Ubiquitous Computing for Sustainable Energy (UCSE2010) Ubicomp 2010 Workshop

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ABSTRACT
Providing sustainable energy is one of the fundamental challenges for mankind. With energy usage being a part of everyday activities and with the increasingly diversity of energy creation this is an inherently multidisciplinary problem. Transportation and travel, heating and cooling, manufacturing and production are major areas in which energy is used and all these domains become more and more linked to ubiquitous computing. With an increase in decentralized energy provision, ranging from energy harvesting in devices to personal green power plants, a great potential for creating sustainable energy arises, however at the cost of a higher complexity of the distribution network and storage mechanisms. Overall we believe that research in ubiquitous computing can provide important contributions for a world with sustainable energy. In this workshop we hope to get people from different disciplines together to share their visions and insights on how to conserve, efficiently produce, use, and distribute energy.

Author Keywords
e-Energy, smart energy, smart grid, energy conservation, green ICT, energy efficiency, energy harvesting

ACM Classification Keywords
J.m [Computer Applications] Miscellaneous, J.7 [Computers in Other Systems], H.5.2 [User Interfaces].

General Terms
Design, Economics, Human Factors, Measurement

INTRODUCTION AND MOTIVATION

Ubiquitous computing is a part of everyday life. Computers are embedded and intrinsic to the myriad of devices and machines we use, ranging from communication and entertainment devices to transportation and production systems. Our energy consumption is strongly and increasingly linked to activities that we carry out while using computerized devices and systems [1]. This opens up the opportunity to design these systems to conserve energy. One canonical example is heating and cooling the home. As such systems become programmable and as sensors become commonplace, systems can be made more efficient without losing quality: a heating system in a house that is aware of the whereabouts of the inhabitants can significantly decrease the needed energy [2, 3]. With devices such as fridges, washing machines and machinery becoming a part of the internet of things, further opportunities arise: devices can negotiate when to use energy with the supplier, e.g. based on a smart grid infrastructure. In this area ubiquitous computing is a central enabling technology for reducing energy consumption. We argue that energy usage should be one fundamental issue that is taken into account when designing systems.

Research shows that users' behavior and users' awareness of their impact is important to motivate a more sustainable behavior [4]. Driving a car more economically or sharing a ride (e.g. 3 people in one car instead of 3 cars) can massively reduce energy consumption. Here we see that ubiquitous computing technologies offer many approaches to take the energy users "in the loop" and to make them more aware of opportunities for saving energy.

With many renewable energy resources such as solar power and wind power and approaches for energy harvesting [5], we move away from energy that is always on and always available at the same cost (e.g., like in traditional power plants). This leads to a model of a highly distribute energy generation – in communities (e.g. a local wind farm), in houses (e.g., solar panels on the roof), or even by individual devices (e.g., a backpack that charges a phone while walking). This model creates new opportunities to make the energy more sustainable, but at the same time increases the complexity of energy provision to devices and systems. Here too, ubiquitous computing and ubiquitous networks can offer solutions and key building blocks.

A further area in which a lot of energy is used is manufacturing and production. This ranges from food to everyday objects and buildings. According to [6], a significant part of energy goes into the production and transportation of the things we buy. Here an interesting question is how we can use ubiquitous computing technologies to reduce the need for things or to make them last longer or to promote sharing within a local community. Technologies can help to increase awareness and on facilitate the more efficient use of things that are already produced.

RELEVANT TOPICS

The small set of examples in the introduction shows that this area of research is very broad but inherently linked to ubiqui-

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tous computing research. We categorize the topics of interest into four areas:

1) Understanding and motivating users of energy systems to consider sustainability as a central concern. Here we expect that ethnographic studies on energy usage can help to increase our understanding of how to develop future systems that put users more in control and increase their responsibility of energy consumption. Such investigations should make assessments of values and constraints that users have and aim at uncovering practices and their rationale. We expect studies and surveys contributed to the workshop to provide the community with new insights.

2) Smart energy systems and technologies are a main topic for many systems and device researchers. The development of new concepts and technologies for smart energy systems poses many technological and business challenges. We hope that by sharing experiences with smart energy production systems and intelligent and adaptive energy consumers new ideas will be spread. User interfaces for energy systems and the interaction between users and smart energy systems link to the first topic and are critical to getting users into the loop and making them aware of their options and responsibilities.

3) Intelligent energy infrastructures, as realized in smart grid technologies and smart meter installations are only a starting point for new infrastructures. We expect that ubicomp technologies offer new opportunities for smart grid infrastructures and enable new and more fine-grained approaches for smart metering technologies and applications. Important issues include security and privacy in intelligent energy systems as they will massively impact the user acceptance of new energy systems. In addition to large-scale infrastructures there will be new challenges in local (in-house) smart energy infrastructures.

4) Socio-Economic drivers and incentives are further important topics that need to be considered when creating new energy systems. Energy has a huge associated economic factor - in the budget of individuals as well as from a national or international economic perspective. We expect that researchers will discuss new models and explanations for energy usage, systems and technologies to increase energy awareness. There is a clear link to persuasive technologies in this field.

GOALS AND EXPECTED AUDIENCE

The goal of this workshop is to bring together researchers and practitioners with different backgrounds that relate to sustainable energy systems. We expect that in order to move forward in this topic we must bring together ideas and research from energy systems, human computer interaction, economics, and ubiquitous computing. The common ground is the interest in ubiquitous computing technologies in the energy domain. The overall aim of the workshop is to foster a community in Ubiquitous Computing for Sustainable Energy and to facilitate interaction.

CONCLUSION

In summary, it is clear that sustainable energy is a central challenge for mankind. The problems faced are inherently multidisciplinary and relate to technology, economics, psychology, and human values and we believe that Ubicomp research – with its approach and methodology as well as its technologies – can make an important contribution. With renewable sources we see changes towards a more decentralized and fluctuating production of energy. Solar and wind powered energy supplies are examples where the availability is basically unlimited but actual availability differs greatly over time (e.g. between day and night). Informed users, who understand the impact of their energy usage and for whom the implications of consuming energy at a certain moment becomes accessible may act very differently. Similarly smart devices and networked systems can adapt to best share available resources. Overall we see a potential that Ubicomp research can contribute to reduce the energy demand of society and to provide means for a better utilization of renewable energy sources.

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