Background Paper

2nd Multinational Knowledge Brokerage Event

Green ICT for Sustainable Consumption?

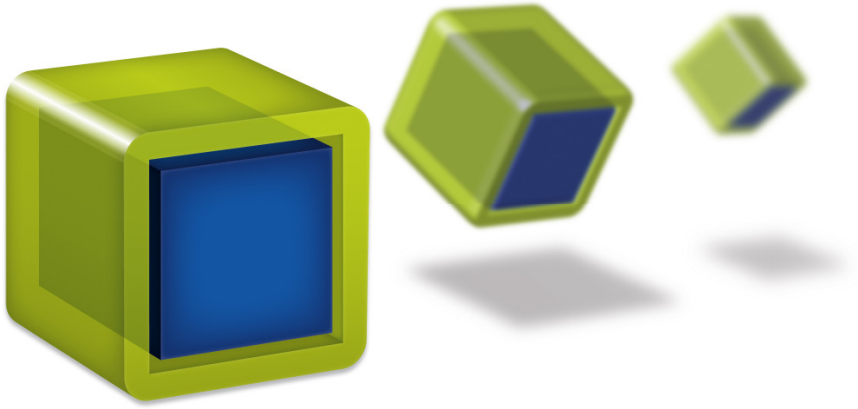
Exploring Emerging Policies and Open Research Questions.

Palais Harrach, Vienna, Austria
January 17-18, 2013

Authors:

Karin Dobernig, Vienna University of Economics and Business (WU)
Gerd Scholl & Tanja Brumbauer & Magnus Grubbe, Institute for Ecological Economy Research (IÖW)

Contributions from ***Inge Røpke***, Aalborg University, Copenhagen



RESPONDER – linking **RES**earch and **P**olicy making for managing contradictions of sustai**N**able consumption an**D** **E**conomic g**R**owth | FP7 Grant Agreement number 265297

RESPONDER
Linking SCP and Growth Debates

The information in this document reflects the author's view and is provided as is. No guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability.

This work was done as part of the RESPONDER project and is published on behalf of its European Consortium. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 265297 (RESPONDER, www.scp-responder.eu).

Join the RESPONDER community today by registering at

www.SCP-RESPONDER.eu

Table of Contents

1 The RESPONDER Journey: Aims & Desired Outcomes

RESPONDER aims to promote sustainable consumption by exploring novel ways of knowledge brokerage between science and policy in the five policy-areas food, housing, mobility, ICT, and private savings and debts. The main objectives are to help improve the management of potential political, social and economic contradictions of sustainable consumption with economic growth, bridge the gap between science and policy, and foster mutual understanding between the "pro-growth community" and the "beyond-growth community". Participatory systems mapping as the core methodology serves as the basis for systematizing empirical findings, questioning different model assumptions, analyzing the effects of different policy options and identifying new research questions in the respective policy areas.

"Green ICT for Sustainable Consumption?" is the 2nd RESPONDER Multinational Knowledge Brokerage Event focusing on Information and Communication Technologies (ICT) and their role for economic growth and sustainable consumption. As such, it serves as an arena for debate between policy-makers and researchers working on different aspects of ICT, and aims to explore open research questions and emerging policies with regards to its potential to foster sustainable consumption in Europe and arrive at a useful impetus for effective policy development. In the course of the event, in a dialogue-oriented atmosphere, we will have a closer look at emerging ICT trends and their implications for sustainable consumption, examine the associated challenges and conflicting priorities, and discuss implications for policy-making. The debate will focus on the two thematic areas of "Smart Metering/Smart Grids" and "Cloud Computing".

This background paper outlines the positive expectations that various actors have with regards to the role of ICT in relation to sustainable consumption. This is intended to encourage a discussion on what kind of political interventions are needed to realize these potentials. Thus, this paper provides a skeleton of thoughts and evidence to which we will add flesh in the course of the event.

2 Green ICT for Sustainable Consumption?

2.1 Introduction

The rise of ICT has been one of the most transformative developments of the last decades. Reflecting the increasingly central role of ICT in economies and societies, a recent study found that - if measured as a sector - Internet-related consumption and expenditure is now bigger than agriculture or energy and that the Internet's total contribution to global GDP is bigger than the GDP of Spain or Canada (McKinsey Global Institute 2011).

The expansion of ICT often goes along with increased energy consumption in production and consumption, leads to high throughput of materials and scarce resources, and poses challenges for end-of-life treatment and recycling. According to a recent study (The Climate Group 2012), the ICT sector´s share of total global carbon dioxide emissions is projected to increase from 1.3 percent in 2002 to 2.3 percent in 2020. Especially emissions due to data centers are becoming an increasingly important issue. Data centers currently consume 1.5 to 2% of global electricity – this figure is expected to grow at a rate of 12% per year (Greenpeace 2011). The global data centre footprint, including equipment use and embodied carbon, is expected to increase to 259 $MtCO_2$ in 2020 – making it the fastest-growing contributor to the ICT sector's carbon footprint, at 7% pa in relative terms (The Climate Group 2008). Thus, direct, indirect and systemic impacts related to the production, use and end of life of ICTs require careful study in order to comprehensively assess their "net" environmental impacts.

At the same time, ICTs have the potential to foster sustainable consumption and greener lifestyles in various consumption contexts. Moreover, ICTs are widely regarded as enablers of low-carbon economic growth ("green growth") in various sectors of the economy by delivering climate and energy solutions. The SMARTer 2020 study estimates that by improving energy-efficiency in production and consumption, enabling the constant monitoring of energy use and carbon emissions as well as transforming existing consumption processes through dematerialization and substitution, ICT technologies could cut 9.1 $GtCO_2$ of global greenhouse gas emissions by 2020, a 15% reduction over business-as-usual projections (The Climate Group 2012). Hence, what is needed is a better understanding of the potential of "Green ICT" to foster sustainable consumption and providing policy-makers with options for encouraging clean innovation and sustainable consumption for greening the economy.

2.2 Enabling Effects of Green ICT

Over the past decade, stakeholders from the ICT sector and policy domain as well as scientific experts in sustainable development, have started to identify opportunities for using ICTs to help foster sustainable consumption and enable the development of a greener economy. The key enabling aspects of ICT concern product-specific improvements (particularly with regards to energy efficiency), information provision for more sustainable consumption patterns, the potential for dematerialization (through the substitution of products by services as well through the support of alternative consumption concepts and business models such as sharing and re-

use systems), as well as the implementation of "smart systems" in, for example, the transport or building sector (Johnston and Vanderhaeghen 2010; MacLean 2011).

In addition to the short- to medium-term opportunities for ICTs to contribute to sustainable consumption, other studies done by interdisciplinary futures forecasting teams in Europe, North America and elsewhere have identified larger-scale, longer-term opportunities for ICT-enabled transformation of economic structures, consumer behavior and societal values (Erdmann et al. 2004; Pamlin 2002; European Information Technology Observatory 2002; Madden and Weissbrod 2008). However, systemic impacts are to a large extent mediated by user behavior (OECD 2010) e.g. in the areas of digital music (Weber, Koomey, and Matthews 2010), smart meters and travel work (Mokhtarian 1991). Intelligent ICT solutions such as smart homes, for example, will not reduce energy consumption if users continue to dissipate energy by not changing their behavior patterns (OECD 2009).

2.2.1 ICTs as Information Systems for Sustainable Consumption

ICT provides various instruments for monitoring consumption activities and receiving feedback – aspects which are important for sustainable consumption. A variety of online calculators exist, which measure the environmental impacts of individual behaviors and lifestyles in different consumption contexts (e.g. mobility, housing, food, etc.). Access to sound information, feedback on the ecological impacts of specific behaviors, and reliable advice on product choices can be important factors when aiming to promote behavioral change towards sustainable consumption. "Green" search engines like *WeGreen* in combination with applications such as *Barcoo, Ecoscan* or *Shopgun* enable consumers to make purchasing decisions according to ethical and ecological sustainability criteria.

Due to the growing number of smart phone users, apps are likely to gain importance as means to provide feedback on the environmental impacts of individual consumption decisions. According to "Branchenverband Bitkom", 21 million people in Germany currently use apps on their smart phones – a number that has doubled since 2010 (BITKOM 2012). Among these applications are a great number of so-called "Green Apps" which address different matters of sustainability and sustainable consumption (Begrüner n.d). Examples include *Erntefrisch* (a seasonal shopping calendar with integrated display of weekly local markets), *Beste Reste* (an innovative recipe book using only leftovers to create delicious meals) or *VegMan* (a listing of nearby vegetarian and vegan restaurants).

Web 2.0 and new information and communication technologies can also serve as important instruments to spread the idea of sustainable lifestyles in society and facilitate sustainable consumption. The emergence of Web 2.0 has allowed new forms of communication and interaction between users and provides for a changed concept of society, often called "network society". News and information get dispersed rapidly, hierarchies and rigid orders vanish as decentralized networking and information becomes a collaboratively produced commodity subject to peer production and open source principles (Meckel 2008). Whereas in Web 1.0 users were still seen as pure receivers of information, nowadays they are able to actively participate in the production of new online content and constantly comment, share and link information. This phe-

nomenon is recently described with the term *prosumer,* signifying a hybrid of producer and consumer (Liokumovica 2012).

This development also creates new possibilities to foster behavioral change. It has even emerged a new area of web science, the so-called *Behavior Change Support Systems (BCSS),* which present "information systems designed to form, alter, or reinforce attitudes or behaviors or both without coercion or deception" (Oinas-Kukkonen 2010). Since persuasion is considered one key aspect in behavioral change, BCSS are designed to influence consumers´ behavior with new technologies that "create opportunities for persuasive interaction". Fogg (2002)calls such technologies "persuasive technology" These can be strategically used to successfully persuade people to live and consume more sustainably. In order to foster responsible and sustainable lifestyles in society, different factors have to be considered and ICT can play a supporting role to accomplish those (Fogg 2002).

In order to upscale pioneers' initiatives, create true "cultures of sustainability" (Flasbarth 2012) and initiate a societal transformation process, it is necessary to facilitate adequate communication platforms. Virtual communities bring together people with same interests and thus facilitate knowledge transfer, the planning of projects and a continuous dialogue with like-minded people. A big advantage of online communities is the freedom of engagement. Members can participate independent of location, time and material resources – everybody is free to decide in which form to contribute and what role to take within the community (Liokumovica 2012). In the German-speaking area, the online community *Utopia* is – in terms of range of influence – an outstanding example for a virtual community dedicated to sustainability.

2.2.2 Dematerialization through ICT

A key enabling factor of ICT concern the use of ICTs to wholly or partially "dematerialize" physical products, services and processes, which could result in vast reductions in energy and materials consumption, with consequent reductions in greenhouse gas emissions. Examples of low-hanging fruits include the substitution of electronic bills sent electronically for paper bills delivered through the post; greater use of telework arrangements and virtual meetings in the public and private sectors; more efficient use of personal vehicles through ICT-enabled pooling and shared ownership; and personalized public transport as an alternative to traditional commuting practices (Mallon et al. 2008; Pamlin and Szomolanyi 2008).

Consumption of digital goods in many areas can help reduce the 19% of global GHG emissions resulting from manufacturing industries (IPCC 2007). Key examples include digital music and online music delivery, digital document delivery and electronic newspapers. For instance, life cycle assessments indicate a significant energy saving potential related to purchasing music based on download of MP3 files as compared to physical CD consumption (Weber, Koomey, and Matthews 2010). Studies on the enabling effects of electronic newspapers reach similar results, i.e. a reduction of energy use in production and delivery compared to print publications (Moberg and al. 2010; Kamburow 2004). However, while environmental benefits are evident at the individual product level, the net environmental impacts of digital goods vary, especially when the direct impacts of required infrastructures and access devices are included (OECD 2010).

2.2.3 Support of Alternative Consumption Concepts & Business Models

ICT also supports alternative business models and consumption concepts such as, for example, collaborative consumption which describes an economic model based on sharing, swapping, bartering, trading or renting access to products as opposed to ownership (Botsman and Rogers 2010a). Network technologies and peer communities – from smart phones to GPS to social networks – are enabling these old market behaviors to be reinvented by supporting the sharing and exchange of all kinds of assets on a scale and in ways not possible before. Potential benefits of collaborative consumption include cost-savings and income generation, resource and waste reductions, as well as trust and community building (Vergara 2012; Botsman and Rogers 2010a; Botsman and Rogers 2010b). According to a recent study, the two most popularly perceived benefits of sharing were "saving money" and being "good for society"; moreover, more than 2/3 of all survey participants – regardless of income – expressed interest in sharing personal possessions if they could make money from it (Latitude Research 2010).

Collaborative consumption encompasses enormous marketplaces such as *eBay* and *Craigslist*, as well as emerging sectors such as social lending (*Zopa*), peer-to-peer accommodation (*Airbnb*), peer-to-peer travel experiences (*LocalGuiding*) and car sharing (*Zipcar*), amongst others (Botsman and Anderson 2011). In the area of travelling and tourism, *Couchsurfing* has enhanced traditional hospitality clubs by exploiting Web2.0 technologies to allow travelers find a couch where to spend the night. However, not only tangible objects are exchanged: *Skillshare*, for example, promotes local meet-ups of citizens who share their personal expertise, and wish to learn from others. Likewise, political, environmental and consumers' movements like *Carrotmobs* and *Guerrilla Gardening* are gaining wide support and spreading around the world (Lugano 2010).

2.2.4 ICTs for Facilitating Behavioural Change

Apart from enabling awareness raising, knowledge sharing, alternative consumption modes and community building through online activities, ICTs can also support sustainable behaviors "offline" in various consumption contexts. With regards to mobility, for instance, a wide range of ICT applications can help to mitigate GHG emissions through e.g. changing driver behavior and vehicle behavior, influencing travel choices or reducing travel needs altogether (SDC 2010). For example, embedded automotive systems[1] have the potential to increase fuel efficiency and to reduce CO_2 from individual vehicles by around 20%, according to industry estimates. Measures such as electric power steering, improved power supply systems and others have been estimated to increase the fuel efficiency of an average US automobile by 16% (Heinrichs, Graf, and Koeppl 2008). The potential reduction of CO_2 emissions amounts to around 10% of an average US automobile's CO_2 emissions in 2007 (or around 14% of an average EU automobile's emissions).

1 Embedded systems are integrated semiconductor devices that enable control, measurement and management in a wide range of application areas.

Smart Moves

The UK Sustainable Development Commission´s (SDC) Project Mobility 2020 project aims to investigate how ICT could help the UK could achieve a major cut in carbon emissions from land-based personal mobility. In its report "Smart Moves", the SDC identifies six categories in which ICT can support more sustainable mobility:

1. **Reducing the Need to Travel** through Home Working or Video Conferencing
2. **Influencing Travel Mode Choice** by proving Journey Planning Tools
3. **Changing Driver Behavior** through enforcement technologies (e.g. cameras to enforce speed limits), intelligent speed adaption (ISA), satellite navigation, eco-driving, and "pay-as-you-drive" insurance schemes
4. **Changing Vehicle Behavior** through technologies such as automated reminders for routine servicing, tire pressure monitors, and engine management system self-diagnosis which help to ensure that vehicles run at optimal efficiency, as well as adaptive cruise control
5. **Increasing Vehicle Utilization** by facilitating car sharing or dynamic ride sharing systems
6. **Increasing Network Efficiency** and ensuring optimal utilization of infrastructure, e.g. through parking management, congestion charging, automated tolls or real-time traffic management

(SDC 2010)

2.2.5 ICT for Smart Systems

Apart from these short- and medium-term opportunities for ICT to contribute to sustainable consumption and green growth, other studies point to the potential of ICT-enabled transformation of economic structures, consumer behavior and societal values. These opportunities are seen to directly and indirectly contribute to the greening the economy and the achievement of sustainable development (Creech et al. 2009; Erdmann et al. 2004). Studies conducted for the Global e-Sustainability Initiative (GeSI), an ICT industry consortium, have found that the deployment of "smart systems" that increase the efficiency of production and consumption in the energy, transportation, building and manufacturing sectors could reduce global greenhouse gas emissions by 15 per cent by 2020, compared to a business-as-usual scenario with a 2002 baseline (The Climate Group 2008).

A study conducted for the European Commission Institute for Prospective Technological Studies (IPTS) concludes that ICTs are important for achieving environmental policy goals and can help – depending on the scenario – to alter a range of different environmental indicators (such as GHG emissions, energy consumption, renewable share of electricity generation, among others) by up to 30% in 2020 (Erdmann et al. 2004).The study projects that ICT applications in the energy sector will contribute to reducing GHG emissions, as ICTs will help to increase the share of renewable energy sources in electricity generation by up to 7% in 2020, e.g. through "smart

system" technologies. In the transport sector, ICTs can help lower the share of private cars in total passenger transport, e.g. through applications such as e-commerce, telework and teleconferencing. In total, ICT applications are projected to have a neutral impact or contribute to increases of overall transport of up to 4% in 2020, mainly due to rebound effects, e.g. intelligent transport systems (ITS) are likely to provide incentives for travelling because they improve traffic fluidity (Erdmann et al. 2004).

2.3 Emerging Policy Initiatives on Green ICT for Sustainable Consumption

When it became apparent that ICT equipment was quite energy consuming, the issue emerged on the regulatory agenda in the late 1980s and first steps were taken, for instance, with the American introduction of Energy Star labeling for office equipment in 1992. The commercialization of the internet in 1995 added a considerable boost to ICT-related energy demand in the following years, and in 2007 Gartner announced its much cited assessment that the total carbon emissions from the ICT industry accounted for about 2 percent of global emissions, a figure equivalent to aviation (Gartner 2007). In a period when climate change was seizing the agenda following the publication of the Stern report in 2006, the increased awareness of the ICT-related carbon emissions encouraged widespread activities to demonstrate the positive potential of ICT in relation to solving the climate problem. Thus, it was argued that ICT was the key to reduce the 98 percent of carbon emissions that originated from other industries. The point was made both by industry groups such as the Global e-Sustainability Initiative, GeSI (The Climate Group 2008) and NGOs such as the Worldwatch Institute, WWF (Pamlin and Pahlman 2008). At the political level several states formulated strategies to promote Green ICT, for instance, in relation to public procurement.

The wave of interest in Green ICT was reflected in various OECD activities. In cooperation with the Danish IT and Telecom Agency, OECD organized a workshop on "ICT and environmental challenges" in 2008[2], followed by a large conference in 2009 on "ICTs, the environment and climate change"[3]. In 2009, OECD published a report "Towards Green ICT Strategies: Assessing Policies and Programmes on ICT and the Environment", reflecting what was going on in different countries. The analysis showed that over two-thirds of "Green ICT" initiatives concentrated on the direct effects (i.e. on reducing the environmental impact of ICTs) of ICTs themselves rather than tackling climate change and environmental degradation through the use of ICTs as enabling technologies (i.e. using ICT applications to reduce society's environmental impact in different consumption and production areas). Among the government programs that considered enabling effects of ICTs (either exclusively or together with direct effects), ICT applications used for the dissemination of environmental information have most frequently been promoted, followed by smart transportation, smart grids (including smart metering), and smart buildings (OECD 2009).

2 http://www.oecd.org/denmark/workshoponictsandenvironmentalchallenges.htm

3 http://www.oecd.org/internet/interneteconomy/high-leveloecdconferenceictstheenvironmentandclimatechange27-28may2009.htm

In 2010 these activities culminated in a "Recommendation of the Council on Information and Communication Technologies and the Environment" (OECD 2010). The ten recommendations focused on the need for coordinating policies related to ICT, climate, environment and energy, promoting green ICT innovation and skills, increasing public awareness through green labeling and sharing of best practices, improving public procurement, and measuring the impact of the green ICT strategies.

Denmark

In Denmark, where the workshop on "ICT and environmental challenges" (2008) and the conference "ICTs, the environment and climate change" (2009) had taken place, an action plan for green IT as well as green IT guidelines for public authorities had been formulated in 2008, followed by a brochure addressed to business on "Green IT in your company – ideas and inspiration for a greener profile" in 2009. In 2010 a "Knowledge Centre for Green IT" was established (http://www.itst.dk/groenit), and initiatives were taken to gather statistics on green IT. The homepage of the centre provides advice on green solutions, focusing mainly on how to reduce carbon emissions in relation to the use of IT. For instance, the advice concerns the acquisition of IT equipment, the arrangement of server rooms, the use of cloud computing, and the importance of employee behaviour. Concerning the 98% – that is, how ICT can be applied to solve environmental problems in other sectors, the homepage provides short descriptions and concrete examples related to video meetings, self-service solutions, route planning, intelligent building management, and other innovative ideas. The concrete examples of green IT (both in the use of IT and applications in other sectors) are gathered in a knowledge bank which is established and run together with the trade organisation for IT (IT Branchen). Each year the knowledge centre in cooperation with IT Branchen and Dansk IT (an association for IT-professionals) award prizes to firms and public institutions that provide the best examples of green IT. While these initiatives may seem useful, it should be noted that the level of activity on the homepage is modest (13 news items have been published over the last two years), and the number of green examples is limited (37 over a three year period). The knowledge centre is expected to close down by the end of 2012, and the responsibility for green IT is expected to be transferred from the Agency for Digitization to the Energy Agency. Simultaneously, the political focus has moved to issues like smart grids and cloud computing with trends that are comparable to the ones described in the box on Germany (see below), but in Denmark these activities are no longer presented as parts of a "Green IT" strategy.

The Danish example may be illustrative of a change of discourse and political focus within recent years. The wave of interest in Green ICT during the period from 2008-2010 has gradually been replaced by the new buzzword 'smart'. The economic crisis has turned the focus towards economic growth, and it has become more important how ICT contributes to competitiveness and growth. When the growth concern can be combined with environmental concerns, it is described as 'smart'. The OECD publication "Greener and Smarter. ICTs, the Environment and Climate Change" from 2010 can be seen as a link between the green ICT discourse and the new focus on smartness. The report provides background information to the OECD Technology

Foresight Forum on "Smart ICTs and Green Growth" in 2010[4] that focused on how "smart" ICTs can play a key role in addressing the green growth challenge in energy, transport and water management and the roll-out of smart infrastructures.

The change of label from green to smart in relation to the enabling effects of ICT may not, in itself, be important, but it seems to be related to a certain shift in the organization of regulation and policies. Firstly, the enabling effects of ICTs are seen as an aspect of sectoral policies in relation to sectors such as energy, transportation, and buildings rather than a concern for ICT policy-making. Simultaneously, there is a need for cooperation with regulatory authorities in the ICT sector. Smart grids, for instance, call for cooperation between the energy sector and the ICT sector, as emphasized in the OECD report on "ICT Applications for the Smart Grid: Opportunities and Policy Implications" from 2012 (OECD 2012). Realizing *smartness* thus entails considerable regulatory challenges. Secondly, the responsibility for the direct environmental impacts related to the use of ICTs may tend to move out of focus for the telecom or digitization agencies. Energy agencies take on the responsibility when it comes to energy consumption (standards, labeling etc.), and environmental agencies deal with waste handling and regulation of chemicals.

Germany

The German "Green IT Action Plan" was established in 2008. It contains measures for greening through ICT and greening in ICT and it calls for a coordinated action among government, business, and science (Weismann 2011; BMWI 2008, 2009). The policy measures mentioned in the Action plan were in part embedded in Germany`s national ICT strategy "Digital Germany 2015", which was established in 2010. The Action Plan includes various programs supporting research and innovation of ICT as an enabler of more energy and resource efficient lifestyles and economy. The flagship project "E-Energy", for example, puts its focus on the development of ICT based measuring methods and control systems. The so-called Smart Grid Systems are mentioned as a necessary precondition to meet the German Federal Government's goal to increase the share of renewable energies to at least 30 percent by 2020. Smart Grid Systems enable the integration of renewable energies and local producers in an efficient way into the existing electricity network. As part of this program, the installation of six pilot projects is promoted financially with a total of 60 million Euros from the German Federal Ministry of Economics and Technology and the Federal Ministry for the Environment. Specific measures include the conceptualizing of electronic market places for an intelligent electricity network, the development of producer-independent norms and standards or the formulation of data protection policies.

[4] www.oecd.org/ict/TechnologyForesightForum

Germany cont.

Moreover, the strategy aims at fostering and facilitating the use of electric cars by means of ICT, e.g. by improving the connection between vehicles and the electrical power supply system when charging the battery. As another example, the project "ICT for electric mobility – Smart Car, Smart Grid, Smart Traffic" supports research and development of intelligent ICT-based solutions to build an adequate infrastructure for the use of electric cars and to provide for a higher energy efficiency of vehicles. Another measure is the initiative "Connected Living" promoting the collaboration between science and enterprises on research and innovation into smart homes. In order to reduce the sector's own energy consumption and to promote greener ICT, a variety of instruments of public policy is applied. Labels and standards for energy consumption such as the "Blue Angel" which is available for e.g. computers, printers, e-book readers, mobile phones (www.blauer-engel.de) or the European Ecodesign Directive have been established and provide more transparency for consumers.

Another publicly supported measure is the "Guide to Energy Efficiency in Data Centers" published by a research group of the Federal Association for Information Technology, Telecommunications and New Media and the Federal Environment Agency. It provides information on how the planning, the modernization and operation of data centers can be made more energy efficient and is directed at businesses (BITKOM 2008).

3 Knowledge Brokerage Event on "Green ICT for SC"

The second Multinational Knowledge Brokerage Event on "Green ICT for Growth and Sustainability?" takes place from January 17 - 18, 2013 at the Palais Harrach in Vienna, Austria.

3.1 Outline of the Event

On **Thursday, January 17**, following the welcome and introductory address by **Evelyn Nowotny (Austrian Federal Ministry of Science and Research), Sigrid Stagl (WU)** and **André Martinuzzi (RIMAS & WU)**, the event kicks-off with a trend spotting session to identify "Mega Trends in ICT" and their implications for household behaviour and sustainable consumption. This session starts with input from **Ray Pinto (Microsoft UK), Ysé Serret-Itzicsohn (OECD)** and **Inge Røpke (Aalborg University)** before the discussion is opened to all participants.

After lunch, **Grégoire Wallenborn (Université Libre de Bruxelles)** sets the scene for the thematic session on "Smart Metering/Smart Grids" with a keynote speech on empowering consumers through smart metering in which he also discusses the place of users in the development of materials devices and policy instruments. The remaining part of the session is dedicated to the core methodology RESPONDER employs for exchanging knowledge and fostering mutual understanding between stakeholders - **participatory systems mapping**. Participants in three parallel working groups are invited to jointly debate the system map on smart metering/smart grids developed in the first Multinational Knowledge Brokerage Event on Green ICT and explore implications for research, policy-making and employment. These system mapping sessions are facilitated by **André Martinuzzi, Michal Sedlacko (RIMAS)** and **Gerd Scholl**

(IÖW). After the mapping, participants are encouraged to share their experience and learning with the rest of the group. The day closes with an **interactive poster walk** in the course of which participants share experiences and best practices on how to harness ICT for sustainable consumption.

On **Friday, January 18, Ray Pinto (Microsoft UK)** starts the session on "Cloud Computing" and discusses the potential of cloud computing to help decarbonise the economy. Following a period for questions and discussion, a second session on **participatory systems mapping** takes place which centres around the system map developed in the first Multinational Knowledge Brokerage Event on Green ICT; participants are again invited to discuss implications for research, policy and employment. After another feedback round, **Ysé Serret-Itzicsohn (OECD)** shares her insights and experiences on green ICT for Sustainable Consumption from a policy perspective. Finally, the whole debate is wrapped-up and a brief outlook provided on upcoming events and activities planned in the RESPONDER project.

3.2 System Mapping

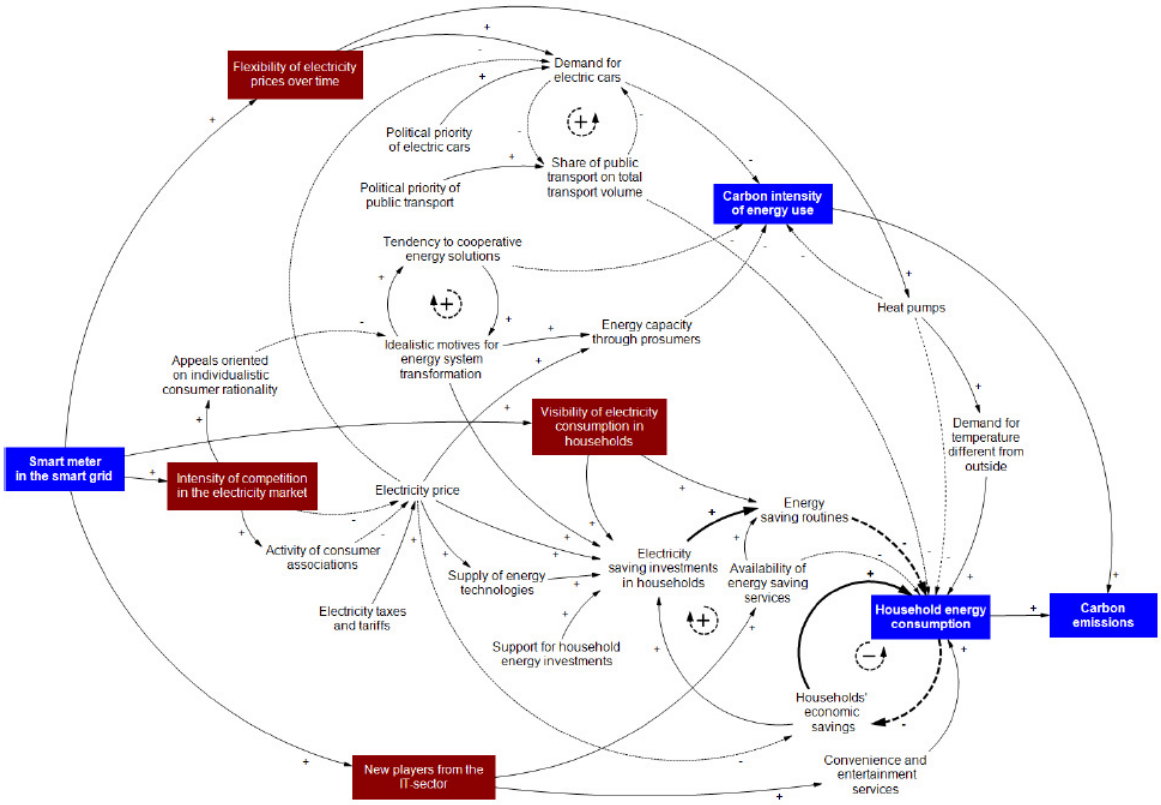
As has already been mentioned, RESPONDER aims to improve mutual understanding and knowledge exchange between policy and science by using participatory systems mapping as a core methodology. So-called ***system maps*** serve as the basis for systematising the links and contradictions between sustainable consumption and economic growth in different consumption domains. The knowledge brokerage event on Green ICT for Sustainable Consumption will put a thematic focus on the two key topics Smart Metering/Smart Grids and Cloud Computing.

3.2.1 How do smart meters in the smart grid affect household energy consumption and carbon emissions?

A key aspect of the transition to a low carbon society is usually considered to involve an increased use of renewable energy sources (RES) like wind power and solar energy in the production of electricity. Electricity production based on RES will become much more decentralized with both large and small production units, including production in households. Since RES are intermittent, balancing supply and demand is a key challenge. The increased dependence on RES necessitates that demand is adjusted to supply and that energy can be stored to provide backup. Both demand management and the integration of many more injection points into the electricity grid call for the development of a more 'intelligent' grid that combines a power exchange highway with a data exchange highway, enabling the necessary real time feedback and interaction between producers and consumers. The many different technological and organizational changes in relation to the grid are often captured by the term 'smart grid', and this is often mentioned as one of the key examples of ICT playing a positive role for the environment.

The smart meter is the key device connecting households to the smart grid. Smart meters are electronic meters that enable two-way communication between the household meter and the electricity supplier and more detailed recording of the electricity consumption in intervals of, e.g., an hour or less. These functionalities open up a number of new applications, including more detailed feedback to customers about their electricity consumption as well as demand management. Households are expected to play a variety of roles in relation to the smart grid.

They are expected to save energy encouraged by the feedback provided through the smart meters and to be much more flexible with regard to the time pattern of their electricity use. Households may also develop into *prosumers* when they provide their own energy input based on RES and sometimes even produce electricity to feed into the grid. Furthermore, many household activities related to the smart grid involve both considerable investments and active participation in new markets. As these changes are highly complex, it is worth discussing how they affect energy consumption and carbon emissions, and how different policy interventions may influence the outcome.



Participatory System Map on

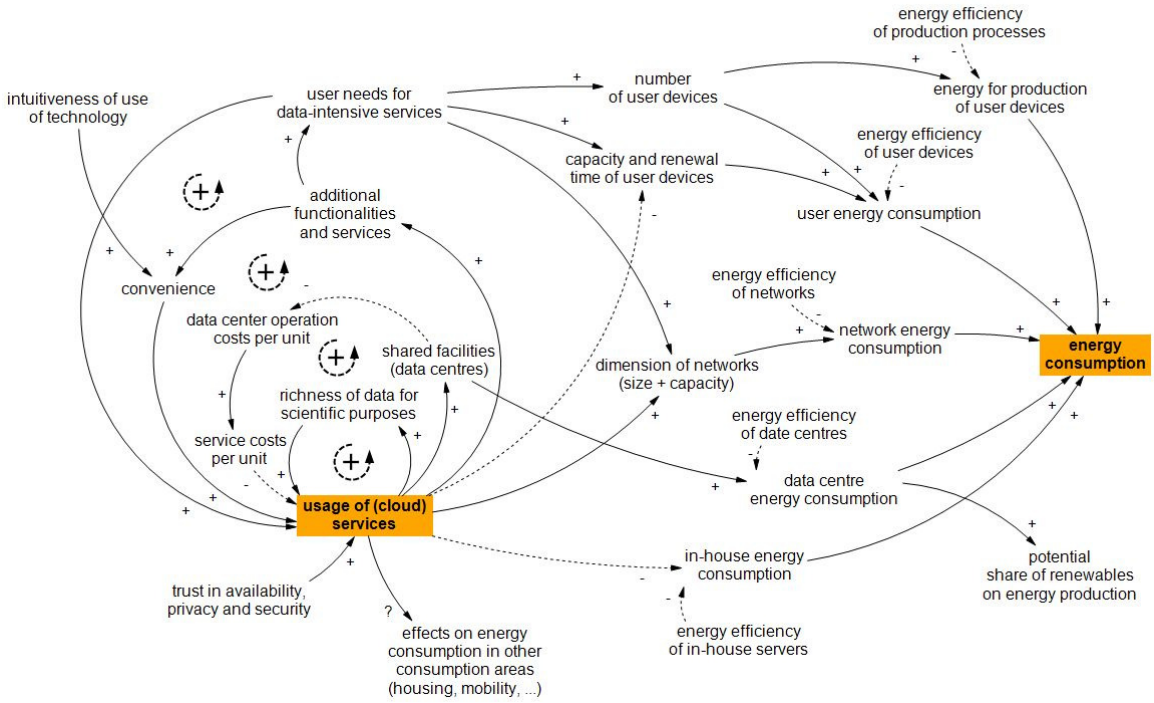
How do smart meters in the smart grid affect household energy consumption and carbon emissions?

3.2.2 Will cloud computing lead to overall savings of energy and other resources?

Cloud Computing is often regarded as form of "green computing"; it appears to be environmentally friendly due to the economies of scale offered by cloud computing resources and facilities. On the individual consumer level, some cloud computing services replace offline activity that is equally or more energy intensive, and hence make a positive contribution to emissions reduction (e.g. digital purchase of music, online browsing of newspapers, Skype audio or video meetings, etc.). Cloud computing also promises high economic benefits, especially through wide-

spread use of cloud solutions by businesses and the public sector. Given wide-spread adoption across all sectors of the economy and economies of scale, organizations adopting cloud computing could achieve cost savings of at least 10-20%.

However, the growth of cloud computing is also accompanied by an increasing demand for energy. For all of this content to be delivered to users in real time, virtual mountains of video, pictures and other data must be available for almost instantaneous access and stored in massive data centres. These data centres are the fastest growing source of IT energy use. Data centres currently consume 1.5 to 2% of global electricity – this figure is expected to grow at a rate of 12% per year (Greenpeace 2011). The greatest effort to reduce the environmental footprint of data centres have so far focused on efficiency gains through e.g. improving data centre design, increasing server energy efficiency or reducing waste associated with cooling and other 'non- computing' energy demands. Hence, the net environmental impacts of cloud computing are still not clear, mainly due to a lack of utilization data provided by the major cloud companies.



Participatory System Map on

Will cloud computing lead to overall savings of energy and other resources?

Moreover, in the absence of common standards and clear contracts, many potential users are deterred from adopting cloud solutions. They are not sure what standards and certificates they should look for to meet their requirements and legal obligations, for example to ensure that their own or their customers' data is safe or that applications are interoperable. Cloud providers and users are also looking for clearer rules when it comes to the delivery of cloud services, for example regarding the question where legal disputes will be resolved or how to make sure that

it will be easy to move data and software between different cloud providers (EC 2012). This was also the key rationale behind the launch of the EC´s strategy for "Unleashing the potential of cloud computing in Europe".

Unleashing the Potential of Cloud Computing in Europe

The European Commission's strategy for "Unleashing the potential of cloud computing in Europe" outlines actions to deliver a net gain of 2.5 million new European jobs, and an annual boost of EUR 160 billion to EU GDP (around 1%), by 2020.

Key actions of the strategy include:

- cutting through the jungle of technical standards so that cloud users get interoperability, data portability and reversibility; necessary standards should be identified by 2013;
- support for EU-wide certification schemes for trustworthy cloud providers;
- development of model 'safe and fair' contract terms for cloud computing contracts including Service Level Agreements;
- a European Cloud Partnership with Member States and industry to harness the public sector's buying power (20% of all IT spending) to shape the European cloud market, boost the chances for European cloud providers to grow to achieve a competitive scale, and deliver cheaper and better eGovernment.

The strategy announcement follows the Commission's 2012 proposal to update the Data Protection rules and comes ahead of a European Strategy for Cyber Security to be proposed in the coming months. The development of European cloud rules is seen as a precondition for the seamless digital space that is meant to bring a true "Digital Single Market".

(EC 2012)

References

Begrüner. Green Apps n.d [cited 19 December 2012. Available from http://www.begruener.de/specials/green-apps/index.html.

BITKOM. 2008. Energy Efficiency in the Data Center. A guide to the planning, modernization and operation of data centers. In Series on Environment and Energy. Berlin.

———. 2012. Der App-Boom geht weiter In [press release], 10 October 2012.

BMWI. 2008. Aktionsplan: Green IT-Pionier Deutschland.

———. 2009. Fortschrittsbericht Aktionsplan Green IT. Stuttgart.

Botsman, R. , and R. Rogers. 2010a. What's Mine Is Yours: The Rise of Collaborative Consumption: HarperBusiness.

Botsman, R., and L. Anderson. 2011. Share Options. The Big Issue: 12-14, http://www.collaborativeconsumption.com/blog-and-writings/Share%20Options%20-%20Big%20Issue%20May.pdf.

Botsman, R., and R. Rogers. 2010b. "Beyond Zipcar: Collaborative Consumption." Harvard Business Review no. 88 (10):30-30.

Creech, H., Vetter Andjelkovic, T., D. MacLean, D. Rothman, and P. Vergragt. 2009. Mapping the future of the Internet onto global scenarios: A preliminary view. Winnipeg: International Institute for Sustainable Development.

EC. 2012. Unleashing the Potential of Cloud Computing in Europe.

Erdmann, L., H. Hilty, J. Goodman, and P. Arnfalk. 2004. The Future Impact of ICTs on Environmental Sustainability. Luxembourg: Institute for Prospective Technological Studies (IPTS).

European Information Technology Observatory. 2002. "The impact of ICT on sustainable development." In European Information Technology Observatory Yearbook 2002, 250-283.

Flasbarth, J. 2012. Approaches to foster responsible living. Paper read at Beyond Consumption Pathways to Responsible Living, at Berlin.

Fogg, P.G. 2002. "Computers as Persuasive Social Actors." In Persuasive Technology: Using Computers to Change What We Think and Do. Morgan Kaufmann.

Gartner. 2007. Gartner Estimates ICT Industry Accounts for 2 Percent of Global CO_2 Emissions.

Greenpeace. 2011. How dirty is your data? A Look at the Energy Choices That Power Cloud Computing. Greenpeace International.

Heinrichs, F., A. Graf, and B. Koeppl. 2008. Reducing CO_2 Emissions and Achieving 2020 Fuel-Efficiency Requirements. A US Perspective on Demand-driven Electric Power Control.

IPCC. 2007. Climate Change 2007. Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. edited by R.K. Pachauri and A. Reisinger. Geneva: International Panel on Climate Change.

Johnston, Peter, and Waldo Vanderhaeghen. 2010. Economic recovery to a greener economy: mobilising ICT-based innovations. In Working Paper No.33: European Policy Centre.

Kamburow, C. 2004. E-Paper–Erste Abschätzung der Umweltauswirkungen. Eine ökobilanzielle Betrachtung am Beispiel des Nachrichtenmediums Zeitung. Berlin: Institut für Zukunftsstudien und Technologiebewertung (IZT).

Latitude Research. 2010. The New Sharing Economy.

Liokumovica, I. 2012. The role of ICT and social media in the process of transition to responsible and sustainable living. Paper read at Beyond Consumption Pathways to Responsible Living, at Berlin.

Lugano, G. 2010. MoSoSo and the shift towards sustainable consumption. Tiedosta magazine.

MacLean, Don. 2011. ICTs as Enablers of the Green Economy: a brie fon Internet policy issues. International Institute for Sustainable Development.

Madden, P., and I. Weissbrod. 2008. Connected: ICT and sustainable development.

Mallon, K., G. Johnston, D. Burton, and J. Kavanagh. 2008. Towards a high-bandwidth, low carbon future:

Telecommunications-based opportunities to reduce greenhouse gas emissions. Climate Risk Pty. Ltd.

McKinsey Global Institute. 2011. Internet matters: The Net's sweeping impact on growth, jobs and prosperity. .

Meckel, M. 2008. "Aus vielen wird das Eins gefunden - wie Web 2.0 unsere Kommunikation verändert." Aus Politik und Zeitgeschichte (39/2008):17 – 23.

Moberg, Å., and et al. 2010. "Printed and Tablet e-Paper Newspaper from an Environmental Perspective – A Screening Life Cycle Assessment." Environmental Impact Assessment Review no. 30 (3):177-191.

Mokhtarian, P. 1991. "Telecommuting and Travel: State of the Practice, State of the Art." Transportation no. 18 (4):319-342.

OECD. 2009. Towards Green ICT Strategies: Assessing Policies and Programmes on ICT and the Environment. Paris: OECD.

———. 2010. Greener and Smarter: ICTs, the Environment and Climate Change.

———. 2012. ICT Applications for the Smart Grid: Opportunities and Policy Implications. In OECD Digital Economy Papers.

Oinas-Kukkonen, H. 2010. Behavior Change Support Systems: The Next Frontier for Web Science. Paper read at WebSci10: Extending the Frontiers of Society On-Line, at Oulu.

Pamlin, D. 2002. Sustainability at the speed of light. WWF Sweden.

Pamlin, D., and S. Pahlman. 2008. Outline for the first global IT strategy for CO_2 reductions. A billion tonnes of CO_2 reductions and beyond through transformative change. WWF Sweden.

Pamlin, D., and K. Szomolanyi. 2008. "Saving the climate @ the speed of light. A report prepared for the European Telecommunications Network Operators Association (ETNO) and the World Wide Fund for Nature (WWF).".

SDC. 2010. Smarter Moves. How ICTs can promote sustainable mobility, UK Sustainable Development Commission. Sustainable Development Commission, United Kingdom.

The Climate Group. 2008. SMART 2020. Enabling the low carbon economy in the information age. The Climate Group and the Global eSustainability Initiative (GeSI).

———. 2012. SMARTer 2020: The Role of ICT in Driving a Sustainable Future.

Vergara, S. 2012. Collaborative consumption – a trend for the young, the hip, the urban. In http://blogs.worldbank.org/.

Weber, Christopher L., Jonathan G. Koomey, and H. Scott Matthews. 2010. "The Energy and Climate Change Implications of Different Music Delivery Methods." Journal of Industrial Ecology no. 14 (5):754-769.

Weismann, B. 2011. The German Green IT Policy. Berlin. Powerpoint Presentation.