‘Watts in it for me?’ Design Implications for Implementing Effective Energy Interventions in Organisations

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ABSTRACT
The design of technological interventions to motivate behaviour-based reductions in end-user energy consumption has recently been identified as a priority for the HCI community. Previous interventions have produced promising results, but have typically focused on domestic energy consumption. By contrast, this paper focuses on the workplace context, which presents very different opportunities and challenges. For instance, financial consequences, which have proved successful as motivations in the domestic environment, are not present in the workplace in the context of employees. We describe the outcome of a sequence of workshops that focussed on understanding employee perceptions of energy use in the workplace, with the locus of activity on energy intervention design. Using a grounded theory analysis, we produced a framework of key themes detailing user perceptions and energy intervention design considerations. Our findings provide a framework of considerations for the design of successful workplace energy interventions.

Author Keywords
Energy; sustainability; behaviour change; HCI; persuasive technologies; organisations.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

INTRODUCTION
The HCI community has recently directed substantial effort towards the design of technological interventions - or ‘Persuasive Technologies’ [15], to motivate behaviour-based reductions in energy consumption. Much of this research has exploited ideas recently re-popularized by Thaler and Sunstein [34] in that individuals can be ‘nudged’ to make better lifestyle decisions, given the right information and the environment in which to do so. Emphasis has also been placed on how individuals might improve their own private and domestic lifestyle, behaviour, and sustainable resource consumption [37],[23]. However, such work has rarely taken account of the fact that people spend a significant amount of their waking hours at work where they also contribute towards resource consumption. With large public and private sector organisations accounting, for example, for 10% of the UK’s emissions [10] there is scope for reductions in such consumption through motivating employees to modify their behaviour.

Designing an energy intervention for the workplace presents challenges for the interaction design process which must address issues ranging from the motivational, to the social, organisational, and technical. For instance, for most people cost is the primary motivating reason to reduce their energy use in the domestic environment (for instance see Chetty et al [9]). In essence a decrease in cost is the reward for reducing consumption in a household. In the workplace, however, employees are typically not responsible for paying energy bills therefore creating a problem in how to incentivise positive behaviour change. Furthermore, there are challenges inherent in understanding and gaining access to organisational cultures, with incumbent cultural constraints, that are not present in the domestic domain. In order to meet this challenge, it is prudent to employ a qualitative research methodology to provide a rich account of the users and the design space.

This paper describes the use of Grounded Theory (GT) [32], a qualitative research methodology, to perform an analysis of a series of organisational energy workshops investigating perceptions and behaviours of workplace energy usage. The resultant GT analysis presents findings that support a greater understanding of employees and how they use and perceive energy in their workplaces. Additionally, the analysis provides an insight into the design considerations of organisational energy interventions. This work forms the user-centred design component of a large organisational energy project, an endeavour which aims to reduce energy consumption in the workplace by developing a suite of social persuasive applications to encourage positive consumption behaviours.

The workplace in the context of this study is educational and public sector workplace environments in the UK.

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BACKGROUND
A substantial set of literature has now been produced about developing and evaluating applications aimed at reducing energy usage in the domestic environment e.g. [14],[29],[9]. As has been noted by other researchers [12],[2], this work makes for interesting comparison with contributions from other disciplines, such as environmental psychology, which have also extensively researched domestic energy for several decades [5],[7]. Other relevant non-domestic work by Odom et al [26] investigated the use of persuasive applications to reduce student accommodation energy usage. Leaving aside the differences in approaches between these communities, we are unaware of any substantial work from the research community on understanding energy related behaviour change with employees in organisational or corporate settings.

To set this lack of research in context, a recent report [1] indicated that if the 17 million UK workers who regularly use a desktop computer powered it off at night this would reduce CO2 emissions by 1.3 million tons - the equivalent of removing 245,000 cars from the road. Deploying automated interventions that turn off desktop computers, lighting and air conditioning may be seen as viable interim solutions to save some energy, with no requirement of behaviour change - a classic engineering approach that effectively removes the ‘human’ from the equation. However, our findings, discussed later in this paper, show that employees may find automated interventions unfavourable, even going to extremes of circumventing them, particularly when they impact on their daily work tasks.

The UK cabinet office recently published a stand-alone ‘Behaviour Change and Energy Use’ white paper [7], with the main focus on motivating domestic energy reductions. Organisational contexts are mentioned in the report, with main emphasis on automating lighting and heating settings (i.e. this disregards behaviour change). Cursory mention is given to organisational behaviour change using social norm theory, competition and feedback albeit with no design or deployment guidelines for best practice exemplary implementation. Similarly, there are numerous 'grey literature' reports produced by consultancies and other non-academic or scientific organisations on the topic of sustainability in the work-place (e.g. [25],[18],[21]). Elements of this material corroborate the research presented in this paper, specifically with respect to the importance of engaging employees as part of a bottom-up sustainable intervention, while being supported by top-down visible management buy-in as well as the value of educating employees, generally, on environmental sustainability.

The research methodologies utilised by grey literature are diverse in type including 1) case studies and green-team interviews [25], 2) evaluating enabling technologies (power reducing hardware) and Energy Awareness PoC’s [21] and 3) large scale surveys [18]. The main difference between such work and that presented here (and indeed that typically undertaken by the rest of the HCI community) is the high-level analysis of the grey literature which typically lacks rigorous and systematic generation of theory from in-depth analysis of users (employees and management) and their motivations and contexts.

Perhaps the only substantial scientific study around engaging employees in energy related behaviour change to-date was carried out by Siero et al [30], which demonstrated that when a group of employees received information not only about their own energy usage, but also about that of a ‘competing’ group of similar people, they significantly altered their energy usage behaviour. The Siero et al study did not use frequent, or indeed any kind of technology-led, feedback yet it was still successful, suggesting further reductions could be made with a technology approach with a number of enhancements including timely and detailed feedback.

More recently, embryonic work has been described by Lehrer & Vasude, which investigated the concept of using an online social network to deliver workplace energy feedback and promote and encourage energy saving practices [24]. The authors have yet to report on the findings of their field-study; which mirrors the social media approach described in successful domestic interventions (e.g. [16]). Hence the work by Siero et al, some fourteen years ago, remains the only rigorous empirical research carried out in energy-related behaviour-change interventions in organisations.

We believe there is a basic research knowledge gap present in understanding the end-users of energy in the workplace and, therefore, the design of appropriate and achievable workplace energy interventions, particularly those that encompass novel ways of encouraging people to adopt positive energy usage behaviour whilst at work. Understanding energy usage in the workplace is a complex task with significant social, organisational, cultural and technical issues that cannot be easily quantified by casual inquiry. In order to help address the problem of adequately understanding employee motivations, engagement and incentivisation in workplace energy interventions, it is important to carry out basic research targeting specific relevant themes. To address these issues we have conducted a series of facilitated in-depth workshops with the specific aim of supporting the principal research question: “How can we positively change the energy consumption behaviours of groups of employees in the workplace using technology-led feedback and tools?”. Our selected methodological approach of using GT to elicit further scientific enquiry into this question facilitated the creation of a framework, generated from workshop data, to support an understanding of both the end-users and design space of workplace energy interventions.

The remainder of this paper is outlined as follows. First, we describe the workshops and design tasks. Second, we expand upon our GT approach by presenting a verbose
description of the analysis process. Next, we summarise the main research findings and discuss the design considerations mapped onto a sample prototype interface. Finally, we conclude with future work direction.

WORKSHOPS
Three day-long workshops were run across 3 locations with a total of 65 participants from 5 universities and a number of businesses in the energy industry. The job roles of participants covered a diverse range including administration, managers, marketing, engineering, librarians, IT support and institutional leaders. Students were not present at the workshops as they are a different type of end-user, usually not subject to the same organisational structures and rules as employees. Many of the workshop participants were senior members of staff with long careers in managing institutional change. Their responses were based on many years of experience of implementing new policies and managing staff.

At the start of the workshop, and to set the scene, participants were asked to first complete a survey rating a range of energy feedback visualisations. The second and most extensive workshop task was to design a 12 month energy intervention for the workplace. The survey was completed individually while the design task was carried out by participants in small groups. The focus of this paper is the GT analysis of both the substantial written and audio accounts of the design task, the survey data was not included in the analysis. Participants were passionate during discussion with heated debate taking place on topics such as automating (taking control away) vs. behaviour change (retaining control) energy reduction strategies.

Design task
Participants were briefed on the design task requirements and asked to think in terms of deployment in their own organisation. Specifically, the task was to design a 12 month intervention, using technologies of their choosing, to reduce energy consumption in the workplace. Basic non-visual details of possible concepts to consider for inclusion in an intervention were given to promote advanced reflection on the task, these were: a) recruitment strategies b) energy feedback and c) sustaining beyond the intervention. Participants were randomly split into smaller focus groups at each workshop (4-5 people) with 2 hours given to complete the task. For each group audio and written accounts of the task were recorded for later analysis.

GROUNDED THEORY
The Grounded Theory method was selected for its suitability for deriving theory for supporting further research direction when analysing a large corpus of qualitative data. Other positives are its usefulness for developing research hypotheses from little understood domains, as well as its effectiveness when working with qualitative text or audio data. In this work, at a basic level, it allows us to understand employees’ energy usage habits and their relationship with the technologies they use at work. At an advanced level, it allows us to understand their personal levels of trust and openness in their organisation when asked to engage with a workplace energy intervention. When combined we can develop a fuller understanding of energy as a ‘resource’ in an organisational context and how employees interact with and perceive this resource. With our GT analysis complete, it provides a series of supporting research hypotheses that contribute to the main research question, as well as providing design insights that aid an informed approach for interface and interaction design.

Other researchers in the interaction design community have long since adopted the GT approach to analyse and explain phenomena such as digital performance spaces [6] and to inform design [33] - both of which are difficult to quantify through statistical analysis alone.

The Nvivo 8 qualitative research software suite [28] was used to code and transcribe the recorded workshop data (including transcribed recordings and post-it notes, examples shown in figure 1), providing an efficient means to collect, analyse and present the data.

Open coding
The first phase of a GT is open coding which includes manually trawling for conceptual labels (codes) relating to energy usage from the corpus of design task data. Open coding is required as the analysis of the empirical data starts with no pre-defined sets of codes or categories. A total of 631 codes were compared and grouped into 36 learned abstracted categories. Concept granularity was at the word or sentence level with examples coded such as ‘hide the overall problem with metrics’, ‘senior management’ and ‘rewards’. Further refining of the codes into key hierarchal categories is carried out in the next step.
Axial coding
Abstract categories from open coding were amalgamated to create a more defined hierarchy forming key related categories. At this stage theoretical saturation occurs with no new concepts or categories emerging from the corpus of data. The resultant axial categories are the central themes formed from the participants’ discussion and activities for the design task and determine which design insights and requirements can be drawn out. From these key categories a ‘core’ category is developed using selective coding that integrates and connects to all others. Six key axial categories were identified and are illustrated in figure 2 with corresponding category relationships.

Figure 2 - Axial coding derived key categories
The six derived categories from the analysis are described in the next section, including supporting quotes from participants.

Selective Coding
The final stage of a GT is “selective coding” where illustrative quotes are selected to form a narrative [31]. Here an overarching “theory” is developed which brings together the axial codes. The central theme of overall responsibility can be seen as an overarching concern. It is used to organise the grounded theory where theory is understood as a broad description rather than a predictive model [8]. Throughout the workshops participants would return to the notion of responsibility. Many of the other themes in the discussions were strongly related to this concern. In this way mundane organisational concerns such as current performance indicators which might conflict with energy targets became drivers of the discussions.

Incentives
Many of the workshop participants approached the problem of motivating employees by asking on their behalf: ‘What’s in it for me?’ They argued that employees want to be incentivised by negotiated rewards. This involves selecting the intrinsic ‘value’ of savings, examples were saving funds for student bursaries or a free Christmas party. Participant quotes of tangible rewards were:

W1P2: “we can offer them a party at the end of the year, that’s an incentive” and W1P6: “free meals in the canteen would be good as a reward”

Other quotes indicated positive and negative financial incentives that were devolved back to a department:

W2P2: “the proportion of what you save comes back to you” and W1P3: “if you go over energy budget it will hit you hard financially and have to come out department’s budget”

Interestingly, employing extra people with savings made was seen as a viable incentive:

W2P6: “sit them - management - down and say look this is why it matters and [this is] how [it] is going to affect your budget, this is how many more people you can employ through savings”

The incentive suggestions were disparate and ranged from small and seemingly innate rewards such as free meals to sweeping high impact, high value rewards like employing more staff. Whatever the reward was, participants argued that it would have to be highly visible with frequent progress updates. Incentives were closely related to Engagement.

Openness
Trust was seen as an important issue for employee engagement with energy interventions. For the programme to be engaging employees would have to accept the reasons why savings were required without being cynical. Having confidence that the organisation was acting in the employee’s best interest was a key theme. The foremost question participants wanted to ask in response to taking part in a workplace energy intervention was: ‘Why am I doing this?’ embodied in the following quotes:

W1P6: “got to ask who benefits from savings, me personally, the department, the company, the government?” and W2P3: “why am i doing this who am i doing it for?” and W3P11: “if head office are putting the money in (returning savings), it’s whether or not they will do it”.

This indicates the importance of a transparent response in the reasons why they should commit to an intervention. Trusting organisations and employers was of course, not necessarily going to be easy:

W3P12: “we had quite a lot of serious redundancies which we were told was because X amount of money needed to be saved, within a year we were told that money saved had been given to students in bursaries, so there is always a danger of politics behind the scenes” and W2P10: “it is useful to define what the value of the savings is going to be, if you don’t, you won’t have any confidence in your institution to do what they say they will with savings”
Trust in the context of automated energy interventions such as air-conditioning thermostat controls and powering off desktop computers outside working hours was discussed. Employees had little trust in such systems and voiced concerns they don’t always support their best interests and comfort at work:

Figure 3 Engagement key category breakdown

W1P9: “If you take all control off me (automated system), I’m going to feel completely disempowered” and W3P21: “If working conditions are uncomfortable, [I] will ‘switch off’ from energy saving, not going engage at all in energy interventions if you can’t heat my office” and W2P7: “[management] have got to convince me that it’s reliable (automated powering off computer)”

Anecdotal stories regarding employees circumventing automated measures were mentioned:

W2P3: “there was one lady in our office who would attach ice cubes to a thermostat to turn heating on, and if it was too hot they would put an electric heater on near it” and W1P4: “...found a way to get around (automated system) switching my computer off, so I didn’t have to wait for it booting up when I came back in the morning”

Lastly, participants indicated privacy was important, with respect to identifying individuals’ consumption levels:

W3P13: “...it’s also about getting into the wrong hands (personal energy data), don’t want other people making inferences about how I do my job” and W3P5: “if it was anonymised (personal energy data) I really don’t mind, as long as there is something that would stop me from being identified”

Without trust in the organisation, participants indicated that the participation in an intervention would be lacklustre at best and likely to fail. An intervention should begin with transparency at the offset by detailing the motivations for reductions. Demonstrations of how savings have been allocated and utilised could be achieved through frequent feedback and by the potential use of public social media, thereby offering public-facing openness and alternative modes of communicating feedback.

Engagement

Competition and negotiated targets were favoured to both lower barriers to participation and engage with an intervention; with particular emphasis on achievable targets. Unrealistic targets, inability to set targets and unfair competition were highly cited for bringing about potential disengagement. Engagement is critical for success in any intervention and understanding its role in an organisational setting is important. A detailed illustrative breakdown of this key category is shown in figure 3.

Participants were vocal on negotiated targets with small incremental steps deemed important for an intervention’s uptake and adherence:

W1P7: “people who are involved in negotiating the basis of the target is an interesting way of getting people to buy in, better than just saying here’s your target, this is from the government” and W3P14: “It’s about setting targets, it’s about sitting down at a meeting and saying what can be the best achievable target with what we have got at the moment”

Participants agreed that competition could be very effective and suggested using league tables:

W1P5: “everybody likes a bit of competitiveness and like to compare themselves against each other” and W2P9: “introducing competition to people like the *blanked* cycle challenge, sent an email and within an hour 20 people had logged into the cycling site and uploaded all their trips, we went from way down in league table to the 5th best”

Although competition was favoured, it was felt that consideration should be made of the granularity and disclosure of performance data. Participants indicated points relating to performance data such as a) data at individual or department level, b) choosing to opt in, and c) implications of publicly disclosing organisational performance data.

Play was also present in the engagement dialogue, manifesting itself as game mechanics such as campaign challenges with rewards and punishments: W3P4: “could play Hangman – if you are over target its one extra piece, could hang the manager!” and the idea of aversive feedback: W3P6: “you can kind of reset the challenge by saying look this is atrocious you’ve slipped by 60%, shame on you in a slightly friendly way”.

Friendly admonishment or teasing was also a theme in previous studies which allowed Facebook friends to check on one another’s energy consumption rates. It is possible there is space for the kind of friendly but pointed banter participants suggest may be provided through social media communication.

Communication

This was seen as critical at all stages of an intervention. Communication encompassed workshops for educating
employees on energy as a finite resource, effective marketing campaigns for recruitment and continuous feedback using multiple channels for all aspects of energy use in the organisation. Lines of communication should be open up and down in the organisation with quality of the message, not the mode of communication, seen as the important factor. Communicating via online social media was discussed in detail:

W2P5: “a lot of the students and academics will be on twitter and that kind of stuff, if you are just admin in the office you are not meant to have your mobile switched on so texting would be useless and you are not looking at Facebook and Twitter” and W2P6: “the thing as well about Facebook and using it at work is some of these channels you could be getting at home at the weekends and that’s the blur between work and play…..it might affect not only what you do at work but at home as well” and W3P16: “if you were looking at Facebook while at work that would be frowned upon, you aren’t doing your job”

These quotes highlight the polarisation of social media use within an organisation such as a university; organisational culture is present in the form of constraining communication with different rules for different groups of employees. Communication restrictions placed on specific job roles can limit an interventions outreach and effectiveness, raising further design implications.

Participants indicated that the quality of a communicated message is important:

W2P8: “even email….if you get so much you don’t read it, we have actually had a comment if it’s important please can you send me a hard copy” and W2P4: “can I just emphasise the quality of the message and not the media being used is important, I think the biggest problem is the quality of the message… a bad message is a bad message” and W1P7: “communication is about communicating in a relatively personal way how different that is from just showing a bunch of numbers”

Communicating an ‘energy awareness’ message in an organisation to seed behaviour change is a difficult task. It is not concerned with conveying messages to an individual but rather groups of people. Employees may have been in roles for long durations where their daily tasks have become routine and deeply embedded in the organisation’s culture, in other words old (often inefficient) habits and routine. Communication therefore needs careful consideration not only of the content of the message but the chosen medium to deliver it. This raises the questions: ‘Which employees can we reach effectively and collectively and through which communication channels?’ and ‘Are online social networks appropriate for organisational use as part of energy interventions?’

Communication is closely linked to the visualisation category, which communicates energy consumption through visual representations.

Visualisation

Representation of energy i.e. bar graphs and other abstract visualisations was the most debated theme in the workshops. However it was the least understood by participants with regards to the technically feasible and what their organisational policies would allow them to do with their own energy data. The overarching finding was there is no single solution or ‘one size fits all’ representation for displaying energy feedback. Instead, a visualisation or ‘dashboard’ that embeds the attributes of the other five key axial categories in the analysis may be the most suitable.

Participants understood the value of visualising energy data but also realised that there is no simple method to generalise a visualisation to all audiences:

W3P8: “…it depends on your learning style, whether you respond to text or images or in some ways again it’s like who the audience is, there is no one silver bullet response, different people need different things”

Presenting progress feedback towards an energy target was also important for visualising:

W1P3: “[we] need to see where we are going you can’t just say let’s reduce energy as that’s a bit woolly” and W1P7: “people feed into it from all the departments…..which means you could have a separate target for each department” and W2P6: “I’d be more motivated if I can see the figures actually working with regards to a target, could we not compare a departments progress against their own individuals targets?”

Energy feedback granularity was considered important, with energy data at departmental level suggested as more useful instead of abstracted to whole organisation level:

W3P13: “…..would like to have office level metering, it’s because we have the power to influence what is going on” and W3P20: ‘coming back to motivation, it’s hard to look at a whole organisation and think I’m going to make a difference’

Displaying fiscal units mapped onto energy consumed and saved was deemed to be a useful metric in making the resource more tangible:

W2P4: “I think putting monetary value on it is really useful, though it’s not saying anything about whether it’s high or low” and W2P9: “the thing for me was that you could actually put pounds and pence to something”

Lastly, the timeliness of energy feedback was discussed:

W1P3: “realtime (energy feedback) has got the potential to be brilliant…. you have a feeling of control and there is direct cause and effect, you can see that happening in real time” and W2P5: “live data (energy feedback)…..we could plot all our stuff that is on, how many computers throughout the day and stuff”
However it is important to note that the timeliness and detail attributes of a visualisation is largely dictated by the format of the energy data being fed into it. We consider this issue further in the discussion section.

Leadership Role

The role of leadership was a thread woven throughout much of the data. Without “management commitment” employees feared their efforts would be frustrated, that results would be trivial and interventions destined to fail. Charismatic leadership and leading change from the top were cited as being the most motivating factors in engaging with and adhering to interventions, with change “trickling down”.

Participants indicated having good leadership and management behind an energy intervention was important:

W1P3: “first point you have to make when creating any campaign is getting senior management buy-in” and W1P4: “…you would need a carbon management plan and somebody leading that project” and W3P5: “if senior management aren’t in then they can’t motivate people, you might have…….certain leaders buying in and certain ones don’t, so you are still seeing variable behaviour”

Some quotes also discussed convincing management of the benefits of a successful intervention:

W2P4: “…approach their manager and say the same thing – look, this is good for you, when you tell them the rewards that they could be saving, that’s when senior management will go ‘oh yes!’” and W2P7: “sit them [management] down and say look this is why it matters”

Leadership was unanimously seen as an essential component of a workplace energy intervention, whether leading from the local level or from the top of the organisation.

The percentage of unique codes in each axial key category is shown in figure 4. This is purely descriptive and important to note it adds no value in making inferences to the potential weighting of a key category.

However it does allow us to identify possible anomalies in the data, for example the ‘Leadership Role’ category had the lowest frequency in terms of open coding count but was communicated during the design task as the single most important attribute for intervention success. Participants likely felt uncomfortable describing management practices due to the hierarchical nature of the organisational structure, with senior colleagues present at the workshop.

RESPONSIBILITY

The theme of ‘Overall Responsibility’ integrates and links all the categories that emerged from the data. The notion of corporate responsibility encompasses trust, ethical values and transparency in an organisation’s activities and acts as the main driver for key categories identified by the participants such as openness, communication and leadership role. Corporate responsibility applies to the whole organisational structure from top to bottom conveying the message that all levels of staff have to be engaged in realising change. For these participants then a successful energy intervention strategy would involve:

- Providing strong leadership and “management buy-in” to ensure all departments and employees are part of the initial outreach as well sustaining engagement long term.
- Promoting trust by ensuring that no part of the organisational structure is exempt.
- Ensuring transparency so that the reasons behind the intervention are clearly and openly communicated.
- Involving employees in setting energy consumption targets.
- Negotiating incentives mapped to any energy savings made either at the departmental or organisational level.

DISCUSSION

Our findings provide a background for understanding the challenges of organisational change in reducing energy usage. The issues discussed here, although organisational rather than technical, are relevant to the HCI community as important context for creating energy interventions in the workplace. We summarise by first highlighting the findings of our analysis and second discussing their relevance to the design space.

A large amount of the workshop discussion was directed towards defining the level at which energy should be monitored, i.e. individual, office, department or organisation. The departmental level was deemed the most accessible level to identify with in terms of an employee’s ability to perceive and influence energy usage. Privacy concerns were raised when identifying an individual’s consumption with organisational level deemed too coarse to relate to. Granularity of energy data is a technical issue and determines the scope of an energy intervention in terms of ability to run fine grain departmental level or coarse organisation level interventions. Energy sub-metering is generally required for office or department level. For example some organisations may only have building level metering that is recorded once every 24 hours, making most office or departmental level interventions difficult and raising further implications for
design when considering the effectiveness of comparative or competitive measures.

Surprisingly the participants didn’t think it was important for the energy feedback to be pleasing aesthetically. Typical organisational style bar and line graphs with set energy targets overlaid were deemed to be suitable for understanding usage, an approach also recommended by Tufte [35] when presenting quantitative data. Suggested metrics a visualisation were cost and the kilowatt hour energy unit. Although the kilowatt unit was not generally understood by all participants, it still gave an indication as to high and low consumption. Alternative tangible offset measurements were suggested to sit alongside energy, such as the number of cars that could be taken off road. Frequent feedback was important with near-real time preferred, allowing employees to see the impact of their actions.

Engagement and maintaining interest in an intervention were highlighted as critical to lasting success. Competition through sharing performance data with others and setting targets to self were frequently suggested as a means of preventing disengagement. Equally, the creation of pledge-enabled incentives where energy savings are piped into a cause or reward was desirable. Frequently suggested intervention attributes were league tables, timely progress feedback and pledging boards. It is of course no accident that these mechanisms are those most commonly used in the public sector for managing any organisational change and monitoring performance.

Another important aspect of engagement was employees’ desire and motivations for empowerment to bring about green and sustainable practices. They wanted to negotiate the terms of an energy intervention, not just as individuals but as a collective group, which in many cases could be the entire organisation. Key to this empowerment was negotiation of energy targets and what should be done with any energy savings made. Work by Dourish [13] suggests scaling issues can occur with sustainable practices unless you have community wide and upwards participation. With empowerment present it alleviates the scaling concerns as employees from top to bottom in the organisation are rallying together, not just a few motivated individuals or small silos of green employees.

The workshop participants were predominantly administrators and managers. It is clear that during these workshops they applied the strategies that they typically used to monitor organisational performance to the problem of reducing energy consumption. The performance of institutions in the public sector such as universities and hospitals has for the past twenty years been measured by indicators like league tables. Measurable targets (e.g. student numbers, increased recruitment and retention rate) are set and counted annually. Research is ranked and rated by the number of publications in conferences and journals. The discussions then centred not only on suggestions for implementing similar mechanisms to achieve energy change but also on the kinds of problems encountered when using such systems.

Participants were from both the public and private sectors, often quite senior managers, who were aware of the problems of this kind of approach to organisational change. Unintended consequences of new performance indicators and league tables are well documented. For example the introduction of waiting time targets in UK Accident and Emergency wards appeared to speed up the queues but further investigation revealed that people were being kept in ambulances, discharged early or sent to the wrong department so that administrators could meet their targets [22]. Similarly in education whenever exam results have been used as performance indicators marks have improved but not necessarily because the pupils were learning more (ibid). In large Health and Education organisations the introduction of new performance indicators has resulted in managers and employees gaming the system. For many participants then a frequent concern was accountability and the ways that blame might be managed in the event of a failure to reach targets. The discussions in then highlighted the importance of organisational culture and politics in the implementation of energy reduction interventions.

Designing interventions for an organisation
User-generated design content was derived directly from participants during the workshop intervention design task. The content included diagrams, textual and audio accounts which were coded to each of the 6 key categories developed in the GT axial coding stage. From the concept of each category and their descriptive content, we can determine the basic design of a workplace energy intervention when delivered as a web application or desktop widget. The basic design should include each of the following themes: Visualisations, Incentives, Engagement, Leadership, Communication and Openness. In figure 5 a prototype design is shown mapping the key GT themes by embedding them in the interface.

![Figure 5 - prototype wireframe interface displaying themes](image321x122to553x285)

Interestingly, during the design sessions little emphatic response was evident towards the suggestion of using eco-
feedback [20],[11] or abstracted visualisations using metaphors for energy usage. The workshop participants preferred the use of bar charts, line graphs and metrics such as cost; typical organisation-centric representations.

Comparing the themes from our findings in the organisational (or work-place) setting to research in the domestic setting reveals some overlap in terms of: visualisation, incentives and engagement. For instance, our preferred visualisations are not dissimilar to those designed in previous eco-feedback work by Petkov et al [27] in the domestic setting. However, our incentives theme, based on commitments and pledging and a return in the form of a tangible reward (e.g. a student bursary or party), differs from work by Bang & Gustafsson [4] which utilised game rewards in a virtual household. Other HCI work on domestic eco-feedback has used ambient displays for water [3] and energy [19], thereby solely focusing on a non-interface visualisation theme.

In the prototype interface, a proposed Visualisation was a container of ‘energy’ that decreases as energy is consumed with markers for projected usage, as well as a marker for monthly target. Incentives are integrated as a pledging chart, with the ability to select the desired cause employees wish to pledge the departmental savings too. Engagement is present as displayed targets with links to a competitive league table with other departments. Leadership Role is manifested as a lead manager displaying responsibility for energy consumption in the selected department, effectively indicating management buy-in. Details of the lead, including job title and personal photo are displayed. Communication is present throughout the prototype with energy and other progress feedback highly visible. Public sharing of the data is possible through various channels such as social media. Openness is displayed through visualising savings made, where the savings are reinvested and the value of a further departmental contribution, all effectively broadcasting organisational transparency.

Equipped with a fuller understanding of the design space, the next phase of this work is mapping design to behaviour change theory. This will be carried out by extending on previous work by the HCI community in applied behaviour change for sustainability [2],[17].

CONCLUSION
Our analysis provides a rich account of employee and management perspectives of current energy usage practices and how to design effective interventions. Although the insights that we describe are largely concerned with organisational cultures and politics, understanding these contexts will be crucial in the development of a successful energy intervention. The Scandinavian traditions of participatory design originated in a Union led insistence that workers should be involved in the design of the tools they used. Understanding work environments will be no less important in the context of designing interventions which encourage employees to use less rather than more technology. This paper has argued that the design of interventions intended to reduce energy consumption must address issues of corporate responsibility. Throughout the workshops the participants returned to issues of personal, departmental and institutional responsibility: who was to be responsible for setting targets? Were they achievable? What would happen if they were not achieved? Who was to be held accountable? Where, in other words did the buck stop? Here or near? The design of energy reduction interventions must be carried out with particular sensitivity to institutional cultures of accountability and blame management.

The next steps in this research will be to apply these findings in an iterative design process mapped onto behaviour change theory, which continues to draw on the insights of the employees of our partner organisations. The final designs will be tested “in the wild” in large scale energy studies across campus and local authority infrastructure.

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