National Collaboration on Green ICT in the Dutch Higher Education: Lessons Learned

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ABSTRACT
This paper describes the attempts in the Dutch Higher Education to collaborate on a community-basis on the topic of Green ICT. The purpose of this paper is to share our experiences on what works and what does not work when supporting a community focused on Green ICT.

Keywords
Green ICT, Communities, Higher Education

1. INTRODUCTION
We live in a world that in many ways is nearing its limits for supporting humanity. In general there is no doubt in the scientific community that society needs to deal with these limits, change behavior patterns, in order to become sustainable and transition into a low-carbon society or face the harsh consequences. Currently most of us do not feel the impacts the human activities have on the earth's system in our daily lives. Yes, there are some weather extremities; yes, droughts in one part of the world can affect food prices in the rest of the world, but these warnings have not led to system wide changes. We still feel that we have a choice between a soft landing or a hard fall going through such a transition. Society as a whole hasn't chosen yet. The increasing attention for sustainability and the many green activities forming an undercurrent in our society may soon lead to a tipping point setting us on a path towards a soft landing. On the other hand, clinging to our current way of thinking and decision making will at some point in time inevitably lead to overtaxing and exhausting planetary resources. The solutions we will need by then will come at a much higher price for society. Practically, this lack of choice means that for those of us who want to do something right now, activities have to fit both ways of thinking. A simple heuristic, for example, is to make sure you have a solid financial business case for your sustainability project (even though many societal costs are not accounted for). This is the general situation we are in now: yes, sustainability activities are accepted or even promoted, but they must have a normal return on investment, they must be economically efficient.

The impact that ICT has (had) on society is nothing short of revolutionary. The scientific advances in computer technologies and the widespread use of telecommunication have made information exchange virtually free. Being able to exchange information freely and perhaps more importantly, automatically are currently the most important drivers for efficiency gains. It is therefore no surprise that many innovations in products, services, production, etcetera, have an important ICT component. At the same time these innovations often also bring efficiency gains in terms of sustainability. Shifting products and processes to the digital world leads to a dematerialization effect in the physical world: instead of shipping pieces of paper all around, we can use e-mail; instead of meeting face to face, we can use videoconferencing. Unfortunately, making information practically free also changes the equation: it changes production and consumption; it changes our behavior. Sending an e-mail may tax the environment much less than sending a letter, but it has become so easy for us that we now send many more e-mails than we would have letters. We might have an increase in productivity by doing so, but the sum of sending e-mails may well exceed the sum of sending letters in terms of environmental costs. This is also known as the *rebound effect* [10]. The impact of the rebound effect is a complex issue and not the central topic here, but it is important to know that this effect exists and that it should be considered in decision-making. In a sense, the rebound effect can only exist because we are unable to express the true (societal) costs of our behavior. When talking about Green ICT we should consider both the abovementioned effects (aside from the environmental effects of ICT itself): the use of ICT as a replacement technology (as an enabler) in general has a positive effect on the environment but the behavioral change that is paired with it may well have a negative effect.

Green ICT is often defined using the words of Murugesan [5]: *"It's the study and practice of designing, manufacturing, using and disposing of computers, servers, and associated subsystems … efficiently and effectively with minimal or no impact on the environment"*. While this adequately defines the environmental problem set within the ICT-sector, it leaves out the enabling effects that ICT-solutions can bring to other sectors; it leaves out the efficiency gains mentioned above. In summary, the impacts of ICT could be expressed in different orders of effect [2]:

- *'First order' or 'primary' effects: effects of the physical existence of ICT (environmental impacts of the production, use, recycling and disposal of ICT hardware).*
- *'Second order' or 'secondary' effects: indirect environmental effects of ICT due to its power to change processes (such as production or transport processes), resulting in a modification (decrease or increase) of their environmental impacts.*
- *'Third order' or 'tertiary' effects: environmental effects of the medium- or long-term adaptation of behavior (e.g. consumption patterns) or economic structures due to the stable availability of ICT and the services it provides.*

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Most consider the global environmental impact of ICT to be around two per cent and growing fast [8]. These two per cent only comprise of the first order effects, the enabling effects are not considered. These effects could be the most powerful, however, and it is not surprising that many organizations advocate a focus on the other 98 per cent [e.g. 12]. The enabling effects of ICT could reduce the global footprint by 10-20 per cent [8, 12]. These studies focus mainly on the positive impact of applying ICT and much less on the negative impacts such as the rebound effect. Hilty et. al. [1] showed through the use of simulations that from a high level perspective the future impact of ICT on the global footprint could be marginal. Not because there were no effects, but because positive and negative effects cancel each other out. Thus, policies stimulating the use of ICT in general will not be as effective as policies focusing on the different kinds of effects, stimulating the positives and inhibiting the negatives [1].

In the Netherlands the ICT infrastructure is well developed. The Netherlands is ranked sixth in the Networked Readiness Index of the World Economic Forum, an index expressing the propensity for countries to exploit the opportunities offered by ICT [11]. Looking specifically at the higher education sector, most of the ICT network infrastructure is serviced by SURFnet, the Dutch National Research and Education Network (NREN – NRENs are specialized and often not-for-profit internet service providers dedicated to supporting the needs of the research and education community in a country [9]). SURFnet is part of the SURF foundation, which is the Dutch higher education and research partnership for network services and ICT. Given any national ICT initiative in the higher education sector, SURF is usually involved. Together with the higher education institutions, SURF started a Green ICT community, the Special Interest Group (SIG) Green ICT, in 2010. It is the activities that surround this community that will be discussed in this paper. First the background and a description of the community is given. Second a number of activities and their effects are described in detail. What follows are some observations and feedback from the community. The effects and feedback are then translated to lessons learned in the next section. We finish this paper discussing the value of the described community.

2. COMMUNITY DESCRIPTION

From a general sustainability perspective the Dutch higher education sector agreed in 1999 (and again in 2002 and 2005) to work on energy efficiency, specifically to become 30% more energy efficient in the period 2005 – 2020 [6]. Until recently, there was not much attention for the energy efficiency of ICT and the role that ICT could play as an enabler. In 2010 SURF and AgentschapNL, a Dutch governmental organization focused on implementing innovation and sustainability policies (among others), carried out a so called ICT-scan at nine higher education institutions (table 1). The aim of this ICT-scan was to determine the amount of energy consumed by workstation equipment and datacenters and to make recommendations for how to reduce that consumption. The scan showed that Dutch higher education institutions could on average reduce the ICT energy consumption by 44% by improving the energy efficiency of their ICT. The actions that institutions should take were basically low-hanging fruit: increase temperature in datacenters, earlier write off of datacenter equipment, more efficient use of datacenter space, more efficient workstation equipment and energy management easures on those workstations [7]. The results of this scan were presented during our first symposium in 2010, which was attended by over 100 people and marked the beginning of the Special Interest Group Groene ICT (hereon abbreviated as SIG).

Table 1 ICT energy consumption of nine Dutch HE-institutions [7].

	Energy consumption	Savings possible
Total of 9 institutions	179 GWh	
Datacenters (9% of total)	16.1 GWh	25%
ICT equipment in datacenters	7.9 GWh	
Workstation equipment (13% of total)	24 GWh	56%

The SIG came to life after members of the Dutch HE-community expressed their interest in the energy efficiency of ICT and to create a platform where staff, students, teachers and researchers alike could share knowledge and experiences. A LinkedIn group was chosen as the central meeting place for announcements, discussions and publications [3]. The group is open to anyone interested but individuals must request membership. In less than two years the group grew to over 330 members. Although the group is predominantly lurking and dependent on outside stimulations from SURF for example, activity is slowly rising with regular discussions, news postings and the creation of workgroups within the community on specific topics.

3. COMMUNITY ACTIVITIES

This section highlights a number of (recurrent) community activities to illustrate which activities are strengthening the community and it's goals and what their effects were. The community also supports other activities such as publicizing white papers and best practices, sharing business cases and supporting a wiki but they are not mentioned here further. The topics that are most discussed in the community are: green datacenters, pc power management, sustainable procurement, e-waste, green cloud computing, green software and sustainable ICT-curricula.

3.1 Measuring the effects of ICT

After the ICT-scan in 2010, SURF started the benchmark pilot in 2012. The ICT-scan was based on the OpenDCME model (figure 1), a measurement model on datacenter efficiency [4]. The creators of the OpenDCME model had launched an online tool in which datacenters could keep track of the 16 KPIs by measuring and reporting various variables. The pilot made this tool freely available for the whole higher education community during 2012. The idea was to let all institutions get acquainted with measuring the sustainability of their datacenter through the use of this comprehensive model. Together with four pilot participant meetings we hoped to stimulate sharing of knowledge and best practices as well as get an idea of the national progress that is being made.

While the actual results of the pilot will be known by the end of 2012, some observations can already be made. Nine institutions participated in the pilot out of roughly a hundred institutions. Some institutions also participated in the 2010 ICT-scan; some were newcomers. It is interesting to note the differences between participants. Some took the lessons from 2010 to heart and improved the energy efficiency of their ICT; others are facing the same issues as those found in 2010. Two of the most common reasons for not joining the pilot were (1) that institutions have

already done an ICT-scan and (2) that institutions did not have the time to participate. The latter is quite interesting given the current environment in which institutions are looking for savings in every corner and that (the energy efficiency of) ICT is, on average, hardly exploited. One might think that learning about possible ICT savings might be worth the effort. One of the root causes of this paradox is that ICT departments at institutions are hardly responsible for their own energy bill.

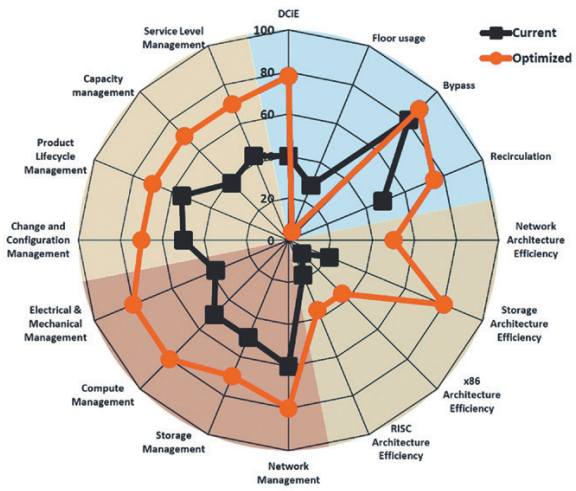

Figure 1 Example of the OpenDCME model [4].

3.2 Funding for Green ICT projects

In 2011 as well as in 2012 funding was made available for innovative Green ICT projects at higher education institutions. The purpose was to stimulate those projects that are innovative and which results could be shared with and learned from by other institutions. The main criterion was that the results should somehow have a positive effect on CO2-emissions in the broadest sense (greening *of* and *by* ICT) so that we would see a wide range of ideas, conventional and unconventional. On the financial side, projects could earn up to 20.000 euros, which must be matched by the institutions. Projects could apply through a template in which they describe their proposal. After the application date had passed, a jury determined which proposals would be awarded.

Table 2 Overview of topics in the funding arrangement for innovative green ICT projects at institutions.

Year	Topic
2011	Sustainable ICT-education
	Paper reduction (dematerialization)
	Digital mobility in education
	Sustainability in e-Science
	Visualization of personal energy consumption
2012	Software energy footprints
	Sharing green ICT practices
	Virtual teaching
	Smart data storage
	Using gamification for energy consumption awareness

In 2011 as well as in 2012 5 proposals were awarded a sponsorship (table 2). All projects were innovative Green ICT projects in their own sense, but covering a wide range of topics and methods. However, during both rounds not all of the funding was allocated due to a lack of well-written proposals. This surprised us especially after the second round since the funding arrangement should have been more known in the community. The projects themselves have seen a number of spin-offs though, ranging from internal and external follow-up to (scientific) publications.

3.3 Green ICT Gatherings

An important function of the community is disseminating knowledge from practitioners of Green ICT in higher education. Several meetings/workshops/seminars on specific topics as well as a yearly general symposium on Green ICT & Sustainability have been organized with various degrees of success. Roughly fifteen gatherings have been held, mostly on specific topics. Those were on average attended by 20-30 people, whereas the yearly symposium has consistently attracted over 100 attendants. The general impression is that many people want to be aware of what is happening but do not have the time or the power to be actively involved. This is also something that was shown in one of the questionnaires we took in the community.

4. COMMUNITY OPINIONS

We know from experience that creating and raising a community takes time. Unless there is a true sense of urgency, it takes at least a year for a community to become active and for members to start profiling themselves and making (pro-active) contributions. After about one year and a half we wanted to learn what members themselves thought about the community and where it is going. We asked them a number of questions through a questionnaire (n = 38). In the same period a survey (n = 35) on green ICT was held among higher ICT-managers (directors, CIOs, etcetera) in general. A selection of both sets of questions is mentioned here and reflect well the current mindset in the community and at the higher education institutes in general.

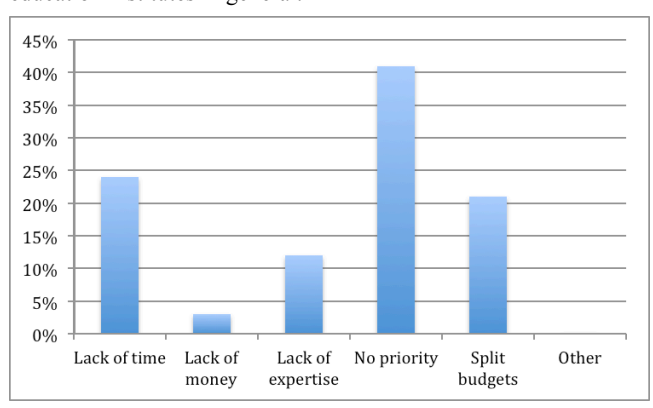

Figure 2 Obstacles for green ICT activities

When asked whether community members find sustainability an important topic, 91% submitted they think it is reasonably to very important. Given the same question on their institution only 59% of the institutions are perceived to rank sustainability as an important topic. This is also reflected in whether community members are working on sustainability: only 14% is paid to work on sustainability, 51% is doing it in between their normal tasks, and another 14% would like to work on sustainability issues. When we asked the managers whether they think Green ICT

contributes to a more sustainable institution, 96% thought this would be an important factor. Yet, there is a lack of action, which 46% of the managers recognized. The reasons behind this, they expressed in figure 2. The reasons are similar to those found in the community activities, mainly: no time (24%), no priority (41%) and split budgets between ICT and other departments (21%).

We also asked whether community members think SURF should continue to support the SIG to which 85% agreed. However, the community is not very influential with an average rating of 4.2 on a scale of 10 and 22% of the respondents stating that they felt no effect at all yet. The irony is that community members themselves of course need to be active to let the community gain influence. This is also reflected in the next question on activity, to which 91% stated to be a mainly passive member.

Finally, we asked a number of questions on the ICT-scan. 50% of the community members were familiar with the scan and its results of possible savings averaging 44%. Figure 3 displays the response of all the members to what effect these results had on their institution. Only 10% got to work straight away, and 20% said it had no effect at all. The large 'No idea' part is largely explained by the other part of the aforementioned 50% (they were not familiar with the results in the first place).

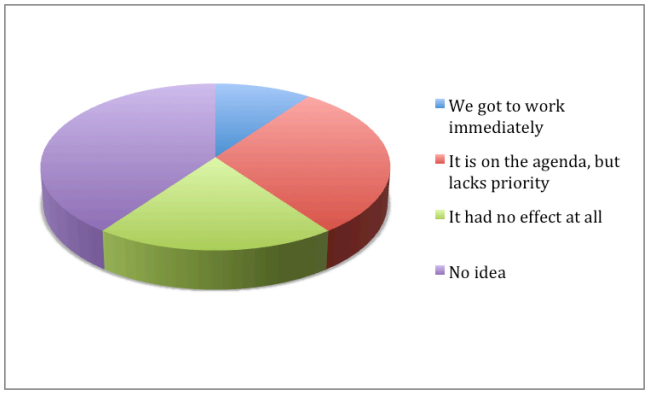

Figure 3 Effects of the results of the ICT-scan on the institutions

5. LESSONS LEARNED

When we look at the SIG ourselves, we see a passive community that is slowly transforming into a more active one. Compared to other communities we support, this SIG has some interesting characteristics. Firstly, it is one of the largest communities we have. Yet, secondly, it remains passive longer than we anticipated. The previous sections illustrated why this might be the case.

Figure 2 summarized it nicely in lack of time, no priority and split budgets. ICT departments are often not responsible for their energy bill and thus hardly care about energy savings. Moreover, why should the ICT department make the investments while another department gets the returns? In addition, priorities often lie elsewhere, mainly in keeping everything run smoothly. Tinkering with proven settings, even raising the temperature in the datacenter, meets resistance.

Another interesting discrepancy is the general interest and the belief in the topic of Green ICT compared to actual community behavior. The yearly symposium is well attended, but activities on specific topics less so. The support for the community is there, yet most members can only give attention to Green ICT issues in between their normal tasks.

As facilitators we evaluated our role as well. We concluded that two aspects needed to be changed. First, we originally wanted to let the community and its activities grow organically and thus supported a wide range of topics. While we still think that all these topics have their merits, this gave the community little focus and widened the gap between those that were well versed in the possibilities of green ICT and those that only just started. We decided to focus on those activities that proved to be easy best practices for the environment as well as financially (the low-hanging fruit) until the message reached the right group of people. The second gap we noticed was between staff and higher managers and directors. There is a willingness on the floor to actively engage in green ICT but a lack of time and priority to do so. On the other hand, managers recognize the importance of sustainability and green ICT but lack the sense of priority to act upon it. This is often dependent on the environment in which ICT is embedded: ICT use steadily grows year after year; who pays the energy bill; etcetera. We want to remedy this by organizing meetings at individual institutions inviting stakeholders from all relevant departments and layers of the organization and discuss ways to move forward. In the end, ICT in itself is often seen and must be seen as part of or a function of something else, it is a means to an end.

6. DISCUSSION

One of the important values of sustainability is collaboration. This is because sustainability must be seen as a systemic issue, something that must be solved at the systemic level and not individually. Optimizing locally might have reverse effects on the whole system, whereas helping to your neighbor's problem could solve one of your own. Take for example, the warmth generated by ICT equipment in datacenters. This could be perfectly used to warm residential buildings instead of letting it blow out in the open air. From this perspective, communities such as the one discussed here, help move thinking towards the systemic level.

Yet, this community is not where it could be. The reason for this might be enclosed in the scope, the topic of green ICT. Is it possible that the scope is too narrow? Should it envelop the processes in which the ICT is used as well?

Looking at green ICT in general, there is regularly a call from influential NGOs like the World Wildlife Fund to focus on the enabling powers of ICT. Yes, ICT could be made more energy efficient, but it is much more interesting to focus on solutions for the other 98%; solutions that the ICT sector should deliver. But is it fair to look at the ICT sector and ask for solutions to green other activities?

How can society, how can higher education institutions make full use of the enabling power of ICT and preferably not fall into the trap of the rebound effect? There is a gap between those who know how to make efficiency gains with the use of ICT and those who know all about specific processes and activities and could actually use such ICT solutions but do not know how. It would be interesting to learn more on how to bridge this gap and with that be one step closer to a low-carbon society.

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