Intrinsic Changes: Energy Saving Behaviour Among Resident University Students

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Abstract This paper presents the results of a study that explored the effectiveness of three intervention strategies in facilitating energy saving behaviour among resident undergraduate university students. In contrast to a dominant practice of motivating with rewards or competition this study sought to appeal to students' intrinsic motivations. An experimental design was used with two intervention groups and a control group. The interventions were the provision of real-time feedback provided by an in-house energy consumption display unit (ecoMeter) and a targeted social marketing approach. They were evaluated using energy consumption data and self-report data from the participants via an on-line survey and focus groups. Across the three research phases the rate of reduced electricity consumption for the interventions ranged from an average of 17% to 28% less than the control group. The findings provide evidence that facilitation of intrinsically motivated behaviours can result in reduced energy use and greenhouse gas emissions.

Introduction

The environment can be viewed in a number of different ways which are reflected in a diversity of environmental education programs (Sauvé & Berryman, 2003). According to Sauvé and Berryman (2003) current environmental education research suggests there are two emerging views of the environment - either as a lively world where attention is on being-in-the-world or on life-world, or as a material environment and associated biophysical and ecological processes that through our use is experiencing an environmental crisis. We have adopted the latter view of the environment in our study and believe that to ensure our environment continues to provide us with adequate resources and quality of life individuals, communities, governments and industries all need to change the everyday practices that impact on the environment (Australian Conservation Foundation, 2007). The study is driven by our own concern about the world's environmental condition and focus on one environmental concern; that of our increasing energy consumption which has the negative environmental impacts of contribution to greenhouse gas emissions, acid rain, atmospheric pollution and land degradation (Shipworth, 2000). The current residential energy use at 402 petajoules (PJ) per annum in Australia (electricity, gas, wood and liquefied petroleum gas) represents an increase between 1990 and 2008 of 24% (DEWHA, 2008). Although appliances have

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become more energy efficient our overall energy consumption continues to increase as we buy and use more appliances (Abrahamse, Steg, Vlek & Rothengatter, 2005; ABS, 2008). This paper explores change in individual domestic energy use brought about from availability of energy feedback, and a selection of tools and information.

We begin from a behaviourist perspective and perceived need for individuals to change the way household appliances are used in order to reduce their energy consumption, and consequent green house gas emissions. However, fostering this change, as with other environmental behaviours, is challenging for many reasons including: the complexity of inter-relationships between behaviours and motives, delayed benefits against immediate gain, and the lack of personal relevance because environmental problems are often framed on a global scale. One of the paradoxes of environmental psychology is that individuals' generally hold pro-preservation attitudes but often engage in environmentally unfriendly behaviours (Shipworth, 2000), often referred to as the "value-action gap" (Kempton, Boster, & Hartley, 1995). Research demonstrates that behaviour cannot be predicted on knowledge and/or attitudes alone (Abrahamse et al., 2005; Brandon & Lewis, 1999; McKenzie-Mohr, 2000; McMakin, Malone, & Lundgren, 2002; Nordlund & Garvill, 2002; Shipworth, 2000; Stern, 2000) although where specific attitudes and behaviours have been explored there is a stronger correlation (Burton, Weston, & Kowalski, 2006, p. 684).

In a review of intervention studies Gardner and Stern (1996) found that use of multiple intervention types was a key principle of success in changing environmentally destructive behaviours. They focused on the barriers or limiting conditions to behaviour change and found that until the barrier is removed there will be little or no change in the behaviour. There is supporting evidence that where attitudes do predict environmental behaviour this relationship is improved when obstacles or constraints to that behaviour are removed (Corraliza & Berenguer, 2000; Guagnano, Stern, & Dietz, 1995; Kaiser & Gutscher, 2003).

One approach to the amelioration of behavioural barriers is social marketing. Social marketing promotes products and practices designed to provide social benefits as opposed to individual benefits and is used in situations where the "product" is an action or changed behaviour; i.e. people are "buying" the changed behaviour, for example exercising more (Kotler & Lee, 2008). Social marketing seeks to provide targeted and accessible information or tools to specific population groups. This approach has been used in the promotion of products and programs designed to yield health or well-being benefits, as well as environmental benefits (Altman & Petkus, 1994; Kotler & Lee, 2008; Maibach, 1993; McKenzie-Mohr, 2000). A prominent approach to social marketing is the Community Based Social Marketing (cbsm) advocated by McKenzie-Mohr and Smith (1999). Interventions may include antecedent tools such as information posters and/or consequent tools such as feedback or comparative feedback (McKenzie-Mohr & Smith, 1999).

Provision of information on the outcome of a particular behaviour, or feedback, can be a component of an effective social marketing strategy and there is clear evidence that the provision of feedback, for example letting people know how much rubbish was correctly sorted, alters their public behaviours and is a useful support mechanism for behaviour change (DeLeon & Fuqua, 1995; Katzev & Mishima, 1992; Kim, Oah, & Dickinson, 2005; Ragnarsson & Bjorgvinsson, 1991; Schnelle, McNees, Thomas, Gendrich, & Beagle, 1980; Van Houten, Nau & Marini, 1980). Indeed, Newman (2005) suggests that sustainability is a process of ongoing improvement and assessment of changing conditions and that feedback systems are crucial to the process of achieving sustainability.

More specifically, feedback mechanisms can be a significant component of the learning process (Butler & Winne, 1995) and Darby (2000) demonstrates this is true for households learning to change their energy consumption patterns. For us feedback is the delivery of information which then allows the individual to choose whether to engage in a particular action. It is an approach that is not about persuading individuals to change their behaviour but is an offer of information on the consequences of their behaviour. In a review of feedback studies Darby (2006) established that feedback can play a significant role in developing energy awareness and conservation, and in the household energy context feedback tools inform people about the impact of their energy saving actions, making energy more visible and more amenable to control by the consumer. According to Shipworth (2000) and Darby (2006) feedback can result in a 10-20% reduction in energy use and, when combined with other incentives, result in a 30% reduction.

Consequent strategies, such as financial incentives, can be useful, but have disadvantages of being ineffective if people would have taken the action anyway, and of promoting action only when the consequence, for example economic reward, is available (Abrahamse et al., 2005). Alfie Kohn (1993) suggests that the use of extrinsic motivators has the disadvantage of eroding any existing intrinsic motive. They can, however, be effective if they help transform the market for energy efficiency products (Shipworth, 2000). Financial incentives are extrinsic rewards, external to the individual, as opposed to intrinsic rewards which are internally derived such as a sense of satisfaction and pleasure. Therefore, acknowledging the ambiguity of external rewards this study has sought to avoid them entirely.

We know also that demographic factors such as age, gender and cultural background influence individual's concern about the environment (Fien, Yencken, & Sykes, 2002; Rickinson, Lundholm, & Hopwood, 2009). For example, in New South Wales, Australia, a longitudinal study of people's environmental knowledge, attitudes and behaviours found that engagement in environmental behaviours increases with age, and that young adults of 15 to 24 are the least likely to perform environmental behaviours (DEC, 2007; DECCW, 2010). The resistance of young people to pro-environmental behaviours has also been found by others (Uzzell, 2008; Wray-Lake, Flanagan, & Osgood, 2010).

To date there has been limited applied energy research in Australia and this study sought to address this gap. The study aim was to investigate and compare the impacts of immediate feedback and social marketing tools in fostering intrinsic motivations associated with reduced energy. The study population was on-campus resident undergraduate students living in self-catered residences on the Wagga Wagga campus of Charles Sturt University (CSU). These students pay a flat rate for their accommodation and services. They do not pay energy bills and do not receive any rewards or penalties for increased or decreased energy bills so the study was able to focus on influencing intrinsic motivations rather than extrinsic motivators.

This study was one response to the University's Institutional Development Plan that identified the need for the University to operate more sustainably. To this end the Plan has set specific targets in relation to energy consumption and greenhouse gas emissions. The first target aims to achieve a 10% reduction in energy consumption by 2011 (compared to 2006) and a 25% reduction by 2015 and the second target is to be greenhouse neutral by 2015 (CSU, nd, p. 5).

Project Method

The project delivered intervention strategies of real-time feedback and social marketing with on-campus residential undergraduate university students, on the Wagga Wagga campus. The city of Wagga Wagga is located 245 kms west of the Australian capital,

Canberra, in a temperate climatic zone experiencing a July (mid-winter) average minimum temperature of 0-3 degrees Celsius and a January (mid-summer) average maximum temperatures of 30-33 degrees Celsius. Our sample population lived in forty eight self-catered residences of similar brick construction and design.

The specific objectives of the project were:

1. To investigate the impact of social marketing strategies on the energy consumption patterns and behaviour of student residents;
2. To investigate the impact of real time feedback using in-house ecoMeters on the energy consumption patterns and behaviour of student residents;
3. To investigate the combined impact of real time feedback and social marketing strategies on the energy consumption patterns and behaviour of student residents; and
4. To compare the impacts of the three approaches on the energy consumption patterns and behaviour of resident students.

Three intervention strategies were tested. The first strategy is based on social marketing mechanisms that address the barriers to, and benefits from, the uptake of energy saving measures (see McKenzie-Mohr & Smith, 1999). The second strategy utilises real-time feedback mechanisms (in-house ecoMeters) for the purpose of facilitating student learning associated with behaviour change, and a third strategy was the combination of real-time feedback and social marketing.

This study used an experimental design with three groups: a control group (energy consumption measured and no intervention); intervention group A (ecoMeters mounted on a wall in their kitchen or living room) and intervention group B (social marketing approach, then later a combination of social marketing and ecoMeters). The ecoMeter units provided energy consumed, equivalent dollar cost, and greenhouse gases produced, and indicated the level of energy use through display lights (see Black, Davidson, & Retra, 2009 for full details). Each residence had a smart or interval meter installed on the outside of the residence, which communicated to the in-house ecoMeters and allowed us to receive web-based electricity consumption data for that residence. In order to evaluate the impact of these tools we collected quantitative energy use data as well as qualitative responses from the participants using focus groups and an on-line questionnaire.

The research was divided into three phases: Phase 1 (pilot), Phase 2a and Phase 2b (see Table 1).

TABLE 1: Summary of project phases and research groups

	Research group			**Combined strategies residences**
	Control	**EcoMeter residences**	**Social marketing residences**	
Phase 1 - seven week period from 3 Oct- 20 Nov 2007 (pilot)	√	√	√	
Phase 2a - 8 week period from 17 Apr -11 Jun 2008	√		√	√
Phase 2b - 11 week period from 24 July – 5 Oct 2008	√		√	√

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Social Marketing Intervention

Drawing from the work of McKenzie-Mohr and Smith (1999) this approach aimed to identify the students' perceived barriers to, and benefits of, low energy use behaviours, allowing us to design tools that would encourage low energy use behaviours. Three focus groups were held with the resident students that explored the barriers and benefits of reducing energy consumption associated with three specific behaviours: turning off standby on appliances, turning off lights, and taking shorter showers. These behaviours were targeted because they were likely to have a significant impact (e.g., hot water accounts for approximately 30% of household energy use) on overall energy consumption and were within student control. Focus group data was used to inform the selection of the four tools that were installed in fifteen residences. They were shower timers targeting shorter showers, night lights addressing safety issues at night, three information posters targeting three behaviours: lights off, standby off and shorter showers and a weekly update feedback report on their energy consumption (see Black et al., 2009 for details). Following Ham (1992) and others' (Jacobson, 1999) principles for developing effective interpretive exhibits the conceptual design of the posters drew from the focus group results. The posters highlighted key messages, layered information and suggested ways students could reduce their energy use. The artistic concept followed the principles of being attractive, brief and clear (Fazio & Gilbert, 1986). Importantly Retra, in the role of research assistant, had regular contact with these students when she installed the tools, carried out tool audits and delivered the information sessions. Students were invited to contact Retra at any time with questions or problems, and often during installation of audits Retra would take the opportunity to chat with the students about the tools and their experience of them.

EcoMeter Intervention

Eighteen residences received an ecoMeter. The only contact with these residents was an information session which was held after installation of the display units. The intention was to test the impact of the feedback on the students' energy consumption without any other support or motivating materials. The ecoMeter feedback is internally comparative so the reader can compare their own current use to past use.

Evaluation of the Strategies

The effectiveness of the intervention strategies was evaluated using a mixed method approach. Many behaviour change programs rely on self-report behaviour to evaluate their success. We used a measurable indicator of behaviour change, electricity use, as well as gathering qualitative data to better understand the students' perception of the behaviour change tools. The quantitative measure of actual energy (electricity in kilowatt hours) consumed by each residence was compared with the control residences' consumption. Qualitative data was collected from students using focus groups and surveys. The focus groups and survey aimed to understand the students' experience and response to the social marketing strategies and ecoMeters strategies. The focus group data were reduced by looking for common themes (Crotty, 1998; Miles & Huberman, 1994). The survey was developed based on the key findings of the focus groups which were written as Likert style statements requiring the student to indicate their level of agreement. The survey was accessed through an online link (administered through Survey Monkey) which was emailed to consenting students at the end of phase 2a and 2b. The responses from the students were similar for both surveys at the end of Phase 2a (28 responses) and 2b (33 responses). The survey results from the sixty one respondents were analysed manually using basic descriptive statistics. As the

quantitative data set of energy use was small and could not be assumed to be normal the data was treated as non-parametric; bivariate analysis was undertaken using the Kruskal-Wallis test with SPSS.

It would have been useful to have more fully explored the comparative impact of the combined approach with the feedback group, however, to fully test this a four-part study was required: feedback group; social marketing group; combination; and control. Reducing our population into four groups would have reduced the meaningfulness of our quantitative data.

Results and Analysis

Behaviour Change as Shown by Electricity Use

Phase 1, the pilot phase, involved the trialling of two behaviour intervention strategies, social marketing and the ecoMeters (real time feedback) over a seven week period. The results indicated that both intervention groups used less electricity than the control group, however, due to technical difficulties associated with obtaining electricity data prior to the interventions we are hesitant to say that the reduction in electricity was a result of the interventions in this pilot phase.

Following the pilot phase, focus groups with the students reported some change in behaviour and attitudes towards energy use and consumption. The ecoMeter units were reported to promote greater awareness of appliance energy consumption, and acted as a reminder to perform chosen behaviours.

> *(it) made me think about turning the lights off, reminded me to turn them off*
>
> *makes you realise that just a few appliances can make a big differences – for example cooking dinner – amazing how much it spikes using just a few appliances*

The night lights, shower timers and posters were considered effective to some degree in influencing the students' attitudes and behaviour. The students appreciated the weekly update report on their energy consumption because they could compare their energy usage over time.

> *I liked the idea of weekly reports, but it would be good if they gave a comparison with previous usage.*

Summary of Findings in Phase 2a

Phase 2a of the project was implemented between April and June 2008 (data collection period of 8 weeks). The two interventions in this phase were the "combined strategies" intervention group which had both the social marketing strategies and an ecoMeter installed in their residences, and the "social marketing" intervention group which had only the social marketing strategy tools in their residences. The "control" group of fourteen residences had no interventions.

The average weekly electricity use per residence by group during Phase 2a is presented in Figure 1.

Figure 1 shows the social marketing and "combined" groups consistently used less electricity than the control group. Table 2 illustrates that in Phase 2a the "combined strategies" residences used 26% less electricity than the control and the social marketing group used 28% less, indicating that social marketing had a slightly stronger effect than the combination of social marketing and real time feedback. Using Kruskal Wallis test to assess the mean ranks of the groups' energy use the social marketing group was found to be significantly lower than the control, chi-square = 10.599, df = 1, $p < .001$,

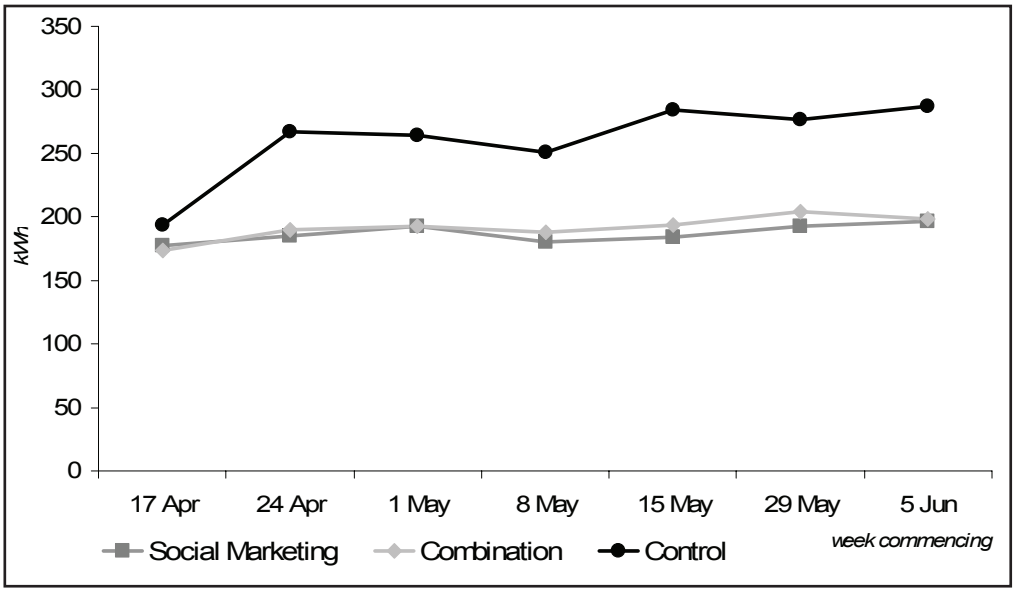

FIGURE 1: Average weekly electricity use, Phase 2a

and the combination group was also significantly lower than the control, chi square = 8.647, df = 1, p <.003.

Summary of Findings of Phase 2b

Phase 2b of the project was implemented between July and November 2008 (data collection period of 11 weeks). The average weekly electricity use per residence by group during Phase 2b is presented in Figure 2. Phase 2b used the same interventions as Phase 2a with some modification to the weekly update report on energy consumption for the social marketing group.

TABLE 2: Summary of reductions over the study period

	Control (av weekly kWh)	Social marketing % reduced (% of control average)	Eco-Meter (only) % reduced (% of control average)
Phase 1	230 kWh	17% (83%)	24% (76%)
Phase 2a	260 kWh	28% (72%)	26% (74%)
Phase 2b	281 kWh	24% (76%)	22% (78%)

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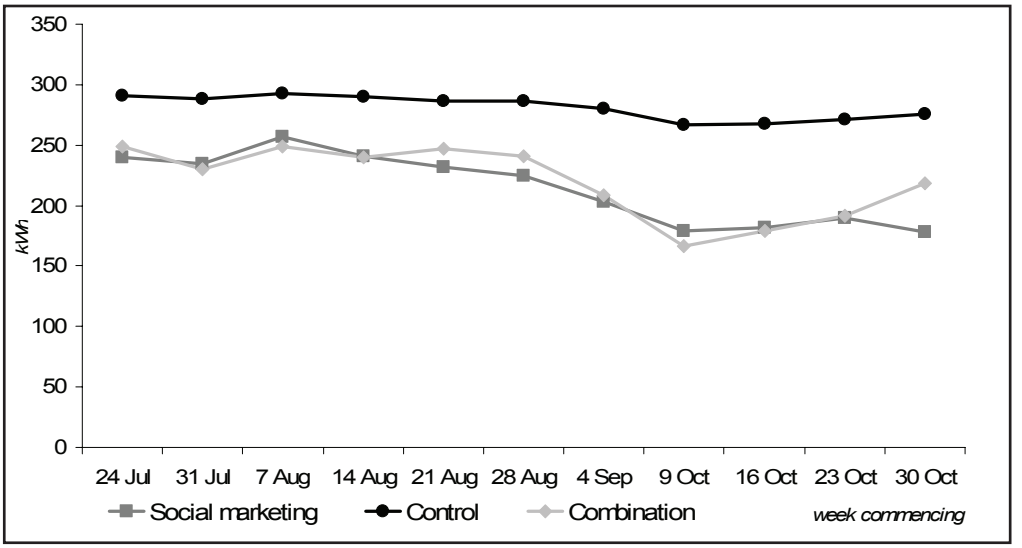

FIGURE 2: Average weekly electricity use per residence, Phase 2b

Figure 2 indicates the residences receiving the interventions had consistently lower electricity consumption averages than the control group, with social marketing using 24% less electricity and the combined group using 22% less. In this phase social marketing again had a stronger impact than the combined approach. A Kruskal Wallis analysis found that both intervention groups' electricity use was significantly different from the control group during this phase, with (coincidently) the same chi-square = 15.783, df = 1, $p < .000$.

Comparing the electricity consumption across the phases indicates an overall reduction in electricity consumption was achieved by each of the intervention groups. However, it is not clear as to whether one of the intervention types produced a greater impact than the other and the data suggests that combining the two strategies does not produce a stronger result. These results are in line with other research which indicates that both the use of social marketing (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009) and the use of real-time feedback (Abrahamse et al., 2005; Van Houwelingen & Van Raaij, 1989) will lead to reduced energy consumption with mixed results from 2% reduction up to 21%. However, our results from the combined strategies seems to be at odds to the conclusion that combined strategies improve the outcome up and achieve up to 30% reduction (Shipworth, 2000; Darby 2006).

Reductions in Greenhouse Gas Emissions

In terms of climate change the more important result is achieving reduced greenhouse gas emissions as a consequence of lower electricity consumption. The residences in this study utilised both electricity and gas but because the gas data suffered from a technical hitch and was not recorded successfully we have reported here on the electricity results only, and calculated greenhouse gas reduction based only on electricity consumption. The ultimate impact of this trial would have been greater than reported here if we included gas consumption and all weeks of student occupation in the calculation. Using the 2010 conversion factor for NSW electricity of EF= 0.90 and the formula CO_2-e tonnes = kWh x EF/1000 (Department of Climate Change and Energy Efficiency, 2010)

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we calculated that over the life of the test period (7 weeks for Phase 1, 8 weeks for Phase 2a and 11 weeks for Phase 2b) a total of 36.5 tonnes CO_2-e were saved, or 7 kg CO_2-e per person per week. Depending then on the source of fuel in each household these results (up to 28% reduced greenhouse gas production) suggest that there is considerable potential to facilitate reduced greenhouse gas production in Australian households. Across the range of previous studies the results have varied from 2% to 30% reduction in energy use and potential emissions (Abrahamse et al., 2005). Dietz et al.'s (2009) study indicated that across a broader range of emission reduction behaviour changes (such as lower use of mechanised transport) there was a potential to save 20% household emissions in the next 10 years, which highlights the strong result here of up to 28%.

Reported Attitude and Behaviour Change Among Students

The study sought to gain feedback from the participating students on the significance and usefulness of the interventions and tools. Following the implementation of Phases 2a and 2b of the project, on-line surveys were used to ask open and closed questions and a number of agree/disagree type statements. For example, "did the tools help you reduce or be more efficient in your energy consumption?", and "did the tools help you learn more about how to reduce energy use?" Likert response options ranged from "not at all" to "always", and "strongly agree" to "strongly disagree".

Figure 3 presents the results of the on-line survey at the end of Phase 2b. Responses that were "strongly agree" and "mildly agree", and "always/often" were aggregated to produce a measure of positive responses and are presented in Figure 3. The results indicate the night lights and posters were considered the most effective tools in helping students to be more energy efficient. All the tools rated highly in helping students to think that it is important and easy to reduce energy. The night lights, shower timers, posters and ecoMeters helped students learn how to reduce energy; and the poster was

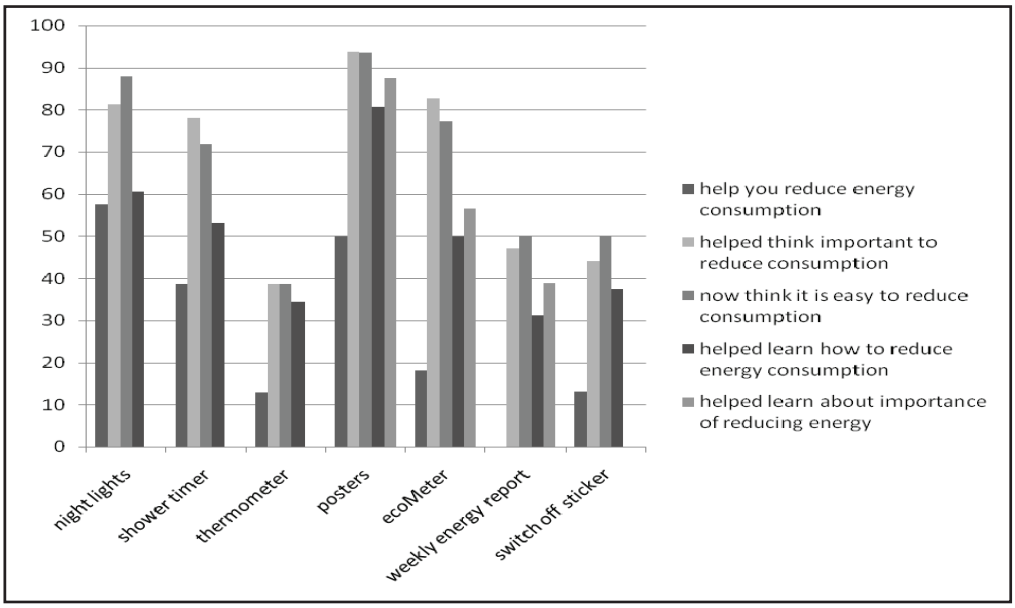

FIGURE 3: Results of the on-line survey with participating students at the end of Phase 2b

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regarded as the most effective tool with respect to learning about the importance of reducing energy. The effectiveness of the posters reflects three key factors; the planning and design process (Fazio & Gilbert, 1986; Ham, 1992; Jacobson, 1999), emphasis on the key message of reducing energy use and personal actions and the location of the poster on the back of the toilet doors. Students commented: "I think the shower timer was the best idea because it lets me know how long I've been in the shower for and not only helps me save water and energy but helps me get ready in time!" and "The night lights were great. I liked them so much I have bought some for my family and we use them at home now!"

Focus groups undertaken at the end of Phase 1 and 2b supported the survey findings that some students felt they had changed behaviour and attitudes towards energy use and consumption. The nightlights, shower timer and posters were considered the most useful in helping to reduce energy consumption followed by the ecoMeter. The night lights encouraged students to turn off lights at night and the posters were read and reported as being the most influential.

> *I found the little reminders very useful in making me aware of the issue of energy consumption. It is not something you generally concern yourself with. Being able to read posters, and see action being taken to solve the issue, increased my awareness and motivation about actively taking a role in the reduction of energy use in my house.*

The weekly energy updates rated poorly and probably reflected the difficulty we had in getting the right format for these reports and a reliable delivery system to the residences. The poster was mentioned as the most effective learning tool regarding the importance and reasons for reducing energy consumption, and learning how to reduce energy consumption.

> *Posters in the toilet (were) very effective ... (I) found myself reading them each time.*

There were several comments about changing the information content on the posters.

> *Change the posters so there are different "tips".*

The student feedback on the ecoMeter indicated they promoted a greater awareness of appliance energy consumption, and a reminder to perform the selected behaviours (commonly switching off unused appliances or lights). Students indicated the ecoMeters "only sometimes" helped to reduce energy consumption but had a greater impact on helping the students understand the importance of reducing energy, and the ease of reducing energy. These results suggest that the ecoMeters do contribute to a greater awareness of energy usage and facilitate reduced energy consumption.

Discussion

In the absence of previous Australia specific household energy studies which focus on intrinsic motivating systems, this study sought to compare the impact of feedback with a more traditional behaviourist approach of social marketing on energy consumption. The trial was also an opportunity to develop a strategy that could be applied across the institution to help meet its environmental targets. The results demonstrated that each of the interventions trialled in this study reduced electricity use and thus greenhouse gas emissions among the resident university students. Across the phases the rate of reduced electricity consumption ranged from 17% to 28% less than the control group. Interestingly, the combined approach (social marketing and ecoMeter) did not result

in a greater reduction in electricity consumption. While the ecoMeters performed well in Phase 1 we are not confident in saying that one intervention strategy worked better than another, or that the combined approach resulted in a greater impact; rather the study indicates that they all had some level of impact.

We premise the following with recognition that the ecoMeter-alone results from Phase 1 need to be repeated and verified, but given the similarity with results in Phases 2a and 2b we feel Phase 1 warrants discussion. The Phase 1 data supports the work of Abrahamse et al. (2005) and Van Houwelingen and Van Raaij (1989) that feedback alone can facilitate reduced energy consumption. In our study the reduction in energy consumption using the ecoMeters exceeded Darby's (2006) findings of 10-20% reductions. We need to acknowledge that the possible high result in this study might be partly because the study group were relatively high users compared to the average Australian household, and small changes resulted in larger benefits. The ecoMeters worked by making the "invisible" energy consumption "visible" and therefore more amenable to immediate control, allowing the user to experiment with their energy consumption to find the approach that has a real impact and suits their lifestyle. When there was a very high energy demand the display lights turned red providing feedback to the students that their consumption was "high". This was the stimulus for some students to look for appliances to turn off. For others it was simply a reminder that energy consumption was a concern. As Darby (2008) notes the use of energy displays has the potential to foster "energy literacy" and we would argue produce more informed energy consumers. The ecoMeter provided the user with information to determine their course of action based on the now known energy outcome. EcoMeters or other direct feedback tools such as the internet offer important opportunities for increased consumer knowledge of energy use, and influencing household energy behaviour. The exploration of the impact of real-time meters warrants further attention.

We suggest that one reason the social marketing tools used in this study were effective was because they provided tangible "technical" support for targeted behaviours. They did what they were intended to do: remove a barrier or constraint to a particular behaviour. They were also a novelty which provoked interest in the issue and project and, as with the ecoMeters, were reminders of the energy reduction goal. In addition the social marketing tools, and ecoMeters, were installed free of charge by the project, and were perceived by the students to reflect a concern and effort from the university to be more sustainable. It has been reported elsewhere (Shipworth, 2000) that organisations that behave in a contradictory manner to their environmental goal will undermine members' motivation, and so it is possible that the tangible tools in this project had the opposite effect, providing additional motivation by helping to build an "organisational culture" of energy reduction.

Both tools then served as reminders of the goal to reduce energy, possibly helping to build a culture of concern about energy reduction. Whilst the qualitative data didn't highlight this point we also feel that the presence of an enthusiastic research assistant, or energy champion, contributed to the development of a culture of concern. Proportionally less energy is used across each consecutive phase suggesting that a change in culture is occurring as a consequence of the interventions. The building of a new culture and the significance of the research assistant didn't emerge clearly in our qualitative data and yet we have a strong sense this was important to the outcome. The significance of social norms to the project is worth exploring in future work.

As demonstrated in the social marketing feedback (Figure 3) these tools also had a learning outcome. The information rich posters rated highly, but the night lights, ecoMeters and shower timers were also considered useful in helping people to learn

how to reduce energy consumption, presumably as a result of their direct experience with the action and its consequence.

An important finding of this study is that reduced energy consumption does not require the use of extrinsic motivators. Prompting intrinsic motivations is potentially a lower cost approach and can potentially lead to longer term change (Kohn 1993). Extrinsic motivators should be used with caution as previous studies have shown that providing extrinsic motives can erode existing intrinsic motives (De Young, 1993; Dwyer, Leeming, Cobern, Porter, & Jackson, 1993; Kohn, 1993). Petersen et al.'s (2007) study of the impact of feedback and competition on student residents found an average 32% (but up to 55%) reduction in electricity consumption. So whilst extrinsic factors can influence behaviour and perhaps produce a larger scale impact we have shown that they are not an essential element for changed behaviour. The critical question for future research is whether the intrinsic strategies have a longer term impact than strategies based on or incorporating extrinsic motivators.

Not only did the study successfully impact on intrinsic motivations but it did so in the context of young adult motivation and behaviour. Uzzell (2008) and other Australian studies (DEC, 2007; DECCW, 2010) have found that young people can be resistant to pro-environmental behaviours but this study of Australian university undergraduates provides hope that one of the least environmentally active groups in society can be prompted to change their approach to energy use.

We approached this research with the aim of exploring the potential to influence the intrinsic motivations related to energy consumption behaviours with a clear ideological goal of finding ways to help change everyday energy practices. The strategies employed, which were devoid of any extrinsic motivators, were successful in that students did reduce their energy consumption. A further critical question is whether or not the new approaches to energy use endure with the students when they leave the campus residences, or even whether those students that were disinterested whilst on campus reduce their energy when they have to directly pay the bill. Our belief is that because climate change requires action from not just individuals but also action from industries, politicians, and communities, energy literate and concerned community members is a necessary precursor for political change.

Keywords: energy conservation; behaviour change; university students; social marketing; energy feedback; ecoMeter; energy literacy.

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