INTRODUCTION TO THIRD EDITION

PASSIVE SURVIVAL HOUSING

Six years after writing the introduction to the first edition of *Ecohouse*, I sit in my Oxford study, looking out over the trees, and wonder that some still have their leaves on in early December. I am wearing a T-shirt in an unheated room and thinking, 'Oh my God, we were so right. It is all happening just as we said it would!' But the world is changing faster than I ever envisaged that handful of years ago.

We first published *Ecohouse* in 2001 and in that introduction we covered theoretical concerns over climate change and fossil fuel depletion. By the second edition of *Ecohouse*, published in 2003, these concerns were firming up with the emerging reality of more extreme climate events and growing publicity over the issue of 'Peak Oil'.

But even in the three years since 2003 so many alarming events and trends have been written on the faces of cities like New Orleans or the landscapes outside our own windows that we are all beginning to get an inkling that there is much worse to come. Even in America the cosy talk amongst the educated architects of 'Sustainable Buildings' has turned to discussions of how we design for 'Passive Survival' in our own homes, when the power fails and the storms menace[1]. People are beginning to take heed of the growing clarion calls for action in the face of the irrefutable evidence of a rapidly changing climate[2].

Four events in particular have penetrated through to the 'conventional wisdom' of the thinking public. The first was the effect of the European heatwave of the summer of 2003 that killed over 35 000 people, of whom some 15 000 alone lived in France. Many were the vulnerable elderly, living on the top floors of blocks with the traditional French, un-insinuated metal, roofs. So even traditional vernacular buildings were beginning to need adaptation to provide adequate shelter for their occupants in extreme weather[3], let alone the 'modern buildings' that typically rely on using large amounts of energy to stay comfortably cool or warm, even in temperate climates.

A heatwave also triggered the second event, the power failure that affected over 50 million people in the Eastern Seaboard of the United States of America in August 2003. In New York people had to evacuate most of the buildings in the city, because they had non-opening windows and air-conditioning systems

in which the air for breathing ran out in under an hour, and internal temperatures surged within minutes. Again these buildings had failed to provide adequate shelter in extreme conditions. What was a unique 'New York' experience on a hot summer evening with people safely sleeping on the streets may, if that had happened during a snow storm in winter, have resulted in untold loss of human life.

1.
The lights go out in New York in August 2003. How many would die if this happened in a blizzard? (Source: AP/Empics).

The third event that shocked the world was the flooding of New Orleans by Hurricane Katrina in September 2005. It was not only the scale of the destruction that occurred to the buildings and the city that made the world hold its breath in horror, but the failure of the social support systems of the United States of America, supposedly the richest country on earth, to deal with the human tragedy that unfolded before our eyes.

The fourth factor has been the inexorable rise of oil and gas prices around the world, heralding the fact that we are beginning to run out of secure supplies of oil and gas[4]. In the last two years alone our gas and electricity bills have doubled in the UK, and over 1.2 million households of the 20 million in England alone have fallen into fuel poverty during that time (namely the old, the young

and the poor). At the Conference on Oil Depletion at the UK Energy Institute[5] on 7 November 2006 Chris Skrebowski, a globally recognised expert, concluded that oil supplies will peak round 2010–2011 at around 92–94 million barrels per day. Speakers also voiced their alarm at the prospect of both oil and gas shortages in the UK, Europe and the rest of the world in the near future due to a range of supply problems[6].

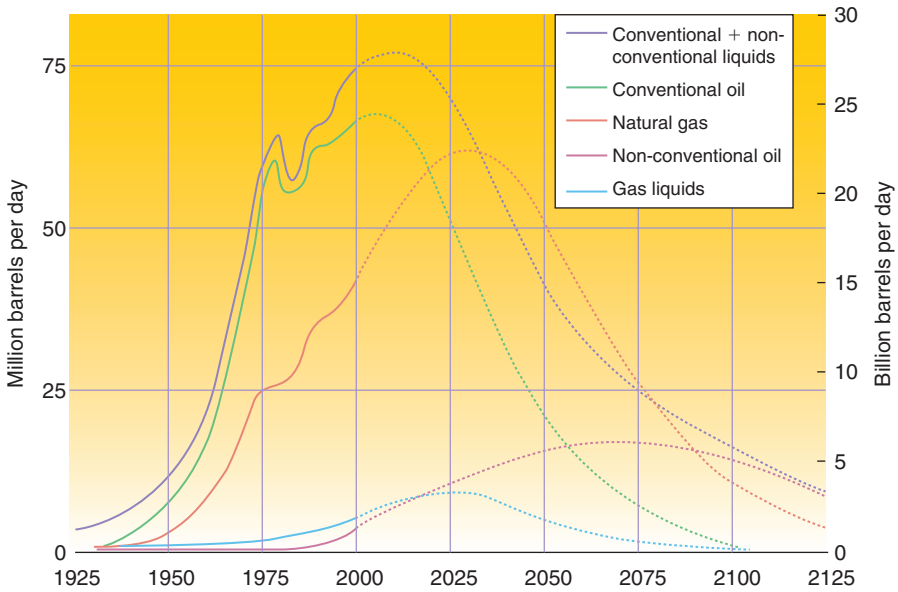
A least we now have politicians around the world waking up to the need to act in the face of the growing economic impacts of climate change. On 30 October 2006 Sir Nicholas Stern published his *Review on the Economics of Climate Change*[7]. This was the first comprehensive UK review of the subject and clearly demonstrated that all countries will be affected by climate change, but Stern stressed that the poorest countries will suffer earliest and most. The review's major conclusions were that average temperatures could rise by 5°C from pre-industrial levels if climate change goes unchecked. Stern shows that warming of 3°C or 4°C will result in many millions more people being flooded. By the middle of the century 200 million may be permanently displaced due to rising sea levels, heavier floods and drought. Warming of 4°C or more is likely to seriously affect global food production, but by then growing areas of the world will be simply too hot to inhabit.

Warming of 2°C could leave 15–40% of the world's species facing extinction. The review reiterates that before the industrial revolution the level of greenhouse gases in the atmosphere was 280 parts per million (ppm) of CO_2 (equivalent); the current level is 383 ppm CO_2 and the level must be limited (by means, we maintain, of Contraction and Conversion policies and mechanisms[8]) to not exceed 450–550 ppm CO_2. Anything higher would substantially increase risks of very harmful impacts. But Stern claims that anything lower would impose very high adjustment costs in the near term and might not even be feasible. He states very clearly that climate change is the greatest and widest-ranging market failure ever seen.

Stern states that what we do now can have only a limited effect on the climate over the next 40 or 50 years, but what we do in the next 10–20 years can have a profound effect on the climate in the second half of this century[9]. What he does not deal with is the significance of buildings as generators of climate change. Buildings use over half of all the energy consumed globally and are responsible for over half of all the climate change emissions, yet year on year 'modern' fashionable buildings become more energy profligate.

The damage this is doing to our cities and businesses is dealt with in another London report, *Faulty Towers*[10], published in July 2006 by the international architectural group 'Gensler'. The authors issue a stark warning to commercial property investors that 75% of property developers believe that impending legislation to grade the energy efficiency of buildings (in response to the EPBD, the European 'Energy Performance of Buildings Directive'[11]) will have a negative impact on the value and transferability of inefficient buildings when certification is imposed from 2007. The report claims that 'Property fund managers are effectively sitting on an investment time bomb. The introduction of energy performance certificates will shorten the lifespan of commercial buildings constructed before the new regulations, and we expect the capital value of inefficient buildings to fall as a result.'

This will happen with homes as well when the requirement for an Energy Certificate – to be produced on the point of sale of every house in Europe – kicks in during 2007[12]. This means that anyone trying to sell a house that is expensive to run will find it increasingly difficult to dispose of. Another potential blight on housing sales relates to homes on the flood plains that may no longer be eligible for flood insurance after 2007[13].



2.
Historical data to 2000, and projections thereafter, on when various fossil fuel reserve outputs will peak. Based on studies by a range of authors including Campbell and Laherrerre.[4] (Source: Boyle, G., Everett, B. and Ramage, J. (eds). (2004). *Energy Systems and Sustainability*. Oxford University Press, p. 289).

This book deals with the design and building of actual houses. Since it was published we have produced *Closing the Loop: Benchmarks for Sustainable Buildings*, in which we have tried to help people understand a wider range of the 'sustainability' issues relating to buildings including how to define and measure quality of life, community, transport, waste, air, land and water pollution, etc. If you are interested in these subjects it is a useful reference book[14].

In 2005 we produced a further, more shocking book, *Adapting Buildings and Cities for Climate Change*, in which were described, in detail, the ways in which the climate is changing, and how these changes will affect the design and performance of buildings and cities in an era of rising fossil fuel prices[3]. Writing this book made me thank God for my own safe secure ecohouse. I have just paid my quarterly gas bill, double what it was last year, but then again it is only £17.50! My bills will double in the next few years then double again and again. That is what the future will be like. Even then I will only pay around £150 for the quarter. What if you pay £300 a quarter for gas now? A quarterly bill for you in the future would be £2400. It would be impossible to pay. This is why everyone in the UK, indeed in the world, has to wake up now to the challenge of surviving in the coming years and decades in a world with more extreme weather and spiralling fossil fuel energy prices.

This is why we have included in the third edition of *Ecohouse* many more ways to exploit the clean, free, infinitely renewable energy around us to

power our buildings, with new chapters on wind, hydro, ground source heat pumps, biomass and more on water conservation. We introduce more information on low embodied energy building materials and construction approaches and some fascinating new case studies.

What has become clear in the past three years of rapid change since the second edition was published is that we have the technology to survive – in fact we all had the necessary technology in the local shops in Oxford in 1995. What we desperately need now is the 'Eco-society' that will enable the necessary changes to happen in time to ensure that everyone, especially the vulnerable, can 'future-proof' themselves against what lies ahead. We urgently need to:

1. Adapt to mitigate our emissions until each of us only produces their fair earth share of greenhouse gasses, in every country, in line with the method of 'Contraction and Convergence', as set out by the Global Commons Institute[8].
2. Adapt our buildings so that we are able to survive in them through the worst that the climate can throw at us, even when the lights go out.
3. Adapt to increase the resilience of our communities to ensure that the fabric of our 'civilised' societies remains in tact through the changes ahead.

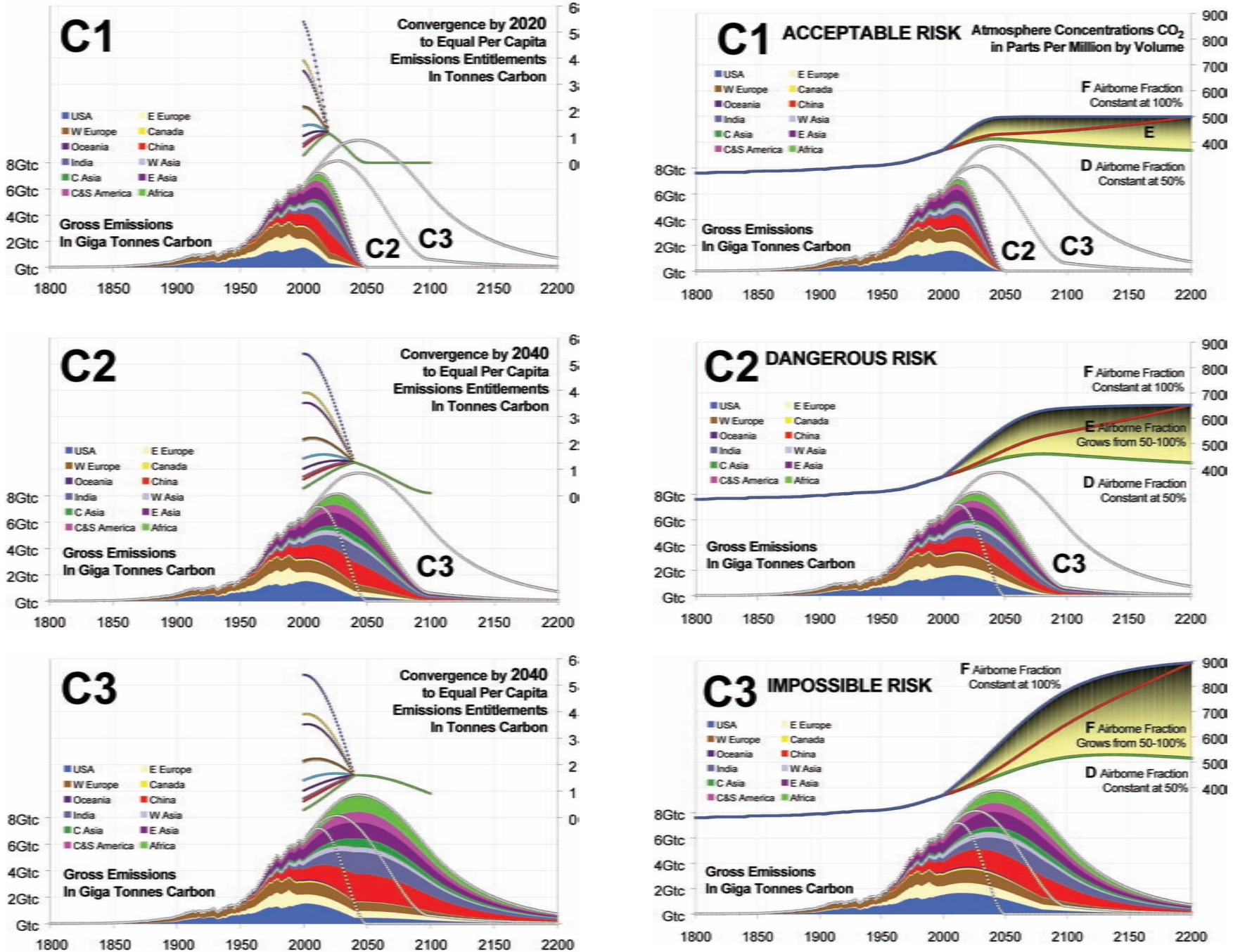
At the heart of all these 'adaptations' is the robust, resilient and safely located ecohouse, powered by renewable energy and embedded in a strong community. If you think that someone else is going to make all that happen for you, you are almost certainly wrong. It is up to you now to ensure that you, your family, your community your business, your society, your economy are all safe, because without all of them in tact it just may not be worth surviving through the coming decades of the twenty-first century.

And the time to start work on all of this is NOW, because we have around ten years before our actions cease to be important in the battle against climate change.

Sue Roaf
July 2007

The Moving Finger writes; and, having writ,
Moves on:
nor all your Piety nor Wit
Shall lure it back to cancel half a Line,
Nor all your Tears wash out a Word of it.

Omar Khayyam
Born: May 31, 1048 in Nishapur, Iran : Died: December 4, 1131



3.

Future CO_2 'path-integrals' – projecting 'aggravated rates of accumulation' of atmospheric CO_2 or accelerated rates of contraction and convergence (C&C) to avoid this (Source: Aubrey Meyer).

CONTRACTION AND CONVERGENCE: A QUESTION OF SURVIVAL

If we are to reduce our global emissions of CO_2, humanity will have to devise a way to work together towards a common understanding of what constitutes a Fair Earth Share of emissions per capita for everyone on this planet. 'The only game in town' to do that is currently C&C – the theory of 'contraction and convergence' (for a definition statement of C&C and support please go to http://www.gci.org.uk/briefings/ICE.pdf).

The six graphs shown in Figure 3 project scenarios for future rates of CO_2 stabilisation in the atmosphere. These are 'path-integrals', in other words carbon transferred to the atmosphere added up over time, in much the same way as water accumulates in the bath as water flows through the tap into the bath and, as the plughole gradually blocks it, progressively stops draining away.

These path-integrals have the underlying carbon consumption – as 'contraction and convergence' budgets – for carbon emissions shown as well. Chart four shows convergence accelerated relative to the rate of contraction for reasons of international reconciliation.

These follow the carbon-cycle modelling published by the IPCC since the Second (1995) and Third Assessments (2000), for

1 350 parts per million by volume (ppmv),
2 450 ppmv, and
3 550 ppmv.

These IPCC reference curves are shown by line D in each case against the emissions contraction budgets also quoted by IPCC.

In each of these four reference cases, the curves for atmospheric accumulation are projected using the C&C model to show the aggravated path-integrals of rates of CO_2 accumulation in the atmosphere into the future at:

a a Constant Airborne Fraction (CAF) at 50 per cent as given with the IPCC determined rates of emissions contraction budgets and path-integrals for atmospheric accumulation – this is path 'D' in Figure 3.
b 100 per cent CAF, in other words the theoretical maximum rate of atmospheric retention of ghg emissions from human sources – this is path 'F' in Figure 3 shown, and
c a rate of ghg retention in the atmosphere that gradually increases from 50 per cent to 100 per cent over the next two centuries – this is path 'E' in Figure 3.

In other words the scenarios shown are 'pairs' of emissions budgets and atmospheric concentrations where the latter should have been stable (following IPCC given values), but can rise faster along paths 'E' due to sink increasing sink-failure and the consequent aggravated rate of concentration build-up.

C1 An emissions budget for 350 ppmv as determined by IPCC, may well rise through 500 ppmv [here called 'acceptable risk']
C2 An emissions budget for 450 ppmv as determined by IPCC, may well rise through 650 ppmv [here called a 'very dangerous risk']
C3 An emissions budget for 550 ppmv as determined by IPCC, 550 may well rise through 900 ppmv [here called an 'impossible risk'].

The justification for doing this relies on the data returned between 2000 and 2006 showing that the aggravated rate of emissions accumulation in the atmosphere is already occurring intermittently. The purpose of doing this is to highlight the much greater extent of risk with which we are already confronted, as the likelihood of aggravated rates of accumulation persisting into the future is real. The point of concern is that conditions of a runaway rise in climate change will take hold much sooner than previously foreseen, if preventive action is not urgently taken.

These 'aggravated rates of accumulation' are a fundamental strategic consideration as we try and determine a stable future over the many following decades when it:

a hasn't yet occurred
b is still caught in poor understanding and indecision about 'policy' to modify human fossil fuel consumption beyond 2012 when the irresolute Kyoto Protocol to the UNFCCC expires, and
c operates under the increasingly challengeable assumption that there is still time to avert dangerous rates of climate change from taking hold when some already take the position that it is all too late; in the analogy, the bath is inevitably now going to overflow.

The priority test to keep in mind for policy to this purpose is comparing path-integrals for:

a the rate at which we cause the problem with our global emissions total where this rate is understood as the possible and likely rates of atmospheric accumulation and therefore
b these rates against the rates at which we are organising globally to stop triggering dangerous rates of climate change (as for example with the Kyoto Protocol) by contracting our global emissions total fast enough to avoid this.

All this shows is that we can reasonably measure the rate at which we presently still continue to cause the problem much faster than we act to avoid it with the wholly ineffectual Kyoto Protocol. In its given time period of 2008–2012, the Kyoto Protocol will theoretically and at best have avoided emitting a few hundred million tonnes of CO_2 (measured as carbon) into the atmosphere. During the same period we will have added several billion tonnes of carbon to the atmosphere from emissions virtually business-as-usual.

As soon as we factor aggravated accumulation into this it is clear that the end result will be that by 2012 we will be more, not less, deeply committed to the accelerating rate at which we are causing the problem than the response rates of C&C that are necessary to avoid it.

NOTES

1 Environmental Building News Vol. 14, No. 12: http://www.buildinggreen.com/articles/IssueTOC.cfm?Volume=14&Issue=12 or http://www.buildinggreen.com/press/passive-survivability.cfm

2 There have been a number of media exposes of the problems – perhaps the most influential has been the Al Gore film *An Inconvenient Truth*. This included a number of images from Mark Lynas's excellent book *High Tide: news from a warming world*, 2004, Flamingo Press, London. The science behind such works has also moved on rapidly and become more accessible. For instance on climate change and its impacts see: www.ukcip.org.uk and www.ipcc.ch You do have to be careful using the internet though as there are many sites in cyberspace that are have their own agendas and some that are downright misleading. For the view of one who thinks it is already too late to act see: Lovelock, J. (2006). *The revenge of Gaia*. Penguin Publications.

3 Roaf, S., Crichton, D. and Nicol, F. (2005). *Adapting Buildings and Cities for Climate Change*. Architectural Press, Oxford.

4 For excellent discussions on the issues of Peak Oil see: www.peakoil.net, www.odac-info.org and www.energycrisis.com. For more insights into how Peak Oil estimates are arrived at see for instance: http://www.hubbertpeak.com/laherrere and Campbell, C.J. and Laherrère (1998). The End of Cheap Oil, *Scientific American*, March (http://dieoff.org/page140.htmn).

5 http://europe.theoildrum.com/story/2006/11/10/17234/128#more and http://www.odac-info.org

6 Sixth Report of the Joint Energy Security of Supply Working Group (JESS), April 2006, p.14. http://www.dti.gov.uk/files/file28800.pdf

7 www.sternreview.org.uk

8 For a full account of the theory of Contraction and Convergence see the website of the Global Commons Institute: http://www.gci.org.uk

9 http://environment.guardian.co.uk/climatechange/story/0,,1935211,00.html

10 www.gensler.com/faultytowers

11 See: www.epbd-ca.org/Medias/Pdf/15_CO_UK.pdf and http://www.eeph.org.uk/energy
www.epbd-ca.org/Medias/Pdf/15_CO_UK.pdf and http://www.eeph.org.uk/energy

12 http://en.wikipedia.org/wiki/Energy_efficiency_in_British_housing#Home_Energy_labelling

13 See: the Association of British Insurers website for more information on this: http://www.abi.org.uk/flooding and if you want to check if your house is at risk of flooding see: http://www.environment-agency.gov.uk/subjects/flood/?lang=_e and fill in your postcode.

14 Roaf, S., Horsley, A. and Gupta, R. (2004). *Closing the Loop: Benchmarks for Sustainable Buildings*. RIBA Enterprises, London.