



The energy efficiency behaviour of individuals in large organisations: A case study of a major UK infrastructure operator



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ABSTRACT

Energy consumption behaviours are gradually becoming better-understood. However, there is still a deficit in terms of knowledge of individuals' energy-use behaviours in organisations, despite a variety of available theories. This paper addresses this need in three main stages, based on a survey among mid-level managers at a major infrastructure operator in Great Britain. Firstly, a principal components analysis is performed to identify key determinant constructs driving energy-efficient behaviours in organisations, revealing the importance of perceived benefit to the organisation and flexibility of existing performance goals and targets. Secondly, cluster analysis is undertaken, in an effort to identify differences in behavioural influences between demographic groups. These clusters highlight the heterogeneity of employee populations' energy behaviours, demonstrating that assumptions cannot be made about these based on single responses to cross-industry surveys. Finally, a structural equation model of individuals' energy use intentions and behaviours using the newly-identified constructs is developed, revealing some similarities with existing behavioural frameworks such as the Theory of Planned Behaviour (Ajzen, 1991). Implications for policymakers are then discussed, in terms of encouraging individual employees' curtailment of energy consumption in organisations through tailored engagement programmes.

1. Introduction

Emissions of greenhouse gas originating from electricity production are a key contributor to climate change processes (IPCC, 2014). The UK has set a target for an 80% reduction in greenhouse gas emissions by 2050 (against 1990 levels) (Climate Change Act, 2008). Transport accounts for 21% of the country's total greenhouse gas emissions (DECC, 2015). Management of transport infrastructure accounts for a large proportion of this consumption; railways in the UK consume 1% of the national electricity supply (over 4 TWh/year) (MacLeay et al., 2015), and the management of transport infrastructure (as opposed to operation of trains) represents approximately one eighth of this total. The railway industry in the UK is currently under regulatory pressure to reduce its financial costs (Shaw, 2016), this imposing a further need for energy efficiency programmes to be implemented. However, studies of other industries (discussed below) suggest that economic drivers alone are not necessarily sufficient to drive improvements in energy efficiency.

Management of energy consumption at the point of use is a key element in efforts to reduce greenhouse gas emissions across any organisational setting (Warren, 2014). Energy behaviours have been

investigated from a wide variety of perspectives, including economics, engineering, psychology and sociology (Lopes et al., 2012). Allen and Chatterton (2013) recommend that a low carbon future should be led by greening businesses and making demand-side improvements, with an emphasis on addressing individuals' behaviours. However, energy attitude and behaviour studies in organisational settings are far less common than those undertaken for consumers or individuals in households (Andrews and Johnson, 2016). This is despite recognition that reducing energy demand in organisational settings is likely to be more difficult than previously assumed, due to multiple overlapping non-price-related barriers (Sorrell, 2015). Some efforts have been made to overcome this by looking at retail firms (Christina et al., 2014a, 2014b) specifically, but larger organisations remain under-researched (Andrews and Johnson, 2016). This suggests a need for further case studies of energy consumption behaviours in larger businesses, to allow observations of employee energy consumption behaviours and their role in improving energy efficiency to be better-understood across a range of operational scales.

The majority of energy behaviour studies to date have focused on domestic settings (Lopes et al., 2012; Greaves et al., 2013; Boomsma et al., 2016). Energy consumption behaviours in households often

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deviate from established economic decision-making theories (Zhou and Yang, 2016). However, it appears that some assumptions are currently made about the uniformity of energy consumption behaviours by individuals within organisations, whereas earlier studies of pro-environmental behaviours suggest that this is not the case (Wehrmeyer and McNeil, 2000). Qualitative analysis by Goulden and Spence (2015) also suggests that commercial organisations need to be treated as heterogeneous networks when considering individuals' approaches to energy use. Whitmarsh (2009) also shows that attitudes toward mitigating climate change do not equate with attitudes towards saving energy, suggesting the value of investigating energy behaviours in greater depth generally. Furthermore, Murtagh et al. (2013) point out the distinction people make between home and the workplace, in terms of personal pro-environmental behaviours. This paper therefore investigates the structure of energy behaviours of individuals in a large organisation and aims to address the question of whether behavioural frameworks developed to understand consumer- or domestic behaviours can be successfully applied to organisational settings.

1.1. Economic and Engineering approaches

The reluctance of organisations to undertake energy efficiency measures despite the profitability of doing so, known as the 'energy efficiency paradox' is well-documented in economic literature (DeCanio, 1998; Kounetas and Tsekouras, 2008; Martin, 2012). A set of barriers to energy efficiency proposed by Sorrell et al., (2000, 2004, 2011) have received repeated attention in recent years, and are commonly referred to by other authors in the field of organisational energy behaviours (e.g. Schleich and Gruber, 2008; Schleich, 2009; Fleiter et al., 2012). However, these were based on an initial case studies within three industries (Sorrell et al., 2000) (higher education, brewing and mechanical engineering), none of which share many characteristics with transport infrastructure operation. This body of research seems to largely downplay the role of behavioural influences on organisational energy efficiency. In particular, credibility and trust in information (Testa et al., 2016), and individually-held values (Papagiannakis and Lioukas, 2012) have both been found to have significant relationships with the environmental performance of organisations, contradicting the aforementioned economics-led studies. Even economically-framed studies suggest that behavioural factors may play a greater part in determining energy efficiency than originally thought (Cagno and Trianni (2014), and that economic incentives only explain a portion of observed behaviour (Sorrell, 2015). This suggests a need for further research into behavioural influences affecting energy consumption in organisational settings. This also raises the possibility that employee performance measures should focus on non-financial goals, if a reduction in employees' energy consumption is to be achieved.

1.2. Psychological and Sociological approaches

General theories of individual behaviour have often previously been applied to analyse pro-environmental, energy consumption, and technology adoption attitudes and behaviours in organisations. The Theory of Planned Behaviour (TPB) (Ajzen, 1991) (following on from Ajzen and Fishbein, 1977) has often been used to characterize both pro-environmental and energy-saving behaviours. This theory assumes that individuals are rational actors, who make decisions based on a consideration of all known factors. However, debates have often arisen around the validity of particular constructs within the overall framework. The association of the 'Subjective Norm' construct with intentions and behaviours in particular is a subject of much debate, either seeming to exert greater (Papagiannakis and Lioukas, 2012) or lesser (Dixon et al., 2015; Tetlow et al., 2015) influence than attitudes in organisational settings. Littleford et al. (2014) suggest the differences between organisational- or home settings are a defining feature of

energy consumption behaviours. However, they believe that there are fewer applications of the Theory of Planned Behaviour in organisational settings than are necessary to fully understand these characteristics.

The Theory of Interpersonal Behaviour (TIB) (Triandis, 1977) shares many similarities with Ajzen's theory, but has not been tested as often (Jackson, 2005). This theory includes a 'Habit' component, to account for behaviours which may be made as a result of familiarity and repetition rather than conscious decision-making. Rare comparisons with the TPB have been favourable, such as for pro-environmental travel behaviours (Bamberg and Schmidt, 2003). Again, the validity of some constituent constructs have been questioned, albeit in contexts other than energy conservation (e.g. Gagnon et al., 2003; Moody and Siponen, 2013). Despite this, The TIB is consistently raised in support literature for UK policy-makers (e.g. Darnton, 2008; Chatterton, 2011). The structure of Triandis' theory closely reflects an energy technology acceptance framework proposed by Huijts et al. (2012) and later tested in Huijts et al. (2014). This suggests that the TIB as a possible framework for describing the determinants of energy-efficient technology adoption.

Observations of pro-environmental behaviour in the workplace are not limited to these two frameworks. Boiral and Paillé (2012) and Paillé and Boiral (2013) find that the level of perceived organisational support is related to 'organisational citizenship behaviours for the environment'. Andersson et al. (2005) found mixed levels of support for constructs proposed by Value-Belief-Norm theory, suggesting that this theory would require revision for application in corporate settings. The profusion of theoretical constructs offered as methods of explaining intentions and behaviours suggests that further research is needed to identify which of these may apply to organisational settings. Given that it is not clear which of these theories might apply in a large-scale organisational context, this raises the proposition that an exploratory analysis method may be used to identify whether any aspects of these existing frameworks are applicable in workplace settings.

1.3. Principal components analysis in energy behaviour research

Principal components analysis (PCA) is often used to identify factors influencing general pro-environmental behaviours, adoption of new (pro-environmental) technologies, and energy conservation, which we draw upon below. This technique has been applied in both consumer- and organisational settings, as described below. However, as with studies of energy behaviour in organisational settings more generally, exploratory, quantitative case studies of this type are not currently widespread in the literature.

Aksen et al. (2012) used principal axis factoring (a close analogue of PCA) to compare general lifestyle practices and pro-environmental technology adoption, finding that the two groups of practices were largely independent of one another. Subsequent cluster analysis also classified groups who were either 'green' or 'technology' oriented. Similarly, Sütterlin et al. (2011) applied PCA and cluster analysis to classify market segments of consumers with commonly-shared energy-saving behaviours, broadly identified as energy 'savers' or 'consumers'. Barr et al. (2005) also identified groups which portrayed varying degrees of environmentalism (or lack thereof). Michelsen and Madlener (2013) investigated homeowners' decisions to adopt types of residential heating systems, identifying cost, general attitude, available grants, energy security considerations, comfort considerations and the influence of peers all played a part in this process. Again, these were broken down into those preferring the convenience of existing technologies, and those who were motivated to adopt new ones, with a third group who were aware of the consequences of energy-efficient technology adoption but experienced other barriers.

Gadenne et al. (2011) used PCA to identify specific characteristics of environmental attitudes and norms relating to energy-saving behaviours for consumers. Their paper takes the additional step of

testing these new factors within a TPB-based framework. Their paper recognises that the TPB does not incorporate institutional influences on individual behaviour. However, incorporating factors determined by PCA into a path analysis framework would enable observations of whether or not these external influences play a part in determining energy-saving behaviours in organisations.

The papers mentioned above clearly indicate the heterogeneity of consumers in terms of energy consumption attitudes and behaviours. However, few papers to date have examined the heterogeneity of energy attitudes within single organisations. Wehrmeyer and McNeil (2000) identified four determinant factors behind employee environmental attitudes in their case study of a pharmaceutical company: ‘Conscientious Activism’ (actions taken in support of the environment), ‘Corporate Environmentalism’ (sharing information on a firm’s environmental choices), ‘Deep Green’ (valuing nature in its own right), and ‘Technological Omnipotence’ (the sense that technology will solve all problems). Considering the separation of attitudes between pro-environmental- and energy-saving attitudes in domestic settings (Whitmarsh, 2009), Wehrmeyer and McNeil’s (2000) clusters suggest that this may not be the case in the workplace, also suggesting the need for further investigation of this topic in different industries.

1.4. Method selection

In conclusion, this paper aims to address calls for further research into individual energy attitudes and behaviours in organisational settings (e.g. Andrews and Johnson, 2016). The case study presented here intends to identify potential antecedent constructs driving end-use energy consumption behaviours through PCA, and propose a new causal framework based on these new constructs through structural equation modelling. This allows comparison of antecedent factors driving behaviours in other contexts, such as those discussed in Section 1.2. Cluster analysis of the new behavioural constructs then presents the case for treating employees of large organisations as a diverse array of individuals, rather than a single homogeneous group. This choice of technique allows identification of heterogeneous networks within organisations, which is thought to enable development of more-effective company policies for reducing employees’ energy consumption (Goulden and Spence, 2015).

2. Method

The current study was conducted in the rail infrastructure operator Network Rail plc in the UK. The overall structure of the empirical analysis process chosen was: (1) Conduct a questionnaire survey on the topic of energy-saving attitudes behaviours and make basic demographic observations; (2) Perform exploratory factor analysis of the questionnaire data to identify the driving factors behind these behaviours; (3) Cluster data based on these new factors to identify key engagement groups for policymakers; (4) Propose a new behavioural framework for the energy-saving behaviours of individuals in large organisations.

A similar methodology has been employed previously to look at pro-environmental technology adoption (Axsen et al., 2012), adoption of household heating systems (Michelsen and Madlener, 2013), energy and conservation behaviours (Sütterlin et al., 2011; Barr et al., 2005), and energy conservation behaviours among household consumers (Gadonne et al., 2011), and gender differences in workplace environmental attitudes (Wehrmeyer and McNeil, 2000).

This paper takes the additional step of applying a selection of the generated factors in a multiple regression path analysis model. This is commonly applied in the field of environmental psychology to assess frameworks relevant to pro-environmental behaviours, such as the TPB (Ajzen, 1991) and TIB (Triandis, 1977). Zhang et al. (2013) used this method to test a model of energy-saving behaviour in organisations based on Norm Activation Theory (Schwartz, 1977), identifying

personal norms and organisational energy-saving ‘climate’ as playing determinant roles. Studies of pro-environmental behaviours in an organisational setting have investigated firms’ willingness to adopt or develop cleaner technologies (Montalvo Corral, 2003), environmental intentions in the workplace (Greaves et al., 2013), and the relationship between managers’ attitudes and corporate environmental performance (Papagiannakis and Lioukas, 2012).

2.1. Questionnaire survey

This paper presents the results of an original questionnaire survey, distributed among all employees of a large infrastructure operator in the UK. The organisation’s operations consume electricity at a rate of more than 400GWh per year. However, a large proportion of this is then sold-on to clients in some of their building-based facilities, and operators making use of their infrastructure.

Survey questions were developed around topics identified by an earlier series of semi-structured interviews (not reported here). These interviews took place with a selection of mid-ranking management staff with responsibilities relating to large-scale energy consumption. Questions were also originally mapped to constructs defined by the TPB and TIB. Further questions were added at the request of the organisation’s sustainability specialists. These included questions 38 (“I have actively changed any kind of behaviour following a [organisation-led] campaign”), 50 (“[The organisation] could benefit from using small-scale renewable energy (such as solar panels)”).

Forms were distributed using the Demographix® distribution platform. This allowed company branding and formatting to be used, as a means of increasing the perceived importance of the survey among employees with busy work schedules.

Five-point Likert scales were used to improve the visual presentation of the online forms, and because other similar surveys within the organisation had previously used these scales. It is noted that seven-point scales have previously been identified as optimal in instances where respondents’ attitudes toward a mental construct have been refined over time (Krosnick and Presser, 2010). However, the topic of energy consumption had not previously been the subject of an internal survey within the organisation, and was not among the firm’s stated priorities (beyond a general acceptance of a need to address sustainability). Meade and Craig (2012) also point out that the reliability of five- and seven-point scales is virtually identical.

A main set of 38 questions used a 5-point agreement-scale format (and unipolar coding scheme); Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly Agree (5). A set of 9 further questions designed to represent a self-report measure of their current behaviours used a five-point frequency-scale format and coding scale; ‘Never’ (1), ‘Once per year’ (2), ‘Once per month’ (3), ‘Once per week’ (4) and ‘Every day’ (5). These questions are presented in Table 1. Employees were also presented with the options ‘Does not apply to me’, and ‘This is done automatically’; these were coded as missing responses for the analysis presented here. A self-report measure was chosen in order to gather data within a relatively short timescale, whilst receiving information from the broadest possible range of company departments and staff specialisms. The researchers recognise the limitations of stated-preference surveys, and discuss this in Section 4.3, below. However, classifying multiple energy behaviours as a generalised group addresses the issue of compatibility raised by Ajzen and Fishbein (1977) (see also Karlin et al., 2015); i.e. behaviours should be treated with the same level of generalisation as their determinant constructs.

Voluntary survey entry forms were made available to all of the organisation’s (approx.) 36,000 staff via a company intranet news website. 874 responses were returned, the vast majority of which originated from mid-level management staff, based on demographic data collected on participants’ pay grades. Results from employees in management-level pay grades were selected, leaving 628 useable forms. This represents approximately 6.5% of the total population in manage-

Table 1
Demographic characteristics of sample, with significance of relationship with cluster membership variable.

Demographic	Subset	No. of responses	Cluster membership Chi-square significance
Gender	Male	513	.449 (NS)
	Female	107	
	Other	2	
	Prefer not to say	6	
Age in years	18–24	7	.001**
	25–34	141	
	35–44	178	
	45–54	206	
	> 55	96	
Company department	Projects	158	.048*
	Finance	46	
	Human Resources	10	
	[A major upgrade project]	16	
	Communications	4	
	Operations	261	
	Technical	96	
	Specialists (including Health & Safety)		
	Strategy	37	
Pay grade	Tier 1	15	.005**
	Tier 2	111	
	Tier 3	280	
	Tier 4	222	
Has people management responsibilities?	Yes	327	.016*
	No	301	
Years of experience at company	< 2	77	.137 (NS)
	2–5	132	
	6–10	151	
	11–15	102	
	> 15	166	

NS='Not Significant'.

Table 2
Self-report behaviour questions, based on the 5-point frequency scale described in main text.

Frequency-scale behaviour questions: "How often do you do the following things, approximately?"
A – Turn off computer monitors when not at your desk
B – Turn off lights when no-one else is left in the room
C – Turn off heating when no-one else is left in the room
D – Turn off other non-essential electrical equipment
E – Turn things off completely, rather than to a "standby" mode
F – Find ways of turning off trackside equipment to reduce energy use
G – Find ways of turning off plant equipment to reduce energy use
H – Discuss energy use in meetings
J – Leave items plugged in, even when they've finished charging

ment-level roles within the organisation. Table 2 provides a full description of the sample's demographic characteristics.

2.2. Principal components analysis

New explanatory factors for energy-saving behaviours were identified using rotated PCA, applied to the 38 Likert agreement-scale question items. As raised by Michelsen and Madlener (2013), this

investigation process requires decisions by the researchers on the analytical procedure which may impact the outcome of the analysis. All analysis was carried out using SPSS version 22.

Having set a minimum eigenvalue of 1 for generating new factor constructs, Varimax rotation with Kaiser normalisation generated 10 new factors after 13 rotations. Beyond this initial acceptance criterion, two other criteria were used to determine the constructs' subsequent inclusion in the later cluster- and path analysis stages. Firstly, factors were required to have 3 or more constituent items (i.e. survey questions) with factor loadings greater than .5, as recommended by Costello and Osborne (2005). Items with loadings greater than .4 are also used in calculations of internal consistency (Cronbach's alpha) for the new factor constructs (factor loadings less than .3 have been suppressed for ease of presentation in this paper). Secondly, new factor constructs were required to have a Cronbach's alpha score of .6 or greater, as recommended by Hair et al. (2014) and George and Mallery (2003) for exploratory research.

2.3. Structural equation modelling

Structural equation models were produced using SPSS AMOS version 22. Our analysis process involved placing constructs from the PCA process which met our aforementioned acceptance criteria into a variety of model configurations. In addition to the factors generated by PCA, a 'Behaviour' construct was produced as a mean of all frequency-scale questions outlined in Table 2.

The model configurations considered were all variations on a linear arrangement of a variety of antecedent factor combinations, leading to intentions to save energy, leading in turn to self-reported behaviours. The model presented later in this paper is the strongest result produced after several iterations following this general pattern. This raises a possible limitation of our study; models of pro-environmental behaviour can be considerably more complex (e.g. Kollmuss and Agyeman, 2002), and associations between intentions and behaviours (as summarised by Jackson, 2005). However, a number of other theories do follow this broad pattern (e.g. Ajzen, 1991; Triandis, 1977), suggesting that such an approach can yield meaningful results.

2.4. Cluster analysis

A cluster analysis process was conducted to determine differences between demographic groups within the infrastructure operator. This was also performed to check whether employees conformed to any existing frameworks for identifying groups within larger populations, such as those relating to technology acceptance (Beal and Bohlen, 1957), pro-environmental choices (Anable, 2005), or other observed cases of (pro-)environmental attitudes in organisational settings (Wehrmeyer and McNeil, 2000).

A two-step clustering method was selected, using a log-likelihood distance measure. The order of the cases within the dataset was reset according to serial number (i.e. the chronological order in which completed forms were returned) for every clustering pass, to ensure replicable results. Results were clustered based on the Factors selected by the preceding PCA stage.

3. Results

Firstly, the outcome of the PCA process is described, along with qualitative interpretations of the 10 attitudinal factor constructs identified. Secondly, clusters based on those factors meeting our acceptance criteria are presented, revealing that groupings based on perceptions of saving energy do not necessarily align to a 1-dimensional 'pro-environmental/non-environmental' scale. The demographic characteristics of these clusters are also described, suggesting only minor variations in proportions of cluster membership across all those demographics presented in Table 1. Finally, the results of the structural

equation modelling process are outlined, presenting the causal model driving energy-savings and behaviours scoring most favourably on multiple indices of model fit.

3.1. Principal component analysis

Data from staff at management pay grades (N=628) was used as a basis for determining a selection of antecedent factors driving self-reported energy consumption behaviours. Although only 17% of the sample was female, this was broadly reflective of the organisation as a whole, which was approximately 15% female at the start of the survey. In terms of organisational departments, project management- and safety specialist staff were somewhat over-represented, whilst staff responsible for day-to-day ‘frontline’ operations were somewhat under-represented. All other demographic categories were broadly representative of the managerial population. The findings of this survey may therefore be transferable to organisations with similar population characteristics, particularly other major engineering or infrastructure

management firms.

10 new factors were identified using the PCA process, as discussed below. 35 of the 38 agreement-scale questions posed to survey participants aligned to one of these new factors. The questions which did not return any factor loadings greater than .4 were “I think that energy saving campaigns work”, “Information I need for my role, on any subject, is easily available for me”, and “New technologies I have used have generally worked reliably”. Most questions were associated with only one factor, although “Reducing [the organisation’s] energy use should be a high priority” and “Changes I make to my energy use have a big impact on the world around me” had loadings higher than .4 for two factors respectively.

Table 3 outlines how questions from the survey map to each of these factors. Question numbers refer to their order in the original questionnaire. Table 4 provides all factor eigenvalues, percentage variance explained, and the total variance explained by the factors chosen using the factor-loading and internal consistency criteria mentioned in the previous section.

Table 3

Results of rotated PCA. Abbreviations: TAN – Technology Adoption Norms. BE – Benefit Evaluation. EI – Energy Intentions. GF – Goal Flexibility. EA – Energy Awareness. ESA – Energy Self-Appraisal. ESE – Energy Self-Efficacy. TA – Technology Awareness, TF – Technological Frustration. EN – Environmental Norms.

		Component										Communalities
		1	2	3	4	5	6	7	8	9	10	
Q. No.	Question phrasing	TAN	BE	EI	GF	EA	ESA	ESE	TA	TF	EN	
25	[The organisation] easily adopts new technologies in general	.811										.714
26	Other [organisation] departments are quick to adopt new technologies	.774										.653
28	It takes too long to adapt to new technologies in my [organisation] department	-.558										.472
29	Innovation in general is adequately supported across [the organisation]	.624										.463
42	Any working practices take a long time to change at [the organisation]	-.529										.534
13	Reducing [the organisation’s] energy use should be a high priority		.532	.415								.518
19	Saving electricity is a good way of reducing costs		.611									.505
46	[The organisation] should be working harder to reduce our effects on the environment		.594								-.318	.530
48	Changes I make to my energy use have a big impact on the world around me		.430	.403								.491
50	[The organisation] could benefit from using small-scale renewable energy (such as solar panels)		.622									.492
5	I plan to use less electricity at home in future			.751								.652
6	I plan to use less electricity in my place of work in future			.725								.681
16	I intend to discuss energy use more often at work in the future			.473	.329							.549
49	I intend to discuss environmental issues more often at work in the future			.522								.590
39	I am able to influence large-scale business decisions in my [organisation] department				.579							.497
40	The targets I work toward give me room to use less energy				.803							.744
41	The targets other people have to work towards give them room to use less energy				.802							.712
3	I have previously taken part in energy-saving activities at [the organisation]					.721						.610
7	I know who can give me information to help me save energy					.618						.499
18	I have seen campaigns specifically around saving energy at [the organisation] before today					.695						.576
1	I don’t think about energy use very often						-.503					.357
2	I think of myself as being careful with energy use						.749					.630
4	I tend to leave equipment switched on						-.656					.493
8	I get frustrated when I see energy being wasted						.550					.557
14	I am responsible for the amount of energy I consume at work							.710				.614
15	I am able to influence the amount of energy I consume at work							.759				.662
17	Saving electricity is easy for my [organisation] department							.601				.576
31	I look for opportunities to use technologies whenever possible								.611			.562
32	In the last year, I have learned how to use a new piece of technology at work								.591			.482
37	I understand the changes that [a specific upgrade project] will bring’								.513			.489
38	I have actively changed any kind of behaviour following a [organisation-led] campaign								.489		-.349	.517
30	Learning to use new technologies is frustrating									.725		.632
43	My general personal performance is disrupted by conflicts between my different targets									.679		.561
45	Climate change is discussed more often than is really necessary										.683	.617
47	I am happy with the way that [the organisation] handles environmental issues										.459	.513

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization (Kaiser, 1958). a. Rotation converged in 13 iterations.

Table 4
Factor constructs produced by PCA – eigenvalues, and percentage variance explained.

Component	Rotation sums of squared loadings			
	Eigenvalue	% variance explained	Cumulative % variance	Cumulative % variance of factors selected for cluster analysis
Technology Adoption Norms	2.982	7.848	7.848	7.848
Benefit Evaluation	2.594	6.827	14.675	14.675
Energy Intentions	2.457	6.465	21.141	21.141
Goal Flexibility	2.329	6.128	27.269	27.269
Energy Awareness	2.050	5.395	32.664	32.664
Energy Self-Appraisal	1.935	5.091	37.755	x
Energy Self-Efficacy	1.864	4.906	42.661	37.570
Technology Awareness	1.783	4.693	47.354	x
Technological Frustration	1.639	4.312	51.666	x
Environmental Norms	1.445	3.804	55.470	x

Technology Adoption Norms (TAN) represents respondents' impression of how easily other parts of the organisation adopt new technologies in general, and the organisational support available for necessary adaptations. Higher scores indicated a perception that the organisation was quicker to adopt new technologies. This factor was comprised of 5 items, and the Cronbach's alpha score was acceptable ($\alpha=.730$), leading to its acceptance for the cluster analysis process.

Benefit Evaluation (BE) represents respondents' appraisal of the economic and environmental benefits of pursuing energy efficiency to the organisation, and supporting the spread of pro-environmental technologies. A higher score here indicated a favourable perception of the economic and environmental benefits of energy efficiency improvements within the organisation, and the level of priority these should take. This factor was comprised of 5 items, and returned Cronbach's $\alpha=.674$, leading to acceptance for further analysis.

Energy Intentions (EI) groups together stated intentions to save energy at work and at home, and to discuss energy and environment-related matters in future. Higher scores indicated a higher level of intention to reduce electricity consumption, and discuss the problem more often at work. There were 4 constituent items, and Cronbach's $\alpha=.769$, leading to acceptance for further analysis.

Goal Flexibility (GF) measures respondents' perceived ease of fitting energy-saving goals around their existing suite of other financial and non-financial performance measures. High scores for this construct indicate that respondents find it easier to overcome goal conflicts, whilst lower scores suggest that these are acting as a personal barrier to reducing energy consumption. There were 3 items in this construct, and Cronbach's $\alpha=.704$, leading to acceptance for cluster analysis.

Energy Awareness (EA) records whether respondents have come across organisation-wide energy-saving initiatives in the past, or have access to energy-saving information. Higher scores indicate a greater awareness of previous efforts to save energy and ease of access to information. There were 3 items in this construct, and Cronbach's $\alpha=.645$, leading to acceptance for cluster analysis.

Energy Self-Appraisal (ESA) is a measure of how careful participants believe they are with their own energy use, and their level of emotional involvement with saving energy. Higher scores indicated that an individual perceived themselves as being more careful with energy consumption, and more likely to get frustrated when they could do nothing about it. There were 3 items in this construct, but Cronbach's $\alpha=.594$, lower than the predetermined threshold. This factor was therefore not taken forward to the cluster- or path analysis phases.

Energy Self-Efficacy (ESE) represents whether participants feel responsibility for- and have an ability to influence their own energy use, with reference to how easy it would be for their own company department to do so. Higher scores indicate that an individual feels it is easier for them to reduce their energy consumption. This shares some features with 'perceived behavioural control' in Ajzen's (1991)

Theory of Planned Behaviour, but only for curtailing energy use – no similar factors for technology adoption emerged from this factor analysis. There were 3 items for this construct, and Cronbach's $\alpha=.629$, leading to acceptance for further analysis.

Technology Awareness (TA) is a measure of how readily participants adopt new technologies, and their level of awareness regarding the organisation's most recent technology upgrades. Higher scores are indicative of a person perceiving themselves as better at adopting new technologies. There were 4 items in this construct, but Cronbach's $\alpha=.499$, leading to this factor being dropped in later analysis stages.

Technological Frustration (TF) relates difficulties with learning new technologies to conflicts between performance goals. Higher scores relate to a higher level of frustration with the organisation's technology adoption processes. However, as there were only 2 input variables produce a factor loading $>.5$, and Cronbach's $\alpha=.352$, this was not taken forward to further analysis phases.

Environmental Norms (EN) relates to how satisfied respondents were with the organisation's handling of environmental issues, and with the overall level of information they are able to access. However, as with Technological Barriers, only 2 input variables have a value $>.5$, and Cronbach's $\alpha=.283$, and so was not taken forward to further analysis phases.

Table 5 provides a summary of Cronbach's alpha scores for the constructs described above. Based on the reasonable internal consistency of these constructs, Technology Adoption Norms, Benefit Evaluation, Energy Intentions, Goal Flexibility, Energy Awareness, and Energy Self-Efficacy were carried forward to the path- and cluster analysis processes.

3.2. Path analysis

Several alternative structural equation models based on new constructs generated by the PCA process were tested. Fig. 1 provides an example of one of the models tested, but not supported by the observed data. The full suite of alternative model structures tested is omitted from this paper for clarity.

The structural equation model in Fig. 2 exhibited the strongest fit according to several indices, whilst including as many factors as possible identified by the exploratory analysis. Table 6 provides the correlation matrix for this model. Benefit Evaluation has a strong positive association with Energy Intentions. Goal Flexibility has a weak positive association with Energy Intentions. Energy Self-Efficacy has a weak positive association with both Energy Intentions and energy-saving Behaviour. Energy Intentions are also seen to have a moderate positive association with Behaviour.

The validity of the model was checked against multiple standard model fit indices, as recommended by Hair et al. (2014). All of the indices most-commonly observed in the literature produced scores which were strongly indicative of a good fit. Chi-square significance divided by degrees of freedom (CMIN/DF) was .049 (i.e. the likelihood

Table 5
Cronbach's alpha values for newly-calculated factors.

Factor	Number of items	Cronbach's α	α 'Acceptability' (after George and Mallery, 2003)	Selected for cluster analysis?
Technology Adoption Norms	5	.730	Acceptable	Yes
Benefit Evaluation	5	.674	Questionable	Yes
Energy Intentions	4	.769	Acceptable	Yes
Goal Flexibility	3	.704	Acceptable	Yes
Energy Awareness	3	.645	Questionable	Yes
Energy Self-Appraisal	4	.594	Poor	No
Energy Self-Efficacy	3	.629	Questionable	Yes
Technology Awareness	4	.499	Unacceptable	No
Technological Frustration	2	.352	Unacceptable	No
Environmental Norms	2	.283	Unacceptable	No

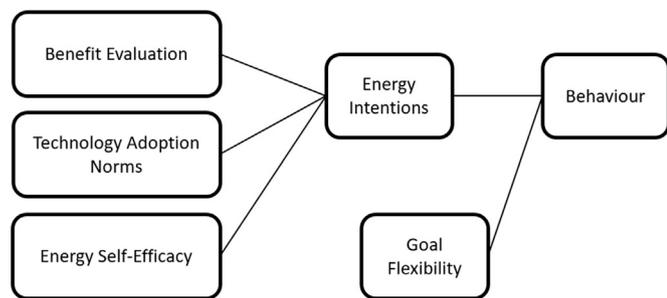


Fig. 1. Example of one of several causal frameworks investigated during the path analysis process.

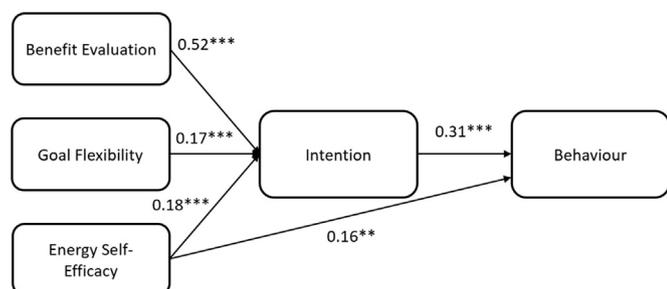


Fig. 2. Final structural equation model. This produced the highest model fit indices of any model tested, based on this study's newly-developed constructs.

Table 6
Parametric (Pearson) and non-parametric (Spearman) Correlation tables for proposed model.

<i>Pearson correlation</i>	EP	GF	ESE	EI	Behaviours
Benefit Evaluation (BE)	1				
Goal Flexibility (GF)	.134**	1			
Energy Self-Efficacy (ESE)	.257**	.341**	1		
Energy Intention (EI)	.497**	.330**	.380**	1	
Behaviours	.145**	.105**	.212**	.269**	1
<i>Spearman correlation</i>	EP	GF	ESE	EI	Behaviours
Benefit Evaluation (BE)	1				
Goal Flexibility (GF)	.087*	1			
Energy Self-Efficacy (ESE)	.224**	.314**	1		
Energy Intention (EI)	.483**	.311**	.393**	1	
Behaviours	.132**	.107**	.209**	.251**	1

** Significant to $p < .01$.
* Significant to $p < .05$.

that the model where all constructs are not associated with one another is true is less than 5%). The Root Mean Square Error of Approximation (RMSEA) was 0 (against a recommended maximum of .05). The Normed Fit Index (NFI) score was 1 (values greater than .9 indicating a good fit). The Comparative Fit Index (CFI) was 1 (values greater than .9 indicating a good fit). It should be noted that inclusion of the 'Technology Adoption Norms' construct in any of the configurations

tested produced models with multiple poor fit index scores. This suggests that this factor may not be a determinant of intentions to save energy, or self-reported energy behaviours.

The model explains 35.2% of variance in Energy Intentions as a result of the three antecedent constructs, and 8.6% of variance in resulting Behaviour. This model is therefore better-suited for explaining the intention to save energy, rather than the self-reported behaviour.

It is interesting to note the similarity between the proposed structural equation model, and that of the Theory of Planned Behaviour (Ajzen, 1991) as shown in Fig. 3. The TPB's 'Attitude' construct is reflected in the new model by 'Benefit Evaluation'. Evaluative attitudes are oriented towards perception of benefits to the organisation, rather than to the individual, and are comprised of both economic and environmental considerations. Similarly, 'Perceived Behavioural Control' is loosely represented in the new model by 'Energy Self-Efficacy', and has causal links with both intentions and self-reported behaviours, as proposed by the TPB. However, constructs similar to 'Subjective Norms' are notable by their absence. All models tested which included one or both of the two normative-style factors (Technology Adoption Norms and Energy Awareness) produced poor fit indices. This suggests that other personal normative concerns in relation to energy use could be overridden by the need to meet performance goals in this organisational setting.

Correlation of variables was checked using both Pearson and Spearman correlation techniques, to account for possible non-linear relationships between variables; both processes returned similar results. According to the classification scheme of Cohen (1988), Benefit Evaluation, Goal Flexibility and Energy Self-Efficacy all exhibit moderate correlation (i.e. $.3 < r < .5$) with Energy Intentions (see Table 7), as demonstrated by the structural equation model. Goal Flexibility is also moderately correlated with Energy Self-Efficacy. Behaviour is only weakly correlated (i.e. $.1 < r < .3$) with all other constructs.

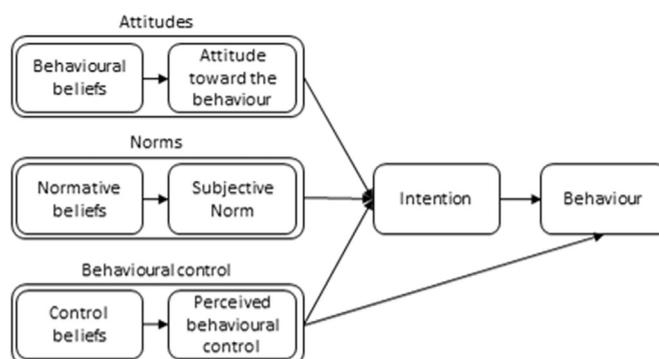


Fig. 3. The Theory of Planned Behaviour (Ajzen, 1991). Diagram based on Ajzen (2006).

Table 7

Characteristics of clusters generated by two-step process. Means and standard deviations are those relative to the centroid for each (PCA-generated) factor score.

		Cluster				
		1	2	3	4	5
		'Technological Sceptic'	'Efficiency-Aware'	'Barrier-Sensitive'	'Organisational Barriers'	'Benefit Sceptic'
Technology Adoption Norms	Mean	.025	-.167	-.502	.047	.925
	St. Dev.	.938	.908	.893	.914	.824
Benefit Evaluation	Mean	-.839	.236	.555	.487	-.545
	St. Dev.	1.022	.854	.724	.723	.749
Goal Flexibility	Mean	-.532	.199	.409	-.838	.623
	St. Dev.	.822	.763	.721	1.295	.652
Energy Intentions	Mean	.085	.143	-.273	-.338	.368
	St. Dev.	.894	.849	1.200	1.085	.761
Energy Awareness	Mean	.119	1.050	-.744	-.462	-.424
	St. Dev.	.849	.591	.720	.736	.755
Energy Self-Efficacy	Mean	-.900	.337	-.571	1.065	.407
	St. Dev.	.795	.635	.848	.655	.674
Population of cluster		131	165	139	96	97
Percentage of total sample		20.9%	26.3%	22.1%	15.3%	15.4%

3.3. Cluster analysis

Five clusters were identified, using the six constructs defined during the PCA process meeting the selection criteria defined in Section 2.2. Factor centroids with values $> \pm .25$ were qualitatively classified as being defining characteristics of individuals belonging to that cluster (e.g. 'Benefit Sceptics' score lowest for the 'Benefit Evaluation' construct). These are listed below in order from the most- to least-significantly different from 0. A full list of standardised factor centroids is provided in Table 7.

These clusters are described in the order of emergence using the chosen clustering method. The quality of these clusters is designated as 'Fair', using SPSS' silhouette measure of cohesion and separation (between .2–.5, see Rousseeuw, 1987).

The relationships between demographic categories and the cluster membership variable were statistically significant for age, organisational department, pay grade, and whether the individual had any directly-reporting staff, but not for gender, or for number of years' experience in the organisation. The descriptions for each cluster's characteristics are as follows:

The 'Technological Sceptic' group (n=131, 20.9%) is characterized by low scores for Energy Self-Efficacy, Benefit Evaluation, and Energy Intentions, and no particular high scores. This can be interpreted as a group who neither feel able nor willing to save energy, and cannot see the economic or environmental benefits to the company of doing so. Although the causal relationship between these factors is not clear from the clustering process alone, this is the only cluster which groups together both low Energy Intentions and Benefit Evaluation, suggesting this as a key defining feature for this cluster. Based on established behavioural theories (e.g. Ajzen, 1991; Triandis, 1977), it is perhaps more likely that evaluation (an aspect of attitudes) leads to intention in this case. This group had notably lower representation among the organisation's projects department, but otherwise showed only minor variations in membership levels cross different demographic groups. None of the other demographic categories with a significant relationship to cluster membership demonstrated a 5% or greater difference between groups.

'Efficiency-Aware' participants (n=165, 26.3%) scored very highly for Energy Awareness, and somewhat high for Energy Self-Efficacy, with no particularly low scores. This cluster identifies individuals with the highest awareness of energy efficiency campaigns, and those who

feel that energy savings are relatively easy for them, but not necessarily those with the highest intention to do so. Of the clusters identified, this perhaps represents those with the best (perceived) access to information. Perhaps unsurprisingly, membership of this group increases with age, and higher pay bands, reflecting greater awareness of previous efforts to save energy due to a longer time in service at the organisation. This group was also most prevalent in the organisation's health and safety department, which included teams responsible for the firm's sustainability policies.

The 'Barrier Sensitive' group (n=139, 22.1%) score highly for Benefit Evaluation, and Energy Intentions, but have low scores for Energy Awareness, Energy Self-Efficacy, Technology Adoption Norms, and Goal Flexibility. This grouping of Factors suggests a personal intention to save energy and a high level of support for energy efficiency measures, but may be held back by a perception that the rest of the organisation needs to adopt technologies faster, and that their personal efforts to save energy will therefore have minimal effect. Membership of this group increases among younger staff, those in lower pay bands, and among employees without subordinate staff.

The 'Organisational Barriers' group (n=96, 46.3%) are identified by a particularly high score for Energy Self-Efficacy, and a fairly high score for Benefit Evaluation, but low scores for Energy Intentions, Energy Awareness, and Goal Flexibility. Of all the clusters, this group had the lowest overall intention to save energy in future, but the highest perceived ease of doing so at a personal level, particularly in economic terms. This suggests that this group may perceive conflicts in desired performance goals as a reason for not pursuing energy efficiency efforts within the business. This cluster showed only minor variations in membership levels cross different demographic groups (i.e. all groups were proportionally represented among the cluster's population).

Those in the 'Benefit Sceptic' cluster (n=97, 15.4%) have high scores for Technology Adoption Norms, Energy Intentions, Energy Self-Efficacy, and Goal Flexibility, and low scores for Benefit Evaluation, and Energy Awareness. The exceptionally high score for Technology Adoption Norms suggests that this group receives the highest perceived technological support from the company, but the low Benefit Evaluation score implies that they are not necessarily in agreement that energy efficiency is a worthwhile use of company resources. As with the 'Organisational Barriers' cluster, this cluster also showed only minor variations in membership levels across all observed demographic groups.

4. Discussion

Firstly, the PCA-generated antecedent behavioural factors are discussed, in terms of their similarities with constructs from existing behavioural theories. Secondly, the implications of the identified clusters are discussed in relation to organisations' policies towards encouraging curtailment of energy use in the workplace. Thirdly, limitations of the present study are outlined, focusing on the method chosen. Finally, overall implications for organisational policies arising from the present study are presented.

4.1. Principal components analysis and structural equation model

The factors identified bear many similarities with constructs proposed by the TPB (Ajzen, 1991). The similarity of the proposed model structure to that of the TPB also implies that there are some similarities between energy-saving behaviours in organisations, and those of consumers more widely. This supports the approach taken by Greaves et al. (2013) in using the TPB to identify employee engagement methods for different energy behaviours, but also suggests some minor variations on the TPB's constructs.

The constructs proposed by the present study are focused more specifically on either curtailing energy use, or adopting energy-efficient technologies; personal attitudes relate to energy use only (i.e. Benefit Evaluation), perceived behavioural control relates to technology adoption only, and Subjective Norms appear to relate to a combination of the two. These observations suggest that further investigation of the TPB and TIB in workplace settings may be warranted. It is not clear why the TIB receives more attention in UK policy literature than the TPB (e.g. Chatterton, 2011), given observations of the applicability of the TPB in a wider variety of settings. A further possibility may be that rational choice-based decision-making models are the most appropriate for individuals in organisations, rather than those (as defined by Jackson, 2005) which focus on moral and normative conduct, or social identity theory (Turner and Oakes, 1986). The relationship between constructs demonstrated by the present study's structural equation model also contrasts with the linear model for pro-environmental behaviours in organisations proposed by Ruepert et al. (2016). This reinforces previous observations that individual actions to save energy are not necessarily related to actions taken to reduce personal impacts on climate change (Whitmarsh, 2009).

The relationships demonstrated by the structural equation model also present some implications for company employee engagement policies around energy-saving behaviours. The relatively strong effect of Benefit Evaluation on the intention to save energy, in relation to normative influences (performance goals) and self-efficacy is consistent with more general observations of pro-environmental behaviour in organisations (Greaves et al., 2013; Lo et al., 2012). To address this, the economic value of energy efficiency measures aimed at changing behaviour need to be explicitly demonstrated to employees before they consider adopting these new behaviours. This could be achieved by sharing examples of best practice from organisations with strong track records of energy efficiency or sustainability initiatives, or raising awareness of scientific studies which have measured the amount of electricity saved by simple behavioural changes (e.g. Goodhew et al., 2015; Kaplowitz et al., 2012).

The strong scores for the various model fit indices indicate the validity of the causal relationship between the different constructs presented in the model. It is recognised that a strong model fit in a single organisational setting alone is not enough to confirm the theory presented here, and we propose that future research test this model or variations upon it in other industries. Nevertheless, this reinforces the possibility that the TPB can be adapted for application in organisational settings (as also proposed by Dixon et al., 2015).

Technology Adoption Norms (i.e. perceptions of how readily the organisation adopted new technologies) could not be included in any of

the structural equation model variants tested without negatively impacting multiple indices of model fit. This may be indicative of previously-observed distinctions between energy-saving measures which require the adoption of a new technology, and those which require lifestyle changes (Aini et al., 2013), being present in organisations as well. Therefore the recommendations arising from this discussion are focused mainly on addressing lifestyle-based energy curtailment activities rather than technology adoption. However, as evinced by the cluster analysis (and discussed in Section 4.2), individuals' perceptions of technology adoption by the rest of the organisation do play a part in the perception of the efficacy of their own energy-saving actions.

The possible co-linear relationship between Goal Flexibility and Energy Self-Efficacy could arise from a perception that achieving company performance goals takes priority over achieving energy efficiency; the latter seems difficult or impossible until the former is achieved.

4.2. Cluster analysis

The existence of clusters of staff with varying characteristics supports the idea that employees of large organisations are not homogeneous, in terms of their energy-related attitudes. This heterogeneity has also been observed previously for more general pro-environmental attitudes in organisational settings (Bansal, 2003). The heterogeneity also occurs despite the survey results reflecting the views of those only in the highest pay bands within the organisation. Future research of this kind in large organisations should be aimed at identifying whether similar clusters emerge when examining data from a wider range of pay grades and experience levels, such as 'frontline' operational or customer-service staff.

Clusters and demographic categories were only loosely related to one another; clusters were not divided strongly between demographic subdivisions (e.g. age brackets, pay bands etc). This suggests that segmentation strategies, with the intention of creating targeted energy-reduction intervention campaigns, may be more difficult to target at specific groups within organisations, as has previously been investigated in domestic settings (Zhang et al., 2012). However, the present study highlights that individuals will respond differently to campaigns aimed at changing energy consumption behaviours, and the varying needs of the members of each cluster described in this paper should be taken into account when designing them. Whilst fostering a sense of community within organisations is known to be important for energy conservation (Dixon et al., 2015), the current study suggests that a diversity of needs and concerns within organisations should also be recognised.

Karlin et al. (2015) proposed that tailored feedback on personal energy performance is essential to reduce individuals' energy consumption. The present study builds on this by suggesting that initial engagement programmes also need to be tailored for different groups to achieve the highest levels of participation in these schemes. Again, it should be borne in mind that, given the nature of the survey responses analysed by this paper, these observations only apply to management-level staff; operational or 'frontline' employees may differ. Nevertheless, focusing campaigns around operational-level managers with responsibilities for facilities or small teams offers a level of tailoring which may be more manageable within a national-scale organisation, compared with directly approaching every single employee.

Some policy recommendations can be drawn from the few demographic differences which arose. There is an age- and experience-related gap around perceptions relating to the efficacy of energy-saving actions. Older, more experienced staff (as exemplified by the Efficiency-Aware group) feel more-able to take on energy-saving actions, whilst younger managers feel more willing to do so, but feel held back by a perceived lack of support from the rest of the organisation (i.e. the

Barrier-Sensitive group). Although those in senior management grades may set pro-energy-efficiency policies, junior management grades are more likely to have control over implementation of these policies on a local scale (e.g. deciding whether to discuss energy consumption at meetings). This confirms Gouliden and Spence's (2015) observations regarding the importance of Facilities Managers in the spreading of energy-efficient organisational practices. Therefore any internal campaigns aiming to reduce energy consumption should target this perceived lack of self-efficacy at the middle management level; neither a 'top-down' nor a 'bottom-up', but a 'middle-out' approach.

4.3. Limitations

There are a few limitations with the exploratory approach taken for the current study. Firstly, this is a cross-sectional study of an organisation at one point in time, limiting the transferability of our findings to an extent. However, as few studies of intra-organisational heterogeneity have been made at the present time, our findings provide a stepping stone for developing wider-reaching studies. Several other papers have examined changes in behaviour over time resulting from interventions in organisational settings (e.g. Boomsma et al., 2016; see Unsworth et al., 2013 for a summary) but have necessarily focused on individual offices or buildings where the effects of behavioural interventions can be isolated more easily. However, this would prove impractical when attempting to assess behavioural antecedents across a whole national-scale organisation as done here. Future research could examine the efficacy of the model proposed by the current study by comparing results of a similar questionnaire survey and replacing the 'behaviour' measure with externally-observed behaviour data.

Secondly, this study's measure of energy-saving behaviours also relies on respondents' self-reports. The validity of self-report questionnaire methods as a means of determining pro-environmental attitudes is often debated. Kormos and Gifford (2014) point out that self-report surveys should not be used as predictors of objective (i.e. 'actual') pro-environmental behaviour. This is also recommended for household energy consumption behaviours (Frederiks et al., 2015), and other pro-environmental behaviours such as recycling (Huffman et al., 2014). However, as the particular organisational environment covered by this study has not been investigated previously, this can be considered as an exploratory study for future work to build upon. This paper has also implemented recommendations by Kormos and Gifford (2014) to reduce the impact of social desirability bias (although the effect of this on self-reports of pro-environmental behaviour is debated (Milfont, 2009)). The exploratory factor analysis method used here (PCA) reflects this. This offers opportunities for future authors to use confirmatory analysis methods in similar settings to test the transferability of findings presented here.

5. Conclusions

This paper offers new insights for policy-makers and energy management staff in large organisations or public institutions. As demonstrated by the large variations between clusters, large companies' internal energy engagement campaigns should be tailored to meet the needs of these different groups (as suggested by Greaves et al., 2013). The high level of engagement with this survey at the junior management level in turn suggests that this group is the most receptive to energy issues, although there is still a large degree of variation across responses. Secondly, organisations should recognise a diversity of attitudes to energy efficiency across staff populations, and design engagement strategies to take account of these. However, few strong links were found between particular demographic groups and cluster membership. Organisations should avoid segmenting energy engagement campaigns based on gender, age, length of experience and company department, as demonstrated by the cluster analysis presented here. These findings specifically address calls by Andrews and

Johnson (2016) for integrated studies of individual and organisational drivers for energy efficiency, and for additional sector-specific research into energy behaviours in organisations.

The current study has added to the scientific literature by developing three inter-related frameworks by which future researchers may develop studies of energy consumption attitudes and intentions in large organisations. Firstly, we have observed six constructs which influence individuals' energy consumption behaviours in organisations: technology adoption norms, personal evaluations of the economic and environmental benefits to the organisation of energy efficiency, stated intention to save energy, perceived flexibility of performance goals, awareness of energy-saving information, and perceived efficacy of small-scale energy conservation actions. Secondly, we have proposed a causal framework for these constructs, and have identified economic evaluations as having the most influences over energy-saving intentions and behaviours among mid-level management staff. This model has promising implications for the applicability of the Theory of Planned Behaviour (Ajzen, 1991) in organisational settings, in line with Dixon et al. (2015). However, less support is provided for current energy behaviour policy support in the UK, which tends to focus on other theoretical frameworks (e.g. Chatterton, 2011). Thirdly, five groups of employees with significantly different attitudes, personal norms, and perceived self-efficacy around energy-saving behaviours have been classified, and these have been identified as having a modest, but unconfirmed relationship with employee age and position in the organisational hierarchy. This paper proposes that individuals in organisations are as diverse as those observed in domestic consumer settings (as reviewed by Lopes et al., 2012), in terms of their attitudes toward energy efficiency.

Ultimately, none of the observations presented here suggest that internal behavioural engagement campaigns would prove ineffective at reducing energy consumption in large organisations. Our findings are most applicable to infrastructure operating bodies, which are responsible for a large volume of electricity use, but are likely to be relevant to other large organisations (i.e. 10,000+ employees). Future research should investigate energy attitudes and behaviours in other industries, or across firms of various sizes.

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