

## 4.0 Appendix 1 - Complete List of Proposed Research Topics, Clustered by Area

This is the complete list of proposed economic and social research topics generated by participants in the Scenario Workshop, grouped together in broad categories. The list was produced by small groups using the scenarios developed in the project to stimulate their thinking about the kinds of research that could prove most important in a variety of future circumstances. This list was used in voting exercises where participants used the Council groupware system to select highest priority short term and long term research areas. The topics are listed as they were entered in the Council system by participants, without editing or elaboration.

| Area                             | No.        | Topic/ Question   |
|----------------------------------|------------|---|
| <b>Changed Policy frameworks</b> | <b>1.1</b> | <ul style="list-style-type: none"> <li>– How do we change the political system to provide an incentive to government to think longer-term? And indeed to take long term decisions?</li> <li>– How to improve foresight in government and the setting of long-term goals?</li> </ul> |
|                                  | <b>1.2</b> | – How do you persuade government and society to accept the fact that government has a role is in supporting more risky ventures and that some failures are OK?  |
|                                  | <b>1.3</b> | – How do we persuade government to tackle the more difficult problems - such as transport? (in this scenario, efficiency rather than modal shift)   |
|                                  | <b>1.4</b> | – How do you build in acceptance of the need to change five year plans and deal with review of effectiveness/changing direction in a more positive way?   |
|                                  | <b>1.5</b> | – Research to integrate whole systems thinking across the board so that it is considered part of standard education?  |
|                                  | <b>1.6</b> | – Research on new approaches to planning that set audacious long-term goals, but run technical and social experiments, make extensive use of the market, and maintain flexibility about how to achieve the goals.   |
|                                  | <b>1.7</b> | – How can we persuade policy makers to shift from rhetoric to reality in relation to joined-up thinking in energy (e.g. aviation white paper vs. energy white paper 60 percent target).   |
| <b>Policy and Governance</b>     | <b>2.1</b> | – What science is required to build consensus across political parties? How do you engage the public and build a consensus behind the required government action?   |
|                                  | <b>2.2</b> | – Alternatively, what are the structures and mechanisms required to avoid the need to build consensus?  |
|                                  | <b>2.3</b> | – What are the implications of this scenario for democracy? This has many elements of significant increase in command and control.  |
|                                  | <b>2.4</b> | – Also important to consider how Government can retain the long-term support in times of adversity which it would need to see through a recovery plan. Would even limited long-term investment aimed at recovery end up being sacrificed to meet the needs of the here and now?     |
|                                  | <b>2.5</b> | – Would more compulsion on energy efficiency construction be a more effective driver of change? Compulsion is the focus of research.  |
|                                  | <b>2.6</b> | – How does the media get used effectively without appearing to be an arm of the 'nanny state'?  |

|   |             |   |
|---|-------------|---|
| <b>Multi-level Governance, decentralisation and regions</b> | <b>3.1</b>  | <ul style="list-style-type: none"> <li>- The impact of devolution (e.g. four nations, regions, LAs, and PR) upon energy futures</li> <li>- To what extent are the changes envisaged in this scenario consistent with the present policy-making processes at different levels from national to local?</li> </ul>   |
|   | <b>3.2</b>  | <ul style="list-style-type: none"> <li>- How might the tensions between re-nationalisation and regionalisation play out? What technologies would permit the regionalisation of energy security (e.g. microgrids) and what would be the conditions for these to become publicly acceptable?</li> </ul>   |
|   | <b>3.3</b>  | <ul style="list-style-type: none"> <li>- Regional/community - UK - and EU levels can be conflicting. This scenario has people with sense of identity that embraces every level, from local citizenship to global citizenship. Research on people's sense of identification and people who succeed in having that kind of broad sense of identity.</li> </ul>  |
|   | <b>3.4</b>  | <ul style="list-style-type: none"> <li>- Regional role in a more distributed approach to allocated limited energy.</li> </ul>   |
|   | <b>3.5</b>  | <ul style="list-style-type: none"> <li>- How decentralised can we make sustainability targets? E.g. regional, local authorities, communities? E.g. is there a national grid? Can regions manage their own grids?</li> </ul>   |
|   | <b>3.6</b>  | <ul style="list-style-type: none"> <li>- Local responsibility for emissions: how could/should regions be defined?</li> </ul>  |
|   | <b>3.7</b>  | <ul style="list-style-type: none"> <li>- Ability to buy local acceptance (through planning gain, free electricity / shares) of intrusive supply - renewables and nuclear.</li> </ul>  |
|   | <b>3.8</b>  | <ul style="list-style-type: none"> <li>- Research on interpreting macro results at regional levels. Most SD research is at a national and international level and research is needed on how to apply it at regional and local level. E.g. how design a regional decarbonization program? International conferences are fine, and..." Doesn't mean it has to be done all by the regions...should involve a national plan for how to do it and best expertise.</li> </ul> |
|   | <b>3.9</b>  | <ul style="list-style-type: none"> <li>- What are the opportunities arising from EU enlargement for UK-based R&amp;D?</li> </ul>  |
|   | <b>3.10</b> | <ul style="list-style-type: none"> <li>- Understanding the capabilities needed in local governance to achieve carbon targets. Because responsibilities have been taken away from local governments, they've actually lost capabilities.</li> </ul>  |
|   | <b>3.11</b> | <ul style="list-style-type: none"> <li>- What standards, policies and technical changes are needed to allow distributed renewable energy grid sources and other small scale technologies to be integrated into the power grid?</li> </ul>   |
| <b>Global issues – security, constraints</b>                | <b>4.1</b>  | <ul style="list-style-type: none"> <li>- More international relations research is needed in the energy field. Geopolitics and anticipating potential future shocks.</li> <li>- International relations - geo-political research and effects</li> <li>- International relations research into security of global markets and geopolitical conditions that might prevent the scenario from coming about in the first place?</li> </ul>                                    |
|   | <b>4.2</b>  | <ul style="list-style-type: none"> <li>- Research on extent of vulnerability that will be created by growing pattern of import dependence? Research on the "vulnerability chains" of energy supplies.</li> </ul>  |
|   | <b>4.3</b>  | <ul style="list-style-type: none"> <li>- Scenario could be very different if UK is part of a generally depressed world, compared to a world where there are pockets of investment and development of technologies to for instance give step changes in energy efficiency. Useful to consider how a Scenario 2 UK could be in a position to make use of developments overseas.</li> </ul>  |
|   | <b>4.4</b>  | <ul style="list-style-type: none"> <li>- Opportunities for providing education, training, consultancy, energy and financial services, etc internationally?</li> </ul>   |
|   | <b>4.5</b>  | <ul style="list-style-type: none"> <li>- The issue of trade and environment is missing – can international trade rules be modified to allow environmental measures to be implemented without being challenged/disallowed at the WTO?</li> </ul>   |
|   | <b>4.6</b>  | <ul style="list-style-type: none"> <li>- How can we persuade the larger polity we are part of to take the appropriate measures? Britain itself is not large and powerful enough to do most things on its own.</li> </ul>  |
|   | <b>4.7</b>  | <ul style="list-style-type: none"> <li>- UK role in influencing global shift to sustainability (policy learning, technology transfer)</li> </ul>  |

|   |             |   |
|---|-------------|---|
| <b>Equity, justice and participation</b>  | <b>5.1</b>  | – What type of employment will be generated by the economy in this scenario - are there equity issues and serious income disparities to be faced - and if so, how?  |
|   | <b>5.2</b>  | – Who will be the winners and losers in economic/energy downturn and how to deal with fairness issue?   |
|   | <b>5.3</b>  | – Social cohesion<br>– What are the conditions for social cohesion under this scenario?   |
|   | <b>5.4</b>  | – What conditions and government actions help people come together rather than come apart in facing economic difficulty? Active case studies on situations in other countries, not just UK.   |
|   | <b>5.5</b>  | – Impact of prolonged global recession on strife/mass migration.  |
| <b>Consumer behaviour and perceptions</b> | <b>6.1</b>  | – What the UK demography (age, wealth, ethnic) will be could substantially influence/affect the options. What will the main demographic components of the British population be and will their behaviour be significantly different than today in reacting to climate change? (For example, a significantly larger Asian population may be more sensitive to problems in Asia, like Bangladesh being flooded; or as people get older, they travel less by air.) |
|   | <b>6.2</b>  | – How will public understanding of climate change develop? How can development in this area be affected if it does not progress 'satisfactorily'?<br>– Attribution of climate impacts (better models) and communication of the results to public  |
|   | <b>6.3</b>  | – Research into the attitude of the general public into the conditions under which they would be prepared to modify their consumption profile in response to strong pricing signals. Psychology of consumer choice – how do consumers make choices and how can this be influenced to focus on more sustainable products as being aspirational?  |
|   | <b>6.4</b>  | – A determination of the price the public would pay to achieve improved supply diversity rather than be extremely reliant on gas from mainland Europe.  |
|   | <b>6.5</b>  | – High energy prices will not in themselves always cause the desired reaction of encouraging investment in energy efficiency. Acceptance of other incentives such as reduction council tax etc. need to be explored.<br>– What fiscal and regulatory mechanisms could be introduced to reward consumer behaviour appropriate to the new economic circumstances? Can the crisis actually be the trigger that forces us to adopt sustainable consumption?         |
|   | <b>6.6</b>  | – Research on best ways of informing and motivating personal behaviour to reduce energy use.<br>– What has to happen to actually change behaviours? Making environmental responsibility a sufficiently has status thing that people forego the big house, big car, etc<br>– Public attitudes to innovation and change should be researched. At the moment, the public is reluctant to accept much new technology.   |
|   | <b>6.7</b>  | – How does communication, education, credibility of science and other institutions, scientific information, have to come together to galvanize public opinion on climate change?  |
|   | <b>6.8</b>  | – Has the influence of the rebound effect in energy efficiency been sufficiently studied?   |
|   | <b>6.9</b>  | – Can we educate for sustainable consumption (and how) and can we address today's consumers (adults) as well as tomorrow's (children)?  |
|   | <b>6.10</b> | – Since voluntary consumer behavioural change might not be enough, we need more research on how far you can push regulatory measures to force behavioural change.   |
|   | <b>6.11</b> | – Public perceptions of – and values placed on – security and reliability of supply.  |

|                                      |             |  |
|--------------------------------------|-------------|--|
| <b>More fundamental value change</b> | <b>7.1</b>  | – Understanding the relative importance to people of higher standard of living (as conventionally measured) versus sustainability issues, including climate change, fuel poverty, international equity, etc.   |
|                                      | <b>7.2</b>  | – Under what conditions would societal values change under the constraints of the scenario so that some ... constraints came to be perceived as a source of benefits (e.g. through strengthened community values)?   |
|                                      | <b>7.3</b>  | – Research to ascertain if the move to higher occupancy levels will actually lead to more family-orientated values or increase social problems   |
|                                      | <b>7.4</b>  | – Study of how value shifts have occurred in other societies/other times and what we can learn about the drivers   |
|                                      | <b>7.5</b>  | – Why would green world views come to dominate other worldviews/ value systems? E.g. quality of life versus standard of living.<br>– How can new post-consumerist values be nurtured? Can efficient resource-use be rewarded by non material incentives?   |
|                                      | <b>7.6</b>  | – To what extent can different value systems, communitarian and individualistic co-exist.  |
|                                      | <b>7.7</b>  | – What is the nature of the interaction of the media and value systems?...understand trends and see how the media shapes value systems - and if its role is affecting adversely the development of sustainability.<br>– Media – society interactions ...Trends in and influences on the evolution of social values                                   |
|                                      | <b>7.8</b>  | – Social attitudes to and acceptability of technical change<br>– How start the process of positive change in tech and behaviour well before a severe shock?  |
|                                      | <b>7.9</b>  | – Reactions to disasters and game-changing events<br>– National pulling together for common good - analysis of historic instances when this has happened, vs. when it hasn't.  |
|                                      | <b>7.10</b> | – How to influence students in sciences and engineering to take on the kind of vision of what's possible and throw themselves into innovation in sustainable technology? Money, brand new labs, a vision of possibility.   |
|                                      | <b>7.11</b> | – How does society view the future benefits of today's self-sacrifice in terms of size and flexibility of products? Can this be a vote-winner?   |
|                                      | <b>7.12</b> | – Should add in some reference to energy implications for people's health?   |
|                                      | <b>7.13</b> | – Research on what do people really want from their energy and transport system. We assume that what people buy reflects what they want. But options for buying are limited. We don't understand what behaviour is indicating in terms of what people really want. (People commuting for hours does not reflect what they really want, for example.) |

|  |             |   |
|--|-------------|---|
| <b>Innovation (in industry)</b>            | <b>8.1</b>  | <ul style="list-style-type: none"> <li>– How do established industries respond to changes in technology to deliver both the incremental and more radical technical changes? Thinking in terms of customers' attitude to risk? What are the (government) incentives required to accelerate the uptake of new technologies? Talking here about moving from demonstration to commercialisation and in some case diffusion beyond early adopters.</li> </ul>  |
|  | <b>8.2</b>  | <ul style="list-style-type: none"> <li>– What is the right policy to support innovation? (personnel, skills, funding incentives, resources for equipment).</li> <li>– What does UK need to do to develop the skills and R&amp;D base to be able to take advantage of this scenario?</li> </ul>  |
|  | <b>8.3</b>  | <ul style="list-style-type: none"> <li>– What innovation is required in the regulatory and pricing system to encourage these sorts of innovation? E.g. compulsory purchase of electricity from renewables and CHP, or feed-in tariffs.</li> <li>– Research on institutional arrangements that have worked best for fostering rapid technological innovation.</li> <li>– What changes are needed in regulatory framework, policies, etc. to let new innovations in energy efficiency and supply move into the marketplace as rapidly as possible?</li> <li>– Are there sufficient incentives to promote the types of innovation that are required here?</li> </ul> |
|  | <b>8.4</b>  | <ul style="list-style-type: none"> <li>– Research into how energy efficiency can be delivered cheaply through energy consumers, including commercial and industrial energy decision-makers at the micro level, becoming experts in the procurement of energy efficient equipment and buildings</li> </ul>   |
|  | <b>8.5</b>  | <ul style="list-style-type: none"> <li>– What mechanisms are most important/effective for scanning globally for hot spots of development of technologies and approaches to use?</li> </ul>  |
|  | <b>8.6</b>  | <ul style="list-style-type: none"> <li>– Research on how to hone entrepreneur skills to manage the implementation/commercialisation of innovation?</li> </ul>   |
|  | <b>8.7</b>  | <ul style="list-style-type: none"> <li>– How do you develop socially responsible entrepreneurship among consumers?</li> </ul>   |
|  | <b>8.8</b>  | <ul style="list-style-type: none"> <li>– Where is the UK capability in zero and low carbon technologies? Better understanding of existing capabilities at present and future opportunities.</li> </ul>  |
|  | <b>8.9</b>  | <ul style="list-style-type: none"> <li>– What is and should be the role of nuclear fusion in the UK's and EU's research programme?</li> </ul>   |
|  | <b>8.10</b> | <ul style="list-style-type: none"> <li>– What is the significance of skills shortage in the energy sector in an international market place?</li> </ul>  |
|  | <b>8.11</b> | <ul style="list-style-type: none"> <li>– Prospects of conditions for and assessment of large scale geo-engineering projects.</li> </ul>   |
| <b>Coping with rapid change and crises</b> | <b>9.1</b>  | <ul style="list-style-type: none"> <li>– If we lost 30% of our electricity supply, how do we maintain health services, etc. What are key vulnerabilities and how to deal with them. How to "case harden" the system to be able to maintain most critical functions?<br/>...vulnerability analysis can be useful for many circumstances.</li> <li>– Research on our capacity to cope with significantly lower energy supplies?</li> </ul>  |
|  | <b>9.2</b>  | <ul style="list-style-type: none"> <li>– Research related to developing "emergency action plans"</li> </ul>   |
|  | <b>9.3</b>  | <ul style="list-style-type: none"> <li>– How to best design an allocation plan in advance for a reduction in fuel availability.</li> </ul>  |
|  | <b>9.4</b>  | <ul style="list-style-type: none"> <li>– What are the trigger points at which you think you may be moving toward a scenario like this (scenario 2) and need to respond?</li> </ul>  |
|  | <b>9.5</b>  | <ul style="list-style-type: none"> <li>– How does society react to game changing events? What institutions do you need to have to ensure a positive outcome when problems come? What would happen in a major climate disaster? What institutions would prevent this?</li> <li>– Research on conditions in which "mini-crises" can cause a major change in thought and behaviour -- if there is a framework of interpretation in place that the mini-crisis validates, and a sufficient amount of societal "homework" done on the changes needed.</li> </ul>   |
|  | <b>9.6</b>  | <ul style="list-style-type: none"> <li>– Public opinion surveys on different perceived threats and people's willingness to change in response to threats.</li> </ul>  |

|   |      |  |
|---|------|--|
|   | 9.7  | – Suppose the Gulf Stream was to change off by 2020, what are the impacts, both negative and positive would result? What kind of advance planning for such a possibility is desirable?   |
|   | 9.8  | – Side effects of disasters in other part of the world – major increases in migration, food price increases and increases in other vital things, terrorism – as a result of energy problems. Don't assume UK is isolated.  |
| <b>Markets and change</b>                                     | 10.1 | – What do we know from research on the effect of price signals on industry and householders - i.e. scenario assumes bigger impact on industry than households?<br>– The extent to which changes in technologies and technological systems can be driven rapidly in response to market signals - e.g. research on technologies and socio-technological change in other contexts/countries/historical times  |
|   | 10.2 | – Would people prefer higher energy prices to drive change or a system of individual tradable carbon quotas?   |
| <b>New concepts/ measures</b>                                 | 11.1 | – What generated quality of life and how do we communicate it?<br>– Indicators of the quality of life - The Welsh example would be useful. ... sustained social science effort to look at indicators of quality of life ....<br>– Quality of life indicators, relation to environmental sustainability<br>– Research on alternative measures of GNP and other measures of quality of life to give a more accurate picture of progress/lack of progress and focus public attention on quality, not just quantity measures.<br>– What research methods are needed to investigate wellbeing and the impact of e.g. economic growth / its absence? |
|   | 11.2 | – How do you evaluate the wider benefits of a new world view? How do you measure the value of this - are new techniques needed?  |
|   | 11.3 | – What types of investment generate the greatest social capital?   |
|   | 11.4 | – Research on new measures of sustainability (versus GDP) and show their practical and popular saliency.   |
| <b>Financial institutions (risk averse and tech ignorant)</b> | 12.1 | – What kinds of financial institutions would be required both to focus available savings on the kinds of cost-reducing activities that would be required, and to permit everyday economic activity (not to mention prevent the export of national savings to more profitable parts of the world)?  |
|   | 12.2 | – Research on liberalizing energy markets in a way that does not frustrate needed investments, especially in energy efficiency.<br>– Research on investment markets - how government can help these markets keep functioning for energy investment even in difficult circumstances.  |
|   | 12.3 | – How can policies which support and direct investment be framed to generate this scenario? (E.g. to redirect investment money from other areas?)  |
|   | 12.4 | – Collaborative research (cross Europe) on mechanisms to maximise limited investment potential   |
|   | 12.5 | – Research to overcome a risk-averse investment market<br>– Research to overcome risk-averse investment market as a way of opening up the nuclear option   |
|   | 12.6 | – Comparative evaluation of "bang for the Pound" investments in energy efficiency and supply so that businesses and individuals have good guidance on what the "best buys" are in difficult economic circumstances.  |
|   | 12.7 | – Can energy efficiency policies change the investment behaviour of those that can already afford it but choose not to do so – i.e. the middle classes?  |

|   |              |   |
|---|--------------|---|
| <b>Images of Future</b>                     | <b>13.1</b>  | – How do you overcome the view of 'green' as backward/wellies etc. How do you make this vision of the future exciting?  |
|   | <b>13.2</b>  | – How do you get across the idea that the choice is between a range of new scenarios - that business as usual is not an option?   |
|   | <b>13.3</b>  | – Research on the power of positive images of the future to motivate change. ... more advanced, humane, environmentally sound technologies, a better quality of life. Can government. Programmes could be deliberately focused around positive visions that go beyond "solving problems" and be more effective as a result?   |
| <b>Changing Academics</b>                   | <b>14.1</b>  | – How do you persuade the academic community that optimisation is old-hat? That iteration will have to happen?<br>– How do we develop the techniques to enable the iteration process?   |
|   | <b>14.2</b>  | – Collaboration and interdisciplinarity which are essential to the success of the new centres of research should be itself a subject of research.   |
| <b>Specific interdisciplinary questions</b> | <b>14.3</b>  | – Complex adaptive systems theory and its application to social sciences in general and the energy system in particular. The energy field is often referred to as an energy system. However, there is little evidence that we know how to define systems thinking, moreover, are we educationally and intellectually equipped to understand and embrace difficult concepts related to systems such as non-equilibrium thermodynamics, chaos, duality as opposed to dichotomy, inherent uncertainty, emergent properties, etc. How can social scientists and policy makers be equipped to embrace such understandings/paradigms? |
|   | <b>15.1</b>  | – How to develop a long-term strategy for aviation given its rapid short-term growth, and the expected increase in fuel prices and inclusion of aviation emissions in international agreements, which would then suppress demand. i.e. how to manage false expectations.  |
|   | <b>15.2</b>  | – Relative effectiveness of demolition and refurbishment - an important dimension in this scenario<br>– What are the relative economics, and relative energy performance, of house refurbishment as against demolition and re-build (especially if there is a large pool of sweat equity because of unemployment)? How could this sweat equity be mobilised?  |
|   | <b>15.3</b>  | – What should be the balance of investment / research attention between solar PV and passive solar design?  |
|   | <b>15.4</b>  | – What are the services people demand from their transport system?  |
|   | <b>15.5</b>  | – A strategic approach to reducing carbon emissions from transport  |
|   | <b>15.6</b>  | – Is the level of land for bioenergy consistent with the more localised production of organic food?   |
|   | <b>15.7</b>  | – What would be the environmental impact of (these) types of localised energy systems?  |
|   | <b>15.8</b>  | – What are the economic benefits of centralised versus distributed generation? What are the carbon benefits? What are the social benefits / issues? How will the regulatory system develop to incentivise the development of the distributed grid and its control systems?  |
|   | <b>15.9</b>  | – What are the issues of scale related to 'small is beautiful'? E.g. the difference between bringing the philosophy to a large urban centre or a small rural community?   |
|   | <b>15.10</b> | – What kinds of technology, ideas and experience could be transferred to developing countries to promote low carbon development?  |