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Reflections on a process for developing public trust in energy technologies:
Follow-up results of the Australian large group process

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Abstract

This paper presents the results of an evaluation of the longer term impact of a series of workshops conducted in four Australian cities which sought to engage representatives of the Australian public in discussions about climate change and low emission energy options. These workshops were designed to explore the public's awareness and acceptance of the various low emissions energy technologies, including carbon dioxide capture and storage (CCS), and to assess whether a large group workshop format was an effective means of affecting change in awareness and acceptance of the various energy technologies. Initial results of these workshops, presented at the International Conference on Greenhouse Gas Technologies (GHGT) in 2008, found that the workshop was indeed effective. Results from an online survey conducted in October 2009 with 95 participants of the original workshops indicate that over the longer term awareness remains at a higher level than prior to workshop attendance, while changes in participants' attitudes were not sustained over time. However, the results of 22 follow-up in-depth interviews conducted in November and December 2009 found that many workshop participants reported a change in their awareness of and preference for the energy technologies, and that they pro-actively spoke with others and sought further information regarding the technologies and their place in a low carbon economy. While wind and solar energy were clearly favored, carbon mitigation was generally recognized as a complex issue requiring a portfolio of energy solutions. Building trust in the range of energy solutions, including carbon capture and storage, will require ongoing engagement and dialogue with members of the public.

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1. Introduction

At a previous International Conference on Greenhouse Gas Technologies (GHGT), hosted in Washington November 2008, researchers from Australia's Commonwealth Scientific Industrial Research Organization (CSIRO) presented a paper describing a novel, large group workshop process they had developed as a way of engaging the public on climate change and low emission energy technologies, including carbon dioxide capture and storage

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(CCS)[1]. The design of the process was based on tenets of social-psychological theories of attitude and behavior change. The process proved both successful at informing large groups, comprising of 45 up to 136 people, and learning more about the views held by the public. This success was replicated across four capital cities in Australia including Adelaide, Brisbane, Melbourne and Perth.

Motivating the original research were the aims of 1) exploring Australian society's acceptance of energy technologies; and 2) assessing the effectiveness of the large group workshop for informing change in attitudes toward and knowledge of these technologies. Since these workshops, the research focus has been to evaluate the longer term impact of the workshops. This evaluation was carried out in October 2009, which represented at least 12 months since attending the large group workshop for participants. All 296 workshop participants were invited to complete a web-based questionnaire about their experiences since the workshop. Ninety-five participants chose to complete this questionnaire, a 32% response rate. The questionnaires asked participants if they were interested in participating in telephone interview and 63 participants expressed an interest. Of these 22 were interviewed.

This paper presents the results of an evaluation of the longer term impact of the workshops. It first introduces the theoretical considerations of the research, some of which were detailed when the workshop process was first introduced by Ashworth et al. (2008) [1]. Second, the data collection process and results from the questionnaires is described, along with qualitative comments from the interviews. In conclusion, some observations are outlined about the effectiveness of such the large group process at encouraging changes in attitudes towards and knowledge of low emission energy technologies that are sustained.

2. Theoretical Underpinnings of Large Group Workshop Design

Research has demonstrated that shifts in people's attitudes do occur overtime and in different context [2]. One element contributing to attitude change is cognitive dissonance, a psychological state, often associated with discomfort and, or negative emotion, when an individual's existing attitude is exposed to and challenged by new information [3]. Attitudinal change is more likely when the existing attitudes are less entrenched and the dissonance created is strong [3,4,5,6]. The large group workshops were designed to introduce participants to new information about low emission energy technologies, through presentations from experts in the field, question and answer sessions, and participants conversing with each other.

The impact of the changing nature of public attitudes towards emerging and controversial technologies has been increasingly considered by researchers. Evans and Durant (1995) found measures of attitudes towards science in general are not an adequate guide to the public perception of specific areas of scientific research [7]. Further, they discovered evidence that higher levels of knowledge are associated with more supportive attitudes towards science, unless the science is morally contentious. The public's attitudes toward technologies such as nuclear power [8,9,10,11], nanotechnology, genetically modified food [12,13,14,15] and biotechnology [16,17,18,19,20] have been examined to determine the impact of the technology on attitudes along with the influence these public attitudes have on the uptake of the technologies. In relation to CCS, a recent study at MIT concluded that for wider acceptance the public must be better informed of both the risks, costs and benefits of the technology [21]. In the large workshops information was presented about each technology in a balanced way that explored the benefits and disadvantages of each technology.

The large group workshops were also designed so that participants were arranged in discussion groups. Discussion groups were used because they are known to promote a stronger cognitive effort in comparison to individual thinking and are more likely to bring about attitude change [22]. This is especially evident when cognitive effort is rewarded with the satisfaction of resolving a problem or achieving greater understanding of an issue [23]. Discussion groups which foster deliberation and dialogue about risks have the potential to create the dissonance required to change attitudes toward, and acceptance of an issue. Findings from the literature indicate strongly, that this potential for change is conditional upon the perceived legitimacy and trust in the information sources used to assess the issue [24]. This is because individuals place their faith in "trustworthy, comprehensible information about the risks" when making decisions [25]. Therefore the effectiveness of the large group workshop at creating attitudinal change is also dependent on the perceived independence and trustworthiness of those providing the information [26,27,28].

3. Methodology

Evaluation of the long term impact of the large group workshops was conducted through a web-based questionnaire and a telephone interview. Participants were invited to complete the survey via email. In total 296 participants were invited to participate in the online questionnaire in October 2009. Depending on what city participants were from this period of time represented at least 12 months since the workshop and up to 18 months for some. Ninety five (95) participants chose to complete the survey, representing a 32% response rate.

The questionnaire and interview questions were developed to be consistent with the questionnaires administered in the large group workshop. Therefore, the follow-up questionnaire measured participants' attitudes and self-rated knowledge of climate change and the range of energy technologies, including CCS. Ashworth et al. (2008) describes the questionnaire design in detail. Additionally questions were included to compare the demographic and environmental profile of re-engaged participants with the original group. Changes in attitude and self-rated knowledge were assessed by comparing the mean responses of participants at three points in time: at the start of the workshop, end of the workshops and then 12 months or more after. The means were compared using 2-tailed, paired t-test comparisons where considered statistically significant at $<0.001^{**}$; $<0.01^{*}$; and >0.05 .

On completion of the questionnaire, participants were invited to participate in a semi-structured interview about their experiences since attending the workshop. In total 63 participants indicated they would like to be interviewed, however given time constraints a total of 22 follow up interviews were carried out. Open-ended interview questions were used to evoke candid descriptions from participants regarding their memories of the workshop, motivations for attending, their preferred energy options, as well as their energy consumption and information-seeking behaviors since attending the workshop. Interviews lasted were between 20 to 45 minutes, and were recorded and transcribed for analysis facilitated by NVivo qualitative analysis software.

4. Results

4.1. Comparison of demographic features and environmental orientation

Demographic features of the participants in the original workshops with those that were re-engaged through the follow-up questionnaire were compared. The participants that were re-engaged were similar in age and sex compared to the larger group. The mean age of respondents from the original workshops was 46 years, and 47 years in the follow-up survey. Similarly, the re-engaged participants were similar in sex (48% males and 51% females) compared to the original workshop participants (52% males and 47% females). Also participants responded from each location were the workshops were held, with slightly less Brisbane participants responding and slightly more participants from Melbourne.

To assess participants' environmental orientations and compare this between the original group and those that were re-engaged the 15 item New Environmental Paradigm Scale [29] was used. The individual 15 pro- or anti-environmental statements were answered on a seven point scale (strongly disagree to strongly agree). Negatively worded items were reverse scored and scores are then averaged to form a single measure that ranges from 1 (anti-environmental beliefs) to 7 (pro-environmental beliefs). Very similar means were reported by both groups (5.3; 5.4). The scores reflect that both groups held a moderate level of pro-environmental belief.

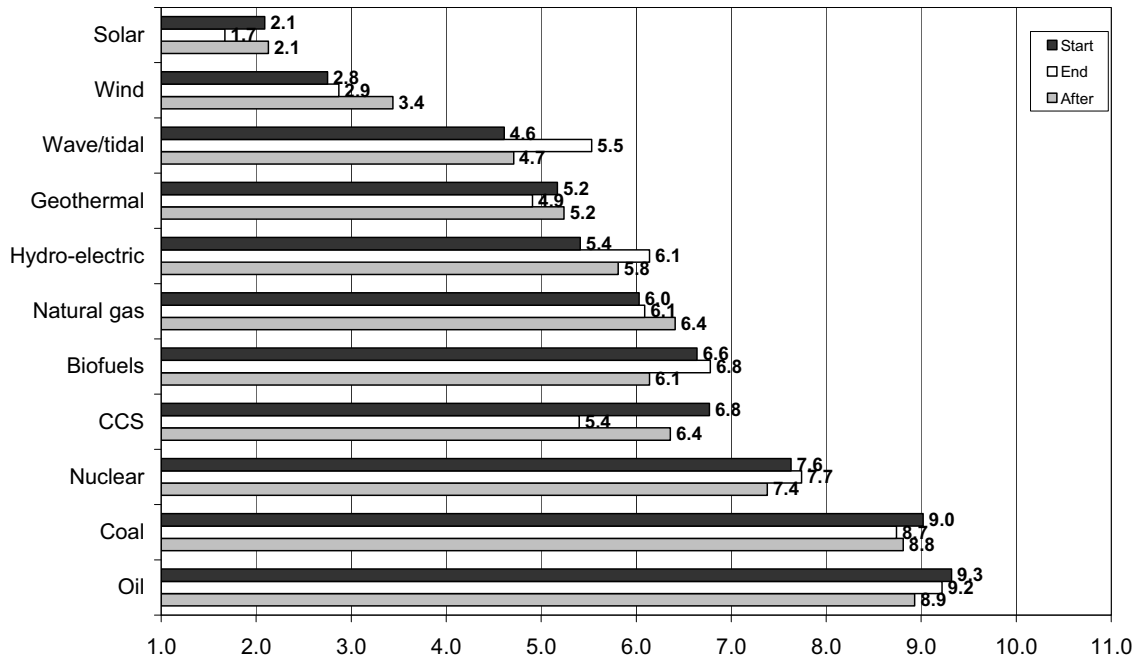
4.2. Changes in attitudes to and knowledge of energy technologies

A major aim of this research was to explore the Australian public's attitudes and knowledge to the range of low emission energy technologies. Although the workshop results showed an attitude shift in the short term, over a longer period of time the majority of attitudes almost rebounded to pre-workshop levels with the follow up survey results. For example, the mean response to "How strongly do you support the use of carbon capture and storage technology?" was 4.4 when first measured at the start of the workshops, 5.1 at the end, then after the workshops similar 4.6 which is similar to the mean at the start.

Another question asked participants to rank the range of technologies in order of priority if they were to allocate public funds to their development and/or implementation. In this exercise 1 indicates highest priority and 11 indicates lowest priority; therefore a low score can be interpreted as higher support. In each round, highest mean priority was accorded to funding renewable technologies in the form of solar and wind. However wind became less popular in the follow-up survey as shown in Figure 1. Other observations showed that biofuels became more popular

since the end of the workshop CCS became more popular immediately after the workshop but has become less popular since the workshop but is not as low as the initial response.

Figure 1 Comparison of how respondents prioritised funding at different stages of engagement.



The workshops increased the participants’ self-rated knowledge for all technologies. Post-workshop this knowledge did drop somewhat, but was still higher than pre-workshop levels as shown in Table 1. This demonstrates that the workshop process does produce the impression of increased knowledge in participants over the longer term. From their responses on reported behaviours it appears that this knowledge empowers them to talk more about the topic to their friends and family.

Table 1 Comparison of mean self-rated knowledge levels.

How would you rate your knowledge of:	Start of workshop	End of workshop	≥12 months
Biofuels technology	3.7	5.1**	4.3**
Carbon capture and storage technology	2.8	5.0**	4.3**
Coal technology	4.3	5.4**	5.0*
Geothermal (hot rocks) technology	3.4	5.1**	4.2**
Hydro-electric technology	4.2	5.1**	4.8^
Natural gas technology	4.2	5.3**	5.0*
Nuclear technology	3.9	4.9**	4.7
Oil technology	4.3	5.2**	4.9^
Solar technology	4.9	5.6**	5.3*
Wave/tidal technology	3.5	4.8**	4.1**
Wind technology	4.3	5.4**	5.0*

Paired two tailed t-test, between start, end of workshop and 12 months after significant at <0.001***, <0.01*, and ^0.05.

4.3. Follow-up interviews

When completing the final survey participants were asked if they would like to participate in an additional interview. It was felt this would allow the researchers to probe more deeply to discover what participants valued most about the workshop and how it had impacted on their daily lives. As discussed earlier, 63 of the 95 participants expressed a willingness to participate which is an excellent response, especially given the time lapsed since the workshop. It indicates that there was an enduring willingness and interest on the part of the lay public to be involved in such complex issues. Given time constraints twenty two interviews were conducted with a good geographical spread between the four cities.

4.3.1. Recall of the workshop

First, participants were asked what they remembered most about the workshops. A key theme in responses was gaining new knowledge, with participants referring to the in-depth information provided, the expert presentations and group discussions regarding what they had learnt, and also the use of technology such as the digivote to showcase the opinions in the room. As illustrated in the quotes below, participants were enthusiastic about gaining this knowledge and these memories of the workshop process were positive.

[I remember] feeling quite enlightened...I was always concerned about climate change but I didn't really know the different options. It just reinforced my sort of love for renewable energy, like solar and wind and that sort of thing. Adelaide

Finally understanding the broad range of different types of environmental options were available. And what they mean. Melbourne

...it was informative and I enjoyed that...even though I try to keep up with what's going on, I found that day that I didn't really know as much as what I wanted to know. So, I remember talking a lot about carbon capture, so I found out what that was. Adelaide

...the guest speakers that talked about the various options in regards to lowering the emissions that we give off, the group activities that we did around the table, and the digivote that showcased the spread of people in the room, both in gender and age. Perth

4.3.2. Changes in behaviour

To probe more deeply participants were also asked to comment on how their energy or other environmental behaviours changed as a result of the workshop, and also on the other things that have influenced their energy and environmental behaviours since the workshop. Of the 22 interview participants, 18 reported that their energy or other environmental choices or behaviours had changed as a result of the workshop. Of the changes reported, the most common involved switching to energy efficient light-bulbs, turning lights off when not needed, switching to green power, and other energy saving activities like installing insulation, buying a manual push-pull lawn-mower rather than a fuel or electric one, and using a cold cycle on the washing machine. Water conservation behaviours were also reported, such as signing up for the WaterWise program, installing water efficient shower heads and reducing shower times and reusing water. Reducing travel related carbon emissions also featured with respondents mentioning choosing to walk rather than drive, starting to save for a hybrid car, and switching to E10 petrol.

...since then there were a few changes that I did make; things like when I was doing the washing I only wash on a cold cycle...everything goes out on the clothesline. Little things, they're not a lot. But yeah, I did change over to power saving light globes and all those sorts of things. So I suppose it has changed a little bit. Adelaide

Three participants reported that they had not changed their energy or environmental behaviours as a result of the workshop. The reasons given why the workshop had little effect on their behaviours included external constraints on energy saving behaviour which prevented them from making changes (for example, living in rental accommodation), that they were already practicing energy and environmental saving behaviours prior to going to the workshop, and that other factors, such as the rising cost of electricity were the key determinants in changes to energy saving behaviours. Interestingly, two participants who reported no changes to their energy use and environmental

behaviours as a direct result of attendance at the workshop still acknowledged that the material provided in the workshop has reinforced their commitment to energy saving behaviours.

I was pretty well probably doing everything I could in a rental property, anyway...but I did learn some things that I didn't already know. It probably didn't change anything I was doing, but there was a good reinforcement that I'm doing the best I can. Adelaide

Participants were also asked whether anything else had happened to change the way they act in regard to climate change or energy use. Twenty respondents responded positively to this question. As the interviews were conducted in December, 2009 it was not surprising that one of the most common influences on behaviour mentioned in interviews was the broader debate regarding climate change measures taking place in the lead up to the UN Climate Change Summit in Copenhagen.

... for example you've got Copenhagen happening at the moment... I'm following it a lot more closely than I would have normally, and it is coming up in conversation with people at work and that sort of thing, so I think I'm more aware of it and while I'm doing as much as I think I can for the moment, I do like to listen out for other things that I could possibly pick up and do easily. Adelaide

Media reports and increased discourse regarding climate change and the need for energy efficiency were also reported to be an influence on behaviour, with some respondents indicating that negative news reports created a fear-based motivation to act.

*I watch some of the programs and some of them have scared the ***** out of me and I can't think of any single event or single thing that's changed. But I've just generally galvanised it into my views into a view of what I think is the truth.* Perth

4.3.3. Energy preferences

When asked what their preferred energy options were, solar was the overwhelming response and was mentioned 16 times, although a number of respondents mentioned multiple energy options. The next most mentioned energy source was wind (7 times) and geothermal (4 times). CCS, nuclear and hydro were mentioned once. Two respondents reported that they had no clear preference and that a range of options was needed. When asked to explain why they preferred a particular energy source renewable energy options were typically described as infinite in supply and being easily available. There was also the perception that wind and solar could be harnessed with less disturbance to the earth and environment, and seen as less wasteful. However, despite broad preference for solar and wind, individuals still acknowledged the drawbacks of these technologies in relation to noise and maintenance costs.

Well, the windmill isn't going to stop, the sun isn't going to stop and the earth's core isn't going to cool instantly. Perth

Seventeen participants reported that the workshop had influenced their preferred energy sources. Learning more about the suite of energy sources that are available or being developed was a key component of their feedback. Many saying they became aware of certain technologies and realized that some of their beliefs about technologies were inaccurate or they became more confident in their opinions about certain technologies.

...we learnt a lot of things that we never knew and there were energy technologies out there that they were contemplating that we didn't even know of. Adelaide

I think it was carbon storage, catchment and storage ...I didn't know much about it before and I've heard the term bandied about but didn't actually know anything about it, didn't understand what it meant. So, I suppose my attitudes have changed a little bit knowing that there are other options out there that I didn't know about. Adelaide

Fourteen participants referred to 'carbon capture' during their interviews. The word carbon appeared 58 times in the interviews, with the word capture being used 36 times. In comparison word solar was used 100 times and geothermal was used 42 times. When they recalled the concept of CCS, participants associated it with clean coal and nuclear energy best reflected in the quote below.

clean coal... it seems to me to be quite a stupid idea to be honest.. it's a bit like using atomic power. All you're doing is using a power which creates a problem, an ongoing problem for the holding of the resultant material, and... you have got to keep the stuff somewhere for hundreds and thousands of years afterwards...

Brisbane

Others saw CCS as a short term solution that was in preference to continue burning coal unabated. However others raised the issue of the power of the coal lobby and felt that the coal industry may be influencing the direction of technology development over other technologies. Some participants expressed their dislike of the concept of CCS alluding to it as ‘hiding things under the carpet’ and others alluding to the potential risks and uncertainties associated with the technology.

5. Discussion

Although the overall quantitative results show that changes in participants’ attitudes were not sustained over time it is apparent from the qualitative comments that participants felt that the workshop had influenced their behaviour, energy preferences and knowledge levels. Participants were also largely enthusiastic about the workshop and reported being pro-active after the workshops to develop their understanding and opinions about each of the technologies and their place in a low carbon economy. The fact that 32% of original workshop participants were willing to complete an on line survey, and of those 95, 67% expressed an interest in being interviewed demonstrates that there is an interest by the Australian public to be engaged in the topic of climate and energy. When asked in the follow up survey to rate the fairness of the workshop, that is, were participants able to express their views and feelings. On a scale of 1 (strongly disagree) to 7 (strongly agree) the mean score was 6.03. Similarly, when asked if the workshop procedures were free of bias the mean score was 5.30, and the workshop procedures were based on accurate information the mean was 5.72. Similarly, when asked their levels of trust on a scale of 1 (low trust) to 7 (high trust), mean score results in the information (5.91) and key figures in the workshop such as the expert presenter (5.94), the Master of Ceremony (5.97) and the facilitator at the table (5.72) were also high. Trust and integrity in the process has been seen as a critical component for informing attitudes [30].

Participants reported self-rated knowledge at the time of the follow up survey was higher than before attending the workshop and is reflected in some of the results from the interviews where gaining knowledge was a key positive memory of the process. While it is difficult to quantitatively assess the impact of this knowledge on general acceptance of energy technologies, interview participants did report a change in their energy preferences. In line with earlier research both in Australia and internationally, renewable energy sources - solar and wind - were found to be the most favored energy options over the long term. This preference appears to be based on a perception that solar and wind are infinite, easily available sources of energy. However, through the interview process it is apparent that workshop participants also recognize that a low emissions future and a secure energy supply is a complex problem and that renewable sources will not always be feasible.

There was a general consensus regarding the need for a portfolio of solutions to be developed. Participants expressed an appreciation for the role of other energy solutions that they previously had not been aware of prior to the workshop, for example geothermal and CCS. Given the high support for solar and wind, care must be taken to ensure that information and dialogue regarding other energy technologies is provided in an open and independent manner, as participants expressed distrust based on the connections between CCS and the coal industry and a perception that CCS is a risky, potentially polluting option.

6. Conclusions

Although the attitudes of participants were not sustained over the longer period between the workshop process and the follow up survey, returning almost to their original levels, participants openly expressed an interest in the topic. Their willingness to participate in follow up research activities indicates a genuine will of the general public to be engaged in discussion about climate change and energy technologies. The participants’ self-rated knowledge was sustained which gives some credibility to the process, reinforcing the value of hearing information from a trusted expert alongside the opportunity for discussion to challenge assumptions and beliefs. This change in attitudes was openly acknowledged by some of the participants in the follow up interviews.

The results should be encouraging for policy makers to continue to invest in efforts to involve the general public in deliberative processes that allow them to access information and ask questions of a trusted expert on the topic of climate and energy technologies. Actions by the participants showed that armed with the new knowledge and information they are confident to discuss the topic with their friends and family and can become informers about the

topic in their own right. This dissemination of information through social networks can be an effective tool when the public are armed with accurate information. This highlights the opportunity for research institutions to work cooperatively with policy and technology developers to ensure the lay public have the most accurate information about the current challenges and benefits of each technology to assist in the deployment of the range of technologies required to take action on climate change.

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