Persuasive Technology for Sustainable Workplaces

A pilot study engages employees of the U.K.'s Department of Energy and Climate Change to lead by example by cutting their own carbon footprints.

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In persuasive technology and the wider field of behavior change—in academia, industry, and government policy—sustainability is a major focus. The usual aim is to design systems that influence users' actions to reduce environmental impact, for example, reducing CO_2 emissions through energy use and transport choices. This can be about influencing people to adopt new systems, or helping people to use existing ones more efficiently, individually or in groups, using a variety of design approaches [1].

One of the key differentiators between approaches is how designers *model* users and their decision-making. As Mike Hazas and colleagues have noted recently in *Interactions*, the assumptions that lie behind many household "sustainable behavior" interventions center on a model of individuals making "constant and active choices" [2] without taking sufficient account of the contexts of everyday life, social and time commitments, and negotiating priorities. Perhaps surprisingly, there also seems to be less emphasis on human factors research for behavior change than might be expected in the HCI community,

Figure 1. Arrows used by staff to annotate the building.

particularly around usability, despite numerous studies highlighting problems with systems such as programmable heating controls.

Workplaces are often contexts where potential impacts of individual behavior change are mediated by organizational and group issues. For example, staff may not be able to make changes to temperature or decisions about lighting. However, alongside infrastructure and operating changes for efficiency, interventions to address staff behavior are increasingly common [3]. These interventions are often communication-led and draw on social marketing, though some approaches use persuasive technology and allied HCI perspectives. Organizational motives include cutting energy bills and wider benefits such as increasing overall employee engagement.

In the U.K., CO_2 emissions arising from non-domestic buildings—primarily workplaces—make up 18 percent of the country's footprint. The government's Department of Energy and Climate Change (DECC) has aimed to lead by example in making improvements in its own building in central London. Technical measures resulted in a 21.3 percent reduction in CO_2 emissions in 2010 and 2011, but DECC recognized that future improvements could come in part through behavior change. As part of an industry-academic collaboration, we were commissioned to develop CarbonCulture at DECC, a range of low-cost HCI-led interventions designed and iterated through a pilot study at DECC's offices (about 1,000 staff).

Our aim was to develop effective methods of engaging employees in understanding the part their behavior plays in CO_2 emissions, as a precursor to behavior change, and to increase "buy-in" to relevant building operation changes. We adopted elements from different approaches for engagement and influencing behavior through design [1], including some gamification mechanics—though always mindful of the kinds of limitations outlined by Sebastian Deterding's panel in *Interactions* last year [4].

Workplaces and households offer different challenges for behavior change; at DECC, there were also political considerations, such as avoiding the perception of "bonus" incentives using taxpayers' money. On the other hand, some DECC staff were already better informed on environmental issues than the general population.

The emphasis throughout was on engagement through participatory design, involving employees in development through workshops and iterative prototyping. Engagement here was less about persuading staff into "correct" behavior and more about involving them in the design process for interventions addressing the everyday contexts of their jobs. Carl DiSalvo et al.'s distinction between seeing "users as the problem" and "solving users' problems" [5] is useful here; solving users' problems *through* more sustainable behavior seems preferable for engagement.

Our research thus focused on whether we could we engage large numbers of people, in one building, in voluntary carbon-saving behaviors by making them *useful*, *fun*, and *rewarding*.

Ethnography and Physical Touchpoints

CarbonCulture at DECC started with user research via ethnography—shadowing and interviews, interspersed with workshops with staff. We also engaged staff through simple physical touchpoints, to identify both behaviors that it would be possible to address and the kinds of tools that would be useful. Activities included asking employees to annotate their working environment with "arrow" comment cards (see Figure 1) to raise issues around CO_2 impact and encourage participation. Comments highlighted details of everyday interactions: for example, that the building's elevators are controlled by two separate circuits with two buttons on each floor; people habitually press both to try to get an elevator quickly, meaning that both respond each time.

One of the aims was to make visible some of the "invisible" links between systems—including the positions of sensors that provide input to the building management system—and provide a tangible starting point for exploring the staff's mental models of the systems around them. For example, the prevalence of staff confusion over the heating and air conditioning systems, revealed through the arrows, led to

investigating behavioral heuristics around heating and cooling and further exploration of ways to elicit mental models of systems [6].

Figure 2. The CarbonCulture dashboard and Scrunch, Foodprints, and OK Commuter apps.

The Digital Platform

The main focus was a digital platform, supporting Web apps and user dashboards (see Figure 2), an internal blog, and electricity- and gas-use visualizations (see Figure 4). The apps were developed via workshops with staff and with quantification of the CO_2 reductions possible. Applying a relatively simple game mechanic, they offered users points for logging particular actions, which could be collected and redeemed for a limited number of "sustainable" prizes.

The three apps employed similar features (logging actions, awarding points, showing other users' actions in an activity feed) targeting different behaviors, all linked to elements of the physical environment.

Scrunch: Your comfortable evening workspace. The DECC building has seven floors, with a majority of staff hot-desking. Keeping lights on outside office hours is expensive and wasteful. The Scrunch app aimed to reduce the "size of the office" to the size of the workforce outside of normal hours by encouraging staff to move to a single floor. Staff received points for logging "heading home" or checking in on the Scrunch floor, and a "social proof" ticker showed colleagues' actions. The head home option was rewarded equally, since taking part is fundamentally what mattered; the focus was on engagement.

Barriers identified through the workshops were expressed in statements such as "I'll only be here another 15 minutes, I promise" and "I have to shut down my laptop and restart it again, which takes ages." To address these, we differentiated between staff finishing work and leaving soon and those who would be working late. The process of un-docking and re-docking laptops was made easier through creating simple (laptop-shaped) postcards (see Figure 3) explaining very simply how to do it without requiring a full shutdown—a conversation starter that also became useful for other DECC staff. The designated floor was made appealing through free cakes and tea, with printers set up to make the move easier. The aim was to make the environment *better* than staying put, with the app providing support and allowing tracking as well as rewards.

Figure 3. A postcard supporting Scrunch.

Foodprints: Healthier lunches, lower carbon. In the U.K., food can represent 20 percent of an individual's carbon footprint; this can be cut by eating less meat and dairy, which can also be healthier. The Foodprints app enabled staff to log their lunchtime choices in the canteen, providing both personal diet and sustainability tracking, together with printed "pledge cards," which canteen staff would stamp.

Equal points were awarded for the action of logging—not for the meal choice—but some game mechanics were used to maintain continued engagement, such as "hidden treasure" (where extra points were hidden somewhere in the lunch-recording tool for that week) and "5 in a row" (extra points for completing the recording for a whole week). The

cards provide the opportunity for verification by canteen staff, enabling different point levels to be introduced at a later date.

OK Commuter: How was your journey today? Transport choices are significant in CO_2 emissions. With DECC's central London location, few staff live nearby and most commute using train, Tube, or bus. Many cycle or walk; parking for cars is expensive. Hence, transport choices are already mostly lower-carbon than at many other workplaces. However, there are still benefits of a recording tool, and behaviors may still be changed—for example, encouraging more walking and cycling for their health benefits. The action of logging each day's journeys, together with visualization of the past month's travel, can maintain engagement, and this function was built into the OK Commuter app. We found that many staff who cycle, in particular, are often proud of their commitment, and showing this to colleagues via the feed capitalized on this pride. Equally, though, most people use the same form of transport every day, reducing personal interest in logging it. We thus introduced a "creative description" field, encouraging users to tag each journey with a short, often witty, comment—for example, "Maria A's bus ride in was: smelly" or "Brian F's cycle in was: blissful." This maintained engagement while providing a playful talking point among colleagues.

Energy visualization. Visualizations of the building's electricity and gas use were also made available (see Figure 4), both five-second data and daily/weekly/monthly, with kWh, costs, and CO_2 given. This ongoing component demonstrated links between the behavioral aspects of the apps and the overall impact of the building, as well as allowed for seasonal trends to be discussed more clearly through an internal blog. It also let DECC's facilities managers identify—and implement—savings in gas use of around 10 percent through changing water-heating

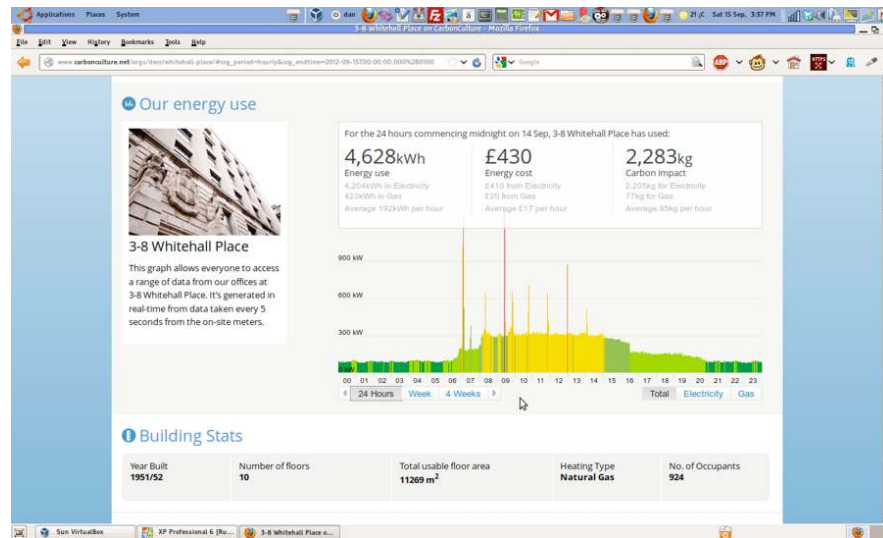schedules. As well as via users' CarbonCulture dashboards, the visualizations are publicly accessible at http://carbonculture.net/orgs/decc

Figure 4. Publicly accessible energy-visualization summary for DECC.

Engagement and Impact

We ran the pilot at DECC in Q4 2011. Scrunch was first to be launched, following the ethnographic work. Of about 1,000 staff, 412 signed up to CarbonCulture, establishing a membership of around 40 percent. While figures for internal programs are difficult to obtain, this compares favorably with, for example, the 13 percent of eBay employees who signed up to the "Green Team" and the 15 percent of U.S. employees

who signed up to BT's solar education program [3]. Of the CarbonCulture membership, 166 used at least one app, representing again 40 percent engagement of members. Overall, 16 percent of all staff used the apps.

DECC staff "Scrunched" 81 times and used the "Head Home" button 1,561 times. With Foodprints, 2,747 lunches were logged and 110 cards registered. OK Commuter users logged 2,229 journeys. Aggregate figures hide detail, of course, but by analyzing users' behavior and comments, we identified some patterns of engagement and retention, as users were attracted by different elements. For example, some competed or collaborated with colleagues to earn points (and prizes), while others used logging primarily for their own interest. Although 123 users of the 166 used all three apps at least once, many users stuck with only one or two of them.

Adding additional apps over time led to increases in user numbers, and we believe this can provide a sustainable mechanism to attract and retain users, as well as attracting new staff as colleagues sign up. However, it makes statistical comparisons more difficult. In addition to quantitative data, users provided comments, continued with in-depth user interviews as the pilot came to a close.

It is likely, of course, that DECC staff were already interested in environmental issues and so perhaps easier to engage. Running CarbonCulture at other organizations will need to address different issues in terms of both CO_2 impact and staff culture, but we believe the platform is flexible enough to achieve this in conjunction with a participatory design process.

One question worth considering is around the longer-term sustainability of this kind of intervention. Was the degree of engagement dependent on the points? Did attitudes change permanently? A few quotes from DECC staff suggest some effect, for example, "It has changed my behavior: I am car-pooling to work with a colleague," but a longitudinal study would be needed to assess the effects in the longer term.

We achieved a high level of engagement, and though the project ran for only three months, we found that while the aspects that engaged users differed, together they addressed multiple motivations. As the focus was understanding how to drive engagement, other than the 10 percent gas savings identified through the visualization, we cannot say that the behavior-change elements led to reducing DECC's emissions directly, but what was learned will enable future versions of CarbonCulture to be deployed with behavior change more specifically the goal. Commercially, a similar CarbonCulture program is in development for universities and a property management and construction group. The platform will also be used for a behavior-change project in the U.K. Parliament itself.

Aside from the apps, the energy-visualization component facilitated communication between building users and building management teams, and helped staff gain more understanding of the systems around them, which may be an underexplored potential for persuasive technology in other fields, too. The displays we developed and used at DECC have now been deployed across eight U.K. government departments (including 10 Downing Street), Tate Modern, and Cardiff Council's estate.

Endnotes

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Author bios

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Insights

- CarbonCulture at DECC used participatory design to develop ways to engage employees in understanding the part their behavior plays in CO_2 emissions
- A digital platform supported web apps for logging actions, targeting different behaviors, as well as user dashboards and energy visualizations which let facilities managers identify 10% gas savings