Figure 1 Lights on earth, at night (NASA composite image)

Environmental Sustainability and Interaction

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Abstract
By its nature, the discipline of human computer interaction must take into consideration the issues that are most pertinent to humans. We believe that the CHI community faces an unanswered challenge in the creation of interactive systems: environmental sustainability. For example, climate scientists argue that the most serious consequences of climate change can be averted, but only if fundamental changes are made. The goal of this SIG is to raise awareness of these issues in the CHI community and to start a conversation about the possibilities and responsibilities we have to address issues of sustainability.

Keywords
Sustainability, energy use, resource consumption, Value Sensitive Design

ACM Classification Keywords
H5.m. Information interfaces and presentation: Miscellaneous. K4.0 Computers and Society: General

Introduction
The central tenet of this SIG is that “sustainability can and should be a central focus of [the field of human computer] interaction” [1]. Humans in developed countries are using an order of magnitude more energy per person than is sustainable for the population at

large, with U.S. energy consumption in particular higher than any other country. Climate change is a crisis that will only be solved if we all innovate solutions. Other aspects of sustainability, such as resource consumption and pollution, also require innovation and attention. As with other values such as privacy, sustainability cannot simply be an afterthought, but instead needs to be considered throughout the lifecycle of a project [4].

One might characterize design and research both as "an act of choosing among or informing choices of future ways of being" [1]. What role and responsibility do those in the HCI field have in addressing the problem of sustainability?

Sustainability in Design

A first set of issues arises around how to take account of sustainability as part of the material design of products. Sustainability is a multi-faceted concept that includes many issues such as those relating to energy footprint, reduction, reuse, and recycling.

Energy use. An example is the electricity consumed by personal computers and servers. Consider the difference between running a screensaver and putting a machine in standby mode. Or consider a program for downloading software that automates the transition to standby mode when it completes a download.

Device re-use. Ubuntu, for example, is designed to endow older less powerful machines with a modern operating system (http://www.ubuntu.com). Devices may also be designed to support remanufacturing for re-use. For example, imagine the ability to "reprogram" the content of an RFID tag as it is recycled for additional contexts of use [5].

Reduction of waste. One step is to increase the longevity of devices, as well as making them easier to repair (rather than throw away) if they do fail. A simple example might be creating a semi-permanent means to adhere an RFID tag to its host material (e.g., building, clothing), such as scotch tape rather than super-glue or cement[5]. Another example is designing a minimalist mobile device such that the market moves from changing (and throwing out) entire devices (with their chips) to simply replacing skins. Another example is encouraging a device to achieve heirloom status, making people less inclined to replace it [1].

Enabling sharing of devices or energy resources. An example would be creating a server model for instant messaging that would allow undergraduates to turn off their personal machines while still staying "logged in" to a conversation that they might want to review later.

Longer example

One can see from these examples that software and hardware are presently intimately connected to a cycle of mutual obsolescence with implications for sustainability effects and modes of use [1].

Exploring further how digital material can cause the disposal of physical material, consider the implications of the introduction of Microsoft's new operating system, Vista, in 2007. The effects have implications for both *consumers* and enterprise. Writing in *Information Week,* Sharon Gaudin reports on 12.06.06 that

> About half of business PCs are unable to run Microsoft's Windows Vista operating system because they don't have the basic system requirements, according to a new study….

> When it comes to computers that are able to meet Microsoft's "premium" vista requirements, 94% don't measure up [6] as quoted in [2].

While these are only predictions and there are other important factors, the need for new machines to run a new operating system is in large part *designed* by the requirement for a larger footprint—a technical term for the amount of resources needed by a program—than existing machines currently can provide. Moreover, computer "users" who fail to upgrade to the new operating system risk being stranded with existing software applications that cannot be maintained as the present operating system becomes unsupported, or become hopelessly insecure over time [2].

Sustainability through Design

A second set of issues arises around how to support sustainable lifestyles and decision-making through the design of technology. In the industrialized nations that contribute most heavily to global warming, information technologies are deeply integrated into users' everyday lives. They therefore may form an effective channel for intervention in the everyday decisions and mindsets that play a large role in the generation of greenhouse gases.

Individual level One opportunity for intervention arises from making abstract environmental data concrete for everyday life. For example, Beatriz da Costa, Cina Hazegh, and Kevin Ponto have used pigeons as mobile bloggers mapping local air pollution, moving pollution data out of the realm of science and into everyday consciousness (http://www.pigeonblog.mapyourcity.net/). As part of their Environmental E-Science project, Ben Hooker, Pedro Sepulveda, and Bill Gaver have placed sensors around London that call passerby's mobile phones to alert them when pollution levels are high (http://www.dataclimates.com/project_escience/escience_maintext.html). The Preemptive Media collective has developed AIR, handheld mobile devices which allow users to track local air pollutants and hot spots for fossil-fuel use (http://www.pm-air.net/). Such informational systems can also encourage individual change, such as the Footprints project, which aims to encourage individuals to make changes in their energy footprint [8].

Group level Another opportunity arises in designing systems and interactions that involve groups of people. One example is to support public deliberation and decision-making around issues of sustainability. For example, sophisticated simulation systems can model the long-term consequences for sustainability of major decisions regarding urban transportation and land use, helping citizens and elected officials to make more informed decisions [3]. Another is a system that encourages carpooling [9].

Societal level A longer-term goal may be in supporting cultural change or enabling a social movement for sustainability to develop, which can occur "through informal networks, pre-existing institutional structures, and formal organizations..." [7], all places the Internet might play a role.

SIG Participants and Goals

We believe that sustainability is an issue that has import for the entire CHI community. We therefore encourage participation by anyone who is interested in how sustainability might impact them, or has thoughts on how we can raise awareness and integrate the

implications of sustainability into the work of the CHI community. A background in sustainability is not required to participate in this SIG.

The discussion presented here is just a first step in what we hope will be a longer discussion in the CHI community. We encourage you to join the discussion and help us to define a vision for greener, more sustainable interactive technologies. Topics will include

- Opportunities for including sustainability in research
- Approaches to including sustainability in practice
- Implications for education

We have created a mailing list, and we encourage anyone interested in participating in an ongoing discussion on this topic to join us at sustainable-chi@googlegroups.com.

SIG Organization

The activity plan for the SIG is:

- Introduction of goals & round table introductions by participants (10 minutes)
- Definition of sustainability and its components (5 minutes)
- Brainstorming (in small groups if attendance is large) of the role that sustainability and its components play in CHI (20 minutes)
- Interactive discussion with participants on the results of brainstorming and general implications of sustainability for the CHI community (25 minutes)
- Discussion of future plans including opportunities for collaboration, and ongoing agenda (30 minutes)
- Opportunity for ongoing small discussions among attendees after breakup of main SIG (remaining time)

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