An Attitudinal and Behavioural Study of Scottish Pupils in Regards to Energy Consumption in Schools

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Abstract

The UK Government have set a target to achieve a 34% reduction in the UKs Carbon Footprint by 2020 (DECC, 2009b). The education sector makes up a significant component of the UK's public sector buildings, so reducing electricity consumption in school buildings will significantly contribute to achieving this target. The behaviour of building users influences electricity consumption and the underlying worldview frames attitudes to energy consumption. Further to this, an understanding of the perceived responsibility for energy establishes a matrix of how energy is used. A study of pupils in the PFI context explored the perceptions of factors influencing electricity consumption. Factors identified in two workshops were the basis of school wide surveys in two PFI schools. One school is new build and has shown a significant reduction in electricity consumption over the previous year; the other a refurbished building which has shown no reduction. Although the pupils represent the largest user group, in both schools the study identified that they had very little influence on electricity consumption. A positive attitude to reducing consumption was countered by a negative attitude to behavioural change to achieve it. Pupils in the new build school were more environmentally negative compared to the refurbished school. This was surprising, considering the new build school had recently significantly reduced its electricity consumption. The reason for this may be that the new build pupils are more aware of environmental issues. The refurbished school may have suffered from "self-generated validity" (Harrison *et al.*, 1996). The results from both the schools were consistently lower than that found in a university setting (Finlinson, 2005), suggesting an opportunity to implement strategies to increase the factors that encourage environmentally positive behaviours. This study is important to the Facilities Management Company for optimising behavioural change in order to reduce electricity consumption across the entire estate of schools.

Keywords: behaviour change, energy, PFI, schools

1. Schools and the UK energy problem

"We face unprecedented challenges to our environment, our economy, and the future security of our energy supplies and the decisions we make now will affect the planet and our way of life for generations to come." Ed Miliband, Department of Energy and Climate Change (DECC, 2009a).

During the last 10 years there has been a surge in public and political interest in the issue and effects of Global Warming. The diminishing supply of fossil fuels, and the link between the rising global temperature of the earth and the increased concentration of CO_2 in the atmosphere, has led governments to act to reduce energy consumption. There has been a significant shift in the public's attitude towards green issues. They have moved from side issues to central political policy; the public have been a driving force behind this change. The front page of the Conservative Party website claims "environmental issues must be at the heart of politics" (Conservative Party Official Website, 2010).

In July 2009 the UK Government released "The UK Low Carbon Transition Plan" which sets out how it plans to cut the amount of CO_2 released by the UK. A target has been set to reduce the Carbon Footprint by 34% of 1990 levels by 2020 (DECC, 2009b). Every Government Department has been given a specific target for adherence to over the coming years in order to reach this objective. Ward (2008) outlined the current energy usage patterns of various sectors of activity within the built environment. This research showed that the Education sector accounts for 10% of the total energy used in the service industry (which is 66% of the total UK energy consumed). As this is approximately 6.6% of the total consumption in the UK, strategies to minimise it could significantly impact the 34% Government target.

Concurrent with reducing energy consumption, the Government has also initiated an ambitious commitment to the building and refurbishing of schools through the 'Building Schools for the Future' (BSF) programme. Unfortunately, over recent years, it has become apparent that new build schools are consuming more electricity than their older counterparts (Bunn, 2008). A significant proportion of new schools have been procured through Private Finance Initiatives (PFIs) and this form of procurement will continue to be an important component of the Government's ability to deliver their BSF programme (DCSF, 2007). The Scottish Government has followed in this trend. They have set a target to build or renovate 300 schools by 2009. Of the 32 Scottish councils, 28 have used PPPs as a funding mechanism for this renewal strategy with an investment of over £2.2 billion (Scottish Executive, 2004).

1.1 Overview of the study

It is recognised that the amount of electricity consumed depends on both the equipment consuming the electricity and how the users are operating it. For the scope of this investigation, only the user aspect of this two sided coin has been considered. This study sets out to explore and further understand the issue of users' attitudes and behaviours and its subsequent impact on energy consumption in schools

Two Councils in Scotland have recently completed the building stage of PFI projects to rejuvenate their school stock. All of the schools in the project are consuming more electricity than is set out in the Government and Construction Professional benchmarks (Carbon Trust, 2008; CIBSE, 2008). The focus of this research is aimed exploring attitudes to how energy is used by building users. A case study approach investigates two schools, one from each Council. One of the schools is a refurbishment of an older school building and the other is a brand new building.

Due to its financial and environmental costs (ECON73, 1995) this study is focused on electricity consumption. The New Building has seen a reduction in its electricity consumption over 2009 (compared to the previous year). The Refurbished Building has seen no change. By investigating specific users' attitudes and behaviour towards energy consumption, this paper identifies the degree to which pupils seem to have an influence on the reduction of energy and considers measures to adopt for reducing the electricity consumption in the schools.

2. Understanding user behaviour

Electricity consumption in schools has increased in recent years (AECOM, 2009). Undoubtedly this is due to the introduction of new types of equipment powered by electricity, e.g. increased levels of use of ICT, security systems and cooling equipment. A large proportion of the energy consumed by this equipment is in the control of the users of the building. Any intervention into reducing the amount of consumption levels must therefore focus on the user's behaviour. As early as 1981, Morell (1981) discussed that it was naive of organisations to think that energy reduction could only be achieved through simply using technological fixes.

Stern (1981) classifies behaviour into four categories, ranging from those who are actively involved in environmental groups to those who make personal day-to-day decisions. Motivations for environmentally positive behaviour include: cultural bias (Steg, 2000); sympathy for others (alturism) (Allen & Ferrand, 1999; Schwartz, 1973 cited in Stern 2000); expression of post modern materialist values (Inglehart, 1990); religion (Dietz, 1998); and general theories of values (Schwartz, 1994). Using research on the behavioural change models, Stern and his colleagues drew up the Value-Belief-Norm (VBN) Theory by drawing together the concepts of Value Theory, Norm-Activation Theory and New Environmental Paradigm (Scherbaum, 2008). Figure 1 shows the interconnectedness of the different aspect of the theory they developed.
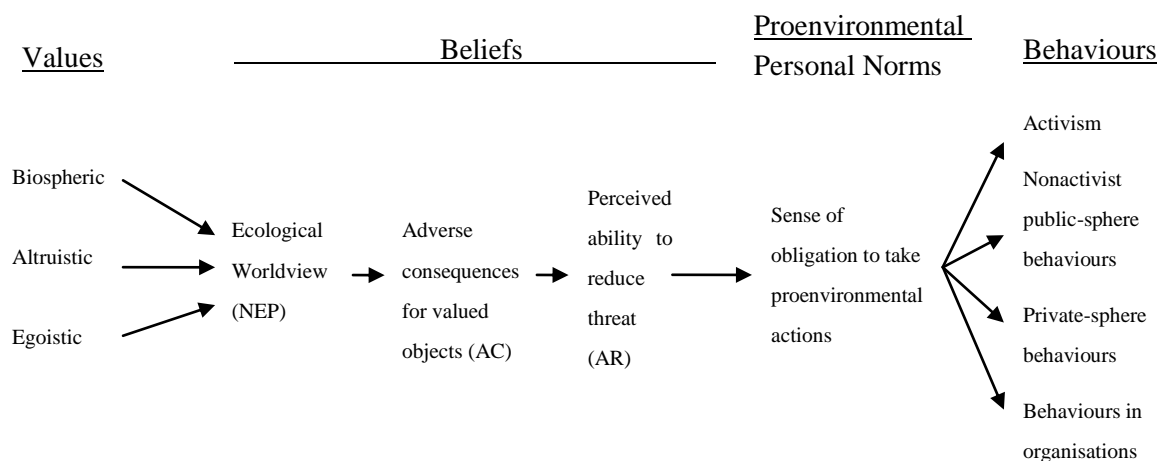
Figure 1   A schematic of the variables in the VBN Theory of environmentalism (from Stern, 2000)

Stern postulated that 'Values' influence 'Beliefs', which in turn influence 'Personal Norms' and therefore 'Behaviour'. This theory has been tested on many occasions over the years (Stern *et al.*, 1999) however all the variables have only been tested once (Steg *et al.*, 2005). Value-Belief-Norm Theory has been proposed as a possible model to assess attitudes towards energy and environmentalism as a mechanism for reducing environmentally negative behaviours, in this instance, overconsumption of electricity. This theory was therefore chosen as a mechanism for assessing the attitude in the two PFI Schools under investigation.

Work undertaken by Scherbaum *et al.* (2008) has shown the relationship of a particular aspect of the VBN Theory. They have shown how individual-level factors have an influence on energy-conservation behaviours, in a university setting. The study methodology used by Sherbaum has been adapted for use in the school setting.
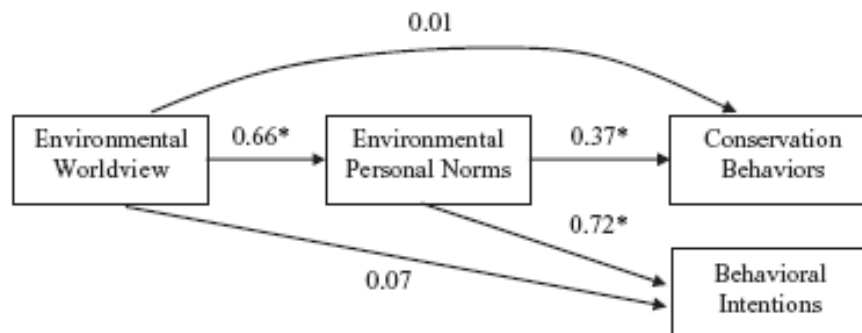

Figure 2. Standardized coefficients from the path analysis ($p < .05$).

Figure 2   Relationships within VBN Theory (Scherbaum et al., 2008, pp830)

Gardner & Stern (1996) reviewed four types of intervention measures aimed directly at behaviours to encourage environmentally positive behaviours. These included:
   1. Religious & moral   change world views and beliefs
   2. Education   change attitudes and provide information
   3. Material Incentives   provide rewards for positive behaviour
   4. Community Management   establish shared rules and expectations

They found that no one measure was successful on its own and that a combination of all the approaches was necessary to promote the behaviour on a medium term capacity. Although material incentives (often through external rewards) are very successful at motivating behaviours that reduce energy consumption in the short term (Siero *et al.*., 1989), research by Hellervik (cited by Scherbaum, 2008) found that factors such as personal norms concerning the environment and environmental worldviews are more likely to maintain this motivation. It was therefore decided to investigate the personal norms, environmental worldview and behavioural intentions of the pupils in the schools to determine if there was any opportunity to achieve long term changes in their behaviour.

3. Environmental behaviour study

3.1 Energy consumption profile analysis

Data for electricity consumption in two schools shows that the new build school has reduced its electricity consumption relative to the same period the previous year. Statistical analysis confirmed that the change was significant and sustained over a period of time. The refurbished school shows no significant change in electricity consumption over the same period. No technical changes have been made within the schools, and it is believed that changed behaviour has contributed to the reduction in electricity consumed.
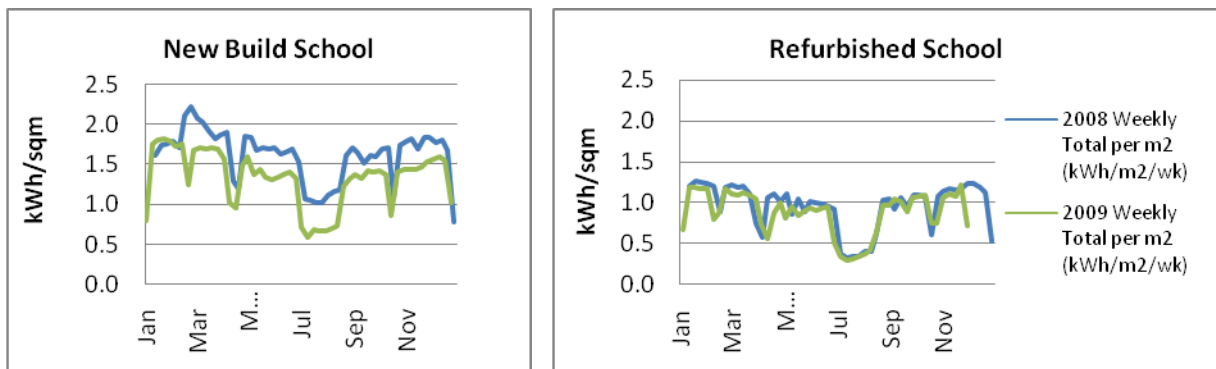

Figure 3   Weekly Electricity Use in New Build and Refurbished School

Analysis confirms that the new build school has seen a significant reduction in electricity consumption. It is therefore important to understand what the causes of this reduction could be and if it could be replicated across other schools.

3.2 Pupil VBN study

As advocated by VBN theory, workshops were utilised to gather information from pupil user groups on electricity consumption. The aim of the workshops was to: identify current knowledge and attitudes related to energy consumption; generate a list of behaviours currently occurring in the schools; generate a list of reasons for engaging in the behaviours; and generate a list of factors considered to be barriers to engaging in behaviours.

The workshops were undertaken in the classroom setting. The pupils were given a brief presentation to introduce them to the subject and to encourage them to begin thinking about energy conserving behaviours and how it affects them. The issues emerging from the workshops formed the basis of the surveys undertaken in the two schools. A scalar 'scoring' mechanism was chosen for the survey. The format was adapted to reflect the age groups carrying out the survey. Two schools were surveyed to determine if any differences existed in the attitudes of the pupil groups. Two-hundred surveys were distributed in both schools and the percentage of usable responses was 35% for the refurbished and 51% for the new build. A random sample was taken to directly reflect the view of the entire population.

Table 1   Survey Sample – Year of pupils

School	School Year (proportion)					
	1	2	3	4	5	6
A(refurbished)	0	10	30	19	6	5
B(new build)	12	12	25	17	37	0

3.2.1 Analysis of surveys

The survey was in four parts according to VBN Theory ; Self reported energy-conservation behaviours (ECB), Behavioural Intentions (BI), Environmental worldviews (EWV), and Environmental Personal Norms (EPN). A 6-point scale was used for this section, a score of 0 related to the pupils 'never' engaging in the behaviour, 5 related to the pupils 'always' engaging in the behaviour. A low mean score therefore means the pupils rarely engage in the behaviour.

Self-reported Energy Conservation Behaviours – ECB describes what the pupils do in practice. The users in the New Build scored a lower average score for these categories (2.10). This suggests that they are not likely to engage in energy conserving behaviours. The Refurbished School also had a low score (2.55).

Table 2   VBN - Energy Conservation Behaviours Results

	Question	Mean (x)		Standard Deviation (σ)	
	What I normally do: (ECB)	*NB*	*R*	*NB*	*R*
3	At the end of a lesson where I have used a computer, I turn it off	3.13	3.56	1.40	1.29
4	When I am not using my computer during a lesson, I turn off the monitor	2.51	2.12	1.56	1.64
5	When I am not using an electric devise, I turn it off at the plug	2.00	2.74	1.68	1.50
6	If there is a bright sky, I ask the teacher to open up the blinds	1.12	1.74	1.55	1.53
7	When I leave a room that is unoccupied, I turn off the lights	1.76	2.61	1.87	1.82
	AVERAGE	**2.10**	**2.55**	**1.61**	**1.56**

It is surprising that the low scores in the New Build School had considering the reduction in energy consumption that has been shown above (figure 3). If changed behaviour of the pupils has contributed to reducing energy consumption, a higher score would have been expected in this category. One explanation for this result could be that the pupils in the New Build School may be more aware of their attitudes and behaviours towards energy consumption through the work of the active Eco-group in the school. As such, they may have been more accurate in the reporting of their behaviours. The Refurbished School, which does not engage their pupils as actively with environmental issues, had a slightly higher score across all categories. The pupils attending this school are demonstrating more environmentally positive behaviours. However this is not materialising in a reduction in electricity consumption which suggests that the behaviour of the pupils is not in direct relationship with consumption, or that the reporting of environmental behaviour is not accurate. As lower scores mean the behaviours are not frequently occurring, there are opportunities in both schools to implement

intervention strategies to increase in the scores and thereby reduce the amount of electricity being wasted.

Behavioural Intentions – BI measures the degree to which the individuals' intend to engage in energy conserving behaviours. The results have been included below:

Table 3   VBN – Behavioural Intentions Results

	Question	Mean (x)		Standard Deviation (σ)	
	What I would aim to do: (BI)	*NB*	*R*	*NB*	*R*
8	I would like to help XX School conserve energy	3.29	3.37	0.93	1.02
9	I would change my daily routine to conserve energy	2.84	2.89	1.02	1.00
	AVERAGE	**3.07**	**3.13**	**0.98**	**1.01**

Again the New Build School scored lower than the Refurbished school, although marginally (NB – 3.07 & R – 3.13). It may be that due to the immaturity of school pupils they may not believe it is their responsibility to carry out energy conserving behaviours. The scores for respondents in both schools are quite positive when asked if they would like to help conserve energy, although when asked if they were willing to change their daily routine to achieve this, the scores reduced to the negative side in both schools. The low score is concerning, although it explains why energy conserving behaviours are not more prevalent (as identified in Part 1). VBN Theory shows that if the behavioural intention is low then the frequency of the positive behaviour will also be low. These results show that pupils are more willing to engage in behaviours that will not be inconvenient to them. If they have to make extra effort to achieve the same result individuals are less likely to choose the more difficult approach. This is consistent with the work carried out by Stern (2000) which discussed the effects of 'limiting conditions' which cause barriers to performing environmentally positive behaviours. The more numerous and the more significant the limiting conditions, the less likely it is an individual will engage in the behaviour. This was seen in the lowest scoring question in part 1 – asking the teacher to turn open the blinds. As there are more limiting conditions to this behaviour, it results in a low score. The challenge will be to identify these conditions and mitigate them.

Environmental Worldview – EWV measures the degree to which individuals believe energy conservation is necessary. Having established that the ECB are at present not likely to occur and that the pupils' intentions are not inclined to engage in the behaviours in the future, it is important to analyse their response to the global energy situation to understand what influence this is having on their behaviours. These results are more promising from an energy conservation point of view. A more environmentally positive response to these questions will result in a higher score.

Table 4   VBN – Environmental Worldview Results

	Question	Mean (x)		Standard Deviation (σ)	
	What I think about the world: (EWV)	*NB*	*R*	*NB*	*R*
10	The UK/US is in the middle of an energy crisis	3.12	3.09	1.05	0.89
12	Energy conservation is something to be concerned about	3.46	3.59	1.07	1.01
	AVERAGE	**3.29**	**3.34**	**1.06**	**0.95**

The Schools scored similarly for both of these questions. Although the pupils give a positive response, it is not overwhelmingly in favour of the statements. The Standard Deviations are not as large for these questions; which suggests the spread of results is smaller, giving more consistency to the answers between the respondents. As the opinions are relatively low, there are again opportunities to increase these scores through intervention measures.

Table 5   VBN – Environmental Worldview Results

	Question	Mean (x)		Standard Deviation (σ)	
	What I think about the world: (EWV)	*NB*	*R*	*NB*	*R*
11	News reports about an energy crisis are blown out of proportion	3.10	2.99	0.96	0.85
13	It is my right to use as much energy as I want	2.74	2.91	1.13	1.11
	AVERAGE	**2.92**	**2.95**	**1.05**	**0.98**

Compared to questions 10 & 12, the scores for these questions are lower, showing that the respondents EWVs are consistent. There is not a significant difference between the responses given by the pupils. They seem to be unsure as to whether or not the energy crisis is blown out of proportion (scoring NB – 2.92 & R – 2.95); this is not surprising considering the mixed reports in the media (BBC, 2004). They tend towards disagreeing with the statement that it is their right to use as much energy as they want. As these scores are consistent, it will be important to build on them to influence the pupils' EPNs.

Environmental Personal Norms – EPN measures the degree to which the individuals' feel a responsibility to engage in energy conserving behaviours. According to VBN Theory the EPN are one of the most important factors. They are influenced by the EWVs and in turn influence both the ECBs and the BIs. The scores for questions relating to EPN should be consistent with those for EWV, ECB and BI.

Table 6   VBN - Environmental Personal Norms Results (Part A)

	Question	Mean (x)		Standard Deviation (σ)	
	What I think about energy: (EPN)	*NB*	*R*	*NB*	*R*
14	Conserving energy and natural resources is important to me	3.06	3.23	0.94	1.01
16	I have a responsibility to conserve energy and resources	3.19	3.41	0.99	1.03
17	XX School should conserve energy	3.94	3.81	0.92	0.92
18	I should help XX School conserve energy	3.14	3.27	1.05	1.02
	AVERAGE	**3.33**	**3.43**	**0.98**	**1.00**

Table 7   VBN - Environmental Personal Norms Results (Part B)

	Question	Mean (x)		Standard Deviation (σ)	
	What I think about energy: (EPN)	*NB*	*R*	*NB*	*R*
15	Conserving energy is not my problem	2.51	2.66	0.96	1.09

The responses indicate environmental attitudes that are slightly positive. As has been the case throughout the study the pupils' responses do not vary significantly. The strongest belief is that the

school should conserve energy. This has been a consistent message throughout the investigation into the pupils' attitudes toward energy consumption. In this part of the survey they say they believe they should help and that it is their responsibility to do so. Question 15 shows consistency with the other questions in this part of the survey. A lower score indicates the pupils disagree with the statement, therefore they think conserving energy is their problem. Being able to build on these responses will be vital if the school management are to reduce their electricity consumption.

This survey has shown that there are many opportunities for the pupils to reduce consumption. As a holistic approach is needed to change each of the factors incorporated in VBN Theory, it should be possible to achieve real and lasting change. The results of the surveys also agree with what was found in the workshops; that although the pupils are the greatest population in the school, they have limited influence on the control of many of the energy consuming behaviours. This means the staff are more likely to influence the consumption levels. For a FM Company trying to change the behaviour of the users this is advantageous. As the Company is contractually bound to the Council there is a joint responsibility to reduce consumption.

4. Summary of the findings

The analysis could be divided into two broad areas. Firstly, a confirmation that one school was showing a reduction in electricity consumption, and secondly an investigation of the pupils attitudes and behaviours. The analysis of the energy consumption profiles clearly proved that the New Build School had significantly reduced its electricity consumption compared to the same period in the previous year, whereas the Refurbished School had not. The latter area of the investigation was the analysis of the pupils' perceptions of energy. This involved workshops aimed at identifying where pupils perceived energy to be wasted in the school; who they thought was responsible, and what could be done about it. The pupils felt they had very little influence on the electricity consumption, and that it was the teaching staff that had the greatest influence and therefore responsibility to reduce it. They also cited the FM Company as a key stakeholder with significant responsibility towards the reduction.

The workshops fed directly into the surveys that were carried out by a large number of students in both schools. These verified what had been said in the workshops – that they felt they had very little influence on the electricity consumption. But it also showed that although they thought the school should reduce consumption they did not want to change their routine to achieve it. The surveys also showed that the pupils in the New Build School answered in environmentally negative ways compared to the Refurbished School. This was surprising, considering the findings of the consumption profile analysis. The reason for this may be that the New Build pupils are more aware of environmental issues and therefore answered more honestly. The Refurbished School may have suffered from "self-generated validity" (Harrison *et al.*, 1996). This phenomenon should be further explored in future study. Finally, the results of both the schools were consistently lower than that found in the university (Scherbaum study), this suggests ample opportunity to implement strategies to increase the factors that encourage environmentally positive behaviours.

This research set out to identify measures a FM Company can utilise to change user behaviour to reduce electricity consumption in PFI Schools. An extensive Case Study investigation has confirmed

that changes in users' behaviours in one school are having a significant impact on the consumption. The research has identified areas where the pupils can reduce consumption e.g. shutting down PCs after use and ensuring lights are off in unoccupied classrooms. It also indicated that the teaching staff have greater influence than the pupils, further research is required to confirm this. By engaging both the staff and pupils in environmentally positive behaviours a FM Company can certainly reduce the Carbon Footprint in school buildings and help the UK Government achieve its Carbon Reduction Target.

1. References

AECOM, Reducing carbon emissions from existing schools, p16, DCSF (August 2009)

Allen, J. B., & Ferrand, J.L. (1999) Environmental locus of control, sympathy, and environmental 1999 behavior. *Environment and Behavior*, **31:** 338-353

Bunn, R., & Leaman, A. (2008). *A special report for the BSRIA Briefing, Primary School Carbon Footprinting*. BSRIA.

Carbon Trust (2008) CTV 037 A whole school approach - management guide, The Carbon Trust, UK

CIBSE (2008), Energy Benchmarks, Guide TM46. The Chartered Institution of Building Services Engineers, London

Conservative Party Official Website (2010) Available www.conservatives.com – [accessed 29/01/10]

DCSF (2007) Evaluation of BsF – 1st Annual Report

DECC (2009a) Available: http://www.decc.gov.uk [accessed 16 July 2009]

DECC (2009b) The UK Low Carbon Transition Plan; National Strategy for Climate Change

Dietz, T., Stern, P.C., & Guagnano, G.A. (1998). Social structural and social psychological bases of environmental concern. *Environment and Behavior*, **30**: 450-471

ECON073 (1995) Saving energy in schools - a guide for head teachers, governors, premises managers and school energy managers, BRECSU Best Practice Publication

Finlinson (2005) Increasing Organisational Energy Conservation Behaviours, Unpublished doctoral dissertation, Ohio University, Ohio, USA

Gardner, G.T., & Stern, P.C. (1996). *Environmental problems and human behavior*. Boston: Allyn and Bacon

Harrison, D.A., McLaughlin, M.E., & Coalter, T.M. (1996). Context, cognition, and common method variance. *Organizational Behavior & Human Decision Processes*, **68** (3): 246-261

Inglehart, R. (1990). *Culture Shift in advanced industrial society*. Princeton, NJ: Princeton University Press

Morell, D. (1981). Energy Conservation and public policy: If it's such a good idea, why don't we do more of it? *Journal of Social Issues*, **37** (2): 8-30

Scherbaum, C.A., Popovich, P.M., & Finlinson, S.,(2008). Exploring Individual-Level Factors Related to Employee Energy-Conservation Behaviours at Work. *Journal of Applied Social Psychology*, **38** (3): 818

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues*, **50**(4): 19-46

Siero, S., Boon, M., Kok, G., & Siero, F. (1989). Modification of driving behavior in a large transport organization: A field experiment. *Journal of Applied Psychology*, **74**: 417–423.

Steg, L., & Sievers . I. (2000). Cultural theory and individual perceptions of environmental risks. *Environment and Behavior*, **32**: 250-269

Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: A test of VBN Theory. *Journal of Environmental Psychology*, **25**: 415-425

Stern, P.C., & Gardner, G.T. (1981). Psychological research and energy policy. *American Psychologist*, **36**: 329-342

Stern, P.C. (2000). Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues*, **56**: 407-424

Ward, C., (2008). What are the energy and power consumption patterns of different types of built environment? *Energy Policy* (36): 4622–4629