# THE RESEARCH PROGRAMME

## RATIONALE

According to the International Energy Agency, existing buildings account for approximately 40% of the world's total primary energy consumption and 24% of the world's $CO_2$ emissions. There is a great opportunity to make significant reductions in demand, thereby reducing the need for supply and end-use energy costs. The introduction of effective energy efficiency measures in the built environment is therefore essential if governments and business are to address successfully both energy security and ambitious carbon reduction targets.

Similarly, rising energy costs encourage households and businesses to reduce energy consumption. There is a growing body of evidence that 'greener', more energy efficient buildings are valued more highly in the property market than conventional buildings, which increases the commercial incentive to invest in properties with improved sustainability performance. Investments in energy efficiency may also be an important contributor to economic recovery.

In 2011 the Energy Efficiency in the Built Environment (EEBE) research programme with Grosvenor and Cambridge University is delivering three main research outputs that have practical relevance and which will help property owners and developers establish optimal strategies for energy management. The research will be presented in three streams:

1. generating and using scenarios for the future of energy management in the built environment;
2. investigating the interventions needed to overcome barriers to energy efficiency; and
3. contributing to the understanding of the current policy landscape and trends.

For additional information about the research programme or the research streams, please use the contact details provided on the back of this publication.

## RESEARCH STREAM 2: BARRIERS AND INTERVENTIONS

The Intergovernmental Panel for Climate Change (IPCC) state that 'there is a high degree of certainty that there is a global potential to reduce greenhouse gas emissions by approximately 30% of the projected baseline from the residential and commercial sectors cost effectively by 2020'. This indicates that buildings represent a substantial proportion of 'low hanging fruit' in improving energy efficiency and reducing the undesirable social and environmental impacts of energy use on the global economy. The unrealised potential that currently exists provides evidence of barriers to behavioural change towards further improvements in energy efficiency.

This publication identifies and describes some of the barriers to achieving energy efficiency most common in the property industry and categorises them into a conceptual framework, and nominates appropriate interventions. An overview of research being undertaken by EEBE to overcome these barriers is given, explaining which barriers the projects address, significant outcomes, and likely implications for the property industry.

Through providing this series of documents for industry, EEBE is seeking to address the 'information and awareness' barrier identified within this publication. Collaboration between researchers and industry is important in order that knowledge can be shared and disseminated to continue confronting the barriers to energy efficiency.

Sources used for this publication can be found in the accompanying report which is available on request.

# THE RESEARCH PARTNERSHIP

## ENERGY EFFICIENCY IN THE BUILT ENVIRONMENT (EEBE)

Grosvenor and Cambridge University have joined together to undertake research into 'Energy Efficiency in the Built Environment' (EEBE). EEBE's focus is the reduction of primary energy use and carbon emissions in the built environment. EEBE's specific interests are assessing policies to promote energy efficiency in the built environment and developing strategies for the future of energy management. Current and planned research activities target existing and new buildings and developments as well as residential and commercial properties, with case studies from the UK and around the world.

EEBE's four aims are to:

- Explore possible future scenarios for energy efficiency in the built environment towards 2050.
- Examine the interventions needed to overcome the barriers to energy efficiency.
- Contribute to the understanding of the current policy landscape, regulations and performance of energy efficiency in the built environment.
- Promote knowledge exchange between thought-leaders in research, government and business on the theme of energy efficiency in buildings.

This Grosvenor - Cambridge initiative was established in 2008 and is based at the Cambridge Centre for Sustainable Development. Today it represents a wider consortium of companies and organisations from both the private and public sectors. Resources are made available from members of the consortium which include: Buro Happold; Department for Communities and Local Government; Department of Energy and Climate Change; Department for Environment, Food and Rural Affairs; EPSRC; Grosvenor; Jones Lang LaSalle; LessEn; SIG; and the Urban Land Institute. Other contributors have included: AEA Technology, Arthur D Little, Arup, Cambridge City Council, Cambridgeshire County Council, London Development Agency, and Westminster City Council.

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## GROSVENOR

Grosvenor is a privately owned property group active in some of the world's most dynamic cities. We recognise that our future success as a business is tied to the sustainable growth of the cities in which we have a presence. We have a vested interest in the future shape of the urban landscape and aim to help create attractive and vibrant cities in which people want to live and work.

Grosvenor is committed to achieving environmental sustainability. We aim to reduce our environmental impact by creating and managing well-designed, environmentally-sustainable buildings and places.

In 2011 we produced our first Environment Review. This is available to download at: www.grosvenor.com

Future energy challenges will inevitably impact the property sector as a whole and the industry needs to be proactive in addressing this. Through our partnership with Cambridge University we are seeking to explore potential impacts and responses and share these with the wider property sector, to help move our industry towards a more sustainable future.

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RESEARCH INTO THE FUTURE OF

# ENERGY EFFICIENCY IN THE BUILT ENVIRONMENT

## HOW CAN BARRIERS TO ENERGY EFFICIENCY BE OVERCOME?

UNIVERSITY OF CAMBRIDGE Department of Engineering | Centre for Sustainable Development

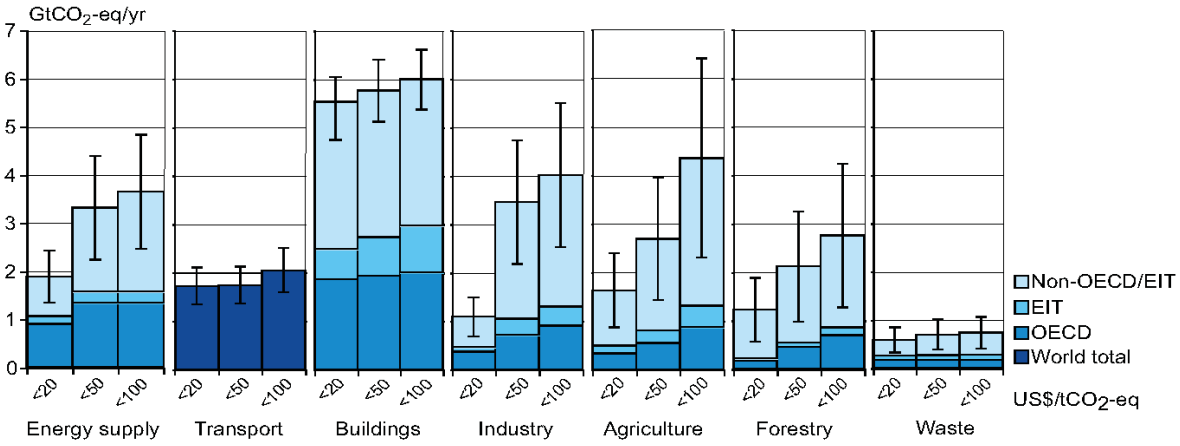
EEBE Energy Efficiency in the Built Environment

GROSVENOR

# STREAM 2: BARRIERS AND INTERVENTIONS

## BACKGROUND

Diagram showing the significance of buildings in the abatement potential of global greenhouse gas emission reduction by sector (figure taken from the IPCC Fourth Assessment Report):

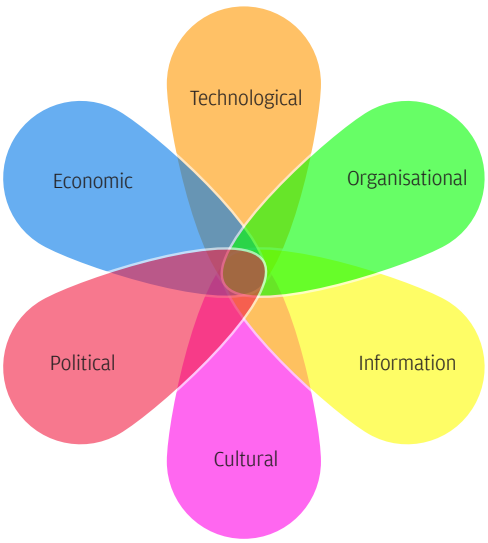



The figure above has been extracted from the IPCC Fourth Assessment Report. It shows the estimated cost of reducing the rate of greenhouse gas emissions from different sectors of the global economy. This figure demonstrates the critical role of buildings in climate change when considering climate change mitigation, both as a major contributor, and as the most cost effective opportunity for improvement.

All energy efficiency improvement strategies involve systematic efforts to overcome existing patterns of energy consumption. Through these interventions more economical practices can be encouraged, and improvements in energy efficiency realised. Such improvements have proven difficult to accomplish. One reason is that it requires the coordination of measures that can influence the behaviour of millions of energy consumers, from heavy industry to households.

From a review of literature, EEBE established six categories of barriers to energy efficiency shown in the conceptual diagram to the right. These barriers maintain inefficiencies in energy-related behaviour. It is important to note that these barriers are interconnected, which means that a number of these barriers may be addressed by a single intervention.

The barriers to energy efficiency in the built environment may be conceptualised by the diagram below:




The table below shows the types of policy interventions that can be made by governments to overcome the barriers to energy efficiency, along with selected examples of such interventions in different regions.

| INTERVENTION | PRICING MECHANISMS | REGULATION | FINANCIAL INCENTIVES |
|---|---|---|---|
| EXAMPLE | Feed-in-Tariffs | Approved Document Part L | Energy Star Tax Credits |
| REGIONS | Germany, Denmark, UK, USA, China, Spain | UK | USA |
| INTERVENTION | PROMOTIONAL MECHANISMS | ORGANISATIONAL DEVELOPMENT | FINANCIAL REMEDIATION |
| EXAMPLE | Energy Performance Certificate | ASHRAE | Green Investment Bank |
| REGIONS | EU | North America | UK |

# BARRIERS

In order to devise appropriate interventions to improve energy efficiency in the built environment the barriers to improvement need to be identified explicitly. The table below shows common barriers identified by EEBE:

| CATEGORY | COMMON BARRIERS |
|---|---|
| TECHNOLOGICAL | • Theoretical performance not demonstrated in reality.<br>• A disproportionate focus on new build.<br>• Insufficient investment into the research and development of new technologies.<br>• Lack of consensus surrounding solution packages, with most focus on proving individual technologies.<br>• Lack of affordable energy efficient technologies suitable to local conditions.<br>• Insufficient local capacity for identifying, developing and maintaining energy efficient investments. |
| ORGANISATIONAL | • Fragmentation of the building sector means that decisions involve multiple stakeholders.<br>• Traditional development is linear and sequential, whereas minimising energy use requires optimisation of an entire complex system.<br>• The principal-agent problem; when one party (the principal) pays an agent for a service, but the parties face different incentives which may result in undesired energy outcomes.<br>• Sector is slow to innovate and respond to change.<br>• Dominance of near monopolistic players in energy markets with little incentive to reduce demand.<br>• Emphasis on reducing capital, rather than life-cycle costs.<br>• Institutional bias towards supply side investments. |
| INFORMATION | • Lack of standardised measurement and verification protocol.<br>• Lack of consumer understanding to make rational consumption and investment decisions.<br>• Uncertainty associated with energy savings. |
| CULTURAL | • Religious, ethnic or national traditions that influence energy related behaviours.<br>• Community or family dynamics.<br>• Contextually specific practices.<br>• Lifestyle choices.<br>• Heritage.<br>• Habits established through historical events. |
| ECONOMIC | • Market organisation and price distortions that prevent customers from appraising the true value of energy efficiency.<br>• Transaction costs, relatively high compared to other investments due to small scale and difficulty in replication.<br>• Low cost of energy relative to other concerns, such as labour, means that business can gain higher returns by investing elsewhere.<br>• Lack of consumer understanding of energy efficiency investments or perceived risk by financial institutions.<br>• Common use of inappropriate appraisal methods to calculate the value of investment decisions.<br>• Some business profits depend on the status quo (particularly in large organisations). |
| POLITICAL | • Lack of political will to adopt policies that could change lifestyles or have adverse short term effects.<br>• Policy inconsistency establishing perverse, misdirected incentives.<br>• Disjointed government with misaligned or confusing requirements or objectives.<br>• Misunderstanding of the scale of challenges faced. |

**Developing Interventions**

Having clearly identified and categorised these barriers, appropriate interventions can be more easily developed in order to address them. Interventions can be developed and enacted through government, industry, both the public and private sectors, academia, and even through individual action.

The table on the page to the right provides an overview of the research being undertaken by EEBE to overcome barriers. Published projects are listed with the date of publication. For each project the barriers being addressed have been indicated, along with a colour that highlights the predominant focus.

# EEBE INTERVENTIONS AND THE IMPLICATIONS FOR INDUSTRY

EEBE has and continues to undertake research projects that address several barriers to energy efficiency. The table below provides an overview of some of the most significant findings. Additional detail can be found in the accompanying report:

| RESEARCH EXTRACTS & RECOMMENDATIONS FOR STAKEHOLDERS | BARRIERS ADDRESSED |
|---|---|
| **1. MARKET RESPONSES TO THE ENERGY PERFORMANCE AND SUSTAINABILITY OF COMMERCIAL PROPERTY (JUNE 2011)** | INFORMATION<br>ECONOMIC |
| There is a growing consensus of reported real asking rent and transaction premiums for Energy Star labelled property in the USA. Energy Star labelled buildings might provide a hedge against escalating energy prices and also shifting preferences of both tenants and investors with respect to environmental issues.<br>• The property industry should take energy related labels and certificates into account when making appraisals and valuations.<br>• Governments should continue to implement labelling and certification schemes as evidence suggest that they are having some success. | |
| **2. SCENARIOS FOR THE FUTURE OF ENERGY MANAGEMENT IN BUILDINGS AND PROPERTY DEVELOPMENTS (MAY 2011)** | ORGANISATIONAL<br>INFORMATION<br>POLITICAL |
| In the long life cycle of property investments, responses to energy management need to be 'future proofed'. Responses based on short term signals could result in inappropriate longer term commitments. (Information available in Research Stream 1)<br>• The property industry needs to focus on becoming more resilient and agile to unexpected events. With the current and expected rate of change the industry needs to be prepared to respond quickly.<br>• Stakeholders should create opportunities to bring together the fragmented property industry, build consensus and take action for more effective governance. | |
| **3. RECONCILING UK PLANNING, THE CONFLICT BETWEEN ENERGY EFFICIENCY AND CONSERVATION (ONGOING)** | INFORMATION<br>CULTURAL<br>POLITICAL |
| There is a significant need for retrofit to improve the energy efficiency of the building stock as It is expected that two thirds of occupied buildings in 2050 have already been built. Current conflicts between energy and conservation policy hinder retrofit.<br>• Policy should be specifically developed to address the differences between urban energy use and national energy use per capita trends and observation.<br>• There is a need to address the large discrepancies in the application of energy and conservation policy in different UK Councils and Boroughs. The current condition leads to confusion and lack of consistency, hindering retrofit. | |
| **4. APPROPRIATE RESPONSES BY LANDLORDS TO THE ENERGY MANAGEMENT OF UK OFFICES (ONGOING)** | INFORMATION<br>ECONOMIC<br>POLITICAL |
| UK offices could be significantly impacted by national carbon budgeting and changes in national energy infrastructure, but there is little understanding of how.<br>• Landlords need to be prepared for a potentially significant transition in how energy is consumed in UK offices if the government is to meet its ambitions. Quality information is needed to make appropriate energy management investment decisions.<br>• The property industry needs more transparent indicators of their reliability. For example, no indicator of uncertainty is provided in Energy Performance Certificates. | |
| **5. EVALUATION OF ENERGY EFFICIENT TECHNOLOGIES (ONGOING)** | TECHNOLOGICAL<br>INFORMATION |
| There is a need for greater access to information and advice, including real time carbon use information. Many good technical solutions are either emerging or already available, but are not always clearly accessible.<br>• A greater evidence base is required to address the concern within industry that some payback periods quoted are misleading.<br>• Robust, detailed data on the size of some technology markets in terms of value, number of installations, trends and forecast is needed. | |

### Conclusion

Many more interventions will be required to bring about the needed improvements to the energy efficiency of buildings and to overcome the existing barriers. The drive for these changes continues to be that success could have wide ranging economic, social and environmental benefits.

In order to take advantage of the opportunities posed by barriers to the improvement of the energy efficiency of buildings and property, more research and investment is required in order to improve the evidence base for decision making in government and in industry. Future collaboration and multi-disciplined holistic approaches between stakeholders and researchers can improve best practice and inform emerging policy in order to help meet today's pressing energy needs and challenges.