
Report

UK Study Tour 2008

Overview and Main Findings

November 2008

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Executive Summary

In June 2008, Beacon Pathway initiated a tour to the United Kingdom to gather information and advice on the UK Code for Sustainable Homes implemented in April 2007. The tour included a three day stopover on the return flight to meet with government departments and other organisations involved in sustainable building initiatives in Hong Kong.

The Code for Sustainable Homes (the Code or CSH) reflects a strategic and systematic approach to meeting some strong drivers for improving sustainability in the United Kingdom, and provides significant stretch targets for the standards of sustainability to be achieved in the design of new homes and the timing of their implementation. Mandatory minimums (Building Regulation) and aspirational standards (Code for Sustainable Homes) are linked together with an integrated suite of interventions to improve the performance of new and existing housing, including: energy performance certificates, home information packs, certification to the Code for Sustainable Homes and the Building Regulations.



Figure 1: The team inspect the houses on the BRE innovation park

The high proportion (approximately 30%) of new housing that is procured through social programmes, and for which the funding is conditional on meeting higher sustainability performance than the Building Regulation requires, provides a strong influence for industry change. The high market share and role modelling through new social housing, plus future changes through stair-casing up the Code Levels being signalled early, provides even greater motivation for industry investment in change.

The industry is engaged, and is identifying market opportunities. Life cycle assessments of carbon emissions are well understood, and the industry accepts that robust information about the environmental performance of their products is vital to satisfying consumer demands for verification of environmental claims.

Decades of high quality research at the (UK) Building Research Establishment (BRE) has provided the technical foundation for the Code for Sustainable Homes. The Code specifies 6 levels of assessment for residential building sustainability. Solutions to Code Level 3 or 4 are practical and robust, and technological solutions exist for zero carbon housing (Code level 6), but at a high cost premium. Some of the solutions for zero carbon energy for homes potentially create a range of other problems such as poor indoor air quality and reliance on maintenance of mechanical systems. A detailed explanation of the Code and how it is to be implemented is covered in [The Code for Sustainable Homes section](#).

The UK faces the same challenge that New Zealand does in relation to its existing building stock. Although the Code for Sustainable Homes is intended to lift the overall performance through new builds and replacements, it is arguably too early in the transformation to be confident about the affordability of the higher standards and legacy issues that are likely to remain for many decades.

A stop-over in Hong Kong provided a contrasting example of the challenges of delivering sustainable development. Hong Kong is effectively totally dependent on imported energy. The cityscape is dominated by the ubiquitous 40 storey apartment buildings in which a population of 7 million people are accommodated in a land area of 1000 square kilometres. Cooling by natural ventilation to reduce energy consumption of air conditioning is a focus, both in the design of the individual apartment buildings and in the way they are grouped, spaced and oriented to allow sufficient “porosity” for air movement around them in such a densely developed urban environment.

Background

The UK Government has set a number of challenging targets for improving sustainability; starting with the overarching goal of a 60% reduction in carbon emissions in the UK by 2050. Some of the largest environmental impacts in the UK come from buildings. These include:

- 45% of total UK carbon emissions: 27% domestic, 18% non-domestic
- 73% of current domestic emissions arise from space and water heating
- domestic usage accounts for 58% of the public water supply. All other uses account for 24% with 18% being lost in the system
- 32% of all landfill waste comes from the construction and demolition of buildings
- 13% of products delivered to construction sites are sent direct to landfill without being used

Authorities and the building industry are aware that the UK cannot meet its declared environmental targets without dramatically improving the life-cycle environmental impacts of buildings. In response to this societal challenge, the Department for Communities and Local Government (DCLG) published their *Building A Greener Future* policy statement in July 2007, setting a timetable for all new homes to be zero carbon from 2016.

As well as setting the future trajectory of Building Regulations, this policy is supported by a range of other measures, including the Code for Sustainable Homes, the proposals for new eco-towns, and a time-limited exemption on stamp duty for new zero carbon homes. In addition, in the 2008 Budget, Alistair Darling (Labour MP and current UK Chancellor of the Exchequer) announced an ambition for new build non-domestic buildings to be zero carbon by 2019. The '*Low Carbon Building Standards Strategy for Scotland*' has prepared the way for similar targets and measures in Scotland.

There is awareness that the existing building stock also needs upgrading, although as yet there has been little action to support projects targeting the refurbishment and retrofit markets.



Figure 2: The wind turbine at RES which powers the restored and converted offices which used to be the Ovaltine egg factory

Aims of the Beacon Tour

The tour had five linked aims and objectives. These are outlined below with a brief synopsis of achievements.

Tour Aims

- *To introduce and inspire a group of building industry professionals, local and central government organisations and researchers to the idea of developing a New Zealand version of the Code for Sustainable Homes (the Code).*
- *To act as a catalyst, through the team building experience of the Tour, in developing a core group of champions to inform and stimulate the development of a sustainable building Code framework that is appropriate for the New Zealand context.*
- *To highlight to the group the market transformation success that has been experienced in the UK in relation to the residential built environment and sustainability.*
- *To provide the opportunity for experiential learning for participants in order that they can bring back case study information and new ideas to transform the market in New Zealand.*
- *To provide an opportunity for the group to make international connections with relevant government and industry professionals who may be able to assist New Zealand in the move to a more sustainable residential built environment - including the development of links which may result in the exchange of ideas, products and services between New Zealand and the UK that could benefit both countries.*



Figure 3: several members of the team outside the BRE office of the future

Introducing and inspiring the development of a Code for New Zealand

The tour succeeded in providing participants with an intimate understanding of the Code from a number of perspectives, which included central government, housing associations, research institutions and industry associations. Representatives of these organisations were particularly generous with their time and knowledge – providing the group with 22 presentations over five days.

Without exception all of the presenters supported the introduction of the Code. However, many of the presenters raised issues and posed questions regarding: the ability of industry to provide the construction capacity and skills needed to meet development targets; adequate timelines; and the additional cost of implementing the new housing performance standards required.

The group gained a thorough understanding of:

- The context and drivers for the introduction of the Code.
- The market dynamics of the residential building sector in England and Wales and more widely in Europe.
- The applicability and relevance of the Code to New Zealand.

Developing champions for a NZ Code system

The team comprised a comprehensive representation of New Zealand's building and construction industry including two architects, an engineer, a builder, a developer / NZRMBF president, and representation from central and local government, a major retailer and researchers.

Highlighting the market transformation successes brought about by the Code

The context for market transformation to carbon zero new homes has effectively been created in the UK through strong political leadership, robust policy frameworks, stretch targets and the strategies to deliver to those targets, all supported by sound science and research.

The immediate economic climate for publicly-listed building companies in the UK is not bright, clearly undermined by the sub prime mortgage crisis. However, the UK building industry has a strong secondary market of housing associations and housing trusts who deliver large volumes of social housing. This sector of the market appears to be less affected by changes in the economic climate as they are funded largely by government social housing grants. Access to these grants requires building to a minimum of Code Level 3 of the Code and they are already planning developments to Code Level 6 (the highest level of the Code).¹ Industry has responded to the challenge with the development of new products and systems aimed to meet specific Code targets.



Figure 4: This example of internal clothes drying caused some concerns about moisture sources and adequate ventilation.

¹ A 345 home development of an innovative, zero carbon neighborhood in the centre of Peterborough was announced recently - a consortium consisting of Morris Homes, Gentoo Homes, and Browne Smith Baker architects – designed to achieve Code 6.

<http://www.englishpartnerships.com/page.aspx?pointerid=323F5C7EAB0B489AA078F4C0C1E87D49>

Providing experiential learning generating new ideas to transform the New Zealand market

A number of potential concerns were identified by our group in relation to achievement of higher Code levels. Firstly, building designers and the building industry appear to have a poor grasp of IEQ and the control of internal moisture. This was particularly apparent in several of the display homes we visited where there were devices inside the house to dry clothes – i.e. clotheslines and clothes frames. It seemed the houses had lower levels of ventilation than may be optimal, which could lead to excessive internal moisture build up, especially during the winter season.

Secondly, (based on the display homes we saw and the discussions we had), it appears that the industry has followed a path of developing technical and mechanised solutions for achieving more sustainable homes rather than making the full use of passive strategies. As a result, many of the homes that achieve higher Code levels rely on more energy intensive systems and appliances.

They also have a potential to be more complicated for a home owner to operate at optimal levels. So, for example, if a full heat recovery mechanical ventilation system fails, the homeowner may fail to address the problem and as a result, could end up with a sub-optimal and possibly dangerous situation. There is a requirement for gas appliances (especially heating) to be checked annually to ensure safety and efficiency. However, this seldom happens.



Figure 5: The complexity of many of the technical solutions was staggering

The visit to Hong Kong was an extremely valuable experience in that it enabled the group to appreciate the scale of the residential sustainability challenge in a built environment where high rise apartments are the predominant form of residential living. Both government agencies who made presentations to the group were struggling to come to grips with energy efficiency, water conservation and outdoor environment quality in extremely dense housing developments. The Hong Kong regulators are just starting to engage with

LCA as a tool to better understand the overall system effects within building systems.

In contrast to New Zealand's PR campaign based focus, both of the government agencies visited devote considerable resources to public education through displays and demonstrations.

International connections and the development of links

The group met with a wide variety of organisations almost all of whom were keen to engage actively in more extensive contact and relationships outside of the remit of the tour. Several of the tour group government representatives met with their counterparts in the UK and Hong Kong and this is expected to foster closer links to further explore the development of the sustainability agenda in each country.



Figure 6 (left and right): Bill Dunster's BedZed provided an interesting insight into the role of the early adopter and 'the pioneer'

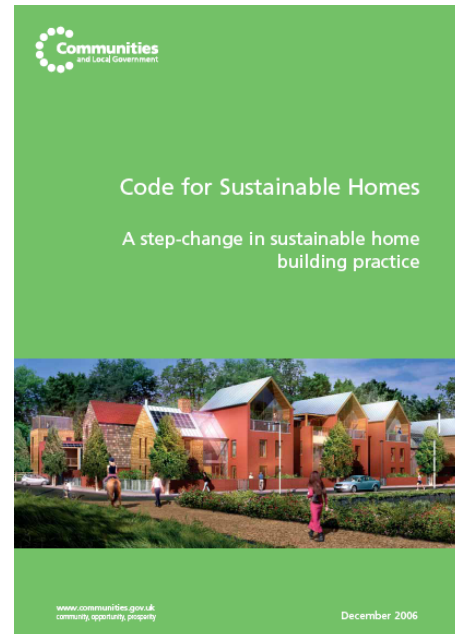


The Code for Sustainable Homes

Overview

The UK Code for Sustainable Homes (the Code) is a national standard for building homes in a more sustainable way, and came into effect in April 2007 (for England and Wales). The Code is administered by the Department of Communities and Local Government (DCLG), which also is responsible for the UK Building Code. The Code is an individual dwelling assessment, calculated at both the design and post construction stages. It builds on and effectively replaces the EcoHomes scheme in England which is owned and run by the Building Research Establishment (BRE)². DCLG contract the Building Research Establishment (BRE) to provide technical input, training, updates and research to support development of the CSH.

DCLG have a licence from BRE to administer the Code and BRE are responsible for upgrading the content and performance standards, maintaining technical guides and the training and licensing of assessors. Note: The Code is currently for new homes only. BRE have developed EcoHome XB – a rating tool for existing homes but, as yet, this has little industry traction.



At the core of the Code for Sustainable Homes is an environmental assessment rating method for new homes which:

- identifies a set of issues which are known to impact on the environment,
- establishes performance measures which:
 - are known to reduce these environmental impacts,
 - exceed the requirements of current legislation and regulations,
 - can be objectively assessed, evaluated and delivered in a practical and cost effective way by the construction industry.
- identifies environmental issues for which mandatory minimum performance must be achieved in order to gain a Code rating,
- assesses environmental performance in a two stage process (design stage and post construction) using objective criteria and verification,
- provides a record of the results of the Code assessment on a certificate assigned to the dwelling³.

² Eco-homes was only a design based rating tool and there was no check to confirm that actual construction complied with design.

³ Communities and Local Government, 2006

The Code was introduced to meet the government's target of all new homes being carbon zero by 2016, thereby contributing to the UK's carbon reduction targets specified to be achieved by 2050. It is anticipated that by 2050, 30% of the UK housing stock will be new homes constructed in the period 2008 - 2050. The UK Government is targeting 3 million new homes by 2020⁴.

Structure of the Code for Sustainable Homes

The Code provides every home assessed with a star rating from 0 to 6 stars (0 being the current building code level and six is a zero carbon home). There are nine categories of assessment and the Code requires minimum standards for key elements and rising standards for energy and water efficiency at each code level. The Code also provides flexibility with a range of tradable sustainability features in addition to the minimum standards.

The table below shows the nine design categories of the Code and the degree of flexibility afforded by each. The third group of 4 categories are those specified as tradable.

Table 1: The nine categories of the Code

Flexibility of the Code	
Categories	Flexibility
Energy/CO ₂ Water	Minimum standards at each level of the Code
Materials Surface water run-off Waste	Minimum standard at Code entry level
Pollution Health and wellbeing Management Ecology	No minimum standards

This is described as a 'regulatory escalator' signalling future regulatory standards and enabling industry to prepare for the introduction of progressively higher standards in future.

⁴ Several speakers acknowledged that this target is ambitious, based on annual new build of 240,000 whereas last year was 180k and this year anticipated to be less than 100k.

The table below shows the minimum standards and number of points required in order to achieve each level of the Code. Code level 1 is very achievable, Code level 3 is reasonably doable, and Code level 6 is very hard at this point in time (i.e. there is not a linear progression up the Code, and notably a big leap from Code level 4 to 6).

Table 2: Minimum standards to achieve a sustainability rating

Achieving a sustainability rating					
Minimum Standards					
Energy			Water		
Code Level	Standard (Percentage better than Part L ¹ 2006)	Points Awarded	Standard (litres per person per day)	Points Awarded	Other Points ⁴ Required
1(★)	10	1.2	120	1.5	33.3
2(★★)	18	3.5	120	1.5	43.0
3(★★★)	25	5.8	105	4.5	46.7
4(★★★★)	44	9.4	105	4.5	54.1
5(★★★★★)	100 ²	16.4	80	7.5	60.1
6(★★★★★★)	A zero carbon home ³	17.6	80	7.5	64.9

Notes

1. Building Regulations: Approved Document L (2006) – ‘Conservation of Fuel and Power.’
2. Zero emissions in relation to Building Regulations issues (i.e. zero emissions from heating, hot water, ventilation and lighting).
3. A completely zero carbon home (i.e. zero net emissions of carbon dioxide (CO₂) from all energy use in the home).
4. All points in this document are rounded to one decimal place.

At the time of the Study Tour it was estimated that a Code level 3 home would cost £3,000 – £5,000 more than a home of similar design built to the current Building Code requirements⁵.

Voluntary performance – mandatory to rate

The UK Government has introduced mandatory CSH certification for all new homes (effective from May 2008), however, at present actual performance to standards of the Code is voluntary. This means that all new homes have to have a CSH rating but it is currently not mandatory to achieve any particular level (consequently, if they do not achieve level 1 or the owners choose not to have the home assessed, then they will receive a nil rating certificate - see below). However, it has been determined that all new homes built with funding from the UK Housing Corporation must meet Code level 3.

⁵ Jeanette Henderson - DCLG

The road map produced by the ramping up of the Code requirements over time provides very clear policy signalling for industry. The fact that this is linked to future building code changes is creating a real and perceptible change in the market.

THE CODE FOR SUSTAINABLE HOMES

FINAL CERTIFICATE
(Issued at the Post Construction Stage)

ISSUED TO:
Test House, 1 Test Street,
Test Town, Test Country
TE1 5T1

The sustainability of this home has been independently assessed at the Post Construction Stage and has achieved a Code rating of 5 out of 5 stars under the April 2007 version.

★ ★ ★ ★ ★

Above Regulatory Standards Current Best Practice Highly Sustainable and Zero Carbon

The next page sets out how this home achieved its rating in the nine categories.

Licensed Assessor Mr L. Assessor	Assessor Organisation The Assessors
Client C L Ltd Ltd	Developer D E Developer Inc
Architect Arc 1 Texts	Certificate Number TEST - Certificate No 1
Date 12 Never 2006	Signed for and on behalf of BRE Global Ltd

This certificate remains the property of [Code Service Provider] and is issued subject to terms and conditions. Copies can be made for the purposes of the Home Information Packs. It is produced from data supplied by the licensed Code assessor. To check the authenticity of this certificate please contact BRE Global Ltd.

Communities and Local Government **Code Service Provider logo**

THE CODE FOR SUSTAINABLE HOMES

FINAL CERTIFICATE
(Issued at the Post Construction Stage)

Certificate Number: **TEST - Certificate No 1** Score: **150**

What Your Code Star Rating Means

Combined Score	36-47	48-56	57-67	68-83	84-89	90-100
Stars	1	2	3	4	5	6

The Code for Sustainable Homes considers the effects on the environment caused by the development and occupation of a home. To achieve a star rating a home must perform better than a new home built to minimum legal standards, and much better than an average existing home.

How this home scored

Category	Percentage of Category Score attained										What is covered in the category
	0	10	20	30	40	50	60	70	80	90	
Energy	[Bar chart showing 100% attainment]										Energy efficiency and CO ₂ saving measures
Water	[Bar chart showing 100% attainment]										Internal and external water saving measures
Materials	[Bar chart showing 100% attainment]										The sourcing and environmental impact of materials used to build the home
Surface Water Run-off	[Bar chart showing 100% attainment]										Measures to reduce the risk of flooding and surface water run-off, which can pollute rivers
Waste	[Bar chart showing 100% attainment]										Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials
Pollution	[Bar chart showing 100% attainment]										The use of insulation materials and heating systems that do not add to global warming
Health & Wellbeing	[Bar chart showing 100% attainment]										Provision of good daylight quality, sound insulation, private space, accessibility and adaptability
Management	[Bar chart showing 100% attainment]										A Home User Guide, designing in security, and reducing the impact of construction
Ecology	[Bar chart showing 100% attainment]										Protection and enhancement of the ecology of the area and efficient use of building land

Further detailed information regarding The Code for Sustainable Homes can be found at www.communities.gov.uk/thecode

This certificate remains the property of [Code Service Provider] and is issued subject to terms and conditions. Copies can be made for the purposes of the Home Information Packs. It is produced from data supplied by the licensed Code assessor. To check the authenticity of this certificate please contact BRE Global Ltd.

Communities and Local Government **Code Service Provider logo**

The front and back of the Final Certificate are shown here, indicating how the star rating system is displayed (above left) as a result of the scores attained in the nine sustainability evaluation categories (above right). This is provided for a house at the post construction stage.

Also shown, on the lower right, is an example of a NIL rated certificate. This strategy provides an effective mechanism to encourage owners to rate their homes against the Code, thereby assisting the consumer in making an informed decision. Time will tell as to how successful this is - but it seems inevitable that eventually home vendors will have to consider the question - who wants to buy a nil-rated home?

THE CODE FOR SUSTAINABLE HOMES

THIS HOME

Address
Address

This home is designed to meet the requirements of current building regulations.

It is not assessed against the Code for Sustainable Homes. The Code sets higher standards for a range of environmental sustainability features than current Building Regulations. It covers issues such as energy/carbon dioxide emissions, water efficiency and the use of materials.

As this home is not assessed against the Code for Sustainable Homes it can not be certified to meet the enhanced environmental performance standards set out in the Code.

The energy performance of this home will be shown on the Energy Performance Certificate.

NIL RATED

Developer Date

Rating system:
Nil rating: A home that has not been designed and built to meet the standards set out in the Code for Sustainable Homes. It has therefore not been formally assessed against the Code and has a 'Nil rating'.
1-6 star rating: A home that has been designed and built to the sustainability standards set out in the Code for Sustainable Homes. A 1 star home is entry level and a 6 star home being a highly sustainable, zero carbon home.
 More information can be found at www.communities.gov.uk/thecode

The Code for Sustainable Homes Assessment Process

The following figure indicates the process involved in rating a home to Code standards. Code assessments are carried out in two stages

- The design Stage (DS) which leads to an interim certificate; and
- The Post Construction Stage (PCS) which leads to a final certificate

Assessment for both stages is very similar and follows a process whereby evidence is gathered and used as the basis for a trained assessor to determine how many points to award for each issue covered under the Code. Further information can be obtained from the Code for Sustainable Homes Technical Guide available from DCLG⁶.

Figure 8: The Design Stage Assessment Process

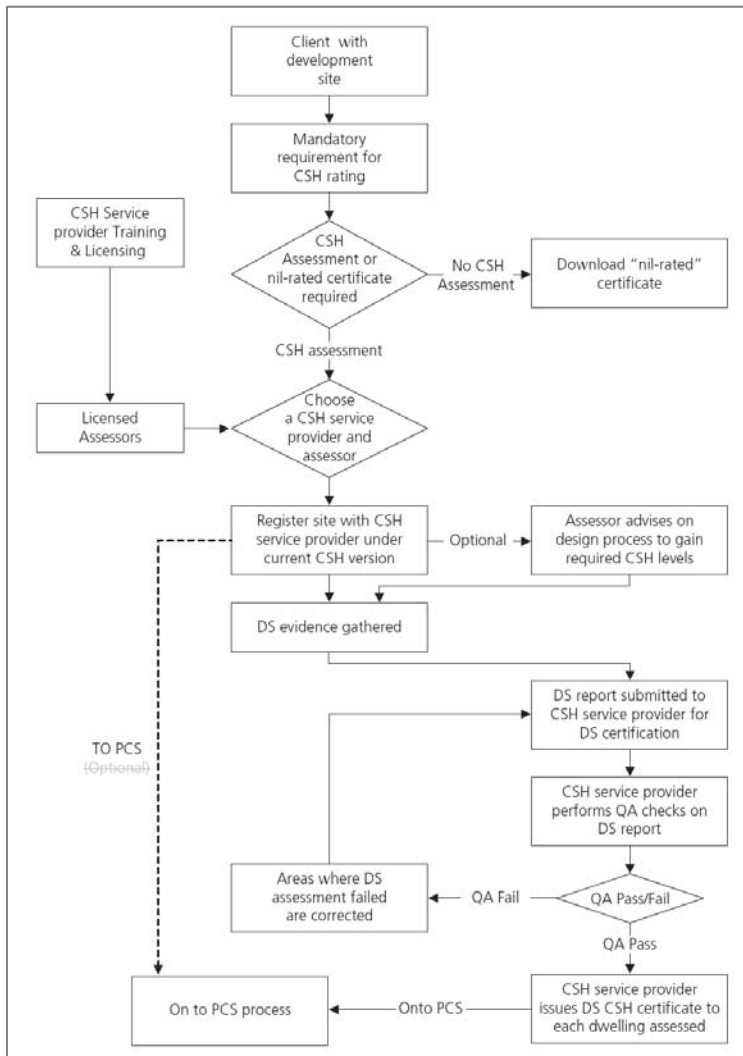
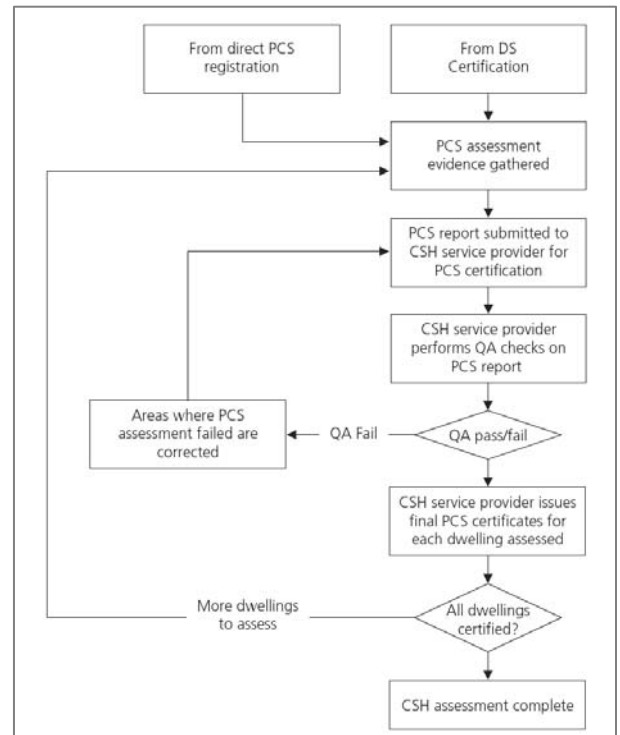


Figure 7: The Post Construction Stage Assessment Process



⁶ <http://www.communities.gov.uk/publications/planningandbuilding/codeguide>

Relationship with the UK Building Code and EU Regulations

The Code and the Building Code (BC) effectively work in tandem and both are managed within the same government agency, the Department of Communities and Local Government (DCLG).

Through the Code for Sustainable Homes, the DCLG is signalling to industry early, the likely standards which will become mandatory in future reviews of Building Codes, i.e.

DCLG is providing the future road map for Building Codes.

Having both the Code for Sustainable Homes and the Building Code in one agency provides the following benefits:

- Consultation and decision-making is under one organisation.
- Consultation and decision-making is robust and transparent and cost/benefit is clearly articulated. Affordability is considered and the Codes are not exclusive or privately owned.
- One rating tool has been nominated as the place for experts and industry to apply their efforts, thus avoiding the inefficiency of developing competing tools as, for example, is evident in the USA.
- Linking the CSH and the BC means good / better / best is clearly flagged (something the system of regulatory minimums doesn't do).
- Best is tested and able to be refined well before it becomes a regulatory minimum. This "trial" period ensures that unintended consequences resulting from the drafting of untested regulations can be avoided.
- The rating tool is used to signal the direction and timing of future changes to regulatory minimum performance standards which means, industry is forewarned and early adopters can initiate early implementation. Business planning and investment decisions are informed by the certainty of knowing to what extent the industry needs to change and when.

Prior to 2006 the Building Code set individual performance standards for the component parts of a building. Post 2006 there was a change to overall building performance, with the target rate for CO₂ emissions per m² being based on a 25% improvement on 2002 performance standards.

(NB: this is operating carbon from energy consumption, not embodied carbon).



Figure 9: The team inspect the inside of one of the Code Level 6 houses



Figure 10: The Kingspan Lighthouse, a Code Level 6 home with an extensive array of photovoltaics

As explained earlier, the Code for Sustainable Homes in effect only covers new build residential projects. However, European Union (EU) sustainable construction regulations also require compliance for “consequential improvements” when undertaking renovations. The UK government is a signatory to the EU regulations but has back tracked and currently only requires EU compliance for refurbishments or extensions that exceed 1,000 m².

Other regulatory tools

Under European regulations all homes require an Energy Performance Certificate (EPC) at point of sale or rental, although the houses do not have to meet a mandated performance level. Recent changes to UK legislation have meant that Home Information Packs (HIPs) are required for all new Homes and existing homes at point of sale. HIPs contain available local authority information relating to the house (similar to a LIM in NZ), as well as basic details about the condition of the house and energy performance information. For new houses there is a requirement to provide a manual (or ‘log book’) indicating how to operate the house.

As part of these HIPs, the house must have an up-to-date EPC in place which indicates the home’s overall performance. Calculations are based on the intrinsic elements of dwelling (usually as a result of a site visit), and comes complete with a list of suggested improvements.

The vendor pays for the Energy Performance Certificate which cost approx £100. The scheme has required the set up of an accreditation scheme of trained energy assessors to support the certification process. Currently the Department for Communities and Local Government are consulting around water efficiency for new buildings with the aim of bringing in tighter standards of performance to achieve water savings. If a local authority in the UK can demonstrate the requirement for higher levels of performance of housing in their area (for instance due to water shortages), then they can regulate accordingly by setting standards that exceed building code minimums.



**Figure 11: The Integer House at BRE.
Standing the test of time against
many of the new Code level homes**

Demystifying Carbon - Defining “The zero carbon home”

As the building industry responds to the need to meet government emission targets, the definition for “zero carbon” has been subject to debate within the UK. The Code currently defines “zero carbon” as meaning:

“...where net carbon dioxide emissions resulting from ALL energy used in the dwelling is zero or better. This includes the energy consumed in the operation of the space heating/cooling and hot-water systems, ventilation, all internal lighting, cooking and all electrical appliances. The calculation can take account of contributions from onsite renewable/low carbon installations. Off-site renewable contributions can only be used where these are directly supplied to the dwellings by private wire arrangement.”

Source: Code for Sustainable Homes, Technical Guide, April 2008

Initially, an option for offsite renewables was considered. However, Treasury later announced a stamp duty land tax relief scheme for zero carbon homes constructed up to 2012 and defined ‘zero carbon’ to exclude the use of off-site renewables that were not connected to the development by a private wire. Subsequently, the zero carbon definition in the Code for Sustainable Homes Technical Guide was amended as above to also exclude the use of off-site renewables, in order to be consistent with the Treasury’s definition.



Figure 12: An interim code certificate on display in one of the homes at the BRE Innovation Park



Figure 13: Integrated PV panels as part of a window detail at BedZed

Drivers for Change

There have been a number of significant factors driving the changes being experienced in the UK building industry and the sustainable homes market. These are briefly outlined below and provide a reference for comparison when considering whether the development of a similar Code approach is appropriate within the New Zealand context.

Global drivers

- The impact of climate change is increasingly evident through the frequency of extreme weather events. The effects being experienced in England include significant flooding events in the North East and more frequent and severe droughts in the South East.
- Changing demographics and increasing population (resulting from a large migration of people from continental Europe and beyond) driving increased housing demand.
- Constrained resource availability (refer below to UK energy focus)

EU drivers

EU Directives setting requirements for

- Increased Energy / Thermal performance,
- Energy Performance Certificates (EPC) and
- Home Information Packs (HIPS), at time of build, rental and resale.
- Certification of Installers.

UK drivers

Undoubtedly the Stern Review on the Economics of Climate Change, released in October 2006 played an influential role in driving a change in attitude and action in the UK. There is also a strong political will and leadership from central government to accelerate the rate of change toward more sustainable construction. The following section outlines the main drivers within the UK market in relation to the political, economic, social, technological and environmental contexts.

UK Political Context

The UK Government has the target to reduce CO2 emissions by 60% by 2050. New build housing targets have been worked back from there to the present day. Whether these targets are met or not will depend on how successfully a number of significant political objectives and initiatives are achieved. For example:

- The Government needs to ensure that the building industry is prepared to take up the challenge of providing:
 - more homes,

- more social housing,
 - more affordable housing
 - more sustainable homes.
- The Government has demonstrated leadership by introducing the Code for Sustainable homes through the Department for Communities and Local Government (DCLG). It is yet to be seen whether the timescales for “stair-cased” increases in performance standards are realistic and achievable.
 - As an EU member state, the UK is expected to support compliance with EU directives setting requirements for energy / thermal performance, the provision of Energy Performance Certificates (EPC) and Home Information Packs (HIPS) at the time of building completion, rental and resale.
 - For new buildings, the only method for demonstrating compliance with the energy efficiency section of the building code is to show that carbon dioxide emissions from the building meet a Target carbon dioxide Emission Rate (TER), measured in kgCO₂ /m²/year. The predicted emissions from the actual building design are known as the Building Emission Rate (BER) and may not exceed the TER; the previous elemental approach which looked at each element that made up the building, is no longer valid. In addition, buildings must meet various minimum design limits; however, meeting only these limits will not achieve the target emissions rate.
 - The 2006 revision of the Building Regulations aims to increase the energy efficiency of new buildings by at least 25%. Combined with the changes introduced in 2002, this was intended to deliver a 40% increase in energy efficiency standards over four years.
 - The Government’s eco-town initiatives are encountering significant NIMBY opposition. Issues being raised by existing communities will need to be resolved if they are to be accepted as an important and form of development.
 - To date, the sustainability of existing homes has received little government focus through the DCLG. Apparently this is considered to be the responsibility of the Department for Environment, Food and Rural Affairs (DEFRA).
 - However, the Existing Homes Alliance, a coalition of organisations formed in mid-2008, is calling for urgent action to transform the UK’s existing housing stock and make it fit for the 21st century. <http://www.existinghomesalliance.org/>
 - The Government is struggling with establishing an acceptable definition for “Zero Carbon” – see earlier discussion in the [Demystifying Carbon section](#).

UK Economic Context

- The building industry is lacking in capacity to deliver on the CSH and the present government targets for new housing. Further reference to this is made in the [UK Technological Context section](#).
- The Government does not require VAT to be paid on new build homes, but VAT is still payable on the refurbishment and/or retrofit of an existing home.
- No stamp duty is required to be paid on Code 6 Homes. The intention being, to provide a financial incentive to stimulate the early uptake of Code 6 performance standards. This initiative is estimated to give a savings/rebate of up to £15,000 per dwelling.

- UK new build homes comprise approx 13% of the construction sector (renovation about same).
- There has been a slow down in the number of new homes being built as a result of the current turbulence in the economy. Billions of £'s have been wiped off the share market capitalisation of publicly traded home builders and thousands of employees here laid off even in the short time the group was in the UK. Conversely, housing authorities and trusts appear to be continuing with their development programs and are set to become the dominant player in a market which is under economic stress.
- None of the over 20 presentations we received advocated against progressing the Code in the current market condition. However, there are obvious issues with:
 - housing affordability.
 - industry's ability to perform in a depressed economy
 - the cost for assessment of compliance
 - the continuing increases in construction costs as performance standards increase with the "stair-cased" timelines.
- Implementation of the Code requirements seems to be generally accepted and no one suggested it was a bad idea. Consequently, building industry organisations are now looking for commercial opportunities to provide products services and skilled construction workforce to meet the requirements for sustainable homes. For example, ConstructionSkills website⁷
- It is now widely accepted that the construction industry has a central role in delivering developments which are sustainable. 'No change' is not an option; therefore the economic implications will have to be accepted and addressed. ConstructionSkills⁸, for instance, is already planning how to provide the construction industry with a trained workforce that has the knowledge and skills necessary to build sustainably and thus realise the full commercial benefits.

UK Social Context

- A major undersupply of available housing is creating significant problems in the UK. The Government has set targets for the housing industry to deliver 240,000 new homes annually, with a goal of 3 million new build homes having been constructed by 2020. The Government expects new housing to comprise 30% of the total housing stock by 2050. Through the stair-cased timelines of the CSH, it is intended that, from 2016 onwards, all new homes will be rated carbon zero. However, in 2007 the industry delivered less than 180,000 houses and it seems likely to be less than 100,000 in 2008. If the number of homes constructed annually continues to fall below the supply targets and the population growth continues its upward trend, this will have knock on effects in relation to availability and affordability. This creates the potential for a significant negative social reaction.
- This situation may put increased pressure on the need for new social housing projects funded by local and/or central government. In most cases these are funded through Housing Trusts and/or Associations or funded through private public / partnerships. Already, such

⁷ Pers. Comm., Patrick Bowen. For more information please see <http://www.cskills.org/>

housing projects are required to achieve Code level 3 rating under the CSH, which in some cases will result in additional capital costs for construction.

UK Technological Context

- The biggest challenge and imperative for the building industry in the UK is to find methods of reducing carbon emissions produced by the existing housing stock. As a crude calculation, getting one poorly performing existing house to a CSH rating of Code level 6 would equate to the CO₂ savings achieved in delivering six new homes built to Code level 6.
- In 2007 a review was carried out by John Callcutt (former Chairman of English Partnerships) into the nature and structure of the house building industry and its capability to deliver increased housing supply in a low/zero carbon environment. One of the main conclusions of the review was that Industry's capability is considered to be wanting⁸.
- The industry appears to have the technologies, construction methods and products to build Code 6, Carbon Zero homes. However, the houses viewed at the BRE Technology Innovation Park suggested that there is a focus on mechanised and energy consuming technology based design solutions to achieve Code level 6 performance standards, rather than firstly exploring simpler passive solar and ventilation solutions, backed up with only those technological systems necessary to supplement any gaps in performance.
- So saying, to achieve the energy savings required for a Code level 6 house, new design approaches and technologies will be required. Other solutions displayed in the concept homes at BRE included, new insulation products (mostly requiring fully insulated wall thicknesses of over 200mm and in some cases up to 300mm), imported triple glazing, highly effective draft sealing of openings and solar technologies such as solar water heating and photovoltaics.

Environmental Context

- At all levels (government, industry and consumer) there is a strong awareness of need to take action to address climate change. The imperative to act is no longer an issue of debate.
- There is a shortage of suitable available land and planning for the location and scale of future sustainable developments and new communities is creating conflict (see the earlier discussion on the Eco Town proposals). An example of the locational risks that are having to be taken as a result of the lack of suitable land is the "Thames Gateway" project, a new development of over 200,000 homes being situated rather precariously on the Thames flood plain.

UK Focus on Energy

Several factors are driving the shift toward renewable energy sourcing in the UK and the setting of targets to lift generation from the current 4.5% renewable energy mix to an aspirational 20% renewable by 2020. These include:

⁸ For more information link to Callcutt review 2007
<http://www.communities.gov.uk/publications/housing/thecallcuttreview>

- Climate change and the need to implement far reaching emissions reduction targets (currently a 60% reduction set against 1990 levels has been suggested)
- Supplies of oil and gas are becoming more expensive and UK's reserves have peaked and are in decline. The need to strengthen UK energy security is an urgent priority. Reliance on Russia for the supply of piped gas is a politically unpalatable likelihood. The UK reliance on imports of natural gas is projected to rise from current 7% to over 70%.
- Nuclear power generation is set to make a declining contribution to electricity production as the current 14 power stations are taken out of service over the next 30 years. The Government has stated an acceptable solution must be found to deal with the existing stockpile of nuclear waste before any new plans for nuclear power are considered. Such a solution is currently not available. Even so, the British government has outlined plans to identify and assess sites that are suitable for new nuclear power stations in the future..
- The UK has large reserves of coal but the EU Emissions trading scheme will make the use of fossil fuels, especially carbon-intensive coal, less attractive in future.

Current residential market and response to Code for Sustainable Homes

In the UK, central and local government procurement and funding is being used to drive the residential market toward more sustainable outcomes through social housing developments which currently need to achieve Code Level 3 and by 2013 will need to achieve Code Level 6.

As stated earlier, in 2007 approx. 180,000 residential units were constructed. To achieve the Government's 2016 / 2050 targets the building industry must increase the number of new build homes constructed to an annual output of 240,000 units per year.

However, the collapse of financial markets and subsequent economic downturn has created a difficult environment for the larger public companies who usually delivered a bulk of the housing. The market valuation of publicly listed building companies has plummeted, and this has been accompanied by massive employee layoffs which may result in less than 80,000 new homes being built in 2008. However, it appears that the social housing sector (building to Code Level 3) is experiencing considerable growth.

Private enterprise housing starts (non-seasonally adjusted) were 27 per cent lower than the June quarter of 2007. In contrast, housing starts by Registered Social Landlords (non-seasonally adjusted) have risen 56 per cent over the same period. They are now at their highest quarterly level in eleven years.⁹

Major house building companies are starting to prepare designs for Code level 3 compliant home typologies that can be mass built in large scale development projects.¹⁰

⁹ UK Statistics Authority House Building: June Quarter 2008, England. In 2006 / 2007 Social housing represented 11% of housing starts. In the first quarter of 2008 Social housing comprised 21% of all new Housing starts.

¹⁰ Jeanette Henderson CLG, personal communication 30 June 2008

Achieving CSH Code levels 5 and 6 is a stretch goal but there is a sense of excitement in the building industry and this is driving the early development and uptake of new sustainable housing designs and technologies which will progressively change the form and functioning of homes over the next few years.

Main UK Stakeholders in the Development of the CSH

■ **Central Government**

- **Department for Communities and Local Government (DCLG);** Responsible for implementation(?) of the Code for Sustainable Homes and regulating the Building Code
- **Department for the Environment, Food and Rural Affairs (DEFRA);** Responsible for climate change and energy, sustainable development, environmental protection and research
- **Department for Business Enterprise and Regulatory Reform (BERR);** Responsible for promoting Government's sustainable development and waste strategies.
- **Department for Innovation, Universities and Skills;** Responsible for further and higher education, innovation, science and technology, intellectual property

■ **Housing trusts and Associations**

- Ownership and management of social housing

■ **Industry organisations**

- **National House-Building Council (NHBC);** The world's leading warranty and insurance provider for new homes
- **NHBC Foundation;** Housing research and development in conjunction with BRE Trust
- **Construction Products Association;** Represents 85% by value, of all manufacturers and suppliers of construction products in the UK
- **ConstructionSkills;** Key Services: Construction Skills Network, National Skills Academy for Construction, and Innovative Construction Skills Forum

■ **Research Organisations and Consultancies**

- **Building Research Establishment (BRE);** Responsible for conducting building research and development of the Code for Sustainable Homes.
- **InBuilt Consulting;** Sustainable development consultancy team which is a division of Renewable Energy Systems Ltd (RES).



Figure 14: The BRE innovation park provides real life examples of actual Code Level 6 houses - proving to the rest of industry that it is achievable

Unintended Consequences

Performance of New Technologies

It is evident, after visiting some of the first sustainable developments off the block (e.g. BedZED - the Beddington Zero Energy Development in Surrey), that performance doesn't always meet the design expectation for a variety of reasons. At times it is a case of leading edge is bleeding edge (as has been the case at BedZED, where a number of significant sustainability initiatives and systems have either failed or underperformed). Issues, such as who is responsible for carrying the costs of the experiment when it is less successful than anticipated, are not always clear.

Frequently, there are cases where manufacturers give optimistic promises about (for instance) new sustainable technologies but when their products are installed, actual performance falls short.

In seeking to achieve zero energy housing developments, there appears to have been a strong reliance on new emerging technologies which appear to have been adopted without rigorous testing (probably through manufacturers seeking "first mover" advantage in the new market). An unfortunate consequence of such examples is that there can be some industry and consumer "push-back" from the leading edge.

Risks associated with leading edge design and technology can be reduced through:

- Extensive research and rigorous testing before releasing products on to the market.
- The installation of new systems to specification followed by close monitoring of performance.
- Identifying and addressing skill gaps.
- Providing user / home owner training on the operation and maintenance of new systems.
- Identifying reasons why the predicted performance has not been achieved.
- Exploring different trialling models where the owner / developer of the technology and the home builder both have a stake in the benefits of successful installation and operation.

Failure to Take a Systems Perspective

The super-insulated homes required for high levels of Code performance need also to be very airtight. Several the demonstration homes visited by the tour group had facilities for drying clothes within the home, often beside bedrooms and in common areas. This practice suggests that there is a lack of appreciation of the relationship between moisture, ventilation and IEQ. The UK house building industry appeared to be only just



Figure 15: A high reliance on mechanical ventilation with heat recovery was evident in all of the Code Level 6 houses

becoming aware of the increased incidence of asthma and bronchial disease in super-insulated and draught sealed Scandinavian homes. It is highly likely that this issue will need to be addressed in the years to come.

The visit to the BRE demonstration homes raised the groups' awareness of the difference in the way we live in our New Zealand houses and several participants queried their expectations regarding the need for adequate fresh air and ventilation of our homes. To a certain extent this expectation will be different for different cultures and it may well be that, in the European environment, people are more prepared to live in sealed houses because of the more extreme winters, whereas in New Zealand we may have a greater desire for a closer connection with the 'outdoors' and what that means in terms of valuing clean, fresh air and reducing dependence on mechanical ventilation systems.

Managing Risk

The National House-Building Council (NHBC) has identified the inherent building / construction risks for the industry resulting from the effects of climate change and the need to develop innovative building systems that mitigate those effects, The NHBC has identified various other reasons driving innovation in the construction industry including:

- A desire to speed up the construction process.
- Reduction in the amount of work undertaken on site.
- Mitigation of situations that could potentially disrupt construction output such as, delays due to a shortage of skilled labour.
- Improvements to quality control.

Building innovation can take two forms: either

- innovations in the construction process or
- innovations in the end product.

The NHBC has developed educational resources to better prepare the building industry for the move toward more sustainable homes and processes to better manage any risks, The New Zealand industry could well learn from this approach. For more information see

<http://www.nhbc.co.uk/>

Significant Issues for New Zealand

The UK appears to have achieved broad consensus on the urgent need to reduce its energy demand, move to a low carbon economy and build more sustainable homes. They have a clear picture of the problem; they've worked out what needs to be done, when and why and are now in implementation phase. This phase of urgent step-change has been preceded by:

- Years of reports which have informed debate and set the framework for change
- EU directives
- Political engagement
- Policy alignment across the Government sector

As a result of the tough targets on carbon reductions in the UK, and the fact that their electricity mix is only 4.5% renewable, the UK Code for Sustainable Homes is heavily weighted toward rewarding reduction in 'operational carbon' which in practice is operational energy. If a Code for Sustainable Homes approach were pursued in New Zealand a different weighting may be applicable as a result of our electricity mix having a much larger renewables component.

As a member of the EU, the UK benefits from the collective intellectual grunt being applied to similar problems in similar countries. However, from another angle, the EU provides a common market for labour and materials, so UK companies operating in this market know they have to get up to speed or get left behind. The UK also has a responsibility to support and comply with EU regulations, directives and targets driving sustainability.

There has been a perceptible and dramatic shift toward greater levels of environmental and social responsibility. The majority of stakeholders from Government through to industry are competing to publicise their credentials in this market. The era of greenwashing in the UK is over - and the industry appears to recognise that they have a significant role to play in tackling the challenges that lie ahead.



Figure 16: Industry innovates - a panel of phase change material being trialled in one of the Code Level 5 houses



Figure 17: In order to meet the high water efficiency standards many suppliers are innovating. One example is this grey water recycling system that is designed to fit within the wall

The Code for Sustainable Homes is proving a very powerful tool which has the full support and commitment from central and local government agencies. Industry buy-in is also high although the message from some of them is that it is too much too fast. However, market transformation of the industry is occurring, in a large part driven by Government policy which is specifying that only homes that build to specific requirements in the Code will achieve funding. The industry players who are ahead of the game and meet stricter standards of the CSH are supportive of moving fast - as this secures their market dominance.

Part of the success of the Code is that it provides a vehicle for Government to set out a clear policy roadmap for industry. This clear policy signalling gives product manufacturers, developers and house builders an investment timeline and more certainty that the R&D required to change to more sustainable building practices will prove worthwhile.

One of the major differences between the UK and NZ is the dominance of local authority provided social housing and European partnerships for sustainable housing. This provides significant levels of funding for building new houses and, together, the organisations building social housing form a large and powerful client base. New Zealand does not have investment on this level from a single point in the market, and therefore we will need to find alternative ways of stimulating consumers to demand higher standards of housing across the board.



Figure 18: The team relaxing briefly before the onslaught of presentations begins...



Hong Kong

As part of the study tour arrangements, a stop-over in Hong Kong was organised to enable the Tour Group to experience and investigate a contrasting example of the challenges of delivering sustainable development. The challenge for Hong Kong is to find an intelligent balance between sustainability concerns and issues of density and compactness. Government is responding to environmental groups and downscaling development sites. But there is a danger that the pendulum is swinging too much the other way too fast. The consequence may be that, by drastically reducing the density of the city, it might lose some of its original strengths such as being extremely well integrated with a connected and walkable street pattern.

Hong Kong's infrastructure merges with its buildings. Mass-transit stations integrate with shopping centres. Pedestrian movement systems merge with architecture. There is no rigid demarcation between what is private and public and no strong psychological demarcation between one piece of architecture and the next, resulting in dynamic public spaces.

Public and private interests haven't merged well on large residential projects. The efficiency the developer is trying to achieve is so great that the resulting architecture ignores the basic requirements of good living units, such as good orientation, or that there should be adequate cross ventilation, or that they should not be overlooking other units. Usually such environmental considerations are given up in order to have as much usable area as possible squeezed out of the limited available land. By the same token, there are sustainability benefits in creating a compact city that can accommodate such a large population at very high densities.

Authorities in Hong Kong have started to down-zone most development to reduce the density of new sites. In two recent examples, they almost halved the amount of development that was previously permitted.

Historic preservation has become a priority. Over the last two years the government has been actively trying to preserve historic structures, for example, the Central Police Station and the old HKSB building.

Background

- Hong Kong imports 99.7% of its energy, the highest proportion of any country in the world. It produces only a small amount of electricity (0.05Mtoe¹¹), all from fossil fuel. Hong Kong therefore has a high imperative to be energy efficient as it is very sensitive to fluctuations in world energy prices.

¹¹ Million tonnes of oil equivalent

- Hong Kong has a population of 7 million in an area of 1,000 square kilometres. In Kowloon, density is very high at 43,000 people per square kilometre (compared to 27,000 in Manhattan and 4,000 in Wellington city).
- Hong Kong has 2.2 million households. The residential sector is typically high rise blocks of flats, with an average size of 55-60 square metres to house a family of four or five. One third of the population lives in public rental housing.
- Hong Kong's climate is sub-tropical, tending towards the temperate for half the year. Mean relative humidity is 77%, and summer temperatures get above 31°C. Air conditioning is common and on most apartment buildings individual AC units are fitted on the exterior wall of almost every flat.
- The residential sector uses 5,700 kWh of electricity per capita. This compares to New Zealand use of about 8,000 kWh, which is likely to reflect our larger house sizes and greater heating requirements.

Hong Kong Professional Green Building Council

- The Tour Group met with and received a presentation by members of the Hong Kong Professional Green Building Council.
- The Hong Kong Professional Green Building Council is not affiliated to the World Green Building Council, but it has similar goals. The Council has four focuses: existing buildings, renovation, planning, and new buildings.
- The Council's Zero Carbon Charter promotes the integration of higher energy efficiency and improved air quality strategies into the built environment. It encourages at the development planning stage, consideration of urban design principles that promote walking, and that introduce greenery to mitigate the heat island effect. Hong Kong is getting hotter, so the introduction of urban greenery into town planning is getting more important.
- The Charter encourages building efficiency through: spatial planning; built form and orientation; building envelope design and materials and passive features for natural ventilation and daylight.
- The Charter also encourages energy efficient lighting, and renewables, energy meters to monitor energy use of major systems, and energy efficient appliances.
- In terms of demand side management, the Charter aims to reduce electricity consumption during peak times, and to achieve higher levels of building energy efficiency overall.
- The Council noted a recent change towards renovating existing buildings, rather than demolishing and rebuilding housing. One problem that has arisen is that many buildings in Hong Kong were made with concrete using salt water, as fresh water was scarce at the time. This has caused the concrete to deteriorate, making renovation more difficult and expensive as the basic structural integrity of the building has been compromised.
- The Council has conducted studies in air ventilation assessment, and how building design can facilitate the flow of cooling air through a building. Not much work has been done to date on wind and buildings in the tropics, so this is relatively new research. The outbreak of SARS, an airborne respiratory virus, in 2003, also triggered this work, in order to create a healthier environment within buildings to reduce virus transmission.

Electrical & Mechanical Services Department, Kai Tak

- Another presentation was given to the Tour Group at The Hong Kong Government's Electrical and Mechanical Services Department.
- The Hong Kong Government's Electrical and Mechanical Services Department (EMSD) established an Energy Efficiency Office (EEO) in 1994, to provide the technical expertise and the drive for energy efficiency and conservation programmes.
- The EEO issues codes of practice, such as Building Energy Codes, establishes guidelines, and is actively involved in working groups and related committees in the efficient use and conservation of electricity. Additional initiatives range from energy management to database management, benchmarking, the exploration of advanced energy efficiency technologies, and energy efficiency labelling schemes, to promoting wider use of new and renewable energy.
- The group was given an extensive guided tour of the organisation's headquarters which is housed in a renovated building which used to be an air cargo terminal at the old Hong Kong Kai Tak Airport. When the airport was relocated, the terminal was unused. After careful feasibility studies, the Hong Kong Government decided to convert it into the new headquarters for the Electrical and Mechanical Services Department. Converting the building compared favourably to the cost of a new development, and minimized demolition and construction waste. The concrete structures, built in the early nineties, were recycled to save a huge amount of energy and building materials in the construction process.
- Many sustainable features have been incorporated in the building design, including:
 - photovoltaic panels covering the roof to generate electricity;
 - an ice maker and tanks and ammonia chillers to cool internal air;
 - ventilated double-layered glass walls, metal sun shades and perforated panels to reduce solar gain;
 - green roofs;
 - sun-pipes and skylights to improve internal light
 - motion & daylight sensors to control electrical lighting
 - grey water recycling
 - waste management; and
 - infra-red systems and electric heater units for paint booths.
- The project was awarded the Merit Award of the Hong Kong Institute of Architects 2004 in recognition of excellence in architecture.
- The solar photovoltaic system installed on the roof



Figure 19: The impressive solar PV array of over 2,300 panels on the EMSD building roof

is the largest of its kind in Hong Kong, consist over 2,300 photovoltaic panels. The area is large and impressive. The power output is, however, only 3% of that required by the building, and the payback period for the investment is in the order of 25 years. EMSD commented that its main function is for demonstration.

- The wind turbine installed on the roof is 1kW in rating, and as such is purely for demonstration purposes.

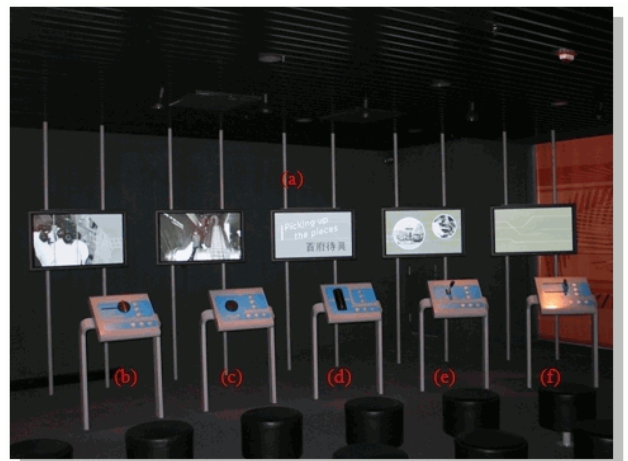
Kai Tak Indoor Games Hall

- The Energy Efficiency Office (EEO) of the Electrical and Mechanical Services Department runs a Pilot Energy Management Opportunity (EMO) Implementation Programme using innovative energy efficient equipment.
- The EEO recently completed a pilot lighting project at East Kai Tak Indoor Games Hall, which cut energy consumption for lighting by nearly half. The existing high intensity discharge (HID) metal halide and high pressure sodium lamps were replaced by the latest high output T5 lighting technology which were more energy efficient and provided a more comfortable visual environment for sporting activities.
- Power consumption was 17.2kW for the existing lighting system. Measurement on site for the new T5 lighting system was 8.7kW, a power reduction of almost 50% in lighting. The average illuminance measured at floor level was found to be increased by 58%. The total cost of the pilot project was \$182,400 and the estimated payback period 3.7 years.

Exhibition Gallery





The EEO has an impressive exhibition gallery designed to promote energy efficiency and renewable energy through interactive exhibits and displays, including:

- A transparent walkway over a scale model of Hong Kong allows visitors to have a bird's eye view of the city's structure and urban design.
- Full scale models of typical state flats, fully furnished, both old and new, to show improvements in energy efficiency and design.
- A Swedish-designed exhibition involves visitors in 17 interactive displays to educate them about energy efficiency, conservation and renewables. The exhibition is entertaining and informative, and very well designed.
- An information show displayed on five screens in a compact theatre format (pictured below) play a video profiling Hong Kong's past and prospective sustainable development measures. The screens are interlinked, so that they behave as one panoramic screen, sharing and transferring images between them in a captivating display.



State Housing

- About 2 million people (one third of Hong Kong's population) live in public rental housing estates in 720,000 flats. There are a further 400,000 subsidised sale flats (ex state-owned flats sold at affordable rates to low-income tenants).
- The Hong Kong Housing Authority has committed to the construction of a large number of high-rise residential blocks to meet its target housing demand. About 40,000 units per year are built. The waiting list is about 110,000 families.
- Given the rate at which new public housing estates are being built, and the high proportion of public housing in Hong Kong, energy efficiency improvements in building design can quickly and significantly change Hong Kong's energy profile.
- The main initiatives to improve public housing seem to have been in the orientation and layout of buildings to maximise natural cross ventilation to cool apartments. Building design has progressed from simple blocks to cruciform-shaped blocks, which are best for providing access to cooling breezes for all apartments. Internal design utilises corridors with ventilation shutters to create cooling draughts.
- When locating blocks, consideration is given to their orientation in relation to Hong Kong's prevailing breezes to reduce the need for air conditioning.

	<p>Early (Mark 1) layout, Lei Ching Estate: parallel buildings can create heat islands with no breezes between them</p>
	<p>H type Shui Pin Wei Estate: the 'H' design improves cross-ventilation somewhat</p>
	<p>Cruciform Tai Hing Estate: Cruciform shape is so far the best improvement in building design for cross-ventilation</p>
	<p>New cruciform block, Chung Ming Court: The Hong Kong Housing Authority is continuing with the successful cruciform design for its newest housing estates</p>

Glossary

BREEAM - Building Research Establishment Environmental Assessment Method. Suite of environmental assessment rating tools designed and owned by BRE, first launched in 1990.

Climate Change - "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods"¹²

Code for Sustainable Homes - Government owned environmental assessment method for certifying and rating new homes in England. It was launched in December 2006.

Communities and Local Government - UK Government Department responsible for Communities and Local Government; owners of the CSH.

Carbon footprint – is “The total set of greenhouse gas emissions caused directly and indirectly by an [individual, event, organisation, product] expressed as CO₂e”¹³.

ECO homes - BREEAM Version for new homes, first launched in 2000 and now replaced in England for new dwellings by the Code. EcoHomes remains in operation for refurbished homes in the UK, and all dwellings in Scotland.

Energy Performance Certificate (EPC) - The Energy Performance Certificate in the UK records a home's energy and CO₂ emission performance rating which is calculated using SAP for dwellings. Energy Performance Certificates display the energy efficiency of a home on a scale of A-G. The most efficient homes – which should have the lowest fuel bills – are in band A. The Certificate also shows, on a scale of A-G, the environmental impact of the home. Further information available from www.homeinformationpacks.gov.uk.

Global warming - the increase in the average measured temperature of the Earth's near-surface air and oceans since the mid-20th century, and its projected continuation.

Greenhouse effect – the natural greenhouse effect is an important factor in heating the atmosphere: short wavelength solar radiation entering the Earth's atmosphere is re-radiated from the Earth's surface in longer infrared wavelengths, and then reabsorbed by components of the atmosphere. Without the natural greenhouse effect the average global temperature would be about -18°C. Due to the greenhouse effect the average global temperature is 15°C.

¹² UN (United Nations). UNFCC (United Nations Framework Convention on Climate Change). Rio de Janeiro, 1992.

¹³ [2] Carbon Trust UK. Definition of Carbon Footprint.
http://www.carbontrust.co.uk/solutions/CarbonFootprinting/what_is_a_carbon_footprint.htm

Greenhouse gases (GHG) –are emitted in the atmosphere and absorb infra-red radiation emitted by the earth's surface, causing a warming of the atmosphere. The Kyoto Protocol has set limits on six specific gases that contribute towards global warming. These are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. Water vapour, although not included in the GHGs that are covered under the Kyoto protocol, is contributing about 62 % to the greenhouse effect.

Global Warming Potential (GWP) - is a relative measure of how effective a gas is at absorbing infra-red radiation compared to CO₂. The GWP measures the total energy absorbed by 1 kg of released gas over a hundred years, relative to CO₂, (which is given a GWP of 1 kg CO₂ equivalents). Methane for example has a GWP of 25 kg CO₂ equivalents and Nitrogen Oxide a GWP of 298 kg CO₂ equivalents¹⁴. By converting all GHGs into kg CO₂ equivalents it is possible to add the effects of different GHGs up into an overall GWP of a specific material or process.

Home Information Packs (HIP) - In August 2007 the government introduced the requirement for Home Information Packs at the point of sale of a property. Further information available from www.homeinformationpacks.gov.uk

Licensed assessor - A competent person trained, examined and licensed by a Service provider (see Service provider) to carry out CSH assessments and recorded on the Service provider register of licensed assessors. Assessors may provide guidance on meeting the standard and may be a member of the design team. Where this is the case, the assessor shall advise the Service Provider of their position within the design team (e.g. Architect, Design Engineer, Energy Consultant, etc.) They shall also identify, document, review and manage all possible conflicts of interests so that these are eliminated. The Service provider reserves the right to audit such documentation and processes.

Licensed CSH assessment organisation - An organisation which employs one or more competent persons with respect to the Code, and also pays a licence fee to BRE Global or a sub-licensee to BRE Global to cover provision of support services including: management of the system; free telephone helpline; regular updates, and access to a private extranet.

Mandatory - A compulsory minimum entry performance requirement for achieving a Code rating

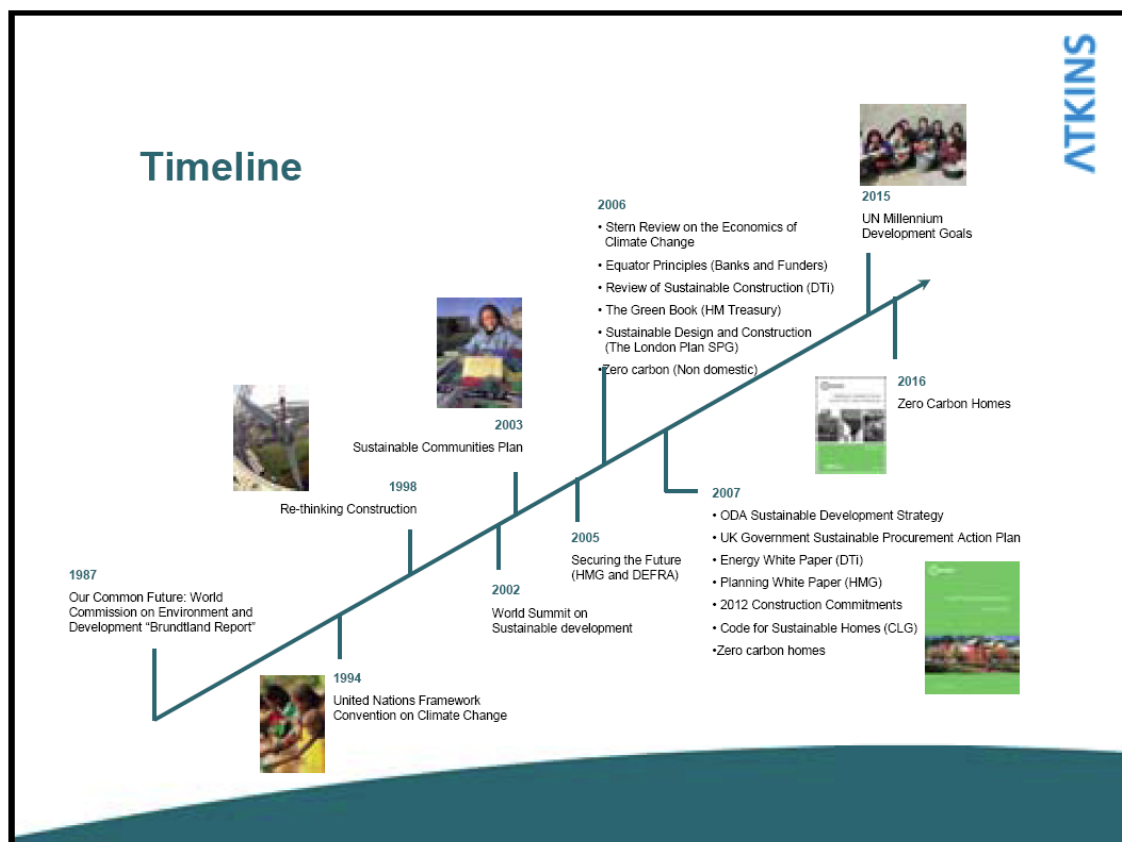
Service provider - A Service provider is any organisation licensed by (and including) BRE Global which offers training and accreditation services to Code assessors. All Service providers have to operate to the same standards that BRE Global are required to do under its contract with Communities and Local Government and with mechanisms that clearly demonstrate the avoidance of conflicts of interest.

¹⁴ IPCC (2007) Fourth Assessment Report: Summary for Policymakers.
<http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>

Appendices

Sustainability in housing - timeline of change

The development of the sustainability framework and the Code for Sustainable Homes can be traced back to a number of important interventions at a national and international scale. This 'timeline for change' was probably best summarised by Sean Lockie, Director of Sustainability from WS Atkins. A reproduction of one of the key slides from this presentation is provided below. In addition to some of the detail outlined in the slide, much of the sustainability agenda in the residential sector was kicked off by the preparation of The Housing Green Paper '*Quality and Choice: A decent house for all*', produced by the Department for Environment, Transport and the Regions, April 2000. This was the first comprehensive review of UK housing for 23 years. The final output was reported in December 2000 and "Quality and Choice: A decent home for all" was followed by a document "The Decent Homes Target Implementation Plan" produced by the Office of the Deputy Prime Minister, June 2003. Further to this, Planning Policy Statement 1: Delivering Sustainable Development, was released in 2005 followed by '*A Decent Home; Definition and Guidance for Implementation*' released in June 2006.



Tour Timetable and presentations

Day	Presentation	Presenter
MON 30 June	Overview of the Code for Sustainable Homes (CSH) and introduction to their roadmap that outlines a move beyond incremental change. http://www.planningportal.gov.uk/england/professionals/en/1115314116927.html	Jeannette Henderson , Sustainable Buildings Division (responsible for implementing the Code) Paul Decort , in charge of building regulations.
	Green Building Council presentation of residential built environment change in UK and Europe and outline GBC plans for residential. http://www.ukgbc.org/site/home	Paul King , CEO and Jenny Buckland , Member Relations Manager, UK Green Building Council
TUE 1 July	Overview of relevant BRE research http://www.bre.co.uk/index.jsp BREAM tools Passivhaus UK	Nick Hayes Director, Sustainable Development, Martin Townsend , Director of BREAM GLOBAL Shaun Kelly , Consultant, BRE Andrew Peel , Consultant, Passive House and Energy Saving Trust
	Putting a Price on Sustainability	Sean Lockie , Director Sustainability WS Atkins
	Tour of the innovative houses built on BRE's innovation park. These houses have been constructed as show homes that meet high CSH standards. http://www.bre.co.uk/page.jsp?id=634	
WED 2 July	RES and Inbuilt consulting 'Beaufort Court' http://www.beaufortcourt.com/ Inbuilt Systems Approach to Design / Construction Process, Passivhaus, UK Drivers for Energy Efficiency	Dr. David Strong , Chief Executive InBuilt Consulting Dr Neil Cutland , Executive Director Sarah Royse , principal Paul Smyth , Consultant Nick Jones , principal
	BRE and Sustainable Communities process and Green Print Tour of Integer House	Lynne Ceeney , BRE Technical Director, Sustainable Communities Andrew Waddelove , Consultant
THUR 3 July	National Centre for Excellence in Housing http://www.homein.org/ NHBC foundation / NHBC www.nhbcfoundation.org/	Clive Turner , Information Manager National Centre for Excellence in Housing Ted Chandler , NHBC Foundation
	BEDZED - tour of BedZed Talk on 'One Planet Living'	Ben Gill (OPL Programme Manager, Bioregional)
	Dongtan masterplan and sustainable development initiatives	Presentation from ARUP

Day	Presentation	Presenter
FRI 4 July	<p>UK Construction Products Association http://www.constructionproducts.org.uk/</p> <p>Housing Trust www.tchg.org.uk</p> <p>Construction Skills UK http://www.constructionskills.net</p> <p>Consultants in Energy for Sustainable Development www.esd.co.uk</p> <p>Sponge Network and ESD consulting on state of the housing industry and encouraging consumers to buy green http://www.spongenet.org/</p>	<p>Jane Thornback, Environmental Policy Adviser, Construction Products Association</p> <p>Paul White, Quality & Innovation Manager, Town & Country Housing Group</p> <p>Patrick Bowen, Construction Skills UK</p> <p>Pratima Washan: Energy for Sustainable Development.</p> <p>Adam Dawson, Sponge Network</p>
MON 6 July	<p>International Wetland Park and sustainable buildings http://www.wetlandpark.com/en/index.asp</p> <p>Hong Kong Housing Authority and tour of Hong Kong Housing Development</p> <p>Hong Kong Professional Green Building Council</p>	<p>CHOW, Wing-sun, Wetland Park Manager</p> <p>Stephen Y C YIM and Lionel Lau, Hong Kong Housing Department</p> <p>Sam Cheng, Vice Chairman PGBC</p> <p>K.S. Wong, Vice Chairman board of Sustainability</p>
Tuesday 7 July	<p>New headquarters for the Electrical and Mechanical Services Department in Kai Tak http://www.archsd.gov.hk/ExhGallery_ViewPage.asp?lang=1&ViewProject=EMSD</p>	<p>Stephen CHAN, Deputy Director</p> <p>Alfred SIT, Assistant Director</p> <p>Ir LO Siu-keen, Senior Building Services Engineer</p>

Tour Participants

Organisation	Named person	Contact details
Beacon Pathway	Nick Collins	nickc@beaconpathway.co.nz
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Placemakers	Jane Cuming , Building Standards Manager	jcuming@placemakers.co.nz
Scion	Barbara Nebel , Group Leader Sustainability Frameworks	Barbara.Nebel@scionresearch.com
Stonewood Homes / Master Builders	Brent Mettrick	Brent@stonewood.co.nz
Waitakere City Council	Peter Joyce	Peter.Joyce@waitakere.govt.nz

Examples of Code Level Houses at the BRE Innovation Park

Tour participants travelled to the Building Research Establishment to see the example houses built at the BRE Innovation Park. The park is a relatively new facility for the construction industry, to showcase full scale examples the latest innovations in sustainable house construction. The Park features a number of demonstration properties showcasing Modern Methods of Construction (MMC), near zero-carbon homes, and over 200 different innovative and emerging technologies. The following brief section outlines the main houses at the park (largely sourced from the BRE site - but for more information please see www.bre.co.uk)

Kingspan's Lighthouse

Kingspan Off-site revealed its innovative LightHouse net-zero carbon home at OFFSITE2007. With impressive levels of efficiency in terms of the construction method, energy use, CO2 emissions and carbon footprint, this high performance, sustainable two bedroom home by architects Sheppard Robson aims to achieve the Code for Sustainable Homes Level 6.



Stewart Milne's Sigma Home

The Stewart Milne Group has constructed one of the UK's first Level 5 near zero carbon houses that is commercially viable to build. Leading-edge in design, this house is highly energy efficient and generates some of its own energy from wind turbines on the roof.

The Hanson Eco-House

The Hanson House brings together many of the latest developments in sustainable construction using modern masonry materials. Designed as a 3 bed detached dwelling, it will show all the benefits of offsite fabrication that together with thermal mass and natural ventilation assists in the achievement of a near zero-carbon home. It is aiming to achieve Level 4 of the Code for Sustainable Homes.





Osborne's demonstration house

The Osborne Demonstration house was built on the BRE Innovation Park in June 2006. An ideal family home with a very modern feel, it has pushed the boundaries of sustainable affordable housing and supply chain integration. Constructed in just one and a half days using the Jabhouse Structural Insulated Panel System, it exceeds current Part L requirements for carbon emissions by 40%. It is 10 times more airtight than the regulations require. The house needs two thirds less energy for heating and cooling than a house constructed to 2006 Building Regulations. Osborne aim to achieve Level 4 of the Code for Sustainable Homes.

Eco-TECH's Swedish 'Organics' home

The Organics modular home on display is a Swedish modern home designed for clean, simple living in collaboration with nature and aims to make thoughtful, sustainable homes accessible to more people. It offers an affordable, low-maintenance, well-designed green housing alternative that is mass produced.



The Barratt House



The construction of the prototype now on the Innovation Park was undertaken by Barratt Development PLC, making it the first home on the Park to be constructed by a mainstream house builder. It has been designed to meet both level six of the Code for Sustainable Homes and the Government's criteria for zero stamp duty - a tax incentive to build greener homes introduced at the beginning of October 2007