and their potential link with the market value and saleability of a house, will encourage home owners to invest in refit improvements; and

- tightening legislation, which is expected to look more and more at existing building stock.

Given these conditions, the market for retrofit and refurbishment solutions is considerable but has, as yet, been largely unexploited. The challenge for the refurbishment/refit sector is to develop products which are not only effective, but are also priced at a level appropriate to a refurbishment project and which can be practically retrofitted without undue disruption.

The Energy Saving Trust is running a CPD event for the RSUA on 11th March 2009 on 'Energy Efficient Refurbishment'. If this topic can be developed into technical guidance, aligned with trade information on locally available products, then the market is considerable.

### 4.2.6 *Construction Product Groups with Potential Product Development Opportunity*

#### 4.2.6.1 Insulation

There are insulation products available with the technical capability to achieve the U-values necessary to satisfy Code level 6. However, these products are not necessarily cost effective or as practical as needed.

There is opportunity for new lower cost high insulation products, suitable for certification, with low or zero ozone depletion, and that can be produced in the volumes needed for large construction projects.

There is also scope for new insulation products suitable for the refurbishment/retrofit of existing buildings. In particular, external render-based insulation products offering improvements over the current products would be of great interest to the market.

Within the retrofit market there are also concerns around dry lining, due to the risk of moisture ingress in older buildings. As a result, in countries such as Germany there has been a move away from dry lining, and so there is an opportunity in the retrofit of older buildings for products with the ability to breathe and "sweat" moisture.

#### 4.2.6.2 High performance windows

According to the consultees, high performance low energy triple glazed argon filled windows are not available within the UK in sufficient volumes, and so they are largely imported from Denmark and Sweden. Contractors and builders would prefer to source locally, if a supplier emerged capable of producing suitable products in the volumes required.

4.2.6.3 Cladding Products

Consultees anticipate that there will be a growing opportunity for high performance exterior cladding products suitable for timber frame houses.

Consultees suggested that these high performance cladding sheets could be made from a cement particle or calcium silicate board, and noted that they would have to be: moisture and weather proof, fireproof, vermin proof, absolutely flat on the interior and exterior surfaces, provide a high degree of uniformity in thickness, certified to ± 1mm on the diagonal, and should not transmit heat.

The cladding sheets could also be fireboards, eliminating the need for the firebreaks that are currently required between adjacent timber buildings. It would also be an advantage if the board did not create a respiratory dust problem during cutting.

4.2.6.4 Air tightness Products

Air tightness is currently best achieved by constructors of buildings prefabricated in off-site factories.

There is an opportunity for products or processes to improve the air tightness of on-site constructions. Appropriate tapes and membranes are not widely available for ensuring air tightness in on-site constructions. The on-site workforce is also perceived to lack the skills necessary to ensure air tightness, especially at interfaces between different materials or components such as windows, doors and roof.

In the retro-fit market, systems for improving air tightness in existing buildings, or for improving air tightness as a result of fitting new components such as doors or windows, do not appear to be defined. This is also perceived to be a gap in the market,

There are inherent health and safety implications associated with improving air tightness. In particular, pockets of stagnant air (where there is an insufficient rate of air change) will increase the potential for damp and mould /mildew and “sick building syndrome”. These risks need to be taken into consideration in any new product developments.

4.2.6.5 Ventilation (passive and mechanical,) especially with heat recovery

Ventilation is a requirement to offset the negative effects of air tightness. When a building becomes air tight, a ventilation system is required to ensure an appropriate number of air changes in order to maintain adequate indoor air quality.

Ventilation is generally achieved through mechanical ventilation. Whilst mechanical ventilation itself consumes energy, on the whole it is still more energy efficient to have an air tight building with mechanical ventilation that to have uncontrolled draughts.

In theory the efficiency of mechanical ventilation systems is improved through heat recovery i.e. heat is recovered from the exhaust air and transferred to the incoming fresh

air. Consultees felt that there was considerable scope for product improvement in this area.

As an alternative, passive ventilation systems are also theoretically a possibility, as systems that would not have any energy consumption. Passive ventilation systems are not commonly available. It is unclear if heat recovery is possible with passive ventilation, and there are concerns that, if a building contains more than 2.4 people, there is a real risk of the system becoming unable to provide adequate ventilation to prevent moisture build-up and condensation. As passive ventilation represents a lower capital outlay, there may be an opportunity for a passive system which can demonstrate that it is as energy efficient as mechanical ventilation and which overcomes the risk of condensation.

Again, there are growing opportunities for ventilation products suitable for cost effective retro-fitting.

Similar to air tightness, ventilation systems also have specific health and safety considerations. In the event of a fire, ventilation could speed the rate at which fire will spread and also spread smoke and fumes throughout the building. Therefore, any ventilation systems should be designed to detect fire and shut down. Similarly, in the event of a power cut or if the mechanical ventilation system shut down, there is a risk of asphyxiation in buildings which rely on such systems to provide the adequate air changes. In such an event these systems should have a fail-safe mechanism which allows a minimum amount of air change to always be maintained i.e. open all dampers for external air (the reverse of the case for a fire) Consultees were not certain that the systems currently available make allowance for these health and safety concerns.

4.2.6.6 Thermal bridging elimination

Thermal bridging is created when there is an element which conducts heat from the internal face of a wall to the external face – thereby losing energy and reducing the insulation of the building.

Thermal bridging tends to occur at lintels over doors and windows, at wall plate level where walls meet roofs, and at floor level where concrete floors meet walls without insulation. To a lesser extent wall ties also contribute to thermal bridging, although carbon fibre wall ties are available which can prevent this problem.

The elimination of thermal bridging can generally be dealt with at the design stage of a new building, although there are always opportunities for new products which could improve this issue. However, the main market opportunity is in the retrofit market – to find products and solutions capable of eliminating thermal bridging in existing buildings whilst minimising the invasion to the current structure.

4.2.6.7 Controls and metering

New generation control systems, facilitated by products such as smart meters etc, allow whole building management and optimise the control of processes and equipment in the building – with the possibility of remote programming using the internet.

These systems have a direct impact on the building owner's ability to manage energy consumption in the building, and the consultees felt that there would be growing opportunities for similar solutions.

In the case of retrofit, there will be an obvious advantage if these systems can connect and communicate wirelessly to the equipment they control and if existing equipment can be adapted to communicate with such wireless control.

4.2.6.8 Skills and Education

Consultees felt that the industry needed support in reskilling, training and education, to understand the expectations and standards required by the sustainability agenda and the meaning of sustainability.

## 4.3 Product Assessments and Certifications

4.3.1 In terms of technical standards and certifications, the two main technical standards for the construction products would appear to be:

British Standards

There is a suite of BSI British Standards for Construction products (www.bsigroup.com/constructionstandards). However, BSI is reviewing its standards, with a view that they should extend beyond purely technical issues, leading to a new generation of standards reflecting new demand for smart sustainable construction.

In September 2008, BSI issued a report on some of its proposals to develop the next generation of construction standards. One of the recommendations was to encourage Government to instigate a standard for whole life-cycle costing, embedding sustainability into construction activity.

CE Mark

The Construction Products Directive 89/106/EEC (CPD) is one of the 'New Approach' Directives (European Community laws) to create a single European market by removing technical barriers to trade between Member States.

Products meeting the essential requirements of the relevant Directive(s) are eligible for 'CE marking' and may be placed on the market anywhere within the EU. Under the Construction Products Directive the route to CE marking is by complying with the relevant technical specifications. The Construction Products Directive has been implemented in the United Kingdom law by the Construction Products Regulations 1991, as amended by the Construction Products (Amendment) Regulations 1994.

However, the European commission is planning to strengthen the construction market by replacing the Construction Products Directive ("CPD") with a new piece of regulation. It is anticipated that this new piece of legislation will not only make the CE mark mandatory but will also introduce a new indicator on the sustainable use of natural resources, making sustainability of products part of the CE marking assessment.

4.3.2 In addition to these more technical standards, there are also a number of assessment schemes available to assess and measure the carbon foot print and sustainability of products:

PAS 2050

PAS 2050 is a Publicly Available Specification for assessing the carbon footprint of products across their life cycle. It has been prepared by BSI British Standards, co-sponsored by the Carbon Trust and DEFRA, and it is an independent standard.

BREEAM

Building Research Establishment ("BRE") Environmental Assessment Method ("BREEAM") is a voluntary measurement rating of the environmental performance of buildings and building materials. It was established in the UK by BRE, and applies to non-domestic buildings.

There are different BREEAM approaches to the different stages of the construction process, whether the manufacture of building materials, through design stage, during construction and post construction, and for different scales of construction activity.

For example:

- 'BREEAM Buildings' assesses the operational and embodied environmental impacts of individual buildings.
- 'BREEAM Specification' and 'BREEAM LCA' look at the environmental impacts and life cycle analysis of construction materials.
- 'BREEAM Communities' is a certification scheme for the planning stage of the development control process;
- 'GreenPrint' process can be used for larger development sites like new settlements, towns and communities;
- 'BREEAM Smartewaste' is concerned with the construction pahse.

The methods and tools also cover different scales of construction. The BREEAM family of assessment methods and tools are all designed to help construction professionals understand and mitigate the environmental impacts of the developments they design and build.

The Code for Sustainable Homes

The Code for Sustainable Homes has set a framework for rating houses on a scale of 1-6, according to their energy and water efficiency, sustainability features and carbon emissions. Section 2.7.5 explains the Code in more detail.

4.3.3 In addition, companies can apply for ISO 14001 Environmental Management System Certification. This scheme provides ongoing independent, third party assessment and certification of environmental management systems. The assessment activities are conducted in two parts (Stage 1 and Stage 2), and are based on the requirements of International Standard BS EN ISO 14001:2004 Environmental Management Systems - Specification with guidance for use.

4.3.4 BRE has also launched a new framework standard for the responsible sourcing of construction products - BRE Environmental and Sustainability Standard (BES) 6001:2008.

The standard sets out requirements under 3 main headings:

- Organisational management
- Supply chain management
- Environmental and social issues.
-

To meet this Standard, organisations must satisfy certain compulsory elements. In addition, there are higher levels of compliance that can result in a higher performance rating being awarded. This Standard will also provide a route to obtaining credits under the BREEAM family of certification schemes.

http://www.greenbooklive.com/page.jsp?id=153

4.3.4 Finally, Green Book Live is a free online database developed by BRE and designed to help specifiers and end users identify products and services that can help to reduce their impact on the environment. A wide range of products and services, from commercial building products and services to domestic energy efficiency products can be found within Green Book Live.

www.greenbooklive.com

## 4.4 University of Ulster and Queens University Belfast – Research Programmes

4.4.1 Both the University of Ulster and Queens University Belfast have specific departments and institutes looking at sustainable building products and innovations. As part of the scoping study, consultations were completed with the relevant staff in each institute, to gather an understanding of the activities of the respective universities and current research projects underway.

4.4.2 ***The Built Environment Research Institute, University of Ulster (http://www.cst.ulster.ac.uk/)***
***Professor Neil Hewitt***

The Built Environment Research Institute, University of Ulster, prides itself on the strength and diversity of research activities within the built environment disciplines. In the RAE 2001, the Built Environment Unit of Assessment was awarded a grade of 5 placing the University of Ulster amongst the leading UK universities. #

Since then there has been significant investment in new laboratory and infrastructure facilities to resource fundamental and applied research. The Built Environment Research Institute (BERI) currently has over 50 academic staff including both core and associate members, supported by full time contract researchers and over 70 PhD students.

BERI provides a major research entity spanning across the Built Environment with expertise ranging from fire engineering research, hydrogen safety to sustainable technologies to property performance analysis. BERI is concerned with the delivery of research that will enhance the quality of the built environment and address the changing needs of society in a more sustainable manner.

<u>Centre For Sustainable Technologies</u>

The Centre for Sustainable Technologies ("CST"), within the Built Environment Research Institute, undertakes multidisciplinary research into sustainable renewable energy, building design, construction materials, transport and environmental modification technologies.

Professor Neil J Hewitt is the director of CST, which incorporates aspects of the Northern Ireland Centre for Energy Research and Technology (NICERT), the River Hydraulics and Hydropower group, the Highway Engineering Research Group (HERG) and Construction.

Specific areas of expertise within CST are:

| Area of Expertise | Expertise |
|---|---|
| **Architecture** | Innovative building design incorporating the latest thinking regarding sustainability. |
| **Building Energy Efficiency** | Development of energy efficient building components e.g. advanced glazing, insulation and energy efficient building systems with high temperature heat pumps and thermal energy storage. |
| **Clean Combustion of Fuels** | Utilisation of the process simulator "ECLIPSE" developed by the University of Ulster to perform techno-economic evaluations of new power generation systems. |
| **Construction** | Advanced procurement methods for the modern built environment |
| **Highway Engineering** | Testing of aggregates for sustainable road construction. |
| **Renewable Energy** | Development of biomass and bioenergy systems including gasification and bio-oil concepts. Development of solar thermal and solar PV systems and concentration technologies. |
| **River Hydraulics** | Evolving methodologies for the accurate predication of discharge capacity and flood depths in rivers during overbank flows. |

Current Research Capability for the Development of Sustainable Building Products

The current areas of research into sustainable building products are:

- Vacuum panel for improved U values;
- Vacuum panels used in glazing systems;
- Phase change materials (PCM) in wall boards;
- Multifoil insulation;
- Structurally insulated panels (SIP);
- Breathable membranes; and
- Development of fire resistant products and systems

The CST is also capable of performing the following tests on building products:

- Insulation U value – using either guarded hotbox or hotplate test systems;
- Thermal Comfort – using an "intelligent" thermal comfort mannequin which can be used in situ for the collection of data relating to thermal comfort. The mannequin is portable and capable of being used in any environment.
- Fire research – Combustion testing and emissions assessment
  Monitoring of materials failure under heating
  Monitoring of Structural failure under heat
- Stress Failure analysis e.g. steel beams
- Timber Research – Research on profiling timber that can be sourced locally and for properties such as effective cutting, structural strength etc.

4.4.3 ***Centre for the Built Environment, QUB (http://space.qub.ac.uk/cber/default.aspx) Professor Muhammed Basheer,***

The Centre for Built Environment Research ("CBER") is one of the three research centres in the School of Planning, Architecture and Civil Engineering. It integrates activities of two research groups from the Schools of Civil Engineering and Architecture, which existed prior to September 2005, viz. the **S**tructures and Materials Research Team (SMART) and the Architecture Technology and Design Group.

The Structures and Materials Research Team (SMART) is one of the long established groups in the School, and has achieved the top research rating in the UK Research Assessment Exercise in 2001. With the amalgamation of this group and the Architecture Technology and Design group, the Centre for Built Environment Research combines architecture concepts and design, material technology and structural engineering.

Commercial Developments

The CBER currently has four patents, 2 spin out companies and 5 Knowledge Transfer Partnerships (KTPs):

- One patent is on a design and manufacturing technique for a flexible concrete arch. The other 3 patents are on instruments that have been developed for the non-destructive testing (NDT) of concretes.

- The two spin out companies are developing and comercialising the NDT ("non destructive testing") sensor products. The names of the two companies are;
  Amphora LTD – formed in 2002; and
  Sengenia LTD – formed in 2007.

- The KTPs are based on the technology for:
  - self compacting concrete;
  - Light weight normal and self compacting concrete;
  - Incorporating waste in to concrete to form low density products.

International Relationships/ Development

The CBER is also actively involved in the development of International Centres for Construction Research - the first will be for UK/China, based in Beijing; the second will be for UK/India; and the third for UK/UAE. Professor Basheer's vision is that CBER will be the UK hub linking all of the international centres.

## 4.5 UK Sustainable Products – Materials Report

4.5.1 The Waste Strategy for England 2007 included a commitment to *"Establishing a **new products and materials unit within Defra** to identify and catalyse actions across the supply chain, to improve the environmental performance of products across their life cycle; with a **progress report on delivery** in Spring 2008."*

The Unit was established, to bring together work on: product lifecycle assessment; product information; and evidence on sustainable consumption, production and waste. It is also responsible for Defra's work on efficiency standards for energy using products.

The progress report ("UK Sustainable Products – Materials Report") was launched in July 2008. Appendix IV summarises the key findings, conclusions and recommendations, which included a recommendation for interventions to:

- drive the development of new more sustainable products (i.e. support for innovation and new product development);
- 'cut out' the least sustainable products (e.g. set minimum product standards); and
- encourage the market to adopt the most sustainable products available (e.g. pricing support; procurement policies; promotion).

The report specifically considered the building sector and set an overall vision for the UK building sector as one in which:

- all construction and architecture is sustainable, and opportunities for waste reduction and recovery are identified from early design stage;
- construction products are chosen on the basis of their environmental impact, as well as effectiveness;
- all new homes are zero carbon;
- all new and refurbished properties have passive and active solar heating and ventilation/heat recovery systems, and maximise use of natural light;
- all new buildings have smart meters for more responsible water and energy usage; and
- water re-use systems are standard.

Clearly, on the basis of this vision, the future for the building products market is in developing effective and commercially viable products which will satisfy the standards and criteria of the sustainability agenda

## 4.6 The Passive House

4.6.1 Finally, in looking at the market opportunities, this section considers a review conducted by the European Commission which compares the common building practices across a number of member states with the standards required in a Passive House (Sustainable Code Level 4).

4.6.2 The general definition of a Passive House is: a house or building with limited heating energy demand of around 15 kWh/m2 treated floor area for heating and around 120 kWhprimary/m2 treated floor area for space heating, domestic hot water ("DHW") and all other electrical equipment combined.

To meet this criterion, the Passive House concept focuses first and foremost on reducing the energy demand of the building, through high efficiency of energy use. The next priority lies with the use of passive (solar) techniques. After high efficiency has been obtained with all forms of energy use in the building, on-site renewable energy sources can be applied to meet the highly reduced energy demand of the building.

Appendix VIII details the key standards and measures for a Passive House.

4.6.3 ***Passive House Capability Across Europe***

Between 2005 and 2007, an EU research project was undertaken (Promotion of European Passive (PEP) Houses - www.europeanpassivehouses.org) which looked at the extent to which passive house solutions have been applied or could be applied in individual member states.

In summary, the study found that there was a high priority with regard to the performance of the thermal envelope, such as high insulation performance of walls, roofs, floors and windows/ doors, thermal bridge-free construction and air tightness. However, due to the required air tightness, special attention needed to be paid to indoor air quality through proper ventilation and efficient ((semi-)solar) heating systems for combined (low temperature) space and DHW heating still required a significant amount of attention.

Appendix VIII summarises the key findings of the research project, looking at the extent to which the Passive House concept is applied across member states in terms of:

- The thermal envelope and insulation (walls, roof, floors, windows and doors);
- Thermal bridges;
- Air tightness;
- Ventilation heat recovery;
- Insulation of ventilation ducts and domestic hot water pipes;

- Minimal space heating for comfortable indoor climate;
- Good indoor air quality through ventilation rate;
- Window glazing and solar orientation;
- Domestic hot water (solar) heating;
- Energy efficient appliances and lighting.

4.6.4 In summary, the study identified three categories of barriers to the realisation of Passive House standards. The barriers, and suggested approaches to dealing with the barriers, are listed below.

| **Barrier** | | **Possible Approach** |
|---|---|---|
| **Technical/ Construction** | Availability of Components ("**A**") | By temporarily importing components, this barrier can be overcome.<br><br>As demand increases it is expected that local availability will improve.<br><br>Another option would be to develop the component (together with proponent groups) for application in a specific project.<br><br>Experience in other countries can be utilised. |
| | Limited Know How ("**K**") | Inform and educate e.g. through materials containing specific (local) solutions and workshops. |
| | Occupant Behaviour ("**O**") | Inform and educate e.g. through an "Owner's Manual" with specific instructions as well as underlying concepts and behavioural effects, or periodic feedback on building performance during occupancy |
| | Construction Skills ("**C**") | Inform and educate e.g. through a practical manual with sufficient visuals illustrating the correct execution, as well as informing the relevance of the quality of work and its effect on performance.<br><br>Another method of education could be by providing hands-on (certification) training of labour |

| | | |
|---|---|---|
| **Market Related** | Financial ("**F**") | Provide accurate information on actual costs and (financial) benefits (including possible subsidy schemes, etc.) |
| | Unkown concept ("**U**") | Communicate and inform relevant parties (future occupants, developers, architects, etc.) regarding the Passive House concept and its benefits. |
| | Acceptance in Market ("**M**") | Communicate and inform relevant parties (future occupants, developers, architects, etc.) regarding the Passive House concept and its benefits.<br><br>Provide an objective comparison with current practice. |
| **Governmental** | Building Regulations ("**B**") | Involve regulators with Passive House developments.<br><br>Communicate benefits regarding the Passive House concept (e.g. CO2 reduction). |

*(Source: EU Promotion of European Passive Houses)*

4.6.5 The barriers identified for the UK and Ireland are summarised as follows:

| | UK | Ireland |
|---|---|---|
| **Technical/ construction barriers:** | - On site build quality and failure to check for continuous airtight barriers on plans are major problems. (C) (K)<br>- Lack of items such as wall ties and lintels to build traditional wall types to the higher performance levels. (A)<br>- Site practices and skills levels are also an issue. (C) (K)<br>- Filters of mechanical ventilation systems are mainly neglected by occupants, which can cause problems. (O)<br>- Adoption of new details is a barrier for large house builders. (C) (K)<br>- Calculation methodologies. (K)<br>- Availability of heating systems to meet lower heating demand. (A) | - Triple glazed windows and other passive house components are being imported (A)<br>- Limited know-how amongst planners, architects, builders and installers. (K) (C)<br>- Limited knowledge on thermal bridges and air-tightness (K) (C)<br>- Cavity brick wall, concrete block wall and timber frame wall are most commonly used construction systems. They have to be adapted to the passive house concept or different building systems adopted.<br>- Builders skill levels<br>- On site build quality of continuous airtight barrier |
| **Market related barriers:** | - Changing the traditional 'cavity-wall'. (M)<br>- Consumer aspirations - they expect central heating and want fireplaces. (M)<br>- Previous voluntary certification schemes have failed. (U) | - Lack of passive house information campaigns for future occupants, developers, planners, architects, builders. (U) (M)<br>- Lack of funding schemes. (F) |
| **Building regulations related barriers:** | - Existing standards. (B) | - Existing standards. (B)<br>- Calculation methodologies and certification schemes. (K) |

*Source: EU Promotion of European Passive Houses)*

# 5. ECO-TOWNS AND SUSTAINABLE DEVELOPMENTS

## 5.1 Eco-Building

5.1.1 Eco-building is about creating buildings which are comfortable and easy to live in, but with minimal impact on the environment. It often takes a mix of innovative technology and design to achieve this dual goal. The Kingspan Off-Site Lighthouse, for example, was built especially for a 2007 exhibition. It showcased features such as a 'wind catcher' to provide ventilation, photovoltaic cells to harvest the power of sunlight and a system to recycle 'greywater' such as the water used in washing up.

All eco-homes are designed to deal with a series of key considerations:

- ***Energy efficiency***: eco-homes are much better insulated than conventional homes. Most generate a proportion of their own energy through such technologies such as solar photovoltaics, wind turbines, ground source heat pumps, and even micro-scale hydro-electric plants for those with a handy stream.

- ***Water efficiency***: A greywater system, which 'cleans' bath or shower water so that it can be used to flush the toilet, can cut household water use by as much as 30%.

- ***Surface water management***: Minimising run-off and harvesting rainwater.

- ***Site and household waste management***: waste should be kept to a minimum during building, and it should be as easy as possible for householders to separate waste for recycling and composting.

- ***Responsible sourcing of materials***: wherever possible, eco-homes should use materials that are locally sourced, sustainable or recycled.

- ***Situation***: eco-builders consider factors such as how a building sits in its landscape, its impact on the local ecology and even the ethical standards of suppliers.

5.1.2 There are financial reasons and incentives for choosing to build or buy an eco-home:

- At a time of rising energy bills, eco-homes do not just mean reduced $CO_2$ emissions, but they are also cheaper to run, something that will become more obvious to prospective buyers and tenants with the introduction of energy performance certificates.

- The eco-option is becoming less costly, as green construction methods become more commonplace and the lifetime savings of the building are taken into consideration.

- Eco-homes typically have a higher re-sale value.

5.1.3 But who decides whether a home is an eco-home? There are established schemes to measure buildings against a set of sustainability criteria:

- The Building Research Establishment's Environmental Assessment Method ("BREEAM") has been developed to measure the environmental impact of buildings, and the BREEAM EcoHomes scheme has become a widely accepted way to measure the eco-credentials of new, converted or renovated homes.

- The Code for Sustainable Homes.

The change in the market is now visible in the development of eco towns in the UK and the introduction of government schemes to encourage the development of more sustainable building products.

## 5.2 UK Eco Towns

5.2.1 The UK Government has plans to develop 5 eco-towns in the UK by 2010, increasing to 10 by 2020, in response to the need for more sustainable living, coupled with continued housing shortages.

These eco-towns will be:

- new settlements for 5,000 – 15,000 homes;
- 30%-50% of the homes will be affordable housing;
- zero carbon rated; and
- equipped with green space, schools, health services, medium scale retail centre, business and leisure services.

The standards set for the eco-towns include:

- zero carbon emissions from buildings within the development;

- more than 50% of trips originating from the eco-towns should be by foot, bicycle or public transport;

- the homes should achieve 'Building for Life Silver Standard' and Level 4 of the Code for Sustainable Homes as a minimum, with set standards for waste recycling, construction waste, composting, water efficiency, energy and CO2, pollution and ecology;

- sustainable drainage systems and exemplars in water efficiency;

- 40% of the area allocated to green space; and

- sustainable waste management and recycling systems.

5.2.2 The Government is currently reviewing application from 12 possible locations for the development of the eco-towns, with a view to selecting the successful locations by the beginning of 2009. Once a location has been selected, the developers of the towns will need to put their specific bids and proposals through the normal planning process and consult with the public on details.

The following is a list and profile of the shortlisted potential locations:

| Potential Eco-Town | Profile |
|---|---|
| Leeds City Region, West Yorkshire | Leads City Region authority is proposing to develop an urban eco-community of similar scale to an eco-town which would pilot eco-town standards. |
| Rossington, South Yorkshire<br><br>www.rossingtonecotown.co.uk/ | This proposed eco-town will comprise:<br><br>A target of 5000 new homes including affordable housing in a range of sizes and tenures. None of the homes will be built in the Green Belt or in the Flood Zone 3 (areas of land with a high probability of flooding) and all development will be built on the former colliery or other previously developed land. The new homes will be built in distinct and walkable neighbourhoods with community facilities, shops and services, health facilities, new schools and children's play areas.<br><br>Low carbon homes that will be built to the higher levels of the Code for Sustainable Homes. The homes and neighbourhoods will promote sustainable and healthy living for both existing and future generations.<br><br>A proportion of affordable housing (homes that are in a realistic price bracket for ownership and rental)<br><br>A new connection to junction 3 of the M18, creating a High Quality Bus Route with frequent services from Rossington to Doncaster Town Centre and Lakeside via White Rose Way.<br><br>A regeneration strategy for existing settlement of Rossington, including improvements to the local environment and green spaces, to the town centre and market place, to existing education facilities, and to help strengthen local shops and businesses.<br><br>A new public park to the south of Rossington, including sports facilities and areas for recreation, cycleways, bridleways and safe routes for walking.<br><br>A large and diverse range of new employment opportunities including jobs within education and local services, the retail sector, as well as a high number of new jobs within the construction industry.<br><br>An emphasis on the use of bicycles and creating safe, well-used cycleways throughout Rossington, as well as improving the existing public transport network.<br><br>Developed in consultation with the community for the community. |

| Potential Eco-Town | Profile |
|---|---|
| Pennbury, Leicestershire<br><br>www.ecotownforleicestershire.coop/default.html | This proposed eco-town will comprise:<br><br>15,000 new homes, of which 4,500 will be 'affordable' housing.<br><br>Excellent and integrated public transport and an emphasis on walking and cycling will also bring health benefits.<br><br>An education strategy including primary and secondary schools, with consideration given to integrating education and employment, to meet the eco-town's needs.<br><br>The land proposed for the eco-town is largely arable or grass farmland, inaccessible to the majority of the population. The town itself would only require around a third of the total landholding, allowing for 30% within the town to be open spaces.<br><br>A 'Great Park' for leisure and countryside uses.<br><br>Sustainable farming will continue on some of the land,<br><br>The potential for 14,000 jobs to be delivered on site and inward investment targeted to support the expansion of the region's priority employment sectors.<br><br>Through local procurement strategies, local businesses will be able to access new markets for innovation in sustainable construction and service provision. |

| Potential Eco-Town | Profile |
|---|---|
| Greater Norwich (Rackheath), Norfolk<br><br>www.rackheatheco-community.com | The government recently awarded Rackheath 'Grade A' status in terms of its sustainability as an eco-community – the only site to attract top rating.<br><br>The proposed Rackheath development will feature:<br><br>Approximately 5000 new and existing properties, of which 30% will be affordable.<br><br>Modern renewable energy production processes, so that the Rackheath Eco-Community will be self-supporting. Options include wind power, biomass boilers and ground source heat pumps.<br><br>The Eco-Community will be commited to efficient public transport links, providing frequent and user-friendly bus and rail services. The Rackheath scheme includes plans for a new railway station, offering residents a regular service to and from Norwich city centre - and beyond. There will also be significant provision for cycle paths and walkways.<br><br>Healthcare, shopping and education at the heart of the community, along with recreation facilities and green open spaces.<br><br>The Eco-Community will favour the use of locally-sourced goods and services. |

| Potential Eco-Town | Profile |
|---|---|
| Middle Quinton, Warwickshire and Worcestershire<br><br>www.middlequintonecotown.co.uk/ | This proposed eco-town will comprise:<br><br>6,000 new homes in a planned and phased development. The development would provide substantial employment incorporating a mix of live work units and employers and a mix of existing employment on site and the creation of new jobs.<br><br>Environmentally responsible material usage including reuse of materials and consideration of the life cycle environmental costs of materials.<br><br>Improved water use through water efficiency mechanisms and/or source substitution such as rainwater and stormwater harvesting.<br><br>Reduced production of greenhouse gases and use of fossil fuels, through efficiencies in energy usage; on site generation of energy through the use of renewable and non-polluting energy sources; and a reduction in energy demand through good design.<br><br>Comprehensive waste management procedures and practices to reduce the amount of waste to landfill and reuse on site where possible. To be the first UK Town to be powered by recycled materials.<br><br>An integrated transport scheme utilising rail and bus consistent with the needs of the future residents. Enhanced road, pedestrian and cycle links to key centres and nodes.<br><br>A tourist/leisure attraction to add to the existing offer within Stratford-upon-Avon and build upon A World Class Stratford-upon-Avon.<br><br>Promote lifelong learning for the existing and new community through the Eco-town, new visitor attraction and the creation of new schools and a college. |

| Potential Eco-Town | Profile |
|---|---|
| Weston Otmoor and Cherwell, Oxfordshire<br><br>www.westonotmoor.co.uk/ | This proposed eco-town will comprise:<br><br>15,000 dwellings and 15,000 jobs, and up to 3 secondary schools and 8 primary schools.<br><br>A network of footpaths and cycleways integrated with a web of greenways and blueways interconnecting all parts of the town as part of an extensive provision of green infrastructure.<br><br>A Sports Village for indoor and outdoor formal.<br><br>Its own, independent tram system which will provide connections around all parts of the town, and a 'High Street' running centrally north to south as the spine of the town, along which will be sited the vast majority of the shopping, leisure, cultural, community, civic and business buildings and activities.<br><br>A new railway station, as the primary point of daily arrival or departure from the town. |
| Marston Vale, Bedfordshire<br><br>www.marstonvale.com/ | This eco-town will comprise:<br><br>15,400 houses, of which c35% will be affordable.<br><br>High efficiency water appliances, along with community wind power and heating systems, geothermal power, and the use of biomass to produce the community's energy needs.<br><br>Schools and healthcare provision, and a range of leisure, arts and cultural facilities.<br><br>Formal as well as informal recreational spaces such as playing fields, leisure facilities and areas for relaxing and enjoying the outdoors.<br><br>A transport strategy:<br>•To minimise car use and journey length – e.g. 50% reduction in car trip rates<br>•To reduce pollution from transport – e.g. 50% reduction in CO2 emissions<br>•To encourage healthy living – e.g. 4 fold increase in walking and cycling<br><br>The settlement will also be water neutral, and will use locally appropriate solutions to generate energy for the eco-town. .<br>A waste minimisation strategy will provide local recycling schemes, Biodegradable waste will be reduced t through the use of home/community composting for garden waste. |
| **Potential Eco-Town** | **Profile** |

| | |
|---|---|
| NE Elsenham, Essex<br><br>www.elsenham-info.co.uk/ | This potential eco-town will comprise at least 5,000 dwellings.<br><br>Its strategic vision is :<br><br>• To grow Elsenham so as to create a distinct community that will function as a new market town within Uttlesford;<br>• To embrace and promote the highest standards of low carbon development and lifestyles;<br>• To respect landscape and ecology and the setting, character and identity of nearby Henham;<br>• To be clearly grounded in the character of traditional Essex country towns and villages; and<br>• To deliver sustainable mixed use development with a culture of walking and cycling supported by new and improved public transport. |
| Whitehill-Bordon, Hampshire<br><br>http://www.whitehillbordon.com/whitehill_bordon_opportun/bid-document.html | This proposed eco-town will have a population of c30,000 and will comprise:<br><br>5,500 new homes, 100% built to code 6 and 100% of existing homes to be retro-fitted, of which:<br>40% affordable<br>72% family homes<br><br>Up to 80 dwellings per hectare.<br><br>7,000 jobs.<br><br>40,000 - 80,000m2 business park.<br><br>Mixed use town centre with: 30,000m2 retail and leisure; 10,000m2 office space; Over 200 Ha new public open space.<br><br>Vastly improved public transport |

| Potential Eco-Town | Profile |
|---|---|
| Ford, West Sussex<br><br>www.fordairfieldecotown.co.uk/<br><br>www.fordenterprisehub.com/ | This proposed eco-town will comprise:<br><br>5,000 new homes, of which 2,000 will be affordable homes.<br><br>Approximately 4,000 jobs in knowledge based industries.<br><br>New facilities such as shops, health clinic, a new secondary school, and community and sports facilities, including green space.<br><br>A relocated railway station with bus. |
| St Austell (China Clay Community), Cornwall<br><br>http://www.claycountryvision.imerys.com/ | Depending upon densities, the master plan for this eco-town could deliver about 5,000 dwellings over a 20-year period. In addition to these uses there will also potentially be in excess of 300 hectares of open space available for a wide range of recreational uses.<br><br>• Sustainable future for the china clay industry in mid Cornwall .<br>• In excess of 700 hectares available for regeneration.<br>• Focus on job creation.<br>• Opportunities for business, leisure & housing.<br>• New and improved infrastructure eg transport, health, education etc.<br>• Partnership with key organizations.<br>• High level of sustainability. |

| Potential Eco-Town | Profile |
|---|---|
| Rushcliffe, Nottinghamshire<br><br>www.newtonecotown.com/index.php | This proposed eco-town will comprise:<br><br>6,000 houses, at an average 40 dwellings per hectare.<br><br>At least one third of homes would be affordable properties (rented and shared ownership).<br><br>New primary schools and significant investment in the existing Toot Hill Secondary School.<br><br>Investment in and protection of leisure facilities through redevelopment or creation of a new 'Community Sports Hub' and playing pitches within the development.<br><br>New health and community centre and land for the facility.<br><br>Walking and cycling links to the town centre and station and railway crossing point improvements.<br><br>Extension of the Robin Hood rail line service and upgrades to station facilities and parking arrangements. Bus service improvements, and road improvements to create a Town Gateway.<br><br>Car-free and low car zones, encouragement of car clubs. Street planning to discourage through-traffic.<br><br>Development of 'live-work' areas to encourage reduction in commuter trips.<br><br>A wide range of job opportunities through the provision of high quality employment sites, investment in infrastructure, other jobs in schools, healthcare and retail. |

### 5.2.3 Cloughjordan, Ireland

Ireland's first ecovillage is being created by a community of people committed to ecological, social and economic sustainability, including 130 dwellings along with shops, playgrounds and communal facilities.

There will be an equal area of community land for growing, and the same area again for shared amenity and woodland.

It is planned to cover a 67 acre development in Cloughjordan, including an extensive area for woodland and wildlife, allotments, three community buildings and a commercial area on Market Square focusing on ecological services, education and training.

After several years of planning, the infrastructure phase is now complete and the homes are expected to be constructed throughout 2009.

## 5.3 Case Study Examples

The following are examples of eco-developments in the UK and Europe, which demonstrate some of the principles sought for eco-towns:

**Freiburg, Germany**

The Vauban development has been built on the site of a former barracks, and has dormitory rooms for around 600 students alongside the houses and apartments. It has been designed to be a child and family friendly neighbourhood, and 20% of residents are under ten. It is also a "district of short distances", with shops, schools, parks and businesses all easily accessible, and 600 jobs are within walking or cycling distance.

Almost half of the homes are car-free, encouraged by good public transport and a car sharing scheme. They are all low energy homes, relying on large numbers of solar panels. Many homes actually produce more energy than they use. Home owners have also benefited from energy saving tips and DIY sessions run by the developer.

Residents helped to design the streets and public spaces, and there are barbeque and sunbathing areas alongside more traditional playgrounds and parks. The overall costs have been kept low, helping many low income families to become homeowners for the first time.

**Upton, Northampton, UK**

This site was originally ear-marked for traditional development, reliant on cars, but the plans were completely transformed to create a sustainable community. Several different architects and builders have been involved, so buildings range from traditional arts and crafts style houses to modern towers with pyramid roofs.

### Scharnhauser Park, Ostfildern, Germany

This former US airbase has been transformed beyond recognition. The housing ranges from one-bedrooms for professionals to larger family homes, as well as homes suitable for the elderly. All the homes have been built to low energy standards, and any extra heating or hot water comes from a district heating system run on wood chips. The whole community benefits from a highly efficient drainage system.

A community development programme is running a variety of clubs, events and interest groups. The local shopping centre attracts people from across the region, helped by the light rail service. The streets and public spaces have received as much attention as the housing, and the promenades in particular are very popular with local residents.

### Tubingen, Germany

Tubingen in Germany is designed to be a model of sustainable development. By 2015, they expect to have homes for 6500 people and 200 new jobs. Homes, businesses and services are built close together, which cuts down on travel time and allows for plenty of green space for recreation. There is a strong sense of community, with high levels of interaction between generations and social groups. Residents are actively involved in their neighbourhood, and much of the public spaces and green areas have been designed in a co-operative process

### Great Bow Yard, Langport, UK

Great Bow Yard, a development in Langport in Somerset, is made up of 12 town houses and apartments as well as office spaces, a restaurant/cafe and a communal garden. All the homes are environmentally friendly, with features such as lightweight timber frame construction. Water is heated with solar panels, which helps to keep healing bills down, recycled newspaper has been used for insulation - and even the toilets are flushed with rainwater. It's been described as "a healthy place with healthy materials."

# 6. CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Conclusions

6.1.1 The UK Department for Communities and Local Government is currently undertaking a consultation exercise, to determine the steps needed to achieve the target for zero carbon housing. The consultation period is open until March 2009, responses to the consultation will be published June 2009 and, in the Summer 2009, the Government intends to issue a further policy statement on zero carbon homes. (A separate consultation exercise will be undertaken in 2009 on the targets for non-domestic buildings).

The purpose of this consultation exercise is to ensure that there is a clear and realistic trajectory to achieving the 2016 zero carbon target, and that the target can be achieved. Government recognises that, for the zero-carbon target to be practical, it needs to be technically feasible and affordable to those who will have to implement it, and that support will have to be provided to industry to support innovation for the development of cost-effective technologies.

At this stage, the UK Zero Carbon Definition Task Group has recommended that the Government should press ahead with its zero carbon target for 2016, but that greater consideration should be given to the use of off-site solutions, with a hierarchy of measures for meeting the zero-carbon standard based on:

<u>Homes</u>

- High levels of energy efficiency should be required;
- Minimum standards for carbon emissions from the home should be improved relative to current regulations (taking into account energy imported from centralised energy systems, directly connected heat networks and onsite energy generation); and
- A further menu of (mainly off-site) allowable solutions should be available to enable new homes to reach the zero-carbon standard.

<u>Non-Domestic Buildings</u>

A similar approach should be adopted, but recognising that non-domestic buildings have different patterns of energy use.

6.1.2 In the meantime, the zero carbon homes policy continues to gain momentum. For example:

- Over 180 builders, local authorities and delivery partners are now signatories to the UK's Zero Carbon Commitment, showing their support for the 2016 target.

- UK industry has established the Zero Carbon Delivery Hub. The 2016 Task Force and the Delivery Hub will work together to oversee the 2016 target and to overcome practical barriers to delivery.

- Examples of zero carbon homes meeting Code Level 6 have been built.

- Social housing is paving the way for uptake of zero carbon by all new homes.

- The devolved Administrations are working on their own proposals for low and zero-carbon development: In Wales, over 40 organisations have signed up to the Green Building Charter committing to support progress towards a low or zero carbon built environment, the Sustainable Development Commission has been established to plan the actions needed toachieve zero carbon development, a draft climate change Planning Policy Statement has been published proposing changes to planning policy in Wales to ensure that climate change is addressed and to promote the delivery of zero carbon homes and buildings; In Scotland, the Government is investigating proposals to improve all new building, including staged improvements to building standards in 2010 and 2013 with the aim of 'net zero carbon' buildings by 2016/17. Public consultation on the proposed new building standards will take place in 2009; Northern Ireland intends to improve te energy and zero carbon requirements of its building regulations by 25% and 40% in 2010 and 2013 respectively, moving towards zero carbon thereafter.

Whilst the exact plans for achieving the zero-carbon targets are still evolving and under consultations, one can conclude with some certainty that the future construction and housebuilding sector will be seeking more and more innovative solutions to improve the energy efficiency and 'green' rating of buildings.

6.1.3 Therefore, the market and demand for sustainable construction products is a very real and an opportunity which construction companies cannot ignore – as sustainability criteria become essentials in the market's expectations and in legislative requirements.

The legislative drivers have been gathering momentum but, as sustainability ratings become increasingly influential on the market value of a building, there is also market growing demand from building owners to have houses and buildings with high sustainability ratings.

In the wake of recent increases in energy and raw material costs, and in the current economic climate, it might be tempting to think that product sustainability is a luxury that the industry and market can do without. But the reverse is true. These price increases are driven in part by increased pressure on resources, and they reinforce the need to find ways to reduce the resource intensity of product supply chains and make products themselves more efficient in their use of energy and natural resources.

We are not just talking about having a few more sustainable options. This is about making sustainability mainstream for all products. It's a huge challenge. But there are huge environmental and social gains to be made, and huge business opportunities available in redesigning, developing and marketing all of our products in a more sustainable way.

## 6.2 Recommendations

6.2.1 The challenge for manufacturers is to:

- Invest in developing sustainable construction products which will 'push the envelope' and help builders and developers to achieve higher levels of energy efficiency in their buildings, as well as meeting their sustainability and responsible sourcing policies, ensuring adequate production capacities and providing a commercial product attractive as a mainstream building material.

- Develop skills capability. There is a need for new skills set for the construction of low to zero carbon homes or passive houses. These skills could be developed through training schemes and an academy of excellence. An interesting comparison here is the Renewable Technology Installers Academy delivered by Action Renewables in response to a skills deficit being experienced in what is also a new and related sector. This could also fast track Northern Ireland into a centre of excellence for sustainable construction.

  Associated with knowledge development are the skills required to provide the ability to successfully deliver new innovative products through targeted R&D.

- Develop knowledge capability. There is a large amount of information available on potential sustainable building products, with such databases as GreenBOOK Live being updated in the last year and The Sustainable Energy in Buildings Network ("SEBNet") in Ireland (http://www.sei.ie/Your_Building/Low_Carbon_Homes_Programme/SEBNet_Products_Services)

6.2.3 It is recommended that, to assist the construction industry in responding to this market opportunity, intervention and support should be provided to:

- Support and encourage appropriate product and process R&D projects;

- Assist and encourage industry players to develop supply chain collaborations and partnerhips, both within Northern Ireland and internationally, to help to progress R&D projects and commercial exploitation;

- Support the development of industry skills and knowledge – technical skills and market knowledge;

- Assist industry players in identifying opportunities specific to their sector and capabilities, and develop action plans and partnerships for progressing these opportunities.

## GLOSSARY OF KEY TERMS AND ABBREVIATIONS

| | |
|---|---|
| **BERR** | UK Government Department for Business Enterprise and Regulatory Reform<br>www.berr.gov.uk |
| **Building Energy Rating Certificate ("BER")** | Building Energy Rating Certificates apply in the Republic of Ireland.<br><br>A Building Energy Performance Certificate records how energy efficient the building is and provides A-G ratings (where A is the most efficient and G is least efficient). They are produced using standard methods and assumptions about energy usage so that the energy efficiency of one building can easily be compared with another building of the same type.<br><br>From the 1st of January 2009 they are compulsory for all homes being sold or rented, regardless of age when being offered for sale or rented. |
| **Building Research Establishment Limited ("BRE")** | The Building Research Establishment is a wholly owned subsidiary of the BRE Trust Companies.<br><br>Building Research Establishment provides research and consultancy services on the built environment, contributes to the development of national and international standards and, through its sister company BRE Global, provides third party approvals and certifications for fire, security and sustainability products and services.<br><br>The BRE Trust (formerly called the Foundation for the Built Environment) is a charitable company whose objectives are, through research and education, to advance knowledge, innovation and communication in all matters concerning the built environment for public benefit.<br><br>Profits made by BRE and by the other subsidiary companies of BRE Trust are passed to the Trust and used by it to promote its charitable objectives.<br><br>www.bre.co.uk |
| **BRE Environmental Assessment Method ("BREEAM")** | BREEAM is a voluntary measurement rating of the environmental performance of buildings. It was established in the UK by BRE, and applies to non-domestic buildings. |

| | |
|---|---|
| **Central Procurement Directorate ("CPD")** | The Central Procurement Directorate is part of the Northern Ireland Department of Finance and Personnel.<br><br>Central Procurement Directorate provides a procurement service to Northern Ireland Department and other public bodies in Northern Ireland.<br><br>www.cpdni.gov.uk |
| **CHP** | Combined Heat and Power - the use of a heat engine or a power station to simultaneously generate both electricity and useful heat. |
| **Code for Sustainable Homes** | The Code for Sustainable Homes ("the Code") sets ratings for houses on a scale of 1-6, according to their energy and water efficiency, sustainability features and carbon emissions.<br><br>The Code sets a framework for the future direction of regulations, and is being integrated into Building Regulations. |
| **Department for Environment, Food and Rural Affairs ("DEFRA")** | DEFRA is the UK Government department tasked with issues such as the environment, rural development, the countryside, wildlife, animal welfare and sustainable development.<br><br>www.defra.gov.uk |
| **Display Performance Certificate ("DER")** | Display Performance Certificates apply in the UK<br><br>A Display Performance Certificate applies to buildings other than houses/dwellings. It records how energy efficient the building is and provides A-G ratings. They are produced using standard methods and assumptions about energy usage so that the energy efficiency of one building can easily be compared with another building of the same type.<br><br>As of January 2008 all buildings which are not dwellings, such as public buildings, will require a Display Energy Certificate (DEC). |
| **Earth Summit** | A United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, June 1992. |

| | |
|---|---|
| **Energy Performance Certificate ("EPC")** | Energy Performance Certificates apply in the UK.<br><br>An Energy Performance Certificate records how energy efficient a house is and provides A-G ratings. They are produced using standard methods and assumptions about energy usage so that the energy efficiency of one building can easily be compared with another building of the same type.<br><br>They allow owners, occupiers and purchasers to see information on the energy efficiency and carbon emissions of a house.<br><br>As of January 2008 all new houses in the UK are required to have an Energy Performance Certificate. Buildings which are not dwellings, such as public buildings, will require a Display Energy Certificate (DEC). |
| **European Energy Performance of Buildings Directive ("EPBD")** | This Directive is one of the EU's key legislative tools for meeting its Kyoto commitments. It came into force in January 2003. Its two main objectives are: improved energy performance of buildings; and convergence of building energy standards towards those member states which already have ambitious targets.<br><br>The Directive was updated (or 'recast') in 2008, to introduce even tighter standards. |
| **Green Book Live** | Green Book Live is a free online database designed to help specifiers and end users identify products and services that can help to reduce their impact on the environment. A wide range of products and services, from commercial building products and services to domestic energy efficiency products can be found within Green Book Live.<br><br>www.greenbooklive.com |
| **Greenhouse Gases ("GHG")** | Greenhouse gases are gases in an atmosphere that absorb and emit radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. CO2 is one of the greenhouse gases. |
| **Gross Domestic Product ("GDP")** | The gross domestic product is one of the measures of national income and input for a given country's economy. |

| | |
|---|---|
| **Home Information Pack ("HIP")** | Since 14 December 2007 every home put on the market must have a Home Information Pack. It contains information such as a sale statement, local searches and evidence of title, and also includes the Energy Performance Certificate. |
| **International Monetary Fund ("IMF")** | The International Monetary Fund (IMF) is an organisation of 185 countries, working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world.<br><br>www.imf.org |
| **Kyoto Protocol** | A protocol to the United Nations Framework Convention on Climate Change which establishes legally binding commitments for the reduction of four greenhouse gases (carbon dioxide, methane, nitrous oxide, sulfur hexafluoride), and two groups of gases (hydrofluorocarbons and perfluorocarbons) produced by "Annex I" (industrialised) nations, as well as general commitments for all member countries. |
| **LZC** | Low and Zero Carbon |
| **MBD Ltd** | MBD is a market research company.<br><br>www.mbdltd.co.uk |
| **The Natural Step** | The Natural Step is an international not-for-profit organisation dedicated to education, advisory work and research in sustainable development. Established in 1989, it works with private and public sector organisations is introducing and developing sustainable products and projects.<br><br>www.naturalstep.org |
| **New Growth Points** | The New Growth Points initiative is a UK Government initiative was announced in December 2005 to provide support to local communities who wish to pursue large scale and sustainable growth, including new housing, through a partnership with Government. |
| **PAS 2050** | Publicly Available Specification for assessing the carbon footprint of products across their life cycle. |

| | |
|---|---|
| **Passive House/Passiv Haus** | The general definition of a Passive House is: a house or building with limited heating energy demand of around 15 kWh/m2 treated floor area for heating and around 120 kWhprimary/m2 treated floor area for space heating, domestic hot water ("DHW") and all other electrical equipment combined. |
| **Planning Policy Statements ("PPS")** | Documents containing policies on land-use and other planning matters, applying to the whole of Northern Ireland. They set out the main planning considerations that the Department takes into account when assessing development proposals, |
| **Private Finance Initiative ("PFI")** | The Private Finance Initiative is a method, developed initially by the United Kingdom government, to provide financial support for "Public-Private Partnerships" between the public and private sectors.<br><br>PFI projects are used in both local and central government, and aim to deliver infrastructure on behalf of the public sector, together with the provision of associated operational services.<br><br>In the case of local government projects, the capital element of the funding, which enables the local authority to pay the private sector for these projects, is given by central government in the form of what are known as PFI "credits". The local authority then selects a private company to perform the work, and transfers detailed control of the project, and in theory the risk, to the company.<br><br>The typical PFI provider has three parts or legal entities: a holding company (known as Topco), a capital equipment or infrastructure provision company (known as Capco), and a services or operating company (Opco). The main contract is between the public sector authority and the Topco. Requirements then 'flow down' from the Topco to the Capco and Opco via secondary contracts. Further requirements then flow down to subcontractors, again with contracts to match. Often the main subcontractors are companies with the same shareholders as the Topco. Large PFI contracts are often won by consortia of companies rather than individual firms. |
| **RSUA** | Royal Society of Ulster Architects<br><br>www.rsua.org.uk |

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| **Sustainable Consumption and Production** | The purpose of sustainable consumption and production is to achieve more with less – not only examining how goods and services are produced, but also the impact of products and materials during their life cycle.<br><br>The aim is to ensure that resources are conserved and wastage is minimised during manufacture, distribution and usage of all goods and services. |
| **Sustainability/Sustainable Development** | Development which meets the needs of the present without compromising the ability of future generations to meet their needs. |
| **TER** | Target Emissions Rate – the standard set for CO2 emissions for a building as a whole. |

## APPENDIX I : PRIMARY CONSULTEES

Government and Government Funded Bodies

- Invest Northern Ireland (construction team; sustainable energy team); (www.investni.com)
- Department of Finance and Personnel, Building Regulations (www.dfpni.gov.uk)
- Action Renewables; (www.actionrenewables.co.uk)
- Sustainable Energy Ireland; (www.sei.ie)
- Carbon Trust; (www.carbontrust.co.uk)
- Energy Savings Trust; (www.energysavingtrust.org.uk)
- Department of Enterprise, Trade and Investment – Energy Division; (www.detini.gov.uk)
- BERR; (www.berr.gov.uk)
- DOE Planning (www.planningni.gov.uk)

Research Bodies

- The University of Ulster Built Environment Research Institute; (http://www.beri.ulster.ac.uk/)
- The University of Ulster Centre for Sustainable Technologies; (http://www.cst.ulster.ac.uk/)
- Queens University Belfast Centre for Built Environment Research; (http://space.qub.ac.uk/cber/default.aspx)
- University College Dublin, Energy Research Group: (http://erg.ucd.ie/)
- The Building Research Establishment (BRE); (www.bre.co.uk)

Communication Groups

Sustain Built Environment Matters – Magazine; (www.sustainmagazine.com)
Construct Ireland – Magazine; (http://www.constructireland.ie/)
Sustain and Build; (www.sustainandbuild.com)

Trade Bodies, Specialist Magazines and Industry Advisers

- Royal Ulster Architectural Society; (www.uahs.org.uk)
- Royal Institute of British Architects; (www.architecture.com)
- Construction Products Association; (www.constructionproducts.org.uk)
- Environmental and Sustainable Construction Association (EASCA) – Ireland; (www.easca.ie)
- Home Builders Federation; (www.hbf.co.uk)
- National House Building Federation;
- Consarc Architects; (www.consarc.co.uk)
- Navigant Consultants; (www.navigantconsulting.com)
- Eco – Energy NI; (www.eco-energy-ni.com)
- Patrick McKernan – Sustainable and Renewable Energy Consultant; (http://www.managenergy.net/actors/A4132.htm)

UK Eco Towns

- Department for Communities and Local Government; (www.communities.gov.uk)

Contractors

- Laing O'Rourke - Matthew Riley, Head of Procurement; (www.laingorourke.com)
- Balfour Beatty - Duncan Reed, Divisional Design Manager; (www.bbcl.co.uk)
- Carillion PLC - Zara Lamont, Performance Improvement Director; (www.carillionplc.com)
- Mantle Homes - Tor H. Høie, Managing Director; (www.mantlehomes.com)
- Stewart Milne - Stewart Dalgarno, Director of Product Development; (www.stewartmilne.com)
- Carvill Group Ltd - Alan Little; (www.carvill-group.com)

# APPENDIX II: EU SUSTAINABLE DEVELOPMENT STRATEGY

The EU Sustainable Development Strategy was first developed in 2001, to deal with many of the challenges highlighted at the Rio de Janeiro Earth Summit:

- Climate change and clean energy;
- Sustainable transport;
- Sustainable consumption and production;
- Conservation and management of natural resources;
- Public health;
- Social inclusion, demography and migration; and
- Global poverty.

In February 2005, the European Commission took stock of the progress that had been made, and it was concluded that the situation had actually deteriorated. As a result, a 'renewed' Strategy was developed and adopted in June 2006.

The first specific long-term objective of the Strategy is to limit climate change, with the EU committing to put pressure on its member states to meet the Kyoto Protocol commitments they signed up to in 1997, and the most recent targets agreed between the heads of state at the Spring European Council in March 2007 - to reduce greenhouse gases by 20% by 2020.

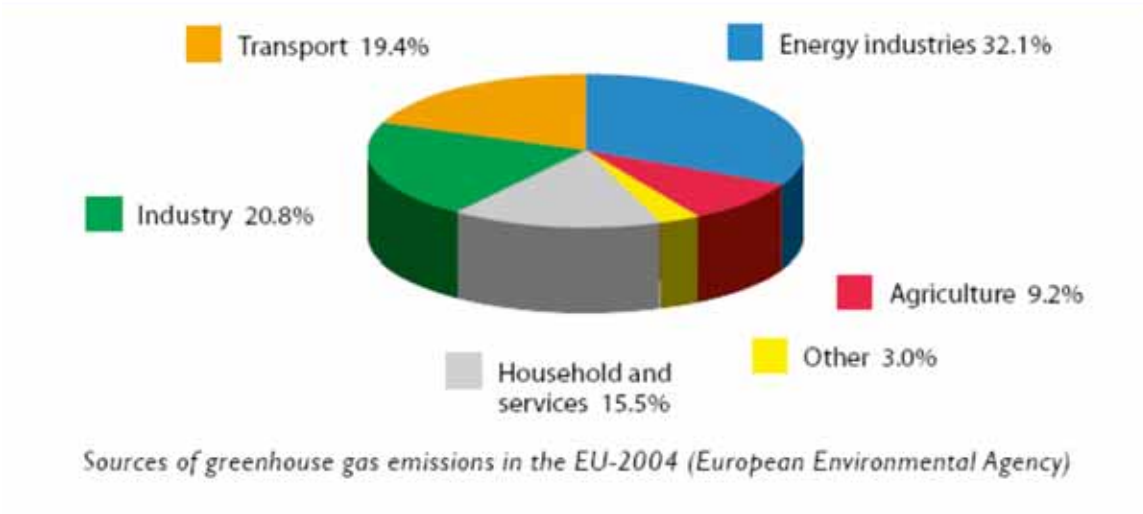
The Strategy themes that will have the most direct impact on the opportunities for sustainable building products are;

- Climate change and clean energy;
- Sustainable consumption and production; and
- Conservation and management of natural resources.

Additional detail is provided below on the objectives and challenges in relation to these three themes.

## Climate Change and Clean Energy

The main sources of greenhouse gas emissions in the EU are energy, industry and transport, followed closely by households and agriculture.




*Sources of greenhouse gas emissions in the EU-2004 (European Environmental Agency)*

***Objectives and Targets***

| ***Overall Objective from the EU Sustainable Development Strategy: To limit climate change and its costs and negative effects to society and the environment*** | |
|---|---|
| Objective 1 | Kyoto Protocol commitments of the EU-15 and most EU-25 to targets for reducing greenhouse gas emissions by 2008 – 2012, whereby the EU-15 target is for an 8% reduction in emissions compared to 1990 levels. Aiming for a global surface average temperature not to rise by more than 2ºC compared to the pre-industrial level. |
| Objective 2 | Energy policy should be consistent with the objectives of security of supply, competitiveness and environmental sustainability, in the spirit of the Energy Policy for Europe launched in March 2006 by the European Council. Energy policy is crucial when tackling the challenge of climate change. |
| Objective 3 | Adaptation to, and mitigation of, climate change should be integrated in all relevant European policies. |
| Objective 4 | By 2010 12% of energy consumption, on average, and 21% of electricity consumption, as a common but differentiated target, should be met by renewable sources, considering raising their share to 15% by 2015. |
| Objective 5 | By 2010 5.75% of transport fuel should consist of biofuels, as an indicative target, (Directive 2003/30/EC), considering raising their proportion to 8% by 2015. |
| Objective 6 | Reaching an overall saving of 9% of final energy consumption over 9 years until 2017 as indicated by the Energy End-use Efficiency and Energy Services Directive. |

With the approval of an Action Plan on an integrated energy and climate change package by the March 2007 European Council11, the EU also decided on the following targets in relation to climate and energy policy :

- Emission reductions of 20/30% by 2020;
- 20% Renewable Energy (RE) by 2020;

- 10% biofuels by 2020 (in a sustainable manner); and
- A review of the EU Emission Trading Scheme.

A major challenge facing the EU is the further negotiations on a global and comprehensive post-2012 agreement building on the Kyoto Protocol. It is the EU's ambition that negotiations should be completed by 2009. This takes place in a challenging context where both the USA and developing economies, whose participation is vital to reach the necessary emission reductions, remain reluctant to accept binding quantitative commitments.

***Progress and Challenges***

The findings of Eurostat's "Measuring progress towards a more sustainable Europe 2007" concluded that there were no favourable changes to report compared to 2000. The 2007 report concluded that:

- Following the considerable progress achieved in reducing greenhouse gas emissions during the 1990s, and despite a significant reduction between 2004 and 2005, the EU-15 trend has reversed and is now moving away from the target. In 2005, EU-15 emissions of greenhouse gases stood at 98% of their Kyoto base year value, while EU-27 emissions were at 92.1% of their 1990 value. Overall greenhouse gas emissions grew by 1.5 percentage points (EU-27) and 1.4 points (EU-15) between 2000 and 2005. Since 2000, the EU-15 emissions trend has thus been moving away from the Kyoto target path.

- Gross inland energy consumption continues to grow. Since 2000, gross inland energy consumption has grown at 1.1% per year for both EU-27 and EU-15, growing considerably faster in EU-27 than in the previous decade, and reflecting increasing energy demand. The switching from high-carbon solid fuels towards gas and renewables continues, but at a slower pace. The greenhouse gas intensity of energy consumption is thus moving in the right direction, but progress is too slow to make a major contribution.

- The rate of energy dependency continues to increase steadily. EU-27 dependence on imported energy has increased every year since 2000, and in 2004 exceeded 50%, ending up 5.7 percentage points higher in 2005 than in 2000. The energy dependency of EU-15 is about 3 percentage points higher than that of EU-27.

- The share of renewables in primary energy consumption is increasing, although at a rate so slow that the distance from the target path is widening each year. The EU-27 consumption of renewable energy sources increased at the significant average rate of 4.1% between 2000 and 2005. Nevertheless, due to the relatively high growth rate of energy consumption over recent years, the share of renewables has increased by only 0.17 percentage points per year since 2000, reaching a level of 6.6% in 2005, far from the 2010 target of 12%.

- Little, if any, progress has been made in increasing the share of renewables in electricity consumption. Progress in the share of renewables in electricity

consumption has slowed down since 2000, growing at an average of 0.04 percentage points per year compared with 0.14 during the previous decade. This leaves a gap of 7 percentage points between the level of 14% in 2005 and the 2010 target of 21%. Achieving the target will require growth of 1.4 percentage points per year, equivalent to the entire progress made between 1990 and 2000.

The Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) concluded and confirmed that the EU is faced with major overall climate-related challenges:

- To achieve the necessary emission reduction targets. global emissions of greenhouse gases will need to peak in the next 10 to 15 years and then be reduced to very low levels.

- To avoid the most catastrophic forecasts made by the IPCC, by 2020, emissions in industrialised countries would need to be reduced to 24%-40% below 1990 levels. Aggregate projections from the European Environment Agency (EEA) show that the EU15 is barely on track to meet its Kyoto commitments of 8% reduction by 2008-12. The 2010 emissions of the EU15 are only expected to be 0.6 % below base-year levels (i.e. a 7.4 % distance from the emission reduction commitment). Additional domestic measures are projected to reduce the gap by a further 4.0 %, down to 3.4 % by 2010. Kyoto mechanisms are expected to deliver an additional 2.6 % emission reductions and the removal through sinks should provide the remaining 0.8%.

- Decoupling of energy consumption and Greenhouse Gas (GHG) emissions from economic growth remains a major challenge.

- While mitigation of future climate change remains a priority, adaptation to the unavoidable climate change that is already taking place also needs to be given priority in government initiatives and legislation.

- Development of sustainable energy technologies and products will be essential if the cuts in emissions are to be achieved.

## Sustainable Consumption and Production

The threat from increasing unsustainable consumption in Europe can be illustrated by the following statement from the business task force on sustainable consumption and production at Cambridge University: “If replicated worldwide, the western patterns of consumption and production, it is estimated, need at least three planets worth of resources”.

### *Objectives and Targets*

| ***Overall Objective from the EU Sustainable Development Strategy: To promote sustainable consumption and production patterns*** | |
|---|---|
| Objective 1 | Promoting sustainable consumption and production by addressing social and economic development within the carrying capacity of ecosystems and decoupling economic growth from environmental |

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|---|---|
| | degradation. |
| Objective 2 | Improving the environmental and social performance for products and processes and encouraging their uptake by business and consumers. |
| Objective 3 | Aiming to achieve by 2010 an EU average level of Green Public Procurement (GPP) equal to that currently achieved by the best performing Member States. |
| Objective 4 | The EU should seek to increase its global market share in the field of environmental technologies and eco-innovations. |

In many ways, this theme represents the most fundamental challenge of the EU Sustainable Development Strategy, as it is concerned with changing the behaviour of consumers and producers, and requires us to change "the way we design, produce, use and dispose of the products and services we own and consume".

***Progress and Challenges***

The key challenges in this area are:

- The environmental consequences of industrialisation in developed economies as well as the life cycles of their citizens arising from the patterns of consumption and production;
- The environmental and social consequences of transition i.e. economic development in industrialising countries;
- The system for production in Europe does not fill its potential of improving competitiveness while reducing negative environmental impacts of the life cycle of products.
- Achieving sustainable consumption and production is a complex concept depending on interrelated actions within political, business and civil society:

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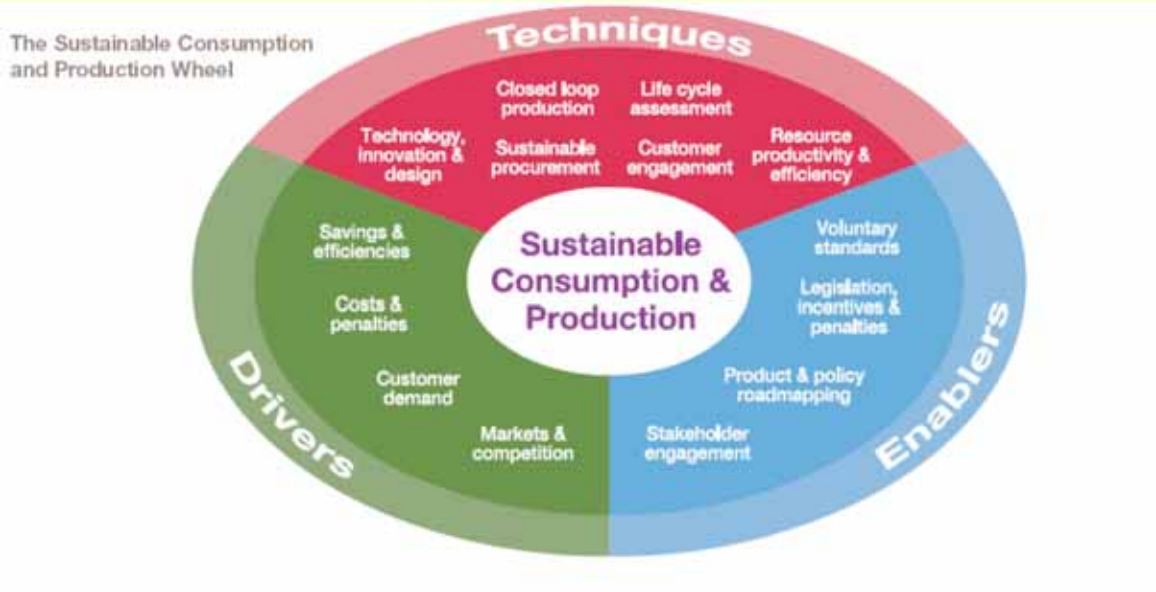


- A broad scope of policy measures are needed in order to stimulate sustainable consumption and production:

    - Consumers alone are not able to change mainstream product;
    - Sustainable products need to demonstrate that they are effective and their price points need to be competitive.
    - Fiscal incentives are effective when they close the price gap for more sustainable products or create significant tax rebates for their use.
    - Lack of consumer and voter focus on, and knowledge of, sustainability and environmental degradation and lack of willingness to pay for sustainable products.
    - Inertia to change to sustainable production patterns.

## Conservation and Management of Natural Resources

### *Objectives and Targets*

| ***Overall Objective from the EU Sustainable Development Strategy: To improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services*** | |
|---|---|
| Objective 1 | Improving resource efficiency to reduce the overall use of non renewable natural resources and the related environmental impacts of raw materials use, thereby using renewable natural resources at a rate that does not exceed their regeneration capacity. |
| Objective 2 | Gaining and maintaining a competitive advantage by improving resource efficiency, inter alia through the promotion of eco-efficient innovations. |
| Objective 3 | Improving management and avoiding overexploitation of renewable natural resources such as fisheries, biodiversity, water, air, soil and atmosphere, restoring degraded marine ecosystems by 2015 in line with the Johannesburg Plan (2002) including achievement of the |

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| | Maximum Yield in Fisheries by 2015. |
| Objective 4 | Halting the loss of biodiversity and contributing to a significant reduction in the worldwide rate of biodiversity loss by 2010. |
| Objective 5 | Contributing effectively to achieving the four United Nations global objectives on forests by 2015. |
| Objective 6 | Avoiding the generation of waste and enhancing efficient use of natural resources by applying the concept of life-cycle thinking and promoting reuse and recycling. |

***Progress and Challenges***

In 2002, the European Commission produced a review into "Sustainable Management of Natural and Environmental resources", which sets out two priority objectives:

- To ensure that current trends in the loss of environmental resources are effectively reversed at national and global levels by 2015; and

- To develop sectoral and intermediate objectives in some key sectors – water, land and soil, energy and bio-diversity

Material consumption in industrialised countries within Europe is between 31 and 74 tonnes/person/year (total material consumption) and, in terms of environmental impact, one of the most significant sectors is the consumption of materials for housing.

Whilst economic output is becoming less dependent on natural materials and raw material extraction, overall levels of resource extraction are increasing in absolute terms in all regions of the world. This trend is at best incompatible with sustainable development, considering the fact that global environmental problems such as climate change, loss of biodiversity, and pollution (all closely linked to the material throughput of the global economy) are already putting pressures on the world's ecosystems beyond a sustainable level.

The challenge for the EU is to maintain and increase economic growth, in a way that is more sustainable, uses resources more efficiently, keeps costs competitive, ensures security of supply, makes better use of waste products and changes consumer and producer behaviour so as to be more sustainable.

EU Member States have gone some way in developing strategic responses to encourage more sustainable use of natural resources:

- mainstreaming the concept of recycling and life-cycle thinking;
- the emergence of the 'source principle', which specifies that environmental damage should preferably be prevented at the source rather than by using the 'end-of-pipe technology';
- a preference for emission standards rather than environmental quality standards, especially to deal with water and air pollution;
- increasing the role of market-based instruments, in particular the use of taxation at EU and national levels to help meet environment policy goals;

- setting a target to halt biodiversity loss by 2010;
- decreasing waste production and promoting waste prevention.

However, within each of the natural resource categories and themes there are specific issues that need to be addressed:

- Europe's tree supply is under threat. Whereas the estimated ratio of felling of trees to increment of trees is still around 60%, land-use changes and the encroachment of built-up areas still jeopardises the long-term viability of Europe's trees. This is of significant concern given the role that woodland ecosystems play in driving biodiversity.

- Biodiversity is decreasing. A century of economic growth across Europe has contributed to a loss of approximately 65% of the original terrestrial biodiversity.

- Total waste production is still around 1.3 billion tonnes per year in the EU.

- Registration of resource use is not currently taking place (and is currently approximated by energy consumption statistics).

- Although there is relative decoupling of resource consumption, waste and pollution with economic growth there is still an absolute level of resource consumption that has remained largely unchanged.

- Technical innovation can only offset relative resource consumption and production and does not really tackle the underlying processes.

# APPENDIX III: EU THEMATIC STRATEGY ON THE SUSTAINABLE USE OF NATURAL RESOURCES AND INTERNATIONAL ACTION ON SUSTAINABLE PRODUCTS

## EU Thematic Strategy on Sustainable Use of Natural Resources

The EU Thematic Strategy on the Sustainable Use of Natural Resources was launched on 21 December 2005, and is one of seven Thematic Strategies resulting from the Sixth Environmental Action Programme (6EAP).

The 6EAP is a 10-year vision for EU environmental policy that outlines goals for four environmental priorities: climate change, nature and biodiversity, environment and health, and natural resources and waste. The 6EAP is the first EAP to request cross-sector Thematic Strategies to be developed and used to implement the broad goals of the 6EAP. The resulting Thematic Strategies address seven themes: air quality; soils; pesticides; the marine environment; the urban environment; waste and recycling; and the management of natural resources.

The 6EAP's cross-sector Thematic Strategies are based on life-cycle thinking, and analyse the entire life cycle of a product from 'cradle to grave'.

One of the main goals of the Strategy on the Sustainable Use of Natural Resources is to develop indicators and mechanisms for setting targets and accurately measuring the environmental impacts of specific products and processes. Overall, the Strategy states that there is a need for three types of indicators to measure the following:

- the progress in efficiency and productivity in the use of natural resources ("Euro/kg");
- resource-specific indicators to evaluate the environmental impact of resource use ("impact/kg"); and
- an overall eco-efficiency indicator to measure progress towards reducing global environmental impacts as compared with overall economic growth ("Euro/impact").

In May 2008, the EU issued a Follow-Up Report to the EU Strategy on the Sustainable Use of Natural Resources. This follow-up report recommended the following four aggregate indicators as tools for monitoring the environmental impact of natural resource use:

- Ecological Footprint (EF)
- Environmentally Weighted Material Consumption (EMC);
- Human Appropriation of Net Primary Production (HANPP); and
- Land and Ecosystem Accounts (LEAC).

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|---|---|
| Ecological Footprint (EF) | The Ecological Footprint measures how much biologically productive land and water area is required to provide the resources consumed and absorb the wastes generated by a human population, taking into account prevailing technology. The annual production of biologically provided resources, called biocapacity, is also measured as part of the methodology. The Ecological |

| | |
|---|---|
| | Footprint and biocapacity are each measured in *global hectares*, a standardised unit of measurement equal to 1 hectare with global average bioproductivity. |
| Environmentally Weighted Material Consumption (EMC) | EMC is a weighted indicator of material consumption based on environmental impacts. It currently is the most advanced indicator capable of illustrating how data on material flows (for example, data included in the indicator Direct Material Consumption, DMC) can be linked with information on the life-cycle wide environmental impacts of these materials, derived from Life Cycle Assessment (LCA). EMC estimates the environmental impacts of materials throughout a product's life cycle. The underlying data for the EMC overlaps with that of the Ecological Footprint to some extent but unlike the Footprint's expression in a single spatial unit (global hectares), the EMC combines a set of specific impact indicators (e.g. CO2 emissions, land use) that are then aggregated using weighting factors. Environmental issues not captured by the Ecological Footprint are included in the EMC, including the human-health and eco-toxicity impacts of certain materials, and the issues of ozone depletion, eutrophication, and acidification. |
| Human Appropriation of Net Primary Production (HANPP) | HANPP is a measure of human use of ecosystems and can be defined as the amount of terrestrial net primary production required to derive food and fibre products consumed by humans, including the organic matter that is lost during the harvesting and processing of whole plants into end products. HANPP is complementary to the Ecological Footprint as it measures how much bioproductivity is appropriated in a given territory, whereas the Ecological Footprint measures how much biocapacity a country utilizes wherever that biocapacity is located in the world. HANPP can thus illustrate the "depth" of the Footprint by tracking how intensively given ecosystems are being harvested. |
| Land and Ecosystem Accounts (LEAC) | LEAC is a method developed and used by the EEA to account for the interactions between nature and society on the basis of a detailed grid (1km x 1km) for land use and land cover changes within the European Union. It is based on CORINE land cover data and its goal is to provide information on land cover and related land use changes. Within LEAC, ecosystem accounts incorporate material and energy stocks and flows, health of ecosystems counts and ecosystem services measurements. The ultimate goal is to measure the resilience of natural capital, its services and maintenance costs. |

However, the objective of the Strategy is to develop one aggregated indicator, illustrating the environmental impacts related to resource use with a single score.

Therefore, future efforts will be devoted to the analysis of overlaps among the different indicators and their further development and extension. This might allow integration of some of

the components (in particular, the Ecological Footprint with indicators based on life cycle analysis such as EMC) and thus reduce the number of indicators.

**International Action on Sustainable Products**

There are a number of international initiatives looking specifically at the subject of Sustainable Products; these include:

United Nations Marrakech Process

The Marrakech process is a global initiative, responding to a call from the World Summit on Sustainable Development in Johannesburg, for a 10 year forward plan to promote the shift towards sustainable consumption and production.

Consultations to identify priorities for each continent were held between 2003 and 2005 and strategies are being developed.

There are seven Task Forces led by national governments, including one on Sustainable Products led by the UK. To date, work has focused mainly on energy using products.

Other activities include a Business and Industry Forum, Non-Governmental Organisation Forum, and Co-operation Dialogues on Sustainable Consumption and Production and Poverty Reduction with development agencies and regional banks.

European Action Plan on Sustainable Consumption and Production

As part of the follow up to the Marrakech process, the European Commission is developing an action plan to:

- identify and overcome barriers for sustainable consumption and production;
- ensure better coherence between the different related policy areas; and
- raise awareness among citizens and change unsustainable consumption habits.

## APPENXI IV: UK SUSTAINABLE PRODUCTS-MATERIALS REPORT (JULY 2008)

### Introduction

The Waste Strategy for England 2007 included a commitment to *"Establishing a **new products and materials unit within Defra** to identify and catalyse actions across the supply chain, to improve the environmental performance of products across their life cycle; with a **progress report on delivery** in Spring 2008."*

The Unit was established, to bring together work on: product lifecycle assessment; product information; and evidence on sustainable consumption and production and waste, in order to influence and support action on products within Government and elsewhere. It is also responsible for Defra's work on efficiency standards for energy using products.

The progress report ("UK Sustainable Products – Materials Report") was launched in July 2008. Its focus was on environmental performance of products, and it aimed to provide an overview of key product and material related work across Government, with some examples from outside Government.

### Key Conclusions

The key conclusions and recommendation of the UK Sustainable Products Report are:

- We need to have a clear definition and understanding of what we mean by 'sustainable'. Whilst transition to a low carbon economy is a high priority, society's production and consumption of products is also associated with other environmental and social impacts – such as ecosystem degradation and unfair labour conditions.

- In assessing the impact and 'sustainability' of a product, we need to look at both the scale of impact associated with the product in question, and the criticality of that impact in environmental or social terms.

- The most obvious impacts associated with a product are often those resulting from its use and maintenance – the direct impacts. However, the main tenet of product policy is to look across the whole supply chain at the impacts over the whole product lifecycle – the embedded impacts of a product. This means considering not just the impacts of use/maintenance, but also the impacts associated with its sourcing, manufacture, distribution and recovery/disposal. In the age of global supply chains, many of the economic, environmental and social impacts from UK consumption of products and services are international.

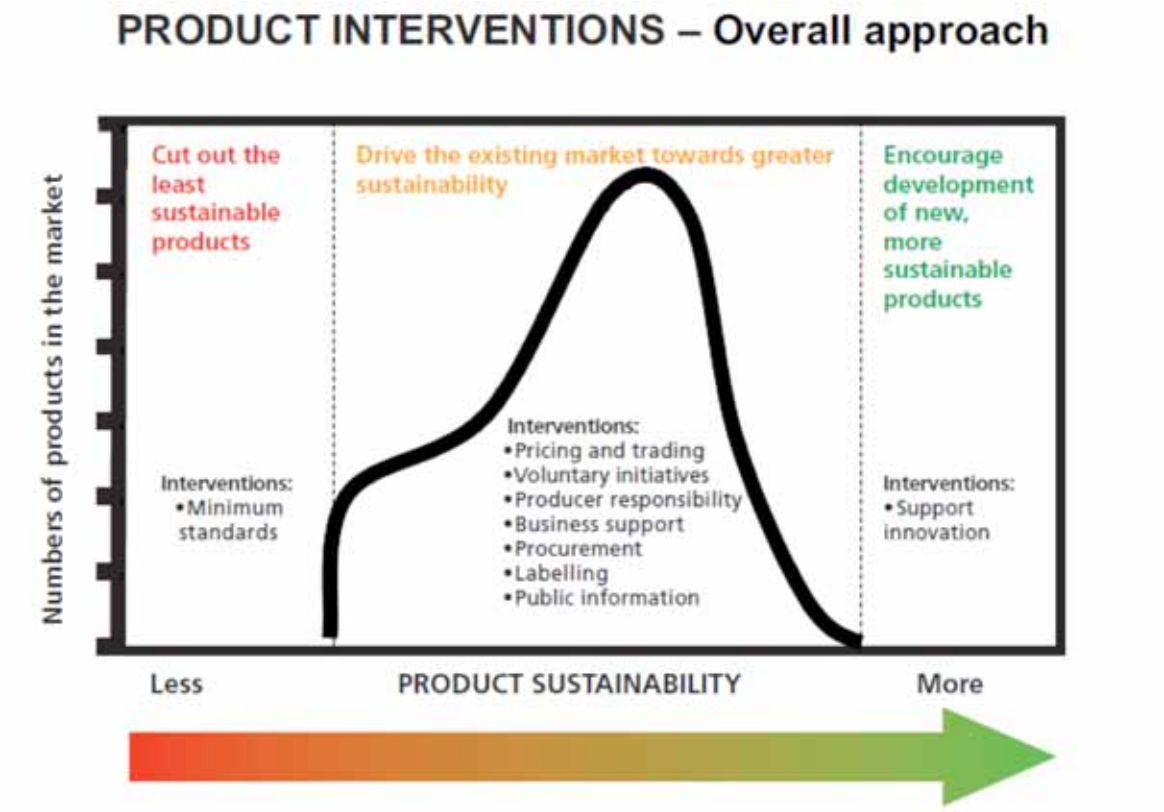
- When it comes to calculating impacts, lifecycle analysis provides a flexible, outline approach which can be adapted to suit different situations.

- A range of actions will need to be taken by Government, business and consumers to drive changes across product lifecycles. Within any product group, and at any point in time,

there is likely to be a range of products on the market with varying degrees of sustainability. Most products are somewhere in the middle of the range, with a few more sustainable than average and a few less sustainable than average. Interventions need to be taken across the whole sustainability range to:

- Drive the development of new products that are more sustainable than all of the current options;
- Move the market average towards the most sustainable of what is available; and
- Cut out the least sustainable products.

The types of intervention which will be effective are illustrated in the following graph:




- The potential for improvement varies from one product to another, but the bottom line is that **all product groups need to improve**.

- However, the scale of the change needed is much greater than Government alone can drive. Good practice on product sustainability is already becoming much more widespread in business. This trend needs to continue and accelerate. Government, businesses, consumers and others will all have to act if we are to deliver improved product sustainability across the board.

- Government's aim is to encourage and drive innovation, research and design, to enable the delivery of sustainability improvements throughout the lifecycle of all types of products. The recent report of the Commission on Environmental Markets and Economic

Performance said that *"by making the UK one of the best locations in the world to develop and introduce low carbon and resource-efficient products, processes, services and business models, the country can attract the investment today that will create tomorrow's prosperity and jobs, as well as contributing to a cleaner environment."*

The report provided the following as a description and vision for a society based upon sustainable products:

- In the future all products are "sustainable products". Sustainability is a normal and expected part of product and service design, manufacture, distribution and marketing.

- Businesses compete to drive up standards of sustainability across the range of products on the market. They recognise the economic benefits of resource efficiency and understand the importance of a healthy natural environment in underpinning their long term survival.

- Consumers routinely take into account environmental and social considerations when buying, using and disposing of products.

- Researchers, designers, manufacturers, retailers, consumers and waste managers – whether in the UK or abroad – understand the environmental and social consequences of their decisions, and the implications of those decisions for the rest of the supply chain.

- Businesses at different stages of the chain routinely work together to minimise overall negative impacts.

- All businesses are clear on what action they need to take to minimise the environmental and social impacts associated with their products, and on the relative priorities attached to tackling different impacts. Trade offs between impacts are routinely considered and factored into business decisions.

## Buildings

Defra is working with a wide range of stakeholders to pilot the development of 10 "roadmaps" to deliver improved product sustainability. One of the product areas covered is: Buildings (including construction), looking specifically at windows, WCs, and plasterboard.

### *Vision*

The Progress Report set the following vision for a sustainable building sector:

- All architecture is green architecture and all construction is sustainable construction.

- Construction materials are chosen on the basis of their whole-life impact – in terms of requirements for energy, water and eventual disposal.

- Alongside social and economic considerations (such as community cohesion and flexible living), architects and builders routinely focus on the long term environmental impact of constructing, maintaining and using a building. They always design and build with a view to sustainability (including energy efficiency, water efficiency, use of sustainable construction materials, surface water run off, waste, pollution, health and well-being, management and ecology).

- All new homes are zero carbon in use.

- New and refurbished properties maximise use of natural light, and have passive and active solar heating and a ventilation/heat recovery system.

- Biomass heating and combined heat and power systems are used in many districts. More accurate sensors enable increased comfort in buildings and lower energy consumption.

- All buildings, new and old, have smart meters which encourage more responsible water and energy usage.

- Water re-use systems such as rainwater-harvesting and grey water systems – to provide water for toilet flushing and outside use – are standard.

- Opportunities for waste reduction and recovery are identified from early in the design stage.

***Impacts***

The Progress Report noted that the environmental impacts associated with buildings include energy use, water use, materials, and waste, in addition to a wide range of social impacts associated with the location, design and construction of buildings.

.

| Raw materials | Manufacturing | Distribution | Use/maintenance | End of life |
|---|---|---|---|---|
| Construction uses over 420 million tonnes of materials per year. Various types of impacts of sourcing materials – resource depletion, pollution, transport, social. | Location of construction – effects on ecology, transport, communities.<br>Local environmental effects of construction – noise, dust.<br>Construction safety. | Impacts from transporting construction products. | Energy: the built environment is responsible for 47% of total UK $CO_2$ emissions.<br>Water use in the home is currently 150 litres/person/day in England and Wales.<br>Community cohesion and rural development impacts associated with location and design of buildings. | Construction produces around 120m tonnes of construction and demolition waste per year, around 50% of which is recycled. |

***Assessment and Standards***

The EU is developing harmonised standards to assess the integrated environmental performance of buildings, including the development of:

- a framework standard for integrated environmental building performance;
- a horizontal standard on the aggregation of Life Cycle Assessment results of individual materials into the buildings;
- a horizontal standard on Life Cycle Assessment methodology for building products/ materials, and;
- a horizontal standard on the communication format/environmental product declaration for business-to-business and/or business-to-consumer.

The Government's ***Code for Sustainable Homes*** sets a single national standard within which the home building industry can design and construct homes to higher environmental standards. It sets a framework for the future direction of regulations and offers a tool (the 1-6 star rating system) for developers to differentiate themselves within the market.

Through mandatory ratings, the Code also gives new homebuyers better information about the environmental impact of their new home and its potential running costs. It includes a set of benchmark levels for the lifecycle environmental performance of products.

There are Buy Sustainable Quick Win ***Government procurement specifications for construction products*** Do we have these? (e.g. lighting, heating and insulation) which have recently been updated to reflect the latest market average values. The recently published EU Green Public

Procurement criteria also include comprehensive criteria for construction products, and the Joint Contracts Tribunal is reviewing how to embed sustainability criteria within industry-standard forms of contract for construction.

Government has also been developing a standard for rainwater harvesting systems, and new performance standards for water fittings. The Government is consulting on proposals to amend the Building Regulations to include water efficiency provisions by introducing a limit of 125 litres per person per day in dwellings and is conducting research on the options for water efficiency in new non domestic buildings.

***Interventions***

The following is a summary of the interventions underway to encourage greater sustainability within the Buildings sector:

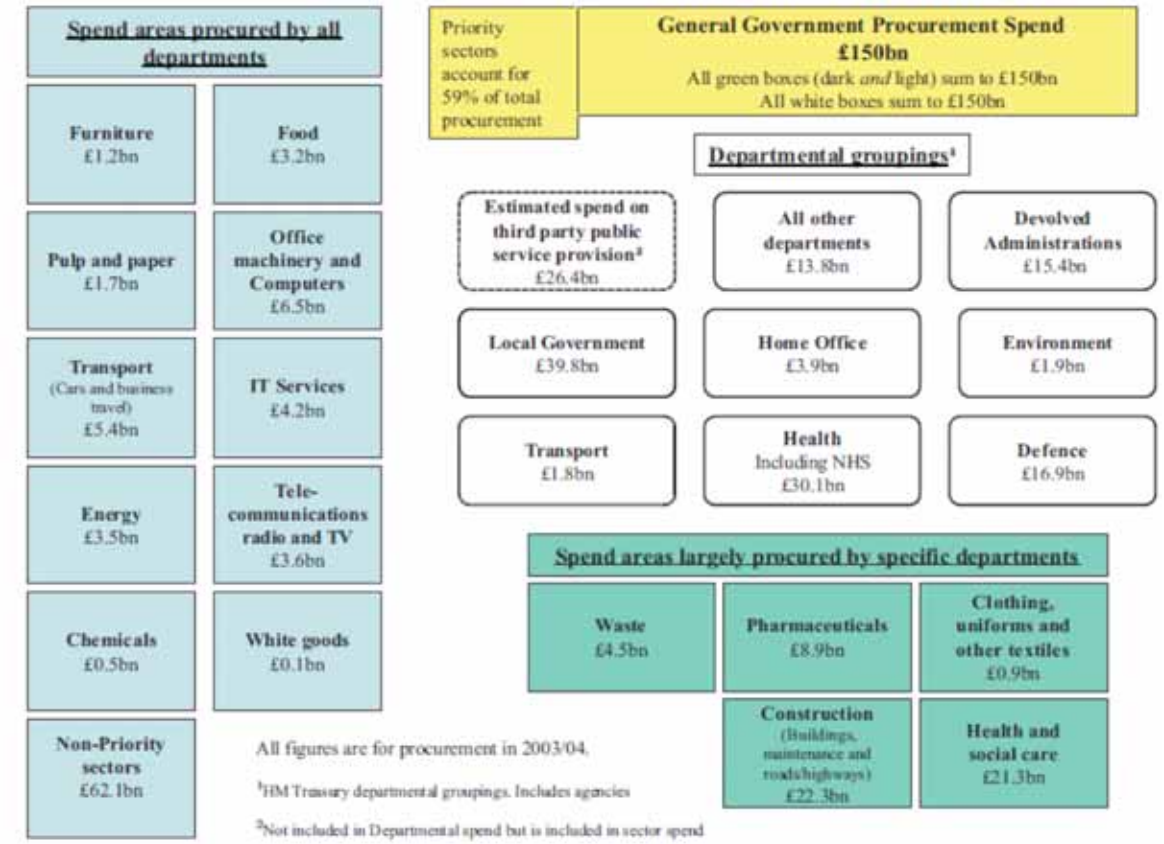
| Intervention type | Product interventions relevant to buildings |
|---|---|
| DRIVE DEVELOPMENT OF NEW, MORE SUSTAINABLE OPTIONS | |
| Innovation | The Technology Strategy Board has launched a Low Impact Buildings Innovation Platform, focused on improvements to the energy efficiency of new and existing buildings. This will work with a number of partners to enable UK industry to deliver the products and services needed for mass deployment of more sustainable buildings though collaborative R&D, demonstration programmes, design competitions, the Modern Built Environment Knowledge Transfer Network and Knowledge Transfer Partnerships.<br>Sustainable Construction is a pilot area under the EU Lead Markets Initiative.<br>The Government response to the Commission for Environmental Markets and Economic Performance report [ref 9] undertook to examine the product approvals regime for innovative products in the construction sector to understand better the barriers to introducing innovative, sustainable products. |

| MOVE THE MARKET AVERAGE TOWARDS MOST SUSTAINABLE | |
|---|---|
| Voluntary initiatives | The Strategy for Sustainable Construction sets out key Government and industry commitments and targets relevant to Sustainable Construction [ref 47]. This includes an industry target for a 50% reduction of construction, demolition and excavation waste to landfill from 2008-2012.<br>The British Retail Consortium has a voluntary scheme for retail buildings to display energy performance certificates (this is a parallel to the mandatory EU requirement for public buildings mentioned below). |
| Producer responsibility | The Government is considering further (voluntary) application of the producer responsibility to other sectors, including paints, building on the work of industry initiatives such as Community Repaint. |
| Procurement | There is a commitment that all Government-funded housing developments must achieve at least a three-star rating under the Code for Sustainable Homes (the highest level being Code level 6 which incorporates zero carbon standards).<br>Government is also committed to achieving BREEAM excellent rating on all new buildings and BREEAM very good rating on all refurbishments.<br>Government-funded construction programmes such as Building Schools for the Future and health PFI have adopted model procurement documentation setting out minimum and target performance standards for key metrics of sustainability.<br>The recently published EU Green Public Procurement criteria include comprehensive criteria for construction products. We plan to review these criteria before they are adopted across central Government. |
| Business support | The Green Guide to Materials Specification is published by the Buildings Research Establishment and will be updated in 2008.<br>WRAP and Envirowise provide a wide range of tools and resources to enable the sector to measure, manage and reduce its waste. |
| Labelling | The "A-G rating" approach has been applied to energy rating of homes and non domestic buildings in Energy Performance Certificates (when built, sold or rented out) and Display Energy Certificates for public buildings. |
| Public information | The Energy Saving Trust provides advice on energy efficient buildings and appliances for all households, and the Carbon Trust does likewise for businesses. Through energy performance certificates and Code ratings, new buyers and tenants will be able to understand the energy efficiency and sustainability of their homes.<br>Energy Performance Certificates are being implemented for all buildings (domestic and commercial) to help potential buyers and tenants understand the energy efficiency of the building (on the A-G scale), and offer suggestions on how this could be improved. Display Energy Certificates are being introduced in public buildings to show members of the public how well the building is being managed. Both types of certificate are part of our implementation of the Energy Performance of Buildings Directive. The Directive also requires inspections for air conditioning systems and the provision of advice for consumers on efficient boiler use.<br>There are plans for real time displays for energy meters to be available on request, and for suppliers to be required include historical information on consumption in bills. The Energy Savings Trust also plans to produce guidelines for consumers on green tariffs. |

| CUT OUT THE LEAST SUSTAINABLE PRODUCTS | |
|---|---|
| Minimum standards | The Government has committed to making all new homes built from 2016 zero carbon homes. The Government has also announced its ambition to make all new non domestic buildings built from 2019 zero carbon.<br><br>A rating against the Government Code for Sustainable Homes is now mandatory for all new build homes. This compels sellers of new homes to provide sustainability information to buyers of new homes.<br><br>The Strategy for Sustainable Construction [ref 47] includes a target for 25% of products used in construction projects to be from schemes recognised for responsible sourcing.<br><br>The European Commission has proposed a new Regulation to replace the existing Construction Products Directive (89/106/EEC). As well as making the CE mark mandatory, there is a proposal to introduce a new indicator on the sustainable use of natural resources: meaning that the sustainability of products could be included in the CE marking.<br><br>Building Regulations in the UK also provide minimum standards for energy performance for new buildings in the form of target $CO_2$ emission rates.<br><br>Since April 2008, there has been a regulatory requirement for site waste management plans for construction and demolition projects to reduce waste impacts. There are plans to introduce water efficiency requirements (eg amendment of Building Regulations, water fittings regulations). There are also plans for the introduction of binding water efficiency targets on water companies set by Ofwat [ref 30]). |

***Government Procurement***

The UK Government is committed to using its purchasing power to support more sustainable products and eco-innovation. The Progress Report provided the following summary of UK Government procurement:



Since 2003 the Government has published mandatory minimum environmental standards for procurement of a wide range of commonly purchased products and Defra has identified a number of "Buy Sustainable – Quick Wins" which could help departments meet these standards. The current product specifications include:

- sustainable as well as environmental criteria;
- a wider range of product groups; and
- voluntary "best practice", as well as the mandatory minimum, specifications.

The minimum requirements are based on the market average level for each product group and are aligned with European Green Public Procurement requirements where appropriate. Best practice specifications stipulate criteria for the better performing products and the market should aspire to reach these levels, as they will eventually become the minimum requirement.

The initial standards were updated and extended in 2007 to reflect new market average levels, and the standards are being reviewed on an ongoing basis.

| Progress on Sutainable Government Procurement | | |
|---|---|---|
| **Product Group** | **Progress** | **Way Forward** |
| Buildings | | |
| Construction | There is a commitment that all Government funded housing must achieve at least a 3 star rating under the Code for Sustainable Homes.<br>Government is also committed to achieving BREEAM excellent rating on all new buildings and BREEAM very good rating on all refurbishments.<br>Government-funded construction programmes such as Building Schools for the Future and health PFI have adopted model procurement documentation setting out minimum and target performance standards for key metrics of sustainability.<br>There are Quick Win specifications for construction products (e.g. lighting, heating and insulation). These have recently been updated to reflect the latest market average values. | The recently published EU Green Public Procurement criteria include comprehensive criteria for construction products. We plan to review these criteria before they are adopted across central Government. |

The UK's plans are set out in the 2007 UK Government Sustainable Procurement Action Plan and similar plans published by the NHS and Local Government, whilst the Government response to the Commission on Environmental Markets and Economic Performance includes information on how public procurement will capture and stimulate innovation, including through application of the 'forward commitment procurement' model.

One action is the establishment of a Centre of Expertise on Sustainable Procurement within the Office for Government Commerce. The Centre will focus on rapidly building departmental capacity to deliver the Sustainable Procurement Action Plan commitments and the Sustainable Operations on the Government Estate targets and help to ensure that Departments have the incentives, capabilities and capacity needed to make full use of recommended sustainable procurement standards.

# APPENDIX V: CODE FOR SUSTAINABLE HOMES

It is anticipated that the UK Code for Sustainable Homes will become more and more engrained in building regulations. In July 2007, the UK Government published a paper ("Building Regulations - Energy efficiency requirements for new dwellings - A forward look at what standards may be in 2010 and 2013"), which anticipated that the building regulations would reflect the Code within the following time frame:

| Date | 2010 | 2013 | 2016 |
|---|---|---|---|
| Building Regulations Minimum Code rating | Level 3<br><br>(i.e. 25% improvement on energy efficiency compared to 2006) | Level 4<br><br>(i.e. 44% improvement) | Level 6<br><br>(i.e. zero carbon) |

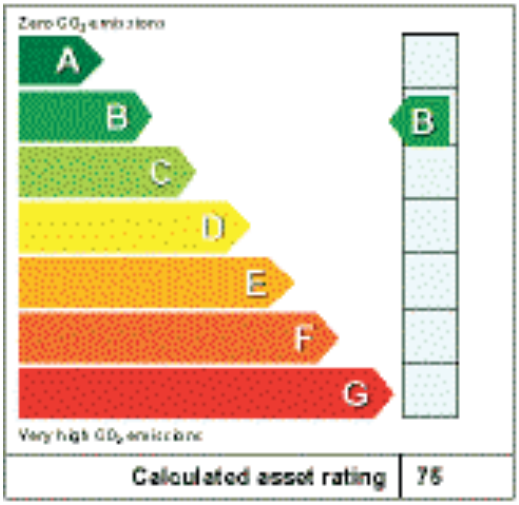
## Impact of the proposed new standards for 2010

The following table illustrates the standards and measures which would be necessary in a 100 sq mtr detached house, to comply with the targeted standards set for 2010 (i.e. Code Level 3).

This package focuses principally on envelope measures and uses a conventional condensing gas-fired hot water central heating system. However, the full impact of the proposed standards will depend on future developments in construction systems and in building designs and how these are taken into account in the prospective revisions of SAP.

| Compliance package for 2010 for 100m$^2$ gas heated detached house | |
|---|---|
| **Roof** | Average U-value 0.14 W/m$^2$K, eg a fully filled 300 mm deep timber I-beam structure. |
| **Walls** | Average U-value 0.22 W/m$^2$K, eg a masonry wall with a 150 mm cavity fully filled with fibre insulation. This would give an overall wall thickness of 370mm. In timber frame, this would require 89mm studs with around 70mm external insulation, giving an overall wall thickness of around 350mm. Structural concrete block walls with external insulation and render with thicknesses of around 300mm would also be possible. |
| **Ground floor** | Average U-value 0.17 W/m$^2$K, eg 150 mm expanded polystyrene (EPS) or equivalent under slab insulation and edge insulation |
| **Windows and doors** | Average U-value 0.9 W/m$^2$K; high performance triple glazed windows, with soft-coat low-e glazing, Argon fill and warm edge technology. (Note safety glazing required by the Building regulations Part N would have to be laminated rather than toughened.) |
| **Thermal bridging allowance** | 0.04 W/m$^2$K; this is a reduction (improvement) of 50% on the current default allowance, and can be achieved through improved construction details such as separate inner and outer lintels in masonry cavity walls. |
| **Ventilation system** | High performance mechanical extract ventilation, typically a specific fan power of 0.4 W/litre/s. |
| **Air** | 3 m$^3$/hour/m$^2$ at a differential pressure of 50 Pa. One way of achieving this is to parge, plaster or |

| | |
|---|---|
| **permeability (resistance to air leakage)** | screed inside surfaces of walls, ceilings and floors. |
| **Hot water central heating** | Boiler 90% (SEDBUK band A) plus thermostatic controls package – SAP control type 2 |
| **Secondary heating** | 10% electric |
| **Hot water storage cylinder** | High recovery performance with 75 mm insulation. This sort of specification may require the labelling system referred to in paragraph 31f). |
| **percentage of low energy light fittings** | 70%, to be provided in rooms with greatest lighting demand |
| **Environmental index** | 75 $kgCO_2/m^2.a$, Band B – see graphic |
| **Code for Sustainable Homes energy level** | Level 3 |




The above compliance package contains U-values which, with the exception of the glazing, are roughly in line with the standards set out in Section 6 of the 2004 consultation package.[1] Construction systems that deliver these U-values have already been developed and published[2]. Indeed standards in advance of these are part of the Passivhaus[3] standard, which typically requires U-values for opaque elements such as walls, roofs and floors in the range 0.10 to 0.14 $W/m^2K$. For those designers who wish to pursue the advanced envelope route, this Passivhaus experience available from mainland Europe will provide a useful source of experience from which the UK industry can benefit.

The impact of low energy lighting is significant in this case. If the percentage of low energy lights in the package changed from 70 per cent to 100 per cent, this would compensate, for example:

b) For the adoption of natural ventilation and a reduced air permeability specification of 9 (rather than 3) $m^3/(h.m^2)$ at 50 Pa;[4]

[1] Overall wall thickness was a big issue for the industry at the last revision. This will be a particularly important issue for discussion.

[2] AECB Silver Guidance. www.carbonlite.net.

[3] Passivhaus. www.passivhaus.org.uk

[4] This is around the performance level builders are now achieving in response to the 2006 amendment.

b) Or a combination of natural ventilation with an air permeability of 6 $m^3/(h.m^2)$ at 50 Pa and window U values of 1.1 (rather than 0.9) $W/m^2K$.

Another important issue is the secondary heating. If there was no secondary heating provision this would allow, for example, the adoption of natural ventilation with an air permeability specification of 9 $m^3/(h.m^2)$ at 50 Pa and windows with a U value of 1.1 $W/m^2K$.

Clearly, if both the percentage low energy lighting and the assumption about secondary heating were allowed to vary from the current rules, other compensatory reductions in specifications would also be possible.

**Impact of the proposed new standards for 2013**

This section illustrates the measure and packages that would be necessary in 2013 for a $80m^2$ semi-detached or end-of-terrace house and consider both gas and electricity options[5]. To re-emphasise however, these packages are illustrative and developers will seek a range of approaches depending on the impact of future developments in construction systems and building designs and how these are taken into account in the prospective revisions of SAP. These options include an estimate of the emissions from appliances as well as space and water heating and lighting.

Three possible compliance packages and resulting emissions for gas and electricity are set out in the following table.

[5] The application of bio-fuels has not been explored in this analysis because it is considered unviable as a mainstream fuel for the foreseeable future.

| **Illustrative compliance package for a 2013 80m$^2$ semi-detached dwelling** | | | |
|---|---|---|---|
| **Element** | **Gas** | **Electricity** | **Electricity – low U** |
| **Roof (U – W/m$^2$K )** | 0.08 | 0.16 | 0.08 |
| **Wall (U – W/m$^2$K )** | 0.10 | 0.15 | 0.10 |
| **Ground Floor (U – W/m$^2$K )** | 0.09 | 0.15 | 0.09 |
| **Doors & Windows (U – W/m$^2$K )** | 0.70 | 1.2 | 0.70 |
| **Thermal bridging allowance (y)** | 0.02 | 0.06 | 0.02 |
| **Airtightness (m/h)** | 2 | 5 | 2 |
| **Ventilation** | MVHR | Natural | MVHR |
| **Heat loss parameter (W/K)** | 0.63 | 1.22 | 0.63 |
| | | | |
| **Space and Water** | 93% | GsHP* 224% | GsHP* 224% |
| **Area of solar collector (m$^2$)** | 4 | 0 | 4 |
| *** Ground Source Heat Pump** | | | |

In order to enable the gas case to achieve 2013 standards, further fabric improvements have been made to achieve the U values in the PassivHaus specification, together with an improvement in air leakage to 2m$^3$/h.m$^2$ @ 50Pa.

This results in a reduction of just under 60 per cent in the heat loss parameter (HLP) from 1.52 to 0.63 W/K and the introduction of solar water heating (4m$^2$). In practical terms the improved fabric insulation would require some 400 to 450 mm of mineral fibre equivalent in the walls, 450 to 500 mm in the roof, 250mm in the floor and high performance triple glazing in insulated frames, coupled with close attention to the avoidance of thermal bridging.

In the case of electricity as the primary fuel, small reductions in wall, ground floor and window U values are necessary in this example (HLP reduced by about 6 per cent), requiring some 200 – 250mm of mineral fibre insulation in walls, 150mm in floors and high performance double glazing in insulated frames. However, the main change is the introduction of a ground source heat pump capable of providing domestic hot water as well as space heating. The improvement in heat efficiency is enough to avoid the need for solar water heating. It is worth noting, however, that electricity is only able to comply if the concessionary fuel factor remains in the calculation of the TER. If this concession was removed then it would be necessary to improve

the fabric and, possibly, install solar water heating as well as installing a ground source heat pump.

The impact of the fabric improvements on space heating is marked with the gas and electricity–low-U options reducing space heating emissions to around 2 $kgCO_2/m^2$ per year and energy to some 10 $kWh/m^2$ per year. This is well within the PassivHaus standard of 15 $kWh/m^2$ per year. It is also important to realise, however, that even with PassivHaus standards the space heating requirement is unlikely to be reduced to zero.

The combination of a highly insulated envelope and a ground source heat pump running at an efficiency of 224 per cent (Electricity-low-U) results in total emissions just over 2 kg less than for gas. If the efficiency were around 300 per cent the reduction would be almost double at $3.7kgCO_2/m^2$ per year. Heat pump efficiency could be higher or lower than these values but the availability of reliable in-use data in the UK is sparse at present so further research will be needed to confirm real seasonal performance values.

The balance between the different energy requirements is now much more heavily focused on the appliance load and lighting. In the gas and electricity-low-U case these two sources account for between 60 per cent and 70 per cent of the total. The space heating load is very low leaving little room for further improvement and suggesting that the need for central heating systems will diminish and that other ways may need to be found to provide residual heating such as providing warm air heating through a mechanical ventilation system with heat recovery (MVHR).

It is likely that more could be done to reduce water heating demand through reduced water consumption (low flow taps, low flow showers instead of baths, cold fill appliances etc.) but it must be recognised that a residual water heating energy requirement will remain to be accommodated with energy from renewable sources beyond 2013.

## APPENDIX VI: ROI BUILDING (AMENDMENT) REGULATIONS 2008 (S.I. NO. 259 OF 2008) – TECHNICAL GUIDANCE: CONSERVATION OF FUEL AND ENERGY

The Technical Guidance document for Ireland's building regulations states that the ultimate aim for Ireland is to achieve zero carbon emissions associated with the operation and use of dwellings, at the earliest date practicable. However, no specific targets or legislation have been created to reflect this aspiration.

For new buildings the key issues to be addressed in meeting the building regulations regarding energy and fuel conservation are:

- Primary energy consumption and related $CO_2$ emissions;
- Use of renewable energy sources;
- Fabric insulation;
- Air tightness;
- Boiler efficiency;
- Building services controls;
- Insulation of pipes ducts and vessels;
- Mechanical Ventilation systems;
- Performance of completed dwelling;
- User information.

For existing buildings the key issues to be addressed are:

- Fabric insulation
- Air tightness
- Boiler efficiency
- Building services controls
- Insulation of pipes ducts and vessels

The following sub-sections detail the technical requirements for the above five issues, which are common to both new build and refurbishment projects.

### *Fabric Insulation*

In order to limit heat loss through the building fabric reasonable provision should be made to limit transmission heat loss by plane elements of the building fabric.

Acceptable levels of thermal insulation for each of the plane elements of the building to achieve this are specified in terms of average area-weighted U-value (Um) in Table 1 (Column 2) for each fabric element type. These values can be relaxed for individual elements or parts of elements where considered necessary for design or construction reasons. Maximum acceptable values for such elements or parts of elements are specified in Column 3 of the following table:

*Table 1* **Maximum elemental U value ($W/m^2K$)[1,2]**

| Column 1 Fabric Elements | Column 2 Area weighted Average Elemental U-Value (Um) | Column 3 Average Elemental U-value – individual element or section of element |
|---|---|---|
| Roofs | | |
| Pitched roof | | |
| - Insulation at ceiling | 0.16 | 0.3 |
| - Insulation on slope | 0.20 | |
| Flat roof | 0.22 | |
| Walls | 0.27 | 0.6 |
| Ground Floors[3] | 0.25 | 0.6 |
| Other Exposed Floors[3] | 0.25 | 0.6 |
| External doors, windows and rooflights | 2.00[4] | 3.0 |

**NOTES**

1. The U-value includes the effect of unheated voids or other spaces
2. For alternative method of showing compliance see Paragraph 1.3.2.3
3. For insulation of ground floors and exposed floors incorporating underfloor heating, see Paragraph 1.3.2.2
4. Windows, doors and rooflights should have maximum U-value of 2.0 $W/m^2K$ and maximum opening area of 25% of floor area. However areas and U-values may be varied as set out in Table 2

However, both the permitted combined area of external door, window and roof light openings and the maximum area-weighted average U-value of these elements may be varied as set out in the following Table 2. The area of openings should not be reduced below that required for the provision of adequate daylight. BS 8206: Part 2: 1992 gives advice on adequate daylight provision.

*Table 2* **Permitted variation in combined areas ($A_{ope}$) and average U-values ($U_{ope}$) of external doors, windows and rooflights**

| Average U-value of windows, doors and rooflights (Uope) ($W/m^2$ K) | Maximum combined area of external doors, windows and rooflights ($A_{ope}$), expressed as % of floor area ($A_f$) |
|---|---|
| 1.0 | 59.2 |
| 1.2 | 46.5 |
| 1.4 | 38.3 |
| 1.6 | 32.5 |
| 1.7 | 30.2 |
| 1.8 | 28.3 |
| 1.9 | 26.5 |
| **2.0** | **25.0** |
| 2.1 | 22.4 |
| 2.2 | 22.4 |
| 2.3 | 21.3 |
| 2.4 | 20.3 |
| 2.6 | 18.6 |

NOTE : Intermediate values of "combined areas" or of "U-values" may be estimated by interpolation in the above Table. Alternatively the following expression may be used to calculate the appropriate value:

$A_{ope}/A_f = 0.4325/(U_{ope} - 0.27)$.

This expression may also be used to calculate appropriate values outside the range covered by the Table.

***Thermal bridges at junctions and around openings***

The linear thermal transmittance (ψ) describes the heat loss associated with a thermal bridge. This is a property of a thermal bridge and is the rate of heat flow per degree per unit length of bridge that is not accounted for in the U-values of the plane building elements containing the thermal bridge.

Table D1 below sets out a set of target values for typical key thermal bridges encountered in dwellings. Thermal bridges which are in accordance with those contained "*Accredited Details*" (downloadable from Department of Communities and Local Government (London) website www. Communities.gov.uk) or the document "*Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details*" (to be published) satisfy these target values.

*Table D1* **Target linear thermal transmittance (ψ) for different types of junctions.**

| Junction detail in external wall | Linear Thermal Transmittance (Ψ) (W/mK) |
|---|---|
| Steel lintel with perforated steel base plate | 0.50 |
| Sill | 0.04 |
| Other lintels (including other steel lintels) | 0.30 |
| Jamb | 0.05 |
| Ground floor | 0.16 |
| Intermediate floor within a dwelling | 0.07 |
| Intermediate floor between dwellings[1] | 0.14 |
| Balcony within a dwelling[2] | 0.00 |
| Balcony between dwellings[1, 2] | 0.04 |
| Eaves (insulation at ceiling level) | 0.06 |
| Eaves (insulation at rafter level) | 0.04 |
| Gable (insulation at ceiling level) | 0.24 |
| Gable (insulation at rafter level) | 0.04 |
| Corner (normal) | 0.09 |
| Corner (inverted) | -0.09 |
| Party wall between dwellings[1] | 0.06 |

Note 1: For these junctions, half the value of Ψ is applied to each dwelling
Note 2: Refers to an externally supported balcony (the balcony slab is not a continuation of the floor slab)

***Air Tightness (Building Envelope Air Permeability)***

To avoid excessive heat losses, reasonable care should be taken to limit the air permeability of the envelope of each dwelling. In this context, envelope is the total area of all floors, walls (including windows and doors), and ceilings bordering the dwelling, including elements adjoining other heated or unheated spaces.

The primary elements that might provide a barrier will include sheathing, plaster, vapour control layer, breather paper etc.

A performance level of $10m^3/(h.m^2)$ is taken to represent a reasonable upper limit for air permeability.

***Boiler efficiency***

Regulation requires oil or gas fired boilers to achieve a minimum seasonal net efficiency of 86%.

***Building services controls***

Space and water heating systems should be effectively controlled so as to ensure the efficient use of energy by limiting the provision of heat energy use to that required to satisfy user requirements, insofar as reasonably practicable. The aim should be to provide the following minimum level of control:

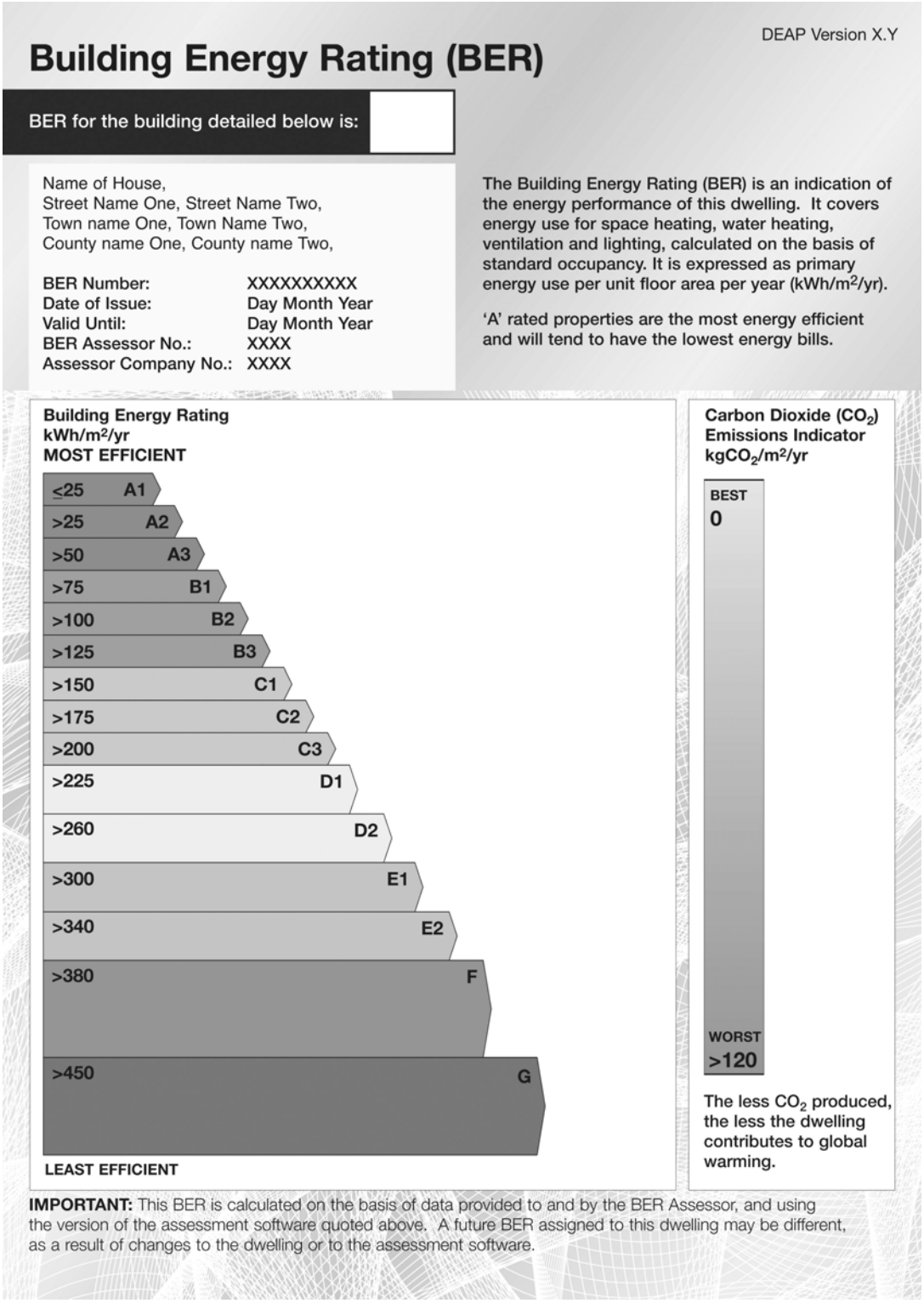
- automatic control of space heating on basis of room temperature; e.g. room thermostats and radiator thermostatic valves;
- automatic control of heat input to stored hot water on basis of stored water temperature; e.g. thermostatic valve on hot water cyclinder;
- separate and independent automatic time control of space heating and hot water;
- shut down of boiler or other heat source when there is no demand for either space or water heating from that source.

***Insulation of pipes ducts and vessels***

Adequate insulation of hot water storage vessels can be achieved by the use of a storage vessel with factory-applied insulation of 50 mm. PU foam having zero ozone depletion potential and a minimum density of 30 kg/m3 satisfies this criterion.

Unless the heat loss from a pipe or duct carrying hot water contributes to the useful heat requirement of a room or space, the pipe or duct should be insulated with material of such thickness as gives an equivalent reduction in heat loss as that achieved using material having a thermal conductivity at 400*o*C of 0.035 W/mK and a thickness equal to the outside diameter of the pipe, for pipes up to 40 mm diameter, and a thickness of 40 mm for larger pipes.

## APPENDIX VII: BER CERTIFICATE FOR A NEW DWELLING



DEAP Version X.Y

# Building Energy Rating (BER)

BER for the building detailed below is:

Name of House,
Street Name One, Street Name Two,
Town name One, Town Name Two,
County name One, County name Two,

| | |
|---|---|
| BER Number: | XXXXXXXXXX |
| Date of Issue: | Day Month Year |
| Valid Until: | Day Month Year |
| BER Assessor No.: | XXXX |
| Assessor Company No.: | XXXX |

The Building Energy Rating (BER) is an indication of the energy performance of this dwelling. It covers energy use for space heating, water heating, ventilation and lighting, calculated on the basis of standard occupancy. It is expressed as primary energy use per unit floor area per year (kWh/m$^2$/yr).

'A' rated properties are the most energy efficient and will tend to have the lowest energy bills.

**Building Energy Rating**
**kWh/m$^2$/yr**
**MOST EFFICIENT**

| | |
|---|---|
| ≤25 | A1 |
| >25 | A2 |
| >50 | A3 |
| >75 | B1 |
| >100 | B2 |
| >125 | B3 |
| >150 | C1 |
| >175 | C2 |
| >200 | C3 |
| >225 | D1 |
| >260 | D2 |
| >300 | E1 |
| >340 | E2 |
| >380 | F |
| >450 | G |

**LEAST EFFICIENT**

**Carbon Dioxide ($CO_2$) Emissions Indicator**
**kg$CO_2$/m$^2$/yr**

BEST
0

WORST
>120

The less $CO_2$ produced, the less the dwelling contributes to global warming.

**IMPORTANT:** This BER is calculated on the basis of data provided to and by the BER Assessor, and using the version of the assessment software quoted above. A future BER assigned to this dwelling may be different, as a result of changes to the dwelling or to the assessment software.

FORM OF BUILDING ENERGY RATING (BER) FOR NEW BUILDINGS OTHER THAN DWELLINGS

NEAP Version X.Y.Z

# Building Energy Rating (BER)

**BER for the building detailed below is: C1**

The Building Energy Rating (BER) is an indicator of the energy performance of this building. It covers energy use for space heating and cooling, water heating, ventilation and lighting, calculated on the basis of standard operating patterns. It is accompanied by a $CO_2$ emissions indicator. These indicators are expressed as respective ratios of primary energy use and $CO_2$ emissions, relative to what would apply for a similar building generally satisfying the Building Regulations 2005. 'A' rated properties are the most energy efficient and will tend to have the lowest energy bills.

Name of Building,
Street Name One, Street Name Two,
Town Name One, Town Name Two,
County Name One, County Name Two

| | | | |
|---|---|---|---|
| BER Number: | XXXX-XXXX-XXXX-XXXX-XXXX | Date of Issue: | Day Month Year |
| Building Type: | XXXXXX | Valid Until: | Day Month Year |
| Useful Floor Area ($m^2$): | XXXXXXXXXXX | BER Assessor No.: | XXXXXX |
| Main Heating Fuel: | XXXXXXXXXXX | Assessor Company No.: | XXXXXX |
| Building Environment: | XXXXXXXXXXX<br>XXXXXXXXXXX | Assessor Scheme: | XXXXXX |

Building Energy Rating (Indicator)
MOST EFFICIENT

| | |
|---|---|
| <0.17 | A1 |
| ≥0.17 | A2 |
| ≥0.34 | A3 |
| ≥0.50 | B1 |
| ≥0.67 | B2 |
| ≥0.84 | B3 |
| ≥1.00 | C1 |
| ≥1.17 | C2 |
| ≥1.34 | C3 |
| ≥1.50 | D1 |
| ≥1.75 | D2 |
| ≥2.00 | E1 |
| ≥2.25 | E2 |
| ≥2.50 | F |
| ≥3.00 | G |

C1
XXX kWh/$m^2$/yr
YYY

LEAST EFFICIENT

Carbon Dioxide ($CO_2$) Emissions Indicator

BEST
0
1.0
2.0
WORST
>3.0

Calculated annual $CO_2$ emissions
XXX kg$CO_2$/$m^2$/yr
YYY

The less $CO_2$ produced, the less the building contributes to global warming.

**IMPORTANT:** This BER is calculated on the basis of data provided to and by the BER Assessor, and using the version of the assessment software quoted above. A future BER assigned to this building may be different as a result of changes to the building, its use or the assessment software.

## APPENDIX VIII: PASSIVE HOUSE – STANDARD AND MEASURES

The key standards and measures for a Passive House are as follows:

| *Measure/ solution* | *Passive House standard* |
|---|---|
| **1. Super Insulation** | |
| Insulation walls | U ≤ 0,15 W/(m²K) |
| Insulation roof | U ≤ 0,15 W/(m2K) |
| Insulation floor | U ≤ 0,15 W/(m2K) |
| Window casing, doors | U ≤ 0,8 W/(m2K) |
| Window glazing | U ≤ 0,8 W/(m2K) |
| Thermal bridges | linear heat coeff ψ ≤ 0,01W/(mK) |
| Air tightness | n50 ≤ 0,6 h-1 |
| Minimal Shape Factor (Area TFA/ Volume TV) | |
| **2. Heat Recovery/ IAQ** | |
| Ventilation counter flow air to air heat exchanger | heat recovery ηHR ≥ 75 % |
| Ventilation air sub-soil heat exchanger | air outlet after sub-soil heat exchanger above frost temperature |
| Ventilation ducts insulated | |
| Other heat recovery (e.g. ventilation & DHW return pipes) | |
| DHW heat recovery | |
| DHW pipes insulated | |
| Minimal space heating | postheater ventilation air/ low temperature heating |
| Efficient small capacity heating syst. | biomass, heat pump, gas, co-generation (e.g. district heating), etc. |
| Air Quality through ventilation rate | min. 0,4 ach [1] or 30 m³/pers/h or national regulation if higher |
| **3. Passive (Solar) Gain** | |
| Window glazing | solar energy transmittance g ≥ 50 % |
| DHW (solar) heater | |
| Thermal mass within envelope | |
| Solar orientation | |
| Night-time shutters | |
| Shading factor [%] (East & West) | |
| **4. Electric Efficiency** | |
| Energy labeled household appliances [Labeling A - G] | Energy reduction 50% of common practice |
| Hot water connections washing machines/ dishwashers | |
| Compact Fluorescent lighting | |
| Regular maintenance ventilation filters | |
| Direct Current motor ventilation | |
| Efficient fans: SFP (Specific Fan Power) | ≤ 0,45 W/(m3/h) (transported air) |
| **5. On-site Renewables** | |
| Wind turbine | |
| Photo Voltaics | |
| Solar thermal energy | |
| Biomass system | |
| Other | |

| | |
|---|---|
| | =basic measure/ solution |
| | =often applied optional measure/solution |
| | =other optional measure/ solution |

Between 2005 and 2007, an EU research project was undertaken (Promotion of European Passive (PEP) Houses - www.europeanpassivehouses.org) which looked at the extent to which passive house solutions have been applied or could be applied in individual member states.

The following sub-sections summarise the findings of the research project, looking at the application of the different aspects of the Passive House concept.

**Insulation (walls, roof, floors, windows & doors)**

The thermal envelope of a Passive House is the most prominent measure required to meet the Passive House criteria. Super insulation and maximum air tightness minimize the heat loss through the envelope.

The research project found that there was considerable diversity between member states with respect to the thermal envelope, such as:

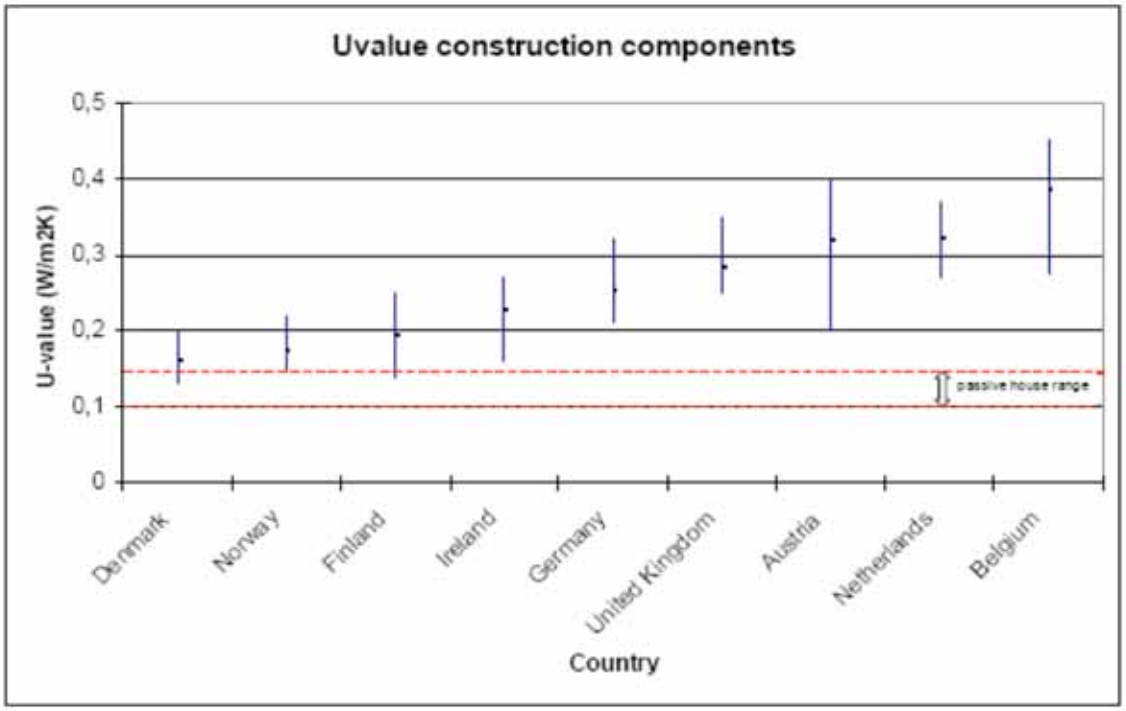
- Type of construction: wood or stone;
- Thermal mass: high or low;
- Type of finish: plaster or brick/ stone.

This diversity indicates that, within local constraints such as building tradition, regulations and availability of components, there are a variety of solutions that can comply with the Passive House standard.

With regard to glazing and window frames, the common practice across the members states was far from the Passive House standard of 0,8 W/(m2K). In the Netherlands for example, best practice in the building regulations is a U-value for window frames of 2,4 W/(m2K). Triple glazing, as well, is not a common measure.

The thermal insulation for walls roofs and floors applied in national common practice versus passive house construction is shown in the following graph.

**Average U-Values of construction components (wall, roof, floor) in European Countries**




As shown, applied U-values in common practice for the partner countries ranged from 0.16 to 0.39 W/m2K. Scandinavian countries show best thermal insulation in their construction, with the performance of the thermal envelope coming close to passive house criteria. In other cases the thermal envelope performance is far from Passive House standards and a catch up with respect to thermal performance of the envelope is needed.

The research study highlighted the following barriers and/or incentives with respect to insulation of the building envelope in the member states:

| Country | Barrier/ Incentive |
|---|---|
| **Austria** | An incentive is that good components are available for all envelope elements. |
| **Belgium** | Increasing the thickness of insulation in the brick cavity wall tradition is not feasible with the existing components.<br>Slow penetration of appropriate window casings.<br>Lack of air leakage standards for windows and doors. |
| **Denmark** | Lack of good window components.<br>Tradition of a brick cavity wall, which the market prefers, forms a barrier for realization of the PH standard for U-value of exterior walls. |
| **Ireland** | 1. Private developer housing<br>2. Boom in construction industry<br>3. Little construction site inspection<br>4. Poor workmanship<br>5. Leaky construction<br>6. Lack of passive house components on the market. |
| **Germany** | The brick cavity wall tradition in North Germany forms a barrier for realisation of the PH standard for U-value of exterior walls. |

| | |
|---|---|
| | An incentive is that good components are generally available. |
| **Netherlands** | Tradition of a brick cavity wall, which the market prefers, forms a barrier for realization of the PH standard for U-value of exterior walls.<br>Lack of appropriate window casing components on the market. |
| **Norway** | Lack of window casing components |
| **UK** | In traditional wall types there is a lack of items such as wall ties and lintels to reach these higher performance levels.<br>For Structural Insulated Panels this is not a problem.<br>With respect to walls site practices and skill levels are an issue.<br>With respect to roofs adoption of new details by large house-builders forms a barrier. However components are generally available.<br>Regarding floors carefully siting of insulation is required to avoid compression of the insulant.<br>With respect to doors there are problems with air leakage and thermal bridging. |

The brick cavity wall building tradition poses challenges in several countries. To meet these challenges, attention must be paid to good detailing, availability of appropriately dimensioned items (such as wall ties), and improvement of site practices. If the market conditions allow, alternative wall-types could be developed.

The other barrier that is encountered in several countries is the lack of good window components. However, in other countries (such as Austria and Germany) these components are readily available. By temporarily importing these components, this barrier can be overcome. As demand increases it is expected that local availability will improve.

***Thermal Bridges***

A thermal bridge-free construction is a basic Passive House measure. Linear thermal conductivity should be lower than 0,01 W/(mK) for connections in the thermal envelope in reference to external dimensions. Attention must be paid to correct detailing and execution thereof, especially around connections with window and door frames, floors, and roofs.

There are many different ways to minimize thermal bridges, dependant on the type of construction and elements applied. The values for linear thermal conductivity encountered in the Passive House examples ranged from -0.03 to 0.01 W/(mK). However, in common practice, linear thermal conductivity ranged from 0.03 to 0.3 W/(Mk). Countries like Germany and Denmark show a narrower range and lie closer to the Passive House standard than countries like the Netherlands and the UK, which show a wider range. With respect to thermal bridges, much attention in detailing as well as construction is still needed to comply with the Passive House standard.

The following barriers and/or incentives were with respect to thermal bridge-free construction in the member states:

| Country | Barrier/ Incentive |
|---|---|
| Belgium | Lack of knowledge and skills-on-site at the level of the sub-contractor. Lack of good details for passive houses |

| | |
|---|---|
| Denmark | Limited know-how |
| Germany | Partly good Passive House details provided by manufacturers (e.g. Isorast, Marmorit), partly knowledge deficits among planners/architects, minimum standard for thermal bridges required by building regulation, www.baudetails.info shows details and psi-values for refurbishment of old buildings with Passive House components |
| Netherlands | Limited know-how and limited contractor skills and inspections, possibly prefabricated elements could form a solution. |
| Norway | Variable contractor skills form a barrier. |
| Ireland | Limited construction detailing know-how, lack of construction skills and site inspections, poor workmanship. |
| UK | Lack of solutions and guidance |

***Air Tightness***

In the construction of Passive Houses, a great deal of attention must be paid to the air tightness of the building envelope, especially at connections between different elements, such as windows and doors. Through a blower-door-test, the air leakage of a house at 50Pa can be measured. The Passive House standard is $n_{50} \leq 0{,}6\ h^{-1}$

As with thermal bridge-free construction and good insulation, there are many different ways to achieve air tightness, dependant on the type of construction and elements applied. The value range for $n_{50}$ encountered in Passive House examples in the member state countries ranged from 0.2 to 0.61 h-1. Here again, attention is needed to comply with the Passive House standard.

Air tightness ($n_{50}$) for common practice in the members states was around:

Austria: 1 $h^{-1}$
Belgium: 7.8 $h^{-1}$ (recommended in national standard: 1-3 $h^{-1}$)
Denmark: 2,3 $h^{-1}$
Germany: 1.5 to 3 $h^{-1}$
Netherlands: 2.3 $h^{-1}$
Norway: 2 $h^{-1}$
UK: 4 $h^{-1}$

In most countries the common practice diverges considerably from the Passive House standard.

The barriers and/or incentives with respect to airtight construction were identified as follows:

| **Country** | **Barrier/ Incentive** |
|---|---|
| Belgium | Limited know-how (contractor, architects) |
| Denmark | Limited know-how |
| Germany | Increasing number of blower door tests in Germany (bonus in standard calculation method if a measurement is carried out) |
| Netherlands | Contractor skills and lack of on-site inspections form barriers to airtight construction. |
| Norway | Variable contractor skills form a barrier |
| UK | On site build quality and failure to check for continuous airtight barrier on |

| | |
|---|---|
| | plans are major problems |
| Ireland | Lack of builders skills, poor workmanship, lack of on site inspection, construction detailing know how. No air tightness measurement required by the building regulations |

As with thermal bridge-free construction, in several countries information and education are needed to overcome limited skills and know-how with respect to air tightness of the envelope. This is possible through standard details and training material for contractors and inspectors.

***Ventilation heat recovery***

Heat recovery in ventilation air can be applied with balanced ventilation, meaning mechanical supply as well as exhaust. This measure is essential to meet Passive House criteria.

The main element of a heat recovering balanced ventilation system is a heat recovery unit. Due to the low heat load requirement of a Passive House, the ventilation system can be used to heat the house. Alternatively, another possibility for heating a Passive House is to utilize low temperature heating (e.g. with few low temperature radiators) through a central heating system. Obviously, aspects such as ductwork insulation are measures taken in Passive Houses to optimize the performance of the system.

In Passive Houses examples in the member state countries, a ventilation air heat recovery of 75% - 90% was encountered.

In a few countries, such as Germany, heat recovery in ventilation air to minimize heat losses is hardly applied in common practice. However, in most countries this technique is available and has become a well-known measure. Common heat recovery rates vary between 65% and 90%. As illustrated below, the common practice in many countries already complies with the Passive House standard, and in the other cases the technology is available.

| Country | Distance to Target |
|---|---|
| Austria | T 75% heat recovery |
| Belgium | Ventilation of buildings only required from 2006 onwards (natural or (semi)mechanical), 90% heat recovery is available |
| Denmark | >65% heat recovery |
| Netherlands | Though existing houses have natural air supply and mechanical exhaust, current common practice is ventilation heat recovery of up to 95%. |
| Norway | None, though > 75% heat recovery is available |
| Germany | >75% heat recovery is available but the common practice is natural ventilation |
| UK | None, whilst it is common practice to naturally ventilate buildings, whole house mechanical ventilation systems with efficient (75% beyond)heat recovery systems are available |
| Ireland | None, most of new build dwellings have natural ventilation with mechanical extract in kitchens and bathrooms. High efficiency ventilation heat recovery systems are available from imports. |

The barriers and/or incentives identified with respect to ventilation heat recovery were as follows:

| Country | Barrier / Incentive |
|---|---|
| Austria | Good components are available |
| Belgium | Good components are available. Lack of installers involved in using these components. Lack of project-based quality assurance (regulation of air flows, usually no handbook for the user, installation in dusty environments, no attention towards recommissioning, correct dimensioning of additional facilities like ground/air heat exchangers, post-heating) |
| Netherlands | An incentive for application of ventilation heat recovery in the Netherlands is the upcoming stricter energy performance regulation, which stimulate the application of balanced ventilation with heat recovery.<br>On the other hand, in the case of balanced ventilation there is a need for service contracts, ensuring regular replacement of air filters. Due to negative experiences with indoor air quality if regular maintenance does not occur, balanced ventilation may get a bad reputation |
| Norway | The new building code will probably be an incentive |
| UK | No barriers |
| Ireland | High efficient mechanical ventilation systems are available from imports only. No incentives from building regulations. The common practice is natural ventilation with mechanical extract in kitchens and bathrooms |

Ventilation heat recovery does not pose any significant barriers for the development of Passive Houses in partner countries.

***Insulation of ventilation ducts and domestic hot water pipes***

To avoid heat loss, a Passive House requirement is to insulate the ventilation ducts and DHW-pipes.

Applying insulation of ducts and pipes is a measure that is readily available and applicable in all countries. The value range encountered in Passive House examples is from >6 cm - >10 cm for ductwork and around a factor 0.5 of the diameter of the pipe for insulation of DHW piping.

In about half of the member states studied, some form of insulation is applied in common practice. In the other half it is merely best practice. For the Passive House standard these practices will need to be adjusted, and there are few barriers to the insulation of pipes and ducts.

The following barriers and/or incentives were indentified with respect to insulation of ducts and pipework:

| Country | Barrier / Incentive |
|---|---|
| UK | No formal regulations in place and site practice can differ. With respect to insulation of piping, complete solutions are available. |

| | |
|---|---|
| | It is evident that this Passive House standard does not cause any significant barriers. The application of this solution requires attention in execution, but no complex components or specialized skills. |
| Ireland | Common practice is insulation of boilers, all pipes and cylinder |

***Minimal space heating for comfortable indoor climate***

In order to reach a comfortable indoor climate in a Passive House, a limited capacity heater is needed to provide the small heating demand that remains. There are different methods in which to produce this heat, for example by post-heating ventilation air, or installing low temperature radiators. One thing that these systems have in common is the small capacity that is required. The advantage of post heating ventilation air is that no additional infrastructure is needed to transport the heat.

Solutions encountered in the Passive House examples were:

- heat pump on geothermal heat & solar thermal collectors supplying small central low temperature floor heating;
- small biomass boiler & solar thermal collectors supplying central low temperature wall heating;
- solar-gas fired combination boiler feeds hot water battery in the ventilation circuit, heating ventilation air;
- district heating (water) and solar thermal collectors supply heat to ventilation air & radiator in bathroom;
- electric postheating of ventilation air;
- post-heating by means of a radiator in the bathroom.

The common practice for space heating in partner countries is listed below:

| Country | Common Practice for Space Heating |
|---|---|
| Austria | Wood pellets fired boiler with solar collectors for central low temperature wall and floor heating |
| Belgium | Condensing boiler (gas) for central heating with radiators and a thermostat for temperature control. Also fuel fired boilers. |
| Denmark | District heating, natural gas or oil boilers with water as heating fluid, supplying radiators and/or floor heating in the house with a thermostat for temperature |
| Netherlands | Gas heater HR (condensing boiler) for central heating with radiators and a thermostat for temperature control. Radiators are high temperature, low temperature radiators and floor/wall heating is applied sporadically |
| Norway | Electric heating (hydro-electricity) with baseboard panels and a thermostat for temperature control. |
| Germany | Electric heating (hydro-electricity) with baseboard panels and a thermostat for temperature control. |
| UK | Gas condensing boiler |
| Ireland | Oil fired boiler with water as heating fluid; thermostat control and radiator panels |

The two main overall differences identified between space heating in Passive House examples and national common practice are the heat source and the heat distribution in the residence. In the common practice the heat source is usually gas, while Passive Houses mostly use solar thermal heat in combination with another efficient heat source. With respect to heat distribution, common practice usually shows central heating with radiators (generally high temperatures), while the Passive House examples demonstrate low temperature heating through ventilation air or radiators or floor/ wall heating.

The barriers and/or incentives identified with respect to minimal space heating were as follows:

| Country | Barrier / Incentive |
|---|---|
| Austria | Good heat pump components are available, but it is still necessary to also find/ develop appropriate concepts based on renewable energy for lowest energy demands (DHW and space heating for Passive Houses or lowest energy buildings). Alternatives to the heat pump (compact unit) need to be developed. Also, at the moment AEE INTEC is trying to work out the potential and solutions for DH-concepts with solar and biomass in new settlement areas.<br>Austria is one of the world's leading countries in using solar thermal systems for DHW and for space heating. The quality of products is quite high but there is still a lack of high quality planning & installing large-scale systems. Plants for DHW in single-family houses are standard. Systems in a high quality, most of them realize as "plug-and-play" systems. |
| Belgium | Components are available (decentral needs market development). Clients have a fear that they will need extra heating and/or cooling or like to stick to a psychological fire-place. Installers stick to standards that require over-dimensioning and provide for large power safety margins. |
| Denmark | Duty of energy take within public district heating grid is in force, but may be abolished for low energy houses in new building regulations |
| Netherlands | The requirement for a certain level of heating capacity to comply with GIW guarantee (voluntary guarantee program, compliance with which increases market value of a house). |
| Norway | Barriers: Lack of affordable small bio-burners, low cost water based heating systems and heat pumps for DHW, only a few suppliers of solar collectors, and restrictive district heating legislation. Incentives: The upcoming energy labelling system. |
| Germany | There are hardly any technical barriers in Germany. |
| UK | Skills of the workforce and cost of building to the standard |
| Ireland | Solar thermal collectors for minimal space heating applications are expensive without funding. Heat pumps and low temperature under floor heating are becoming more widespread. Also, there is an Irish wood pallet burners manufacturer, and systems are becoming more available |

***Good indoor air quality through ventilation rate***

Good indoor air quality is of vital importance to the occupants of a residence. Indoor air quality is influenced greatly by the amount of fresh air that enters the dwelling. This fresh air replaces

stale air, which contains (biological) pollutants, excess moisture, and volatile organic compounds (VOCs), released from building materials, carpets, furniture and other household items as a result of aging, decomposition, or curing.

Due to the extreme air tightness of passive houses, close attention must be paid to the ventilation rate that is reached inside the house. Furthermore, attention must be paid to the noise level produced by the installation system. Due to the high insulation levels of the building, the building is more prone to higher noise levels, which can cause annoyance for the occupant.

The humidity of a climate can have an impact on the ventilation rate required to accomplish adequate indoor air quality. The Passive House standard for this measure is T 0,4 $ach^{-1}$ or 30 m3/pers/h, or the national requirement if it is higher. If this national requirement is much higher than the Passive House minimum, this will entail more heat loss for the Passive House in that country, which will need to be compensated in another way. In the Passive House examples acoss the member states studied, a value range of 0,22 – 0,69 $ach^{-1}$ was encountered

In all cases the minimum of 0,4 $ach^{-1}$ is reached in common practice, as indicated below. In fact, in many countries the national regulations lie (slightly) higher than the Passive House

| Country | Common Practice |
|---|---|
| Austria | T 0,4 $ach^{-1}$ or 30 m3/pers/h |
| Belgium | 30 m3/pers/h ventilation rate per room Denmark: ~ 0,5 $ach^{-1}$<br>Germany: ~ 0,5 $ach^{-1}$ |
| Netherlands | ~ 0,9 $ach^{-1}$ |
| Norway | 0,5 $ach^{-1}$ |
| UK | ~ 0,61 $ach^{-1}$ (recommended in national document 0,5 – 1,0 $ach^{-1}$) |
| Ireland | Recommended in building regulations:<br>- ventilation opening suitable for background ventilation having a total area not less than 6500mm2, and<br>- ventilation opening suitable for rapid ventilation having a total area of at least 1/20th of the floor area of the room.<br>For mechanical ventilation: 30 Lit/s mechanical extract in kitchen and utility rooms; 15Lit/s in bathrooms for mechanical extract. |

Besides the fact that building regulations requirements need to be satisfied, no other barriers have been identified. However, since Passive Houses have high air tightness, sufficient ventilation is more critical than in common practice, as the margin of error is smaller. Therefore sufficient attention must be paid to the actual realization in practice of the required ventilation rate.

***Window glazing and solar orientation***

By placing windows with a high solar energy transmittance (and a low e-value and U-value, as described earlier) in the residence and optimal orientation of the dwelling (windows towards the South), maximum advantage can be achieved from passive solar gains. (If applicable, well-dimensioned overhangs or awnings can be applied, to let the low winter sun enter the home, while in summer the window is shaded to avoid overheating.)

Generally, besides a high solar energy transmittance, windows usually have triple low emittance glazing and well insulated frames, which let in more solar heat than is consequently lost again

The value range for solar energy transmittance of windows in the Passive House examples across the member states studied lay at 45% and higher.

The common practice values for solar energy transmittance were as follows:

Austria: >50%
Belgium: 60-70%
Germany: 58%
Netherlands: 60-70%
Norway: 60-70%
UK: >50%
Ireland: >50%

The common practice U-values of glazing were as follows:

Belgium: 1,6
Germany: 1,5
Netherlands: 1,2
Norway: 1,6
UK: 2
Ireland 2,2
Finland: 1,2

The Passive House standard with respect to solar energy transmittance is generally applied in the common practice. However, the low U-value and low-e (triple) glazing is not generally achieved in common practice and requires attention.

With respect to solar energy transmittance value, no barriers were identified across the member states. However, careful choice in glazing type must be made in each individual situation. Barriers or incentives that have been identified with respect to solar orientation and glazing are listed below.

| Country | Barrier / Incentive |
|---|---|
| Belgium | Constructors are not used to handle heavy triple glazing. This requires extra manpower or facilities for lifting. Glazing is often placed after placing the window frame in an opening in the construction |
| UK | With respect to solar orientation local site factors can restrict orientation. The preferred South orientation is, however, recognized within building regulations. |
| Ireland | All triple glazed units have to be imported, as there is no manufacturer in Ireland. |

***Domestic hot water (solar) heating***

Not unlike any other type of residence, the Passive House requires a system that provides domestic hot water ("DHW"). As with space heating, it is important that the system is energy efficient and/or has a small capacity that meets demand.

Generally the DHW heating system in a Passive House is combined with the source for the space heating system. In the Passive House examples studied, the main solutions were: heat pump on geothermal heat & solar thermal collectors (1-2 m2 collector area/person) and/or gas heater; small biomass boiler & solar thermal collectors; solar-gas fired combination boiler; DHW storage provided by solar thermal collectors and/ or district heating.

Similar to the distance to target for space heating, the main overall difference identified between DHW heating in Passive House examples and national common practice was the heat source. In the common practice, the heat source is usually gas, mostly with storage, while Passive Houses generally use solar thermal heat with storage in combination with another efficient heat source.

| Country | Common Practice |
|---|---|
| Austria | Wood pellets fired boiler with solar collectors, combined with space heating |
| Belgium | Combi-kettle gas, combined with space heating |
| Denmark | District heating, natural gas or oil boiler supplies spiral in hot water tank,<br>combined with space heating |
| Netherlands | Gas heater HR (condensing boiler) for instantaneous DHW, combined with<br>space heating. |
| Norway | Electric heating (hydro-electricity) with storage for DHW, combined with space heating. |
| Germany | Condensing boiler (gas) with storage for DHW, combined with space heating |
| UK | Gas condensing boiler supplies hot water cylinder with 37,5 mm of spray foam<br>insulation, and medium duty coil (typically 15-25 min. recovery period) |
| Ireland | Wood pellets fired boiler with solar collectors, combined with space heating (as used in the only one passive house example in Ireland at present) |

The barriers and/or incentives identified with respect to DHW (solar) heating in Passive Houses were as follows:

| Country | Barrier / Incentive |
|---|---|
| Austria | Good heat pump components are available, but it is still necessary to also find/ develop appropriate concepts based on renewable energy for lowest energy demands (DHW and space heating for Passive Houses or lowest energy buildings). Alternatives to the heat pump (compact unit) need to be developed.<br>Also, at the moment AEE INTEC is trying to work out the potential and solutions for DH-concepts with solar and biomass in new settlement areas.<br>Austria is one of the world's leading countries in using solar thermal |

| | |
|---|---|
| | systems for DHW and for space heating. The quality of products is quite high but there is still a lack of high quality planning & installing large-scale systems. Plants for DHW in single-family houses are standard. Systems in a high quality, most of them realize as "plug-and-play" systems. |
| Belgium | Belsolar certification for solar heating equipment. Hot water temperatures defined according to the avoidance of legionella.<br>Lack of experience with heat recovery from waste water |
| Denmark | Duty of energy take within public district heating grid is in force, but may be abolished for low energy houses in new building regulations |
| Netherlands | Limited availability integrated (incl. passive) compact HR systems for DHW.<br>Lack of small heat pumps |
| Norway | Barriers: Lack of affordable small bio-burners, low cost water based heating systems and heat pumps for DHW, only a few suppliers of solar collectors, and restrictive district heating legislation.<br>Incentives: The upcoming energy labelling system |
| Germany | There are hardly any technical barriers in Germany |
| UK | Solar thermal collectors for DHW are not currently widespread, however very cost effective and available throughout the UK. 2006 building regulations are likely to drive uptake. Most European wide products are available |
| Ireland | Wide range solar thermal domestic hot water systems are available. However, insufficient training and certification schemes for designers and installers |

***Energy efficient appliances & lighting***

Regarding household appliances and lighting, the European Commission reports the following:

*"The energy demand in households accounts for 25% of the final energy needs in the EU. Electricity used for domestic appliances in households show the sharpest increase. Higher standards of living and comfort, multiple purchases of electric appliances and the growing need for air-conditioning are main reasons for this trend to prevail. Energy consumption by consumer electronics and new media as Internet is also steadily growing."*

Energy efficiency is a basic principle of the Passive House concept. However, despite its importance, efficiency of household appliances is designated as an optional Passive House solution.

As indicated above, household appliances account for a large portion of energy use. Applying energy efficiency requirements to household appliances will therefore have significant impact on energy use in a residence. However, household appliances are not necessarily considered part of a house, meaning control over the appliances used is not always with the designers/ builders of the house. Obviously this control varies per situation, type of appliance and local regulations. For example, in some countries certain residences are equipped with washer and full kitchen upon completion. In other situations no household appliances are included, and therefore there is no control over future appliances that are placed in the residence.

To influence efficiency of household appliances and lighting, the EU has responded with two complementary sets of legislation:

1. EU labelling schemes: Seen that the market of household appliances such as washing machines, dishwasher, oven, airconditioning systems etc. are highly visible to the consumer, the intention is to increase consumer's awareness on the real energy use of household appliances through a liable and clear labelling in their sales points. These labelling schemes are applicable to: Household electric refrigerators, freezers and their combination; Electric ovens; Airconditioners; Lamps; Dishwashers; Combined washers-driers; Electric tumble driers; Washing machines; Household Appliances.

2. Minimum Efficiency Requirements: Compulsory minimum efficiency requirements will encourage producers of household appliances to improve the product design in view to lower the energy consumption at their use. These efficiency requirements are applicable to: Fluorescent lighting; Household electric refrigerators, freezers and combinations; Hot-water boilers.

Generally, based on CEPHEUS findings, the Passive House standard regarding energy efficiency is an energy use reduction of 50% with respect to common practice. (This requirement partly coincides with the Passive House definition of a maximum total energy demand of around 42 kWh/m2.)

The Passive House and best practice examples in the member states studied recommended the use of A/ B rated appliances and energy savings lamps.

The common practice for energy efficiency of household appliances was:

| Country | Common Practice |
|---|---|
| Austria | Recommended: A/ B rated & energy savings lamps |
| Belgium | No appliances are specified in common practice |
| Denmark | No appliances are specified in common practice |
| Netherlands | No appliances are specified in common practice |
| Norway | EU labelling |
| Germany | No appliances are specified in common practice |
| UK | Where specified A & B rated appliances now most common, approximately 30% low-e lighting is required by building regulators |
| Ireland | A and B rated appliances are common |

Generally it can be concluded that, beyond EU legislation, not many energy efficiency requirements regarding household appliances have been established in the national common practices. This leaves plenty of room for improvement in the form of the energy use reduction of 50% with respect to common practice.

The following incentives were identified with respect to energy efficient household appliances and lighting:

| Country | Barrier / Incentive |
|---|---|
| Norway | Incentives: The upcoming energy labelling system |
| UK | Worse than D-rated appliances generally not available anymore |

In general an important barrier that is more or less applicable in all partner countries is the matter of control over appliances and lighting placed in the residence after completion.