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# Understanding stakeholder attitudes to carbon capture and storage (CCS) in Victoria

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# Executive summary

This research aimed to understand how Victorian residents perceive and accept potential Carbon Capture and Storage (CCS) projects. Four focus group sessions were each conducted in Bairnsdale, Traralgon and Melbourne, in Victoria. A total of 108 participants were engaged in this study which involved a total of 12 focus groups. This is a small sample compared to the full population of Victoria but sufficient in number to gain a reasonable understanding of the thinking of the local people on emerging energy technologies.

Similar to previous CSIRO research, results from the focus groups showed that support for CCS improved significantly ($p<0.001$) over the course of the focus group, from an average of 4.08 to an average of 5.48, where 1 represented strongly disagree to 7 strongly agree. Participants also indicated that they became more knowledgeable on a range of climate and energy related issues. Post-focus group questionnaires indicated that most participants (58%) expressed a preference for CCS projects to be located more than 10 km away from them, the furthest option offered.

Focus group results indicated concerns and questions of participants that are commonly documented in CCS discussions for the first time. These included some themes that demonstrated curiosity about the basic technical aspects of CCS, including questions about underground storage and long-term impacts of carbon dioxide ($CO_2$); whether CCS is a durable solution over time; and concerns about the effect of CCS on potential natural disasters. Participants also raised issues that adopted a broader perspective, such as asking whether $CO_2$ has alternative uses, and what comparisons and evaluations had been carried out to justify the decision to develop CCS compared to other potential climate mitigation technologies. Discussion also encompassed the economic status and prospects of CCS, the connection of CCS to a carbon price, the development of CCS internationally, and the interests and institutions supporting CCS.

The results demonstrate there is limited awareness of the technology and a need for information and education on CCS. A proportion of the respondents (more than 32%) had questions of a “technical” nature, suggesting that participants sought additional information while considering their acceptance of CCS technology. These questions related to topics including procedures, $CO_2$ properties, $CO_2$ behaviour, impacts, potential for disasters, risks of leaks and aquifer damage, alternatives to CCS, and the ability to use existing infrastructure.

The results are significant in that they call attention to the fact that members of the Victorian public are currently formulating an understanding of CCS that may also apply to other industries, such as coal and gas mining in Australia, and to other alternative technologies and policy solutions. To summarise, the main recommendations that arise from this study include:

**R1: Proactive engagement on CCS is required to build overall knowledge and awareness of CCS across a range of stakeholders in Victoria.**

**R2: Any engagement should be set in the context of climate change and the portfolio of energy options for Victoria.**

**R3: Ensure the information provided includes the relativity of each technology in terms of costs, ability to mitigate greenhouse gases and potential within Australia over the short, medium and long term.**

**R4: Where possible provide examples of existing CCS operations to help overcome the uncertainties that arise in discussions about CCS.**

**R5: Make readily available responses to Frequently Asked Questions about CCS with the most up to date information from technical research findings.**

**R6: Avoid advocating for any one technology when engaging the public.**

**R7: Ensure objectivity in the information by drawing from a range of experts with diverse opinions about CCS i.e. NGO, University and Industry perspectives.**

**R8: Consider the range of stakeholders that require engagement and tailor processes accordingly.**

**R9: Ensure local communities are made aware of the engagement processes available and their opportunities for participation, and consult communities about their engagement preferences.**

**R10: Utilise the full gamut of communication media for engagement to suit various stakeholders' different levels of interest and ability to participate.**

# 1 Introduction

Brown coal is the primary energy source (85%) for electricity generation in Victoria - one of the largest contributors to Australia's total domestic greenhouse gas emissions (ABARE, 2009). The remainder of Victoria's supply is natural gas and renewable energy sources including hydro-electricity, wind and solar. As such, low emission energy technologies have the potential to reduce greenhouse gas emissions substantially over the coming decades. Carbon Capture and Storage (CCS) is one such technology that has been identified as being able to capture large amounts of $CO_2$, both from electrical power generation and other industrial processes, and store it underground. However, as a new and emerging technology, CCS is not well understood by many, particularly the general public (Ashworth, Carr-Cornish, Boughen & Thambimuthu, 2009). As CCS has a number of uncertainties associated with it, public acceptance has been identified as a critical success factor for the ongoing deployment of CCS.

Recognising this, DPI initiated this research to be carried out by the CSIRO with contributions from the Global CCS Institute. CSIRO was commissioned to conduct a serious of 12 focus groups across regional and metropolitan Victoria.

The objectives of the research were to:

- Identify current knowledge levels and attitudes towards climate change and low emission energy technologies with a specific focus on CCS.
- Identify issues and concerns raised and the information gaps that may exist about the understanding of these technologies with a specific focus on CCS.
- Evaluate the impacts of information provision on existing opinions of the lay public.
- Determine how best to engage the public about CCS projects in Victoria in order to inform the development and enhancement of community engagement and communications strategies and tools.

# 2 Methodology

Focus group participants were recruited from the general public within three study areas in both regional and metropolitan Victoria. A total of 12 focus group sessions were conducted across Bairnsdale, Traralgon and Melbourne. In each location, on average, two groups of ten individuals aged 18-35 years old, and two groups of ten individuals aged 36-60 years old were recruited to participate in the study. The age breakdowns were selected by DPI to represent a cross section of the community with an original cut-off age of 60 which was extended to 65 to increase participation in the regional areas.

## 2.1 Recruitment

A market research company was contracted to recruit participants for the focus groups. In the metropolitan area of Melbourne, participants were recruited via cold-calling of the contacts available in the company's database. The company used multiple methods of recruitment, including various mediums to reach people in the hard-to-access areas of Bairnsdale and Traralgon. Despite increased efforts, males' attendance to the focus groups was lower than expected due to the lower population numbers in those areas. The approach for recruiting in the regional areas included:

- Placing a generic advertisement in the local newspaper in Bairnsdale (The Bairnsdale Advertiser) asking for people to register their interest in participating in research.
- Cold-calling landline numbers within the target regions, a common method of gaining a random sample of the population. However, this method was abandoned in Bairnsdale as there was competing research running at the time and the local community appeared suspicious as to the motives of the cold-calling/free-find approach.
- Gaining contacts through various community organisations including schools, RSL clubs and local networks.

The combination of these methods, gathered 289 contacts in Traralgon and 163 contacts in Bairnsdale. Of these numbers, approximately 15% were male in each location.

The recruitment company reported that the main issues/difficulties faced during recruitment included:

- Competing research was being conducted in the area of Bairnsdale.
- People in these locations were unfamiliar with the concept of market research (specifically focus groups) and were both hesitant and suspicious of the recruitment company's intent.
- The accessible population was limited (just under 2,000 men in Bairnsdale aged 20-64).
- Males are typically less willing to participate in research.
- The session times may not have suited when males would likely be available, given that approximately 75% of males aged 15-64 years of age in Bairnsdale work more than 35 hours per week in contrast to 43% of females in the same age bracket, according to ABS statistics.
- The general population in Bairnsdale has an older age range, with many contacts not meeting CSIRO's quota criteria. Due to difficulty in recruiting males within the age criteria, the cut-off age was increased to 69 but this proved unsuccessful at increasing the number of males attending the focus groups.

Each participant was offered a $100 gift voucher for their participation in the focus groups.

## 2.2 Focus group process

Each focus group was scheduled to run for two hours and ten minutes. After the initial welcome, participants were asked about their reactions to climate change, their understanding of Victoria's electricity supply and their existing knowledge of CCS. Next, three forms of information on CCS were presented:

1. Information from a scientist who has been working in the energy domain for his entire career and is the current Chair of the International Energy Agency's Greenhouse Gas Research and Development program. Dr Kelly Thambimuthu provided an overview of climate change and the portfolio of energy options for transitioning to a low carbon energy supply.
2. A short video, the "Carbon Capture and Storage Movie" sourced from Geosciences Australia[1], was shown.
3. A fact sheet, developed by World Wildlife Fund (WWF) for Nature and the Construction, Forestry, Mining and Energy Union (CFMEU) entitled "The Power to Change: Carbon Capture and Storage (CCS)" was shared.

After each information piece, participants were asked to express their immediate reactions to them via an electronic voting system.

At the end of the information sharing sessions, the focus group opened up to participants to discuss further their reactions to CCS and how best to engage the Victorian public on the topic. In addition to electronic voting, participants were asked to complete a short questionnaire at the beginning and end of the focus group. All focus group discussions were audio recorded and then transcribed for accuracy.

A copy of the complete process can be found in Appendix A.

## 2.3 Participant characteristics

In total, 108 participants attended the focus groups. Table 1 displays the gender split of 31% males and 69% females who participated. As discussed earlier, recruitment of male participants was challenging, resulting in a skewed gender balance towards females.

**Table 1 Participants' gender and focus group location**

| LOCATION | MALES | | FEMALES | |
|---|---|---|---|---|
| | FREQUENCY | PERCENT | FREQUENCY | PERCENT |
| Bairnsdale | 8 | 21.6 | 29 | 78.4 |
| Traralgon | 10 | 27.8 | 26 | 72.2 |
| Melbourne | 15 | 42.9 | 20 | 57.1 |
| Total | 33 | 30.6 | 75 | 69.4 |

[1] http://www.ga.gov.au/ghg/carbon-capture-and-storage-movie.html

Adults aged 18 to 69 years old were sought for participation. Table 2 below shows that there was a reasonable spread of age groups represented across all the focus groups.

**Table 2 Age range of participants across all focus groups**

| AGE RANGE | BAIRNSDALE | | TRARALGON | | MELBOURNE | | ALL | |
|---|---|---|---|---|---|---|---|---|
| | FREQUENCY | PERCENT | FREQUENCY | PERCENT | FREQUENCY | PERCENT | FREQUENCY | PERCENT |
| 18-25 | 7 | 18.9 | 3 | 8.3 | 12 | 34.3 | 22 | 20.4 |
| 26-35 | 10 | 27.0 | 14 | 38.9 | 6 | 17.1 | 30 | 27.7 |
| 36-45 | 5 | 13.5 | 6 | 16.7 | 11 | 31.4 | 22 | 20.4 |
| 46-55 | 4 | 10.8 | 8 | 22.2 | 4 | 11.4 | 16 | 14.8 |
| 56-69 | 11 | 29.7 | 5 | 13.9 | 2 | 5.7 | 18 | 16.7 |
| Total | 37 | 100.0 | 36 | 100.0 | 35 | 100.0 | 108 | 100.0 |

Participants' highest level of education achieved varied considerably, with 22% having completed up to Year 12 or equivalent and 47% having had some level of high school education (Table 3). Eight percent (8%) had completed either a trade certificate or apprenticeship. Similarly, 8% indicated they had a postgraduate degree, with a further 22% achieving a bachelor or honours degree and 14% a diploma.

**Table 3 Highest level of education achieved**

| EDUCATION LEVEL | FREQUENCY | PERCENT |
|---|---|---|
| Year 9 or below | 2 | 1.9 |
| Year 10 or equivalent | 6 | 5.6 |
| Year 11 or equivalent | 19 | 17.6 |
| Year 12 or equivalent | 24 | 22.2 |
| Trade certificate or apprenticeship | 9 | 8.3 |
| Diploma | 15 | 13.9 |
| Bachelor or honours degree | 24 | 22.2 |
| Postgraduate degree | 9 | 8.3 |
| Total | 108 | 100.0 |

During the focus group welcome and introductions, participants identified themselves as working in a range of professions including tutors, teachers and coaches; retail and food service professionals; tradesmen; consultants and business owners; human resources and administrative professionals; and artists, actors and designers. Others identified themselves as students and researchers. Some said they were not working and several described themselves as stay-at-home parents or homemakers. Table 4 and Table 5 below provide more details of the employment status and occupation as indicated on participant survey forms.

### Table 4 Employment status of participants

| EMPLOYMENT STATUS | FREQUENCY | PERCENT |
|---|---|---|
| Employed full time | 23 | 21.3 |
| Employed part time or casual | 33 | 30.8 |
| Self employed | 9 | 8.4 |
| Unemployed | 7 | 6.5 |
| Retired/pension recipient | 8 | 7.5 |
| Home duties | 18 | 16.8 |
| Full time student | 7 | 6.5 |
| Part time student | 2 | 1.9 |
| Total | 107* | 100.0 |

*Missing 1 therefore n=107

### Table 5 Occupation of those employed

| EMPLOYMENT STATUS | FREQUENCY | PERCENT |
|---|---|---|
| Manager | 8 | 7.4 |
| Other | 6 | 5.6 |
| Professional | 18 | 16.7 |
| Technician or trade worker | 4 | 3.7 |
| Community or personal service worker | 5 | 4.6 |
| Clerical or administrative worker | 10 | 9.3 |
| Sales worker | 13 | 12.0 |
| Machinery operator or driver | 3 | 2.8 |
| Labourer | 2 | 1.9 |
| Not in paid employment | 20 | 18.5 |
| Missing | 19 | 17.6 |
| Total | 108 | 100.0 |

# 3 Results

## 3.1 Energy technologies

Previous research has shown that discussions of CCS are enhanced if framed around climate change and the portfolio of energy options. This is because without a need to mitigate climate change the need for CCS becomes obsolete (Ashworth, Boughen, Mayhew & Millar, 2010). In addition, knowledge, including self-rated knowledge, will impact on an individual's attitude towards the technology (Hobman, Ashworth, Graham & Hayward, 2012). As such, focus group participants were asked to rate their knowledge of energy sources/technologies on a scale of 1=no knowledge through to 7=high knowledge. Table 6 shows the changes in mean self-rated knowledge of all participants between the beginning and end of the focus group sessions. In similar research processes including an information provision component, participants' self-rated knowledge increased significantly across all technologies (Ashworth et al., 2009). The greatest reported increase in knowledge took place for CCS, the main topic of the focus group.

**Table 6 Changes in mean self-rated knowledge of energy sources and technologies**

| HOW WOULD YOU RATE YOUR KNOWLEDGE OF THE FOLLOWING ENERGY SOURCES/ TECHNOLOGIES? | PAIRED T-TESTS | | PRE-FOCUS GROUP | | POST-FOCUS GROUP | |
|---|---|---|---|---|---|---|
| | T-VALUE | DF | MEAN | SD | MEAN | SD |
| Solar *** | 6.14 | 107 | 3.91 | 1.322 | 4.56 | 1.285 |
| Coal fired (traditional/current methods)*** | 8.05 | 107 | 3.56 | 1.429 | 4.55 | 1.226 |
| Wind*** | 8.49 | 106 | 3.34 | 1.228 | 4.21 | 1.046 |
| Natural Gas*** | 6.97 | 107 | 3.31 | 1.351 | 4.19 | 1.104 |
| Hydro-electric*** | 8.46 | 104 | 2.94 | 1.336 | 3.85 | 1.350 |
| Oil*** | 8.11 | 107 | 2.88 | 1.302 | 3.94 | 1.255 |
| Nuclear*** | 8.43 | 106 | 2.58 | 1.244 | 3.62 | 1.264 |
| Wave/tidal*** | 9.66 | 106 | 2.42 | 1.394 | 3.83 | 1.384 |
| Biofuels*** | 8.13 | 107 | 2.39 | 1.281 | 3.55 | 1.307 |
| Geothermal (hot rocks)*** | 8.37 | 107 | 2.31 | 1.235 | 3.56 | 1.475 |
| Carbon Capture and Storage (CCS)*** | 20.53 | 107 | 2.19 | 1.177 | 5.06 | 1.248 |
| Coal seam gas*** | 9.04 | 107 | 2.16 | 1.060 | 3.44 | 1.356 |

Likert scale 1=no knowledge, 7=high knowledge
DF= degrees of freedom; SD= standard deviation
*** Statistically significant at p<0.001

Participants were asked to rate their level of agreement with the use of several energy sources/technologies. As shown in Table 7, renewable sources such as solar and wind received the most support while non-renewable sources received the least. Support for CCS increased the most of all the energy sources/technologies presented. Reflecting a positive response to the focus group process and information provided.

**Table 7 Changes in attitudes towards energy sources and technologies**

| HOW STRONGLY DO YOU AGREE WITH THE USE OF THE FOLLOWING ENERGY SOURCES/ TECHNOLOGIES? | PAIRED T-TESTS | | PRE-FOCUS GROUP | | POST-FOCUS GROUP | |
|---|---|---|---|---|---|---|
| | T-VALUE | DF | MEAN | SD | MEAN | SD |
| Solar | -1.69 | 107 | 6.16 | 1.112 | 6.00 | 1.059 |
| Wind** | 2.81 | 107 | 5.20 | 1.551 | 5.55 | 1.278 |
| Natural Gas** | -3.13 | 105 | 5.06 | 1.286 | 4.70 | 1.243 |
| Hydro-electric | 0.27 | 104 | 4.97 | 1.087 | 4.94 | 1.183 |
| Wave/tidal | 1.35 | 106 | 4.81 | 1.230 | 4.99 | 1.370 |
| Geothermal (hot rocks) | 1.76 | 106 | 4.45 | 1.135 | 4.68 | 1.186 |
| Biofuels** | 3.10 | 107 | 4.35 | 1.263 | 4.71 | 1.261 |
| Coal fired (traditional/current methods) | -0.76 | 104 | 4.17 | 1.464 | 4.07 | 1.482 |
| Carbon Capture and Storage (CCS)*** | 9.40 | 103 | 4.08 | 0.921 | 5.48 | 1.174 |
| Coal seam gas* | 2.41 | 106 | 3.79 | 1.141 | 4.03 | 1.201 |
| Oil* | 2.35 | 106 | 3.68 | 1.138 | 3.95 | 1.269 |
| Nuclear** | 3.01 | 107 | 3.05 | 1.660 | 3.50 | 1.912 |

Likert scale 1=strongly disagree, 7=strongly agree
DF= degrees of freedom; SD= standard deviation
***Statistically significant at p<0.001
** Statistically significant at p<0.01
*Statistically significant at p<0.05

## 3.2 Climate change

Previous research has shown that public acceptance of CCS technology is associated with the public recognising that climate change is an important issue and that a reduction in $CO_2$ levels is therefore required (Bradbury et al., 2009). Accordingly, participants were asked a series of questions around climate change to ascertain their current thinking about this topic. Questions focused around their belief in climate change, the causes of climate change and what they think the response to climate change will be. In response to the question "Do you believe the climate is changing now or will change in the next thirty years?" the majority (85%) of participants responded yes, it is already happening (Table 8). One participant indicated they did not believe it was happening, and 7% either felt climate change will start happening in the next 30 years or did not know and were unsure. Similarly, the majority (71%) of participants indicated they felt climate change was caused by both human activities and natural changes in the environment (Table 9).

### Table 8 Belief in climate change

| | FREQUENCY | PERCENT |
|---|---|---|
| Yes, it is already happening | 92 | 85.2 |
| It will start happening within the next 30 years | 8 | 7.4 |
| No it is not happening and won't | 1 | 0.9 |
| I do not know or I am not sure | 7 | 6.5 |
| Total | 108 | 100.0 |

### Table 9 Causes of climate change

| | FREQUENCY | PERCENT |
|---|---|---|
| Caused mostly by human activities | 24 | 22.2 |
| Caused mostly by natural changes in the environment | 4 | 3.7 |
| Caused by both human activities and natural changes in the environment | 77 | 71.3 |
| I do not know or I am not sure | 2 | 1.9 |
| Is not happening and won't | 1 | 0.9 |
| Total | 108 | 100.0 |

When asked to indicate whether they felt Australia should take action to respond to either current or future climate change, participants overwhelmingly indicated a positive response (94%; Table 10). The majority (74%) were also of the belief that new technologies would be developed to solve the issue of climate change (Table 11).

### Table 10 Should Australia take action on climate change?

| | FREQUENCY | PERCENT |
|---|---|---|
| Yes | 102 | 94.4 |
| No | 2 | 1.9 |
| I do not know or I am not sure | 4 | 3.7 |
| Total | 108 | 100.0 |

### Table 11 Most likely response to climate change

| | FREQUENCY | PERCENT |
|---|---|---|
| New technologies will be developed to try and solve the issue of climate change | 79 | 73.8 |
| We will change our lifestyles to reduce energy consumption | 14 | 13.1 |
| We will live with climate change and adapt to a warmer climate | 6 | 5.6 |
| Climate change is a problem but Australia won't do anything about it | 4 | 3.7 |
| I am not sure which of these is closest to my views on climate change | 4 | 3.7 |
| Total | 107 | 100.0 |

Consistent with the evaluation about knowledge of energy sources and technologies, a set of questions were included in the pre-focus group and post-focus group questionnaires to determine if there was any shift on self-rated knowledge of climate change and related topics as a result of participating in focus group. Participants were asked to rate their knowledge on a scale of 1=no knowledge through to 7=high knowledge. Because the topic of climate and energy was the focus of the expert presentation it was expected that the majority of participants would report an increase in their self-rated knowledge from the beginning to the end of the focus group. Table 12 shows that all changes were significant, except around electricity conservation in the home which was not a primary focus of the presentation or discussions.

### Table 12 Changes in mean self-rated knowledge of climate change and related topics

| HOW WOULD YOU RATE YOUR KNOWLEDGE OF THE FOLLOWING? | PAIRED T-TESTS | | PRE-FOCUS GROUP | | POST-FOCUS GROUP | |
|---|---|---|---|---|---|---|
| | T-VALUE | DF | MEAN | SD | MEAN | SD |
| Climate change*** | 12.37 | 107 | 3.70 | 1.079 | 4.85 | 0.873 |
| Greenhouse gas emissions*** | 10.95 | 107 | 3.49 | 1.156 | 4.76 | 0.994 |
| Government initiatives to reduce greenhouse gas emissions*** | 8.61 | 105 | 3.32 | 1.167 | 4.38 | 1.082 |
| Electricity conservation in the home | 1.32 | 106 | 4.60 | 1.302 | 4.73 | 1.154 |
| Industry initiatives to reduce greenhouse gas emissions*** | 11.05 | 107 | 3.10 | 1.067 | 4.34 | 1.129 |
| Electricity conservation in the workplace*** | 6.29 | 107 | 3.37 | 1.048 | 4.12 | 1.364 |
| The relationship between the price of electricity and greenhouse gas emissions*** | 11.80 | 107 | 2.97 | 1.286 | 4.48 | 1.156 |

Likert scale 1=no knowledge, 7=high knowledge
DF= degrees of freedom; SD= standard deviation
*** Statistically significant at p<0.001

When asked about their attitudes towards climate change, many agreed that electricity is a major contributor to greenhouse emissions and more should be done to reduce greenhouse gas emissions. Most attitudes that were investigated (except that 'people should be doing more to promote electricity conservation in the workplace') changed positively over the course of the focus group (Table 13). While overall, participants were still unsure about the effect of increasing the price of electricity on greenhouse gas emissions, participants' attitudes towards climate change and greenhouse gas emissions were more positive as a result of participating in the focus group.

**Table 13 Changes in attitudes towards climate change and related topics**

| HOW STRONGLY DO YOU AGREE WITH THE FOLLOWING? | PAIRED T-TESTS | | PRE-FOCUS GROUP | | POST-FOCUS GROUP | |
|---|---|---|---|---|---|---|
| | T-VALUE | DF | MEAN | SD | MEAN | SD |
| Climate change is an important issue for Australia*** | 5.45 | 106 | 5.28 | 1.541 | 5.94 | 1.227 |
| The production of electricity is a major contributor to greenhouse gas emissions*** | 8.02 | 105 | 4.78 | 1.302 | 5.81 | 1.296 |
| Industry should be doing more to reduce greenhouse gas emissions*** | 7.15 | 106 | 5.33 | 1.196 | 6.07 | 1.052 |
| People should be doing more to promote electricity conservation in the home* | 2.05 | 106 | 5.75 | 1.158 | 5.93 | 1.012 |
| Government should be doing more to reduce greenhouse gas emissions*** | 5.96 | 106 | 5.42 | 1.274 | 6.06 | 1.131 |
| People should be doing more to promote electricity conservation in the workplace | 1.92 | 105 | 5.78 | 1.130 | 5.95 | 1.055 |
| Increasing the price of electricity to help reduce greenhouse gas emissions*** | 6.66 | 106 | 2.87 | 1.608 | 4.03 | 1.930 |

Likert scale 1=strongly disagree, 7=strongly agree
DF= degrees of freedom; SD= standard deviation
***Statistically significant at p<0.001
*Statistically significant at p<0.05

## 3.3 Factors influencing support for energy technologies

In the post-focus group questionnaire, participants were asked to consider a number of factors that might influence them "in deciding whether or not to support new energy sources and related technologies" and results are shown in Table 14. Participants agreed strongly that environmental issues (M=5.58, SD=1.36) and electricity prices (M=5.43, SD=1.36) would influence whether or not they supported a new energy source and related technologies. However all of these factors were rated highly. Future research may investigate the priority order for these factors to better distinguish which of these might have greatest influence.

**Table 14 Important factors influencing support for energy technologies**

| FACTORS | N | MEAN | SD |
|---|---|---|---|
| Environmental issues | 108 | 5.58 | 1.361 |
| Climate issues | 106 | 5.29 | 1.187 |
| Economic issues | 108 | 5.24 | 1.373 |
| Electricity prices | 108 | 5.43 | 1.355 |
| Reliability of electricity supply | 108 | 5.18 | 1.400 |
| The issues of the surrounding community where new infrastructure is implemented | 108 | 5.12 | 1.302 |

Likert scale 1=strongly disagree, 7=strongly agree
SD= standard deviation

Participants were also asked whether they think others that are important to them, such as friends and family, would approve of their decision to support particular energy technologies. Results are presented in Table 15 and show that, in general, participants felt that those who are important to them would approve of their decision to support renewable energy. Participants were more likely to believe that other people would approve of their decision to support renewable energy resources (M=5.77, SD=1.32) when compared to low carbon fossil fuels (M=5.36, SD=1.22); $t(106)=3.03$ $p<0.01$. And participants were more likely to believe that other people would approve of their decision to support low carbon fossil fuels (M=5.36, SD=1.22) compared to nuclear energy (M=3.78, SD=1.71); $t(106)=8.37$ $p<0.001$. Note that the t-values calculated here compare between the energy types listed in Table 15 rather between pre- and post-focus group questionnaires as done previously.

**Table 15 Approval from important others**

| IF I SUPPORTED THE USE OF | N | MEAN | SD |
|---|---|---|---|
| Renewable energy | 107 | 5.77 | 1.322 |
| Low-emission fossil-fuel based energy | 107 | 5.36 | 1.215 |
| Low-emission nuclear | 107 | 3.78 | 1.712 |

Likert scale 1= disapprove, 7=approve
SD= standard deviation

# 4 Focus on CCS

## 4.1 Response to information

Throughout the focus group sessions, participants had the opportunity to ask the expert questions about CCS and its context. Occasionally they followed lines of questioning which led into broader topics and areas connected to CCS, such as the carbon price and other motives and incentives for mitigating climate change. A full set of questions asked by participants can be found in Appendix B. Analysis of all of the 156 questions from participants, across all focus groups in relation to CCS were considered to represent six key themes (Figure 1) which included:

1. CCS impacts and $CO_2$ behaviour underground (32%)
2. Alternatives and comparisons i.e. between CCS and other technologies/options (22%)
3. Economics of CCS and the Australian carbon price (17%)
4. Current events in relation to CCS and international comparisons (17%)
5. Ulterior motives and vested interests supporting CCS (6%)
6. Timelines for deployment and future use of CCS (5%)

Note: Total not equal to 100% due to rounding error.

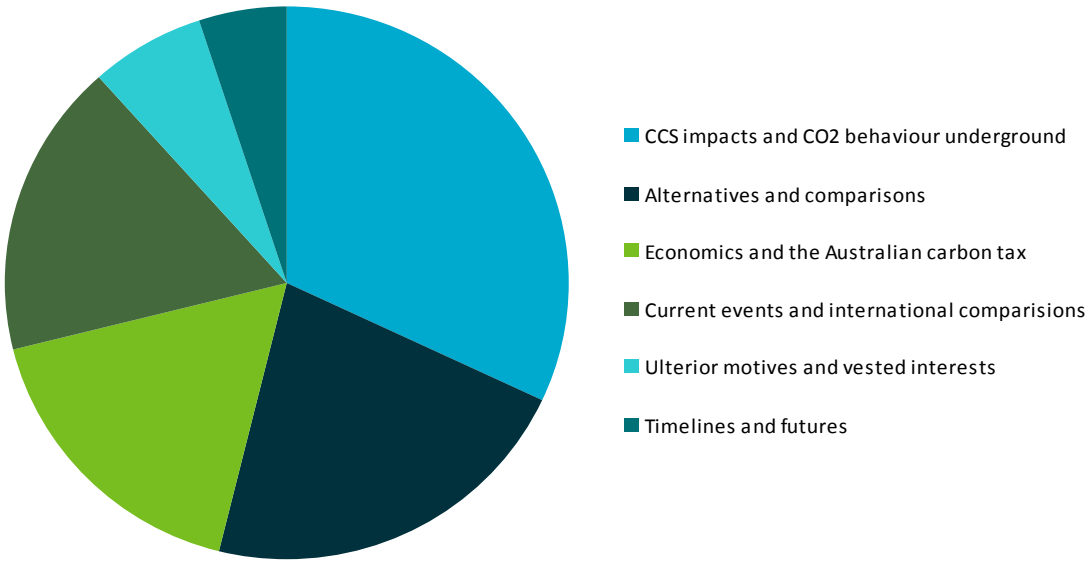


**Figure 1 Key themes participants asked questions about in response to information**

A similar pattern of questions was asked in each location, with only a few exceptions. For example, Bairnsdale participants did not raise any questions about when CCS is expected to be widely used. Instead, they were more focused on the economic viability of CCS and about the carbon price. In contrast, Melbourne and Traralgon participants had more questions about how CCS works, how $CO_2$ behaves, its properties, and what potential consequences might result from CCS.

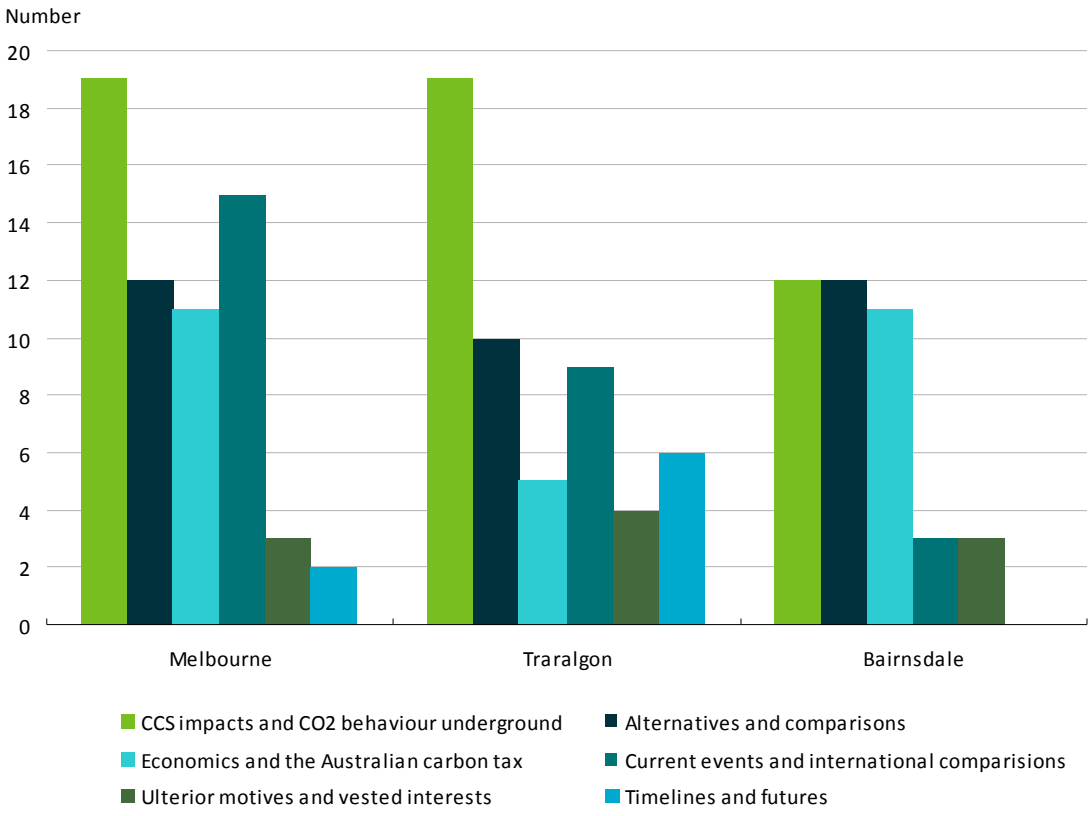


**Figure 2 Question themes asked by location**

### 4.1.1 CCS IMPACTS AND $CO_2$ BEHAVIOUR UNDERGROUND

Participants in each of the three locations asked whether the injection of $CO_2$ will create environmental problems, particularly over the long term. Concerns centred on how $CO_2$ will behave underground, such as whether it would displace oil, solidify, create cracks underground, affect groundwater, or change the composition of the earth.

Participants wanted to know how scientists and engineers currently know that CCS is safe and will continue to be safe over time. They wanted to know how leaks would be monitored and what worst case scenario might result from CCS. The questions posed by participants displayed some concerns about the limits of human knowledge regarding environmental risks and potential natural disasters that may affect energy infrastructure.

In addition to concerns over the behaviour of $CO_2$ and the long-term safety of having it underground, people were also interested in how long the solution of CCS can be sustained, and whether, after some point, all of the storage space will have been taken up. They also wanted to know if CCS was successful in storing $CO_2$, could it cause larger knock-on effects and impacts. For example, would it impact on availability of jobs, out-competing other types of energy, or demanding the construction of completely different power plant infrastructure?

Not only did people ask about potential environmental and long-term problems that could be caused by CCS, they also asked more general questions about how CCS works, such as whether natural and human-created $CO_2$ deposits are different; how capture works; and what properties are associated with naturally-occurring $CO_2$.

### 4.1.2 ALTERNATIVES AND COMPARISONS

Focus group participants wanted to know whether CCS is truly necessary, or whether there is some alternative technology or process that could meet the same needs. People asked whether there is some use that $CO_2$ can be put to. For example, whether it can be converted into another gas or can be broken down. Participants asked whether CCS has been chosen as a research direction because it has been shown to be better than other technologies, and if so, why has it been considered the most appropriate. They wanted to know whether it is truly appropriate for society to be considering such a broad range of alternative energy technologies or whether investment should be more focused on specific ways to stop climate change, such as renewable energy developments, infrastructure developments, lifestyle modification, education, or any combination of these. A few people also wanted to know about the emissions produced by the CCS process itself.

### 4.1.3 ECONOMICS AND THE AUSTRALIAN CARBON PRICE

Participants in eight of the twelve groups had questions relating to carbon taxes or incentives for CCS. Questions ranged from whether CCS investment will raise consumer prices? How CCS will be supported? Why carbon tax revenues are not supporting CCS? And how the price for $CO_2$ is expected to change?

### 4.1.4 CURRENT EVENTS AND INTERNATIONAL COMPARISONS

Participants asked whether CCS research was currently underway in particular Australian locations. They were also curious about the international progress and testing status of CCS projects, and whether it is truly a new technology given that it has been used overseas. Repeatedly, participants asked whether Australia, as an energy exporter, has more responsibility to investigate or develop CCS than do other countries. That is, making Australia accountable for the emissions of the energy exports that are subsequently burned offshore.

### 4.1.5 ULTERIOR MOTIVES AND VESTED INTERESTS

Participants observed that the WWF/CFMEU information sheet that was used in the focus group presented a biased view towards CCS as a solution. As such, participants were quick to link the CFMEU as having a vested interest in prolonging the life of coal mining for their workers. Based on previous research by Terwel, Harinck, Ellemers and Daamen (2009) that examined elements of trust in the message source, this response was not unexpected. Participants also questioned why power stations and energy companies had not already taken responsibility for their own emissions without the support of public research dollars.

### 4.1.6 TIMELINES AND FUTURES

Participants raised some questions about how long it would take before CCS can be used, and when it is expected to be implemented at power stations. They wondered whether the time line for large-scale development, alluded to in the information sheet, is already underway or not. There was also a question about whether CCS would be widely implemented due to potential ownership of the technology by its developers.

## 4.2 Perceived impacts of CCS

On the final focus group questionnaire, participants were asked a series of open ended questions for them to outline what they felt would be the impacts of CCS on the environment, on people/wider society, on community infrastructure and the economy.

### 4.2.1 PERCEIVED IMPACTS ON THE ENVIRONMENT

In response to the question on what they felt would be the environmental impacts of CCS, a series of open ended comments were provided (Table 16). For example, a considerable number of participants (31.4%) thought CCS will improve the environment and/or lower emissions, however there was a reasonable degree of risk consciousness shown by some (17.5%) recognising that effects (including long-term) are uncertain and could be negative. Quotes summarising the key phrases that were raised under each topic are listed in Appendix C.

**Table 16 Perceived environmental impacts of CCS**

| TYPE OF IMPACT | THEME | PERCENT |
|---|---|---|
| **Negative** | Effects (including long-term) are uncertain and could be negative | 17.5 |
| | Leak or explode and cause harm above ground | 9.3 |
| | Infrastructure will consume habitat, living space, and financial resources | 6.4 |
| | Harm water and aquifers underground | 3.9 |
| | Destabilise or fracture the earth | 3.6 |
| | Choosing this technology is not the right path forward | 3.6 |
| **Neutral** | I don't know what the environmental effects will be | 7.9 |
| | No environmental impact | 3.6 |
| | Very small environmental impact | 3.6 |
| | Missing or other | 1.4 |
| **Positive** | Will improve the environment and/or lower emissions | 31.4 |
| | Could have some effects but it is still the right path if done correctly | 6.4 |
| | Tolerable as a temporary, initial solution | 1.4 |
| **Total** | | 100.0 |

### 4.2.2 PERCEIVED IMPACTS ON PEOPLE/WIDER SOCIETY

Similarly, participants were asked to identify what they thought might be the impacts of CCS on people and wider society. Table 17 shows the main themes related to participants perceived impacts on people and society. Many participants were neutral in their response. However, the most commonly reported impacts were more, different and protected jobs (15.4%), followed by increased costs and taxes to the community (13.8%). Examples of the key phrases for each theme are found in Appendix C.

**Table 17 Perceived impacts on people/wider society**

| TYPE OF IMPACT | THEME | PERCENT |
|---|---|---|
| **Negative** | Increased tax and costs to communities | 13.8 |
| | Confusion, uncertainty, fear, opposition, social unrest | 4.9 |
| | Fewer jobs | 3.3 |
| | Negative health effects on communities | 2.4 |
| | Decreased awareness or increased complacency, laziness, unwillingness to change | 2.4 |
| | Disasters, leaks, explosions | 1.6 |
| | Change in land use | 0.8 |
| **Neutral** | Missing or other | 25.2 |
| | No (or very little) effect | 6.5 |
| | Unsure | 3.3 |
| **Positive** | More, different, or better-protected jobs | 15.4 |
| | Clean/ generally improve the environment | 7.3 |
| | Increased awareness, optimism, and/or responsibility | 5.7 |
| | Decrease emissions, prevent excess climate change | 4.9 |
| | Support for future generations | 2.4 |
| **Total** | | 100.0 |

### 4.2.3 PERCEIVED IMPACTS ON COMMUNITY INFRASTRUCTURE

As part of the question participants were asked to indicate the perceived impacts on community infrastructure. In this instance participants were more positive where they saw an opportunity for increased jobs within the local area (Table 18). However, a considerable proportion (40%) of participants chose not to respond. This lack of response may be an indication that participants found this question of little concern to them at present. Some of the quotes regarding community infrastructure are listed in Appendix C.

**Table 18 Perceived impacts on community infrastructure**

| TYPE OF IMPACT | THEME | PERCENT |
|---|---|---|
| **Negative** | Change in land use | 4.3 |
| | Increased tax and costs to communities | 3.4 |
| | Confusion, uncertainty, fear, opposition, social unrest | 1.7 |
| | Fewer jobs | 1.7 |
| | Decreased awareness or increased complacency, laziness, unwillingness to change | 0.9 |
| | Negative health effects on communities | 0.9 |
| **Neutral** | Missing or other | 40.2 |
| | Unsure | 13.7 |
| | No (or very little) effect | 5.1 |
| **Positive** | More, different, or better-protected jobs | 12.8 |
| | New or better infrastructure | 6.0 |
| | Clean/ generally improve the environment | 3.4 |
| | Increased awareness, optimism, and/or responsibility | 2.6 |
| | More business for big business | 0.9 |
| | Decrease emissions, prevent excess climate change | 0.9 |
| | Support for future generations | 0.9 |
| | Strengthen economy | 0.9 |
| **Total** | | 100.0 |

### 4.2.4 PERCEIVED IMPACTS ON THE ECONOMY

Finally when asked to outline the perceived impacts of CCS on the economy, again participants' responses were varied (Table 19). Twenty five percent (25%) reported an anticipated increased tax and costs to communities. In a more positive sense, a considerable number of participants (17%) recognised the potential boost to the jobs market, and a further number (11%) recognised the possible strengthening of the economy. A more detailed breakdown of the comments received at the end of the focus group is listed in Appendix C.

Table 19 Perceived impacts on the economy

| TYPE OF IMPACT | THEME | PERCENT |
|---|---|---|
| **Negative** | Increased tax and costs to communities | 25.0 |
| | Weaken economy | 4.5 |
| | Fewer jobs | 2.3 |
| | Change in land use | 0.8 |
| **Neutral** | Missing or other | 25.8 |
| | More business for big business | 3.0 |
| | Unsure | 1.5 |
| | No (or very little) effect | 0.8 |
| **Positive** | More, different or better-protected jobs | 17.4 |
| | Strengthen economy | 10.6 |
| | Decrease emissions, prevent excess climate change | 2.3 |
| | Clean/generally improve the environment | 1.5 |
| | Increased awareness, optimism and/or responsibility | 1.5 |
| | New or better infrastructure | 1.5 |
| | Support for future generations | 1.5 |
| **Total** | | 100.0 |

## 4.3 The concept of a local CCS project

Previous research has shown that individuals tend to hold more negative attitudes when certain activity is proposed for their local residential area than they would normally (Terwel and Daamen 2012). As such, the post-focus group questionnaire included a series of questions about the participants' willingness to accept CCS technology in their local area in the future. Table 20 shows the perceptions of participants in relation to having CCS projects operating in their area. The majority of respondents reported to agree that in general, they approve of CCS energy projects in their local area (65.5%) and believe that they should proceed in their area (66.6%). The majority of participants also reported to believe CCS projects will be carried out credibly (63.9%) and responsibly (56.5%). This is considered an important aspect of public acceptance of CCS, as previous research has shown that the general public is more likely to accept new technologies if they believe the deployment of the project will be conducted in a fair and just manner (Bradbury et al., 2009).

### Table 20 Perceptions of CCS projects in their local area in percentages

| | RESPONSE | | | | | TOTAL |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| You believe CCS energy projects should proceed in your area | 3.7 | 6.5 | 24.3 | 42.1 | 23.4 | 100 |
| You approve of CCS energy projects in your area | 6.5 | 4.6 | 22.2 | 40.7 | 25.9 | 100 |
| You believe that CCS projects have a legitimate place within your community | 4.6 | 5.6 | 21.3 | 42.6 | 25.9 | 100 |
| You believe that CCS projects will be carried out credibly | 2.8 | 6.5 | 26.9 | 37.0 | 26.9 | 100 |
| You trust that CCS projects will be carried out responsibly | 3.7 | 4.6 | 35.2 | 35.2 | 21.3 | 100 |

Likert scale 1=not at all, 5=very much

In the post-questionnaire, participants were also asked at what distance they think CCS projects should be kept from the nearest residence. Table 21 and Figure 3, show the participants' responses. The majority of participants (58%) indicated that CCS projects should be kept more than ten kilometres away, which was the furthest option available to them in the question.

### Table 21 Minimum preferred distance of CCS project from local area

| MINIMUM DISTANCE | FREQUENCY | PERCENT |
|---|---|---|
| 1 km from nearest residence | 8 | 7.4 |
| 2 km from nearest residence | 3 | 2.8 |
| 5 km from nearest residence | 12 | 11.1 |
| 10 km from nearest residence | 16 | 14.8 |
| More than 10 km away | 63 | 58.3 |
| Missing | 6 | 5.6 |
| Total | 108 | 100.0 |

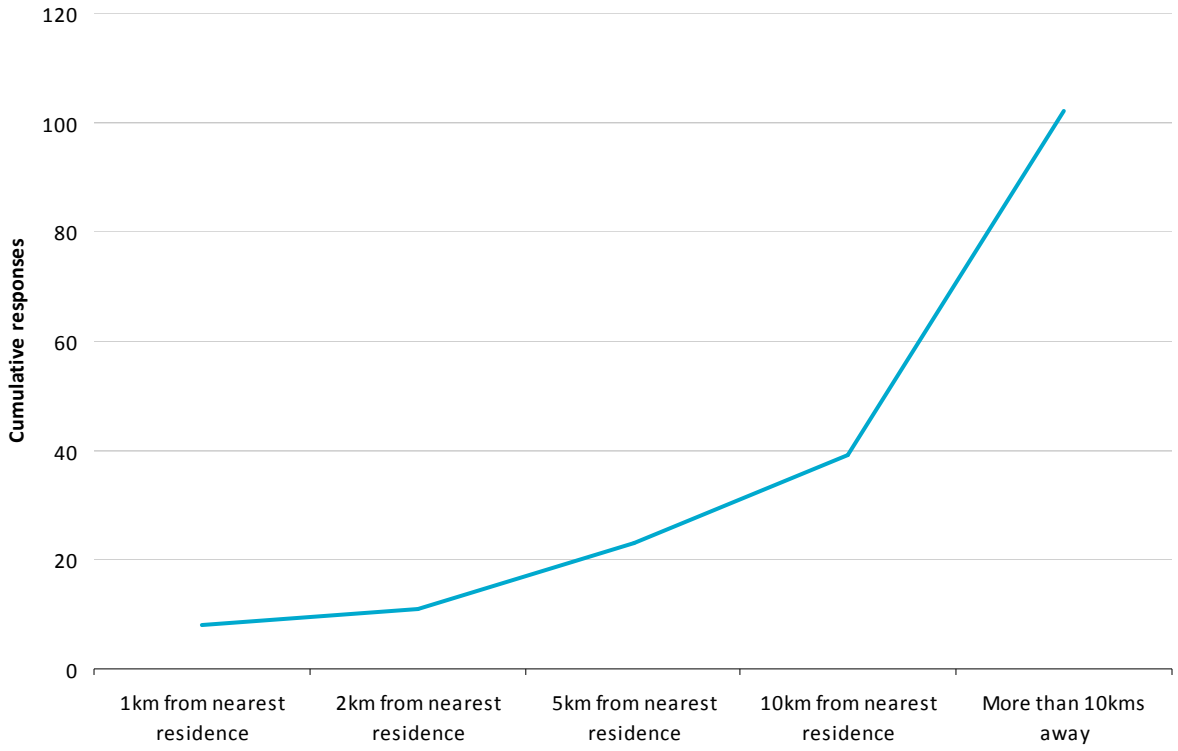


**Figure 3 Cumulative total of minimum preferred distance**

Those participants who responded "more than 10 km away" were asked to specify their minimum preferred distance. The responses ranged from more than ten kilometres with a caveat for some around being unsure if it was safe, or only if it does not leak has been proven. However, there were other numerical responses such as 1,000,000 km off the earth, to more qualitative responses such as in America, in another part of the world – desert or sea, and "as far away as possible". Table 22 summarises the coded numerical responses that were received and the additional open ended comments included:

*As far as possible until more testing is completed once built*
*Depends on health and noise pollution issues*
*Depends on the location*
*The Latrobe Valley could become a $CO_2$ carbon filled bowl*
*In an area where carbon can't be trapped if it leaked – 20 km from nearest populated area i.e. town*
*Miles away – I would consider moving*
*Depends on where the storage edge reaches*
*Not in built up areas*
*Whatever is proved to be the safest in case of leakage*
*Whatever would be deemed the safest distance by the experts*

**Table 22 The closest minimum distance beyond 10 km**

| | FREQUENCY |
|---|---|
| More than 10 km up to 50 km inclusive | 30 |
| More than 50 km up to 100 km inclusive | 5 |
| 100 km or more | 5 |
| Far away, or as far away as possible | 8 |
| Nowhere, or I don't support CCS | 1 |
| Not sure, or I don't know enough to decide | 9 |
| Total | 58 |

## 4.4 Comparison with wind

Participants were asked to respond to the same question in relation to the preferred minimum distance for siting a wind farm. In comparison to CCS it appears that the majority of participants are slightly more accepting of wind farms being closer to their local area than they are of CCS. In this instance only 45 participants were expecting wind farms to be sited more than 10 km away from their local area (Table 23). However, again as we see play out in society, there were those who were opposed to wind farms that again wanted them “as far away as possible”. Others that responded “I don’t agree with wind farms”, “not in eyesight” or “at a distance that the noise was at a level deemed safe for people. I'm not sure what that distance is.”

**Table 23 Minimum preferred distance of wind farm from local area**

| MINIMUM DISTANCE | FREQUENCY | PERCENT |
|---|---|---|
| 1 km from nearest residence | 9 | 8.3 |
| 2 km from nearest residence | 9 | 8.3 |
| 5 km from nearest residence | 19 | 17.6 |
| 10 km from nearest residence | 24 | 22.2 |
| More than 10 km away | 45 | 41.7 |
| Missing | 2 | 1.9 |
| Total | 108 | 100.0 |

## 4.5 Trust

Previous research has shown that trust in information sources can influence public attitudes and the effectiveness of communication strategies ( Van de Velde, Verbeke, Popp & Van Huylenbroeck, 2011). In order to investigate which sources of information people trust in relation to climate change and emerging technologies, participants were asked to rate a range of sources of information on a scale of 1=distrust

through to 5=trust a lot. As shown in Table 24, CSIRO was one of the highest trusted information sources followed by books, government factsheets, the Internet and family or friends. Industry associations, social media and both state and local newspapers were less trusted overall.

**Table 24 Trust in information sources**

| IF I SUPPORTED THE USE OF | N | MEAN | SD |
|---|---|---|---|
| The CSIRO | 107 | 3.79 | .855 |
| Books | 107 | 3.58 | .727 |
| Government factsheets | 107 | 3.36 | .993 |
| Internet | 106 | 3.35 | .756 |
| Family or friends | 108 | 3.31 | .870 |
| Community groups | 108 | 3.28 | .708 |
| National newspapers | 108 | 3.11 | .824 |
| Industry employees | 108 | 3.10 | .842 |
| Radio | 108 | 3.06 | .852 |
| Television | 108 | 3.06 | .910 |
| Your employer | 107 | 3.03 | .884 |
| Local newspapers | 108 | 2.94 | .846 |
| Industry association | 107 | 2.92 | .791 |
| State newspapers | 107 | 2.84 | .923 |
| Social networking | 106 | 2.42 | .956 |

Likert scale 1=distrust a lot, 5=trust a lot
SD= standard deviation

Trust in information sources arose during discussions and opinions were somewhat similar to the results of the survey, with participants preferring information that was delivered by an independent source such as the CSIRO. Similarly, some participants expressed distrust towards certain sources such as the government and media. Furthermore, participants showed preference towards information that was balanced and without bias.

> *"If there's an ad put on the television by the CSIRO I am going to trust that more than just an editorial article that might have some sort of agenda".* (M1)
>
> *"I think it's perhaps also good to have someone from outside of this area come in rather – I mean CSIRO, rather than a local group".* (T1)
>
> *"I personally, wouldn't trust the Victorian government putting out any information on it…"* (B1)
>
> *"We want all the facts, we don't just want the facts that you guys want us to hear".* (B2)

When asked to evaluate how much trust they placed in each of the focus group communication activities, the highest rating was awarded to the information from the expert (M=5.68, SD=1.21), followed by the complete package of information (M=5.46, SD=1.26). The video and then the discussions were the next most trusted, with the fact sheet being rated least trusted as was expected given the bias of the fact sheet (Table 25).

**Table 25 Focus group activities and features: Trust in the activities**

| | N | MEAN | SD |
|---|---|---|---|
| The presentation from the expert | 108 | 5.68 | 1.214 |
| The factsheet that was provided | 108 | 4.86 | 1.501 |
| The video | 108 | 5.16 | 1.382 |
| The discussions | 108 | 5.12 | 1.365 |
| The total package of information | 108 | 5.46 | 1.256 |

Likert scale 1=distrust a lot, 7=trust a lot
SD= standard deviation

## 4.6 Response to new developments

Most participants reported that they generally take an interest in finding out about new developments that are happening in their local area. As shown on Table 26, the majority of participants (72%) indicated that they typically find out about projects. Half of the participants also indicated that they typically ask questions of the organisers and that they do not normally oppose new developments.

**Table 26 Actions in response to proposals for new developments in their area**

| | NOT AT ALL | NOT SURE | VERY MUCH |
|---|---|---|---|
| Find out about them | 13% | 15% | 72% |
| Oppose them | 51% | 44% | 5% |
| Ask questions of organisers | 27% | 19% | 54% |
| Having nothing to do with them | 49% | 37% | 14% |

## 4.7 Preferences for engagement

One of the topics discussed during the focus group sessions were participants' preferences for engagement. In particular, participants were asked how they would like to be engaged with regards to new energy technologies or projects. Participants expressed a range of opinions on this discussion topic, with several common themes emerging.

Overall, there seemed to be consensus that more engagement on these topics was required and that multiple methods would be needed to reach a wide audience. Participants indicated that people would learn from and respond to information in different ways and therefore communication efforts would need to be targeted towards specific groups. One participant gave the following example.

> *"… say for the youth, you might do more YouTube, videos or film. For the more academic society, you would put a published paper…but making sure you focus the message you're sending to specific groups at their level that they would take it in best."* (T3)

This idea was further illustrated by the range of personal preferences described by the participants. Some preferred television either through programming or advertising as an effective way to inform them of new information. Whereas others said they would be more likely to read information that was made available on the internet or in the newspaper. In addition, participants felt face-to-face communication similar to

what they experienced in the focus group was useful, as they were able to ask an expert their specific questions.

> *"I've always watched stuff on TV to learn more."* (T4)
>
> *"I'm a reader, I read. So none of that would work for me. Yet if I got it in an email."* (T3)
>
> *"I think information sessions like this are good because you can ask questions."* (T1)

Another opinion that was commonly shared was that information should be delivered in layman's terms, so scientific and technical issues would be easy for the general public to understand. Participants also expressed that too much information can be overwhelming and confusing.

> *"Talk in layman's terms and people can understand and people can see with a vision that, yeah, this is going to work."* (T4)
>
> *"And for people like me, I prefer something that was just basically informative."* (M2)
>
> *"As soon as you get into jargon and big words. Like I tune out…but in simple language that people can, oh yeah, yeah, that works. I think that would help."* (B2)
>
> *"It's no good bombarding us sometimes with overloaded information because then you do get confused."* (B4)

As shown in Table 27, when participants were asked if they would like to be engaged if a new energy technology project was proposed in their area, the majority (89%) expressed an interest in being engaged, with a further 9% unsure. This demonstrates that the general public is interested in consultation and it appears the majority of participants view this as a positive opportunity.

**Table 27 Interest in engagement for your area**

| | FREQUENCY | PERCENT |
|---|---|---|
| Yes | 96 | 88.9 |
| No | 2 | 1.9 |
| Unsure | 10 | 9.3 |
| Total | 108 | 100.0 |

Previous research in relation to CCS projects and other energy technologies have raised issues around procedural justice (Bradbury et al., 2009). Procedural justice refers to the extent people perceive the decision process to be fair and transparent, whether they are able to express their opinions freely, and their views heard (Gross, 2007). Gross (2007) suggests: "People who feel that they have been treated fairly are more likely to accept the decisions resulting from the process, and also will be more likely to trust the institution making the decision."

Focus group participants were asked how confident they were that if a new energy project was proposed for their area, the process for engagement would be fair, transparent, allow for open communication and dialogue, and provide a point of contact for the project. In general, one-third of participants believe that the process would be fair, their views would be heard and the process would provide them the opportunity to have a say and be ongoing. However, a large proportion of participants (35-49%) were unsure about how just the engagement process would be, with about a quarter of participants expressing they were not confident that an engagement process would be just (Table 28).

**Table 28 Procedural justice issues**

| | NOT CONFIDENT | NOT SURE | CONFIDENT |
|---|---|---|---|
| Be fair | 16% | 49% | 36% |
| Be transparent | 29% | 47% | 24% |
| Allow my views to be heard | 29% | 38% | 33% |
| Provide me with the opportunity to have a say | 28% | 35% | 37% |
| Be ongoing (e.g. I would be able to call someone) | 27% | 42% | 31% |

## 4.8 Focus group evaluation

As shown in Table 29, most participants indicated that their understanding about CCS had improved due to participating in the focus group activities, particularly from the expert presentation.

**Table 29 Focus group activities and features: Understanding from the activities**

| | MEAN | SE | SD |
|---|---|---|---|
| The presentation from the expert | 5.98 | 0.108 | 1.127 |
| The factsheet that was provided | 4.82 | 0.142 | 1.471 |
| The video | 5.42 | 0.136 | 1.408 |
| The discussions | 5.43 | 0.120 | 1.247 |
| The total package of information | 5.73 | 0.107 | 1.104 |

Likert scale 1=strongly disagree, 7=strongly agree
SE= standard error; SD= standard deviation

Participants were also asked to indicate from a list of words, those they felt reflected the main purpose of the focus group. Most participants (69%) believed that the focus group purpose was to inform, followed by engage (55%), and access opinions (52%). Only a minority of respondents believed that the focus group purpose was to consult (22%), influence (20%) or convince (17%).

# 5 Factors associated with support for CCS

In this section we present the participant characteristics that were associated with attitudes toward CCS as an energy technology. Hierarchical regressions analyses were undertaken in order to investigate the associations between participants' characteristics and their attitudes towards CCS and distinguish the specific effects of them on participants' attitudes towards CCS after attending the focus group and on their likely acceptance of CCS in their local area. A regression model was run to determine the effect of the focus group attendance on participants' overall attitudes towards CCS. The analysis reports on investigations of the effect of participants' knowledge, attitudes and beliefs towards climate change, level of trust in CSIRO and the focus group presenter, and the influence of other people's opinions on participants' attitudes towards CCS.

## 5.1 Attitudes towards CCS post-focus group

A hierarchical regression analysis investigating the overall acceptance of CCS technology after the focus group was undertaken. In the first step, the demographics variables, age and gender, were included. The results are presented in Table 30 and show that age and gender were not able to contribute to the explanation of the variance in attitudes towards CCS as an emission reduction technology ($R^2$=0.01, Adj.$R^2$= 0.03, F(2, 104)=1.66, *ns*).

Step 2 included participants' attitudes and knowledge about CCS, participants' beliefs about climate change and participants' trust in CSIRO before the start of the focus group. Results show that beliefs in climate change (-0.20, p<0.05) was the only variable able to significantly contribute to the explanation of the variance in attitudes towards CCS. Combined, the variables in the model explained 9% of the variance in attitudes towards CCS ($R^2$=0.15, Adj.$R^2$=0.09, F(6, 95)=2.74, p<0.05).

Step 3 included the participants' reported knowledge and attitudes towards CCS, participants' beliefs in climate change, participants' reflection of the approval of friends and family, and trust in the expert that delivered the focus group presentation. Results indicate that participants that had a high level of trust in the focus group presenter (0.30, p<0.01), and the belief that people who are important to them will agree with their position towards the use of low emission fuel based energy (0.22, p<0.05) contributed significantly to the explanation of the variance in attitudes towards CCS ($R^2$=0.49, Adj.$R^2$=0.43, F(10, 89)=8.46, p<0.001). Taken together the variables in the model explain 43% of the variance in post-focus group attitudes towards the use of CCS as an energy technology. In summary, taking into consideration all variables in the model, support for CCS after the focus group was:

- Negatively influenced by participants beliefs towards climate change prior to the focus group, meaning that participants with stronger beliefs towards climate change prior to the focus group were less likely to support CCS.
- Positively influenced by subjective norms, meaning that participants who believed that their support for CCS would be approved by family and friends were more likely to support CCS.
- Positively influenced by trust in information source, meaning that participants who placed a higher level of trust in the focus group presenter were more likely to support CCS.

**Table 30 Regression results for attitudes towards CCS after the focus group**

| ATTITUDES TOWARDS CCS POST-QUESTIONNAIRE | UNSTANDARDISED COEFFICIENTS | BETA | STD ERROR | T - VALUE | P VALUE |
|---|---|---|---|---|---|
| **Step 1** | F (2, 104) = 1.66 $R^2$ = 0.03 Adj.$R^2$ = 0.01 | | | | |
| Age | 0.009 | 0.104 | 0.008 | 1.20 | 0.234 |
| Gender | -0.271 | -0.104 | 0.208 | -1.31 | 0.194 |
| **Step 2** | F (6, 95) = 2.74* $R^2$ = 0.15 Adj.$R^2$ = 0.09 $\Delta R^2$ = 0.11* | | | | |
| CCS attitudes pre-questionnaire | -0.086 | -0.065 | 0.107 | -0.80 | 0.425 |
| Knowledge CCS pre-questionnaire | -0.037 | -0.036 | 0.090 | -0.41 | 0.686 |
| Attitudes towards climate change pre-questionnaire* | -0.037 | -0.199 | 0.019 | -1.99 | 0.049 |
| Trust in CSIRO | 0.175 | 0.127 | 0.119 | 1.46 | 0.147 |
| **Step 3** | F (10, 89) = 8.46*** $R^2$ = 0.49 Adj.$R^2$ = 0.43 $\Delta R^2$ = 0.34*** | | | | |
| Knowledge CCS post-questionnaire | 0.157 | 0.164 | 0.086 | 1.82 | 0.072 |
| Attitudes towards climate change post-questionnaire | 0.038 | 0.198 | 0.022 | 1.72 | 0.088 |
| Attitude of others regarding support for low emission fossil fuel based energy* | 0.208 | 0.218 | 0.086 | 2.43 | 0.017 |
| Trust in expert** | 0.302 | 0.304 | 0.106 | 2.85 | 0.005 |
| Constant | 1.520 | | 0.917 | 1.66 | 0.101 |

***Statistically significant at p<0.001
** Statistically significant at p<0.01
*Statistically significant at p<0.05

## 5.2 Acceptance of CCS in local area

Research has shown that individuals hold more negative attitudes when certain activity is proposed for their local residential area (Terwel and Daamen 2012). A study by Huijts et al. (2007) in Germany has shown the public is less likely to accept CCS if the development is proposed in their local residential area as opposed to accepting a CCS project outside urban areas. As such, the post-focus group questionnaire included a series of questions about the participants' willingness to accept CCS technology in their local area in the future. First a variable 'acceptance of CCS in local area' (Cronbach alpha=0.97) was created by summing the following three variables:

1. You believe CCS energy projects should proceed in your area;
2. You approve of CCS energy projects in your area; and
3. You believe that CCS projects have a legitimate place within your community.

A hierarchical regression analysis investigating the overall acceptance of CCS technology in the local area was undertaken. In the first step, the demographics variables age and gender were included. The results are presented in Table 31 and show that age and gender were not able to contribute to the explanation of the variance in acceptance of CCS in local area ($R^2$=0.01, Adj.$R^2$=0.01, F(2, 104)=0.59, *ns*).

Step 2 included participants' trust in CSIRO before the start of the focus group. Results show that trust in CSIRO did not contribute to the explanation of the variance in acceptance of CCS in the local area ($R^2$=0.07, Adj.$R^2$=0.06, F(3, 102)=2.56, *ns*).

Step 3 included the participants' reported knowledge and attitudes towards CCS, participants' beliefs in climate change, participants' reflection of the approval of friends and family, and trust in the expert that delivered the focus group presentation. Results indicate that the level of trust in the focus group presenter (0.36, $p<0.01$), contributed significantly to the explanation of the variance in attitudes towards CCS ($R^2=0.23$, Adj.$R^2=0.17$, $F(07, 96)=4.02$, $p<0.001$). Taken together the variables in the model explain 23% of the variance in accepting a CCS project in their local area.

In summary, taking into consideration all variables in the model, participants' acceptance of CCS projects in their local area was positively influenced by trust in information source, meaning that participants who placed a higher level of trust in the focus group presenter were more likely to accept the development of a CCS project in their local area.

**Table 31 Regression results for acceptance of CCS in local area**

| ACCEPTANCE OF CCS IN LOCAL AREA | UNSTANDARDISED COEFFICIENTS | BETA | STD ERROR | T - VALUE | P VALUE |
|---|---|---|---|---|---|
| **Step 1** | F (2, 104) = 0.59 $R^2$ = 0.01 Adj.$R^2$ = 0.01 | | | | |
| Age | -0.007 | -0.031 | 0.021 | -0.32 | 0.746 |
| Gender | -0.416 | -0.063 | 0.619 | -0.67 | 0.503 |
| **Step 2** | F (3, 102) = 2.56 $R^2$ = 0.07 Adj.$R^2$ = 0.04 $\Delta R^2$ = 0.06 | | | | |
| Trust in CSIRO | 0.401 | 0.115 | 0.355 | 1.13 | 0.261 |
| **Step 3** | F (07, 96) = 4.02*** $R^2$ = 0.23 Adj.$R^2$ = 0.17 $\Delta R^2$ = 0.16*** | | | | |
| Knowledge CCS post-questionnaire | 0.199 | 0.082 | 0.237 | 0.84 | 0.403 |
| Attitudes towards climate change post-questionnaire | -0.072 | -0.160 | 0.052 | -1.38 | 0.169 |
| Attitude of others regarding support for low emission fossil fuel based energy* | 0.429 | 0.176 | 0.254 | 1.69 | 0.095 |
| Trust in expert** | 0.868 | 0.355 | 0.311 | 2.79 | 0.006 |
| Constant | 5.353 | | 2.158 | 2.48 | 0.015 |

***Statistically significant at p<0.001
** Statistically significant at p<0.01
*Statistically significant at p<0.05

## 5.3 Difference in attitudes towards CCS due to focus group attendance

In order to investigate the impact of the focus group on participants' attitudes towards CCS, a hierarchical regression analysis was performed. In the first step, the demographics variables age and gender were included. The results are presented in Table 32 and show that age and gender were not able to contribute to the explanation of the variance in changes in attitudes towards CCS ($R^2=0.01$, Adj.$R^2=0.03$, $F(2, 104)=1.66$, *ns*).

Step 2 included participants' trust in CSIRO before the start of the focus group. Results show that trust in CSIRO did not contribute to the model, but taken together, the variables explained 5% of the variance in changes in attitudes towards CCS ($R^2=0.08$, Adj.$R^2=0.05$, $F(3, 100)=2.94$, $p<0.05$).

Step 3 included changes in participants' knowledge and attitudes towards CCS, change in participants' beliefs about climate change, participants' reflection of the approval of friends and family, and trust in the expert that delivered the focus group presentation. Results indicate that participants changes in attitudes (0.22, $p<0.05$) and the belief that people who are important to them will agree with their position towards the use of low emission fossil fuel based energy (0.28, $p<0.001$) contributed significantly to the explanation

of the variance in changes in attitudes towards CCS ($R^2$=0.32, Adj.$R^2$=0.27, F(7, 92)=6.20, p<0.001). Taken together the variables in the model explain 27% of the variance in changes in attitudes towards the use of CCS as a result of attending the focus group. In summary, taking into consideration all variables in the model, changes in attitudes towards CCS due to participation in the focus group were:

- Positively influenced by an increase in participants' beliefs towards climate change, meaning that participants who increased their climate change beliefs as a result of participating in the focus group were more likely to increase their support for CCS.
- Positively influenced by subjective norms, meaning that participants who believed that their support for CCS would be approved by family and friends were more likely to increase their support CCS.

**Table 32 Regression results for changes in attitudes towards CCS due to focus group attendance**

| CHANGES IN ATTITUDE TOWARDS CCS | UNSTANDARDISED COEFFICIENTS | BETA | STD ERROR | T - VALUE | P VALUE |
|---|---|---|---|---|---|
| **Step 1** | F (2, 101) = 1.67 $R^2$ = 0.03 Adj.$R^2$ = 0.01 | | | | |
| Age | 0.013 | 0.110 | 0.011 | 1.13 | 0.260 |
| Gender | -0.006 | -0.002 | 0.298 | -0.02 | 0.985 |
| **Step 2** | F (3,100) = 2.94* $R^2$ = 0.08 Adj.$R^2$ = 0.05 $\Delta R^2$ = 0.05* | | | | |
| Trust in CSIRO | 0.162 | 0.090 | 0.173 | 0.94 | 0.350 |
| **Step 3** | F (7, 92) = 6.20*** $R^2$ = 0.32 Adj.$R^2$ = 0.27 $\Delta R^2$ = 0.24*** | | | | |
| Difference in knowledge | 0.177 | 0.165 | 0.106 | 1.67 | 0.098 |
| Difference in climate change attitudes* | 0.060 | 0.216 | 0.026 | 2.33 | 0.022 |
| Attitude of others regarding support for low emission fossil fuel based energy** | 0.345 | 0.277 | 0.124 | 2.79 | 0.006 |
| Trust in expert | 0.131 | 0.100 | 0.149 | 0.88 | 0.383 |
| Constant | -3.046 | | 0.973 | -3.13 | 0.002 |

***Statistically significant at p<0.001
** Statistically significant at p<0.01
*Statistically significant at p<0.05

# 6 Discussion

As previously outlined, this study has four main aims which include to:

1. Identify current knowledge levels and attitudes towards climate change and low emission energy technologies with a specific focus on CCS;
2. Identify issues and concerns raised and the information gaps that may exist about the understanding of these technologies with a specific focus on CCS;
3. Evaluate the impacts of information provision on existing opinions of the lay public; and
4. Determine how best to engage the public about CCS projects in Victoria in order to inform the development and enhancement of community engagement and communications strategies and tools.

This section discusses some of the main findings arising from the twelve focus groups in relation to these aims.

## 6.1 Current knowledge levels and attitudes

The findings from the focus groups show that participants were knowledgeable about the more familiar forms of energy technologies used in Victoria. In Traralgon and Bairnsdale in particular, participants were very familiar with coal most likely due to their proximity to coal mines and power stations with friends and family working there. As is consistent with earlier research most participants however, had very low levels of knowledge about CCS at the beginning of the focus group. The results also showed that renewable energy sources, such as solar and wind, were more popular when compared to CCS technology. This is in line with previous studies that found the general public has a preference for renewable energy over CCS (Upham and Roberts 2011). Similarly, the results of a one-day process conducted in the Netherlands around climate change and energy technologies noted that, *'support for renewable energy technologies is larger than support for non-renewable technologies ... The least support is expressed for coal technologies, followed by nuclear, oil, and CCS'* (Brunsting, van Bree, Feenstra, & Hekkenberg, 2011, p.7).

Eighty five percent (85%) of participants agreed that climate change is already happening, with 7% responding that it will happen in the next 30 years, 7% unsure and only one participant denying that climate change was an issue at all. Of those that believed in climate change, 71% attributed causes of climate change to both human activity and natural causes.

## 6.2 Issues, concerns and information gaps

Within the regional workshops, coal and the local power stations, were seen as integral to the local community's economy. However, participants in Melbourne held a somewhat different view about its importance but were similarly aware that coal was a key provider of Victoria's energy. Some participants in Bairnsdale and Traralgon vividly recalled the negative impact of the privatisation of Victoria Energy on their livelihoods through downsizing and retrenchments at the time. These reactions meant that initially some participants in the regional focus groups were positively disposed to the concept of CCS as it appeared to present an opportunity to prolong a fundamental industry for their local economy.

However, there were a range of issues and concerns that were raised through participant questions. Many of these related to the safety of CCS and potential environmental risks that might arise from the process – either through unexpected leaks back into the atmosphere or through contamination into fresh water. The likelihood of contamination with water was discussed in relation to the area being seen as an important food producing area.

Another issue was the need for CCS to be placed in context with other options such as renewable energy technologies. More specifically, participants were interested to find out more about comparisons and evaluations that had been carried out to justify the decision to invest and develop CCS as opposed to other potential climate mitigation technologies. There was a clear message from all workshops that participants did not want to see CCS technology developed at the expense of renewable energy and they were keen to see ongoing investment in development of the renewable energy industry.

The other major issue was around the cost of CCS, the size of investment required and connection to the carbon price. Participants saw the need for a price to bring about action on climate change but were worried about the flow on impacts to them - recognising the high emissions generated from coal might eventually lead to local power stations being closed. Similarly, because they had already experienced increased electricity prices they were concerned what the final cost of electricity generation might be with the move towards a low carbon energy supply.

## 6.3 Impacts of information provision on existing opinions

Before the focus group, participants' beliefs and attitudes towards climate change were not related to their attitudes towards the use of CCS as an energy technology. Results indicate that prior to the focus groups, participants might not have considered CCS as a potential low emission energy technology that could contribute to climate change mitigation. As a result of the information provided in the focus groups, participants became more knowledgeable on a host of climate and energy related issues, including CCS. Increased support for the use of CCS as an energy source by participants was affected by an increased belief that climate change is an important issue to Australia and more should be done to reduce greenhouse gas emissions. This is in line with previous research that has shown that discussions of CCS are enhanced if framed around the portfolio of energy options (Ashworth et al., 2010).

In the regression analysis, participants' trust in the expert was shown to be an important factor for informing their positive opinions and appeared to positively impact on their attitudes towards CCS. Participants appreciated the opportunity to engage with the expert so that they could have their questions answered and to seek further clarification about any issues that arose as a result of hearing the information.

As well, participants commented that they found the video format useful to provide them with an overview of how the technology process might work. However, concerns were expressed around the positioning of the fact sheet, in that it was seen to be overly positive and advocating for CCS technology rather than presenting a more objective view. In almost all of the workshops, the discussion that followed the fact sheet was that around vested interests and how it made them sceptical of the information and switch off. Some even saying, "After the first part I just stopped reading" and this action was observed by the facilitator as well. This demonstrates the importance of finding objective information about the topic if it is to maintain credibility with the public or other sources.

## 6.4 Engaging the public about CCS projects in Victoria

The focus group discussions suggested a need for more information and engagement about CCS, particularly having more technical information available in easily understood and accessible formats. However, participants cautioned that too much information can be overwhelming and confusing so it would be important to simplify the amount of information provided so as not to overload the end user. Through the discussions, participants also acknowledge that people would learn from and respond to information in different ways and therefore communication efforts would need to be targeted towards specific groups.

This idea of targeting specific groups was further illustrated by the range of personal preferences described during the focus groups. Some preferred television, either through programming or advertising, as an effective way to inform them of new information and hence responded to the video as being a useful way to inform the masses. Others however said they would be more likely to read information that was made

available on the internet or in the newspaper. Participants felt face-to-face communication, similar to what they experienced in the focus group was useful as they were able to ask an expert their specific questions. They were also appreciative of CSIRO facilitating the workshop as an independent, well known and respected source.

The majority of participants expressed willingness and an interest to be engaged if a new energy project was proposed in their area. In fact, many saw this as a positive opportunity. However, not all were confident that the methods of engagement would be just. This is an important consideration for those with an interest in engaging local communities around new projects. Much has been written about fairness and participation in citizen engagement and the importance of transparency in the process that is used to inform and these considerations will be equally important for energy projects in Victoria.

# 7 Conclusion and recommendations

This research set out to understand how Victorian residents perceive and accept potential CCS projects through the use of focus groups. The results indicate that members of the Victorian public have low levels of knowledge about CCS. However, when presented with information in a variety of formats, they develop their own personal understanding of the technology. These opinions are impacted by the information source and the discussions they are engaged in with peers in response to that information.

In addition, while it is important that the public understands the science about CCS, it is also important to place CCS in context with other energy technologies including renewable energy sources, coal and gas. This ensures that public attitudes towards CCS are formed with an understanding of the tradeoffs involved between the alternative technologies and policy solutions. The results also confirm the importance of information on climate change also being presented, as without a belief in the need for action on climate change, it is hard to justify the large investments required to transition to a low carbon energy supply.

Post-focus group attitudes towards CCS were influenced by the high level of trust focus group participants placed in the expert. Future engagement needs to take into consideration that the success of public engagement strategies are highly dependent on the level of trust in the information source as a range of participants were quick to identify and disregard information they felt was biased. Bringing together information that has been peer reviewed by a diverse range of stakeholders is one way to build that trust. Similarly, those with no vested interest in the outcome can help to ensure credibility in the information.

In terms of engagement strategies, participants were particularly fond of the opportunity to talk in face-to-face environments where they could ask questions. However, it is worth noting that the focus group participants received an incentive to attend the workshops which no doubt impacted on their willingness to attend. Participants also acknowledged that variety in the processes used was important, that is there was recognition of the need to develop a range of options to suit a cross section of the population. It was also stressed that the message and information provided needs to be very clear and easy to understand.

Finally, there was an overwhelming interest to be engaged at the local level, yet there seems to be some uncertainty about the actual engagement processes used and whether they will be fair or not. Therefore, it will be important that communities are adequately informed about the engagement processes and the various options for participating so that those who wish to be involved can be engaged.

To summarise the main recommendations that arise from this study in line with the aims include:

1) Identify current knowledge levels and attitudes towards climate change and low emission energy technologies with a specific focus on CCS:

   **R1: Proactive engagement on CCS is required to build overall knowledge and awareness of CCS across a range of stakeholders in Victoria.**

   **R2: Any engagement should be set in the context of climate change and the portfolio of energy options for Victoria.**

2) Identify issues and concerns raised and the information gaps that may exist about the understanding of these technologies with a specific focus on CCS:

   **R3: Ensure the information provided includes the relativity of each technology in terms of costs, ability to mitigate greenhouse gases and potential within Australia over the short, medium and long term.**

   **R4: Where possible provide examples of existing CCS operations to help overcome the uncertainties that arise in discussions about CCS.**

3) Evaluate the impacts of information provision on existing opinions of the lay public:

**R5: Make readily available responses to Frequently Asked Questions about CCS with the most up to date information from technical research findings.**

**R6: Avoid advocating for any one technology when engaging the public.**

4) Determine how best to engage the public about CCS projects in Victoria in order to inform the development and enhancement of community engagement and communications strategies and tools.

**R7: Ensure objectivity in the information by drawing from a range of experts with diverse opinions about CCS i.e. NGO, University and Industry perspectives.**

**R8: Consider the range of stakeholders that require engagement and tailor processes accordingly.**

**R9: Ensure local communities are made aware of the engagement processes available and their opportunities for participation, and consult communities about their engagement preferences.**

**R10: Utilise the full gamut of communication media for engagement to suit various stakeholders' different levels of interest and ability in participating.**

# Appendix A Focus group session plan

| ITEM | LEAD SPEAKER | TIME | MIN |
|---|---|---|---|
| Completion of pre-session questionnaire<br>Demographics<br>Current knowledge and attitudes towards climate change and energy technologies with a focus on CCS | Lead facilitator | 0:00 | 15 min |
| Welcome and introductions<br>Aims of the social research and this focus group<br>Participants' names, backgrounds and expectations<br>Guidelines for participation | Lead facilitator | 0:15 | 10 min |
| Facilitated discussion - pre-existing knowledge<br>What do you think about climate change?<br>What do you know about carbon dioxide?<br>When I use the term energy, what do you think about?<br>Do you know where Victoria's energy comes from?<br>Have you heard of carbon dioxide capture and storage?<br>What do you know about carbon dioxide capture and storage? | Lead facilitator | 0:25 | 20 min |
| Expert presentation on climate change, energy technologies and potential of CCS<br>The presentation will cover the following topics:<br>Update on climate change science<br>Energy challenge - in relation to security of supply, mitigation etc.<br>Range of technologies - benefits and challenges for each<br>What is CCS?<br>The benefits and challenges of developing CCS<br>Common applications of CCS and examples, including The CarbonNet Project<br>Use KeePad for quick check in on response | Expert presenter | 0:45 | 20 min |
| Video presentation on CCS - sourced from CO2CRC<br>Short clip will be played to the participants<br>Use KeePad for quick check in on response | Lead facilitator | 1:05 | 10 min |
| Provision of CCS information sheet prepared by non-government organisation (WWF)<br>Participants will be asked to read the information<br>Use KeePad for quick check in on response | Lead facilitator | 1:15 | 10 min |
| Discussion<br>Participant responses to the presentation<br>Issues and concerns arising from any of the information provided<br>Preference for engagement around energy technology projects<br>Any other information they might like | Lead facilitator | 1:25 | 35 min |
| Evaluation questionnaire and thank you voucher<br>Ask participants to complete evaluation questionnaire before leaving<br>Ask participants to leave, collect name badge and provide them with thank you voucher | Lead facilitator | 2:00 | 15 min |
| End | Lead facilitator | 2:15 | 0 min |

# Appendix B Range of questions asked from participants

## B.1 CCS procedures

- Is CCS the same as catching gases off of sewerage and burning them? (M1)
- Where in the ground is the $CO_2$ put? (M3)
- How is the carbon compressed for CCS, and how much carbon does the compression process itself produce? (M1)
- Are the carbon emissions of digging for pipes etc included in the emissions calculation for CCS? (M1)
- Why is less monitoring being done in some places (e.g. America) rather than others- isn't everyone concerned about the risks associated with storage? (M2)

## B.2 $CO_2$ properties and effects

- Is the $CO_2$ stored in CCS different to the $CO_2$ stored naturally? (M1)
- What is the stability and what are the properties of $CO_2$ underground and above ground? What experiments have been done to discover these? (M4)
- What is the viscosity and toxicity of $CO_2$? (M4)
- Can you tell us about naturally occurring $CO_2$? (M4)
- What form is naturally occurring $CO_2$ in? What form is it in naturally occurring underground deposits? (M4)
- Is naturally occurring $CO_2$ underground in a similar state to how it would be in CCS? (M4)
- If $CO_2$ is not a fluid, what makes it a liquid that has to be buried underground? (T4)
- If $CO_2$ is an odourless gas, why do you have to hide it underground? (T4)
- How is $CO_2$ going to be captured? (B1)
- $CO_2$ is not a stable product, is it? (B1)

## B.3 $CO_2$ behaviour underground

- Where does the naturally-occurring oil that was underground go in the case of CCS, and what are the effects on the planet? (M1)
- Is the pressure underground kept on an even balance? (B4)
- Are the pressures that are used going to create cracks into the next system? (T4)
- Do you have data on the actual pressures of these chambers that you are going to be drilling? (T4)
- Could you get an effect similar to the coal seam gas fracking effect from putting $CO_2$ underground? (M4)
- Could there be environmental issues in storage? (B1)

## B.4 General impacts

- Why doesn't the fact sheet outline any of the risks? [What are they?] (T2)
- What could physically go wrong with CCS? (B1)
- What sort of issues do we need to look at in CCS, if we go down that track? (B1)

- Pumping so much down into underground areas, do we really know what is going to happen? (B4)

## B.5 Long term impacts

- Will it all eventually solidify? (B4)
- Given that for every action there is a reaction, is there a point in time with the amount that's being pumped down there that it's oversaturated and starts to affect the ocean? (B4)
- Putting it into the ground is fine, but I'm just worried about what's going to eventually happen, like is it going to destroy the earth in 50, 100 years time, more than what we're doing? (B4)
- Isn't there a risk that we could later find out that we should not have been doing this? (M4)
- Will the $CO_2$, once it becomes carbonates, become a resource again? (M3)
- Are we going to be here in 100 years saying: this is what they did 100 years ago, we've got to fix it because now we have another problem? (T4)
- What is CCS going to cause on a long-term basis; if you keep pumping $CO_2$ into a space for over 50 years [which it had the capacity for], is that going to create cracks into the next system? (T4)
- Will it change the composition of the earth and potentially create another problem that in 100 years time, we will need to try to reverse? (M4)

## B.6 Man-made disasters

- Is CCS going to create another type of man-made disaster? (M3)
- What is the worst case scenario for the worst effect that could happen from CCS? (M4)
- How does the risk assessment for CCS compare with the risk assessment for nuclear power, considering the chain of disasters that have recently befallen nuclear power? (T1)

## B.7 Natural disasters

- How does CCS survive earthquakes? Are they placed in a fairly stable zone? (T1)
- If there is a natural disaster like an earthquake, how would sticking it under the soil affect the actual temperature of the earth? (M4)

## B.8 Water and aquifers

- How much will the water underground be affected by pumping carbon into it, given that there is a lot of pressure on that water table? (T4)
- If you are pumping $CO_2$ offshore in pipelines that are obviously through the water, doesn't the $CO_2$ turn the water acidic? (T1)
- What are the effects on rainwater if $CO_2$ comes into contact with it? (T1)

## B.9 Leaks

- If $CO_2$ did leak, what would it do to the environment? Would it make people very sick like what happened in Japan? (T2)
- If there were a leak in the line, what would be the result? (M4)
- What if there was a leak? How is that monitored? (M4)
- When they pipe $CO_2$ to storage, what happens if there is a leak? What happens to the atmosphere? (T1)
- What happens in the case of a slow leak? (T1)

## B.10 Storage capacity over time

- What is the size of available storage (i.e. volume) and for how long can $CO_2$ be stored (i.e. number of years)? (M3)
- How long before they run out of places [to put $CO_2$]? (B2)
- Is there endless storage? (B1)
- "A huge amount of storage" is different to "endless", isn't it? (B1)

## B.11 Infrastructure

- Given that we have some power plants that are close together, such as Hazelwood and Loy Yang, how do they work out geologically what connects to others, considering the levels of soil underneath? (T1)
- Would the gasification process require significant changes to the infrastructure of the power station if you're changing the coal for . . . . ? (T3)
- If we used gasification, is there any use for our current power stations in the way they are designed, or would you have to redesign? (T3)

## B.12 Technical status

- Has CCS been tested? Is it going all right? (B1)
- Where does $CO_2$ go now, in terms of which countries CCS is being trialled in? (M2)
- I thought CCS has been used overseas for a long time, but the fact sheet suggests it is [new]. (M1)
- I thought CCS had already been figured out overseas and we are just building on that knowledge—is that the case? (M2)
- How far away are we from being able to use this technology? (M4)
- When will CCS be implemented? (T2)
- Roughly when do you expect CCS [to be used]? (T2)
- Is there a timeframe in which these might actually start to put these on power stations? (T2)

## B.13 Technical alternatives

- Are there other ways of storing $CO_2$, rather than shoving it in the ground—such as reconverting it to oxygen? (M4)
- Can we chemically convert $CO_2$ back to oxygen ourselves at great expense? (M4)
- Are there any other feasible projects going on that will convert [?]? (M4)
- Is there an existing technology, element, microbe, or other mechanism that could break down existing carbonates in the atmosphere? (M3)
- Why does smoke need to be produced by a factory or power station—why can't the carbon be extracted and used as an input to a process as it is in every other factory? (T4)
- Wouldn't it be better to find an industrial process that [takes up $CO_2$ rather than having it released to the atmosphere]? (T4)
- If we are turning this $CO_2$ into a gas are there any byproducts of that gas that can be used for anything else? Have they ever done a test on it to see if it can be broken down or something that can be used? (T4)
- How could we use that gas for anything else? (T4)
- Why can't we change what we already have to make it clearer—all our coal and all that underground carbon—[why can't we] just use what we've got? Keep the pollution and change it and all that. Whatever they can do – use it on coal and that but just take. [?] (T2)

# Appendix C Summary phrases on CCS impacts

## C.1 Environmental impacts

**Negative impacts:**

- Effects (including long-term) are uncertain and could be negative

  *I feel that as we don't know what the implications are in 100 years of using this technology*
  *New things and especially as huge as this will cause problems.*
  *What will happen if there is too much $CO_2$ underground once it has been pushed down there?*
  *Overtime will it do something to the environment?*
  *Potential problem in ground years later*

- Leak or explode and cause harm above ground

  *May leak*
  *If in the rare case the CCS project failed and $CO_2$ leaked it could affect plant/animal life?*
  *Explosions/$CO_2$ leakages*
  *What happens to ecosystems and animal life if there is a leak?*

- Infrastructure will consume habitat, living space and financial resources

  *The infrastructure may affect the environment, depending on where it was built.*
  *How/where the pipes are to transport $CO_2$*
  *Concern about removal of habitat to build infrastructure*
  *Unaddressed concern: Transport costs/emissions to storage sites; obviously lower $CO_2$ emissions will improve the atmosphere*

- Harm water and aquifers underground

  *It may affect underwater supplies*
  *Leakage to water table, aquifers*
  *Concerns with water being taken out and replaced by $CO_2$*
  *Drilling and water table impacts*

- Destabilise or fracture the earth

  *Pressure causing fractures*
  *Potential to cause future harm with ground movement*
  *May disrupt sedimentary layers and cause movement in tectonic plates - natural disaster*
  *The holes and damage it may have underground to the structure of the earth*

- Choosing this technology is not the right path forward

  *I don't see it as a permanent solution to our causes*
  *It is not a viable option as there is an effect for every cause*
  *The focus of attention needs to be on discouraging people from damaging the environment.*
  *It may take a while to see improvements.*

**Neutral impacts:**

- I don't know what the environmental effects will be

*I am not sure*
*Hopefully none*
*Would need to see more info to back this up*
*Unsure on how the earth would be effected*

- No environmental impact

  *Don't see any potential impact as it seems to just be filling the 'holes', we have created.*
  *As long as it is stored properly and there is no problems later on in life.*
  *Don't see any impacts.*
  *If done properly, it appears to not have any major impact on the environment other than the reduction which it is meant to do.*

- Very small environmental impact

  *Very little*
  *Doesn't seem that there would be a large impact*
  *From what I understand the impact environmentally is minimal*
  *Low environmental impact*

**Positive impacts:**

- Will improve the environment and/or lower emissions

  *It will also, according to studies be a positive solution for all $CO_2$ emissions by something like 20%.*
  *It should be a positive step for the environment if it means less $CO_2$ will be emitted into the atmosphere.*
  *Improving the world we live in.*
  *It should be good for the environment for the carbon not to be released into the air.*

- Could have some effects but it is still the right path if done correctly

  *Was unsure about the process of storing underground but have trust in scientist/engineers and risk assessments in this day and age.*
  *I am unsure about long term impact but it can't be any worse than what is currently happening.*
  *We need to try something and they seem to have researched the effects thus far.*
  *There are risks as with every energy source, but I see these as minimal.*

- Tolerable as a temporary, initial solution

  *I believe CCS might help mitigate emissions, but it is certainly not a permanent solution.*
  *As an initial strategy prevent unstoppable decline*

- Missing or other

  *Reduce fossil fuel usage.*

## C.2 Perceived impacts on people/wider society

**Negative impacts:**

- Increased tax and costs to communities

  *CCS projects will improve over the whole world. But would have a huge start-up cost.*
  *More tax*
  *increased expenses*
  *Cost more*

- Fewer jobs

  *It might cost jobs*

- Confusion, uncertainty, fear, opposition, social unrest

  *People would want both sides of the information otherwise they will oppose it.*
  *Initially people will reject it because they won't understand it and because they will not get any money from it.*
  *I think there could be a lot of people against it because the risks aren't explained and people may feel the risks are being hidden, even though it probably doesn't outweigh the pro's.*
  *The fear of not understanding*

- Decreased awareness or increased complacency, laziness, unwillingness to change

  *As above, (though people will continue to be complacent and allow other people to keep making all the decisions and blindly trusting or being too lazy).*

- Negative health effects on communities

  *If there are leaks close to residential areas there is the potential that people can get sick.*
  *What the medical effects could be e.g. the same idea is happening to people living near wind farms?*
  *People would be unhealth. [sic]*

- Disasters, leaks, explosions

  *I think of the negatives occurring - similar to an explosion of a nuclear power plant. You can't rely on humans to prevent disasters. Policies and procedures need to be extraordinarily tight.*
  *May leak or blow up*

- Change in land use

  *More land is being allocated away from fruit, vegetable and grain production into energy.*

**Neutral impacts:**

- Unsure

  *Not sure*
  *Unsure*

- No (or very little) effect

  *Very little, most people don't care*
  *If monitored – none*
  *It is adopted, people's usage and lifestyles will not change, i.e. continue with current usage patterns and do not have a positive solution to an ongoing problem.*

**Positive impacts:**

- More, different, or better-protected jobs

  *It should create jobs in this area, with minimal risk*
  *It could be more employment with new infrastructure being built*
  *May increase job opportunity*
  *Job creations to build new projects*

- Clean/generally improve the environment

  *CCS would/could protect the environment and therefore the environmental rights of people to enjoy the planet.*
  *Giving us a cleaner place to live i.e. less pollution*

- Increased awareness, optimism and/or responsibility

  *There will always be people who object to change, a lot more debate about climate change, hopefully more awareness tba action to combat climate change.*
  *Will make society more aware of the issue and gives them some relief that something is being done to resolve the issue.*
  *Increase people's hope that we can reduce $CO_2$ emissions.*
  *Sense of doing/contributing to something that will save the environment.*

- Decrease emissions, prevent excess climate change

  *It should benefit as it may prevent climate change getting out of hand.*
  *Positive – a low risk solution*

- Support for future generations

  *Generational security*
  *Lots of people have a 'me' mentality and would think that they won't be around to benefit not realising future generations are getting a say in the planning of what is essentially their future.*

## C.3 Perceived impacts on community infrastructure

**Negative impacts:**

- Confusion, uncertainty, fear, opposition, social unrest

  *It would be out of control*
  *Employment/indigenous concerns/land ownership*

- Increased tax and costs to communities

  *It will lead to increased infrastructure costs and methods of gas transmissions and storage are developed.*
  *Job losses and cost*

- Change in land use

  *Reducing agricultural land*
  *I think of similar to coal seam gas and people possibly losing their homes because of big businesses*
  *Have a higher priority than an individuals' farm or well-being.*
  *Maybe need to shift communities away from deposit areas*

- Negative health effects on communities

  *Noise pollution to surrounding communities*

- Decreased awareness or increased complacency, laziness, unwillingness to change

  *People may think problem solved*

- Fewer jobs

    *Job losses and cost*

**Neutral impacts:**

- No (or very little) effect

    *No effect I can imagine*
    *Very little, most people don't care*
    *No impact really, from my understanding the plants will be attached to the powerplants/factories or in the located geologically approved areas.*

- Unsure

    *Not sure*
    *Unsure*

**Positive impacts:**

- More business for big business

    *Will sustain the mining industry, supporting workers*

- More, different or better-protected jobs

    *May provide more jobs*
    *It would produce more jobs and business in rural communities so would be a plus*
    *Increase in jobs - new jobs*
    *May increase job opportunity*

- Clean/generally improve the environment

    *It will make it a better place to live*
    *Work together for the better of our world*

- Decrease emissions, prevent excess climate change

    *Should become incentive to avoid carbon taxing*

- Increased awareness, optimism and/or responsibility

    *People would feel more positive and inspired that collectively we are getting somewhere both local and global.*
    *People may become more aware of their actions and become more responsible*
    *Make people more conscious in the manner they use electricity*

- New or better infrastructure

    *Improvements for CCS project hot spots via increased jobs and infrastructure*
    *More energy efficient infrastructure*
    *Possibly need additional housing etc to support additional workers at CCS projects.*
    *Positive it improves and re-uses existing infrastructure that will become redundant i.e. an exhausted oil reserve.*

- Support for future generations

    *Larger community*

- Strengthen economy

  *Great if at ex-mining locations; Expensive if in new areas - but will stimulate economy.*
  *New infrastructure being built should bring more people to the community*

## C.4 Perceived impacts on the economy

**Negative impacts**:

- Increased tax and costs to communities

  *It might increase the price of energy*
  *It will make electricity bills bigger*
  *It might increase the price of energy*
  *The price to implement these changes will be take [sic] out of the individuals pocket*

- Change in land use

  *Reducing agricultural land*

- Fewer jobs

  *Higher costs will reduce exports and lead to unemployment in export industries.*

- Weaken economy

  *Negative*
  *The economy might decrease*
  *It will strain the economy with more tax and make recession more apparent in the future.*

**Neutral impacts:**

- More business for big business

  *Power companies/renewable companies stand to become even bigger players.*
  *At the end of the day the consumer/general population will be paying for this.*
  *Help protect viability of existing industries*

- No (or very little) effect

  *Net zero*

- Unsure

  *Unsure*

**Positive impacts:**

- More, different or better-protected jobs

  *It could have a good affect in the economy as it would create jobs.*
  *Could provide jobs in both mining coal and monitoring CCS systems.*
  *Jobs*
  *The need for the construction of the pipelines, condensing plants etc to allow CCS would create jobs.*
  *New technologies would also drive new employment in that field.*

- Clean/generally improve the environment

  *No impact, in the short term but in the long term it could be better.*

- Decrease emissions, prevent excess climate change

  *Hopefully longer term benefits associated with environmental benefits (but unlikely to impact in my life time).*

- Increased awareness, optimism and/or responsibility

  *As above - if people need to pay more it may prompt them to be more efficient with energy use.*
  *It should further encourage the transfer to more sustainable methods of energy production.*
  *Where it will enable coal to continue to be used, it will do so with less impact on the environment if it is offset by CCS.*

- New or better infrastructure

  *Initial improvement due to building infrastructure.*
  *Negated by increased costs of electricity etc*
  *To cover the costs of infrastructure.*

- Support for future generations

  *Hopefully longer term benefits associated with environmental benefits (but unlikely to impact in my life time).*

- Strengthen economy

  *Hopefully develop it in a good way*
  *May cost to start with, but better in the long run, worth it.*
  *New industry - should improve our economy but may impact badly on other industries.*
  *Great potential*
  *More money*

- Missing or other

  *Means we will have an energy source to go back*
  *In the long run I think CCS projects when implemented will become cheaper*
  *Sizable but justifiable those profiting from non-renewable sources should heavily fund R&D, rather than government.*

# Appendix D Further analyses on factors associated with support for CCS

## D.1 Gender

As shown on Table 33, in general, there was no difference in support for energy technologies between males and females. The only exception was for nuclear energy. Mean responses for support for nuclear energy were statistically higher ($t=2.64$, $p<0.05$) for males when compared to females. This means that, in general, males tend to be more supportive of nuclear energy sources when compared to females.

**Table 33 Gender and attitudes towards energy technologies**

| HOW STRONGLY DO YOU AGREE WITH THE USE OF THE FOLLOWING ENERGY SOURCES/TECHNOLOGIES? (POST-QUESTIONNAIRE) | PAIRED T-TESTS | | MALES | | | FEMALES | | |
|---|---|---|---|---|---|---|---|---|
| | T-VALUE | DF | N | MEAN | SD | N | MEAN | SD |
| Wind | -0.00 | 106 | 33 | 5.55 | 1.371 | 75 | 5.55 | 1.244 |
| Carbon Capture and Storage (CCS) | 0.66 | 105 | 32 | 5.59 | 1.188 | 75 | 5.43 | 1.199 |
| Nuclear* | 2.64 | 106 | 33 | 4.21 | 1.996 | 75 | 3.19 | 1.799 |
| Hydro-electric | 1.59 | 104 | 33 | 5.21 | 1.293 | 73 | 4.82 | 1.110 |
| Coal fired (traditional/current methods) | -0.82 | 105 | 33 | 3.85 | 1.603 | 74 | 4.11 | 1.458 |
| Natural Gas | -1.09 | 106 | 33 | 4.48 | 1.395 | 75 | 4.77 | 1.203 |
| Geothermal (hot rocks) | 1.87 | 105 | 33 | 5.00 | 1.346 | 74 | 4.54 | 1.088 |
| Solar | -0.99 | 106 | 33 | 5.85 | 1.278 | 75 | 6.07 | 0.949 |
| Biofuels | -0.75 | 106 | 33 | 4.58 | 1.415 | 75 | 4.77 | 1.192 |
| Oil | -1.08 | 105 | 33 | 3.75 | 1.414 | 75 | 4.04 | 1.202 |
| Wave/tidal | 0.35 | 105 | 33 | 5.06 | 1.456 | 74 | 4.96 | 1.339 |
| Coal seam gas | -1.56 | 105 | 33 | 3.76 | 1.601 | 74 | 4.15 | 0.961 |

*Statistically significant at $p<0.05$

## D.2 Location

Table 34 shows that, in general, there was no difference in support for energy technologies between the regional groups when compared to the Melbourne group. The only exception was for biofuels. Mean responses for support for biofuels were statistically higher (t=2.15, p<0.05) for participants in the regional groups. This means that, in general, respondents in regional areas tend to be more supportive toward biofuels when compared to Melbourne respondents.

**Table 34 Location and attitudes towards energy technologies**

| HOW STRONGLY DO YOU AGREE WITH THE USE OF THE FOLLOWING ENERGY SOURCES/TECHNOLOGIES? (POST-QUESTIONNAIRE) | PAIRED T-TESTS | | REGIONAL GROUPS | | | CITY GROUP | | |
|---|---|---|---|---|---|---|---|---|
| | T-VALUE | DF | N | MEAN | SD | N | MEAN | SD |
| Wind | -0.78 | 106 | 73 | 5.48 | 1.355 | 35 | 5.69 | 1.105 |
| Carbon Capture and Storage (CCS) | 0.29 | 105 | 72 | 5.50 | 1.222 | 35 | 5.43 | 1.145 |
| Nuclear | -0.81 | 106 | 73 | 3.40 | 1.998 | 35 | 3.71 | 1.725 |
| Hydro-electric | -0.17 | 104 | 71 | 4.93 | 1.211 | 35 | 4.97 | 1.124 |
| Coal fired (traditional/current methods) | 1.94 | 105 | 72 | 4.22 | 1.567 | 35 | 3.63 | 1.285 |
| Natural Gas | 1.63 | 106 | 73 | 4.82 | 1.347 | 35 | 4.40 | 1.035 |
| Geothermal (hot rocks) | -0.71 | 105 | 72 | 4.63 | 1.238 | 35 | 4.80 | 1.079 |
| Solar | -0.58 | 106 | 73 | 5.96 | 1.086 | 35 | 6.09 | 1.011 |
| Biofuels* | 2.15 | 106 | 73 | 4.89 | 1.231 | 35 | 4.34 | 1.259 |
| Oil | 1.38 | 105 | 73 | 4.07 | 1.206 | 34 | 3.71 | 1.382 |
| Wave/tidal | -0.35 | 107 | 72 | 4.96 | 1.347 | 35 | 5.06 | 1.434 |
| Coal seam gas | 1.37 | 105 | 72 | 4.14 | 1.259 | 35 | 3.80 | 1.052 |

*Statistically significant at p<0.05

## D.3 Knowledge of CCS

Participants' responses from the pre-questionnaire show that knowledge of CCS was not correlated with attitudes towards CCS before participating in the focus group. However, after receiving information, participants indicated an increased level of knowledge about CCS as well as increased support for CCS in the post-questionnaire. Bivariate correlations from the post-questionnaire measures show that participants with a higher self-rated knowledge of CCS were more likely to support the use of CCS as an emission reduction technology (0.39, p<0.001).

**Table 35 Correlation between participants' knowledge and attitudes towards CCS**

| | CORRELATION WITH SELF-RATED KNOWLEDGE OF CCS | |
|---|---|---|
| | PRE- QUESTIONNAIRE | POST-QUESTIONNAIRE |
| Attitudes towards CCS | 0.006 | 0.39*** |

***Statistically significant at p<0.001

## D.4 Beliefs and attitudes towards climate change

Previous research has shown that a person's values, beliefs and norms (VBN theory) influences their acceptability of energy policies (Steg, Dreijerink & Abrahamse, 2005). Table 36 shows the questions asked to participants in both the pre- and post-questionnaires to understand their beliefs and attitudes towards climate change and energy conservation. Results show that before the focus group, participants' beliefs and attitudes towards climate change were not related with their attitudes towards the use of CCS as an emission reduction technology. However, after attending the focus group, participants with stronger climate change beliefs and attitudes were more likely to support the use of CCS as an emission reduction technology. This change in attitude towards CCS is most likely due to the focus group being about CCS and climate change. This finding is in line with previous research that has shown that discussions of CCS are best framed around the portfolio of energy options (Ashworth et al., 2010).

**Table 36 Correlations between beliefs and attitudes towards climate change and attitudes towards CCS technology**

| | CORRELATION WITH ATTITUDES TOWARDS CCS | |
|---|---|---|
| | PRE- QUESTIONNAIRE | POST-QUESTIONNAIRE |
| Climate change is an important issue for Australia | 0.17 | 0.27** |
| The production of electricity is a major contributor to greenhouse gas emissions | 0.16 | 0.33*** |
| Industry should be doing more to reduce greenhouse gas emissions | 0.15 | 0.31*** |
| People should be doing more to promote electricity conservation in the home | 0.10 | 0.07 |
| Government should be doing more to reduce greenhouse gas emissions | 0.12 | 0.32*** |
| People should be doing more to promote electricity conservation in the workplace | 0.21* | 0.14 |
| Increasing the price of electricity to help reduce greenhouse gas emissions | -0.06 | 0.22* |

*Statistically significant at p<0.05
**Statistically significant at p<0.01
***Statistically significant at p<0.001

## D.5 Trust

Previous research has shown that public trust in information sources affects their perceptions towards different technologies (Van de Velde et al., 2011). As presented in Section 4, participants indicated they place a high level of trust in CSIRO as an information source. As the focus group was facilitated by CSIRO, it is important to investigate whether trust in CSIRO influences participants' attitudes towards the use of CCS as an energy source. Table 37 shows Pearson correlation coefficient before and after the focus group. Results indicate that before the focus group, participants' level of support for CCS was not correlated with trust in CSIRO. However, on the post-questionnaire the Pearson's correlation coefficient indicated that participants who trust CSIRO as an information source about climate change and energy technologies were more likely to support the use of CCS as an energy technology. In addition, participants who trusted the expert presentation were also more likely to support the use of CCS.

**Table 37 Correlation between trust and attitudes towards CCS before and after the focus group**

| | CORRELATION WITH ATTITUDES TOWARDS OF CCS | |
|---|---|---|
| | PRE- QUESTIONNAIRE | POST-QUESTIONNAIRE |
| Trust in CSIRO information | 0.01 | 0.35*** |
| Trust in expert presentation | n/a | 0.54*** |

***Statistically significant at p<0.001
Variable level of trust rated on a scale of 1= distrust a lot and 5=trust a lot
Variable attitudes towards CCS rated on a scale 1=strongly disagree and 5=strongly agree

## D.6 Social norm

Azjen's (1991) Theory of Planned Behaviour (TPB) suggests that subjective norms influence people's behavioural intention. Subjective norms refers to the perceived social pressure to perform or not to perform a particular behaviour (Ajzen 1991). Subjective norms are usually measured by asking respondents to rate the extent to which "important others" would approve or disapprove of their performing a given behaviour (Ajzen 1991). In order to investigate whether subjective norms influence people's attitudes towards CCS, participants were asked in the post-questionnaire if they think people who are important to them would approve or disapprove of them if they supported the use of low emission fossil fuel based energy such as CCS. Results show that the opinion of others regarding participants support for energy sources was positively correlated with the participants' attitudes towards CCS. Bivariate correlation shows that participants that believe that most people who are important to them would approve if they supported the use of a low emission fossil fuel based energy such as CCS, were more likely to agree with the use of CCS as an emission reduction technology (0.47, p<0.001).

# Glossary

**Adjusted $R^2$** is the proportion of total variance explained by the explanatory variables taking into account the number of explanatory variables included in the regression

**Beta** or standardized coefficient represents how many standard deviations a dependent variable will change for a one standard deviation increase in the explanatory variable while controlling for the other explanatory variables

**$R^2$** is the proportion of total variance explained by the explanatory variables included in the regression

**Degrees of freedom** (df) are the values that are free to vary when calculating a statistic

**F value** is the score obtained when you perform the F-statistic. The F-statistic gives a test of the collective effect of all independent variables on the dependent variable

**Mean** is the sum of all observed scores, divided by the total number of observations

**ns** means that the statistic is not significant ($p>0.05$)

**P- value** is the probability of the test statistic

**Standard deviation** (SD) is the positive square root of the variance. Variance is an average of the squared deviations; that is, it approximates the average of the squared distances from the mean

**Standard error** (SE) is the standard deviation of the sampling distribution **T-value** is the score obtained when you perform the test-statistic. In this report it represents the difference between the mean of responses in the pre and post-questionnaire, while taking into account any variation in scores

**Unstandardized coefficient** represents how many units a dependent variable will change for a one unit change in the explanatory variable while controlling for the other explanatory variables

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