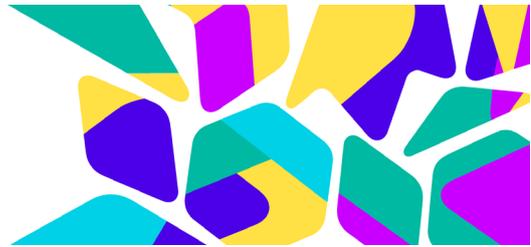


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# A Curated Chronology: Traits of Electro-Energy from Research-through-Design Practices

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**Abstract:** Over the past two decades a number of design-led projects undertaken on the topic of energy research have contributed to the research-through-design domain. We present selected studies from design and HCI undertaken as research-through-design on the topic of energy as a curated chronology. Four design practice-based research groups from different global regions engaging with energy related issues are discussed in a chronological presentation. Using descriptive analysis of these projects we interpret four specific traits of design for approaching energy as a design subject. The interpretation is presented through tracings of traits and are analysed in a sequence. Building such a curated chronology of prior projects we generate an approach for designing a relation building consumer reward system for a project on wind-based electricity production. With this we show that such a curated chronological approach can be interpretive and generative, complimenting and strengthening conventional literature reviews when undertaking research-through-design projects.

**Keywords:** research-through-design; energy studies; curation; design methods

## 1. Introduction

Since 1960s contemporary art and design practices in the West have raised energy-related issues. These have been towards, political action, activism, community engagement and also for academic interest (Beuys et al., 2004; Coles & Rossi, 2013; Hemauer & Hemauer, 2013; Klimke & Scharloth, 2008). Within design research, the topic of energy, has gathered interest over the past two decades (Backlund et al., 2006; Dunne, 2005; *ECDC*; Pierce & Paulos, 2011). We have seen projects where the politics of electricity and its networks have been theorized by design (Dunne, 2005; Dunne & Raby, 2001, 2013). There have been programs where design practice has occupied a central position as an output of research that address energy issues (Backlund et al., 2006; Pierce & Paulos, 2010; Pierce & Paulos, 2013; Mazé, 2008) and a significant corpus of design studies from HCI has engaged with designing energy feedback for behavior change (Abrahamse et al., 2005; Froehlich et al., 2010; Holmes, 2007;



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Lau & Vande Moere, 2007) and categorized as involving either antecedent strategies (i.e. commitment, goal setting, information, modeling). Our interest is in a design led analysis of particular design practices that have undertaken research on the topic of energy. Before we proceed further, we would like to make a clarification regarding our use of the term 'energy'. While this term can be broadly interpreted, the scale of attention to energy issues by the design and HCI community has tended to tip more towards electronic and electrical related energy than towards other forms and mediums. Thus, when we use 'energy research-through-design practice' we refer to design practice-based research that are concerned with electrical energy use, its feedback, designing for electricity use as a technology and research that looks into the social and cultural implications of electromagnetic contexts as well. With that clarification, we ask how can we interpret the subject or topic of energy by analysing prior design-led projects that have undertaken research on this subject and how could such a process be further generative by design?

## 2. Tracing the Design Traits of Energy as a Chronology

Our response to such a question can be considered to be designerly as well. In what is to follow we present four sequential aspects as steps for producing a curated chronology which we consider to be our methodical stance with a designerly approach. With this while we present our particular subject matter relating to energy, it should also be seen as a clarification of the underpinning approach of how to arrive at a curated chronology and how this can be generative to further design.

As a first step we begin by identifying design projects based on the specific topic, i.e. in the case of our research we have selected academic design practices whose projects have engaged with the topic of energy. This provisions us to interpretively analyse how the entity of energy has been approached by them within their design-led projects. In terms of project selection we see this approach to be an act closer to curating an exhibition in a gallery or showroom so as to highlight particular characteristics of a design object (Durrant et al., 2017; Koskinen et al., 2012).

Secondly and essentially our approach to curation has a temporal component. This means the selection of design research projects on a particular topic is made by selecting projects in a temporal sequence of their undertaking. In the case of our research we have deliberated our selection of research-through-design projects dealing with the subject of energy in a chronological sequence. Thus, as a methodical consideration it is pertinent to be aware which projects and programs were undertaken in what year or decade, and these are analytically ordered on a time line, hence the use of the term chronology. Terminologically we have also taken inspiration from the book titled '*A chronology of energy and art related development*' (Hemauer & Keller, 2013). As a methodical arrangement such a chronological sequence is also purposeful. We utilize the sequence for both, analysing the energy component and also such that the sequential pattern is generative to further design.

The third step is to use both description and figures from the design-led projects to 'trace the design trait' from concepts and objects from the selected chronologically ordered projects. By 'design trait' we mean, the primary characteristic of the topic (in our case that of energy) as approached and considered by the design practitioners in those particular projects. Design traits are the characteristics of the central focus or subject of the project. Gaver & Bowers (2012) discussing annotated portfolios mention of the myriad of choices that go into the design of any artefact. These could be functionality, practicality, motivation to socio-political concerns. These aspects can be considered when identifying traits that could be traced in a curated chronology. In this paper we literally draw a red line tracing the design trait of energy across chronologically sequenced projects from different academic design practices. So, the presented figures and the red highlighting on them are analytical in purpose. Thus in this step the treatment of the trait tracing and following it in chronological order is integral to both the analysis and presentation.

The fourth step after tracing is to be generative by using the sequencing of the trait from prior projects. In this paper we show this generative process by arriving at a concept for designing a relation building consumer reward system for a project on wind-based electricity production. With this overall four step procedure we demonstrate that while undertaking research-through-design projects producing such a curated chronological approach can be both interpretive and generative, complementing and strengthening conventional literature reviews.

In what is to follow in the next sections, our curated chronology begins by presenting a descriptive analysis of energy related projects undertaken by selected four design research groups. Through this process we interpretively distil and highlight four traits of energy as an entity from the design-led projects of four research groups. The interpretation of each trait is presented through a tracing of a design object or concept from the project undertaken by each group. These tracings are treated as traits of energy as approached by the design practices. Then the four tracings of traits from the design approaches are placed and analysed in a chronological sequential pattern. Following such a design-based analysis of prior practices, we present the conceptualization of an ongoing project for designing a relation building consumer reward system for a project on wind-based electricity production. We conclude with a discussion of our contribution to the research-through- design approach and the need for diversity in approaches for furthering energy research.

### **3. Academic Design Practices' concern with Energy Issues**

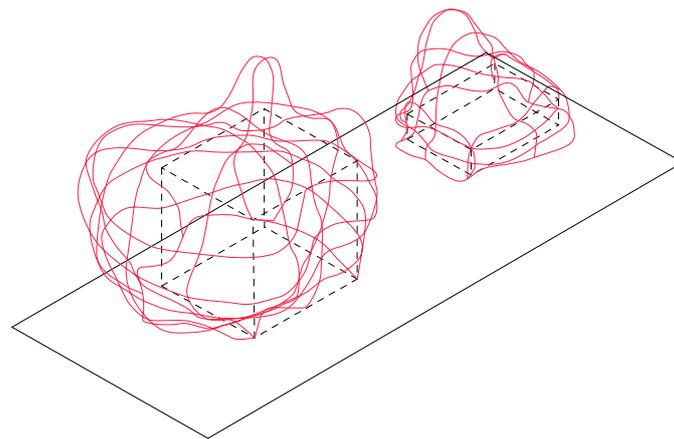
The four design groups whose approaches to energy are considered in the chronology are from four different institutions. The logic of selecting these groups is that they all have three aspects in common. The projects from these groups are well cited within the academic design research community. Secondly all the academic practitioner groups' works lean towards the more humanistic and artistic approaches. Thirdly they all have undertaken design led projects on the topic of electrical and electronic energy. The order of

presentation and the analysis of the research groups and their projects that is to follow next is chronologically sequenced, i.e. from the earliest to the latest.

The first group from London, with humanist and artistic tangents has been popular for looking into electricity and energy issues through critical and design for debate approaches. The second group of design researchers from Stockholm have specifically addressed energy studies through design research programs with reference to critical practice and post-critical practice-based approaches. The third group of researchers in discussion were based in Pittsburgh from the HCI community who have addressed energy-related issues through categories of design-oriented perspective in HCI and sustainable HCI. The fourth group again from London, who are known for their work on cultural probes and ludic design, are reviewed for a project undertaken on co-designing with energy communities. These four design research groups, their projects and programs dealing with energy, and their approaches to energy within these projects will be chronologically discussed next.

### *3.1 English Design I: For Debate (1999-2002)*

Anthony Dunne's doctoral dissertation, *Hertzian Tales* (Dunne, 2005), led to the emergence of what today is considered Critical Design. Basing arguments on speculative design artefacts and their ability to mediate aesthetical experience this approach set in 'design for debate' approach (Kerridge et. al. & ., 2009). This work presented an ideology for product design practice that put social, psychological and cultural experiences as its basis, rather than being technological and commercially based. The portrayal of speculation carried out through prototypes, videos and imagery leading to discussions, reflections and debate spawned a new discourse within academic and artistic design practice.



*Figure 1* Tracing the Hertzian dreamscape: Radiating electromagnetic waves from a computer and fax machine

Within the scope of this paper's argument, two initial projects from Dunne and Raby are considered. In *Hertzian Tales: Electronic Products, Aesthetical experience and Critical Design*, Dunne (Dunne, 2005) raises a critique of the aesthetic role of electronic products and

indicates the invisible 'electrosphere' that electronic products and artefacts generate around themselves. He presents the idea that electronic products hold a subversive aesthetical potential because of their dissipating invisible electromagnetic waves. He discusses his experimental process of measuring and drawing electromagnetic fields around electronic objects in order to arrive at an alternative vision of electro-artefacts (Figure 1). He refers to them as 'dreamy objects'. Presenting the design potential in the electromagnetic sphere through designed artefacts, he asks for a more meaningful social benefit than designing merely towards a commercial end. Dunne's thesis on design artefacts is referred in *Hertzian Tales* as 'sublime gadgets'. Through these prototypes, categorized as post-optimal objects, Dunne presented five conceptual design proposals. Each of these design outputs was considered as an interface between the electromagnetic environment of the Hertzian space and people. With these designed objects, Dunne's work raised questions about the technological realm and daily living than offering solutions to conventional problems. This approach from Dunne also got carried over to the next work, titled *Design Noir*, with Fiona Raby (Dunne & Raby, 2001). They again raised attention to the issue of invisible and hidden electromagnetic fields, taking forward the idea that electronic objects 'dream' in electromagnetic radiation. From these early works from a part of the English design academia, we distil 'dreamscapes' of electronic objects, the Hertzian space as the first trait of energy as a design entity.

### *3.2 The Swedish Shaping: Technology as Material (2005-2010)*

The Interactive Institute at Stockholm is the second group whose body of work has approached energy studies through design practice. They mention the formulation of a program/experiment dialectic (Redström, 2011) approach that has provided their process with an alternative and design-led perspective on energy consumption. They also mention of programs that are based on "provisional knowledge regimes" (Binder & Redström, 2006), and position design practice centrally through conceptual designing, making artefacts and staging design interventions. Based on a critique of both modernist thinking and usability, the program has looked at technology beyond functionality and usability and addressed it as 'material', as something to be crafted and formed. Building on a range of critical traditions in design such as post-critical architecture, anti-design and critical design discourse, this program addressed two main interrelated concerns: materiality in design and in use. Three projects have been specifically aimed at energy use and everyday practices: 'Static!', 'Aware' and 'Switch! All have considered an aesthetic and material-based approach to everyday energy interactions, resulting in the presentation of a number of experimental everyday artefacts as examples of staging design interventions on larger urban scales. These artefacts and interventions have attempted to generate reflection and awareness on and through energy use. The design artefacts and interventions through the programs suggest finding and discussing problems rather than providing solutions, whereby design becomes a mode for critical reflection and for shaping a wider discourse.

The Swedish school's program begins by presenting, technology as material (Redström,

2005) and then also energy as material (Backlund et al., 2006). Redström has argued that designing in practice through material and form is different from predicting use, which is how technology is conventionally understood (Redström, 2005). Redström's concern seems to be centred on the fixation of predefined ways of using and interpreting technology, which he critiques as leading to inflexibility. He is also of the view that electronic technologies have a discrepancy between their inner functional complexity and their surface, which fails to communicate the intended use. To overcome this, he presents technology as design material and asks us to think of technology as form and material rather than technology as prescribing functionality. For Redström, as a basis for design, as temporally forming elements, a material needs some kind of spatial presence through a spatial surface for presenting itself. With this argument, he recommends that computational technologies could also be treated as material that could be worked with in both spatial and temporal forms.

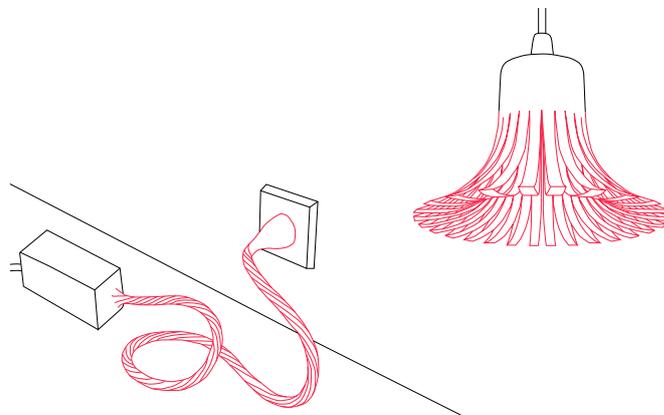


Figure 2 Tracing energy as material for design: The Power Aware Cord and Flower Lamp

Backlund and others (Backlund et al., 2006), writing on developing a program for design research and practice, have mentioned the expressive and aesthetic potential of energy as a material in design. They also have mentioned a type of design practice with strategies to invoke engagement for exploring alternative notions of the role, actions and responsibilities of designers. According to them, this results in a 'critique from within' design practice. In the same publication, the authors also present nine prototypes as poetic objects of everyday life and show how energy-related issues could be made more present through form. Eight of the nine prototypes are also interior domestic artefacts. However, these are not furniture pieces like Dunne and Raby's set in *Design Noir*. In *Design Noir*, the furniture pieces could be seen as movable domestic artefacts, able to gain focus on themselves, by being able to move and be taken into any room, by being pieces that centre visual attention within the volume of a room. The domestic artefacts from the Swedish school differ from the furniture pieces from *Design Noir* as they are more peripheral to the structure of the architectural home. These can be considered to be closer and tangibly connected to the wires in the wall of a home. Everyday objects such as curtains, wall heaters, power cords, wall tiles, cord connected lamps, the exceptional odd erratic radio and such domestic objects formed the set of prototypes from this initial energy related project by the Swedish school (Figure 2). In later

projects with design interventions into everyday energy ecologies (Mazé, 2008), the program also scaled up, continuing with a material for design centred argument. Thus, to build the chronology, energy as design material is considered as the second trait of energy, coming from the Swedish school.

### *3.3 The North American Schools: Sustainable HCI (2009-2014)*

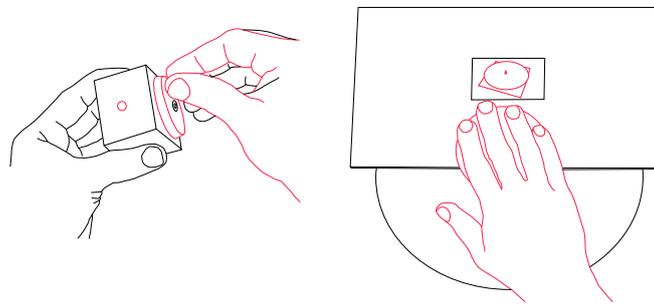
The topic of Human-Computer Interaction grew widely through the last two decades of the 20<sup>th</sup> century. With cognitive sciences, computer science engineering and usability as its foundations, it has been fast in borrowing approaches from other fields and disciplines.

However, the emergence of sustainability as an issue, through design featuring in its discourse, can be considered to be recent in HCI when compared to the design academia. While approaches such as ‘persuasive computing’ to address habits and behaviours emerged in the early 2000s, it was in 2007 that Eli Blevis (Blevis, 2007) presented the view that sustainability should be the core semantic for interaction design, positioning it differently from experimental psychological approaches of persuasive computing. Basing his views on the perspective of design values, he defined design in his paper as “an act of choosing among or informing choices of future ways of being”. The paper by Blevis set in motion the emergence of ‘Sustainable interaction design’, or the sustainable HCI approach. It particularly led HCI-based design practitioners to deal with energy use through design. In the same year, Zimmermann and others (Zimmerman et al., 2007) presented a model for research through design as a method for interaction design research. In it, building on various previous models and particularly on Frayling’s (Frayling, 1993) model of research through design, they highlighted design practice and making as a method of inquiry. Then, other established researchers in the HCI field such as Paul Dourish also began to contribute, calling for a wider political basis and scaling for sustainable interaction design[15].

Amongst the American researchers the work of James Pierce with Eric Paulos has particularly dealt with issues of energy use through what they call a ‘design-orientated’ perspective in HCI. Their approach has tackled a range of energy-related issues such as design for awareness, design for feedback and examining energy use as a phenomenon in specific contexts. They have also approached the issue through wider philosophical perspectives (Pierce & Paulos, 2010; Pierce, 2009; Pierce et al., 2010; Pierce & Paulos, 2011, 2012, 2013). Within this design-orientated perspective, this group’s contribution has been particularly useful in reviewing energy use visualizations and feedback design, and in furthering the concept of energy as ‘material’. After this the work from this group, too an everyday ‘practice turn’, moving away from the ‘individual action’ as a unit of analysis.

When positioning the work of American researchers of energy through design practice within the chronological sequence of practitioner groups for this paper, an article from Pierce and Paulos is of particular interest (Pierce & Paulos, 2013). In their paper ‘Electric Materialities and Interactive Technology’ they characterize electric technology in terms of three forms of materiality: as electric object, its electric materiality and electric power. In the project, their

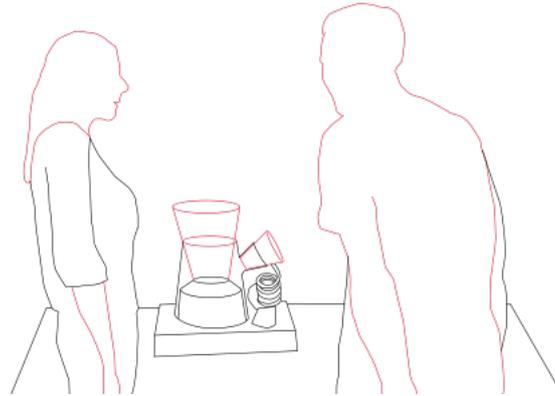
approach can be considered different from that of the previously discussed Swedish school. For the above triadic categorization, they draw particularly from phenomenology and present a set of bodily powered electric technology artifacts. Their intention with such a presentation they mention, is to amplify the difference between ordinary and bodily powered objects. Then they phenomenologically characterize the bodily powered objects with three themes. Firstly, because bodily powering such electro artifacts can be never without power, second that power of such artifacts can originate within the context of interaction and thirdly such objects invite bodily exertion and involvement. They present two sets of bodily powered prototypes; the first set is of four types of illuminating LED's and another set of two electric visual displays of OLED and e-paper (Figure 3).



*Figure 3 Tracing of energy through the phenomenological body: Crank LED and Flywheel OLED display*

Through demonstrations with these prototypes they argue that bodily powered technologies can expand electrifiable space, can engage through bodily involvement and then forge new relationships to electric technologies. Moreover, in their conclusion they mention that electricity cannot stand apart, on its own as an object, distinguishing themselves away from the framework of the Swedish school. From this work by Pierce and Paulos, their position of approaching electricity as energy through the phenomenological body can be interpreted. Such a position of reflecting on energy use as a phenomenon through the individual and experiential body can be traced to their prior works(Pierce & Paulos, 2010; Pierce, 2009; Pierce & Paulos, 2011, 2012). With the above case this subsection has interpreted the third energy trait from design practitioners from the United States.

### *3.4 English Design II: Ludic making Publics (2012-2015)*



*Figure 4 Tracing Energy Babble: Making the publics*

More recently another team of English design practitioners has engaged in energy issues utilizing the route of co-designing with communities using fieldwork, workshops and probes (ECDC). They prototyped an automated talk radio service called Energy Babble to communicate about energy reduction with selected communities in South of England (Figure 4). Building on some of their previous approaches of cultural probes (Gaver, 1999), and ludic design (Gaver, 2009) they first engaged with designated communities in their local settings and brought in the participants' imaginative experiences into the design process. After this the team designed and deployed twenty-one prototypes of networked devices called Babbles into the natural settings of communities. The Energy Babble service, through online social networking platforms gathered and communicated energy issues to the designated communities. These were energy and related concerns from people, their devices, from online sources, communities and also programmed bots (Gaver et al., 2015; Kerridge et al., 2013). The group mentions of using technology as a basis for public reflection on energy as a political entity and also as a domestic metric. With such a service as a publicity platform that communicates about energy demand and reduction, this group's approach refers to their design of the Energy Babble for the construction of 'publics'. Referring to DiSalvo (DiSalvo, 2009), Gaver et.al, say that when design brings issues to prominence then it results in the formation of publics.

In this fourth case the trait of energy is interpreted as communicating about energy to form publics. What is further taken into consideration is that the design object uses an input from a variety of sources to communicate about energy issues. This includes humans, non-humans such as devices and appliances and the output generated as a voice through an algorithm does not make a distinction between the sources, if it has been given out from a human or non-human.

## 4. A Generative Chronology with Energy Traits for Design

From the four design groups discussed, the design trait of energy from the first group can be considered to be the ‘Hertzian dreamscape’. In the second group, the trait is of ‘energy as material’ for crafting and forming an object for reflection. With the third group, a relationship between the ‘phenomenological body’ and its experiencing energy was discussed. In the fourth case, energy issues are communicated and spread to ‘form publics’ by design. As a design-led approach, if these four approaches to energy are to be considered in their chronological sequence, then first comes the conception of the dreamscape, electro-magnetic frequencies emanating from electro-products, after that there is technology and energy get to be material to craft and form everyday appliances and objects. Thirdly a relationship of the electrical artifact and the experiential body is present. With the fourth case, energy related information creates publics. Thus, when considering the design traits of energy by the practitioners from 1999 till 2015, a movement can be interpreted where energy as an electro component moves from the dreamy Hertzian space, into an object of design, from there enters into the experiential human body and then moves out with voices of humans and machines, indistinguishable from each other, to form publics. Such a conception is entirely interpretive but based on a framework of analytical chronology sequencing of energy design traits, it becomes useful for generative purposes to further design. So, with such an aim then, what could be imagined next in this sequence after the making of publics (Figure 5)? While much could be imagined to further such a sequence, we utilize the ongoing context of energy transition into renewables for conceptualizing an extension of the discussed sequence.

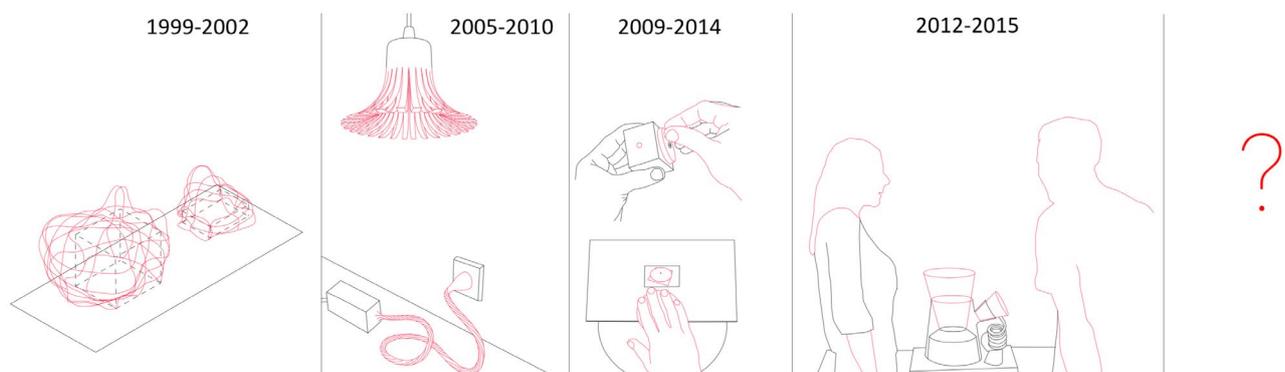


Figure 5 A Curated Chronology: Traits of Energy from Research-through-Design Practices (1999-2015-)

### 4.1 A Generative Design trait for Energy: Transition Shaping New Relationships

With the rise in renewable energy generation, with a sporadic spreading of decentralized power systems, the emergence of the prosumer and net metering where citizens with their own energy infrastructure are able to sell power back to the grid, digitalization of the energy systems, the emergence of more dynamic energy markets and many such ecological and technological changes are shaping a rapidly evolving energy transition globally. In such an

evolving context we see a design potential of the information generated publics transitioning to a more dense socio-relational culture. The potential we indicate is that designing for the energy transition can be made to shape new social relations on one side. Reflexively on the other side using design to shape social relationships between people can be made to foster the society towards a more meaningful and amicable energy transition. By shaping of social relations we mean the implications for the development of social relations between multiple roles and identities, like relations between family members, between neighbours, between communities living in blocks and scaling further to the neighbourhood and city scales. We see a potential for energy systems to matter at a socio-relational level between all these entities with a transition of energy systems. Building on the curated chronology discussed in this article, we have envisioned designing a relation building consumer reward system for a project on wind-based electricity production through a project conception. As design-led energy research our focus is to increase integration of renewable energy sources to balance the energy loads at the neighbourhood scale. For this we are seeking community and citizen led possibilities for collaboratively consuming energy based on the rhythm of wind energy production. Thus, our goal is to bring together neighbourhood communities, energy utilities and the local municipalities together to work towards questioning our future dependencies on fossil fuels and large-scale batteries for energy storage. With this we see a scope for business models with new community centric energy services building new relations. Our project looks at initiating a longitudinal community engagement, wherein we inform households of time periods when wind-based energy production in a regional-level is more than the total electrical energy consumption within that region. During these periods of wind produced energy production if a minimum of two households or families, were to take care of their daily activities like their dishwashing, laundry, cooking, electric scooter and car charging then they gather points for a special cake and coffee together at a neighbourhood café. Within the project local communities would co-design such a points system that can show ways to manage renewable energy production and consumption in a collaborative way. With such a conception we indicate the potential of the energy transition to shape more collaborative and meaningful energy new services while shaping new relationships between families and households as units of the society. Here the design trait of energy is to not only provide wind-based renewable energy for utility but through its use but to actively shape and mediate new relationships between households at the neighbourhood scale. We see such a service description, built from and generated by interpreting the prior design traits of energy, fit well into the sequence of the chronology we have presented so far.

## **5. Discussion**

In this article we have now presented a curated chronology by selecting projects from design and HCI undertaken as research-through-design on the topic of energy. As a methodical stance we began by clarifying our approach by presenting four steps and aspects for producing such a curated chronology. The four aspects being selection of topical projects, a chronological ordering of these projects in a sequence, tracing design traits with descriptive

analysis and after this a generative procedure to further design. Following this, four design practice-based research groups from different global regions engaging with energy related issues were discussed in a chronological presentation. Using descriptive and visual analytical means from the selected projects we interpreted and traced four specific traits of design for considering energy as a design subject. The interpretation of the design traits was presented through tracings and these are analysed in a patterned chronological sequence. Building such a sequence of a curated chronology of prior projects we arrived at a conception for our project to design a relation building consumer reward system for wind-based electricity production. We see our service description brief fit into the sequence of the chronology we have presented this far.

With such a curated chronology our contribution is methodological for research through design projects. We indicate that such an interpretive and generative approach can be complementary to conventional literature reviews within research-through-design projects. Such an approach could strengthen the design component within design-led projects. Although there are also limitations when undertaking such an approach. Firstly, such an approach cannot replace conventional literature reviews, but should be undertaken to complement and embolden design-led analysis within research-through-design projects. Secondly, as seen within this article, when undertaking such an analysis, there is a need to be selective with projects and approaches, and thus the number of studies that get considered might limit the research to be comprehensive. Thirdly, as concerned with any research the very interpretive nature of analysis could sometimes result in an imprecise understanding of design research work of other practitioners. These risks and limitations could be overcome if such an approach were to be further developed by undertaking it within research-through-design projects that aim to tackle a variety of subjects and topics.

In our case undertaking the development of such an approach from a research-through-design position has been useful for looking at the subject of energy from a design-led analytical perspective. It has also allowed our analysis to be spread over two decades and has helped us interpret and build on prior research-through-design projects on energy. It has also provisioned a generative streak into our approach. With this we hope to contribute to both, to the methodological corpus of research-through-design approach and also provide a diversity in approaching energy studies.

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