Original research article

# The feasibility of saving energy in challenging organisational contexts: Testing energy visualisation in a social services office in the United Kingdom

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## ARTICLE INFO

## ABSTRACT

The workplace offers opportunities for energy savings, but few studies have evaluated the effect of energy feedback in offices. This paper reports a case study of an energy visualisation intervention among social care staff. The research examined the role of feedback design (simple graphs vs. visualisation) and discusses the feasibility of implementing a near real-time visual feedback intervention into a work setting with staff keenly aware of their primary job roles. The findings show a staff sample with positive beliefs towards energy saving, but bounded by low feelings of self-efficacy, weak social norms, and perceived barriers in the office. Feedback may have supported feelings of collective efficacy and encouraged staff to talk with colleagues about ways to save energy. But engagement with feedback – and energy use in general – was limited. Energy use was embedded in other concerns and issues, such as a strong team culture and wider problems in the building. The case study highlights the complexities of energy-related behaviours in the workplace and the role visualising energy could play in this context. Engagement will be a key challenge in achieving successful feedback initiatives; we provide recommendations to tackle this challenge and identify areas for future research.

## 1. Introduction

Research on energy saving has primarily focused on households, however in Europe the only increase in energy consumption recently has been observed in the service sector (e.g. Local Authorities, banking, tourism etc. between 2005 and 2013 [24]). Although energy consumption at home is now understood better, research on energy use in the office is lacking [26,33,36,44]. This paper focuses on energy saving in offices as a workplace setting. Evidence on intervention strategies to motivate energy saving in the workplace is so far inconclusive [33]. A key debate within the energy and social science field relates to how people make energy-related decisions, especially when these decisions require tradeoffs, e.g. in terms of comfort or money [45]. Crucially, these tradeoffs depend on the context within which energy decisions are made. The workplace offers a 'distinct' context [36] that warrants further investigation [14] because findings from studies on home energy use may not be easy to translate to the workplace.

A number of barriers might prevent individuals from engaging in energy saving activities in the workplace, but opportunities have been identified as well. It is assumed that individuals in the workplace, compared to the domestic context, feel less personally responsible for energy use through a lack of direct financial interest [36]. Further, shared appliances might reduce opportunities for employees to save energy as well as reducing feelings of control and the perceived impact of their actions [14]. The complexity of energy-related behaviours in the workplace should also be noted, with factors such as organisational roles and work objectives that can work against energy saving (see Refs. [11,17] for an overview). Typically individuals do not act in isolation in the workplace but are embedded in group membership and social systems [3]. They are influenced by the energy-related norms and attitudes that their colleagues hold [3], and the collective beliefs regarding the outcome of energy-saving actions (i.e. collective outcome expectancies or collective efficacy [22]. The influence of these social/collective factors is thought to be emphasized in the workplace, compared to the household, due to the presence of many shared workspaces,

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tasks and appliances—in addition, energy-related behaviours in the workplace are regularly observed by others [14].

But the organisational context also provides opportunities for energy saving. Compared to households, individuals interact with, and have control over, fewer electrical appliances in office workplaces, and behaviour may be embedded in fewer different practices than at home [36]. Employees also provide a 'captive audience'—low cost communications can easily reach the target group [14]. Beyond direct financial motives, individuals might have other reasons to save energy at work (e.g. supporting the organisation or caring for the environment [33]). But more research is needed to investigate how academics, energy managers and policy makers can utilise these motivations and promote energy saving behaviours in the organisational context.

This paper describes an exploratory field study that implemented an energy visualisation intervention, using a near real-time feedback display, in a Local Authority office in the United Kingdom (UK) which houses social services employees (e.g. children social care). In the UK, and elsewhere in Europe, there is increasing pressure on the public sector to save money and reduce energy consumption. Financial cuts to public sector spending are put in place by governments across Europe to reduce country deficits [4,34,39]. At the same time, the EU Energy Efficiency Directive sets out targets requiring ambitious energy savings by 2020, against a 2007 business-as-usual projection. This directive calls for public sector buildings to play an exemplary role [23]. In the UK, a 18% energy saving target by 2020 has been set, and policies are in place to reduce energy use in the public sector [21]. Therefore, the UK provides a relevant case study for the feasibility of energy saving interventions in public sector offices.

This research responds to a call for studies in real-world organisational settings, which are able to capture important context-individual interactions [14]. Also, scholars have called for sector specific research to capture opportunities and barriers to energy saving in particular sectors [3]. The present study is set in an environment where high demands are placed on staff working on difficult cases with constant time pressures. Next to exploring the results of the energy visualisation intervention, the paper will also discuss the challenges and barriers involved in implementing a feedback display in this workplace context. The study will examine factors at the individual level (e.g. feelings of control, personal norms) and collective level (e.g. collective efficacy, social norms) as both are thought to be important in shaping responses to energy feedback in the workplace [3,22]. The next sections will review previous studies in both the domestic and organisational context that have informed the current research.

## 2. Feedback: making energy use visible?

Energy has been described as invisible, abstract and intangible [7,25]. It is difficult for the average building user to understand how much energy is used overall, and how energy is connected to what s/he does in their day-to-day life [13]. In a recent study members of the public were asked to draw what they thought energy looked like [6]. The drawings ranged from end-points of energy use (e.g. plug sockets), nature images (e.g. trees, sun), to more abstract images. The results showed varied, sometimes opposing views, highlighting the difficulty of visualising energy.

There has been a push in the literature towards 'making invisible energy visible' [18,27,28], in particular by providing feedback. Feedback provides individuals with information on energy consumption or savings, often using devices such as in-home displays [1]. Feedback can increase the relevance of behaviour by linking consumption to specific actions, and in turn, increasing a sense of control [25]. Thus feedback has the potential to empower householders [47] through increasing knowledge on energy con-

sumption, enabling householders to see the outcomes of their efforts, and linking to social encouragement and support for further savings [48]. This taps into three factors known to influence energy conservation: knowledge, motivation and ability [46].

A meta-analysis of feedback studies found savings in energy consumption between 5 and 12% [25]. Compared to other interventions, Abrahamse et al. [1] concluded that feedback can be very effective in changing energy behaviours in households, especially when provided frequently. Approaches that combine different strategies tend to be even more effective; for instance, goal setting can be combined with feedback [1]. However, despite its potential, problems with feedback in the household context have also been identified (see Ref. [10] for an overview). In particular, studies have observed that in-home displays can fade into the background and might be unable to retain householders' interest in the longer term as the novelty wears off [29,40,49].

### 2.1. Feedback in the workplace

Some studies set in the workplace show mixed support for the effect of energy feedback. Siero et al. [43] tested the use of feedback amongst staff in a metallurgical plant. Two types of feedback were examined: a graphical display with energy saving results for the whole unit (updated weekly), and a comparative feedback condition where – in addition to the above – workers received information on the energy saving results of two other units. Both types of feedback reduced energy wasting behaviour, especially the comparative feedback. More recent studies have mainly used university offices. Carrico and Riemer [14] reported a 7% reduction in energy use after a feedback intervention amongst university staff across twenty-four buildings. The feedback consisted of a monthly email with a graph depicting the building's energy use, along with goal setting information. In a small scale study by Coleman et al. [17], paper-based feedback was provided to four staff in their research department using in-depth energy and occupancy data. They suggest that the feedback helped raise awareness and identify energy saving opportunities. Murtagh et al. [36] examined the effect of near-real time feedback in university buildings using the MyEcoFootprint gadget, which displayed a colour (red/amber/green) reflecting last week's energy efficiency. The gadget directed staff to a website with more in depth energy information (e.g. by hour, day and week). Individual feedback was provided, monitoring the electrical appliances connected to power sockets at the person's desk. Energy use reduced during the intervention period, compared to baseline, especially near the end of the sixteen week intervention. However, the same reduction was found for the participants who registered to use the gadget (necessary to get access to the website information), and those who did not. Also, accessing the website (i.e. number of times accessed and duration of visit) did not relate to energy use. The authors suggest feedback had a weak effect and highlight that staff reported a 'syndrome' of reasons for not saving energy while recognising that saving energy was a socially desirable thing to do. Murtagh et al. [36] suggest office workers may lack a positive aim for saving energy, and initial motivations may not have been strong enough to overcome technical issues and barriers.

Indeed, Darby [20] stresses that feedback may not automatically increase energy saving behaviour. Specifically, few studies consider the relevance of feedback design [25]. How information is presented is a crucially important area of research that is often neglected, thus a key question remains: what types of information and feedback are most effective at influencing energy users? [45]. Research on visualisation can offer key insights into feedback design while technological advances have made it possible to move beyond the rather factual numbers and graphs typically used to represent energy use. Visual information is closely linked to emotions [30,50], has qualities to condense complex information, and can