First International Conference on ICT for Sustainability, Zurich, February 14-16, 2013.

Conference Recommendations:
How to Improve the Contribution of ICT to Sustainability

Summary

The speakers and participants of ICT4S 2013 have endorsed a set of recommendations to stakeholders derived from the research results presented and discussed at the conference. Statements provided by the speakers before the conference were compiled to a draft document that was then being discussed in plenary sessions. The main directions of impact of this document can be grouped into three categories with two main issues in each category:

- Sustainability in ICT:
  - There is a large unused potential to save energy by *designing software for energy efficiency*. The power of software should be used more systematically to reduce the energy consumption of hardware.
  - The short service lives of hardware products in combination with the broad variety of scarce material resources used in production lead to material losses and environmental pollution. Efforts are needed to *reduce hardware obsolescence and to close material cycles* at a global scale.
- Sustainability by ICT:
  - ICT offers a high potential for *more intelligent energy management in buildings*, in particular for heating and cooling and in connecting the buildings to smart grids. Smart homes and offices can substantially contribute to sustainability.
  - Urban structures should be planned, managed and further developed in a way taking into account the *structural changes enabled by ICT,* supporting a change towards a sustainable information society that will need less energy and physical transportation.
- Overarching Aspects:
  - ICT applications can and should be used to *create incentives* for more sustainable behaviour and to support people systematically in adopting more sustainable lifestyles.
  - Progress in these areas requires systematic *research and education* in many fields contributing to ICT4S, including systematic interdisciplinary efforts in "ICT for Sustainability".

These general directions are refined to detailed recommendations addressing specific stakeholders in the long version of this document.

Preamble

The transformational power of ICT can be used to make our patterns of production and consumption more sustainable. However, the history of technology has shown that increased energy efficiency does not automatically contribute to sustainable development. Only with targeted efforts on the part of politics, industry and consumers will it be possible to unleash the true potential of ICT to create a more sustainable society.

Speakers and participants of ICT4S 2013, the First International Conference on ICT for Sustainability, held February 14-16 in Zurich, Switzerland, have formulated the following recommendations to stakeholders as a result of their research and discussions, grouped in six main themes.

A. Sustainability in ICT

1. Use the power of software to reduce hardware energy consumption.

Decisions made in systems software and applications software development have important consequences for the hardware load and the resulting energy consumption.

1.1 *Software engineers* should become aware of the implications of software structure for energy consumption. The ability to address energy issues, including the automation of energy-efficient behaviour of software systems, should be included in the education of software engineers.
1.2 *Researchers* should create more knowledge about the relationship between software structure and energy consumption and how to minimize the latter under practical conditions, including the operation of legacy systems.
1.3 *Standardisation bodies* should develop metrics and labels for software energy efficiency based on established and emerging knowledge, *policy makers* should encourage the development of such software energy metrics and standards.
1.4 *Organizations providing ICT services* (including cloud computing services) should make the energy consumed in providing a service transparent to their customers.
1.5 *Organizations using ICT services* should endorse cloud computing where this clearly leads to net energy savings.
1.6 *The ICT Community* should encourage more open sharing of knowledge about software and hardware development.

2. Reduce hardware obsolescence and close material cycles.

Most ICT goods as they are produced, used, and disposed of today are “inherently unsustainable”, both environmentally and socially, from a life cycle perspective.

2.1 *Hardware designers and software engineers* should be aware of the consequences of their decisions in terms of hardware obsolescence, decomposability, reusability and recyclability, and strive for intrinsic sustainability.
2.2 *Researchers* should create more knowledge about the relationship among hardware architecture, software architecture, ICT business models, and the service life of hardware.
2.3 *Standardization bodies* should define metrics for the life-cycle-wide sustainability of ICT solutions; the metrics should (a) be based on established knowledge, (b) be transparent and (c) be helpful to the final consumer.
2.4 *Consumer organisations* should support consumers in demanding and using sustainable ICT solutions and in developing sustainable behaviour in using ICT goods and services.
2.5 *ICT manufacturers* should abolish planned obsolescence, declare the resources and CO2 footprint used in production and include informal e-waste recycling in their Corporate Social Responsibility (CSR) policies.

2.6 *ICT providers* should shift their business models towards services (in particular: infrastructure as a service) in order to reduce incentives for hardware obsolescence. The technologies used in service-oriented computing should preserve privacy to be acceptable.
2.7 *Policy-makers* should make every effort to effectively close the material cycles of the scarce elements used in ICT hardware - e.g. through eco-design, take-back and recycling of hardware.
2.8 *Policy-makers* should create better conditions for leasing, renting, and collective/cooperative use of ICT devices.
2.9 *International organisations* should develop a global transparency platform for ICT hardware materials, supporting designers and engineers with sustainable data for the hardware's impact on resource consumption and environmental impact.
2.10 *Regulators* should effectively prevent that e-waste is exported to poor countries to avoid the cost of the recycling or waste management.

B. Sustainability by ICT

3. Enable smart energy use in buildings.

The energy used in buildings for heating, cooling and the operation of appliances should be reduced and shifted to renewable energy sources, using ICT as an enabling technology.

3.1 *ICT innovators* should support the end consumers of energy in shifting from 'demand-' to 'supply-driven' behaviour, changing behaviours towards a more sustainable lifestyle.
3.2 *Manufacturers and providers* should increase the energy awareness of the technical systems that provide, store, transmit and use energy.
3.3 *Investors and innovators* should create business models that make it easy for real estate owners as customers to purchase increased energy efficiency via innovative use of ICT, in particular ICT-enabled energy rating systems, making the energy infrastructure smarter.
3.4 *Public authorities* should create and provide knowledge about energy efficiency potentials of existing buildings through ICT to real estate owners making them "knowledgeable demand shapers".
3.5 *Standardisation bodies and manufacturers* should increase the transparency of any energy consumption of devices in a way that customers understand (i.e. real money); include the whole infrastructure from the sensor up to the display.
3.6 *Standardization bodies* should develop standards for "building operating systems" to enable different systems to communicate with each other to save energy by information sharing and cooperation.
3.7 *Standardisation bodies and policy makers* should establish labels (e.g. based on EN 15323) for energy-efficient building automation.
3.8 *Professional associations and academia* should establish training programs for professionals in energy-efficient building automation technology.
3.9 *Energy industry and interdisciplinary researchers* should develop smarter grids and homes in a way that does not affect the privacy of the users.
3.10 *ICT providers* should improve the ways people interact with buildings and encourage sustainable behaviour.

4. Make use of the sustainability potential of the information society in planning and managing urban structures.

4.1 *City planners* should embrace the opportunities of the information society by planning for the reduction of space heating and cooling, for less parking places, for collaborative consumption, for more local work and for other structural changes enabled by ICT.
4.2 *City planners* should use ICT solutions supporting the planning process to develop urban structures from an energy consumption perspective.

4.3 *Local and regional authorities* should employ experts in *ICT for Sustainablity* to include the opportunities of the information society in their planning, regulation and procurement (capacity building in local an regional authorities).
4.4 *Public transportation providers and road authorities* should provide travel plans nudging energy-efficient travel with minimal environmental impact.

C. Overarching aspects

5. Create incentives for sustainable behaviour

5.1 *Companies with their own ICT departments* should create incentives for saving energy. Create a green IT-strategy that increases the employee's awareness of sustainability.
5.2 *Utility companies, smart grid researchers and developers* should utilize community based social marketing to enable consumer behavioural change as an integral part of the smart grid, in a privacy-preserving manner.
5.3 *Academic research* should develop better metrics for the sustainability of ICT services that are needed as a basis for the creation of incentive systems.
5.4 *Regulatory bodies,* when creating incentives for the use of a certain kind of technology, should make the intentions behind the use and promotion of the technology as transparent as possible.
5.5 *Academic institutions, non-governmental organizations:* Use social media to improve collective decision-making and encourage sustainable behaviour, bearing in mind the energy consumption issues of the media as well.
5.6 International organizations: provide a platform to share best practices, promote partnership and encourage cross-sectional collaboration.
5.7 Policy makers, researchers, ICT providers and designers: Be aware of and try to minimize unintended and indirect sustainability impacts (i.e. rebound effects) of ICT.
5.8 *Social scientists* should devise ways to encourage sustainable ICT use by building up peer group pressure and 'nudge' techniques (e.g. behaviour-changing Apps).

6. Develop research and education for ICT4S.

6.1 *Academia* should engage in interdisciplinary research about the actual impacts of systems developed to support sustainability.
6.2 *Educational institutions* should include cross-disciplinary classes for learning about the relation between ICT-related decisions and sustainability in relevant courses.
6.3 Aspects of sustainability should be emphasized in the fields of computer architecture and programming.

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