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Final Report
South Australian Local Government Association Energymark Trial

Emily Mendham, Simone Carr-Cornish and Anne-Maree Dowd
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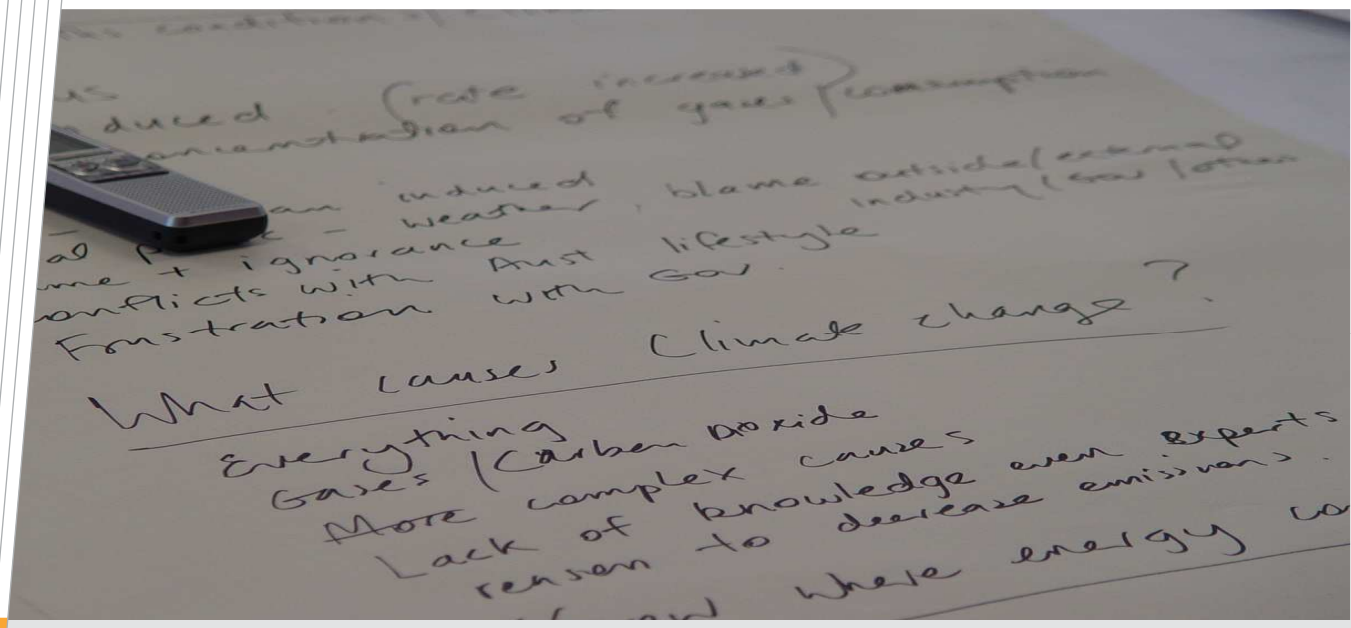

Enquiries should be addressed to:
Emily Mendham
(07) 33274073 Emily.Mendham@csiro.au

Distribution list

Adam Gray, SALGA	1
Julie Grant, DPC	1
Anne-Maree Dowd, CSIRO	1
Peta Ashworth, CSIRO	1

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1. EXECUTIVE SUMMARY

This final report provides the South Australian Local Government Association (SALGA) with an analysis of the results achieved throughout the Energymark trial. The South Australian Energymark Trial commenced in August 2009, following on from a successful national trial. The Commonwealth Scientific and Industrial Research Organisation's (CSIRO), working together with the SA LGA, aim to create momentum at the community level around the topic of climate change and energy use.

Energymark draws on previous work conducted in the water sector to develop a process that can increase knowledge and understanding about reducing greenhouse gas emissions to bring about behavioural change in individual energy consumption. Active and interested community members volunteer to be a group convenor. Each group convenor then commits to hosting a series of eight 'kitchen table' meetings on energy and climate change mitigation with a small group made up of friends, colleagues or family. The group proceeds through the meetings at their own pace using material supplied by CSIRO covering a range of climate change topics. After each discussion the group convenor provides a short summary to CSIRO, detailing the key points raised and actions that have been committed to by each individual in their group. The group completes voluntary questionnaires at the start, middle (session four) and end of the process to monitor any change in attitudes, behaviours and knowledge. Participants also fill in a carbon footprint questionnaire at the start and end of process to monitor changes in greenhouse gas emissions. The data collected enables assessment of Energymark's impact on individual behaviour over time as well as evaluation of information exchange through social network analysis.

The main findings from the South Australian Energymark Trial are:

- The median age of participants was 45 years. There was a good representation of all age groups. The majority of participants were female (55% compared to 45%).
- Participants were well educated, with 64% holding a diploma or above. Thirty-eight percent of respondents were employed full time, and 29% were retired. Most participants were 'white-collar' workers.
- The median household income of Energymark participants was $70,000-$79,000.
- Energymark participants were in households of couples with no children (32%) or couples with children (28%). Most respondents lived in a house, as opposed to a flat or other structure. Fifty percent of respondents owned their own home or had a mortgage, and 48% were renting.
- The majority of Energymark participants were from non-metropolitan regions, with 78% living 'in a town'.
- On average Energymark participants reduced their carbon footprint by three tonnes or 15%. The greatest reduction in greenhouse gas emissions occurred in the spending sector.

- There was an increase in Energymark participants' positive attitudes, intentions and behaviours towards reducing their household electricity consumption.

- On average Energymark participants' knowledge of various energy technologies increased, as did knowledge of climate change and related issues

- A significant increase was observed in respondents' support of several energy technologies (e.g. nuclear), with a significant decrease observable in others (e.g. gas without carbon capture and storage). Support of different strategies and behaviours for reducing greenhouse gas emissions also increased (although were already relatively high), such as increasing the price of electricity and a Carbon Pollution Reduction Scheme.

- On average, Energymark participants communicated information from Energymark sessions to nine people beyond their Energymark group for the first half of the program (pre - interim), and another nine people for the second half of the program (interim - post).

- Participants and groups who were linked with greater reductions were: likely to have higher incomes and non-tertiary educations; by the end of the process they were likely to identify as being members of the community; and perceive others as approving of and to be reducing their own household energy consumption. Groups that by the end of the process perceived their group convenor as a role model and described their group as having cohesive values were more likely to have greater reduction in CO_2 emissions from household electricity consumption.

In the next section of the report we outline the process and methodology of Energymark. We then outline the project management aspects of the South Australian Energymark trial, including recruitment methods. Following, we outline the results of the trial. First, we present the demographic profile of participants, followed by behavioural, attitudinal and knowledge change, change in support for different energy technologies, and social networking behaviour. To explore these issues we draw upon both quantitative data from the surveys as well as qualitative data from the open ended questions included in the surveys and group convenor session summaries. We then explore the influence of individual and group level characteristics, including the influence of location. In the following section we explore some of the impacts of Energymark and key issues, concerns and messages of participants using qualitative data from the convenor session summaries.

2. INTRODUCTION

This final report provides the SALGA with an evaluation of the Energymark trial. The South Australian Energymark Trial, which commenced in August 2009, follows on from a successful national trial of the Energymark process. The CSIRO, working together with the SALGA, had the shared goal of creating momentum at the community level around the topic of climate change and energy use.

The Energymark concept was drawn from a similar process used in the water sector. The Energymark process is directed towards increasing public awareness and concern about reducing greenhouse gas emissions. The Energymark process can also increase knowledge and understanding of the role energy technologies in reducing emissions to bring about individual behavioural change in energy consumption. Behavioural change is an important component of the energy debate as societal behaviour determines consumption patterns (which affects demand) and technology acceptance (which affects the prospects for new energy technologies in Australia). As a result, CSIRO has been grappling with the problem: *how to create national momentum around the topic of climate change and its relation to energy that will change the way Australians think and act about energy and climate change mitigation.* To address this question CSIRO has developed Energymark.

2.1 Energymark

The CSIRO's Energy Transformed Flagship is committed to increasing public awareness and knowledge about climate change and the range of energy technologies available to reduce greenhouse gas emissions. In addition to its technical research program, the Flagship has become increasingly aware of the critical role that changing individual energy behaviours will play in successful efforts to mitigate climate change.

The Energymark concept is based on a behaviour change program developed by the Victorian Women's Trust called Water*mark* (Victorian Women's Trust, 2009). The Water*mark* approach clearly demonstrated the success of utilising pre-existing social networks for generating social change. Water*mark* groups were formed around already existing friendships and community groups. Thus, feelings of mutual respect, trust and accountability were prevalent and participants felt safe to discuss the issues and problems openly.

The Energymark process has embedded within it monitoring and evaluation. CSIRO has included questionnaires to measure and track knowledge, attitudes and behaviours throughout the process in order to provide evidence of reduction in individual carbon footprints, knowledge and attitude change.

The Energymark process is based on six key points that encourage, support and create social change (see Gardner, Dowd, Mason, & Ashworth, 2009), including:

1. The need to reach people in a safe environment (people prefer kitchen table discussions/workshops to major Government publicity campaigns).

2. Perspectives of participants involved in deliberative processes shift as they develop more informed opinions. In many cases this leads to a more positive attitude towards new technologies.

3. Trust in the messenger is as significant as the message in shaping public perceptions.

4. A lack of knowledge exists in communities about energy technologies and their relationship to greenhouse gas emissions and there is a clear need and demand for education at all levels.

5. People want balanced, accurate information which is independent and credible.

6. Engagement is a way to develop leaders within the community to move the debate forward.

In order to apply the above social change agents, there are essential engagement principles that can assist in the implementation of the change process. These include:

1. Inclusiveness - recognising individual effort, acknowledgement, and incorporate ideas and perspectives.

2. Mutual respect - provides the opportunity to explore, listen and understand different viewpoints, values and beliefs by encouraging others to share their experiences.

3. Transparency - the open sharing of and access to information.

4. Mutual responsibility and accountability - actively contribute to building a better solution, define boundaries and expectations helps to build confidence in the participants about the process.

5. Adequate resources - confirm the overall commitment to the process.

6. Mutual trust - trust is crucial if real outcomes are going to be achieved from any engagement activities.

2.2 Process and methodology

2.2.1 Process

The Energymark process brings together small groups of people who meet at their own pace to discuss energy technologies and climate change. Within the eight meetings individuals share their thoughts, anecdotes and first hand experiences. Engaging the public in this way ensures the information is more likely to be translated into action by individuals because they can relate to the concepts, discuss them openly and change their behaviours accordingly.

There are three key roles involved in the Energymark process: 1) the Expert Panel (made up of scientists from within and external to the CSIRO); 2) the Secretariat (CSIRO Energymark

project managers); and 3) the Group Convenor [Figure 1]. The Expert Panel approve all factsheet information and provide answers to technical questions from Energymark groups. The CSIRO Secretariat supports each convenor, collects Group Convenor summaries and participant questionnaires and is the link between the groups and the Expert Panel. The Group Convenor is crucial to the success of the project. Group convenors bring together a small group of people and instigate the process of talking about energy, climate change and mitigation. Group convenors organise and manage the meetings of their group and provide the link back to the Secretariat. In order to qualify to be a group convenor, individuals need to have a minimum of a Year 12 (or equivalent) education level, the capability to lead, engage, facilitate, and maintain an *Energymark* network, and provide feedback and questions from group discussions to CSIRO.

Figure 1 Energymark process

2.2.2 Data collection and analysis

To evaluate the effectiveness of the trial and capture feedback from participants, questionnaires were administered at the beginning, interim (session 4) and final stage of the trial. These questionnaires were voluntary, and we have received data back from 20 of the 35 groups. The surveys included questions that covered the topics: knowledge of energy technologies; knowledge of climate change topics; beliefs and attitudes concerning climate change; beliefs and attitudes concerning energy technologies; household energy consumption and intentions; the role of the group convenor and group function; and information regarding social networks. A carbon footprint survey was administered at the start and end of the process in order to measure any change in participants' carbon footprints over the duration of the trial. Convenor session summaries provided valuable qualitative information regarding the discussion which occurred in each session and actions committed to by Energymark participants. The data collected enables assessment of Energymark's impact on individual behaviour over time and information flows through the use of social network analysis. This mixed method enables measurement of the process and outcomes.

To understand the effectiveness of Energymark in encouraging reduced energy consumption and increased awareness and preparedness to act on climate change, participants' knowledge, attitudes and behaviours at the beginning and then end of the trial were compared. These comparisons were made using paired sample t-tests, with differences considered significant at $p < 0.001$, $p < 0.01$, and marginally significant at $p < .05$ or $p < .10$. Multiple regression tests were

used to identify if reducing CO_2 from household energy consumption was linked to participants or groups with particular features. These associations were considered significant at $p < 0.001$, $p < 0.01$, and marginally significant at $p < .05$. Only participants that volunteered responses on each questionnaire were included in these analyses. The qualitative convenor session summaries were analysed thematically using NVivo version 8. Qualitative coding was undertaken to locate key themes, patterns, ideas, and concepts within the data.

2.2.3 Limitations

There are several limitations which need to be recognised. Energymark does not rely on a random recruitment process. Rather, groups and participants are self-selected. As explained, engaging with pre-existing networks and those with an interest in the topic is an important part of successful engagement in mitigation behaviour change programs. In order to provide a comparison and partially address this limitation, we have compared the carbon footprints of Energymark participants with those of South Australia as a whole, as measured by the Australian Conservation Foundation (ACF). The pre-Energymark average of Energymark participants was marginally more than the 17.24 tonnes average per capita for South Australia as estimated by the (ACF Consumption Atlas (Dey et al., 2007). The measure of CO_2 emissions used in the Energymark project is comparable to the ACF Consumer Atlas with some minor differences. Both approaches include the emissions generated through direct energy consumption such as household electricity and indirect energy usage which takes place through the purchasing of goods and sources. Similarly, both approaches include weightings that are based on statistics from a range of secondary sources such the Australian National Greenhouse Gas Inventory and Australian Bureau of Agricultural and Resource Economics (ABARE). There are two key differences. The ACF Consumer Atlas considers emissions generated through construction and renovation whereas the Energymark methodology does not consider construction and renovation as a standalone activity. The ACF methodology projects emissions per person statistically, whereas the average emissions calculated in Energymark are based on self-reports from participants.

While the embedded monitoring and evaluation process is a unique and important aspect to Energymark enabling assessment and evaluation of the process, the lack of a control group means that it is possible factors outside of the Energymark engagement process influenced any change in behaviour or knowledge observed. While the qualitative data and communication with convenors gives a strong indication of the importance of Energymark in instigating the change process, it is not possible to quantitatively determine the individual impact of the Energymark process on behaviour change.

Owing to the short time period of the SALGA Energymark trial, any behaviour change observed (such as changes in carbon footprints) may be a conservative indication. From the initial start date of the trial (August 2009) to July 2010, taking into account the time taken to recruit convenors and holiday periods when convenors are less active, change in some participants' carbon footprints, electricity and gas usage may be minimal. Energymark is designed to be a longer-term process, conducted ideally over eight months (one session a month) to facilitate long-term engagement and thus behaviour change.

3. PROJECT MANAGEMENT

3.1 Project Responsibilities

Table 1 summarises the responsibilities completed as stated in the 'Consulting Services Agreement'. Ms Sarah Crossman commenced work as Energymark Project Officer in South Australia on the 4th of August 2009. The SA LGA sent a circular to all South Australian councils and posted it on the SA LGA website on the 6th of August 2009 (http://www.lga.sa.gov.au/site/page.cfm?c=18588). The circular was reissued on the 25th of September. Of the 68 South Australian councils, a total of 25 councils registered their interest (19 in response to the first circular and a further three councils expressed interest after the second circular). Ms Crossman received a spreadsheet of council contacts as a result of the circular on the 11th and 21st of August and commenced making contact with those councils. A further four councils also registered their interest, one independently of the circular and three after personal contact was made by Ms Crossman. The councils comprised 15 metropolitan and ten non-metropolitan councils. Of the 25 councils, 21 came across as very enthusiastic about the project and willing to help. Two of the councils who registered interest were of average enthusiasm, and the remaining two were not able to be contacted. Throughout August and September the session materials, surveys and convenor packs were updated to include South Australia specific information and incorporate frequently asked questions from previous Energymark Trials.

Table 1 Trial responsibilities

CSIRO	SA LGA
1. Deployment of a CSIRO social science staff member at CSIRO Waite Site, South Australia for project support and as key contact for participants and group convenors. 2. Re-development of the survey and session materials. Session materials can be found at: http://www.em.csiro.au/energymarkresources/index.html 3. Newsletter every four months. 4. Update to SA LGA and Interim Report. 5. Final report to SA LGA.	1. Input and feedback on the Energymark process and content (including recruitment, group convenor materials, session fact sheets, auditing materials and questionnaires). 2. Provision of materials already in existence that could assist in the development of the SA Energymark. 3. Provide CSIRO with network contacts within the 68 South Australian councils and NGO or other appropriate groups who could support either the development or implementation of Energymark across the state.

Promotion began after the list of expressions of interest was received. Table 2 outlines the promotion and publicity avenues pursued in order to recruit convenors. Several different mediums and approaches have been utilised. Table 2 outlines the date and details of each

approach while Table 3 further summarises the promotion activities undertaken specifically by councils.

Table 2 Publicity and promotion

Source	Details
SA LGA (6th August)	The SA LGA disseminated a circular to all local governments in South Australia on the 6th of August calling for expressions of interest. Mr Adam Gray of the Local Government Association has promoted Energymark throughout his networks and to councils. CSIRO provided Mr Gray with flyers to hand out at presentations to assist in the promotion of Energymark.
Local Governments	▪ Ceduna Council emailed everyone on their ratepayer list as part of their weekly updates, promoted Energymark on the council's radio segment, and included an advertisement in their newsletter. ▪ A staff member from Port Adelaide Enfield gave a presentation to an environmental forum and emailed his network of contacts. ▪ Burnside City Council promoted the project on their website and emailed a network of people interested in environmental issues. ▪ Campbelltown City Council promoted Energymark on their website and emailed community groups including the 'Mums, Kids and Climate Change' group. ▪ Whyalla Council discussed the project with the Sustainability Strategic Planning Group and promoted the project in their council newsletter. ▪ Mount Remarkable sent an email to the Community Builders' Forum (community leaders) and the project was mentioned at their meeting. ▪ Flinders Ranges emailed the CEO and all councillors. ▪ Charles Sturt emailed their network and distributed hardcopy fact sheets to potential group convenors. ▪ York Peninsular NRM Officer registered interest but the CEO did not support her assistance with the project. ▪ Holdfast Bay included an advertisement in the council section of the local Messenger newspaper and the Community Advisory Committee was contacted. ▪ Marion sent information out to the local Sustainability Street Group. ▪ Norwood, Payneham and St Peters emailed groups that are interested in environmental issues. ▪ Onkaparinga emailed information to their community network and placed an advertisement in newsletters that are disseminated to peri-urban areas within council. ▪ Playford Council presented Energymark to a Community Engagement session, emailed Landcare volunteers, emailed a youth advisory council and tried to get councillors involved. ▪ Prospect emailed a group of environmentally-minded residents. ▪ Tea Tree Gully emailed community groups and CSIRO sent the council flyers for use in community meetings. ▪ The City of Unley promoted Energymark on their website, in the local Messenger newspaper and emailed contacts. ▪ Victor Harbor's NRM Officer emailed all his contacts. ▪ The CEO of Grant Council sent out information to his contacts and

	the Community Development Officer emailed a community network.
South Australian Conservation Council	CSIRO approached the South Australian Conservation Council who promoted Energymark in their E-Bulletin which is sent to environmental groups throughout South Australia.
Newspapers (7th and 12th October)	Advertising and editorials were placed in Messenger newspapers in eight regional and seven urban councils throughout South Australia
Press release (9th October)	CSIRO released a press release on Friday the 9th of October. This was reported on several different internet sites, including: http://ecomedia.org.au/press/2009/10/08/energymark-communities-tackle-climate-change-in-sa/ http://wotnews.com.au/like/energymark_communities_tackle_climate_change_in_sa/4075864/ http://thegovmonitor.com/tag/energymark http://www.sciencecentric.com/news/article.php?q=08102702 http://www.m2.com/m2/web/story.php/200936CA99DAD43BC5AC802576480021DC78 http://www.aaev.net/news/index.html http://groups.google.com.au/group/transition-initiatives-sa/search?group=transition-initiatives-sa&q=energymark
CSIRO Internet and newsletters (9th October-early November)	Energymark featured as the main graphic on CSIRO webpage, featured as an item on "Monday Mail" (an email sent to all CSIRO staff every Monday) and in an email sent to CSIRO alumni called 'Siroscope'. It has also been posted on the CSIRO Facebook page.
NRM Boards (presentation to SAMDB 20th October)	▪ Eyre Peninsula emailed those who attended a Climate Change Forum run in July (over 400 attendees), staff, key contacts and the CEO who were asked to further disseminate throughout their networks. ▪ South Australian Murray Darling Basin (SAMDB) sent out information to NRM Officers and community contacts. ▪ Ms Crossman, Energymark Project Officer, gave a presentation to a SAMDB NRM sub-group (the Ranges to River NRM group).
Universities (email) (8th and 30th of October)	CSIRO approached Adelaide University, TAFE SA and the University of South Australia who sent an email to all staff, students and alumni promoting Energymark. Information was also been posted on the UniLife Noticeboard: http://unione.unilife.edu.au/eNotice/Notice.aspx?NID=17.
Schools (newsletters) (19th October)	CSIRO approached regional schools with over 100 enrolments and asked if they would be able to promote Energymark in their school newsletters.
Libraries (poster and flyers) (21st October)	CSIRO approached regional libraries and asked them to display a poster and flyers about Energymark.
Energy-Transformed Flagship Newsletter (22nd October)	Energymark featured in the Energy Transformed Flagship newsletter, which is sent to industry and government stakeholders.
Email (23rd October)	CSIRO purchased an email list of over 26,000 people from regional South Australia. An email was sent to these recipients on the 23rd of October.
Radio (25th November)	Ms Peta Ashworth appeared on ABC Riverland to speak about the South Australian Energymark Trial.
Email SA SIFE Teams (20th	Ms Dowd emailed the South Australian SIFE Teams to ask for their involvement in the project.

January 2010)	
Newspaper (26th May 2010)	Energymark was featured in an article in the Riverland News, Wednesday 26th of May 2010. This convenor also appeared on local Win News.

Table 3 Promotion and publicity by council

Promotion method	Number of councils using method of promotion (several councils used a number of methods)
Email sent to environmental networks/groups	21
Presented at local group meeting	6
Promoted on council website	4
Email sent to staff	3
Promoted in council newsletter	2
Promoted in newspaper	2
Promoted in other print	1
Promoted on local radio	1

Table 4 outlines the ways those who registered interest in Energymark heard about the project. Emails from South Australian universities elicited the greatest number of responses, followed by CSIRO contact or presentations and newspaper advertisements/advertorials.

Table 4 Sources of information about Energymark

Source of information	Number of registrations
University email/website	16
CSIRO presentation/contact	13
Newspaper	10
Email/website not specified	7
Email from group/NRM network/Landcare	5
CSIRO email (purchased list)	5
Friend/networks/relatives	5
Council	4
CSIRO Siroscope publication/website	2
School bulletin	1
South Australian Local Government Association	1
Unknown	14

There were 83 registrations for group convenors, 22 for participants and two registrations for general information. Thirty-five (42%) of those who expressed interest in being a convenor will complete the Energymark group process (19 groups and approximately 322 participants from non-metropolitan councils, and 16 groups and approximately 106 participants from metropolitan councils). Approximately 450 participants have taken part in the trial (three groups have not provided group numbers). Six participants who registered interest were assigned to a group.

Of the 83 people who expressed interest in convening a group, 11 did not respond to our contact, one expression of interest was rejected as there was a conflict of interest, and three were assigned to another group after not being able to form a group of their own. Thirty people were not interested in becoming a group convenor or were unable to form a group. The main reasons for not being interested or able to convene a group were time commitment, unable to obtain enough interest to form a group, health issues and illness, bullying issues at work, increased work commitments or loss of job. Only three convenors whose group had met pulled out of the process. Two were unable to be contacted and did not respond to our attempts at contact, and one was a new working mother. It is therefore important for convenors to get a group together and meet as soon as possible to maintain momentum.

4. RESULTS

4.1 Demographic profile of participants

Of the 35 groups, 20 had finished and returned all their surveys by the time of preparing this report. Another seven groups had finished Energymark but not returned their surveys by the time this report was written.

4.1.1 Key points

- The median age of participants was 45 years. There was a good representation of all age groups.
- The majority of participants were female (55%).
- Participants were well educated, with 64% holding a diploma or above.
- Thirty-eight percent of respondents were employed full time, and 29% were retired.
- Most participants were ‘white-collar’ workers.
- The median household income of Energymark participants was $70,000-$79,000.
- Energymark participants were most commonly in households of couples with no children living with them (32%) or couples with children (28%).
- Most respondents lived in a house, as opposed to a flat or other structure.
- Fifty percent of respondents owned their own home or had a mortgage, and 48% were renting.
- The majority of Energymark participants were from non-metropolitan regions, with 78% living ‘in a town’.

4.1.2 Age and sex

The median age of participants was 45 years (mean 46.37). Energymark participants were slightly older than the South Australian population as a whole (the median age of South Australians is 39 years). Table 5 shows the age distribution of Energymark participants compared to South Australia. The 19-29 year old age group had the greatest representation, with 24.4% of Energymark participants. Twenty-nine percent participants were aged over 60 years of age, with good representation of all other age groups [Table 5].

Table 5 Age distribution of Energymark participants (N=394) *Statistics are from the Australian Bureau of Statistics 2006 Census of South Australia.

Age group	Energymark participants (%)			South Australian Population (%)*		
	Male	Female	Total	Male	Female	Total
18-29	11.4%	12.9%	24.4%	10%	10%	20%
30-39	4.6%	12.9%	17.5%	9%	9%	17%
40-49	8.1%	5.8%	14%	9%	10%	19%
50-59	6.6%	8.9%	15.5%	9%	9%	17%
60-69	10.4%	8.4%	18.8%	6%	6%	12%
70-79	3.0%	5.1%	8.1%	4%	4%	9%
80 +	0.8%	1.0%	1.8%	2%	4%	6%
Total	**44.9%**	**55.1%**	**100%**	**49%**	**51%**	**100%**

4.1.3 Education, employment and income

Eighty-nine percent of respondents gave information about their education (N=366). Sixty-four percent of respondents' level of education was a diploma or above (including bachelor, honours or postgraduate degree). Twenty-two percent were educated to the year 12 level or trade certificate/apprenticeship. Fourteen percent had a formal education level of year 11 or below.

Of those who responded to the question (N=360), 38% of participants stated they were employed full time (compared to 58.5% of South Australians in full-time employment). Thirteen percent were employed part-time or causally (compared to 30% for South Australia), 5% were self-employed, and 5% were unemployed (the same percentage as the total for South Australia). Twenty-nine percent were retired and 10% were students. Two percent of respondents stated their occupation was home duties.

The most common category of employment (N=292) was professional, with 42% stating they were employed in a professional occupation (18% of South Australian are in a professional occupation). The next most common category was clerical/administrative (15%, the same as for the whole of South Australia), followed by managerial (7% compared to 13.4% of South Australians), sales (5%, 10% of South Australians), technician (4.5%, 14% of South Australians), community or service (2%, 9% of South Australians) and labourer (1%, 12% of South Australians).

Thirty-six percent of people who responded to the question (N=341) household's earned less than $50,000 per year. Thirty-four percent earned between $50,000-$100,000 and 30% earned over $100,000. The median household income for Energymark participants was $70,000-$79,000 (greater than the median of $46,000 for South Australia).

4.1.4 Location, household size, composition and dwelling structure

Eighty-eight percent of respondents gave information regarding their household size (N=364). Of those who responded to the question, 42% stated they were a two-person household, followed by three (22%) and four person households (16.5%). Fourteen percent were living alone, with the remainder (5%) living in households of five or six people.

As expected, this was reflected in the household type (N=366) with the majority of respondents stating they were a couple with no children (32% compared to 40% of South Australians), followed by couple with children (28%, 42% of South Australians), single parent and children (20%, 16% of South Australians), single (15%), and group/other family (5%). The majority of respondents lived in a house (89%, compared to 79% of South Australians), with 9% stating they lived in a flat (the same proportion as for the whole of South Australia). Fifty percent of respondents owned their own home or had a mortgage (68% of South Australians), and 48% were renting (more than the 26% of South Australians).

Classifying the councils that participated in Energymark as either metropolitan or urban, 308 Energymark participants were from non-metropolitan council regions and 99 were from metropolitan councils. Table 6 shows the specific location of Energymark across South Australia.

Table 6 Location of Energymark participants (N=413)

Location	N	Percent
Streaky Bay	91	22.0%
Ceduna	61	14.8%
Yorke Valley	58	14.0%
Adelaide	55	13.3%
Thevenard	28	6.8%
Yorke Town	27	6.5%
Port Lincoln	13	3.1%
Gawler	7	1.7%
Mount Gambier	7	1.7%
Kalangadoo	5	1.2%
Mount Torrens	5	1.2%
Murray Bridge	5	1.2%
Waikerie	5	1.2%
Whyalla	5	1.2%
Willunga/Mount Compass	5	1.2%
Elizabeth	4	1.0%
Mount Barker	4	1.0%
Aldinga	2	0.5%
Penola	2	0.5%
Tungkillo	2	0.5%
Monarto/Monarto South	2	0.5%
Noarlunga/ Noarlunga City/Adelaide	2	0.5%
Kingston on Murray	1	0.2%
Lyndoch	1	0.2%

Mount Compass	1	0.2%
Norwood	1	0.2%
Port Augusta	1	0.2%
Sellicks Beach	1	0.2%
Missing	12	2.9%

Energymark participants were also asked where best described where they lived (options included ‘in a town’, ‘in a city’, ‘on the fringe of a town’, ‘on the fringe of a city’, ‘outside of a town’ and ‘outside of a city’). Eighty-eight percent of participants (N=365) responded to the question, with most stating they lived in a town (78%). Ten percent lived in a city, 5% outside a town, 5% on the fringe of a city, 3% on the fringe of a town and less than half a percent outside a city.

4.1.5 Electricity bills

The mean electricity bill of Energymark participants was $290 (N=324), with a minimum of $47 and a maximum of $930. Figure 2 shows the distribution of electricity bills across participants. Not included in this diagram were five individuals who were currently in credit (generating their own electricity) and five who did not know the current electricity usage.

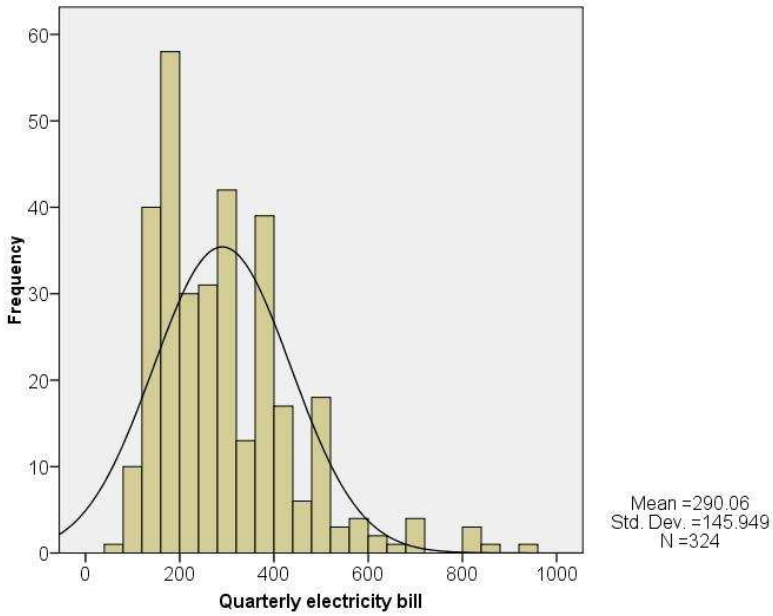

Figure 2 Electricity usage of South Australian Energymark participants

4.2 Behaviour, knowledge and attitudinal change

In this section we discuss whether there was change in behaviour (carbon footprints and electricity consumption), intentions to change behaviour, knowledge and attitudes by comparing survey results from before and after Energymark. We also outline any changes in support for different technologies and explore the social networking behaviour of Energymark

participants. Individual and group level characteristics are also explored using multivariate statistics. In this section we draw upon both quantitative and qualitative data.

4.2.1 Key points

- On average Energymark participants reduced their carbon footprint by three tonnes or 15%.
- The greatest reduction in greenhouse gas emissions occurred in the spending sector.
- There was an increase in Energymark participants' positive attitudes, intentions and behaviours towards reducing their household electricity consumption.
- Energymark participants' knowledge of various energy technologies increased, as did knowledge of climate change and related issues
- A significant increase was observed on average in respondents' support of several technologies (e.g. nuclear), with a significant decrease observable in others (e.g. gas without carbon capture and storage).
- Support of different strategies and behaviours for reducing greenhouse gas emissions also increased (although were already relatively high), such as increasing the price of electricity and a Carbon Pollution Reduction Scheme.
- On average, Energymark participants communicated information from Energymark sessions to nine people beyond their Energymark group for the first half of the program (pre - interim), and another nine people for the second half of the program (interim - post).
- Participants and groups who were linked with greater reductions were: likely to have higher incomes and non-tertiary educations; by the end of the process they were likely to identify as being members of the community; and perceive others as approving of as well as reducing their own household energy consumption. Groups that by the end of the process perceived their group convenor as a role model and described their group as having cohesive values were more likely to have greater reduction in CO_2 emissions from household electricity consumption

4.2.2 Change in intentions and behaviour

Over the duration of Energymark, participants reduced their carbon footprint by an average of three tonnes, reducing it from 20.8 to 17.7 tonnes [Figure 3]. The greatest reduction in greenhouse gas emissions was made in the spending sector. There was a significant reduction in emissions in each sector. This average of 20.8 pre-Energymark was greater than the state average of 17.24 tonnes and national average of 18.9 tonnes (Australian Conservation Foundation).

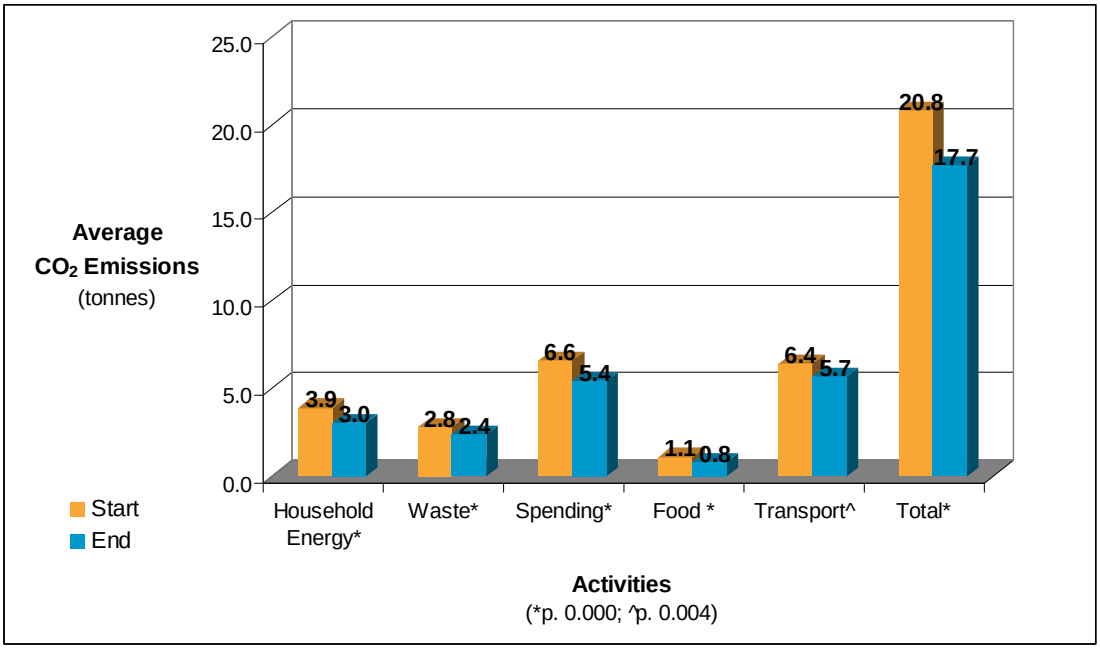

Figure 3 Average carbon footprint: pre and post Energymark (N=310)

In Figure 4 participants' average attitudes towards household electricity consumption, intentions to reduce household electricity consumption and self appraisal of their consumption are compared. A significant increase in positive attitudes and intentions towards reducing household electricity consumption over the next 12 months, and self-rated behaviour regarding reducing household electricity consumption over the past 12 months was evident [Figure 4].

These responses were measured both at the start and end of the Energymark process. Attitude towards reducing household electricity consumption was measured by asking participants to rate their response to "Reducing my household electricity consumption over the next 12 months would be" on five items (1- worthless, 4-unsure, 7-valuable). These items were then averaged to create a summated scale for "Attitude toward reducing household electricity consumption over the next 12 months" with a sound reliability score (Cronbach's Alpha: start 0.809; end 0.882). Intentions were measured by asking participants "I intend to reduce my household electricity consumption over the next 12 months", "I plan to reduce my household electricity consumption over the next 12 months" and "I will try to reduce my household electricity consumption over the next 12 months". Participants could rate their responses from 1-strongly disagree, 4-unsure to 7-storngly agree. These responses were then averaged to create a summated scale for "Intention to reduce household energy consumption over the next 12 months" with a sound reliability score (Cronbach's Alpha: start 0.919; end 0.911). A self-rated assessment of behaviour was measured by asking participants to rate their responses from 1-strongly disagree, 4-unsure to 7-strongly agree to "I have reduced my household electricity consumption in the past 12 months".

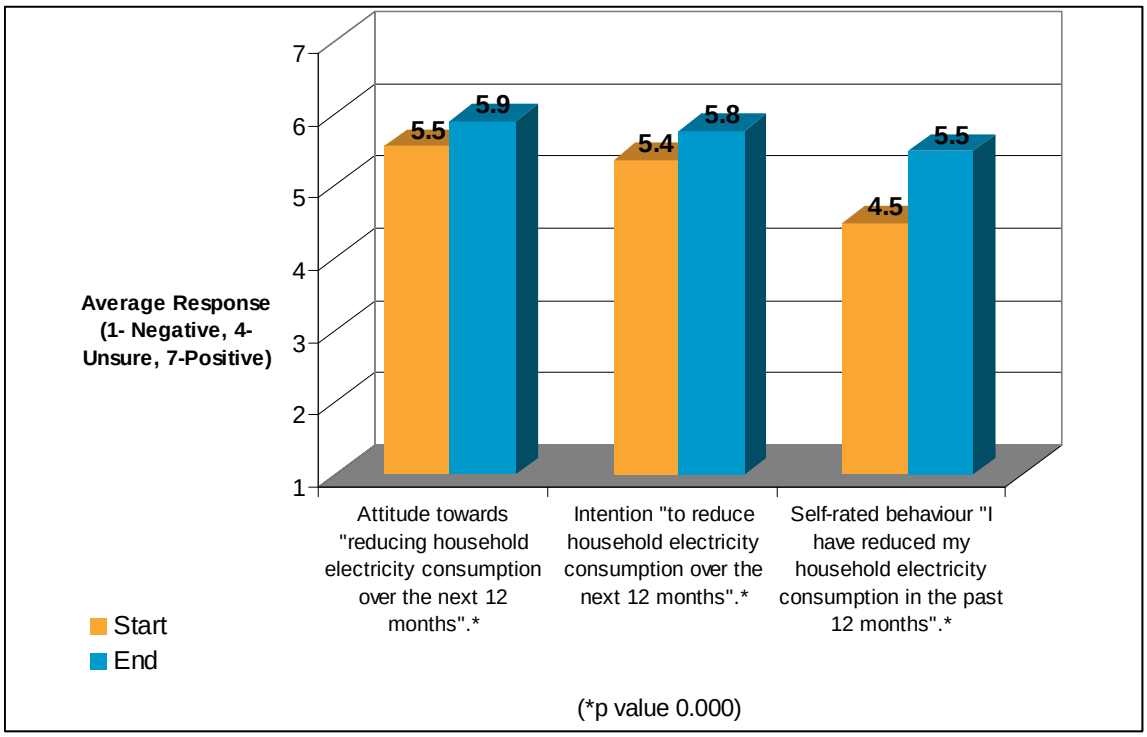

Figure 4 Energymark participants' attitudes, intentions and self-rated behaviour towards electricity consumption (N=298-318)

Energymark participants were asked also to rate their climate friendly behaviours. There was a significant increase in climate friendly behaviours for all the behaviours measured except 'used energy efficient travel for short trips' (which increased from a rating of 4 to 4.2, p=0.366) [Figure 5 and Figure 6].

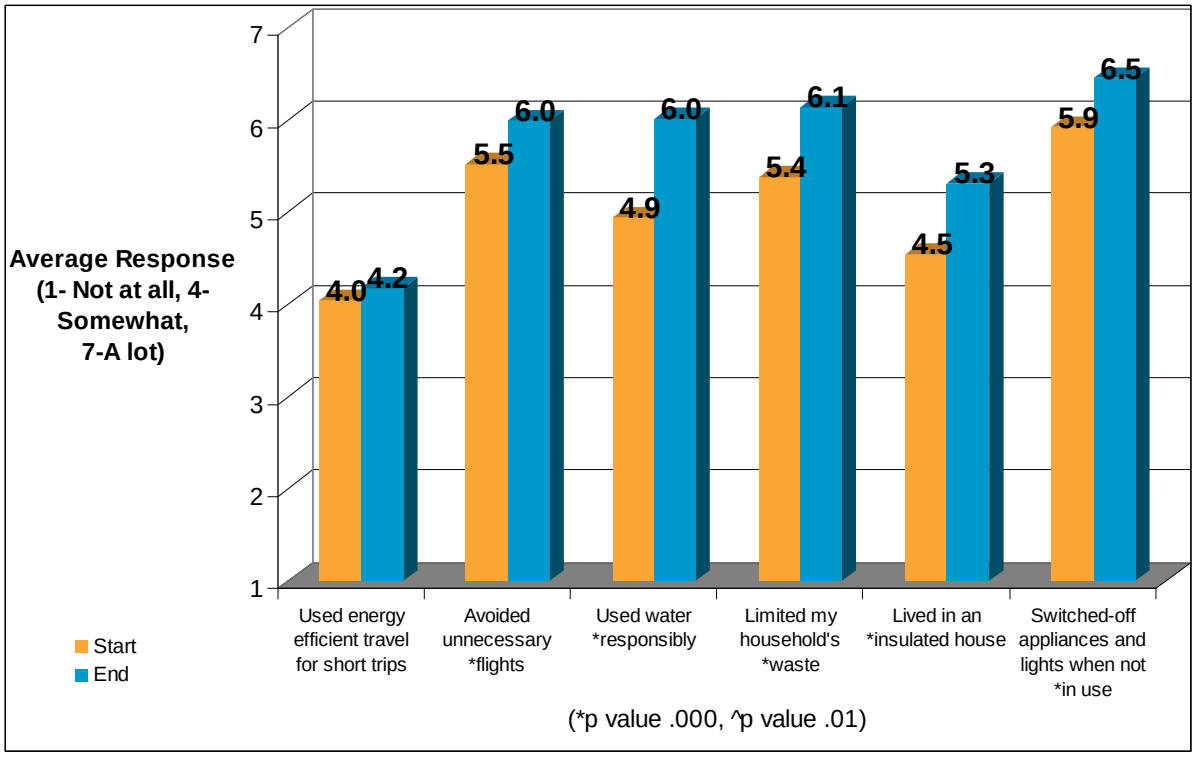

Figure 5 Climate friendly behaviours: participants' self-rated behaviour (N=281)

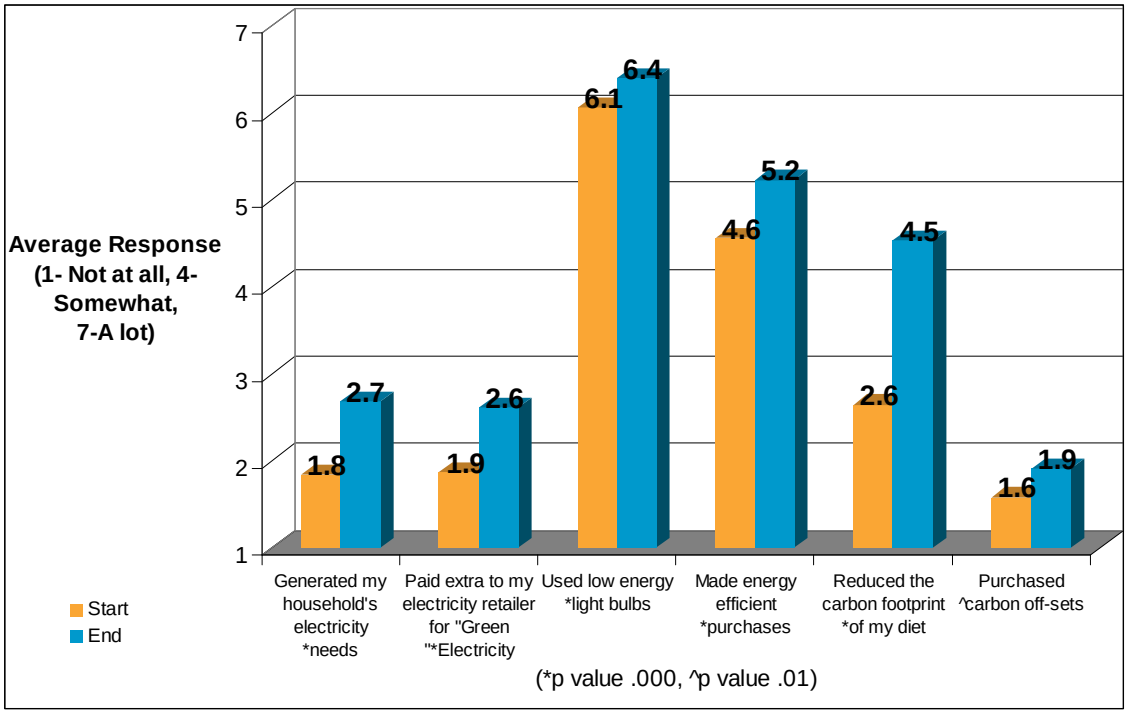

Figure 6 Climate friendly behaviours: participants' self-rated behaviour (N=281)

Energymark participants were also asked to identify an 'action plan' to help them to reduce their carbon footprint. The surveys also asked respondents to describe any changes they had implemented since beginning Energymark in an open ended question. Climate friendly behaviour changes made included:

- Planting a vegetable patch using grey water
- Plan trips and car pooling; having a 'car free day' a week
- Staying in town instead of commuting to work
- Planting native trees
- Altering diet and eating locally
- Reducing unnecessary expenditure; 'spend free day'
- Replacing lawn with trees and shrubs
- Changing light-bulbs
- Less hot showers
- Increase thermostat temperature; use fan rather than air-conditioning
- Cancel junk mail
- Composting
- Purchase offsets and Greenpower
- Reduced the amount of packaging purchased
- Turning off standby power
- Recycled
- Do not use air-conditioning unnecessarily and limited use of heating

- Use less products (hairspray, makeup)
- Maintain appliances (defrost freezer)
- Solar power – pv and solar heating
- Installed rainwater tanks
- Buy local products and 'free trade'
- Introduce sunlight (less lights) and passive cooling system
- Installed low emissions film on windows
- Installed pelmets on curtains
- Installed efficient LGP hydronic heating system to replace wood
- Replaced carpet and vinyl flooring with bamboo
- Used natural paints
- Painted roof with solar reflective paint
- Installed whirly birds to remove excess heat
- Installed smart meter
- Stopped using disposable gift wrapping
- Eat red meat once a week and buy locally slaughtered free range meet
- Buy bulk food from farmers' market
- Mulched garden
- Used scooter or motorbike rather than car and push bike for short trips
- Washing full loads using cold water
- Maintain tyre pressures

Some of the main barriers to implementing these behaviours were identified and included:

- Habits, selfishness, laziness and forgetfulness
- Cost
- Family and flat mate preferences and compliance
- Requiring careful thought and planning
- Difficult to change current house set up and house position for solar or passive cooling
- Time
- Local and state government regulations (regarding installing a 12 volt wind turbine)
- Access to power points for switching off standby power
- Finding suitable alternatives for packaged products and diet
- Affects lifestyle
- Renting
- Safety, distance, time constraints, fitness and convenience for cycling
- Lack of public transport (especially in rural areas)
- Availability of car pooling and communication, work location and hours for car pooling

4.2.3 Change in knowledge

There was a significant increase in knowledge of all the energy technologies included in the survey when comparing self-rated knowledge before and after Energymark [Figure 7 and Figure 8]. The average knowledge of Energymark participants increased from low to moderate knowledge to high to very high knowledge.

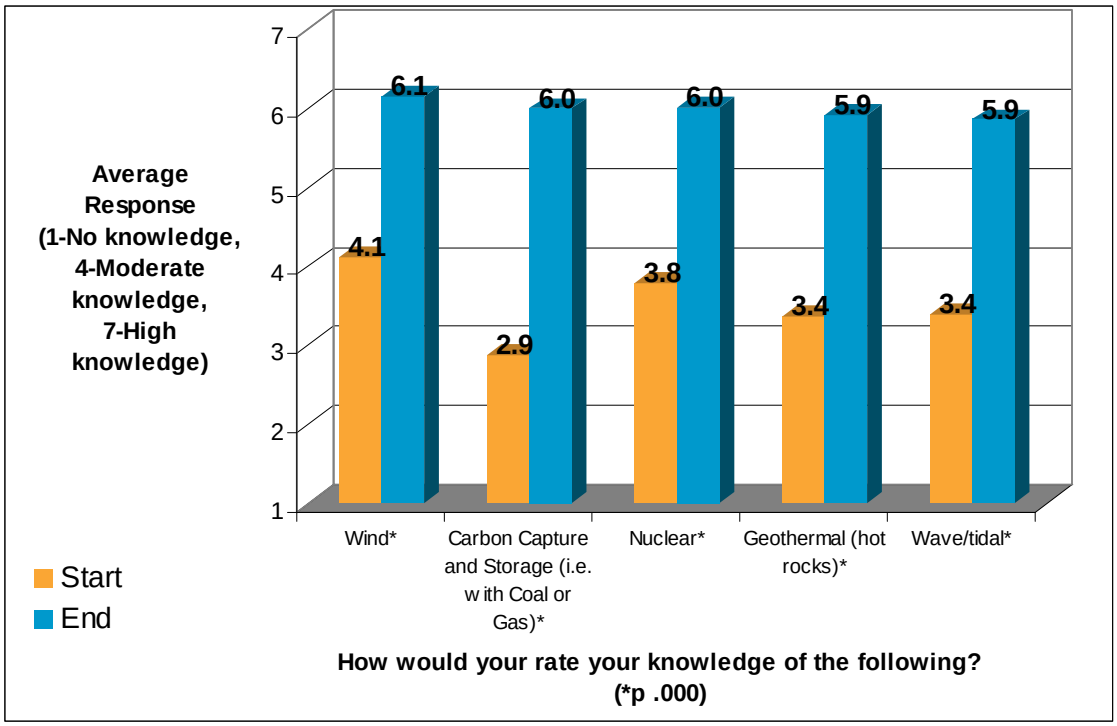

Figure 7 Knowledge of energy technologies (N=312)

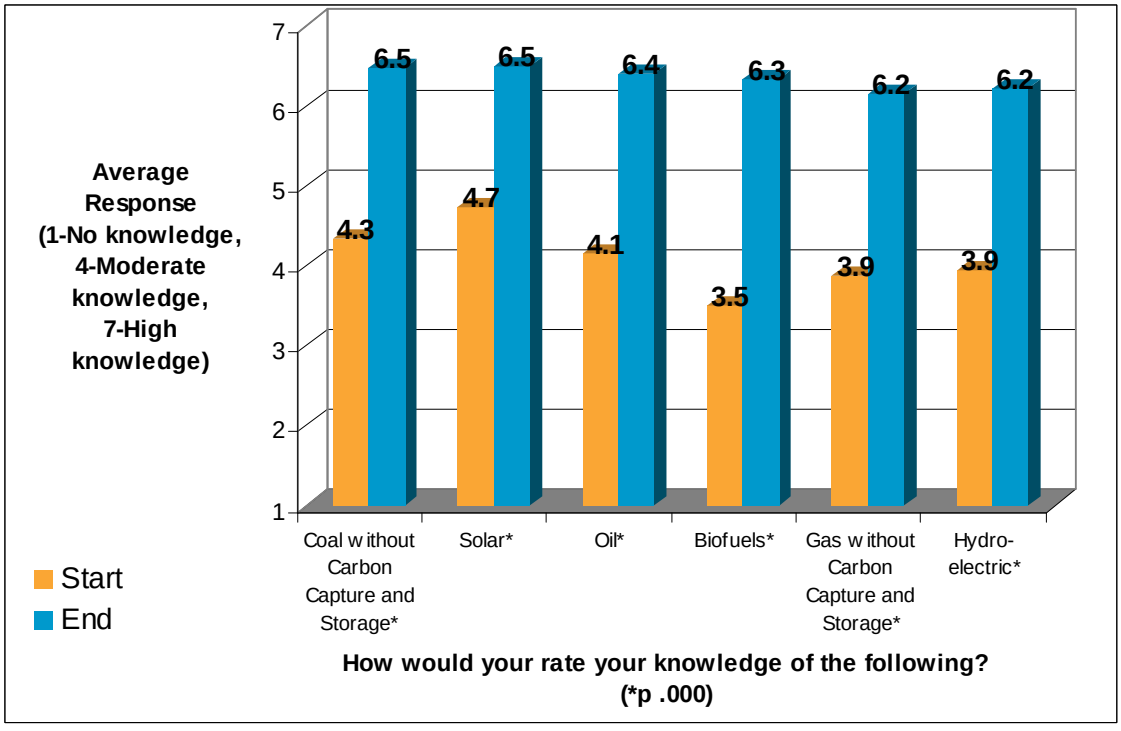

Figure 8 Knowledge of energy technologies (N=312)

A significant increase in the knowledge of Energymark participants regarding issues associated with climate change, such as green house gas emissions and embodied energy, was also observed [Figure 9]. The greatest increase in knowledge was observed for the topic ‘embodied energy’.

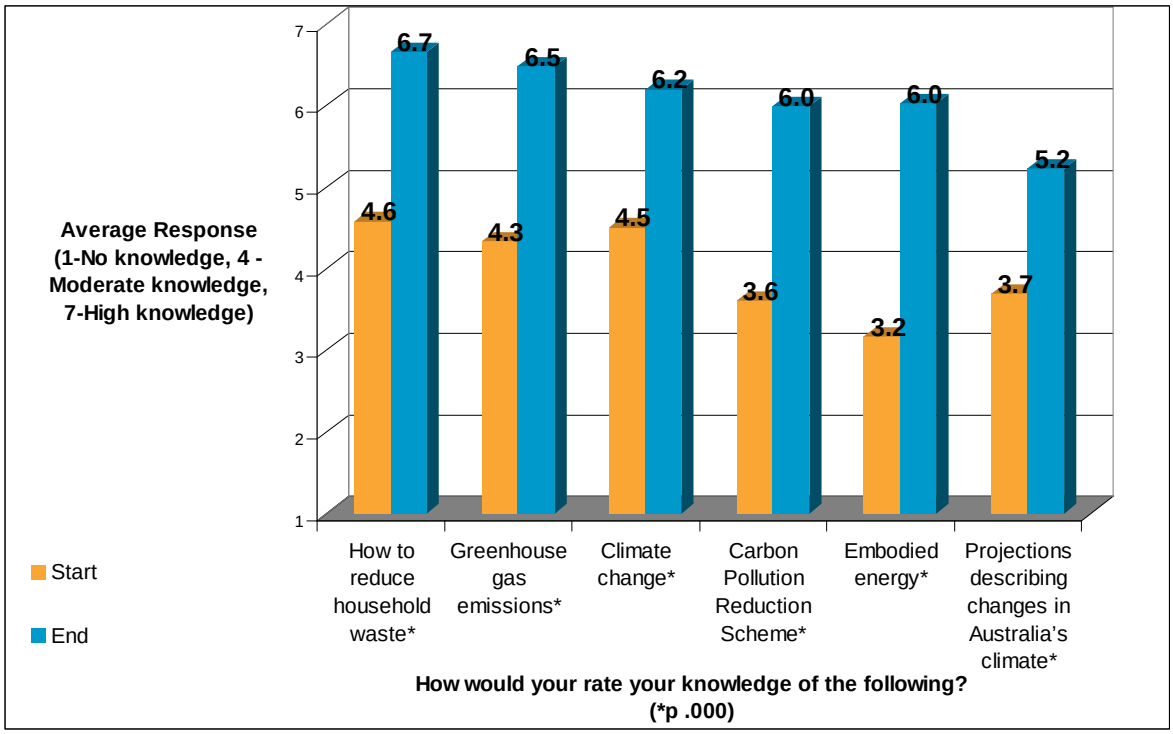

Figure 9 Knowledge of climate change issues (N=305)

4.2.4 Support for energy technologies

There was a significant increase in support for several energy technologies, including carbon capture and storage, nuclear and hydro-electric. There was no significant change in support for the use of coal without carbon capture and storage and a significant decrease in support for the use of gas without carbon capture and storage. There was no change in levels of support for wind, which was highly supported at the beginning of Energymark [Figure 10].

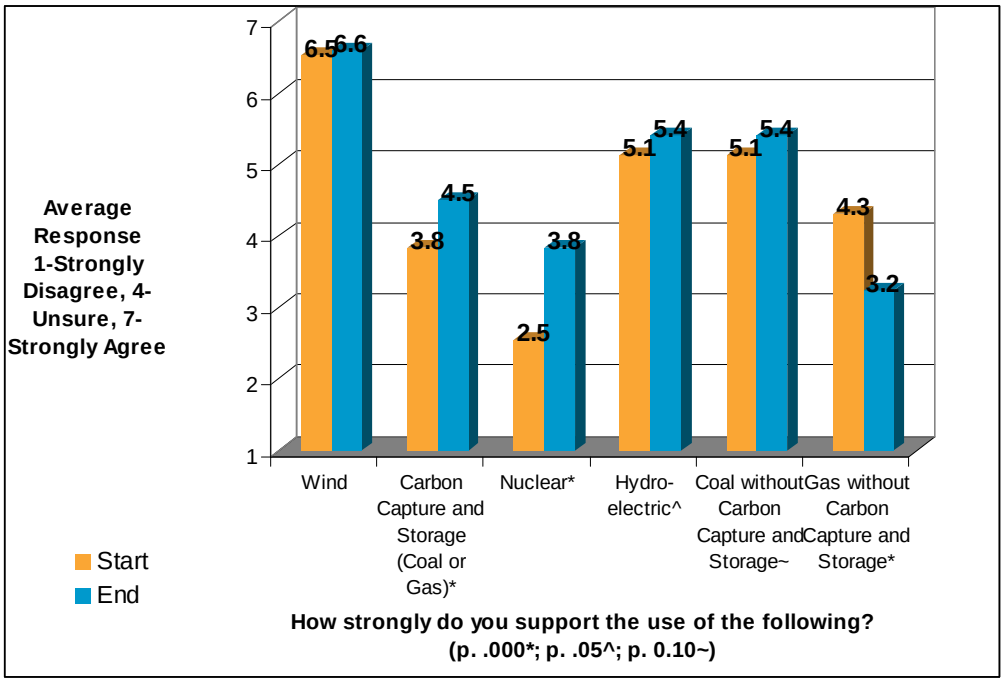

Figure 10 Support for energy technologies (N=292)

The convenor session summaries included information on the discussions held about these various technologies, including the positives, negatives and preferences of group members. The questions posed by Energymark groups to the Expert Panel (see Appendix A) provide insights into some of these discussions and concerns about the various technologies. Some of the points raised included:

- There were concerns about carbon capture and storage (CCS) technologies and a desire for more information, as reflected in the number of questions about these technologies directed towards the Expert Panel. Some felt CCS may be necessary in the interim while transitioning away from coal towards renewable, and benefits were it could be added to the existing plant. Some also thought it was useful given the feeling we were unlikely to move away from coal and the technology at least provided a way to reduce emissions. Some felt the lack of existing infrastructure was a barrier, as was the time it would take to fully develop the technology. There was concern about the long-term safety of the technology, a feeling that 'clean coal' was an oxymoron and it was just 'buying time'.

- There were various opinions regarding geothermal power. Some felt it had a lower impact than coal but still involves drilling, so some groups' preferences were directed towards wind, tidal and wave, and solar technologies. However, others were highly supportive of geothermal (in particular for providing base load power). There were concerns regarding its safety (please refer to Appendix A) and use of water. Some groups were very interested in geothermal, thought it was environmentally sound and wanted to see more government support directed towards its development. There was, however, concern about the distance of the source from the consumer.

- There were various opinions expressed about nuclear power, ranging from support to concern over safety, waste and decommissioning plants. Some felt it represented (and indeed would like to see it as) a future for Australia, while others pointed out uranium

was a finite resource and effort should be put into renewable technologies. Groups discussed the ‘fear factor’ associated with nuclear power.

- Some felt biomass was a way to provide base load power and remove waste. Others were concerned about using land, food and water for producing energy and would be supportive if chaff and waste was used. There was concern about agricultural land being used.

- Some participants were interested in seeing hydrogen cars and questioned the impact of major car companies. The cost and infrastructure requirements were discussed.

- Several participants had solar power and were pleased with its results. Many felt it represented the greatest hope and discussed establishing solar farms on unproductive land. There was also discussion about feeding RECS back into the grid.

- Some groups had positive attitudes towards tidal, wave and hydro power. Concerns included the environmental impact such as dams and possible impact on the ocean environment.

- Many were supportive of wind. Some would be happy to see wind powers in their district. There was discussion about the noise and visual appearance of turbines. It was seen as a good option for farmers to guarantee income.

- There was interest in embodied energy and discussion on the current materialistic and ‘throw away’ society. Some expressed concern about the number of variables to take into consideration.

4.2.5 Change in attitudes

There was a significant increase in agreement with all strategies to reduce green house gas emissions, except for ‘conserving energy in the workplace’ (5.9 to 5.9, p=0.551.). However, agreement with many of these strategies was already high before Energymark [Figure 11 and Figure 12].

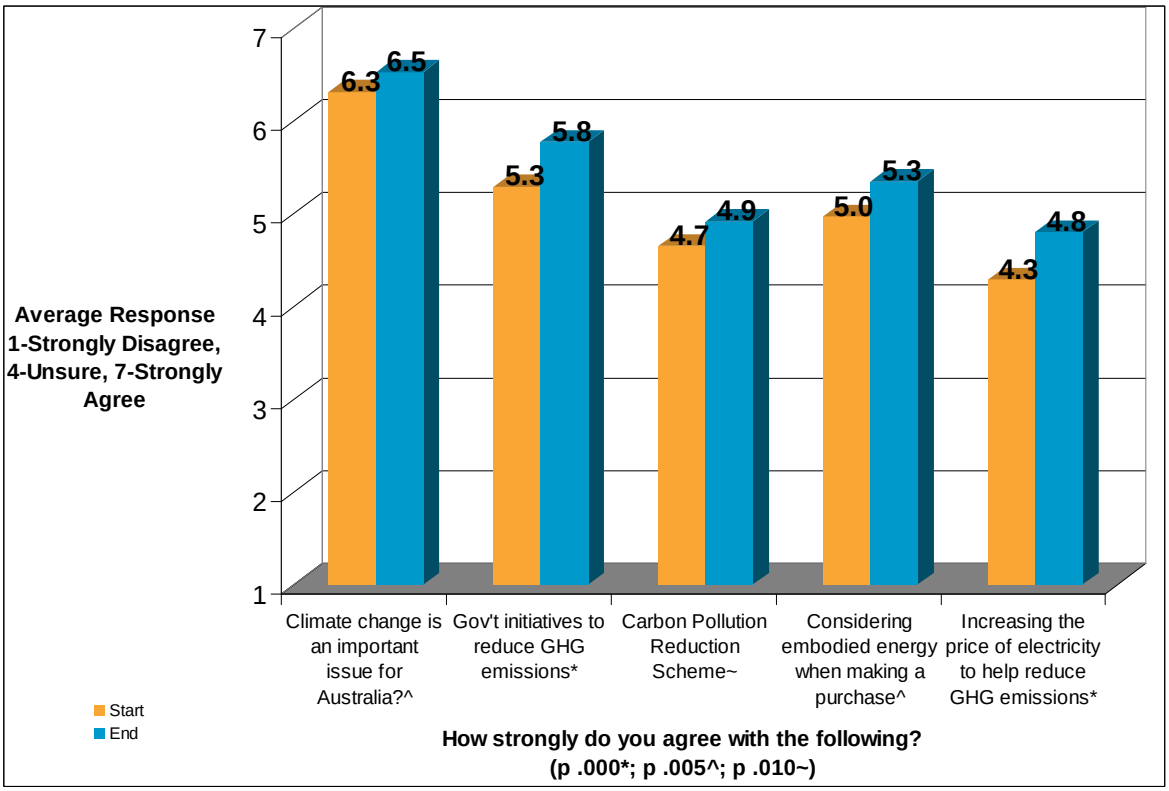

Figure 11 Agreement with strategies to reduce greenhouse gas emissions (N=283)

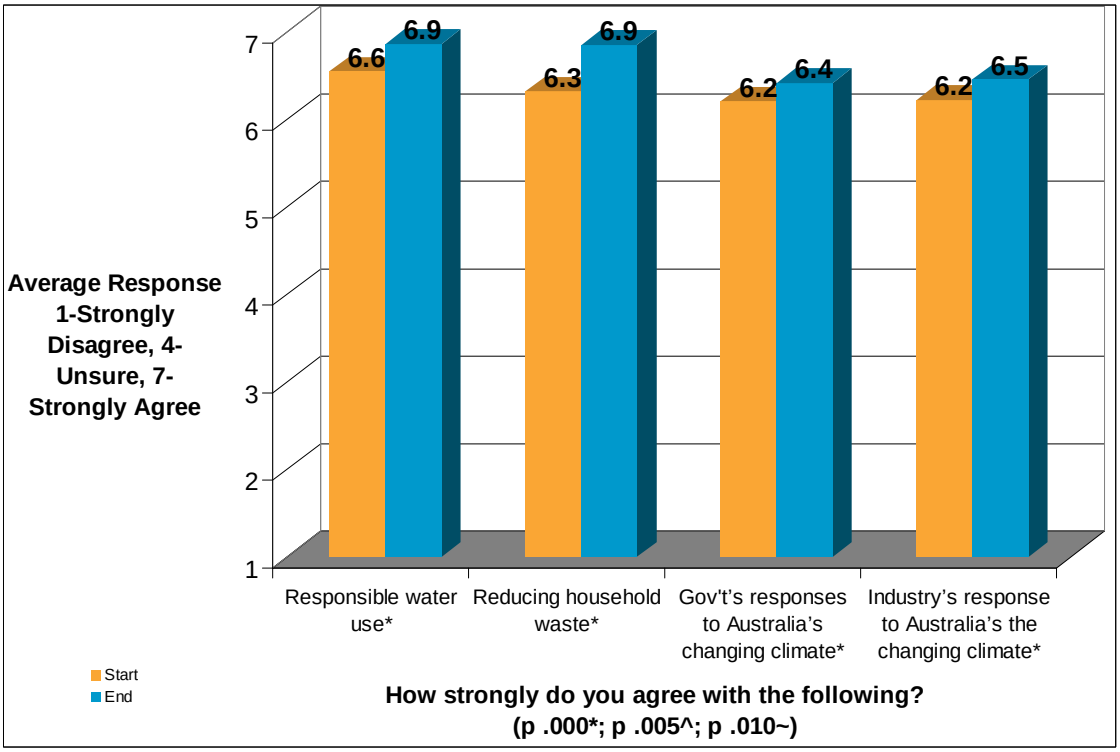

Figure 12 Agreement with strategies to reduce greenhouse gas emissions (N=283)

4.2.6 Social networking

Energymark participants communicated the information they learned from Energymark about climate change, energy consumption and mitigation, as well as information about the program itself, to an average of nine people (minimum 0, maximum 40, mode 10 with 55 people having spoken to 10 people) since starting Energymark (N=335) at the interim survey. At the post-project survey Energymark participants had also spoken to an average of nine people about Energymark, climate change and energy related issues (N=323) (minimum 0, maximum 200 where a participant spoke at a public meeting, and mode of five people with 44 participants speaking to five others about these issues). Box 1 includes a quote from a convenor summary where they spoke about their social networking behaviour.

Box 1 Social networking behaviour

"Most of us agreed we hadn't spent much time speaking to others about Energymark – although several of us had plenty of discussions about issues surrounding climate change and sustainability with people outside the group, they weren't necessarily involving Energymark. From this we came back to the lifestyles lead by most of our parents – and the difficulty some of us have had convincing them that climate change exists, is influenced by human activities and needs to be addressed (and then translating any understanding into a beneficial action). One thing that we all agreed on was it was easier to make people understand the significance of the issue if we could describe the likelihood, scale and timing of impacts such as sea level rises (the prediction of which is obviously fraught with difficulty)."

4.2.7 Participant and group characteristics linked to reducing CO_2 emissions from household electricity consumption

Overall, many participants reported reductions in their carbon footprint, including their household electricity consumption. Participants and groups linked with greater reductions had some distinguishing characteristics. These participants were likely to have higher incomes and non-tertiary educations, by the end of the process they were likely to identify as being members of the community, and perceive others as approving of and to be reducing their own household energy consumption. Groups that by the end of the process perceived their group convenor as a role model and described their group as having cohesive values were more likely to have greater reduction in CO_2 emissions from household electricity consumption [Figure 13]. Location was not significant in the model.

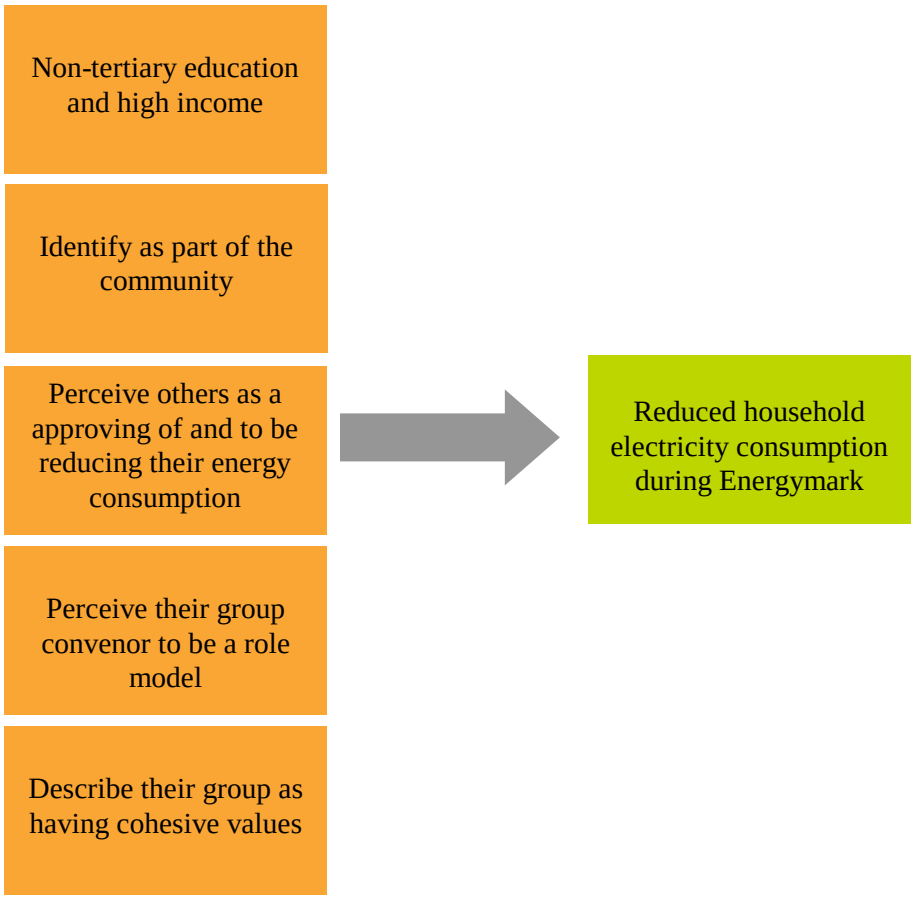

Figure 13 Characteristics of participants and groups that were linked to reductions in CO_2 emissions from household electricity consumption.

4.3 Energymark impact

In this section of the report we draw upon the qualitative information from the session summaries provided by Energymark Convenors. These data provide further insight into the actions undertaken by individuals and any barriers or challenges experienced. The summaries also outline some of the key issues and concerns felt and discussed by the Energymark groups in each of the sessions.

The questions posed to the Expert Panel by the Energymark Groups also provide insight into the concerns and discussion of Energymark groups. The complexity and technical nature of many of the questions illustrates the depth of thinking of Energymark participants, which moved beyond questioning the simple details of climate change to the technicalities, positives and negatives of different mitigation technologies and methods, the details of different energy technologies and ways to reduce energy consumption (Appendix A).

4.3.1 Belief in climate change

There were various opinions expressed about climate change in the convenor session summaries, ranging from belief to scepticism. Some of these comments are outlined in Box 2. These quotes illustrate that even though Energymark is a self-selected process, and Convenors are likely to already have an interest in the topic, Energymark was reaching those not knowledgeable and perhaps slightly sceptical of climate change.

Box 2 Belief or scepticism about climate change

"There was general agreement that climate change is 'definitely on' and it manifests itself in global warming. This in turn can lead to droughts, etc, but there was a diversity of opinion about just how dramatic it really is. Some believe that here is abundant evidence of quite rapid change, citing Adelaide heat waves and sequence of record temperatures; floods in UK and Philippines; etc. Others are far less sure, arguing that one-off events such as floods and heat waves say nothing about overall trends in climate."

"There was also a diversity of opinion as to whether a significant component of climate change is man-made. Some believe strongly that it is, others that this is a very small component compared with natural causes, while others felt that the evidence either way is very difficult to interpret."

"Are we looking at the differences in weather more closely, and therefore stating that there are changes, when before when there was no issue on climate change, we didn't care so much?"

"Too much spin around climate change in the media – not sure who or what to believe."

"We don't have enough reliable knowledge/information – not sure whether facts are being exaggerated or not being told how bad it really is."

"How can be sure it is anthropogenic?"

Several groups held discussions about climate change scepticism, exploring some of the reasons why people may not believe in climate change [Box 3]. Some groups expressed concern at members of the public not taking the issue seriously.

Box 3 Climate change scepticism

"People don't take it seriously, either they don't believe it's happening or they don't believe it's a man made problem."

"Why are there people 'denying' climate change? Climate Change heralds the long-term possibility of the end of the world for humans. Kids today are not going to be able to enjoy the outdoors as we used to ... Antarctic ice is melting – troubling! We will soon be faced with "climate migration [my term] with displaced people becoming immigrants – to Australia? They are our neighbours – Indian Ocean, Pacific Ocean."

"People don't grasp the potential severity of this problem, it will not outweigh the immediacy of keeping your job or financial security for the majority of people."

"There is a lack of general awareness about climate change effects and the need to reduce carbon emissions."

"A perception that the general public feels it is not my fault so why should I change."

"The question was raised – 'What case do the sceptics have?' Someone answered that they don't like to change, others that there are so many different aspects of CC that it is confusing…We all agreed that the sceptics don't have a true hold on the subject."

"We talked a little about politics and we also discussed 'what makes a sceptic?' and why do they choose to take that view? One opinion was that people don't like to hear something that is going to cause them discomfort or force them to make changes to their comfortable lives, or cost them money. It was thought that perhaps sometimes these people find it easier to deny the existence of climate change, meaning that then they don't need to make any sacrifices."

There was also discussion about the role of the media [Box 4]. Some discussed the role the media may have played in the current confusion about the science. Others felt that perhaps changes in climate were not as strong as thought, but reporting of them had increased leading to that impression.

Box 4 Role and influence of the media

"The public still need to be convinced there is a problem – there is still a lot of "scientific disagreement" presented in the media that is perpetuating confusion."

"A view was put that climate has always changed but we are accelerating it. Apparent climate change is highlighted by media concentration on extreme events so we are left with the impression that there are more severe weather events than ever before."

"It was discussed whether this is actually a result of better news coverage and concluded that while news coverage was better now, there still seems to have been an increase in the occurrence of these events."

Related to this point, participants recognised the need for reliable information and more education [Box 5]. Indeed, one group stated they did not feel comfortable looking up information themselves as they were not sure what were reliable sources of information. Several groups stated they thought Energymark was a good idea and talked about the need for increased education and understanding of the issue. These quotes point to the use of the Energymark program.

Box 5 Need for reliable information and education

"We feel like we need to do a lot of our own personal research to actually get a proper understanding of climate change but either don't have time or know where to look or how to evaluate what is actually a reliable source of information."

"The group discussed that there needs to be broad education within the Australian community about the fact that it is going to 'cost us all extra' in some way, to address climate change."

"We discussed the fact that there should be incentives for community and individual renewable energy system installation, and a broader approach to educating communities about the rebates etc that exist."

4.3.2 Actions by individuals and groups

In addition to the carbon footprints, Energymark group convenors outlined the actions taken by individuals in their groups over the course of Energymark. In addition to the wide range of actions undertaken to reduce individual carbon footprints already outlined [some further quotes relating to this point are shown in Box 6], initiatives also emerged from whole Energymark groups such as investigating implementation of a barter system and seeking ways to continue meeting after completing the Energymark sessions [Box 7]. Several convenors spoke of their groups seeking out extra information beyond the Energymark sessions.

Box 6 Individual actions to reduce carbon footprints

"Some of us have implemented small changes which might actually open the door to more significant changes - now that we have seen it is not all that difficult."

"The group feels more educated and can form a better opinion about these issues; more thoughts about these issues but their opinion has not changed; more interested about these issues; sharing these issues with family and friends; some have changed their behaviour in the home – turning lights/appliances off when not in use/standby, carpooling, catching the bus, using CFLs"

"After completing our individual carbon footprint surveys, all members of the group expressed a certain amount of 'horror' at seeing our personal impact, and we all agreed that we would endeavour to improve our carbon footprint."

"Some members felt that their habits hadn't really changed that much, but that the sessions had made them more mindful, and more diligent. Other members felt that the sessions had changed their habits in a profound way, and that they would now have new ongoing habits and views on saving energy in the home."

Box 7 Energymark group initiatives

"Our group intends to lobby local government for a recycling waste program… Also, we will talk to our local media outlets re an ongoing column about climate change related issues."

"Group agreed to send letter to Mayor in order that it is read at council meeting..."

"Management of recyclable rubbish within the community (i.e. one man's poison is another man's gravy). Members of the group will research community bartering for the next meeting."

"Advertised workplace for 'green tick' approval – provided options for recycling etc."

"Worked with council on bicycle lanes on roads."

The group convenor session summaries also discussed some of the barriers experienced by Energymark group members when trying to reduce their greenhouse gas emissions [Box 8]. Some of the main barriers which emerged related to renting and living in a rural area, particularly regarding the lack of public transport.

Box 8 Barriers to change

"We also discussed some of the problems we encounter at a local level, for example no 'recycling' service."

"It is difficult to make positive changes when you are renting."

"We are taking steps to reduce our C footprints, although, regarding transport it is very hard here in the rural situation."

"Most members of the group travel considerable distances by car, often as single occupants. There was widespread agreement about the 'virtues' of car pooling and public transport but many 'reasons' why it is impractical for us."

Although many convenors reported that their group members had changed their practices, some convenors reported that individuals had not directly changed their behaviour but Energymark had influenced their thinking about these issues [Box 9]. This highlighted the difficulty bringing about change. One group convenor remarked that members of the group still wanted to drive their large cars, despite recognising themselves how 'selfish' this was.

Box 9 Lack of action

"There was agreement that the series had certainly made us think in a more informed way about our C footprint. However it did not seem to have resulted in much action."

"The series has made us think about a lot of things we ***should do*** *- time will tell if we turn these thoughts into action and outcomes."*

"We now have two sessions to go. Maybe we bite the bullet and see what each of us is willing to commit to!"

Energymark group convenors also provided feedback on the process of Energymark itself [Box 10]. Several convenors commented the process of sharing views and questions among friends facilitated healthy and honest discussion. The convenor summaries also highlighted that participants were encouraging each other to commit to actions and offering up suggestions on ways to reduce their carbon footprints, for example "*suggestion: use salvaged fabric wrapping presents, and reuse; avoid buying packaging, avoid tea bags, avoid supermarkets (to avoid packaged products and poor quality food ie not organic); use rechargeable batteries…"* Others commented that they enjoyed being able to discuss these issues, often issues which are usually never discussed during their normal social events, and they enjoyed discussion around the different session topics which all related back to the one central issue.

Box 10 Feedback on Energymark process

"Hearing the views and questions of trusted friends seems to be a useful way of gaining a better understanding of the issues - not just how to reduce the C footprint, but why some people do not do it".

"The energy series sessions has made the group more aware of climate change and their energy usage. It has triggered the group's consciousness in a positive way."

"The EnergyMark program ended on a very positive note, the final agreement to disagree on issues of moral responsibility just showing that we do all think about these things even if we come to different conclusions."

"Someone commented that the diversity of backgrounds (farming, science, engineering, medicine/health, education, real estate) and a gender balance was a good recipe for this sort of thing."

There were also other, indirect outcomes from Energymark. Convenors spoke of the greater sense of community and getting to know their neighbours. Indeed, some groups were looking for ways to continue meeting after finishing [Box 11].

Box 11 Indirect influences

"It might be nothing more than coincidence, but the local Landcare group (of which half of this EnergyMark group are on the committee) has found a new lease on life. Difficult to know if there is a connection and then which is the chicken and which the egg."

4.3.3 Key issues and concerns

The Energymark convenor session summaries revealed some key recurring issues and concerns discussed among the Energymark groups. These included things such as: the impact and responsibility of big business; current levels of consumerism and the need for a lifestyle change; concern at the enormity of the problem; the need for a change in infrastructure; and population [Box 12]

Box 12 Key issues and concerns the were raised during Energymark meetings

"Businesses need to pull their weight they have a corporate responsibility, climate change is such a huge issue and businesses/industry have the biggest impact, they need to be making the most significant changes, we are only individuals and me choosing not to buy a lipstick, for example, because of its carbon footprint is not going to make a difference, one participant said (this sentiment has been raised every session and all the participants agree – climate change is too big an issue for individuals and businesses/industry that have the money and resources need to be pulling their weight)."

"We also discussed problems within our culture and society in regard to what we purchase, and our commercialized mentality. Also, for most of us, the fact that the line between 'needs' and 'wants' seems to have become very blurred."

"As we are learning more, some in the group are feeling depressed at the enormity of the problem, the astronomical numbers (millions, billions, trillions) and the complexity of 'solutions'. Once again we were reminded of the positive changes we've experienced over the last 40 years – water conservation in many forms; deposit & recycling of drink cans & cartons; planting of trees, etc."

"The need to build homes and infrastructure to suit the environment."

"Population growth is a huge problem, how are we the reduce consumption and at the same time as increase population?"

Throughout the convenor session summaries, discussion returned to the role of government. In particular, there appeared to be a strong feeling towards the need for government to show leadership and take action [Box 13]. There was also discussion regarding the responsibilities of developed and developing counties. Opinions varied on the topic, from that 'Australia should show leadership' to 'why act when China and India do not', and some quotes are shown in Box 14.

Box 13 Opinions of government

"Government must be more responsible."

"Members feel that while politicians continue to use climate change as a political tool to further themselves, no real action will be taken."

"We operate on very short (electoral) cycles so long-term thinking, planning and innovation don't get the support they deserve."

"The Government (Federal) is not going anywhere near far enough in addressing the problem."

"The government needs to take the lead, be visionary and put policy in place to encourage a move away from coal and gas towards renewable energy."

"More rhetoric than action the state and federal government are preoccupied with winning the next election not developing and enacting serious changes to Australia's energy supply."

Box 14 Role of developed and developing countries

"From there the discussion looked at whether Australia should show international leadership in terms of environmental management. Some saw an opportunity/responsibility there for Australia while others felt that Australia was almost a non-entity on the world stage and so it would be a waste of effort and risk to the economy."

"Reduce our carbon emissions, Australia needs to be one of first countries to make changes, we need a leader who will take action. We are worried."

"One member says it is futile turning things off at home (for other than economic reasons) because the impact that the whole of Australia has on ghg is miniscule compared with what is happening in China and India (let alone Brazil, etc). When asked by another if he sleeps better knowing that he has done what he can to reduce ghg he says emphatically "No!". Followed considerable discussion about the morality of individual responsibility, example setting, leadership, etc. Using the excuse that we are not a major 'world' emitter is a copout! The Australian Government should be leading the way and setting a good example to developing countries."

"There was a strong view held by a few members (but possibly not shared by the others??) that developed countries have an obligation to assist underdeveloped countries- that the burden of CO2 reduction cannot be shared equally."

"Developing nations are consuming huge amounts of energy/electricity/resources but don't have to commit to international agreements, however, they should be allowed to develop so that they have comparable standards of living to us."

Water also discussed during the sessions. Indeed, one group convenor mentioned that the discussion '*always come back to water'*. Many discussed droughts and the water efficiency methods they had adopted in their homes [Box 15].

Box 15 Water

"Issue – water! Everyone needs it and with drought situation it's making it harder to rely on our natural resources of water as it's been taken by the farming industry for irrigation."

"Tougher penalties for people using water out of restrictions and going over limits What is going to happen to our children's children."

Groups discussed the Copenhagen meeting and Carbon Pollution Reduction Scheme (CPRS). Some groups expressed the opinion that Copenhagen was unlikely to achieve anything, while others were disappointed that an agreement hadn't been reached. The benefits of a CPRS over a carbon tax, and vice versa, were discussed [Box 16 and Box 17].

Box 16 Copenhagen

"There was discussion about COP15 and in particular did it achieve anything at all. Comments were varied from "waste of time and money" to "the meeting that had to happen" and "necessary first step". But generally we were all disappointed, the extent of that disappointment depending on one's initial expectations and one's assessment of the final outcome. There was a bit of discussion about who were the real villains and were there any heroes - Australia did not get a mention in either category."

"There was considerable debate (and not much agreement) about whether Australia should show leadership on GHG reduction. Some argued that Australia missed an opportunity at Copenhagen when it was unable to claim that it had in place an ETS. Others argued that it would have made no difference for several reasons - most of the world is disinterested in what Australia does; our proposed scheme has such weak targets that they would be seen as inconsequential (or even a cop-out); most countries came to Copenhagen with their minds already made up on ETS."

"Members feel that Copenhagen will only produce another agreement to keep talking and that no real action will be taken."

"A concern was that agreements would not be reached between world leaders at Copenhagen (we heard on the news today that things have not started well. For example, there are disagreements about the amount of financial help that developed countries are willing to give to developing countries.)"

"Getting all of the countries around the world to agree on the correct level of action is going to be very difficult (as seen at Copenhagen), and it is unlikely single nations will take any drastic action unilaterally."

Box 17 CPRS

"The one thing we all agreed upon is that the most effective way to reduce ghg is to put a price on carbon."

"There was a mixed response to the Aust Govt's ETS. Some believe it is a tax to finance a bureaucracy to administer an unnecessarily complicated system – they argued for regulations limiting the amount of carbon that can be emitted from particular industries. Others had more faith in a market based system that rewards cutters and penalises emitters."

"There was considerable discussion but no real conclusion. There was no support shown for a carbon tax - increased bureaucracy to administer; many of the big operators will find loopholes to avoid the tax; it will not necessarily improve the environment."

"Open to routing; individual trading scheme for houses too small; it is very complex; too difficult to calculate."

"Consensus that emissions trading is the best way to move forward."

"Unhappy about carbon trading because it is seen to be a way for many people to make a lot of money (through transactions) without them actually doing anything about it – all they do is shuffle paper."

"A carbon tax would not be as good because there would be no cap on emissions."

"It was disappointing that the parliament couldn't come to any agreement on the system – Why could the legislation not have been implemented as is, and modified to suit down the track."

"We didn't have a lot to say about carbon trading schemes, as there hasn't been a reliable source of information about the outcomes of them. A lot of what we read is speculation."

"Without international agreements, a carbon trading scheme is likely to send jobs and manufacturing off shore. Generally, the schemes proposed are not good enough."

Several groups expressed the clear desire for action [Box 18]. Several groups expressed that this should be the case regardless of consensus on the issue, 'one does not need to believe in climate change in order to want to pollute less'.

Box 18 Desire for action

"There is question as to whether the climate changes we are experiencing are part of a cycle or not. Even if it is, we still need to do something rather than just wait and look forward to the change – what if it doesn't come? Must act now – do something."

""The key issue is urgency". We had no hesitation to agree to that and decided that if the Govt won't act quickly, we will have to ourselves."That's why we are here!" I added."

"Rate of change in policy, attitudes, technology etc is slow – very frustrating."

"The need for immediate action to stop polluters. Urgent need to protect the existing natural environment."

"The world needs to bite the bullet and act now."

4.3.4 Changes observed, adaptation and impacts on community

Groups discussed the changes they had already observed in the environment and the effects these had, or were likely to have, on their local communities. Indeed, some participants had already begun adapting to these effects.

Some of the changes that had already been observed included:

- Drought, fire, increased temperatures and hot days
- Affect on crops
- Loss of marginal land and dairy farms
- Impacts on the mental health of primary producers
- Change in rainfall patterns and less water
- Shorter transition time between summer and winter; later arrival of the seasons
- Storms

Participants were concerned about the impact these changes would have on their local communities, including primary producers and tourism industries. Concern was also expressed about food and water security. Several convenors reported that group members were already undertaking adaptation strategies, including planting different trees and crops, changing in irrigation infrastructure and installing dam covers.

4.4 Energymark: lessons learned

Several key lessons have emerged from the SALGA Trial of the Energymark process. These relate to: promotion and recruitment; maintaining group and convenor interest; and project management.

Promotion of Energymark via the LGA of SA had limited success. Feedback received from several Environmental Officers within council suggests that this may have been due to inadequate distribution of the circular to all council staff from the LGASA contact person within council. Direct promotion to council Environment Officer's and Community Engagement Officer's may be a better approach. Promotion of Energymark through council contact lists also had limited success.

The low drop-out rate for convenors once having held a meeting highlights the need to create and maintain momentum in groups as soon as possible after signing up. Only three convenors did not continue with the process after having held a meeting. Unfortunately, two of these were unable to be contacted so we cannot ascertain the reasons for this. The other convenor was a new mother who had recently returned to work and found she had overcommitted herself.

The SALGA trial also highlighted the need for a contract period of at least 18 months. The time it took for councils to express interest, to recruit convenors, and then taking into account holiday periods and travel meant the time period was too short for Energymark groups to complete the eight sessions and return the voluntary surveys to CSRIO. Energymark is designed to be conducted over eight months to facilitate long-term behaviour change and so changes in carbon footprints are observable.

Several groups expressed the desire for interaction between Energymark groups to be facilitated and for Energymark to be promoted more widely (indeed, one group stated members of their council were not aware of who they were and what they were trying to achieve). The provision of newsletters and providing the answers to the expert panel questions to all groups, not just those who asked the question, were greatly appreciated by the groups (as was the gift of the CSIRO Home Energy Savings Handbook). This trial has highlighted the need to go beyond this level of interaction between Energymark groups and provide opportunities for greater interaction between groups and increase awareness of Energymark in the community.

5. CONCLUSIONS AND FUTURE RESEARCH

The SALGA Energymark Trial was successful. Participants reduced their carbon footprints on average by 15%. Groups from rural areas were successfully engaged, and some of the barriers to reducing carbon emissions pertinent to rural areas were highlighted. Energymark also successfully engaged with a wide range of age groups and those with higher carbon footprints than the average for South Australia as a whole. Energymark participants were generally well educated, had a good income, were 'white-collar' workers or retired. Many were in a household of a couple with no children or a couple with children. Half owned their home and 48% were renting.

There was an increase in Energymark participants' positive attitudes, intentions and behaviours towards reducing their household electricity consumption. Energymark participants' knowledge of various energy technologies and climate change also increased. Information about Energymark, climate change and mitigation spread beyond Energymark groups, with participants speaking to an average of nine other people at the interim and post-project survey points. Participants and groups who were linked with greater reductions were likely to have higher incomes and non-tertiary educations; by the end of the process they were likely to identify as being members of the community; and perceived others as approving of, we well as reducing their own household electricity consumption. Groups that by the end of the process perceived their group convenor as a role model and described their group as having cohesive values were more likely to have greater reduction in CO_2 emissions from household electricity consumption

It is recommended that follow-up work be conducted to evaluate whether the behaviour change observed in this report is sustained in the long term. As several of the groups were unable to return their final surveys, once these have been received we will reanalyse the information and, if there are any significant differences, provide an update to the SAGLA.

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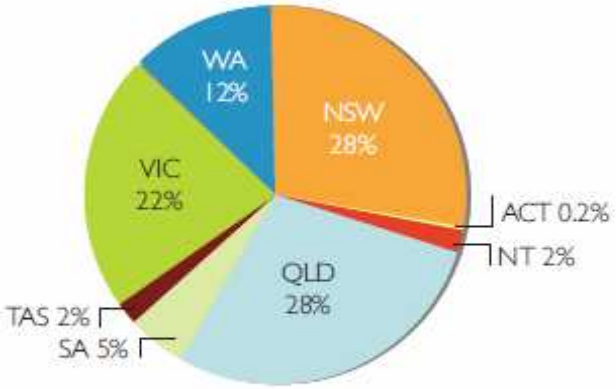
APPENDIX A EXPERT PANEL QUESTIONS

No.	Question	Expert Panel Answers
1	What is the origin of per fluorocarbons and sulphur hexafluoride - which industries emit/use these substances?	SF6 and PFCs are entirely artificially made chemicals not found in nature. SF6 is typically used as an inert gas in electrical switchgear, in magnesium casting or windows. PFCs represent a range of compounds that are used in medical, cosmetic, electronic and refrigeration applications.
2	There was general surprise at the amounts of C02 equiv. contributed by the DRC and Malaysia. Are these emissions predominantly as a result of deforestation?	Yes, both these countries have seen extensive deforestation that has contributed to their high per capita GHG emissions. In the case of Malaysia most of the deforestation is due to logging activities.
3	Is there a version of Figure 3 (State and Territory Shares of National Emissions) normalised on a per capita basis?  > Figure 3. State and Territory shares of national emissions, 2005	The information asked is obtained by dividing for each state the greenhouse gas emissions by its population in any given year. For your information the per capita emission figures in tonnes per CO2e for the year 2007 are presented below. Queensland 43.44 New South Wales 23.65 Victoria 22.92 Western Australia 36.33 South Australia 18.67 Tasmania 17.24 National 28.42 Clearly Tasmanians are the lowest GHG emitters in Australia.
4	Is there an emissions per capita comparison available for nations that include carbon exports, such as oil, gas or coal	The figures you ask can be found with some digging. However, IPCC protocols dictate that these carbon emissions are reported at the point of end use of these fossil fuels, i.e., where they are

	which will become emissions once they reach the end user?	burnt to produce energy (otherwise it would be double counting these end use emissions). However, any emissions incurred in producing the fossil fuels for export are reported under the country that produced the fossil fuels and not the country that used it in a fair and equitable application of the Kyoto protocol.
5	Is there somewhere we can see a payback analysis on the embodied energy of solar panels, nuclear energy, wind turbines and geothermal - aside from the unique benefits and advantages of each, we wondered which was the most efficient in terms of capital invested for the output?	Yes these figures relating to how much fossil fuel induced emissions are incurred in producing solar panels, wind turbines and infrastructure to produce geothermal energy are available. However they require some digging and the numbers are specific to the location where the components are manufactured (i.e. depending on fossil fuel consumption in the region or nation producing these goods and services). Generally the most inefficient, lowest quantity (i.e. electricity produced per unit) and high capital cost energy producer is the one that requires the longest payback time in terms of the GHG and fossil fuel emissions embedded in their production. Applying this analysis, solar panels are clearly the worst followed by wind in terms of payback in the trio of energy sources queried.
6	How would permits be allocated under an Australian ETS? Who determines the allocations?	Permits in most emissions trading schemes are usually allocated from set caps in emission levels imposed by the regulating authority (in this case government when the legislation is passed or becomes law) for a particular sector, industry or individual organisation.
7	For CO2 reinjection plants, does the liquefied C02 undergo any changes after reinjection that make it more stable? Does it form carbonate compounds with other materials below ground or will it stay as pure CO2 as long as it is down there?	Generally CO2 is injected or re-injected underground in a liquid-like or supercritical state. In most cases they are stored at depths of around 800 to 1000m depending on temperatures of the formation so that they do not undergo any phase transformation back into a gas. Depending on the chemistry of the rocks and dissolved salts in water in these storage formations, the injected CO2 will react to form solids or salts (mainly carbonates) that are permanently locked up. However, since mixing of the CO2 and the reaction rates are very slow, it could take millennia to lock up the CO_2 injected for storage. In formations that contain a lot of chalk reaction to form carbonates can be quicker. Note that a similar process to the above that occurred over millennia has caused most chalk and related minerals found on the surface of the earth, and dissolved solids found in the ocean, to react with atmospheric CO2 to form mineral carbonates. For example the dissolved carbonates in the ocean are the source of the material found in sea shells.
8	How badly will a spike in oil prices, or a scarcity in supply, affect agricultural production worldwide?	Because of the dominant role of oil in transportation and to an albeit more minor extent of use in fertiliser production, it would significantly affect agricultural production. To a lesser extent it would also affect the use of arable land to produce alternate transport fuels such as corn derived ethanol and diesel derived from palm oil. There have been reported impacts of increased corn

<table>
<tr><td></td><td></td><td>derived ethanol production in the USA affecting the price of soya bean production and supply to poor countries in the world. Thus there are definitely many primary and secondary effects on global agricultural production.</td></tr>
<tr><td>9</td><td>What fraction of C02 emissions are produced by human respiration?</td><td>The table below lists the carbon dioxide emission (last column) due to respiration per person depending on their activity:
<table>
<tr><th>Activity</th><th>Respiration per Person (m^3/h)</th><th>Carbon Dioxide Emission per Person (m^3/h)</th></tr>
<tr><td>Sleep</td><td>0.3</td><td>0.013</td></tr>
<tr><td>Resting or low activity work</td><td>0.5</td><td>0.02</td></tr>
<tr><td>Normal work</td><td>2 - 3</td><td>0.08 - 0.13</td></tr>
<tr><td>Hard work</td><td>7 - 8</td><td>0.33 - 0.38</td></tr>
</table>
The range of carbon dioxide emissions is from 0.013 to 0.38 cubic metres per hour or 26 to 760 grams of CO2 per hour. Taking this range, the annual CO2 emission due to human respiration for 6 billon people is 6x0.365x24x0.760 = 1 to 39 Gt per year depending on our state of activity at any particular time. Clearly it would help mitigate emissions if we were all asleep most of the time!

By comparison in 2005 fossil fuel emissions were 27 Gt of CO2 per year.

I hope I have not made an error in my maths, but you are welcome to check my maths using 2 kg/cubic metre as the density of CO2 emitted at the conditions of human breath.</td></tr>
<tr><td>10</td><td>What are the methane emission differences between beef and other livestock (eg. kangaroos, sheep, etc?)</td><td>Kangaroos, which are not ruminants, emit one-third as much methane as ruminant animals such as cattle, sheep and goats which are responsible for 60 per cent of global methane emissions.

If you are interested in more information on the impact of livestock, please retrieve and read the attached report from the World Watch Institute that controversially disputes (saying its higher) some older numbers published by the UN’s Food and Agricultural Organisation. The report may be found at: http://www.worldwatch.org/files/pdf/Livestock%20and%20Climate%20Change.pdf</td></tr>
<tr><td>11</td><td>One question that raised some debate and was not resolved was how to calculate Australia's C02 emissions - should we be responsible for at least some of the C02 emitted by (for</td><td>To put things bluntly from a moral stand point, those that produce the offending product and those that want to use it are both responsible.</td></tr>
</table>

	example) our coal customers since we dug up the fossil fuel and largely benefit from the sale and hence the burning. What about the consumer of the manufactured product? Where does the obligation end?	The current Kyoto emission protocols that count the emissions at the point of production and at the point of end use are agreed principles adopted by all nations. Similarly, under the above agreed principles, emissions at the point of manufacture are absorbed by the country that manufactures the product.
12	The current state of development with nuclear fusion - is there anything on the horizon?	In June 2007, seven nations got together and decided to fund an experimental reactor in France called the International Thermonuclear Experimental Reactor (ITER) whose aim is to experiment and create nuclear fusion using magnetic spinning to enable the reaction. Plans for another project called the High Power Energy Research (HIPER) are also underway in the UK. HIPER is looking at the use of lasers to produce high power energy from fusion.
13	What is the feasibility of carbon capture and sequestration at the power station?	Carbon capture and storage involves three components of a chain. Capture and compression of CO2 which occurs at the power plant, transport of the liquefied or supercritical CO2 usually by pipeline to a storage site and injection for permanent storage of CO2 at a storage site. When a power plant is located in a region where there are proven geological structures for the safe storage of CO2, all three operations can be carried out at a power plant location. Often however power plants located near population centres may be some distance away from storage sites. In this case the CO2 is pipelined some distance from the power plant to the CO2 storage site.
14	What happened to the Holden Hybrid Car that had funding for development from the CSIRO?	The following website gives information on CSIRO's involvement in the Holden Hybrid car development: http://www.csiro.au/solutions/ECOmmodore.html
15	How were the weights and multipliers calculated in the Carbon Footprint survey? Is there a resource we can refer to to help understand this in more detail? People were concerned they weren't filling out the survey correctly, through misunderstanding the definition of what they were counting, or being unable to estimate with any confidence. What is the reasoning behind the selection of the data being measured in the Carbon Footprint Survey?	We have focused on the greenhouse gas we as individual households contribute i.e. household carbon footprint. We've also focussed on items over which households have direct control. We include greenhouse gas from goods consumed by the average Australian household including imported goods; but do not include the greenhouse gas contributions made by: investors in Australian resources, our export industries, or the Australian Government's work. The amount of greenhouse gas a household produces in a year, i.e. the household carbon footprint, roughly divides into: 1) One-third due to the energy and fuel we consume in our homes and cars - energy and fuel produces greenhouse gas when it is burnt and we use the National Greenhouse Gas Inventory factors published by the government and particularly the National Greenhouse Accounts (NGA) Factors handbook to calculate how much greenhouse gas is produced. 2) One-third due to the food we eat - producing food and getting it to our homes produces greenhouse gas so we have worked out the amount of greenhouse gas it takes to provide

		food on average to a household though this is very approximate. We decided to focus on general dietary patterns rather than individual items of food because its only appropriate to show options in a general way as people are so varied in where they purchase food, what form the food takes, and in their dietary needs. The estimate is based on an input output model i.e. an unbounded LCA assessment across the Australian economy, cross checked by a comparison against food industry statistics available from sources such as ABARE, ABS and the MLA as well as the National Greenhouse Gas Inventory and its associated National Greenhouse Accounts (NGA) Factors handbook. It's a rather technical process, which does require training in the area. 3) One-third due to the goods and services we purchase as part of our daily living (excluding power, transport fuel, food, which are already accounted for in the previous two). Again it's very approximate and based on an input output model for unbounded LCA assessment across the Australian economy, cross checked against inflation measures, ABS statistics, and other economic statistics. The factors are meant to be a rough guide rather than a precise measure - the science isn't sophisticated enough yet for precise measures. Another really good source of information is "the CSIRO Home Energy Saving Handbook" and its associated web site.
16	What are the qualifications of the people providing answers on your panel?	The two main experts on the Energymark panel have vast experience in this area. One has worked for over 30 years as a bio-physicist, electrical engineer and project manager. The other has over 20 years experience in the field of low emission technology, has been involved in the International Energy Agency/Organisation of Economic Cooperation and was an editorial panel member and coordinating lead author of the UN Intergovernmental Panel on Climate Change (IPCC) committee.
17	Carbon Footprint: We find it hard to believe bus emissions are the same as aeroplane emissions?	If you look at the graph on the scanned pages from the CSIRO Home Energy Savings Handbook attached, you'll see that buses actually use quite a bit less fuel per person/km than planes (this is not quite the same as efficiency but the fuel used per person/km is what really counts rather than efficiency). Buses and trains and even cars would be much better than aeroplanes if we carried more people

		in them. Aeroplane companies go to a lot of trouble to ensure their planes are packed as full as possible whereas buses, trains and cars are often less than half full. If we used buses and trains more they could use typically up to three times less fuel per person/km because buses, trains, cars and planes are so heavy that adding extra people doesn't make much difference to their total weight and fuel consumption. This means that the more people you carry the less fuel per person is used.
18	Carbon Footprint: Do we include green energy? Solar energy?	If you have used RECs to buy a renewable energy system then you've done a lot to encourage the renewable energy industry to develop but you haven't reduced your carbon footprint. By using RECs you transfer your carbon rights to whoever buys the RECs from you or your agent (usually the installer). In this case you should still count the solar energy in your carbon footprint. If you've not used RECs to help purchase your solar panels then there's no need to include the renewable energy in your carbon footprint – it's mostly free of carbon. In this case you have both encouraged the renewable energy industry and reduced your carbon footprint at the same time. If you've purchased 100% GreenPower then you don't have to count the energy you've purchased in your carbon footprint. If you've purchased less than a 100 percent then you still have to include the percentage of your energy use that isn't covered by GreenPower. For example if you purchased 10% GreenPower then ten percent of your energy is mostly free from carbon and you don't need to count it in your footprint and the remaining 90% should be counted in your footprint.
19	Carbon Footprint: Are we supposed to count electricity and gas twice in yearly spending?	The Carbon Footprint measures the total electricity and gas used over the year in the Energy section. Calculate your daily usage from one bill and multiple it by 365 to get your yearly usage. If there are several people in your household, divide the total amount by the number of individuals in the household. The Spending section measures your spending on other products (excluding transport and electricity). Electricity and gas should each be counted but only need to be counted once.
20	Carbon Footprint: Where does water usage come into it?	Water usage is not included in the Carbon Footprint. The Carbon Footprint only measures greenhouse gas emissions. Saving cold water is a great thing to do in order to save water supplies, but will not reduce greenhouse gas emissions. On the other hand, saving hot water is one of the most important energy savings individuals can make.
21	Carbon Footprint: Recycled goods have carbon dioxide associated with them, why are these not treated?	Recycled goods are accounted for in the Carbon Footprint Survey in the Spending section. This section is divided into two rows. The first row deals with the amount spent on general products and services (e.g. new products, going out, clothes). The second row measures the amount spent

		on environmentally friendly products and services, including second hand or recycled goods. The multipliers applied to new and used items are different.
22	Carbon Footprint: If expenditure is for the purpose of another person, then should this be included in spending?	This is a really good question - there are several ways of dealing with this – a well known study from Sydney University suggests sharing the expenditure equally between purchaser and seller. This could arguably apply to purchasing for another person. Also how do you deal with tax or gifts to charity? I'm not aware of any formal rules in this area because we don't have a carbon tax system. My suggestion is that it's a matter of personal judgement and perhaps negotiation. If your household includes more than one person, when calculating your carbon footprint you should calculate total household expenditure and then divide that by the number of members of the household to get a figure for each individual.
23	Has Sweden closed down their nuclear plants? If so, why?	Following the "Three Mile Island" nuclear reactor incident in the USA in 1979, Sweden held a referendum in the early 1980's and the result of this referendum led to a decision by the Swedish parliament to phase out nuclear power by 2010. Although a few reactors were shut down under this decision, shifting public opinion and the reality of finding alternative means of power production have resulted in the continued operation of the bulk of the remaining reactors to this day. However, no decisions have been taken to build any new reactors by the government, and for that matter the main political parties in government and opposition in Sweden, despite evidence that recent public opinion in Sweden is shifting with the majority favouring the building of new reactors
24	Can hydrogen be compressed for storage?	Yes hydrogen can be compressed for storage and it is stored and routinely transported this way today using cylinders, tanks and pipelines. However the problem is that hydrogen is the lightest element found in nature. Its low density means that we would have to use very high pressures to compress, store and transport what are relatively small quantities by weight. In practical terms this would mean a hydrogen fuelled vehicle today probably wouldn't be able to store as much fuel to give the same range of travel distance as a petrol fuelled one (which has a higher density of energy storage in the same volume of tank). However research is underway with the use of sophisticated materials that can store hydrogen in their chemical matrix. This will lead to the development of hydrogen storage devices that can store a lot more hydrogen in the same volume of tank (or cylinder) than simple compression of the gas to very high pressures.
25	How much water is required to produce hydrogen?	In its chemical composition water is made up of 2 atoms of hydrogen and one atom of oxygen. From this composition we can work out that 18 grams of water is required to produce 2 grams of hydrogen. If this production process for hydrogen is undertaken by the electrolysis of water we would also produce 16 grams of oxygen as a by product.

26	Can the by-product water from electrolysis, be collected and reused?	The water used in electrolysis for hydrogen production generally has to be of very high purity. If it isn't it will foul the electrodes in the electrolysis cells and render the process inefficient. Any residual water from the electrolysis cells might contain trace amount of salts and other debris from the electrolysis process. The sophisticated water treatment system used to purify the water before electrolysis will be able to easily treat the residual water. In fact it would make a lot of sense (in terms of promoting sustainable practise) to treat and recycle the residual water back for use again in the electrolysis cell.
27	Some people argue that in years gone by there were a lot of bison in USA and wildebeests in Africa and that the number of cattle around today does not surpass that number – so why the concern about their methane emissions? What is your answer and could you give us your source of information please?	The scientific assessment of diet and carbon footprint is still in its infancy, but it is estimated that about one-third of our individual carbon footprint comes from food. There are many ways to eat for good health, and different eating patterns suit different people. Fortunately, moving to a healthy diet can also reduce greenhouse gas emissions. Red meat is a nutrient dense food that provides protein, iron, zinc and vitamin B12 essential for red blood cell production, the good health of the nervous system, and childhood growth and development. However, some red meat, particularly beef, can be associated with up to one-quarter of the greenhouse gas associated with the food we eat. For beef this will vary greatly depending on how it is produced, how and where the cattle are raised, and how much land clearing or re-clearing is carried out. Other meats such as pork and game are associated with considerably less greenhouse gas. It is well worth considering how much red meat you and your family eat but this will also depend on individual health requirements. For a study of the relative effects of bison vs cattle try this reference "Methane emissions from bison—An historic herd estimate for the North American Great Plains." Agricultural and Forest Meteorology Volume 150, Issue 3, 15 March 2010, Pages 473-477. Francis M. Kellihera and Harry Clark. The American and Africans might want to argue a partial offset due to bison and wildebeest but Australians couldn't even attempt to do this as of course these animals aren't native to Australia. The international convention is that each country is responsible for its own carbon emissions. If Australians wish to take advantage of emissions reductions in other countries we can do this by buying carbon credits through a carbon trading scheme.
28	It makes sense to us that to produce enough meat to feed x number of people would take less energy than to grow the equivalent amount of grains/beans to feed those people. What do you say? What are your sources?	Energymark principally concerns itself with climate change and the effect of household consumption on greenhouse gases. Two web pages that describe CSIRO's work on sustainable livestock production are:

		http://www.csiro.au/science/SavannaGrazingDistribution.html http://www.csiro.au/news/GrazingLandManagement.html
29	Does geothermal smell?	I don't think Geothermal energy from 'hot rocks' smells as a consequence of something unique to this energy generation process. Steam/water from hot springs linked to volcanic areas 'smell'. This latter source is different from hot rocks due to the emission of sulphurous gases (usually hydrogen sulphide) from volcanic hot springs or even certain sources of shallower bore water drawn and used in the outback. It is quite possible that if some hydrogen sulphide containing bore water is drawn as a source for steam produced in geothermal (hot rocks) plants, then they will possibly smell.
30	Is there any reason why wind turbines can't be painted camouflage colours to make them less conspicuous?	There is some information out there regarding camouflage covers painted on small wind turbines but without scientific evidence on whether these colours are detrimental or not, for example bird kill. There is plenty of evidence in nature of camouflage colours protecting animal species and in particular colours and stripes that hide when viewed from long distance but become visible in closer proximity. Perhaps this concept could be pursued as a way of hiding long distance visual impairment whilst being more visible to approaching bird flocks
31	Desalination: How will the brine from the desalination plant get dissipated, particularly when there are seasonal current & tidal changes?	Discharge of brine is generally a major issue that needs to be addressed in building coastal desalination plants. Typically the more concentrated brine waste discharged is denser than surrounding sea water, and tends to sink rather than mix rapidly. Higher concentrations of salinity could kill small marine species, bottom dwellers and species that grow in fixed locations whilst larger species like fish may be able to swim away from more salty plumes of water. Another effect from brine discharge is reduced dissolved oxygen concentration in the sea water important for plant and animal respiration. Clearly these impacts need to be avoided and are often overcome by carefully studying the natural sea water flow patterns and currents in the region and ensuring that the discharge from a desalination plant is located such that it very rapidly mixes with the surrounding sea water to reduce any density, salinity and dissolved oxygen gradients. This practice should also be accompanied by regular sampling of marine life to ensure that there is no short or long term impact on these species.

32	What is the source of the green energy used to power the desalination plant? Nb: these questions refer to the following information from Session 6: *A desalination plant is currently under construction at Port Stanvac in South Australia. The plant will have the capacity to supply 100 billion litres of water, representing about half of the State's current water needs. The plant will begin supplying water to Adelaide at the end of 2010/ South Australia leads the country in stormwater and wastewater recycling. Stormwater is currently used in parks and gardens, agriculture, industry and housing developments/.*	The energy supplier chosen for the project is AGL and information indicates that AGL plans to supply the desalination plant with energy generated mainly through its portfolio of wind farm operations in Hallet (333 MW), Red Hill (130 MW) and Burra (180 MW) all of which are located in South Australia
33	How much energy is lost in electrical transmission from the power station? What proportion of the energy loss occurs in the long distance high voltage lines and how much in the lower voltage distributor lines? Do these figures change much over the range of ambient temperatures? Is any research done to reduce these losses or are the potential benefits too small to bother about?	Electrical energy from a power station goes through the following steps before it reaches an end user: step up to high voltage, transmission in high voltage lines, step down to medium/low voltage and supply to the consumer. The overall loss from the power station end to delivery to the end user can be between 8 to 15% of which between 5.5 to 7.5% can be lost in voltage step up, step down and transmission losses and between 2.5 to 7.5% in local supply lines and equipment to the consumer. As a general rule low voltage systems suffer greater losses as the current flow is higher at a given voltage and these energy losses are proportional to the square of the current flow. The converse happens in the high voltage systems where the current flows are much lower at high voltage but the reduced losses may be mitigated by longer distance transmission lines that provide a greater resistance to flow (losses being proportional to current squared multiplied by the resistance for both high voltage and low voltage systems). The losses would change with ambient temperature since most electrical conductors reduce their resistance as they heat up. However the change in resistance over the range of ambient temperatures encountered is usually small relative to the overall losses. The above mentioned losses are not trivial and reducing electrical losses due to long distance and local transmission is important and is an area of R&D that is pursued - often by searching for better and cost effective conducting materials, switch gear and transformers.
34	The high capital cost of large infrastructure for power	We have become accustomed to the supply of power from large scale centralised plants which

	generation and transmission presumably means this infrastructure will be designed to last for many years. Is this an impediment to R&D or at least to uptake of new technology beyond just retrofitting new components? If so, would a similar impediment exist with smaller scale local power transmission (e.g. solar, heat pumps, etc)?	bring an economy of scale factor that also reduces electricity supply costs. Unfortunately the downside of large scale infrastructure is high capital (construction) costs which require large periods of time to pay back. For example it is not unusual to see plant construction costs of $2-3 billion for a typical coal fired plant that would require between 25-30 years to pay off the capital investment. Thus the high capital cost of infrastructure is definitely an impediment to its renewal and when a government or society is cash strapped they tend to extend the life of older existing infrastructure (often more polluting) for longer periods of operation beyond the intended dates of closure. One would expect less of an impediment to the renewal of small scale power sources that are often less capital cost intensive. However it must be kept in mind that many of these smaller scale power sources are owned by individual householders who may not be able to afford the rapid turnover of such devices and may require subsidies to cushion the impact of this technology renewal. System wide economic modelling needs to be undertaken in a particular energy supply/demand environment in order to properly analyse the relative merits of these large and small scale options and their impact on technology and infrastructure turnover.
35	We understand that newly installed intermittent energy sources (e.g. wind and solar) must be backed up by switch-on/switch-off sources. Is there a formula for calculating the legal requirement for how much back-up must be provided?	I am not aware of any new regulation affecting this requirement to comply. However, in order to ensure a stable electricity grid, fluctuations from intermittent renewable power sources need to be smoothed out and can be achieved by a number of ways. The general rule also is that the greater the intermittent renewables market share, the greater the importance of efficient backup options. There are a number of ways this backup option can be provided. Incentives could be provided for further development of less fluctuating renewables and for technologies that allow for temporary storage of energy such as batteries. Demand management initiatives, like smart networks, could also enable better matching of electricity demand with renewable power generation. A final approach is to have spare backup capacity provided by coal, gas and biomass fired power generation that could be brought into service and ramped up quickly with swings in the supply of renewable energy power.
36	Would it be feasible to use the energy generated from geothermal or tidal power at remote sites to be stored in portable sources of energy such as hydrogen?	Yes it would be possible to store the energy generated as hydrogen. However the efficiency losses and the cost of producing hydrogen (usually from the electrolysis of water with desalination/purification) could be prohibitive and would need to be evaluated to see if it is an economically sustainable means of generating, storing and using energy in remote locations. Other competing storage options such as batteries need to be also investigated for cost

<table>
<tr><td></td><td></td><td>effectiveness and portability in supplying energy.</td></tr>
<tr><td>37</td><td>How safe is the process of turning Carbon dioxide from a gas to a liquid and once in a liquid underground what will stop it turning back into a gas?</td><td>Every compound depending on its temperature and pressure exists principally in three different phases – solid, liquid and gas. At the temperature and pressure of normal ambient conditions, CO2 is a gas. Compressing and cooling it will turn it into a liquid or solid. Some minor variations can also occur, such as CO2 combining with water to form hydrates (a form of ice) or existing in a supercritical state where it is neither a gas nor liquid but has densities close to a liquid-like state.
CO2 is normally stored underground at depths usually greater than 800 km where the underground temperature and pressure gradient (both increasing with depth) keeps it in a liquid like supercritical state. As long as carbon dioxide in this fluid state does not migrate to shallower depths less than 800 km (and storage sites are specifically picked without the danger of this occurring) it will not change from a liquid like supercritical state to a gas.
If, for example, (as opposed to underground storage) CO2 were injected into the deep ocean at around 1000 m and deeper, the temperature and pressure conditions will favour the formation of hydrates and/or liquid CO2. Liquid CO2 is denser than sea water and will sink. Depending on depth, a skin of solid CO2 hydrates will form at the surface of these liquid pools. If for some reason (i.e. seismic movements or underground volcanic eruptions) the pools of liquid CO2 are ejected to shallower depths at lower pressure it will turn to gas and erupt as a bubble. Putting CO2 in the ocean does not have cap rock seals that can prevent migration to shallower depths as underground storage formations do.</td></tr>
<tr><td>38</td><td>Are there any further developments in geothermal production in Australia or other references we may be able to source?</td><td>Geothermal energy production is an actively researched and developed area in Australia. Searching the internet for websites of production companies like Geodynamics for example will provide more information for your perusal.</td></tr>
<tr><td>39</td><td>With the assessment of our carbon footprint there were a few points from the survey that were unclear e.g .why not include meat sources other than beef?</td><td>All sources of food not just beef or meat have a carbon foot print. Beef production has a very high carbon foot print partly due to high methane emissions from digestion from cattle. Please see earlier expert panel answers for more information on food and your carbon footprint. The table below shows emissions for different food groups from a German publication:
CO2-Emissions (in g CO2e per kg food):
<table>
<tr><th>Food group</th><th>Food</th><th>CO2-Emissions (in g per kg food)</th></tr>
<tr><td rowspan="2">Meat and sausages</td><td>Beef</td><td>13'300</td></tr>
<tr><td>Raw sausages</td><td>8'000</td></tr>
</table>
</td></tr>
</table>

			Ham (pork)	4'800
			Poultry	3'500
			Pork	3'250
		Milk- and dairy products	Butter	23'800
			Hard cheese	8'500
			Cream	7'600
			Eggs	1'950
			Quark (curd)	1'950
			Farmer cheese	1'950
			Margarine	1'350
			Yogurt	1'250
			Milk	950
		Fruits	Apples	550
			Strawberries	300
		Baked goods	Brown bread	750
			White bread	650
40	How many trees would we have to plant to overcome our carbon footprint and how long would it take to balance out?	It is difficult to provide definitive answers as the amount of carbon sequestered by trees will depend on the tree species, the climatic zone and soil conditions that they are grown in. Generally the approach to reducing a carbon foot print works like this - if emissions from various activities that one undertakes is 1 tonne of carbon equivalent per year then we have to each support tree planting schemes that remove and store in trees 1 tonne/y. To give you an idea of how the amount of carbon sequestered by trees see the example below from a Canadian calculation. For the lifetime (80 year) carbon removal for urban Canadian planting: Number of trees/5.0 x survival factor (1.0 = 100%) = tonnes of C removed by over 80 years Therefore 1 "average" Canadian tree that survives (=1 or 100%) absorbs in an urban situation 0.2		

		tonnes of C (or 200 kg) over 80 years or 2.5 kg per year for this duration. If the average Canadian's emission and lifespan is 1 tonne of C/yr and 80 years respectively he/she will have to plant 400,000 urban trees to offset his or her carbon foot print. The following is a reference source for the above calculation http://www.tcf-fca.ca/publications/pdf/english_reduceco2.pdf
41	How does a hydrogen energy market compare with an electricity/battery storage market – each will require a dedicated infrastructure for consumption and supply, and the two would have varying efficiencies for conversion from source to output. Which has the higher overall efficiency?	From my understanding of the situation and particularly from a transportation perspective, the electric battery market is in a more advanced stage of development. There are simply more battery and hybrid vehicles than say hydrogen fuel cell vehicles. Energy for charging batteries is also distributed through a well established infrastructure that forms our electricity power grid while that for storing and distributing hydrogen is virtually non-existent by comparison. If we were to rely on coal fired power stations for electricity (as most of Australia does), between 25 to 40% (depending on coal type) of the original energy in coal is converted to electricity. Once converted to electricity the charging and recovery of this energy from batteries can be very efficient and in the 90% range for example. If we were to produce hydrogen from gas (the most popular method currently) we could do it at an efficiency of about 75%. Compressing and transporting it under pressure uses another 20% of the energy leaving 60% (0.8 x 0.75) of the original energy as hydrogen. If we were to use the hydrogen in a fuel cell car the fuel cell coverts it at roughly a 75% efficiency resulting in an overall efficiency of 45% (0.75 x 0.6). The above very rough comparison would suggest hydrogen from natural gas in a fuel cell might be marginally more efficient than electricity from coal in a battery. Electricity made from natural gas is more efficient at 50% so it would put electricity from natural gas in a battery at about the same efficiency as hydrogen from natural gas in a fuel cell. Please realise this calculation gives ball park numbers to illustrate the problem of converting and using energy from different sources and the emissions that go with it. More rigorous analysis of every stage of the life cycle efficiency and emissions, commercial readiness and technology costs, availability of distribution infrastructure etc are issues that have to be taken into consideration when selecting one or the other option.
42	Comparing LPG to petroleum – what are the relative efficiencies in terms of CO2 emissions per km; is there any significant improvement in the efficiency of natural gas over liquid petroleum (LPG available in vast quantities locally; petrol sources, not so much)?	Calculations I have seen put the vehicle CO2 emissions from LPG at 0.26 kg/km compared to 0.31 kg/km for the same Holden Commodore vehicle. Looking at the same source, the GHG emissions from natural gas are shown to be only marginally higher. To get a good understanding of the difference we have to do a well to wheels comparison, i.e., the efficiency and emissions producing the fuels, compressing, transporting and distributing the fuels and finally utilising the fuels in a vehicle. It will take a lot of research and effort on my part to give a definitive answer but hopefully, like the answer to the above question on hydrogen and

		batteries, you get an idea of the assessment involved.
43	How many shopping centres have rainwater tanks to use for their plants and lawns?	This is a difficult question to answer. I would expect that governments running rebate programs or those responsible for rolling out building infrastructure would have an idea of shopping centres registered with them and using rain water. I doubt that even these government agencies would have complete lists. You might be interested to know that all new Qld housing construction requires the installation of rain water tanks. Perhaps this ought to be extended to offices, buildings and shopping centres throughout Australia.
44	Is there some simple technology for at least collecting the waste heat from slow combustion stoves (the heat that goes up the flue) and distributing it efficiently to other uses?	In principle you could do it but practically it would not be cost effective to do it on any reasonable scale to make a difference. That heat is best utilised in the place where the combustion stove is operating.
45	If H_2 becomes a significant fuel for vehicles, will the H_2 be produced at a central location and distributed to retail outlets? Or would it be produced at the outlets, since the only raw material would be water?	It will depend on the extent of the market for hydrogen and the availability of infrastructure to distribute it. If there is a large market then one can rely on economy of scale arguments to produce hydrogen centrally and distribute it. In small scale use one could produce it from water using electricity (at home for example). I suspect that the efficiencies and costs may be lower and higher respectively for the latter mode of production and utilisation. Please see answers to a related question above on hydrogen and batteries to get an idea of some of the issues involved in calculating the efficiency of overall energy utilisation for example.
46	We assume that it would be impractical to liquefy H_2, so does this mean it would require a much large tanker fleet to carry the same energy equivalent as petrol or diesel? Does it also mean that vehicles would need much larger fuel tanks?	It will require a lot of energy contained in the hydrogen to liquefy it -perhaps upwards of a quarter or more of the energy value. We obviously can store more liquid than gas in a given volume but the pressures would also be very high and costs and greenhouse emissions would also be exorbitant knowing that practically all of the hydrogen on the global market today is sourced from fossil fuels (most popular being production from natural gas). Some estimates suggest that liquefied hydrogen also requires three times more volume than petrol for the same energy content. The steel required to contain the pressures of liquefied hydrogen would also make the tankers very heavy such that tankers with the same tare weight as petroleum tankers will carry significantly less liquid hydrogen fuel.
47	Why can't we be paid for putting wind powered electricity back into the grid as is the case for solar? Is it a State or Federal decision?	It would appear that in Australia, the states are responsible for operating such initiatives, particularly when they are involved in providing incentives for the installation of small scale renewable energy infrastructure such as solar. There was a scheme introduced by the commonwealth government that rebated users that used wind energy for water pumping and I believe this scheme is no longer in operation. The larger scale production of wind energy has become cost competitive in many parts of Australia and the world, and as a consequence, require less incentives in the form of rebates from government to implement.
48	On what basis do we estimate the likelihood of a serious	The reference for this statement is:

	terrorist attack on a nuclear power station to be less than 1 in 170,000 years? What would have been the result if the terrorist attack that destroyed the World Trade Centre had targeted a nuclear power station instead? What would be the likely consequences of such an attack on Lucus Heights?	http://www.ansto.gov.au/__data/assets/pdf_file/0005/38975/Umpner_report_2006.pdf on page 81 of the document (page 86 of the pdf). It would have been much of a major catastrophe than that on the World Trade Centre to say the least. However one could speculate and that would not be necessarily right. The best example I could cite is for the questioner to look into what happened after the Chernobyl nuclear power plant incident in Ukraine (April 1986) and what damage radiation from the plant caused to the immediate surroundings and further afield in Europe. The Lucas Heights site currently has a small 20 MW Opal reactor that was commissioned in 2007. The older 10MW reactor that was previously used on site from the 1960's is now mothballed. It would be irresponsible on my part to speculate on the consequences of what would happen from an attack on Lucas Heights as a non nuclear technology expert. Suggest that ANSTO who operate that site be contacted directly for further information as they will have assessed the consequences of any potential risks to the facility.
49	What is the percentage of households in SA that are self sufficient via solar energy on their roofs?	Unfortunately I have been unable to find the information that you have requested. I suspect that average statistics could be compiled by tracking at each household level the amount of electricity produced versus that consumed by importing from the supply grid.
50	Are there any wave energy plants here in South Australia? Are there any in Australia? Can they be offshore?	Please see this site for information on a proposed wave power project for South Australia: http://www.energymatters.com.au/index.php?main_page=news_article&article_id=322 As well as here: http://www.carnegiewave.com/index.php?url=/ceto/australian-sites Here for NSW: http://www.oceanlinx.com/index.php/current-projects/operations Here for Tasmania: http://www.biopowersystems.com/projects.php And here for projects in Victoria and Western Australia: http://www.carnegiewave.com/ For an interesting report, see: http://www.climatechange.gov.au/publications/coastline/wave-climate.aspx Wave energy plants can be located offshore but they will also have onshore facilities to receive and transfer energy.
51	Can liquefied CO2 (coal steam gas/green house gases) be used as an energy source rather than pumped underground?	It would be more practical to convert gaseous CO2 into energy. The easiest way is by what nature has provided where plants in the presence of sunlight convert CO2 to carbohydrates and then biomass that can then be used as an energy source (this by the way is how coal and other fossil fuels were made by nature in the first instance over billions of years). Generally the process of converting CO2 into another useable form of energy requires a lot of energy input to reduce it from its oxidised state. If that energy is provided by the sun or other

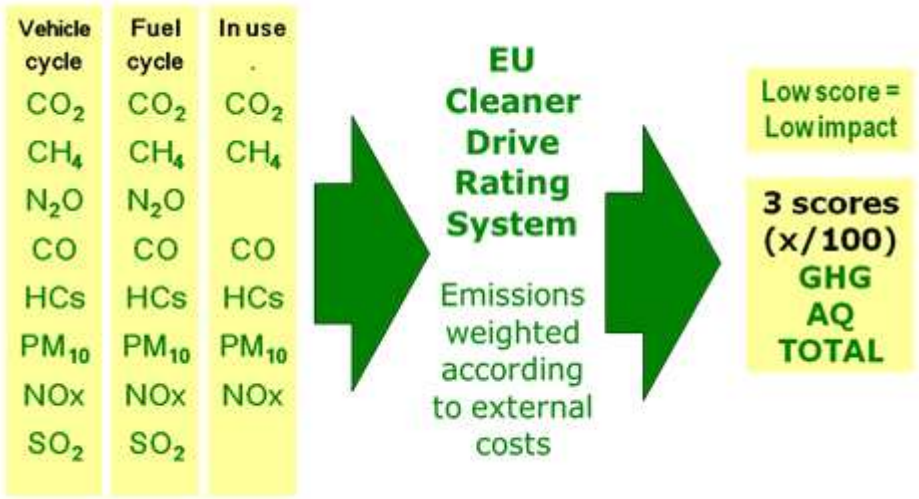
		renewable or nuclear sources, then there will be no further CO2 emissions - but the use of fossil fuels will generate the same amount or more of CO2 as was produced by burning fossil fuels in the first place. Even with the use of renewable or nuclear energy sources, the cost of deploying technology to provide the energy to convert CO2 could be prohibitive. However tapping solar energy by planting trees is currently a cost efficient means to convert CO2. The question also asks about coal seam gas. Coal seam gas is predominantly methane, the same ingredient as in natural gas. It is recovered from underground coal seams for its use as an energy source in Australia and elsewhere in the world.
52	Can large tree growing areas be set aside to absorb this CO2 and turn it into oxygen? Can the liquefied CO2 be used as a fertiliser? Can trees absorb CO2 through the roots or just through their leaves?	The process of photosynthesis in plants and trees that converts gaseous CO2 in the presence of sunlight, water and other nutrients to carbohydrates noted in the answer to the previous question also releases oxygen. Yes CO2 is turned into oxygen and reafforestation and forestation are effective methods of sequestering carbon dioxide. Currently the cutting down of forests in countries like Brazil and Indonesia (and others) also contribute alongside fossil fuels to about 2/7 of the net emissions of CO2 into the atmosphere. Therefore reafforestation can effectively remove similar fluxes of CO2 but not all of the CO2 emitted from fossil fuels. Issues also arise from other uses for the deforested land such as in agriculture, industry and dwellings. The answer to the latter question is that generally plants absorb CO2 in the presence of sunlight and because of this most absorption by the bulk of the earth's vegetation occurs through the leaves.
53	When paying the $1 to offset the carbon emissions of a flight, where does the money go? What purpose does it serve and where is the co2 traded?	Carbon offsetting involves investing in projects that prevent or reduce emissions being released thus counterbalancing the emissions associated with your flight. These projects must comply with stringent rules to ensure they are of the highest quality and actually deliver what they promise. The trading occurs by the act of investing to purchase avoided or reduced carbon emissions.
54	It was heard on ABC radio in Adelaide that the trees of greater Adelaide make up the South's largest "forest" area. They went on to say that we grow trees to capture carbon but the trees of this "forest" are not counted when it comes to carbon capture. Is this true and if so, why?	Generally the tree coverage area in a landscape (usually nowadays from satellite images) is used to calculate with other on-ground measured scientific data (of tree species, growth conditions, age etc, etc) the carbon stock held in trees. Perhaps it may be more difficult to obtain accurate satellite imagery of 'urban' tree coverage.
55	In relation to geothermal technology, are the full impacts of pumping water in and out of the earth and cooling the crust truly known?	Geothermal technology in Australia is a newly emerging venture and will require longer term operational data to fully understand the risks involved with the situation described. Having said this we could apply our best scientific judgement to assess these risks and put in place measures to avoid detrimental impacts. As for the cooling of the crust, the questioner should be reminded that the geothermal hot rocks are actually heated by the natural radioactive decay of nuclear material in these rocks. Since most natural radioactive materials decay over time, the continued heating of these rocks will diminish

		but would occur over a relatively long geological time span.
56	Will the production of geothermal power create as many jobs as the production of coal energy?	I would not expect the uptake of geothermal energy to be on such a large scale as to create the same amount of jobs as the production, use and export of coal from Australia. Also economic considerations dictate usually that power plants (applies also to other types of power plants) are staffed with the least amount of people and well automated to keep the cost of labour low.
57	Is CCS safe? Can it be done on a large enough scale to make a difference, and will it always stay underground and liquefied?	There are risks associated with any and every energy utilisation and climate mitigation option. By choosing special types of sedimentary formations at the right depth sealed with cap rock, the risks of CO2 escaping from underground storage is judged to be minimal. Over longer geological timescales the stored CO2 becomes mineralised in the form of carbonates for very safe storage. Estimates from modelling studies carried out by the International Energy Agency (IEA) suggest that large scale CCS can contribute up 20% or about 10 billion tonnes/y of CO2 emissions reduction by 2050. This scale of emissions reduction is comparable to that also obtained from the deployment of renewable energy and energy efficiency measures respectively. It is estimated by the IEA that a multitude or portfolio of energy technology solutions need to be deployed to tackle the climate change challenge.
58	Is geothermal a closed system or can steam escape to form clouds which would result in rain somewhere that wouldn't normally get that rain?	Given the scarcity of water in arid regions of Australia where geothermal energy is likely to be produced, it would be as much as possible a closed system I would expect.Steam escaping to produce rain would be a very remote prospect I would think.
59	Who gets rid of nuclear waste – the uranium producing country or the using country?	Nuclear waste from uranium fuel cell rods contain recoverable fissionable and bomb making material. The spent fuel rods are usually reprocessed in the country supplying the fuel rods since it requires sophisticated technology to produce and reprocess uranium fuel. Part of the requirements of preventing nuclear proliferation from peaceful uses of uranium is that countries adhere to a strict regulatory regime for such activity under the auspices of the International Atomic Energy Agency.
60	Are we ruining the balance of the Earth's heat? Is there a release point where we've released too much heat?	The source of the geothermal (hot rocks) heat is the low level (natural) radioactive decay that occurs in these rocks. Because this heat is insulated by the earth's upper mantle, the rate of this heat loss to the surface is considerably reduced. Nevertheless the heat loss does occur naturally and the earth also loses heat to space. In the scale of geothermal energy production that we are currently contemplating, I doubt that we would release too much heat to the earth's surface to make a big difference environmentally. However, we ought to be thinking about these issues when planning and developing new energy sources.
61	What about steam erosion?	Because steam is water vapour under very high pressure it can in theory erode surfaces of any material. We also know that water does naturally erode rocks. In fact high pressure steam and water with grit is used to fracture rocks underground in the exploration stages so as to make them

		more permeable. During operation high pressure water is then injected to flow through these permeable spaces created, turning into steam which is then piped to the surface geothermal plant to generate electricity using steam turbines coupled to an electrical generator.
62	We are playing with the Earth's core, could that affect the Earth's rotation?	In the recovery of geothermal (hot rocks) energy, we are not really playing with the deep molten core of the earth nor altering it. Hence we will not affect the earth's rotation due to this activity. We are merely undertaking a more modest activity of just partly cooling hot rocks roughly up to 5 km deep that heat up from ongoing natural radioactive decay in these rocks.
63	Would we need a carbon trading scheme to make it viable?	A carbon trading scheme will put a cost on the energy produced from the carbon emitting fuels that currently produce the lowest costing electricity. By lifting the price of electricity it allows geothermal energy, which is currently more expensive (due to exploratory and early stages of technology development), to compete more effectively in the market place.
64	Would the saline water used for geothermal erode the rocks?	Yes it will, but please see the answer given to the question on "steam erosion" above for more context.
65	Is it true that Acacia trees reduce emission more than other trees?	CO2 and N2O (carbon dioxide and nitrous oxide) are both greenhouse gases regulated under the Kyoto climate protocol. The acacia tree in its growth phase like any other tree species fixes (removes) carbon from the atmosphere. However, the acacia tree (from study and observations made in Africa) sheds its leaves early in the agricultural planting season. The leaves which are rich in nitrogen, decay and provide a source of nutrients to food crops planted around them and don't redevelop foliage again until later in the growth season – hence not competing with food crops for sunshine. However this nitrogen fixation process for food crops by the leguminous roots of this tree has a downside in promoting higher N2O emissions (a greenhouse gas) from the soil. Other research undertaken in Japan suggests that on a global warming potential basis, the net emissions of N2O are equivalent to less than 10% of the carbon uptake by plants. Thus whilst contributing to natural nutrient recycling through nitrification, these benefits are diminished by a warming impact that effectively reduces the net carbon emission uptake (carbon fixation) by the trees. Thus, leguminous trees such as the Acacia whilst promoting natural nutrient recycling that avoid the use of synthetic fertilisers (whose manufacture generate even more carbon emissions), are less effective in direct carbon fixation in growth compared to other trees/plants.
66	Is there seven times as much carbon in a patch of soil as there is in the column of air above it?	Soils represent a short to long-term carbon storage medium, and globally, soils contain more carbon than all terrestrial vegetation and the atmosphere combined

67	How much energy is required to pump CO2 into storage and what is the cost?	Up to a third of the energy for CO2 capture, transport and storage (CCS) could be expanded for CO2 transport and storage. In coal fired power plant studies between 6 to 9 percentage points in power plant efficiency is used for the entire CCS operations. In US EPA studies US $15/tonne of CO2 is used as the average cost of transport and storage. The cost split between transport and storage in this range cited can vary depending on distance of plant from storage site and the geological characteristics (mainly permeability) of the storage formation.
68	One group member pointed out that USA did a lot of research on carbon capture some decades ago and have steered clear of it ever since. Does anyone know why USA pulled out of R&D on carbon capture? What did they learn?	This information is not true. The USA has been an early leader in carbon capture and storage (CCS) and despite the 'climate change stance' adopted by the previous Bush administration, the US has continued to be a world leader in CCS. They contribute a lot to the global advancement of CCS science and technology.
69	What percentage of the total amount of electricity sold by a retailer must be from renewable sources?	In a bill passed by the Australian parliament, the renewable energy target has been increased from 9,500 to 12,500 GWh for 2010 and increases to 45,850 GWh by 2020. The renewable power percentage for 2010 set on retailers by this legislation is 6% for 2010 (and aiming for 20% in 2020).
70	What percentage of green electricity is purchased by consumers?	According to one market report, 1.3 million households were expected to be on a green tariff by the end of June 2009 equivalent to 14.6% of the market.
71	Can you tell us if SA Government is lowering the feed-in tariff for solar power?	*The Electricity (Feed-In Scheme-Solar Systems) Amendment Act 2008* for South Australia was the first solar feed-in law in Australia that will pay a premium guaranteed tariff of $0.44 per unit of electricity (kilowatt-hour, kWh), to households and small customers (max size 10 kW) who feed solar electricity into the grid. The law came into effect on 1 July 2008, and will extend for 20 years to 2028. In May 2009, South Australia reached a solar generation capacity of 10 MW capacity, which triggered a review of the feed-in scheme as per the original enacted legislation. The Terms of Reference and the formal announcement of the review were released on 31 October 2009 and submissions for the review closed on 23 November 2009. Independent consultant, Mr Paul Miley of Consulting Partners, is now reviewing the submissions received, and is expected to provide a report to the State Government by the end of 2009. Likely interrupted by the recent elections, there have been no formal announcements made as yet

		by the SA Govt on the outcome of this review (at least in the official SA Govt's solar power website)
72	If Australia was to go 100% nuclear for all its power, how much reduction would there be in its carbon footprint?	In 2007 Australia produced about 200 Mt/y out of 541 Mt/y of CO2 from power generation. Coal (black and brown) fired power generation constitutes about 76% of Australian power supply emissions currently with no nuclear whatsoever. Technically focusing only at the generation output, replacing all coal by nuclear could reduce Australia's carbon footprint by about 152 Mt/y of CO2 or about 28% of the 2007 CO2 emissions
73	In South Australia cleared Mallee swamps were replaced by crops, what is the overall carbon credit balance?	N/A
74	Is there any chance of using salt bush in arid regions to produce ethanol?	The "river" and "old man" salt bush can be used readily as animal fodder that contribute to sheep and cattle muscle-skeletal health and also help to prevent soil erosion and salinisation. It is apparent that these advantages are best for the utilisation of a unique plant species aimed at protecting certain types of landscapes. In theory any type of cellulosic plant material such as that provided by the salt bush, in the presence of a certain type of enzyme to break them down to sugars, can be used as a feed for ethanol production by micro-organisms. However, given the unique fodder-based use and environmental benefits of this plant species, is this the best use of this resource? Perhaps it would be better to use salt bush to reduce a large fraction of the grain fed to animals and divert the saved grain to ethanol production instead. Clearly the value of this approach has to be carefully analysed in the context of carbon reduction and overall sustainable development issues.
75	What percentage of electricity goes on street lighting?	Information that I have managed to unearth suggests that Australia has approximately 2 million streetlights. Annually, this public lighting costs $210 million and uses 1035 Gigawatt hours (GWh) of electricity. This electricity consumption (that is mainly coal-fired in Australia) is responsible for 1.15 million tonnes of carbon dioxide emissions that equates to 0.2 per cent of Australia's total greenhouse gas emissions. For many local governments general lighting represents between 30-50 per cent of a Local Government's total electricity bill. Greenhouse gas emissions derived from energy use in public lighting often also make up between 20-50 per cent of total council emissions

		As a saving grace, many local and state authorities have active programs trialling the use of more energy efficient street lighting that include the use of low power consumption LEDs.
76	The fuel efficiency of cars is increasing at a fairly rapid rate so there is an argument for trading in the older vehicle every few years to take advantage of the new technology. But this needs to be set against the energy embodied in the 'old' car which has not outlived its useful life. Of course the 'old' car will be reused and probably reused again before it is finally crushed and some of the materials recycled. So the question is, what is the optimum time to trade in a vehicle (assuming like for like)? No doubt this will also depend on kms travelled and other things, but presumably someone has modelled this important lifecycle process since it affects us all.	There are various groups that have developed methodologies to assess the life cycle greenhouse emissions arising from the manufacture of a vehicle, the emissions from fuel production and vehicular fuel use. One such system developed by a group called Whatgreencar.com and information obtained from their website is shown below;  This system as seen above ends up scoring vehicles in an index of 0 to 100 with 0 being the greenest and 100 being the most polluting. Shown below are ratings for some common vehicles published on the Whatgreencar.com website; WhatGreenCar.com emissions ratings  I would suggest that armed with this information one could assess the scenarios you have outlined

		in your question to determine the best environmental option.
77	How does the efficiency of a wood heater (slow combustion or open) compare to electric or gas heating? Is there a comparison in terms of CO2 per heating unit or fuel energy in to heat out?	In terms of transferring heat per unit of *primary energy* input, I would rate a gas heater as being the most efficient, followed by wood with electric being the lowest. This is because electricity produced from coal as a primary fuel in Australia is about 35% efficient and by the time it gets to your home it cannot improve on this figure as there are further minor losses. I would think gas and wood would be closely comparable depending on the type of wood fed to the heater. Generally wood is not as energy intensive or clean to burn compared to gas and would thus incur more losses in the transmission of primary to useful heat from the heater. However when one throws in CO2 emissions into the picture, by virtue of the fact that trees could be replanted to sequester CO2, I would *rate the impact* of CO2 emissions per unit of useful heat from wood to be the least followed by gas and with electricity being the worst. However please note that the actual emissions of CO2 per unit of useful heat will be higher for the wood heater compared to the gas heater but its impact is less if the wood used is replanted sustainability. With a bit more digging one would be able to compare CO2 emissions and the efficiency of heating of particular models of wood, gas and electric heaters available in the market.
78	Considering the different distribution methods between a local store (lets say a bike store) and large, overseas online retailers, is one more efficient at distributing goods than the other, is there a greener choice?	A general off the cuff answer to this question would be that due "to economies of scale" efficient volume production and handling methods could yield lower GHG emissions. I would caution however that specific cases should be carefully analysed. I could not say the same say for a local store sourcing a bike from a local manufacturer or even Thailand versus a global chain supplying out of Brazil for example.
79	We are trying to workout if RECS are any different to Green Power and if either really contributes to reducing the Carbon footprint. If you buy Green Power or gift RECs back to the power utility it seems you are just giving them permission to keep burning coal at their usual rate. On the other hand the fact that they are required to invest in renewables (Green power) or that you have installed a renewable source presumably means there is that much less need for non-renewable energy. Help!	The Commonwealth has a renewable energy supply target and power suppliers are mandated to meet this target. My understanding is that in order to meet this supply target, RECS are issued (with monetary value) and you and I who put in solar panels gift back the RECS in order to reduce the cost of the installation by the value of the RECS generated by the installation. In addition to this many states as a further incentive have also mandated the purchase of solar electricity at a higher price than what is supplied by the utility. Overall these incentives actually have the net impact of reducing the amount of ghg polluting electricity consumed due to increased generation of renewable electricity.
80	Some of us think that growing forests sequester more CO2 than grasslands because the former has a much larger leaf area per square metre of ground covered. Is this correct?	Australia has 149 million hectares of forest. Of this, 147 million hectares is native forest, dominated by eucalypt (79%) and acacia (7%), and 1.82 million hectares is in plantations. Grassland covers around 440 million hectares of land in Australia. The size of the difference in the total carbon storage between grasslands and woodlands depends not just on the amount of land covered by the plants, but on the capacity of the individual

<table>
<tr><td></td><td></td><td>ecosystems to store carbon, and the depth to which the carbon sink is tested. The sinks can be the plant material above ground, below ground (roots), and soil that is enriched in carbon by dead plant material.
Based on data from typical perennial grasslands and mature forests in Australia, forests are typically more than 10 times as effective as grasslands at storing carbon on a hectare per hectare basis. Therefore the forest carbon sink in Australia is a more effective in carbon storage despite its lower coverage in terms of land area.
The interpretation in your question is generally correct.</td></tr>
<tr><td>81</td><td>Is it correct that a mature forest is effectively carbon neutral?</td><td>Yes. A mature forest is one in which fresh growth is at a steady state balanced by dying vegetation.</td></tr>
<tr><td>82</td><td>It has become customary to ‘blame’ beef for a massive contribution to ghg. In terms of ghg/unit of protein produced, how does beef compare with dairy products (e.g. cheese)?</td><td>(From answer provided to a previous question)
All sources of food not just beef or meat have a carbon foot print. Beef production has a very high carbon foot print partly due to high methane emissions from food digestion from cattle. Please see earlier expert panel answers for more information on food and your carbon footprint.
The table below shows emissions for different food groups from a German publication:
CO2-Emissions (in g CO2e per kg food):
<table>
<tr><th>Food group</th><th>Food</th><th>CO2-Emissions (in g per kg food)</th></tr>
<tr><td rowspan="5">Meat and sausages</td><td>Beef</td><td>13'300</td></tr>
<tr><td>Raw sausages</td><td>8'000</td></tr>
<tr><td>Ham (pork)</td><td>4'800</td></tr>
<tr><td>Poultry</td><td>3'500</td></tr>
<tr><td>Pork</td><td>3'250</td></tr>
<tr><td rowspan="3">Milk- and dairy products</td><td>Butter</td><td>23'800</td></tr>
<tr><td>Hard cheese</td><td>8'500</td></tr>
<tr><td>Cream</td><td>7'600</td></tr>
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<tr><td></td><td></td><td>
<table>
<tr><td rowspan="5"></td><td>Quark (curd)</td><td>1'950</td></tr>
<tr><td>Farmer cheese</td><td>1'950</td></tr>
<tr><td>Margarine</td><td>1'350</td></tr>
<tr><td>Yogurt</td><td>1'250</td></tr>
<tr><td>Milk</td><td>950</td></tr>
<tr><td rowspan="2">Fruits</td><td>Apples</td><td>550</td></tr>
<tr><td>Strawberries</td><td>300</td></tr>
<tr><td rowspan="2">Baked goods</td><td>Brown bread</td><td>750</td></tr>
<tr><td>White bread</td><td>650</td></tr>
</table>
</td></tr>
<tr><td>83</td><td>Will it ever be feasible to farm kangaroos as an alternative non-ruminant source of animal protein? There are two parts to this question: a) is it worth even trying when there are so many wild roos in the pastoral country and rangelands? b) this would take a very different style of grazing management (e.g. re fences, mustering, transport) but should such thinking be out of the question?</td><td>Part (a) of this question on kangaroo numbers in the wild and current culling practices is partially answered by the following Wikipedia excerpt;

“Although it is impossible to determine the exact number, population estimates are calculated each year by the government conservation agency in each state. Nearly 40 years of refinement has led to the development of sophisticated aerial survey techniques which enable overall populations estimates to be constructed. Current estimates indicate that there may be between 35 to 50 million kangaroos in Australia. In 2002 the number of kangaroos allowed to be shot by commercial hunters was increased from 5.5 million to 7 million per year. While animal rights activists protested the move, Australian farmers claimed that kangaroos were a plague after a huge increase in their numbers. A 2002 report studying the grazing pressure caused by kangaroos indicated that scientific evidence is lacking that kangaroos reduce wool production or sheep carrying capacity. In 2007 the national kangaroo culling quota was more than 3.5 million (but significantly down on the figures earlier in the decade).”

The following is an abstract of a paper published in 1983 and I would suggest the questioners’ request a copy of the article since it appears to squarely address their question in part (b);
“The feasibility of farming kangaroos.

NC Shepherd, The Australian Rangeland Journal 5(1) 35 – 44, 1983, CSIRO Publishing.
Abstract</td></tr>
</table>

		The possibility of farming kangaroos for profit has generated interest for more than a decade. This article discusses aspects of kangaroo biology and husbandry, markets for kangaroo products, and some legal and administrative matters that could affect a kangaroo farming enterprise. Production under intensive conditions is limited by a low reproduction rate and a slow growth rate. Handling difficulties would also ensure many husbandry problems. Rangeland farming of kangaroos is limited by the mobility of kangaroos, their ability to jump stock fences and behaviour patterns which prevent mustering or herding. Markets for meat and skins are limited and are adequately supplied from the existing rangeland harvest (i.e. kangaroo hunting). Farmed kangaroos could not compete successfully in these circumstances because of high costs associated with establishing and operating a kangaroo farming enterprise. The conclusion is that kangaroo farming is not a feasible proposition at this time." Finally a more recent paper on a policy perspective on this the issues raised published in 2008 by the Australian Wildlife Service is attached as a pdf for additional reading.
84	How does the current global domestic beef cattle population compare with lost wild population due to desertification, loss of grazing land to farming and urbanisation?	*Partly answered in the response given below. It would be hard to seek information to compare precisely with wildlife populations that might have existed prior to the adoption of animal husbandry by the human race.*
85	Some people argue that in years gone by there were a lot of bison in USA and wildebeests in Africa and that the number of cattle around today does not surpass that number – so why the concern about their methane emissions? What is your answer and could you give us your source of information please?	(From an answer provided to a previous question) The scientific assessment of diet and carbon footprint is still in its infancy, but it is estimated that about one-third of our individual carbon footprint comes from food. There are many ways to eat for good health, and different eating patterns suit different people. Fortunately, moving to a healthy diet can also reduce greenhouse gas emissions. Red meat is a nutrient dense food that provides protein, iron, zinc and vitamin B12 essential for red blood cell production, the good health of the nervous system, and childhood growth and development. However, some red meat, particularly beef, can be associated with up to one-quarter of the greenhouse gas associated with the food we eat. For beef this will vary greatly depending on how it is produced, how and where the cattle are raised, and how much land clearing or re-clearing is carried out. Other meats such as pork and game are associated with considerably less greenhouse gas. It is well worth considering how much red meat you and your family eat but this will also depend on individual health requirements. The American and Africans might want to argue a partial offset due to bison and wildebeest but Australians couldn't even attempt to do this as of course these animals aren't native to Australia.

		The international convention is that each country is responsible for its own carbon emissions. If Australians wish to take advantage of emissions reductions in other countries we can do this by buying carbon credits through a carbon trading scheme. For a study of the relative effects of bison vs cattle try this reference "Methane emissions from bison—An historic herd estimate for the North American Great Plains." Agricultural and Forest Meteorology Volume 150, Issue 3, 15 March 2010, Pages 473-477. Francis M. Kellihera and Harry Clark.
86	We suggest that before drilling 800 km deep holes for CO_2 burial you try 800 m first. It was interesting to read recently that Total has successfully 'buried' 2000 tonnes of CO_2 at a depth of 4.5km in France as part of a 120,000 tonne experiment. But apparently this is a very expensive process.	CO2 depending on the pressure and temperature gradient underground is generally stored at depths greater than 800 m so that it is in a supercritical state with a density close to that of water. This allows the mass of CO2 stored underground to be maximised. If 800 km was given as an answer before, it is clearly a typographical error. Greater depths may used for CO2 storage depending on the geology – which is typically selected to provide safe and secure CO2 storage underground. Generally, the cost of compression for CO2 injection increases with the depth of injection. In the grand scheme of things, the cost of CO2 pipeling and injection underground (depending on the distance transported and the depth of injection for storage) is generally less than one third the cost of the entire capture, transport and storage operation.
87	There was great surprise and disappointment at the prediction of 400,000 trees needed to offset our C footprint for one year. We get 400 by dividing 80,000 (80,000 kg C emitted @ 1 t/yr) by 200 (net kg /tree absorbed over that period). Please tell us we are right!	Your answer of 400 urban trees to offset an emission of 1 tonne/y of C is right. My error arose from inadvertently multiplying tonnes to kg by 1000 twice instead of once. Please note that the amount of trees will be less in warmer climatic zones compared to Canada – the region for which the tree growth conditions were used.
88	We would like comparative data between the different sources of energy Costs to build, capital cost, Costs to run, Output, Area, Emissions Costs/kwh Longevity Amount of water used Amount of waste and what type In graph form.	This question requires a lot of research to put the requested information together and apologise that I cannot do so in the time available. The best I could do is perhaps offer a publication (attached pdf GHG emissions from electricity chains) that provides a lifecycle comparison of GHG emissions arising from various power systems and how the choice of different boundary conditions used in the analysis could affect the results. As you can see from the graph the lowest GHG emissions are from nuclear plants and despite

		these findings we know the controversy this outcome generates. For some it is the radiation threat and waste, others cost and liability or even water use age. The above succinctly illustrates the fact that all of you have asked the right questions about the relevant factors that should influence the final decision. Please remember that in a market driven society the impacts expressed in the true costs of power supplied together with policy (political) intervention would end up being the final arbiters of choice for the power systems adopted.

Contact Us

Phone: 1300 363 400
+61 3 9545 2176

Email: enquiries@csiro.au

Web: www.csiro.au

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