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Proposal for a new COST Action

COST C23

**“STRATEGIES
FOR A LOW CARBON URBAN BUILT ENVIRONMENT”**

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MEMORANDUM OF UNDERSTANDING for the implementation of a European Concerted Research Action designated as COST C23

“STRATEGIES FOR A LOW CARBON URBAN BUILT ENVIRONMENT”

The Signatories to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the Technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 400/01 "Rules and Procedures for Implementing COST Actions", the contents of which the Signatories are fully aware of.
2. The main objective of the Action is to investigate how carbon reductions can be achieved through appropriate design and management of the urban built environment.
3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at Euro 12 million in 2004 prices.
4. The Memorandum of Understanding will take effect by being signed by at least five Signatories.
5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first MC meeting, unless the duration of the Action is modified according to the provisions of Chapter 6 of the document referred to in Point 1 above.

COST C23

“STRATEGIES FOR A LOW CARBON URBAN BUILT ENVIRONMENT”

A. Background

Carbon emissions from different sectors of the built environment exceed the capacity for maintaining the planet at a sustainable level. A study by the World Wildlife Fund (WWF International (2000)) has estimated that an area equivalent to three times the size of Europe is required to support its population if carbon emission trends are not reversed. The UK Royal Commission on Environmental Pollution (2000) has called for a 60% reduction in carbon emissions by 2050 and 80% by 2100. The EU has signed up to achieve the Kyoto target of 8% carbon reductions over 1990 levels by 2008-2012 (UNEP, 2002). Some countries have set higher reduction targets. For example, the recent UK Energy White Paper (DTI, 2003) has set a target of 60% reductions by 2050.

Significant progress towards these targets can be achieved by addressing issues in the urban built environment. Over half of the resources consumed globally are used in construction, and 45% of the energy generated across the world is used to heat, light and ventilate buildings with a further 5% being used in construction (Edwards, 2001). A low carbon built environment can be achieved through the use of renewable energy sources and by reducing energy demands through better design and construction and the incorporation of low embodied energy materials and planning. The EU Directive on the energy performance of buildings (Directive 2002/91/EC) (EPBD) has set criteria for Member States to address energy efficiency through building design and operation, including more standardised energy use calculation procedures and building energy labelling.

The Third Assessment Report produced by the Intergovernmental Panel on Climate Change (IPCC, 2001), documenting technological and biological options to mitigate climate change, reported that although several technologies to alleviate greenhouse gas emissions, such as wind turbine design, have advanced more rapidly than foreseen in earlier analysis, by the year 2010, most of the opportunities to reduce emissions will still come from energy efficiency gains in the end use sectors. In the energy consuming sector, it is major government actions that can promote energy efficient use and the replacement of high (such as coal) to lower carbon fuels (such as natural gas and renewables).

A low carbon built environment addresses all four of the areas highlighted by the Sixth Environment Action Programme set by the European Commission (2001): climate change, protecting wildlife and nature, addressing environmental and health issues, and preserving natural resources and managing waste. The EU and national initiatives mentioned above recognise that the main means of achieving carbon reductions in the urban built environment are:

- i) Higher standards of energy efficiency to reduce overall demand for energy,
- ii) The use of renewable and alternative sources of energy to ensure that the supply of energy is from sustainable sources.

Currently, there is a lack of long term planning of energy consumption in the urban built environment and barriers to the implementation of energy saving technologies and renewables need to be investigated. Energy efficiency measures are primarily targeted at new build. However, initiatives need to be aimed at existing buildings and infrastructure, as this is where the potential for energy savings are greatest but more difficult to achieve. The rate of renewal of the urban building stock is too slow to achieve significant progress towards carbon and energy reduction targets.

EU States have specific design and operations criteria for achieving greater energy efficiency, for example, through building control but, so far, only new build has been addressed to any significant extent (and some of the new Member States do not yet have Building Regulations). Local authorities / municipalities support and advise city-wide and smaller changes to the built environment through planning and building control whilst being guided by national government and EU policy. The EU directive (EPBD) calls for more attention to be paid to the existing built environment, and Member States will need to address this by 2006, particularly the renovation of large existing buildings.

The WWF One Planet Living report (2003) has identified infrastructure as an important area for energy savings. The European Commission (2003) has reported that energy consumption in Europe has increased by 10% during the period 1990-2000. 80% of this is increase from household, commercial and public services, 22% from transport and 2% from industrial sources. So the main increases in energy consumption are taking place in buildings. This is a major focus of this Action.

The EPBD recommends increasing the amount of renewable energy generation, particularly through decentralised systems, not only for environmental reasons, but also to provide a greater security of supply. Renewable energy sources vary from large-scale grid based sources to small scale building integrated techniques. The contribution of electricity from renewables to total electricity consumption in the EU ranges from 1-2% (Belgium) to about 71% (Austria) with an average of 14%. The integration of low / zero carbon energy source technologies into the built environment will also be a major focus of this Action.

Policies such as those implemented through the EPBD increasingly recognise issues surrounding energy consumption in the urban built environment. Energy is not only used directly in the operation of buildings for example for lighting, heating, ventilation and cooking but is also consumed in the construction of buildings, in transportation of people and materials, and in the treatment of water, waste and sewage. Modifying the built environment to reduce the need to travel, to provide more sustainable means of travel, and to reduce the use of water and the production and treatment of waste and sewage will result in a holistic reduction of energy consumption and emissions, so contributing to a low carbon built environment. There is a need to investigate carbon emissions associated with the construction processes itself, including transportation associated with materials and people, water consumption and treatment and disposal of waste. The energy implications of the urban infrastructure relating to the built environment and the process of construction will also be a focus of this Action.

The Strategic Environmental Assessment (SEA) Directive, implemented by EU Member States in 2004, ensures that environmental consequences of certain plans and programmes are identified and assessed during their preparation and before their adoption. The Directive places greater emphasis on social impacts of projects and is likely to have a particular impact on planning systems, since most physical plans, at regional, urban and local level will be subject to SEA. This will contribute to more transparent planning and will provide additional means to involve the public in decision-making.

There are barriers to achieving a low carbon built environment. The Action will focus on how professionals, such as those involved in planning, design, construction, regulation, management and maintenance, should address such barriers, which include:

- *Outmoded conceptual tools.* Although there is much existing knowledge and experience about technical performance of the built environment in relation to energy efficiency, there are still problems in the integration of these technical solutions, and in managing associated change and social acceptability. Benefits are not generally considered in a holistic way; they tend to be component based with only information that can be measured being measured. A broader view, for example the conceptual model of a cost ratio of 1:5:200 allocated to design and construction; energy and maintenance; operation (Evans et al., 1998) needs to be considered for incorporation into decision making procedures.

There is a need to consider the ‘added value’ of changes to the urban built environment to both private and public sectors, which generally significantly outweigh energy savings. There is a lack of understanding of costs and cost-benefits associated with sustainable concepts and measures. This is particularly so when capital investments may need to be higher to reduce running costs or maximise operational benefits. ‘Through greater efficiency and better use of natural resources, we can break the old link between economic growth and environmental damage’ Environment 2010: Our Future, Our Choice (2001). As sustainable practice becomes more widespread any additional building costs that do exist will diminish. Solutions will require a change from the traditional, component-based, way of thinking to performance-based systems.

- *Limited scope of investigation.* Many development projects fail to achieve substantial reductions in emissions because they are restricted in scope in time and space. There is an overemphasis on new development despite the fact that it will take many years to renew the current building stock to a point where it produces significant reductions in carbon emissions. There is clearly a need to develop retrofit solutions to improve the quality of existing infrastructure and buildings. Similarly, most developments do not address energy efficiency and waste reduction associated with urban infrastructure during operation. This is due to a lack of awareness and forward planning, often because it is unclear who is responsible for overseeing the different stages of a project. Most efforts to reduce carbon emissions and energy consumption start too late in the procurement process by trying to improve designs for which many of the key decisions have already been made at the briefing stage.

A narrow focus on the immediate vicinity of development also reduces effectiveness. A broader, more holistic, emphasis is needed to gain greater reductions in carbon emissions. The envelope of a building is no longer the obvious boundary to study the impact of new developments, since development can impinge on the operation of an entire city and beyond.

- *Social and political resistance to innovation and change.* Planning systems in most Member States are not sympathetic to new forms of building and renewable energy equipment that are essential if reductions in emissions are to occur. Change is often unacceptable to politicians, public and industry, both in relation to design and operation. This is due to a fear of investment in innovative concepts, perhaps because of potential failure. Among citizens and decision makers, there is creeping level of ‘environmental fatigue’. People are becoming tired of making an effort to be sustainable without being able to see tangible evidence of efforts. Innovative strategies are needed to make the invisible and slowly changing environmental indicators visible to citizens and key decision makers. Forward thinking and innovative concept acceptance are often a result of individual effort rather than formal procedures. Acceptance of low carbon concepts needs to be holistic and driven from all levels.

The Action will need to assess what factors will really encourage a low carbon built environment – regulation, incentives for change, improved quality of life, joined up thinking between relevant actors including local authorities, industry, professional bodies and public, appropriate taxation such as on the use of raw materials, carbon trading. The Action will provide advice on what changes need to be made to make low carbon options favourable in order to develop the potential for a low carbon built environment.

The Action will encourage consistency in low carbon development across the EU by identifying discrepancies between countries to fill the gaps by transfer of knowledge and good practice. The Action will investigate whether regulations and legislation relating to a low carbon built environment are comparable across nations. The Action is particularly timely with the implementation of the EPBD having to be implemented in national law by January 2006 (with a possible 3 year extension for some articles).

B. Objectives and Benefits

The main objective of this Action is to investigate how carbon reductions can be achieved through appropriate design and management of the urban built environment. This will involve:

- minimising energy use and associated emissions from buildings,
- examining the indirect energy impacts of infrastructure developments.

Carbon emissions are associated with the construction, refurbishment and operation of buildings. Sources of emissions relating to buildings include:

- Direct emissions resulting from heating, lighting and ventilation of buildings.
- Indirect including construction of buildings, transportation of people and materials, and in the treatment of water, waste and sewage.

Both the cases of newly constructed and refurbished buildings will be investigated. Social and economic implications of the incorporation of low carbon modifications should be considered to prevent conflict.

End users who will be involved with the project and for whom the results will be relevant include government organisations at a national and local level, professional bodies, and public and private industry involved at all stages of construction and maintenance of the built environment and the Dissemination Plan (chapter G) takes this into account.

C. Scientific programme

Investigation needs to consider what is currently being undertaken to create a low carbon built environment and what can be done in the future. The Action will create a situation for transfer of good practice between various European countries.

The specific forms of the research used and their outputs are therefore:

Theme 1 – Case study selection and analysis

Case studies are required to exemplify good practice for a low carbon built environment. Methods of applying low carbon technologies will be investigated including the investment required for incorporation and transferability to other locations. Case studies will be selected from all partner countries for: new and existing building projects, renewable and alternative energy supply projects and infrastructure projects, including transportation, water supply and sewage and waste treatment and disposal, and green/blue structures.

The case study projects will be selected to represent good practice in low carbon built environments. This will provide information about lessons learnt from previous investment in order to document and inform government, industry and the public. Decision making processes, the tools and benchmarks used in practice to investigate the impact of low carbon technologies will be reported on.

Theme 2 – Performance Criteria

Review and comparison of existing legislation, technical regulations and policy relating to low carbon built environment in participating countries will identify what existing criteria are used to assess different aspects of performance of the urban built environment in relation to low carbon environments. The Action will undertake a review across partner countries to investigate how low carbon considerations are encouraged and enforced. This will also involve investigating laws, planning guidance and building regulations that have an impact on the integration of low carbon measures.

This work will help to identify the similarities and differences of the different management procedures across European countries in terms of existence and compliance of low carbon techniques. Successful

techniques should be transferable and adaptable to suit contextual situations. The review will enable EU and national approaches to a low carbon built environment to be collected in order to provide guidance relevant produce a low carbon built environment across the EU and Europe.

Theme 3 – Decision making processes

A study of decision making structures in each Member State will be conducted to identify the chains of authority and responsibility for promoting low carbon development. This will provide a context in which to locate where key decisions are made. The Action will help to realise what level of management technologies are identified and when and where they are accepted and applied.

Theme 4 – Cost analysis

The costs relating to the incorporation of low carbon into the urban built environment will be investigated. There is a general lack of understanding of costs and cost benefits associated with sustainable concepts and measures, which often prevents the inclusion of technologies. The Working Group will assess how cost effectiveness and cost benefits can be assessed and what additional costs are incurred as a result of incorporating low carbon technologies into buildings and infrastructure. This will also include an evaluation of indirect costs and cost benefits over time. A long term assessment of capital, operational and other costs will be considered to enable a holistic view of environmental, economic and social benefits.

Theme 5 - Guidelines

Guidelines will be produced to assist built environment professionals with procedures to ensure maximum consideration for low carbon are made for all built environment construction and renovation. These will focus on carbon reduction strategies identified and reviewed from working groups 1 and 2 relating to new/existing buildings and urban infrastructure.

Each of these factors will be considered at different stages of development, for example:

- Urban and local planning and development – how are low carbon issues dealt with in urban and detailed planning and what are the conflicts with other planning issues? How are buildings and infrastructures integrated and what are the conflicts? What evaluation tools are used and how do they relate to decision making?
- Brief development – How are/should be low carbon issues incorporated into project briefs? What benchmark information is used and how are targets set? How are cost effectiveness and cost benefits assessed?
- Design – what are the impacts of low carbon issues in design and what design innovations lead to a low carbon building? What tools are used and to what extent are they performance or prescriptive driven?
- Commissioning and operation – how is low carbon performance achieved in practice throughout the life of the building? What are the operating costs and cost benefits?

In order to carry out the aims of the Action, three Working Groups described in Chapter D will be established to address the different aspects of the urban environment in relation to carbon reductions and to carry out reporting and dissemination.

Networks for exchange of information will be established with other scientific and industrial based research projects (incl. other EU funded research projects) that are investigating low carbon technologies. Information will be recorded and incorporated where relevant.

The Action also provides an opportunity to review laws, regulations and administrative provisions that have been made by individual countries in order to comply with the EU Directive on the Energy Performance of Buildings (EPBD), which is set for January 2006.

The relationship between themes and working groups is summarised in the table below:

Working group Theme	1 New/existing buildings	2 Urban Infrastructure	3 Dissemination and Reporting
1 Case study selection and analysis	✓	✓	
2 Performance criteria	✓	✓	
3 Decision making process	✓	✓	
4 Cost analysis	✓	✓	
5 Guidelines			✓

D. Organisation

The co-ordination of research will be achieved through a series of three Working Groups that will interact. Overlaps between Working Groups will exist with members active in Working Groups 1 and 2. Working Group 3 will include the chairs of the other two WGs. Working Group 3 will ensure frequent interaction with national, regional and local government in order to ensure a high transfer of knowledge regarding low carbon technologies.

Working Group 1: New and Existing Buildings

This WG will consider carbon reductions in relation to the design and construction of new buildings and the improvement of the existing building stock. It will focus on the EPBD and how EU states are implementing its requirements through national building regulations and planning. It will especially consider the existing building stock and how carbon reductions can be achieved in both domestic buildings and other building types and the possibility of including building integrated renewables and alternative energy systems. The EPBD does not cover smaller buildings and housing. This is an area where significant carbon reductions can be achieved. Many EU states have large amounts of sub-standard housing where carbon reductions may be part of general improvement programmes.

Working Group 2: Urban Infrastructure

This WG will consider carbon reductions associated with urban infrastructure which includes transport, water/sewage, waste and green/blue structures. Many urban infrastructure projects, which are cross-sectoral in nature, may also be more holistic. The WG will in particular look at how low carbon technologies can be established around urban infrastructure projects and independent renewable and alternative energy systems, for example, energy from waste and energy from biomass. Green structures can have an important role as sources of renewable energy (e.g. wood biomass) and sites for renewable energy systems (e.g. wind power). There are also links between planning and infrastructure (e.g. transport and land use) which impact on carbon reductions.

Working Group 3 – Dissemination and Reporting

Dissemination and reporting will be continuous throughout the period of the Action. A number of dissemination methods will be used by this Working Group including:

- regular formal and informal dialogue with national and regional governments is essential throughout the duration of the study to ensure the effective transfer of information. This includes partnerships with organisations such as local authorities, national regulatory bodies and public infrastructure organisations that can be developed further to ensure appropriate transfer of knowledge. Meetings and contact with end users will take place on a regular basis in order to maximise interaction. Outcomes from these meetings will be documented and discussed across the Working Groups to ensure transfer of knowledge.

- Networks and links with other scientific and industrial based research projects investigating low carbon technologies.
- A website will be set up which will be used as a means of transfer of information between the Working Groups and also to disseminate the aims and findings of the research group to end users and other interested parties.
- Two conferences will be held.
- Guidelines and Final Report will be produced. The Guidelines will include a review of the Energy Performance of Buildings Directive and best practice for a low carbon urban built environment illustrated by case studies.

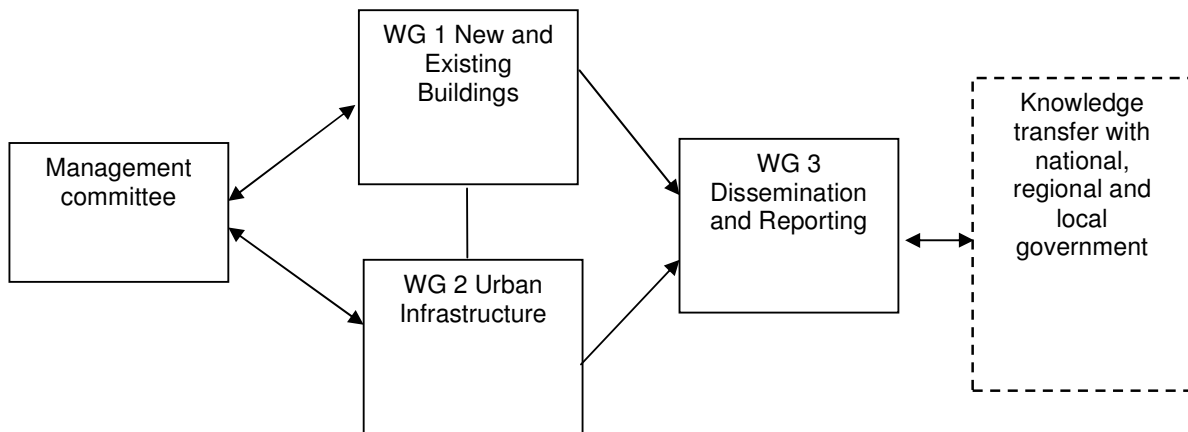


Figure 1 - Flow chart illustrating transfer of information between working groups and the Management Committee

E. Timetable

The Action will take place over 4 years. Reporting of progress will take place at the end of each year in a combined report. A report will be prepared 12 months from the end of the duration of each Working Group. The Final Report will comprise of a summary of Working Group 1, 2 and 3's findings together with guidelines to assist built environment professionals with procedures to ensure maximum consideration for low carbon are made for all built environment construction and renovation.

An interim report will be prepared after 18 months. This will be a consultation document to be circulated for comment to interested parties and key stakeholders. The comments received will be incorporated into the Final Report.

Gathering of case study material will take place throughout the duration of the Action, and publication on the Action's website will extend beyond completion of the work. Project conferences will be held at the end of year 2 and at the end of month 42.

Year →	1	2	3	4
Working group ↓				
1 New and Existing Buildings				
2 Urban Infrastructure				
3 Reporting and Dissemination				
	Conference		Conference	

Figure 2 - Timetable for proposed COST Action

F. Economic Dimension

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest:

Austria	Denmark	Portugal
Belgium	Finland	Slovakia
Bulgaria	Germany	Slovenia
Croatia	Italy	Spain
Cyprus	Malta	Switzerland
Czech Republic	The Netherlands	U.K.
	Norway	

On the basis of national estimates provided by the representatives of these countries, the economic dimension of the activities to be carried out under the Action has been estimated, in 2004 prices at roughly Euro 12 million.

This estimate is valid under the assumption that all countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

G. Dissemination plan

There is a significant need to promote, disseminate and reward good practice in low carbon built environment in order to give others confidence to invest in similar appropriate techniques, which are generally financially driven.

Regular formal and informal contact with national and regional governments is essential throughout the duration of the study to ensure appropriate transfer of information. A formal meeting, in the form of a seminar or workshop will take place at least once a year between each partner and local governments. Informal meetings/contact with end users will also take place in order to maximise interaction. Regional and national government representatives will be invited to attend the COST meeting when taking place in their locality.

Collaboration with potential end users of the findings of the Action is ongoing through various research projects such as the Fifth Framework Programme funded research project 'Practical Evaluation Tools

for Urban Sustainability' which is highly end user interactive. This includes partnerships with organisations such as local authorities, national regulatory bodies and public infrastructure organisations.

Two conferences will be held, one at the end of year two and one after 3.5 years of the Action. The conference at the end of the second year will disseminate preliminary findings of the review and publicise good practice in developing a low carbon built environment through a series of case studies. The second conference will be held at the end of 3.5 years which will produce the final findings of the review and will reveal guidance recommendations to assist built environment professionals with procedures to ensure maximum consideration for low carbon are made for all built environment construction and modifications.

WG Reports will be produced at the end of each Working Group to document the findings. These will also be combined in a Final Report that will include Guidelines to assist built environment professionals with procedures to ensure maximum consideration for low carbon are made for all built environment construction and renovation. This will include detailed information about each of the themes of each Working Group. The Guidelines will include a review of the Energy Performance of Buildings Directive and best practice for a low carbon urban built environment illustrated by case studies.

A website will be set up for the COST Action which will be used as a means of transfer of information between the working groups and also to disseminate the aims and findings of the research group to end users and other interested parties.

Academic members of the Action will be encouraged to incorporate results into teaching programmes in their institutions.

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STRATEGIES FOR A LOW CARBON URBAN BUILT
ENVIRONMENT

ADDITIONAL INFORMATION
NOT PART OF THE MoU

History of the Proposal

This COST Action has been developed in response to a combination of:

- the EU Directive on Energy Performance of Buildings (EPBD) and the general need to address carbon reductions for environmental and security of supply reasons,
- Member States need to address the built environment as a major area in which to make carbon reductions.
- The establishment of a good working partnership is well established between a number of the participants of this proposal who have worked together in a previously funded COST Action ‘COST C8 - Sustainable Urban Infrastructure’ which aimed at assisting local authorities, urban planners and designers as well as other urban practitioners in their task to promote sustainable solutions in urban infrastructure. This existing network has been strengthened by the inclusion of a number of organisations from the new EU Member States and candidate countries.
- Several potential members are participating in the C16 Action “Improving the quality of Existing Urban Building Envelopes” which is targeted specifically at one sector of the built environment, that is non-traditional housing stock. The main focus of C16 is on the engineering and social impacts, although improving energy performance is mentioned as a one of a range of factors within the broad scope of the project.

The C23 proposal “Low Carbon Urban Built Environment” focuses directly on reducing carbon emissions from all aspects of the urban built environment. It includes new and existing buildings, and infrastructures such as the transport of people and materials and the treatment of waste, water and sewage. It looks at reducing carbon emissions at the construction, refurbishment and operation stages of buildings and infrastructures.

There is no significant overlap between the two Actions, with C23 concerned with reducing carbon emissions across the whole of the urban built environment, while C16 just interested in the energy efficiency of the building envelope within a relatively small sector of existing housing.

- The links between a number of the partners who are also working together on a Fifth Framework Programme funded project ‘Practical Evaluation Tools for Urban Sustainability’ which aims to develop a framework of practical evaluation tools for urban sustainability which will enable a consistent approach across a range of urban infrastructure projects including water/sewage, waste, energy, green areas, transport and holistic urban developments. It is hoped that the network developed as a result of this proposed Action will further the capacity to co-operate internationally in the field of urban civil engineering in relation to sustainability.
- Some examples of other complementary work that experts from the collaboration are involved in include:
 - membership of P. Jones in the UK Building Regulations Advisory Committee (BRAC) and chair of the working group for ‘Part L: Conservation of Fuel and Power’, which is the main means of implementing the EPBD in the UK.
 - membership of the ISES Italia (Section of the International Solar Energy Society) based in Rome (Italy).
 - membership of the ENHR (European Network for Housing Research) – based in Gävle (Sweden).

- membership of the IAHS (International Association for Housing Science) – based in Miami (Florida - USA).
- membership of IEA (International Energy Agency) task 34/43: "Testing and validation of building energy simulation tools". This is a joint task/annex for the IEA Solar Heating and Energy Conservation in Buildings and Community Systems groups. The task involves defining test procedures and empirical and analytic data sets in order to provide simulation users, developers, and regulatory bodies with tools for quality assurance and certification. 12 countries worldwide are involved in this task. The works formally began in Autumn 2003 and will last for four years.
- membership of IEA Energy Conservation in Buildings and Community Systems Annex 42 FC+COGEN-SIM The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems which will end in June 2007. This annex involves defining generic energy profiles for domestic dwellings in order that the modelling tools being developed for the cogeneration systems studied may be assessed for their applicability and efficacy in domestic dwellings.
- Involvement in the new EU project 'Intermediary services and the transformation of urban water supply and wastewater disposal systems in Europe'. This EU-funded research project provides the first in-depth investigation of the contribution of intermediary organisations to the sustainable management of urban water re-sources in Europe. The project contributes to the more rapid implementation of key objectives of EU water policy.
- involvement in a project concerning Sustainable Urban Management of Greenlandic Cities, carried out in collaboration with two Greenlandic Municipalities, a Danish Municipality and a Danish private consulting firm.
- subcontracted expert to concerted action EPBD for Ministry of Environment, Spatial Planning and Energy, Agency for Energy Efficiency and Renewable Energy, Slovenia, on a basis of national contract for transposition of EPBD directive BCEI ZRMK,
- involvement in EIE 2003 call, SAVE, E-TOOL, Energy-toolset for improving the energy performance of existing buildings (co-ordinator Naturgas Midt-Nord, Denmark, partner BCEI ZRMK, Slovenia)
- EIE 2003 call, SAVE, BUDI, Take-off of the Building Directive – Pilot Actions to develop a functioning market for energy performance certificates (co-ordinator Grazer Energie Agentur, Austria, partner BCEI ZRMK, Slovenia)
- SAVE II, LCC-REFURB, Integrated planning and LLC at building refurbishment, 4.1031/Z/02-089/2002.

List of Experts

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Recent publications

Jones P and Alexander D, Thermal Comfort and Innovative Office Design, Proceedings of the 7th Asia Pacific Conference, 18-19 November 2003, Hong Kong (2003) pp2, 16-2, 22.

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