



Researcher/Stakeholder Workshop

Park Inn Hotel, Birmingham

28th/29th January 2008

This report documents the outputs, views and comments of the workshop delegates. These do not necessarily reflect the thinking of the SKCC programme team.

The researcher/stakeholder workshop held in Birmingham on the 28th/29th January 2008 was the final event of the Sustaining Knowledge for a Changing Climate programme. This workshop built upon themes and knowledge gaps identified in previous stakeholder workshops held in Edinburgh and London on 1st and 12th October 2007. 100 delegates attended the workshop: 50% were researchers and 50% were stakeholders.

This report documents in detail what went on at the workshop and records the thoughts and ideas of the delegates.

Day 1: 28th January

Introduction, aims and anticipated outputs

Roger Street (UKCIP) opened the workshop and presented the aim of the workshop and the desired outputs.

Aim of the workshop:

To inform EPSRC, in the form of a Science Plan, of current research challenges and knowledge gaps concerning climate change and the built environment infrastructure and utilities, identified by end users and researchers.

Main themes of the workshop:

1. Presentation of the results of the stakeholder workshops. Review to identify further gaps and prioritise research needs.
2. Review of cross-cutting science/research issues e.g. climate scenarios, uncertainty analysis etc. and how they might be integrated in a research programme.

3. Development of plans for co-ordination, integration and dissemination.

Presentation: Towards the next phase: ARCC

Dave Holtum (EPSRC) described some of the work on climate change and adaptation that EPSRC have funded recently; the BKCC/SKCC framework and presented the new Programme: **Adaptation and Resilience to a Changing Climate (ARCC)** which has a remit to:

- Address research gaps (e.g. existing buildings)
- Integrate with existing programmes (CREW, Probabilistic Scenarios, Tyndall etc.)
- Continue research identified in SKCC
- Maintain Integrating Framework and link to Stakeholders

ARCC will be under the umbrella of LWEC (Living With Environmental Change), an interdisciplinary research & policy partnership programme of 10-year duration to increase resilience to and reduce costs of environmental change. There will be a call launch event for ARCC on 27th March in Birmingham.

Presentation: Background to SKCC and review of outcomes/research topics from stakeholder workshops (Jim Hall, Principle Investigator on SKCC, Newcastle University)

This presentation gave an overview of the BKCC (Building Knowledge for a Changing Climate) programme and described what activities have taken place under the SKCC (Sustaining Knowledge for a Changing Climate) programme. A review of the report on the research challenges identified in the stakeholder workshops was given. The full report can be viewed at: www.k4cc.org etc. To summarise 15 topics were identified which formed the starting point for discussions at this workshop:

Systems - Cross-sectoral and Cross-disciplinary

- Buildings: existing and new build
- Transport Systems and infrastructure
- Water Resources
- Energy Systems - supply and distribution
- Interactions with land-use decisions
- Strategic, system-scale understanding of vulnerability, robustness and resilience
- Links between adaptation and mitigation
- Practical methods or guidance to support:
 - Assessment of land-use change and development
 - Performance of materials - lifecycle assessment of materials
 - Assessment of economic trade-offs in adaptation/mitigation
 - Assessment of knock-on effects on other sectors and issues (tourism, migration, industry relocation, and potential disruptions of global supply chains)

Highlighted climate change processes and impacts

- Increasing temperature: Disruptive impacts on infrastructure, thermal comfort, vulnerable populations
- Flooding: Urban drainage, flash flooding, multiple sources, groundwater flooding, land-use planning as an adaptation option, soft and hard flood risk management
- Sea-level rise: coastal erosion, coastal flooding, vulnerability of coastal habitats
- Wind: impacts of climate change on wind speed; identifying vulnerable locations
- Drought and water scarcity: availability of water, technologies for supply and storage, demand and demand management

Cross-cutting issues

- Adapting to Extremes
- Appraisal of adaptation options - tools at various scales (local to national)
- Embedding adaptation decisions into design
- Assessment of lifecycle analysis of costs of adaptation
- Benefits of climate change
- Governance, planning and regulations, including implications of regional nature of climate
- Building institutional and individual adaptive capacity, and understanding barriers to adaptation and the efficacy of adaptation options

Research and dissemination

- Mechanisms, legislation and constraints to implementation of research results - design of solutions
- Development of case studies, including at the strategic scale (city, catchment, system-wide)

Presentation: Existing and recent research initiatives on climate change impacts and adaptation on the built environment, infrastructure and utilities (Clare Goodess, UEA)

In this session two matrices were presented, described and discussed. The first (Table 1) lists the knowledge gaps and challenges identified by stakeholders prior to BKCC in 2001. Each of the nine funded BKCC projects are also listed and compared with the list of knowledge gaps and challenges, to determine which gaps and challenges were tackled by the BKCC projects.

The second table (Table 2) lists the research challenges identified in the two stakeholder workshops held under the SKCC programme in Edinburgh and London. These are then compared with existing and recent research

initiatives on climate change impacts and adaptation on the built environment, infrastructure and utilities, to determine which challenges are already being addressed in other funded projects. Undoubtedly, the list of existing and recent research projects would not be 100% complete, therefore delegates were asked in a subsequent workshop to identify any further projects they were aware of that may tackle some of the identified challenges and gaps.

| Pre-BKCC Knowledge Gap and/or Challenges | Building Knowledge for a Changing Climate core projects | | | | | | | | |
|---|---|-------------------|-----------------------------|-----------------|-------------------------------|------------------|---------------------------------|-------------------------------|---------------------------|
| | AUDACIOUS ^{Urb} an Drainage | GENESIS Energy | ASCCUE Urban Planning | EHF Heritage | BIONICS Slope Stability | Air Transport | BETWIXT Weather Scenarios | CRANIUM Risk Management | BESEECH Socio-economic |
| Direct Physical Impacts and Adaptation | | | | | | | | | |
| Building resilience into existing building stock – vulnerability and risk audits as a means to establishing priorities | | | | X | | | | | |
| Soil mechanics, subsidence risk and foundation construction and design specifications – including drying and frost damage potential | | | | | X | | | X | |
| Role of groundwater in flooding – associated risks | | | | | | | | | |
| Sustainability of existing drainage systems (SUDS) in the face of climate change – implications for design of new drainage systems | X | | | | | | | | |
| Potential of grey water systems as an adaptation option | | | | | | | | | |
| Continued viability and comparative advantages of building material and construction techniques – implications for maintenance and costs | | | | | | | | | |
| • Construction site conditions, techniques for flood risk areas, performance of traditional materials, impacts of air pollution, pests and insects. | X | | X | | | | | | |
| Energy and telecoms infrastructure | | | | | | | | | |
| • Coping with peak demands, performance under changed climate, viability of wind, wave and hydropower, access to offshore facilities | | X | | | | | | | |
| • Impacts on transmission lines above and below ground | | X | | | | | | | |
| Overheating of buildings and alternative cooling techniques | | | | | | | | | |
| Humidity and ventilation in buildings – drying and performance of building materials in the face of projected changes in climate | | | | X | | | | | |
| Broader Socio-economic Issues | | | | | | | | | |
| Land-use policy and planning – guidance on flood risk, long-term efficacy of remediation measures for brown field sites, and vulnerability to wind damage | | | | | | | | | |
| Changes to legislation, standards and regulations as drivers of change – regionally specific and more flexible legislation to allow for innovation | | | X | | | | | | |
| Lifestyle changes – implications for future use of buildings, energy demand and the efficacy of adaptation options | | | | | | | X | X | |
| Effects on tourism and knock-on effects on land use and transport | | | | | | | | | |
| Effects on transport – choice, reliability, costs of impacts and safety in light of extremes | | | | | | | | | |
| Barriers to Uptake of Research | | | | | | | | | |
| Dissemination from research to professionals and practitioners – accessibility and understanding | BKCC Stakeholder Forum and SKCC | | | | | | | | |
| Need to draw on best practice and experience from other locations | | | | | | | | | |
| Assessment of the capacity of the sector (and components thereof) to respond to change – adaptive capacity and barriers to change | | | | | | | | | |

Table 1: Pre-BKCC Knowledge Gap and/or Challenges.

| Stakeholder Identified Research Themes and Issues | SCORCHIO Heat Island | LUCID Heat Island | Prob. Info. Drainage: Heriot-Watt | Prob. Info. Low carbon future: Heriot-Watt | EPSRC Funded | | | Prob. Info. COPSE | FRMRC2 | CREW Coping with Extremes | Tyndall | LCCP | Interreg IVB |
|--|-------------------------|----------------------|---|---|---|---|------------------------------------|----------------------|--------|------------------------------|---------------------------|--|--------------|
| | | | | | Prob. Info. Building simulation: DMU & UEA | Prob. Info. Future proof buildings: Exeter | Phase 2, Programme 6: Cities | | | | Retrofitting Dwellings | Project ideas: e.g., Future Cities, Linking green & blue | |
| Systems - Cross-sectoral and Cross-disciplinary | | | | | | | | | | | | | |
| Buildings: existing and new build | X | X | | | X | | | | | | | X | |
| Transport Systems and infrastructure | | | | | | | | | | | X | | |
| Water Resources | | | | | | | | | | | X | | |
| Energy Sytems - supply and distribution | | | | | | | | | | | X | | |
| Interactions with land-use decisions | X | | | | | | | | | | X | | |
| Strategic, system-scale understanding of vulnerability, robustness and resilience | | | | | | | | | | X | X | | |
| Links between adaptation and mitigation | | | | | | | | | | | X | | |
| Practical methods or guidance to support: - Assessment of land-use change and development | X | | | | | | | | | | | | |
| - Performance of materials - lifecycle assessment of materials | | | | | | | | | | | | | |
| - Assessment of economic trade-offs in adaptation/mitigation | | | | | | | | | | | | | |
| - Assessment of knock-on effects on other sectors and issues (tourism, migration, industry relocation, and potential disruptions of global supply chains) | | X | | | | | | | | | | | |
| Highlighted climate change processes and impacts | | | | | | | | | | | | | |
| Increasing temperature: Disruptive impacts on infrastructure, thermal comfort, vulnerable populations | X | X | | X | X | X | | | | X | X | X | |
| Flooding: Urban drainage, flash flooding, multiple sources, groundwater flooding, land use planning as an adaptation option, soft and hard flood risk management | | | X | | | | | | X | X | X | X | |
| Sea-level rise: coastal erosion, coastal flooding, vulnerability of coastal habitats | | | | | | | | | X | | X | | |
| Wind: impacts of climate change on wind speed; identifying vulnerable locations | | | | | | X | | | X | | | | |
| Drought and water scarcity: availability of water, technologies for supply and storage, demand and demand management | | | | | | | | | | | X | X | |
| Cross-cutting issues | | | | | | | | | | | | | |
| Adapting to Extremes | X | | | | | | | | | X | | | |
| Appraisal of adaptation options - tools at various scales (local to national) | X | | | | | | | | | | | | |
| Embedding adaptation decisions into design | | | | X | | | | | | | | | |
| Assessment of lifecycle analysis of costs of adaptation | | | | | | X | | | | | | | |
| Benefits of climate change | | | | | | | | | | | | | |
| Governance, planning and regulations, including implications of regional nature of climate | | | | | | | | | | | | | |
| Building institutional and individual adaptive capacity, and understanding barriers to adaptation and the efficacy of adaptation options | | | X | | | X | | | | | | | |
| Research and Dissemination | | | | | | | | | | | | | |
| Mechanisms, legislation and constraints to implementation of research results - design of solutions | | | | | | | | | | | | | |
| Development of case studies, including at the strategic scale (city, catchment, system-wide) | X | | | X | X | | | | X | X | X | | |
| | | | | | | | | | | | | | |

Table 2: Stakeholder Identified Research Themes and Issue

Workshop: identification of missing research topics

The aim of this workshop was to identify missing research topics that delegates found not to be covered by those listed from the two stakeholder workshops; they were also encouraged to add to or elaborate on those topics that had been identified and listed.

For this task delegates were divided into four groups, the following records outputs from this workshop.

Green Group:

Cluster 1

- Buildings – Assessment of existing building stock to wind extremes
- Groups of buildings
- Subset of buildings – Adaptive buildings
- Buildings to include various scale, i.e. single unit dwelling, street, neighbourhood and conurbation scales

Cluster 2

- Adaptation – effect on prioritization of maintenance
- Embodying adaptation/mitigation into facilities management

Cluster 3

- Integration of climate change adaptation/mitigation measures with wellbeing and health strategies in public health (i.e. exercise and green spaces)
- Ensuring the systems approach informs regional planning processes – regional spatial strategy/regional economic strategy in particular
- Integration of systems with people and their understanding/use of systems
- Smart homes and building control systems integrate adaptation options

Cluster 4

- Transport systems – adapting old infrastructure to extremes/affordability of adaptation/contingencies across transport systems/modes
- Rail transport – understand DfT Rail Strategy and White Paper aspirations (30 yr and look ahead)
- Transport systems adaptation – design for extremes; materials resilience; flooding/drainage of highways. Should they be designed to be allowed to flood in extreme events (with emergency routes only kept open?)
- What to do about legacy transport infrastructure, e.g. old motorways, where there is no adequate drainage

- Highway infrastructure – good interactive data on combined effects of temperature (beneficial and detrimental) and water (always detrimental)
- Identification of critical infrastructure for transport – will modal shift cause problems (e.g., a shift to rail which is more sensitive than the road network)
- Transport systems and infrastructure – needs splitting into (1) Vehicles – energy/better systems software/cleaner engineering; (2) Civil engineering – energy during construction and whole life (mitigation and adaptation of existing networks/Effects of water)
- Transport systems: modal shift drivers – fiscal/non-fiscal

Cluster 5

- Building regulations – constraint or opportunity
- How do we help the ordinary manager who has just been given the job in his organization of managing “climate change”?
- Climate change tools to guide local government master planning, urban design and economic regeneration policies
- Cost-benefit toolkits for building adaptation options (validation, etc.)
- Software/modelling – whole life costing
- Improving the BESEECH transport scenarios, need to have scenarios for freight and modal shift within the sector.
- Need more indicators

Cluster 6

- Habitat networks in urban areas
- Green infrastructure and economic impacts – temp extremes; flooding/drought; storminess etc.
- Green infrastructure and health impacts and benefits – temperature extremes in particular
- Impacts and adaptation related to Infrastructure (heat) – not just temperature/heat island but also solar gain. Very significant in the context of glass buildings/road surfaces
- Cool public realm – use of green spaces, low emissivity and high albedo materials/cross references to flood risk mgt, noise reduction etc.

Cluster 7

- Building: thermal comfort/reduced energy requirements/vulnerability to extremes
- Improvements to building materials for better adaptation to climate change

Cluster 8

- Education systems/leisure and recreational system
- Knock-on effects of climate on economic systems due to public perceptions (e.g. not visiting a recently flooded town centre for shopping/tourism)
- Tourist/visitor behaviour – attitude toward climate change

- Tourism built heritage: reliance on private transport, i.e. carbon emissions

Cluster 9

Stakeholders

- The ones we have today may not be here in 10-15 years time
- The important businesses and companies of tomorrow may not be here yet.
- How does innovation happen and how can we drive it?
- How can existing businesses manage change in response?
- How can we drive innovation and change better, faster? – to create benefits, to make adaptation easier
- In taking a broader systems approach – How do we network with a much bigger cross section of stakeholders? How do we get beyond stakeholders being self selected? (i.e. very large, already aware incumbents only)
- Political (Networking) Stakeholders – how to engage politicians generally?

Cluster 10

- Dissemination – do not frighten the politicians or cry wolf. We have time if we start now to keep pace with change at low extra cost. Otherwise we will not get anywhere
- Mechanism for feedback (general tool). Who/what will follow-up the “impact” of research and dissemination?
- Research dissemination – communication strategy to utilize stakeholder framework
- Research and dissemination: clear research statistics – press/media love survey results, especially if identifiable in a regional context
- Dissemination: new designs (outputs from research) included within Industry Standards, e.g. DMRB for Highways

Cluster 11

- Impact of rural land-use decisions and infrastructure on flash flooding in urban areas
- Flood risk – definition of standards that public want
- Urban runoff – climate changes linked to changes in evaporation?
- Increasing rainfall intensities and increasing storminess

Cluster 12

- Infrastructure should be a separate item/area

Cluster 13

- Short and long term impacts on climate change of a national energy efficiency upgrading programme for dwellings
- Energy systems: demand scenarios what impact will varying types of energy efficiency have? Regulatory, consumer, choice, incentives, etc

- Energy systems: interaction of adaptation and mitigation – how will more microgeneration and energy efficiency interact with increased temperature extreme events, energy security? Work with UKERC, Supergen, Carbon Vision.
- Energy systems: vulnerability of networks to climate change impacts (clustering of infrastructure)
- Energy systems: joint probability (probability of high energy demand and no wind) i.e. reduced supply

Cluster 14

- Awareness as drive to change: engineering institutions, standard change, BSI. Design for Future Climate not for Historic Climate

Cluster 15

- Long-term planning – perceptions and resistance to adaptation within the built environment.
- Risk perception. Risk: Social amplification
- Intergenerational equity – heritage drivers for adaptation mitigations.
- Define the benefits of making ‘hard’ decisions now rather than later
- Loss of revenue to various business sectors (tourism/heritage) due to climate change impacts (e.g. flooding)

Cluster 16

- Adapting to extreme – what if...? Contingency planning across sectors. E.g. no motorway / no railway / no utilities = no water, no food
 - I.e. who ensures providers prepare properly for persistent precipitation!?

Cluster 17

- Register of technical and engineering solutions – find out and log!
- Disseminate best/good practice
- Not all doom and gloom – engineers hold key to adaptation
- Make people aware that they have a responsibility themselves to do things and not rely on others.
- EC FP7
- Coordination and awareness of other RD

Cluster 18

- Can changes in legislation bring benefits in flood management for:
 - Property, business, transport, utilities
 - Therefore investigate legislation framework and tool for improvement
- Patterns of consumption – dominance of major operators
- Food Systems – From production – distribution – use – disposal

Cluster 19

- Funding for retrofitting work? Where does / should it come from.
- Research – double blind testing of policy(ies) (to test the gap between rhetoric and reality)

Blue Group

- Timescales of business planning versus climate change timescale.
- Do stakeholders see CC as pertinent in long-term planning?
- Asset management – building changing demands with new supply over time.

- Effect of extremes on temporary works / plant?
- Communication – designers – users – managers
- Professional institution involvement? (designers)

- Health and quality of life. Social inclusion deprivation.
- Climate change process and impacts: increased cloudiness in winter and seasonal affective disorder (SAD) – health issues?

- CLG as stakeholder?
- Government – potential conflict of legislation on different sectors
- Insurance - how will the climate change affect how we insure against loss?
- How do you model community? What scale is sensible?
- Cross-cutting issues
- Designing and processing new infrastructure with climate change in mind

- Water resources to include 'blue' infrastructure
- Water grid
- Feasibility of combined grey/rainwater harvesting systems in new development (critical thresholds)
- Demand-side measure risks in water resources management. Compare and contrast risks of demand-side measure to supply-side measures.

- Positive effects of climate change
 - 1. winter maintenance
 - 2. reduced air travel to holiday destinations
 - 3. crops etc

- Identifying the critical market 'tipping points' for retrofitted adaptation technologies (take up, costs, incentives etc.)
- Living with uncertainty – identification of different adaptation strategies for different probability scenarios. Are current predictions alarmist? Should link with UKCIP08.
- Landscape e.g. urban and suburban taken as a whole system.
- Impacts to natural systems with urban environment (i.e. street vegetation, parkland) invertebrate
- Local flora – urban cooling, biomass resource

- Links between adaptation and mitigation with relation to urban densities.
- Performance of existing buildings in the socio-economic context (not just physical adaptation)
- Sustainable trigeneration (?) – new dev and retrofitting
- Develop a hierarchy of sustainability, looking at single and mixed land uses)

Red Group

- Health problems due to deterioration of indoor air quality – moulds / VOCS
- Health impacts relating to many of the identified gaps (e.g. energy generation, water resources, drought buildings) etc.
- Environmentally sustainable design / Weather – proof housing units (buildings)
- Rain penetration through novel building systems
- Buildings: innovation systems turn plastics for dwellings and commercial buildings
- Transport: Maglev transport system
- Water resources: grey water systems
- Energy: air and groundsource heat pumps
- Maintenance Issues: buildings and transport
- Major changes in style and density of new home build – fewer homes/acre, more green spaces – 3 story homes?
- Damage to roofs from increased wind storms.
- Telecoms
- Are there available construction skills to deal with the higher standards necessary?
- Energy: multic-variable (renewable)
- Supply-side=> must have a matching (?) demand side and storage
- Biomass + weibus food??
- Climate change influences biomass growth, supply chain / land use food
- Implications of building regulations on attitudes to construction
- Building design for changing climate
- Cross-sectoral – where should we go with building regulations
- Adaptation of building occupants to climate change
- Adaptation and aesthetic:
- Benefits of CC: less winter salting of roads – less disruption snowfall and ice greatly reduced
- Distributed energy generation impacts on communities.
- Knowledge transfer mechanisms

- SUDS – legislation – responsibility for maintenance etc
 - Research and dissemination – access to case study info/ datasets/ monitoring sites (a sharing of)
 - What does it take to be a transformational leader (organisation) in a changing climate?
 - Cross-cutting issues – has to support organisations to change (around climate adaptation) – what it takes to support an organisations to take the info on board – effective strategies
 - Warning and informing the public of the risks and mitigating plans in existence
 - Knowledge transfer mechanisms
 - Process of bringing organisations/ groups / individuals together (out of silos) to reflect (and not fix too soon) what such spaces / orgs exist, good examples,
 - People often (usually?) don't behave in the way you expect
 - Regulatory inconsistencies (contradictions) relating to the environment.
 - Abandon or partial-relocation of coastal towns (see level rise)
 - Sea level rise – increased storminess
 - Making coastal communities aware of the future they face
 - New storm intensity – description – return periods
 - Interactions with land use
 - Flood protection
 - Promotion of hemp i.e. hemcrete
 - Flooding coastal erosion
 - Recycling of scrap rubber tires
 - Systems Green Infrastructure
 - Climate amelioration, human health -> heat, skin cancer
 - Social behaviour, retail processes
 - Species and habitat adapt ability
 - Flood buildings
 - Climate change impact on critical national infrastructure (pulling together the strands)
 - Systems – integration of water management (flooding, water quality and water resources) as required by WFD.
 - Urban design spaces. Water, green infrastructure.
 - Understanding changing material properties due to climate variation – soil, concrete etc
 - Systems – soil , ground water, vegetation, climate change, engineered systems (links between the latter two)
 - Adaptation duties as may be required by the climate change bill. Can we provide guidance for key sectors?
-
- Carbon capture and storage
 - Air conditioning
 - Increasing temp, flooding, wind, sea-level rise ->
 - Age proof
 - Weather
 - Building

- Long-term flexibility / limitations of adaptation options.

Orange Group

- Resilience of suburban, rural, and coastal communities
- Gaps cross cutting better understanding of extremes. Better understanding of extremes/variability/uncertainty. We have just had 2 dry winters and a wet summer – explain
- Appraisal: multi-sector issues, robust adaptation
- Sewage, drainage and disposal (backing up of systems in floods, effect of temps etc.
- Definitions of extreme events vary from sector to sector. Need definition e.g. railway would be effect upon delivery/reliability of service
- Cross cutting use of social simulation methods to explore relationship between people and adaptation and resilience
- Gaps water resources. Need more on droughts/drought management/forecasting/ behaviour/ governance etc.
- Gaps water resources. Needs more focus on local/community level adaptation/resilience/distributed infrastructure/rainwater harvesting/grey water etc.
- Water supply engineering
- Water resources: effect on aquifers, ground water tables going down or up and these affect foundations of building
- Introduction of grey water supply
- Focus on critical infrastructure as defined by civil contingencies secretariat
- Green corridors
- Critical infrastructure – lifelines
- Gaps transport – understanding cc impacts on roads/rail. Asset deterioration, costs of disruption etc.
- Broader consideration of resources (i.e. not just water, waste, materials, food etc.)
- Fire risk: urban-rural interface, water resource implications, other infrastructure impacts
- Impact climate change on: amenity vegetation e.g. erosion and vegetation
- Green infrastructure (green roofs, SUDS,
- Climate change and security of energy
- Green infrastructure
- Systems – interactions with land use decisions – landscapes
- Energy storage systems
- Life cycle analysis of renewable energy and distribution network and supply
- Gaps – links. Carbon costs of adaptation options
- Impacts on critical and green infrastructure
- Linking building adaptation/impacts/mitigation with wider energy system
- Cost analysis mitigation of adaptation
- Transport and infrastructure effects on roads and earthworks due to increase or decrease
- Marine infrastructure – energy supply/shipping
- Spatial scales of adaptation response
- Planning for population migration from SE England
- Transport and infrastructure – effect on existing drainage; are the sizes of pipes adequate

- Zero carbon buildings
- Retrofitting buildings – energy efficiency
- Methods for interdisciplinary analysis of system and multi-sector decision-making
- Systems vulnerability: de-centralisation of energy
- Supply security and air quality
- Accessible data – base of current knowledge and applications to wider markets
- Strategic/systems scale analysis – relationship between infrastructure form, function etc. and efficiency and climate impacts of whole systems
- Regulatory constraints e.g. OFWAT vs. Environment Agency
- What benefits? In this process and of climate change
- Methods/approaches for cross-sectoral / regional assessments
- Climate information NOT in UKCIP
- Evaluation of existing prototypes to guide large scale policy advice
- Integrate climate change benefits into business decision making and impact on built environment Wide variety of business styles
- Gaps – recognise EC initiatives FP7, WSSTP, LIFE etc. Numerous projects ongoing by UK universities
- ITC (information communication technology) control, management, all systems, buildings and transport
- Waste incineration biomass CHP/boilers and air pollution
- Waste
- Waste handling and disposal
- Waste recycling and carbon flows
- Integrating with the current schools building programme
- Education/building schools for the future
- Effect of climate change on the school year
- Retro fit in social housing
- Vulnerability mapping as a cross-cutting management/prioritisation tool
- Understanding needs/capabilities of stakeholders who will implement research findings
- Helping local authorities deliver
- Land use and offsetting using forestry regulation
- Changes in soil moisture levels
- Sustaining city ‘growth agenda’ in a changing climate
- Legal implications of post performance reviews
- Change in insect population and the impact on life in buildings and the durability of buildings
- Commercial cost-benefits and interfaces in systems (transfer of costs and benefits)
- Integration of renewable energy and buildings
- Systems – buildings existing and new build. Sites of archaeological culture and historical interest
- Buildings – fuel poverty, health and equity
- Understanding comfort thresholds (what expectations should we have, perceptions)
- Health care – needs supply of items – where climate extremes will break supply chain?
- Health – assisted living
- Health – hospitals as buildings that need to be adapted
- Impact of climate change on leisure activities and resources

- Health – vulnerability of people, interaction with vulnerability of buildings
- Indoor air quality
- Health – quality of life
- Synergistic effects on health – from climate change from policies to mitigate or adapt
- Health impacts
- Environmental externalities of mitigation/adaptation responses – urban pollution
- Brownfield sites (definition, functions)
- Relationship between air quality, climate change impacts, adaptation and mitigation
- Atmosphere (emissions from buildings, vehicles, interaction with climate change)

Activity: Selection of topic areas

Based on suggestions from the previous workshop, 20 topic areas were highlighted. Delegates were then asked to choose which topic area they would like to be assigned to for the afternoon session. The 20 topics were as follows:

1. Existing buildings
2. New buildings
3. Neighbourhood scale (buildings) – green space/ blue space
4. Heritage buildings
5. Transport systems and infrastructure
6. Critical infrastructure
7. Water resources – supply and demand
8. Integrated water resources management
9. Energy systems
10. Land use decisions and spatial planning
11. Risk assessment and appraisal tools; methodologies and guidance
12. Knock-on effects – tourism, migration, food supply
13. Health e.g. air quality; internal and external environments
14. Adapting to extremes – thresholds
15. Embedding adaptation decisions into design
16. Costs of adaptation
17. Benefits of climate change
18. Governance, planning and regulations; targets
19. Building institutional and individual adaptive capacity, and understanding barriers to adaptation and the efficacy of adaptation options
20. Waste management

Based on delegate's preferences only 11 topics formed the basis for discussion groups during the afternoon session. These topics were:

1. Existing buildings
2. New buildings
3. Transport systems and infrastructure
4. Integrated water management

5. Energy supply and demand
6. Land use and spatial planning
7. Risk assessment and appraisal tools; methodologies and guidance
8. Health e.g. air quality; internal and external environments
9. Adapting to extremes - thresholds
10. Governance, planning and regulations; targets
11. Building institutional and individual adaptive capacity, and understanding barriers to adaptation and the efficacy of adaptation options

Presentation and plenary discussion: Criteria for prioritising research topics (John Handley, University of Manchester)

This session began with a presentation on some initial thoughts on criteria for prioritising research topics. Delegates were then invited to refine the criteria and the following four were agreed:

1. *Benefit to Society of Understanding and Alleviating Impacts*
 - a) Social (including human health and wellbeing of individuals and communities);
 - b) Economic (including direct and indirect costs of climate related damage, e.g. to infrastructure);
 - c) Environmental (including impairment of climate-regulatory functions of natural environment).

2. *Relevance to the stakeholder communities (to be specified):*

High/medium/low

Examples:

- a) nature and scale of potential beneficiaries
- b) relevance to stakeholder priorities
- c) time-frame for take-up of knowledge
- d) potential to improve processes/products

3. *Scientific Understanding*

- a) Degree of originality
(Novel, innovative, routine)
- b) Likely significance to research community
(International, national, regional)

4. *Research Capacity*

- Relevance to EPSRC (high/medium/low)
- Potential for co-funding
- Alternative modes of delivery

Workshop: Breakout groups in chosen topic areas. Aim to identify relevant recent and ongoing research initiatives/work that can be built upon and start to develop research ideas in that topic area.

This section of the report will for each topic area:

- list the existing/recent research projects
- document notes recorded by each topic area
- list the research ideas that each group came up with by the end of day 1

Existing buildings

Research projects

- TARBASE mostly energy / mitigation focus. Linkages to adaptation
- CARB
- ENGLISH HERITAGE
- Universities
- EU funding – Noah's ark

Notes

- Lack of knowledge (XB)
- Technical Deficiencies
- Build types:
 - Domestic
 - Office
 - Hospital
 - Schools
 - Factories
 - Misc
- Technical Deficiencies
- Impacts:
 - Flood
 - Water
 - Heat/cool
 - Tenure
 - Wind?

Research ideas

- Define critical comfort / performance criteria for different building types.
- Cost of not adapting existing building
- Pre and post evaluation of retrofit adaptation options.
- Identify mechanisms for mainstreaming adaptation with existing buildings (types, tenures, etc.)
- Case studies (theoretical + physical)
- International examples – new and historic
- Co-benefits of adaptation to mitigation agenda (energy)
- Economics of climate change on existing buildings
- Letting, valuation, tourism

New buildings

Research projects

- EST /Carbon Trust
- Carbon Vision
- Network comfort /energy EPSRC
- Case studies- mined
- NGOs (e.g. JRF, National Trust)
- Overseas e.g. Malmol
- Hammarby Sjostad

6 and 7 are Swedish projects

Notes

- Translate future climate scenarios to performance requirements -> regulations
- Update performance models (thermal, durability, health, comfort)
- New construction methods/ materials
- Holistic design and performance interactions
- New ways of working for processes
- Site /spatial issues – where is the boundary?
- Movable houses
- Post-completion testing
- Social attitudes to eco-design
- Solar overheating
- Design for disassembly
- Flood resilience
 - Water – resistant materials
- Aesthetic design for middle England – technology exists
- Density of build
- Whole life costing / capital cost
- Affordability / flexibility
- Tools for site specific design for prevailing climate
- Adaptability
- Future proof building
- Conflict between embodied energy and energy saving
- Interior environment – size + space
- Weather proof – wind etc.
- Smart buildings
- Contracts
- Passive technologies
- Integrated construction and design processes
- Adopting methods from other climates
- Understanding climate change effect on thermal models
 - Updating thermal models
- Phase change materials
- Change to a buyers marker

Research ideas

- Designing new buildings for the changing climate (overarching programme)
- Meeting challenges of high density yet adaptive buildings
- Devise a methodology for post-construction post-occupancy testing
- “Smart passive” building management
- Whole life costing of adaptive designs
- Social understanding and acceptance of adaptive measures

Transport systems and infrastructure

Research projects

- Slopes:
 - EPSRC CLIFFS network
 - EPSRC collaborative research
 - Network Rail
 - Highways Agency progressive failure
- Highways:
 - Highways Agency portfolio manager on climate change
 - Transport Scotland
- Sustainable transport systems: EU Interreg Climatic (Scotland)
- NPP EU Climate change impacts; coastal communities and habitats
- Transport to remote communities (small transport component)
- EPSRC Railway Research Centre – climate change effects on rail e.g. buckling.
- Framework Programme 7 – effects of climate change on transport (focus appears to be on inland waterways).
- Highways Agency: Risk Based Adaptation Strategy
- Network Rail: Risk Based Adaptation Strategy
- EU Framework 7 Climate Research Call

Notes

- Research likely transport system and usage in medium term (need to add new layers of transport, modal shift, reuse of existing infrastructure).
- Effect of mitigation strategies on usage/integrated system.
- Definition of thresholds – failure criteria – expectations; define new design criteria; define refurbishment design criteria; predictions/costing.
- Definition of extreme events for a transport network/infrastructure (e.g. degradation of service/reliability); what is acceptable today; what is acceptable in the future.
- Identification of vulnerability points in the network relative to the effect to the defined extreme event.
- Solution to adapt vulnerable points in the network; cost/benefit analysis leading to physical solution or management solution.
- Ability to predict extreme events and provide information to manage the network (failure/degradation). Social-economic impact.
- Sea-level rise effects on maritime transport infrastructure.
- Value of transport infrastructure asset in respect of climate change.
- Investment requirements.

- Deterioration models to take account of climate change.

Research ideas

- Definition of failure criteria in response to changing climate.
- Methodology for identification of system/network vulnerability (include definitions of thresholds).
- Socio-economic, environmental and health impact of system failure (prioritisation).
- Decision support tools for adaptation in relation to identifying system/network vulnerability (physical vs. management solutions).
- Cross-cutting theme: spatial and temporal scale.
- Predicting future transport requirement.

Integrated water management

Research projects

- NERC FREE programme
- ESPACE II (Intereg)
- EU Framework Programme 6/7 e.g. ADAM, WATCH (CEH), EuroLIMPACS (UCL), FLOODsite (HRW), Newater, Rubens.
- Environment Agency climate change programme – Water Framework Directive, probabilistic scenarios, uplands.
- UKWIR – sewerage
- Water UK – programme checklist
- DTI – SAM – 2D rainfall
- TE2100
- NET projects
- FRMRC2
- Interreg III (completed)
 - Urban water
 - Urban water cycle
 - MORIS
 - FLOWS
- Interreg IV (starting-up)
 - Flood resilient city
 - PLUS water
 - MARE
 - Maximum value of urban green space

Notes

- Strategic planning tools covering water resources, floods, water quality: 'catchment vision' – WFD RBMP – screening of measures (flexibility, robustness, sustainability).
- Water 'systems' approach.
- Water efficiency services and technologies.

Research ideas

1. Water 'neutrality' – options for sustainable water management
 - Use/build on climate predictions of water resources availability

- Identify supply and demand – side options (includes engineering options, tariffs, water services companies, regulation and policy)
 - Assess sustainability (including climate resilience) of options/packages
2. Systems approach to water management – integrating floods, droughts, water supply, water quality, ecology
 - Rural and urban areas interdependence
 - Defining future cycles of WFD and Floods Directive
 - Systems models – decision tree/robustness under future scenarios
 - Opportunities to identify and assess multiple objectives (multi-functional)
 3. Research to overcome limitations in spatial/temporal modelling in UKCIP08. Ex: spatial correlation in weather generators.

Energy supply and demand

Research projects

- UK based
 - Renewable impacts
 - Supply generation
 - UCL domestic air conditioning
 - Met office scoping study
 - Tarbase – nearterm climate change impact demand / existing building stock
 - UK
 - FP6 – Nordic Energy
- US
 - Scoping study
 - Robust assessment of wind energy impacts

Notes

- Energy Supply and Demand
- Effect of climate change on generation (renewables / thermal)
- Effect of climate change on demand
- Infrastructure -> economics -> future supply / security
- Feedback carbon capture on generation
- Energy storage
- Demand – temporal resolution
- Intermittency
- Seasonal
- Domestic heating
- Fuel choice -> economic drivers + impact back to climate change
- Security supply – age infrastructure
- Near climate change
 - Impact demand
 - Supply
 - Feedback loop

- Local grid/ control intermittency
- Link climate change to demand prediction
- Wind prediction -> yields -> resolution climate change => resource potential
 - Renewables
- Temperature
- Rainfall, wind speed, humidity and cloud cover
- Supply and demand concepts
- Mitigation / matrix?
- Plot pathway minimum risk
- Techo-socio-economic
- Energy pathways
- Scale?
 - Transformation existing stock for flexible response
 - retrofit
 - Storage with building
 - Heating / cooling
- Region?
- Mitigation, technology and control
 - E.g. fridge control, air-conditioning control
- Constrain the demand to make supply potential -> bottlenecks
- Smart building – energy efficiency
- Resilience to temp extreme change. What if it gets cold? / next ice age
- Energy Supply and Demand (diagram)
- Supply
 - Renewable yield
 - Thermal /decent
 - Fuel choices
- Demand
 - Building loads
 - Demand flexibility
- (supply and demand together) - Risk Resilience Economics -> Climate Change

Research ideas

- Supply
 - Changing renewables
 - Fuel choices (no nuclear)
 - Changing climate
 - Decentralisation
- Demand
 - Detailed power response of buildings
 - Flexible demand
 - Effect of climate change on load and flexibility
 - Storage/ dispatch ability

Land use and spatial planning

Research projects

- Coastal defence – Interreg 3 and 4
- Spatial planning – ESPACE
- UKWIR – urban creep project
- Creating a setting for investment – Interreg
- Urban buzz – UCL/UEL
- EPSRC funded – eco-city networks (UCL/Southampton)
- Spatial planning for climate change – Netherlands
- CRUE - EU

Notes

- RCEP (limited overlap)
- Floodplain research
- Risk indicators
- Grip tool (model compliments decision-making)
- Forestry Commission
- DOH

- Scale of decision making
- ESPACE
- Research at University of Manchester and RTPi (limited crossover environmentally)
- TCPA Climate Change Adaptation by Design (local not regional or national)
- RCEP report on environmental planning
- TCPA Connecting England report

- Quantum of Change
- Beseech/ASCCUE
- DEFRA turning point

- Modelling Impacts of Fiscal Regimes
- Green fiscal commission
- GLA/LCCP
- Synergy with fiscal regimes for mitigation e.g. commission for sustainable transport, UKERC

- Crisis Vs Strategy
- James Hanson research; RAPID programme – references for scenarios

Research ideas

- Coastal defence (towns, ports, harbours) – economic, social and environmental assessment of options (comment: already being progressed)
- Public/organisational acceptance of climate change adaptations – information/education.
- Effects of green, blue, brown space in urban areas.

- Potential conflicts – building density – runoff and other effects.
- Whole urban systems
 - Utilities, roads, traffic etc.
 - Scale of intervention to adapt/mitigate
 - Energy implications
- Whole urban systems
- Redistribution of settlements
 - Balance of benefits
 - Transport systems effects
- Location/adaptation of critical infrastructure installations

Risk assessment and appraisal tools; methodologies and guidance

Research projects

-

Notes

-

Research ideas

-

Health e.g. air quality; internal and external environments

Research projects

- SCORCHIO – vulnerability index
- FRMRX II – water quality / sediment quality, flooding and health impact assessment
- CARB – data on temperatures in
- NERC ENV + HUMAN HEALTH
- CITY FORM – valuing greenspace
- EUROHEAT – short term health impacts
- PURE – pollutants in the urban environment
- WAND (EPSRC) – water management options and health
- DOH – air pollution and health (call)
- INTRAWISE – indoor air quality / environmental quality

- *Notes*

- Wetter winters-> increased moisture – increased indoor air quality problems
- Hotter summer -> increased internal temps -> increased heat stress
- Indoor environment – commercial environment (offices)
- Air con – domestic – légionnaire (?)
- Low C buildings (ventilation / heating) in hospitals etc – trade offs and vulnerable groups
- Water resources – decreased availability
- Social behaviour – increasing/decreasing activity and increasing/decreasing exposure
- Outdoor infrastructure (trees etc) -> influence on buildings – indoor environmental air quality etc

- Outdoor greenspace – ecosystem services – mental well-being, biodiversity (also negative impacts)
 - Climate change -> cost impracticalities (expense re watering etc)
 - Design for wetter winter and drier summers
- What do you want from the greenspace – are they compatible?
- Interventions -> impacts and climate change ☺ ☹
 - E.g. greenspace – monitoring effect – checking the received wisdom
- Evaluation

Research ideas

Climate Induced Change to the Domestic Environment and Health

- Wetter winters, warmer summers, increased moisture, increased air con, increased temperatures

Climate Induced Change to Outdoor Green infrastructure

- Impact on the green infrastructure – is it still going to be there?
- Changes in ecosystem services
 - Air quality; biodiversity
 - Flood risk/ temp. shading etc (trade offs, balances positive and negative)
- Changing in amenity value *activity, well-being, aesthetics)
- Optimisation of greenspace design

Interactions between the internal and external environments

- Behaviour /social aspects
- Energy generation (micro generation)
- Increasing/decreasing Exposure
- Increasing/decreasing Activity

Impacts on commercial buildings

- Hospitals
- Nursing/ care homes
- School
- Health of their occupants

COMMON THEME – evaluation of interventions – checking the received wisdom

Adapting to extremes – thresholds

Research projects

- Making Space for Water: EA/DEFRA; pilot SUDS; local early warning.
- EA application of EARWIG to assess vulnerability of floodplains/nearby areas.
- Pitt Review: report on 2007 summer flooding.
- Project Aquarius: fire service – emergency response to flooding.

Notes

- UKCIP08
- Probabilistic information.
- PDF's 25 x 25 (17 RCM runs)
- Weather generator 5 x 5 grid.
- Defining extremes that cause 'failure' in communities (vulnerability).
- Critical infrastructure
- Hotspots
- UKCIP08 enhance reliability, robustness and resilience.
- What are the critical extremes/thresholds? Translate as quantitative indices/criteria.
- To what extent does UKCIP08 provide this information? E.g. 1st year of the project.
- Identification of additional work to enhance UKCIP08 i.e. fill gaps (wind is likely to be an issue, also spatial rainfall (variability/dependence); joint probability events).
- Tools for handling probability information of extremes in decision-making (adaptation).

Research ideas

- Defining extremes for emergency response
 - Local vs. regional
 - Vulnerability (people/infrastructure)
 - Thresholds (ARI)
 - Critical infrastructure
 - Changing climate vs. adaptation
- Adapting to wind extremes
 - Buildings
 - Critical infrastructure
 - Downscaling/direction;
 - UKCIP08
- Urban flooding
 - UKCIP08: reliability/use of outputs
 - Spatial correlation
- Joint probability
 - Pluvial/fluvial (independence)
 - Storm surge/tides
 - Driving rain
 - Emergency response/critical infrastructure
 - Wind power generation vs. demand
 - Independence/physical processing
 - Storminess (the lot)
 - Application of statistical techniques; critical infrastructure; emergency response; electricity generation/demand.

- Drought
 - Water resources
 - Fire
 - Land use/agriculture
 - Foundations

Governance, planning and regulations; targets

Research projects

-

Notes

- Building regulations-what would it take construction industry to adapt?
- How do you engage relevant stakeholders
- Overload of guidance -> not getting incorporated into tools
- Unanswered questions in Foresight report
- Rapid programme
- Modelling of the impacts of fiscal regimes – what are the levers of change?
- Appropriate evidence before action
- What analogy does climate adaptation/mitigation have to the economic / engineering/ social transformation into a war economy (cf WW2)
- Role of intelligent systems (ITC) in management, governance and dissemination.
- What is good
- Targets for adaptation
- Local government's role in setting climate change targets PPS
 - Lack of skills and understanding
- Development of tools -> SEAs
- SEAs and EIAs lack of science / credibility
- How to manage net benefit vs. alternative (e.g. Brownfield regeneration)
- Review of current mechanisms
- How to get a quantum change in implementation? Theory -> practice
- Living with worst case scenarios
- Building regulations / targets -> negative implications of Local Authority's setting targets.
- Change Change Tsar
- Massive research gap – climate scenarios not getting into SEAs – need proper science”

Research ideas

- Targets: what is good
 - Adaptation + how to measure it / setting targets for adaptation
- Scale of decision making –
 - National, regional, local governments
 - Role in setting security targets (PPS1) + spatial planning
- How do we achieve the quantum of change that is required

- e.g. transformation into a war economy (theory -> practice)
- Modelling of the impacts of fiscal regimes e.g. role of intelligent management systems
- Crisis vs. strategy / appropriate evidence before action and worst case scenarios

Building institutional and individual adaptive capacity, and understanding barriers to adaptation and the efficacy of adaptation options

Research projects

- UKCIP lots of tools; research into HOW tools are used
- ADAM project – adaptation and mitigation.
 - Developing EU policies
- Oxford Brookes – GIS modelling of household emissions
- Climate Champions – What does it take to effect change in LAs
- CSE – Defra research re what makes a good LA?
- We Adapt (Wiki) brings info together; communicating supporting decision making
- SEI Stockholm community research (climate change and forestry)
- Forestry commission – ability of different species to survive climate extremes

Notes

- Very large and complex organisation
- Small change - potential for large change
- Appropriate engagement used as a positive way to influence
- GAP = V large public sector
- + very large private
- + SMEs
- +professional bodies
- Individuals and communities

Research ideas

- Within an organisation (e.g. NHS)
- Within an area (e.g. regeneration area / local authority)
- Within a supply chain (e.g. BT suppliers and customers)
- Through professional bodies (e.g. TCPA 'adaptation by design')
- Appropriate knowledge / tools for user (e.g. 'so what? Guide')
- Integration into appropriate legislation / codes (e.g. building regs; SAP; code 4 sus housing)
- Individual
- Action research into putting policies into practice
- Flood guidance (planner skills; resources; political support)
- Defined 'capacity' - ability to make decisions
- Knowledge
- Support

- Resources
- Decision-making framework

Tools – to assess impacts of CC on commercial build and what impacts on productivity, rent, total returns and liability.

CAPACITY BUILDING: Appreciative Enquiry into NHS Capacity

Day 2: 29th January

Presentation: Networking initiatives in BKCC (John Handley, University of Manchester)

This presentation gave an overview of the networking initiatives that took place in BKCC. A description of the BKCC Integrating Framework, Stakeholder Forum and programme structure was given. This presentation was given to provoke ideas for a subsequent workshop on identifying networking approaches for ARCC.

Presentation: Stakeholder experiences in BKCC (Alex Harvey, UKCIP)

UKCIP are conducting a survey of stakeholder experiences in BKCC, their approach and some preliminary findings were presented. Again the findings in this presentation were developed in the subsequent workshop.

Workshop: Carousel approach to identify activities for a networking project in ARCC

Delegates were divided into four groups and allowed to contribute to the following brainstorming sessions using a carousel approach i.e. each group moved around four stations, each of which had one of the following questions:

- Effective dissemination: When? To whom? Of what? How?
- Training and development: When? To whom? Of what? How?
- Effective stakeholder interaction: When? To whom? Of what? How?
- Integration of research: When? To whom? Of what? How?

Initial brainstorming

- Annual assembly.
- Governance data – IPR – privacy, confidentiality.
- Openness and trust – developing relationships, can be volatile and change quickly.
- Stakeholder/partners and those beyond – relationships need to be structured and planned; alienation.
- Share data so not to waste money.
- Translation of results built in from the start to wider community; employ communications professional.
- Standard collaboration agreements: what and with whom to share; across projects.
- Timelines and co-ordination during the project; outputs available; use of results.
- Getting up to speed – list of definitions, process.
- Keep an eye on recent developments to bring into projects.
- Who is to hold a data depository?

Effective dissemination

- Extra time devoted to dissemination – 1 year of dedicated project time.
- User-friendly publications e.g. 'so-what' document. Link to regulations and standards; tailored to audiences; technical writers.
- Advance executive summary of publication.
- Outline of projects – peer reviews, are the stakeholders the most 'ideal' – problem with self-selection; clarification of the remit.
- Project updates.
- Effective communicators.
- Workshops for academics and general audiences.
- Stakeholder networks.
- Internet forums – intranet initially; strategy for external web presence.
- Road shows as a way into organisations e.g. tools developed by e-learning companies; lecture tours e.g. Round Table.
- Study days – 'boots-on' days; 'hands-on' days.
- General public – science festivals, media (TV, radio, newspapers, 'tabloid headings'); videos, podcasts, press releases through universities.
- Wider trade press.
- Timing of information releases e.g. event related such as times of flooding.
- Communication training: takes a different group of people to communicate results, tools etc.
- Evaluation of the dissemination process.
- Spin-off training e.g. short training courses.
- Conflicts between academic publications and public dissemination.
- Deliverables throughout the project: building capacity, communication plan.
- Does it affect research time?
- Targeting the 'right' people – identify at the outset.
- Communication and research plan written together at the outset of the project.
- Champions with 'thick skin', with a presence, 'fit for purpose'.
- Does not have to be the research team – trade bodies, professional institutions, KTN's.
- Awareness of government announcements.
- Target audiences: 'exclusives', to widen base, Local Strategic Partnerships, policy-makers, general public.
- University course material.
- Private sector publications.
- Wikis, blogs etc.

Training and development

- Identify training that exists.

- Difficulties – need to know more about each other.
- Knowledge transfer.
- Secondments if appropriate.
- LARC I
- Skills shortage – who needs to be trained?
- Professional institutions – CPD, manpower planning.
- Needs of the stakeholder community.
- Resource implications.
- Revenue opportunities.
- Training link to government targets.
- Commercial market.
- Influencing degree courses.
- Specific element of project plan/pack.
- Transferable academic credits.
- Training the trainer.
- Training within project – temporal and spatial (life of project).
- Topic areas (training PhD e.g. engineering and climate change).
- Gaps in knowledge – not just gaps in research.
- Definitions of standards – professional bodies.
- Innovative training bodies.
- Link to academy of sustainable communities – LEEDS.
- NGO's providers, need for other related organisations – RSPB, Oxfam.
- Training must be specified in same detail as research – assessment criteria.
- Training planning – beyond life of the project.
- EPSRC evaluation.
- Intra-project training.
- KTP – Knowledge Transfer Partnership.
- Where is training needed? E.g. board level.
- Geographical spread of training e.g. at regional level.
- Briefings for professionals.
- Researchers spending time in industry and vice versa – induction training with work partners.
- Training for stakeholders.
- Training needs some validation.
- Internal and external training – time needed to integrate across projects.
- Integrated training for researchers beyond research needs e.g. core competencies for professional bodies.
- Language – shared, not jargon.
- Standards and competencies for training.
- Funding – where is the money coming from? Appropriate sized groups.
- Graduate training – more responsive education programme.
- Education vs. training.
- Research findings finding way into education of professionals/students.
- Experiential/on the job training.
- Degrees with placement.

- Researchers spend time on building sites.
- Distance learning.
- Review success of training (evaluation).
- Performance review – more study days.
- Support for post-doctoral researchers.
- Fellowships.
- Training and dissemination skills.
- Complex end products – end users down the line able to use e.g. case studies showing how methods are applied.
- Validating with outside world, what is required – demand led.
- Training in facilitation.
- Listening skills.
- Development of learning alliances.
- Training policy makers.
- Stakeholder capacity – ongoing use of tool, not a one-off.
- Training steering committee - training/open days ensure understanding.
- Training in different disciplines.

Effective stakeholder interaction

- Involve stakeholders early.
- Manage expectations.
- Clarity on objectives.
- Respect/trust.
- Not a day job for the stakeholders.
- Involve stakeholders in real work.
- There are different types of stakeholders.
- Share outcomes widely.
- Incorporate dissemination in the role of stakeholders.
- Distinguish between industrial collaborators and other stakeholders.
- Researchers to help stakeholders translate findings.
- Resource dissemination process and monitor performance.
- Professionalism.
- Relate agendas/risks of researchers vs. stakeholders.
- Review stakeholder engagement to consider timescales of stakeholders.
- Researchers kept up to speed with policy context.
- Stakeholder moderators.
- Website moderator.
- Disaggregate stakeholders; map the different types of stakeholders.
- Make it the day job for some stakeholders.
- Needs managing.
- Involve researchers in real work.
- Continuity of personnel.
- Commitment of stakeholder personnel.
- Levels of stakeholders.

- Researchers need to be aware of pressure on stakeholder individual and corporate.
- Embed stakeholder time in stakeholder organisation.
- Stakeholder map.
- Manage the process.
- Regulate feedback both ways.
- How to entrust stakeholders.
- IPR and confidentiality.
- Guidance for stakeholders.
- Who should be involved?
- Don't ask for too much time from stakeholders.
- Free loaders.
- Assistance from EPSRC/UKCIP on the selection of stakeholders.
- How to tie in stakeholders.
- Stakeholder involvement and time commitment in negotiating levels of stakeholder involvement.
- Involve the stakeholders involved in BKCC.

Integration of research

- Web forum – researchers and stakeholders.
- Reinforce common understanding of objectives.
- Central data management.
- Networking events.
- Special edition journals.
- Cascade communications – target, with links.
- Researcher – stakeholder presentations.
- Structured networks.
- Social events.
- Timelines of outputs (dependencies).
- Parallel projects.
- Consortia.
- Consortia presentations.
- Sharing processes.
- Integrating project outputs – link to end-user needs and standards.
- Sharing researchers.
- Researchers' expectations of stakeholders.
- Researcher placements in stakeholder organisations.
- Dispute resolution (effective and clear).
- Avoid duplications.
- Early understanding of partners.
- Matrix of activity – events and timelines.
- Cross-assignment of researchers/stakeholders to other projects.
- Better understanding of other research inside and outside of the programme.
- Different things are needed at different times in the process – flexibility.
- Application of outputs in case studies – project specific.
- Not be too prescriptive re stakeholder involvement.

- Allowing time to share.
- Demonstrating and learning from the process.
- Funding for secondments.
- Integrate within BKCC or within sector.
- Linking outside of BKCC2.
- KTP opportunities.
- Integration with policy-maker agendas – what's coming up?
- How to deal with non-performance.
- Cross-sharing of resources and responsibilities.
- Industrial PhD/MSc/MA.
- Need a clear understanding of why integration is being sought.
- Project management and administration should be a separate responsibility and training should occur to make sure it happens.
- Shared deliverables.
- Integrity mechanisms for when conflicts arise.
- Equality amongst participants.
- Involvement of all from the beginning – mechanisms to deal with changes in partners and management.
- Issue of timing – starting at different times, problems for project management.
- Recruitment of staff.
- Resource in voluntary sector.
- Means of dealing with changes in urgency.
- Potential value of matched funding to support integration.
- See recommendations from data management group.

Keynote presentation: Climate proofing concept: a case of the Netherlands (Pavel Kabat, Wageningen University and Research Centre)

Workshop: refine research gaps and prepare presentations

During the final workshop each topic area group was asked to further develop two of their research ideas, and to prepare a presentation to describe the ideas in detail using the following headings:

- Title
- Background
- Description
- Benefits
- Impact/novelty
- Stakeholders
- Relevance to EPSRC

Existing buildings

Thermal Comfort and Building Performance

Background

- Rising temperatures will lead to severe/potentially fatal thermal discomfort in many existing building types. This will result in health impacts, loss of well-being and economic impacts such as loss of productivity.

Description

- The project will develop guidelines for overheating based on occupant type and building use. The extent and severity of future overheating will be identified.

Benefit to Society

- Improved health and well-being
- Productivity maintained
- Keep more of existing building stock in use
- Export potential

Scientific Impact and Novelty

- Better understanding of thermal comfort in dwellings and under extremes. Proven understanding of interaction of occupants, buildings and climate.

Stakeholder Relevance

- Central government (health, treasury CLG)
- Public landlords
- Professional associations (RIBA, CIBSE, RICS)
- Commercial landlords

Relevance to EPSRC

- Underpins other arc themes and climate projects
- DTI, DFES
- Knowledge needed now.

Changing buildings for changing climate

Background

- 2/3 of building stock in 2050 already exists. 5 million homes in England And Wales are at risk of flooding. People are beginning to adapt their buildings to this future. There is a pressing need to evaluate the success of adaptations. Currently, existing building use 46% of UK energy.

Description

- This project will review options for realistic adaptations to existing buildings in theory and practice. It will develop realistic datasets, through case studies and action research to underpin mainstreaming of adaptation / mitigation solutions.

Benefits to society

- Health, well-being, productivity, extend use of building stock

- Reduce energy demand and CO2 emissions

Scientific impact and novelty

- New area, little known
- Development of novel datasets

Stakeholder relevance

- Building owners and managers
- UK government
- Building materials and component manufacturers

Relevance to EPSRC

- Provides missing knowledge
- Inform policy
- Wider dissemination of best practice in adaptation

New buildings

DURABUL – Durable Adaptive Buildings

Background

- Current buildings not sufficiently well designed or adaptable for likely future climate scenarios

Description

- Translate future scenarios into performance requirements and develop performance models (durability, structure, health, comfort).
- Buildings will require holistic design, new methods, new materials, new ways of working, new processes and consideration of site/spatial issues

Benefits to Society

- New business opportunities, improved health and comfort for users.

Scientific Impact

- Systems integrations of existing disparate elements. Development of new expertise, maintain standing as world leaders in design.
- Outcome: codes and regulations for adaptable buildings, which will mirror mitigation and buildings regulations.

Stakeholder Relevance

- Huge community, from material producers, engineering consultancies to architects and users. CABE, DCLG, HBG

Relevance to EPSRC

- Models, processes, systems, integration, new materials

Social Impacts of New Building Technologies

- New buildings may require changes in patterns of use and ways of working and living.
- Overcoming barriers, creating awareness and understanding what will need to change. Possible opportunities for joint funding with ESRC. Socio-technical understanding and interaction.

Benefit

- Environmental benefit major in changing behaviour.
- Social benefit in increased comfort, health

Scientific Impact

- Filling a necessary gap, understanding barriers and the new adaptations needed as climate and designs change.

Stakeholder Relevance

- Influences design, engage building, clients, building owners and local authorities.

Relevance to EPSRC

- Technical advances to make buildings more adaptable, building management, developments user friendly.

Transport systems and infrastructure

Climate proofing UK transport infrastructure

Background

- Enabling infrastructure managers to assess risk and make appropriate adaptation decisions.

Description

- Overarching project that takes an integrated systems approach to provide decision support tools for assessing impact of failure and prioritisation of physical and management approaches targeting the points of vulnerability in the infrastructure. To consider future transport requirements within a spatial and temporal context.

Benefits

- Improving predictability of transport infrastructure to minimize economic, social and environmental cost of disruption within a changing climate.

Impact/novelty

- Taking a whole systems approach: novel and internationally significant.
- Discrete packages: novel and closing gaps.

Stakeholders

- Infrastructure managers: e.g. Highway Agency, Ports, Network Rail, Local Authorities.
- Infrastructure users: business, Transport User Associations.
- Relevance to stakeholders is high for use in prioritising investment decisions, budget predictability, valuing the asset, national/regional local.

Relevance to EPSRC

- High because of cross-sector dimension and relevance. Complex and high risk. Avoids duplication.
- Possible other funding with ESRC.

Integrated water management

Towards Water Neutrality

Background

- Water scarcity/stress in the South East.
- High carbon emissions in water supply, treatment of water.
- Opportunities for environment and development.

Description

- Research optimal balance of technologies, behaviour, governance to deliver secure and sustainable water supplies in a changing environment and increasing growth.

Benefits

- Improved water security, reduced carbon emissions and more resilient water environment will bring social, economic and environmental benefits.

Impact/novelty

- Current water resource planning does not optimise water resource management. This project integrates water resource planning, spatial planning, technologies, consumer behaviour and climate risk analysis.

Stakeholders

- Water companies (engagement expected to improve following Climate Change Bill, Pitt Review, DEFRA Select Committee); Water UK; Waterwise; UKWIR; Environment Agency; Climate Change for Water; OFWAT; Natural England; Developers; TCPA; DEFRA; DCLG; Treasury.

Relevance to EPSRC

- Builds on existing work (WAND, CRANIUM, Watersave) and compares ecosystems services vs. new technologies.

Systems approach to water management

Background

- WFD requires integration of different aspects of water management e.g. water quality, quantity, flood risk, droughts, groundwater, climate change.

Description

- Develop an integrated systems model as a tool for phased, adaptive decision-making for the water environment.

Benefits

- Better decision-making leading to improved flood and drought risk management and enhanced environment.

Impact/novelty

- Integration of drought, flood, water quality, land use models to support better decision-making.

Stakeholders

- Supports participation of varied stakeholders in River Basin Management Plans including attribution of risks and who pays. Informs spatial plans and tools for future cycles of the WFD.

Relevance to EPSRC

- Combines built and natural environment; integrates previous/current EPSRC funded models; compares hard vs. soft engineering approaches.

Energy supply and demand

Energy Supply and Demand

Background

- Climate change and mitigation approaches will affect both supply and demand. Current projections ignore climate change adaptation.

Description

- Building on existing work that does not primarily address climate change (e.g. super gen, likerc, cvb etc), this project will:
 - Improved prediction of yield from generation and demand
 - Tailoring the climate change scenarios for this purpose.

Benefit to society

- A. Social – meeting society's energy needs
- B. Economic – strategic security of supply and business opportunities
- C. Environmental – low carbon energy delivery

Scientific Impact

- Current forward views of on energy supply and needs do not fully incorporate climate change and adaptation.

Stakeholder Relevance:

- Utilities – delivering adaptation strategies.
- Government policy/regulation, local government: implementation
- Developers, investors

Relevance to EPSRC

- Utilities, ETI, EPSRC (high relevance)
- Cross-disciplinary (social etc)

Effect of Climate Change on Energy Infrastructure

Background

- Asset management planning practice do not account for climate change

Description

- Translating climate change scenarios into an understanding of design of energy infrastructure.

Benefit to society

- Reliable energy

Scientific Impact

- Major research gap, adaptation strategies for future-proofing energy infrastructure

Stakeholder relevance

- Utilities, developers, insurance investments

Relevance to EPSRC

- High and cross-disciplinary support from utilities, FP7, transport and water.

Land use and spatial planning

Mainstreaming climate into spatial planning

Background

- Climate Change Bill; Development framework – land allocations, habitability, social cohesion/well-being.

Description

- Framework to support spatial planning through integrating evidence from multiple sources e.g. transport, utilities, flooding, heat and to test resilience and adaptation in settlements.
- CPD and capacity building.

Benefits

- More transparent planning.
- Informed governance and better integration of public policy.
- Social cohesion/happy society.

Impact/novelty

- Integration of sources.
- Understanding feedback from adaptation/mitigation from common metrics e.g. energy.

Stakeholders

- Informed planners, politicians, public, raised public awareness/understanding, quantifying impacts before decisions are made.

Relevance to EPSRC

- Integrates engineering/planning interests for ARCC and others.

Synergies and conflicts of land-use adaptations

Background

- Evidence-based decision making.
- Identify synergies/conflicts to facilitate the best outcome.

Description

- Understand sensitivities to the effects of land-use types at various scales in the context of climate change.

Benefits

- Best outcome for health, welfare and lifestyle.
- Optimal welfare and lifestyle i.e. biodiversity.
- Manage risk of disruption (economic and physical).

Impact/novelty

- Application of UKCIP08.
- Combination of disciplines – planners, drainage, engineers, green space managers.
- Decision-making tools expressing benefits in tangible terms e.g. money.

- Stakeholders
- Decision-makers – regional and local strategies.
- Developers, utilities, transport.
- Communities, householders.

Relevance to EPSRC

- High!
- Balancing the contribution of 'green' infrastructure within the built environment.

Risk assessment and appraisal tools; methodologies and guidance

UK Critical Systems: Performance under multiple geographically distributed threats

Rationale

- Recent weather events have demonstrated the vulnerability of critical infrastructure. The obvious is now being dealt with. We need tools to deal with interactions and multiple sectors.

Phase 1: Idealisation

Description

- System character. Interdependencies. Uncertainties. Extremes. Vulnerability. Test/responses to shocks.

Phase 2: Demonstration and Scenarios with Key Stakeholders

Phase 3: Guidance

Benefit to Society

- Avoiding damaging losses. Optimising spend on resilience. Improve recovery.

Scientific impact:

- New methods of system performance under uncertainty. Testing on complex spatial systems.

Stakeholder relevance

- Transport. Energy. Water. Food. Health. Telecoms. Local government and community

Relevance to EPSRC

- Highly relevant. Potential for links with other EPSRC programmes e.g. UKERC

Health e.g. air quality; internal and external environments

Health impact of climate change upon people – HICCUP

Background

- Wetter winters, warmer summers, changing ventilation, novel materials etc. will all impact on the domestic environment and hence health.

Description

- Health impacts of climate change on future internal built environments. Surveys and modelling will be used to predict the future domestic environment.

Benefit to society

- Increased Health and well-being
- Decreased load on NHS
- Decreased hospital beds. Decreased missed school and work days.
- Decreased energy usage.
- Decreased pollution levels.

Scientific Impact / Novelty

- Improved understanding of links percentage internal and external environment, clarification of interrelationships, percentage engineering, microbiology, behaviour and socio-economics. Identification of changing vulnerabilities and vulnerable groups.
- Innovative. National.

Stakeholder relevance

- Householders, developers, architects, NHS – high
- Need to identify a coherent group
 - Housing associations etc.
 - Local authorities

EPSRC Relevance

- Yes
- Co funding MRC, construction.

GROWTH – Green Infrastructure Opportunities for Wellbeing, Adaptation and Health

Background and Rational

- Climate Change impacts on Urban Ecosystem and human health.

Description

- Changes in climate, land-use planning, transport, energy generation and social behaviour and impacts on environmental quality and urban ecosystem health (air, soil, water, climate)
- Transport change => AP model (future meteorological drivers)
- Impacts of CC on greenspace functions, resilience and trade-offs.

Scientific Impact / Novelty

- Adaption and mitigation of CC impacts on urban ecosystems and human health
- Green infrastructure resilience and trade offs of services

Stakeholder Relevance

- NHS / Health bodies
- CABE SPACE/ EP/ EA

- Community Bodies
- Landscape Architects
- Transport
- Waste Industry
- Water Industry
- Sports Bodies (sports council)
- LAs

EPSRC

- High relevance
- Potential co-funding/ support
 - NHS
 - MRC
 - NERC

Climate Change Impacts on Human health: Interactions between Internal and External Environments

Benefit to society

- Impacts of changing building use on indoor and outdoor environments,

Adapting to extremes – thresholds

Vulnerability of critical infrastructure to extremes

Background

- Hazards, vulnerability and exposure of emergency services, hospitals, electricity supplies, transport infrastructure, water treatment to extremes.

Description

- What are the critical extremes/thresholds?
- Can we translate these to quantitative indices/criteria (where do they already exist)?
- To what extent can we use UKCIP08 data to project these extremes?
- What gaps exist? E.g. spatial variability dependence of rainfall; how reliable is wind; joint probability.
- Develop tools for decision makers to assess adaptation strategies with probabilistic information.

Benefits

- Increased resilience and reduced vulnerability to future extremes.

Impact/novelty

- Pooling disparate knowledge.
- Methods for wider stakeholder and scientific community to use UKCIP08 effectively and efficiently.

Stakeholders

- National, regional and local resilience forums; community stakeholders; local authority planners.

Relevance to EPSRC

Governance, planning and regulations; targets

Identifying Adaptation Targets

Background/rational

- Major changes are required in the implementation of adaptation. Research is needed to identify and set targets for good adaptation.

Description:

- A multidisciplinary research project to develop robust methods for setting and monitoring adaptation targets in the area of climate change.

Benefit to society

- Transparency, direction, clarity of objectives, ownership, better management

Scientific implications

- Novel methods will be developed for setting hard and soft adaptation targets (outcomes and process)

Stakeholder relevance

- Providing a clear framework for decision-making and monitoring feedback and accountability

Relevance to EPSRC

- The best scientific and engineering knowledge is essential to formulate the most appropriate targets.

Decision making in planning for climate change

Background/rational

- Need for clearer governance in delivering adaptation for climate change

Description:

- Identifying system, partnerships and processes which deliver adaptation in different UK contexts, in particular investigating the distribution of power and resources that is implied by different adaptation strategies.

Benefits to society

- More resilient communities earlier and less crises management; more effective planning system (good governance)

Scientific implications / novelty

- Better understanding of how to deploy infrastructure for adaptation and design the enabling institutional and financial mechanisms for delivery

Stakeholder relevance

- Policy makers, developers and community identifying roles and responsibilities

Relevance to EPSRC

- Medium
- Sniffer
- ESRC
- Cross-cutting theme, relevant to all projects

Building institutional and individual adaptive capacity, and understanding barriers to adaptation and the efficacy of adaptation options

Building Stakeholder-led Effective Adaptive Capacity (Bsleac)

Background

- To enable EAC in research teams (academic + stakeholder-partner) and wider stakeholder community.

Description

- Aims
 - What do stakeholder communities and research teams needs?
 - What models for communication are there?
 - How can projects (BKCC1+2) inform stakeholder need?

Benefit to Society

- Scientists get better understanding of wider stakeholder need.
- Science gets to be relevant. More likely to be repeat-funded.

Stakeholder relevance

Duh!

Relevance to EPSRC / DEFRA

- Inform DEFRA's plans for UKCIP Post-2010

Voting session

Based on agreed assessment criteria on the first day of the workshop, delegates were asked to vote on the presented research ideas. Each delegate was given five red, five orange and five green dots. The red dots represented relevance to society, the orange dots relevance to stakeholders

and the green dots relevance to research. Table 3 shows the results from the voting exercise.

| Research idea | Red | Orange | Green | Total |
|---|------------|---------------|--------------|--------------|
| Thermal Comfort and Building Performance | 10 | 21 | 20 | 51 |
| Changing buildings for changing climate | 35 | 36 | 45 | 116 |
| DURABUL – Durable Adaptive Buildings | 25 | 18 | 29 | 72 |
| Social Impacts of New Building Technologies | 8 | 8 | 4 | 20 |
| Climate proofing UK transport infrastructure | 37 | 36 | 33 | 106 |
| Towards water neutrality | 31 | 20 | 17 | 68 |
| Systems approach to water management | 23 | 22 | 29 | 74 |
| Energy Supply and Demand | 8 | 11 | 12 | 31 |
| Effect of Climate Change on Energy Infrastructure | 4 | 4 | 3 | 11 |
| Mainstreaming climate into spatial planning | 18 | 19 | 15 | 52 |
| Synergies and conflicts of land-use adaptations | 19 | 18 | 16 | 54 |
| Identifying adaptation targets | 21 | 22 | 21 | 64 |
| Health impact of climate change upon people – HICCUP | 24 | 20 | 25 | 69 |
| GROWTH – Green Infrastructure Opportunities for Wellbeing, Adaptation and Health | 24 | 17 | 26 | 67 |
| Climate Change Impacts on Human health: Interactions between Internal and External Environments | 0 | 0 | 2 | 2 |
| Vulnerability of critical infrastructure to extremes | 24 | 16 | 28 | 68 |
| Decision making in planning for climate change | 13 | 11 | 9 | 33 |
| UK Critical Systems: Performance under multiple geographically distributed threats | 18 | 19 | 25 | 62 |
| Building Stakeholder-led Effective Adaptive Capacity (Bsleac) | 11 | 20 | 4 | 35 |

Table 3: Results from voting exercise

