# Creating 'Cool' Mobile Technologies To Reduce Teen Energy Use

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**ABSTRACT**
In this paper we present an overview and initial work from a research project creating 'cool' mobile technologies to educate and inform teenagers in order to reduce their energy use. Teenagers are already becoming consumers and will form the next generation of workers, homeowners, managers and policy makers; a longitudinal change in their habits could have huge impact. However, it is notoriously difficult to engage with teenagers and effect changes in their attitudes or actions. Teenagers are often most motivated by their peer group and what is currently 'cool' or 'uncool'. The challenges of this work are not only the creation of persuasive mobile technologies to encourage teenagers to reduce their energy use, but to make these technologies sufficiently 'cool' that they are desirable and socially acceptable enough to support adoption and appropriation by teenagers. In addition to providing personalised and aggregate energy usage data and educational information in a meaningful way, the mobile technologies we are designing will allow for appropriation in 'cool' ways thereby fostering an active community of teenagers where it is cool to minimise energy use.

**Author Keywords**
Energy Use, Teenagers, Mobile Technologies



**ACM Classification Keywords**
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**INTRODUCTION**
Governments across the world are now committed to reducing CO2 emissions and one key area for improvement is reduction in domestic and personal transportation energy usage. In the home CO2 is released primarily in the generation of electricity, the combustion of gas and oil for heating and combustion of fuel in transport. Within the past 20 years there has been a steady increase in the number of appliances in the modern home coupled with growth in the ownership of energy hungry devices such as tumble driers and plasma TVs and an increase in the use of devices with standby facilities [5]. Many of the electrical devices contributing to the rise in domestic energy are used and sometimes owned by teenagers. Research in the UK has indicated that 95% of teenagers had a TV, music system or phone in their rooms, with two thirds having all three [13]. A separate study reported that 400 surveyed teenagers aged 13 to19 were collectively wasting enough energy to power 4,702 schools and a third of the energy being used was a direct consequence of 'standby' behaviour [1].

Our work on the 'taking on the teenagers' projects (www.mad4nrg.org) will engage young people (aged 12-19[1]) in reducing their own personal energy use and make

[1] It is problematic running studies with teenagers from age 14-15 in schools in the UK when they begin preparing for GCSE examinations, we therefore also target pre-teens to ensure we can work the same subjects for the 3 year duration of the project.

positive changes in attitudes towards energy use that will last through adulthood. This will be achieved through the creation of mobile technologies (called MAD: Make A Difference) to educate teens about choices they can make to reduce energy use and provide feedback on energy usage. Mobile technologies will also be used to gather energy usage information through self-report and sensing technologies, for example detecting which transport methods are being used, in addition to more usual energy monitoring in the home. These mobile technologies will make personalised and aggregated energy usage information accessible in meaningful ways to enable comparison and competition between peers to foster an active community of teenagers interested in reducing energy use. The mobile devices will also make available status updates about individual energy use and provide targeted educational material to users.

The popularity of home energy monitors from manufacturers such as AlertMe (www.alertme.com) and Current Cost (www.currentcost.com), and services such as Google PowerMeter (www.google.com/powermeter) mean that monitoring electricity use in the home is inexpensive and uncomplicated. However, even where the energy consumption information is provided, the visualization of this information often cannot easily correlated with consumption behaviour [9]. This is either because the units of measurement are relatively meaningless to users or the information is irrelevant to their interests (e.g. cost information may not mean much for teenagers who do not pay the bills). Furthermore there is a common lack of awareness about the amount of energy consumed by device sin the home and energy-saving options [6].

The key challenge of this work is not only design highly usable mobile technologies to provide access to energy usage information presented in a meaningful way for teenagers, but also to ensure that these technologies that are sufficiently 'cool' that they are desirable and socially acceptable. Having created devices that are used and understood by the teens, we will then use a range of approaches to lead to long-term behavioural modification. To achieve these goals a participatory approach is used which involves working directly with young people in schools to carry out design and evaluation studies.

We now discuss the challenge of 'cool' and our initial findings, the persuasive aspects of the technologies we are creating, and the technological challenges we face. We give an overview of related work and finish with a discussion of key issues and future work.

## THE CHALLENGE OF 'COOL'

While the meaning of 'cool' has been considered, for example [10] [12], there is not a single universally applicable definition. Cool may be anti-social or illicit, it may be expensive and highly desirable, or it may represent innovation (and these are not mutually exclusive categories). In the case of teenagers, peer groups often define the attributes of cool and being 'cool' is often extremely important. From studies of existing literature and initial design sessions we have identified three main levels of coolness in the context of teenager. The first, and easiest to achieve, is the coolness associated with having desirable things that others aspire to (such as latest technology or clothes), the second is coolness associated with actions or activities that gain recognition from peers. The third, and most challenging to achieve, is that of holistically 'being' cool and often results in being admired and often deferred to by peers. It is this latter category that marketing companies often seek to influence as, by virtue, products they associate with become cool and are then desirable by others.

Coolness is generally a challenging property to design into a product and within the three types of cool we have identify the second (associated with actions or activities that gain recognition from peers) as most likely to be achievable within the project. This will be coupled, to a lesser extent, with the first type (having desirable things). The mobile applications we are designing will enable teen users to monitor their energy usage (captured using low cost monitoring technology in the home and mobile devices) and devise their own ways of representing, sharing and comparing the information. Through our participatory approach we will create applications that support customisation and expressivity such that they can be appropriated in a 'cool' ways by teenagers. One scenario we envisage is teenagers being able to compare energy usage using a metric and visualization they themselves have devised and/or adopted (which is assumed to be cool in their peer group) to determine who is the winner (using the least energy) and who is the loser (using the most energy). In this example it is likely that competition will encourage consideration and reduction of energy use. Also, these motivations will be nurtured and supported through use of the MAD technologies that will provide information and advice on measures to reduce energy use, in addition to providing information on current energy usage.

## CHANGING BEHVIOUR

This work will build upon the TTM model of behaviour change [11] and will link into more recent work on emotional engagement for behaviour change ([2],[4]) which demonstrates that behaviour change is more effective, engaging and productive if there is an emotional engagement between the technology and the user. Thus our mobile technologies have to support appropriation in cool ways but also have to be designed in a way that teenagers can easily relate to them and in a manner that is receptive to emotional interpretation (i.e. the systems themselves do not necessarily have to be emotional, they just have to be able to appear emotional even if that effect is projected by the user).

This project works from the assumption that teenagers have the potential to make significant changes to energy usage. Not only can changing teenage behaviour affect their long-

term personal use, but they are also in a position where they can use 'pester power' to affect the attitudes and behaviours of their parents, siblings and friends. As many teenagers have a greater amount of leisure time than adults, this can result in the use of many high energy technologies such as computers, games consoles and entertainment systems, while their behaviours are not monitored by parents or guardians in the way a younger child's activities might be. The project will aim to gather more information about teenagers' patterns of energy use in order to understand their behaviours and motivations more, and how they may be influenced.

The initial goal for behaviour change in this work in to influence reduction in electrical and transport energy use. Initially, stories of energy usage will be collected from teenagers in the schools with which we are working. The stories will be composed of text, images, video or audio and will give qualitative insights into teen energy use and attitudes towards energy use (some will be collected in school, others will be collected during focus groups). At a later stage in the project, after we have deployed the MAD1 and MAD2 products, we will then collect energy stories again to allow for qualitative comparison of change in behaviour.

## TEEN TECHNOLOGY

The project aims to create two key mobile products, one for 13-16 year olds (MAD1) and another for 16-19 year olds (MAD2). A key issue is selecting which mobile platform(s) to target and this is likely to be the trade-off in terms of features provided and device popularity. While smart phones such as Blackberry devices, iPhones, Android devices, and Nokia Symbian handsets are increasingly prevalent among adults in the UK, their high cost often makes them inaccessible to younger teenagers with little spending power and restricted to 'pay as you go' (contract free) call plans. From our current studies in schools with year 7s (age 10-11) and year 10s (age 13-14) it is apparent that the phones they own are basic devices often handed down from an older sibling or parent. We have also found that the children in our initial studies have little interest in owning and using a mobile phone. Boys in particular admitted that they failed to remember to charge their phone or ensure they had enough credit to make calls. Several year 10 boys claimed that they found their mobile phone useful as an alarm clock but little else.

Technologies adopted by older teenagers (17-19) with slightly high spending power are often fashion led, but not necessarily those which hit the mainstream or adult media. For example, in a survey of all new undergraduate entrants to a major UK University, Blackberry devices outnumbered both Nokia's and iPhones, for example. This is partly due to the cost of such devices but also the availability of specific communication channels – Blackberry Messenger being a popular one, but not (easily) accessible without a Blackberry handset. Within the project we have funds to provide a small number of participants with mobile devices (the number depending on the cost of the device), but after initial trials we wish to open the system up to as wider participation as possible.

In order to enable energy monitoring in the home the project will use low cost COTS home energy sensing technologies from manufacturers such as AlertMe and Current Cost that can sense electrical energy use on a per-home and per-appliance granularity, and make it available over the Internet. Sensing kits will be provided for a number of user 'champions' and is hoped that they will help encourage other teens to pester parents into buying the kit so they can take part.

A participatory design process to create MAD1 and MAD2 will be ongoing with several different groups in teenagers in schools across the UK involved. We expect to develop a mixture of education, game-playing and competition, collaboration, peer pressure and self-awareness raising approaches within and around these products to lead to reduction in personal energy use in the short term and long-term behavioural change. In addition to MAD1 and MAD2, a specially designed web portal will be used throughout the project to allow participants in the project to share stories about their energy usage, using narrative, images and video. These will provide a rich source of qualitative data for the project and also allow the identification of change in energy usage habits as the project progresses.

## RELATED WORK

A small number of wearable/mobile research prototypes and products have been developed for conveying energy usage information. UbiGreen [7] used mobile phones as ambient displays to give user feedback on their transportation behaviours. It relied on the wearable sensing unit, GSM cell signals and the participants' manual input to detect transportation mode. Eco-friendly transportation behaviours, such as carpooling, taking bus and cycling etc. were encouraged and shown as rewards on the ambient display. EnergyLife [3] is a pervasive sensing and feedback system. A server was connected wirelessly via a base station to energy sensors which reported their energy usage every couple minutes. The real time energy consumption information together with device consumption history, energy reservation tips etc. were delivered to a smart phone upon user's request using a Carousel interface. GridCarbon is an iPhone app produced through the iDEaS Project (www.ideasproject.info) which shows the current carbon intensity, the quantity of CO2 produced for 1 kWh of electricity consumed, of the electricity currently being generated in the UK. The intention of the app is that it can be used as a tool to influence energy demand and reduce CO2 emissions. AlertMe provide an iPhone app to allow remote access to data recorded by their home energy monitoring product. The app allows current energy usage to be viewed remotely and provides a 'personal swingometer' which is a simple graphical representation to help convey energy usage in an easily understandable manner. While these examples highlight some innovative approaches to

reducing energy use though mobile technologies none of them align with the more holistic and long-term energy reduction aims of this work.

## DISCUSSION

In creating energy saving devices for teenagers we consider that 'cool' is a powerful factor in motivating adoption and appropriation. To make energy saving attractive, we need to tap into the potential for peer pressure, personal goal setting and achievement, and make good use of energy an integral part of the general discourse between teens. Our approach is not to attempt to produce cool products per se, but to create technologies that can be personalised and appropriated in cool ways.

The ethics of persuasion [8] in the context of this project are somewhat mitigated in that the reduction of energy use is accepted to be a necessary move. However, this will be an area we explore in detail as the development of the MAD1 and MAD2 prototypes progress. The project is currently engaged in design sessions with teenagers to explore initial scenarios and requirements for MAD1 and further understand the key characteristics of cool for different groups. In parallel we are also exploring and technical possibilities and expert technical designs, and investigating teenagers' current attitudes towards energy use. We hope that the novel themes in this work will be of interest to the participants of the workshop and provoke interesting discussion.

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