UKERC

Agent Based Modelling: Application to Policy

Meeting Report

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Reported and edited by Sarah Keay-Bright, UKERC Meeting Place

THE UK ENERGY RESEARCH CENTRE

Operating at the cusp of research and policy-making, the UK Energy Research Centre's mission is to be the UK's pre-eminent centre of research, and source of authoritative information and leadership, on sustainable energy systems.

The Centre takes a whole systems approach to energy research, incorporating economics, engineering and the physical, environmental and social sciences while developing and maintaining the means to enable cohesive research in energy.

To achieve this we have developed the Energy Research Atlas, a comprehensive database of energy research, development and demonstration competences in the UK. We also act as the portal for the UK energy research community to and from both UK stakeholders and the international energy research community.

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The UK Energy Research Centre (UKERC) was set up in 2004 to provide a focus for energy research in the UK while galvanising collaborative international energy research. A key supporting function of UKERC is the Meeting Place, based in Oxford, which aims to bring together members of the UK energy community and overseas experts from different disciplines, to learn, identify problems, develop solutions and further the energy debate.

Core organisomg team
Henry Leveson-Gower, Environment Agency
Jonathan Kohler, Tyndall Centre
Tom Downing, Stockholm Environmental Institute (Oxford)
Takeshi Takama, Stockholm Environmental Institute (Oxford)
Sarah Keay-Bright, UKERC Meeting Place, sarah.keay-bright@ukerc.ac.uk

Background

Agent based modelling (ABM) has been applied successfully in a number of areas such as modelling financial markets, organic farming technique adoption and household waste prevention activity. However, application of ABM techniques to policy intervention design in the energy sector has been limited to date. ABM could potentially make a very useful contribution to energy policy as this approach to modelling could particularly be used to better understand consumer behaviour and energy demand, resulting in the design of more effective policy interventions.

This workshop had several aims:
1. To increase understanding of the different approaches to ABM and their applicability to informing energy and other policy intervention design
2. To identify policy areas where ABM techniques could be usefully applied and to examine how they could be incorporated into the policy making process.
3. To develop joint research proposals aimed at relevant research funding bodies.
4. To develop relationships between key researchers in this emerging area

The two-day workshop brought together some 25 researchers and policy practitioners - largely ABM experts and energy experts interested in learning more about ABM techniques with a view to applying these techniques to energy problems and policy intervention design. The first day of the workshop focussed on sharing knowledge and insights on the use of different ABM approaches. At the end of the first day participants considered different energy policy areas to which ABM techniques could be applied and developed an initial list of potential areas of research.

The second day of the workshop explored the practical application of ABM modelling in the policy making process, in the areas identified in the first day. A key topic for discussion was the challenge for modelling, particularly ABM, in how it can be used to effectively support the policy making process. Groups developed research proposals for presentation to users, including policy-makers, and potential funders at a follow up workshop on January 16th.

This report is available from the UKERC website www.ukerc.ac.uk

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1. Introduction

Henry Leveson-Gower from the Environment Agency opened the seminar by explaining to participants why the seminar came about. Through his work with the Environment Agency, Henry is particularly interested in how social science can be brought into the policy-making process. Henry regards agent-based modelling (ABM) as a tool which could make a more significant contribution to policy design. ABM could be used in the energy sector to formalise social interactions and behavioural change and add to the more traditional qualitative and discursive approach. ABM provides the potential to explore a new approach to economics. There is limited application of ABM techniques to the energy sector but considerable ABM expertise exists in other research fields.

Henry referred to the book, "The Origin of Wealth" by Eric Beinhocker, which draws upon five dimensions which can be applied to ABM in comparing the technique to more traditional models:

- Agents can have inductive knowledge. ABM recognises that people/agents are intelligent and have very good inductive reasoning (but not such good deductive reasoning).
- Traditional models are able to capture basic interactions between, for example, markets. ABM is able to explore many more dimensions of interactions such as through networks.
- ABM can represent non-linear and non-equilibrium relationships which other types of model have difficulty in representing.
- Emergence in complexity is a characteristic of ABM. For example, the macro scale will 'emerge' from the micro.
- ABM also copes with 'evolution'. Traditional models are limited e.g. with the capacity to only incorporate shocks as 'exogenous'.

Henry reminded participants of the aims of the workshop:

- To increase understanding of the different approaches to ABM and their applicability to informing energy and other policy intervention design
- To identify policy areas where ABM techniques could be usefully applied and to examine how they could be incorporated into the policy making process.
- To develop joint research proposals aimed at relevant research funding bodies.
- To develop relationships between key researchers in this emerging area.

The joint research proposals will be further developed offline and presented at a follow-up seminar on January 16th. This seminar will bring together modellers, academics from other disciplines, policy officials, research funding body representatives and other potential users of agent-based models.
There followed a tour de table so all participants could introduce themselves and share their research interests.

2. Discussion on key issues relating to ABM

An experienced ABM modeller kicked off the discussion by outlining a major problem faced by the ABM modelling community. He explained that there is often an expectation that ABM is a substitute for technology, economic or market models. ABM is not a substitute, it is simply a different kind of model. ABM should fit with the use of appropriate language (e.g. resilience, vulnerability) and can provide not only a richly expressive account but a formal unambiguous account. The output can be used by experts wanting to develop richer dialogues which avoid the use of inappropriate language. Agent based modelling needs to be seen as part of a process involving the development of a narrative into which ABM feeds in. ABM can introduce greater precision (which is different to 'accuracy'). Another expert added that ABM is able to help explore variance in policy design. Exploration of variance helps policy makers get a handle on different possible scenarios and realities. Econometric models are largely based on fixed equations whereas ABM can offer variation in responses or behaviour which helps to better understand reality and instil more confidence in policy design.

The discussion moved on to how ABM models might fit into or be used in the policy-making process. A participant pointed out that work carried out by academics is sometimes wasted because it is not in a useful or appropriate format for policy-makers. Another participant added that presentation of outputs or results is therefore very important. Policy-makers are not always interested in models which present a more complete but more complicated picture – they want answers that can be translated into policy.

The workshop organisers pointed out that this workshop aims to address this issue. The second day of the workshop will require participants to develop a research proposal involving application of ABM modelling to an energy problem. The development of this proposal should consider the policy process and how ABM could be applied within it. A follow-up workshop is planned for January 16th where the proposals will be presented to potential funders and policy officials. The research community will then have the opportunity to ask Government representatives how specific ABM models could potentially be used in the policy process.

The Markal model has been used by policy-makers in the development of the Energy White Paper (EWP). A participant involved in the use of the Markal model for the EWP informed that policy-makers are willing to use models if they are formulated to answer questions and provide practical information. It was also pointed out that policy-makers are used to complexity and technical issues. The policy-makers involved in incorporating the Markal outputs into the EWP were well informed and keen to interact with the modellers. They were prepared to invest much time in understanding why and how the model worked. The policy-makers wanted many more scenarios than the modellers had planned to provide. In the end 54 scenarios were developed with different assumptions and answers. The policy-makers then decided which scenarios/runs to focus on. In conclusion, the participant suggested

the question is whether ABM models can help to answer policy questions in a more robust way.

Another participant added that there are other users in addition to policy-makers and indeed they are all looking for clear, simple answers. The current system is driven by statistics and models based on mathematical equations. As people are very familiar with this system they are willing to work with it or accept it despite the shortfalls and provided the assumptions are known. ABM models can provide insights and more variance in scenarios but expectations need to be managed as there is only so much a model can achieve.

One expert pointed out the need to map a very large scenario space to enable a rich understanding of the problem or situation. The outcomes can then be screened through stakeholder engagement. Validation is also important and modellers should ask themselves, "Could someone else capture the same output/result?". It is necessary to demonstrate confidence in the process. Another comment related to the use of ABM models as policy instruments to help prevent disastrous policy by, for example, identifying unintended outcomes. Models can help develop policy responses in situations when things (e.g. policies) go wrong.

The UKERC integration project involves the use of modelling (Markal), complemented with qualitative research, to explore a range of scenarios that are based on two core concepts/dimensions: low carbon and resilience. There is an awareness that Markal may fall short on incorporation of human behaviour and ABM may be able to make a contribution here. It would be useful to know what happens if preferences change or what changes in preferences might cause decentralisation of power generation to come about. Ambition or lack of ambition, bound up in regulation/targets/agreements, may help us rule out the behaviours that would have to be prevented, those that should be promoted or those that will take place. For example, what kind of human interactions would an 80% carbon reduction target bring about? Another modeller pointed out that scenarios and forecasts are never correct or accurate. We can do our best with a model but scenarios are not the only option.

The discussion touched on how to encourage greater take-up of ABM techniques by academics and more modellers that currently use more traditional models. Such experts may be willing to learn about ABM techniques and how such models can be applied but they may be reluctant to give up on their own more traditional model because of vested interests (personal, career, financial). Another participant suggested that an initiative should be set up to promote sharing of models and to reduce the cost of trying out other models.

3. ABM demonstrations

A large part of the first day was dedicated to the demonstration of different types and applications of ABM models. Participants were divided into small groups (expert or non-expert) to view the demonstrations. Details of the demonstrations can be found on the Meeting Place section of the UKERC website www.ukerc.ac.uk .

A reflective discussion followed the demonstrations. The participants generally found the demonstrations useful. For some participants, it was useful to learn about different approaches and how they could be applied. Some had learned that ABM models can contain mathematical functions and/or rule-based functions. Some pointed to the clarifications they had picked up between: deductive and inductive; dynamic and static; reactive and constant; simple theory-driven and complicated empirically-driven. The incorporation of system feedback was discussed. There was a remark relating to how some models can be too complicated (often a facsimile of a situation using as much observation data as possible and perhaps no clear theoretical framework) with too many parameters such that it is not possible to test the model or identify why it behaves as it does.

Validation at macro level tends to involve statistical validation while validation at micro level tends to involve qualitative validation. A key attribute of ABMs is that they can model clustered volatility, which is a property of many systems that are observed in reality eg financial markets, sales of shampoo etc. Distributions that have the the property of clustered volatility cannot be analysed with normal statistical validation techniques, which creates particular challenges.

The importance of appropriate application of a model to a research question was emphasised. Effective presentation and communication of how models work and their outputs was also stressed – this is of critical importance for policy-makers, users and non-experts.

4. Development of research proposals: policy/research problems and application of ABM

At the end of the first day participants put forward policy areas or policy problems relevant to the energy sector to which ABM modelling techniques could be usefully applied. Ideas were written down on hexxies (large post-it notes) and displayed on a board. The ideas were clustered into themes. These themes and ideas became the basis for the small group work which followed the next day.

Participants were divided into groups based on the following themes (see appendix for original brainstorm ideas): power generation and networks; buildings; community level; individual/personal level; bioenergy; consumer information and influencing behaviour. As many of these themes overlap and as many participants had interests in more than one theme, the small groups worked alongside one another in parallel so that participants could switch between groups easily and keep an eye on developments in other groups.

Groups considered the output from the brainstorm and prioritised the ideas/suggestions which could be worth exploring further. Groups were also free to add new ideas, package ideas together, or to develop more than one idea. Groups were given the option to stay together or split into pairs/threes to develop the highest priority idea(s) in more detail, depending on the number of possible ideas worth developing and the preferences of the individuals in the group.

Participants were given pre-formulated poster templates to summarise their detailed ideas. The poster headings were as follows:
- **Research gaps where ABM might contribute and rationale**: This section describes: the policy problem; the nature of the research gap; why more research is needed; and how ABM could be usefully applied.
- **Comments on research process and incorporation of research into policy:** This section covers process issues, including barriers and solutions, relating to the undertaking of the research and its application to the policy problem.
- **Research proposal:** This needs to be a sufficiently detailed and clear description of the research proposal.
- **Actions and who to involve:** The proposals and other outputs of this workshop will be presented to representatives of the Research Councils and Government officials at a follow-up workshop in January. The proposals resulting from this workshop will need to be developed in more detail offline by volunteers before January. The actions should include details of who will deliver the action and by when. There may also be other people/institutions that should be involved or invited to contribute.

The completed posters were displayed in the room and participants were asked to inspect them during the refreshment break. A plenary discussion about the proposed research proposals then followed. The participants shared thoughts and comments on each others' research proposals. Teams will develop and finalise the proposals offline for presentation at a follow-up workshop on January 16th.

5. Next steps

Participants fully supported the idea of a follow-up seminar on January 16th. The group briefly discussed how the seminar should be set-up and managed. The following was agreed:

- Based in London
- Half-day
- To have an opening presentation(s) which set out clearly what agent-based modelling is and why/how it could be applied to the energy sector.
- Involving display of posters: research proposals developed at this workshop; any other ABM-energy research proposals put forward by the research community; information on existing application of ABM models more generally, particularly to energy; ABM initiatives that may be of interest.
- Proposals developed at this workshop to be developed and finalised offline. The UKERC Meeting Place will provide shared webspace and access to communication/meeting tools to facilitate this.
- The UKERC website for the ABM workshop and follow-up seminar will provide info of interest to the research community including: a report of this workshop; details of the January workshop; details of the ABM demonstrations given in this workshop; links to relevant websites; details of ABM initiatives, existing work/application; and anything else that may be of interest to the wider community.

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Appendix 1

Brainstorm themes and ideas for energy policy problems to which ABM could be usefully applied

Transport

- Road congestion: Agents – motorists in traffic congestion; transport authorities; central Government. What are the key reasons why motorists spend time in congestion? What transport provisions and supporting policy would be required to achieve radical modal shift?
- Promotion of walking/cycling/public transport within cities: comparative studies
- What sets of policy will lead to modal switching in: urban areas; rural areas?
- Cycling policy: What cities can/need/should do to genuinely promote cycling and keep people at it?
- How is the accessibility to public transportation important as regards mode-switching?
- How could sustainable mobility (not the same as sustainable transport) be achieved?

Consumer information and influencing behaviour

- "Conspicuous non-consumption" – making demand reduction fashionable
- How to counter the apparent adverse reaction from well-off parts of the society to current green thinking e.g. more SUVs, power showers, large plasma and multiple TVs
- How does information distribution affect to the behaviour of energy reduction? – by broadcasting; by word-of-mouth?
- The energy supply companies have an obligation to deliver energy efficiency targets: how can their customers best be involved in this process?
- Carbon intensity labelling schemes
- Energy efficiency: Agents – households; energy efficiency advice centres; local authorities; central government. What should EEACs give to households, what supporting policy, to greatly increase uptake of household measures?
- Promotion of resource-efficient cars/appliances/lifestyle. What kind of message and by whom?
- Changes in consumer behaviour re. microgeneration or smart meters and energy displays.
- Microgeneration: Agents – households; renewable energy advice centres; local authorities; central government. What kind of advice should REACs provide, and what supporting policy to increase microgeneration?

Individual/personal level

- Personal carbon trading – shifts in consumer behaviour
- Changing consumption patterns to reduce personal carbon footprints – taking wider industrial and commercial impacts into account.
- Model the way in which the small number of electricity generators will take decisions about how and when to add new capacity i.e. look at the interests of the actual companies, not a theoretical oligopoly model.
- Taxation policies to influence personal consumption patterns in order to reduce global (including international) GHG emissions. Agents: individual consumers; enterprises; policy agencies; foreign enterprises.

Community level

- What policies would lead to more communities with a smaller environmental carbon (and other) footprint?
- Interaction of central and local government in reducing urban GHG emissions.
- Community level carbon-neutrality/energy-saving initiatives.
- Urban planning/design: What policies could help create liveable, desirable settlements with low environmental impacts and high quality of life?
- How to make the carbon reduction commitment as effective as possible?
- What are the costs of new towns, not just in housing, but in support of infrastructure (roads, water, sewage, improved buildings)?

Bioenergy

- Development of bioenergy supply chains internationally for supply to UK/EU including unintended consequences e.g. land-clearing change from food to energy crops
- Development of local (UK) bioenergy supply networks for electricity and heat (agents: growers; processors; generators; users etc.)
- Food, biofuels and the tragedy of the commons
- Biodiversity. Agents: farmers, local authorities, environmental NGOs. Comparison of different systems of incentives to achieve biodiversity conservation.
- How to develop a system for reducing and collecting food waste and converting into energy
- Development of bioenergy supply networks for liquid fuels (agents: growers; processors; biofuel processors and users)
- Trade offs and synergies between land uses as a result of moving to greener sources of energy. Agents: rural households.

- Local, regional, international competition for biomass: Where will it go? What are the implications for international policy?

Buildings

- Increasing the supply and demand for low-carbon buildings. Where: Buildings = commercial real estate; Supply = architects; Demand = owners, occupants.
- What policies could lead to deep cuts in CO2 emissions from existing buildings: housing stock; non-domestic stock?
- Housing developers and home-buyers: Assessing the effectiveness of a voluntary code for sustainable homes and a 2016 zero-carbon house.
- Adoption of green energy by households (motivations, technologies, impact e.g. reduced demand for centralised generation, implications for energy planning).
- The effect of HIPS energy assessments on the housing market.
- What policy would help in rapidly increasing carbon neutral/waste minimal housing (new and retrofit)?
- Why don't more people install condensing boilers? (issues like info networks; consumer behaviour; savings and wealth, perceptions of climate change).
- Demand side measures, household adoption and effectiveness
- How to promote building practices, particularly in SMEs, that reduce energy in houses.

Power generation and networks

- Distributed generation (at municipal, council level). Adoption, motivation, public acceptance, drivers etc
- Nuclear power. Agents – Electricity generators; banks; investment houses; central governments. What guarantees would banks require to finance new nuclear power stations and electricity generators to build them?
- Which design of wholesale electricity auctions leads to a long-term increase in the share of renewables in the generation mix.
- Modelling of the electricity sector:
    o Influence of different policy rules
    o Influence of emissions constraints and renewables
    o Long term 'evolution' of the energy mix (security of supply and how to achieve it)
    o Transmission planning and its influence on generation and loads
- The role of infrastructure on evolution of the energy network in the UK
- Competition between clean fossil and green energy technologies
- ABM based analysis of dynamic evolution of green energy technology clusters in the UK
- Interaction between electricity and gas sectors
- How investments in power network can be directed to arrive at a low carbon economy? (by taking into account interactions between end users and power suppliers and network operators).

- ABM study of coevolution of green technologies from solar-wind-biomass, with incumbent grid based energy.

Climate change and adaptation

- How to reduce demand in existing urban areas for drainage services – and so reduce energy consumption for provision of services.

Appendix 2 - Programme

Agent based modelling: Application to energy policy

15 & 16 October 2007, St Hugh's College, Oxford.

A 2-day residential workshop to increase understanding of the application of agent based modelling (ABM) to energy policy intervention design. The workshop aims to explore the potential for this type of modelling approach to play a significant part in informing energy policy and to identify research requirements necessary to ensure successful application to policy intervention design.

Day 1, 15th October
9:30 Arrival refreshments

10:00 Session 1: Welcome and introduction

10:40 Session 2: General discussion on ABM issues.

11:20 Refreshment break

Session 3: ABM demonstrations

11:40 Demo session 1

12:20 Demo session 2

13:00 Lunch

14:00 Demo session 3

14:40 Demo session 4

15:20 Refreshment break

15: 50 Session 4: Policy applications brainstorm

16:50 Session 5: Plenary discussion and prioritisation of research areas

17:30 Close

19:00 Pre-dinner drinks, St Hugh's College

19:30 Dinner, St Hugh's College

Appendix 3 - Attendee List

First name	Surname	Email	Organisation
Olivier	Barthelemy	olivier.barthelemy@environment-agency.gov.uk	Environment Agency
Lauren	Basson	l.basson@surrey.ac.uk	Centre for Environmental Strategy, University of Surrey
Noam	Bergman	n.bergman@uea.ac.uk	University of East Anglia and Tyndall Centre
Mike	Bithell	mike.bithell@geog.cam.ac.uk	University of Cambridge
Thomas	Downing	tomdowning.sei@gmail.com	SEI
Paul	Ekins	p.ekins@psi.org.uk	Policy Studies Institute
Nigel	Gilbert	n.gilbert@surrey.ac.uk	University of Surrey
Nick	Gotts	n.gotts@macaulay.ac.uk	Macaulay Institute
Nick	Hartley	Nick.Hartley@oxera.com	Oxera Consulting
Katy	Janda	Katy.Janda@ouce.ac.ox.uk	ECI
James	Keirstead	j.keirstead@imperial.ac.uk	Imperial College
Ruud	Kempener	r.kempener@usyd.edu.au	SPRU, University of Sussex
Gavin	Killip	gavin.killip@eci.ox.ac.uk	ECI
Ivana	Kockar	ivana.kockar@eee.strath.ac.uk	Universtiy of Strathclyde
Henry	Leveson-Gower	henry.leveson-gower@environment-agency.gov.uk	Environment Agency
Sheri	Markose	scher@essex.ac.uk	Economics Dept. and Centre For Computational Finance and Economic Agents (CCFEA)
Robin	Matthews	r.matthews@macaulay.ac.uk	Macaulay Institute
Ruth	Meyer	ruth@cfpm.org	Centre for Policy Modelling, MMU
Scott	Moss	scott@cfpm.org	Centre for Policy Modelling, MMU
Nazmiye	Ozkan	n.ozkan@psi.org.uk	Policy Studies Institute
Michele	Pittini	Michele.Pittini@occ.gsi.gov.uk	Shadow Committee on Climate Change
Alessandro	Sapio	ssapio@sssup.it	University of Napoli PartheOpe, Italy
Kieron	Stanley	kieron.stanley@environment-agency.gov.uk	The Environment Agency
Takeshi	Takama	takeshi.takama@sei.se	SEI Oxford
Richard	Taylor	richardtaylor.sei@googlemail.com	SEI

Appendix 4 – Research proposals

1. Communities
James, Nick, Noam, Mike and Tak

Policy Problem:
Facilitating sustainable energy communities.
Specifically household demand reduction and micro generation

Research gaps where ABM might contribute and rationale:
How do existing communities evolve towards household/energy sustainability?
What policies, institutional changes can support this?

Comments on research process and incorporation of research into policy:
AMB, 2 or more case studies of past transitions, at least 1 of a high energy use
community – quantitative and qualitative data. Visualisation for feed back to
communities.
Assessment of different policy instruments for encouraging transition to low
energy visualisation. Aimed at local councils, DTI, Ofgem and CLG (sustainable
communities initiative)

Description of possible research proposal(s)
Dynamic modelling of community transitions to energy sustainability,
- Scoping, possible case studies   1 Potential of transition towns,
  2 comparing village and urban communities
- Enlisting literature search
- Qualitative and quantitative data collection from case study communities
- ABM Validation against case studies, 1 access level, central government
  and individual policy options/regimes, eg. unlocking the power mouse.
- Visualisation for feedback to policy makers and communities
- Policy recommendations

Actions by 16th Jan
Nick to coordinate for Jan 16th

Others to involve
Sarah Darby (ECI), David Miller (Macauley institute), Gordon Walker (Lancaster)

2. Power Generation and Networks:
Ruth Meyer, Ruud Kemperner, Alessandro Sapio, Ivana, Michele Pittine, Nazyme

Policy Problem:
Robust policies for low carbon future

Research gaps where ABM might contribute and rationale:
Evaluation of power sectors based on the behaviour of decision makers, allowing
for ?bounded ? rationality and imperfect foresight
Existing and evolving infrastructure with a regional focus

Comments on research process and incorporation of research into policy:
- Interdisciplinary (financial markets, power networks, policy makers…)
- Involvement with stakeholders
- Modular approach

- Communication with policy makers
- Peer review and model validation

Description of possible research proposal(s)
How power sector can be enticed to arrive at low carbon UK economy?
Agents : network operators, generators, investors (Banks), policy makers (national and local), local community, consumers(Households, industry, and commerce)

Scenarios, with different
1. Input assumptions
2. Behaviours rules
3. Policy levers (subsidies, taxes)
4. Innovation (invention)

Actions by 16th Jan
1. Policy context and significance (NO and IK, from MP)
2. Review of literature(NO and IK, network and AS, investment)
3. methology (ABM) (RK and RM)
4. Process (All)
5. Expected outputs(NO and IK and ALL)
6. Timeline and milestones (ALL)
   (emphazise interdisciplinary aspects)

Others to involve
Network models and SPRU

3. Households and Buildings:
Henry, Kate, Gavin, Scott

Policy Problem:
Fit lifestyle choices and stakeholder behaviour into household energy design

Research gaps where ABM might contribute and rationale:

- Existing micro scale evidence not currently used in policy analysis or energy modelling
- Identification of gaps in micro scale evidence is problematic

Comments on research process and incorporation of research into policy:
The research process engages stakeholders in an integrated, interactive policy analysis/formation/implementation process.

Description of possible research proposal(s)
Develop scenarios informed by ABM to achieve a 60% reduction of carbon emissions in UK housing stock
- Baseline model assuming existing and near to Market technology
- Implementing agents to capture wider lifestyle contexts and institutional environment

Actions by 16th Jan

Gavin : Description of current practise
Kate: Description of current evidence

Scott: Description of model

Others to involve

Policy person from DEFRA/DCLG/BERR
(Henry, and Gavin)

4.Bioenergy
Lauren Basson, Nigel Gilbert, Robin Matthews

Policy Problem:
How do we manage a transition to sustainable bio energy use for domestic
purposes in a way that maximises environmental benefit?

Research gaps where ABM might contribute and rationale:
1. Implications of current and future potential policies
2. Household behaviour and preferences
3. Collective preferences and effect of institutions
4. Systemic barriers to uptake (technology, infrastructure, markets)
5. Impacts on land use choices and consequent effects for ecosystems
   services.
6. Appropriate scale of Bio energy use.

Comments on research process and incorporation of research into policy:
- Input from Policymakers on valuable project outcomes
- Build on current work
- Focus on Bioenergy for domestic use
- Develop an AMB stimulator for the Bioenergy supply chain for the
  evaluation of policies.
- Case Studies – Stakeholder involvement – help joined up policy making

Description of possible research proposal(s)
1. Description of status quo of Bio energy supply chains (Biofuels, heat and
   electricity)
2. Identify case studies (Barnsley Heat, Teasside biofuels, Aberdeenshire
   electricity)
3. Develop ABM of supply chains, agents represent suppliers, consumers,
   logistics, regulations Etc
4. Enhance ABM to model potential institutional household and political
   changes and their implications
5. Use model to explore and evaluate policy options.

Actions by 16th Jan (who)
Identify existing projects and additional partners
Refine this proposal description. Robin is the champion for this group

Others to involve: Resolve, TSEC Biosys, Clusterprojects, Macaulay climate
change theme

5. Climate change adaptation and drainage:
Olivier, Kieran Richard, Tom

Policy Problem: CC adaptation and Drainage
Development and assessment of local planning guidelines regarding R.W.H/Subs
and their effects on community resource use.

Research gaps where ABM might contribute and rationale:
Finding out the overall outcome of households with heterogeneous behaviours in
communities shaped by local geography, climate and social interactions

Comments on research process and incorporation of research into policy:
Process: integrate existing models as layers.
Incorporation: use participatory approach Planners)

Description of possible research proposal(s)
Scoping phase : 1 year
Get experts, local government involved
Model Prototype: 2 years
Inc. Modelling + selection site(s)
+ surveys

Model + Scenarios generation: 2 years

Actions by 16th Jan (Who)

- HLG speak to P. Rothwell
- KS speak to C Mitchell
- SEI : Draft main Lines for 2 sites proposal (POSTER)
- OB: Contact P Chatfield.
- Richard is team coordinator