Public perceptions of low carbon energy technologies

Results from a Scottish Large Group Process

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Disclaimer

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Executive Summary

This report describes the outcomes of a large group process workshop held in Edinburgh, capital city of Scotland, United Kingdom on 24 September 2011. The one day workshop was designed to investigate Scottish citizens' perspectives on climate change and low carbon energy technologies, with a particular focus on carbon dioxide capture and storage (CCS). The report presents the large group process methodology and the results, both from questionnaire answers and discussions during the workshop. Results include participants' environmental profile, stated beliefs, knowledge and attitudes, support for different energy technologies and environmental behaviours and intentions. The report also presents observed changes therein over the course of the workshop. Throughout the report we provide some conclusions and inferences from the observations made; however the focus of the report is on presenting empirical results.

The key findings of the report reflect a mixed range of public opinions with regard to climate change, low carbon energy and CCS. Most participants saw climate change as being an important issue for Scotland, although there was some doubt over the extent to which it was caused by humans and whether reductions in carbon emissions would be effective in mitigating climate change. The majority of participants indicated that they took part in environmentally-friendly activities such as recycling and domestic energy conservation. Support for renewable energy sources remained high throughout the workshop – with some participants expressing particular pride in Scotland's renewable energy achievements and ambitions. Support for CCS declined following the information provision and group discussion – it was the only energy option for which support diminished. Whilst there was broad consensus that energy costs would have to rise to meet carbon reduction targets, many participants were unwilling to pay more for their electricity – particularly when they read media reports of utility companies' profits rising.

The study, commissioned on behalf of the Global Carbon Capture and Storage Institute (GCCSI) by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia, replicates a number of large group process workshops held in Australia by CSIRO. To enable comparison of the outcomes, the Scottish large group process methodology, analysis and report structure has followed the approach taken by CSIRO as closely as possible. The large group process is a full-day workshop consisting of a mix of large group plenary sessions featuring expert presentations followed by questions, and small group breakout sessions where participants discuss the topics amongst themselves with the help of a facilitator. The workshop also features a series of questionnaires throughout the day, both individual paper based questionnaires and interactive large group digital voting.

The workshop participants (n=99) were recruited by a professional agency to form a representative sample of the Edinburgh and Lothian region's population with respect to age, gender, socio-economic grouping and ethnic background. Under the direction of a 'lead facilitator', the workshop featured presentations on climate change and energy technologies. Two Scottish experts presented objective and unbiased information and knowledge on climate change, energy use and energy technologies. After the presentations, participants were given the opportunity to discuss the material in small group (n = 10 +/- 2) discussions led by a 'table facilitator'. Opportunity was also given to ask the experts questions. This process was designed to engender trust in the information presented, validate individual viewpoints, and promote informed judgements about climate change and energy issues.

At the start, middle and end of the workshop the participants completed a questionnaire on their knowledge about and attitudes towards climate change and energy technologies. The questionnaires were designed to build up a detailed picture of the participant's knowledge and attitudes and to track changes therein during the workshop.

Results from the questionnaires revealed the environmental profile of the participants and shows a relatively high stated engagement with pro-environmental behaviour. More than 80% of the participants indicated that they use energy efficient light bulbs, conserve energy at home, use reusable bags when shopping, and recycle their rubbish.

The results show that, on average, the participants had limited knowledge of climate change, energy use and energy technologies. Questions testing knowledge of climate and energy issues were answered with an even split of correct and incorrect answers. However, participants' self-reported knowledge on climate change and energy technologies increased significantly during the workshop. The largest increases in self-reported knowledge of energy technologies were for new and emerging technologies such as CCS, geothermal, coal seam gas, biofuels and wave/tidal.

Most participants expressed agreement that climate change is an important issue for Scotland and believed that all actors, including government, industry and individuals, should be doing more to address it. Significant changes in opinion were observed over the course of the workshop, with an increase in the number of participants agreeing that more needed to be done to reduce carbon emissions. Support for increasing the price of electricity in order to reduce greenhouse gas emissions significantly increased over the course of the workshop; however the majority of participants remained unwilling to pay more as individuals in order to reduce greenhouse gas emissions from electricity generation. It was also noticeable that there was a reluctance to pay higher electricity bills because of a general distrust of the electricity supply companies, in particular their pricing regime and perceived profitability.

The expert presenters introduced twelve energy technologies to the workshop participants who were asked to rank their support for each technology. There was considerable variation in support for the energy technologies amongst the participants. Generally, support for renewable energy technologies was larger than support for non-renewable technologies. Wind, wave/tidal and solar energy, received the highest levels of support both before and after the workshop. The least support was expressed for coal technologies, oil, nuclear and CCS. On average, the support for eleven of the twelve technologies presented increased during the workshop. The exception was CCS, for which mean support significantly decreased. It is important to note that migration of opinion with respect to CCS within the group during the day went from a large number of 'un-knowns' to a mixture of more positive views and more negative views – but in which the negative views outweighed the positive views; hence the overall decrease in support reflects something of a polarisation in opinion once participants understood more about CCS. The technologies which received the largest increases in support during the workshop were wind, wave/tidal, and geothermal energy.

With regard to energy related behaviour and intentions, at the end of the workshop the majority of participants (58%) indicated that they were unwilling to pay more for electricity even if it would reduce greenhouse gasses. Of the minority who were prepared to pay more, most were willing to pay up to £25 extra per quarter. At the end of the workshop participants expressed a continued commitment to environmentally friendly behaviour, with the stated intention of conserving energy, reusing shopping bags, recycling rubbish and using energy efficient appliances.

When asked to rank their trust in sixteen nominated sources of information, participants expressed varying and fairly low mean levels of trust in the information providers. Universities and research institutes, academic articles and family and friends were rated most trustworthy, while industry and internet blogsites were least trusted as information sources.

The opinions that participants expressed verbally in the small group discussions confirm many of the quantitative results from the questionnaires. Participant discussions serve to add depth and meaning to the participants' concerns, as well as to illuminate their heterogeneity, and provide insight into their thought and decision making processes. Participant quotes are used throughout the report to illustrate the qualitative findings.

Outcomes from the Scottish large group process workshop suggest that engaging people in facilitated discussion about climate change and energy technologies can shift perspectives. For example, the workshop was effective in raising levels of knowledge of climate change issues and a variety of energy technology options, particularly new and emerging technologies. The workshop process also shifted participants support for the energy technology options.

In the case of renewables, particularly wind and wave/tidal, support among participants increased during the workshop. This may have been due, in part, to Scotland's existing successes in deploying wind energy, a fact unbeknownst to most participants prior to the day. In the case of CCS, there was a decrease in support. Participants cited concerns over leakage of carbon dioxide from geological storage sites (including offshore ones) and the possibility of funding shifting away from investment in renewable energy. Other participants did recognise the carbon mitigation potential of the technology, however, and supported continued CCS research and development.

Participants indicated a willingness to do more to reduce their emissions, though were less supportive about paying extra for electricity. Increasing energy prices and claims of unfair pricing practices from energy companies had been on the news in Scotland prior to the group study, and many participants expressed frustration with this increasing expense, particularly as they believed that energy companies' profits are also on the rise at the same time. Many participants expressed pride in Scotland's achievements thus far in developing renewables. This was juxtaposed with frustration at the seeming inaction of governments worldwide to address the climate/carbon problem.

Several implications can be extrapolated from this research. First, is that an understanding and acceptance of anthropogenic climate change should not be assumed among the public. The evidence points to some misunderstanding of the basic scientific concepts of climate change and also to an element of climate scepticism in which at least some people are reluctant to accept the scientific consensus perspective regarding the anthropogenic influence upon past and future climate change. Hence, enabling an effective discussion on low carbon energy and CCS will possibly require more than the justification of reducing anthropogenic carbon dioxide emissions. Areas such as improving energy security, opportunities for carbon dioxide usage such as enhanced oil recovery and economic stimulation could all be encompassed within the CCS narrative.

Second, is that conceptions of who is responsible for taking action to mitigate climate change vary greatly from person to person, thus future public engagement needs to be able to deal with these varying conceptions. Third, is the importance of providing information that situates CCS in relation to a much broader range of possible energy technologies, and that allows participants to determine for themselves what the costs, benefits, risks and opportunities of CCS may be. Fourth and final, trust plays a key role in shaping public perceptions of the organisations developing and/or promoting an energy technology – and thus of the technology itself. The implication of this is that developers need to think very carefully about how they engage the public at an early stage of project development to ensure that sufficient trust is built up to allow developments to proceed.

In summary, the Scottish large group process has been very effective at engaging the public participants in issues of climate change and energy provision. The workshop significantly increased the participant's knowledge of climate change and energy technologies, and in so doing proved itself to be an effective technique for increasing public awareness and stimulating an active public debate. The rich data collected during the workshop has been very insightful in understanding how the public view and frame issues of energy and climate, and how they form their opinions on these issues.

1. Introduction

This document reports on the outcomes of a large group process workshop that was held on 24 September 2011 in Edinburgh, Scotland, United Kingdom. The study, commissioned by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia, aims to replicate a number of large group process workshops held in Australia by CSIRO. The Global Carbon Capture and Storage Institute (GCCSI) has supported CSIRO and its partners in undertaking this research.

These workshops are part of a wider research program exploring the likely acceptance of various energy technologies among the Australian and international publics, and to identify likely pathways to low carbon energy futures. In order to enable cross-country comparison of results, the Scottish large group process methodology and analysis has followed the approach taken by CSIRO as much as possible.

CSIRO has conducted such workshops successfully in four Australian cities in 2009 and one in 2011, documenting the perspectives of the Australian public towards climate change and low emission technologies as well as demonstrating the effectiveness of the large group process. To compare perspectives of citizens in different countries and to further test the effectiveness of the large group process, CSIRO has commissioned Scottish Carbon Capture and Storage (SCCS) to replicate this method in a workshop in Scotland. In the same period, CSIRO also commissioned similar workshops in Canada and the Netherlands.

Scottish Carbon Capture and Storage is an organisation administered by the University of Edinburgh, drawing on expertise from many academic disciplines relevant to carbon capture and storage. SCCS has a number of members with social science backgrounds, who have experience of conducting social research similar to the large group process. SCCS also has easy access, through the University of Edinburgh, to the kind of conference, IT and procurement facilities required to run a large group process, in addition to experts on climate change and low-carbon energy technologies.

The workshops have two main research objectives:

1. To explore society's knowledge and acceptance of climate change and energy technologies;
2. To examine the effectiveness of the large group process for informing participants' knowledge and attitudes on the topic of climate change and low emission technologies.

This report first outlines the context of the research (chapter 2) and the methodology used for the research (chapter 3). Next it describes demographics (chapter 4) and environmental beliefs (chapter 5) of the participants in the workshop. The knowledge and attitudes of the workshop participants towards climate change and energy technologies are presented in chapter 6. Chapter 7 details participants' behaviour and intentions towards the environment and energy use. Participants' trust in information sources is presented in chapter 8. The report concludes with the key issues from the workshop (chapter 9) and the key messages (chapter 10).

2. Research context

A considerable body of evidence points to human activity as one of the sources of climate change (IPCC, 2007). Low carbon energy technologies will be essential to mitigating climate change. The large-scale implementation of these technologies will require societal acceptance and support, and there is a risk in technology uptake and wide scale diffusion without this social support. Resistance to wind turbines in rural locations and public opposition to new electricity grid infrastructure and proposed CCS initiatives in a number of European countries are well documented. Building or changing societal acceptance of an issue requires an understanding of the present perceptions and degree of social acceptance or lack thereof. It is also necessary to have information channels that provide publics with the opportunity for more informed decision making around the range of low carbon energy technologies, even though in many cases the range of 'decisions' available to the public might be quite restricted.

A well established approach to assess citizens' perspectives is to undertake discussions with participants in focus groups of 8-12 people. In the UK context, focus groups, in-depth discussion groups and citizen panels have been used for over twenty years for better understanding public perceptions of, and beliefs concerning, environmental change and policy. In order to improve the efficiency of this approach, CSIRO has developed the 'Large Group Process' methodology for workshops that enables participation of approximately 100 people while maintaining the characteristics and benefits of smaller groups (Ashworth et al, 2009). Apart from collecting valid and reliable data on public perceptions on climate change and energy technologies, the Large Group Process also aims to promote informed judgments about these options.

Discussion groups have the potential to change attitudes toward, and acceptance of, an issue. However, the effectiveness of the process is dependent on the perceived legitimacy, independence and trustworthiness of those providing the information (Moon & Balasubramanian, 2003; Slovic, 1993; Marks et al, 2004). Given this context, the process was designed to ensure the objectivity of information provided to participants and to engender trust in the information sources used in the workshop. The process demonstrates that opinions on the topics vary and encourages participants to engage in meaningful dialogue by making them feel comfortable to share individual thoughts and opinions.

3. Methodology

To enable comparison with the workshops conducted in Australia, the Scottish Large Group Process followed the Australian methodology as closely as possible. Minor changes were made to adapt to the Scottish context.

3.1 Recruitment

Participants were recruited through an external recruitment agency with experience of recruiting members of the public for participation in focus groups and opinion polls. The recruitment process described the workshop topic as climate change and low carbon energy technologies.

The agency recruited participants from across the Edinburgh and Lothians region. East, Mid and West Lothian are the three counties which are adjacent to Edinburgh. The agency was instructed to obtain a sample that reflected the gender, age, socio-economic grouping and ethnic characteristics of the area. People less than 18 years of age and more than 75 years of age were not recruited. People with professional knowledge about climate change and energy technologies were also excluded from the workshop.

Following telephone recruitment, participants were posted additional information about the schedule for the day and featuring the University of Edinburgh logo and contact details, in order to add legitimacy to the telephone contact.

Although the target number of participants was 100, 110 participants were recruited and confirmed on the assumption that around 10% would not turn up on the day. 100 people attended the workshop and 99 completed the questionnaires and were included in the analysis. Participants who attended the full day were rewarded with £80 at the end of the workshop. A free lunch and tea/coffee was also provided for participants.

3.2 Process

The workshop was held on Saturday, 24 September 2011, between 9am and 4.30pm. The workshop took place at the Moray House School of Education, a University of Edinburgh building located in the centre of the city. The workshop contained a mix of plenary and breakout sessions (Figure 3.1).

The overall workshop and the plenary sessions were managed by a professional lead facilitator, recruited to ensure that the day ran smoothly and stayed to time. The breakout sessions involved discussion groups of 8-11 people, each seated at a round table to facilitate discussion. Participants were allocated to tables according to the order in which they arrived at the venue, so that each table filled up in turn. A member of the organising team kept an eye out to make sure that each table contained a good balance of age and gender, and was prepared to direct people to different tables if necessary.

Each breakout group was hosted by a table facilitator to encourage introductions, guide the discussion and ensure all participants had a chance to speak. The facilitators – all either university staff or experienced postgraduate students – were briefed and trained beforehand in facilitation skills and were provided with a list of questions for prompting discussion for all the sessions. Facilitators were also put in charge of audio recording the discussions on their table and of all the ‘paperwork’ for their table – questionnaires, copies of presentation slides, receipt of payment forms – and distributed this to their groups at the appropriate times.

Figure 3.1: Workshop schedule

Session	Start	Time
Welcome	9:00	10 mins
Round table introductions	9:10	10 mins
Questionnaire #1 – Pre-workshop	9:20	20 mins
Digital voting warm up	9:40	5 mins
Digital voting - Round 1	9:45	15 mins
Interactive Discussion – awareness, state of play	10:00	15 mins
MORNING TEA	10:15	10 mins
Presentation Part 1 – Climate Change, Andy Kerr	10:25	25 mins
Reactions and points of clarification	10:50	15 mins
Presentation Part 2 – Energy Technologies, Andy Kerr	11:05	30 mins
Reactions and points of clarification	11:35	15 mins
Presentation Part 3 – CCS, Maxine Akhurst	11:50	20 mins
Reactions and points of clarification	12:10	15 mins
Questionnaire #2 – Process	12:25	15 mins
LUNCH	12:40	30 mins
Deliberation	1:10	70 mins
AFTERNOON TEA	2:20	10 mins
Ask the Expert	2:30	30 mins
Key themes/ summary presentation	3:00	30 mins
Voicing concerns	3:30	10 mins
Questionnaire #3 – Post-workshop	3:40	20 mins
Digital voting – Round 2	4:00	15 mins
Wind up	4:15	15 mins
FINISH	4:30	

The workshop was opened by the lead facilitator who set the context of the workshop and the focus for the day. This was followed by a breakout session, in which participants were allowed time for introductions within each of their small groups, led by their table facilitator. After introductions but prior to any discussions or presentations, participants completed the pre-workshop questionnaire to assess their existing knowledge and attitudes toward climate change and energy technologies and to collect demographic data.

Participants were then introduced to the digital voting process. This process allows participants to electronically vote and then displays the results on a large screen at the front of the room. The lead facilitator asked a question to which all participants responded by pressing a button on their digital voting handset. After a warm-up round to make the participants familiar with the technology, digital voting was used to determine the group's pre-workshop attitudes towards climate change and energy technologies. The group thus received instant feedback on the range of attitudes in the group. The use of the digital voting had two main aims:

1. To provide feedback to the participants and facilitators of the range of views in the room;
2. To build the identity of the participants as members of the larger group.

After the digital voting, there was another breakout session in which table facilitators led a short interactive discussion around participants' awareness of climate change and energy technologies. This breakout session was followed by a morning tea break.

After the break, there was a series of three presentations by Scottish experts in the fields of climate change and energy technologies. One expert (Dr Andrew Kerr, Director of the Edinburgh Centre for Carbon Innovation) delivered the first presentation on climate change, energy and carbon emissions, and the second presentation on the range of technology options for climate mitigation and low-carbon energy. The other expert (Dr Maxine Akhurst, British Geological Survey) gave the third presentation on carbon capture and storage (CCS).

After each presentation, the breakout groups had 5 minutes to discuss what they had heard and to formulate any questions, and there was then 10 minutes to ask the presenter questions. Any additional questions could, at any time, be written down and stuck up on a 'question board' at the front of the room and would be responded to later.

Figure 3.2: Dr Andrew Kerr explains the science of climate change.

To finish the morning session participants filled out the process questionnaire in order to assess their perceptions of the group, the experts and the information provided. The workshop then broke for lunch.

During lunch the table facilitators convened with the lead facilitator and organisers to report on the key themes and questions from their table discussions thus far. This also gave an opportunity for the facilitators to raise any concerns they had about the dynamic of their groups or the discussion process and for all facilitators to share and learn from each other's experiences so far.

After lunch, 70 minutes was given for the table groups to deliberate on the information presented during the morning. Table facilitators led this deliberation and asked participants to share their reactions to the information, their concerns and preferences for the range of energy options presented, and also to identify what further information they felt was needed. This session was aimed at giving the participants all the information and viewpoints that they required in order to make their own assessments about each of the technologies. During this time, the expert presenters and event organisers reviewed the questions posted on the question wall, grouped the questions into themes and prepared their responses for the next session.

Figure 3.3: Breakout session discussion.

Following a tea and coffee break, a 30-minute 'ask the expert' session took place. This involved Dr Maxine Ackhurst and also two additional experts on CCS with specialisations including geology, socio-economic and policy dimensions (Dr Vivian Scott and Dr Simon Shackley from University of Edinburgh). The experts responded to some of the questions that had been posted on the question wall, then took questions from the participants on issues of energy, climate change and CCS. Participants raised 'question flags' to indicate that they wished to ask a question.

Whilst the 'ask the expert' session took place, the table facilitators convened and fed back their main findings from each of their individual tables to the lead facilitator. The lead facilitator collated this feedback into a number of key messages which he then shared with the large group in a plenary session. The lead facilitator asked the large group whether the key messages that had been identified by the facilitators were an accurate summary of the feelings of the group. After additional feedback from the group some time was spent reflecting on what participants had learned during the day.

To close, participants were asked to complete the post-workshop questionnaire in order to measure shifts in knowledge and attitudes that had taken place during the day. At the same time participants were asked to write down 'one key message' that they would like to give to policy makers. After this, the digital voting session was repeated to provide instant feedback to the group about changes in attitudes during the day.

Figure 3.4: 'Ask the expert' session.

3.3 Information materials

The three presentations that were delivered during the day were based upon the Australian presentations, and adapted to include information relevant to the context of Scotland. The presentations strived to present a balanced view of each technology, illustrating both the advantages and disadvantages of each technology. Participants were given a print out of the presentations to refer to during the day and take home with them.

3.4 Data collection and analysis

The quantitative and qualitative structure and measures used in the large workshops were based on previous group process research (Ashworth et al, 2006; Ashworth & Gardner, 2006).

3.4.1 Quantitative data

Quantitative data was collected using questionnaires that participants completed at the beginning, middle and end of the workshop (pre-, process and post-). See Appendix A for a copy of these questionnaires. The questionnaires served two purposes. First, to assess participants' actual and perceived knowledge of climate change and energy technologies, as well their attitudes towards and acceptance of these topics. Second, to assess the effectiveness of the large group process.

Three measures of social acceptance were used to assess the issue of climate change and each of the technologies in the pre-, process and post-questionnaires. The measures included: 1) attitudes towards climate change and energy technologies, 2) self-rated knowledge of climate change and energy technologies and 3) preferences for the funding priority of the technologies. The technologies assessed were biofuels, CCS, geothermal, hydro-electric, nuclear, oil, solar, wave/tidal, wind, coal, natural gas and coal seam gas.

Attitudes toward the technologies were captured by asking "How strongly do you agree with the use of the following?". Responses were recorded on a seven-point Likert scale where 1=strongly disagree, 4=unsure and 7=strongly agree. Self-rated knowledge was measured by asking "How would you rate your knowledge of the following?" on a seven-point Likert scale of 1=no knowledge, 4=moderate knowledge and 7=high knowledge.

Attitudes toward the funding priority of the technologies were measured by asking participants to "Rank the following energy sources and related technologies in the priority order that you would use to allocate public funds toward their development and implementation". Participants recorded their highest priority as 1 through to 12 for their lowest priority.

The second objective of the questionnaires was to assess the effectiveness of the large group process and this was measured in the post-questionnaire. Attitudes toward particular features of the process were measured by asking "How strongly do you agree with the use of the following?" on a seven-point Likert scale ranging from 1=strongly disagree, 4=unsure and 7=strongly agree. Attitudes toward the purpose of the workshop were measured by asking respondents to tick boxes that "most closely match your opinions of the purpose of today's workshop".

Additionally, the post-questionnaire contained questions relating to behavioural intention and communication. The quantitative measures of the pre- and post- questionnaires are described by reporting descriptive statistics namely, mean scores. T-tests ($p < 0.05$) were used to identify if the changes in responses were statistically significant at the 95% level of confidence. Measures that did not look to compare change in pre-and post questionnaire were reported using descriptive statistics.

3.4.2 Qualitative data

Collecting qualitative data was important, given that one of the research aims was to explore Scottish society's knowledge, understanding and interpretation of climate change and low emission energy technologies. Each of the table conversations were audio taped and then transcribed verbatim. The transcriptions were analysed to identify key themes, which encompassed the range of ideas, attitudes and beliefs. The qualitative analysis helped the researchers understand how participants' thought about climate change, and low carbon energy technologies, and how they related this to their own lives and experiences, as well as commenting on what they thought was the role of different societal actors.

Other opportunities to provide individual feedback were given at the end of the day. As well as the 'one key message' for policy makers that participants were asked for, there was space at the end of the post-workshop questionnaire to write down any other comments to share with the organisers.

4. Participant characteristics

This section outlines the demographic characteristics of the people who participated in the workshop. Of the 99 participants, 98 completed both the pre- and post-workshop questionnaires, although not all participants completed all the questions, which is noted in the relevant tables.

4.1 Age and Gender

There was an almost equal representation of males and females amongst the workshop participants. The gender ratio at the workshop was slightly different from the Edinburgh and Lothians population at large. Whereas in the Edinburgh and Lothians population there are slightly more females than males, among the workshop participants there are slightly more males than females. Age ranged from 18 to 73 years, with a mean of 44 years. People under 18 years of age and over 75 years of age were not recruited for the workshop. The age distribution was similar to that for the Edinburgh and Lothians population as a whole, though with somewhat higher proportions of people aged 30-44 and 60-74 in the workshop than in the wider population, while the 18-29 and 45-59 age groups were somewhat underrepresented at the workshop.

Table 4.1: Age and gender of workshop participants compared to Edinburgh and Lothians population

	Workshop Participants			Population Statistics		
Age	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
18-29	8.1%	12.1%	20.2%	13.9%	14.6%	28.5%
30-44	16.2%	21.2%	37.4%	14.2%	13.9%	28.1%
45-59	15.1%	7.1%	22.2%	12.4%	13.4%	25.8%
60-74	13.1%	17.1%	20.2%	8.3%	9.3%	17.6%
Total	52.5%	47.5%	100.0%	48.8%	51.2%	100.0%

Note: Edinburgh and Lothians population data are derived from the National Records of Scotland and the age categories are defined by this data set.

4.2 Education

Table 4.2 summarises the highest education level attained by the workshop participants. The levels are for the Scottish education system and are listed from lowest to highest. Almost all participants had completed secondary school, with over 95% having left school with some form of qualifications. More than 50% had gone on to earn further qualifications, either a trade certificate or apprenticeship (6%), a diploma (13%), a bachelor or honours degree (28%), or a postgraduate degree (13%).

Table 4.2 Education level

Education Level	Frequency	Percentage
Primary School	1	1.0
Secondary School – no qualifications	5	5.1
Secondary School – GCSE/Standard grade	13	13.1
Secondary School – AS level/Highers	8	8.1
Secondary School – A level/Advanced Highers	9	9.1
Trade certificate/apprenticeship	6	6.1
Diploma	13	13.1
Bachelor/honours degree	28	28.3
Postgraduate degree	13	13.1
Did not answer	3	3.0
Total	99	100.0

4.3 Employment

Table 4.3 shows that the majority of workshop participants were in paid employment, with 33% employed full-time and the rest part-time or casual (13%) or self-employed (11%). 7% were unemployed, and 16% were retired or on a pension; 4% performed home duties, and another 13% identified themselves as either full or part-time students.

Table 4.3: Employment status

Employment status	Frequency	Percentage
Employed full time	33	33.3
Employed part time or casual	13	13.1
Self employed	11	11.1
Unemployed	7	7.1
Retired/pension recipient	16	16.2
Home duties	4	4.0
Full-time student	12	12.1
Part-time student	1	1.0
Did not answer	2	2.0
Total	99	100.0

Table 4.4 shows that about one-quarter of the participants (24%) worked as professionals, the most common mode for the group. Fewer than 10% of participants were in any of the other categories. About one-third (35%) were not in paid employment. 6% did not fit into any of these categories and 4% did not respond to the question.

Table 4.4: Employment status

Employment status	Frequency	Percentage
Manager	6	6.1
Professional	24	24.2
Technician/trade worker	6	6.1
Community/personal service worker	3	3.0
Clerical/administrative worker	9	9.1
Sales worker	5	5.1
Labourer	1	1.0
Not in paid employment	35	35.1
Other	6	6.4
Did not answer	4	4.0
Total	99	100.0

4.4 Household structure

Table 4.5 illustrates that almost half of the workshop participants lived as part of a couple, either with children (25%) or without (23%). About a further one-quarter lived in a group household (22%), and 17% lived alone. The remainder either lived as a single parent (8%) or with other family (2%).

Table 4.5: Household structure

Household structure	Frequency	Percentage
Group household	22	22.2
Single person household	17	17.2
One parent with children	8	8.1
Couple with no children	23	23.2
Couple with children	25	25.3
Other family (e.g. extended family household).	2	2.0
Did not answer	2	2.0
Total	99	100.0

Participants' household sizes ranged from one to eight (Table 4.6). The most common household size was two people (39%); this was followed by single person households (18%) and three-person households (16%) Almost three-quarters of the participants indicated that they lived in a one-, two- or three-person household.

Table 4.6: Household size

Household size	Frequency	Percentage
1	18	18.2
2	39	39.2
3	16	16.2
3	7	7.1
5	12	12.1
6	2	2.0
7	2	2.0
8	1	1.0
Did not answer	2	2.0
Total	99	100.0

4.5 Income

Participants' household incomes varied from less than £10 000 to more than £100 000, with the median income being £30 000 - £39 999 (Table 4.7). Approximately one-quarter of the group (24%) were from households earning less than £20 000 and about one-quarter (23%) from households earning more than £50 000.

Table 4.7: Household income

Household Income	Frequency	Percentage
Less than £10 000	10	10.1
£10 000 - £19 999	14	14.1
£20 000 - £29 999	15	15.2
£30 000 - £39 999	19	19.2
£40 000 - £49 999	13	13.1
£50 000 - £59 999	12	12.1
£60 000 - £69 999	5	5.1
£70 000 - £79 999	2	2.0
£80 000 - £89 999	2	2.0
£90 000 - £99 999	1	1.0
£100 000 - £124 999	1	1.0
Did not answer	5	5.1
Total	99	100.0

5. Environmental profile

This section summarises the position, beliefs and behaviours participants held in relation to the environment at the beginning of the workshop.

5.1 Position

Participants were asked to self-rate their environmental position, by indicating to what extent they agreed with two statements: 'I think of myself as an environmentally-conscious person' and 'I am the type of person who engages in environmentally friendly behaviours' (1=strongly disagree, 4=unsure, to 7=strongly agree). On the whole the participants considered themselves to be moderately pro-environmental with mean responses of 5.1 and 4.9 respectively. However, only 9% of participants stated that they were currently members of an environmental group.

5.2 Beliefs

Fifteen statements about environmental beliefs (see Appendix B) were averaged to form a single summary measure that ranged from 1=anti-environmental beliefs, 4=unsure, to 7=pro-environmental beliefs. The group average was 4.8 (SD=0.73) reflecting that the group had a moderate level of pro-environmental beliefs. The highest mean level of agreement was accorded to the statement 'Plants and animals have as much right as humans to exist'. The second-highest mean level of agreement was to the statement 'Despite all our special abilities humans are still subject to the laws of nature'. The lowest mean level of agreement was accorded to the statement 'The earth has plenty of natural resources if we just learn how to develop them'.

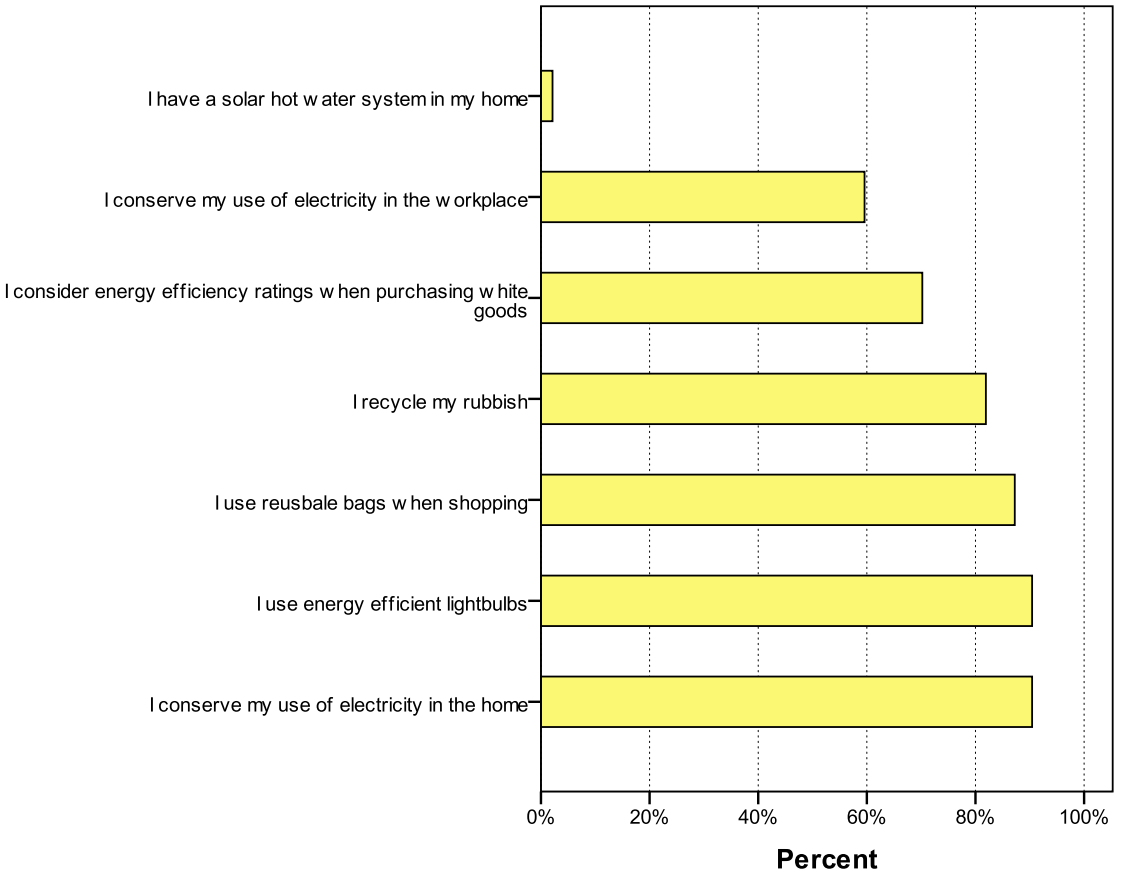
5.3 Behaviours

Participants were presented with a list of seven pro-environmental behaviours and asked whether they engaged in these behaviours. At least 80% of the participants performed four of the seven behaviours; using energy efficient light bulbs (91%), conserving energy at home (91%), using reusable bags when shopping (88%) and recycling rubbish (83%).

Considering energy efficiency when buying white goods (71%), and conserving energy in the workplace (60%), were fairly widely practiced behaviours. The least adopted pro-environmental behaviour was having a solar hot water system in the home, with only 2% of respondents doing this.

Participants' 'environmental impact score' (derived by summing each participant's 'yes' responses to the seven behaviours) span across the whole range from 0 to 7. The mean score was 4.8 with a standard deviation of 1.2.

Figure 5.1: Environmental behaviours (percentage of participants who circled yes)



6. Knowledge and attitudes

This section summarises participants' self-rated knowledge and attitudes regarding climate change and energy technologies. These have been measured in both the pre- and post-workshop questionnaires, thus making it possible to highlight changes that occurred during the workshop.

Overall, the workshop was particularly effective in raising participant knowledge of climate change and energy technology options. Knowledge of all climate change issues and energy technologies significantly increased over the course of the workshop. There were significant changes pre- and post-workshop in support towards all energy technologies with the exception of solar and wind (although both solar and wind were already highly supported pre-workshop and this continued post-workshop). There was also significant change on three of the seven statements regarding climate change and related issues.

6.1 Knowledge about climate change and related issues

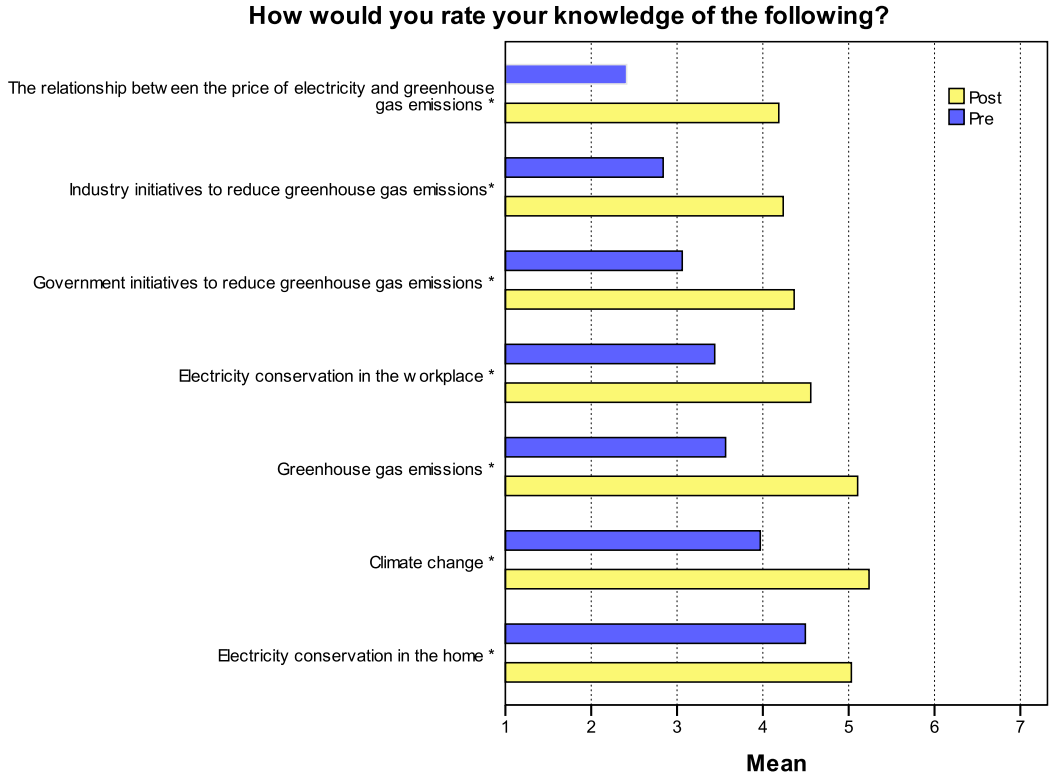
The participants were presented with eight factual statements about climate change and related issues, and asked to indicate whether these statements were true or false (see Appendix B). There was also an option for 'Don't know', and for six of the eight statements the most widely selected option was 'Don't know' implying that there was a lack of knowledge about these issues.

Seven of the eight statements were false. The majority of participants correctly identified the true statement 'Embodied energy is the energy used to produce and transport the goods and services that we buy'. The participants also correctly identified two of the statements as false, with the statement 'Climate change can completely be explained through natural variability in climatic cycles' being most widely recognised as false. The remaining five statements were not recognised as false, with the statement most incorrectly recognised as true being 'The greenhouse effect is caused by a hole in the earth's atmosphere'.

A summary measure of knowledge was obtained by assigning a score of -2 to an incorrect answer and a score of +2 to a correct answer. Scores were summed across all eight items, yielding a total knowledge score which could range from -16 to +16. The mean summary measure of knowledge for all participants was 0.1. This indicates that, while overall slightly more correct than incorrect answers were provided, there was limited knowledge of the issues in the statements. The scores per question are presented in Appendix B.

Participants were also asked to rate their knowledge of climate change and related issues. Results show that self-rated knowledge of all seven issues increased significantly during the workshop (Figure 6.1). At the beginning of the day, participants indicated that they knew least about the relationship between the price of electricity and greenhouse gas emissions, and most about energy conservation in the home. At the end of the workshop participants self-rated that they knew most about climate change, and greenhouse gas emissions.

Figure 6.1: Mean changes in knowledge of climate change and related issues (pre- vs post-workshop)



Knowledge was measured as (1) no knowledge, (4) moderate knowledge, (7) high knowledge.
*Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

6.2 Knowledge of energy sources and related technologies

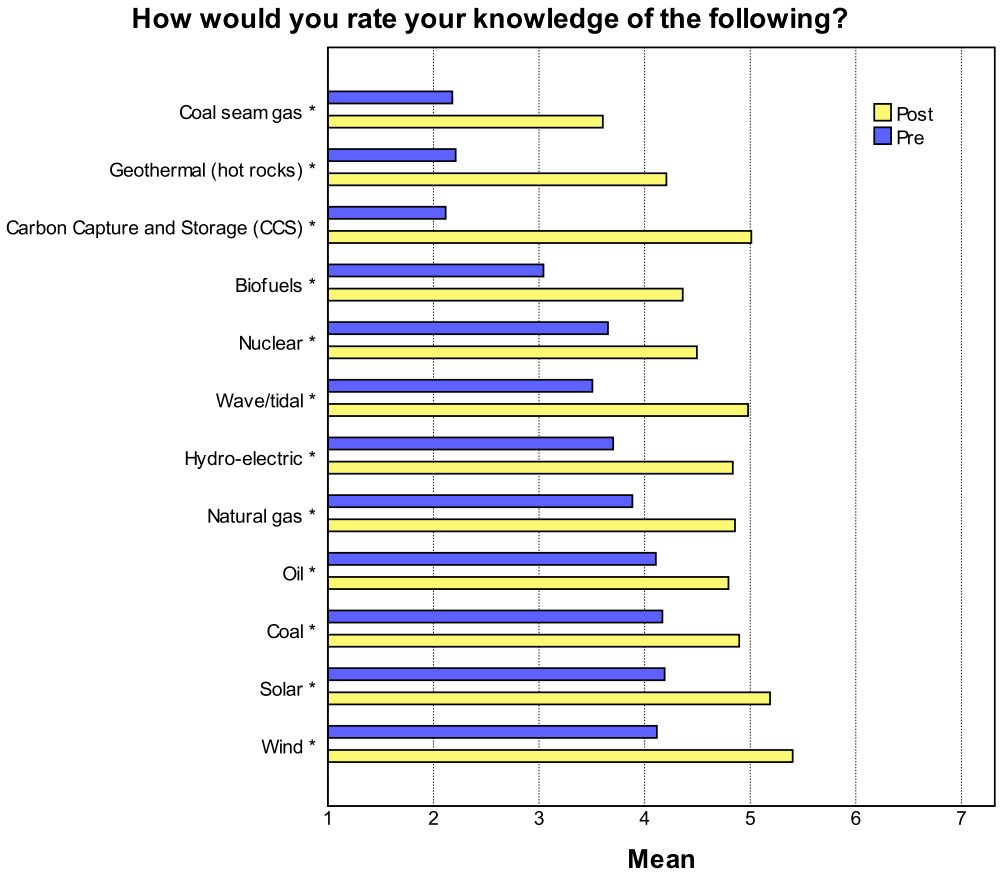
Participants' self-rated knowledge of all twelve energy technologies significantly increased during the workshop (Figure 6.2). The largest increase was seen in carbon capture and storage (CCS), to which one of the three presentations was entirely devoted. There were also large increases in self-rated knowledge for new and emerging technologies such as geothermal, coal seam gas, biofuels and wave/tidal. The lowest mean level knowledge increases were for the more established technologies such as coal and oil.

Of the twelve energy technologies, participants self-rated their knowledge of solar energy the highest, pre-workshop. This self-rated knowledge increased over the workshop. The highest self-rated knowledge post-workshop was of wind power, and this self-rated knowledge also rose over the workshop.

The lowest average levels of self-rated knowledge reported at the beginning of the workshop were for the new or emerging technologies of CCS, geothermal, and coal seam gas. Coal seam gas and geothermal remained the lowest post-workshop.

The difference in self-rated knowledge between the various energy sources and related technologies was smaller after the workshop than before the workshop. The range between the technology with the lowest mean self-rated knowledge and the technology with the highest mean self-rated knowledge was 2.1 prior to the workshop and 1.8 after the workshop.

Figure 6.2: Mean changes in knowledge of energy sources and related technologies (pre- vs post-workshop)



Knowledge was measured as (1) no knowledge, (4) moderate knowledge, (7) high knowledge.
*Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

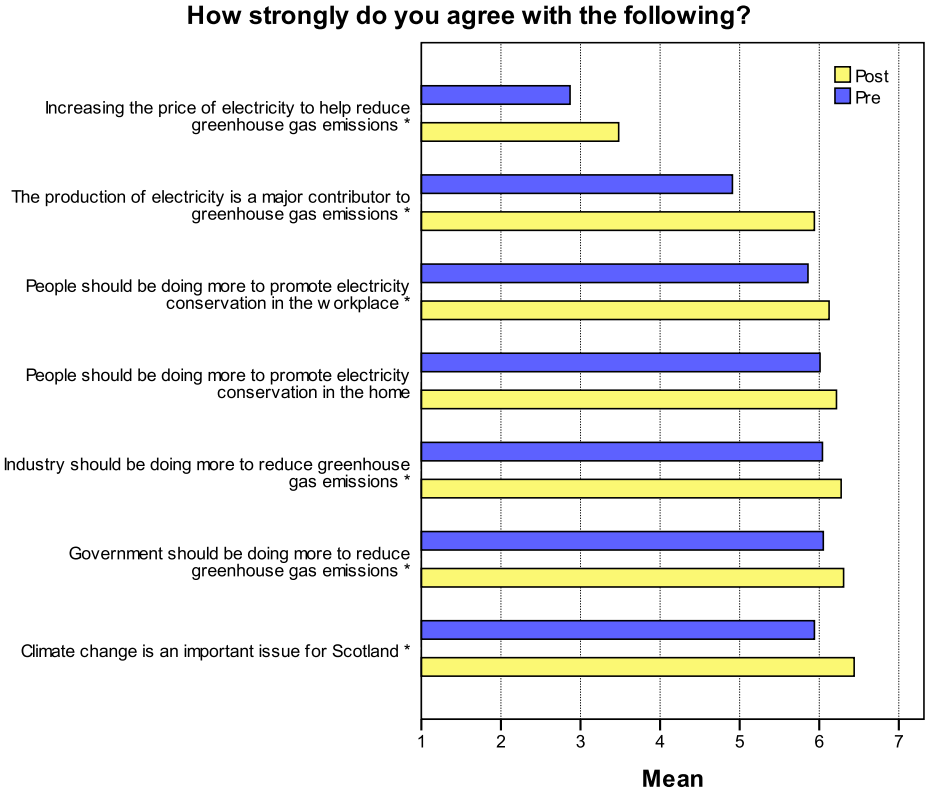
6.3 Attitudes toward climate change and related issues

Most participants supported six out of the seven statements about climate change and related issues that were presented, both before and after the workshop (Figure 6.3). More than 85% of respondents at least moderately agreed with five of these six statements (percentage of participants answering "moderately agree", "agree", or "strongly agree"), and almost 60% at least moderately agreed that the production of electricity is a major contributor to greenhouse gas emissions.

The seventh statement about increasing the price of electricity to help reduce emissions received less support. More than 60% of the participants at least moderately disagreed with this statement (percentage of participants answering "moderately disagree", "disagree", or "strongly disagree") prior to the workshop. While support did increase significantly during the day, at the end of the workshop almost 50% of participants still disagreed with the statement.

The largest change in opinion pre- and post-workshop was for the statement that 'the production of electricity is a major contributor to greenhouse gas emissions' with the level of at least moderate agreement increasing from 60% to more than 90%. Four other statements also showed significant differences between the pre- and post-workshop questionnaire results. After the workshop, participants agreed more strongly that climate change is an important issue for the Scotland, that industry as well as government should be doing more to reduce greenhouse gas emissions, and that people should be doing more to promote energy conservation in the workplace. There was no significant difference pre- and post-workshop for the statement that 'people should be doing more to promote energy conservation in the home'.

Figure 6.3: Mean changes in attitudes toward climate change and related issues (pre- vs post-workshop)



Attitude was measured as (1) strongly disagree, (4) unsure, (7) strongly agree.
*Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

6.3.1 Climate change

The majority of workshop participants (>90%) considered climate change to be an important issue for Scotland, both before and after the workshop. In the group discussions, there was a fairly broad consensus that climate change exists, although some participants were unsure about the extent to which climate change is caused by human activity. There was also some confusion between the greenhouse effect and ozone depletion. This is reflected in the statements that participants made during the discussions:

> *"We seem to be speeding it up, my opinion is, we're not causing it, it's a natural cycle, but we're definitely speeding it up."*
>
> *"Climate change has always been in place, but I think, you know, by creating an ozone effect, a greenhouse effect, it's accelerating the process."*
>
> *"Climate change is a natural phenomenon – we can't stop it, but we can stop aggravating it."*
>
> *"I think we don't know enough about what has caused the changes in climate. I mean, for the last two years we have had very severe winters, far more so than for a long, long time. Is that because of what's happening into the environment, or would that just have happened anyway?"*
>
> *"I worry about these earthquakes, these earthquakes and tsunamis, and why they should be coming, and coming more regularly. Are they going to carry on, or what are we doing about it? Is there anything being done about it?"*
>
> *"It's [CO_2] the gases that come out of things like fridges and things like that, is it?"*

6.3.2 Electricity and climate change

Before the workshop, almost 60% of participants agreed that the production of electricity is a major contributor to greenhouse gas emissions. At the end this share had increased to more than 90%. The mean level of agreement thus significantly increased, and the share of participants agreeing or agreeing strongly increased from 33% to 67%.

6.3.3 Doing more to reduce emissions

There was a rather broad agreement that more should be done to reduce greenhouse gas emissions. The questionnaire results show that participants think that all societal actors have a responsibility in this reduction effort. There was substantial agreement concerning the statements that government and industry should do more to reduce greenhouse gas emissions. Likewise, the statements that people should do more to conserve electricity in the home and in the workplace received substantial support. Some quotes from the table conversations illustrate these findings:

> *"If you put the same amount of, like, impetus and government's money behind the renewable energy system as they do into their computer development system, I wonder if we'd be five times better in ten years with solar panels and stuff, or maybe they just don't have enough money."*
>
> *"We hear these huge big numbers, millions of pounds, people like industry and energy companies. But on a small scale we're the consumers of all these things, so if we could have maybe more of a, like, knowing about things like fitting solar panels on roofs. It's small, it's not going to make a huge difference once over, but if millions of people have these things."*
>
> *"My concerns are about what I can do, and the lack of information that's out there unless you really want to investigate it. Unless you're very interested in the subject matter, the information's not easily accessible."*

6.3.4 Increasing the price of electricity

Of the seven statements on attitudes toward climate change and related issues there was least agreement with 'increasing the price of electricity' as a measure to reduce greenhouse gas emissions. However, there was a significant difference between the pre- and post-workshop results. 17% of participants agreed with this statement prior to the workshop, whereas 34% agreed after the workshop. However this means that two-thirds of the participants remained against price rises. There was scepticism as to whether 'green' electricity was indeed truly green, and whether increases in prices would result in increases in low carbon energy or rather in increases in corporate profits:

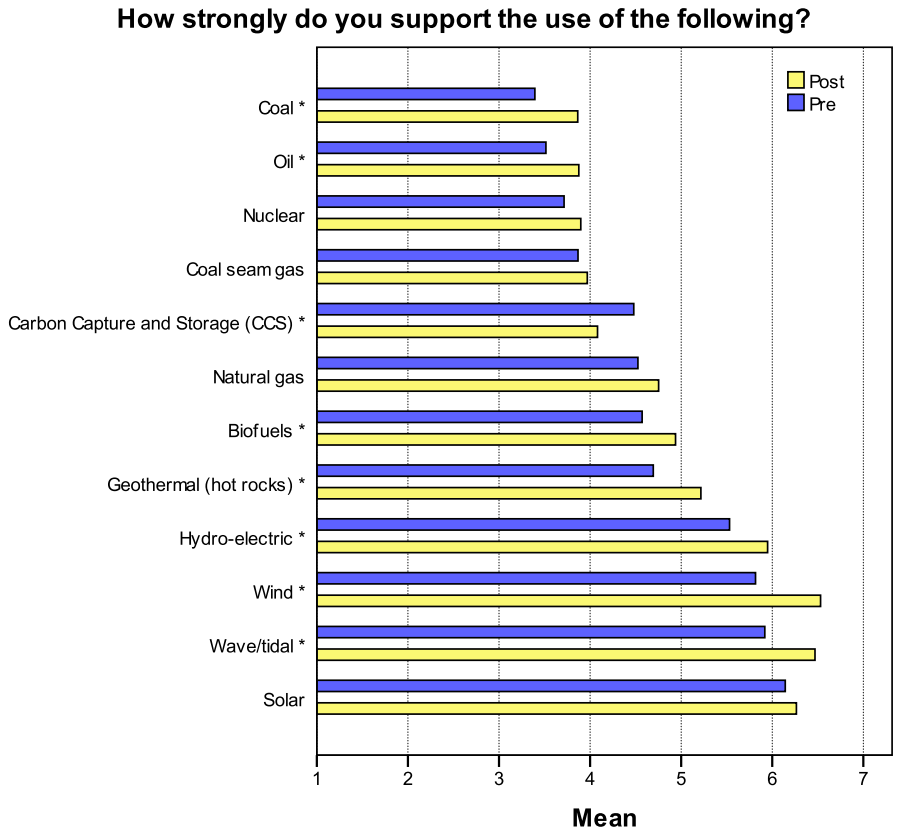
> *"It's important, but I'm skint."*
>
> *"How much are all these [carbon reduction] technologies going to cost? We've already gone through so many energy price rises in the past few years. My energy bills have doubled over the past few years. If it's going to cost more I'm not sure people are going to go for that."*
>
> *"When the price of oil goes up it goes up, but when the price of oil goes down, the prices that we pay for electricity and gas, they don't go down."*
>
> *"What I would like to know is what companies are actually doing this, is it just the big conglomerate oil and gas companies making more money out of things they are doing already or are there smaller companies getting involved?"*

6.4 Attitudes toward energy sources

Attitudes toward energy sources varied substantially (Figure 6.4). Generally, there was greater support for renewable options than for non-renewable options. At the beginning of the workshop, more than 20% of participants were unsure of their support for seven of the twelve technologies. The most uncertainty was for coal seam gas (68% were unsure), Geothermal (62% were unsure), and CCS (61% unsure). After the workshop, the share of participants that indicated they were unsure about individual technologies was substantially lower, e.g. 28% for CCS and geothermal and 44% for coal seam gas. Greater self-rated knowledge (see Section 6.2) may have contributed to the reduction of uncertainty. During the workshop there was an entire presentation devoted to CCS, while very little information on geothermal and coal seam gas was presented. It is therefore interesting to note that levels of uncertainty in CCS did not change markedly compared to the change in expressed uncertainty regarding geothermal and coal seam gas.

The mean level of participant support increased during the workshop for all technologies with the exception of CCS.

Figure 6.4: Mean changes in attitudes toward energy sources and related technologies (pre- vs post-workshop)



Attitude was measured as (1) strongly disagree, (4) unsure, (7) strongly agree.
*Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

6.4.1 Solar, wind, hydro and wave/tidal

The highest mean levels of support, both before and after the workshop, were for solar, wind, hydro and wave/tidal power, all eliciting a mean moderate to strong agreement. At least 90% of participants supported these technologies at the end of the workshop. At the end of the workshop 97% of participants supported wave/tidal, with 59% expressing strong support (Figure 6.5). Wind received support from 96% of the participants, with 65% expressing strong support (Figure 6.6). 95% of participants supported solar and 90% supported hydro.

Figure 6.5: Changes in response for support for wave/tidal energy (pre- vs post-workshop)

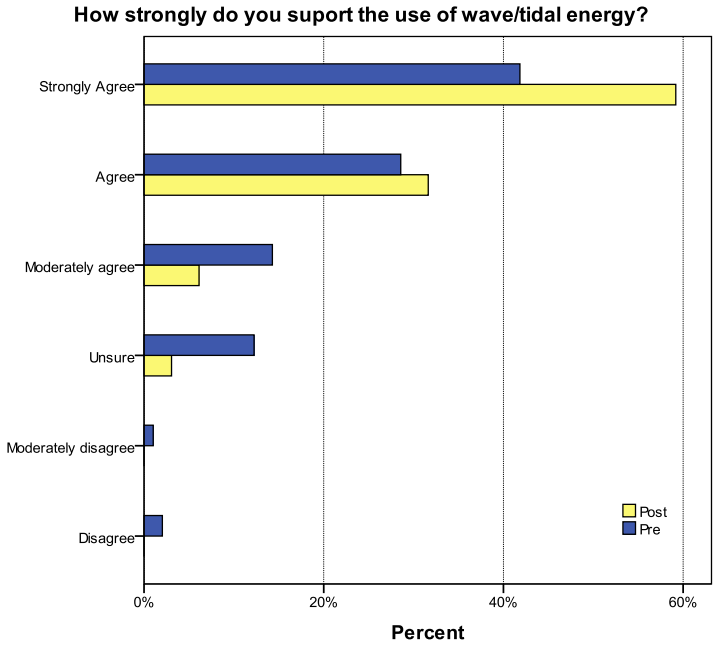
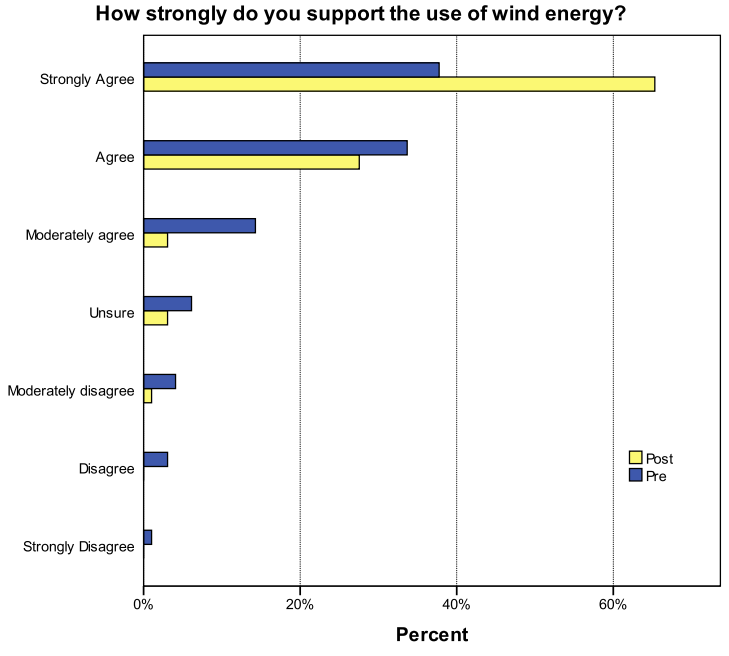


Figure 6.6: Changes in response for support for wind energy (pre- vs post-workshop)



Despite these high levels of support, some perceived local problems with wind energy arose during the discussions. The impact of wind turbines on the landscape was mentioned as well as the noise produced by the turbines, though others played down these impacts:

> *"See the Inverness council yesterday knocked back an application to build a wind farm, 23 turbines, and the council knocked it back because the locals didn't want it because of the effect on the environment. The look and the noise, I'd imagine it would be quite noisy."*
>
> *"They are a blot on the landscape."*
>
> *"They judder, they get a bit of a crosswind and they judder, but you don't hear anything. You could live half a mile away and you wouldn't hear a thing, you'd just see them going round."*
>
> *"They look pretty cool some of them."*

6.4.2 Geothermal and biofuels

Two other renewable technologies – geothermal and biofuels – were the next most supported options, both pre- and post-workshop. There was a lot of uncertainty about these technologies at the start of the workshop, but support had significantly increased by the end. The proportion of participants that supported geothermal increased from 34% to 65% during the workshop while the proportion that was uncertain decreased from 62% to 28% (Figure 6.7). Likewise for biofuels, the proportion of participants that supported the technology increased from 41% to 67%, while the proportion that was unsure decreased from 44% to 20% (Figure 6.8). In both instances, it seems that participants became more favourably disposed towards the technology during the workshop, even though there was limited information provided about these technologies.

Figure 6.7: Changes in response for support for geothermal energy (pre- vs post-workshop)

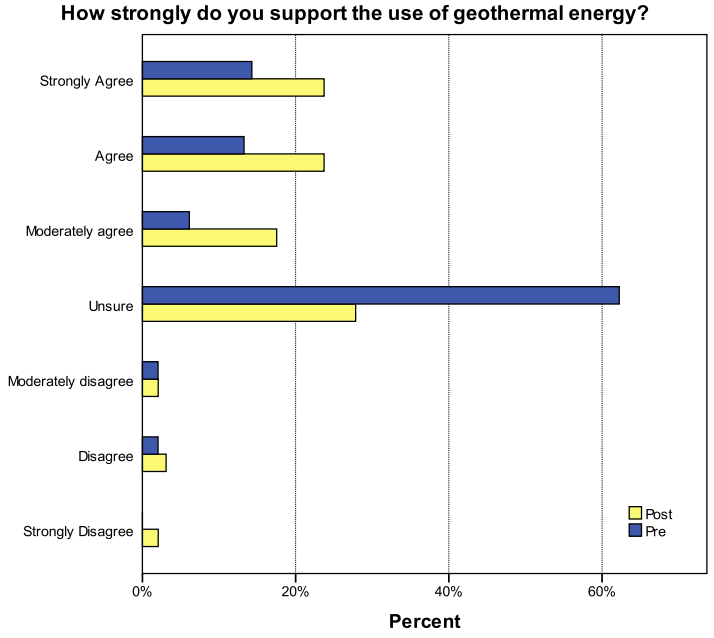
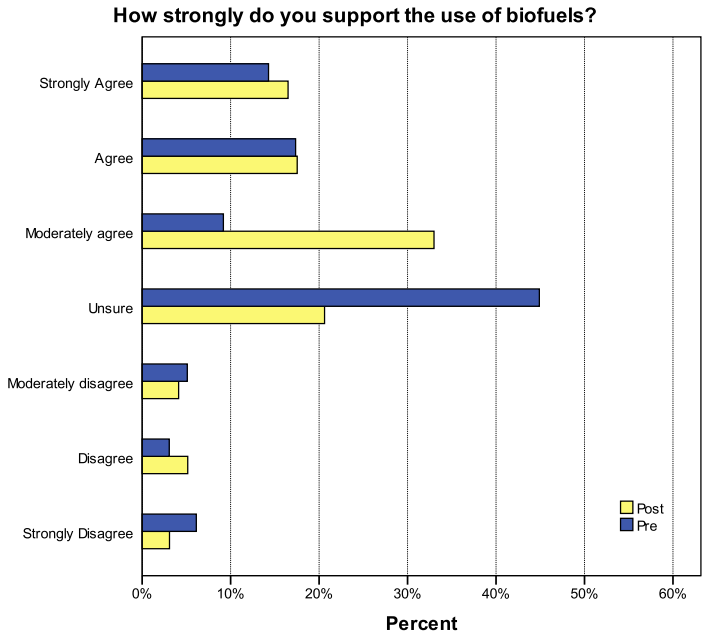


Figure 6.8: Changes in response for support for biofuels (pre- vs post-workshop)



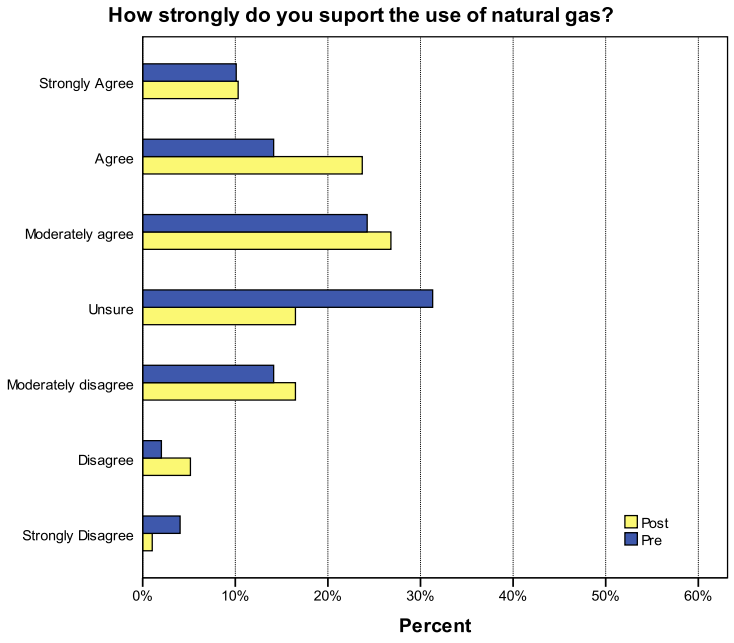
"Scotland has a lot of granite, so I'm wondering why geothermal isn't being considered as a major energy source."

"The geothermal thing, I just thought, like, Scotland's such a tiny country, does it really make such an impact that the granite is far away?"

6.4.3 Natural gas

Of the non-renewable energy technologies, natural gas receives the largest support. The support for natural gas increased slightly, but not significantly during the workshop. The percentage of respondents that were unsure about the use of natural gas declined from 31% to 17%, and there was a shift towards moderate support (Figure 6.9).

Figure 6.9: Changes in response for support for natural gas (pre- vs post-workshop)

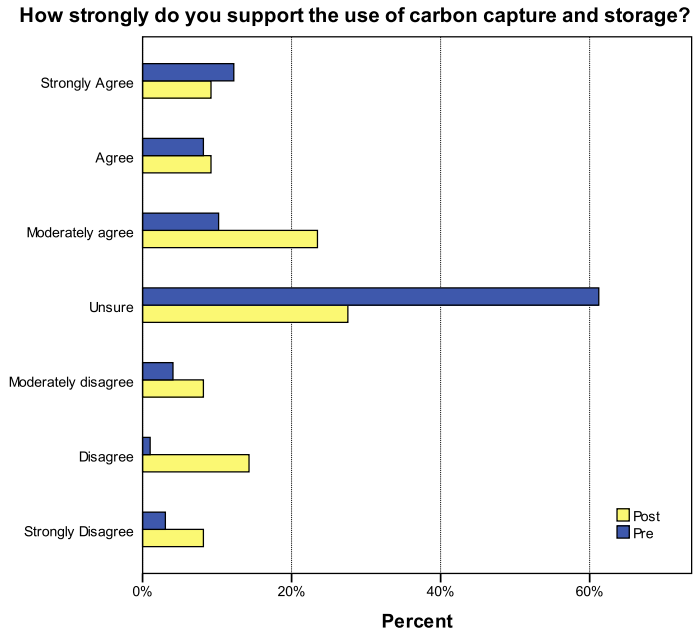


6.4.4 Carbon capture and storage (CCS)

61% of the workshop participants were uncertain about carbon capture and storage at the start of the workshop (Figure 6.10). Of those who had an opinion, three-quarters were supportive. This uncertainty was reflected in participants' knowledge about CCS prior to the workshop, which was the lowest of all the technologies. While there was moderate support for CCS prior to the workshop with a mean level of support of 4.48, this fell significantly (at 95% confidence levels) during the workshop to 4.1 (Figure 6.4).

During the workshop, a lot of information on CCS was presented, and self-reported knowledge increased significantly (see section 6.2). The percentage of participants that indicated that they were unsure about their support for CCS decreased from 61% to 28% during the workshop. Although the mean level of support decreased, there were some interesting changes in support, as the percentage of participants that indicated agreement did increase. Most of this increase was attributable to an increase in the number of people expressing 'moderate agreement' from 10% to 24%, while the percentage of people 'strongly agreeing' decreased. The percentage of participants indicating disagreement with CCS also increased with the number of people 'moderately disagreeing', 'disagreeing' and 'strongly disagreeing' increasing from 8% to 30%. Overall, this leads to the mean reduction in support.

Figure 6.10: Changes in response for support for carbon capture and storage (pre- vs post-workshop)



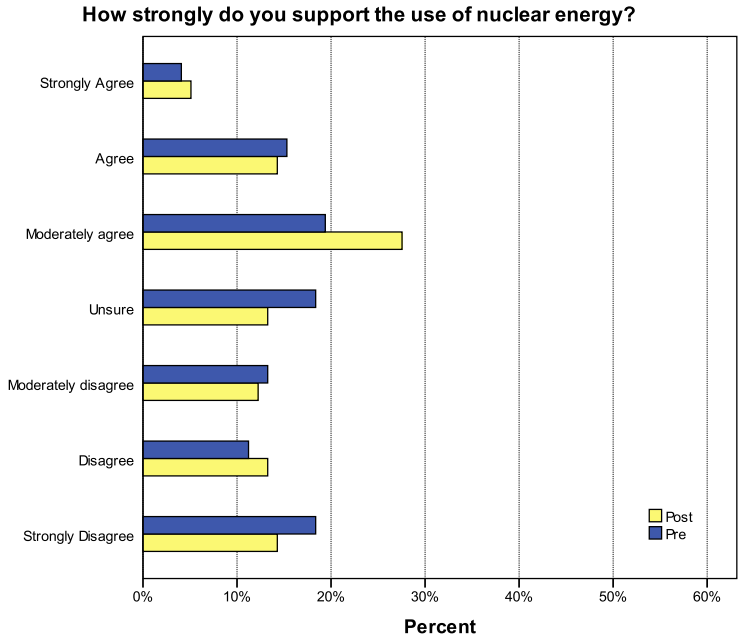
It appears as if many of those who started the process being 'unsure' about CCS came to an opinion during the day, and that this was towards the categories of 'moderately agree', 'disagree', moderately disagree' and 'strongly disagree'. Quotes from the group discussions illustrate that CCS splits opinion:

> *"I just can't get, you know, if it's causing us so many problems up here, surely it's going to cause problems down there. Would there be earthquakes, would the plates move?"*
>
> *"We're not concerned about massive eruptions as such. But the point is to get this stuff out of the atmosphere and if you have a leak…"*
>
> *"I feel uneasy about CCS but the only alternative is that it goes into the air... and it increases GHGs. What I don't want it to be is an excuse for government to say we can continue using as much fossil fuels …. You know, producing as much carbon as we do because we have a solution".*
>
> *"We're not going to transfer to whether it's wind power or nuclear, we're not going to have that as a total source of energy. We're still going to have to use fossil fuels, so if you can take the carbon away from that, well, it's a short-term fix which is probably good."*
>
> *"CCS is a nice easy solution. You keep all your existing stuff and you suck the CO_2 out of the chimney".*
>
> *"The elephant in the room is cost".*
>
> *"I would feel very sad if the Scottish Government got a totally negative view of a new technology [CCS] from the general public, just because we haven't got questions answered on it."*

6.4.5 Nuclear

Apart from the coal technologies and oil, nuclear energy solicited the least support from participants. There was a widespread range of opinions in relation to nuclear power and there was no significant shift in the mean during the workshop. At the start of the workshop about equal proportions of participants were supportive (39%) and opposed (43%) with 18% uncertain (Figure 6.11). This changed very little during the workshop, with support increasing slightly, but not significantly, to 47%, and opposition dropping to 40%, 13% remained unsure. Most of the increase in agreement was at the level of 'moderate agreement'.

Figure 6.11: Changes in response for support for nuclear energy (pre- vs post-workshop)



"I don't know why, there's a total taboo about nuclear. See if you're pro-nuclear, it's as if, you know, it's kind of forbidden because of the stigma around it."

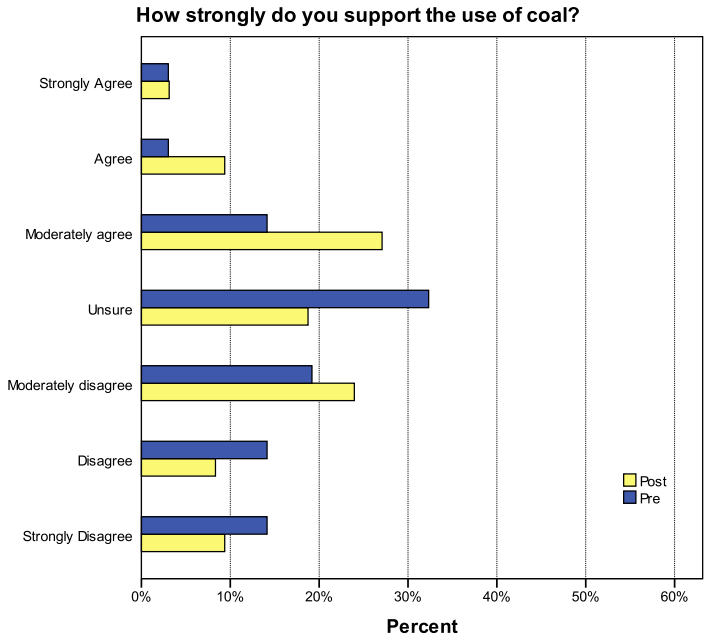
"I worked in the nuclear industry, and there's a lot of poor information out there about nuclear, and to a large extent they're to blame for not putting over the correct information. I worked there, I'm perfectly happy, and I know a lot about the effects of it, and I know there's a load of nonsense talked, and people are against it because they just don't know the truth."

*"When it does go wrong, oh f**k do we pay for it. Children are still being born in Chernobyl now with radiation effects… So I think it's just a case of when it goes well it goes well, when it goes bad oh my god."*

6.4.6 Coal, oil and coal seam gas

There was limited support for coal, oil and coal seam gas. At least 40% of participants opposed coal (Figure 6.12) and oil as energy sources both at the start and end of the workshop. Though support for the technologies did increase significantly during the workshop. There was a lot of uncertainty about these three energy options, particularly for coal seam gas, with 68% of participants unsure pre-workshop and 46% remaining uncertain post-workshop.

Figure 6.12: Changes in response for support for coal (pre- vs post-workshop)



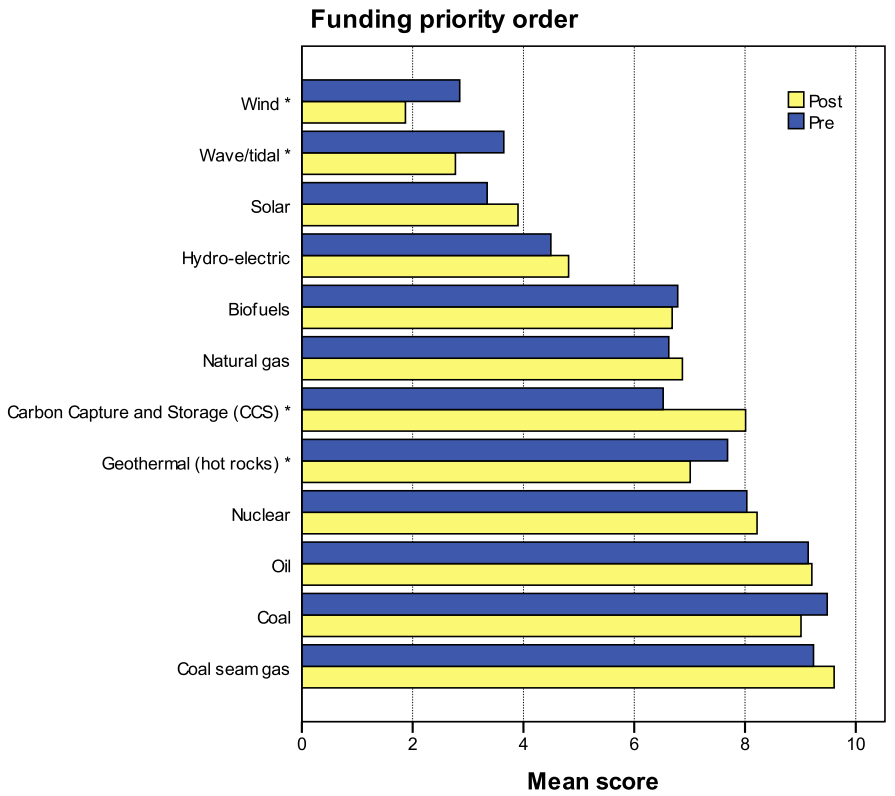
6.5 Energy technology preferences

At the start and end of the workshop, participants were asked to rank the twelve energy technologies in order of priority if they were able to allocate public funds to their development and/or implementation. Participants were asked to assign a score of 1 to their most preferred technology, and a score of 12 to their least preferred technology. A low score thus indicates a larger preference for a technology. The average pre- and post-workshop rankings are listed in Table 6.1. Figure 6.13 shows the mean funding priority order of each technology before and after the workshop.

Table 6.1 Ranking of average technology funding priority (pre- and post-workshop)

Energy Technology	Pre-workshop rank	Post-workshop rank
Wind *	1	1
Solar	2	3
Wave/tidal *	3	2
Hydro-electric	4	4
Carbon Capture and Storage (CCS) *	5	8
Natural Gas	6	6
Biofuels	7	5
Geothermal (hot rocks) *	8	7
Nuclear	9	9
Oil	10	11
Coal seam gas	11	12
Coal (traditional/current methods)	12	10

Figure 6.13: Changes in priority of the mean preferred energy technology (pre- vs post-workshop)



Priority was measured from 1=highest priority to 12=lowest priority.
*Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

Both Table 6.1 and Figure 6.13 show that in general, participants rank renewable technologies higher than non-renewable technologies. Solar, wind, hydro-electric, and wave/tidal energy top the list both before and after the workshop. At the bottom end of the list are coal (both traditional and seam gas), oil and nuclear. In the middle of the list are CCS, biofuels, geothermal and natural gas. There were changes in ranking within these sub groups during the course of the workshop. The biggest mover was CCS which dropped from being ranked 5th pre-workshop to 8th post-workshop. There was a significant difference in preference before and after the workshop for four of the technologies: wind, wave/tidal, CCS and geothermal.

Table 6.1 shows that wind energy was the most preferred option both before and after the workshop, and that its standing as the most preferred option increased during the workshop (Figure 6.13). Pre-workshop 73% of participants ranked wind in their top-3 of most preferred options, post-workshop 92% of participants placed wind in their top-3.

Wave/tidal overtook solar as the second-most preferred option during the workshop. Pre-workshop, 59% of participants ranked wave/tidal in their top-3, post-workshop this figure had risen to 78%. Meanwhile the number of participants ranking solar in their top-3 declined from 66% to 55%. Hydro-electric energy ranked as fourth mean priority both before and after the workshop, with 40% and 30% of participants ranking hydro-electric energy in their top-3 preferred options pre- and post-workshop respectively.

Before the workshop, CCS ranked fifth. After the workshop, it had fallen below biofuels, natural gas and geothermal. Before the workshop, 14% of participants had put CCS among their three most preferred options; this percentage had declined to 8% after the workshop, with nobody ranking it as their number one option. Before the workshop, 16% of participants had put CCS among their three least preferred options; at the end of the workshop 27% of participants ranked CCS in their bottom three. This decline in mean ranking score was statistically significant.

Natural gas remained in sixth place both before and after the workshop. Biofuels moved up two places to fifth during the workshop, and geothermal moved up one place to seventh. Even though biofuels moved up two places, the shift in mean score was small and not statistically significant. Whereas despite only moving up one place, the shift in mean score for geothermal was significant.

Pre-workshop, geothermal energy was ranked among the three most preferred options by 3% of respondents and in the top six by 37% of participants, while 31% ranked it in their bottom three. Post-workshop 5% of participants ranked it in the top three, 48% ranked it in the top six, and only 21% ranked it in the bottom three.

There was a small drop in mean ranking for natural gas and a small increase for biofuels. Natural gas ranked among the top six technologies for 46% of the participants pre-workshop and for 44% of participants post-workshop. While biofuels was ranked among the top six by 41% of the participants at the start of the workshop, this percentage had increased to 50% at the end.

Among the four least preferred technologies, nuclear was ranked ninth both pre- and post-workshop. Pre-workshop 39% ranked it in the bottom three, and this figure was largely unchanged with 36% ranking it in the bottom three post-workshop. Coal, which had been the least preferred technology pre-workshop, climbed two places to tenth post-workshop. However this change was not statistically significant. 60% of participants had ranked coal in the bottom three at the beginning of the workshop, but this percentage had decreased to 52% at the end of the workshop.

Oil and coal seam gas, which had been ranked tenth and eleventh respectively pre-workshop, both dropped one place to fall below coal post-workshop. Before the workshop, 55% of participants ranked oil among their three least preferred options. After the workshop, this percentage had decreased, with 49% ranking it among the bottom three. Before the workshop, coal seam gas was ranked among the bottom three by 50% of participants. After the workshop, this percentage had increased, with 55% of participants ranking it among the three least preferred options.

It is also worth noting that during the table discussions, participants often thought beyond the information that was presented to them, considering energy issues in different ways. The following quotes illustrate some of the alternative angles from which participants approached the discussion:

> *"There are so many other kinds of energy sources that we've not really gone into, things like the wind and the tidal, because these are things we could easily tap into. Money could be better spent on that than bombing people in Libya and things like that."*
>
> *"Scotland's moving further and further away from industrial things so our emissions are naturally going down in that sense so surely we would be much better just jumping to renewables. Yes we'd still have CO_2 emissions but they'll be a hell of a lot less than they are at the moment".*
>
> *"What we've been talking about is what is the best way to produce energy, but we haven't really said a lot about how to save energy, and I feel we could make a much bigger contribution by saving a lot of our energy. You go into stores and you, personally I feel the heat, I think if they dropped their temperature by about three or four degrees in all city centre stores they could save a huge amount."*

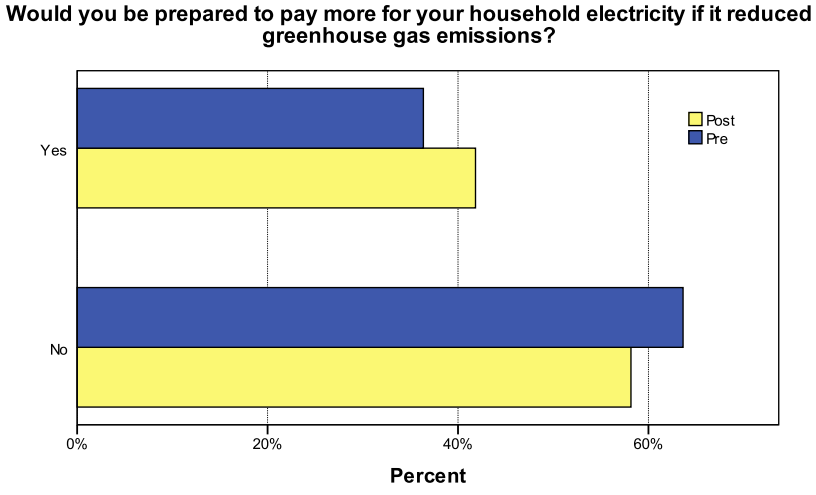
7. Energy related behaviours and intentions

This section describes participants' willingness to pay more for electricity if it reduced greenhouse gas emissions and other behavioural intentions as expressed in the questionnaires.

7.1 Willingness to pay more for electricity

Participants were asked whether they would be willing to pay more for electricity if it reduced greenhouse gas emissions. This question was asked in the pre-questionnaire and in the post-questionnaire. Figure 7.1 shows that 36% of the participants were willing to do so before the workshop, and that 42% were willing to do so after the workshop.

Figure 7.1: Percentage of participants that indicated they would be prepared to pay more for electricity if it reduced greenhouse gas emissions (pre- vs post-workshop)



Participants who answered that they would be willing to pay more for electricity if it reduced greenhouse gas emissions were also asked how much extra they would be willing to pay. Table 7.1 shows that there was hardly any difference between pre- and post-workshop answers. Of those willing to pay extra, approximately 20% were only willing to pay less than £25 extra per quarter of a year both pre- and post-workshop. Approximately 45% would pay up to £25 more per quarter, and approximately 22% would pay up to £50 per quarter extra. This finding suggests that more information, and a change in attitude, would not necessarily change stated willingness to pay, this remaining remarkably stable pre- and post-workshop.

Table 7.1 Willingness to pay more for electricity (pre- and post-workshop)

If you answered yes, which of the following best describes how much more you would be willing to pay for your household electricity if it reduced greenhouse gas emissions?	**Pre-workshop**	**Post-workshop**
I would pay less than £25 extra per quarter	20.0	24.4
I would pay up to £25 extra per quarter	45.7	43.9
I would pay up to £50 extra per quarter	22.9	22.0
I would pay up to £75 extra per quarter	5.7	4.9
I would pay up to £100 extra per quarter	2.9	2.4
I would pay up to £150 extra per quarter	2.9	2.4
I would pay more than £151 extra per quarter	0	0
Total	100	100

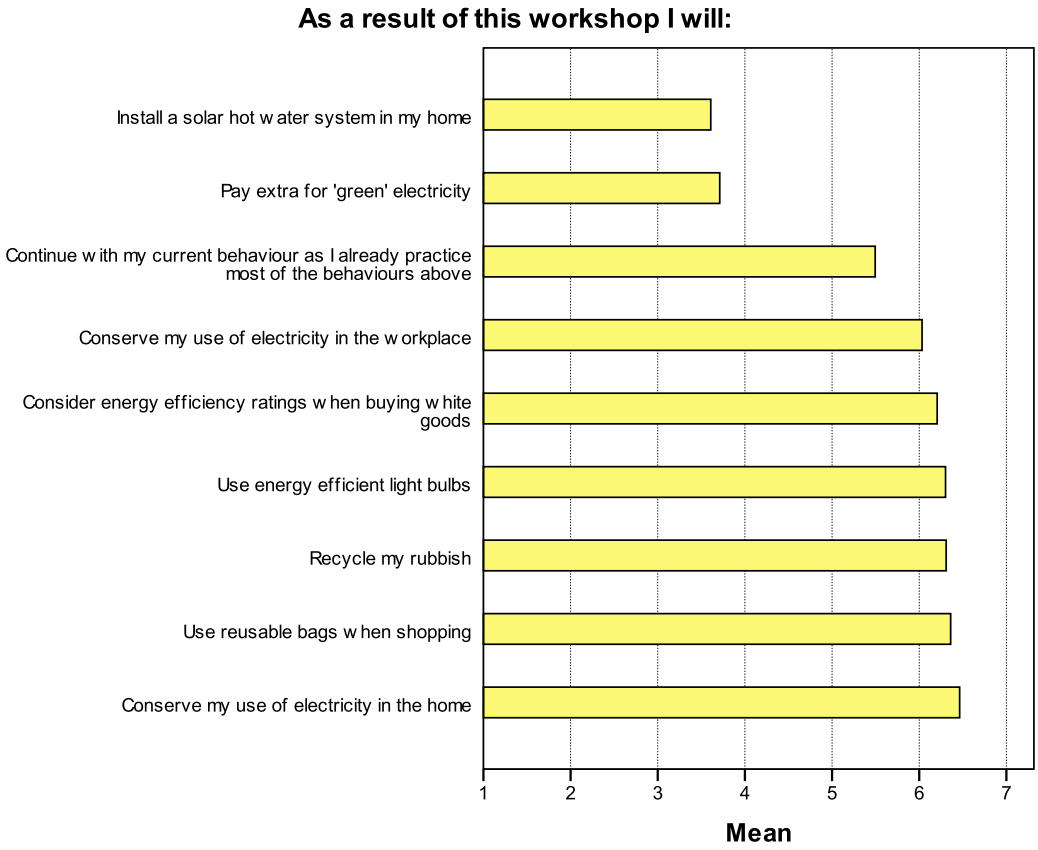
7.2 Intended behaviours as a result of the workshop

Participants were asked in the post-workshop questionnaire whether they intended to change their behaviour as a result of the workshop. Figure 7.2 shows that there is a (relatively) strong intention to adopt behaviour generally considered to be more environmentally friendly. The exceptions are paying extra for 'green' electricity and installing a solar hot water system in the home. The mean scores for these activities were 3.7 and 3.6 respectively and reflect a moderate reluctance among participants to carry out these activities. As noted above, paying extra for electricity is not popular among the participants, and the installation of a solar hot water system also has an upfront cost to the homeowner (and may have been regarded some what skeptically by Scottish citizens).

The highest mean score is given for conserving electricity in the home. The other relatively simple and cost effective behaviours of conserving energy, using energy efficient options and recycling also score highly, reflecting willingness among participants to carry out these activities.

There was also moderate agreement with the statement that "I will continue with my current behaviour, because I already do most of the above". This is supported by the results from the pre-questionnaire (see Section 5.2) where participants were asked whether they already exhibit given behaviours. The majority of participants stated that they already carried out most of the behaviours with the exception of paying more for 'green' electricity and having a solar hot water system.

Figure 7.2: Intended behaviour as a result of the workshop



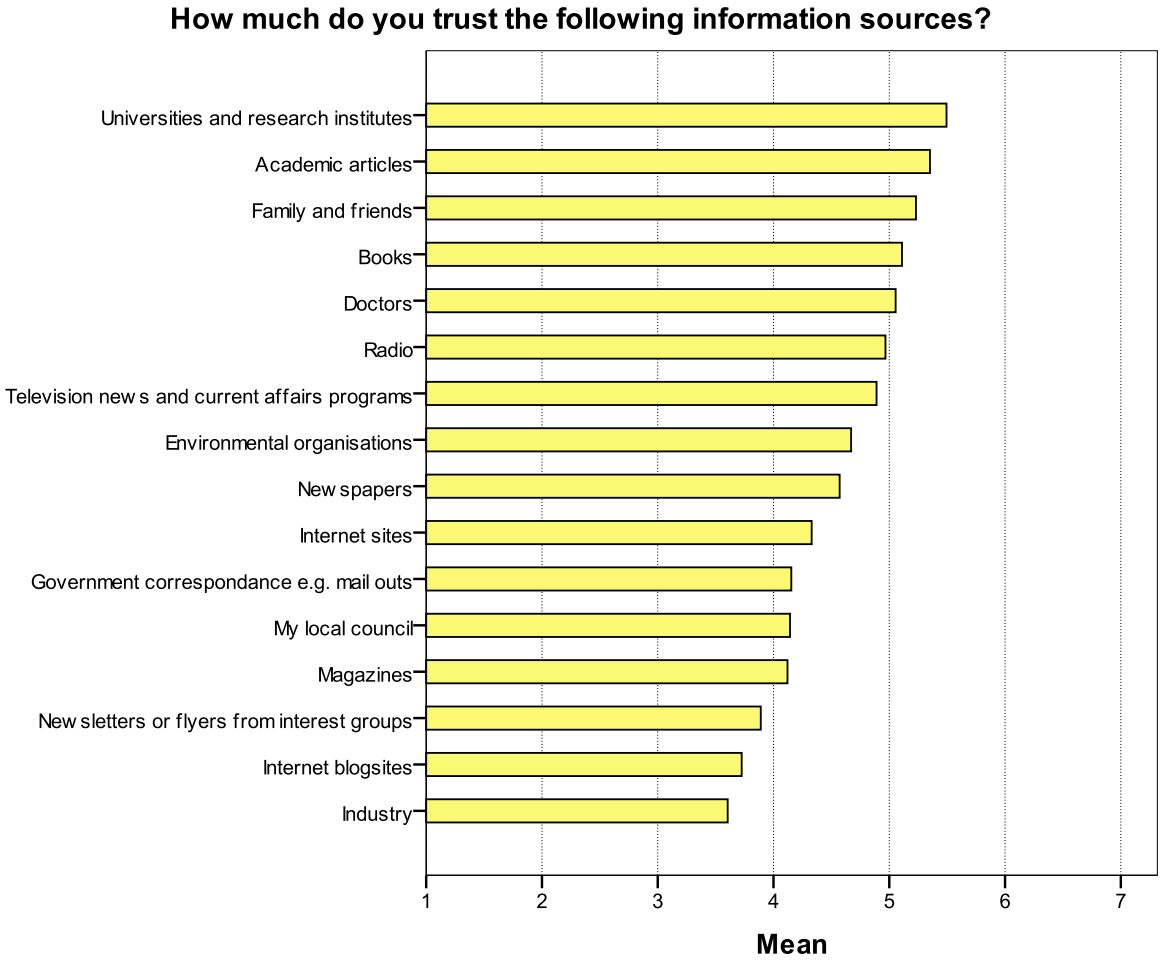
8. Communication

This section presents participant perceptions of trust in sources of climate change information as answered in the pre-workshop questionnaire.

8.1 Trust in information sources

Participants expressed varying levels of trust in sixteen nominated sources of information when asked at the beginning of the workshop (Figure 8.1). Highest trust was accorded to research institutes and academic articles, closely followed by family and friends. Industry and internet blogsites were the least trusted information sources.

Figure 8.1: Trust in information sources (trust measured as (1) strongly distrust, (4) unsure, (7) strongly trust)



9. Key issues arising from discussions

During the group discussions participants had the chance to discuss in more depth the issues arising from the presentations. In this chapter, we extract the key issues and concerns that arose from these group discussions.

9.1 Climate change

Most participants agreed that climate change was happening, however there were mixed opinions as to the role of humans in causing it. While most participants concurred that we need to address the problem, others expressed concern that carbon reduction would have no impact on climatic change.

> *"I'm not sceptical it's an issue. I'm sceptical that humans are causing it as bad as it is, and whether it is a natural cycle."*

> *"I agree that it is happening. The disagreement is the contribution that man is making to all of this."*

> *"The question is, if we got down to the levels of carbon emissions that are so desired, would the weather change, not immediately but over a period of time. I'm not sure it would. Not a vast amount."*

9.2 Energy technologies

Participants showed a preference for renewable technologies over fossil fuel based technologies, while CCS and nuclear both invoked mixed reactions. The positivity around renewables was also tempered by realism surrounding the practicalities of increasing renewable generating capacity. This led some participants to consider the potential role and value of CCS.

> *"It's [renewables] the only way forward. There is no other solution."*

> *"Tides are constant, and once they crack it [tidal power technology] that's a constant energy."*

> *"Renewable energy, yes, might upset people from an aesthetic point of view, but on the main issue, CO_2, it cuts that right out. I'd rather see a load of turbines about the place than have a nuclear power plant that could do a Fukushima on me at any moment."*

> *"Every second day you hear about wind farms being knocked back. It's a good energy source but can it be delivered in the timescales that we need it?"*

> *"A solar unit on your roof costs £15-17 000 a unit, you get a return on your investment, but how many people can afford to do that?"*

> *"If you can still use fossil fuels which we are going to have to use, and you take the carbon away from that then it [CCS] is a good short term fix."*

9.3 Costs and Benefits

The issue of who would pay for, and who would benefit from, new energy technologies, both renewables and CCS, was of utmost importance to participants when considering their support for any given technology.

Participants in virtually all groups spoke at length about the increasing costs of energy, and broadly agreed that the transition to low-carbon energy would incur additional costs. However, there was disagreement on who should pay for these costs. Participants were largely opposed to paying more for their electricity due to the perception that energy companies were already making healthy profits and even profiting from 'green technology'. Numerous participants expressed discontent about a perceived mismatch between increases in their energy bills on one hand, and soaring profits of utility companies on the other.

> *"See the price of oil? Oil fluctuates, it can go up the way, down the way. But it never fluctuates, the price at the pump never fluctuates down the way. How come the price stays?"*
>
> *"If CCS is done at power stations, those power stations are owned by utility companies, so they'll have to pay for it, which means in turn we'll have to pay for it."*
>
> *"When British Gas and Scottish Power announce their profit margins for each quarter they're phenomenal sums of cash. Profitable… or to the benefit of Scotland is yet to be seen. Whenever these companies get asked they say that the money is being pumped back into renewables energy. Personally I haven't seen anything that can be said to be of benefit to Scotland…. There are no clear approaches on what they are doing with the money aside from punting it straight back to shareholders."*
>
> *"They're saying everyone'll get a new boiler because it'll no be as bad for the environment. See right now, I'm in a house with a boiler that's maybe twenty years old, still going okay, but you're giving me what four hundred pound for the scrappage scheme, but you see what you've got to pay for it, it's just a money-making racket for these companies. And you see the statistics now, you'd be lucky if half of these boilers last eight or nine years."*
>
> *"I think the companies and the government have to take responsibility, and they have to put their money... because the consumer can't just keep… you pay your council tax, what are you paying your council tax for? And then the gas prices go up twenty percent across the board. We're getting done and done. You get a price raise, or a council tax raise, fair enough, but where's that money actually physically going? We don't know, and we don't get told."*

For most participants, adoption of a new technology was perceived as beneficial if it provided jobs and brought inward investment; there was less appetite if the main outcome was to boost corporate profits. There was some support for the idea that CCS could bring jobs to Scotland and possibly even be the basis of a new export industry, though also considerable scepticism on this issue. There was also the perception that Scotland might fare better in this regard via development of renewables, and several participants expressed confidence in Scotland's lead on renewable technologies such as wind, wave and tidal power.

> *"How many jobs do these things produce? We do need work for people. It's important to create things that create employment, because people need to work. We shouldn't object to carbon capture if it creates jobs."*
>
> *"Who are these people who will get these jobs? They are highly skilled jobs. Will it be people on the dole the now?"*

"We're creating this innovative technology for wave and CCS. We could export the technology to other countries, which creates jobs."

"We should probably be looking at environmental and economic… as well as at also how many jobs we can create to develop society as a whole. Possibly putting them [CCS projects] in slightly more deprived areas to create a hub. We can build societies around that. Bring slightly more depressed areas up to the rest of Scotland's level in terms of employment and social mobility."

9.4 Responsibility

There was a lot of discussion around who was responsible for addressing climate change. Some people wanted individuals to do more, while others wanted government to show greater initiative. There was also debate about which countries should be doing more, specifically developed or developing countries.

"I recycle every week as much as I can. My neighbours don't, so I think why the hell should I keep doing this?"

"Personal recycling, the bit we can do, is not going to make a big difference. The big difference is going to have to come from industry and governments."

*"We can't just sort Scotland out. Because as was illustrated, if China carries on, and Brazil carries on, it's just a drop in the ocean, and we're all f****d anyway."*

"The poorest countries have the lowest per capita emissions because they don't have electricity. They're emitting so little. The focus is on the richest countries, with the most money, and the most educated people choosing to do nothing about it. So to focus on poorer countries and say they are part of the problem is a bit cheeky."

"If we keep helping everybody, Scotland is going to end up a third world country."

"I'm from Africa and I see a tremendous amount of developed world coming in and taking resources out of Africa and not returning them."

"Russia can put up thousands of wind turbines and nobody would ever see them because there is so few people compared to the land mass."

9.5 Consumption

Patterns of consumption ran through participants' discussions of low energy technologies. Participants recognised that their consumption patterns were often unsustainable and would need to change. A number of participants talked about excessive consumption of consumer goods in contemporary society, making links in particular to the energy required to produce consumer goods and also the waste problems caused by 'disposable' goods with a short life cycle such as computers and mobile phones.

"Things like iPhones which are essentially disposable, because when the battery runs out that's it, you cannae change it. Because I found that out with my son about five years ago, he got an iPod Nano and he said 'it's no charging, can you change the battery?' And I was like 'there's no battery, it just goes in the bin, buy a new one', and that's what all these things are like."

"You see the spike since the 70s of the fossil fuels, and it seems to coincide exactly with this spike in consumerist greed, I think the government doesn't address that at all, like advertising run rampant and telling people they need this, that and the other, I think there needs to be some attempt at curbing this."

"The thing that worries me is all these species that face extinction because of everybody that buys all this stuff, I think we're pushing the climate that way."

9.6 Trust

Two types of trust can be distinguished: trust 'in' someone else, an organisation or in a process (e.g. regarding their honesty, integrity or impartiality) and trust 'to do' (e.g. with respect to their operational capabilities). During the discussions there was ample evidence of a lack of trust in 'experts' or energy information providers. In many cases, the lack of trust arises from the perception that commercial self-interest is causing bias in the information provided. This suspicion also appears to influence people's willingness to pay for low carbon energy technologies. For example:

"CCS is very technical, but I thought it was real interesting. It kinda highlights the mistrust of industry. All it is, is CO_2 that we're storing, it's not like radiation. There is such a stigma on oil companies."

"We need more impartial information. There is a lot of information out there but it's all quite biased. Its coming from the wind farm [developers], 'Oh, and did you know wind turbines is the best kind of energy', but that is coming from a business which profits from that."

"I'm willing to pay a little bit more on my electricity bill to help improve matters. But you see electricity companies making huge profits and you are just wondering where you money is going."

"The chances are the costs'll filter down to Joe public".

"Can we be reassured it's [CCS] not just for economic growth?"

While distrust of government was not generally pronounced, there were some participants who did express distrust at the ability of government to get the job done properly:

"But we do have a bit of reputation for screwing these sorts of things up. We're probably going to screw this one up as well".

"I've got little faith in governments to fix it. Deforestation is very important and affects the climate, but we don't stop it, we still let people do it."

A more frequently expressed view, however, was one of satisfaction and even pride in the performance of the government and companies in implementing renewables.

"People seem quite suspicious about anything that comes from government about renewable energy and the environment ….. Some of the stuff that has come out of this [workshop] has been really positive, about wind power and how they want Scotland to be a forerunner of this in the world."

Trust, or lack of, in 'experts' was also clearly demonstrated during the day. Some participants did not trust climate scientists:

> *"We're not having as big an impact as they [experts] make out."*
>
> *"What you hear and what you get are two different things. Like predicted and observed weather. They don't know what they're talking about. They say hotter summers and they're freezing."*

While others were more supportive:

> *"I think they do though [know what they are talking about]. This is their livelihood. People do nothing but spend hours studying this, hours in the Arctic digging up ice from thousands of years ago."*

Issues of trust and distrust towards experts on CCS also frequently arose:

> *"I suppose a lot of it is, do you trust geologists? Geologists are good enough to find these oil fields and suchlike in the first place, they've got the technology to do that, they've got the technology to advise the companies on how to get it out, I reckon I could trust them to put this stuff in again. These deposits have been down there for countless, millions of years. I can't see any reason why we can't put this stuff back to where it came from."*
>
> *"I think they're good enough for their jobs and they know that the worst-case scenario is that the carbon that's captured becomes uncaptured. I think that's symptomatic about the whole sort of fear-mongering that goes on in society about these issues. They're geologists, the issue is not safety I'm sure."*
>
> *"They're telling you what they're proposing to do, they're not telling you what they've got in place in case there's a leakage."*
>
> A: *"We tried asking the question … what would be the problem if this did leak, would it affect people's health? But [the expert] never really gave us an answer."*
> B: *"The answer was that it won't leak."*
> A: *"They don't know."*
>
> *"She couldnae answer the second question. If she is an expert in her field she should be able to answer it properly."*
>
> *"They're presuming the effects in 1000 years time … how do they know that? It's all hear say you know."*

9.7 Certainty and Uncertainty

A very common theme throughout the day was that the uncertainties surrounding CCS were large and some way from being resolved. There was general anxiety regarding the extent of uncertainty and the 'fledging' state of the CCS technology. Some responded to this uncertainty by arguing that it justified more work on CCS.

> A: "*It's difficult to give an informed opinion without all the information*.
> B: *I agree with that. I'd also like to say that I am pleased that there are people working on the solutions."*

The participants responded differently to the uncertainty that arose, with some using uncertainty to justify their reservations towards CCS, and others tending to accept uncertainty as a 'fact of life'.

> "*Seems like a lot of conjecture ….and buts, etc."*

> *"Lots of 'ifs' and 'buts', but if it can be done properly, then why not?'*

> "*They do have the scientific models don't they? But we've only just started to use this technology and who knows 1000 years down the line if it turns out their models are wrong?"*

> *"There are too many uncertain questions for me to make a decision. I'm leaning towards 'no' because there are so many questions that an expert in the field was unable to answer. There's probably not enough known about this."*

Another response to uncertainty appeared to be a request for better and more simply and clearly communicated information.

> *"Education and transparency are key and the fact that none of us knew about it [CCS] before we walked into the room seems a bit strange …. And it does have this massive potential."*

9.8 Emotion

Emotions came into many participants' discussions, and gave an insight into what in particular it was about certain technologies or outcomes that most concerned them. Emotions were not only used to justify action to reduce carbon emissions, but also as a way of conveying scepticism or cynicism. Although emotive judgments were made on many aspects covered in the process, it is worth taking seriously the role that emotions themselves play in discussion.

One of the key areas in which emotions bubbled to the surface was in imagining future scenarios. Some participants expressed more hopeful feelings that energy and emissions targets could be met, with others also expressing pride and satisfaction that Scotland itself was projected to be able to meet those targets. On the other hand, others expressed despair or fear at what the future would hold.

> *"We were happy that the government, the Scottish government had said they were going to get x amount in renewables by 2020, and I thought, we thought that was a positive thing. It looked like we were actually going to make it, which I've never thought before, and if we do make it I'll be happy because we're not pumping out CO_2s into the atmosphere."*

"Would they rather be looking out onto ice-capped mountains when it's all mucked up so much that we have no, you know that global warming has had so much effect on the country that its knackered anyway, or would you rather have a couple of turbines up on the hill?"

Emotions also seemed to play a role in galvanising people's convictions for not taking immediate action to mitigate climate change. Feelings of dissatisfaction or outright rage were expressed not only to energy companies, but also to over-zealous campaigners.

*"To be honest, do most people give a s**t about where it actually comes from? It's the cost of it, and it's like, it's not so much how we've got to pay out every month, it's how much profit they're getting at the end of it, so we're like why should we have to pay one hundred, two hundred pounds every month, when they're getting millions every month, that's what p***es most people off."*

"I hate when people are like trying to promote like a good cause, and they're like we're right, you're evil for using energy, I hate when they, because at least at uni there are always people with banners and leaflets saying you're evil."

"So many people who are pro, pro, pro climate change and things like that, who drink their own bath water and, blah, blah, blah, they're just, you're just like they're so completely nuts, they're just, if someone was talking like that I'd be like gosh you're just Green Party crazy and I don't want to listen to you, a lot of people turn off."

9.9 Analogues

In discussions over CCS in particular, participants often made analogies to other energy technologies to find a sort of 'anchor' for their developing viewpoints. Participants often did this in order to illustrate what they saw as technological risks of CCS; to imagine what some of the aesthetic effects of carbon storage could be; and to contextualise financial or managerial issues that may arise.

As far as technological risks go, the most commonly raised analogues were the Fukushima nuclear event in Japan and the recent 'fracking' episodes in the United States – both of which pertain to the risks associated with seismic activity. Concerns centred around the seismic effects of putting carbon *in* to the ground, and around the perceived danger of seismic effects causing carbon to come back *out* of the ground. Although many participants freely admitted to having very little knowledge of CCS, they made reference to these other technologies to illustrate what they thought could go wrong.

"I'm an idiot, what's this going to do to tectonic plates? And is it really going to stay there? And what are the knock-on effects that we haven't heard of, because like fracking is a big thing in the States, okay initially it was safe but now they're starting to realise, you know."

With regard to the aesthetic effects and potential objections to uncertain technologies, wind farms were almost exclusively used as the analogues. Indeed, participants used their own embodied experience of wind farms to show what they saw as the disparities that can occur between perception and reality, and also to demonstrate the ways in which energy issues are getting 'closer to home'.

"I think they're perceived negative aspects as well, because like not everybody thinks they're horrible, I've camped quite close to a wind farm and there was no noise at all, we were pretty close!"

"We were talking about where wind farms will be located. There will become a point where they will be more and more required, there will come a point where these things will end up being in your back garden. We're all saying yes just now because we're in the central belt, we're all quite happy just now, but soon there will be a lot of people's going to be affected by it."

Finally, analogues were also used to illustrate participants' points more broadly about behaviour change and decarbonisation. Participants tended to use familiar domestic processes to represent some of the behaviour change and technological challenges that they saw as lying ahead in terms of the costs of decarbonisation and the incentives on offer.

"What's going to make us actually make a change. You know, if someone's building a house, do they get penalised? Do they get incentives? Who's making it happen?"

"It's a huge paradigm shift, in the sense that 20-30 years ago smoking was acceptable and now it is unacceptable, and we're going to have to do that with energy."

"Imagine that if they came out and said you can't eat meat. I think that 5-a-day is enough already, I think it's arbitrary enough. They just plucked 5-a-day, and now everybody knows 5-a-day and you'll be fit. To me that's just ludicrous."

"Years ago they started telling us to start eating healthily, blah blah blah, start taking your 5-a-day, this that and the next thing you've got to eat more healthily. Now they're telling us that we're living too long."

"When you're at the forefront of technology, if you buy the latest iPhone or the latest TV, you'll pay through the nose for it, and I think it's the same with any technology. Like this wave machine like this Edinburgh company's developed, it's been up in Orkney for the last ten years, I'm sure there's been millions poured into it."

9.10 The process

Feedback from participants at the end of the workshop was generally very positive. Most participants felt that they had learned a lot about climate change and energy technologies and found the workshop to be a worthwhile experience.

However, there was some scepticism as to the purpose of the workshop. Some participants were not sure why they had been invited to the workshop as they felt that their opinions were of no importance. While others worried that the process was skewed in favour of CCS.

"My opinion on this I think is kind of worthless, the man on the street's opinion on climate change. I know that governments want the man on the street's opinion, but I don't now how worthwhile the man on the street's opinion is on climate change. We can say our opinion, but then somebody who actually knows about the issue could just come down and say that 'this is what it is' and we would have to say 'you know your stuff'."

"For anything that you're gonna change you first of all have to know where you are at the moment. So that would be why they want to know our opinions, even though they are uninformed in some cases."

"Maybe they think we know stuff we don't."

"We are quite sceptical about the whole thing (this workshop), they are spending a lot of money on us being here and maybe they should have put that into actual renewable energy research."

"This [day] has been incredibly biased towards CCS. If they are trying to find out our general views on climate change and control of emissions, it needs to be a more well balanced ..... who is actually creating this bias? ... I've got a problem with the government using information from a company that has a vested interest in it ...."

"Why the emphasis on CCS technology? Is this part of a precursor to the re-emergence of coal-fired power stations in Scotland?"

"I think it'd have been good if we'd been given a talk on nuclear as well as then we'd be able to make an informed choice".

10. Key messages from the process

At the end of the workshop table facilitators summarised key messages, which represented the voice and opinions of the participants at each table. These were the issues that arose as part of the small group deliberative process and were subsequently compiled and distilled into key outcomes by the lead facilitator. These key outcomes were presented to the workshop group as a whole and participants were collectively satisfied that these were representative of the key messages of their group as a whole. The following outlines the key messages that emerged from this process:

Renewables

- Generally very positive views
- Scotland can lead the way
- On shore wind cheaper than expected
- Renewables providing more energy than expected
- But – intermittency / back up
- Who is going to pay?

Intermittency / back up

- CCS v Nuclear
- Don't feel we know enough about either
- CCS: Lack of trust in companies & scientists
- Who's behind CCS? Who benefits?

CCS

- Spectrum of views
  - OK as part of energy mix
  - Negative
- We don't understand the science
- Risks not clear (and on capture side)
- Reinforces high energy lifestyles
- Who is going to pay?

Other concerns

- Personal / moral responsibility
- Saving energy
- Corporate / government responsibility
  - Penalties and incentives
  - Better communication / promotion / education
- Scotland v the world
- Jobs – long-term prospects?

11. Conclusions

The large group process workshop was the first of its kind in the UK. The workshop involved 99 members of the Edinburgh and Lothian region's population in a full day discussion of climate change and energy technologies. The workshop provided a wealth of data that is very illuminating of the views of the general public on these topics.

While most participants recognised that climate change was happening, some participants believed that it was naturally occurring rather than being an anthropogenic phenomenon. There was also some scepticism that decarbonisation would lead to a reduction in climatic changes. This lack of belief and understanding of the impact of anthropogenic carbon dioxide emissions on the climate, potentially presents a difficulty for those advocating CCS. The lack of understanding can possibly be mitigated by improved communication of climate science, however, recognising that some people are unlikely to accept the anthropogenic climate change narrative, other rationales for renewables and low carbon technologies like CCS need to be articulated. These rationales could touch on areas like energy security, enhanced oil recovery and economic stimulation. It cannot be assumed that a single rationale driven by scientific consensus will succeed in influencing stated public opinions and behaviours, at least not universally across all sections of the public.

There was a lot of discussion during the workshop about who was responsible, both for causing and for mitigating climate change. Some participants felt that individuals were responsible, while others believed that the responsibility lay with governments and industry. There was also debate about whether developed or developing countries were most responsible. For example, some participants thought that the increasing use of carbon-intensive energy technologies in other parts of the world was more than off-setting any carbon reduction in Scotland, though others argued that it was right that Scotland was 'leading the way'.

These differing conceptions of responsibility influence people's support for energy technologies. It would seem to be important to discuss the issue of responsibility with the public more fully, as the belief that others are responsible could be a barrier to public support. In addition, it may be necessary to develop new ways of engendering a sense of shared responsibility or to find ways of working around these different ideas of responsibility. It is also important to take into account peoples' sense of 'agency' – that is their capability to act on information. The ability to 'be environmental' is not uniform and the reasons for this heterogeneity need to be better understood if positive change is to occur.

During the workshop, participants were asked to consider their preference for a dozen energy technologies. This is a strength of the methodology, as participants were able to consider the pros and cons of each technology in relation to each other, rather than looking at the technologies in isolation. It also highlights the need to provide balanced information on each technology option. It is clear that when engaging the public on CCS, it is necessary to carefully frame the information within the wider context of the full range of available energy technologies. This is particularly true as the sense that the public are being 'sold' a particular option can easily create resistance towards that option.

The most important factor in determining whether participants supported a technology or not, were the perceived costs (including risks) and benefits of the technology. The costs and benefits could be felt individually, locally, nationally or globally. For most participants the costs and benefits were seen in economic terms, though social and environmental issues were also considered. It is therefore important to give the public sufficient information of each technology to allow them to determine the costs, benefits, risks and opportunities for themselves. It should be noted that the definition and presentation of costs in this area is complex and comparing 'like with like' is fraught with difficulty. Research on improving the

presentation of information on the costs of competing low-carbon technologies is an important area for future work.

Trust was a very important issue for the participants, some of whom expressed deep levels of distrust in energy companies. Suspicion of government, industry, the media and scientists was also expressed during the workshop by some participants. It is clear that public support for an energy project or technology is very much linked to the trust that the public has in the organisations and institutions that are developing and promoting it – and sometimes even in individuals such as politicians. Developers therefore need to think very carefully about how they engage the public to ensure that they can build up levels of trust and should consider early engagement wherever possible.

The large group process was a very effective way of engaging members of the Scottish public in issues of climate change and energy provision. The workshop was highly successful at providing information, increasing participant knowledge and stimulating debate on the issues. Given the reaction of the participants to CCS, it should be questioned whether the large group process is an effective way of building public support for CCS. In future work there needs to be a focus on how to present all possible options in realistic and accurate terms, including presenting uncertain information on costs, benefits and risks, possibly through use of different future scenarios that help to provide a clear context for considering all the options.

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Appendix A - Pre-workshop, Process, and Post- workshop questionnaires

PRE-WORKSHOP QUESTIONNAIRE

This questionnaire will assess some of your perspectives toward climate change and energy. The responses you provide form part of a larger research project into the Scottish public's perspectives on these issues. This questionnaire should take approximately 20 minutes of your time.

Your participation is greatly appreciated.

SECTION 1: IDENTITY CODE

To help us analyse your responses, we need to be able to link your responses to other questionnaires you may complete for us later on. To do this, while keeping your responses anonymous, we will ask you to form an anonymous identity code and record your table number.

Please form an identity code by following these instructions: In the space below list the ***first two letters of your mother's or guardian's first name*** (e.g. Mary becomes MA) ***followed by the date and month of your birthday*** (e.g. if you were born on the 2nd April you would write 0204). So this example ID Code becomes **MA0204.**

PLEASE PRINT YOUR ID CODE HERE: ____ ____ ____ ____ ____ ____

PLEASE PRINT YOUR TABLE NUMBER HERE: ____

SECTION 2: BELIEFS & VALUES

This section is designed to measure the beliefs and values you hold in relation to the environment and society.

QUESTION 1: BELIEFS ABOUT THE ENVIRONMENT

Listed below are statements about the relationship between humans and the environment. For each one, please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you agree or disagree with the following statements?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
We are approaching the limit of the number of people the earth can support	1	2	3	4	5	6	7
Humans have the right to modify the natural environment to suit their needs	1	2	3	4	5	6	7
When humans interfere with nature it often produces disastrous consequences	1	2	3	4	5	6	7
Human ingenuity will make sure that we do NOT make the earth unliveable	1	2	3	4	5	6	7
Humans are severely abusing the environment	1	2	3	4	5	6	7
The earth has plenty of natural resources if we just learn how to develop them	1	2	3	4	5	6	7
Plants and animals have as much right as humans to exist	1	2	3	4	5	6	7
The balance of nature is strong enough to cope with the impacts of modern industrial nations	1	2	3	4	5	6	7
Despite all our special abilities humans are still subject to the laws of nature	1	2	3	4	5	6	7
The so-called "ecological crisis" facing humankind has been greatly exaggerated	1	2	3	4	5	6	7
The earth is like a spaceship with very limited room and resources	1	2	3	4	5	6	7
Humans were meant to rule over the rest of nature	1	2	3	4	5	6	7
The balance of nature is very delicate and easily upset	1	2	3	4	5	6	7
Humans will eventually learn enough about how nature works to be able to control it	1	2	3	4	5	6	7
If things continue on their present course, we will soon experience a major ecological catastrophe	1	2	3	4	5	6	7

QUESTION 2: ENVIRONMENTAL POSITION

How strongly do you agree or disagree with the following statements?	**Strongly disagree**			**Unsure**			**Strongly agree**
I think of myself as an environmentally-conscious person	1	2	3	4	5	6	7
I am the type of person who engages in environmentally-friendly behaviours	1	2	3	4	5	6	7

QUESTION 3: ENVIRONMENTAL GROUP MEMBERSHIP

The following questions relate to membership in environmental groups

Are you currently a member of an environmental group, either as a voluntary member or as a financially-subscribed member?	YES	NO (please go to Question 4)
How many environmental groups do you belong to? _____		
Please write the names of the environmental groups you belong to: _____		

SECTION 3: AWARENESS & KNOWLEDGE

This section is designed to measure your awareness and knowledge of climate change, energy sources and related technologies, and other related issues.

QUESTION 4: AWARENESS OF CLIMATE CHANGE AND RELATED ISSUES

Please *circle "yes" or "no"* to indicate whether you are aware of the following topics:		
Climate change	YES	NO
Greenhouse gas emissions	YES	NO
Government initiatives to reduce greenhouse gas emissions	YES	NO
Electricity conservation in the home	YES	NO
Industry initiatives to reduce greenhouse gas emissions	YES	NO
Electricity conservation in the workplace	YES	NO
The relationship between the price of electricity and greenhouse gas emissions	YES	NO

QUESTION 5: AWARENESS OF ENERGY SOURCES AND RELATED TECHNOLOGIES

Please *circle "yes" or "no"* to indicate whether you are aware of the following energy sources/technologies:		
Wind	YES	NO
Carbon Capture and Storage (CCS)	YES	NO
Nuclear	YES	NO
Hydro-electric	YES	NO
Coal fired (traditional/current methods)	YES	NO
Natural Gas	YES	NO
Geothermal (hot rocks)	YES	NO
Solar	YES	NO
Biofuels	YES	NO
Oil	YES	NO
Wave/tidal	YES	NO
Coal seam gas	YES	NO

QUESTION 6: KNOWLEDGE OF CLIMATE CHANGE AND RELATED ISSUES

Please complete the following by ***circling*** the number that most closely matches your knowledge of the following topics.

How would you rate your knowledge of the following?	**No knowledge**			**Moderate knowledge**			**High knowledge**
Climate change	1	2	3	4	5	6	7
Greenhouse gas emissions	1	2	3	4	5	6	7
Government initiatives to reduce greenhouse gas emissions	1	2	3	4	5	6	7
Electricity conservation in the home	1	2	3	4	5	6	7
Industry initiatives to reduce greenhouse gas emissions	1	2	3	4	5	6	7
Electricity conservation in the workplace	1	2	3	4	5	6	7
The relationship between the price of electricity and greenhouse gas emissions	1	2	3	4	5	6	7

QUESTION 7: KNOWLEDGE OF ENERGY SOURCES AND RELATED TECHNOLOGIES

Please complete the following by ***circling*** the number that most closely matches your knowledge of the following topics.

How would you rate your knowledge of the following energy sources/technologies?	**No knowledge**			**Moderate knowledge**			**High knowledge**
Wind	1	2	3	4	5	6	7
Carbon Capture and Storage (CCS)	1	2	3	4	5	6	7
Nuclear	1	2	3	4	5	6	7
Hydro-electric	1	2	3	4	5	6	7
Coal (traditional/current)	1	2	3	4	5	6	7
Natural Gas	1	2	3	4	5	6	7
Geothermal (hot rocks)	1	2	3	4	5	6	7
Solar	1	2	3	4	5	6	7
Biofuels	1	2	3	4	5	6	7
Oil	1	2	3	4	5	6	7
Wave/tidal	1	2	3	4	5	6	7
Coal seam gas	1	2	3	4	5	6	7

QUESTION 8: KNOWLEDGE OF CLIMATE CHANGE, ENERGY SOURCES AND RELATED TECHNOLOGIES

Listed below are some statements about energy and the environment. Please indicate whether you think each statement is true or false.

Is each of the following statements true or false?			
Once the infrastructure is in place, carbon capture and storage will reduce emissions from coal-fired power at no additional costs, other than maintenance	True	False	Don't know
Climate change can completely be explained through natural variability in climatic cycles	True	False	Don't know
The greenhouse effect is caused by a hole in the earth's atmosphere	True	False	Don't know
Generating electricity from renewable energy costs less than generating electricity from coal	True	False	Don't know
Embodied energy is the energy used to produce and transport the goods and services we buy	True	False	Don't know
Scotland uses less water per person than any other country in Europe (including industrial, agricultural, and domestic water use)	True	False	Don't know
About half of Scotland's carbon emissions come from electricity generation	True	False	Don't know
Recycling paper, cardboard, metals, and glass saves on materials, but does not help in saving water, energy, or fuel	True	False	Don't know

SECTION 4: ATTITUDES

This section is designed to measure your opinions toward climate change, energy sources and related technologies and other related issues.

QUESTION 9: ATTITUDES TOWARD CLIMATE CHANGE AND RELATED ISSUES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you agree with the following?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Climate change is an important issue for Scotland	1	2	3	4	5	6	7
The production of electricity is a major contributor to greenhouse gas emissions	1	2	3	4	5	6	7
Industry should be doing more to reduce greenhouse gas emissions	1	2	3	4	5	6	7
People should be doing more to promote electricity conservation in the home	1	2	3	4	5	6	7
Government should be doing more to reduce greenhouse gas emissions	1	2	3	4	5	6	7
People should be doing more to promote electricity conservation in the workplace	1	2	3	4	5	6	7
Increasing the price of electricity to help reduce greenhouse gas emissions	1	2	3	4	5	6	7

QUESTION 10: ATTITUDES TOWARD ENERGY SOURCES AND RELATED TECHNOLOGIES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you agree with the use of the following energy sources/technologies?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Wind	1	2	3	4	5	6	7
Carbon Capture and Storage (CCS)	1	2	3	4	5	6	7
Nuclear	1	2	3	4	5	6	7
Hydro-electric	1	2	3	4	5	6	7
Coal (traditional/current methods)	1	2	3	4	5	6	7
Natural Gas	1	2	3	4	5	6	7
Geothermal (hot rocks)	1	2	3	4	5	6	7
Solar	1	2	3	4	5	6	7
Biofuels	1	2	3	4	5	6	7
Oil	1	2	3	4	5	6	7
Wave/tidal	1	2	3	4	5	6	7
Coal seam gas	1	2	3	4	5	6	7

QUESTION 11: PRIORITY RANKING OF ENERGY SOURCES AND RELATED TECHNOLOGIES

Please ***rank*** the following energy sources and related technologies in the priority **order that you would use to allocate public funds** toward their development and implementation. Your priority order should be written next to the energy sources below, in the order of 1 (one) for the highest priority, through to 12 (twelve) for the lowest priority. Note you should use each number between 1 and 12 only once.

Energy sources and related technologies	**Funding Priority Order**
Wind	
Carbon Capture and Storage (CCS)	
Nuclear	
Hydro-electric	
Coal (traditional/current methods)	
Natural Gas	
Geothermal (hot rocks)	
Solar	
Biofuels	
Oil	
Wave/tidal	
Coal seam gas	

QUESTION 12: IMPORTANT OTHERS

Please indicate whether you think people who are important to you (e.g., family, friends, colleagues) would approve or disapprove of you supporting the use of the following categories of energy sources and related technologies	**Disapprove**		**Neither approve nor disapprove (4)**				**Approve**
If I supported the use of traditional coal-fired or oil-based energy, most people who are important to me would…..	1	2	3	4	5	6	7
If I supported the use of renewable energy (e.g., wind, wave/tidal, solar), most people who are important to me would…	1	2	3	4	5	6	7
If I supported the use of low-emission fossil-fuel based energy (e.g., gas or coal with CCS technology), most people who are important to me would…..	1	2	3	4	5	6	7
If I supported the use of low-emission nuclear energy, most people who are important to me would…..	1	2	3	4	5	6	7

SECTION 5: INTENDED BEHAVIOUR

This section is designed to measure various aspects of your intentions.

QUESTION 13: WILLINGNESS TO PAY MORE FOR ELECTRICITY

Would you be willing to pay more for your household electricity if it reduced greenhouse gas emissions? Please ***tick "no" or "yes"*** to indicate your opinion:

☐ No (Go to Question 14)

☐ Yes (Continue below)

If you answered yes, which of the following best describes how much ***more*** you would be willing to pay for your household electricity if it reduced greenhouse gas emissions? (*Please tick **only one box**.*)

☐ I would pay less than £25 per quarter.
Please specify the amount more per quarter in pounds: £_____

☐ I would pay up to £25 more per quarter (about £2 per week)

☐ I would pay up to £50 more per quarter (about £4 per week)

☐ I would pay up to £75 more per quarter (about £6 per week)

☐ I would pay up to £100 more per quarter (about £8 per week)

☐ I would pay up to £150 more per quarter (about £12 per week)

☐ I would pay more than £151 more per quarter.
Please specify the amount more per quarter in pounds: £_____

SECTION 6: CURRENT BEHAVIOUR

This section is designed to measure various aspects of your current behaviour.

QUESTION 14: BEHAVIOURS

Listed below are some specific behaviours that relate to the environment. Please ***circle "yes" or "no"*** to indicate whether you do each of the following:

Please circle "yes" or "no" for each statement below:	**YES**	**NO**
I recycle my rubbish (e.g. cans, bottles, newspapers)	YES	NO
I consider energy efficiency ratings when purchasing white goods	YES	NO
I use reusable bags when shopping	YES	NO
I have a solar hot water system in my home	YES	NO
I use energy efficient light bulbs	YES	NO
I conserve my use of electricity in the home	YES	NO
I conserve my use of electricity in the workplace	YES	NO

QUESTION 15: GREENPOWER

Please indicate what percentage of lower-emission electricity you subscribe to (e.g., "GreenPower")? (*Please tick **only one box***).

0% - I do not subscribe to GreenPower	**1 - 10%**	**11 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**Don't know**

SECTION 7: INFORMATION ACCESS

This section is designed to identify the information sources you access.

QUESTION 16: TRUST IN INFORMATION SOURCES

Please complete the following by ***circling*** the number that most closely matches how much trust you hold in information or news from the following sources.

How much do you trust the following information sources?	**Distrust a lot**			**Unsure (4)**			**Trust a lot**
Family and friends	1	2	3	4	5	6	7
Internet blogsites	1	2	3	4	5	6	7
Internet sites	1	2	3	4	5	6	7
Television news and current affairs programs	1	2	3	4	5	6	7
Radio	1	2	3	4	5	6	7
Newspapers	1	2	3	4	5	6	7
Magazines	1	2	3	4	5	6	7
Newsletters or flyers from interest groups	1	2	3	4	5	6	7
Environmental organisations	1	2	3	4	5	6	7
Books	1	2	3	4	5	6	7
Academic articles	1	2	3	4	5	6	7
My local council	1	2	3	4	5	6	7
Government correspondence e.g. mail outs	1	2	3	4	5	6	7
Universities and research institutes	1	2	3	4	5	6	7
Doctors	1	2	3	4	5	6	7
Industry	1	2	3	4	5	6	7

SECTION 8: DEMOGRAPHICS

These final questions are designed to help us summarise the types of people who respond to this survey.

QUESTIONS ABOUT YOUR HOUSEHOLD

QUESTION 17: HOUSEHOLD SIZE

How many people (including yourself) live in your household? _____

QUESTION 18: HOUSEHOLD TYPE

Which of the following best describes your household? (Please tick ***one only***.)

- ☐ Group household
- ☐ Single person household
- ☐ One parent with children
- ☐ Couple with no children
- ☐ Couple with children
- ☐ Other family (e.g. extended family household).

QUESTION 19: HOUSEHOLD INCOME

What is your household's total income per year (before tax)? (Please tick ***one only***.)

- ☐ Less than £10 000
- ☐ £10 000 - £19 999
- ☐ £20 000 - £29 999
- ☐ £30 000 - £39 999
- ☐ £40 000 - £49 999
- ☐ £50 000 - £59 999
- ☐ £60 000 - £69 999
- ☐ £70 000 - £79 999
- ☐ £80 000 - £89 999
- ☐ £90 000 - £99 999
- ☐ £100 000 - £124 999
- ☐ £125 000 - £149 999
- ☐ £150 000 - £199 999
- ☐ £200 000 - £249 999
- ☐ £250 000 or more

QUESTION 20: LOCATION

What is the postcode of your home address? _____

QUESTION 21: CURRENT ENERGY USAGE

How much was your last electricity bill? £ _____

How often do you pay your electricity bill? (*Please tick **one only**.)*

- ☐ Monthly
- ☐ Quarterly
- ☐ Half-yearly
- ☐ Annually
- ☐ Other *(please specify* _____ *)*

QUESTIONS ABOUT YOU

QUESTION 22: AGE

What is your age (*in years*)? _____

QUESTION 23: GENDER

What is your gender? (*Please tick **one only**.)*

- ☐ Male
- ☐ Female

QUESTION 24: EDUCATION

What is the highest level of education you have completed? (*Please tick **one only**.*)

- ☐ Primary School
- ☐ Secondary School – no qualifications
- ☐ Secondary School – GCSE/Standard grade
- ☐ Secondary School – AS level/Highers
- ☐ Secondary School – A level/Advanced Highers
- ☐ Trade certificate/apprenticeship
- ☐ Diploma
- ☐ Bachelor/honours degree
- ☐ Postgraduate degree

QUESTION 25: EMPLOYMENT

Which term below best describes you? (*Please tick **one only**.*)

- ☐ Employed full time
- ☐ Employed part time or casual
- ☐ Self employed
- ☐ Unemployed
- ☐ Retired/pension recipient
- ☐ Home duties
- ☐ Full-time student
- ☐ Part-time student

QUESTION 26: OCCUPATION

If you are currently in paid employment, which term below best describes you? (*Please tick **one only**.*)

- ☐ Manager
- ☐ Professional
- ☐ Technician/trade worker
- ☐ Community/personal service worker
- ☐ Clerical/administrative worker
- ☐ Sales worker
- ☐ Machinery operator/driver
- ☐ Labourer
- ☐ Not in paid employment
- ☐ Other (please specify) _____

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY

PROCESS QUESTIONNAIRE

This questionnaire will assess some of your perspectives toward the workshop and the group of people you are working in. The responses you provide form part of a larger research project into the Scottish public's perspectives on these issues and help us to evaluate the effectiveness of the process. This questionnaire should take approximately 10 minutes of your time.

Your participation is greatly appreciated.

SECTION 1: IDENTITY CODE

To help us analyse your responses, we need to be able to link your responses to the questionnaire you completed earlier. To do this, on the earlier questionnaire we asked you to form an anonymous identity code, by listing the ***first two letters of your mother's or guardian's first name*** (e.g. Mary becomes MA) ***followed by the date and month of your birthday*** (e.g. if you were born on the 2nd April you would write 0204). For this example, the ID Code becomes **MA0204**. Below, please write in your own identity code (it should be the same as the code you wrote on the Pre-Workshop Questionnaire).

PLEASE PRINT YOUR ID CODE HERE: ____ ____ ____ ____ ____ ____

PLEASE PRINT YOUR TABLE NUMBER HERE: ____

SECTION 2: DEMOGRAPHICS

To ensure our records are correct we would like you to enter some information about yourself.

QUESTION 1: AGE
What is your age (*in years*)? _____

QUESTION 2: GENDER
What is your gender? (*Please tick **one only**.)*

☐ Male ☐ Female

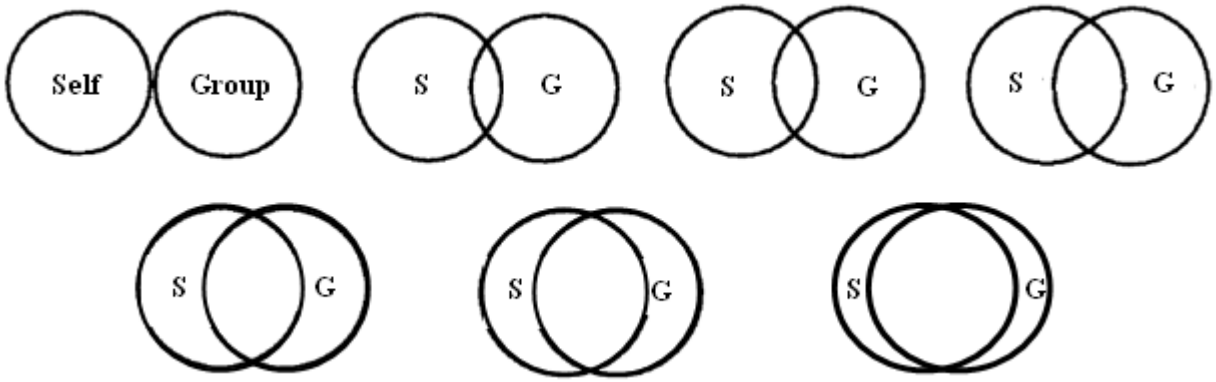
QUESTION 3: LOCATION
What is the postcode of your home address? _____

SECTION 3: PERCEPTIONS OF THE PEOPLE AT YOUR TABLE

This section is designed to measure your perceptions of the group of people at your table.

QUESTION 4: IDENTIFICATION WITH THE GROUP OF PEOPLE AT YOUR TABLE

Please select the pair of circles that you feel best represents how much you identify with the group of people at your table. Please note that S=self and G=group of people at your table.



QUESTION 5: FEELINGS ABOUT THE GROUP OF PEOPLE AT YOUR TABLE

Please respond to the following statements regarding the group of people at your table.

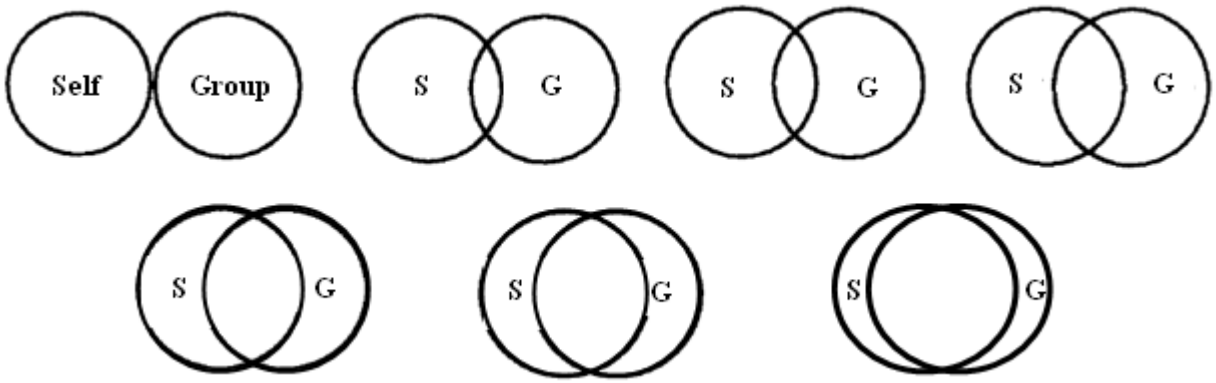
How strongly do you agree with the following?	Strongly Disagree			Unsure (4)			Strongly Agree
I am glad to be part of the group at this table	1	2	3	4	5	6	7
It is pleasant to be in this group at this table	1	2	3	4	5	6	7
Being in this group gives me a good feeling	1	2	3	4	5	6	7
I feel that I belong to this group	1	2	3	4	5	6	7
I am happy to be part of this group	1	2	3	4	5	6	7
I see myself as part of this group	1	2	3	4	5	6	7
I believe I contributed important ideas to group discussions	1	2	3	4	5	6	7
I believe I had a lot of input in group discussions	1	2	3	4	5	6	7
We are a closely knit group	1	2	3	4	5	6	7
Our group works well together	1	2	3	4	5	6	7
This group engaged in effective discussion	1	2	3	4	5	6	7
This group allows for group members to express themselves	1	2	3	4	5	6	7

SECTION 4: PERCEPTIONS OF THE PEOPLE IN THE LARGER WORKSHOP

This section is designed to measure your perceptions of the group of people in the larger workshop.

QUESTION 6: IDENTIFICATION WITH PEOPLE IN THE LARGER WORKSHOP

Please select the pair of circles that you feel best represents how much you identify with the group of people in the larger workshop. Please note that S=self and G=group of people in the larger workshop.



QUESTION 7: FEELINGS ABOUT THE GROUP OF PEOPLE IN THE LARGER WORKSHOP

Please respond to the following statements regarding the group of people in the larger workshop.

How strongly do you agree with the following?	Strongly Disagree			Unsure (4)			Strongly Agree
I am glad to be part of this workshop group	1	2	3	4	5	6	7
It is pleasant to be in this workshop group	1	2	3	4	5	6	7
Being in this workshop group gives me a good feeling	1	2	3	4	5	6	7

SECTION 5: PERCEPTIONS OF THE EXPERTS AND THE WORKSHOP INFORMATION

This section is designed to measure your perceptions of the experts and information provided in the workshop.

QUESTION 8: TRUST IN THE WORKSHOP INFORMATION

	Not at all			Moderate (4)			Very much
To what extent do you trust the information provided in the workshop?	1	2	3	4	5	6	7

QUESTION 9: TRUST IN EXPERT WHO SPOKE ABOUT CLIMATE CHANGE AND ENERGY TECHNOLOGIES (DR ANDY KERR)

Please consider the expert who spoke about climate change and low emission technologies when answering the following:	**Not at all**			**Moderate (4)**			**Very much**
To what extent do you consider this expert to be trustworthy?	1	2	3	4	5	6	7
To what extent do you trust the information provided by this expert?	1	2	3	4	5	6	7
To what extent do you consider this expert to be honest?	1	2	3	4	5	6	7
To what extent do you think that this expert speaks the truth?	1	2	3	4	5	6	7
	Completely disagree			**Neutral (4)**			**Completely agree**
This expert has a lot of knowledge about climate change and low emission technologies	1	2	3	4	5	6	7
This expert was able to demonstrate relevant knowledge	1	2	3	4	5	6	7

QUESTION 10: TRUST IN EXPERT WHO SPOKE ABOUT CARBON CAPTURE AND STORAGE (CCS) (DR MAXINE AKHURST)

Please consider the expert who spoke about carbon capture and storage when answering the following:	**Not at all**			**Moderate (4)**			**Very much**
To what extent do you consider this expert to be trustworthy?	1	2	3	4	5	6	7
To what extent do you trust the information provided by this expert?	1	2	3	4	5	6	7
To what extent do you consider this expert to be honest?	1	2	3	4	5	6	7
To what extent do you think that this expert speaks the truth?	1	2	3	4	5	6	7
	Completely disagree			**Neutral (4)**			**Completely agree**
This expert has a lot of knowledge about Carbon Capture and Storage (CCS)	1	2	3	4	5	6	7
This expert was able to demonstrate relevant knowledge	1	2	3	4	5	6	7

SECTION 6: ATTITUDES

This section is designed to measure your opinions toward climate change, energy sources and related technologies and other related issues.

QUESTION 11: ATTITUDES TOWARD CLIMATE CHANGE AND RELATED ISSUES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you agree with the following?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Climate change is an important issue for Scotland	1	2	3	4	5	6	7
The production of electricity is a major contributor to greenhouse gas emissions	1	2	3	4	5	6	7
Industry should be doing more to reduce greenhouse gas emissions	1	2	3	4	5	6	7
People should be doing more to promote electricity conservation in the home	1	2	3	4	5	6	7
Government should be doing more to reduce greenhouse gas emissions	1	2	3	4	5	6	7
People should be doing more to promote electricity conservation in the workplace	1	2	3	4	5	6	7
Increasing the price of electricity to help reduce greenhouse gas emissions	1	2	3	4	5	6	7

QUESTION 12: ATTITUDES TOWARD ENERGY SOURCES AND RELATED TECHNOLOGIES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you support the use of the following energy sources/technologies?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Wind	1	2	3	4	5	6	7
Carbon Capture and Storage (CCS)	1	2	3	4	5	6	7
Nuclear	1	2	3	4	5	6	7
Hydro-electric	1	2	3	4	5	6	7
Coal (Traditional/current methods)	1	2	3	4	5	6	7
Natural Gas	1	2	3	4	5	6	7
Geothermal (hot rocks)	1	2	3	4	5	6	7
Solar	1	2	3	4	5	6	7
Biofuels	1	2	3	4	5	6	7
Oil	1	2	3	4	5	6	7
Wave/tidal	1	2	3	4	5	6	7
Coal seam gas	1	2	3	4	5	6	7

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY

POST-WORKSHOP QUESTIONNAIRE

This questionnaire will assess some of your perspectives toward climate change and energy. The responses you provide form part of a larger research project into the Scottish public's perspectives on these issues. This questionnaire should take approximately 20 minutes of your time.

Your participation is greatly appreciated.

SECTION 1: IDENTITY CODE

To help us analyse your responses, we need to be able to link your responses to the questionnaire you completed earlier. To do this, on the earlier questionnaire we asked you to form an anonymous identity code, by listing the ***first two letters of your mother's or guardian's first name*** (e.g. Mary becomes MA) ***followed by the date and month of your birthday*** (e.g. if you were born on the 2nd April you would write 0204). For this example, the ID Code becomes **MA0204**. Below, please write in your own identity code (it should be the same as the code you wrote on the Pre-Workshop Questionnaire).

PLEASE PRINT YOUR ID CODE HERE: ____ ____ ____ ____ ____ ____

PLEASE PRINT YOUR TABLE NUMBER HERE: ____

SECTION 2: DEMOGRAPHICS

To ensure our records are correct we would like you to enter some information about yourself.

QUESTION 1: AGE
What is your age (*in years*)? _____

QUESTION 2: GENDER
What is your gender? (*Please tick **one only**.)*

☐ Male ☐ Female

QUESTION 3: LOCATION
What is the postcode of your home address? _____

SECTION 3: KNOWLEDGE

This section is designed to measure your knowledge of climate change, energy sources and related technologies, and other related issues.

QUESTION 4: KNOWLEDGE OF CLIMATE CHANGE AND RELATED ISSUES

Please complete the following by ***circling*** the number that most closely matches your knowledge of the following topics.

How would you rate your knowledge of the following?	No knowledge			Moderate knowledge			High knowledge
Climate change	1	2	3	4	5	6	7
Greenhouse gas emissions	1	2	3	4	5	6	7
Government initiatives to reduce greenhouse gas emissions	1	2	3	4	5	6	7
Electricity conservation in the home	1	2	3	4	5	6	7
Industry initiatives to reduce greenhouse gas emissions	1	2	3	4	5	6	7
Electricity conservation in the workplace	1	2	3	4	5	6	7
The relationship between the price of electricity and greenhouse gas emissions	1	2	3	4	5	6	7

QUESTION 5: KNOWLEDGE OF ENERGY SOURCES AND RELATED TECHNOLOGIES

Please complete the following by ***circling*** the number that most closely matches your knowledge of the following topics.

How would you rate your knowledge of the following?	No knowledge			Moderate knowledge			High knowledge
Wind	1	2	3	4	5	6	7
Carbon Capture and Storage (CCS)	1	2	3	4	5	6	7
Nuclear	1	2	3	4	5	6	7
Hydro-electric	1	2	3	4	5	6	7
Coal (traditional/current methods)	1	2	3	4	5	6	7
Natural Gas	1	2	3	4	5	6	7
Geothermal (hot rocks)	1	2	3	4	5	6	7
Solar	1	2	3	4	5	6	7
Biofuels	1	2	3	4	5	6	7
Oil	1	2	3	4	5	6	7
Wave/tidal	1	2	3	4	5	6	7
Coal seam gas	1	2	3	4	5	6	7

SECTION 4: ATTITUDES

This section is designed to measure your opinions toward climate change, energy sources and related technologies, and other related issues.

QUESTION 6: ATTITUDES TOWARD CLIMATE CHANGE AND RELATED ISSUES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you agree with the following?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Climate change is an important issue for Scotland	1	2	3	4	5	6	7
The production of electricity is a major contributor to greenhouse gas emissions	1	2	3	4	5	6	7
Industry should be doing more to reduce greenhouse gas emissions	1	2	3	4	5	6	7
People should be doing more to promote electricity conservation in the home	1	2	3	4	5	6	7
Government should be doing more to reduce greenhouse gas emissions	1	2	3	4	5	6	7
People should be doing more to promote electricity conservation in the workplace	1	2	3	4	5	6	7
Increasing the price of electricity to help reduce greenhouse gas emissions	1	2	3	4	5	6	7

QUESTION 7: ATTITUDES TOWARD ENERGY SOURCES AND RELATED TECHNOLOGIES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you support the use of the following energy sources/technologies?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Wind	1	2	3	4	5	6	7
Carbon Capture and Storage (CCS)	1	2	3	4	5	6	7
Nuclear	1	2	3	4	5	6	7
Hydro-electric	1	2	3	4	5	6	7
Coal (traditional/current methods)	1	2	3	4	5	6	7
Natural Gas	1	2	3	4	5	6	7
Geothermal (hot rocks)	1	2	3	4	5	6	7
Solar	1	2	3	4	5	6	7
Biofuels	1	2	3	4	5	6	7
Oil	1	2	3	4	5	6	7
Wave/tidal	1	2	3	4	5	6	7
Coal seam gas	1	2	3	4	5	6	7

QUESTION 8: PRIORITY RANKING OF ENERGY SOURCES AND RELATED TECHNOLOGIES

Please ***rank*** the following energy sources and related technologies in the priority **order that you would use to allocate public funds** toward their development and implementation. Your priority order should be written next to the energy sources below. Please follow the order of 1 (one) for the highest priority, through to 12 (twelve) for the lowest priority. Note you should use each number between 1 and 12 only once.

Energy sources and related technologies	**Funding Priority Order**
Wind	
Carbon Capture and Storage (CCS)	
Nuclear	
Hydro-electric	
Coal (traditional/current methods)	
Natural Gas	
Geothermal (hot rocks)	
Solar	
Biofuels	
Oil	
Wave/tidal	
Coal seam gas	

SECTION 5: INTENDED BEHAVIOUR

This section is designed to measure various aspects of your intentions.

QUESTION 9: INTENTION TO CHANGE BEHAVIOUR

Listed below are some specific behaviours that relate to the environment. Please complete the following by ***circling*** the number that most closely matches your opinion.

As a result of this workshop I will:	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Pay extra for 'green' electricity	1	2	3	4	5	6	7
Recycle my rubbish (e.g. cans, bottles, newspapers)	1	2	3	4	5	6	7
Consider energy efficiency ratings when purchasing white goods	1	2	3	4	5	6	7
Use reusable bags when shopping	1	2	3	4	5	6	7
Install a solar hot water system in my home	1	2	3	4	5	6	7
Use energy efficient light bulbs	1	2	3	4	5	6	7
Conserve my use of electricity in the home	1	2	3	4	5	6	7
Conserve my use of electricity in the workplace	1	2	3	4	5	6	7
Continue with my current behaviour as I already practice most of the behaviours above	1	2	3	4	5	6	7

QUESTION 10: WILLINGNESS TO PAY MORE FOR ELECTRICITY

Would you be willing to pay more for your household electricity if it reduced greenhouse gas emissions? Please ***tick "no" or "yes"*** to indicate your opinion:

☐ No (Go to Question 11)

☐ Yes (Continue below)

If you answered yes, which of the following best describes how much ***more*** you would be willing to pay for your household electricity if it reduced greenhouse gas emissions? (*Please tick **only one box**.*)

☐ I would pay less than £25 per quarter.
Please specify the amount more per quarter in pounds: £_____

☐ I would pay up to £25 more per quarter (about £2 per week)

☐ I would pay up to £50 more per quarter (about £4 per week)

☐ I would pay up to £75 more per quarter (about £6 per week)

☐ I would pay up to £100 more per quarter (about £8 per week)

☐ I would pay up to £150 more per quarter (about £12 per week)

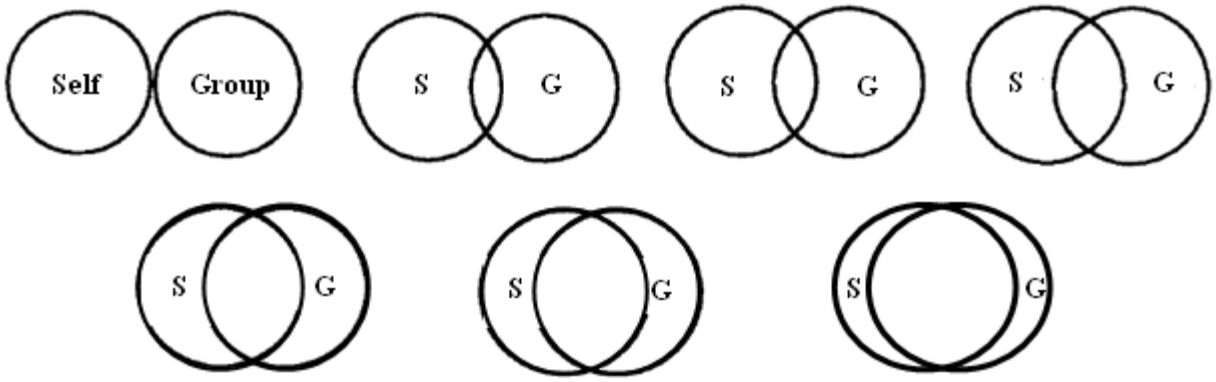
☐ I would pay more than £151 more per quarter.
Please specify the amount more per quarter in pounds: £_____

SECTION 6: PERCEPTIONS OF THE PEOPLE AT YOUR TABLE

This section is designed to measure your perceptions of the group of people at your table.

QUESTION 11: IDENTIFICATION WITH THE GROUP OF PEOPLE AT YOUR TABLE

Please select the pair of circles that you feel best represents how much you identify with the group of people at your table. Please note that S=self and G=group of people at your table.



QUESTION 12: FEELINGS ABOUT THE GROUP OF PEOPLE AT YOUR TABLE

Please respond to the following statements regarding the group of people at your table.

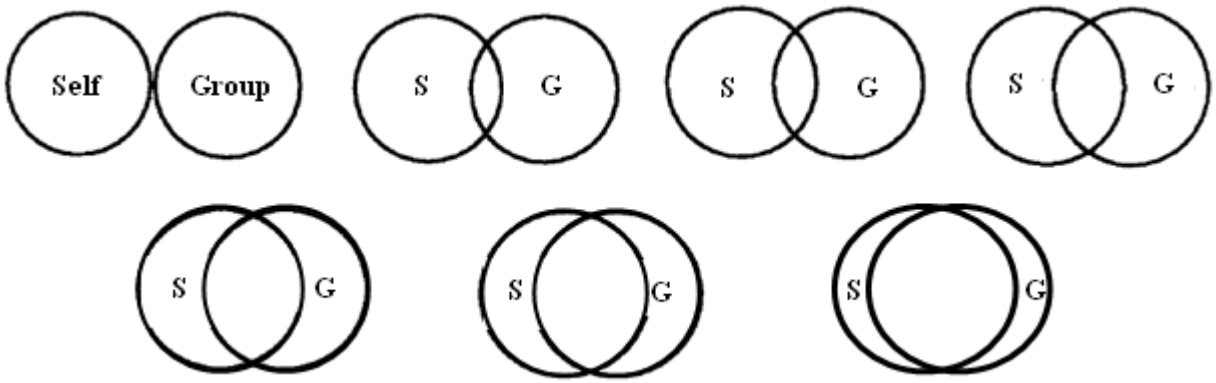
How strongly do you agree with the following?	Strongly Disagree			Unsure (4)			Strongly Agree
I am glad to be part of the group at this table	1	2	3	4	5	6	7
It is pleasant to be in this group at this table	1	2	3	4	5	6	7
Being in this group gives me a good feeling	1	2	3	4	5	6	7
I feel that I belong to this group	1	2	3	4	5	6	7
I am happy to be part of this group	1	2	3	4	5	6	7
I see myself as part of this group	1	2	3	4	5	6	7
I believe I contributed important ideas to group discussions	1	2	3	4	5	6	7
I believe I had a lot of input in group discussions	1	2	3	4	5	6	7
We are a closely knit group	1	2	3	4	5	6	7
Our group works well together	1	2	3	4	5	6	7
This group engaged in effective discussion	1	2	3	4	5	6	7
This group allows for group members to express themselves	1	2	3	4	5	6	7

SECTION 7: PERCEPTIONS OF THE PEOPLE IN THE LARGER WORKSHOP

This section is designed to measure your perceptions of the group of people in the larger workshop.

QUESTION 13: IDENTIFICATION WITH PEOPLE IN THE LARGER WORKSHOP

Please select the pair of circles that you feel best represents how much you identify with the group of people in the larger workshop. Please note that S=self and G=group of people in the larger workshop.



QUESTION 14: FEELINGS ABOUT THE GROUP OF PEOPLE IN THE LARGER WORKSHOP

Please respond to the following statements regarding the group of people in the larger workshop.

How strongly do you agree with the following?	Strongly Disagree			Unsure (4)			Strongly Agree
I am glad to be part of this workshop group	1	2	3	4	5	6	7
It is pleasant to be in this workshop group	1	2	3	4	5	6	7
Being in this workshop group gives me a good feeling	1	2	3	4	5	6	7

SECTION 8: PERCEPTIONS OF THE WORKSHOP INFORMATION

This section is designed to measure your perceptions of the information provided in the workshop.

QUESTION 15: TRUST IN THE WORKSHOP INFORMATION

	Not at all			Moderate (4)			Very much
To what extent do you trust the information provided in the workshop?	1	2	3	4	5	6	7

SECTION 9: WORKSHOP FAIRNESS

This section is designed to measure your perceptions of the workshop.

QUESTION 16: WORKSHOP FAIRNESS

We are interested in how you perceived the workshop process. Please complete the following by ***circling*** the number that most closely matches your opinion.

To what extent:	**Small Extent**			**Moderate Extent (4)**			**Large Extent**
Were you able to express your views and feelings during the workshop?	1	2	3	4	5	6	7
Did you have influence over the outcomes (e.g., summary of key points) of the workshop?	1	2	3	4	5	6	7
Were you able to provide feedback regarding the outcomes arrived at by the workshop?	1	2	3	4	5	6	7
Did the workshop outcomes reflect the effort you put in?	1	2	3	4	5	6	7
Were the workshop outcomes appropriate considering the input you had?	1	2	3	4	5	6	7
Did the workshop outcomes reflect what you contributed?	1	2	3	4	5	6	7
Were you treated in a polite manner?	1	2	3	4	5	6	7
Were you treated with dignity?	1	2	3	4	5	6	7
Were you treated with respect?	1	2	3	4	5	6	7
Was communication in the workshop sincere?	1	2	3	4	5	6	7
Was the workshop process thoroughly explained?	1	2	3	4	5	6	7
Were explanations regarding the workshop process reasonable?	1	2	3	4	5	6	7

SECTION 10: WORKSHOP EVALUATION

The questions in this section are designed to identify your perspectives of the workshop. This assists with the continued advancement of our research processes.

QUESTION 17: WORKSHOP ACTIVITIES

Please complete the following by ***circling*** the number that most closely matches your opinion.

Was your understanding improved through the following?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
The presentations	1	2	3	4	5	6	7
Being able to ask questions	1	2	3	4	5	6	7
The discussions	1	2	3	4	5	6	7
All of the information and activities	1	2	3	4	5	6	7

QUESTION 18: WORKSHOP FEATURES

Please complete the following by ***circling*** the number that most closely matches your opinion.

How strongly do you agree with the following?	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
The venue was suitable	1	2	3	4	5	6	7
I will read the written information provided	1	2	3	4	5	6	7
The workshop was informative	1	2	3	4	5	6	7
The facilitator of the workshop was easy to understand	1	2	3	4	5	6	7
The length of the workshop was appropriate	1	2	3	4	5	6	7
The food provided was excellent	1	2	3	4	5	6	7
The activities were enjoyable	1	2	3	4	5	6	7

QUESTION 19: PURPOSE OF WORKSHOP

Please complete the following by ***ticking*** the box(es) that most closely match your opinions of the purpose of today's workshop.

- ☐ Convince
- ☐ Inform
- ☐ Engage
- ☐ Access my opinions
- ☐ Influence
- ☐ Other purposes (please state)_____
- ☐ Consult

_____

QUESTION 20: FURTHER INFORMATION

Please complete the following by ***circling*** the number that most closely matches your opinion.

As a result of this workshop I will:	**Strongly Disagree**			**Unsure (4)**			**Strongly Agree**
Seek further information on the topic from books	1	2	3	4	5	6	7
Seek further information on the topic from the Internet	1	2	3	4	5	6	7
Talk to my friends about the workshop	1	2	3	4	5	6	7
Talk to my family about the workshop	1	2	3	4	5	6	7
Talk to my work colleagues about the workshop	1	2	3	4	5	6	7
Speak with other people from the workshop about the information provided	1	2	3	4	5	6	7

QUESTION 21: INFORMATION TOPICS

Please complete the following by ***ticking*** the box next to the topic(s) that you would like more information on as a result of this workshop.

- ☐ Climate change
- ☐ Wind energy
- ☐ Solar energy
- ☐ Nuclear energy
- ☐ Natural Gas
- ☐ Wave/tidal energy
- ☐ Coal seam gas
- ☐ Coal (traditional/current methods)
- ☐ Carbon Capture and Storage
- ☐ Geothermal (Hot Rocks)
- ☐ Hydro-electricity
- ☐ Biofuels
- ☐ Other (please state)_____

QUESTION 22: COMMENTS

In the space provided please write any other comments you would like to share with us.

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY

Appendix B - Statistical tables

Table B.1: Environmental beliefs

How strongly do you agree with the following? [1]	Mean	Std. Dev.
We are approaching the limit of the number of people earth can support	4.77	1.70
Humans have the right to modify the natural environment to suit their needs. [2]	4.14	1.55
When humans interfere with nature it often produces disastrous consequences.	5.12	1.67
Human ingenuity will make sure that we do NOT make the earth unliveable. [2]	4.28	1.45
Humans are severely abusing the environment.	5.32	1.51
The earth has plenty of natural resources if we just learn to develop them. [2]	3.21	1.69
Plants and animals have as much right as humans to exit.	6.03	1.41
The balance of nature is strong enough to cope with the impacts of modern industrial nations. [2]	5.09	1.49
Despite all our special abilities humans are still subject to the laws of nature.	5.87	1.40
The so-called ecological crisis facing humankind has been greatly exaggerated. [2]	4.78	1.61
The earth is like a spaceship with very limited room and resources.	4.82	1.52
Humans were meant to rule over the rest of nature. [2]	5.30	1.78
The balance of nature is very delicate and easily upset.	5.37	1.43
Humans will eventually learn enough about how nature works to be able to control it. [2]	4.53	1.64
If things continue on their present course we will soon experience a major ecological catastrophe.	5.01	1.56
Average Environmental beliefs[3]	4.84	0.73

1: Pro-environmental beliefs were measured on a scale of 1-strongly disagree, 4-unsure, to 7-strongly agree.
2: These items are reversed scored.
3: The 15 items were averaged to form a single measure which ranges from 1- anti-environmental beliefs, 4-unsure, to 7-pro-environmental beliefs.

Table B.2: Environmental behaviours

Circled 'yes'	Frequency	Percentage
I recycle my rubbish (e.g. cans, bottles, newspapers)	81	82.7
I consider energy efficiency ratings when purchasing white goods	70	71.4
I use reusable bags when shopping	85	87.6
I have a solar hot water system in my home	2	2.0
I use energy efficient light bulbs	89	90.8
I conserve my use of electricity in the home	89	90.8
I conserve my use of electricity in the workplace	57	60.0

Table B.3: Knowledge of energy and the environment

Is each of the following statements true or false?	Percentage		
	True	False	Don't know
Once the infrastructure is in place, carbon capture and storage will reduce emissions from coal-fired power at no additional costs, other than maintenance	14.7	10.6	74.7
Climate change can completely be explained through natural variability in climatic cycles	12.6	50.6	36.8
The greenhouse effect is caused by a hole in the earth's atmosphere	45.7	34.1	20.2
Generating electricity from renewable energy costs less than generating electricity from coal	33.7	25.2	41.1
Embodied energy is the energy used to produce and transport the goods and services we buy	16.8	1.1	82.1
Scotland uses less water per person than any other country in Europe (including industrial, agricultural, and domestic water use)	13.7	20	66.3
About half of Scotland's carbon emissions come from electricity generation	21.5	7.5	71
Recycling paper, cardboard, metals, and glass saves on materials, but does not help in saving water, energy, or fuel	33.7	31.6	34.7

Table B.4: Mean changes in knowledge of climate change and related issues

How would you rate your knowledge of the following?[1]	Mean	
	Pre-	Post-
Climate change [2]	3.97	5.24
Greenhouse gas emissions [2]	3.57	5.1
Government initiatives to reduce greenhouse gas emissions [2]	3.06	4.36
Electricity conservation in the home [2]	4.49	5.03
Industry initiatives to reduce greenhouse gas emissions [2]	2.84	4.24
Electricity conservation in the workplace [2]	3.44	4.56
The relationship between the price of electricity and greenhouse gas emissions [2]	2.41	4.19

1: Knowledge was measured as (1) no knowledge, (4) moderate knowledge, (7) high knowledge.
2: Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

Table B.5: Mean changes in knowledge of energy sources and related technologies

How would you rate your knowledge of the following? [1]	Mean	
	Pre-	Post-
Wind [2]	4.2	5.43
Carbon Capture and Storage (CCS) [2]	2.13	5.01
Nuclear [2]	3.65	4.49
Hydro-electric [2]	3.71	4.84
Coal (traditional/current methods) [2]	4.16	4.9
Natural Gas [2]	3.87	4.86
Geothermal (hot rocks) [2]	2.19	4.21
Solar [2]	4.2	5.19
Biofuels [2]	3.02	4.36
Oil [2]	4.1	4.79
Wave/tidal [2]	3.51	4.98
Coal seam gas [2]	2.20	3.6

1: Knowledge was measured as (1) no knowledge, (4) moderate knowledge, (7) high knowledge.
2: Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

Table B.6: Mean changes in attitude toward climate change and related issues

How strongly do you agree with the following?[1]	Mean	
	Pre-	Post-
Climate change is an important issue for Scotland [2]	5.94	6.44
The production of electricity is a major contributor to greenhouse gas emissions [2]	4.91	5.94
Industry should be doing more to reduce greenhouse gas emissions [2]	6.04	6.28
People should be doing more to promote electricity conservation in the home	6.01	6.22
Government should be doing more to reduce greenhouse gas emissions [2]	6.05	6.31
People should be doing more to promote electricity conservation in the workplace [2]	5.86	6.12
Increasing the price of electricity to help reduce greenhouse gas emissions[2]	2.87	3.48

1: Attitude was measured as (1) strongly disagree, (4) unsure, (7) strongly agree.
2: Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

Table B.7: Mean changes in attitudes to energy sources and related technologies

How strongly do you agree with the use of the following energy sources/technologies? [1]	Mean	
	Pre-	Post-
Wind [2]	5.81	6.53
Carbon Capture and Storage (CCS) [2]	4.48	4.10
Nuclear	3.72	3.88
Hydro-electric [2]	5.55	6.0
Coal (traditional/current methods)	3.41	3.86
Natural Gas	4.54	4.75
Geothermal (hot rocks) [2]	4.71	5.2
Solar	6.14	6.26
Biofuels [2]	4.57	4.97
Oil [2]	3.53	3.88
Wave/tidal [2]	5.92	6.46
Coal seam gas	3.87	3.99

1: Attitude was measured as (1) strongly disagree, (4) unsure, (7) strongly agree.
2: Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

Table B.8: Changes in priority of the mean preferred energy technology

Funding priority order[1]:	Mean	
	Pre-	Post
Wind[2]	2.89	1.88
Carbon Capture and Storage (CCS) [2]	6.56	8.08
Nuclear	8.01	8.20
Hydro-electric	4.51	4.80
Coal (traditional/current methods)	9.44	9.05
Natural Gas	6.67	6.90
Geothermal (hot rocks) [2]	7.71	6.97
Solar	3.36	3.85
Biofuels	6.81	6.67
Oil	9.10	9.23
Wave/tidal[2]	3.68	2.77
Coal seam gas	9.21	9.59

1: Technologies were ranked from 1-12 with 1 being highest priority and 12 lowest priority.
2: Paired t-test ($p<0.05$) identified differences between responses pre- and post- workshop were significant.

Table B.9: Intended behaviour as a result of the workshop

As a result of this workshop I will: [1]	Mean	Std. Dev.
Pay extra for 'green' electricity	3.71	1.768
Recycle my rubbish (e.g. cans, bottles, newspapers)	6.31	1.034
Consider energy efficiency ratings when purchasing white goods	6.21	0.946
Use reusable bags when shopping	6.36	0.949
Install a solar hot water system in my home	3.61	1.649
Use energy efficient light bulbs	6.3	1.189
Conserve my use of electricity in the home	6.46	0.778
Conserve my use of electricity in the workplace	6.03	1.199
Continue with my current behaviour as I already practice most of the behaviours above	5.49	1.838

1: Intentions measured as (1) strongly disagree, (4) unsure, (7) strongly agree.

Table B.10: Mean trust in information sources

How much do you trust the following information sources? [1]	Mean	Std. Dev.
Family and friends	5.22	1.289
Internet blogsites	3.69	1.459
Internet sites	4.30	1.302
Television news and current affairs programs	4.86	1.331
Radio	4.94	1.206
Newspapers	4.58	1.337
Magazines	4.12	1.348
Newsletters or flyers from interest groups	3.93	1.495
Environmental organisations	4.67	1.434
Books	5.08	1.106
Academic articles	5.32	1.271
My local council	4.15	1.446
Government correspondence e.g. mail outs	4.12	1.348
Universities and research institutes	5.47	1.085
Doctors	5.02	1.225
Industry	3.64	1.590

1: Trust measured as (1) strongly distrust, (4) unsure, (7) strongly trust.

Appendix C - Expert Presentations

Presentation 1

Climate change, energy and low carbon energy technologies - Part 1

Presentation to Large Group Workshop

Dr Andy Kerr
Director, Edinburgh Centre on Climate Change

September 24, 2011

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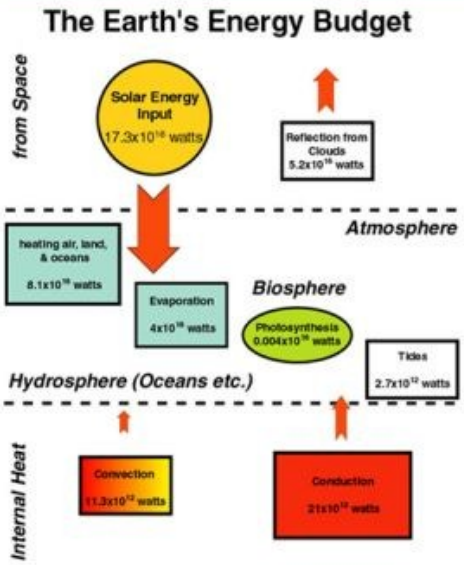
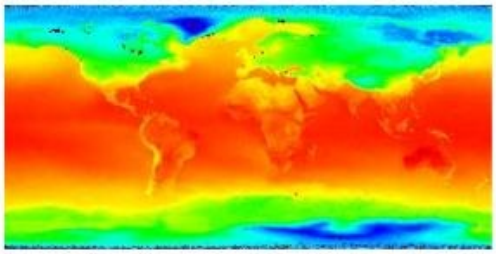
EDINBURGH CENTRE ON CLIMATE CHANGE

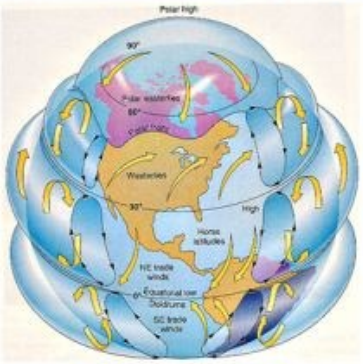
Outline of this presentation

- Climate, climate change and greenhouse gas emissions
- Global energy use and greenhouse gas emissions
- Scottish emissions

What is climate ?

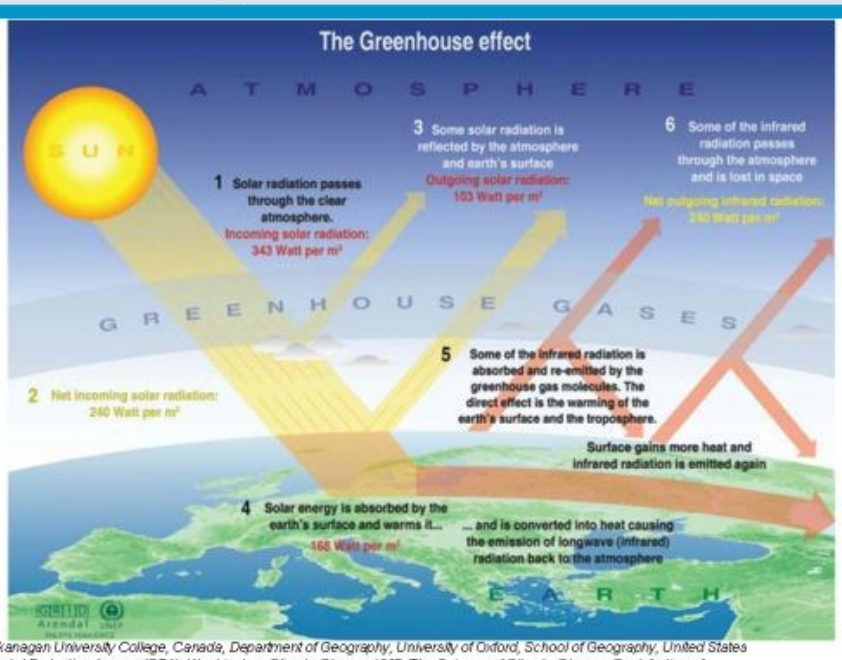






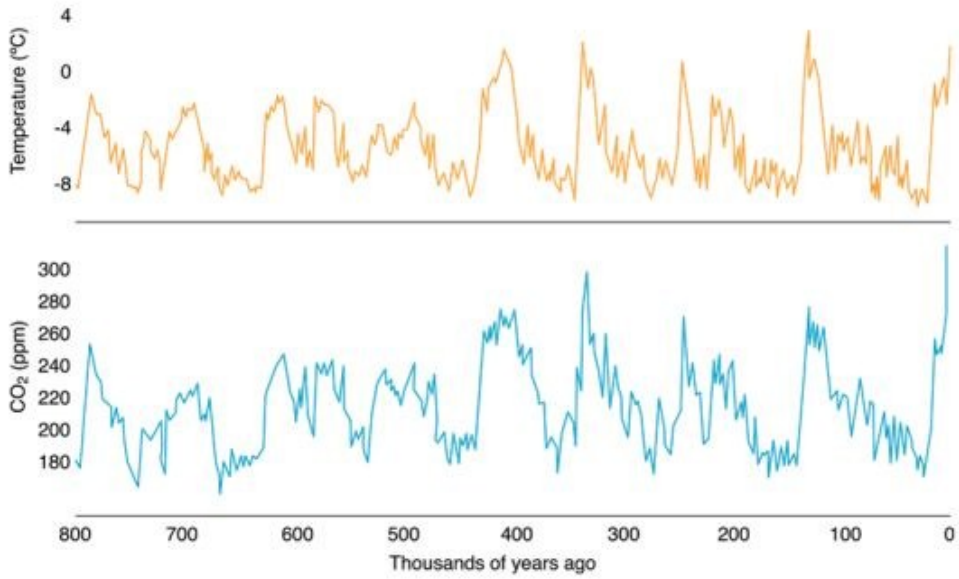
http://www.indiana.edu/~geol105/1425chap4.htm

What is the greenhouse effect?



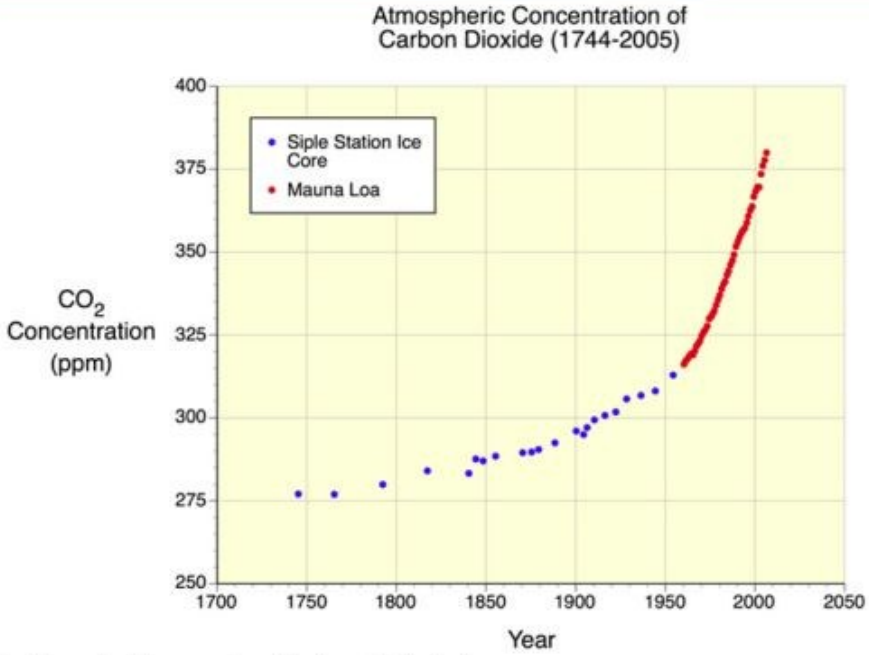
Source: Okanagan University College, Canada, Department of Geography; University of Oxford, School of Geography; United States Environmental Protection Agency (EPA), Washington; Climate Change 1995, The Science of Climate Change, Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), UNEP and WMO (World Meteorological Organization), Cambridge University Press, 1996.

Climate has always changed



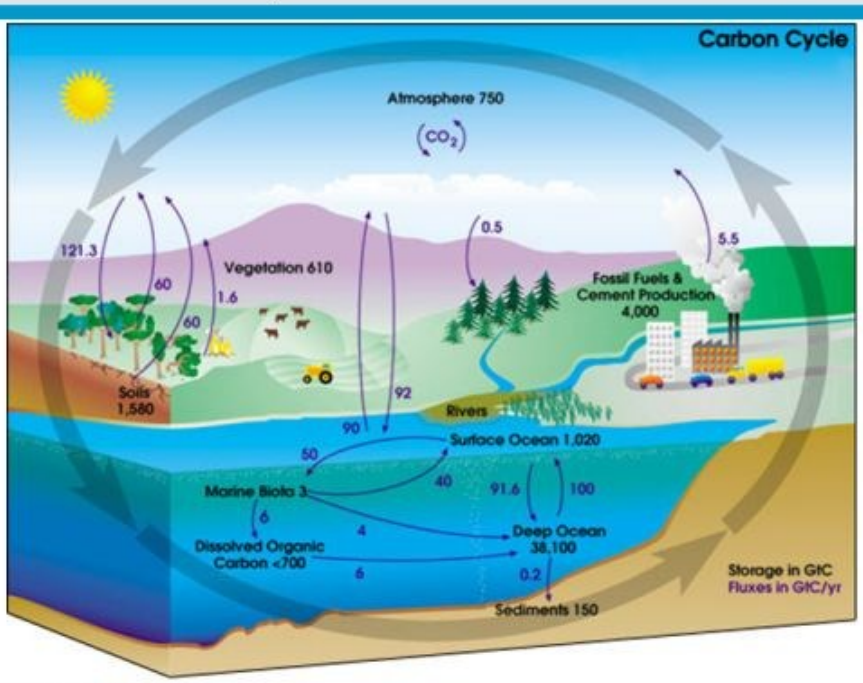
Source: New Scientist 2008 from CSIRO Climate change: the latest science

Carbon dioxide (CO_2) levels in the atmosphere



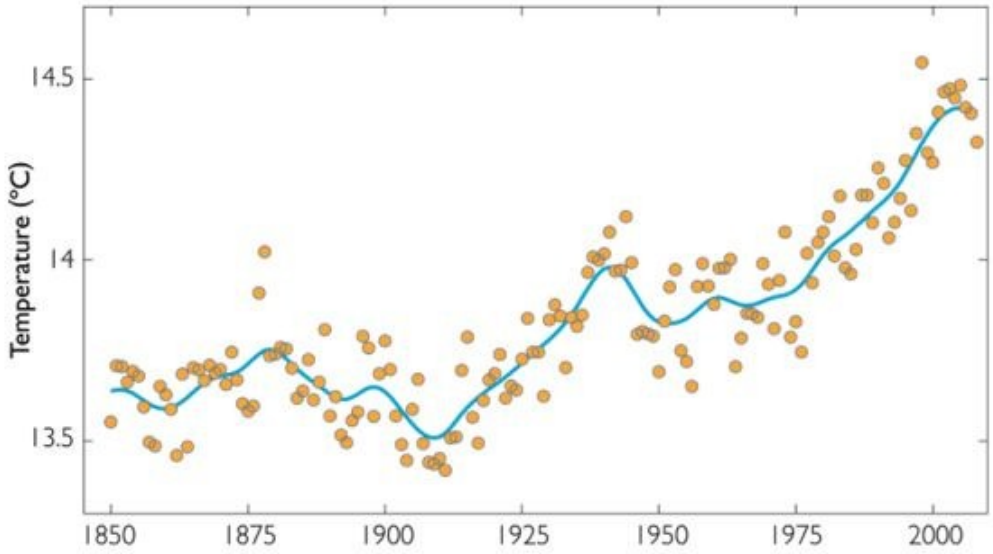
Source: http://www.physicalgeography.net/fundamentals/7y.html

The carbon cycle



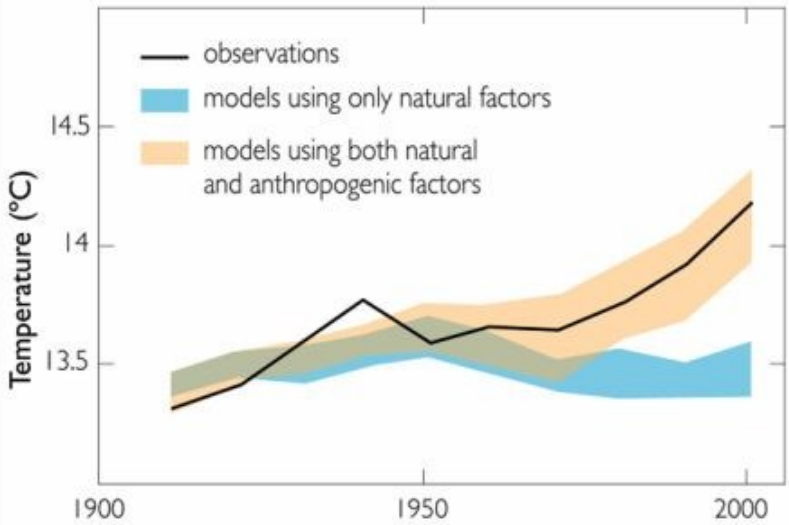
Source: NASA Earth Observatory
http://earthobservatory.nasa.gov/Features/CarbonCycle/carbon_cycle4.php

Global average temperatures are rising



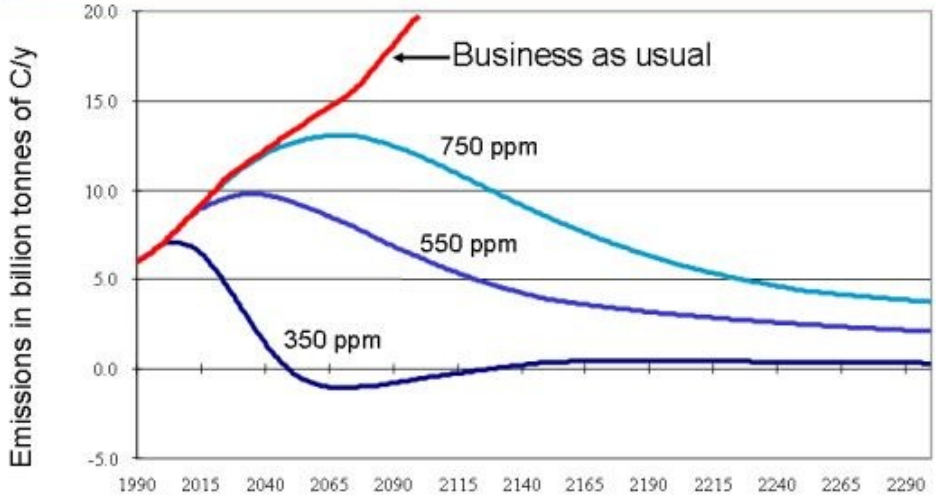
Source: Climate Research Unit, University of East Anglia from CSIRO Climate change: the latest science

Mean global temperatures



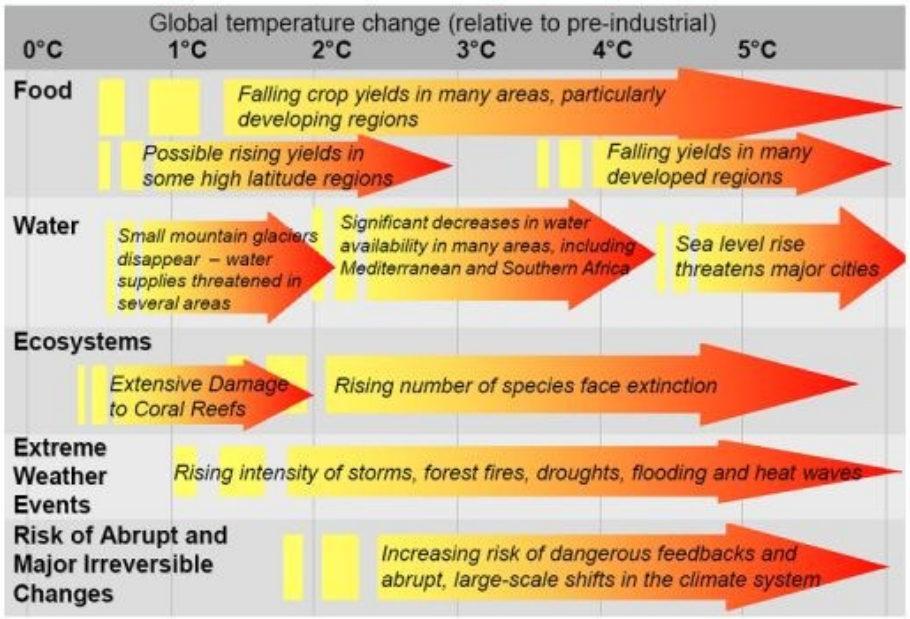
Source: CSIRO Climate change: the latest science

IPCC projections of CO_2 emissions



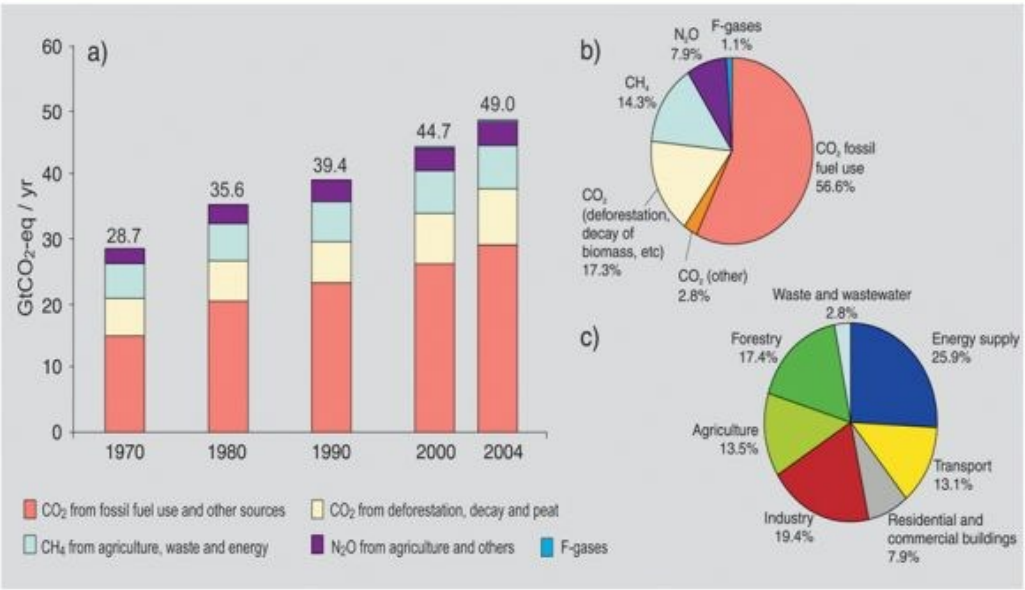
- Pre-industrial concentrations in the atmosphere 275 ppm
- Today's concentration in the atmosphere ~380 ppm

Stern Report - projected impacts



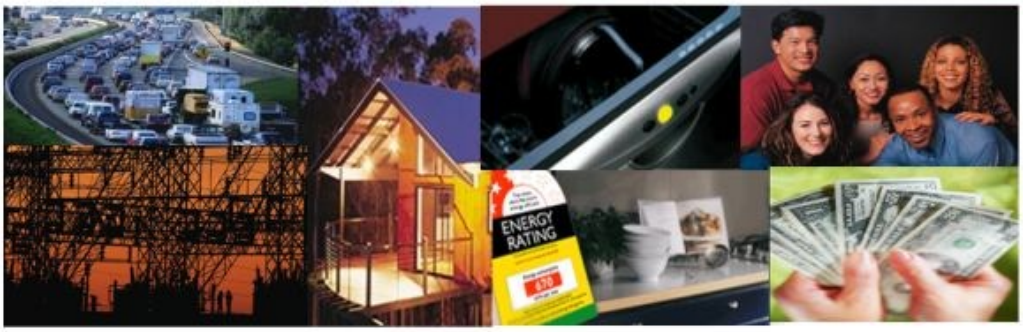
Source: Stern Review 2006

Emissions volumes and source



Source: IPCC (2007)

Key determinants of CO_2 emissions



$$CO_2 = \frac{\text{Emissions}}{\text{Energy}} \cdot \frac{\text{Energy}}{\text{GDP}} \cdot \frac{\text{GDP}}{\text{Popn.}} \cdot \text{Population}$$

Technology *Energy use* *Wealth*

Current trends in energy use

Projections (IEA/EIA) suggest:

- World energy demand rising: 1.5%/yr
- 90% of growth in demand from non-OECD countries; Asian countries main drivers
- Fossil fuel share remains at ~80%
- Liquid fuels remain dominant fuel type
- Demand for power generation rises 75%

Figure 1. World marketed energy consumption

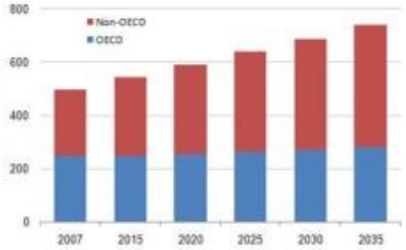
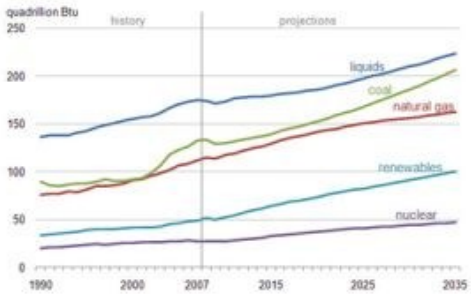
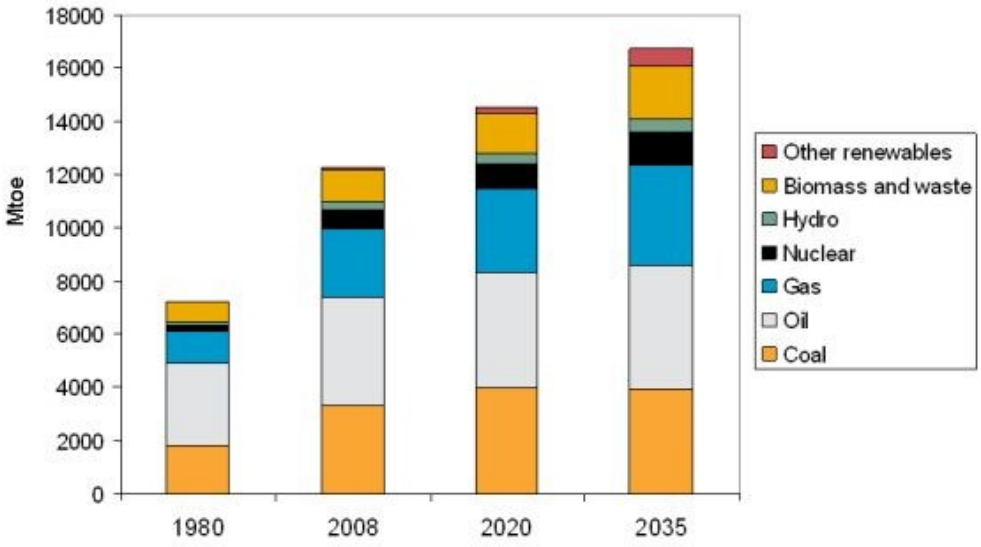


Figure 2. World marketed energy use by fuel type

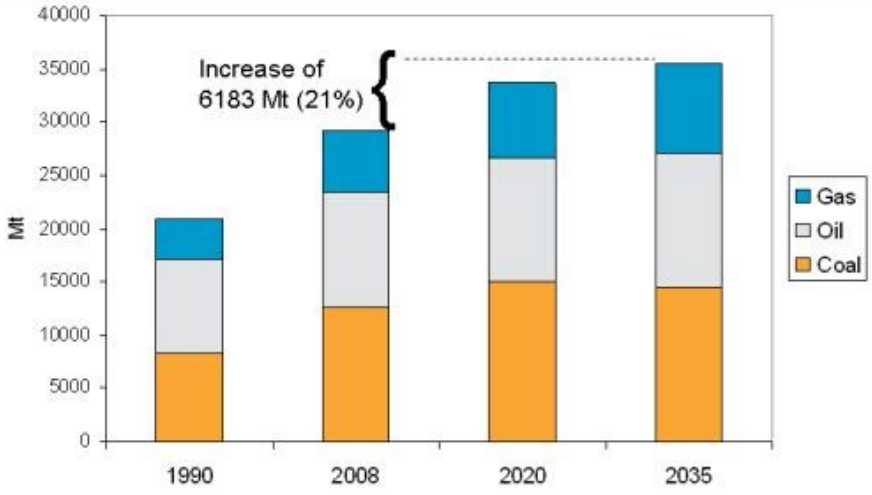


World primary energy demand by fuel



Source: International Energy Agency World Energy Outlook 2010

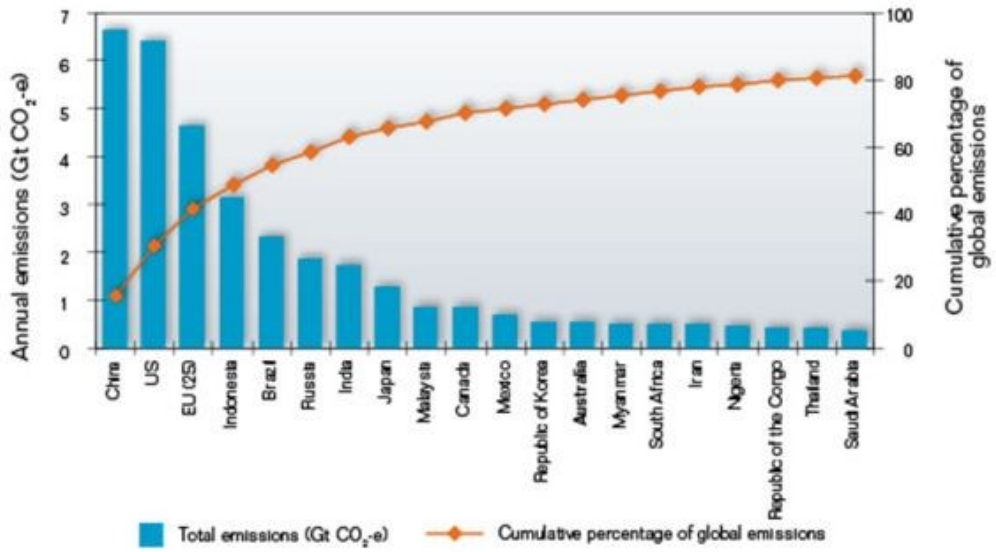
CO_2 emissions – projected increase



Most of the projected increase in emissions comes from new power stations, mainly using coal & mainly located in China & India

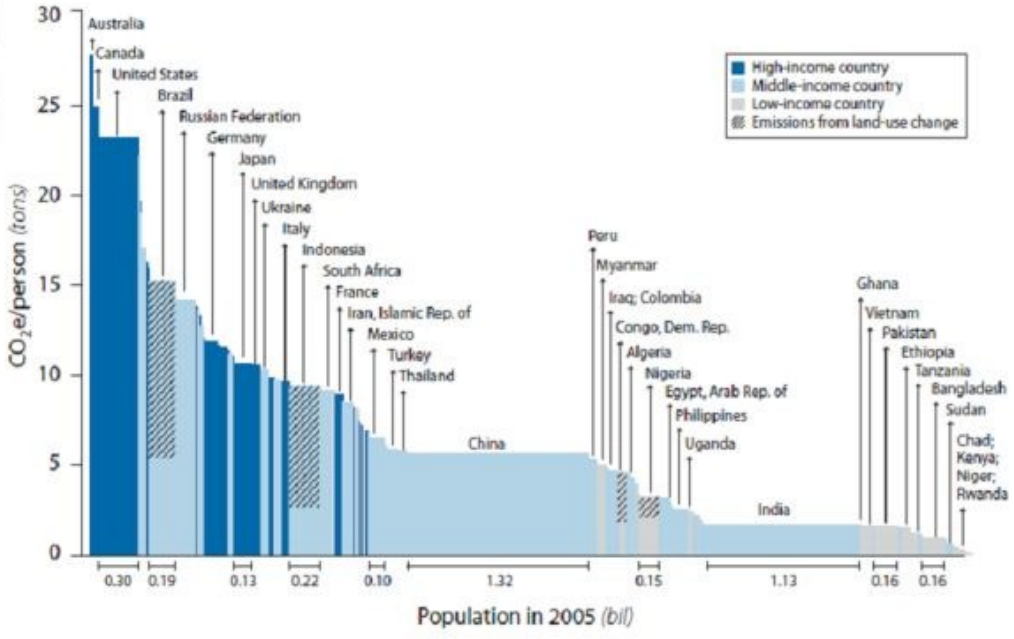
Source: International Energy Agency World Energy Outlook 2010

The largest greenhouse gas emitters



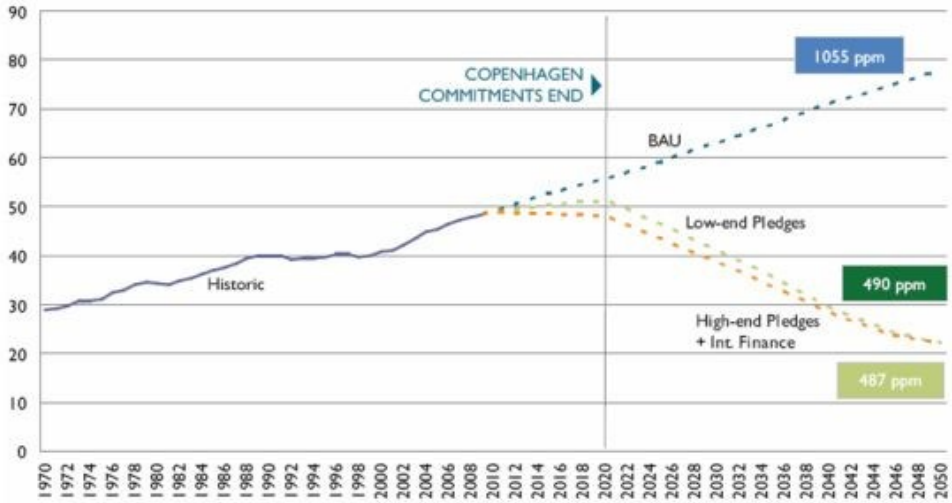
Source: The Garnaut Climate Change Review: Final Report. 2008

Issues of equity: per capita emissions



International pledges to reduce emissions…

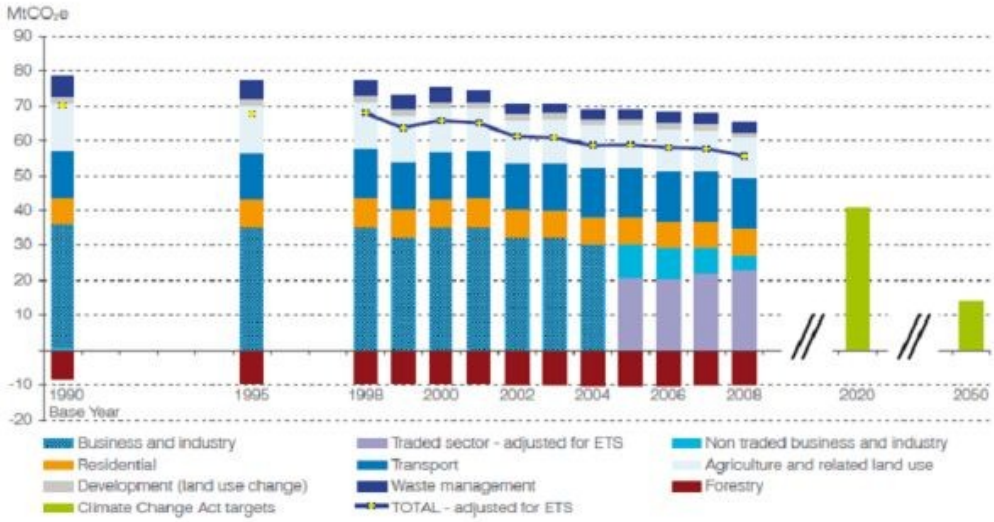
billion tons CO_2e - potential emission reductions following the pledges in the Copenhagen Accord and resulting atmospheric concentrations in 2100.



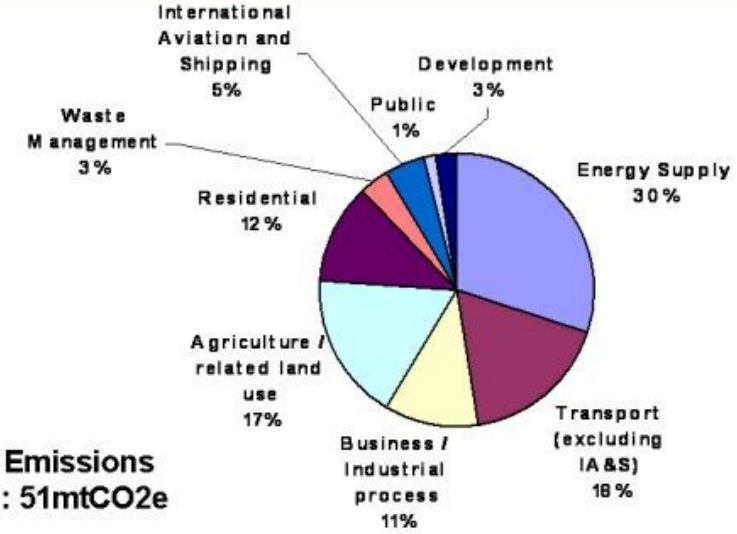
Source: Historic emissions from CDIAC (2009). BAU emissions projections based on IEA (2009) and Stanford (2009). Emission reduction pathways are author's estimates based on Copenhagen Accord commitments as of March 2, 2010, and post-2020 assumptions described in this Policy Brief.

Focus on Scotland: emissions

Million tonnes CO2e



Scottish emissions



2009 Emissions
Total: 51mtCO2e

Source: Scottish Government, Sept 2011

Expert Presenter
Dr Andy Kerr

Thank you

Presentation 2

Climate change, energy and low carbon energy technologies - Part 2

Presentation to Large Group Workshop

Dr Andy Kerr
Director, Edinburgh Centre on Climate Change

September 24, 2011

eccc EDINBURGH CENTRE ON CLIMATE CHANGE

Options to stabilise emissions

- Increasing the use of low emission technologies
  - Renewable energy: wind, solar, hydro, biomass, geothermal
  - Nuclear
- New lower emission fossil fuel technologies
  - Advanced coal with carbon capture and storage
  - Natural gas with carbon capture and storage
- Reducing energy use
  - Energy conservation
  - Improving efficiency of use

Electricity Generation Options

Geothermal Nuclear

Wind

Solar

Biomass

Hydro

Tidal

Wave

Fossil fuels
(Coal, Oil & Natural gas)

Source: www.actewagl.com.au

Solar Power

- There are two approaches to solar power, photovoltaic (PV) and thermal, that have significant differences
- Solar thermal systems already results in reductions in gas use at a domestic scale in Scotland
- PV provides intermittent power with energy storage issues
- Modular and easy installation for domestic use but large scale applications are more complex and require large land areas
- Feed-in-Tariffs encouraging small scale PV in Scotland

Wind Power

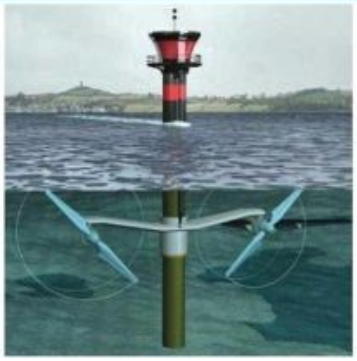
- Wind has a long history as a source of energy
- Scotland has >2GW onshore wind installed capacity
- One of the lowest cost sources of energy
- Wind power is intermittent, requiring back-up from other sources
- Community concerns – visual, noise and vibration
- Environmental concerns – land use and impacts on birds, bats

Hydro-power

- Scotland has hydroelectric schemes totalling ~1.3GW capacity
- Technology is highly efficient, high capacity, maintenance costs are relatively low
- Susceptible to seasonal rainfall, snowfall and drought patterns
- Environmental impacts of dams means that little opportunity for further large scale schemes in Scotland
- Increasing numbers of small "run of the river" schemes being developed
- Pump-hydro used to store energy – and manage electricity grid demand constraints

Wave and Tidal

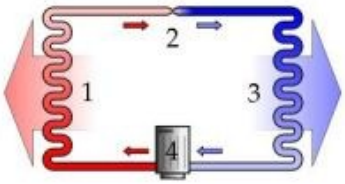
- Tidal power creates electricity by moving underwater turbines
- Tidal plants are in infancy & construction costs are high
- Wave power plants leverage the movement of the ocean surface
- Leading wave and tidal companies based in Scotland: large potential (25% and 10% EU potential energy)
- 1.2GW of tidal & wave power sites were leased by Crown Estate in Pentland Firth



Biomass

- Biomass energy is generated from organic matter, such as wood, agricultural and forestry by-products, landfill, and industrial, human or animal wastes
- Historically used to provide electricity or steam for factory operations - in particular, timber mills have operated using biomass power
- Energy is generated in a variety of ways depending on the fuel source e.g. combustion for steam generation (wood or bagasse), production of ethanol and liquid transportation fuels
- Lower efficiency of energy use compared to fossil fuels, some issues with emissions and management of purpose grown biomass for energy, availability can be seasonal in some cases
- Biomass is co-fired with fossil fuels
- Renewable Heat Incentive coming!

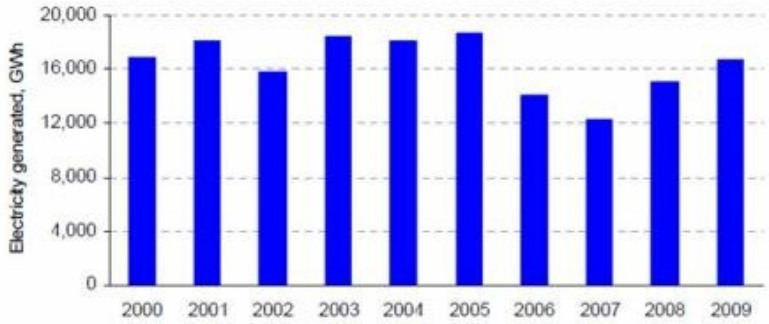
Geothermal Energy: Heat pumps



- Large scale geothermal energy derived from hot granite rock which heats from the slow decay of radioactive elements
- Used to heat water (naturally occurring or artificially induced) which is extracted and used to generate steam
- More common in Scotland is use of heat pumps: these are "reverse refrigerators",
- These use certain refrigerant fluids which absorb heat as they vapourise and release heat when they are compressed: this allows heat to be transferred from one environment (e.g. the ground outside a home) to another (inside a home)

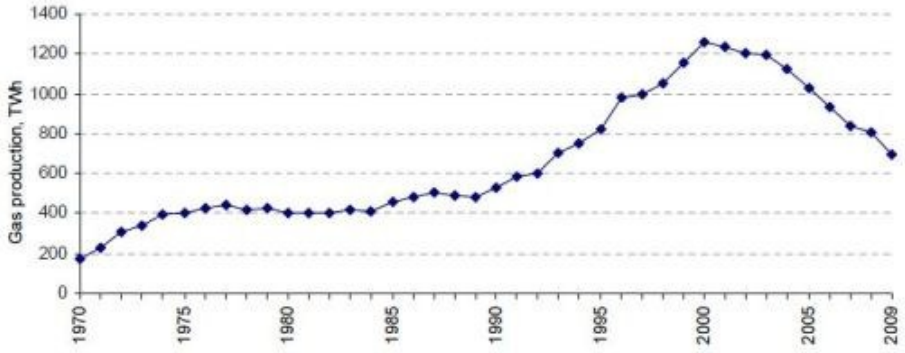
Nuclear Power

- Scotland has 2 nuclear power stations: Hunterston & Torness
- 32% of Scottish electricity was produced from these two power stations in 2009
- Their decommissioning dates are 2016 and 2023; no new nuclear power stations are planned at this point
- Nuclear technology is proven
- Concerns reflect radiation, security and weapons risks, waste disposal and containment issues



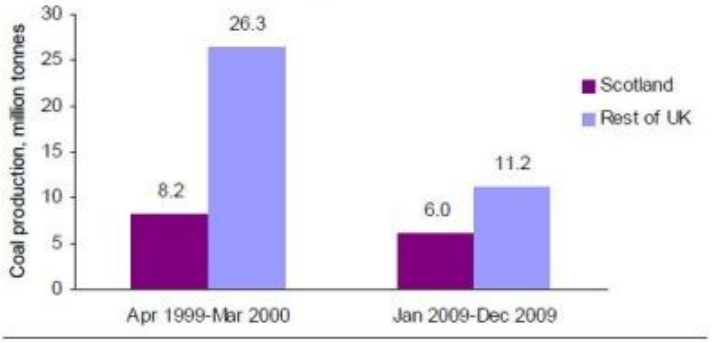
Natural gas

- Gas is used heavily for water/space heating in homes
- Also used for electricity generation: Peterhead is a ~1.5GW gas-fired power station
- Cheapest form of electricity generation
- Produces as little as half the emissions of traditional coal fired power stations
- Increasingly reliant on imports



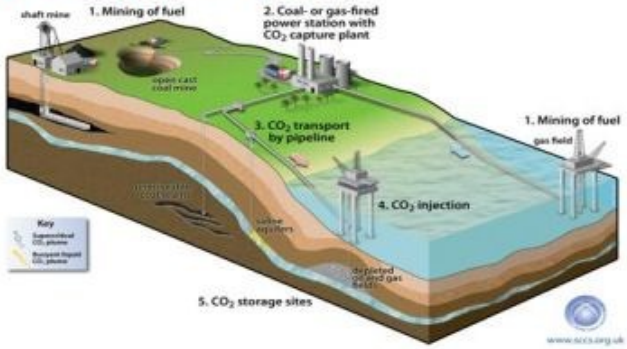
Coal

- Scotland mines about 1/3 of UK coal
- Two coal-fired power stations: Longannet and Cockenzie
- Cockenzie about to be re-powered as a gas-fired power station
- Coal-fired power stations have higher GHG emissions than other electricity sources
- Coal can be used to manufacture hydrogen, liquid transportation fuels and chemicals, displacing oil

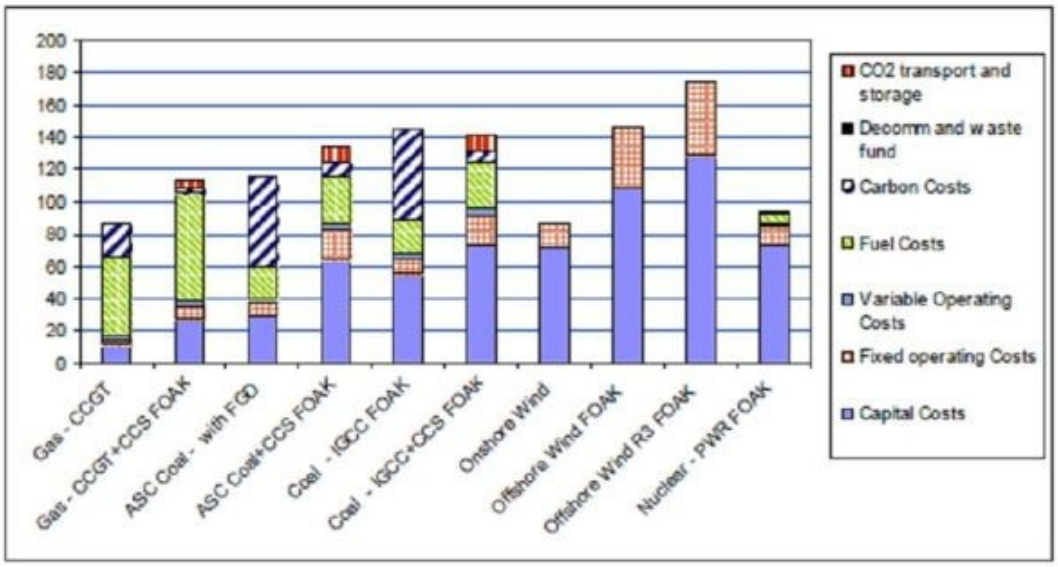


Carbon dioxide Capture and Storage (CCS)

- Enables carbon dioxide emitted from burning fossil fuels (coal, oil and gas) to be captured, transported and then pumped deep underground in a super critical (liquid like) state for storage in depleted gas and oil fields, or other geological structures
- CCS is estimated to potentially reduce GHG emissions per MWh of electricity by up to 85-95%
- Provides a means to adapt an already vast, existing and costly global energy infrastructure currently based on fossil fuels

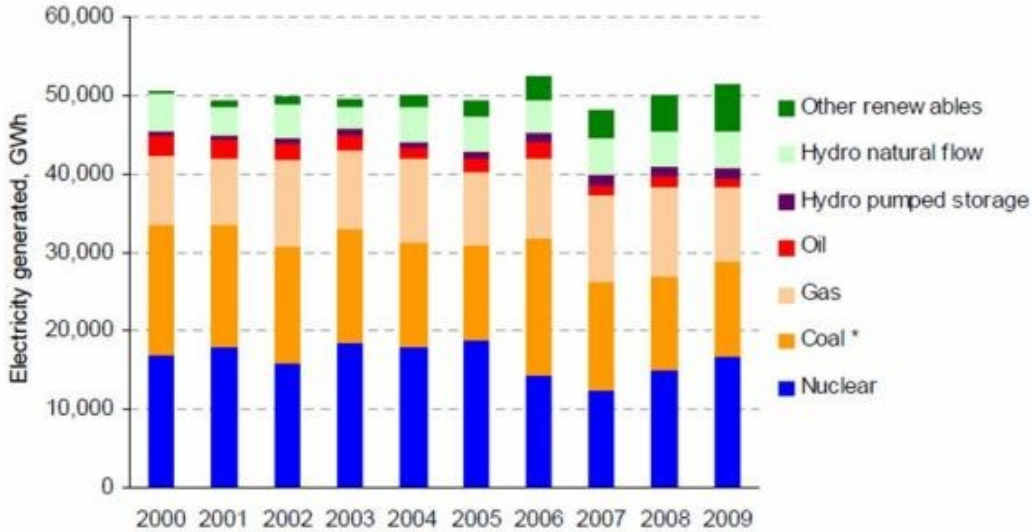


How much does this all cost?

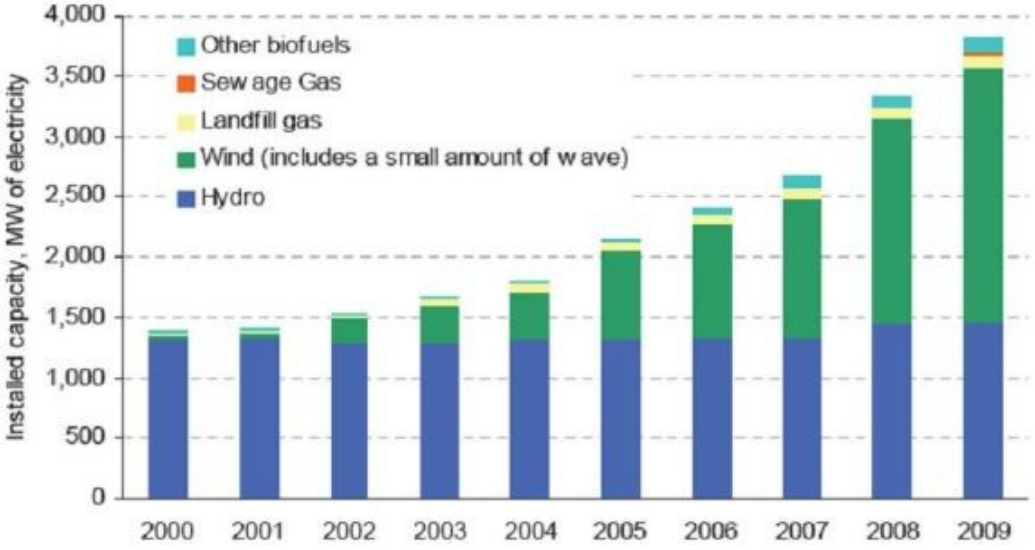


2013 project start date: Source – Mott McDonald

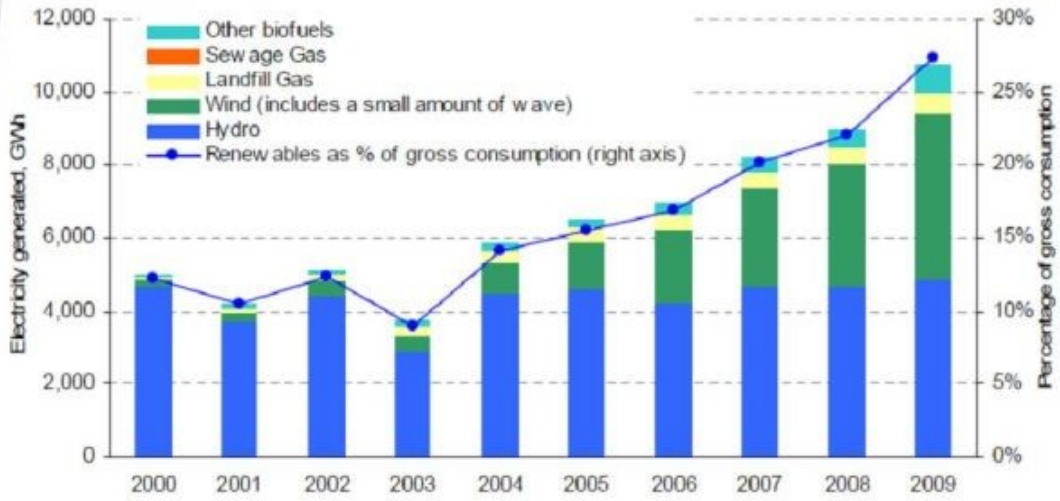
Historical electricity generation in Scotland



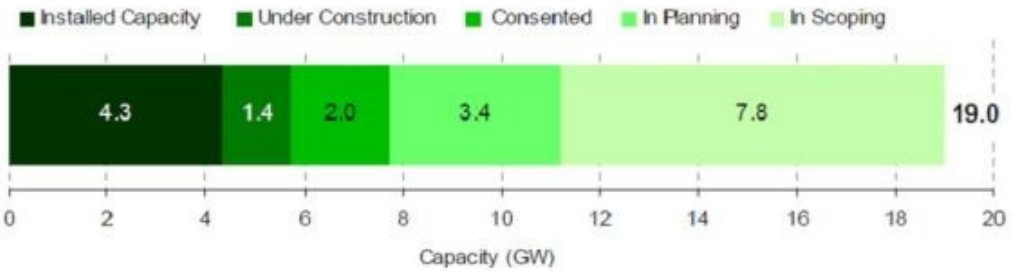
Installed capacity of renewables in Scotland



Electricity delivered in Scotland by renewables

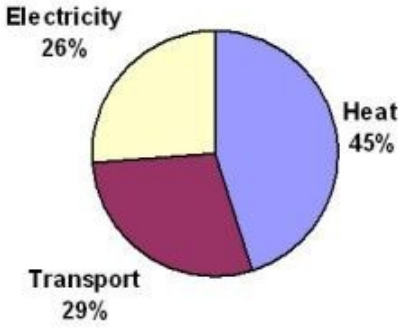


Planned renewable capacity increases

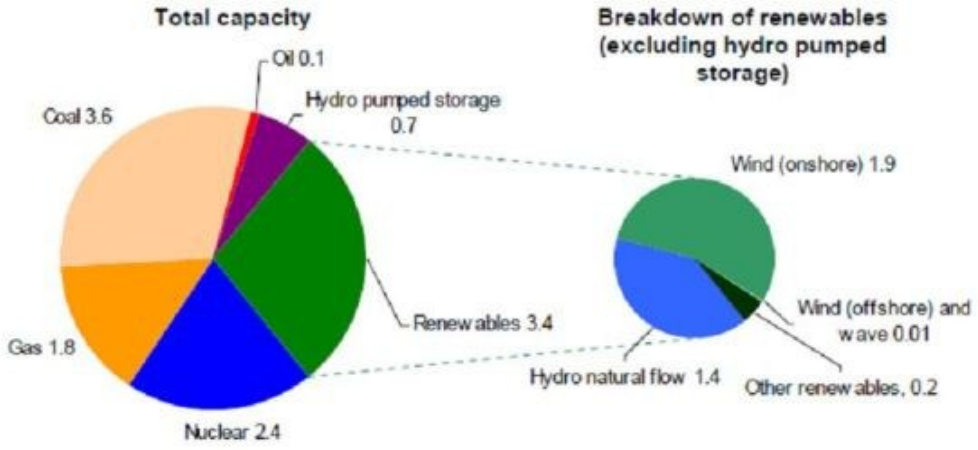


Scottish energy intentions

- Reduce final energy demand by 12% by 2020
- 100% of electricity demand from renewables by 2020
- 11% heat demand from renewables by 2020
- 30% total energy demand from renewables by 2020
- 500MW of community and locally owned renewable capacity by 2020
- No new thermal power stations without CCS fitted to at least 300MWe from the start

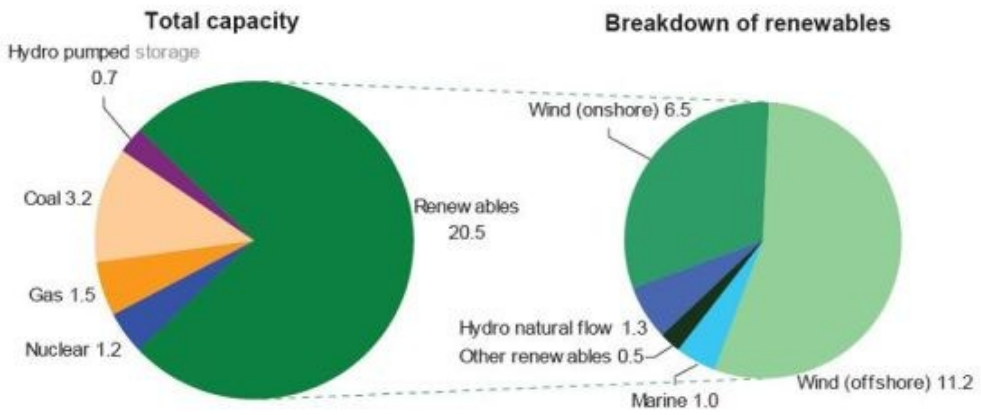


Scottish installed capacity (GW)

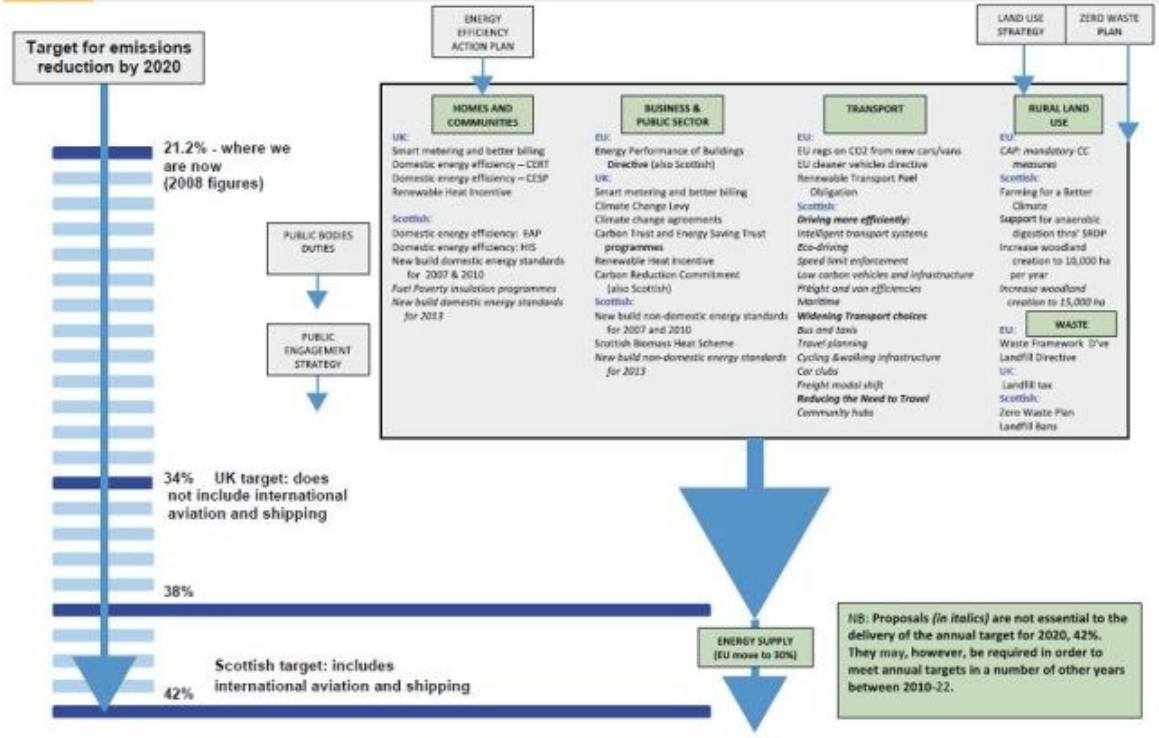


Source: UK Department of Energy and Climate Change

Future plans? 2020 and beyond



What are we doing in Scotland?



Expert Presenter
Dr Andy Kerr

Thank you

Presentation 3

Carbon Capture and Storage
What is it and what does it look like?

Maxine Akhurst, Scottish Carbon Capture & Storage
24 September, 2011

Outline

- What is Carbon Capture and Storage (CCS)?
- How do you do it?
- Where is it happening?
- What does a CCS project look like?
  - Examples from Scotland
- What have we learned about CCS in Scotland?
  - Work done
  - Further work required
- Conclusions

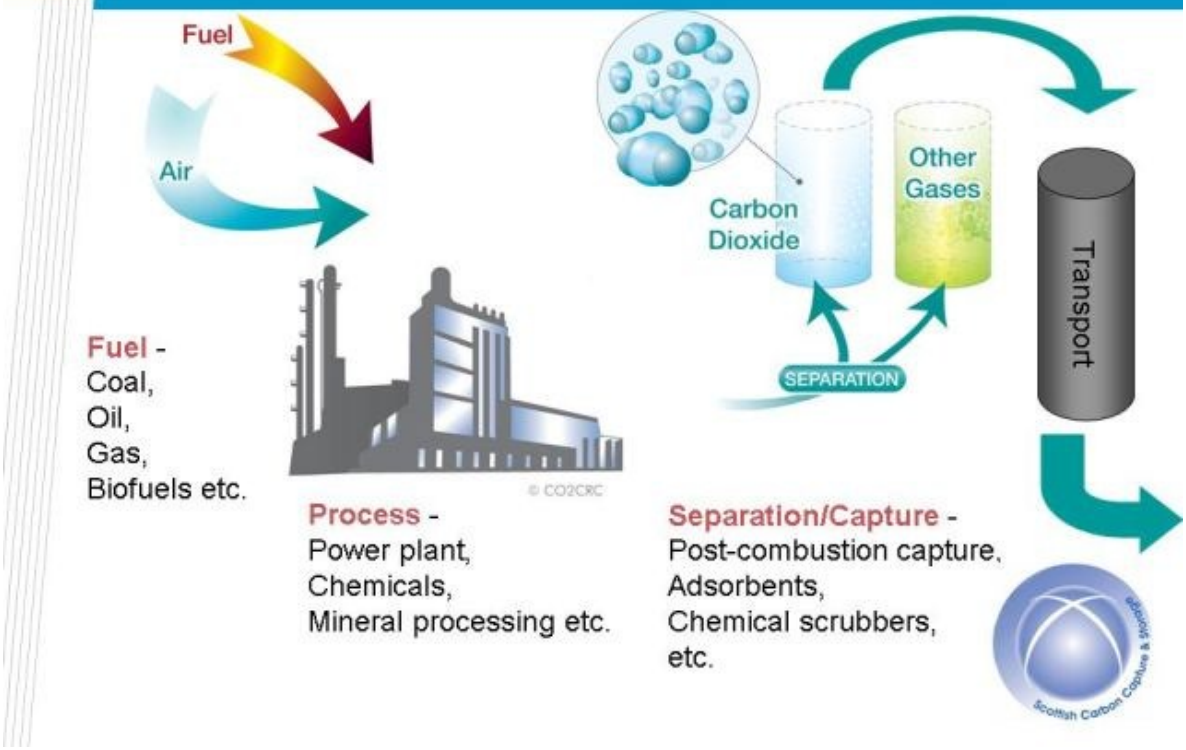
What is Carbon Capture and Storage?

- **"Carbon capture and storage (CCS)** involves capturing **carbon dioxide** that would otherwise be emitted to the **atmosphere,** compressing it, transporting it to a **suitable site**, and injecting it into **deep geological formations** where it will be **trapped** for **thousands or millions of years.**"

Source: www.co2crc.com.au/aboutccs 25/01/2011

CCS captures the carbon dioxide created during power generation and permanently stores it in deeply buried rocks.

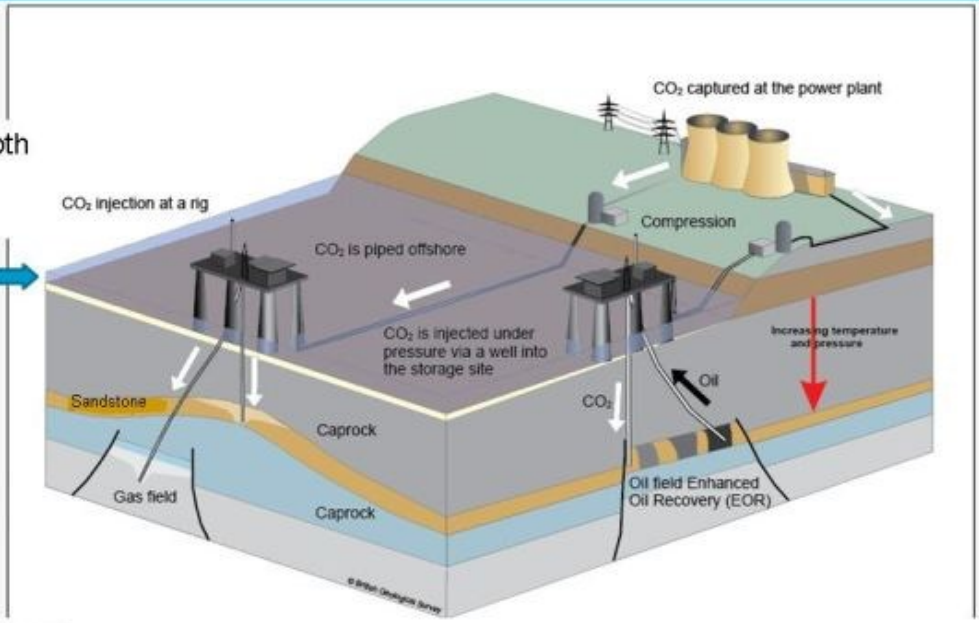
How Do You Do It? Capture…..



How do we store CO_2?

Water depth ~ 100 m (300 feet)

Depth to store ½ m to 1½ mile below sea bed



Why so deep?

At depth and high pressure CO_2 is a liquid &occupies much less space within the rock

The CO_2 is heavy but not as heavy as water and will rise up through it

Where is it happening worldwide?

Twenty current or completed projects worldwide
- Eleven test or pilot projects
- Nine large-scale projects

Where is it happening in Scotland?

Three planned or proposed projects in Scotland
One active project, Sleipner, in Norwegian North Sea

Planned and proposed projects in Scotland

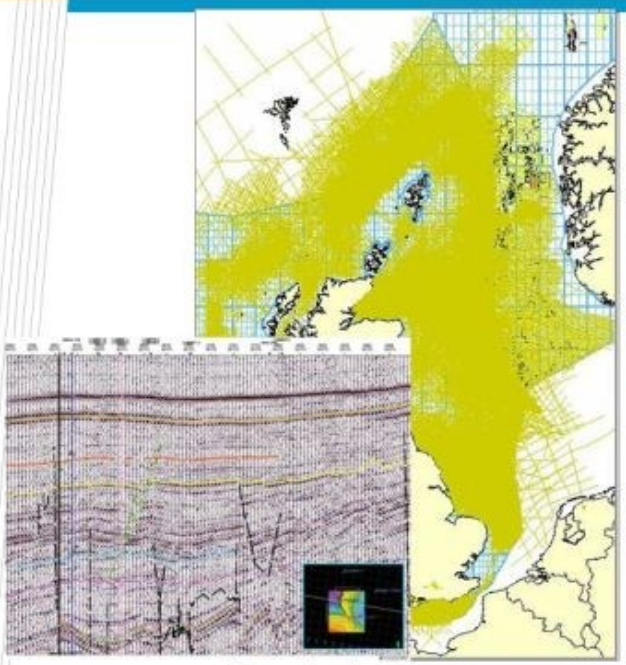
Longannet power station
Mobile test capture plant

Hunterston power plant proposal waits for planning consent

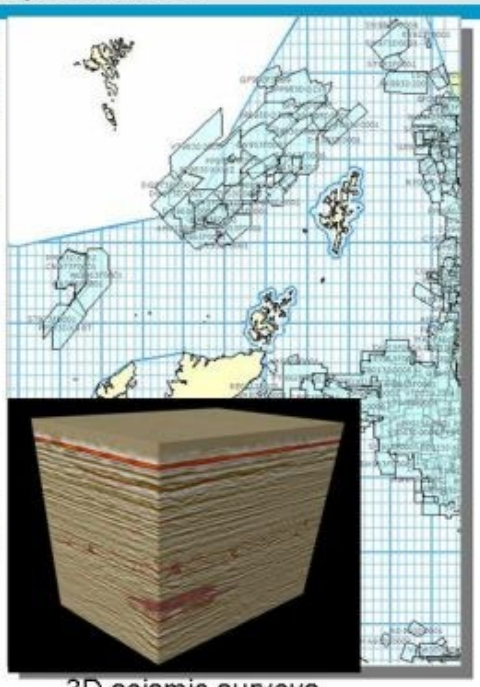
2 June 2010

Ayrshire Power, the company proposing to develop a new multi-fuel power station with carbon capture and storage (CCS) technology at Hunterston, North Ayrshire, has completed the first planning hurdle for its project.

Why in Scotland?
Data from oil and gas exploration

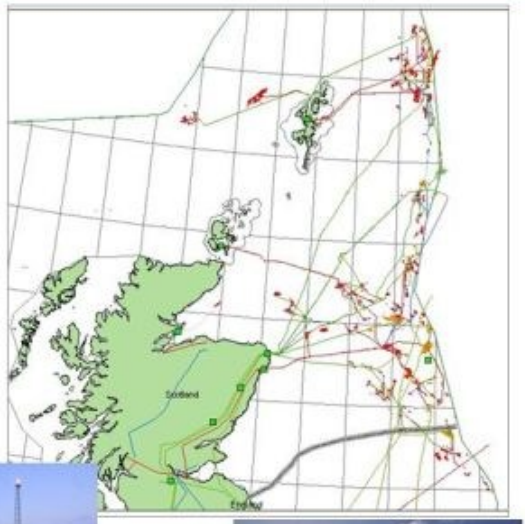


2D seismic surveys



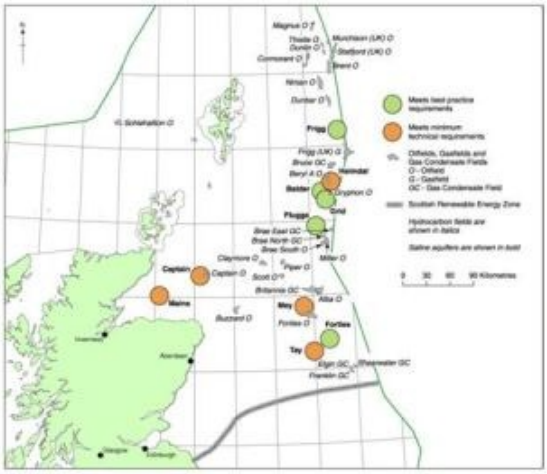
3D seismic surveys

Why in Scotland?
Data, infrastructure, knowledge & expertise



- Data from exploration and production
- Infrastructure of pipelines and platforms
- Knowledge and experience of North Sea offshore operations

Why in Scotland?
Large potential capacity to store CO_2



Screened
- 200 oil and gas fields
- 80 sandstones
- > 50 million tonnes CO_2

Outcome
- 29 oil and gas fields each with 10's to 100's millions of tonnes storage capacity
- 21 sandstones with potential as CO_2 stores

How much storage do we need?
- A large power station 10 Mt per year
- UK produces 560 Mt per year

How much could be stored? Estimated CO_2 storage capacity in sandstones

Sandstone extents from UKOOA

Shortlist of 10 sandstones with acceptable or optimal characteristics

- Extensive and overlapping
- Total CO_2 storage capacity between 4 600 and 46 000 Mt
- At least 200 years worth of Scotland's CO_2 output
- Detailed mapping of individual sandstones is necessary to fully understand their CO_2 storage potential e.g. Captain Sandstone

How much could be stored? Mapping and modelling CO_2 storage capacity

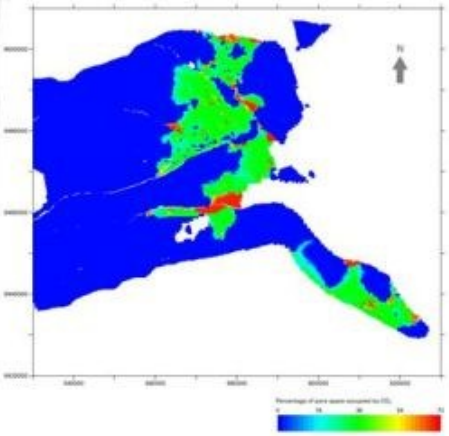
Calculations to model CO_2 injection in the Captain Sandstone

- 450 Mt CO_2 in each of 12 wells
- Predicted migration 5000 years

Modelling endorsed the upper value of previous capacity estimate (up to 363 Mt CO_2)

- If most stringent conditions are applied, 25 years worth of Scotland's 'industrial' CO2 could be stored in this one sandstone
- If more relaxed conditions are applied more that four times as much could be stored

Where is it stored? Modelling of CO_2 capacity and migration

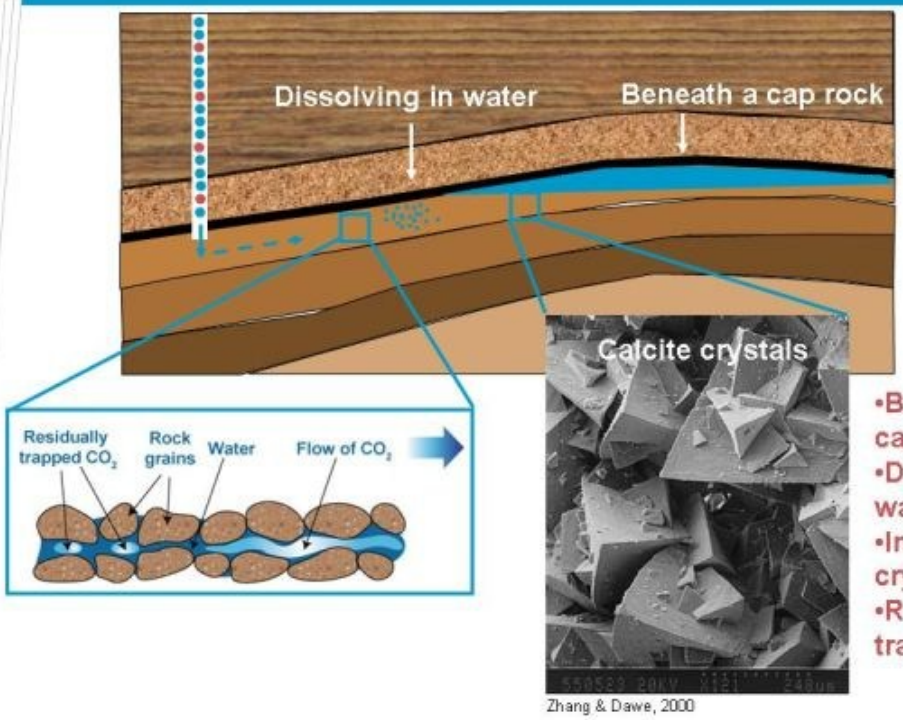


Predicted CO_2 saturation, 900 years after injection has ceased

Migration of injected CO_2 modelled for 5000 years in the Captain Sandstone

- Reached top of sandstone after 5 years and stopped moving after 1000 years
- After 1000 years all CO_2 retained at more than ½ mile (800 m) depth
- Without significant localised pressure increase

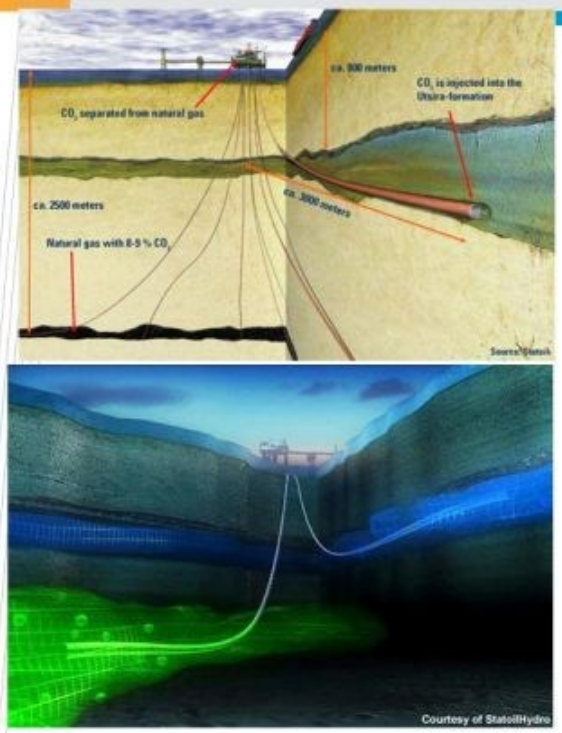
How does it stay there? Trapping

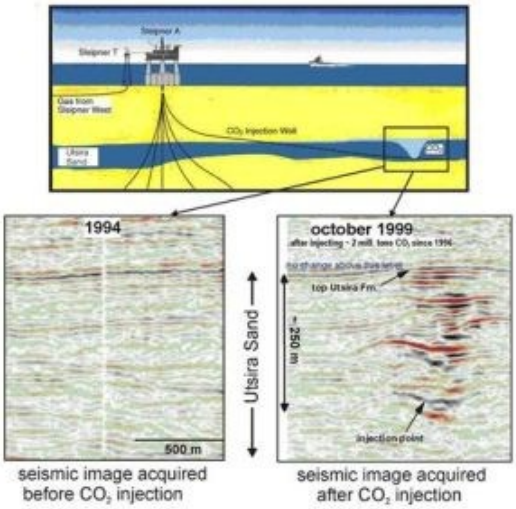


Zhang & Dawe, 2000

- Beneath a cap rock
- Dissolving in water
- In mineral crystals
- Residual trapping

Carbon storage in the North Sea
Sleipner Field, offshore Norway





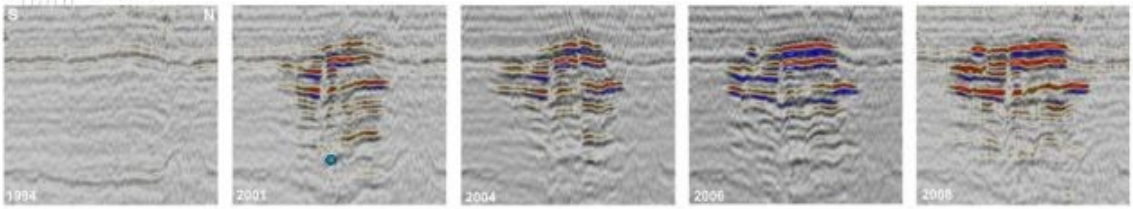
CO_2 injection commenced 1996

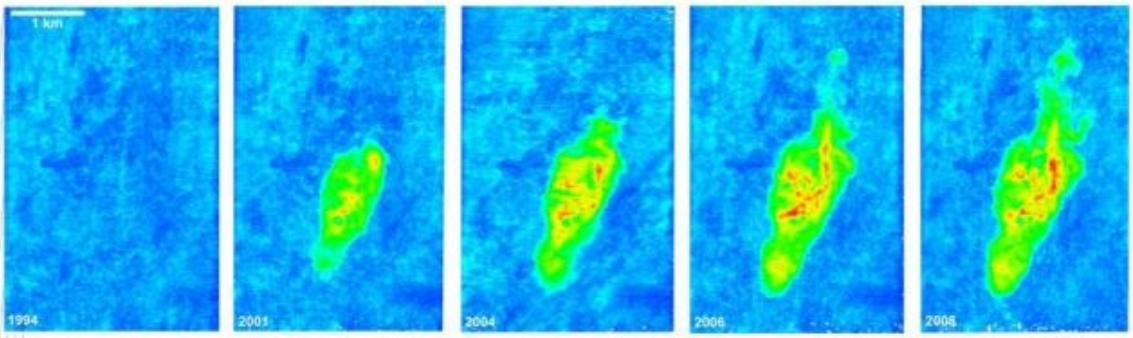
~ 1 Mt CO_2 injected per annum

~12 Mt currently *in situ*

How do we know where the CO_2 is?
Sleipner: Imaging CO_2 in the reservoir

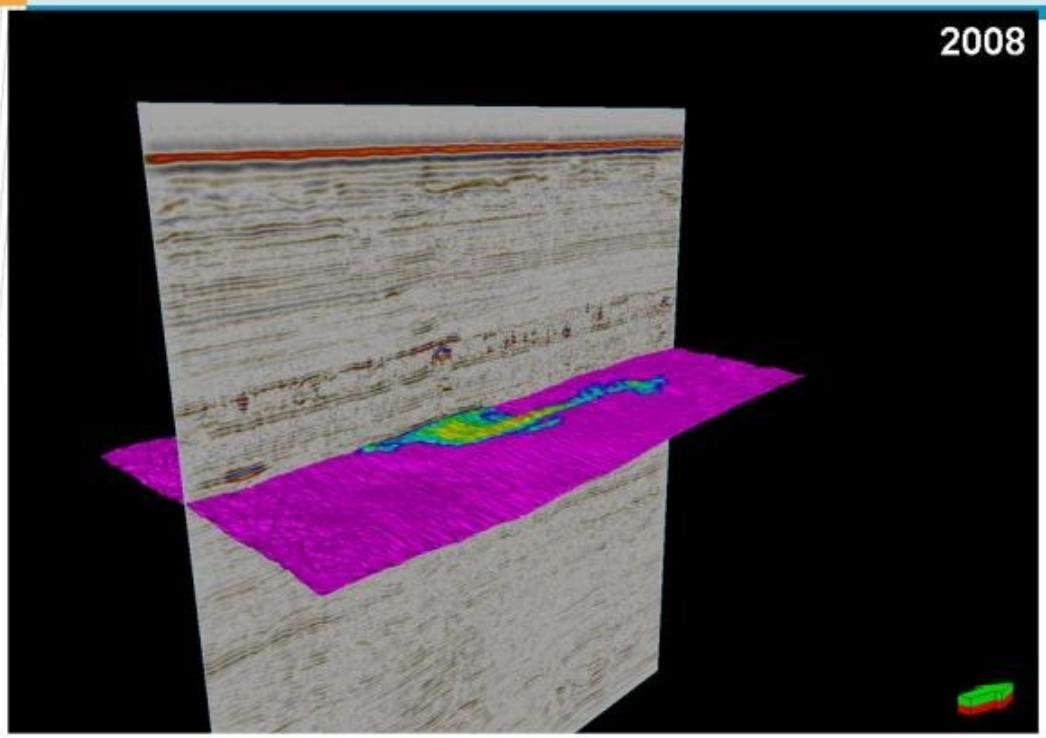
vertical section



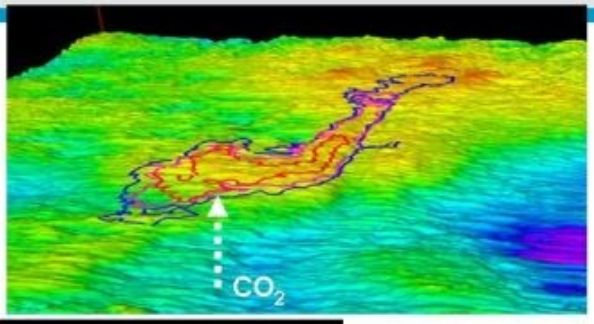


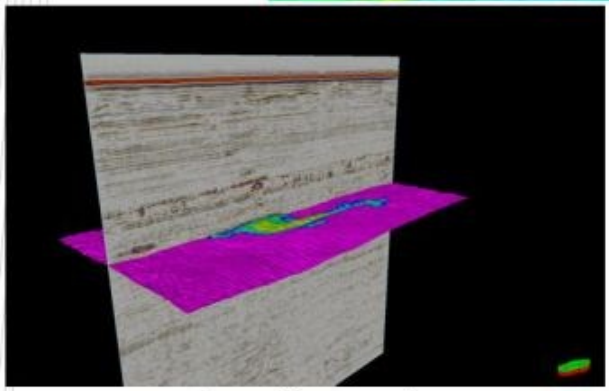
plan view

Monitoring CO_2 migration at Sleipner

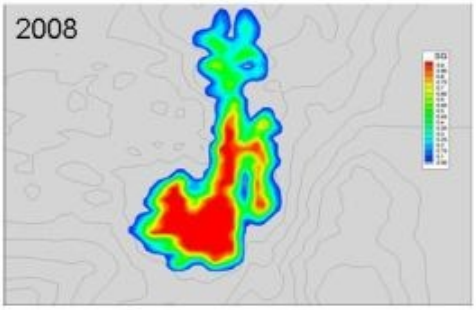


Monitoring & verifying CO2 migration at Sleipner





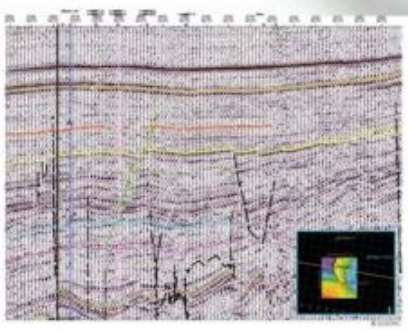
observed layer growth

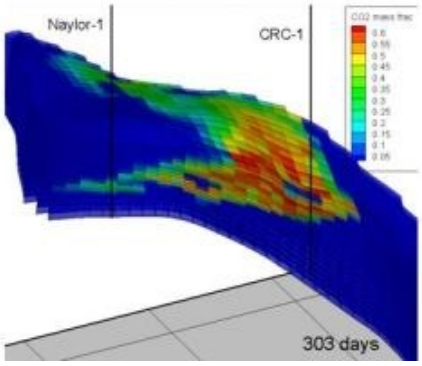


simulated layer growth

What's next in Scotland?

1. **Demonstration projects storing CO_2 in oil and gas fields**
2. **Research into more efficient capture of CO_2**
3. **Further investigation of sandstones as large-scale stores**
4. **Monitoring of sites before and during injection**





Conclusions

- Carbon Capture and Storage is a low-carbon technology to reduce CO_2 emissions to the atmosphere
- Carbon Capture and Storage is a fledgling industry in Scotland
- The first UK demonstration plant may be offshore Scotland into a gas field
- Scotland (and UK) has large-scale potential CO_2 storage capacity in sandstones
- Research is in progress in Scotland, UK and worldwide to implement commercial-scale geological storage of CO_2

Thank you

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Scottish Carbon Capture and Storage