Refurbishing Europe

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

Executive Summary

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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.

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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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

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

Alan Kay, computer pioneer[4]

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[4] 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.

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