The University Of Sheffield.

Mini-project report 2

Understanding Energy Use in University Buildings

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The University Of Sheffield.

ASSIGNMENT COVER SHEET 2010/2011

A completed copy of this sheet MUST be attached to coursework contributing towards theme 2 assessment.

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I declare that this work is my own and that I have made appropriate reference to any sources used. I am aware of the handbook section on 'Plagiarism' and declare that this work is consistent with those guidelines.

Mini-Project Mark Sheet

Student: **Grade:** fail/satisfactory/good/very-good/excellent

Supervisor:

Feedback:

	Excellent	**Good**	**Average**	**Poor**	**Very Poor**	**Not Done**	**Not applicable**
Introduction to the problem / subject							
Statement of aims							
Experimental description							
Presentation of results / findings							
Quality and depth of discussion / interpretation							
Relevance of conclusions							
Quality of English							
Use of reference material							
Evidence of external reading							
Quality of presentation							
Use of figures							

Comments:

Understanding Energy Use in University Buildings

~Part 1~

Introduction

McKinsey & Company (2009) argue that the building sector provides the most profitable greenhouse gas mitigation possibilities through focusing on demand reduction and energy efficiency. Jones (1998), showed that despite buildings having a large embodied energy, the greatest amount of a building's energy consumption is during its occupation (see fig. 1).

Occupants can, therefore, influence the carbon footprint of the building. In recognition of this, there has been a surge of research into the conservation of energy in households (e.g. McMakin et al., 2002; Gardner and Stern, 2008), however relatively few studies have been conducted in Universities and other large institutions (Marans & Edelstein, 2010), which represent a sizeable energy consuming sector. For example, in Europe, the non-residential sector accounts for 8.7% of total energy use, of which 13% are from Educational buildings (ATLAS 2006).

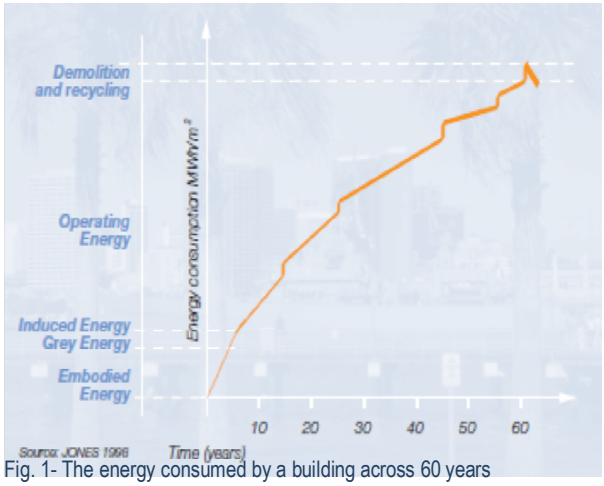

Fig. 1- The energy consumed by a building across 60 years

As a way of improving its environmental performance, The University of Sheffield has set reduction targets of a 10% reduction in carbon emissions by 2015/16 compared to a 2005/6 baseline and 10% Energy and water consumption reduction over 5 years. It has invested in a technical investment programme to improve lighting, mechanical services and control systems, which is expected to deliver direct savings of 15-20%. However, additionally, they initiating programmes targeting human behaviours to prevent energy waste and increase conservation. Such initiatives currently include a "Switch it off" campaign targeting student halls and the BeCause group.

Initially this project was intended to be the second stage in a three part "Low Carbon Initiative" within the University. In part one all of the University buildings were going to be ranked in terms of the energy consumption, crucially taking into account building size and purpose. As part two, the present project would then look for differences between occupants in the comparatively high and low consuming buildings. However, after a large amount of time chasing relevant departments, it was found part one of the Low Carbon Estates project had not been completed. Whilst we were provided with the gas and electricity readings from all the University buildings, they were not ranked and it was felt it would be too time consuming for the current project to take on the responsibility of the analysis. Therefore, a previous study by Douglas (in press) was used as a source of data.

Douglas investigated the use of five buildings within the University and compared their actual energy use with "good" and "typical" benchmarks (See table 1 for a list of the buildings included). It was found that each electricity performance was lower than a 'good' benchmark except

for in Regent Court , but this can be explained by the electrical heating used in the building. Gas usage, on the other hand, was much greater than the benchmarks (except for Regent Court).

The aim of the present research, which is extended across two projects, is to investigate and explore the human factors behind the energy used within these University buildings and gain an understanding of the experiences, attitudes and priorities of the occupants relating to their day to day energy use.

Table 1.	Year of Construction	Department	Main Room Types and Functions
Crookesmoor Building	1970s	Architecture	The building contains lecture theatres, IT facilities, staff office space, study rooms, and a library space
Graduate Research Centre	1960-1970	Multi-disciplinary	Research space and seminar rooms
Northgate House	University owned from 1976	Archaeology	Lecture theatres, ceramics workshops, labs, study rooms, IT facilities and staff office space
Regents Court	1993	Computer Science, the Information School and ScHARR	Seminar rooms, study rooms, IT facilities and staff office space
Humanities Research Institute (HRI)	Refurbished Georgian building	Interdisciplinary research in the arts and humanities	Research space, conference and seminar rooms

Method

Semi-structured focus groups were chosen to explore people's experiences and opinions. Staff members and post-graduates who regularly used the buildings were invited via a building-wide email to attend a focus group to discuss the energy consumption of their building. Undergraduate students were not invited as it was felt they were too transient a population within the building.

The focus groups lasted between 60 and 90 minutes. A series of questions were designed in order to explore occupant's awareness of the impact of their energy use on the building's overall use, their main priorities for preventing waste and the conservation barriers and facilitators they felt existed. A questionnaire was also developed to administer after the focus group. The questionnaire included the revised New Ecological Paradigm scale (Dunlap et al., 2000) and a series of devised scales designed to measure people's feelings of responsibility and beliefs in global warming and satisfaction with the working environment.

Before the main focus groups, a pilot group was also run in order to trial the questions and to gain experience at moderating a focus group. Some minor changes to the wording of the questions resulted.

The focus groups were recorded and later transcribed. At the time of writing, 3 groups have been transcribed. Once all the groups are transcribed the thematic analysis software NVivo will be used to qualitatively analyse the responses of the group for common themes and content. For the results in this summary, the transcripts were manually searched for recurring themes and responses.

Results and Discussion

At this stage in the project the themes are only emergent and tentative, however, there are interesting commonalities across the groups in the issues that were raised and discussed.

Responsibility and Ownership was often considered and is seen as one of the main barriers towards making people more energy conservative. Home versus work comparisons naturally arose, with individuals comparing the necessity of being energy conscious at home due to responsibility for the bills, whereas at work, there is not this responsibility and so there is not the same direct need for conservation. The quote below is illustrative of this:

> "you're much more likely to be aware and take responsibility of what you're doing if you're responsible for paying the bills" (W2-HRI)

This lack of responsibility not only stems from not paying for the energy used, but it also seems to emanate from the lack of ownership some groups felt was common in the buildings:

> "People don't tend to feel that sense of ownership over the space so they're less likely to feel like it's their responsibility" (W1- GRC)

One group discussed how they felt that Masters students and Undergraduates in particular were much more likely to "transgress" and waste energy because they did not use the building regularly, whereas postgraduates and staff develop an ownership over the space through extended use and therefore are seen as more likely to pay more attention to issues within the building.

Problems of shared control over the working environment and diffusion of responsibility was also discussed across groups. There was the awareness that everyone has preferred temperatures and levels of brightness and no one person felt they alter them. As a consequence of this, it was felt that there was a need for there to be someone with the explicit responsibility and authority to take the lead introduce and maintain energy saving efforts. One woman in the GRC discussed the problem of a lack of authority:

> "If I was told [by the University] you should be saying this this and this to people, then at least you'd be saying it with some authority…because I could be asking people, but who am I?" (W1- GRC)

Each building also discussed topics that could come under a theme of Knowledge and awareness. There was a general consensus that before energy conservative behaviours could begin, they would want to know how much the building is costing in energy, which behaviours/parts of the building were most wasteful and what changes would make the greatest savings, otherwise "you would just be guessing"(M1- HRI). In line with this, it was felt that if such information was provided (and all groups strongly felt the University *should* provide it), then it would raise people's awareness of the amount of energy being consumed and maybe enable them to "make more informed decisions about it" (W2- HRI).

Overall, the issue of energy use within University buildings is a highly social one, compared to in the home environment where energy related decisions are often economical. Other themes are emerging relating to the associations of the user of energy usage and the development of social norms and the related peer pressures. The next stage of the project will continue to explore and develop these themes and fit them into a wider theoretical framework.

References

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the new environmental paradigm: A revised NEP scale. Journal of Social Issues, 56, 425–442.

Gardner, G.T. and Stern, P.C. (2008), The short list: the most effective actions US households can take to curb climate change, *Environment, 50*, 5, pp. 12-24.

Jones, D. Ll. (1998). *Architecture and the Environment*. London, Laurence King Publishing

McMakin, A.H., Malone, E.L. and Lundgren, R.E. (2002), Motivating residents to conserve energy without financial incentives, *Environment & Behavior*, *34* (6), pp. 848-63

McKinsey & Company (2009) Pathways to a Low Carbon Economy, Version 2 of the Global Green House Gas Abatement Cost Curve.

Nicol, J. F. and Humphreys, M. A. (2002) Adaptive thermal comfort and sustainable thermal standards for buildings, *Energy and Buildings , 34,* pp. 563–572.

Robert W. Marans, Jack Y. Edelstein, (2010), The human dimension of energy conservation and sustainability: A case study of the University of Michigan's energy conservation program. *International Journal of Sustainability in Higher Education, 11* (1) pp. 6 – 18

Unvirersity of Sheffield Environmental Policy, last accessed 17-05-12: http://www.shef.ac.uk/polopoly_fs/1.4675!/file/Environmental-Policy-Aug-2009.pdf