

Changing energy consumption behaviour in academic departments: A longitudinal intervention study

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Headline Findings

1. Overall, the project had an effect. The saving for participating schools was 7% over comparable non-participating schools.
2. The most important factor in terms of promoting saving seems to be having comparative information about how other schools are doing. The school given this information saved 12% over the average of non-participating schools.
3. The key factor leading individuals to take energy saving seriously was the belief that the School and University took the issue seriously.
4. Identification with the University (i.e. seeing the centre as part of 'us' rather than 'them') was also of critical importance. Only when people identified with the University did they see the University as taking energy saving seriously and take energy saving within the University seriously themselves.
5. Overall, the findings suggest that there is serious scope for introducing a university wide scheme, though perhaps comparing St. Andrews savings to those of other Universities. However it would be critical to introduce the scheme in a way that is inclusive and creates the sense of a University community working together rather than a centre imposing procedures on Schools.

1. Introduction

The *Saving Energy at the Workplace Initiative* was funded and supported by the University of St. Andrews and the Carbon Trust. It was, however, run by an independent team of researchers based in the School of Psychology and the Bute Medical School. This social psychological longitudinal study involved an intervention that lasted for 12 weeks from March 11, 2008 to June 11, 2008.

Aim. The aim of the project was to encourage energy saving behaviours at the workplace within the University of St. Andrews. Specifically, the goal was, for each participating school to save within a 12-week period as much energy as possible; at least a 10% to 15% reduction in electricity consumption compared to the consumption in the month immediately before the project commenced and a reduction of 5% in heating consumption.

Design. This was a longitudinal intervention study that involved giving different information to four schools within the University. All schools received the basic programme, which included energy saving tips, targets to be achieved and feedback on their own performance. In addition to the basic programme, School 2 was offered a monetary reward; School 3 was given feedback on its own performance in comparison with performance of other schools in the University (simulated rather than actual); and School 4 was given the same comparative feedback and was also offered a reward (see below).

School 1	Basic program
School 2	Basic program + monetary reward
School 3	Basic program + comparative feedback
School 4	Basic program + monetary reward + comparative feedback

Methods. A questionnaire measuring energy related attitudes/behaviours and sense of identification with the School and University was administered to all members of the schools before and after the intervention. Feedback on energy consumption performance was given to participating schools every fortnight for 12 weeks. A sample of participants from each school was interviewed toward the end of the intervention.

2. Was energy saved?

Main findings

Overall savings of 4 participating schools. Over the 12-week project period, the four participating schools combined showed a saving of approximately 4% in electricity consumption compared to the theoretically predicted consumption if the intervention had not been conducted. The theoretical consumption was the expected consumption taking into account the weekly weather during the intervention period and energy consumption performance of the four schools in the preceding year. The combined theoretical electricity consumption for the four participating schools for the project period was 61,052 kWh, and the actual consumption during the project period was 58,504kWh. As gas consumption is mainly under central Estates control and is largely dependent on weather and building features, we decided to emphasize the findings for electricity consumption, which is much more under the control of individuals within schools. Energy saving measures suggested during the study would have little effect on heating consumption.

Energy use of non-participating schools. It is insufficient to look purely at the performance of the participating schools. Rather, their performance must be seen in the context of the 'typical' energy performance of similar schools outside of the project over the same time period. In order to do this, nine non-participating schools were selected, based on comparability of building features, as a baseline group for comparison with participating schools performance. This resulted in a benchmark of what the participating schools were likely to have used if they had not been part of the project. Over the project period these non-participating schools showed an increase of approximately 3% in electricity consumption compared to their theoretically predicted consumption. Their actual consumption during the project period was 262,768 kWh and the theoretical consumption was 254,202 kWh.

Savings compared between participating and non-participating schools. Over the project period, the four participating schools combined saved 7.3% more electricity than the baseline group, compared with the theoretically predicted consumption. This suggests that undertaking this type of intervention has achieved a modest, but significant, decrease in electricity used.

Savings compared within the participating schools. Within the four participating schools, the school receiving comparative feedback on how others were doing (School 3), made the greatest savings in electricity consumption compared with their theoretically predicted consumption (9% total saving over the six periods, 25% saving in the peak period in which the greatest savings occurred and 10% saving in the final period). Offering a reward (School 2) had a minimal effect on electricity consumption (0% over the six periods, 11% in the peak period and 3% in the final period). When comparative feedback and reward were combined (School 4), the saving was intermediate (4% over the six periods).

Evidence

A baseline measure of energy consumption for each school was taken in February, 2008 before the intervention began. During the 12-week project period, energy consumption for electricity and heating were obtained every two weeks for the four schools. The energy officer from the University Estates adjusted the data for weather; that is, if it were colder or more overcast then consumption would be expected to rise. These weather-adjusted data were then made into graphs to show energy saving performance for each school compared to the baseline consumption and in relation to target goals. For schools receiving comparative feedback (School 3 and School 4), the graphs also included simulated energy consumption performance of other schools in the University. Graphs over the six 2-week periods were cumulative, in that data for preceding periods were retained in the graphs for later periods. Energy consumption performance compared to the expected theoretical consumption was not shown on the graphs when they were sent to the schools.

Feedback on consumption (the graphs and a short text explaining the graphs) was sent fortnightly to the heads of schools and circulated by email to all members of the four schools.

Feedback on structural and other factors linked to energy consumption within each school was collected and incorporated. For example, information was collected on special events that occurred in the school during the intervention period that may have impacted on energy consumption. At the end of the intervention, the consumption data were adjusted, taking account of some uncontrollable internal and external factors.

Table 1 summarizes the differences between the theoretical energy consumption and the actual consumption in electricity over the project period for the four participating schools and nine non-participating baseline schools.

Table 1 Theoretical and actual electricity consumption for participating and non-participating schools (six periods combined)

	School 1 (basic)	School 2 (reward)	School 3 (comparative)	School 4 (comp. + reward)	4 schools combined	9 non- participating schools combined
Theoretical consumption	12,357	17,753	12,571	18,501	61,052	254,202
Actual consumption	11,611	17,760	11,377	17,755	58,504	262,768
Saving	6%	0%	9%	4%	4%	3% (increase)

We can see from Table 1 that, by participating in the project, the four schools combined saved 4% in electricity consumption; while the nine non-participating baseline schools used 3% excess electricity consumption compared to the theoretical consumption. None of the four participating schools used more energy than was expected according to weather change, building factors and their energy consumption last year. Within the four schools, the school receiving comparative feedback only (School 3) saved most electricity.

Table 2 shows the savings made by the four participating schools in (a) the total electricity consumption over the six periods, (b) the peak saving period (Period 3) and (c) the last period (Period 6).

Table 2 Electricity saving for four participating schools at various periods

School	Total saving for all periods	Peak saving period (P3)	Final period (P6)
1 (basic)	-6%	-9%	-2%
2 (reward)	0%	-11%	-3%
3 (comparative)	-9%	-25%	-10%
4 (reward + comparative)	-4%	-10%	2%
All 4 schools combined	-4%	-13%	-3%

The patterns for total savings, peak period savings and final period savings were similar. In each case, the school in comparative feedback condition was highest on electricity saving and the reward seemed to have had a very minimal effect on electricity saving.

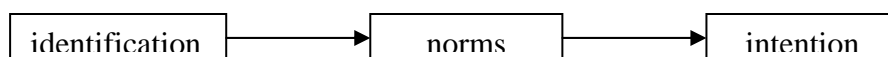
3. Why was energy saved?

Differences between the four schools

- Questionnaire data from members of the school in the basic programme were less favourable toward energy saving in general and less engaged with energy saving activities than the schools in comparative feedback and reward conditions.
- The energy consumption data suggested that the schools in the comparative feedback conditions made higher savings in electricity than the schools in the reward and basic conditions. There is research evidence (e.g., Siero et al. 1989) that providing comparative feedback is an effective tool to motivate employees to reduce their energy-wasting behaviour. Empirical research (e.g. Siero et al. 1996) shows that receiving information about performance of others can lead to consequences for group dynamics. First, comparative feedback emphasises the existence of the school as an 'in-group'. The 'in-group' will be made more salient by making school members conscious of another group (an out-group), with which they compare their group. Second, knowing how others in the out-group are performing could lead to feelings of competition and increased motivation to perform better. The importance of competitive feelings was supported from the interview data from this project (see below).
- A possible reason why the reward condition did not yield great savings in electricity is that a monetary reward of £500 might not have been meaningful enough to schools. It is possible that a greater effect would have been achieved if the reward had been made more tangible. For example, it could have been translated into something positive to be experienced by all members of the school, such as sponsorship of a group event. Another possibility is that the reward might be more linked with extrinsic motivation than intrinsic motivation, the latter being more likely to trigger and sustain positive behavioural changes.

Factors contributing to the saving

- Models of socio-psychological processes underlying energy related changes were explored using pre-intervention questionnaire data. It seems that a high identification with university/school and perception of university/school norms favourable to energy saving increases propensity to engage in energy saving behaviours. The socio-psychological process is summarized as follows:



The model suggests some processes that appeared to underlie the occurrence of energy-saving behaviours during the project period. We found that identification with the University had an effect on intentions to save energy and that this effect came about through the way that identification with the University led to a stronger belief that the University supported energy saving which in turn affected intentions.

- In addition, consideration of the post-intervention questionnaire data suggested that the intervention had some positive effects on the processes (e.g., identification and norms)

underlying energy consumption behaviours. Overall, following the intervention, participants became more likely to agree that the University and their schools take energy saving seriously. Knowing that their schools were doing something about energy consumption increased participants' sense of control over their own energy consumption. Another positive effect of the intervention was that identification with the University and the participants' schools seems to have had an increasingly direct effect on their intention to engage in energy saving activities.

4. What did people say?

Interview data provided rich information about how people think about energy saving in general and aspects of the intervention in particular.

- **Awareness and engagement improved during intervention.** In the interviews participants reported increased awareness of energy conservation issues and reported being more likely to engage in energy saving behaviours. Here are some typical comments from one interview:

(Q: Can you give me one or two examples of some positive impact that this project has had on you?)

Well, I think it's focused on the things that we can control as individuals and I would say that this would be monitors and obviously lighting and I think radiators by our own work stations which can be controlled with thermostats. I think we're much more conscious about now. Am I warm? So think, turn the radiator down. And I think the way I travel to work, out of the University's fuel consumption again, I would think a lot more about whether I take my car or my bicycle and unless I'm thinking I have a lot of shopping or something to take home, the bicycle usually wins at the moment.

(Q: Do you feel your views and attitude have been influenced as well?)

Yes, my attitudes have been influenced and I think it's encouraged me to think more widely and to understand the various projects that if they're not happening at least they're being considered in the University to find alternative ways of getting energy, renewable energy and all these things.

(Q: Did you notice any of your colleagues changing their views and behaviours in any way after this project started?)

I don't know. I suppose as individuals I mean some might talk with it more than others but as I said these issues come up now in conversations whereas before, you know they probably wouldn't have so I do think it has certainly stimulated people's minds and certainly I think improved their level of awareness, you know and whether this has also been improved too because in a domestic setting at home people have obviously become very annoyed with fuel prices and so if you understand at home what the impact is on your economy then you can easily translate this into the institution so I think people realise that, you know if you want the University to make the best use of its budget, you know that you can help by helping the University reduce its fuel budget. You know, we're all intelligent people so although they, I don't think they necessarily express this but I think the understanding is there.

(a member of academic staff from the comparative feedback condition)

- **University/school identification helped engagement in saving activities.** Interview data suggested that a high identification with the University and participant's schools helped them to engage in activities that the University/school are in favour of. Here is one typical quotation:

(Q: Do you have a sense of your individual effort being part of a collective effort of your school?)

Definitely, yes. And I switch off the lights, you know when I go out. I hope that everybody else when they're leaving a room are doing the same as well and I do feel that because I think of it collectively as a whole and I think well if I'm just doing this one tiny bit but if everybody in the school is doing that one tiny bit and then everybody in the University, all the buildings are doing that it will make a huge difference, yes.

(a postgraduate student from the comparative feedback condition)

Another example from one member of academic staff:

(Q: we have just talked about individual effort. Do you feel that your individual effort is part of the collective effort of your school?)

Oh, definitely. I was quite surprised at the change in energy use through particularly the first and second graphs that came because I really didn't expect there to be very much difference and there really was.

(an academic staff from the reward condition)

- **Lack of trust in University activities hindered engagement.** Interview data also suggested that when people lacked an understanding of the University's energy policy, they were less motivated to engage in energy saving activities.

(Q: what do you think of the University's position in terms of saving energy?)

I'm sure the University would like to save energy because point one it would save them money and point two it would look good. I know enough about organisations to know that a lot of publications that they put out are for brownie points. It doesn't necessarily mean they're really committed to it. I would see that what it needs is to be matched by action from part of the University in dealing with those things which are not within the control of individuals. I think that would actually be the test of it because otherwise it will look as though the only way that the University is actually trying to deal with energy is to try and change the behaviour of its staff without dealing with the infrastructure. I think it ought to lead on to the University examining what it does as well in conjunction with that so that people who are more motivated feel that they're partners in this rather than the people who have been got at.

(a member of support staff from the reward condition)

- **Comparative feedback encouraged participants to strive for better performance.** Interview data showed that the two schools given comparative feedback were generally most interested in doing better than other schools, as one of the participants in the comparative feedback condition said:

(Q: do you have a sense of your school being seriously involved in this project?)

Yes, yes absolutely and we're slightly competitive too. We want to do better. I think we genuinely, we are thinking of ways we can do better and certainly in the common

room area now I mean I know if I go in and there's no one around and, you know I'll switch lights off, you know. Before I might not have bothered.....
(a member of support staff from the comparative feedback condition)

5. Limitations and future directions

This was a 10-month project, which limited the number of schools participating (4) and the length of the intervention (12 weeks). In the future, if more resources could be made available, it would be possible to select additional schools in each condition. We could also have a longer total period for intervention preferably to cover different seasons so that feedback on energy consumption performance could be provided more frequently. This would permit more powerful statistical tests and findings could be more confidently generalized.

Again, time constraints did not allow us to conduct direct observations of energy consumption behaviours in this project. In the future, if resources permit, we could have observations of target locations randomly and/or for selected periods.

The reliabilities of seven of the attitudinal constructs of interest, such as identification with school and university and school and university norms, were established in this study. In a more extensive study with a greater number of participants, the measurement properties of further constructs could be tested and potentially improved.

The project suggests that comparative feedback did seem to work better than reward in promoting people's energy saving behaviours. In the future, we could, however, explore variations in comparative feedback (e.g., extent of differences; effects of 'leading' versus 'trailing' comparative data) to find out which kind of comparative feedback works best. Similarly, we could also explore variations in rewards to discover how a reward can be made most effective, for example, linking the reward with group activities or school priorities related to research or teaching budgets. How to *maintain* energy saving behaviours is also an area deserving wider investigation in the future.

In future studies, it may be worth considering web-based data-gathering and feedback delivery systems that would be more energy and time efficient than a paper-based system and might also be more effective in getting participants' attention.

From a practical viewpoint, if the University sought to provide energy saving advice to all schools and if data were provided as to how the schools are performing then it is likely that energy savings would be achieved. Energy savings, however, are likely to be affected by several factors (for example, identification with the University and schools) and the performance is difficult to predict with certainty. More information should be provided about the activities, such as refurbishing, that the energy and environment team are undertaking to reduce energy use. This view is based upon some qualitative evidence obtained from this work which demonstrated that there is a low level of awareness of these activities. Knowledge of what the University is doing to achieve energy use reduction may motivate others to seek reductions by changing their behaviour.

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