Abstract
This position paper presents a number of challenges and opportunities for sustainable HCI that have emerged from research conducted by the authors within domestic energy demand reduction and sustainable transport over a period of 15 years. It is argued that the complexity of sustainability problems requires HCI design to be situated within a wider User Centred Design (UCD) approach that supports holistic consideration of user experiences and collaboration across disciplines beyond the traditional scope of HCI.

Author Keywords
User Centred Design; Sustainability; HCI; Domestic; Transport

ACM Classification Keywords
D.2.2 [Software Engineering]: Design Tools and techniques
H.5.2 [Information interfaces and presentation]: User Interface---Ergonomics, User-centred design, Theory and methods
General terms: Design, Human Factors.

Introduction
The authors have a long track record in sustainable HCI, spanning both domestic energy demand reduction and sustainable transport. Our research can broadly be described as user centred design (UCD) [1], and has sought to enable sustainability through design [8]. Over time, it has utilised both traditional analytical human factors approaches [2] as well approaches more
orientated towards user experience (UX) design and third paradigm HCI [5,10]. From a range of research projects spanning 15 years, we have seen a number of research challenges, and therefore opportunities, emerge.

**Emerging challenges and opportunities**

HCI is, by nature, a multi-disciplinary field but addressing the ‘wicked problem’ [11] of sustainability requires multi and interdisciplinary working with a broad spectrum of scientists, engineers, social scientists and policy makers which goes beyond the more traditional bounds of HCI research. This is reflected in the scope of UK government research calls (e.g. the EPSRC funded BuildTEDDI programme) where multidisciplinary working across computer science, social science, design and civil engineering has been encouraged. In such projects, HCI research may, for example, be focused on the design and implementation of smart heating controls but the wider project remit will see the HCI researchers working closely with experts in building physics in order to understand where the best opportunities for energy demand reduction lie when people and buildings and technology are considered together. Working within these broad multidisciplinary teams presents new challenges including using appropriate language and terminology, working across data sets that contain rich qualitative as well as quantitative data, generated through the monitoring of energy consumption.

In response to these systemic problems, we have developed holistic approaches to user research, for example making ‘the home feel right’ [9,10], understanding home improvements [3,7] and influencing the journey to work [12]. To do this, participatory methods have been developed to engage users, encourage situated reflection and share tacit knowledge about their everyday activities and routines. The complexity of sustainability and pervasive computing steers us towards designing with users to ensure the complexity of people’s experiences is captured. However this leads to challenges relating to communicating knowledge generated in this way to engineering colleagues more familiar with more empirical user requirements. As user centred designers, we are often responsible for building bridges between disciplines within project teams and have become acutely aware of the tension between capturing the messiness of everyday life and providing a clear-cut outcome for engineers; we have used personas effectively to bridge this gap [4].

In recent years, we have seen the emergence of practice-based research in the sustainability field, sometimes openly pitched as being in conflict with behavioural approaches grounded in psychology. This somewhat echoes the HCI research trend from second paradigm cognitive psychology-based HCI to third paradigm approaches. Engineers are often problem solvers rather than theory builders and we have found that they find such debates confusing and distracting. We believe that the complexity of the challenges presented by sustainability means that behaviour-orientated and practice-orientated research both have a role to play in terms of framing and re-framing the problem-solution space and theoretical debates should not distract from the need to find pragmatic solutions to critical environmental problems.

Future sustainable HCI will need to take into account novel business models arising from end users as energy producers, leading to complex demands on user interfaces. For example, if users choose to store energy from domestic PV in a local thermal store or car battery prior to selling it back to the grid, new metaphors are needed to empower the user, ensuring the information they have is meaningful and useful. By understanding people’s goals and then designing interfaces to meet those goals, effective systems can be developed that are functional, usable and desirable [6].
These challenges also provide opportunities for future research through UCD. By taking an holistic approach, the opportunity to encourage sustainability through covert measures emerges. For example, our research into users’ motivations for home improvement enabled the identification of energy saving measures that can be incorporated into existing home improvement practices [4]. Likewise, using technology to enable social comparison of personal commutes can encourage a shift from cars to more active modes [12]. In both cases, we sought to enhance a meaningful experience for users rather than focus directly on sustainability, as this is not always the users’ goal. The designers of future systems must recognise that sustainability is often not a priority for users, but systems must save energy despite this.

User centred design, as a naturally problem-solving specialism, that can be applied across disciplines and which supports holistic consideration of the user, provides an approach to understanding the interaction between people, their environment and the systems and technology that they use. Through the application of creative, participatory methods within UCD, HCI can be explored in a way that ensures full consideration of the user and so offers the potential to enable effective sustainable HCI in a complex future.

References


