Refurbishing Europe

An EU Strategy for Energy Efficiency and Climate Action Led by Building Refurbishment

February 2012

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"On planned policies, rising fossil energy use will lead to irreversible and potentially catastrophic climate change. ... In the 450 Scenario, we need to achieve an even higher pace of change, with efficiency improvements accounting for half of the additional reduction in emissions. ***The most important contribution to reaching energy security and climate goals comes from the energy that we do not consume.***"

International Energy Agency World Energy Outlook 2011, 9 November 2011.

"The best way to predict the future is to invent it"

Alan Kay, computer pioneer.

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***"The decarbonisation goal required to limit warming to 2 degrees, will now require reductions in carbon intensity of at least 4.8% every year until 2050**. ... From 1980-2010, no country has sustained decarbonisation rates close to 4.8% per year. ... The UK decarbonised at 3.0% per year in the 1990s during a 'dash' for gas power generation which replaced coal generation."*

Counting the cost of carbon, Low carbon economy index 2011, PricewaterhouseCoopers LLP, 7 November 2011.

"We need a transformation of the building sector towards zero net energy use ... ***Retrofitting older, inefficient houses is the biggest challenge in Europe."***

Energy Efficiency in Buildings: Transforming the Market, World Business Council for Sustainable Development, August 2009.

***Build with CaRe** is an international project with the ambition to help mainstream low-energy construction in the North Sea region and across the EU. Build with CaRe (BwC) is partly funded by the Interreg IVB North Sea Region Programme, European Regional Development Fund. Please visit www.buildwithcare.eu.*

In brief.....

- Dangerous climate change can only be avoided if global greenhouse emissions begin to reduce before 2020.
- Current predictions show fossil fuel use and global greenhouse gas emissions increasing for decades.
- Energy efficiency has delivered far more greenhouse gas saving in recent decades than transformation of supply even without any serious attention by governments.
- Demand reduction facilitated by radical improvement in energy efficiency makes it possible to achieve a decarbonised clean energy supply.
- The EU is foremost in having the capability to show how this can be achieved.
- A 40 per cent target for a reduction in EU primary energy demand would galvanise near-term action consistent with the Energy Roadmap 2050.
- Dramatically enhancing the energy efficiency of buildings is the critical step to reducing demand.
- Passivhaus quality is a European innovation that can make low energy buildings a reality.
- There remains huge potential for demand reduction led by mandating passivhaus quality for new build and for refurbishment of existing buildings.
- Build with CaRe has shown that the knowledge to bring this about already exists within Europe.
- A massive expansion of transnational learning and dissemination could bring great benefit.
- Focus on ‘deep’ low-energy refurbishment of the EU building stock can lead action to tackle climate change; it will also bring multiple benefits in terms of jobs, skill formation, competitiveness, and health and well-being.
- The barriers that inhibit action need to be addressed by the EU and by governments.

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Executive Summary

Overview

Action to dramatically enhance the energy efficiency of buildings is an essential step to reducing demand for energy. It will also create healthier and more affordable environments, a great many jobs and stimulate economies. Only with demand reduction, led by action on building energy use, can energy supply be decarbonised rapidly enough to make effective action on climate change a possibility.

At present, across most of the EU, the political will to act on energy efficiency seems to be lacking. However, passivhaus quality, a European innovation, provides the platform for action and EU leadership.

The Durban Conference on climate change agreed to EU proposals[1] for a road map to draw up a legal framework for all countries to take climate action. This agreement creates some hope that there will be effective action to tackle potentially dangerous climate change. But there remains great urgency to begin to reduce global greenhouse gas emissions well before 2020.

Achieving such a reduction will be extremely challenging. In 2010, global carbon emissions rose faster than ever. Current projections for future global energy needs predict major increases in fossil fuel use and greenhouse gas emissions for decades. The EU can act to provide leadership to help the developing world also pursue energy saving pathways to a clean energy supply and so avoid the energy supply and climate change problems that otherwise seem inevitable.

Policies in place in the near future shape the energy picture over the long term. An accelerated transition to a renewables-based energy supply system seems to offer the only route to effective and rapid greenhouse gas reduction.

EU climate change targets for 2020 are now seen to be insufficient. The EU can once more show leadership by demonstrating accelerated growth of renewables and accelerated reduction of emissions in the near term. But such change will only be possible with a simultaneous acceleration of progress in energy efficiency and demand reduction.

Energy efficiency has delivered far more greenhouse gas saving in recent decades than has been, or will be, achieved by transformation of energy supply. Yet energy efficiency is still relatively ignored by governments compared to energy supply. A key message of this paper is that progress in energy efficiency has been dramatic

[1] *Durban conference delivers breakthrough for climate*, Europa Press Release, Brussels, 11 December 2012, MEMO/11/895, http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/895&format=HTML&aged=0&language=EN&guiLanguage=en.

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but slower than it could have been and there is far more saving still to be had. Making this saving is now absolutely necessary if there is to be effective action on climate change. We suggest a target for a 40 per cent cut in EU primary energy demand by 2050. Such a target should be achievable and would galvanise near-term action.

The principal message of this paper is that achieving this saving is possible because of passivhaus and related innovation within Europe. EU action on energy efficiency, led by the transformation of the building stock to passivhaus quality, will not only assist the transformation to a clean energy system but will bring many related benefits.

Presently, improvement in energy efficiency across the EU is far less than planned and far less than needed. Buildings are responsible for 40 per cent of EU energy-related greenhouse gas emissions, and energy efficient buildings represent the greatest opportunity for energy saving and greenhouse gas reduction.

In this paper we show that knowledge of how to build new very-energy-efficient buildings and how to refurbish existing buildings to achieve great improvements in energy efficiency is already in place and often makes economic sense. Build with CaRe partners are demonstrating what is possible but many barriers to widespread effective action remain. The biggest barrier is lack of political will to accelerate progress in energy efficiency. New build ambition is insufficient and the rate of building refurbishment to achieve high standards of energy efficiency is far too low.

The Energy Roadmap 2050[2] is encouraging and the high energy-efficiency scenario identifies the need for swift implementation with nearly zero energy buildings becoming the norm. Accelerated action is necessary before 2020 if ambitious targets are to be met. In respect of energy efficient buildings, Build with CaRe has shown that the knowledge exists. What is needed is political ambition and accelerated learning within and across national borders.

The passivhaus concept is a European innovation. Adopting passivhaus quality as the standard now for both new build and refurbishment of existing buildings will bring many benefits in addition to creating the capability to tackle climate change.

Energy use will be minimised, providing financial security for occupants. The poor health outcomes associated with energy inefficient buildings will be eliminated. Building performance will be as designed because of the quality built into design and construction. The healthy internal environments will promote well-being. Skills and supply chains will be enhanced so promoting job creation and competitiveness.

Energy efficiency and energy supply are intertwined. The current structure of energy supply, reflecting 20th century priorities, makes rapid progress in energy efficiency very difficult to achieve and hence also hinders the ability to tackle climate change. These difficulties are compounded by the continuing subsidies received by

[2] *Energy Roadmap 2050*, European Commission, Brussels, COM(2011) 885/2, 15 December 2011, http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf.

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fossil fuels and nuclear power that far outweigh all subsidies received by renewables and for energy efficiency.

Yet the cost of electricity from renewables is dropping fast while passivhaus quality can dramatically reduce energy use in buildings. Transforming the built infrastructure will create the capacity to transform energy supply and storage. Energy efficient buildings are key to the ability to tackle climate change.

With political will, the EU can create a new reality and demonstrate leadership on energy supply, energy storage and energy efficiency. Political will to transform buildings will demonstrate EU leadership on climate action post Durban.

Cities can lead this change. Transnational learning across national borders, enabled by Build with CaRe, demonstrates massive potential for innovation, new thinking and skill formation in construction and related industries. Adopting passivhaus ambition will bring economic benefits, health benefits and security benefits in addition to leading the battle against climate change.

Looked at in another way, if there is no near-term action of this kind to transform buildings, while the long-term 2050 targets on emissions may be met, by then, it will be far too late to prevent potentially very dangerous climate change.

There are several barriers that inhibit action to accelerate construction and refurbishment of buildings to very low energy quality such as passivhaus. Key barriers are identified. Some countries and cities are already tackling them.

Section 1: Wasting energy

Waste of energy is taken for granted. In the UK and across the EU, as in most developed countries, by far the largest user of energy is the building stock. Nearly 27 million homes in the UK are responsible for over a quarter of the UK's carbon dioxide emissions. Buildings are responsible for 40 per cent of EU energy related greenhouse gas emissions. Heating is responsible for over half of UK domestic carbon dioxide emissions whilst heating, hot water and lighting together account for four-fifths of the total. There is huge scope for both increased energy efficiency and greatly reduced carbon emissions in our existing homes and other buildings.

At all levels of society we have grown used to taking energy supply for granted and planning activity around energy delivered at low cost. Governments focus on energy supply, but less so on energy efficiency. A very large proportion of delivered energy is effectively wasted because of inefficiencies in its use.

The biggest barrier to beneficial transformation of the building stock is lack of political will to set a challenging target. This lack of political will reflects attitudes to energy efficiency in general and is a consequence of a fossil-fuel economy mindset.

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Section 2: Polluting energy versus clean energy: the road that must be travelled

Without great subsidy, or any particularly strong mandate, energy efficiency has delivered far more greenhouse gas saving in recent decades in the developed world than has been, or will be, achieved by transformation of energy supply. Yet this energy efficiency has happened 'under the radar' and energy efficiency is still relatively ignored by governments compared to energy supply. Had good advice given over thirty years ago been followed we could now already be part of a sustainable and prosperous economy. It was not. There is now no time for further delay.

A key message of this paper is that progress in energy efficiency has been dramatic but far slower than it could have been. With a focus on energy efficiency, there is far more saving still to be had. Making this saving is now absolutely necessary if there is to be effective action on climate change. Ambitious targets on energy efficiency not only help achieve environmental goals but stimulate economies and create jobs.

In developed countries, the exponential rise in primary energy use observed until the 1970s has been halted. Primary energy use remains roughly constant as economies grow. Now, ambitious focus on energy efficiency, is needed to enable a fall in primary energy use while economies still grow. The EU can lead such a transformation.

The principal message of this paper is that achieving this saving and associated demand reduction is possible because of passivhaus and related innovation within Europe. Action on energy efficiency, led by transformation of the building stock to passivhaus standards, will bring many related benefits.

Energy supply and energy efficiency are utterly interlinked. The present energy supply system promotes inefficiency and makes it almost impossible to optimise the whole system within which the energy is used. This dysfunctional separation is the fundamental reason why progress in energy efficiency is slower than it could be, why the transition to a renewables based economy is slower than it could be, and hence why efforts to tackle climate change proceed so slowly. These issues are all inter-related. Accelerating change on energy efficiency and renewables, now urgently necessary because of the threat of climate change, requires political action to tackle this dysfunction.

Government policies still, in large part, do not take account of the dramatic cost reductions in renewable energy that are happening today. Policies, thinking, and expenditure reflect the realities of the 20th century, not the 21st, although a few EU countries are showing what is possible. Denmark, for example, already generates a quarter of its electricity supply from renewables and has ambitious future targets that demonstrate that the near-term action now needed is indeed achievable. A recent report has shown that the UK could meet up to 90 per cent of electricity demand by

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2030 with renewables if there is effective action on energy efficiency and energy demand.

Often spurious debate about costs of renewables also obscures wider benefits from their introduction and ignores the continuing costs of pollution from the extraction and combustion of fossil fuels. An energy supply system based on renewables, just like a building refurbishment ambition based on passivhaus quality, promises a much healthier environment for citizens everywhere.

Fossil fuels are doubly damaging, creating both global warming and also widespread pollution. Once these extra costs are taken into account, renewable energy sources become the most cost effective sources of electricity. The European Environment Agency has recently reported that air pollution by the facilities it analysed cost every European citizen approximately €200-330 on average in 2009 with emissions from power plants contributing the largest share of the damaging costs. Fossil fuels will continue to pollute even if unproved carbon capture and storage technologies do actually work technically. There never can be 'clean coal'.

A recent OECD report notes that renewables will be seen to be uncompetitive while fossil fuels remain heavily subsidised and that governments must create an 'investment grade' policy of support. Yet the transformation to renewables - and hence to an energy efficient economy - is made much more difficult than it should be by continuing subsidies to fossil fuels and nuclear power that reflect the priorities of half a century ago not of today.

In spite of this unequal playing-field, the costs of renewable technologies are dropping rapidly as deployment grows worldwide and the costs will continue to fall. Depending on the location, wind and PV either are already or will soon be the most economical option. PV module costs continue to drop by over 20 per cent for every doubling of historic cumulative production and onshore wind costs by 14 per cent. The benefit of renewable technologies such as PV and wind is that they are modular and scalable.

The combination of cost-effective renewables technologies with grid-compatible storage promises reliable electrical power with almost no greenhouse gas emissions. The combination of renewable energy, electrolysis of water, and production of renewable methane is already being developed by Audi in Germany to create a renewable fuel for gas powered vehicles.

But without strong government initiatives to stimulate low-carbon investment, path dependence – the impact of historical investments and current market power – will encourage investment in dirtier technologies. This means that current attitudes make promotion of energy efficiency more difficult and tackling climate change more difficult. Yet the rate of decarbonisation necessary, globally, nearly 5 per cent a year, year on year, to have a chance of limiting global warming to 2 degrees, is almost unprecedented in any nation.

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Only a totally focused political effort to make renewables-based supply a reality, supported by an equally determined focus on energy efficiency, can achieve such a target. The transformation of the building stock is a key activity in such a transition.

Section 3: Energy efficiency: key to tackling climate change

This need for action very soon on global greenhouse gas emissions has been recently highlighted. Yet global emissions, far from moderating, are rising faster than ever. The EU 2020 targets for greenhouse gas reduction, introduction of renewables, and energy efficiency are too modest to meet the need. Indeed, emissions in EU countries, when consumption is accounted for, may well have increased rather than decreased as the national accounts appear to show.

There is a total disconnect globally between what needs to happen and what is happening. Globally, natural gas consumption is predicted to grow by over 50 per cent from 2008 to 2035, with strong growth of gas from unconventional supplies such as shale gas, coal consumption by 50 per cent, and CO_2 emissions to increase by 43 per cent.

Switching from coal to natural gas from any source will have little impact on global warming unless leakage rates for new methane can be kept very low. Shale gas, or other fossil fuels, will only stay in the ground, as they must, if there is a rapid and transformative change in political emphasis to support energy supply by renewables and urgent action on energy efficiency. Attention to the building stock must lead the campaign on energy efficiency.

Only the EU seems to have the capability to change course and to demonstrate that a low-emissions path is both possible and beneficial to economies as well as to the environment.

Section 4: Tackling buildings tackles energy efficiency

Buildings present the greatest single opportunity for an energy efficient economy. We know from real-life examples by Build with CaRe partners in several countries what to do and how to do it.

The challenge is to overcome the barriers that presently mean best practice is just a few isolated examples in order to make best practice common-place across Europe. Less than 10 per cent of worldwide research and development expenditure on energy has been spent on energy efficiency. Energy efficiency is a poor relation compared to nuclear and fossil fuels, yet is key to tackling climate change.

Recent research has shown that over 70 per cent of global energy use could be saved by practically achievable design. The greatest savings are available in passive buildings and are dominated by savings in heating and cooling spaces. These savings could be achieved by designing buildings to the passivhaus standard. We already have the knowledge to make these savings.

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It would be eminently sensible to spend far more than we do on energy efficiency. A similar figure to the £200billion investment needed up to 2020 in the UK to develop new energy supply capacity and to strengthen the electricity and gas grids might be roughly what it would cost to bring the entire UK housing stock up to or near to passivhaus standards. Almost no energy will then be needed for heating and cooling homes. Similar arguments will apply in other countries.

Once the fabric is improved to this degree then the zero-emissions building or even the energy-plus building become viable options. A focus on energy efficient buildings will bring systems thinking to the fore and promote energy efficiency more widely.

With such investment in buildings, total energy use will be significantly reduced and the occupants of these buildings will also be living or working in much healthier and more pleasant homes or workplaces. The construction industry will of necessity have become up-skilled and globally competitive and supply chains will have been developed that are equally competitive. There can be a focus on renewable energy supply rather than inappropriate investment in nuclear and fossil technologies meaning that the energy supply industry also can become globally competitive.

An appropriate mix of support and penalties can stimulate the necessary investment but innovative thinking will be needed to find the most effective pathways. Ensuring the necessary financial stimulus to accelerate building refurbishment to passivhaus or similar standard will be a most effective use of public funds compared to the massive historical support and subsidy for energy supply by fossil fuels and nuclear.

If this investment to upgrade buildings is not made there will be lock-in of energy inefficiency and of greenhouse gas emissions because the renewal and refurbishment that does occur will be to lower standards than could be achieved. Lack of progress in transforming buildings means lack of progress in tackling climate change.

Section 5: We must go faster on energy efficiency

Across the EU, the current ambition of a 20 per cent reduction in energy consumption by 2020 is unlikely to be achieved. Projections indicate a likely reduction by 2020 of only 10 per cent or less. The reason for this lack of action is lack of political and financial support for energy efficiency and for energy efficient buildings.

The EU has admirable long-term intentions to decarbonise buildings by 2050 but, near-term, energy efficiency remains the poor relation to energy supply. Some long-term projections, as in the UK, assume continuing need for heating in 2050 because progress in energy efficiency will have been limited. The UK, like possibly several other EU Member States, has no clear plan or route map to promote energy efficiency to the degree required. Such a policy is expensive and wasteful and will divert investment from action to tackle climate change.

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Germany is one of the most advanced European economies in the promotion of renewable energy and in demonstrating 'deep' refurbishment of buildings to save three-quarters or more of energy use. The German Energy Concept has a renovation roadmap targeting an 80 per cent reduction in primary energy demand by buildings by 2050 and a 50 per cent reduction across the whole economy.

Germany seeks to cut electricity consumption by 25% by 2050, which will be possible if there is sustained and ambitious progress in energy efficiency. In the UK, in contrast, electricity consumption is projected to at least double by 2050. A major reason for the difference is the lack of UK ambition for energy efficiency.

Even in Germany, the need to double the rate of building refurbishment is acknowledged but there is no clear pathway yet defined to enable this to happen. Across the EU the rate must at least triple. Lack of urgency across Member States explains why the EU is falling so far short of the 2020 target for energy efficiency. There seems no credible strategy so far for making up lost ground while the urgent need now is to go even faster than planned.

The American Council for an Energy-Efficient Economy has shown how the US economy could reduce primary energy use from current levels by up to 50 per cent through an aggressive energy efficiency campaign with benefits for the economy and for jobs. This is also the German ambition. We suggest a minimum 40 per cent cut in primary energy demand by 2050 could become an EU target with transformation of the building stock a centre-piece.

Action must start now. The high energy-efficiency scenario in the EU Commission's Energy Roadmap 2050 foresees a 41 per cent decrease in energy demand by 2050 compared to the 2005-2006 peaks. Setting a 40 per cent target relative to an appropriate baseline would galvanise action which the Roadmap acknowledges must be implemented swiftly.

The Roadmap highlights the importance of nearly zero energy buildings becoming the norm. This paper demonstrates that there are major barriers to achieving this desirable outcome. The time to tackle these barriers is now. As has been stressed, the benefits will flow not just to the environment but to economies and jobs as well.

Section 6: "Zero-carbon homes" no longer zero-carbon

What happens in refurbishment will be influenced by the standards that are agreed for new buildings. If these fall short of what is feasible and possible, then the regulations, the skills, and the supply-chain to make possible 'deep' low-energy refurbishment of the existing building stock may be inadequate for the task.

A low-energy building can only be called low-energy (or low-carbon) if it performs this way in practice. Low-energy design is meaningless without real-life data on energy use. The UK body developing standards for 2016 and beyond has acknowledged that ensuring what is designed is actually delivered will represent a significant challenge for the whole industry - including designers, the supply chain, and housebuilders.

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UK-defined “zero-carbon homes” post 2016 will not now be zero-carbon. The proposed new standard falls short of what is possible and it is freely acknowledged that the delivered quality is almost certain to fall short of even this standard. This is likely to mean lock-in of carbon emissions, more expense for owners and occupiers, and poorer quality.

This UK post 2016 standard may imply that new homes also fall short of the quality of passivhaus homes as well as falling short on energy efficiency. Without mechanical ventilation, new UK homes post 2016 may suffer from poor ventilation and air quality issues. These so-called “zero-carbon homes” cannot be the “nearly zero-energy buildings” that the EU is requesting from 2020 because the on-site renewable energy cannot make up for the energy consumed in the home.

The UK Committee on Climate Change has estimated that an additional 6TWh of renewable electricity supply will be needed by 2030, costing consumers in excess of £100m at today’s prices, because of the weakening of the UK standard proposed for so-called “zero carbon homes”. This extra investment in supply may be compared with the potential saving of £40billion suggested by WWF in a recent report if there is effective action in the UK on energy efficiency and, in particular, on energy efficiency in the building stock. Across the EU, such saving could possibly be multiplied ten-fold: around €500billion no longer needing to be spent on constructing new energy supply.

These extra costs, resulting from weaker standards, show that supposed cost savings to business by not having to meet more demanding energy efficiency standards are illusory as the costs merely reappear somewhere else. But the extra unnecessary costs to consumers in less energy efficient buildings will be paid year after year. Focusing on maximising energy efficiency as the priority, rather than energy supply with energy efficiency trailing behind, makes economic as well as environmental sense.

This UK decision to weaken standards for new homes will have negative impacts over decades for industry, for consumers, for innovation and for tackling climate change and, crucially, in the ability to undertake ‘deep’ low-carbon refurbishment of the existing building stock.

A concern about the UK development is that it could undermine efforts to promote energy efficiency in buildings across much of the EU, not just new construction but, because of the linked supply chains and because of the reduced standards, in refurbished buildings as well. It is important that such misguided decision-making is avoided.

Section 7: Misguided Government thinking

The current UK Government believes that it can help business and restore growth by removing regulation – or ‘red tape’ as regulation is provocatively called. This is the reason given for weakening standards for post-2016 so-called “zero carbon homes.

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Such thinking is misguided. Weakening of standards disadvantages the innovators that are the only hope for a competitive, prosperous, green economy in favour of businesses that are reluctant to change or to innovate. The weakening of environmental standards ensures that the economy will be weaker in the future and less competitive than it could be.

In the partner countries and regions of Build with CaRe, including the UK, we have encountered many companies and organisations involved in construction that do wish to innovate and that see demanding environmental standards such as passivhaus as a challenge to improve the quality of their product and also of their processes. They innovate, they find ways to cut costs, and they improve quality.

The rolling back of standards for "zero carbon homes", and the rolling back of regulation in the UK over display of DECs (Display Energy Certificates), will reduce the competitiveness of the UK industry, entail poorer quality construction, and make tackling climate change far harder.

A UK construction task force reported in 1998 that quality would not improve and costs would not reduce until the industry educated its workforce not only in the skills required but in the culture of teamwork. These issues remain today and very likely also apply to a greater or lesser degree in several other Member States. It is teamwork that enables passivhaus quality to be delivered.

The urgent need to transform construction in order to create an energy efficient building stock means that change must happen and happen fast. Innovation and teamwork are essential in enabling this change. Building to or near passivhaus standard not only delivers a low-energy home that is pleasant and healthy to live in but entails exactly the teamwork and high quality standards that should, by now, be common-place.

Supposedly supporting growth by weakening standards is exactly the wrong way to go. One of the key mechanisms for improving competitiveness is, in fact, regulation. Environmental regulation, in particular, stimulates not only beneficial innovation but also benefits wider society.

A recent report about the USA noted that today's clean-tech innovations represent tomorrow's jobs and GDP growth while the American Council for an Energy-Efficient Economy has shown how an aggressive energy efficiency campaign could lead to a cut in United States' primary energy use of nearly 60 per cent by 2050 relative to business-as-usual projections with benefits for the economy and for jobs. It is vital that governments grasp the benefits of action to promote energy efficiency and accelerate reductions in greenhouse gas emissions.

How can innovation in energy efficiency be promoted? The answer may be to pursue the 'lean thinking' vigorously promoted by the UK construction task force in 1998. As well as considering how to eliminate waste of material and waste of process time, it is now timely also to consider delivered energy as potential waste to be reduced at every opportunity.

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Section 8: Energy as waste

The confusion created by subsidies for polluting fuels, lack of support and subsidy for energy efficiency, undemanding improvements in building standards, and ill-informed political thinking about regulation, means that progress in energy efficiency is, at present, pre-determined to be slow. A complete redirection is necessary. This should focus on innovation in construction and promotion of passivhaus principles.

Waste of energy should be addressed by regulation – demanding standards – by quality of construction and passivhaus standards, and by monitoring in use. Three-quarters of energy used today can be saved by adopting best-practice passive technology. This means that three-quarters of energy used today is effectively wasted.

Nearly a century after the development of centralised electricity generating plant and half a century after the development of North Sea gas fields, our energy production and supply system, and our inefficient buildings that need heating systems, seem the natural order of things. Hence the continuing focus on centralised large-scale energy supply and new fossil fuel resources such as shale gas.

Building new and refurbishing existing buildings to or close to passivhaus standard provides the transformative innovation to make it possible to drive out this energy waste. Passivhaus is a European innovation only two decades old and demands detailed attention to the house as a system, to the building physics, and to the importance of avoiding defects in construction.

Building to passive principles is disruptive innovation in the construction industry. The waste (of energy unnecessarily used for heating) that people either do not recognise, or that is tolerated, is removed. Build quality is transformed because without it the passivhaus standard cannot be achieved. The internal air quality is clean and healthy. A passive building is a building as it should be and is cheaper to run and to maintain than a building built to conventional standards.

Construction to passivhaus quality has yet to overcome industry conservatism and become mainstream. Relatively few passivhaus homes (or other kinds of building built to passivhaus standard) have been constructed for general sale or rent. Therefore, very few people are aware of the benefits of life in a passivhaus home or building. This lack of awareness is a major barrier to change.

Innovative companies are showing what is possible but the natural rate of innovation in construction is not fast enough. Only political leadership can make isolated examples of best practice become the common-place. Political leadership, demanding passivhaus standards wherever possible for all new and refurbished buildings, can drive out waste of energy and stimulate transformation of the construction industry.

If this transformation happens, shale gas can hopefully be kept in the ground and energy supply can be transformed. Homes and other buildings need not use any more energy than they generate while cities can become self-sufficient in energy.

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By adopting passivhaus quality as standard for refurbishment as well as for new build across the EU, now, Europe can lead the world in construction and workplace skills. It can demonstrate that effective climate action, post Durban, will not just reduce greenhouse gas emissions and tackle climate change but also create jobs and a healthier and more secure environment.

The alternative is a worst-case outcome where some energy-efficiency improvements are made but buildings still perform poorly, with poor internal air quality, and still need more energy for heating and cooling than they can themselves generate. The construction industry will continue largely as it is today. Fossil fuels will be unnecessarily produced and burned. Carbon emissions that could be eliminated will be locked in for decades. Tackling dangerous climate change really will become impossible.

Section 9: Creating a new reality

The UK has led the way in making legally binding commitments to greenhouse gas reduction but missed an initial target for a 20 per cent reduction in CO_2 emissions between 1990 and 2010. It did not achieve an average reduction of just 1 per cent each year over these twenty years in spite of decarbonising at a rate of 3 per cent a year in the 1990s during the 'dash for gas' (a major switch from coal to gas as fuel for electricity generation).

The UK's greenhouse gas emissions actually increased by 3 per cent in 2010, largely as a result of the heating need of energy inefficient buildings due to a colder winter. Yet 3 per cent annual average emissions reductions are necessary year on year to meet the first four carbon budgets to which the UK Government has committed in legislation. Even this target is far less demanding than the nearly 5 per cent annual emissions reduction globally that is now required if there is to be a chance to keep global temperature rise below 2°C. These numbers highlight why long-term targets, as in place in the UK and the EU, although admirable, do not meet the present challenge.

A recent report by Shell examining future energy scenarios makes clear that what happens in the next five years largely shapes the global energy picture out to 2050. This means that effective steps to tackle climate change must be taken very soon. Continuing investment in fossil-fuel supplies in the short-term will set back efforts to tackle climate change even over the very long term.

At present, energy policy, both for supply and for use, seems still dominated by 20th century ideas of large centralised electricity generators and relatively inefficient infrastructure. Building or refurbishing buildings to very high energy standards is often cost effective, and will almost certainly be so over a period of decades. Very many energy efficiency actions save costs almost from day one. It is mind-sets – influenced by decades of fossil fuel plenty, by massive subsidies for fossil fuels and for nuclear technologies, and by a centralised electricity system that institutionalises inefficiency – that must change.

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The EU is uniquely placed to make change happen – to be the Steve Jobs of energy and climate change, to create the "reality distortion field" that can lead to the 21st century reality now urgently needed. This "reality distortion field" will focus on renewable supply and energy storage at all scales, and passive technology throughout the economy.

Build with CaRe partners in Germany, Holland and Sweden have already shown how change can happen via the refurbishment of existing buildings to or close to passivhaus standards. Such work demands detailed attention to both design and to construction to ensure continuity of insulation and elimination of thermal bridges and air leakage pathways. This is the kind of attention to detail and design that Steve Jobs insisted be brought to Apple's products. It is demanding but is certainly possible, and will also stimulate real up-skilling and quality improvement by the construction industry, and enhanced competitiveness of the supply chain.

There will also be great welfare benefits across society. In passive homes, fuel poverty will be a thing of the past while indoor air quality and well-being can be outstanding. More than a quarter of Britain's households are said to be living in fuel poverty while poor quality housing is a public health problem resulting in £7bn annual costs to the NHS, social services and education bodies. Building new and refurbishing homes to passivhaus standards might repay the entire cost of the work by eliminating these costs to society.

We know how to do it. We now have to act with urgency to make such refurbishment standard rather than exceptional.

The urgency may be summarised:

- Emissions reductions must happen fast
- Fossil fuels must be replaced by renewables as fast as possible
- Much more rapid gains in energy efficiency and demand reduction are critically important to enable rapid renewables introduction and more rapid emissions reductions
- Buildings present the biggest opportunity for reducing energy use
- The capability for low-carbon 'deep' refurbishment exists today
- Refurbishment rates are far too low across the EU
- Current plans are inadequate for the need
- Energy efficiency and tackling energy 'waste' must take centre stage.

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Section 10: Necessary actions to accelerate refurbishment

Key issues discussed in turn are:

- Effective target setting and action at EU and Member State level on energy efficiency
- Focus on passivhaus standards for new build and refurbishment
- Targets and mechanisms for rapid refurbishment
- Investment in training and skills to enable passivhaus standards in practice
- Information campaign on passivhaus benefits for new and refurbished buildings
- Innovative thinking on financial support for 'deep' refurbishment
- Transnational learning and knowledge sharing
- Systems thinking and energy storage
- Cities enabled to lead

S10.1: Effective target setting and action at EU and Member State level on energy efficiency

The EU non-mandatory target for a 20 per cent improvement in energy efficiency by 2020 will, on present trends, be missed by a wide margin. The proposed new Energy Efficiency Directive seems unlikely to stimulate the radical change needed.

There is no compelling EU vision on energy efficiency in general or in buildings via 'deep' renovation in particular. This means that effective, wide-scale programmes for building refurbishment to 'deep' low carbon standards are very difficult to develop. Exceptions are countries such as Denmark and Germany that have demonstrated commitment to renewables and to energy efficiency over many years.

The structures and priorities of government can exacerbate this problem. A recent report has noted that the vast majority of senior staff in the UK Department of Energy and Climate Change (DECC) are assigned to energy generation rather than energy saving. The report notes that there is neither a clear target nor ambition for energy efficiency savings in the UK, nor an indication of what contribution energy savings can make to the achievement of the carbon targets.

In its forecast of electricity supply for 2050, DECC seems to assume only around one-third energy saving in the built environment by 2050. Yet we know from successful projects within Build with CaRe that energy for heating can be reduced by over 80 per cent and total energy use by over 60 per cent using today's knowledge and today's materials and appliances. Innovation will help us do even better.

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Attitudes and mindsets within government that reflect a continuing focus on centralised electricity supply can inhibit the innovation and investment necessary to drive the transition to a renewables-led system as well as undermining ambition in energy efficiency. Big cuts to the feed-in tariff for solar PV have undermined a growing and successful UK renewables industry. In Germany, in contrast, there has been consistent support for renewables since the passing of the Renewable Energy Act in 2000. Indeed, the 3GWp PV installed in Germany in December 2011 is greater than the total PV capacity planned for the UK in 2020. The total installed PV capacity now in Germany is already almost ten times greater than the UK plans for 2020 – by which time Germany plans that PV will account for 10 per cent of electricity production.

Yet with very energy efficient buildings, local generation, together with local storage, can become a major component in an energy network that brings energy efficiency to the fore. Without a transformation in thinking and leadership from government, however, this can never happen. Costs will then remain high, buildings less energy efficient than they could be, fossil fuels cannot be eliminated nearly so fast, and climate change cannot be effectively addressed.

In contrast to the consistent support for renewables and energy efficiency in Germany and Denmark, for example, about turns on feed-in tariffs, as in the UK, will deter investment in renewables and make the achievement of climate change targets more difficult.

A transformation within governments to bring energy efficiency to the fore seems a pre-requisite for progress. Misguided thinking that sees benefit in reduced environmental standards must be eliminated. Only Governments can truly create the necessary “alternative reality”. Germany’s success in promoting renewable energy as well as ‘deep’ renovation of buildings shows that commitment by government, and targets for energy efficiency that reflect the urgency of the need, are essential.

Now is the time to set targets for renewables and for energy efficiency that match the need. A target of a 40 per cent cut in primary energy use by 2050 could become an EU target with transformation of the building stock a centre-piece. The EU Commission’s Energy Roadmap 2050 states that *“Nearly zero-energy buildings should become the norm”*. The way to achieve this ambition is through the adoption of passivhaus standards.

S10.2: Focus on passivhaus standards for new build and refurbishment

Moving to, or close to, passivhaus standard provides the confidence that buildings will be constructed as planned and will perform as planned. Award of impressive standards, codes, or Energy Performance Certificates (EPCs) at the design stage to buildings designed in the conventional way may imply low-energy performance but may mean little in practice. A low-carbon building is only low-carbon if it performs as such.

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A recent report for the UK Government on low carbon construction pointed out that studies repeatedly show that buildings do not achieve their design criteria, in energy efficiency terms, when tested post-completion. The report said it is extraordinary that so little priority is attached to seeing how buildings perform in practice. Such issues will apply in most countries across the EU.

Building new or retrofitting to passivhaus standard transforms this current situation where there is general ignorance about building performance and sometimes much poorer performance than specified. This is one of four important reasons why designing or refurbishing to passivhaus standard provides great benefit:

- energy use for space heating is minimised,
- performance is as designed,
- the internal environment promotes well-being, and
- construction is undertaken to high quality standards.

The building is modelled in detail so that thermal performance is known and, once the design is finalised, no changes that could affect thermal performance are allowed. Quality is demanded at every stage during design and during construction of a passivhaus building. The result is a building that is effectively guaranteed to perform as specified.

Once energy use for space heating is minimised, then it becomes much more straightforward to address other sources of energy use such as water heating and appliances, and also to help building occupiers to understand how their behaviour impacts on overall energy use and to help them modify behaviour to achieve savings.

S10.3: Targets and mechanisms for rapid refurbishment

EuroACE, the European Alliance of Companies for Energy Efficiency in Buildings, has pointed out that the recast EU Energy Performance of Buildings Directive does not create a satisfactory platform for the refurbishment of the existing building stock. They point out that clear and measurable targets are required.

Renovate Europe has noted that, across Europe, 3 per cent of buildings must be deep-renovated each year for the next forty years if the 2020 and 2050 energy, carbon and economic goals are to be met. They note that, at present, only about 1.2 per cent of Europe's buildings are renovated each year and 0.1 per cent demolished and estimate that the 3 per cent annual ambition would create up to 1.1 million direct new jobs.

This 3 per cent ambition amounts to at least 5 million buildings across the EU each year and around 500,000 in the UK. A target of 500,000 homes plus large numbers of office and commercial buildings, refurbished to standards of very low energy use each year, is way above anything the UK construction industry has achieved in peacetime. Such a challenge has to be met but can only be met with unwavering

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political commitment. Clear targets for refurbishment across Europe are needed together with the political commitment to ensure these are met.

An ineffective policy that does not put in place the skills and the quality to ensure effective low-carbon construction and refurbishment will only ensure that things just get worse. A report by the European Climate Foundation has detailed the problem of lock-in of carbon emissions where sub-optimal refurbishment is undertaken. They point out that in a sub-optimal scenario, the big reductions in emissions needed by 2050 will become extremely difficult and expensive to achieve.

In respect of new build, the Chief Executive of the Royal Institute of British Architects has said that in a rush to build quickly and cheaply we risk storing up unnecessary problems for the future. He pointed out that there does not need to be any contradiction between building or refurbishing enough homes and making sure that they are of the highest quality.

So targets and political commitment for both refurbishment and new build are essential. Only by demanding higher quality standards can the industry move forward to be able to deliver the quality that is necessary to deliver low-energy buildings. There needs to be a focus on skills, on learning and quality, and on systems thinking.

In the UK, the Energy Company Obligation (ECO) is proposed as a mechanism to involve the major energy supply companies in tackling hard-to-treat and vulnerable properties. It is concerning, however, that neither the UK Green Deal nor the complementary ECO take a whole-house approach. Lock-in is therefore very likely.

It is also difficult to see how the ECO will work unless there is a total transformation of the energy supply industry. The Professor of Energy Policy at Exeter University, Catherine Mitchell, has pointed out that it is simply not in the interests of the handful of dominant energy companies and their shareholders to dramatically transform the energy system, whether on the supply side (as in pervasive penetration of solar PV) or the demand side (via 'deep' low-energy whole-house refurbishment).

EuroACE has likewise warned of sub-optimal outcomes via involvement of energy supply companies. EuroACE noted that experience from the UK, France and beyond, suggests that utility companies, when given a strong incentive to act, for example through an energy efficiency obligation, tend to focus on low hanging fruit – which will create lock-in.

Large-scale action at the street or neighbourhood level will be necessary and essential if the necessary 'deep' refurbishment rates are to be achieved and costs reduced to acceptable levels. It will also be essential to monitor performance to assure building owners and occupants, as well as the authorities, that what happens in practice is what is claimed by the advisors and installers.

Given the current lack of confidence that the construction industry has the knowledge and the skills to embark on a massive refurbishment programme that really could achieve major energy saving, how could an obligation on the major energy supply companies be most effectively utilised. It might be most effective to

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channel it, at least in part, towards creating mechanisms for learning and skill formation and to nurture entities that have the necessary skills and dedication to undertake cost-effective, high-quality, whole-house refurbishment.

S10.4: Investment in training and skills to enable passivhaus standards in practice

The teamworking that was enabled by Skanska during the low-energy 'deep' refurbishment of 1970s apartments at Brogården, southern Sweden, and assisted by the Swedish Passivhuscentrum, Västra Götaland, a Build with CaRe partner, is still not common-place in any EU country.

In the UK, and, quite likely, in many EU Member States, skills and quality may need to be significantly improved if passivhaus standards are to be assured. At present, working practices, with sub-contracting the norm, do not encourage either teamwork or the highest quality standards that only excellent teamwork can make possible.

The Barker Report in 2004 on UK housing emphasised the need for housebuilders to improve the quality of customer service and was concerned about the low level of training undertaken by the industry. In a follow-up study, the UK Office of Fair Trading found that estimates from two snagging companies indicated that they would expect to find around 40 snags [faults] for new one bedroom houses and flats and around 70-75 snags for an average three bedroom family home. These numbers do not inspire confidence.

The skills and expertise required for refurbishment are similar to those required for new build – possibly even more so because of the issues that will arise during work needing expert decision-making. Yet the recent report for the UK Government on low carbon construction noted that the repair, maintenance and improvement sector has a poor reputation, with relatively high levels of complaints and disputes.

It is unlikely that these issues are restricted to the UK. A restructuring of the vocational education system amounting to a paradigm shift has been called for. But while major changes in training and education are almost certainly necessary, there is no shortage of skilled people in any Member State. What is essential is to create a working environment where quality, teamwork and learning are paramount and to create the learning and training structures that are necessary for high quality outcomes.

If the magnitude of the challenge is not acknowledged and not properly met, then the danger is that appropriate skills will not be created, that work will not be undertaken to the quality and depth of energy saving needed, and that home owners and building occupants will be left with inefficient and expensive structures to heat and to maintain. Climate change targets will not be met and a unique opportunity to create a low-carbon and prosperous Europe will have been missed.

The EU has a potentially very important role to stimulate the learning and skill formation that a successful and extensive 'deep' refurbishment programme across Europe, lasting decades, will require. Build with CaRe has already stimulated very successful transnational learning and knowledge sharing. Rather than rushing into extensive work programmes, it may be preferable to direct Energy Company

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Obligation and other funds in the first instance to ensure learning from success and knowledge in 'deep' refurbishment from across Europe and to develop the skills and teamwork necessary to ensure work is done to the depth and quality necessary.

S10.5: Information campaign on passivhaus benefits for new and refurbished building

In promoting low-carbon refurbishment of buildings, governments must ensure that an information campaign gives people clear and useful information about what can be done and why. They must also ensure that all work that is done is done to high standards, and that it really does enable the energy savings necessary. Finally, but most importantly, governments must ensure that misleading advertising, inappropriate advice and inflated pricing are identified and warned against so that building owners or occupiers can avoid getting trapped into high-cost works that may be inappropriate.

The Bremen Bauraum, developed by a Build with CaRe partner, is an excellent example of how information can be provided in the most accessible way both to tradespeople and businesses and also to the general public. The establishment of such centres in every town and city across Europe could have a hugely beneficial impact on people's awareness.

The awareness that good and trustworthy advice can be obtained as well as financial support for effective refurbishment is critical for success. The establishment of a network of regional competence centres in Germany is acknowledged to have been very important.

Persuading the owners of millions of homes to agree to and to undertake 'deep' low energy refurbishment is a massive challenge. Regulations and mandates may help, but refurbishment, although disruptive, may not be more so than works very many home owners typically undertake today to increase comfort and convenience - such as installing central heating or new kitchens and bathrooms. Energy efficiency can reduce fuel bills but especially important for motivation will be awareness of the greatly improved comfort and well-being that a home converted to low-energy passivhaus standard can bring. Equally important is awareness of the financial benefit of undertaking refurbishment at the same time as other improvement works.

As buildings, homes in particular, become more energy efficient, occupant behaviour will become more prominent in determining total energy use. A smart meter in every home and business, planned for the UK by 2020, and across the EU in at least 80 per cent of homes, should be a catalyst not just for energy suppliers to improve efficiency of supply but also for providing advice on refurbishment and on occupant behaviour, and maximising energy efficiency in homes and more widely.

There are major concerns expressed in the UK, however, about the cost and the nature of the smart meter programme. This will be undertaken totally by the energy companies. The predicted £11.3billion cost will be passed on to consumers through their energy bills.

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The introduction of smart meters brings a one-off opportunity to gain an essential understanding of the 'deep' low-energy refurbishment requirements of almost every home in the EU. There seems little indication at present, however, either that such information collection relevant to refurbishment, or that productive engagement with occupiers, is currently planned. In the UK, indeed, the mode of smart meter introduction provides little confidence that such information could be collected while retaining the confidence of owners and occupiers. This is a most unsatisfactory situation. Not to enable such information collection and such engagement would be a huge wasted opportunity.

It will be critically important to develop ethical but effective ways to engage with consumers and to use the information that smart meters can potentially provide. City-based energy companies such as Hamburg Energy or initiatives such as the Bremen Bauraum that will have the confidence of consumers, unlike the energy companies, and also have a remit to promote energy efficiency, might be the most effective vehicles for the introduction of smart meters and for gaining the maximum benefit for consumers.

Mere provision of smart meters may stimulate some consumers to act on energy use and to develop more energy efficient lifestyles, but the great majority of consumers may not find the enthusiasm to make many changes. People cannot be encouraged or 'nudged' to become more energy efficient in their lifestyles until governments act to make clear that energy efficiency is an absolute priority. A commitment by government to radical action on energy efficiency, with building refurbishment leading the way, is the kind of signal that is needed.

There is a hierarchy of actions in planning energy efficiency in buildings.

- Firstly, it is essential to reduce energy waste for space heating and cooling. Aiming to achieve passivhaus standards and quality is the essential first step.
- Once this ambition is in place then efficiency for production and storage of hot water can be tackled
- Then there is energy efficiency in appliance use which, as with all use of energy, has two components, the appliance itself and individuals' behaviour and use patterns.

If governments are seen to be serious in dealing with the biggest waste of energy, space heating and cooling, then there can be effective debate with appliance makers to bring down energy use very sharply, almost certainly technically possible in very many cases.

Likewise, if residents and business people sense the urgency for energy efficiency that must, first of all, come from government, then it will be possible to engage in effective ways to help enable more energy efficient behaviour. Smart meter installation and use provides a one-off opportunity to make real progress.

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S10.6: Innovative thinking on financial support for 'deep' refurbishment

As noted in the accompanying paper, *Green Deal Appraised*[3], many of the measures that will be necessary to accomplish 'deep' low-energy refurbishment to achieve passivhaus or near passivhaus standards – with a reduction in total energy use of well over half – will not pay for themselves within a Green Deal package. Lock-in of energy use and carbon emissions is likely with a Green Deal or Energy Company Obligation approach that does not consider the whole house as a system.

Two important aspects must be considered when considering how to finance 'deep' low-carbon refurbishment of buildings. Firstly, long-term, such refurbishment should create value. Looked at from a top-down perspective, financing refurbishment should not be a show-stopper if the right players with long-term perspectives can get involved.

Secondly, as work by Build with CaRe partners and others makes clear, the economics, whether for housing or for commercial buildings, become much more favourable if refurbishment for energy efficiency is carried out at the same time as other renovation works. Examples within social housing described within Build with CaRe include refurbishment at Brogården, Sweden, and Roosendaal in The Netherlands.

If the renovations are done but not the low-energy refurbishment, however, then the economics may change. It may well not be cost effective to revisit the properties at a later date to do just the low-energy refurbishment. Such thinking applies to almost every refurbishment/renovation and not doing the works together is very likely to lead to 'lock-in' of emissions.

'Lock-in' will also lead to higher costs for owners or tenants. Payment of rents plus energy costs will become increasingly difficult for many. If, however, homes are refurbished to become very energy efficient, then there is the potential to manage costs. If more developers could be persuaded to be innovative like Hastoe Housing Association in the UK and other social housing providers elsewhere, then costs would be driven down rapidly and supply chains developed. Refurbishment would benefit from innovation in new build.

The refurbishment of the Empire State Building in New York is a high-profile example of energy efficient refurbishment of an iconic commercial building that was part of a more extensive whole-building renovation. The energy saving component is estimated to have a three year payback.

Every large building in every city can feasibly do the same thing. At present, however, this is not happening on any significant scale either for commercial buildings or for social housing. The commercial sector and the social housing sector should take a long-term perspective. It now needs social housing providers to learn

[3] *The 'Green Deal' Appraised*, Martin Ingham, Build with CaRe, October 2011, http://www.buildwithcare.eu/articles/78-partners/219-the-green-deal-appraised.

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from what is already being done at Brogården and Roosendaal, and building owners, city officials and regulators to work together to accelerate the 'deep' refurbishment of commercial buildings.

The majority of buildings across many EU countries, however, are homes where owners often do not have the long-term perspective that makes 'deep' refurbishment a financially feasible proposition for social housing providers and owners of commercial buildings.

Subsidies will be necessary as the example of Germany already makes clear. KfW, the German Federal Bank for Reconstruction (the Kreditanstalt für Wiederaufbau) provides loans of up to €75,000 for refurbishment with interest subsidies and partial debt relief (the details and incentives depend on the extent of the refurbishment planned and the energy saving expected). In 2009, out of €20billion invested by KfW, €9billion went towards energy efficiency in the housing sector. Depending on the city or region, further subsidy may be available. Hamburg, for example, has provided extra incentives to promote low-carbon refurbishment.

The sums of money needed for building refurbishment are huge. Getting it wrong would be disastrous for everyone. Hence the over-arching importance of skills, expertise and expert advice. If these aspects are well dealt with then taking into account the overall value tied up in the housing stock in the UK reveals the potential for funds to be available. The same situation may not apply in all EU Member States but the principles may be relevant.

Once debt is subtracted, there is residual value of the order of £3trillion or more in the UK housing stock. Even just 10 per cent of this residual value, about £300billion, approximates to our estimate of £200billion to undertake 'deep' refurbishment of almost the entire stock to low-energy standards.

Buildings are a long-term investment. The finance to undertake refurbishment on the scale required should also have a long-term perspective. This will become easier to achieve when, as will almost certainly happen, energy efficient buildings are valued more highly than those that are less efficient. As energy prices rise, it seems quite likely that the value of the most energy efficient – and hence comfortable and cheap-to-run – homes could eventually be at least 10 per cent higher than that of similar homes that are not energy efficient.

It seems that, with the right incentives - and with the necessary commitment from the EU and from governments - institutions with long-term financial interests, for example insurance groups and pension funds, could create the mechanisms to fund 'deep' refurbishment on a massive scale if they were rewarded with long-term value in the form, for example, of 10 per cent of the value of houses of which they had funded 'deep' refurbishment.

If a 'deep' refurbishment was made compulsory whenever a house was sold neither vendor nor purchaser might wish to have this done. But if a significant proportion of the work was funded by an institution with a very long-term perspective that then took a charge on the property to compensate, everyone could share the benefit.

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The purchaser would have a much-improved property that costs little to run while the institution would possess an up-graded asset which would retain value.

A further benefit would result from the interest of the long-term funder in ensuring that work was done cost effectively and to high quality. Long-term funders might have the biggest incentive to ensure that all this happens, much more so than energy companies.

A recent OECD report noted that pension funds' asset allocation to 'green' technologies was less than 1 per cent at present. Such mechanisms for financing effective whole-house 'deep' refurbishment are not discussed in the proposed UK Green Deal but must be considered if opportunities are not to be lost and a significant proportion of present-day energy consumption locked-in because only the low-hanging fruit of refurbishment needs are undertaken. With the right mechanisms developed, there should indeed be long-term finance potentially available and arrangements capable of development that can satisfy both investors and building owners.

Who would do the work? An interesting model has been developed by Hamburg in Germany, a city with several Build with CaRe partners. The city created its own publicly funded energy agency in 2009 with a remit to work to develop model projects for households and to help the city create a low-carbon sustainable future. Such an organisation that brings together supply needs, energy efficiency, and energy storage initiatives, seems highly appropriate to coordinating and organising the refurbishment task.

S10.7: Transnational learning and knowledge sharing

The transnational learning and knowledge sharing that has taken place within Build with CaRe has been, without doubt, one of the most important aspects of the whole project. Of especial note has been the exchange of expertise on passivhaus construction leading to new initiatives in the East of England and elsewhere.

The most effective way to develop the expertise, the skills and the knowledge to be able to ensure that a massive refurbishment effort can be undertaken across Europe to the quality levels necessary would be to greatly expand the kind of networking developed by Build with CaRe. In large part, the necessary knowledge already exists somewhere.

Now, to support the capital investment in new build and refurbishment to passivhaus standard that needs to happen across Europe, a huge learning exchange would be extremely beneficial. There needs to be learning by thousands of people from all parts of the UK and from all EU Member States.

This is something the EU could very effectively help organise.

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S10.8: Systems thinking and energy storage

As renewable energy becomes a greater and greater part of the total energy mix and, in particular, as end users make efforts to minimise energy use, it will become much more common-place to think of energy use within a system and hence of energy storage. The European Association for Storage of Energy, EASE, has recently been formed.

District heating can reduce costs and greenhouse gas emissions compared to individual boilers in buildings. More than four out of five UK homes are heated using individual gas boilers. In Denmark, in contrast, district heating supplies over 60 per cent of households and about half the space heating demand in all buildings, providing significant savings in CO_2 emissions, and the importance of focusing on integrated solutions – including the building envelope – is emphasised.

Heating hot water for district heating can be effected by renewable energy, either by wind and electric heating or by solar thermal methods. Graz in Austria, for example, has installed 6.5MW of solar thermal capacity. There is enormous potential for widespread solar thermal heating. In Denmark there is expectation that solar thermal heat could provide 40 per cent of the energy needed to heat Denmark's buildings by 2050.

In the UK interesting initiatives are appearing, typically operated by new companies focusing on the benefits of energy storage. For example, a supermarket in south London is storing waste heat from refrigeration, normally discharged as waste, that could cut the store's overall energy consumption by about 30 per cent. This technology has been developed with a local renewable energy start-up company.

As buildings become refurbished and much more energy efficient, all kinds of options become interesting. One example is an innovative mini-CHP and heat storage system demonstrated to us recently in a 1950s apartment block being refurbished to passivhaus standard in Hamburg, Germany. The heating and hot water were provided by a gas engine that was also generating electricity supplied to the grid. Heat storage was provided in the form of large cylinders of hot water enabling the engine to run only for a few hours a day when the demand is highest and revenue is maximised. Once again, the supplier is a small company supplying principally sustainable energy systems.

A single unit only a little larger in capacity than a typical gas boiler found in a single UK house is providing all the heat and hot water for 27 apartments. This unit can be linked up to thousands of similar units to provide what the operator, Lichtblick, calls "swarm electricity". Combined heat and power is achieved in "the swarm" without the need for extensive roadworks. The generating capacity of a large power station can become available with a distributed network installed in individual buildings.

The innovators are new entrants not established energy supply companies - for which such a system would be a threat to their existing business. Volkswagen brings expertise in engine technology while Lichtblick is a new entrant to the energy supply business with only a few hundred thousand customers.

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Such “swarm electricity” based on mini-CHP units is an example of the innovation that is both possible and necessary if there is to be a transition to a clean energy efficient economy. Often, governments seem to have been overly influenced by traditional networks and suppliers.

It is urgent now that such inappropriate and out-of-date thinking is overturned and that local energy supply and storage, integrated with innovative concepts such as “swarm electricity”, develop rapidly, and hand-in-hand with rapid advances in ‘deep’ low-energy refurbishment of buildings. The building and refurbishment of buildings to or close to passivhaus standards creates the potential for simplified and local energy storage. This is why ‘deep’ low-energy refurbishment and local energy supply are so complementary.

S10.9 Cities enabled to lead

Over half the global population is now thought to live in urban rather than rural areas. In European countries the proportion is even higher. Progressive cities in Germany such as Hannover and Hamburg – where Lichtblick is based – are stimulating low-carbon and passivhaus construction and refurbishment, and promoting energy suppliers that focus on efficiency and assist consumers to reduce their use.

Cities such as Hamburg are aware of the importance of renewable energy, of systems thinking, and of energy efficiency. Governments should therefore enable cities to make key decisions and investments that can drive forward innovation.

Metrex is a self-help network of practitioners in spatial planning and development at the metropolitan level. The Metrex EUCO2 80/50 project on planning for energy in metropolitan areas makes it clear that the first target for energy self-sufficiency is the reduction of waste energy, particularly from buildings. Once again, making buildings energy efficient is the critical step forward.

The Metrex report notes that dramatically reduced energy demand from buildings and vehicles opens up the prospect of metropolitan renewable energy self-sufficiency, and that new technologies are opening up opportunities for urban land and buildings to become sources of energy supply and for metropolitan areas to become power stations of the future.

This potential for energy self-sufficiency within Europe’s metropolitan areas is poorly appreciated at present. There is tremendous potential for innovation that can dramatically and beneficially transform our energy landscape. It is likely that this innovation will be led by new entrants and will operate in very different ways to the grid system developed some generations ago.

There is admirable activity already in many EU cities but the clear message of this paper is that progress must go faster. Long-term targets are admirable but short-term action is essential.

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Barriers

This paper discusses several barriers that can inhibit rapid progress towards low-carbon construction. None is insuperable and, for many, we highlight countries or cities that have already found ways to make progress. Most fundamental are the political barriers, in particular the lack of commitment at EU and Member State level towards energy efficiency and demand reduction. With political commitment, all other barriers can be overcome.

Key barriers discussed are summarised below. As we note through the paper, these barriers will not all apply in all EU Member States. Some countries and cities, as we note, have made remarkable progress and demonstrate the progress that could be possible by every Member State if the political will was present.

Political and structural barriers

- Lack of political commitment towards rapid progress on energy efficiency and demand reduction.
- Lack of effective and mandated targets at EU and Member State level for energy efficiency and demand reduction.
- Weakening of proposed standards for so-called “zero carbon homes”
- Focus on energy supply rather than demand reduction
- Emphasis on fossil fuels and nuclear electricity rather than clean energy
- Lack of ‘long’, ‘loud’ and ‘legal’ support for clean technologies and demand reduction
- Focus on long-term targets for emissions reduction rather than deeper near-term targets and action
- Recast EU Energy Performance of Buildings Directive does not mandate the necessary rate or depth of refurbishment
- UK ‘Green Deal’ likely to promote mainly shallow refurbishments, and at too low a rate; ‘Energy Company Obligation’ refurbishments unlikely to look at the whole house.
- Structure of the energy supply industry
- Public display of DECs (Display Energy Certificates) not mandatory
- Involvement of energy companies in refurbishment likely to lead to sub-optimal refurbishment with ‘lock-in’ of emissions

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- Unique opportunities offered by the introduction of ‘smart meters’ to create detailed awareness of refurbishment options and possibilities for homes and buildings likely to be wasted
- Lack of emphasis on energy storage and local energy supply
- No mechanisms to enable extensive transnational learning and dissemination of passivhaus principles and know-how
- Towns and cities without the flexibility or the financial independence to pursue local energy efficient solutions
- No innovation or emphasis to create entities that can undertake efficient and effective wide-scale ‘deep’ low-energy refurbishment combined with innovation in local energy supply and storage
- Government Housing Strategy ignores low-energy innovation and passivhaus quality
- Lack of innovative thinking to enable funding of ‘deep’ low energy refurbishment of homes and buildings
- Lack of consideration of wider benefits flowing from ‘deep’ low energy refurbishment of homes and buildings, for example job creation and health and wellbeing

Industry barriers

- Lack of a quality culture and lack of recognition of the benefits thereof
- Lack of interest to promote passivhaus quality
- Lack of skills, training and teamwork to make possible passivhaus quality, and lack of determination to address this deficiency
- Overstated cost estimates for building to passivhaus quality
- Immature supply chain for many materials and products required for low energy building
- Design performance for energy efficiency not achieved in practice for new or refurbished buildings
- Little or no post-occupancy evaluation to monitor and improve energy performance of buildings
- Lack of training and competence centres to ensure a good supply of skilled assessors capable of ‘whole house’ assessment and of tradespeople capable of ‘whole house’ refurbishment
- Lack of capacity to undertake the 5 million ‘deep’ low-carbon building refurbishments needed each year across the EU

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- Lack of advice and training centres for homeowners and building owners and occupiers
- No motivation to link refurbishment to other building works to minimise cost and maximise benefit

Social barriers

- Wasteful energy use is accepted as normal
- Lack of awareness of passivhaus quality and benefits for health and well-being
- Problem of 'lock in' of energy use and greenhouse gas emissions if refurbishment not done to 'whole house' deep low-carbon standard
- Lack of clear advice and information available to homeowners on refurbishment and what can be done and why
- Lack of subsidy to incentivise homeowners to undertake 'deep' low-energy refurbishment
- Lack of long-term investment to undertake 'deep' low energy refurbishment by commercial building owners and social housing providers

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1. Wasting energy

> *"The world has edged incredibly close to the level of emissions that should not be reached until 2020 if the 2ºC target is to be attained. Given the shrinking room for manoeuvre in 2020, unless bold and decisive decisions are made very soon, it will be extremely challenging to succeed in achieving this global goal agreed in Cancun."*
>
> Dr Fatih Birol, Chief Economist at the International Energy Agency, 30 May 2011 (http://www.iea.org/index_info.asp?id=1959).

To avoid potentially disastrous climate change, energy supplies must be decarbonised. Such a change will necessitate a massive restructuring of energy supply with renewable sources of energy displacing fossil fuels. The necessary investment is great. A satisfactory outcome can only be achieved if large reductions in energy demand are simultaneously realised. Energy efficiency must show a dramatic improvement across all economies.

We note in this paper how recent studies have emphasised the urgency of action to reduce global greenhouse gas emissions if potentially dangerous climate change is to be avoided. The EU is a global leader in enabling a long-term transition to an almost zero-carbon economy by 2050. There is impressive investment underway[4] to bring the proportion of renewable energy to 20 per cent by 2020 but even greater ambition is now essential if the EU is to reap the benefits from a fossil-fuel free economy[5] and to lead global action to tackle climate change. But the transition to a low-carbon economy can only happen if there is a similar ambition for achievement in energy efficiency, led by a transformation in the energy efficiency of the building stock, as there is for the growth of renewable energy supply. This ambition is presently inadequate. The biggest barrier to beneficial transformation of the building stock is lack of political will to set a challenging target. This lack of political will reflects attitudes to energy efficiency in general and is a consequence of a fossil-fuel economy mindset. It is manifested, in the UK at least, in mistaken government thinking about energy efficiency and regulation.

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4 *Huge renewable energy growth this decade, if EU countries meet projections*, European Environment Agency, Press Release, November 28, 2011, http://www.eea.europa.eu/highlights/massive-renewable-energy-growth-this.

5 In the European Environment Agency press release, Footnote 1, Jacqueline McGlade, EEA Executive Director, noted: *"However, with a concerted effort we can and should go even further to phase in renewable energy sources"*; she also noted that *"pollution from coal and gas power plants is costing Europe many billions of euros a year in health costs."*

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In this paper we outline the problems and how they could be overcome to create a 'new reality'. Build with CaRe partners are already demonstrating that what is necessary can already be done. The benefits for jobs, for innovation, and for fuel security, as well as for the environment will be great. In this first Section, we outline our attitudes to energy, why wasting energy is seen as the normal way of life, and how innovation within the EU has created the possibility to transform the energy efficiency of the building stock.

In the UK and across the EU, as in most developed countries, by far the largest user of energy is the building stock. Nearly 27 million homes in the UK are responsible for over a quarter of the UK's carbon dioxide emissions, and non-domestic buildings for a further 18 per cent. Across the EU-27, homes are responsible for a quarter of energy related greenhouse gas emissions and commercial buildings for another 15 per cent, 40 per cent in total[6]. Heating is responsible for over half of UK domestic carbon dioxide emissions whilst heating, hot water and lighting together account for four-fifths of the total. There is huge scope for both increased energy efficiency and greatly reduced carbon emissions in homes already built.

Three-quarters of the UK homes that will exist in 2050 have already been built; around 60 per cent of today's non-domestic buildings will still exist and will represent 40-45 per cent of the total floor space[7]. The existing building stock is where the big energy savings must be found. Studies in the UK and across the EU show that most existing homes and buildings can indeed be refurbished to achieve very large reductions in energy use. At the same time, the internal environment can also often be greatly improved, promoting health and well-being and eliminating fuel poverty. These gains are achieved by greatly reducing wasteful loss of heat through the fabric and by more efficient use of energy in the building, as well as through improved heating systems and localised micro-generation.

The companion paper, *Green Deal Appraised*[8], outlined a diverse range of challenges that will have to be overcome if the proposed UK Green Deal programme for building refurbishment is to deliver the success that is necessary to achieve the carbon reductions required of the built environment. In this paper we outline more fundamental barriers that seem to exist almost across the EU – with some prominent exceptions that demonstrate what can be achieved – that presently prevent energy efficiency in general and building refurbishment with 'deep' cuts in

6 *End-user GHG emissions from energy: Reallocation of emissions from energy industries to end users 2005–2009*, European Environment Agency, Technical report No 19/2011, 15 December 2011, http://www.eea.europa.eu/publications/end-use-energy-emissions/full-report-2014-end-user.

7 *Building the Future Today*, Carbon Trust, 2009, http://www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTC765.

8 *The 'Green Deal' Appraised*, Martin Ingham, Build with CaRe, October 2011, http://www.buildwithcare.eu/articles/78-partners/219-the-green-deal-appraised; elsewhere in this document we refer to it as "*Green Deal Appraised*".

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energy use, in particular, gaining the attention and investment they must have if climate change targets are to be met.

Building refurbishment cannot happen in a comprehensive manner until energy efficiency takes centre stage. When that happens, building refurbishment can and must play a central role. Across the EU, progress in energy efficiency is far less than planned and far, far less than needed.

We outline some reasons why energy efficiency is not pursued with the vigour that it must be and propose a change of attitude that can, if followed, lead to sustainable growth. If change of the kind we suggest does not happen, then there seems little or no possibility of preventing dangerous climate change. On the other hand, the EU could take the lead in demonstrating how to decarbonise economies while following a path to sustainable prosperity.

The World Business Council for Sustainable Development[9] (WBCSD) published a report[10] in 2009 that made clear (p19) that: *"We need a transformation of the building sector towards zero net energy use"* if energy reduction and climate change targets are to be met. This report took a global perspective but noted (p27) that: *"Retrofitting older, inefficient houses is the biggest challenge in Europe."*

To achieve this transformation of the building sector – for both domestic and commercial properties – and both globally and within the EU - requires several barriers to be overcome and the WBCSD report alludes to several of these. They include financial barriers, skill barriers and knowledge and behaviour barriers. However, perhaps the biggest barrier to creating a truly energy efficient economy – within which efficient energy use in buildings is a major part - is the way in which we view energy. At all levels of society we have grown used to taking energy supply for granted and planning activity around energy delivered at low cost. Fossil fuel companies and energy supply companies are some of the biggest players in the global economy. As a consequence, governments still focus on energy supply while putting less emphasis on energy efficiency. But a very large proportion of delivered energy is effectively wasted because of inefficiencies in its use. In many EU countries we have grown used to having energy inefficient houses and buildings, we behave in energy inefficient ways, and most appliances use far more energy than need be the case with the necessary innovation.

This 20th century mindset prevents serious discussion about energy efficiency even today. If problems of supply arise, or if costs rise, then focus will turn to improving supply and mitigating cost rises rather than to asking why we need this energy in the first place.

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9 The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress, http://www.wbcsd.org/.

10 *Energy Efficiency in Buildings: Transforming the Market*, World Business Council for Sustainable Development, August 2009, see http://www.wbcsd.org/Plugins/DocSearch/details.asp?DocTypeId=25&ObjectId=MzQyMDQ

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As the WBCSD report notes (p14), however: *"People do not want "more energy"; they want more of the services energy provides: heating, cooling, lighting and communicating. ... The bad news is that since energy is not intrinsically valued, conserving energy tends to be a low priority for most building owners and operators."*

The fundamental barrier to achieving an energy efficient economy, and hence to achieving an energy efficient building stock, with all the benefits that this would bring, is that wasteful energy use and energy supply is accepted as normal by consumers and by governments as well. As we note below, governments emphasise supply not efficiency. DECC, the UK Government Department of Energy and Climate Change, is weighted very much towards energy supply. There is, at this moment in time, apparent enthusiasm from UK Government ministers[11] over potential new UK supplies of natural gas from shale deposits while the UK Government is reported[12] to be supporting extraction of fossil fuels from tar sands in Canada, a country that has withdrawn from the Kyoto process and whose greenhouse gas emissions have risen by a third since 1990[13]. Such a situation is not unique to the UK. The concerns outlined here will apply in many other EU countries.

The consequence of this attitude is that untold £billions have been spent on exploring and producing North Sea gas only for a significant proportion to be effectively wasted by being burned in central heating systems across the UK. The heat produced promptly leaks out of energy inefficient buildings just as water will leak out of a swimming pool with cracks in the walls. There would be an outcry if almost every home in the country had a swimming pool that had continually to be topped up with water because so much leaked away, yet this is exactly the situation with energy to heat buildings in countries such as the UK.

Other EU Countries bordering the North Sea, such as The Netherlands, have followed a similar path while, across Europe, Russian gas is likewise wasted. Consumers have effectively wasted a large portion of the £billions spent heating their homes – most by gas – because their homes are energy inefficient.

Tolerating such waste sustains inefficiency and inhibits innovation which is why government ministers are still expressing great interest in new supplies of gas, much to be wasted heating inefficient homes. Irrespective of whether there is more gas to

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11 *The potential for shale gas is worth exploration*, Charles Hendry, guardian.co.uk, Thursday 22 September 2011, http://www.guardian.co.uk/environment/2011/sep/22/shale-gas-exploration; Charles Hendry is minister of state at DECC.

12 *UK secretly helping Canada push its oil sands project*, Damian Carrington, guardian.co.uk, 27 November 2011, http://www.guardian.co.uk/environment/2011/nov/27/canada-oil-sands-uk-backing

13 *Canada condemned at home and abroad for pulling out of Kyoto treaty, China calls Canada's decision 'preposterous', while Greenpeace says the country is protecting polluters instead of people*, Damian Carrington and Adam Vaughan, guardian.co.uk, 13 December 2011, http://www.guardian.co.uk/environment/2011/dec/13/canada-condemned-kyoto-climate-treaty.

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be found and supplied, it would be far more efficient and far more comfortable for homes and other buildings not to need this piped-in waste. Supporting new production of fossil fuels undermines the effort to develop renewable energy supplies, with dangerous long-term consequences for climate change (Section 9).

Much of manufacturing around the world has been transformed by so-called 'lean thinking', where elimination of waste drives out cost and drives up quality. But energy has been largely absent from the wastes pursued in this campaign, perhaps because it has been too cheap and because we do not easily appreciate how it is being wasted. Now, with the threat of climate change more urgent than ever, it is essential also to treat energy use as another activity where waste must be relentlessly eliminated wherever possible. As we already know from building refurbishments being done now to very high standards of energy efficiency in partner Build with CaRe countries, the result can be health-giving and transformative.

As we describe later in this paper, Toyota, the company in Japan that largely developed 'lean thinking', found that eliminating waste reduces cost and increases quality. By a relentless focus on innovating to eliminate waste they achieved change that the rest of the car industry would have previously claimed to be impossible.

With passivhaus[14] thinking, similar improvements are now being made in how we think about and construct or refurbish buildings. Making huge cuts in the use of energy by buildings does not necessarily imply either huge cost or worse performance. In fact, quite the reverse. Homes built or refurbished to or close to passivhaus standards will usually be far more pleasant, healthy and comfortable to live in.

New thinking is needed to make possible a wide-scale transformation of the EU building stock to the very high standards of energy efficiency that we know are possible. Established mindsets, both among politicians and among the industry, are often the hardest things to change; which is why energy efficiency remains in the slow lane. As we describe below (Section 9), we need a 'new reality' about energy use and energy efficiency if we are to have any chance of meeting climate change targets. As passivhaus thinking about construction teaches us, this new thinking can bring many benefits: jobs, skills, healthy environments, a clean energy supply system based on renewables, and, in particular, a real possibility of tackling climate change.

The EU is the global leader in passivhaus innovation. By bringing this thinking to the mainstream along with a dramatic acceleration in action on energy efficiency, the EU can demonstrate sustainable growth with great benefits for its citizens. Only with such leadership, can other countries worldwide follow our example[15] and realise

14 See http://en.wikipedia.org/wiki/Passive_house for a description of passivhaus standards and examples.

15 The developing world in Asia, in particular, is driving increases in global carbon emissions, with an increase of 10 per cent in China in 2010 (*Record High 2010 Global Carbon Dioxide Emissions from Fossil-Fuel*

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similar benefits. Such leadership on energy efficiency, allied with single-minded focus on decarbonising energy supplies, is the only option if potentially dangerous climate change is to be avoided.

What must not happen is any relaxing of environmental standards for buildings in EU countries under the misguided impression that such action can stimulate growth. Any such action would set back everything that is desirable, not just action against climate change but also innovation, job and skill creation and improved health and well-being. We outline in Section 10 below how a forward-looking process to promote energy efficiency in buildings can evolve and warn in Section 7 about misguided government thinking on environmental regulation.

Combustion and Cement Manufacture Posted on CDIAC Site, Contributors, Tom Boden and T.J. Blasing, http://cdiac.ornl.gov/trends/emis/perlim_2009_2010_estimates.html); a recent study of China's emissions increases between 2002 and 2007 has identified the major role of capital investment including buildings and the lock-in of carbon emissions that energy inefficient buildings entail: *"large parts of the new building stock put in place at the moment may not be constructed in an energy efficient way nor for a long lifetime. The resulting lock-in effects are largely avoidable because energy-efficient new-built can be created at negative or little extra costs."*, A "Carbonizing Dragon": China's Fast Growing CO2 Emissions Revisited, Jan C. Minx et al, Environ. Sci. Technol., 2011, 45 (21), pp 9144–9153.

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2. Polluting energy versus clean energy: the road that must be travelled

> *"Renewables subsidies in 2010 were $66billion against $409billion for fossil fuels"*
>
> International Energy Agency World Energy Outlook 2011, 9 November 2011 (http://www.iea.org/index_info.asp?id=1959).
>
> *"In the next few years the mainstream world is going to wake up to wind cheaper than gas, and rooftop solar power cheaper than daytime electricity. Add in the same sort of deep long-term price drops for power storage, demand management, LED lighting and so on – and we are clearly talking about a whole new game."*,
>
> Justin Wu, Bloomberg New Energy Finance, Onshore wind energy to reach parity with fossil-fuel electricity by 2016, 10 November 2011, http://bnef.com/PressReleases/view/172.

We focus here on energy supply because energy supply and energy efficiency are – or rather should be - totally and utterly interlinked. At present, they are not. An energy supply system, such as that presently dominant in most of Europe and the developed world, sells electricity and fuels as commodities. In other words, the production and sale of electricity (and of fuels such as gas for heating) is quite separate from their use[16]. Such an arrangement promotes inefficiency and makes it almost impossible to optimise the whole system within which the energy is used. As we noted in Section 1 above, users of energy are not interested in electricity, in gas or in fuels. They want the services the energy makes possible.

It is this dysfunctional separation between energy supply and energy use that is the fundamental reason why progress in energy efficiency is slower than it could be, why the transition to a renewables based economy is slower than it could be, and hence why efforts to tackle climate change proceed so slowly. We note in this

[16] There are many examples of energy efficiency campaigns conducted via energy supply companies in the UK and elsewhere but, as we note below (Section 8) the overall impact has not been great, a primary reason being the separation between use and supply. One location where a more focused attempt to involve supply companies in supporting energy efficiency has been successful over time is California. In California, there has been a 40 per cent reduction in electricity use relative to the rest of the United States where there has not been such attention on energy efficiency. Information on California is given in a recent blog about the rebound effect (and lack of evidence for it) by David Goldstein of the US National Resources Defense Council: *Some Dilemma: Efficient Appliances Use Less Energy, Produce the Same Level of Service with Less Pollution and Provide Consumers with Greater Savings. What's Not to Like?*, David Goldstein, 17 December 2010, http://switchboard.nrdc.org/blogs/dgoldstein/some_dilemma_efficient_applian_1.html.

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section how these issues are all inter-related. Accelerating change on energy efficiency and renewables, now urgently necessary because of the threat of climate change, requires political action to tackle this dysfunction. Hence, while costs and skills to promote 'deep' building refurbishment across Europe need to be dealt with and are discussed below (Section 10), the biggest barrier to mainstreaming low-carbon construction and to accelerating refurbishment is political. There has not been the necessary political urgency for action. It's no surprise that those EU countries that are farthest advanced in developing a renewables economy, because of the political commitment that renewables have received, are also the countries most advanced in promoting energy efficient buildings.

Hermann Scheer, one of the authors of the German Renewable Energy Act posed the problem in blunt terms[17]: *"There can be no environmental revolution in energy supply without creative destruction (à la Schumpeter) in the existing conventional energy industry."* The issues were described in more measured terms by Walt Patterson in a briefing paper[18] in 2007: *"If we are to redesign our energy systems within a timescale that will prevent dangerous climate change, we need to move beyond the prevailing fixation on fuels and electricity. We need to identify and distinguish the systems – the complete systems – that deliver the different energy services we desire. A complete system includes the end-use energy technology, the fuel or electricity to run it, and the natural ambient energy of the surroundings. Only by taking this whole-system approach can we find the best ways to upgrade the systems, the investments involved and the policies to foster these investments."*

Patterson goes on to point out that transforming energy structure also means transforming infrastructure including buildings: *"Transforming energy systems means transforming infrastructure. That means investment. When traditional energy policy talks about infrastructure it means pipelines, power stations and other technologies to deliver fuels and electricity. For climate security and fuel security, however, what really matters is the energy service infrastructure – the buildings, appliances and other technologies that give us comfort and illumination and the other services we want."* We discuss systems thinking in Section 10.8.

In fact, since the mid-1970s, when energy efficiency first gained serious attention following the first oil price shock, there has been remarkable progress in spite of lack of government interest. Without this progress, not predicted at the time, there would not now be the brief window of opportunity still available to act on climate change. So much more could have been done over the last thirty years, however, had governments taken energy efficiency and demand reduction seriously. Now, there

17 In the Foreward of *The Solar Economy: A Sustainable Global Future*, Hermann Scheer (Earthscan 2002; first published in German as Solare Weltwirtschaft, 1999).

18 *Transforming our energy within a generation*, Walt Patterson, Chatham House Briefing Paper, June 2007, http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/bp0607climatewp.pdf.

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has to be a rapid transition to a 'soft' path, one that could have been followed, with huge benefit to society, over three decades ago.

Thirty-five years ago, Amory Lovins published a seminal paper[19] that posed the key question we are still grappling with today. He outlined two divergent paths along which America's energy policies might lead: *"The first path resembles present federal policy and is essentially an extrapolation of the recent past. It relies on rapid expansion of centralized high technologies to increase supplies of energy, especially in the form of electricity. The second path combines a prompt and serious commitment to efficient use of energy, rapid development of renewable energy sources matched in scale and in energy quality to end-use needs, and special transitional fossil-fuel technologies. This path, a whole greater than the sum of its parts, diverges radically from incremental past practices to pursue long-term goals."* In particular, he noted that these two paths are likely to be mutually exclusive because commitment to the first may foreclose the second.

Lovins noted that the first path, the 'hard' path, entailed potentially serious environmental risks whereas the second, 'soft' path would have small and reversible environmental impacts: *"The hard path entails serious environmental risks, many of which are poorly understood and some of which have probably not yet been thought of. Perhaps the most awkward risk is that late in this century, when it is too late to do much about it, we may well find climatic constraints on coal combustion about to become acute in a few more decades: for it now takes us only that long, not centuries or millennia, to approach such outer limits. The soft path, by minimizing all fossil-fuel combustion, hedges our bets. Its environmental impacts are relatively small, tractable and reversible."* Even in 1976, Lovins was warning about the possibility of dangerous climate change due to excessive fossil fuel use and how this could be avoided through a transition to a more sustainable energy path.

Had Lovins' lower cost 'soft' path been followed by the United States from this time, it is almost certain that there would now be no debate about climate change or any need to take urgent action now to bring about a renewables based energy supply system. Fossil fuels would be used only in moderate amounts and energy efficient ways of living and working would be the norm world-wide.

Two things happened after Lovin's paper was published. Firstly, the fossil fuel industry and the energy supply industries continued to influence decision-making. From an energy supply perspective, the hard path was followed.

Lovins published two figures showing schematically how gross primary US energy use might evolve in the fifty years between 1975 and 2025. The 'hard' path remained 100 per cent fossil fuel and nuclear driven while total primary energy use increased about three fold. In the 'soft' path, nuclear was abandoned right at the start and use of fossil fuels was eliminated by 2025. By 2011, his figure for the 'soft'

[19] *Energy Strategy: The Road Not Taken?* Amory B. Lovins, Foreign Affairs, 1976, available from http://www.rmi.org/Knowledge-Center%2FLibrary%2FE77-01_EnergyStrategyRoadNotTaken.

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path shows 'soft' technologies have about two-thirds penetration. In fact, in 2010, the proportions in gross primary US energy use were[20] 83 per cent fossil fuel, nearly 9 per cent nuclear and just over 8 per cent renewable (which includes biofuels for transport) – a very 'hard' path indeed. The path followed by the UK is even more 'hard' with an even smaller renewables proportion[21] by 2010. Luckily, as we note below, some other EU countries have been more alert to the importance of making the transition to a fossil-free economy.

The second outcome since 1976 might well have surprised Lovins at the time he wrote his paper, however. His figure for the 'hard' path, reflecting the prognosis of US energy agencies at the time, predicted that gross primary energy use might rise from about 75 quads[22] in 1975 to around 200 quads by 2011. In fact, in 2010, US gross primary energy use was about 98 quads, only around half of what was being predicted thirty-five years before and not so very different to the 90 quads or so that Lovins was predicting might be possible via the 'soft' path. The path remains hard but total primary energy use is only half that predicted.

The principal reason is energy efficiency. Without any major effort, the market-place for energy efficiency in the United States has delivered four or five times as much energy saving (called 'negawatts' by Lovins[23]) as has been supplied by new sources of energy. This is a fantastic result as it means that there is still time, just, to act to combat climate change which there most certainly would not be if the projections from the 1970s had proved correct.

It's a similar story in Europe, at least in the UK. Professor Peter Chapman of the UK's Open University published a detailed analysis[24] in 1975 of the UK's energy options over the next forty years or so – about to now in other words. He observed that the UK's primary energy use had been rising exponentially over the past fifty years or so with an apparent doubling time of thirty-seven years, corresponding to a growth rate of 1.87 per cent per annum (the 60th Anniversary Digest of UK Energy Statistics[25] in 2009 gave some historic data showing that UK primary energy use increased by 40 per cent in the twenty years after WWII from 1948 to 1968).

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20 Detailed information can be found in *Annual Energy Review 2010*, US Energy Information Administration, http://38.96.246.204/totalenergy/data/annual/pdf/aer.pdf.

21 See Digest of UK Energy Statistics, 2011: long-term trends, http://www.decc.gov.uk/assets/decc/11/stats/publications/dukes/2311-dukes-2011-long-term-trends.pdf.

22 A "quad" is a quadrillion British Thermal Units (BTU) or 10^{15} (peta) BTU. The BTU is still in common use in the United States as a measure of energy. A BTU is equivalent to about 1055 joules. See http://en.wikipedia.org/wiki/British_thermal_unit.

23 *The Negawatt Revolution - Solving the CO_2 Problem*, Keynote Address by Amory Lovins at the Green Energy Conference, Montreal 1989, http://www.ccnr.org/amory.html.

24 *Fuel's Paradise: Energy Options for Britain*, Peter Chapman, Penguin Books, 1975.

25 60th Anniversary Digest of UK Energy Statistics, July 2009, http://www.decc.gov.uk/assets/decc/statistics/publications/dukes/1_20090729135638_e_@@_dukes60.pdf.

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Chapman outlined three scenarios for the future. 'Business-as-usual', similar in concept to Lovins' 'hard' path, assumed continuing growth at historical rates with an increase in primary energy demand of around 250 per cent by 2010 relative to 1970. This huge increase in energy supply could only be met by massive expansion of all energy sources including fast breeder nuclear reactors[26]. A 'technical fix' scenario, which assumed considerable energy efficiency gains, increased primary energy demand by a more manageable 150 per cent over the same period. Finally, a 'low-growth' scenario, somewhat similar to Lovins' 'soft' path, assumed a levelling out of primary energy demand after a 10 per cent or so rise in the first few years.

What actually happened was that UK primary energy demand peaked at just over 220 million tonnes of equivalent oil (toe)[27] in 1973 as Chapman was writing his book and has stayed at or near this level ever since. In 2010, the figure was 218.5 million toe, less than in 1973. In spite of the UK following a 'hard' path to this day, just like the United States, energy efficiency, combined with other changes not foreseen by Chapman[28] has led to a primary energy demand in the UK no higher than predicted in his low-growth scenario. Yet Chapman was seriously concerned that such an outcome would lead to a "great depression" via positive feedback where reduction in growth led to unemployment that produced a further reduction in growth. In fact, over most of the period, economic growth continued at more or less historic rates.

Chapman's analysis was as good as could be achieved at the time. What he could not have envisaged was the potential for energy saving that could be achieved by the economy in response to price pressures[29] and technical change. Only a few years after Chapman's book was published, however, a detailed analysis appeared[30] of how the UK actually could, through practical application of energy efficiency actions, avoid the need for demand to rise and hence could abandon the ambition to build a succession of new nuclear power stations.

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26 It seems to be conveniently forgotten now by the nuclear industry that the promise of plutonium burning fast reactors was originally the principal justification for a thermal reactor programme. However, no fast reactor programmes worldwide have successfully survived technical and cost challenges. The consequent waste and storage problems resulting from existing nuclear operations are a principal contributor to the steadily rising costs of nuclear electricity which will only get worse if further nuclear investment is made. As we note in this Section, the costs of renewable electricity continue to fall while the cost of nuclear electricity continues to rise (it should not be forgotten also that nuclear weapons proliferation tends to follow dissemination of so-called civilian nuclear technology).

27 The units used in the Digest of UK Energy Statistics; 1 tonne of equivalent oil is equal to 1.163×10^4 kWh.

28 For example the widespread penetration of gas central heating which is much more energy efficient than the electrical storage heating in place and promoted when Chapman was writing and the decline of heavy industry in the UK; another contributing factor more recently is the export of manufacturing (see Section 3 where consumption-based greenhouse gas emissions are discussed).

29 Starting with the first oil price shock following the Arab-Israeli war in 1973.

30 *A low energy strategy for the United Kingdom*, G. Leach, C. Lewis, F. Romig, A. van Buren and G. Foley, International Institute for Environment and Development and Science Reviews Ltd, London, 1979.

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The suggestions in *A low energy strategy for the United Kingdom* are eerily similar to thinking today, over thirty years later, about how to improve the energy efficiency of UK buildings, for example through solid wall insulation and the widespread introduction of heat pumps. However, the thinking was politely dismissed by most commentators such as economists[31] and the UK nuclear power industry[32].

The problem for economists is that they cannot cope with innovation. Even as these responses were being formulated in 1980, the United States was wrestling with an economic crisis brought about by the quality of products that Japan was exporting[33]. Yet no economist would have recommended such action on quality by the Japanese because they could only have seen increasing costs rather than the transformation in cost and quality that would result. It was engineers such as W Edwards Deming, not economists, who helped teach quality methods in Japan and who, in the 1980s, helped guide the United States also along the quality path[34].

It is revealing that Deming's book contains many principles that appear in this paper in respect of the benefits of addressing poor quality in construction and of moving towards the high quality passivhaus standard. For example: *"Defects are not free. Somebody makes them, and gets paid to make them."* (p11), *"There is no substitute for teamwork and good leaders of teams to bring consistency of effort, along with knowledge."* (p19) and *"Innovation, the foundation of the future, cannot thrive unless the top management have declared unshakable commitment to quality and productivity. ... Constantly improve design of product and service. This obligation never ceases."* (p25). Pursuing energy saving in buildings in a similar manner to the striving for quality described by Deming thirty years ago creates the transformative innovation that is passivhaus quality as we describe in Section 8.

The response of the UK nuclear industry to *A low energy strategy for the United Kingdom* was bizarre in claiming that a strategy based on conservation was "inherently risky": *"A policy based on expansion and diversity of energy supply together with conservation is far less risky and more likely to provide the base for economic growth in the future."* However, the energy saving that happened anyway meant that only one of the ten new pressurised water reactors planned for the UK in 1980 was actually ever built[35].

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31 *Low energy strategies for the UK — an economic perspective*, Eileen Marshall, Energy Policy (1980), 8(4), 339–343.

32 *Energy policy: optimism is not enough* (Review of A Low Energy Strategy for the United Kingdom), P M S Jones, Futures, August 1980, 333-336

33 We have mentioned Toyota's 'lean thinking' in Section 1 and link such innovation to passivhaus quality in more detail in Section 8.

34 *Out of the Crisis*, W Edwards Deming, (MIT Centre for Advanced Engineering Study, Cambridge, Mass) 1982.

35 Although not acknowledged by the government, this avoidance of construction of nine new nuclear power stations has meant a massive saving in spent nuclear fuel storage costs not needed; energy saving has extensive benefits!

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This present paper calls for a fundamental change of approach and for governments at last to take energy efficiency and demand reduction seriously. As Walt Patterson has recently noted[36], had change happened when *A low energy strategy for the United Kingdom* was published: *"the UK would have led the world in showing how to avoid fuel supply problems and minimize climate disruption."* Luckily some countries such as Denmark did act at the time and have demonstrated what could have been achieved by all European countries.

The hope expressed in *A low energy strategy for the United Kingdom* still holds true: *"We show that Britain - and by implication other countries - can move into a prosperous low-energy future with no more than moderate change. All that is necessary is to apply with a commitment little more vigorous than is being shown today by government, industry and other agencies some of the technical advances in energy use which have been made, and are still being made, in response to the oil price increases of 1973-74."* Now there is even less reason not to act for there is both the urgency of climate change and also proper understanding of the benefits that can accrue from adopting standards such as passivhaus as well as a healthy renewables industry that is demonstrating dramatic cost reductions as the global installed capacity base rises sharply.

Unfortunately, the UK Government, in constructing what passed for energy policy, did not take account of one important recommendation in *Fuel's Paradise*. Chapman noted that the North Sea would produce an oil bonanza in the 1980s: *"But as the analyses have shown, North Sea oil is only a bonanza, it does not provide a basis for a long-term energy policy."*[37] Sadly, not just in the UK, but across much of Europe and more widely, the bonanza of N Sea oil and gas, Russian gas, and other discoveries, in Alaska in particular, and consequent low fossil fuel prices in the 1990s, enabled governments to avoid facing up to the important issues of energy policy and climate change. The one-off bonanza was indeed treated as the basis for policy with the resulting waste we have noted in the previous section.

This lack of policy for so long is why so much of the developed world is still following a 'hard' path focusing on energy supply and why transformation is now so urgent. For some, shale gas or Canadian tar sands are seen as the next 'fix' but, as we outline in the next Section, a non-fossil fuel future is now the only option to avoid dangerous climate change.

Luckily, developed nation economies, as just noted for the USA and the UK, have created, through largely unplanned improvement in energy efficiency, the breathing space, just, for action to tackle climate change. What the magnitude of the reductions, compared to predictions, in primary energy demand since the mid-70s demonstrates is the dominant contribution of energy efficiency gains. Energy

36 *Managing Energy: Rethinking the Fundamentals - Managing Energy Wrong*, Chatham House Energy, Environment and Resource Governance Working Paper One, Walt Patterson, July 2008, http://www.waltpatterson.org/mewfinal.pdf.

37 Fuel's Paradise, p217.

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efficiency, happening without any strong government mandate, has avoided a global energy crisis and provided the narrow window of opportunity we now have to act to avoid dangerous climate change.

There is, as we note below (Section 4), significant further potential for demand reduction in the developed world if energy efficiency is taken seriously by governments, led by action on buildings. Current prediction for future global energy needs (Section 3), however, with major increases predicted, seem analogous to the business-as-usual predictions of Lovins and Chapman in the 1970s. It is urgent that the EU acts to provide leadership to show that these predictions can be as erroneous as those of the 1970s and that the 'developing world' can also pursue energy saving pathways to a clean energy supply to avoid the energy supply and climate change problems that otherwise seem inevitable.

Without much subsidy, or any particularly strong mandate, energy efficiency has delivered far more greenhouse gas saving in both the US and the UK than has been, or will be, achieved by transformation of energy supply. Yet this energy efficiency has happened 'under the radar' and, as we describe below (Section 10.1), energy efficiency is still relatively ignored by governments compared to energy supply. This Section focuses on energy supply and clean energy but it is essential to understand the critical importance of energy efficiency and demand reduction in making possible the necessary transition to clean energy.

One key message of this paper is that progress in energy efficiency has been dramatic although far slower than it could have been. With a dedicated focus on energy efficiency, there is far more saving still to be had. Making this saving is now absolutely necessary if there is to be effective and urgent action on climate change through transformation to a clean renewables based supply. The necessary investment in supply seems impossible to achieve without serious action on energy efficiency and demand reduction. Without demand reduction, it will be almost impossible to phase out fossil fuels and build sufficient renewables supply and hence to act to avoid dangerous climate change. As the quote from the International Energy Agency on the cover page of this report notes: *"The most important contribution to reaching energy security and climate goals comes from the energy that we do not consume."*

The principal message of this paper is that the necessary action on energy efficiency and demand reduction is indeed possible because of passivhaus and related innovation within Europe. Action on energy efficiency, led by the transformation of the building stock to passivhaus quality, will not only assist the transformation to a clean energy system but will bring many related benefits as we note throughout this paper.

There are huge savings in energy use still to be made because the market-place is not efficient. Energy efficiency, efficiently promoted, could have delivered so much more if energy systems had been restructured as Lovins and Leach proposed. While the natural rate of innovation has, indeed, delivered impressive savings in energy use over thirty-five years, both in the United States and also in Europe, this moderate rate of change cannot deliver the transformation now urgently necessary if

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climate change is to be addressed in a meaningful way. The EU and Member State governments must act to enable much more rapid change.

Now, as detailed in the next Section, there is not the luxury of several years to choose a path. An immediate choice has to be made to follow a 'soft' path towards a fully renewables-based economy with accelerated progress in five years or less. The 'hard' path, that most countries are still following, and the 'soft' path remain mutually exclusive. Urgent political action is necessary to enable a rapid transition to a 'soft' renewables based path. The EU has been a leader globally in mandating a transition over decades to a low-carbon economy by 2050 but the facts of rising global carbon emissions now mean that such long-term timescales are not adequate to the task.

In developed countries, the exponential rise in primary energy use observed until the mid 1970s has been halted. Now, as just noted, primary energy use remains roughly constant. As we describe in Section 7 for the UK, continuing growth in the economy is balanced by a reduction in the energy ratio, the amount of primary energy used for each unit of gross domestic product. As we note in Section 7, the need now is to accelerate this trend through more effective focus on energy efficiency so that the economy grows while primary energy use falls.

The American Council for an Energy-Efficient Economy (ACEEE) has shown[38] exactly how this could happen for the United States. A dedicated focus on energy efficiency could reduce US primary energy use from today's 98 quads (as noted above) down to as low as 50 quads by 2050, far lower even than the 75 quads used in 1975 at the time of Lovins' paper and nearly 60 per cent less than the business-as-usual projection of 122 quads from the US Energy Information Administration.

Especially noteworthy is the positive impact that such a focus on energy efficiency would have on both the economy and on employment. The ACEEE report notes that: *"The savings would benefit all parts of the economy including the residential, commercial, industrial, and transportation sectors. These savings come from many current and advanced technologies but also from improved optimization of building, transportation, industrial, and electric power systems as existing systems are renovated or replaced. Critically, a pattern of productive efficiency investments would drive a net gain of almost two million jobs even as consumers save an average of $400 billion per year (the equivalent of about $2,600 per household)."*

Radical action on energy efficiency is thus win-win. Not only is it essential to enable a rapid transition to a clean economy and to tackle climate change, but it also provides a positive boost to economies and to jobs. At the present time, it is unclear whether the United States has the political motivation to embark on such a programme but surely a similar project with similarly beneficial outcomes can become a reality for Europe.

[38] *The Long-Term Energy Efficiency Potential: What the Evidence Suggests*, John A. "Skip" Laitner, Steven Nadel, R. Neal Elliott, Harvey Sachs, and A. Siddiq Khan, Research Report E121, American Council for an Energy-Efficient Economy, 11 January 2012, http://aceee.org/research-report/E121.

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As the ACEEE report notes, action on buildings and infrastructure is a key part of the programme. But as Walt Patterson noted about the built infrastructure: *"Progress in upgrading the built infrastructure, and its energy performance, is still glacial, not only in the UK but worldwide."* That was true in 2007 and remains true today. But, as he noted in an earlier book[39] about the electricity supply industry and how it might be transformed: *"we can be pretty certain what 'unsustainable electricity' looks like; it looks like most of the world's present day electricity systems."* The current energy supply set-up in most countries is inimical to promoting energy efficiency, which is why progress on the latter has proceeded far more slowly than the potential for savings would suggest.

In Transforming Electricity, Patterson explains how the traditional shape of electricity supply is "intrinsically inappropriate" to promoting energy efficiency: *"If what you are selling is illumination and you want to make it as economical as possible, you have to optimize the entire system – the generator, the network and the light bulbs – as a system, because it all works together, moment by moment. The traditional shape of electricity, however, militates against this objective. The rest of the system is not selling illumination; it is selling electricity. The electricity is measured at your meter, moment by moment, unit by unit, and that is what you pay for. If you use lights or motors that are less efficient, you use more electricity to get the same amount of service. But the rest of the system sells more electricity, and gets paid more, so the rest of the system benefits from your inefficiency. The traditional shape of electricity is thus intrinsically inappropriate to foster the optimum use of resources, or to minimize economically the environmental impacts of electricity."* Similar arguments apply to the sale of fuels such as gas.

There is thus an inevitable conflict between the current energy supply system in most countries and the imperative for ramping up energy efficiency. Right now, energy supply is winning with its historic access to and influence over governments (see Section 10.1). Only governments can drive change, however. Without such drive from governments, initiatives that encourage energy efficiency are hamstrung and will have only the modest impact that we observe today (see Sections 8 and 10.1).

[39] *Transforming Electricity*, Walt Patterson (The Royal Institute of International Affairs and Earthscan, 1999).

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Luckily, key factors, not present when Lovins published his paper in 1976, are now clear.

- A renewables-based economy is both possible and cost effective and costs will continue to fall, whereas costs for fossil fuels and nuclear power will continue to rise;
- A renewables-based economy creates jobs[40] which the current energy supply system does not do to anything like the same extent (with many more jobs created[41] by action on energy efficient buildings);
- A renewables-based economy is modular and can be scaled to match, where appropriate, usage needs and requirements;
- A properly designed renewables-based economy, locally driven[42], automatically encourages energy efficiency through addressing the complete supply and use chain as a system;
- Renewables are intermittent but that need not be a problem; there are many storage options being developed and renewables can be used as clean sources of power to produce hydrogen by electrolysis of water that can be used as a fuel directly, or be combined with atmospheric carbon dioxide to yield renewable methane and renewable liquid transport fuels: with renewable energy, fossil fuels can eventually be replaced entirely;
- A renewables world is clean because, as well as avoiding greenhouse gas emissions, it also avoids the massive pollution that results from current-day fossil fuel extraction, processing and use; indeed, as we note later in this

40 For example, according to official figures, some 370,000 people in Germany were employed in the renewable energy sector in 2010, especially in small and medium sized companies; see http://en.wikipedia.org/wiki/Renewable_energy_in_Germany.

41 In Germany, over 200,000 jobs have been created or saved via the promotion of energy efficient refurbishment of buildings: *Supporting the energy efficient rehabilitation of the building stock – The German experience*, Presentation by Tatjana Bruns, KfW Bankengruppe, Presentation to Build with CaRe Conference, Norwich, 21 October 2010, accessed via http://www.buildwithcare.eu/; hence over half a million jobs have already been created or saved in Germany through initiatives on renewables and on energy efficiency. We have just noted the positive impact on jobs through an aggressive energy efficiency campaign highlighted by the ACEEE report, *The Long-Term Energy Efficiency Potential: What the Evidence Suggests*.

42 As Walt Patterson notes in Transforming Electricity: *"Local systems in turn facilitate integrated thinking and planning, to optimize the whole system, including buildings and the electrical equipment inside them. That will require and stimulate wide-ranging interactions between people and firms with the requisite competence and experience."*, and Hermann Scheer in The Solar Economy: *"The potential of the green electricity market lies not in a few large suppliers, but in many regional ones. ... With renewable energy it becomes possible to co-locate source and consumer, thus rendering transmissions over a high-voltage grid unnecessary. It would be like taking an unnecessary detour via a private toll-road. A distributed system, on the other hand, would revolutionize energy supply and open the floodgates for renewable energy. It is also the only way out for municipal and regional electricity suppliers, including the municipal electricity utilities."*

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Section, once these pollution-related costs of fossil fuels are taken into account, renewables are already the cheaper option.

Every signal points towards greater benefit for economies and for jobs, as well as for the environment, the faster the transition is made to a renewables based economy. There is every reason, therefore, for governments to want to accelerate the pace of such a transition. It is particularly important that it does happen fast because, as we highlight in Section 9, the policies in place over the next five years broadly shape the global energy picture out to 2050. Further investment in fossil fuel energy technologies will create not only short-term carbon emissions but almost certainly ensures that these carbon emissions continue for decades, so making it almost impossible to tackle dangerous climate change.

Just as in 1976, the 'hard' and 'soft' paths remain mutually exclusive today. The EU has the capacity to lead and to act decisively to accelerate the transition to a renewables-based and energy-efficient global economy. So doing would have the beneficial side-effects of stimulating Member States' economies, of creating many jobs and new skills, and also of demonstrating the benefits of a 'soft' path to other countries around the world. It seems quite irrational, therefore, for the EU to be reluctant to make a commitment to increased carbon reduction targets unless other countries follow suit[43]. While the environmental benefits will be maximised if other countries do follow suit, the economic benefits will accrue whatever other countries do.

Current EU targets of a 20 per cent cut in greenhouse gas emissions by 2020[44] and a 20 per cent penetration by renewables in energy supply may indeed be met. But these are targets on a road map towards 2050. By only following the road map to 2050, near-term decisions will be made that make necessary action to tackle climate change difficult if not impossible. The International Energy Agency has recently highlighted the urgency of radical action now to tackle carbon emissions[45]. By 2020, it will be too late. Current ambition across the EU to decarbonise economies is inadequate to the meet the need that is now apparent. But radical action on decarbonisation coupled with radical action on energy efficiency would have many beneficial outcomes for business and for citizens alike.

Government policies still, in large part, do not take account of the dramatic cost reductions in renewable energy that are happening today. Policies, thinking, and

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43 See, for example, *UK commitment to climate change*, Letter from Chris Huhne MP, UK Secretary of state for energy and climate change, guardian.co.uk, Monday 21 November 2011, http://www.guardian.co.uk/environment/2011/nov/21/uk-commitment-climate-change.

44 Relative to 1990

45 *"Four-fifths of the total energy-related CO_2 emissions permissible by 2035 in the 450 Scenario are already "locked-in" by our existing capital stock (power plants, buildings, factories, etc.). If stringent new action is not forthcoming by 2017, the energy-related infrastructure then in place will generate all the CO_2 emissions allowed in the 450 Scenario up to 2035"*, International Energy Agency World Energy Outlook 2011, 9 November 2011 (http://www.iea.org/index_info.asp?id=1959).

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expenditure reflect the realities of the 20th century, not the 21st. There needs now to be a single-minded focus on a supply system that combines clean renewables with energy storage and on a refurbishment strategy for buildings encompassing energy storage as well as local renewable supply. As just noted, the strategies for energy supply and energy efficiency cannot be separated.

A few EU countries are showing what is possible. Denmark, for example, already generates a quarter of its electricity supply from renewables[46], and has ambitious future targets, with plans for 50 per cent of electricity to come from wind power by 2020 (implying a 35 per cent reduction in greenhouse gas emissions relative to 1990) and the phasing out of fossil fuels entirely by 2050[47]. WWF has recently shown[48] that the UK could meet nearly 90 per cent of electricity demand by 2030 with renewables, far beyond current UK Government ambition.

Reducing energy demand is a critical component of such ambition. WWF showed that the capital cost of construction of new supply could be reduced by up to £40billion with effective action on energy efficiency with total supply capacity no greater than today[49]. As the WWF report said: *"The government must recognise the economic and environmental benefits of reducing demand for electricity long-term. ... The government should make the take up of energy efficiency measures happen: There are many financial and technical barriers which stop the domestic and commercial take up of energy efficiency measures. Removing these will require a range of measures"*. This paper outlines approaches to overcoming many of these barriers.

Any other EU country could have made and could make the same progress that Denmark has made yet the EU average penetration of wind power in electricity generation at the end of 2010 was only 5.3 per cent compared to Denmark's 25.6 per cent[50]. Denmark has no exceptional advantage apart from a long-term ambition and the near-term policies to implement that ambition. Germany, the largest EU economy, has likewise made remarkable progress but, overall, across the EU, ambition and progress do not match the need reflecting the continuing influence of

46 *Danish government: "50 percent of power consumption from wind power in 2020"*, Danish Wind Industry Association, 12 October 2011, http://www.windpower.org/en/news/news.html#720.

47 *Our Future Energy*, The Danish Government, November 2011, http://www.kemin.dk/Documents/Klima-%20og%20Energipolitik/our%20future%20energy.pdf.

48 *Positive Energy: how renewable electricity can transform the UK by 2030*, WWF, 25 October 2011, http://assets.wwf.org.uk/downloads/positive_energy_final_designed.pdf.

49 Current UK Government policies indicate a very big increase in supply being necessary, with the massive extra cost this entails, largely because of lack of ambition in demand reduction.

50 *Pure Power: Wind energy targets for 2020 and 2030*, European Wind Energy Association, July 2011, http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/Pure_Power_III.pdf.

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out-dated attitudes and priorities[51]. There is current debate[52] in the UK about the impact of support for renewable energy on people's electricity bills. What most people do not realise is that subsidies for fossil fuels and for nuclear power are generally much greater than subsidies for renewables. They are just better disguised.

Debate about costs of renewables that ignores these continuing subsidies elsewhere obscures wider benefits from the introduction of renewables and also ignores the continuing costs of pollution from the extraction and combustion of fossil fuels. An energy supply system based on renewables, just like a building refurbishment ambition based on passivhaus quality, promises a much healthier environment for citizens everywhere.

A recent OECD report[53] notes how renewables will be seen to be uncompetitive while fossil fuels remain heavily subsidised and that governments must create an 'investment grade' policy of support. Such support is only evident in one or two countries across the EU such as Denmark and Germany. The EU and Member States could act with urgency to make support 'loud', and ensure also that it is 'long' as well as 'legal'. Sadly, the about-turn by the UK Government on feed-in tariffs for solar PV[54] is an example of exactly how not to do things (see Section 10.1). This paper discusses how such 'loud' and 'long' support could be developed to enable much more effective action on energy efficiency and building transformation (Section 10.6).

Fossil fuels are doubly damaging, creating both global warming and also widespread pollution. Making the big reductions in fossil fuel use that are necessary to tackle climate change will bring multiple health and welfare benefits. Unlike fossil

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51 Friends of the Earth have described this attitude in more colourful language: *Reckless gamblers: How politicians' inaction is ramping up the risk of dangerous climate change*, Friends of the Earth, 16 December 2010, http://www.foe.co.uk/news/reckless_gamblers_26472.html.

52 See, for example, *Number 10's criticism of DECC lacks credibility without new energy ideas*, James Murray, Business Green Blog, 5 September 2011, http://www.businessgreen.com/bg/james-blog/2106683/10s-criticism-decc-lacks-credibility-energy-ideas.

53 *"However, they* [green investments] *are also uncompetitive due to market failures – with existing, 'black' technologies mispriced due to pollution externalities not being accounted for and fossil fuels still being heavily subsidized. ... To create this type of 'investment grade' policy, such support* [for new technologies such as renewables and, indeed, for radical energy efficiency measures] *needs to be 'loud' (big enough to impact the bottom line), 'long' (for a sustained period) and 'legal' (with regulatory frameworks clearly established).",* The Role of Pension Funds in Financing Green Growth Initiatives, Raffaele Della Croce, Christopher Kaminker and Fiona Stewart, OECD Working Papers on Finance, Insurance and Private Pensions, No. 10, OECD Publishing, 1 September 2011, http://www.oecd-ilibrary.org/finance-and-investment/the-role-of-pension-funds-in-financing-green-growth-initiatives_5kg58j1lwdjd-en.

54 *Feed-in tariff cuts threaten to 'kill interest in solar PV'; Executive at UK's largest solar firm fears fast-expanding industry is being shunned by a Whitehall culture that continues to favour traditional energy*, James Murray, Business Green 27 October 2011, http://www.businessgreen.com/bg/news/2120568/feed-tariff-cuts-threaten-kill-solar-pv.

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fuel production and combustion which creates massive pollution and damage, energy efficiency is doubly clean. A passivhaus home is both more comfortable and healthy and far less polluting because of the lower energy use. Yet society bears the cost of fossil fuel pollution while subsidies for fossil fuel production further perversely distort the economics. In effect, society is actively paying with its money and with its health to make climate change happen faster. As Hermann Scheer pointed out[55]: *"Nobody has the right to simply leave their rubbish lying in the street"*, yet fossil fuel use does just this on a massive scale[56].

Carbon dioxide emissions from fossil fuel combustion are the dominant contributor to climate change but, also, whenever fossil fuels are burned, the combustion processes release particulates and chemicals that are dangerous to health[57]. Counting the pollution caused by fossil fuel use in the United States, it has been calculated[58],[59], that this indirect subsidy – the costs are borne elsewhere – is greater

55 In *The Solar Economy: A Sustainable Global Future*, Hermann Scheer (Earthscan 2002; first published in German as Solare Weltwirtschaft, 1999)

56 For example it is reported that 1 per cent of Russian oil production, or 5 million tonnes, is spilled every year, equivalent to a Deepwater Horizon every two months: *AP Enterprise: Russia oil spills wreak devastation*, Nataliya Vasilyeva, BostonGlobe.com, December 17, 2011, http://www.boston.com/business/articles/2011/12/17/ap_enterprise_russia_oil_spills_wreak_devastation/?page=full.

57 "Right now we don't have a free market, we have a free-loading market where the fossil fuel companies pollute the air, and get subsidies from the government. Subsidies should be given for a benefit, not to allow people to damage other people's health. But the fossil fuel companies are taking subsidies and at the same time damaging people's health, including killing them. In the US, 50,000 to 100,000 people die each year [from fossil fuel pollution], and worldwide, it is 2.5 million people per year.", *Financial Times interview with Professor Mark Jacobson*, 12 May, 2010, http://blogs.ft.com/energy-source/2010/05/12/qa-mark-jacobson-on-100-renewables/. Professor Jacobson is the author of one recent study that demonstrates that an essentially 100 per cent renewable energy system worldwide is feasible by 2050: *Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials*, Mark Z. Jacobson and Mark A. Delucchi, Energy Policy (2011), 39, 1154-1169.

58 "Fossil fuel and nuclear power plants are the nation's second largest users of water, produce millions of tons of solid waste, emit mercury, particulate matter, and other noxious pollutants into the atmosphere, and cause social inequity by exacerbating poverty. Yet in the current system, they do not have to pay for most of this damage. .. Given that the average residential price of electricity in the United States for 2007 was about 10 ¢/kWh, the damages from these energy systems currently outweigh the amount that customers pay for them.", *Rejecting renewables: the socio-technical impediments to renewable electricity in the United States*, Benjamin K. Sovacool, Energy Policy (2009), 37, 4500–4513.

59 "Each stage in the life cycle of coal - extraction, transport, processing, and combustion - generates a waste stream and carries multiple hazards for health and the environment. These costs are external to the coal industry and are thus often considered "externalities". We estimate that the life cycle effects of coal and the waste stream generated are costing the U.S. public a third to over one-half of a trillion dollars annually. Many of these so-called externalities are, moreover, cumulative. Accounting for the damages conservatively doubles to triples the price of electricity from coal per kWh generated, making wind, solar, and other forms of nonfossil fuel power generation, along with investments in efficiency and electricity conservation methods, economically competitive.", *Full cost accounting for the life cycle of coal*, Paul R. Epstein et al, Annals of the New York Academy of Sciences, Ecological Economics Reviews (2011), 1219, 73–98.

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than the cost of the electricity supplied to consumers. As these authors note, once these extra costs are taken into account, renewable energy sources become the most cost effective[60] sources of electricity. There is a similar situation in Europe as the European Environment Agency has recently reported[61]: *"Air pollution by the facilities covered by EEA's analysis cost every European citizen approximately €200-330 on average in 2009. ... Emissions from power plants contributed the largest share of the damage costs (estimated at €66–112 billion)."*

Combustion of biofuels[62] poses similar pollution problems to that of fossil fuels. Fossil fuels will continue to pollute even if unproved carbon capture and storage technologies do actually work technically[63]. There never can be 'clean coal'[64] and a study[65] about the options for Germany noted that renewables could develop faster and be cheaper over the long term than carbon capture and storage (and we should note that the costs of renewables such as wind energy and solar PV have continued to fall since this work was done while there has been no development of note on carbon capture and storage from fossil fuel power generation).

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60 Which is happening in any case as the costs of renewables continue to fall as volumes increase and continuing innovation increases efficiency – in contrast to nuclear power where costs continue to increase (see, for example *The costs of the French nuclear scale-up: A case of negative learning by doing*, Arnulf Grubler, Energy Policy (2010), 38, 5174-5188, and *The EPR in Crisis*, Professor Steve Thomas, November 2010, http://216.250.243.12/The%20EPR%20in%20crisis%203-11-10.pdf) and electricity from coal where carbon capture and storage will increase the cost of coal-fired electricity by at least fifty per cent.

61 *Industrial air pollution cost Europe up to €169 billion in 2009, EEA reveals*, European Environment Agency, 24 November 2011, http://www.eea.europa.eu/pressroom/newsreleases/industrial-air-pollution-cost-europe.

62 It should be noted that there are major concerns over the large-scale use of biomass in power generation and first-generation liquid biofuels in transport; except in special circumstances biomass and biofuels may not help to reduce greenhouse gas emissions. Concerns about biomass have been raised by the European Environment Agency (Opinion of the EEA Scientific Committee on Greenhouse Gas Accounting in Relation to Bioenergy, European Environment Agency Scientific Committee, 15 September 2011, http://www.eea.europa.eu/about-us/governance/scientific-committee/sc-opinions/opinions-on-scientific-issues/sc-opinion-on-greenhouse-gas) and key issues concerning biofuels have been summarised in a letter from eminent UK scientists to the UK Secretary of State for Transport (Open Letter from Professor Keith Smith and others, 2 June 2011, http://www.actionaid.org.uk/_content/documents/Biofuels%20open%20scientists'%20letter.pdf).

63 "Our analysis also suggests that the proposed measure to address one of the emissions - CO_2, via CCS - is costly and carries numerous health and environmental risks, which would be multiplied if CCS were deployed on a wide scale.", *Full cost accounting for the life cycle of coal*, Paul R. Epstein et al, Annals of the New York Academy of Sciences, Ecological Economics Reviews (2011), 1219, 73–98.

64 *The Myth of Clean Coal*, Richard Conniff, Yale Environment 360, 3 June 2008, http://e360.yale.edu/feature/the_myth_of_clean_coal/2014/.

65 "depending on the growth rates and the market development, renewables could develop faster and could be in the long term cheaper than CCS based plants.", *Comparison of carbon capture and storage with renewable energy technologies regarding structural, economic, and ecological aspects in Germany*, Peter Viebahn, Joachim Nitsch, Manfred Fischedick, Andrea Esken, Dietmar Schüwer, Nikolaus Supersberger, Ulrich Zuberbühler and Ottmar Edenhofer, International Journal of Greenhouse Gas Control (2007) 1, 121-133.

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The considerable barriers to successful deployment of carbon capture and storage have recently been detailed[66]. Action to tackle climate change must be taken urgently and wasting effort and resources on non-viable, expensive and polluting technologies is a luxury that cannot be afforded.

By accelerating the transition to renewable energy sources[67] not only can climate change be addressed but also the many other sources of pollution that arise from fossil fuels and nuclear power will be hugely reduced[68],[69]. People everywhere will benefit. Of course, transforming energy supply – which we have to do if we are to address potentially dangerous climate change – is a massive undertaking. It only becomes feasible if there is, in parallel, a major change of emphasis in energy use to a total focus on energy efficiency, spearheaded by a campaign of 'deep' refurbishment of the building stock. Luckily, as just noted, and unlike the current energy supply system based on fossil fuels, a renewables-based economy, where local supply is encouraged, naturally seeks to maximise energy efficiency.

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66 *The case against CCS*, Peter Droege and Matthew Ulterino, European Energy Review, 3 October 2011, http://www.europeanenergyreview.eu/site/pagina.php?id=3251; as the authors note: *"Waiting for cost drops and efficiency gains that eventually will arrive if CCS is brought to maturity and scale might be an admirable strategy if there were no other options. But renewable energy, with both distributed and concentrated sources, in combination with an advanced grid and storage system, can make the fossil fuel economy obsolete. Renewable energy price trends and its immediate availability are far more promising than anything demonstrated by CCS to date or likely to be seen in the next half decade."*

67 A number of studies have shown that a complete transition to renewable energy sources is feasible by 2050, for example: *Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials*, Mark Z. Jacobson and Mark A. Delucchi, Energy Policy (2011), 39, 1154-1169; *The Energy Report: 100% Renewable Energy by 2050*, WWF, Ecofys and OMA, February 2011, http://assets.panda.org/downloads/101223_energy_report_final_print_2.pdf, and *2050: 100%, Energieziel 2050: 100% Strom aus erneuerbaren Quellen* [100% renewable electricity supply by 2050], German Federal Environment Agency, July 2010, http://www.umweltdaten.de/publikationen/fpdf-l/3997.pdf. The IPCC has come to similar conclusions: *SRREN, Special Report on Renewable Energy Sources and Climate Change Mitigation*, Final Release, IPCC, May 2011, Summary for Policy Makers, http://srren.ipcc-wg3.de/report/IPCC_SRREN_SPM.

68 Disasters such as the Deepwater Horizon blow-out in the Gulf of Mexico and the Fukushima nuclear accident are the consequences of the ways the fossil fuel and nuclear industries are run and will continue to happen periodically, if unpredictably; see, for example, *How fast can he cook a chicken?*, Mattathias Schwartz, London Review of Books, 33(19), 6 October 2011, 25-26, about Deepwater Horizon, and *Preventing the Next Fukushima*, Matthew Bunn and Olli Heinonen, Science, 16 September 2011, 333(6049), 1580-1581, about international standards in the nuclear industry.

69 An interesting comparison between today's fossil fuel industry and the nineteenth century whaling industry has been made: see *The Ahab Parallax: 'Moby Dick' and the Spill*, Randy Kennedy, The New York Times, June 12 2011, http://www.nytimes.com/2010/06/13/weekinreview/13kennedy.html?pagewanted=all: *"Whaling was the petroleum industry of its day in the 18th and 19th centuries, with hundreds of ships plying the oceans in search of the oil that could be rendered from the world's largest mammals. ... New England ports, the Houstons of their era, and fortunes were built with whale oil money. ... But in the same way whalers had to sail farther and farther for their prey, oil companies are drilling deeper and deeper to tap the gulf's oil, to levels made possible only by the most advanced technology, operating near its limits."*

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The transformation to renewables is made much more difficult than it should be, however, by continuing subsidies to fossil fuels and nuclear power that reflect the priorities of half a century ago not of today. Compared to the costs of renewables deployment that are added to electricity bills in countries such as the UK and Germany, continuing and very large subsidies for fossil fuels[70] and nuclear power[71],[72] are hidden – but we still all pay. In the UK, the continuing subsidy to fund the decommissioning of nuclear power stations is £2billion a year, twice the level of support for renewables; while the total subsidy to nuclear power in the UK has been estimated[73] to be £3.6billion a year – without a single new nuclear power station being built and with a further £3billion now to be spent[74] on a nuclear fuel plant that may never be used! A German study[75] of the subsidy to nuclear power created by the capping of insurance liabilities estimates that, if operators were obliged to carry full insurance, the costs of nuclear electricity could at least double.

In a lecture to the Royal Society of Arts a few years ago, Professor Norman Myers highlighted[76] how energy efficiency and renewables have been the poor relations in

70 "The study, which reviewed fossil fuel and energy subsidies for Fiscal Years 2002-2008, reveals that the lion's share of energy subsidies supported energy sources that emit high levels of greenhouse gases. Fossil fuels benefited from approximately $72 billion over the seven-year period, while subsidies for renewable fuels totaled only $29 billion.", *Estimating U.S. Government Subsidies to Energy Sources: 2002-2008*, Environmental Law Institute, September 2009, http://www.elistore.org/reports_detail.asp?ID=11358.

71 "From 1947 to 1999, for instance, federal subsidies for nuclear power totaled $145.4 billion, more than 25 times the cumulative spending on wind and solar over the same period.", *Rejecting renewables: the socio-technical impediments to renewable electricity in the United States*, Benjamin K. Sovacool, Energy Policy (2009), 37, 4500–4513.

72 "Nuclear power has been in commercial operation for more than 50 years, yet it continues to receive large direct and indirect subsidies, in part because electricity prices fail to reflect the full environmental costs, and because of government guarantees for the final storage or disposal of radioactive waste. In the United States, even though nuclear and wind technologies produced a comparable amount of energy during their first 15 years (2.6 billion kWh for nuclear versus 1.9 billion kWh for wind), the subsidy to nuclear outweighed that to wind by a factor of over 40 ($39.4 billion versus $900 million).", *The World Nuclear Industry Status Report 2010–2011: Nuclear Power in a Post-Fukushima World, 25 Years After the Chernobyl Accident*, Mycle Schneider, Antony Froggatt and Steve Thomas, Commissioned by Worldwatch Institute, April 2011, http://www.worldwatch.org/system/files/NuclearStatusReport2011_prel.pdf.

73 *The Hidden Costs of Nuclear Power*, Ente Consulting, June 2011, http://www.enteconsulting.com/home/wp-content/uploads/2011/07/HiddenCostsofNuclearpower_Final1.pdf.

74 *Mox plant U-turn by coalition stuns anti-nuclear campaigners*, Terry Macalister, guardian.co.uk, 1 December 2011, http://www.guardian.co.uk/environment/2011/dec/01/mox-u-turn-stuns-nuclear-campaigners.

75 *Berechnung einer risikoadäquaten Versicherungspramie zur Deckung der Haftpflichtrisiken, die aus dem Betrieb von Kernkraftwerken resultieren* (Calculation of risk-adjusted insurance premiums to cover the liability risks arising from the operation of nuclear power plants), Versicherungsforen Leipzig, April 2011, http://www.bee-ev.de/_downloads/publikationen/studien/2011/110511_BEE-Studie_Versicherungsforen_KKW.pdf.

76 *Perverse subsidies*, Norman Myers, RSA Journal, 314, 85-91 (1999); more detail is provided in *Perverse Subsidies: How Misused Tax Dollars Harm the Environment and the Economy*, Norman Myers and Jennifer Kent (Island Press, 2001).

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respect of government support relative to fossil fuels: *"Over the past 17 years Americans have gained four times as much new energy from efficiency savings as from all net increases in supply* ['negawatts' as noted above] *– and of the increases in supply, one-third has come from renewables. ... Yet governments seem singularly reluctant to seize the full manifold benefits available from energy efficiency and renewables. In Western Europe they have assigned only $3.2billion of subsidies a year to energy efficiency and a mere $1.5billion to energy sources such as solar electricity and wind power, while subsidising fossil fuels to the tune of well over $10billion a year"*.

The situation has changed little since those words were written except that the fossil fuel industry now wants extra subsidies to promote carbon capture and storage. Yet, in spite of this unequal playing-field, the costs of renewable technologies are dropping rapidly as deployment grows worldwide and will continue to fall. Depending on the location, wind and PV either are already or will soon be the most economical option. In the EU, countries such as Germany and Denmark have demonstrated that effective support for renewables can have remarkable results because costs fall rapidly as deployment stimulates innovation and economies of scale – while jobs created rise in number. The learning curves for these renewable technologies are steep because they are modest in scale and modular compared to nuclear where there are also complex and costly systems for fuel production, storage and reprocessing as well as the generating stations themselves. Fossil fuel technologies, including electricity production by combined-cycle gas powered generators, are already almost as well developed as possible after a century of development with little scope for further cost reduction. Prices can only go up as the costs of fossil fuels rise. Renewable sources of power such as wind, solar PV and solar thermal, need no fuel.

Government support for nuclear power has been over fifty times that for solar PV[77] yet, as PV installations are deployed around the world, and in particular in Germany in Europe, costs continue to drop and will shortly be competitive with conventional technologies[78]; PV module costs continue to drop by over 20 per cent for every

[77] "Technological research and development investments for PV has been less than 2% of comparable market introduction R&D expenditures for nuclear energy, whereas true cost of both technologies are currently of the same order and PV fulfils, but nuclear energy violates all relevant sustainability criteria. Due to technological, social and economic trends, PV can be expected to become a major global energy supply technology within next two decades." *Research and development investments in PV - a limiting factor for a fast PV diffusion?*, Ch. Breyer, Ch. Birkner, F. Kersten, A. Gerlach, J.Ch. Goldschmidt, G. Stryi-Hipp, D.F. Montoro and M. Riede, 25th European Photovoltaic Solar Energy Conference and Exhibition/5th World Conference on Photovoltaic Energy Conversion, 6-10 September 2010, Valencia, Spain, http://www.calyxo-solar.eu/medien/presse/publikationen/downloads/6CV.5.22_Breyer_RDinvestmentsPV_paper_25thPVSEC_final.pdf.

[78] See, for example, *Global overview on grid-parity event dynamics*, Ch. Breyer and A Gerlach, 25th EU PVSEC Valencia 2010, http://www.q-cells.com/uploads/tx_abdownloads/files/11_GLOBAL_OVERVIEW_ON_GRID-PARITY_Paper_02.pdf.

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doubling of historic cumulative production and onshore wind costs by 14 per cent[79]. Bloomberg note that: *"we expect wind to become fully competitive with energy produced from combined-cycle gas turbines by 2016[80] in most regions offering fair wind conditions."* The EU Commissioner for Climate Action, Connie Hedegaard has likewise noted[81] the competitiveness of offshore wind power compared to nuclear.

The combination of cost effective renewables technologies with grid-compatible storage promises future potential for reliable electrical power with almost no greenhouse gas emissions[82] while studies in Germany show[83] that combining a range of renewable technologies can provide reliable electricity: *"The Combined Renewable Energy Power Plant shows how, through joint control of small and decentralised plants, it is possible to provide reliable electricity in accordance with needs."*

The combination of renewable energy, electrolysis of water and production of renewable methane is already being developed by Audi in Germany[84] to create a renewable fuel for gas powered vehicles. Recently, engineers at Lotus in the UK have pointed out the potential not just to produce renewable methane but also renewable liquid transport fuels via carbon dioxide capture from the air and combination with hydrogen generated by renewable energy[85]. Commercialisation of such technology will be a dramatic breakthrough far more beneficial than hoping to expensively bury carbon dioxide from fossil fuels in the ground (so-called carbon capture and storage). With such innovation, it could eventually become possible to avoid the use of fossil fuels altogether while still maintaining the benefits of liquid

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79 *Onshore wind energy to reach parity with fossil-fuel electricity by 2016*, Bloomberg New Energy Finance, 10 November 2011, http://bnef.com/PressReleases/view/172.

80 As Bloomberg point out, if the cost of carbon was included, wind would already be competitive.

81 *Wind power cheaper than nuclear, says EU climate chief*, Fiona Harvey in Brussels and Terry Macalister, guardian.co.uk, Thursday 17 March 2011, http://www.guardian.co.uk/environment/2011/mar/17/wind-cheaper-nuclear-eu-climate.

82 *Hybrid PV-Wind Renewable Methane Power Plants - a Potential Cornerstone of Global Energy Supply*, Ch. Breyer, S. Rieke, M. Sterner, and J. Schmid, Preprint to be published in the proceedings of the 26th European Photovoltaic Solar Energy Conference, 5–9 September 2011, Hamburg, Germany; http://www.q-cells.com/uploads/tx_abdownloads/files/16_6CV.1.31_Breyer2011_HybPV-Wind-RPM-Plants_paper_PVSEC_preprint.pdf.

83 *Background Paper: The Combined Power Plant*, Informationskampagne für Erneuerbare Energien (Information Campaign for Renewable Energies), Berlin, October 2007, http://www.kombikraftwerk.de/fileadmin/downloads/Background_Information_Combined_power_plant.pdf.

84 *Audi balanced mobility - The route to CO_2-neutral mobility*, Audi press release, 13 May 2011, http://www.audi.com/com/brand/en/company/news/company.detail.2011~05~audi_balanced_mobility.html; see also http://www.youtube.com/watch?v=3oLJtpcZ-mM.

85 *Energy storage via carbon-neutral fuels made from CO_2, water, and renewable energy*, R. J. Pearson et al, To be published in Special Issue of Proc. IEEE: Addressing the intermittency challenge: Massive energy storage in a sustainable future. DOI: 10.1109/JPROC.2011.2168369.

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fuels for transport. Instead of an expensive disposal process after combustion of fossil fuels with no added value (carbon capture and storage as presently envisaged), carbon dioxide from the air is converted to a product with high value.

Offshore wind farms or PV farms in arid regions could be dedicated or largely dedicated to liquid fuel production without the dangers and pollution associated with fossil fuel extraction. It is such fossil-fuel free technology that the EU should be urgently supporting with research and investment funds. Such carbon capture and conversion technology – allied with agricultural and forestry practices that sequester carbon in the soil – is almost the only geoengineering option to tackle climate change that does not also bring serious risk of adverse side effects.

It is no surprise that Audi and partner companies in Germany are leading such development. Germany continues to be a leader in Europe in the introduction of renewable energy technologies as a result of the Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG[86]) that came into force in 2000. A recent analysis[87] has shown that, in spite of the great rate of renewables installations in recent years in Germany, the EEG apportionment will not exceed 15% of household electricity prices, a relatively small share, and the average household will have to spend only about 0.3% of its net income on the support for renewable energies via the EEG. This review also pointed out that this financial support for renewables via the EEG was, even in Germany, a small proportion of the support for environmentally damaging activities including coal production. The UK Committee on Climate Change has recently published[88] an analysis for the UK with similar conclusions. As we have already noted, subsidies for renewables are, in almost all countries, far less than for environmentally damaging activities. Those for renewables get attention because they are more visible but the main driver for rises in prices that consumers notice is rising fossil fuel prices not costs of renewables.

Economic analysis has shown that, in the absence of government initiatives to stimulate low-carbon activity, such as supporting the market entry of renewable technologies and refurbishment of buildings to use much less energy, path dependence – the impact of historical investments and current market power - will encourage investment in dirtier technologies[89]. The continuing subsidies and

86 http://www.erneuerbare-energien.de/inhalt/.

87 *Brief Analysis on the Current Debate about Costs and Benefits of Expanding the Use of Renewable Energies in Electricity Generation*, Dr Stefan Lechtenböhmer and Sascha Samadi, Wuppertal Institute for Climate, Environment and Energy, October 2010, http://www.wupperinst.org/uploads/tx_wiprojekt/EEG_Expand_report.pdf.

88 *Household energy bills – impacts of meeting carbon budgets*, Committee on Climate Change, 15 December 2011, http://downloads.theccc.org.uk.s3.amazonaws.com/Household%20Energy%20Bills/CCC_Energy%20Note%20Bill_interactive_1.pdf.

89 *Rethinking industrial policy*, Aghion P, Boulanger J and Cohen E (2011), Brussels: Bruegel. http://www.bruegel.org/publications/publication-detail/publication/566-rethinking-industrial-policy/

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support for environmentally damaging technologies not only distort the market-place and prevent a necessary emphasis on renewables and on energy efficiency but, as we note below, also create mistaken perceptions and policies (Sections 7, 10.1) that make support for energy efficiency even harder to put into effect.

For example, even if it were cheaper, nuclear power cannot help now in tackling climate change. This is because the very long timescales for new plant relative to investment in renewables exceed the short timescale in which effective action must be taken. In other words, investment in nuclear power rather than in renewables will prolong and add to unnecessary carbon emissions because the money diverted to nuclear will prevent necessary investment in renewables and hence prolong the lifetime of fossil fuel plants. Likewise, continuing investment in fossil fuel power plants, including those powered by gas, makes tackling climate change harder as these displace investment in renewable energy.

The benefit of renewable technologies such as PV and wind is that they are modular and scalable. PV module production, in particular, has all the advantages of being part of the electronics industry. The consistent long-term learning curve of over 20 per cent cost reduction for every cumulative doubling of historic production is higher than for any other energy production technology. As Kees van der Leun of Ecofys in the Netherlands has recently noted[90], solar PV is rapidly becoming the cheapest option to generate electricity. Given this development, and the similar cost reductions for wind power, the EU and Member States should be focusing absolutely and urgently on how to create an energy supply and storage transformation based on renewables. This is the road that should be travelled.

As a recent report by PricewaterhouseCoopers has made clear, the rate of decarbonisation necessary, globally, to have a chance of limiting global warming to 2 degrees, nearly 5 per cent a year, year on year, is almost unprecedented[91] - much greater, for example, than the UK achieved, about 3 per cent a year, when replacing a major part of its coal generating capability for electricity by gas in the 1990s. In fact, as we note below (Section 9), the UK did not meet a target of a 20 per cent reduction from 1990 to 2010 (an average of only 1 per cent a year reduction) and UK emissions actually increased by 3 per cent in 2010. EU-27 emissions increased by 2.4 per cent in 2010 relative to 2009[92] and were 15.5 per cent below the 1990

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90 *Solar PV rapidly becoming the cheapest option to generate electricity*, Kees van der Leun, Grist, 11 October 2011, http://www.grist.org/solar-power/2011-10-11-solar-pv-rapidly-becoming-cheapest-option-generate-electricity.

91 "The decarbonisation goal required to limit warming to 2 degrees, will now require reductions in carbon intensity of at least 4.8% every year until 2050. ... From 1980-2010, no country has sustained decarbonisation rates close to 4.8% per year. ... The UK decarbonised at 3.0% per year in the 1990s during a 'dash' for gas power generation which replaced coal generation" *Counting the cost of carbon, Low carbon economy index 2011*, PricewaterhouseCoopers LLP, 7 November 2011, http://www.pwc.co.uk/eng/publications/counting-cost-of-carbon-low-carbon-economy-index-2011.html.

92 *Approximated EU GHG inventory: early estimates for 2010*, EEA Technical report No 11/2011, 7 October 2011, http://www.eea.europa.eu/publications/approximated-eu-ghg-inventory-2010.

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base level. Yes, the aimed for 20 per cent reduction by 2020 is likely to be met, but there is no indication that current plans will cause the much greater emissions reductions across the EU-27 countries that are necessary globally and soon.

Only a totally focused effort to make renewables-based supply a reality, supported by an equally determined focus on energy efficiency could achieve such a target. The EU could demonstrate to the world what is achievable and obtain great benefit in terms of innovation, growth and job creation by following such a path. Only a transition to an energy efficient economy can make possible the shift to clean supply in the time still available to act on climate change[93]. The transformation of the building stock is the key activity in such a transition.

93 *"The most important contribution to reaching energy security and climate goals comes from the energy that we do not consume."* International Energy Agency World Energy Outlook 2011, 9 November 2011, http://www.iea.org/index_info.asp?id=1959.

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3. The urgent need for action on climate change

> *"The analysis within this paper offers a stark and unremitting assessment of the climate change challenge facing the global community. There is now little to no chance of maintaining the rise in global mean surface temperature at below 2°C, despite repeated high-level statements to the contrary. Moreover, the impacts associated with 2°C have been revised upwards, sufficiently so that 2°C now more appropriately represents the threshold between dangerous and extremely dangerous climate change."*
>
> Beyond 'dangerous' climate change: emission scenarios for a new world, Kevin Anderson and Alice Bows, Phil. Trans. R. Soc. A, (2011) 369, 20-44, http://rsta.royalsocietypublishing.org/content/369/1934/20.full.

Unless we act now, the Earth will warm by more than 2°C. Even more worryingly, 2°C, considered in so many scenarios to be the threshold for dangerous climate change, seems now more likely to represent the threshold between dangerous and extremely dangerous climate change. Dangerous climate change may occur even before a 2°C global temperature rise.

The real concern is with cumulative greenhouse gas emissions – how much in total we emit – rather than emissions limits as targeted by the UK and EU. To have any chance of avoiding dangerous climate change a significant proportion of known fossil fuel reserves must be left in the ground[94] and annual greenhouse gas emissions must begin to come down very soon.

This need for action very soon has been recently highlighted in a new study just published[95]: "*We find that in the set of scenarios with a 'likely' (greater than 66%) chance of staying below 2°C, emissions peak between 2010 and 2020 and fall to a median level of 44 Gt of CO_2 equivalent in 2020 .... Our analysis confirms that if the mechanisms needed to enable an early peak in global emissions followed by steep reductions are not put in place, there is a significant risk that the 2°C target will not be achieved."*[96] The UNEP too has recently reported on "*an emissions gap that*

94 Summaries of the climate science findings with references to original work are in *A burden Beyond bearing*, Richard Monastersky, Nature (2009) 458, 1091-1094, and *Too much of a bad thing*, Gavin Schmidt and David Archer, Nature (2009) 458, 1117-1118.

95 *Emission pathways consistent with a 2°C global temperature limit*, Joeri Rogelj, William Hare, Jason Lowe, Detlef P. van Vuuren, Keywan Riahi, Ben Matthews, Tatsuya Hanaoka, Kejun Jiang and Malte Meinshausen, Nature Climate Change, 2011, 1, 413-418, published online 23 October 2011, doi:10.1038/nclimate1258.

96 Or in plain language, as the editorial in the same issue points out: *"What their analysis reveals is that to stay below 2°C throughout this century, annual emissions will have to come down by about 4 billion tonnes of carbon dioxide equivalent from the present day level to about 44 Gt of carbon dioxide equivalent in 2020.*

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urgently needs addressing" in order to *"have a likely chance of keeping within the 2°C limit this century, emissions in 2020 should not be higher than 44 Gt of CO_2 equivalent"*[97]. Similar conclusions have been reached by another group[98] who also point out that if climate sensitivity[99] is higher than assumed, carbon emissions must become negative very soon to avoid temperature rises above 2°C.

The International Energy Agency has recently emphasised this urgent need for action to reduce carbon emissions[100]. The UK Confederation of British Industry acknowledged[101] the need for urgency back in 2007: *"Emissions need to peak and fall in the next 10 to 20 years"* but, as the most recent work now shows, the time for effective action is now much less than 10 years.

Yet global emissions, far from moderating, are rising faster than ever[102]. The increase of 5.9 per cent of 2010 over 2009 emissions of carbon dioxide from fossil fuel combustion and cement manufacture[103] is possibly the highest annual net increase of carbon pollution ever.

These recent results mean that the EU 2020 targets for greenhouse gas reduction, introduction of renewables, and energy efficiency are far too modest to meet the need. Luckily, as noted in the previous section, a more rapid move to renewables

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Even then, there is just a 66% probability of staying within the 2°C threshold by 2100.", Editorial, *Crossing the threshold*, Nature Climate Change 1 ,371 (2011), published online 27 October 2011.

97 *Bridging the Emissions Gap*. United Nations Environment Programme (UNEP), 2011, http://www.unep.org/publications/ebooks/bridgingemissionsgap/.

98 *Long-term climate implications of twenty-first century options for carbon dioxide emission mitigation*, P. Friedlingstein, S. Solomon, G-K. Plattner, R. Knutti, P. Ciais and M. R. Raupach, Nature Climate Change, 1, 457–461 (2011), published online 20 November 2011, doi:10.1038/nclimate1302,

99 "Climate sensitivity is a measure of how responsive the temperature of the climate system is to a change in the radiative forcing. It is usually expressed as the temperature change associated with a doubling of the concentration of carbon dioxide in Earth's atmosphere", http://en.wikipedia.org/wiki/Climate_sensitivity.

100 *"If stringent new action is not forthcoming by 2017, the energy-related infrastructure then in place will generate all the CO_2 emissions allowed in the 450 Scenario up to 2035"*, International Energy Agency World Energy Outlook 2011, 9 November 2011 (http://www.iea.org/index_info.asp?id=1959).

101 *Climate change: Everyone's business*, A report from the CBI Climate Change Task Force, November 2007, http://www.cbi.org.uk/pdf/climatereport2007full.pdf.

102 *Greenhouse gases rise by record amount: levels of greenhouse gases are higher than the worst case scenario outlined by climate experts just four years ago*, Associated Press, guardian.co.uk, 4 November 2011, http://www.guardian.co.uk/environment/2011/nov/04/greenhouse-gases-rise-record-levels.

103 *Record High 2010 Global Carbon Dioxide Emissions from Fossil-Fuel Combustion and Cement Manufacture Posted on CDIAC Site*, Contributors, Tom Boden and T.J. Blasing, http://cdiac.ornl.gov/trends/emis/perlim_2009_2010_estimates.html, and *Rapid growth in CO_2 emissions after the 2008–2009 global financial crisis*, Glen P. Peters, Gregg Marland, Corinne Le Quéré, Thomas Boden, Josep G. Canadell and Michael R. Raupach, Nature Climate Change (2011), doi:10.1038/nclimate1332, Published online 4 December 2011.

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can bring many benefits to EU economies as well as helping, we hope, to lead the world to a less worrying climate change trajectory.

Self-evidently, the EU cannot, on its own, effect the global emissions reduction necessary. What it can do is to lead by showing that real and substantive substitution of fossil fuels by renewables is possible and can happen fast. By so doing, it can also show that such a course of action brings many benefits apart from those to do with climate change. Indeed, as we note in the paragraphs that follow, viewed on a consumption basis, it is likely that there have, in fact, been no greenhouse gas emissions reductions across the EU in recent years because emissions have merely been transferred to countries that manufacture products for export to the EU. Only by going much faster can the EU actually reduce total emissions including those associated with the products it consumes.

It is very worrying to read recent estimates of future global energy use and carbon emissions that seem to assume that serious action to face up to climate change will not happen any time soon. The US Energy Information Administration, for example, has recently published[104] its estimate of global energy consumption up to 2035. Natural gas consumption is predicted to grow by over 50 per cent from 2008, with strong growth of gas from unconventional supplies such as shale gas, and coal by 50 per cent with global CO_2 emissions increasing by 43 per cent. There is a disconnect between what needs to happen and what is happening. As we noted in Section 2, the American Council for an Energy-Efficient Economy has highlighted[105] the beneficial impact of an aggressive energy efficiency campaign on both the economy and on jobs, but only the EU seems to have the capability, at present, to change course and to demonstrate that a low-emissions path is both possible and beneficial to economies as well as to the environment.

Most of this growth in emissions is in what is today called the developing world – nearly half the coal burned in the world in 2010 was burned in China – but it is instructive to realise[106] that the carbon emissions reductions in developed countries pledged in the Kyoto accord are possibly more than offset by the embedded carbon emissions in products imported from developing countries. In other words, globalisation of trade has merely exported carbon emissions from developed to developing countries. Emissions in EU countries, when consumption is accounted for, may well have increased rather than decreased as the national accounts appear to show.

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104 *International Energy Outlook 2011*, U.S. Energy Information Administration, 19 September 2011, http://www.eia.gov/forecasts/ieo/pdf/0484(2011).pdf.

105 *The Long-Term Energy Efficiency Potential: What the Evidence Suggests*, John A. "Skip" Laitner, Steven Nadel, R. Neal Elliott, Harvey Sachs, and A. Siddiq Khan, Research Report E121, American Council for an Energy-Efficient Economy, 11 January 2012, http://aceee.org/research-report/E121.

106 *Growth in emission transfers via international trade from 1990 to 2008*, Glen P. Peters, Jan C. Minx, Christopher L. Weber and Ottmar Edenhofer, PNAS (2011), 108, 8903-8908.

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An analysis[107] for the UK shows just this state of affairs. The authors note that: *"Emission reductions in the UK through changes in the production structure are therefore not a reflection of a greening domestic supply chain, but of structural shifts in the international division of labor in the global production of goods and services."* Taking into account the emissions associated with the production of all the things now imported, apparently impressive emissions reductions across the EU are illusory. Hence, apart from the urgency to act on climate change noted in this paper, more urgent action to achieve deeper cuts in greenhouse gas emissions are necessary to show real reductions once consumption emissions are added in.

Professor Kevin Anderson, one of the Tyndall Centre[108] authors quoted at the head of this section has said[109] of shale gas: *"Consequently, if we are serious in our commitment to avoid dangerous climate change, the only safe place for shale gas remains in the ground"*, a rather different perspective to that of some EU governments and of the fossil fuel industry[110].

What we do not hear from governments and certainly not from the fossil fuel industry is the fact that switching from burning coal to burning shale gas (or any other source of natural gas) may not actually help tackle climate change. While gas (principally methane) is a less carbon intensive fuel than coal, there is always some leakage to the atmosphere and methane has a much greater global warming impact than carbon dioxide. Also, as already noted, combustion of coal creates many pollutants that pose health problems, whereas the levels of such pollutants from combustion of gas is very much lower. While this reduction of pollutants is beneficial from a public health perspective, these pollutants do have another impact in that they counteract the climate change effect of the carbon dioxide emitted by coal. Even if clean-up systems on coal plants become much more effective than today, and even if the

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107 *Understanding Changes in the UK's CO_2 Emissions: A Global Perspective*, Giovanni Baiocchi and Jan C. Minx, Environ. Sci. Technol., 2010, 44 (4), 1177–1184.

108 The Tyndall Centre is a unique partnership between a selection of researchers from eight UK research institutions, who together form the Tyndall Consortium, http://www.tyndall.ac.uk/Partner-Institutions.

109 *Shale gas: a provisional assessment of climate change and environmental impacts*, A research report by The Tyndall Centre University of Manchester, January 2011, http://www.tyndall.ac.uk/shalegasreport; this work has recently been updated with equally firm conclusions: *"If the UK Government is to respect its obligations under both the Copenhagen Accord and Low Carbon Transition Plan, shale gas offers no meaningful potential as even a transition fuel. Moreover, any significant and early development of the industry is likely to prove either economically unwise or risk jeopardising the UK's international reputation on climate change."*, Shale gas: an updated assessment of environmental and climate change impacts, Broderick. J., et al, a report commissioned by The Co-operative and undertaken by researchers at the Tyndall Centre, University of Manchester, November 2011, http://www.tyndall.ac.uk/sites/default/files/broderick2011_shalegasexecsummary_conclusions.pdf.

110 For example, a letter by the Country Chair of Shell UK has advocated increased use of natural gas: *"The European Gas Advocacy Forum report has shown that in the next 20 years Europe could save about €500bn by more reliance on natural gas and less on coal."*, Fracking in the energy mix, Letter by Graham van't Hoff, The Guardian, Wednesday 27 April 2011, http://www.guardian.co.uk/environment/2011/apr/27/fracking-in-the-energy-mix.

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leakage rates from shale gas are much lower than suggested[111], a recent study[112] indicates that switching from coal to natural gas from any source will have little impact on global warming. The author notes: *"...unless leakage rates for new methane can be kept below 2%, substituting gas for coal is not an effective means for reducing the magnitude of future climate change."* The urgent emphasis must be not on finding new sources of fossil fuels such as shale gas but of switching from fossil fuels of any kind to renewable sources of energy

As we see from forecasts such as that just published by the U.S. EIA, current policies indicate, however, that fossil fuel use and carbon emissions will continue to grow. Shale gas, or other fossil fuels, will only stay in the ground if there is a rapid and transformative change in political emphasis from energy supply by fossil fuels with renewables slowly taking market share and weak action on energy efficiency – the case today - to energy supply by renewables with urgent action also on energy efficiency. Attention to the building stock must lead the campaign on energy efficiency. The necessary path today is very like the 'soft' path proposed by Amory Lovins in 1976 as noted in the previous Section.

The EU, by its actions, cannot solve climate change alone, but it can demonstrate that taking urgent action to promote the switch to renewables, and to promote energy efficiency, has great benefit in stimulating green growth and sustainable prosperity. Thus it can help shape global thinking on tackling climate change and, through its own actions, help show the developing world that a clean alternative to fossil fuels is both viable and beneficial.

The proposed increase[113] in EU greenhouse gas emissions cuts to 30 per cent by 2020 should be just the beginning of this process and would benefit the European economy. As the European Climate Forum has shown[114]: *"Raising the European climate target from 20% to 30% emissions reductions can open the way towards higher growth and increased employment."* This report also notes the importance of building retrofit in this ambition: *"The new growth path implies a major effort to retrofit buildings and enhance the built environment."*

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111 *Methane and the greenhouse-gas footprint of natural gas from shale formations*, Robert W Howarth, Renee Santoro and Anthony Ingraffea, Climatic Change, 106, 679-690 (2011) who point out that: *"Compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon and is comparable when compared over 100 years."*

112 *Coal to gas: The influence of methane leakage*, Tom M L Wigley, Climatic Change, 108, 601-608 (2011)

113 Letter to the Guardian on 30% EU Emissions Cut from Chris Huhne and EU Environment Ministers, 14 March 2011, http://www.guardian.co.uk/theguardian/2011/mar/14/europe-japan-and-energy-options.

114 *A New Growth Path for Europe: Generating Prosperity and Jobs in the Low-Carbon Economy, Synthesis Report*, Carlo C. Jaeger et al, European Climate Forum, February 2011, http://www.european-climate-forum.net/fileadmin/ecf-documents/Press/A_New_Growth_Path_for_Europe__Synthesis_Report.pdf.

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One of the authors of this European Climate Foundation report has separately summarised[115] the transition in attitude that action to tackle climate change must reflect: *"What we are witnessing is a watershed in the debate on greenhouse-gas emissions.* ***A low-carbon growth path requires neither coal nor new nuclear power. The way forward is to pursue more ambitious and consistent climate and energy policies that drive the massive deployment of renewables; install new load-balancing electricity grids; and ensure large-scale adoption of energy-efficiency measures.****"* Denmark, as noted in Section 2, is already showing all this can be done, with ambition for 35 per cent greenhouse gas reduction by 2020[116].

What has now been confirmed by the reports on emissions rises in 2010 and by the IEA in the World Energy Outlook 2011 is that such massive deployment of renewables must happen very soon together with real and effective action on energy efficiency – where low-carbon refurbishment of buildings is key.

115 *The End of Nuclear Power*, Roland Kupers, 25 April 2011, http://www.project-syndicate.org/commentary/rkupers2/English.

116 *Our Future Energy*, The Danish Government, November 2011, http://www.kemin.dk/Documents/Klima-%20og%20Energipolitik/our%20future%20energy.pdf.

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4. Tackling buildings tackles energy efficiency

> *"We think it's pretty unlikely that we'll find a good response to the threat of global warming on the supply side alone but if we can make a serious reduction in our demand for energy, then all the options* [for changing the energy supply] *look more realistic."*,
>
> Julian Allwood, quoted in: *Efficiency could cut world energy use over 70 per cent*
> Helen Knight, New Scientist, 26 January 2011, http://www.newscientist.com/article/dn20037-efficiency-could-cut-world-energy-use-over-70-per-cent.html.
>
> [See also *Reducing Energy Demand: What Are the Practical Limits?*, Jonathan M. Cullen, Julian M. Allwood, and Edward H. Borgstein, Environ. Sci. Technol., (2011), 45, 1711–1718.]

Long-term targets such as the proposed EU Roadmap for 2050[117] are admirable but, as already noted, more immediate action to tackle climate change is now essential. Single-minded investment in energy efficiency and in renewables is the only viable way forward.

Buildings present the greatest single opportunity for an energy efficient economy. As already noted (Section 1), across the EU-27 homes are responsible for a quarter of energy related greenhouse gas emissions and commercial buildings for another 15 per cent, 40 per cent in total[118]. We know from real-life examples by Build with CaRe partners in several countries what to do to dramatically reduce this energy use and consequent greenhouse gas emissions, and how to do it, as we note below. The challenge is to overcome the barriers that turn best practice from a few isolated examples to being the common-place across Europe. If this can be achieved, the benefits will be great.

An important recent study by researchers from Cambridge University[119] demonstrated that 73 per cent of global energy use could be saved by practically achievable design and the authors noted that: *"The greatest energy savings can be achieved in the passive systems of buildings, both absolute (179 EJ) and as a percentage of total demand (83%). This is dominated by the savings in heating and*

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117 *A Roadmap for moving to a competitive low carbon economy in 2050*, European Commission, Brussels, 8 March 2011, COM(2011) 112, http://ec.europa.eu/clima/documentation/roadmap/index_en.htm

118 *End-user GHG emissions from energy: Reallocation of emissions from energy industries to end users 2005–2009*, European Environment Agency, Technical report No 19/2011, 15 December 2011, http://www.eea.europa.eu/publications/end-use-energy-emissions/full-report-2014-end-user.

119 *Reducing Energy Demand: What Are the Practical Limits?*, Jonathan M. Cullen, Julian M. Allwood, and Edward H. Borgstein, Environ. Sci. Technol., (2011), 45, 1711–1718.

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cooling spaces (85 EJ), which could be avoided by designing buildings to the Passivhaus standard[120], and appliances (59 EJ).”

However, the study noted that energy efficiency (demand reduction) is rarely a priority in national or international policies and that, as already noted, less than 10 per cent of worldwide research and development expenditure on energy has been spent on energy efficiency, compared to 40 per cent on nuclear fusion and nuclear fission. Just like the situation with renewables, energy efficiency is a poor relation compared to nuclear and fossil fuels, yet, as one of the Cambridge authors has pointed out[121], energy efficiency is a key to tackling climate change.

Viewed in these terms, the cost of much increased support for energy efficiency programmes seems minimal compared to the benefits realised. It would be eminently sensible to spend far more than we do on energy efficiency. The lack of any public subsidy for the UK Green Deal, for example, seems certain to inhibit achievement as discussed in *Green Deal Appraised*.

Consider, for example, the £200billion investment said to be needed[122] up to 2020 in the UK to develop new energy supplies and to strengthen the electricity and gas grids. Interestingly, a similar figure seems to be roughly what it might cost[123] to bring the entire UK housing stock up to or near to passivhaus standards, where essentially no energy is needed for heating and cooling. If implemented globally, together with similarly enhanced standards for new buildings, such a transformation could make a major contribution to cutting energy demand. As examples from Build with CaRe partners show, a lot of the knowledge to do this is already in place somewhere. What is needed are the policies for effective implementation and appropriate financial support.

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120 See http://en.wikipedia.org/wiki/Passive_house for a description of passivhaus standards and examples.

121 Julian Allwood, see the box at the head of this Section.

122 *Energy firms must invest £200bn to meet UK targets, says regulator*, Terry Macalister and Julia Kollewe guardian.co.uk, Friday 9 October 2009, http://www.guardian.co.uk/business/2009/oct/09/ofgem-warns-energy-prices-could-surge.

123 It is impossible accurately to cost such a sum but an average for the building stock has been estimated to be about £20,000 per house at today’s figures (see, for example *Meeting the C80 retrofit challenge: pilot examples and learning*, Paul Ciniglio, Sustainability Manager, Radian, June 2009, http://sticerd.lse.ac.uk/textonly/LSEhousing/Events/climate_change_begins_at_home/presentation07-Paul_Ciniglio-Radian.pdf). The process for such ‘deep’ refurbishment down to one-fifth of the carbon emissions before refurbishment is at its infancy in the UK and hence costs will inevitably fall. It is reasonable to assume that they might average out at half this figure, about £10,000 per house, for the total housing stock over a period of twenty years or more. If we then assume that around 80 per cent of the existing stock, about 20 million homes, is fit to be refurbished to C80 levels of efficiency, then the total cost will be £200billion, just the amount that is said to be needed by 2020 for new supply and grid improvement. Even if the figure for refurbishment is double this amount, there should, with innovative long-term thinking, be finance available to fund such work (as we indicate in Section 10.6).

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Once this investment in energy efficiency is made, the energy these homes once required will never again be needed. An unnecessary and wasted investment in large-scale energy supply is avoided[124] so creating a permanent, repeated, financial saving – the opposite situation to the extra investment in energy supply needed if new building codes are weakened as we discuss below (Section 6). Once the fabric is improved to this degree then the potential for on-site renewables to offset total used energy – the zero-emissions building (or even the energy-plus building where more energy is generated than is consumed) – becomes a viable option.

With such investment in buildings, not only will total energy use be significantly reduced but occupants of these buildings will be living or working in much healthier and more pleasant homes or workplaces. There will no longer be draughts and cold corners. Ventilation will be carefully planned. Improved air quality will enhance alertness, performance and health.

The construction industry will, of necessity, have become up-skilled and globally competitive, and supply chains will have been developed that are equally competitive. There can be a focus on renewable energy supply rather than inappropriate investment in nuclear and fossil technologies meaning that the energy supply industry also can become globally competitive. It really can be win-win-win and good for business as well as good for citizens, for communities and for the environment[125].

If this investment to upgrade buildings is not made – or not made fast enough so that extra investment and expense in new supply cannot be avoided – then homes and buildings will be less comfortable and pleasant to live and to work in as well as remaining much more expensive to run. The construction industry and its supply chains will be disadvantaged relative to competitors in countries that are more focused on becoming energy efficient. There will be lock-in of energy inefficiency and of greenhouse gas emissions because the renewal and refurbishment that does occur will be to lower standards than could be achieved[126]. The financial burden of weaker building standards and the increased investment in energy supply that

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124 As the recent WWF report, *Positive Energy: how renewable electricity can transform the UK by 2030*, mentioned above, noted, up to £40billion of capital investment in supply could be avoided if there were really effective demand reduction policies in place (or else could be productively used in a process to produce renewable methane and liquid transport fuels as noted in Section 2).

125 The list of supporting comments from industry leaders for the WWF renewables ambition detailed in *Positive Energy: how renewable electricity can transform the UK by 2030* is impressive; Supportive Quotes, http://assets.wwf.org.uk/downloads/positive_energy_supportive_quotes.pdf.

126 "Every year lost on the way towards rehabilitation of energy systems in buildings in Germany can, for example, mean an additional 1.5 million tonnes of CO_2. These buildings will then not be rehabilitated again for another 40 years. The same is also applicable, for example, to CO_2 emissions from power stations and the installation of inefficient heating systems." *Climate protection in Germany: 40% reduction of CO_2 emissions by 2020 compared to 1990*, Climate Change 13/07, German Federal Environment Agency, August 2007, http://www.umweltdaten.de/publikationen/fpdf-l/3304.pdf.

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results has been very precisely shown this year in respect of the UK's weakening of the proposed "zero carbon house" standard as we note below (Section 6).

It is revealing to note that while this £200billion sum for the refurbishment of the existing UK building stock would be spent over many years, similar sums have been made available in months in response to the continuing financial crisis. The first round of so-called "Quantitative Easing" in the UK, begun in 2009, released exactly this sum into the economy. It has been argued[127], however, that the cash ends up overwhelmingly in profits, exacerbating already extreme income inequality and the consequent social tensions that arise from it. If such measures can be agreed in response to the financial crisis, with possibly few beneficial consequences, how much better value can be obtained by investment to improve the building stock!

The UK expenditure on housing benefit in 2009/10 was £20billion[128]. If a similar sum was devoted to refurbishment almost the entire UK building stock could be brought to very-low energy and passivhaus quality by 2030!

A focus on energy efficiency, led by building refurbishment, is essential if climate change is to be addressed in a meaningful manner. A focus on buildings pulls along other sectors because low-energy energy-efficient buildings then direct focus to appliances[129] and to individual behaviour (see Section 10.5), and to transport. Also, as we note below, energy efficiency in buildings cannot be considered in isolation from questions of local generation of energy and local energy storage so that a focus on buildings can bring systems thinking to the fore, something almost totally ignored in today's supply system.

Yet the UK Green Deal[130] envisages no subsidy for energy efficiency while new energy production is totally subsidised in the sense that all costs must eventually appear on customers' energy bills. Germany is one of the EU states most advanced in terms of refurbishment of the building stock and: *"the examples show that public*

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127 *Quantitative easing 'is good for the rich, bad for the poor'*, Heather Stewart, The Observer, Sunday 14 August 2011, http://www.guardian.co.uk/business/2011/aug/14/quantitative-easing-riots.

128 *Housing benefit changes: Who will be affected?*, BBC News, 31 March 2011, http://www.bbc.co.uk/news/uk-12674409.

129 A recent Energy Saving Trust report into appliance use in the UK notes that: "despite householders' best efforts to switch to energy-saving products, we are actually consuming more energy [in appliance use] than five years ago", *The elephant in the living room: how our appliances and gadgets are trampling the green dream*, Energy Saving Trust, 4 October 2011, http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/The-elephant-in-the-living-room. While there is great scope to reduce energy use of most appliances through innovation this will only happen through effective and enforced regulation. It is difficult to envisage more demanding regulation than exists today being introduced unless the major energy use within buildings, heating and cooling, is firmly tackled in the first instance.

130 Described in the accompanying paper, *Green Deal Appraised*.

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funds are one success factor"[131]. The UK's Green Deal, however, follows the long-established pattern whereby support for energy efficiency is minimal compared to support for energy generation. Yet, unlike the situation in large-scale energy generation, only a modest input is necessary to generate a large multiplier in energy efficient refurbishment because many millions of building owners or occupiers are involved.

An appropriate mix of support and penalties can stimulate the necessary investment but innovative thinking will be needed to find the most effective pathways (Section 10.6). Ensuring that necessary financial stimulus is in place will be a most effective use of public funds compared to massive historical support and subsidy for fossil fuels, for nuclear power and for energy supply. Of particular importance will be the transformation of the skills and capabilities of the construction industry, especially of the medium and small-sized businesses that will surely undertake a great deal of refurbishment work, and of ensuring that household and building surveys are done thoroughly and professionally. These issues are discussed in more detail in Section 10.

131 *Energy Efficient Residential Housing: Chances and Challenges*, Jochen Flasbarth (President of the German Federal Environment Agency), UNECE Conference "Energy Efficiency in Housing", Vienna, November 2009, http://www.umweltbundesamt.de/uba-info-presse/reden/wien_energyefficiencyhousing.pdf.

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5. We must go faster on energy efficiency

> *"The most important contribution to reaching energy security and climate goals comes from the energy that we do not consume."*
>
> International Energy Agency World Energy Outlook 2011, 9 November 2011 (http://www.iea.org/index_info.asp?id=1959).

At present, effective action to refurbish buildings across the EU cannot happen because initiatives to promote energy efficiency across the EU are lamentably inadequate. This situation is a consequence of the focus on energy supply and the subsidies that have followed (outlined in Section 2).

Energy efficiency continues to be the poor relation even though many energy efficiency measures are widely recognised to be more cost-effective than creating new generating capacity[132]. The EU has emphasised the benefits of investment in energy efficiency for jobs[133] as well as for emissions reduction, energy security, competitiveness, and tangible benefits to citizens. The objective of achieving 20 per cent primary energy savings was one of the five headline targets of the Europe 2020 Strategy for smart, sustainable and inclusive growth[134].

These are fine words, but the reality is that actual progress is far short of even present day ambition. The reason for this lack of action is the lack of political and financial support for energy efficiency we have already noted (Section 2). Energy

132 For example, research by the American Council for an Energy-Efficient Economy has shown that the cost of saving a unit of electricity is one-third or less than the cost of installing any new source of electricity supply; *Saving Energy Cost-Effectively: A National Review of the Cost of Energy Saved Through Utility-Sector Energy Efficiency Programs*, Katherine Friedrich, Maggie Eldridge, Dan York, Patti Witte, and Marty Kushler, ACEEE, 1 September 2009, Research Report U092, http://www.aceee.org/research-report/u092.

133 "Investments in cost-effective energy-efficiency improvement will almost always have a positive impact on employment. In all cases, the number of jobs created is greater than those created from comparable alternative investments, including investments for the extraction, transformation and distribution of energy. ... That is to say, energy end-use efficiency investments create three to four times the number of jobs created by comparable energy supply investments." *Doing More With Less: Green Paper on Energy Efficiency*, Directorate-General for Energy and Transport, European Commission, 2005, http://ec.europa.eu/energy/efficiency/doc/2005_06_green_paper_book_en.pdf.

134 "Energy efficiency is the most cost effective way to reduce emissions, improve energy security and competitiveness, make energy consumption more affordable for consumers as well as create employment, including in export industries. Above all, it provides tangible benefits to citizens: average energy savings for a household can amount to €1,000 per year.", *Energy 2020: A strategy for competitive, sustainable and secure energy*, Brussels, 10 November 2010, COM(2010) 639 final, http://ec.europa.eu/energy/strategies/2010/doc/com(2010)0639.pdf.

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efficiency is not a mandated target as are renewable energy and emissions reduction which means that EU member states have not responded with the resolve required[135].

Across the EU, the current ambition of a 20 per cent reduction in energy consumption by 2020 is way off target with projections indicating a likely reduction by 2020 of only 10 per cent or less, (as noted in the new Directive on Energy Efficiency recently proposed[136]). This inaction persists in spite of the claim in the Energy Efficiency Plan 2011 that, if EU-wide action is taken to meet the 20 per cent target, up to two million jobs can be created in the building sector[137]. Some governments remain so focused on energy supply that they seem unable to create a conceptual space to promote energy efficiency in a serious and effective manner.

The institutional mindset created by the present energy supply system, and the resultant lack of awareness of what is possible in respect of energy saving while maintaining or even improving quality of life, means that, in several Member States, there seem to be no strong forces promoting energy efficiency. There also seems little recognition of the urgency needed to take strong action on climate change. These barriers are compounded in the UK by ill-advised Government thinking on growth as we note below (Section 7). We discuss how to create "a new reality" in Section 9.

There are, indeed, admirable long-term intentions by the EU to decarbonise buildings by 2050 but, near-term, energy efficiency is the poor relation to energy supply. Yet, as noted above (Section 3), it is in the near-term that action must happen.

The proposed EU Roadmap for 2050 suggests that the built environment should (and can) achieve an emissions reduction of around 90 per cent by 2050[138] as a key element in reducing GHG emissions by at least 80 per cent by 2050 compared to 1990.

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135 "the existing strategy is currently unlikely to achieve all the 2020 targets, and is wholly inadequate to the longer term challenges. ... The quality of the National Energy Efficiency Plans, developed by Member States since 2008, is disappointing, leaving vast potential untapped. ... We are a long way from achieving the 20% energy savings objective. ... Measures need to be developed to speed up significantly the rate of refurbishment using energy-efficient products and technologies.", *Energy 2020: A strategy for competitive, sustainable and secure energy*, Brussels, 10 November 2010, COM(2010) 639 final, http://ec.europa.eu/energy/strategies/2010/doc/com(2010)0639.pdf.

136 Home page at http://ec.europa.eu/energy/efficiency/eed/eed_en.htm; *Proposal for a Directive of the European Parliament and of the Council on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC*, European Commission, Brussels, 22 June 2011, COM(2011) 370 final, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0370:FIN:EN:PDF.

137 *Energy Efficiency Plan 2011*, European Commission, Brussels, 8 March 2011, COM(2011) 109 final, http://ec.europa.eu/energy/efficiency/action_plan/doc/20110308_efficiency_plan_act_en.pdf.

138 'A Roadmap for moving to a competitive low carbon economy in 2050' Brussels, 8 March 2011 COM(2011) 112: http://ec.europa.eu/clima/documentation/roadmap/index_en.htm.

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In the UK, the Committee on Climate Change[139] states: "*By 2050, we expect the buildings sector to be highly energy efficient and most heating requirements to be met by low carbon sources. This will ensure that the buildings sector is zero carbon or close to zero carbon as required to meet the economy wide 2050 target*." It is revealing, however, that this expectation still assumes space heating systems are necessary, not a target one would hope for if energy efficiency were being vigorously pursued.

Germany is one or the most advanced European economies in the promotion of renewable energy and in demonstrating 'deep' refurbishment of buildings to save three-quarters of more of energy use[140]. The German Energy Concept[141] sets a target of 'almost climate-neutral' building stock, with a renovation roadmap targeting an 80 per cent reduction in primary energy demand by buildings by 2050 as a major contribution to an overall reduction in primary energy consumption of 50 per cent. Germany also seeks to cut electricity consumption by 25 per cent by 2050.

This is a much more promising strategy than that of the Green Deal in the UK, which has no overall target on demand reduction, as it focuses on a major reduction in primary energy demand by buildings. The Energy Concept states that "*Buildings are the key to greater energy efficiency*", but also notes that, even in Germany, the renovation rate needs to double if the targets are to be met: *"Building renovation will be a central focus. In this field, it is vital to more or less double the current rate of renovation."*

Even in Germany, therefore, a major acceleration of 'deep' refurbishment is needed but the Energy Concept does not call for the *"renovation road-map for existing buildings"* to start until 2020. Yet, as already noted, urgent action to stimulate energy efficiency must happen much sooner if potentially dangerous climate change is to be addressed. There are admirable long-term ambitions for the EU and for individual Member States but the need for urgent action is now and action on energy efficiency is not happening to anything like the degree either necessary or possible.

The UK has put in place a major programme for new electricity generation[142] entailing over £100billion of investment. But the UK Association for the Conservation

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139 4th Carbon Budget: Chapter 5: Reducing emissions from buildings and industry through the 2020s. December 2010; http://downloads.theccc.org.uk.s3.amazonaws.com/4th%20Budget/4th-Budget_Chapter5.pdf

140 See, for example, *Energy saving techniques, upgrading and renewables*, Tobias Timm, proKlima, Hannover, http://sticerd.lse.ac.uk/textonly/lsehousing/events/DENA/Tobias_Timm2.pdf or *Pilot Project "Energy Efficient Homes"*, Nicola Pillen, German Energy Agency (dena), November 2010, http://www.iea.org/work/2010/sbn/Pillen.pdf.

141 *Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply*; 28 September 2010;: http://www.bmu.de/files/english/pdf/application/pdf/energiekonzept_bundesregierung_en.pdf.

142 Electricity Market Reform (EMR) white Paper 2011, 12 July 2011, http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/emr_wp_2011.aspx.

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of Energy has pointed out[143] that: *"the Government is drawing up plans for long term energy needs and expensive new infrastructure – but they have admitted to us that they have NOT carried out an assessment to compare the costs and benefits of energy efficiency against those of generating energy."* The UK, like possibly several other EU Member States, has no clear plan or route map to promote energy efficiency. It would appear that the UK Green Deal to promote energy efficiency in the building stock will take all the strain of tackling building refurbishment without the support of any over-arching promotion of energy efficiency. Indeed, the UK Secretary of State for Business, Innovation and Skills has said[144] that: *"The Green Deal is at the heart of the plans we have set out to support the transition to a green economy."*

The companion paper, *Green Deal Appraised*, describes many of the potential pitfalls of the Green Deal and the problems that ensue from not having any wider comprehensive strategy for tackling energy efficiency. Of particular concern is the imposition of the so-called "Golden Rule" whereby the cost of refurbishment works undertaken must be recouped in Green Deal payments. The Golden Rule states that expected savings must at least equal the costs to the bill payer. This lack of any subsidy or financial support is likely to lead to refurbishments that are shallow rather than deep, leading to lock-in of energy inefficiency and greenhouse gas emissions, and will not create the large improvements in energy efficiency that are possible and necessary. Hence we see quite clearly in the case of the UK, and most likely in the case of many other Member States, that there is no focused strategy to tackle energy efficiency.

In a few countries, and explicitly in Germany, there is a strategy and desire to tackle energy efficiency. Even in Germany, the need to go faster with building refurbishment is acknowledged but there is no clear pathway yet defined to enable this to happen. In other countries, such as the UK, there is no apparent strategy at all for making energy efficiency a priority. This lack of urgency across Member States explains why the EU is falling so far short of the 2020 target for energy efficiency. There seems no credible strategy so far for making up lost ground while the urgent need now is to go even faster than planned.

As noted in Section 2, the American Council for an Energy-Efficient Economy has shown[145] how the US economy could also reduce primary energy use from current levels by up to 50 per cent through an aggressive energy efficiency campaign with benefits for the economy and for jobs. This is also the German ambition. We

143 *The Big Debate: Energy Demand vs Energy Generation*, 14 February 2011, http://www.ukace.org/index.php?option=com_content&task=view&id=610&Itemid=37.

144 Vince Cable speech - Resource Security, CBI / Green Alliance conference, 12 December 2011, http://www.bis.gov.uk/news/speeches/vince-cable-resource-security-2011.

145 *The Long-Term Energy Efficiency Potential: What the Evidence Suggests*, John A. "Skip" Laitner, Steven Nadel, R. Neal Elliott, Harvey Sachs, and A. Siddiq Khan, Research Report E121, American Council for an Energy-Efficient Economy, 11 January 2012, http://aceee.org/research-report/E121.

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suggest that setting a minimum 40 per cent cut in primary energy demand by 2050 could become an EU target with transformation of the building stock a centre-piece. Action must start now. The high energy-efficiency scenario in the EU Commission's Energy Roadmap 2050[146] foresees a 41% decrease in energy demand by 2050 compared to the 2005-2006 peaks. Setting a minimum 40 per cent target relative to an appropriate baseline would galvanise action which the Roadmap acknowledges (para 3.1) must be implemented swiftly: *"Current initiatives need to be implemented swiftly to achieve change. Implementing them in the wider context of overall resource efficiency will bring cost- efficient results even faster. ... Higher energy efficiency in new and existing buildings is key. Nearly zero energy buildings should become the norm. Buildings – including homes - could produce more energy than they use. Products and appliances will have to fulfil highest energy efficiency standards."*

The Roadmap highlights the importance of nearly zero energy buildings becoming the norm. This paper demonstrates that there are major barriers to achieving this desirable outcome. The time to tackle these barriers is now. As has been stressed, the benefits will flow not just to the environment but to economies and jobs as well.

146 *Energy Roadmap 2050*, European Commission, Brussels, COM(2011) 885/2, 15 December 2011, http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf.

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6. "Zero-carbon homes" no longer zero-carbon

> *"In the space of two weeks, this government has gone from a firm commitment on zero carbon homes, to watered down policy. A zero carbon home will no longer do what it says on the tin."*,
>
> Paul King, Chief Executive, UK Green Building Council, in *'Greenest government ever' under threat*, 23 March 2011, Isabel Hardman, Inside Housing,
>
> http://www.insidehousing.co.uk/ihstory.aspx?storycode=6514206.
>
> *"At a time when the UK faces rapidly rising energy bills, increasing capacity constraints and a huge cost to renew the UK's generating capacity, the decision not to include the public display of energy use in large commercial buildings in the Act is incomprehensible and hugely disappointing, especially from a government that markets itself as being "green" and business friendly"*,
>
> Andy Ford, President of CIBSE, the Chartered Institute of Building Services Engineers, CIBSE Journal, NEWS, November 2011, http://www.cibsejournal.com.

If climate change is to be tackled, and if the transformation in the building sector called for by the WBCSD (Section 1) is to become a reality, the EU must go much faster on energy efficiency in buildings. Unfortunately, current developments in the UK, which may influence what happens in other Member States, are pointing in exactly the wrong direction. What happens in refurbishment will be influenced by the standards that are agreed for new buildings. If these fall short of what is feasible and possible, then the regulations, the skills, and the supply-chain to make possible 'deep low-energy refurbishment' of the existing building stock may be inadequate for the task.

Similarly, there can be considerable waste of energy in a building of any kind if energy use is not monitored and efforts made to eliminate waste. It is acknowledged that there is great scope for energy savings in very many buildings even without expensive refurbishment. A low-energy building can only be called low-energy (or low-carbon) if it performs this way in practice (Section 10.2). Low-energy design is meaningless without real-life data on energy use. Hence the importance of DECs (Display Energy Certificates) showing actual energy use for public and commercial buildings and the likelihood of continuing waste of energy if these are not mandatory.

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In the UK, the Zero Carbon Hub[147], the body set up to define how "zero-carbon homes" could be defined and developed, has adopted a fabric energy efficiency standard for "zero carbon homes" that falls short[148] of the passivhaus standard. If followed, this UK standard may imply that new homes fall short of the quality of passivhaus homes, because, with reasonable air tightness and good insulation, but without mechanical ventilation, they may suffer from poor ventilation and air quality issues, giving a bad name to zero carbon, or low energy, buildings in general.

In fact, it is most likely that, without the quality of construction that passivhaus standards demand, delivered energy efficiency standards of the UK's so-called "zero carbon homes" may be far poorer even than the proposed standard. The Zero Carbon Hub itself has noted in its report[149] on Carbon Compliance: *"Ensuring what is designed is actually delivered will represent a significant challenge for the whole industry, including designers, the supply chain, and housebuilders."*

What the Zero Carbon Hub is saying is that delivered build quality of "zero carbon homes" in the UK is likely to be significantly worse than design quality if the practices of the industry do not change. As proposed, the standards for "zero carbon homes" do not require such an industry change and will not deliver the transformation called for by the WBCSD (Section 1). A move to passivhaus standards would, on the other hand, help deliver exactly such a transformation.

One thing that UK-defined "zero-carbon homes" will not be is zero-carbon. The proposed standard falls short of what is possible and, as just noted, it is freely acknowledged that the delivered quality is almost certain to fall short of even this standard. This is likely to mean lock-in of carbon emissions, more expense for owners and occupiers, and poorer quality.

As we note below, because of the less demanding energy standard proposed, even with renewable energy systems installed, new so-called "zero-carbon homes" in the UK cannot be the "nearly zero-energy buildings" that the EU is requesting from 2020 in the recast Energy Performance of Buildings Directive[150]. This is because the on-site renewable energy cannot make up for the energy consumed in the home.

To make matters even worse, in the Budget this year, the UK Government reduced even further the demands on housebuilders to deliver zero-carbon homes when it announced that developers would only have to offset by renewable energy the

147 http://www.zerocarbonhub.org/

148 *Defining a fabric energy efficiency standard for zero carbon homes, Task Group Recommendations*, Zero Carbon Hub, November 2009, http://www.zerocarbonhub.org/resourcefiles/ZCH-Defining-A-Fabric-Energy-Efficiency-Standard-Task-Group-Recommendations.pdf.

149 *Carbon Compliance: Setting an appropriate limit for zero carbon new homes, Findings and Recommendations*, Zero Carbon Hub, February 2011, http://www.zerocarbonhub.org/resourcefiles/CC_TG_Report_Feb_2011.pdf.

150 Described, for example, in CIBSE Briefing, *The Recast Energy Performance of Buildings Directive*, http://www.cibse.org/content/documents/Knowledge_Bank/EPBDBriefingFINAL2011.pdf.

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regulated energy consumption (heating, hot water and lighting) and not the energy used by appliances. The fabric energy efficiency standard is such that on-site renewables on the average new "zero-carbon house" cannot get close to making up for the energy consumed. The proportion that can be generated on-site is discussed under the heading Carbon Compliance. The rest should come from off-site renewables somewhere and this proportion was called "allowable solutions".

What the Government decided (without consultation) was that whether by on-site generation or by off-site "allowable solutions" only regulated energy consumption (heating, hot water and lighting) would have to be generated by renewable sources for a new house to be called "zero carbon". The energy used by appliances of all kinds could be ignored.

These changes led the campaign manager for sustainable homes at WWF UK, Darren Shirley, to lament[151] that: *"This is no longer a policy for zero carbon homes. They are nothing of the sort."* Darren Shirley also noted that: *"This decision will undermine British business that was innovating and leading in low carbon products and services."*

Equally scornful was Paul King, chief executive of the UK Green Building Council[152], who said[153]: *"In the space of two weeks, this government has gone from a firm commitment on zero carbon homes, to watered down policy. A zero carbon home will no longer do what it says on the tin."*

Concern at the UK Government's sudden weakening of commitments towards sustainability and low carbon innovation led the WWF to resign from the Zero Carbon Hub. Colin Butfield, head of campaigns at WWF-UK, said[154]: *"Since 2007, WWF has been dedicated to working with the zero carbon taskforce on a pioneering piece of housing policy. So it is a shattering blow to find out, without consultation, that the government has taken a decision to undermine both climate and housing legislation. WWF is left with no choice but to resign from the taskforce as the zero carbon homes policy comes tumbling down."*

Such a watering down of standards has a direct impact on the investment needed for energy supply. As the UK Committee on Climate noted[155] in its 3rd Progress Report in June 2011: *"This change in definition has some potential implications for*

151 *A shameful U-turn*, Darren Shirley, Inside Housing, 23 March 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6514210.

152 UK-GBC: Our mission is to radically improve the sustainability of the built environment, by transforming the way it is planned, designed, constructed, maintained and operated, http://www.ukgbc.org/site/aboutus

153 *'Greenest government ever' under threat*, Isabel Hardman, Inside Housing, 23 March 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6514206.

154 *WWF quits zero carbon task group*, Rhiannon Bury, Inside Housing, 4 April 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6514363

155 *Meeting Carbon Budgets - 3rd Progress Report to Parliament*, Committee on Climate Change, June 2011, http://www.theccc.org.uk/reports/3rd-progress-report.

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carbon budgets. In our fourth budget report, we had assumed no emissions or additional electricity capacity requirement from new homes. We now estimate that by 2030, new homes could require up to an additional 6TWh of electricity which would have to be met by low carbon electricity generation capacity."

An additional 6TWh of renewable electricity supply, costing consumers £100-200million, needed just because the Government decides to weaken already relatively undemanding standards would mean major extra investment in renewables over and above the already large sums envisaged. Such a weakening of the building regulations makes the delivery of a renewables based energy supply more expensive for suppliers and consumers alike but it is bill payers who ultimately foot the cost. Contrast this situation with the potential saving, noted above (Section 2), of £40billion investment in supply suggested by WWF in their recent report, *Positive Energy: how renewable electricity can transform the UK by 2030*, if there is effective action on energy efficiency and, in particular, on energy efficiency in the building stock.

What this calculation by the Committee for Climate Change shows is that supposed cost savings to business – by not having to meet more demanding standards – are not savings at all. The costs merely reappear somewhere else later as unnecessary energy supply has to be constructed. What is saved is not even cost to business but the effort to have to think a little differently and do things differently. But the unnecessary costs to consumers will be paid year after year. This example encapsulates with absolute clarity the point that focusing on maximising energy efficiency as the priority rather than energy supply, with energy efficiency trailing behind, makes both economic as well as environmental sense.

This UK decision to weaken standards for new homes will have negative impacts over decades for industry, for consumers, for innovation and for tackling climate change and, crucially, in the ability to undertake 'deep' low-energy refurbishment of the existing building stock. The consequences will be, inter alia:

- more expensive energy supplies
- slower wind-down of fossil fuels and slower reduction in carbon emissions
- lower standards of construction and lower internal quality of homes
- innovation and development of supply chains compromised
- reduced capability to undertake low-carbon refurbishment
- UK construction industry less able to compete internationally.

Unlike, say, the car industry, much of the construction industry is more localised and more based within national borders and hence appears less vulnerable to international competition. This means that inefficiencies that develop in one country may, without regulation, take a long time to be remedied. But, equally, issues that arise in one country, for example in the UK, are likely also to occur in many other countries within the EU and beyond.

Indeed, the UK seems likely to propose that its definition of a "zero-carbon house" should be accepted as complying with the recast Energy Performance in Buildings

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Directive[156], EPBD2, that, from 2020, requires all new buildings to be "nearly zero-energy buildings". If this were to be accepted, the UK definition of the "zero carbon house", which certainly is not "nearly zero energy", could become widely accepted within the EU.

There is indeed promising work going on in some countries such as Germany, Austria and Sweden on developing "zero-energy buildings" or even "energy plus homes"[157] to comply with EPBD2. However, the most important initiative required in the near term is to gain commitment to passivhaus quality across Europe because the passivhaus fabric standard marks the major step-change for construction. Moving to a zero-energy building then entails addition of on-site renewables to an already excellent fabric.

The concern about the UK development is that it could undermine efforts to promote energy efficiency in buildings across much of the EU, not just as newly constructed but, because of the linked supply chains and because of the reduced standards, in refurbished buildings as well. The inaccurate claim that the UK standard is actually "zero carbon" may be accepted quite widely. The misguided thinking about regulation that seems to lie behind this weakening of standards in the UK may also find some sympathy in other countries in time of economic difficulty.

It is important that such adverse decision-making is avoided. There is discussion at the present time in the UK about the potential for construction to help drive forward the economy in this period of economic weakness. There is talk of the need to stimulate new housing construction. This would be a great opportunity to require an up-grading of standards so benefiting skills, innovation and consumers alike[158]. Innovative housing providers would welcome such an initiative. The danger is that Government will agree with less innovative providers that standards should be relaxed to facilitate growth by removing "unnecessary regulation" on business. As we point out in the next Section, such a decision would weaken the economy, reduce competitiveness and make tackling climate change even harder. It is strong regulation that stimulates innovation and creates a competitive economy.

Another adverse move recently made, it would seem, by the UK Government has been to block plans to roll out mandatory display of DECs (Display Energy Certificates) to the private sector, once again on the basis of removing unnecessary regulation. The comment on this (*"incomprehensible"*) by the President of the Chartered Institute of Building Services Engineers, Andy Ford, is at the head of this Section. Paul King, Chief Executive of the UK Green Building Council, already

156 Described, for example, in CIBSE Briefing, *The Recast Energy Performance of Buildings Directive*, http://www.cibse.org/content/documents/Knowledge_Bank/EPBDBriefingFINAL2011.pdf.

157 See, for example, http://www.plusenergiehaus.de/ and http://www.nollhus.se/.

158 A recent press release by Build with CaRe at the University of East Anglia together with innovative housing providers outlined the potential: *From housing crisis to housing transformation*, UEA Press Release, 2 September 2011, http://www.buildwithcare.eu/articles/78-partners/213-2011-09-07-15-06-30 and https://www.uea.ac.uk/mac/comm/media/press/2011/September/buildwithcare.

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quoted just above about the changes to the definition of "zero-carbon homes", said[159] of the decision about DECs: *"This is a very big own goal from government. Its much trumpeted 'Carbon Plan' sadly appears not to be worth the paper it's written on."* Such a change will both lose the construction industry a great deal of work and greatly slow down progress in energy efficiency improvement in commercial building refurbishment. The danger is that such decisions will be copied by other Member States under the guise of stimulating growth.

159 *Government U-turn on green energy policy*, Building.co.uk, September 16, 2011, http://www.buildingrating.org/content/government-u-turn-green-energy-policy.

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7. Misguided Government thinking

> *"New thinking on environmental quality and competitiveness recognizes that pollution is waste and a sign of inadequate technology and poor management."*,
>
> Professor Michael Porter, Harvard Business School, http://www.isc.hbs.edu/soci-environmental.htm.

> *"The race toward a clean-energy future is underway, and those nations that lead will reap enormous economic benefits,"*, Out of the Running? How Germany, Spain, and China Are Seizing the Energy Opportunity and Why the United States Risks Getting Left Behind,
>
> Kate Gordon, Julian L Wong and J T McLain, Center for American Progress, March 2010, http://www.americanprogress.org/issues/2010/03/pdf/out_of_running.pdf.

In a time of low growth and global financial insecurity, the current UK Government believes that it can help business and restore growth by removing regulation – or 'red tape' as regulation is provocatively called[160]. Hence the response[161] of a spokesman for the UK Government Communities and Local Government department about the weakening of the "zero carbon home" standard: *"The new approach is a practical and realistic solution to achieve a 100 per cent reduction in CO_2 emissions from new homes, without piling unfair costs on housebuilders."*

Note the Orwellian double speak. The weakening of the "zero carbon homes" standard means that the *"100 per cent reduction in CO_2 emissions from new homes"* mentioned cannot be achieved. It will be an impossibility.

The comment on *"piling unfair costs on housebuilders"* is, however, revealing of Government thinking. It shows that the innovators that are the only hope for a competitive, prosperous green economy are being ignored in favour of businesses that are reluctant to change or to innovate. Not only do these "unfair costs" reappear elsewhere, as just noted in the previous section, but weakening of environmental standards also disadvantages innovators. The weakening of environmental standards does not actually help the economy grow but what it does

160 *How business can challenge red tape*, UK Government Department for Business, Innovation & Skills, http://www.bis.gov.uk/policies/better-regulation-at-bis/how-business-can-challenge-red-tape.

161 '*Greenest government ever' under threat*, Isabel Hardman, Inside Housing, 23 March 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6514206.

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do is ensure that the economy will be weaker in the future and less competitive than it could be.

Businesses are split between the innovators that wish to find new and better ways of doing things and those that would prefer to stick with established routines. The members and supporters of the World Business Council for Sustainable Development that called (see Section 1 above) for *"a transformation of the building sector towards zero net energy use"* will largely represent the innovators. Member companies include Skanska that was responsible for the innovative 'deep' low-energy refurbishment of run-down 1970s apartments in Sweden we note below (Section 9) and that also won the accolade this year of UK Green Company of the year[162].

In the partner countries and regions of Build with CaRe, including the UK, we have encountered many companies and organisations involved in construction that do wish to innovate and that see demanding environmental standards such as passivhaus as a challenge to improve the quality of their product and also of their processes. They see the benefit for quality of product and for good business of innovating and finding ways to make available at reasonable cost homes either new or refurbished that achieve or come close to the passivhaus standard. They innovate, they find ways to cut costs and they improve quality.

However, there are other businesses that prefer continuity rather than innovation and these will embrace Government roll-back of standards and regulation. Hence the response[163] of the UK Home Builders Federation[164] to the lowering of standards for 'zero carbon homes': *"HBF welcomes the move to set a realistic objective that is within the gift of housebuilders to actually deliver. It is critical that if we are to build the homes the country desperately needs we reduce the overall regulatory burden on house building sites."*

UK members of the WBCSD do not include any construction companies. The approach being taken in the UK to new build (see previous Section), which will inevitably have consequences for refurbishment, is closer to the WBCSD scenario of *"too little too late"* where *"incremental continuous improvement in energy efficiency, will come nowhere near offsetting growth in building energy demand, making it impossible to achieve the necessary reductions in total energy consumption"* rather than the *"transformation of the market"* the WBCSD calls for[165] where: *"tougher*

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162 *Skanska named The UK's Best Green Company by the Sunday Times*, 12 June 2011, http://www.skanska.co.uk/News--Press/Display-news/?nid=6TpehwYx.

163 *'Greenest government ever' under threat*,, Isabel Hardman, Inside Housing, 23 March 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6514206.

164 HBF is the voice of the home building industry in England and Wales, http://www.hbf.co.uk/.

165 *Energy Efficiency in Buildings: Transforming the Market*, World Business Council for Sustainable Development, August 2009, see http://www.wbcsd.org/Plugins/DocSearch/details.asp?DocTypeId=25&ObjectId=MzQyMDQ

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building codes are enforced for new and existing buildings; new energy and climate change policies are implemented; new design approaches and technologies are developed and applied; new skills are learned; and new financing mechanisms emerge."

In the UK, innovators that do want to innovate, reduce waste, and improve quality, and are building and refurbishing homes and other buildings to or near passivhaus standard, have considerable difficulty today in finding local components and suppliers that comply with the standards and quality required. Often, items have to be imported from countries that have innovated in construction such as Germany, Austria or the Scandinavian countries.

These difficulties add to costs and put a real brake on innovation and quality. They are the result of the lack of innovation by the construction industry over many years that has been identified in a number of reports. The rolling back of standards for "zero carbon homes", and the lack of regulation over display of DECs, will only prolong these difficulties, reduce the competitiveness of the UK industry, entail poorer quality construction and make tackling climate change far harder.

One particularly influential report on construction in the UK was the so-called Egan Report[166], named after its chairman, Sir John Egan, that identified the lack of teamwork in construction as a major brake on innovation and quality: *"The experience of Task Force members is unequivocally that quality will not improve and costs will not reduce until the industry educates its workforce not only in the skills required but in the culture of teamwork."*

What the report proposed was radical change: *"What we are proposing is a radical change in the way we build. We wish to see, within five years, the construction industry deliver its products to its customers in the same way as the best consumer-lead manufacturing and service industries. To achieve the dramatic increases in efficiency and quality that are both possible and necessary we must all rethink construction."*

It is over a decade since Egan reported. There have undoubtedly been many changes for the better across the industry but the problems our UK innovators experience today reflect some continuing issues identified back in 1998 and in earlier reports as well. The issues identified by Egan in the UK very likely also apply to a greater or lesser degree in several other Member States. It is teamwork that is so prominent in the Skanska refurbishment in Sweden just mentioned and that enables such high quality to be delivered.

It is teamwork that is lacking in developments we hear about where quality suffers. Concerns about quality and skills in the industry are noted in Section 10.4. Egan in

166 *Rethinking Construction, 1998, The report of the Construction Task Force to the Deputy Prime Minister on the scope for improving the quality and efficiency of UK construction* (The Egan Report), http://www.constructingexcellence.org.uk/download.jsp?&url=/pdf/rethinking construction/rethinking_construction_report.pdf.

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1998 was not concerned with climate change but with costs, with quality, and with competitiveness. Now, the urgent need to transform construction identified by the WBCSD, in order to create an energy efficient building stock, means that change must happen and happen fast. Innovation and teamwork are essential in enabling this change.

In almost any other manufacturing industry, teamwork and outstanding quality are taken for granted. Cars are no longer delivered with dozens of faults. Appliances work. The housing industry should aspire to deliver similar quality as the Egan Report in the UK called for over a decade ago. Building to or near passivhaus standard not only delivers a low-energy home that is pleasant and healthy to live in but entails exactly the teamwork and high quality standards Egan called for to enable passivhaus achievement that should, by now, be common-place.

Supposedly supporting growth by weakening standards is exactly the wrong way to go. Such action not only weakens economic competitiveness and impedes innovation but creates a barrier to both low-carbon construction and refurbishment and also, as we have seen, to the wider and more urgent need to decarbonise energy supplies.

One of the key mechanisms for improving competitiveness is, in fact, regulation. Environmental regulation, in particular, stimulates not only beneficial innovation but also benefits wider society. This was recognised by Professor Michael Porter of Harvard Business School several years ago[167] where, for example, the resistance of the US automobile companies to proposed clear air legislation in the 1970s was described: *"Lee Iacocca, then executive vice president of the Ford Motor Company, predicted that compliance with the new regulations would require huge price increases for automobiles, force U.S. production to a halt by 1975, and severely damage the U.S. economy. The 1970 Clean Air Act was subsequently enacted and Iacocca's dire predictions turned out to be wrong."*

Construction companies that welcome weakened standards or complain about costs of environmental regulation are acting as the Ford Motor Company did in the 1970s in opposing environmental regulation in the form of the Clean Air Act. To his credit, then President Nixon ignored the warnings of damage to the economy and passed the Act, with great benefit to human health. Similar legislation is now in force across the EU and in many other countries worldwide.

On his web page, Environmental Quality and Competitiveness[168], Professor Porter points out the benefits of environmental regulation to reduce pollution: *"New thinking on environmental quality and competitiveness recognizes that pollution is waste and a sign of inadequate technology and poor management."* A recent report by the

167 *Green and Competitive: Ending the Stalemate*, Michael E. Porter and Claas van der Linde, Harvard Business Review, September-October 1995.

168 http://www.isc.hbs.edu/soci-environmental.htm.

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Center for American Progress[169] identified the importance for future competitiveness and jobs of environmental innovation: *"Today's clean-tech innovations represent tomorrow's jobs and GDP growth. ... The race toward a clean-energy future is underway, and those nations that lead will reap enormous economic benefits"*.

As we noted at the end of Section 3, the European Climate Forum has also emphasised the economic benefits of more demanding environmental standards[170]: *"Raising the European climate target from 20% to 30% emissions reductions can open the way towards higher growth and increased employment."*, and in respect of buildings in particular: *"The new growth path implies a major effort to retrofit buildings and enhance the built environment."*

We now know how to build new and refurbish to or close to passivhaus standard. Any less demanding standard is wasteful and polluting.

Sadly, the current UK Government does not seem to see things this way. The Chancellor of the Exchequer, George Osborne, was responsible for the weakening of proposed "zero carbon" building standards noted in the previous Section and has made clear his lack of enthusiasm for environmental ambitions. At the Conservative party conference this Autumn he said[171]: *"We're going to cut our carbon emissions no slower but also no faster than our fellow countries in Europe."*, and in his recent Autumn budget statement[172]: *"If we burden* [British businesses] *with endless social and environmental goals – however worthy in their own right – then not only will we not achieve those goals, but the businesses will fail, jobs will be lost, and our country will be poorer."*

Such thinking has echoes of the assertions of the US motor industry in the 1970s about the impact of the clean air act just noted. Unfortunately, in this time of economic concern, this misplaced view that regulation of any kind is a brake on business and growth may well be echoed in other countries similarly concerned about growth. Economic activity may be stimulated by weaker standards but it will be 'grey growth' that inhibits innovation and environmental improvement while

169 *Out of the Running? How Germany, Spain, and China Are Seizing the Energy Opportunity and Why the United States Risks Getting Left Behind*, Kate Gordon, Julian L Wong and J T McLain, Center for American Progress, March 2010, http://www.americanprogress.org/issues/2010/03/pdf/out_of_running.pdf.

170 *A New Growth Path for Europe: Generating Prosperity and Jobs in the Low-Carbon Economy, Synthesis Report*, Carlo C. Jaeger et al, European Climate Forum, February 2011, http://www.european-climate-forum.net/fileadmin/ecf-documents/Press/A_New_Growth_Path_for_Europe__Synthesis_Report.pdf.

171 *George Osborne reveals his true colours on emissions – and they aren't green*, posted by Damian Carrington, 3 October 2011, http://www.guardian.co.uk/environment/damian-carrington-blog/2011/oct/03/george-osborne-carbon-emissions-conservatives.

172 *Autumn statement 2011: environmental issues at a glance*, Fiona Harvey, environment correspondent, guardian.co.uk, 29 November 2011, http://www.guardian.co.uk/uk/2011/nov/29/autumn-statement-2011-environment-issues.

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adding to costs and leading to poorer outcomes for all, rather than 'green growth' that helps decouple energy use from economic growth[173].

We noted in Section 2 that the American Council for an Energy-Efficient Economy has shown how an aggressive energy efficiency campaign could lead to a cut in primary energy use of nearly 60 per cent by 2050 relative to business-as-usual projections with benefits for the economy and for jobs. It is vital that governments grasp the benefits of action to promote energy efficiency and accelerate reductions in greenhouse gas emissions.

Indeed, as we note in Section 10.1, contrary thinking in government already seems to be having a negative impact on renewables investment in the UK, exactly the opposite of what needs to happen. The fact remains that stronger standards, as we propose for buildings, would equally stimulate activity, but this time it would create a platform for innovation and a stronger and more competitive economy.

Peter Wilby has recently written[174] pointing out that such a message from the Chancellor implies that solving the climate problem can be put on hold until the world's economic problems have been sorted out. Wilby identifies correctly that we have to rely on politicians to lead progress in tackling climate change but is concerned that current political systems no longer have any concept of the common

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173 Each year, the UK publishes DUKES, The Digest of UK Energy Statistics (see http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx). Each year there is a summary of long-term trends. Chart 1.1.4 of the 2011 long-term trends chapter on energy (see http://www.decc.gov.uk/assets/decc/11/stats/publications/dukes/2311-dukes-2011-long-term-trends.pdf) shows the UK Energy Ratio from 1970 to 2011. The Energy Ratio is the amount of primary energy used for each unit of gross domestic product. Since 1970, the UK energy ratio has fallen by over half but the gross domestic product has more than doubled meaning that temperature corrected primary energy consumption in 2010 was almost identical to that in 1970 (this change from the previous exponential increase in primary energy demand has been discussed above in Section 2). This means that, like the United States, also discussed in Section 2, there has been an impressive improvement across the economy in energy efficiency over forty years. But, as discussed in Section 2, the progress, although impressive, is not enough and less than could have been achieved. The UK, like many other countries, is running to stand still. There is an almost uniform rate of reduction over forty years in the UK energy ratio. To achieve real decoupling and energy saving, there has to be a step change reduction in the energy ratio, Only by aiming for passive standards across the economy can the capability for such a change be created. This is why passivhaus is such an important objective. This is why there has to be an obsessive focus on energy as waste - just as focused as Toyota and other companies focused on wastes in production.

174 "Osborne's message is that we may as well carry on belching carbon into the atmosphere because, if we don't, someone else will – an argument that could equally be used to justify selling your daughter into prostitution. ... The implicit message is that the job of tackling global warming can be placed on hold while they sort out the economic crisis. That, on more optimistic estimates, will take until about 2017. The planet will then be perilously close, scientists predict, to the tipping point for irreversible climate damage. Some say we need a miracle to save the eurozone and the banks. We need a far bigger one to save the planet. ... No, if we want the planet to be saved, we must rely on the politicians.", *If George Osborne and co forget the common good, the planet will fry: As Durban limps towards failure, it seems the west's leaders, bankers and citizens refuse to take a lead on climate change*, Peter Wilby, guardian.co.uk, 2 December 2011, http://www.guardian.co.uk/commentisfree/2011/dec/02/george-osborne-planet-durban-failure.

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good: *"The common good has become, to western politicians of both left and right, a completely alien concept. They have no language in which to convey to their electorates the importance and urgency of what needs to be done. They will no doubt emerge from Durban with fine words and some semblance of agreement or, if nothing else, agreement on when they should make an agreement. But for now, the planet will just have to carry on burning."*

We believe this is not necessarily so. And, as this present paper emphasises, creating 'green growth' is the best option to help countries emerge from the current economic crisis with more resilient economies. If George Osborne believes that "heavy, energy-intensive industries" must be supported (as comments reported by Wilby would suggest) then it would make far more sense to support these in the short term to develop carbon capture from local fossil fuel energy supplies[175] rather than using these industries as excuses to avoid wider action on climate change.

While politicians in particular countries may not have the will to make sensible choices, the EU has already shown itself capable of leadership. What is now necessary we argue is to rapidly accelerate a process already underway in the EU and help politicians to realise that going slow on sustainable, low-carbon investment is not the smart thing to do.

How then can a different perspective be promoted? How can we realise the "transformation of the market" that the WBCSD called for (Section 1), and that is essential if climate change concerns are to be addressed with any confidence, rather than the "too little too late" scenario that seems to be playing out at present?

The answer may be to pursue the 'lean thinking' promoted so vigorously by the Egan Report over a decade ago but, as well as considering waste of material and waste of process time, to consider also delivered energy as potential waste to be reduced at every opportunity.

[175] and in the longer term to become supplied with renewable energy.

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8. Energy as waste

> *"Many people settle for eliminating the waste that everyone recognises as waste. But much remains that simply has not yet been recognized as waste or that people are willing to tolerate."*
>
> Shigeo Shingo in "Study of the Toyota Production System from an Industrial Engineering Standpoint", translated by Andrew P Dillon (Productivity Press, 1989; originally published by Nikkan Kogyo Shimbun Ltd, Tokyo 1980).

Notwithstanding well-intentioned EU Directives on renewable energy and reducing greenhouse gas emissions, energy efficiency, as already noted (Section 5), attracts too little attention. The European Council for an Energy Efficient Economy[176] commissioned a study[177] of national target setting across the EU. What came across most clearly was the confusing plethora of targets and initiatives, almost none of which had any significant impact in enhancing the energy saving effort. The clear conclusion was that energy efficiency has to be granted the same binding status as carbon emissions reduction and renewable energy targets if the EU is to be seen to be serious about energy efficiency. Especially notable was the complete absence of any public sector legally-binding energy saving targets.

Only an obsessive focus on energy efficiency, led by 'deep' low-energy refurbishment of buildings, complementing transformation of energy supply to a renewables based system, can make possible the sustained and sustainable progress that is necessary to avoid dangerous climate change. The confusion about energy supplies created by subsidies for polluting fuels, lack of support or subsidy for energy efficiency, undemanding improvements in standards, and ill-informed political thinking about regulation, means that progress in energy efficiency is, at present, pre-determined to be slow. A complete redirection is necessary which could be led by focus on innovation in construction and promotion of passivhaus principles.

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176 The European Council for an Energy Efficient Economy, eceee, is a non-profit, membership-based European NGO. The goal of eceee is to stimulate energy efficiency through information exchange and co-operation, http://www.eceee.org/.

177 *National Energy Efficiency and Energy Saving Targets*, Dr Joanne Wade, Pedro Guertler, Darryl Croft and Louise Sunderland from the Association for the Conservation of Energy, UK, Commissioned by eceee with financial support from the European Climate Foundation, 24 May 2011, http://www.eceee.org/press/Target_setting; see also *Are some targets more equal than others? The evidence*, Association for the Conservation of Energy (ACE), 25 May 2011, http://www.ukace.org/index.php?option=com_content&task=view&id=622&Itemid=26.

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The lean thinking that Sir John Egan was referring to in his 1998 report on construction (see previous Section) was the system of production developed by Toyota in Japan over thirty years from the end of WWII to the mid-1970s (although continuous improvement never stops!) and described in books by two of the key personnel involved, Taiichi Ohno[178] of Toyota and consultant Shigeo Shingo[179]. As Mr Ohno wrote in the preface to the English edition of his book: *"The most important objective of the Toyota system has been to increase production efficiency by consistently and thoroughly eliminating waste"*. Now is time not only to achieve the production efficiencies in construction and also the quality that the Egan report was calling for but also, and especially, to achieve efficiency in energy use – by consistently and thoroughly eliminating waste of energy. Waste of energy should be addressed by regulation – demanding standards, by quality of construction, and by monitoring in use – for example through the mandatory display of Display Energy Certificates (DECs) in non-domestic buildings and continuous improvement in energy efficiency by building energy managers and facilities managers.

As recent work discussed in Section 4 showed[180], three-quarters of energy used today can be saved by adopting best-practice passive technology. This means that three-quarters of energy used today is effectively wasted. The energy landscape today is analogous to the production methods that Toyota engineers observed when they visited Ford and other US factories in the 1950s. The mass production systems of Ford and General Motors had many inefficiencies built-in – waste that was not visible to senior management, to factory managers or to the workers on the lines – but what was done seemed the natural order of things. As the quote by Mr Shingo at the head of this Section suggests, waste was there to be eliminated but was not recognised until the visitors from Toyota began to work out how to recognise and to eliminate this waste.

Nearly a century after the development of centralised electricity generating plant and half a century after the development of North Sea gas fields, our energy production and supply system, and our inefficient buildings that need heating systems, also seem the natural order of things. Hence the continuing focus on centralised large-scale supply and the search for new fossil-fuel resources of natural gas such as shale gas.

Now we know that much of the expensively generated energy we use is wasted, in particular in heating buildings. There needs to be total focus, led by the EU and national governments, on driving out this energy waste. Yet there is no equivalent

178 *Toyota Production System*, Taiichi Ohno, English translation by Productivity Press, 1988; Original Japanese edition published by Diamond Inc., Tokyo, Japan, 1978.

179 *Study of the Toyota Production System from an Industrial Engineering Standpoint*, Shigeo Shingo, translated by Andrew P Dillon (Productivity Press, 1989; originally published in Japanese by Nikkan Kogyo Shimbun Ltd, Tokyo 1980).

180 *Reducing Energy Demand: What Are the Practical Limits?*, Jonathan M. Cullen, Julian M. Allwood, and Edward H. Borgstein, Environ. Sci. Technol., (2011), 45, 1711–1718.

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of Toyota in the construction sector driving forward quality and driving out waste of energy across the industry globally. How can progress be stimulated?

Building new and refurbishing existing buildings to or close to the passivhaus standard provides the transformative innovation that makes such a focus possible and rewarding. Passivhaus is a European innovation[181] only two decades old. While many passive buildings have been constructed over the centuries in several countries[182], detailed attention to the house as a system, to the building physics, and to the importance of avoiding defects in construction first happened in Europe only twenty years ago in work begun by Professor Wolfgang Feist of Germany, Professor Bo Adamson of Sweden and architect Hans Eek of Sweden[183].

Building to passive principles is disruptive innovation in the construction industry. The waste (of energy unnecessarily used for heating) described by Shingo that people either do not recognise, or that is tolerated (Section 1), is removed. Build quality is transformed just as Toyota achieved with cars – it has to be because without exceptional build quality the passive standard cannot be achieved. The internal air quality is clean and healthy. There is no need for unnecessary items such as central heating systems, and there are no draughts or areas of thermal discomfort. A passive building is a building as it should be and is cheaper to run and to maintain than a building built to conventional standards.

Just as Mr Ohno, assisted by Mr Shingo, at Toyota, realised that eliminating waste reduces cost and increases quality, so building to passivhaus standards increases quality and makes, at most, only a minor addition to build cost[184] if done with proper

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181 Refer to the Passiv Haus Institut, Darmstadt, Germany, http://www.passiv.de/.

182 http://www.passipedia.passiv.de/passipedia_en/basics/the_passive_house_-_historical_review.

183 Hans Eek and Wolfgang Feist shared the 2003 Göteborg Award for Sustainable Development for the technology of building houses without heating systems, http://www.gothenburgaward.com/en/pristagare-2003/award-winner-2003.html; Hans Eek is working with colleagues in the UK innovating to create passivhaus new homes and made the keynote presentation to the Build with CaRe conference in Norwich, October 2010.

184 There are, indeed, concerns raised by some within the construction industry that building to passivhaus standards means a big increase in cost. These concerns seem to reflect either unwillingness to change established ways of doing things, big contingencies in case quality cannot be guaranteed, or extra costs where supply chains have not been established because of lack of innovation. Where quality and attention to detail is part of the culture – as has become the norm in many other industries – the extra capital cost of building to passivhaus standard (over current building standards) may be at most a few per cent and sometimes non-existent. As Deming noted (quote from *Out of the Crisis* in Section 2): *"Defects are not free. Somebody makes them, and gets paid to make them."* In conventional construction there is very likely to be a cost of defects and a cost of putting them right that will be hidden within the detail. When building to passivhaus quality this cost should be near zero as teamwork and quality working should be emphasised by management. Similarly, any modest extra capital cost, if present, will be more than compensated for in a short time by lower energy and running costs. Buildings are long-term assets and long-term costs including running costs are what are relevant, not just initial capital costs, whether for new build or for refurbishment. Productivity, health and well-being will also be enhanced in a passivhaus home, office or school. Concerns

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care and attention to design and to build quality. Over a decade or two the savings can be considerable because energy costs are far less. Unfortunately, in many countries (as noted for the UK in Section 6), building codes and standards do not reflect what is now possible with passivhaus quality, nor do they require the detailed system thinking that means that performance in practice will be very close to that designed (see discussion in Section 10.2).

Building to passive house standards, indeed, achieves something very interesting. It is often assumed, for example by economists, that saving energy costs more and more as standards tighten and that there is a limit to the savings that are cost effective – that there are diminishing returns. This is the approach taken by bodies setting standards for energy efficiency with modest improvements every few years as industry learns to try a little bit harder but at a very slow rate of improvement.

But going to the passive house standard creates a new paradigm because once a building becomes passive, many costs considered normal – for example a central heating system - are no longer necessary. The care taken in design and construction means that the (usually hidden) costs of correcting many of the faults built in during normal construction are eliminated; building to high quality standards reduces the cost of quality. In addition, working to a demanding standard of quality and design such as passivhaus means that the building will perform as predicted. As already noted (Section 6), compliance with design in terms of energy use is something often not found with conventional construction where the actual performance can be far worse than the design predicts. As we noted in Section 6, the Zero Carbon Hub highlighted this concern in its Carbon Compliance report.

The authors of Natural Capitalism[185] call such a transformation, where smart design achieves exceptional quality, "tunnelling through the cost barrier". In a passivhaus building, for example, the insulation and air tightness are so good that the people in the building and the appliances become the heating system.

Why then do home owners and developers not demand and promote passive homes and buildings and why do architects and builders not build many passive houses?

Only when large numbers of Japanese cars had penetrated the US market and their outstanding quality and reliability became widely known in the 1980s did consumers realise that the models from US manufacturers they were used to driving performed poorly in comparison and understood that a better alternative was possible. The impact has been described in a best-selling book[186].

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raised over the, possibly inflated, cost of passivhaus construction do, however, constitute a barrier to quality and to innovation in construction.

185 *Natural Capitalism: The Next Industrial Revolution*, Paul Hawken, Amory B Lovins and L Hunter Lovins (Earthscan, 1999).

186 *The Machine that Changed the World*, James P Womack, Daniel T Jones and Daniel Roos (Maxwell Macmillan International, 1990)

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It's a similar story that explains why so few people today are demanding to live in a passivhaus. As Amory Lovins[187], founder of the Rocky Mountain Institute[188] said[189] in a lecture in London attended by one of the authors back in 1997: *"very few people today have ever experienced real comfort in a building, thermal, visual or acoustic comfort, so they hardly know what they're missing"*. This lack of awareness of passivhaus quality and comfort remains the problem in most countries over a decade later.

The building industry in most countries has mostly resisted passivhaus standards because it is easier to continue with current practices where quality is less demanding. Therefore, relatively few passivhaus homes (or other kinds of building built to passivhaus standard) have been constructed for general sale or rent. Therefore, few people are aware of the benefits of life in a passive house or of passive buildings in general. This lack of awareness is a major barrier to change.

The lack of systems thinking by the construction value chain helps to explain why buildings do not normally get built to or perform to passivhaus standard. As Lovins also said in 1997: *"It requires that you optimise the whole system. What normally happens is that some value engineer comes along and says, 'You don't need these windows. They're too dear. Let me save you $8 a square metre. I'll put in this other stuff.' Well, the window looks like it costs less, but then of course you need more cooling and more fan capacity. It's like squeezing a balloon; it pops out somewhere else. By optimising each component separately it's quite easy to pessimise the system."* We hear many such stories still today. Most cars and appliances are not designed this way but buildings mostly are. They are not considered as a system either in design or construction. The benefit of passivhaus quality is that it demands system thinking.

Such "value engineering" described by Lovins and lack of system optimisation are still the norm. Very few people are aware of the healthy internal air quality of a passive house and the well-being this creates. The construction industry is not organised to design to passive standards or to provide the build quality that is essential to achieve the standard. The disruptive innovation in construction that is key to achieving energy efficiency targets has yet to overcome industry conservatism and become mainstream for new build and certainly not for refurbishment of existing buildings.

But the urgency of the climate change situation that is now apparent means that there is not the time to wait for decades for better standards finally to deliver. As we have described for energy efficiency in general (Section 2), the natural rate of innovation in construction is just not fast enough. Yet this 'natural rate' is what the

187 Author of *Energy Strategy: The Road Not Taken?*, the paper from 1976 discussed in Section 2.

188 http://www.rmi.org/.

189 *Greening the building and the bottom line*, Amory Lovins, Lecture to the RSA, 3 March 1997.

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EU and most Member States seem primed to deliver with the timescales presently on offer.

Now we know that we have to do better and to go faster. Innovative companies are showing this is possible. But only political leadership can make isolated examples of best practice common-place. The overall aim of the Build with CaRe project is to help make low-carbon construction mainstream. We are identifying the barriers that presently prevent this happening and showing how these can be overcome as in this paper. But the biggest barrier of all is the lack of political ambition to move as fast as possible to a renewables-based, energy efficient economy.

A focus, led by political direction, on demanding passivhaus standards wherever possible for all new and refurbished buildings can kickstart a really effective energy efficiency campaign and drive out waste of energy, while at the same time stimulating the transformation of the construction industry that Egan called for[190] in the UK and the WBCSD is still calling for globally. Without the teamwork Egan highlighted as being essential - from developer and architect and engineers through to workers on site, passivhaus quality cannot be delivered.

If this transformation happens, as it must, then instead of concern about energy bills and fuel poverty it will become normal for houses to need little or no heating even in severe winters. Shale gas can be kept in the ground and energy supply can be transformed much more rapidly than predicted to an almost totally renewable system. Homes and other buildings need not use any more energy than they generate while cities can become self-sufficient in energy.

As Kevin Anderson, one of the authors quoted at the beginning of this note, has pointed out[191]: *"2°C is an issue demanding immediate action, and this must be driven primarily by social and political change."*

Construction and refurbishment to passivhaus standard and quality provides a rationale for the political action required for a step change in action on energy efficiency. The transformation required will not only bring about dramatic reduction in energy use but it will also transform the skills and capability of the construction industry and create buildings that are healthy and promote well-being.

At present, as we have noted (Section 5), action is too slow and too fragmented and we summarised some of the reasons why this is the case. EPBD2 will have an impact over decades but, as already noted (Section 6), current trends in the UK may create an environment where "zero-carbon buildings" are nothing of the sort. There

190 *"The experience of Task Force members is unequivocally that quality will not improve and costs will not reduce until the industry educates its workforce not only in the skills required but in the culture of teamwork."*, Rethinking Construction, 1998, The report of the Construction Task Force to the Deputy Prime Minister on the scope for improving the quality and efficiency of UK construction (The Egan Report), http://www.constructingexcellence.org.uk/download.jsp?&url=/pdf/rethinking construction/rethinking_construction_report.pdf

191 http://www.tyndall.ac.uk/online-tools/personal-blog/kevin-anderson-2.

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is great danger of progressing to a worst-case outcome where some energy-efficiency improvements are made but buildings still perform poorly with poor internal air quality and still need more energy for heating and cooling than they can themselves generate. The construction industry will continue largely as it is today. Fossil fuels will be unnecessarily produced and burned, and carbon emissions that could be eliminated will be locked in for decades. 2°C really will become impossible.

But this outcome need not happen. Passivhaus is a European innovation. Adopted across the EU, now, as an EU standard for refurbishment as well as for new build, and Europe can lead the world in construction and workplace skills, in the construction supply chain and in acting to reduce greenhouse gas emissions and tackling climate change, while at the same time creating jobs and a healthier and more secure environment. Such action is the only option available to help stimulate governments elsewhere in the world become aware of the benefits of construction to passivhaus standard. If it is taken, we all benefit. If it is not, then dangerous climate change becomes inevitable. We all suffer.

There would be great benefit near-term if energy was considered as a key element in wider action to improve resource efficiency. The EU has recently published its Roadmap to a Resource Efficient Europe[192] but the section on *"Turning waste into a resource"* (Chapter 3.2) does not mention energy. There is, of course, an urgent need to use resources much more efficiently across the economy as stressed by the UN Environment Programme in its Decoupling report[193] earlier this year: *"By 2050, humanity could devour an estimated 140 billion tons of minerals, ores, fossil fuels and biomass per year – three times its current appetite – unless the economic growth rate is "decoupled" from the rate of natural resource consumption."*

Energy use is so often a major component in resource use and extraction. By focusing on energy as a potential waste – as an input to be reduced wherever possible – as is done with passivhaus thinking, then this thinking will also help stimulate the innovation necessary to accomplish 'decoupling'. Indeed, as we noted as the end of Section 5, the EU Commission's Energy Roadmap 2050 highlights that energy efficiency initiatives can be appropriately implemented within the wider context of resource efficiency.

192 *Roadmap to a Resource Efficient Europe*, COM(2011) 571 final, European Commission, Brussels, 20 September 2011, http://ec.europa.eu/environment/resource_efficiency/pdf/com2011_571.pdf.

193 *Decoupling natural resource use and environmental impacts from economic growth*, United Nations Environment Programme, 12 May 2011, http://www.unep.org/resourcepanel/decoupling/files/pdf/Decoupling_Report_English.pdf.

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9. Creating a new reality

> *"The policies in place in the next five years shape investment for the next 10 years, which largely shape the global energy picture out to 2050."*,
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> Shell Press Release about "Signals & Signposts: Shell Energy Scenarios to 2050", 14 February 2011, http://www.shell.com/home/content/media/news_and_media_releases/2011/scenarios_signals_signposts_14022011.html.

We argue above that effective action to tackle refurbishment of the EU's building stock cannot happen without a wider political commitment to energy efficiency. The current lack of such a commitment is the major barrier to transforming construction. Treating energy as a valuable resource – as a potential waste to be eliminated in use at every opportunity - creates the rationale for a political focus on energy efficiency that can drive forward an innovative and sustainable economy. Only with such a focus can there be a viable chance of tackling dangerous climate change. A centre-piece of such a campaign must then be the refurbishment of the existing building stock to or very near to passivhaus standards, something we already know is possible.

As noted in Section 2, present EU and most member states' plans for greenhouse gas emissions reductions seem too long-term to tackle the challenge of climate change as it is now perceived. It is also politically simpler to set long-term targets than to take near-term action. For example, although the UK has led the way in making legally binding commitments to greenhouse gas reduction, it has *"decisively missed"*[194] an initial target for a 20 per cent reduction in CO_2 emissions between 1990 and 2010[195]. In large part, this lapse was due to increased heating bills at the end of this period because of a hard winter - a direct consequence of inefficient homes burning more fuel. As we saw earlier (Section 6) about the direct impact of weaker building standards on the need for extra supply investment, so here we see the impact of energy inefficient building stock on the ability to meet emissions

194 Cambridge Econometrics Press Release, 16 September 2011, at http://www.camecon.com/UK/UKEnergy/PressRelease-UKEnergy.aspx

195 This was in spite of the exceptional situation in the UK where the 'dash for gas' in the 1990s gave abnormally high emissions reductions of around 3 per cent a year – see *Counting the cost of carbon, Low carbon economy index 2011*, PricewaterhouseCoopers LLP, 7 November 2011, http://www.pwc.co.uk/eng/publications/counting-cost-of-carbon-low-carbon-economy-index-2011.html.

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targets[196]. This failure by the UK just shows how hard it is, within a largely business-as-usual approach, to make the big emissions cuts that are actually needed.

The Cambridge Econometrics press release that pointed out this failure also noted that future UK carbon budgets may be missed by increasingly wider margins. In particular, it was noted that policies for carbon reduction – of which the UK Green Deal is one – often have less impact than expected: *"The unmistakable lesson from the effect of emissions reduction policies over 1997-2010 is that policies tend to have a lower impact than forecast, and therefore their strength needs to be increased if targets are to be achieved."* Tackling buildings to drive out unnecessary waste of energy, both for new build and for the existing stock, is critical if necessary progress is to be made. Widespread achievement of the passivhaus standard, or close to it, as fast as possible, is the way forward.

Indeed, the UK's greenhouse gas emissions actually increased by 3 per cent in 2010, largely as a result of the heating need due to a colder winter. Even after adjusting for the weather, emissions were broadly flat, a result inconsistent with the 3 per cent annual average emissions reduction necessary to meet the first four carbon budgets to which the Government has committed in legislation. The Committee for Climate Change argued for a significant acceleration in the pace of emissions reductions and suggested[197] in its 3rd Report that the Government should commit to ambitious targets to insulate all lofts and cavity walls by 2015 and 2 million solid walls by 2020.

Yet the UK 3 per cent per annum target – that was missed by a wide margin in 2010 – is far less demanding than the nearly 5 per cent annual emissions reduction globally that is now required[198] year on year if climate change targets are to have any hope of being met (Section 2). These numbers put the challenge in perspective. They highlight why long-term targets, as in place in the UK and the EU, although admirable, do not meet the present challenge. They make clear that only radical action now can be effective in meeting the challenge of potentially dangerous climate change. The lack of substantive progress on energy efficiency (Section 5) demonstrates that demanding, legally-binding targets are essential.

As this paper has argued, the way forward is to focus absolutely on renewables and on energy efficiency, the latter led by a transformation of the building stock. The EU is best placed to take on global leadership and itself will benefit from such action

196 But we must also remember (see Section 3) that claimed emissions reductions in the UK and other developed countries are illusory once emissions associated with consumption are added in.

197 http://www.theccc.org.uk/reports/3rd-progress-report, 30 June 2011

198 *"The decarbonisation goal required to limit warming to 2 degrees, will now require reductions in carbon intensity of at least 4.8% every year until 2050. ... From 1980-2010, no country has sustained decarbonisation rates close to 4.8% per year. ... The UK decarbonised at 3.0% per year in the 1990s during a 'dash' for gas power generation which replaced coal generation."* Counting the cost of carbon, Low carbon economy index 2011, PricewaterhouseCoopers LLP, 7 November 2011, http://www.pwc.co.uk/eng/publications/counting-cost-of-carbon-low-carbon-economy-index-2011.html.

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(Section 3). Action of this kind will not only have beneficial consequences for the environment more widely but will help to lead countries presently in economic difficulty towards a more sustainable future.

As a recent book[199] by Amory Lovins and the Rocky Mountain Institute has made clear, the costs of a fossil fuel economy are far higher than they seem. Some estimates of the costs of pollution by fossil fuels were outlined in Section 2 and we noted there that if these costs are accounted for then many renewables are already more cost effective than fossil fuels. The huge military expense associated with ensuring continuing fossil fuel supplies from the Middle East and elsewhere are additional. The link between the demand for oil and military capability has been recently discussed.[200]

Problems with meeting targets for emissions reductions, as in the UK, were predicted[201]. As Pielke wrote of the demanding targets set by the UK's Climate Change Act: *"Such rates necessarily must be several times greater than observed in the UK in recent decades, and based on different contributors as the sectoral shift away from manufacturing has its limits."* His conclusion, based on historical trends in the UK (and in almost all other developed countries), is that the targets would be impossible to meet – something already happening as Cambridge Econometrics and the Climate Change Committee are realising and as the 2010 emissions data make clear.

Pielke's solution was not to abandon efforts to cut emissions but to work in a practical way to achieve them: *"Far more important than setting impossible national targets on timetables that cannot be met would be efforts to accelerate decarbonization in the UK to higher rates, while at the same time working internationally to assist other countries in meeting the challenge of decarbonization. ... Policy should focus less on targets and timetables for emissions reductions, and more on the process for achieving those goals, and the various steps along the way."*

We believe that targets are important, as we highlight in the next Section, but, as Pielke highlights, there must be process in place to meet them. Clear process to achieve climate change goals is exactly the reason why focus on energy efficiency and on buildings is so important. Setting a target of passivhaus standard and then defining how that can be met is the only effective way to make the necessary progress. Such a way forward applies not just to the UK but across the EU.

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199 *Reinventing Fire: Bold Business Solutions for the New Energy Era*, Amory B Lovins and Rocky Mountain Institute, Chelsea Green Publishing, Vermont, September 2011, see http://www.rmi.org/rfexecutivesummary.

200 *Obama's risky oil threat to China: Playing with fire*, Michael T. Klare, European Energy Review, 8 December 2011, http://www.europeanenergyreview.eu/site/pagina.php?id=3408.

201 *The British Climate Change Act: a critical evaluation and proposed alternative approach*, Roger A Pielke Jr., Environ. Res. Lett. 4 (2009) 024010 (7pp)

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It is now important that national governments and transnational entities, especially the EU, accept the urgent need to decarbonise economies and the importance of action on energy efficiency to make this possible. The very worrying global business-as-usual projections have been noted[202] in Section 3 above. Another recent forward look, by Shell, has pointed out[203] not only the global energy dilemma for business-as-usual but also the need to change course urgently if change is to be possible, something confirmed most recently by the International Energy Agency[204] (see Section 2).

Shell points out that decisions made over the next five years – up to 2017 and well before 2020 - are crucial and influence the global energy picture out to 2050: *"The policies in place in the next five years shape investment for the next 10 years, which largely shape the global energy picture out to 2050."* This five year timeframe that determines what then happens for a long time into the future is also the conclusion reached by climate scientists (see Section 3) when analysing when global emissions must peak and then begin to fall (well before 2020) if there is to be any chance of maintaining climate change within a 2°C global temperature rise.

The International Energy Agency notes that if *"stringent new action is not forthcoming by 2017"* then all the CO_2 emissions allowed up to 2035 in a scenario that hopes to keep global temperature rise to 2°C or less will already be accounted for. This means that, unless there is urgent action within the next five years, then in order to avoid potentially dangerous or very dangerous climate change, all energy supply and other investment after 2017 would have to be zero carbon – clearly an impossibility. These reports emphasise the urgency of action now and in the next five years.

Investments in energy supply are long-term. Continuing investment in fossil-fuel supplies in the short-term will set back efforts to tackle climate change even over the

202 See *International Energy Outlook 2011*, U.S. Energy Information Administration, 19 September 2011, http://www.eia.gov/forecasts/ieo/pdf/0484(2011).pdf.

203 *"In broad-brush terms, natural innovation and competition could spur improvements in energy efficiency to moderate underlying demand by about 20% over this time* [to 2050]. *Ordinary rates of supply growth – taking into account technological, geological, competitive, financial and political realities – could naturally boost energy production by about 50%. But this still leaves a gap between business-as-usual supply and business-as-usual demand of around 400 EJ/a – the size of the whole industry in 2000. This gap – this zone of uncertainty – will have to be bridged by some combination of extraordinary demand moderation and extraordinary production acceleration."* ... and ... ***"The policies in place in the next five years shape investment for the next 10 years, which largely shape the global energy picture out to 2050."***, Shell Press Release about "Signals & Signposts: Shell Energy Scenarios to 2050", 14 February 2011, http://www.shell.com/home/content/media/news_and_media_releases/2011/scenarios_signals_signposts_14022011.html.

204 *"Four-fifths of the total energy-related CO_2 emissions permissible by 2035 in the 450 Scenario are already "locked-in" by our existing capital stock (power plants, buildings, factories, etc.). If stringent new action is not forthcoming by 2017, the energy-related infrastructure then in place will generate all the CO_2 emissions allowed in the 450 Scenario up to 2035"*, International Energy Agency World Energy Outlook 2011, 9 November 2011 (http://www.iea.org/index_info.asp?id=1959).

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very long term. This is why shale gas should be kept in the ground, why the focus must be on renewables to replace fossil fuels as fast as possible, and why the 'dash for gas' now apparent in the UK (see Section 10.1) is so damaging towards effective action on climate change.

It is vital, therefore, especially given the massive investments needed, that effort and time are not wasted. It is essential to focus on clean renewables technologies, energy storage, and, in a complementary manner, energy efficiency – or as Shell describes it: *"extraordinary demand moderation"* – led, as this paper argues, by focus on buildings and building refurbishment to passivhaus or near passivhaus standards.

The fossil fuel company, Shell, and the climate scientists agree on the one key point – action is urgent and must be ongoing well before 2020. For the EU, as we have already noted, this presents a great opportunity. Presently, however, EU roadmaps and directives are too long term as are most government initiatives.

The present time of great economic uncertainty is worrying for governments and citizens alike but it may be an appropriate moment to create the new reality for energy supply and energy efficiency that is required. As we wrote this paper we read the obituaries of Steve Jobs of Apple. It was said of Jobs[205] that he created a *"reality distortion field"* that people came to believe in and that then became the new norm: *"But at a certain point, the view of the world from Steve Jobs' brain ceased to become distorted. It became an instrument of self-fulfilling prophecy. As product after product emerged from Apple, each one breaking ground and changing our behaviour, Steve Job's reality field actually came into being. And we all live in it."*

At present, energy policy, both for supply and for use, seems still heavily influenced by 20th century ideas of large centralised electricity generators, relatively inefficient infrastructure and fossil fuels. The EU seems uniquely placed to have the ambition and the capability to make the necessary near-term changes happen – to be the Steve Jobs of energy and climate change. We need the EU and its Member States to think forward rather than back, to create the *"reality distortion field"* that can lead to the 21st century reality that is now urgently needed. This *"reality distortion field"* will focus on renewable supply and energy storage at all scales and passive technology throughout the economy which, as we have already noted, has the potential to save almost three-quarters of energy presently used.

Building or refurbishing buildings to very high energy standards is often cost effective, and will almost certainly be so over a period of decades. Very many energy efficiency actions save costs almost from day one. It is mindsets – influenced by decades of fossil fuel plenty, by massive subsidies for fossil fuels and for nuclear technologies, and by a centralised electricity system that institutionalises inefficiency – that must change.

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205 For example by Steven Levy in Wired Magazine, 6 October 2011, http://www.wired.co.uk/news/archive/2011-10/06/steve-jobs-obituary?page=all.

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Build with CaRe partners in Germany, Holland and Sweden have already shown how change can happen via the refurbishment of existing buildings to or close to passivhaus standards. A new passivhaus is designed to use no more than 15 kWh/m^2/year energy for space heating and cooling (a little more is permitted for refurbished older buildings). Such a value is an order of magnitude less than typically achieved currently in the UK and most of Europe and demands detailed attention to both design and to construction to ensure continuity of insulation and elimination of thermal bridges and air leakage pathways. This is the kind of attention to detail and design that Steve Jobs insisted be brought to Apple's new products. It is demanding but is certainly possible.

Achieving such standards is the result that achieves the *"transformation of the building sector towards zero net energy use"* that the WBCSD has called for (Section 1) and the quality of work that is needed to deliver this transformation. Not only does transformation of the building stock deliver the massive improvement in energy efficiency that is required, but it also stimulates real up-skilling and quality improvement by the construction industry and enhanced competitiveness of the supply chain. Presently, even in those countries such as Germany and Sweden that are leading the way, the examples highlighted by Build with CaRe are still not the norm. The reason is that regulation lags behind capability and need. This must change.

Such change would bring great welfare benefits across society. In passive homes, fuel poverty will be a thing of the past while indoor air quality and well-being can be outstanding. The Pro-Housing Alliance in the UK has brought to attention[206] the fact that more than a quarter of Britain's households are said to be living in fuel poverty and that poor quality housing is a public health problem resulting in £7bn annual costs to the NHS, social services and education bodies: *"In 2009/10 the Office for National Statistics reported there were 25,000 excess winter deaths. The 2010 Public Health White Paper states 'we could prevent many of the yearly excess winter deaths through warmer housing'."*

Building new and refurbishing homes to passivhaus standards might repay the entire cost of the work by eliminating these costs to society. The UK is by no means unique among EU Member States in having such problems that result from inefficient poor quality housing. A recent UK report on fuel poverty has noted[207] that

206 *Recommendations for the Reform of UK Housing Policy*, August 2011, The Pro-Housing Alliance, http://www.cieh.org/WorkArea/showcontent.aspx?id=38462

207 *"Living in cold homes has a series of effects on illness and mental health. But the most serious is its contribution to Britain's unusually high rates of 'excess winter deaths'. There are many contributors to this problem, but even if only a tenth of them are due directly to fuel poverty, that means that 2,700 people in England and Wales are dying each year as a result – more than the number killed in traffic accidents."*, Fuel Poverty: The Problem and Its Measurement; Interim Report of the Fuel Poverty Review, John Hills, Centre for Analysis of Social Exclusion, CASE Report 69, October 2011, http://www.decc.gov.uk/assets/decc/11/funding-support/fuel-poverty/3226-fuel-poverty-review-interim-report.pdf.

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the number of excess winter deaths due to fuel poverty (i.e. due to poorly heated, inefficient homes) each year may well be greater than the number of people killed in traffic accidents each year. Hence, apart from any issues to do with climate change, there is a major public health reason for tackling energy efficiency in buildings.

One example that demonstrates all these benefits is a major refurbishment of 1970s apartment blocks in Brogården, Sweden to almost passive house standard. Energy for heating was reduced by over 80 per cent and total energy use by over 60 per cent[208]. Teamworking of the kind described by Egan was a key feature of the working practice on site and enabled the necessary quality to be delivered to cost. These apartments had become very run down and were potentially the cause of poor health outcomes for tenants. After refurbishment, the air quality is exceptional and the environment is one of well-being. We know how to do it. We now have to act with urgency to make such refurbishment standard rather than exceptional.

The urgency may be summarised:

- Emissions reductions must happen fast.
- Fossil fuels must be replaced by renewables as fast as possible.
- Much more rapid gains in energy efficiency and demand reduction are critically important to enable rapid renewables introduction and more rapid emissions reductions.
- Buildings present the biggest opportunity for reducing energy use.
- The capability for low-carbon 'deep' refurbishment exists today.
- Refurbishment rates are far too low across the EU.
- Current plans are inadequate for the need.
- Energy efficiency and tackling energy 'waste' must take centre stage.

208 Presentation by Hans Eek, Swedish Passive House Centre, Build with CaRe conference, Norwich, October 2010, accessed via http://www.buildwithcare.eu/, and *Skanska Case Study 64, Brogården, Sweden*, http://skanska-sustainability-case-studies.com/pdfs/64/64_Brogarden_v001.pdf.

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10. Necessary actions to accelerate refurbishment

> *"Now the task is to prevent catastrophic climate chaos. And yet, government leaders continue to ignore the scale of the threat. ... With the current financial meltdown and global economic recession, we failed to heed the signs before it was too late, and we have been forced to deal with the consequences and to bear the burden of bailouts. We are making the same mistake with our environment, but when this system breaks, it may not be possible to fix it at all"*,
>
> Bianca Jagger, Chair: World Future Council Climate and Energy Commission, Foreword to: *A Renewable World: Energy, Ecology, Equality - A Report for the World Future Council*, Herbert Girardet and Miguel Mendonca, Green Books Ltd, Totnes UK, 2009

This note cannot specify detailed actions but we can identify a number of issues that must be addressed if such transformation in construction is to have any chance of success. We summarise some of these below, notably from the perspective of the UK. However, as we have already noted, the UK is not exceptional in its lack of attention to energy efficiency – the problems extend to most countries. Our thoughts, developed from our engagement and conversations with our Build with CaRe partners in Sweden, Germany, The Netherlands and Belgium, as well as in the UK, are relevant across the EU.

Key issues discussed in turn are:

1. Effective target setting and action at EU and Member State level on energy efficiency.
2. Focus on passivhaus standards for new build and refurbishment.
3. Targets and mechanisms for rapid refurbishment.
4. Investment in training and skills to enable passivhaus standards in practice.
5. Information campaign on passivhaus benefits for new and refurbished buildings.
6. Innovative thinking on financial support for 'deep' refurbishment.
7. Transnational learning and knowledge sharing.
8. Systems thinking and energy storage.
9. Cities enabled to lead.

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10.1. Effective target setting and action at EU and Member State level on energy efficiency

Concern about the moderate rate of emissions reduction in the UK and across the EU relative to the need has already been noted[209],[210],[211] (Section 2, Section 9), as has the ineffectiveness of energy efficiency initiatives[212] overall across most EU Member States (Section 5, Section 8). The consequence of this widespread lack of focus on energy efficiency is that the EU non-mandatory target for a 20 per cent improvement in energy efficiency by 2020 will, on present trends, be missed by a wide margin as the EU Commission noted in its Energy Efficiency Plan 2011[213].

The proposed new Energy Efficiency Directive that resulted[214] seems unlikely to stimulate the radical change needed. There is no mandate on Member States and a review only by 2014. EuroACE[215] highlighted concerns in March 2011[216] and

209 http://www.theccc.org.uk/reports/3rd-progress-report, 30 June 2011

210 Cambridge Econometrics Press Release, 16 September 2011, at http://www.camecon.com/UK/UKEnergy/PressRelease-UKEnergy.aspx

211 *Approximated EU GHG inventory: early estimates for 2010*, EEA Technical report No 11/2011, 7 October 2011, http://www.eea.europa.eu/publications/approximated-eu-ghg-inventory-2010.

212 *National Energy Efficiency and Energy Saving Targets*, Dr Joanne Wade, Pedro Guertler, Darryl Croft and Louise Sunderland from the Association for the Conservation of Energy, UK, Commissioned by eceee with financial support from the European Climate Foundation, 24 May 2011, http://www.eceee.org/press/Target_setting; see also *Are some targets more equal than others? The evidence*, 25 May 2011, http://www.ukace.org/index.php?option=com_content&task=view&id=622&Itemid=26.

213 *Energy Efficiency Plan 2011*, European Commission, Brussels, 8 March 2011, COM(2011) 109 final, http://ec.europa.eu/energy/efficiency/action_plan/doc/20110308_efficiency_plan_act_en.pdf.

214 Home page at http://ec.europa.eu/energy/efficiency/eed/eed_en.htm; *Proposal for a Directive of the European Parliament and of the Council on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC*, European Commission, Brussels, 22 June 2011, COM(2011) 370 final, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0370:FIN:EN:PDF.

215 EuroACE, the European Alliance of Companies for Energy Efficiency in Buildings was formed in 1998 by twenty of Europe's leading companies involved with the manufacture, distribution and installation of a variety of energy saving goods and services. EuroACE works together with the European Institutions to help Europe move towards a more sustainable pattern of energy use in buildings, thereby contributing to the EU's commitments on carbon emissons reductions, job creation and energy security, http://www.euroace.org/.

216 "Industry is deeply concerned by the release of the European Commission's Energy Efficiency Plan 2011. Although it is clear and publicly acknowledged that the 2020 energy savings target will not be met by current measures in place in Member States, Brussels is delaying taking concrete action until at least 2013. In the case of buildings, the lack of a clear and coherent target both at EU and Member State level often leads to shallow energy savings measures that lock-in the potential of a building that may only be renovated once every thirty years.", *A Communication for Non-Action: Energy Efficiency Plan 2011*, EuroACE Press Release, Brussels, 8 March 2011, accessed from http://www.euroace.org.

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Renovate Europe[217] emphasised these[218] in June 2011 when the proposed new Energy Efficiency Directive was published.

Their concerns, sad to say, seem, totally valid. There is no compelling vision on energy efficiency in general – as we propose above (Section 8) - or energy efficiency in buildings via 'deep' renovation in particular. How might this situation change?

One major roadblock that could be removed is the existing focus within governments on energy supply in 20th century mode via large centralised distribution networks (the barriers to energy efficiency presented by the present-day energy supply system have been noted in Section 2). Current attitudes in many Member State governments to energy supply are almost certainly inhibiting the transformation to the renewables based supply system we outline in Section 2. This is why we propose 'a new reality (Section 9). Likewise, these attitudes or mindsets entail that energy efficiency is never a priority. This means that effective, wide-scale programmes for building refurbishment to 'deep' low carbon standards are almost impossible to develop.

Exceptions are countries such as Denmark and Germany that have demonstrated commitment to both renewables and energy efficiency over many years. We noted in Section 2 the impressive ambitions of Denmark for renewables penetration and phasing out of fossil fuels, not just in the long term, but continuing from today with targets for 2020 that demonstrate that the action now needed can indeed be achieved.

A recent report[219] from the Association for the Conservation of Energy has noted of the UK Department of Energy and Climate Change (DECC) that: *"The vast majority of senior staff are assigned to energy generation rather than energy saving"*. As a consequence, the authors note that: *"... there is neither a clear target nor ambition*

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217 The Renovate Europe campaign was initiated by EuroACE (the European Alliance of Companies for Energy Efficiency in Buildings), with a focus on EU, national, regional and local policy levels. It is an ambitious roadmap on how to raise the yearly renovation rate to 3% in Europe by 2020 and achieve an average improvement in energy performance of ~80%, http://www.renovate-europe.eu/renovate-europe-campaign.

218 "We were shocked by the lack of ambition in the Commission's proposal" says Rick Wilberforce, President of EuroACE. ... "The forces of conservatism have watered down this Directive so much that we find ourselves on the brink of failure. We can only hope that the European Parliament and some of the more progressive Member States will step up and see the opportunity, both for the environment and for the economy that the deep renovation of buildings and improved energy efficiency can deliver for Europe"., *Feckless Commission fails to deliver on energy efficiency, Renovate Europe-EuroACE*, Brussels, 22 June 2011, http://www.renovate-europe.eu/uploads/Modules/Documentsmanager/EEFD%20-%20press%20release%2020110622.pdf.

219 *Dangers and unintended consequences of siloed renewable energy and energy efficiency policy making: Evidence from the UK*, Andrew Warren, Darryl Croft and Louise Sunderland, ACE, ECEEE 2011 Summer Study, Energy Efficiency First: The Foundation of a Low-Carbon Society, July 2011, pp137-144, http://www.ukace.org/publications/ACE%20Research%20(2011-06)%201-398%20Warren.pdf.

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for energy efficiency savings in the UK, nor an indication of what contribution energy savings can make to the achievement of the carbon targets."

Such attitudes may well be the result of the evolution of DECC from what was originally a Ministry of Fuel and Power, as noted[220] by Walt Patterson. The interests centre on supplies and prices of fuels and electricity not on energy efficiency or on system change to make energy efficiency possible.

The authors of the Association for the Conservation of Energy report note that this lack of ambition for energy saving is made clear in the DECC Pathways analysis for 2050[221]: *"The expectation driving policy making in the recent 2050 Pathways Analysis produced by DECC's chief scientist is that total electricity consumption will double, even treble by 2050. This analysis places enormous emphasis on the need for supply side investment. The assumptions for delivery of energy efficiency within these scenarios are, even at best, minimal"*.

In Section 5 we noted the comment by the Association for the Conservation of Energy[222] on UK plans for new electricity generation: *"the Government is drawing up plans for long term energy needs and expensive new infrastructure – but they have admitted to us that they have NOT carried out an assessment to compare the costs and benefits of energy efficiency against those of generating energy."*

In this forecast of electricity supply for 2050, DECC seems to assume only around one-third of energy used in the built environment can be saved by 2050. Yet we know from the Swedish refurbishment project at Brogården (see Section 9), that energy for heating can be reduced by over 80 per cent and total energy use by over 60 per cent[223] using today's knowledge and today's materials and appliances. There will be many improvements in coming years so that a several-fold reduction in primary energy use in buildings becomes easily possible with the right motivation.

DECC's rather dismal prognosis – with massive implications for unnecessary investment in energy supply to heat inefficient buildings – reflects not what is easily possibly but the mental attitude that considers almost only questions of supply with

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220 *"What had been a Ministry of Fuel and Power, as in the UK and other countries, became a Department of Energy, so-called* [now DECC]*, and its responsibility became 'energy policy'. But its interests were still essentially centred on supplies and prices of fuels and electricity, considered as commodities."*, Transforming our energy within a generation, Walt Patterson, Chatham House Briefing Paper, June 2007, http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/bp0607climatewp.pdf.

221 2050 Pathways Analysis, HM Government, July 2010, http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx.

222 *The Big Debate: Energy Demand vs Energy Generation*, 14 February 2011, http://www.ukace.org/index.php?option=com_content&task=view&id=610&Itemid=37.

223 Presentation by Hans Eek, Swedish Passive House Centre, Build with CaRe conference, Norwich, October 2010, accessed via http://www.buildwithcare.eu/ and Skanska Case Study 64, Brogården, Sweden, http://skanska-sustainability-case-studies.com/pdfs/64/64_Brogarden_v001.pdf.

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energy efficiency tagged on as an optional extra. It seems possible, that, with a few exceptions such as Germany and Denmark, this attitude may be common across the EU. Yet it is absurd to embark on a massive and hugely expensive expansion of electricity supply just because it seems too difficult to do energy efficiency.

This attitude within DECC was brought into focus as it proposed big cuts[224] to the FiT (feed-in tariff) for solar PV installations that will have the effect, that, as James Murray puts it: *"...one of the greatest economic success stories of recent years will have the rug pulled from under it, leaving businesses bankrupt, a promising renewable energy technology treading water, and the government's increasingly tarnished green credentials looking worse than ever."*

What is telling is that along with the focus on energy supply rather than energy efficiency, identified by the Association for the Conservation of Energy, this report on cuts to the PV FiT also pointed out that not a single representative from the solar industry is seconded to DECC: *"our revelation yesterday that DECC has failed to second a single representative from the solar industry, and failed to set up a promised government-industry working group, is symptomatic of the manner in which a solar sector that now employs more people than the nuclear industry is being grossly short changed."*

Renewables mean jobs. The solar sector *"now employs more people than the nuclear industry."* But in spite of the benefit of renewables to the wider economy, mindsets within government are slow to change. Compare this situation of the UK solar industry, with no representation in government, to the UK Nuclear Development Forum[225], *"established to secure the long-term future of nuclear power generation in the UK"*, intimately integrated into DECC, and chaired by the Secretary of State. Fossil fuel interests and the major energy supply companies have similar access to government[226]. The UK government complains about the modest cost of

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224 *Solar shambles leaves industry in the dark*, James Murray, Business Green, 28 October 2011, http://www.businessgreen.com/bg/james-blog/2120891/solar-shambles-leaves-industry-dark.

225 *"The Nuclear Development Forum (NDF) has been established to secure the long-term future of nuclear power generation in the UK"*, see http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/forums/develop_forum/develop_forum.aspx.

226 *Energy companies have lent more than 50 staff to government departments: Oil and nuclear industries' presence throughout Whitehall exposed by Green MP, who warns of undue influence on policy*, Damian Carrington, guardian.co.uk, 5 December 2011, http://www.guardian.co.uk/business/2011/dec/05/energy-companies-lend-staff-government: *"At least 50 employees of companies including EDF Energy, npower and Centrica have been placed within government to work on energy issues in the past four years, the Guardian can reveal. The staff are provided free of charge and work within the departments for secondments of up to two years. ... "Companies such as the big six energy firms do not lend their staff to government for nothing – they expect a certain degree of influence, insider knowledge and preferential treatment in return," said Caroline Lucas, the Green party MP. ... Friends of the Earth executive director, Andy Atkins [said] "It's time to break the cosy relationship between the government and energy giants, and help new British companies provide clean home-grown energy we can all afford."*

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the successful feed-in tariff scheme for PV[227] while at the same time preparing to spend a huge sum, £3billion, on a nuclear fuel plant that may never be used[228] and, as noted in Section 2, subsidising the nuclear industry to an estimated £3.6billion every year.

Such attitudes and mindsets within government, discussed in respect of the current UK Government in Section 7, create massive distortions in funding that prevent the strategic thinking about the nature of a 21st century energy system, as discussed in Section 2. The maintenance of a 20th century system, depending still on large energy supply companies, with little or no focus on local generation and energy storage, will mean that energy efficiency can never become a priority or be efficiently pursued. With very energy efficient buildings, local generation, together with local storage, can, as discussed below, become a major component in an energy network that brings energy efficiency to the fore. But without the transformation in thinking outlined in Section 2, this can never happen. Costs will remain high, buildings less energy efficient than they could be, fossil fuels cannot be eliminated nearly so fast, and climate change cannot be effectively addressed.

James Murray of Business Green has highlighted[229],[230] likely reasons for the UK Government's sudden cuts in the PV FiT. Whether his interpretation is correct or not in detail, the focus on energy supply within DECC, outlined in the ACE report, and the lack of engagement with the solar industry, demonstrates clearly how the

227 Although, as noted in Section 2, a similar scheme in Germany has led to massive PV (and wind) installation in that country while impacting only modestly on electricity bills.

228 "The government has astonished the anti-nuclear lobby by outlining plans to spend £3bn of public money building a new mixed-oxide fuel (MOX) plant – months after announcing the closure of a similar facility that lost taxpayers hundreds of millions of pounds.", *Mox plant U-turn by coalition stuns anti-nuclear campaigners*, Terry Macalister, guardian.co.uk, 1 December 2011, http://www.guardian.co.uk/environment/2011/dec/01/mox-u-turn-stuns-nuclear-campaigners.

229 "But, according to the parliamentary rumour mill, there is an increasingly tense battle behind the scenes between those who think decentralised energy such as solar should play a key role going forward, and those who believe micro-generation will always be too expensive and it is more sensible to focus the UK's efforts on large scale centralised low carbon projects. Unsurprisingly, the Big Six energy companies are lobbying hard in favour of this centralised approach, which would allow them to maintain their dominance over the market and head off the risk of millions of homes installing technologies that could slash demand for energy by anywhere between 30 and 70 per cent.", *What is the real reason behind the government's solar cuts?*, James Murray, Business Green, 3 November 2011, http://www.businessgreen.com/bg/james-blog/2122520/real-reason-government-s-solar-cuts.

230 "Senior officials at the Department of Energy and Climate Change (DECC) are sceptical that solar can play a significant role in the UK's future energy mix and are committed to restricting demand for the technology to a level where it becomes little more than "a toy for rich boys". ... There is also speculation across the solar industry that the large energy companies are lobbying the department to cut support levels to a level that effectively kills off the solar sector.", *Exclusive: DECC officials privately dismiss UK solar potential, Senior officials question whether solar is suitable for UK and dismiss solar industry jobs as unsustainable*, James Murray, Business Green, 25 November 2011, http://www.businessgreen.com/bg/news/2127857/exclusive-decc-officials-privately-dismiss-uk-solar-potential.

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UK Government is most likely heavily influenced by the existing dominant players from the fossil fuel[231] and supply industries at the expense of renewables technologies such as solar PV and certainly at the expense of energy efficiency.

The recent announcement[232] by the new UK Minister for Energy and Climate Change of an Energy Efficiency Deployment Office, EEDO is encouraging. Indeed, in his speech[233] at the launch of the EEDO, the Minister, Edward Davey, said: *"By 2050, we'll need to cut our energy use by between a third and a half"*, in agreement with the proposal in this paper for the EU of a 40 per cent cut in primary energy demand. However, mere deployment of civil servants will not lead to necessary action unless there is acknowledgement of the importance of more rigorous energy efficiency construction standards for both new build and refurbishment. As we have noted in Sections 6 and 7, there is little evidence of such thinking so far by the UK Government. The UK Green Deal, as we note in many places through this report, is unlikely to drive the necessary change.

Of even greater concern is evidence recently presented by Unlock Democracy and the Association for the Conservation of Energy (ACE) in the UK[234] showing that evidence given to UK Ministers and to the UK Parliament, used as a basis to support new nuclear power stations, was a false summary of the analysis carried out within Government. As the note about *A corruption of governance?* on the ACE website[235] says: *"The report outlines that, on the basis of the Government's own evidence, we do not need any more new nuclear power stations in order to 'keep the lights on' and reduce CO2 emissions by 80% by 2050. It goes on to show that, on the basis of the Government's own evidence, electricity generated by nuclear power is the not the least expensive of all low carbon technologies. In everyday terms, the building of new nuclear power stations to provide electricity is likely to mean higher fuel bills."*

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231 UK support for oil extraction from Canadian tar sands was noted in Section 2: *UK secretly helping Canada push its oil sands project*, Damian Carrington, guardian.co.uk, 27 November 2011, http://www.guardian.co.uk/environment/2011/nov/27/canada-oil-sands-uk-backing.

232 *Davey puts energy saving at heart of strategy*, DECC Press Release 2012/009, 8 February 2012, http://www.decc.gov.uk/en/content/cms/news/pn12_009/pn12_009.aspx.

233 *Speech by Energy and Climate Secretary Edward Davey on the launch of the Energy Efficiency Deployment Office*, 8 February 2012, http://www.decc.gov.uk/en/content/cms/news/eedolaunch/eedolaunch.aspx.

234 *A corruption of governance? How Ministers and Parliament were misled*, Ron Bailey and Lotte Blair, Unlock Democracy and the Association for the Conservation of Energy, January 2012, http://www.ukace.org/publications/ACE%20Campaigns%20(2012-01)%20-%20Corruption%20of%20Governance%20-%20Jan%202012.

235 *A corruption of governanace?*, http://www.ukace.org/.

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A corruption of governance? shows, in particular (page 14), using the Government's own figures, that placing as much reliance as possible on energy saving costs less than supplying energy and results in greater CO_2 reductions. The report highlights key questions that need to be answered. These include the following:

- Why did the Government repeatedly refuse to carry out an assessment of the full potential for the policy that it regards as the most cost-effective (energy efficiency) before making the decision to support new nuclear power stations, despite the fact that the Chief Scientific Adviser described the assessment as crucial?
- Why did the 2011 White Paper on Energy Market Reform not include a full assessment of energy efficiency despite the fact that one of its principle objectives was to minimise costs to the consumer?

The UK cannot have both an effective Energy Efficiency Deployment Office while at the same time adopting wasteful energy supply policies that ignore the potential and opportunities for energy efficiency and the economic benefits these will bring. We will have confidence that there really is a new and necessary approach to energy efficiency in the UK when the questions raised in *A corruption of governance?* are fully acknowledged and answered by the UK Government, and the UK then acts to promote renewable energy, including PV[236], and energy efficiency, as purposefully as countries such as Germany are already doing - as we note later in this section.

As we outlined in Section 2, and note again in the following paragraphs, there is neither the time nor the resource to waste on ineffective supply options. An EU demand reduction target of 40 per cent by 2050, consistent with the scenarios outlined in the new 2050 Roadmap[237], will be the most effective driver for action across the EU-27, with the benefits in jobs and competitiveness this will bring.

It is well established that disruptive innovation is rarely introduced by established players in the market[238], but comes mostly from newcomers. Governments often like to think that they support innovation but, in fact, because it is the established players that have the resources to lobby and to influence government, it is more likely the case that, unwittingly perhaps, governments actually hinder innovation. We see this playing out, in the UK, in the lack of influence within Government by the innovative solar energy companies compared to the institutionalised presence of the nuclear industry – and, equally, by the continuing influence of the established energy companies and the fossil fuel companies.

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236 As we note just below, in just one month, December 2011, more PV capacity was installed in Germany than the planned total installed capacity for the whole UK in 2020.

237 *Energy Roadmap 2050*, European Commission, Brussels, COM(2011) 885/2, 15 December 2011, http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf.

238 See, for example, *The Innovator's Dilemma*, Clayton M Christensen (Harvard Business School Press, 1997) and *Creative Destruction*, Richard Foster and Sarah Kaplan (Doubleday/Currency, 2001)

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In the normal course of events, this bias by Government towards the status quo would slow down innovation and transformation but not halt it over the long term. However, the energy infrastructure is not normal. As noted in Section 9, the long lifetimes of investments create a major barrier to innovation, maintain the dominance of existing players far beyond reasonable limits, and encourage new investment in dirty rather than clean technologies[239].

As this paper has stressed, the urgency to tackle climate change means that a leisurely, business-as-usual, pace of innovation and change in energy supply and energy efficiency is hopelessly inadequate to the need. It is urgent that governments in the UK and across the EU do create "a new reality" (Section 9) and face the future rather than the past to support and promote the necessary innovation in renewables, new supply chains, energy storage and energy efficiency.

As the recent OECD report[240] notes: *"support* [for new technologies such as renewables and, indeed, for radical energy efficiency measures] *needs to be 'loud' (big enough to impact the bottom line), 'long' (for a sustained period) and 'legal' (with regulatory frameworks clearly established)."* The present confusion about the PV FiT in the UK, and lack of support and subsidy for energy efficiency, shows only too clearly that this support is, at present, neither 'loud' nor 'long'. This must change. About-turns on feed-in tariffs, just like the comments of the UK Chancellor of the Exchequer noted in Section 7, have a negative impact on low-carbon investment as pointed out[241] by the Chief Executive of the UK Green Alliance[242].

Indeed, such adverse impact on renewables investment seems to be already happening in the UK as recently reported[243]: *"The construction of new renewable energy generation capacity has fallen dramatically, as the big six energy suppliers pursue a "dash for gas" policy that could put the UK's climate change targets out of*

239 *Rethinking industrial policy*, Aghion P, Boulanger J and Cohen E (2011), Brussels: Bruegel. http://www.bruegel.org/publications/publication-detail/publication/566-rethinking-industrial-policy/.

240 *The Role of Pension Funds in Financing Green Growth Initiatives*, Raffaele Della Croce, Christopher Kaminker and Fiona Stewart, OECD Working Papers on Finance, Insurance and Private Pensions, No. 10, OECD Publishing, 1 September 2011, http://www.oecd-ilibrary.org/finance-and-investment/the-role-of-pension-funds-in-financing-green-growth-initiatives_5kg58j1lwdjd-en.

241 "Every time the Chancellor attacks high environmental standards he raises the cost of capital for the UK's low-carbon and waste infrastructure, because investors fear the coalition might row back on its green policies. In the first half of this year the private sector announced over 9,000 new jobs and £1.7bn of investment in the UK renewables sector, despite the financial turmoil. That investment will dry up if the chancellor keeps playing politics with the environment." Letter from Matthew Spencer, Director, Green Alliance, *Climate change must stay on the agenda*, Letters, guardian.co.uk, Thursday 1 December 2011, http://www.guardian.co.uk/environment/2011/dec/01/climate-change-on-agenda.

242 Green Alliance is an influential environmental think tank working to ensure UK political leaders deliver ambitious solutions to global environmental issues, http://www.green-alliance.org.uk/.

243 *UK green energy projects fall by wayside in dash for gas, • Wind turbine construction down by half on last year, • Rising energy bills result of higher fuel import costs*, Fiona Harvey, guardian.co.uk, 4 December 2011, http://www.guardian.co.uk/environment/2011/dec/04/renewableenergy-energy-industry.

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reach and leave households with higher bills. ... The number of new wind turbines built this year is down by half on last year. ... The pipeline of new projects has also stagnated... This contrasts with the 30GW of new gas-fired power stations that are at planning stage. These will require tens of billions of pounds of investment, coming mostly from the big six energy suppliers." Such a 'dash for gas' reflects the continuing emphasis on supply within government described in this Section and will be disastrous for action on climate change as outlined in Section 9.

Of course, there is support for renewables by the UK as there is an EU-mandated target, but, as Jonathan Porritt, former Chair of the UK's Sustainable Development Commission, has pointed out[244], the UK's ambition pales relative to that demonstrated by countries such as Germany and Denmark: *"Germany plans to generate 50% of its day-time electricity from solar by 2020 – with installed capacity of 52 GW. Despite the fact that solar PV has the potential to meet more than 30% of the UK's day-time electricity by 2040, our target for 2020 is just 2.7 GW – not much more than the 2 GW that Germany installed in one month in June 2010."*[245]

In the same piece, Porritt also makes clear the total interdependence of renewables and energy efficiency that is at the heart of this present paper: *"I believe a 100% renewable supply strategy for the UK is feasible by 2050 at the latest, assuming only that we succeed in reducing total energy consumption in the UK by at least 40% by 2030 through a wholly different approach to energy efficiency than any government has ever demonstrated before."* In other words, Porritt is suggesting that the UK does what Germany and Denmark are already demonstrating is possible. This paper emphasises that such an approach to energy efficiency is indeed possible with adoption of passivhaus quality standards and will bring many associated benefits.

The continuing focus by the UK Government on energy supply by 20th century supply chains is why it is still taken for granted that shale gas will be extracted in the UK. As a BBC radio programme[246] makes clear: *"Huge swathes of Britain are up for grabs in a new round of gas exploration licences which the government is due to issue soon. Could this be the answer to cheaper energy bills?".* The concern is totally with how to reduce gas bills with the unspoken but underlying assumption that

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244 *Why George Monbiot is completely wrong on nuclear power*, Jonathan Porritt, 26 July 2011, http://www.jonathonporritt.com/blog/why-george-monbiot-completely-wrong-nuclear-power.

245 This record monthly installation total of June 2010 seems to have been exceeded in Germany in December 2011 when 3.0GWp was installed bringing the yearly total to 7.5GWp and the total installed capacity to almost 25GWp, already nearly ten times the UK target for 2020 (by which time Germany plans that PV will account for ten per cent of electricity production). Information on German PV installation to the end of 2010 is at http://www.solarwirtschaft.de/fileadmin/media/pdf/BSW_Solar_Factsheet_1110.pdf where the steady price drop per KWh generated is shown; a sensible and rational approach that reflects the steady drop in prices over time.

246 *Is shale gas Britain's answer to cheaper gas bills?,* Simon Cox, BBC Radio 4, The Report, see http://www.bbc.co.uk/news/business-15248683.

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inefficient homes needing new supplies of gas for heating will be a continuing fact of life.

It is likely that the picture in the UK is mirrored to some degree in many other Member States across the EU. While governments such as that in the UK maintain this focus on energy supply, there is little opportunity for major change. Greenhouse gas targets will not be met and the major transformation of the building stock cannot happen[247]. The current attitude of Governments is the biggest barrier to effective action on energy efficiency, to transforming and refurbishing buildings, and hence to action on climate change.

A transformation within Governments to bring energy efficiency to the fore seems a pre-requisite for progress. To achieve such a transformation, misguided thinking that sees benefit in reduced environmental standards (Section 7) must be eliminated. Only Government can truly create the necessary "alternative reality".

Along with Denmark, Germany is demonstrating that the "alternative reality" can happen. Germany is one or the most advanced European economies in the promotion of renewable energy[248] and in demonstrating 'deep' refurbishment of buildings to save three-quarters of more of energy use[249]. The German Energy Concept[250] sets a target of 'almost climate-neutral' building stock, with a renovation roadmap targeting an 80 per cent reduction in primary energy demand by buildings by 2050 as a major contribution to an overall reduction in primary energy consumption of 50 per cent. Germany also seeks to cut electricity consumption by 25 per cent by 2050 – compared to the UK prognosis of a doubling or more of capacity.

Germany's success in promoting renewable energy as well as 'deep' renovation of buildings shows that commitment by government, and targets for energy efficiency that reflect the urgency of the need, are essential. Such attitudes must become the norm across the EU so that the EU can act to drive out wasteful use of energy in the same manner that Toyota led the world in driving out waste in car production. The

247 The companion paper, *The 'Green Deal' Appraised*, Martin Ingham, Build with CaRe, October 2011, http://www.buildwithcare.eu/articles/78-partners/219-the-green-deal-appraised, notes the many challenges to the proposed UK mechanism for building refurbishment and several concerns are similarly noted in this section including 'lock-in' of emissions because of a lack of a 'whole house' approach, and the lack of any effective targets for energy efficiency and demand reduction in the housing sector.

248 German Federal Association of Energy and Water Management (BDEW) announce German renewable electricity generation for first six months of 2011 over 20 per cent, http://www.bdew.de/internet.nsf/id/DE_20110829-PI-Erneuerbare-liefern-mehr-als-20-Prozent-des-Stroms.

249 See, for example, *Energy saving techniques, upgrading and renewables*, Tobias Timm, proKlima, Hannover, http://sticerd.lse.ac.uk/textonly/lsehousing/events/DENA/Tobias_Timm2.pdf or *Pilot Project "Energy Efficient Homes"*, Nicola Pillen, German Energy Agency (dena), November 2010, http://www.iea.org/work/2010/sbn/Pillen.pdf.

250 *Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply*; 28 September 2010, http://www.bmu.de/files/english/pdf/application/pdf/energiekonzept_bundesregierung_en.pdf.

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results will be similar: increased quality and lower costs along with, of course, meaningful reductions in greenhouse gas emissions.

The lack of any UK targets for energy efficiency or building refurbishment and reliance on so-called 'market forces' may undermine the UK's Green Deal programme[251]. Even in Germany, it is acknowledged that a major acceleration of 'deep' refurbishment is needed. The Energy Concept notes that the renovation rate needs to double if the targets are to be met: *"Building renovation will be a central focus. In this field, it is vital to more or less double the current rate of renovation."*

Hopefully, the ambition and demonstrated success of the most far-sighted of the EU's Member States can act as a catalyst for wide-scale progress. Now is the time to set targets for renewables and for energy efficiency that match the need. As we suggest in Section 5, a target of a minimum 40 per cent cut in primary energy use by 2050 could become an EU target with transformation of the building stock a centre-piece. The EU Commission's Energy Roadmap 2050 states[252] that *"Nearly zero-energy buildings should become the norm"*. The way to achieve this ambition is through the adoption of passivhaus standards.

10.2. Focus on passivhaus standards for new build and refurbishment

Passivhaus standards of energy efficiency and of quality create the step-change in energy use that is needed (Section 8). We have noted above (Section 6) concerns about the proposed standards for so-called "zero carbon homes" in the UK. Moving to or close to passivhaus standard provides the confidence that buildings will be constructed as planned and will perform as planned.

We reported (Section 6) the concerns by the Zero Carbon Hub in the UK about the performance of new buildings[253]: *"Ensuring what is designed is actually delivered will represent a significant challenge for the whole industry, including designers, the supply chain, and housebuilders."*

It is unfortunate that few detailed studies are made of building performance in use because this can fall far short of design performance as a recent study[254] of two supposed low-energy buildings in the UK reveals. These 'low energy' buildings had

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251 See more detailed discussion in the companion paper *Green Deal Appraised*.

252 *Energy Roadmap 2050*, European Commission, Brussels, COM(2011) 885/2, 15 December 2011, http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf, para 3.1.

253 *Carbon Compliance: Setting an appropriate limit for zero carbon new homes, Findings and Recommendations*, Zero Carbon Hub, February 2011, http://www.zerocarbonhub.org/resourcefiles/CC_TG_Report_Feb_2011.pdf.

254 *Post occupancy: Is your building really so green?*, Thomas Lane, Building, 1 July 2011, http://www.building.co.uk/buildings/special-projects/post-occupancy-is-your-building-really-so-green?/5020231.article.

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been supported through design and construction by the UK Carbon Trust[255] and were monitored for at least a year after completion. As this study says: *"...most are designing low-energy buildings in a vacuum. Monitoring buildings for post-occupancy energy use is time-consuming and expensive. And if the money is found and the results aren't flattering, then the results are unlikely to get past the building owner out into the public domain."* So results about actual building performance are rare but there was no reason to suppose that these two would perform less well than any others.

The results were not encouraging. For example, for West Suffolk House, a new building in Bury St Edmunds, Suffolk, shared by the local council and the county council, the report notes that: *"All this* [the design features] *added up to a carbon emissions design prediction of 31.4 kgCO_2/m^2 per year .... Unfortunately the reality is very different: the building emits 88.4 kgCO_2/m^2, which is nearly three times the design estimate, meaning it could not fairly be described as a low-carbon building. To add insult to injury the building is slated by its occupiers who complain the building is either too hot or too cold, makes them ill and is noisy."*

Sadly, such deviation of performance from design may well be the norm rather than the exception. Today's building practices allow work to begin before design is finalised, so-called value engineering may remove key aspects that make low-carbon and low-energy performance possible (see Amory Lovins' comment in Section 8), while work on site may lead to inadequate quality of work that is never noticed or corrected. Once completed, few buildings at all are studied to check that they perform as expected – there is no intelligent handover process. Such ways of working are not unique to the UK and monitoring of actual performance is as rarely performed across the EU as it is in the UK. Not only may energy use in buildings be far higher than the designs predict but, as found in West Suffolk House, a so-called low-carbon building may also be uncomfortable to live or to work in. There can potentially be considerable penalties in lost productivity.

Award of impressive standards, codes or Energy Performance Certificates (EPCs) at the design stage may imply low-energy performance but may mean little in practice as the example in Suffolk shows. If the energy consumption of either new buildings or refurbished buildings is two to three times the design performance then effort to meet ambitious targets on energy efficiency will be in vain. Savings achieved in the UK's Green Deal programme, for example, will be based on a simplified energy survey rapidly undertaken when a building is first assessed. Supposed energy savings after refurbishment may appear to be impressive but there will be no monitoring to confirm these. Given what is likely to happen, actual energy savings, and hence actual greenhouse gas savings, may be far less than stated.

255 The Carbon Trust is a not-for-profit company providing specialist support to help business and the public sector boost business returns by cutting carbon emissions, saving energy and commercialising low carbon technologies, see http://www.carbontrust.co.uk/.

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The UK Innovation and Growth Team on Low-Carbon Construction reported[256] that such a situation where buildings do not achieve their energy design criteria is common-place: *"Studies repeatedly show that buildings do not achieve their design criteria, in energy efficiency terms, when tested post-completion. ... it is extraordinary that so little priority is attached to seeing how buildings perform in practice."* The Innovation and Growth Team recommended that: *"post occupancy evaluation becomes as routine a part of bringing a new building into use as the construction itself"* and that: *"beyond commissioning and post occupancy evaluation, there is a continuous process of measurement, and feedback and of acting on the indications of the data gathered"*.

A low-carbon building is only low-carbon if it is operated as such. Such post-occupancy evaluation and feedback could have a dramatic impact on energy use in all kinds of buildings, with major savings being realised even without any change to the building fabric as evidence is accumulated about how to operate buildings in the most energy-efficient way. Sadly, not just in the UK, but across the EU, there seems little emphasis in making the Innovation and Growth Team's recommendations a reality. Post-occupancy evaluation and monitoring is not happening to any extent. So-called low energy buildings may be low-energy or they may not, as the example of West Suffolk House shows. The Innovation and Growth Team's research suggests that the latter is common-place. It is likely to be just as common-place for refurbishment as for new build.

Architect Rab Bennetts, a board member of the UK Green Building Council, has recently expressed[257] similar concerns to the Innovation and Growth Team: *"How many times is a sparkling new construction project published under the "green" banner, with no substantiating information? How often is a corporate social responsibility report dressed up with "green" facts and figures in order to avoid substantive action where it most counts? How frequently are innovative "green" buildings found to be underperforming in practice? ... So far so simple, but how is the nation's building-stock measuring up? The alarming truth is that we don't really know, as very few people are measuring the performance of their new buildings, let alone the existing ones."*

Publication of actual energy use via Display Energy Certificates (DECs) would help promote change, but, as we have noted above (Section 6), in the UK, the Government has recently acted to revoke mandatory display of DECs by the private sector. The consequence will be much less action to promote energy efficiency and

256 Low Carbon Construction, Innovation & Growth Team, Final Report, HM Government, November 2010 at http://www.bis.gov.uk/assets/biscore/business-sectors/docs/l/10-1266-low-carbon-construction-igt-final-report.pdf, see p70.

257 *Green buildings – separating fact from fiction*, Rab Bennetts for the Guardian Professional Network, guardian.co.uk, 26 September 2011, http://www.guardian.co.uk/sustainable-business/green-buildings-environmental-impact-green-wash.

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much less action to monitor how buildings perform – exactly contrary to recommendations.

Sadly, at present, the care and attention to detail during design, during construction and after handover that enabled our own university's Elizabeth Fry Building to be called possibly "the best building ever"[258] is the exception not the rule. Some of the issues that impact on building performance have been recently summarised[259]. As one slide points out: *"The credibility gap: we couldn't deliver low-energy and carbon performance reliably in the 1990s. We're still finding it difficult."* And another: *"Why are we being encouraged to spend money on green bling when we aren't getting the fundamentals right?"* While some countries may have higher standards overall than the UK, these issues affect construction to some degree or other across the EU.

Building new or retrofitting to passivhaus standard transforms this current situation where there is ignorance about building performance and often much poorer performance than specified. This is one of four important reasons why designing or refurbishing to passivhaus standard provides great benefit:

1. energy use for heating is minimised,
2. performance is as designed,
3. the internal environment promotes well-being, and
4. construction is undertaken to high quality standards.

To design an effective low-energy building, the focus must first and foremost be on the fabric. This is exactly what passivhaus does. The building is modelled in detail so that thermal performance is known and, once the design is finalised, no changes that could affect thermal performance are allowed. Quality is demanded at every stage during design and during construction of a passivhaus building. The result is a building that is essentially guaranteed to perform as specified.

Not every new build or refurbishment will be able to be completed to full passivhaus standard, and not every passivhaus building may need to be certified to passivhaus standard, but the passivhaus process sets a quality standard that, if followed, reduces to a feasible minimum the waste of energy for space heating, presently the major source of energy use for most buildings.

Once such energy use is minimised, then it becomes much more straightforward to address other sources of energy use such as water heating and appliances and also to help building occupiers to understand how their behaviour impacts on overall energy use.

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258 *The best building ever?*, PROBE Team's verdict on the Elizabeth Fry Building, Building Services Journal, April 1998, E20-E25, accessible at http://www2.env.uea.ac.uk/gmmc/energy/env2d02/articles/efry_1.doc.

259 *Be Professional: Get real about building performance*, Bill Bordass, Useable Buildings Trust, Association for Consultancy and Engineering (ACE) annual conference, May 2011, accessible at http://homepage.mac.com/aleaman2/UBToverflow/ACE25May11.pdf.

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The second, equally important, reason for following passivhaus standards is, as just noted, to ensure that building performance is as designed, something that cannot at all be taken for granted in normal construction as the discussion above makes clear.

The third important reason is that the internal environment of a building built or refurbished to passivhaus standards, with regular air changes via mechanical ventilation and filtering of particles and pollutants, will be healthy, will be noise free and will provide a sense of well-being. Again, as noted just above (and also in Section 6), internal comfort and well-being may not be achieved in so-called low-carbon buildings that are not designed to passivhaus standards.

The fourth, and equally important reason to follow passivhaus standards, is that the quality of the construction process is brought up to the highest standards. Without total quality during construction, the passivhaus standard cannot be met. Raising skill levels and quality of work is essential if low-energy buildings are to become the norm whether new build or refurbished.

These remarks apply equally to building refurbishment as to new build. Without the care and quality that ambition to achieve passivhaus standards brings, neither energy use, comfort, nor well-being can be guaranteed. Without passivhaus standards, supply chains will not develop as they could and the construction industry in general will be less competitive than it could be. There is no point whatsoever calling for low-energy buildings, whether new or refurbished, at considerable expense, if there is no guarantee that they will be low-energy buildings in practice. Following the passivhaus standard is a proven way to avoid this concern.

At present, the EU is calling for 'nearly zero energy' new buildings from 2020 as part of the recast EPBD (Energy Performance of Buildings Directive)[260]. Not only is this too far in the future to impact on today's urgent need to act on climate change, but in Section 6 we have outlined concerns that weaker definitions such as that of the UK's "zero carbon house" might be accepted as complying with the recast EPBD. On the other hand, new 2012 standards in countries such as Germany, although not yet published[261], may well be close to the passivhaus standard. The German EnEV standard does not demand the same degree of detail in calculation of the building envelope as does passivhaus, but a sensible way forward could be for the EU to require fabric properties similar to EnEV 2012 with detailed calculation as necessary with passivhaus. The detailed insight brought by use of PHPP[262] could be used more widely indeed to supplement regulations in different countries.

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260 Described in CIBSE Briefing, *The Recast Energy Performance of Buildings Directive*, http://www.cibse.org/content/documents/Knowledge_Bank/EPBDBriefingFINAL2011.pdf.

261 See http://www.enev-online.de/enev/index.htm for information on EnEV 2012, the new build standard that will be introduced in Germany in 2012.

262 PHPP (The Passive House Planning Package) is a software tool used to help design and certify passive houses – see http://www.passiv.de/.

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10.3. Targets and mechanisms for rapid refurbishment

We have already noted (Section 6) concerns about so-called "zero-carbon homes" not being zero carbon. Unless new build standards force the industry to build to or near to passivhaus standards then there will be many wastes and unnecessary expenses incurred. While there will always be innovators who want to go beyond the minimum standard and regulations, most companies in the construction industry will build to the minimum standard. In spite of the call by the recast Energy Performance of Buildings Directive for "nearly zero-energy homes" across the EU by 2020, as just noted in Section 10.2, this can only be guaranteed by enforcing passivhaus fabric standards.

EuroACE, the European Alliance of Companies for Energy Efficiency in Buildings, as well as commenting[263] on the proposed Energy Efficiency Directive, has pointed out[264] that the recast Energy Performance of Buildings Directive does not create a satisfactory platform for the refurbishment of the existing building stock. They emphasise that clear and measurable targets are required.

At present these targets do not exist, except perhaps in Germany. Even here, a doubling of the refurbishment rate of homes is acknowledged to be needed. Across Europe, nearly 3 per cent of buildings must each be deep-renovated annually for the next forty years if the 2020 and 2050 energy, carbon and economic goals are to be met[265]. Indeed, there are strong arguments that the target rate should be higher given the current concerns on carbon emissions and climate change already detailed in this paper.

This Renovate Europe report notes that, for the 3 per cent deep renovation to happen, whenever building renovation takes place, all available energy saving technologies must be incorporated Only in this way can we ensure a reduction in energy consumption of between 60 and 90 per cent for the majority of Europe's buildings. In particular, Renovate Europe notes that *"an unwavering political commitment"* is necessary. We have already outlined in Section 10.1 above the lack of political commitment across Europe that is preventing even current targets for energy saving to be achieved.

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263 See Section 10.1

264 "While the Recast of the EU Energy Performance of Buildings Directive (EPBD) sets targets for new buildings and for major refurbishment, the majority of the existing building stock has not been effectively addressed at EU level. .... Without a clear and measurable target for reducing the demand for energy use in all existing buildings, Europe risks falling far short of its efficiency goal. The mandatory approach is necessary to guarantee that large-scale renovation programmes are carried out over the next decade.", *EuroACE position on the EU Energy Efficiency Plan 2011*, Brussels, March 2011, available at http://www.renovate-europe.eu/resources.

265 *How can we reduce energy demand in Europe?*, http://www.renovate-europe.eu/how-can-we-reduce-energy-demand-in-europe.

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This 3 per cent proportion amounts to at least 5 million buildings across the EU each year and around 500,000 in the UK. A target of up to 500,000 homes with, in addition, large numbers of office and commercial buildings, refurbished to standards of very low energy use each year, is way above anything the UK construction industry has achieved in peacetime. Such a challenge has to be met but can only be met with unwavering political commitment. The commitment and determination of politicians at both EU and Member State level to enforce demanding targets on energy efficiency and building refurbishment is a critically urgent step that must be taken in beginning to tackle climate change with serious intent. Unfortunately, the proposed Green Deal programme for refurbishment in the UK does not take a whole-house approach. Lock-in of energy inefficiency and carbon emissions is likely (see Section 5).

At present, as Renovate Europe notes[266], only about 1.2 per cent of Europe's buildings are renovated each year and 0.1 per cent demolished. However, it is extremely unlikely that this 1.2 per cent is renovated to anything like the highest standards of energy efficiency.

Deep refurbishment will create a vastly improved and healthier building stock and, as pointed out[267] by Renovate Europe, will create up to 1.1 million direct new jobs across the EU. Energy efficiency is not something like the economic crisis that creates widespread distress. Rather, if done well and effectively, it will stimulate job creation, skill formation and a better environment for many citizens.

The benefits are great but there is a real danger that, because of the misguided government thinking about environmental standards and growth we have already noted, standards will be lowered rather than raised. As noted in Section 7, the UK Chancellor of the Exchequer, George Osborne, has recently said[268]: *"We're going to cut our carbon emissions no slower but also no faster than our fellow countries in Europe."* Such an attitude could mean a weakening of resolve just at the moment when unwavering political commitment is needed to ensure refurbishment happens at the necessary rate and the necessary depth. If copied across Europe the consequences could be disastrous.

An ineffective policy, pursuing growth without putting in place the skills and the quality to ensure effective low-carbon construction and refurbishment, will only ensure that things just get worse. But build new and refurbish to high quality standards and fuel poverty can be slowly eliminated and health and well-being enhanced.

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266 *Why renovate Europe's buildings?*, http://www.renovate-europe.eu/why.

267 *Renovating Europe's buildings: the secret weapon in creating up to 1.1 million direct jobs and saving up to 32% of EU energy consumption*, Renovate Europe Press Release, Brussels, 11 October 2011, link from http://www.euroace.org/, 11 October 2011, Renovate Europe day.

268 *George Osborne reveals his true colours on emissions – and they aren't green*, Posted by Damian Carrington Monday 3 October 2011, http://www.guardian.co.uk/environment/damian-carrington-blog/2011/oct/03/george-osborne-carbon-emissions-conservatives.

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In launching its recent report[269] on "shameful shoe box homes" in the UK, the Chief Executive of the Royal Institute of British Architects (RIBA) said[270]: *"In a rush to build quickly and cheaply we risk storing up unnecessary problems for the future. There does not need to be any contradiction between building or refurbishing enough homes and making sure that they are of the highest quality."*

Our recent Build with CaRe press release[271] emphasises that a home building programme to tackle a housing crisis in the UK should emphasise quality and skill creation just as RIBA also recommend. This should be accomplished by making passivhaus the default standard. Only by demanding higher quality standards can the industry move forward to be able to deliver the quality that is necessary to deliver low-energy buildings.

For refurbishment, the problem of 'lock-in' of carbon emissions as a result of inadequate works has already been noted (Section 4, Section 6). In their response to the proposed EU Energy Efficiency Plan 2011, EuroACE also expressed[272] their concern: *"Sub-optimal renovations will, over the short-term, allow Member States to meet interim targets. However, over the long-term, projections have shown that this will make it harder to meet 2050 reduction targets and could even increase overall energy use and carbon emissions in such buildings."*

The European Climate Foundation has detailed[273] concerns over lock-in in a study of the situation in Hungary: *"If renovations aim at keeping today's retrofit depth… (i.e. reducing around 40% of present energy use in existing buildings on average), this results in a significant lock-in effect. This sub-optimal renovation scenario saves only approximately 40% of final heating energy use, locking in approximately 45% of 2010 building heating-related emissions at the end of the programme… . This means that reaching ambitious mid-term climate targets, such as the often quoted*

269 *The Case for Space: the size of England's new homes*, Royal Institute of British Architects, September 2011 http://www.architecture.com/Files/RIBAHoldings/PolicyAndInternationalRelations/HomeWise/CaseforSpace.pdf

270 RIBA Press Release: *Shameful shoe box homes: new research reveals how thousands of brand new houses are failing to provide the space families need*, 14 September 2011, http://www.architecture.com/NewsAndPress/News/RIBANews/News/2011/Shamefulshoeboxhomesnewresearchrevealshowthousandsofbrandnewhousesarefailingtoprovidethespacefamiliesneed.aspx

271 *From housing crisis to housing transformation*, UEA News Release, 2 September 2011, http://www.buildwithcare.eu/news/213-2011-09-07-15-06-30, and https://www.uea.ac.uk/mac/comm/media/press/2011/September/buildwithcare.

272 EuroACE position on the EU Energy Efficiency Plan 2011, Brussels, March 2011, available at http://www.renovate-europe.eu/resources.

273 *Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary*, Diana Ürge-Vorsatz et al, Prepared by the Center for Climate Change and Sustainable Energy Policy (3CSEP) of Central European University, Budapest, on behalf of the European Climate Foundation, June 2010, http://3csep.ceu.hu/sites/default/files/field_attachment/project/node-6234/employment-impactsofenergyefficiencyretrofits.pdf.

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75 – 85% reductions that are needed by 2050, will become extremely difficult, and expensive, to achieve."

Such conclusions will equally apply in most Member States.

So targets and political commitment for both refurbishment and new build are essential. Politicians may think that by weakening standards, they help growth, but this is misguided thinking. The real jobs and growth will come from a targeted programme of 'deep' low-carbon refurbishment of the magnitude outlined here.

How will this be organised? That is not a question this paper can answer directly but, as we note below, there needs to be a focus on skills, learning and quality, and on systems thinking. While some businesses will prefer to continue with moderate quality the companies represented by the WBCSD (see Section 1), for example, demonstrate that there are many forward-thinking and innovative businesses that are eager to step up to the plate. These include the co-signatories to our BwC press release just noted.

In respect of refurbishment, however, there are concerns about over-involvement of the energy supply industry.

In the UK, the Government has acknowledged that the Green Deal as currently structured will only tackle low-cost aspects of refurbishment to modest standards of energy-efficiency. The Energy Company Obligation (ECO) is proposed as a mechanism to involve the major energy supply companies in tackling hard-to-treat and vulnerable properties[274]. It is, however, difficult to see how the ECO will work unless there is a total transformation of the energy supply industry (as we outlined in Section 2), something not in prospect at the present time, certainly not with the focus within DECC on energy supply as discussed in Section 10.1. Indeed, the involvement of the major energy supply companies in the ECO seems to confirm the suspicions discussed in Section 10.1[275].

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274 Some more detail is given in *Low Carbon Construction Action Plan*, Government response to the Low Carbon Construction Innovation & Growth Team Report, HM Government, June 2011, http://www.bis.gov.uk/assets/biscore/business-sectors/docs/l/11-976-low-carbon-construction-action-plan.pdf; see also Green Deal consultation documents at http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx.

275 Apart from such strategic questions of the suitability of the energy supply companies for this role, there are also fundamental issues that neither the Green Deal nor the ECO address. In particular, as noted in Section 5, there is no focus on a 'whole house' approach that is essential if 'deep' refurbishment to low-energy standards is to be accomplished. The Green Deal will offer occupiers a package of measures based on a rapid (inexpensive) survey. The outcome is likely to be that the 'low hanging fruit' are addressed – as EuroACE has already suggested – with lock-in of considerable energy losses and carbon emissions. As work by the European Climate Foundation, just noted, has made clear, lock-in is a major worry if sub-optimal refurbishments are what happen in practice. While this ECF study addressed Hungary in particular, the results apply everywhere. The UK energy company obligation will focus on solid wall properties in addition to vulnerable households, but, once again, there is minimal mention of a whole-house approach.

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The Professor of Energy Policy at Exeter University, Catherine Mitchell, has summarised[276] the problem: *"It is simply not in the interests of the handful of dominant energy companies and their shareholders to dramatically transform the energy system, whether on the supply or demand side. In particular, an increase in the energy efficiency of buildings will undermine a company's future sales and profits. Only when the government confronts head-on the interests in maintaining the system largely as it is, will the energy system change."*

EuroACE have provided a similar perspective[277] from a European viewpoint emphasising once again the importance of 'deep renovation': *" Whilst it would be a positive development to see utilities increasing their activities in the support of energy savings for their customers, it is difficult to imagine how, under the current market pressures, they could be a real change agent for deep energy efficiency renovation in the European building stock. Moreover, experience from the UK, France and beyond, suggests that utility companies, when given a strong incentive to act, for example through an energy efficiency obligation, tend to focus on low hanging fruit, given that this tends to be the rational market action to take. Yet if we are to seriously conceive of meeting long term climate and energy objectives, we need the deep renovation of the built environment, not simply focusing on low hanging fruit."*

EuroACE suggest that the imposition of deep energy efficiency renovation obligations on utilities, as the UK ECO could become, could be a way forward; but the lack of consumer trust[278],[279] inspired by the behaviour of the major energy supply companies over the years does not create confidence (we note also concerns over the introduction on smart meters above in Section 10.5).

More pertinently, it seems far more sensible to allow new and innovative suppliers to emerge as suggested by Professor Mitchell: *"We need regulated obligations on the scale of the transition from town gas to natural gas. Tendering for street-by-street or area-by-area contracts to make homes energy efficient is cost effective, but crucially creates a mechanism for new companies to enter the market, thereby potentially diluting the dominance of the current energy companies."*

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276 *UK must shake off the dominance of the energy giants*, Catherine Mitchell, guardian.co.uk, Monday 13 December 2010, http://www.guardian.co.uk/environment/cif-green/2010/dec/13/uk-energy-efficiency-green-deal.

277 *EuroACE position on the EU Energy Efficiency Plan 2011*, Brussels, March 2011, available at http://www.renovate-europe.eu/resources.

278 "You trust your energy supplier even less than you trust your bank, with only 24% of you thinking the companies who heat and light your home are trustworthy.", CUSTOMERS DON'T TRUST THEIR ENERGY SUPPLIERS in WHICH? YOUR RIGHTS page, Which Magazine, Feb 2011, p6

279 *Energy suppliers charged inflated prices in gas boiler scrappage scheme; Figures show big energy suppliers charged on average a third more than independent traders*, Jo Adetunji, guardian.co.uk, Tuesday 21 September 2010, http://www.guardian.co.uk/money/2010/sep/21/gas-boiler-scrappage-inflated-prices.

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Given the current lack of confidence that the construction industry has the knowledge and the skills to embark on a massive refurbishment programme that really could achieve major energy saving (see next Section), if there is to be an obligation on the major energy supply companies, it might be most effective to channel funds towards creating mechanisms for learning (from success across Europe – see Section 10.7 – as well as within the UK) and skill formation and to nurture entities that have the necessary skills and dedication.

As Professor Mitchell noted, large-scale action at the street or neighbourhood level will be necessary and essential if 'deep' refurbishment rates are to be achieved and costs are reduced to acceptable levels (as could happen if cities are able to take a lead – see Section 10.9). It will also be essential to monitor performance (see discussion in Section 10.2) to assure building owners and occupants, as well as the authorities, that what happens in practice is what is claimed by the assessors and installers.

But before all this can happen we need clear targets for refurbishment across Europe both in terms of volume, and depth, together with the political commitment to ensure these are met.

10.4. Investment in training and skills to enable passivhaus standards in practice

The Egan report, as noted above (Section 7, Section 8), outlined the need for a transformation in working practices if quality in the UK construction industry was to improve: *"The experience of Task Force members is unequivocally that quality will not improve and costs will not reduce until the industry educates its workforce not only in the skills required but in the culture of teamwork."*

Yet the teamworking that was enabled by Skanska during the low-energy refurbishment of the 1970s apartments at Brogården in southern Sweden, described by Build with CaRe partner Hans Eek[280], is still not common-place in any EU country. Some Member States where passivhaus buildings have become more common, for example, Germany, Austria and Sweden, have well-established systems that do help ensure the necessary skills and quality but effective oversight is always necessary if passivhaus quality is to be achieved.

In the UK, and, quite likely, in many EU Member States, skills and quality may need to be significantly improved if passivhaus standards are to be assured for either new build or refurbishment. At present, working practices, with sub-contracting the norm, do not encourage either teamwork or the highest quality standards that only excellent teamwork can make possible.

280 Presentation by Hans Eek, Swedish Passive House Centre, Build with CaRe conference, Norwich, October 2010, accessed via http://www.buildwithcare.eu/, and Skanska Case Study 64, Brogården, Sweden, http://skanska-sustainability-case-studies.com/pdfs/64/64_Brogarden_v001.pdf.

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The Barker Report in 2004 highlighted[281] concerns in UK housebuilding exacerbated by the prevalence of sub-contracting that still persists. These concerns were for new build. While there has hopefully been some improvement since that review, the prevalence of sub-contracting remains, bringing with it inevitable quality concerns.

The UK Innovation and Growth Team report in 2010 likewise highlighted[282] continuing concerns with the repair and refurbishment sector – the sector that may well be responsible for a considerable part of building refurbishment work.

The UK Office of Fair Trading, in a follow-up study[283] to the Barker Report, quoted the numbers of snags (faults) that inspectors would expect to find in newly-completed homes (after the builder had completed work): *"Estimates from two snagging companies indicate that they would expect to find around 40 snags* [faults] *for one bedroom houses and flats and around 70-75 snags for an average three bedroom family home"*. These numbers do not inspire confidence. Someone buying a new car would be concerned to find a single fault yet alone over 70!

The nature of the transformation (*"paradigm shift"*) required in the UK if passivhaus standards are to become the norm has been described by Professor Linda Clarke of the University of Westminster[284]. It is unlikely that these issues are restricted to the UK.

There is, however, tremendous opportunity to learn from Europe as some of our local colleagues in the construction industry are already doing as a result of Build with CaRe initiatives. There is no shortage of skilled people in any Member State. What is essential is to create a working environment where quality, teamwork and

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281 For example in Chapter 6: *"...housebuilders do not have to deliver a good product, or high levels of customer service, to win market share. ... The industry must improve the quality of customer service. ... The need to improve standards applies right across the industry... Of particular concern is the low level of training undertaken by the industry. Levels of training are low compared to other industries and by international standards. ... International comparisons of apprenticeships within the key crafts of bricklaying and carpentry show that Germany trains nearly three times as many apprentices per hundred workers than the UK... These general problems with training provision are exacerbated in the housebuilding industry by the prevalence of sub-contracting..."*, 'Delivering stability: securing our future housing needs', The Barker Review (2004) at http://www.barkerreview.org.uk/.

282 *"The repair, maintenance and improvement sector has a poor reputation, with relatively high levels of complaints and disputes, and contractor default is considerably higher than for the new build sector."*, p127, Low Carbon Construction, Innovation & Growth Team, Final Report, HM Government, November 2010 at http://www.bis.gov.uk/assets/biscore/business-sectors/docs/l/10-1266-low-carbon-construction-igt-final-report.pdf.

283 *Homebuilding in the UK: A market study*, Office of Fair Trading, September 2008, OFT 1020, para 4.149, http://www.oft.gov.uk/shared_oft/reports/comp_policy/oft1020.pdf.

284 *"if "green" buildings are to be considered as standard by the construction industry a paradigm shift is needed, involving not only technological measures (super insulation, air tightness, appropriate ventilation), but a restructuring of the vocational education system."*, Professor Linda Clarke, Taking a lesson from Europe, Construction Manager, 7 January 2011, http://construction-manager.co.uk/news/taking-lesson-europe/.

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learning are paramount and to create the learning and training structures that are necessary for high quality outcomes. It is difficult to imagine a greater benefit to the economy and to society as a whole if this happens.

The skills and expertise levels required for refurbishment are similar to those required for new build – possibly even higher levels are required because of the issues that will inevitably arise during work on existing buildings that will demand expert decision making. With leadership from the EU and Member State governments over the scale and ambition required, and partnership with both the industry and with consumers, progress can be made. If the scale of the challenge is addressed then it really can be possible, as Renovate Europe has suggested, to create large numbers of jobs that have the skills required, and to transform the construction industry itself and the supply chains that feed it. The new build sector will benefit as well as the refurbishment sector.

If the magnitude of the challenge is not acknowledged[285] and not properly met, then the danger is that appropriate skills will not be created, that work will not be undertaken to the quality and depth of energy saving needed, and that home owners and building occupants will be left with inefficient and expensive structures to heat and maintain. Climate change targets will not be met and a unique opportunity to create a low-carbon and prosperous Europe will have been missed.

The EU has a potentially very important role to stimulate the learning and skill formation that a successful and extensive 'deep' refurbishment programme across Europe, lasting decades, will require. We outline below (Section 10.7) how Build with CaRe has already stimulated very successful transnational learning and knowledge sharing. As we suggest in the previous section, it may be preferable in the UK to direct a portion of Energy Company Obligation funds in the first instance to ensure learning from success and knowledge in 'deep' refurbishment from across Europe and to develop the skills and teamwork necessary to ensure work is done to the depth and quality necessary, rather than rushing into extensive work programmes based on insufficient skill and knowledge. Another beneficial use of energy company funds could be to create centres in every European city similar to the Bremen Bauraum we describe next.

285 The Innovation and Growth team noted that [in the UK but probably also across the EU]: *"...very few businesses have an accurate understanding of the sheer scale of the undertaking ahead; and there is a level of disbelief about whether (or at least when) the difficult decisions that will lead to the necessary changes in the built environment and in the behaviour of those who occupy it might be made."*, Low Carbon Construction, Innovation & Growth Team, Final Report, HM Government, November 2010 at http://www.bis.gov.uk/assets/biscore/business-sectors/docs/l/10-1266-low-carbon-construction-igt-final-report.pdf, p44.

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10.5. Information campaign on passivhaus benefits for new and refurbished building

A recent survey[286] of EU citizens showed that over two-thirds consider climate change a "very serious problem" and almost 90 per cent view it as either "very serious" or "fairly serious". Over three-quarters said that fighting climate change could help create jobs and help the economy and this proportion was over two-thirds in every one of the 27 EU Member States.

Hence, if policies for action on buildings are presented in an appropriate way, there is likely to be a great measure of support for action across the EU. What can be done?

In promoting low-energy 'deep' refurbishment of buildings there are three key needs that can all be most effectively driven by governments that are leading strong action on energy efficiency.

- Firstly, an information campaign that gives people clear and useful information about what can be done and why.
- Secondly, to insure that all work that is done is done to high standards and that it really does enable the energy savings necessary; in this way people can have confidence to embark on what are often quite likely to be fairly disruptive works.
- Thirdly, and linked to the first two, to make sure that misleading advertising, inappropriate advice and inflated pricing are identified and warned against so that building owners or occupiers can avoid getting trapped into high-cost works that may be inappropriate. Hard-sell campaigns for renewable energy systems[287] warn about the potential dangers ahead.

In Bremen, north Germany, a Build with CaRe partner, the Bremen Bauraum[288] has proved hugely popular[289]. The Bauraum is an excellent example of how information can be provided in the most accessible way both to tradespeople and businesses and also to the general public.

The Bauraum contains exhibitions that members of the public can see and touch to gain insight and understanding into how a house can be made energy efficient and how to recognise and avoid common problems. Admission is free and free advice and training are available. The establishment of such centres in every town and city

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286 Special Eurobarometer Report 372, Climate Change, October 2011, http://ec.europa.eu/public_opinion/archives/ebs/ebs_372_en.pdf.

287 REAL Assurance Scheme to take action against solar thermal sellers exposed in Which? report, REAL Assurance Scheme - press release, 27 April 2010, http://www.r-e-a.net/info/rea-news/100427WhichReport.

288 http://www.buildwithcare.eu/articles/78-partners/122-opening-of-bauraum-bremen.

289 See http://www.bauraum-bremen.de/.

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across Europe could have a hugely beneficial impact on people's awareness of what could be done in their homes or workplaces. Transnational, national and regional investment, supported in a major way by an energy company obligation, would be appropriate to ensure this happens fast and effectively.

As in Bremen, it would be most effective to link such exhibitions and information to the skills and competences to assess properties and to undertake refurbishment. While the Bauraum in Bremen is unusually informative and interesting, the establishment of a network of regional competence centres in Germany is acknowledged[290] to have been very important in creating the momentum for action that has placed that country at the forefront of building refurbishment to low-energy standards.

We were told at the Build with CaRe conference in Norwich in October 2010 by Tatjana Bruns from the German Federal Bank for Reconstruction, the Kreditanstalt für Wiederaufbau (KfW), that, as low-carbon refurbishments become more common and awareness is created, so peer pressure is created and people want to copy neighbours who have had low-energy refurbishment done.

What is critical for such success is the knowledge that good and trustworthy advice can be obtained as well as financial support for effective refurbishment. Setting up demonstration facilities and advice centres for trustworthy information is as important as the work of refurbishment itself. As in Germany, once refurbishment becomes noticed and more common-place, it will become something "to be done".

Of course, in a country like the UK, getting the owners of around 25 million homes and of millions of non-domestic buildings to agree to and to undertake 'deep' refurbishment to low-energy standards is a massive challenge. As noted, even in Germany, a doubling of the rate of refurbishment is accepted to be necessary. There will need to be new regulations, new mandates and new ways of approaching financing (see next Section).

Regulations and mandates will emerge as the commitment of governments to lead the transformation to an energy efficient economy is made explicit. Examples already widely discussed include variations in property taxes or sales taxes depending on a building's energy efficiency, publication of EPCs, and especially of actual energy use data (DECs), and making property rental illegal if a building is below a certain energy efficiency standard. Mandating a 'deep' low-energy refurbishment to achieve a very high standard of energy efficiency as a condition of a sale of a property could be one effective way of ensuring progress.

290 "However, what has also proved to be very important was the establishment of a network of existing regional competence centres to increase the multiplier effect of energy-efficient refurbishment, with new partners joining the network constantly. Within such networks highly qualified energy consultancies are essential.", *Energy Efficient Residential Housing: Chances and Challenges*, Jochen Flasbarth (President of the German Federal Environment Agency), UNECE Conference "Energy Efficiency in Housing", Vienna 23 November 2009, http://www.umweltbundesamt.de/uba-info-presse/reden/wien_energyefficiencyhousing.pdf.

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If refurbishment is, at the end of the day, voluntary, then adequate change may not happen. Enabling transformation without unnecessary coercion will be a particular challenge but one that should be possible once governments accept the vital importance of action on energy efficiency and as property values reflect standards of energy efficiency. As already noted, the lack of priority for energy efficiency shown at present by the EU and by most Member States makes progress very difficult.

As was noted by Professor Mitchell (Section 10.3 above) major change has happened in the past in the UK as when the gas supply was changed from town gas to natural gas. Every house on gas was visited by engineers to change fittings on gas appliances and very few homes on natural gas now do not have central heating that was installed after the switch to natural gas. Slum clearance was also undertaken on a large scale in post-war UK with whole neighbourhoods being demolished and residents sometimes being moved to new towns far away. Refurbishment is more disruptive than changes to gas appliances but not dissimilar to initial installation of central heating and far less disruptive than demolition!

People accepted the disruption during the change from town gas to natural gas because they knew they would get many benefits – including central heating, another disruptive installation. Indeed, there is continual upgrading of homes going on, often with considerable disruption – for example, the installation of a new kitchen or bathroom. Occupants accept the disruption and often significant cost because of the future benefits in terms of comfort they perceive.

So, disruption in homes is already common-place but, to date, the aim is usually increased comfort or convenience rather than increased energy efficiency. What can help make disruption that greatly enhances energy efficiency equally acceptable will be the knowledge and expectation that, as well as greatly reduced running costs, comfort and well-being will be greatly improved throughout the home or building – which is a benefit that refurbishment to passivhaus standard brings. As we note in the next Section, the economics of refurbishment to low-energy standards become much more attractive if work is carried out at the same time as other disruptive improvement work.

Such comfort benefit underlines the importance of aiming for passivhaus quality whether in new build or after refurbishment. There are many benefits indeed for building owners and occupiers alike. Not only greatly reduced fuel bills but a much improved and more pleasant internal environment that can make a major contribution to individual and societal health and well-being in homes, in schools, and in other buildings.

It is vital that these benefits become widely known and understood – at present this is not happening, as noted in Section 8, and this lack of awareness is a major barrier to uptake of passivhaus quality more widely. Appreciation of the benefits will also help create value that will be reflected in price and will help making refurbishment a practical proposition.

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The new passivhaus homes built by Hastoe Housing Association[291] at Wimbish in Essex in the East of England have recently been occupied[292]. The comments by occupants reflect the impression these new passivhaus homes make:

"As a passivhaus resident I am already enjoying a more comfortable, healthier home with economical savings to come; before I moved in, I knew that filtered fresh air, a constant pleasant temperature and plenty of natural light were benefits that could only enhance my well-being,";

"We love it! Our old house was so cold and damp; we are really happy here."

"The great thing about living here is that it's so easy to use. It requires such little thought to live in and keep cool."

The benefits claimed by these residents are a clear acknowledgment of the well-being created by life in a passivhaus home.

Indeed, passivhaus ambition not only tackles energy use and associated costs for heating and cooling but can provide a platform to enable further progress in energy efficiency.

As its part of an EU-wide initiative, the UK is planning[293] a roll-out of so-called 'smart meters' to 30 million homes and business premises between 2014 and 2019. A smart-meter in every home should be a catalyst not just for energy suppliers to improve efficiency of supply but for providing advice on refurbishment and on occupant behaviour, and maximising energy efficiency in homes and more widely.

The visit to every home, not just in the UK but across the EU, that will be part of the smart meter roll-out, could be an opportunity for expert advisors to assess every property in detail in terms of refurbishment works necessary to upgrade to very high standards of energy efficiency[294]. Creating such a database could be hugely beneficial in organising and undertaking future refurbishment work. It would be very helpful if this opportunity is used to the fullest extent possible, consistent with consumer protection, to create synergy with fabric refurbishment and also to engage with occupant behaviour.

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291 http://www.wimbishpassivhaus.com/.

292 Build with CaRe has worked with Hastoe to plan the monitoring of the properties, see http://wimbishpassivhaus.blogspot.com/2011/03/tsb-funding-secured-for-in-depth-study.html.

293 http://www.decc.gov.uk/en/content/cms/news/pn11_032/pn11_032.aspx.

294 The assessment of measures likely to be feasible under the UK's Green Deal will be very rapid and possibly rather superficial. As it is energy companies that will be installing smart meters, it could be sensible to request an obligation on the energy companies to have a detailed assessment of each property undertaken when properties are visited to check about smart meters, and to make the results of the assessment available to the occupier and other relevant bodies so that full knowledge of refurbishment options is available. There is a great opportunity to gather important information but a great problem also concerning the manner of smart meter introduction as we note.

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However, there are major concerns associated with the fact that, in the UK at least, the smart meter roll out is to be undertaken totally by the energy companies and the predicted £11.3billion cost passed on to consumers through their energy bills. As Which? Magazine has warned[295]: *"Great though smart meters are, we're worried that energy companies have spotted an excellent opportunity to sneak sales people through your front door. Our research shows that 93% of people wouldn't let an energy salesperson into their home, and 30% wouldn't even open the door to them."*

Concerns over the lack of ambition of energy companies in promoting energy efficiency have already been outlined (Section 10.3) and the manner in which the present electricity supply networks inhibit progress in Section 2. Separately from its concern about energy companies using the smart meter campaign to press sales opportunities – with awareness of the public's lack of trust in energy sales people – Which? Magazine has also warned[296] about the potentially escalating cost of the programme: *"Which? believes that the roll-out is flawed as it has the potential to further undermine consumer confidence as well as cost consumers millions more than the initial estimate."* So has the UK National Audit Office[297]: *"...today's report identifies uncertainty, based on the evidence available so far, about the extent to which smart meters will result in changed energy use by consumers over a sustained period. The Department has still to develop its benefits realisation plans and consumer engagement strategy."* So has an industry insider – from an EU perspective[298] - who says of the involvement of the energy companies: *"You have to leave this to the free market. My smart meter should belong to me, not to the network company. All they will do is just change the meter from electro-mechanically to electronically driven with remote reading. They will manage to block a lot of other innovations."*

On the one hand, the introduction of smart meters brings a one-off opportunity to gain an essential understanding of the 'deep' low-energy refurbishment requirements of almost every building in the EU. On the other hand, at least in the UK, the mode of smart meter introduction provides little confidence that such information either will be collected, or, indeed, could be collected while retaining the confidence of owners and occupiers. This is a most unsatisfactory situation.

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295 *Our smart meter challenge to help stop stealth sales*, Jenny Driscoll, Senior Advocate, Energy & Home, 11 July 2011, http://conversation.which.co.uk/energy-home/smart-meter-stealth-sales-which-challenge/#more-14536.

296 *Time to stop and review the smart meter roll-out: Which? says DECC should stop and think*, 15 January 2012, http://www.which.co.uk/news/2012/01/time-to-stop-and-review-the-smart-meter-roll-out-276712/.

297 *Preparations for the roll-out of smart meters*, National Audit Office, 30 June 2011, http://www.nao.org.uk/publications/1012/smart_meters.aspx.

298 *Pier Nabuurs, Chairman Smart Energy Collective, ex-CEO KEMA, on how to go forward with liberalisation and smart grids: 'My smart meter should belong to me, not to the network company'*, Karel Beckman, 19 December 2011, http://www.europeanenergyreview.eu/site/pagina.php?id=3431.

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As buildings, homes in particular, become more energy efficient, occupant behaviour will become more prominent in determining total energy use. Social housing providers, in particular, have the capability to engage with tenants to understand behaviour and to influence it in ways that can lead to good practice and excellent energy efficiency. But the advent of smart meters in every home and many businesses provides the potential to engage with everyone. If done with appropriate safeguards, major efficiency gains are possible.

Similar considerations apply across the EU but there seems little indication of any joined-up thinking at present. There is no indication either that such information collection relevant to refurbishment or that productive engagement with occupiers is currently planned. Not to enable such information collection and such engagement would be a huge waste of opportunity.

Mere provision of smart meters may stimulate some consumers to act on energy use and to develop more energy efficient lifestyles, but the great majority of consumers may not find the enthusiasm to make many changes. Indeed, given the lack of trust created by the behaviour of the major energy suppliers in the UK, it is quite likely, as Which? has highlighted, that a majority of consumers will see the smart meter not as a device to help save energy but as a ploy by the energy companies to sell more services.

Hence, it will be critically important to develop ethical but effective ways to engage with consumers and to use the information that smart meters can potentially provide. City-based energy companies such as Hamburg Energy (Section 10.9) or initiatives such as the Bremen Bauraum (above, this Section), that will have the confidence of consumers, unlike the energy companies, and also have a remit to promote energy efficiency, might be the most effective vehicles for the introduction of smart meters and for gaining the maximum benefit for consumers.

There is currently much talk about 'nudging' people to become more energy efficient and sustainable in their lifestyles but, as contributors to a Green Alliance[299] discussion have made clear, such change is impossible at present and will remain so until governments act to make clear that energy efficiency is an absolute priority[300].

These Green Alliance contributors point out: *"While the government busily introduces tiny green nudges, the very way our economy and existing policies are structured screams out a very different message. People are nudged, prodded,*

299 Green Alliance is an influential environmental think tank working to ensure UK political leaders deliver ambitious solutions to global environmental issues, http://www.green-alliance.org.uk/.

300 *Nudging people towards greener living would be great – but it's not happening*, Rebecca Willis, 28 March 2011, http://greenlivingblog.org.uk/2011/03/28/nudging-people-towards-greener-living-would-be-great-but-its-not-happening/; *Nudging individuals will never be enough*, Tim Jackson, 30 March 2011, http://greenlivingblog.org.uk/2011/03/30/nudging-individuals-will-never-be-enough/; *The problems with nudge*, Lorraine Whitmarsh, 31 March 2011, http://greenlivingblog.org.uk/2011/03/31/the-problems-with-nudge/.

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poked and shoved many times a day, every day: and nearly always in the wrong direction." (Rebecca Willis); *"Change will be impossible without strong leadership and investment from governments. ... The transition to sustainable living demands changes in underlying structures – changes that strengthen social behaviour and support the social good. Government is the principal agent in this task."* (Professor Jackson); *"Nudge can help in uptake of low-carbon alternatives, but those alternatives have to be put in place."* (Dr Whitmarsh).

A commitment by government to radical action on energy efficiency, with building refurbishment leading the way, is the kind of signal that is needed. A real and tangible alternative is indeed then put in place. Government has to be the principal agent to lead the process. Smart meters could then be seen to be a helpful part of the process.

There is a hierarchy of actions in planning energy efficiency in buildings.

- Firstly, it is essential to reduce energy waste for space heating and cooling. Aiming to achieve passivhaus standards and quality is the essential first step.
- Once this ambition is in place then efficiency for production and storage of hot water can be tackled. We mention hot water below in discussing energy storage (Section 10.8).
- Then there is energy efficiency in appliance use which, as with all use of energy, has two components, the appliance itself and individuals' purchasing, behaviour and use patterns.

If governments are seen to be serious in dealing with the biggest waste of energy, space heating and cooling, by vigorously promoting and supporting construction and refurbishment to passivhaus quality, then there can be effective debate with appliance makers to bring down energy use very sharply, almost certainly technically possible in very many cases[301].

Likewise, if residents and business people sense the urgency for energy efficiency that must, first of all, come from government, then it will be possible to engage in effective ways to help enable more energy efficient behaviour. If these building blocks are in place, smart meter installation and use provides a significant opportunity to make real progress.

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301 As a recent Green Alliance blog makes clear, there is still as long way to go: *The rise of the screens: why electricity use keeps increasing*, Rebekah Phillips, 6 October 2011, http://greenlivingblog.org.uk/2011/10/06/the-rise-of-the-screens-why-electricity-use-keeps-increasing/; this blog refers to the Energy Saving Trust report on appliance use that we have noted above in Section 4: *The elephant in the living room: how our appliances and gadgets are trampling the green dream*, Energy Saving Trust, 4 October 2011, http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/The-elephant-in-the-living-room.

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10.6. Innovative thinking on financial support for 'deep' refurbishment

One major problem that arises in discussion of refurbishment is that of cost. Many energy efficiency measures, including many within buildings such as insulation, more than pay for themselves[302] but are still not undertaken[303]. The proposed Green Deal programme in the UK aims specifically to overcome the barriers that prevent low-cost efficiency measures in buildings being undertaken. However, as discussed in the accompanying paper, *Green Deal Appraised*[304], many of the measures that will be necessary to accomplish 'deep' refurbishment to achieve passivhaus or near passivhaus standards – with a reduction in total energy use of well over half – will not pay for themselves within a Green Deal package. These latter measures might include solid wall insulation, removal of all thermal bridges in balconies and other structural elements, installation of triple-glazed windows and warm roof conversion. A few of these works, in particular solid wall insulation, are planned to be funded in the UK by the proposed Energy Company Obligation, the ECO, and we have expressed concerns about this above (Section 10.3) along with concerns about the problems of 'lock-in' of energy use and emissions if a 'whole house approach' is not undertaken when planning refurbishment. What can be done?

There are two important aspects of financing refurbishment that need to be considered.

Firstly, over the longer-term, as we show below, there should be finance that can be unlocked. What is required is innovative ways to make this available to fund actual refurbishment.

Secondly, as noted in the previous section, if refurbishment is undertaken at the same time as other improvements to a building, as some examples by Build with CaRe partners show, then the economics become much more favourable.

This combination of works creates the favourable economic case for the low-energy refurbishments in Sweden and Holland noted below and in the next Section. There

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302 For example see *Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve*, McKinsey&Company, 2009, http://www.mckinsey.com/en/Client_Service/Sustainability/Latest_thinking/Pathways_to_a_low_carbon_economy.aspx.

303 There are several reasons for the lack of investment in energy efficiency which are discussed in detail, for example, in *Quantifying the Effects of Market Failures in the End-Use of Energy*, Final Draft Report Prepared for International Energy Agency, American Council for an Energy-Efficient Economy, Washington DC, February 2007, http://s3.amazonaws.com/zanran_storage/www.aceee.org/ContentPages/4790329.pdf and *Mind the Gap; Principal-Agent Problems in Energy Efficiency*, IEA, 2007, http://www.iea.org/textbase/nppdf/free/2007/mind_the_gap.pdf.

304 *The 'Green Deal' Appraised*, Martin Ingham, Build with CaRe, October 2011, http://www.buildwithcare.eu/articles/78-partners/219-the-green-deal-appraised.

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seems to be no acknowledgement of this critical link in the UK Green Deal proposals. Such combination also applies to major low-energy refurbishment of commercial buildings as exemplified in the renovation of the Empire State Building noted below. Thinking in this way is an example of system thinking, sadly absent from the current energy supply system as noted in Section 2, and discussed with reference to energy efficiency in Section 10.8.

There will absolutely need to be a mix of incentives, regulation and subsidy, but, looked at from a top-down perspective, financing refurbishment should not be a show-stopper if the right players with long-term perspectives can get involved and if the appropriate works are done in the right way.

We note below some of the investments in 'deep' refurbishment that have already been made by building owners with a longish-term perspective and then outline the potential sources of finance that might become available for owners where the up-front costs of 'deep' refurbishment might be unaffordable.

Buildings are a long-term investment. Mortgages are often for twenty-five years. The finance to undertake refurbishment on the scale required should also have a long-term perspective, possibly over an even longer time horizon as most homes and buildings are expected to remain in use for forty years or more. Once Government commitment is made clear, investors can potentially raise funds at low-rates over the long-term. This will become easier to achieve when, as will almost certainly happen, energy efficient buildings are valued more highly than those that are less efficient[305]. How this happens will emerge in time but there are already interesting arrangements being made for new housing[306] and extension of such activity to the refurbishment sector is an obvious next step. The impact of occupant preference for the comfort and well-being that passivhaus quality brings, together with regulation and incentives, will help drive assessment of value.

The commercial sector and the social housing sector both normally take a long-term perspective as regards investment in buildings. In both cases, 'deep' low-energy refurbishments have been undertaken as part of more extensive renovations that make sense economically.

Examples in the social housing sector include the refurbishment at Brogården, Sweden, already mentioned (Sections 9, 10.1, 10.4), and refurbishment of

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305 At the present time, certainly in the UK, house prices do not seem to include any positive contribution reflecting above-average energy efficiency. However, in the commercial office market, there is already discussion of a "grey discount" where poor energy efficiency leads to lower rental rates. See, for example, a recent paper from Low Carbon Workplace Ltd: *Less embodied carbon, more value? The relative impact of operational and embodied carbon on the value of commercial office stock*, September 2011, http://www.lowcarbonworkplace.com/PDF/LCW%20paper%20Less%20embodied%20carbon%20more%20value%20Sept%202011.pdf. As the health and well-being benefits of low-carbon homes become more widely understood, such up-lift should transfer also to the domestic sector.

306 Aviva completes £45m homes transfer, Carl Brown, Inside Housing, 13 September 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6517738.

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apartments by social housing provider alleewonen at Roosendaal in The Netherlands[307]. If the renovations are done but not the low-energy refurbishment, however, then the economics may change. It may well not be cost effective to revisit the properties at a later date to do just the low-energy refurbishment. Indeed, for just this reason, alleewonen do not go back to do energy-related refurbishment on properties that were upgraded for other reasons prior to their decision to undertake 'deep' low-energy refurbishment. Such thinking applies to almost every refurbishment/renovation and we have mentioned above the problem of lock-in of carbon emissions and energy inefficiency if 'deep' refurbishment is not fully undertaken when work is done.

These social housing providers have made clear the financial problems that tenants will experience if fuel prices continue to rise while buildings remain energy inefficient. Payment of rents plus energy costs will become increasingly difficult for many. If, however, homes are refurbished to become very energy efficient, then there is the potential to manage costs. Indeed, increased rents, necessary to fund refurbishment costs, can be offset, for tenants, by reduced fuel costs in apartments refurbished to 'deep' low-energy standards as alleewonen has shown at Roosendaal.

Similar arguments apply in respect of construction of new build homes which is a particular reason why Hastoe Housing Association in the UK, noted above (Section 10.5), is pursuing passivhaus construction. If more developers could be persuaded to be innovative like Hastoe in the UK and other social housing providers elsewhere, then costs would be driven down rapidly and supply chains developed. Refurbishment would benefit from innovation in new build.

The refurbishment of the Empire State Building in New York[308] is a high-profile example of low-energy refurbishment of an iconic commercial building, anticipated to save 40 per cent of the energy use, double the saving typically achieved in such commercial building retrofits. The energy efficiency work was part of a more extensive $550m whole-building renovation project and is expected[309] to have a three-year pay-back. While this project left some energy efficiency work not done for commercial reasons, what it clearly showed was the importance of treating the whole building as a system[310],[311] and not picking off individual components in a silo

307 Presentation by Erik Franke, Franke Architekten, Build with CaRe conference, Norwich, October 2010, accessed via http://www.buildwithcare.eu/.

308 See Empire State Building Fact Sheet, http://www.esbnyc.com/documents/press_releases/ESB_Retrofit_Fact_Sheet_FINAL_07_26_10.pdf.

309 *Empire State Building's green transformation earns LEED Gold*, Leslie Guevarra, GreenBiz.com, 14 September 2011, http://www.businessgreen.com/bg/news/2109048/empire-buildings-green-transformation-earns-leed-gold.

310 Empire State Building, Sustainability and Energy Efficiency, Lessons Learned, http://www.esbnyc.com/sustainability_lessons_learned.asp.

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approach as is often done in a multi-tenanted building (and as is likely to be done in a UK Green Deal package).

Notwithstanding such examples, however, at present, whether in the social housing sector or the commercial sector, they are the exception rather than the rule. As Lauralee Martin of Jones Lang LaSalle, one of the companies involved in the Empire State Building refit, has made clear[312]: *"Every large building in every city can feasibly do the same thing, and if they did, the reduction in greenhouse gas emissions would be historic."* However, at present, this is not happening for a range of reasons described by Ms Martin. It is disappointing, for example, that the current, otherwise exciting, refurbishment of the iconic Park Hill Estate[313] in Sheffield[314] in the UK, itself the result of earlier demolition and clearance of slum housing, mentions[315] the "shimmer" provided to the external fabric but nothing about any major improvement in energy efficiency as undertaken in the refurbishments just noted at Brogården and Roosendaal.

It now needs social housing providers to learn from what is already being done at Brogården and Roosendaal, and building owners, city officials and regulators to work together to accelerate the 'deep' low-energy refurbishment of commercial buildings. All this would be much easier to accomplish if the EU and Member States engaged seriously with energy efficiency as proposed in this paper and may be easier to accomplish on a city basis (see Section 10.9).

The majority of buildings across many EU countries, however, are homes where owners often do not have the long-term perspective that makes 'deep' refurbishment a financially feasible proposition for social housing providers and owners of commercial buildings. The UK Green Deal may help with less expensive actions but a major proportion of home owners may not easily be persuaded to invest considerable sums in 'deep' energy saving refurbishment that might take several decades to pay back in energy savings. What can be done?

Certainly, as already noted in Section 4, subsidies will be necessary as the example of Germany already makes clear: *"the examples show that public funds are one*

311 *Height of Sustainability*, Andy Pearson, CIBSE Journal, November 2011, 28-33, http://www.cibsejournal.com.

312 *Sustainable Cities, Building by Building*, Lauralee Martin, Jones Lang LaSalle, 15 June 2011, http://www.greentogoldplaybook.com/Sustainable-Cities-Building-by-Building.

313 Park Hill featured prominently in the award-winning film *The Full Monty*.

314 *Sources for the Study of Park Hill and Hyde Park Flats*, Sheffield Libraries Archives and Information, Sheffield City Council 2010, http://www.sheffield.gov.uk/libraries/archives-and-local-studies/publications/park-hill-flats.

315 *This refreshing renovation promises to bathe the 'streets in the sky' in a bold new light – but at what cost to council tenants?*, Rowan Moore, The Observer, Sunday 21 August 2011, http://www.guardian.co.uk/artanddesign/2011/aug/21/park-hill-sheffield-renovation and http://www.urbansplash.co.uk/residential/park-hill.

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success factor"[316]. These need not be for a large percentage of the cost of works because many owners will be prepared to commit a considerable multiplier if they perceive value. This will imply understanding by owners of the benefit of undertaking energy-saving measures at the same time as other works, the support provided by local facilities such as the Bremen Bauraum and by expert and reliable advice, and by confidence that works will produce the expected results and will be undertaken in a cost effective but reliable manner (refer to the key needs discussed in Section 10.5).

KfW, the German Federal Bank for Reconstruction (the Kreditanstalt für Wiederaufbau) provides loans of up to €75,000 for refurbishment with interest subsidies and partial debt relief (the details and incentives depend on the extent of the refurbishment planned and the energy saving expected). It is such financial incentives that have stimulated the refurbishment activity in Germany alongside investment in renewables. In 2009, out of €20billion invested by KfW, €9billion went towards energy efficiency in the housing sector. Depending on the city or region, further subsidy may be available. Hamburg, for example, has provided extra incentives to promote low-carbon refurbishment.

In 2008, as the financial crisis was unfolding, a group of UK economists and others closely linked with environmental issues published[317] *"A Green New Deal"*. As regards the UK, this called for *"an interlocking programme of action"* involving: *"Executing a bold new vision for a low-carbon energy system that will include making 'every building a power station'. Involving tens of millions of properties, their energy efficiency will be maximised, as will the use of renewables to generate electricity. This will require a £50 billion-plus per year crash programme to be implemented as widely and rapidly as possible. We are calling for a programme of investment and a call to action as urgent and far-reaching as the US New Deal in the 1930s and the mobilisation for war in 1939."*

As already noted in Section 4, the £200billion of funds put into the UK economy by the Bank of England in 2009 under the title of quantitative easing – supplemented recently by another £75billion - may not have provided the same benefit to the economy that carefully thought investment in building refurbishment could do. The UK Green New Deal proposal is useful because it highlights the nature of the refurbishment challenge. However, given the situation at present in the UK already noted, and probably to some degree also in several other Member States, in skills, in training, and in availability of expert advice, the areas where governments could most appropriately invest initially is in these topics (augmented to a greater or lesser

316 *Energy Efficient Residential Housing: Chances and Challenges*, Jochen Flasbarth (President of the German Federal Environment Agency), UNECE Conference "Energy Efficiency in Housing", Vienna, November 2009, http://www.umweltbundesamt.de/uba-info-presse/reden/wien_energyefficiencyhousing.pdf.

317 *A Green New Deal: Joined-up policies to solve the triple crunch of the credit crisis, climate change and high oil prices*, The Green New Deal Group, July 2008, http://www.neweconomics.org/sites/neweconomics.org/files/A_Green_New_Deal_1.pdf.

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degree we have suggested in Sections 10.4 and 10.5 by an energy company obligation funding training and related initiatives) so that, as refurbishment activity grows in scale, there is the capability and expertise necessary to ensure things are done successfully. Such investment, in any country, would have great future benefit in job creation and in competitiveness as well as in energy saving and energy security and in health and well-being.

What must not happen is a weakening of standards and ambition under the guise of promoting growth which, as noted already in Section 7, will just delay everything that is needed to enable positive change and send totally the wrong signals about government intentions (assuming that governments have an intention actually to promote energy efficiency).

The sums of money needed for building refurbishment are huge. Getting it wrong would be disastrous for everyone. The Australian experience[318], with a similar scheme to the UK Green Deal, is a salutary lesson. Highly publicised failings (poor quality, fraud, house fires and deaths) destroyed credibility and resulted in the scheme being withdrawn at great expense. Hence the over-arching importance of skills, expertise and expert advice.

If these aspects are well dealt with then taking into account the overall value tied up in the housing stock in the UK reveals the potential for funds to be available. The same situation may not apply in all EU Member States but the principles may be relevant.

A report by the Halifax in January 2010 analysed[319] UK house price inflation over the previous fifty years. After allowing for inflation, average house prices had increased by 273 per cent in real terms, much faster than earnings where the growth was 169 per cent. It has been argued[320] that the easing of credit in recent years that led to a recent surge in prices has been, to a large extent, the source of today's financial instability. An analysis[321] to 2005 of thirty years of house price inflation in the UK revealed the staggering amount of money tied up in housing debt that was not therefore available for other purposes. As Professor Ambrose noted, if, instead, prices had kept pace with earnings: *"Housing debt outstanding would be about £180billion (if RPI related) not over £800billion – the £600+billion not invested in house prices over the past 30 years might have been invested over that period in*

318 *Review of the Administration of the Home Insulation Program*, Allan Hawke, April 2010,http://www.climatechange.gov.au/~/media/publications/energy-efficiency/home-insulation-hawke-report-pdf.pdf.

319 *The UK Housing Market over the past 50 years*, The Halifax, 20 January 2010, http://www.lloydsbankinggroup.com/media/pdfs/research/2010/50_Years_of_Housing_UK.pdf.

320 *Forever Blowing Bubbles? Housing's role in the UK economy*, Tony Dolphin and Matt Griffith, IPPR (Institute for Public Policy Research), 31 May 2011, http://www.ippr.org/images/media/files/publication/2011/06/forever_blowing_bubbles_May2011_7576.pdf.

321 *UK House Prices – what if…?*, Peter Ambrose, Visiting Professor in Housing Studies, Brighton University, June 2005.

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new hospitals, new schools, housing renewal and maintenance, new water mains, research and development of all kinds of economic activity, other support for UK industry, etc. etc."

From our perspective, however, of interest now is the total value of the UK housing stock, perhaps around £4trillion[322]. The IPPR report notes that at the end of 2009, the UK household sector had debts totalling £1.53 trillion, of which £1.19 trillion (78 per cent) was secured on dwellings. This debt then leaves of the order of £3trillion of residual value in the UK housing stock.

This debt is very unevenly distributed, but nonetheless, even just 10 per cent of the residual value of the housing stock, about £300billion, approximates to our estimate of £200billion (see Section 4) to undertake 'deep' refurbishment of almost the entire stock to low-energy standards. Even if our estimate of around £200billion is too low by a factor of two, these figures still mean there should, in principle, be mechanisms that could be developed to fully fund the 'deep' low-carbon refurbishment if owners are obliged, in some way, to release about 10 per cent of the value of their homes.

Such a move might not be initially popular but, as the value of energy efficient property is, as is likely in the future, reflected in higher prices, such a transaction might be seen as advantageous on all sides. As energy prices continue to rise, it seems quite likely that the value of the most energy efficient – and hence comfortable and cheap-to-run – homes could eventually be at least 10 per cent higher than that of similar homes that are not energy efficient. What would be needed, over the long term, in addition to mechanisms for providing finance, is a combination of regulation and incentives from governments that compel owners to undertake refurbishment or to have it undertaken.

While house ownership levels and house price levels around the EU Member States vary quite widely, similar arguments are nonetheless likely to apply in most EU countries. In some Member States, social housing is a much bigger proportion of the total housing stock than in the UK and refurbishment should be easier to manage while in others the proportion in private ownership is higher than in the UK. Nevertheless, across the EU, it seems that, with the right incentives, and with the necessary commitment from the EU and from governments, institutions with long-term financial interests, for example, insurance groups and pension funds, could create the mechanisms to fund 'deep' refurbishment on a massive scale if they were rewarded with long-term value in the form, for example, of 10 per cent of the value of houses of which they had funded 'deep' refurbishment.

If a 'deep' refurbishment was made compulsory whenever a house was sold neither vendor nor purchaser might wish to have this done. But if a significant proportion of the work was funded by an institution with a very long-term perspective that then took a charge on the property to compensate, everyone could share the benefit.

322 If we assume, in rough terms, 25 million homes with an average value of £160,000. The precise numbers are not important but the rough figure, £4trillion, for the total value demonstrates the possibilities; if the average value rises to £200,000 then the total becomes £5trillion.

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The purchaser would have a much-improved property that costs little to run while the institution would possess an up-graded asset which would retain value.

A further benefit would result from the interest of the long-term funder in ensuring that work was done cost effectively and to high quality. We have noted the concerns about quality above (Section 10.4) and highlighted the need to ensure training, skill formation and learning on a wide scale, both within countries and between countries (see the next section). Long-term funders might have the biggest incentive to ensure that all this happens, much more so than energy companies whose interest (see Section 2) is in selling electricity or fuels, not in promoting energy efficiency or in ensuring long-term value.

The OECD report[323] already noted (Sections 2 and 10.1) that highlighted the need for government support for green technologies such as renewables and building refurbishment to be 'loud', 'long' and 'legal' also noted that pension funds' asset allocation to such green technologies was less than 1 per cent at present. With the right mechanisms developed, there should indeed be long-term finance potentially available and arrangements capable of development that can satisfy both investors and building owners.

Such mechanisms for financing effective whole-house 'deep' refurbishment are not discussed in the proposed UK Green Deal but must be considered if opportunities are not to be lost and a significant proportion of present-day energy consumption locked-in because only the low-hanging fruit of refurbishment needs are undertaken (as discussed in Section 10.3). One thing that must not happen is for such funds to be directed to projects that are not energy efficient such as supporting near-term new house construction to only modest standards of energy efficiency. A unique opportunity to make the progress in 'deep' refurbishment that is necessary to reduce energy use and enable a transition to a renewables economy would be wasted and the possibility of tackling climate change would be lost.

There are indeed reports[324] that the UK Government is planning to tap into large private investors such as insurance companies and pension funds to create a £50m boost to the economy for infrastructure projects including housing. This could be a tremendous opportunity to incentivise the construction industry to move faster towards low-carbon methods as we have, jointly with innovative social housing providers, recently suggested[325]. It would be short-sighted[326] not to use such an

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323 *The Role of Pension Funds in Financing Green Growth Initiatives*, Raffaele Della Croce, Christopher Kaminker and Fiona Stewart, OECD Working Papers on Finance, Insurance and Private Pensions, No. 10, OECD Publishing, 1 September 2011, http://www.oecd-ilibrary.org/finance-and-investment/the-role-of-pension-funds-in-financing-green-growth-initiatives_5kg58j1lwdjd-en.

324 *Treasury plots £50bn housing boost*, Gavriel Hollander, Inside Housing, 14 November 2011, http://www.insidehousing.co.uk/ihstory.aspx?storycode=6518998.

325 *From housing crisis to housing transformation*, UEA Press Release, 2 September 2011, http://www.buildwithcare.eu/articles/78-partners/213-2011-09-07-15-06-30 and https://www.uea.ac.uk/mac/comm/media/press/2011/September/buildwithcare.

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opportunity to move forward faster to passivhaus standards given what we now know about the seriousness of climate change.

Longer-term, which organisations, perhaps ones that presently do not exist, will actually do the huge task of refurbishment work cannot be known at this time. Concerns about the large-scale involvement of today's energy companies have been noted above in Section 10.3.

An interesting model has been developed by Hamburg in Germany, a city with several Build with CaRe partners. The city created its own publicly funded energy agency[327] in 2009 with a remit to work to develop model projects for households and to help the city create a low-carbon sustainable future. Such an organisation that brings together supply needs and energy efficiency and energy storage initiatives seems much more appropriate to coordinating and organising the refurbishment task than a company dedicated solely to energy supply.

10.7. Transnational learning and knowledge sharing

Hugely important for new build, but especially for refurbishment, is to ensure that work is done to high standard and to acceptable cost and that building owners receive clear and useful information. We have discussed these issues above (Section 10.5) and also concern about skills and quality of work in Section 10.4.

The benefit of a European project such as Build with CaRe is that participants can see how things are done in other countries and can learn from partners elsewhere.

The transnational learning and knowledge sharing that has taken place within Build with CaRe has been, without doubt, one of the most important aspects of the whole project. We have observed the benefit of a resource such as the Bremen Bauraum (see Section 10.5) and have seen how passivhaus training is developed by colleagues in Hamburg at AzB-Hamburg[328] (Ausbildungszentrum-Bau in Hamburg GmbH, the Construction Training Centre, Hamburg). These examples are already leading to initiatives at UK partners including West Suffolk College.

Of especial note has been the exchange of expertise on passivhaus construction leading to new initiatives in Norwich and elsewhere. Andrew Savage, Executive Director, Business Growth, Broadland Housing Association Ltd, spoke at the Build with CaRe conference[329] in Brussels during European Sustainable Energy Week in April 2011 describing a major new development in Norwich. This initiative has

326 The UK Government's recently published housing strategy for England, *Laying the Foundations: A Housing Strategy for England*, Department for Communities and Local Government, November 2011, http://www.communities.gov.uk/publications/housing/housingstrategy2011, does not discuss any such move towards promoting enhanced energy efficiency.

327 See http://hamburggreencapital.eu/climate-energy/.

328 http://www.azb-hamburg.de/.

329 See http://www.buildwithcare.eu/images/pdfs/build_with_care_agenda_12-04-11.pdf.

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become possible as a result of several visits by Broadland Housing staff, and others from businesses involved with their projects, to the Swedish Passive House Centre[330] in Västra Götaland, Sweden, a Build with CaRe partner, and to several passivhaus projects in the Västra Götaland region.

Together with colleagues from local housing associations, we have visited refurbishment projects such as those at Roosendaal in Holland[331] and Brogården, Sweden[332], where 1960s and 1970s apartment blocks are being refurbished to or close to passivhaus standards with energy saving for heating over 80 per cent and total energy saving up to 60 per cent. As already noted (Section 10.6), the housing associations that own these buildings undertake these works because they create value for both owner and occupiers. The works are done as part of a more extensive up-grade of the properties that makes the 'deep' refurbishment to very-low energy standards viable (Section 10.6).

The most effective way to develop the expertise, the skills and the knowledge to be able to ensure that a massive refurbishment effort can be undertaken across Europe to the quality levels necessary would be to greatly expand the kind of networking developed by Build with CaRe.

In large part, the necessary knowledge already exists somewhere. What is needed is not so much more research, as is often funded in EU-supported projects, but a massive expansion of learning exchanges. While, in the UK, there is increasing interest in passivhaus construction, the knowledge and awareness of how to do this is still very limited. Within national borders, diffusion of new knowledge can take a very long time to become widespread and common-place. But in cities such as Hamburg, and regions such as Västra Götaland, extensive knowledge and experience exists.

We have been impressed by the willingness of architects and others in partner cities and regions to share knowledge and know-how. Already, the learning undertaken within Build with CaRe has led to exciting new low-carbon construction projects that would not otherwise have happened in the same way.

Now, to support the capital investment in new build and refurbishment to passivhaus standard that needs to happen across Europe, a huge learning exchange would be extremely beneficial. Rather than a handful of architects, engineers and surveyors learning from Swedish, Dutch and German experience as has happened so effectively, but on a very small scale, within Build with CaRe, there needs to be

330 http://www.passivhuscentrum.se/.

331 Presentation by Erik Franke, Franke Architekten, Build with CaRe conference, Norwich, October 2010, accessed via http://www.buildwithcare.eu/.

332 Presentation by Hans Eek, Swedish Passive House Centre, Build with CaRe conference, Norwich, October 2010, accessed via http://www.buildwithcare.eu/ and Skanska Case Study 64, Brogården, Sweden, http://skanska-sustainability-case-studies.com/pdfs/64/64_Brogarden_v001.pdf.

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learning by thousands of people from all parts of the UK and from all EU Member States.

This is something the EU could very effectively help organise.

10.8. Systems thinking and energy storage

In Section 2 we noted the importance of considering energy use within a system if energy efficiency is to be facilitated. As renewable energy becomes a greater and greater part of the total energy mix and, in particular, as end users make efforts to minimise energy use, this systems thinking will become much more common-place. Often the energy supply system will be local, either within a city or a particular building. Many of the businesses involved are now, or will be, modest in size or focused on a particular location, perhaps a city or large town.

We note here, in particular, energy storage in conjunction with supply and energy efficiency innovation but we emphasise also the importance of systems thinking in new build and refurbishment. The passivhaus concept is innovative in thinking about a building as a system and we have noted the importance of systems thinking in undertaking effective refurbishment whether 'whole house' for domestic dwellings or 'whole building' for larger buildings as in the case of the Empire State Building noted in Section 10.6. Just as for new build, passivhaus quality brings rigour and systems thinking to refurbishment as well as the potential for transformation to reliable very low energy performance.

Energy storage can be done on a very large scale – as in pumped hydro for electricity – or on a long time-frame – as for example in the conversion of renewable electricity into renewable methane or renewable liquid transport fuels noted in Section 2. Methane and liquid fuels can be stored for years. More locally, within buildings, energy storage in the form of hot water, phase change materials, or thermal mass can be utilised to minimise system costs and greenhouse gas emissions.

District heating can reduce costs and greenhouse gas emissions compared to individual boilers in buildings. The UK demand for heat is a similar quantity to the waste heat from large electricity generating stations and from industrial processes across the country. Storage can be employed to address lack of synchronicity. More than four out of five UK homes are heated using individual gas boilers but in Denmark, in contrast, district heating supplies over 60 per cent of households and about half the space heating demand in all buildings[333].

The Copenhagen district heating system has been described[334] by one of the supplier companies with an outline of future ambitions. This document notes the

[333] Danish District Heating Association, http://www.danskfjernvarme.dk/Faneblade/OmOs.aspx?sc_lang=en.

[334] *Copenhagen District Heating System*, September 2009, http://www.copenhagenenergysummit.org/applications/Copenhagen,%20Denmark-District%20Energy%20Climate%20Award.pdf.

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significant savings in CO_2 emissions provided by district heating compared to individual systems. A country-wide ambition was also outlined[335] in 2009. This presentation notes that the Danish heating sector has reduced CO_2 emissions by 60 per cent since 1980 with a further 50 per cent reduction possible by 2020 and the achievement of almost CO_2 neutrality by 2030. It also emphasises the importance of focusing on integrated solutions, including the building envelope – on systems thinking in other words.

Heating hot water for district heating can be effected by renewable energy, either by wind and electric heating or by solar thermal methods. Graz in Austria, for example, has installed 6.5MW of solar thermal capacity[336] and the enormous potential for widespread solar thermal heating has been outlined[337]. More information is found on the Solar District Heating in Europe website[338]. The European Association for Storage of Energy, EASE, has recently been formed[339]. Solar thermal heating capacity in Denmark increased from 30 to 150MWth between 2005 and 2010 and there is expectation that solar thermal heat could provide 40 per cent of the energy needed to heat Denmark's buildings by 2050[340].

As we have already noted in respect of renewables (Section 2), there seems no reason why, with the right commitment, almost any other EU country could not have made and could not now make similar progress to Denmark in utilisation of energy storage. The UK, with its focus on continued use of fossil fuels, especially gas, has not, sadly, been prominent in promoting district heating but there are interesting energy storage initiatives now appearing, typically operated by new companies focusing on the benefits of energy storage.

For example, a supermarket in south London is storing waste heat from refrigeration, normally discharged as waste, in the ground using an advanced

335 *Heat Plan Denmark: Low Carbon Urban Heating*, Anders Dyrelund, 2009, http://www.copenhagenenergysummit.org/Low%20Carbon%20Urban%20Heating,%20Heat%20Plan%20Denmark%20paper.pdf.

336 *Austria: Solar District Heating on the Rise in Graz*, Bärbel Epp, 16 June 2009, http://www.solarthermalworld.org/node/656.

337 *Action Plan for 50%: How Solar Thermal Can Supply Europe's Energy*, David Appleyard, Associate Editor, Renewable Energy World, 15 April 2009, http://www.renewableenergyworld.com/rea/news/article/2009/04/action-plan-for-50-how-solar-thermal-can-supply-europes-energy?cmpid=WNL-Friday-April17-2009.

338 http://www.solar-district-heating.eu/; detailed information at http://www.solar-district-heating.eu/LinkClick.aspx?fileticket=0miWQCr16_I%3d&tabid=69.

339 *Creation of EASE: European Association for Storage of Energy*, 29 September 2011, http://www.internationalsustainableenergy.com/3476/news/creation-of-ease-european-association-for-storage-of-energy/.

340 *Denmark: Solar District Heating Capacity increases 5-fold*, Bärbel Epp, 10 February 2011, http://www.solarthermalworld.org/node/3069.

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ground-source heat pump[341]. It is estimated that this technology, developed with a local renewable energy start-up company, could cut the store's overall energy consumption by about 30 per cent. An innovative district heating system with two large thermal stores has recently been opened at a site with 750 new homes in Sussex[342] and a UK company has developed interseasonal heat storage for heating and cooling applications[343],[344].

Aquifer thermal energy storage (ATES), developed particularly in The Netherlands[345], is now being considered as a potential low-carbon technology to provide heating and cooling to several buildings in London's South Kensington[346],[347]. The Victorian museums including the Natural History Museum, the Victoria and Albert Museum and the Science Museum, along with the Royal Albert Hall, are very big users of energy for heating while Imperial College, also in the proposed system, needs principally cooling. This 20MW scheme, if it goes ahead, would be the largest ATES project in the world and demonstrates the benefits of systems thinking, not just within a single building but within a locality, and not just to meet daily needs but taking account of inter-seasonal balances. Mott MacDonald, the firm leading the technical study, hopes to use the existing Victorian network of tunnels beneath the institutions for the pipework needed to pump the warm and cold water.

While Denmark is leading in penetration of renewables, in district heating and in energy efficiency standards for homes, it is disappointing that such examples of energy storage from the UK are isolated and uncommon. Sadly, the UK is probably more typical of Europe as a whole and, as with renewables and energy efficiency standards already discussed, it is urgent that these energy-saving systems become common-place. Once again, this will require political will to move the market-place faster.

As buildings become refurbished and much more energy efficient, all kinds of options become interesting. The capital intensity of district heating systems may not always be required. One innovative mini-CHP and heat storage system was

341 *Sainsbury's - looking to geo-thermal energy to make savings*, Simon Beavis, guardian.co.uk, Thursday 26 May 2011, http://www.guardian.co.uk/sustainable-business/sainsburys-geo-thermal-energy-savings.

342 *Energy centre opens at landmark carbon neutral development*, 17 October 2011, http://www.building4change.com/page.jsp?id=995.

343 ICAX Ltd, http://www.icax.co.uk/.

344 *Skins of power – buildings as energy collectors*, Bill Holdsworth, Green Building Magazine, Autumn 2008, 48-51, http://www.icax.co.uk/pdf/SkinsOfPower.pdf.

345 *Aquifer thermal energy storage: theoretical and operational analysis*, J S Dickinson, N Buik, M C Matthews and A Snijders, Géotechnique (2009) 59, 249-260.

346 *Museums take underground route to energy saving*, Gill Plimmer and Will Hurst, Financial Times, 24 November 2011, http://www.ft.com/cms/s/0/8637cae2-1687-11e1-bc1d-00144feabdc0.html.

347 *How many holes to heat the Albert Hall: Urban Scale Sustainable Heating and Cooling*, New Civil Engineer Infrastructure 2012 Special Report, pp28-31.

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demonstrated to us recently in a 1950s apartment block being refurbished to passivhaus standard in Hamburg, Germany. The heating and hot water were provided by a gas engine that was also generating electricity supplied to the grid. Heat storage was provided in the form of large cylinders of hot water enabling the engine to run only for a few hours a day when the price of electricity is highest, or when the thermal stores are depleted. Once again, the supplier is a small company supplying principally sustainable energy systems.

Three things are noteworthy and different about this set up. The first is that a single unit only a little larger in capacity than a typical gas boiler found in a single UK house is providing all the heat and hot water for 27 apartments. Refurbishment to passivhaus standards, and the use of hot water storage, makes a massive difference to the required capacity of heating systems.

The second is that this unit can be linked to a control centre, along with thousands of similar units, to provide what the operator, Lichtblick, calls "swarm electricity"[348]. While the heat from this mini-CHP unit provides local heat and hot water, the electricity is fed to the grid. Because of the hot water storage installed, the unit is run for only a few hours each day when the electricity demand is greatest. 100,000 such units connected up will make a highly responsive part of the renewable energy network. Compare this to a massive central gas power station producing a similar electrical output of 2500MW. At least as much heat energy again is wasted. Combined heat and power is achieved in "the swarm" without the need for extensive roadworks necessary to install a conventional district heating system. The generating capacity of a large power station can become available with a distributed network installed in individual buildings.

There are several mini-CHP systems of comparable size available using automotive or similar small gas engines, and these are now commonly installed in energy efficient apartments in Germany, but the ability to couple up potentially thousands of individual units is a new and exciting innovation.

The third point to note is that the innovators are new entrants not established energy supply companies - for which such a system would be a threat to their existing business (see Sections 2, 10.1, 10.3). Volkswagen brings expertise in engine technology while Lichtblick is a new entrant to the energy supply business with only a few hundred thousand customers. Once renewable methane is available, either as biomethane from anaerobic digestion plants or, in the future, from renewable hydrogen and atmospheric carbon dioxide, then mini-CHP systems could be running on a fossil-free gas grid.

Such "swarm electricity" based on mini-CHP units is not an obvious new development but is an example of the innovation that is both possible and necessary if there is to be a transition to an energy efficient economy. To date, innovation in energy supply and storage has been slow and has not penetrated to any significant

348 http://www.lichtblick.de/h/english_information_395.php.

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degree in most EU countries. Often, governments, as in the UK, have been overly influenced by traditional networks and suppliers as discussed above (Section 10.1).

It is urgent now that such inappropriate and out-of-date thinking is overturned and that local energy supply and storage, integrated with innovative concepts such as "swarm electricity", develop rapidly, and hand-in-hand with rapid advances in 'deep' energy refurbishment of buildings. Only if such system thinking, often developed on a local basis, is enabled to develop to its full potential can energy efficiency be maximised, greenhouse gas emissions minimised, and energy security be guaranteed.

Looked at from another perspective, the building and refurbishment of buildings to or close to passivhaus standards creates the potential for simplified and local energy storage. This is why 'deep' low-energy refurbishment and local energy supply are so complementary. We have noted in Section 6 work on 'zero-energy buildings' and 'energy plus homes' in Germany, Austria and Sweden[349]; these initiatives all assume construction to passivhaus standard before local energy supply is added. On a more comprehensive perspective, the benefits of local, small-scale energy supplies have been outlined in detail by Amory Lovins and colleagues[350].

10.9. Cities enabled to lead

It is likely to be cities that stimulate the necessary innovation and transformation both in 'deep' refurbishment on a large-scale street and area basis and in local systems thinking and energy storage. Over half the global population is now thought to live in urban rather than rural areas. In European countries such as the UK, the proportion is even higher.

Already, progressive cities in Germany such as Hannover and Hamburg – where Lichtblick (Section 10.8) is based – are stimulating low-carbon and passivhaus construction and refurbishment, and promoting energy suppliers that focus on efficiency and assist consumers to reduce their use. Hamburg's ambition for one region of the city is described in English in a recent book[351] published by IBA_Hamburg[352], a Build with CaRe partner. Hamburg Energy operates for the benefit of the city[353].

As the Energy Atlas notes: *"In a large, modern city little is not related to energy. The conversion of the energy system is therefore a complex task. The complexity also*

349 See, for example, http://www.plusenergiehaus.de/ and http://www.nollhus.se/.

350 *Small is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*, Amory B. Lovins et al (Earthscan Ltd, 2003); see also http://smallisprofitable.org/.

351 *Energy Atlas. Future Concept: Renewable Wilhelmsburg*, IBA Hamburg (Jovis Verlag, 2011)

352 http://www.iba-hamburg.org/de/00_start/start.php.

353 http://www.hamburgenergie.de/ueber-uns/unternehmen.html.

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harbours tremendous potential, however, for energy supplies based on renewable sources will mean that the intelligent integration of energy production, distribution, and consumption will play a key role." Cities such as Hamburg are aware of the importance of renewable energy, of systems thinking, and of energy efficiency that this paper has emphasised but that some national governments seem not yet to grasp. Governments should therefore enable cities to make key decisions and investments that can drive forward innovation.

There is some recent hope in the UK that more responsibility for financial expenditure may be transferred from central government to the larger cities[354] although the details remain to be defined. It has been noted[355] that 72 per cent of UK spending is decided centrally as opposed to just 19 per cent in Germany and 32 per cent in France.

Cities driving forward an energy supply, energy storage and energy efficiency transformation may well lead the way in the innovation and change that is so necessary if 'deep' low-energy transformation of the building stock is to happen. Metrex is a self-help network of practitioners in spatial planning and development at the metropolitan level[356]. The EUCO2 80/50 project was promoted by Metrex in 2008 to explore an appropriate and effective metropolitan response to the issue of greenhouse gas emissions. The Metrex study on planning for energy in metropolitan areas[357] makes it clear that the first target for energy self sufficiency is the reduction of waste energy, particularly from buildings: *"More urban energy is wasted than is used. More greenhouse gas emissions come from wasted energy than from used energy. So there is absolutely no doubt that the first target for energy self sufficiency is the reduction of waste energy, particularly from buildings."* Once again, making buildings very energy efficient is the critical step forward.

Particularly exciting is the related conclusion from the Metrex study that new technologies are opening up opportunities for urban land and buildings to become sources of energy supply and for metropolitan areas to become power stations of the future: *"Dramatically reduced energy demand from buildings and vehicles opens up the prospect of metropolitan renewable energy self-sufficiency. Whereas the need for urban areas to become more efficient in their use of energy is well understood, what is not yet so fully appreciated is their energy generating potential. ... New technologies are opening up opportunities for urban land and buildings to*

354 *Unlocking Growth in Cities*, Cabinet Office, 8 December 2011, http://www.dpm.cabinetoffice.gov.uk/sites/default/files_dpm/resources/CO_Unlocking%20GrowthCities_acc.pdf.

355 Quoted in *Clegg in pledge to take on 'baronial' Whitehall*, Yorkshire Post, 9 December 2011, http://www.yorkshirepost.co.uk/news/at-a-glance/main-section/clegg_in_pledge_to_take_on_baronial_whitehall_1_4045216.

356 http://www.eurometrex.org/.

357 http://www.eurometrex.org/E-MA/Docs/EN_EMA_Booklet_.pdf.

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become sources of energy supply and for metropolitan areas to become power stations of the future."

This potential for energy self-sufficiency within Europe's metropolitan areas is poorly appreciated at present. As well as innovations such as 'swarm' electricity based on thousands of mini-CHP units (see Section 10.8), no doubt electricity will be generated in coming decades by large-area building-integrated photovoltaics, possibly based on dye-sensitised solar cells such as the technology recently demonstrated in Wales[358].

There is indeed already admirable activity in many EU cities[359] but the message from this paper is that progress must proceed much faster. Long-term targets are admirable but short-term action is essential.

There is tremendous potential for innovation that can dramatically and beneficially transform our energy landscape. It is likely that this innovation will emerge in cities, will be led by new entrants and will operate in very different ways to the grid system developed some generations ago. It will be possible to create a prosperous and sustainable low-carbon economy based on renewable energy and energy efficiency. These two must advance hand in hand.

As this paper has attempted to describe, building refurbishment to 'deep' low-energy standards must form the major component of the energy efficiency transformation. There are major barriers to achieving what is necessary but, with the political will at government level, cities and regions, by innovating and by sharing knowledge, can drive forward change.

"The best way to predict the future is to invent it",

Alan Kay, computer pioneer[360]

358 http://www.dyesol.com/index.php?page=Dyesol+Commercialisation+of+DSC.

359 See about Energy Cities: http://energy-cities.eu/-ABOUT-.

360 Alan Kay worked at Xerox Palo Alto Research Center from 1972 to 1983. He is one of the inventors of the Smalltalk programming language and one of the fathers of the idea of Object Oriented Programming. He is the conceiver of the laptop computer and the architect of the modern windowing GUI, used first in the Apple MacIntosh and later in Microsoft Windows. Xerox did not support Kay's ideas - the company could not see beyond their existing product line of photocopier products. But when Steve Jobs and some other Apple pioneers visited PARC in 1979, they recognized immediately that Kay's ideas were the way of the future. When Jobs saw a prototype with a GUI and a mouse, he had an epiphany: *"I thought it was the best thing I'd ever seen in my life. Within ten minutes it was obvious to me that all computers would work like this some day"*. See http://www.smalltalk.org and http://ei.cs.vt.edu/~history/GASCH.KAY.HTML.

Build with CaRe is a project partly funded by European Regional Development Fund.
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