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Energy and Emotions: transdisciplinary design education for resource conservation

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Abstract: *In our contemporary world we are using resources extensively to the point of their depletion. The call for more sustainable ways of living is louder than ever before, asking for a better awareness of the flows of resources and energy. This paper looks into existing design perspectives towards energy use in our daily living. By exploring relevant literature in social sciences and in design, and earlier research related to energy use, we identify a need to connect the design for conservation more strongly with human emotions and their relations in the social realm, and thus iterate the systems collaboratively in real-life settings through constructive design research approach (Koskinen et al. 2011). The questions arising from the earlier research on design in such context are elaborated further into notions relating to design action and education. Consequently, we suggest elements for such action, as well as an educational model to further the inquiry between energy use and emotions.*

Keywords: design for sustainability, design education, emotions, conservation, feedback.

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Introduction

As of today, global consumption is not on par with our intention to preserve the ecological system. Annual use of resources exceeds sustainable levels (see e.g. Pollard 2010; Rockström et al. 2009). Along with resource usage there also exists evidence of a rise in the overall energy consumption. Systems for feedback are built upon one another but they still seem to fail to deliver energy and resource conservation. The call for more sustainable approaches still demands further iteration on the ways design can help to raise awareness of these topics.

Energy in the form of electricity becomes more and more essential yet ubiquitous in our contemporary life, thus rendering it more integral to our daily living. The material implications of energy production and use, however, remain rather detached from our emotive selves in being often invisible during the particular moments of consumption. This poses the following dilemma: how to transform the invisible flow of particles into something tangible and socially connectable?

Designers must look for ways to better induce human understanding of the material impacts relating to resource and energy over-use. This calls for alternative approaches that could be experimental and artistic, taking into account the power of human emotions, which are neither simple nor straightforward or reducible into mere seemingly objective numbers. In this light, we call for design research that is curious to investigate into a range of encounters dealing with daily energy consumption and artefacts in the process.

Aim of this paper

This paper aims to describe how contemporary design research connects emotions to the use of resources by the means of interface design and its collaborative iteration. The descriptions emerge from literature studies and are then elaborated further into suggestions for important elements to consider in design research and education. In the context of energy conservation, the main guiding questions of this inquiry are:

- What are the important elements in design action?
- What are the necessary focus areas in design education?

In the following sections we elaborate these questions further, and suggest implications to design action and education.

On emotions and resource use

In our contemporary everyday setting, we are often unable to perceive the energy and resource flows that are yet essential to our life. Extending the confusion even more, electronic artefacts describing these systems are again embodying and using energy, concluding in a mind-bending combination of conceptual models, symbolic logic, software, electrons and matter (Dunne 2006). Technology has – whether intentionally or not – been unsuccessful in presenting these dimensions to its users, or in helping comprehend the flows of electrons and the impacts of their production. Thus, the ever-growing use of resources falls short of connecting to human perception, thinking, emotions and, ultimately, behaviour.

For emotions to emerge, something needs to be perceived either consciously or subconsciously. Emotions are ephemeral or lasting evaluations that present us with information about the world influencing our attitude or behaviour. This makes

emotions an interesting topic in the context of design and in particular relation to the invisible flows of resources and energy. According to Shove (2004, 114) in contemporary daily living energy consumption (as well as any other unperceivable resource) becomes part of "the routine accomplishment of what people take to be the 'normal' ways of life". Pierce et al. have demonstrated (2010, 1985) that "everyday interactions with technology in the home are performed without conscious consideration of energy consumption but rather are unconscious, habitual, and irrational". Their study also reveals that people are often unaware of the resource-conserving options of products, and people often ignore visible options, instead relying on habit and split-second decisions (Ibid., 1991).

It is by now well established that energy – being transparent and invisible – will always be expressed in some other form of perceivable representation (e.g. light, heat, movement, sound or information) and hence does not itself manifest in its own physicality. Also the information related to it remains often very abstract. This is indicative of the above-mentioned relation and of the gap in understanding the relation between the actual resource use and its perception in daily living. Such a gap has not existed for long. Less than a century earlier there were times when resources for everyday living (e.g. water and heat systems) were more perceivable in the everyday life (see Fig. 1). Today with the advances in technology, we as designers should look for new ways to induce awareness of this topic. To achieve this, we suggest that consumption of resources should be not only easily perceivable and understandable, but also connected to the social existence in our shared, physical reality.

Figure 1. *Logs for heating in Hakaniemi square, Helsinki, Finland, around the second World War (Source: Helsinki City Museum).*

Social studies on emotions

While both these entities of interest, energy and emotion, are matters that have been studied crossing disciplinary boundaries, combined studies to relate these two together with design are of recent emergence. As mentioned before, while the design research community exploring the energy-material relation has shed some light on this matter, the explicit relation is yet to be set in design education. Lutz and White (1986, 408) – considering emotions from an anthropological perspective – suggest that emotions are embedded in socially constructed categories, and hence the truth about emotion becomes problematic. While the view that emotional experience is almost endlessly mediated through language and culture (Ibid., 408) is fairly popular as a social science approach, its relation to electrical energy from a historical materialistic perspective is a fairly niche area of study. Lutz and White (Ibid., 417), through the review of numerous studies also note that emotions are a primary idiom for defining and negotiating social relations of the self in a moral order, and emotions emerge as socially shaped and socially shaping in important ways.

Research relating to conservation, behaviour and attitudes has received special attention from environmental psychology (Bechtel and Churchman 2002; Lindberg and Steg 2007). Within this field – and its related sub-disciplines – studies that focus on the emotional aspects of conservation have also received due consideration. Vining and Ebreo (2002) describe three functions of emotions and their importance for understanding conservation behaviour, namely emotion and motivation, structure of emotion and emotion and communication. They point that self-evaluative emotions such as pride, guilt and shame are central to conservation motivations and such emotions become functions of moral and social norms. As studies have shown a social comparison of consumption increases efficiency improvements. Evidence from prior studies (Acharya and Mikkonen 2011) also shows that a social network approach to communicate and publish energy use has the potential to reduce the resource consumption as competitive conservation. From a sociological perspective of associations (Latour 2005) it has been argued that materials, which are considered as non-human actors, have agency, and that material objects help in tracing social connections. These associations that are generated when interacting with material configurations as things, objects and resources, and the non-human entities as actors, have been argued to be an integral part of the social (Ibid., 70-78).

Creating perceptions of energy use through design research and education

There are several theories studying the differences in how designers intend their products to be used and how they are actually used in their use context, but they remain "largely disconnected from each other" (Crilly et al. 2008). Furthermore, we find that design research and related studies that address resource and energy usage seem to rarely attend to self-evaluative emotions, such as pride, guilt and shame through objects, interfaces and services. To bridge these gaps, the relation between emotions and electricity need not only be explored from the perspectives of multiple sources from hard science, engineering and social science, but also from its manifestation in designed objects as artefacts in a social realm. A work of design, whether a product or an interface, can be appreciated for its "perceptual properties", attributed qualities, and "elicited feelings" (Ibid.). The design of a product or a system "can intend these

features to elicit certain interpretations" (Ibid.). Hence, design can be embedded in dialogue within society by its very nature (Fuad-Luke 2009) and used to convey embedded messages, whether social or emotional.

Transdisciplinarity and sustainability in design

According to Schön's definition, design focuses not merely on knowledge in action, but "reflection-in-action" (1983), where existing knowledge is iteratively reflected upon in new problem contexts, fittingly to tackle the wicked problems of sustainability. Inter-professional collaboration in the context of sustainability requires a "transdisciplinary design dialogue" between different professionals and laypeople in real-life contexts (Wahl and Baxter 2008). Such process would increase the knowledge base for decision-making (Ibid.). Important processes of innovation and learning are increasingly taking place in collaborative constellations and networks, and a growing number of institutes and new actors such as private enterprise and government agencies are adopting inter-professional practices (Bruun et al. 2005). This calls for better understanding to set the stage for collaborative design and learning.

Sustainable design often aims to tackle with difficult and complex problems and problem-contexts. These problems can be described as “wicked problems” (Rittel and Webber 1973) – their assessment requires systemic understanding and knowledge from several perspectives. Design thinking and reflection can help in this collaborative process by creating new integrations of signs, things, actions and environment (Buchanan 1995). As problems of sustainability call for negotiations between several interests and stakeholders, the developments in the design process itself are deliberately seeking new frontiers. These developments require widespread discourse on the values and driving forces behind the process. How to prioritize stakeholders or their interests and from which perspective to assess sustainability? These questions should be brought into everyday discourse in design. Nevertheless, when design begins to be about the aesthetics of the message, it is also about the ethics of communication, whether in the actual interaction or embodied in the product-relationship. The sustainable designer has to use a consequentialist approach – in which the emphasis is on "means to an end" (Ritter 2008). This also raises a question regarding this end, and regarding the designer's ethical responsibility for making such a matter visible.

Increasing energy awareness

From a historical perspective, the development of electricity in the western world – and its social implications – has been well attended through the works of Hughes (1983), and Akrich (1992) has studied the relations of electricity use and technological objects from a Science and Technological studies perspective. Shove (2004; 2005; 2007) and Strengers (2009; 2010) have helped in broadening the understanding of the effects of electrical energy in relation to our daily living. The works of Pierce and Paulos et al. (2010; 2011), and Blevis (2007) have also been useful in furthering this perspective from the sustainable HCI point of view. Sustainable HCI and interaction design, as recent sub-disciplines in HCI, are not just looking at generating more awareness of consumption of resources like electricity through personal communication devices but in the recent past have also been critical with questions relating to the material relations that are needed support such functions.

Also in design research there has existed an active interest regarding the representations of energy use. Studies have both explored and focused on the relation between energy, materiality, visualization, domestic living and behavioural change by

researchers such as Redström, Backlund, Gustafsson, Gyllenswärd, Ilstedt-Hjelm, Mazé (2007; 2008; 2009), Pierce, Paulos (2010; 2011) and Blevis (2007), Shove (2004; 2005; 2007), Strengers (2009; 2010) and many others. While some members of the design research community have been specifically looking at the relation between energy and materiality, we wish to emphasize the importance of the human dimensions, including the emotional, social and cultural aspects.

In this respect a very recent work of Broms (2011) on sustainable interactions is worth mentioning, for it directs focus towards emotional states, such as anxiety as an emotional state, generated by "energy awareness artifacts" (Ibid., 62). Besides the dimension of usability and effectiveness, people's attraction towards products depends also on the products ability to satisfy needs related to the emotional dimension (Norman 2005). This dimension, however, should not be supported by only embedded ideologies of efficiency or performance (Dunne 2006), but rather with aesthetically surprising interactions that can induce critical and collaborative reflection. Sustainable behaviours are most effective when emerging from the users themselves, and from their interaction with other actors in a system. The social network around the user and the activity plays an important role in this development. Hence, we posit here that within the contemporary setting the approaches promoting conservation should be promoted as well as studied foremostly in their social context.

Sharing of knowledge alone, however, is not sufficient to change attitudes and actions towards models promoting sustainability (Saito 2007). Such design approach must also emphasize aesthetics, as most of us will be more disposed to act "responsibly and respectfully" towards nature or an artefact if we perceive them "aesthetically positive" (Ibid., 71), even more so if it can be connected to positive cultural or social values by the means of design. This development does not necessarily mean that more aware interaction with our material world requires only more aware, aesthetically positive technology. Rather it calls for more conscious approaches towards the resource use within products or systems, humane "skepticism" (Dunne 2006, 22) and critical awareness those that are able to connect to our emotional selves.

Imaginative feedback systems

From a socio-economic and institutional exchange perspective the provision of electricity remains regulated by the state or by a corporate entity deciding its production, cost and distribution. This current model is highly hierarchical. A 'fact' of consumption reaches its metering address often in mere numbers through abstract scalar quantities (money, kilowatt hours) or then gets invisibly incorporated as a cost within products, services and spaces. In the context of this proposal it is argued that these facts are hard to be felt as emotion – consumption of energy only generates feelings through its contextual use. We propose a research inquiry that encourages 'imaginative' dimension to fill this gap, the 'imaginative' stemming from the practice of art, design and research (see Fig. 2) and manifested in artefacts' aesthetics and interaction.

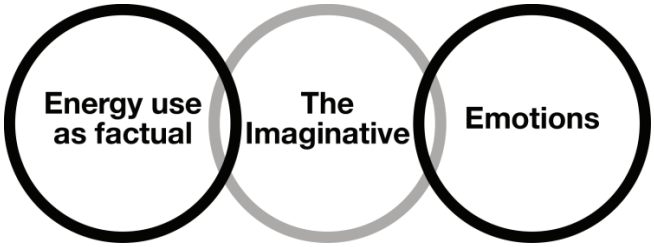

Figure 2. *Energy use as factual and through emotions combine in the "imaginative"*

Krippendorff and Butter represent "four semantic infelicities" that may hinder successful product (and system interface) design (1984). These concern shortcomings in 1) identifiability, 2) perceived possibilities to "manipulate" (differentiation, arrangement and indicativeness), 3) enabling user exploration, and finally 4) compatibility with the symbolic environments (Ibid., 5-6). However – as they conclude – after an awareness of the importance of such semantics has been gradually identified, the next step is "the development of concepts and suitable language" to discuss the "transmission of meanings" (Ibid., 7). The findings presented here suggest that art and design, supported by engineering skill, should aim towards making consumption of energy more apparent in social context, and to connect it to our human emotions. With respect to more sustainable models for consumption, designers could be encouraged to induce social friction (Jensen and Lenskjold 2004), perceived to be at play whenever people challenge existing norms. When this understanding is positioned within the contemporary educational setting, the process of inter-professional, transdisciplinary and constructive prototyping linked with artistic reflection, social and cultural understanding and systemic scope would support design knowledge creation for more energy-aware user approaches. The strategies proposed by Krippendorff and Butter (1984) remain meaningful – designers have a role as communicators and nodes in a bigger network of topics and stakeholders. We further this approach to suggest that the most promising approach to tackle these aspects is through constructive design research and experimenting in real-life setting (as in Koskinen et al. 2011).

To establish relations and new knowledge on the role and use of electricity as something that mediates social relations in contemporary daily living can be a formidably large subject to address, but yet through transdisciplinary design dialogues these matters can be taken into tests, through a collaborative network of people sharing a like-minded interest in the subject. Hence, to engage in the mentioned subject focus we propose 1) a set of essential elements for design for conservation, as they seem to be necessary dimensions to address to make interactions more emotive, and 2) implications for design education that follow from these.

Design for energy conservation: the essential elements for feedback design

So far this text has described several elements that seem to be of importance in designing for energy conservation. We have identified the importance of systemic approaches and collaborative reflection, and also the power in an emotive approach. Furthermore, the constructive approach to design entails that work involves prototyping in real-life settings, fittingly as a transdisciplinary approach. These findings

guide us in identifying the essential elements for energy conservation and feedback design.

The essential elements for feedback design:

- Systemic – the approach should embrace complexity but also channel it: the human end must be simple but also as factually true as possible;
- Reflective – the interaction with the system should be responsive: the dialogue with the meanings and messages embodied in the artefact should be reflective and thought-provoking;
- Reliable – the information conveyed in the system must be factual and based on accessible knowledge. It should also be open and just for all stakeholders – the key here being transparency;
- Emotional – the meanings and messages embodied in the interaction should connect to several humanly important dimensions, such as 1) aesthetic and semantic, 2) social, 3) cultural and 4) ethical;
- Sensorial – the means of working, testing and prototyping should embrace sensorial interfaces, whether tangible, auditory or visual;
- Inter-professional – the factual knowledge, as well as the systems and the messages that it communicates would benefit if based on an expanded knowledge base;
- Transdisciplinary – the work has to be taken into a real-life context into the actual problem context, to be able to assess its true potential.

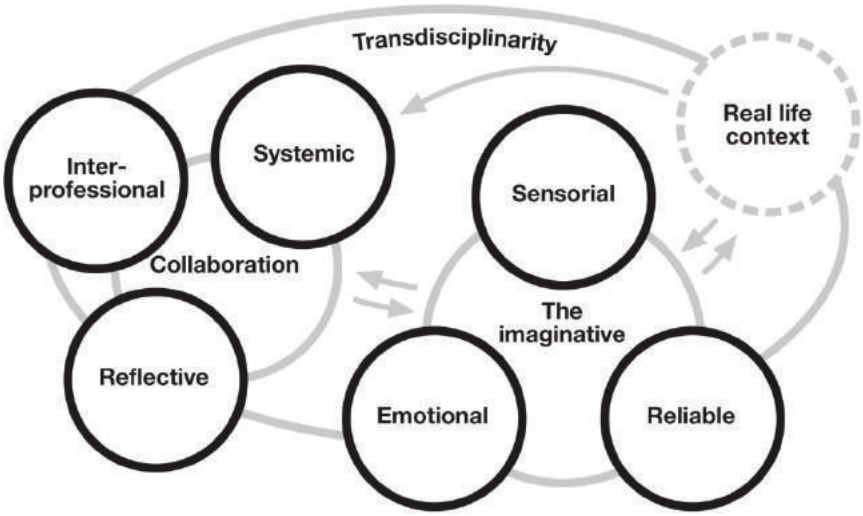

Figure 3. *The essential elements of design for energy and resource conservation*

The elements presented above (see Fig. 3) seem to be rather essential for design for resource conservation and feedback systems in general. Some of these elements

describe the mode of collaboration, while others are essential elements in building imaginative approach to the feedback system. Finally, transdisciplinarity refers not only to inter-professional approach but also to the need to take the testing and prototyping to the real-life context, to assess the feasibility of the system and iteratively continue to develop the prototypes at hand.

Implications to design education

As explained throughout the text, there is a need to further the inquiry between energy use and emotions by providing a platform to diverse backgrounds to come and engage with the topic. This, together with the approach to design presented earlier, calls for a certain type of approach to design education as well. Such an approach would aim to bring in a network of interested students, artists, designers, academicians, researchers and scientists to explore and open the matter of energy and emotions to a wider engagement in a collaborative fashion. Thus for such an approach it is essential to intervene with the subject not just with art and design but also with members from other disciplines, technical and economical, inviting them to bring in their views and expertise. With such an engagement the approach highlights the inter-dependency of contemporary human existence and the matter of limited resources with a more perceivable and emotive manifestation as an eclectic transdisciplinary dialogue.

In energy and resource conservation the relation between factual and emotional needs to be explored with a similar framework, but from the perspectives of multiple sources from hard science, engineering and social science, and also from its manifestation in designed objects as artefacts. Our proposal for design education aims to make such attempts visible, with an emphasis on public engagement and artistic interplay. We propose that this gap can only be bridged through a series of constructive design research experiments (Koskinen et al. 2011) that aim to stimulate imagination and thinking. Constructive design research introduces a new type of iterative loop to the design process, in which – against the "basic structure of a communication-based model of design" that happens only through artefact and not in between designers and users (see Crilly et al. 2008) – the collaboration in design iteration extends to the use phase.

Participants of such design program would have to collaborate in highly reflective and multidisciplinary manner, entailing intensive teamwork through which students then create artefacts and systems to be tested in real-life settings. According to Koskinen et al. design tradition that arises from "art and design schools" has to, in many ways, "deal with the "halfway" between people and things (2011, 8). Through this testing activity, the knowledge is diffused into the surrounding system, whether in commercial, public or private location and context, or within the academia (see Fig. 4).

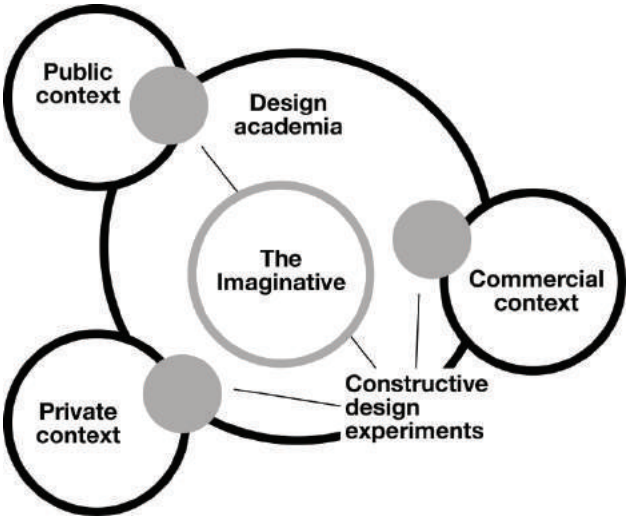

Figure 4. *Constructive design experimenting in different contexts*

Such an approach to design education thus aims to explore the matter by engaging it through a program/experiment dialectic (Redström 2011) and interplay between philosophy and practice, focusing on the imaginative to fill in between the factual and emotional seen in the energy usage and consumption in our contemporary society. The model we depict here also resembles the elaborated "integrated communication-based model of design" by Crilly et al., where there exists a network-based iterative development with producers, consumers, researchers and artefacts (2008). Such model should create platforms to encourage artists, designers and researchers to get together and tackle the matter as a collaborative network. It would also aim to formalise the network and bring this matter to the fore by generating and publishing events like exhibitions, experimental installations, workshops and seminars and also conventional publications like students' theses and scientific papers in a collaborative way.

Discussion

As Koskinen et al. note, "[d]espite increasingly sophisticated methods aimed at handling complexity, human, social, and ecological problems prove to be "wicked" and unsolvable by rationalistic methods" (2011, 16). We wish to open a discussion for the design of more emotive interactions in the context of resource and energy conservation. Multidisciplinary reflection through art, science and sociological elements can help to identify feedback systems that are imaginative, sensible and able to be humanly perceived. This development does not necessarily mean that more energy-aware interaction with our material world requires only more energy-aware, or aesthetically positive technology. Rather it calls for a more conscious approach towards the design of products or systems, and critical awareness to help to connect these to our emotional selves.

Interesting design requires new ways to communicate with "imaginative use of design […] to penetrate beyond the 'white noise'" (Fuad-Luke 2009, 88). The emergence of synthetic and imaginary trans-species awareness between participants

(Faste 2010, 171), or the approaches provoking questions on consumption (Marttila 2011), can be suggestions to be employed to allow people to challenge existing norms. Furthermore, the linkage to the people's social reality can help to make systems and their feedback more concise for their users. Sustainable design should not just aim to downscale consumption models by systems development, but also to approach it through artistic explorations, constructive and collaborative reflection in real problem context, and with several professional and personal perspectives. The effort must be also directed towards the aspects of interaction that can connect to human emotions with meaningful elements of the social and cultural dimensions. Initiatives for design education for conservation of energy should embrace and make own such settings.

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