

Design thinking for the everyday aestheticisation of urban renewable energy



Suzanna Törnroth and Åsa Wikberg Nilsson, Design Group at the Department of Social Sciences, Technology and Arts, Luleå University of Technology, Luleå, Sweden

Andrea Luciani, Architecture Group at the Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Luleå, Sweden

Renewable energy infrastructures are becoming increasingly present in our environments, inevitably shaping the urban experiences of the everyday person as they move through the city. The profound impact these infrastructures have on social worlds has yet to be explored, with contemporary renewable energy discourse primarily focussing on the techno-economic. We argue for the everyday aestheticisation of renewable energy infrastructures, and how design thinking might offer a way forward in co-creating future meaningful experiences with renewable energy. We offer a collaborative design thinking workshop on the speculative experimentation of energy futures as a case study. The findings provide multi-scalar insights on exploring urban energy futures with citizen-designers – with aesthetics and lived experiences as central.

© 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: aesthetics, design thinking, renewable energy, collaborative design, urban design

In a global move towards a fossil free future, the increasing development of renewable energy infrastructure consequently influences the design of our cities (Kammen & Sunter, 2016). Clean energy infrastructures continue to pervade our environments in multiple ways, leading to unprecedented changes in the aesthetic experiences of our environment (Sánchez-Pantoja, Vidal, & Pastor, 2018a, 2018b). In turn, these so-called *emerging energy spaces* also provide new opportunities for innovative design that respond rapidly to shifting needs – with design here applied in the dual meanings of the tangible and the intangible processes that feed into situated place-makings. In dense and compact urban environments, renewable energy infrastructures tend to be decentralised and small-scaled, such as micro wind turbines and solar photovoltaic panels (PVs), leaving the challenge to designers (i.e. urban designers, planners, architects, and engineers) to pave a way

Corresponding author:
Suzanna Törnroth
suzanna.tornroth@ltu.se



www.elsevier.com/locate/destud

0142-694X *Design Studies* 79 (2022) 101096

<https://doi.org/10.1016/j.destud.2022.101096>

© 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

forward for the infrastructures' aesthetic integration into the urban fabric. This process, thus far, has often entailed a lack of consideration towards the sensitive integration of these infrastructures within social, cultural and spatial contexts (Tarekegne, 2020). Renewable energy infrastructures, although soon-to-be ubiquitously present in our urban habitat, has yet to move beyond its primary production purposes to provide new arenas for interactions, experiences and conversations for people.

Everyday aesthetics, drawing from the field of design, offers a way to shape and democratise human experiences with renewable energy infrastructure in the urban environment – contrary to popular views that aesthetics only encompass that which is beautiful. This paper aims to expand this limited notion of aesthetics by putting forth a broader conceptualisation of it; transcending an aesthetic of appearance towards an aesthetic of use (Locher, Overbeeke, & Wensveen, 2010). In particular, the paper tests and explores, through a case study, how urban everyday aesthetics can be generated from co-explorations and co-productions of values from the bottom-up – both in theory and in practice. The case study design thinking workshop was conducted with 15 participants at the Architecture Group in Luleå University of Technology, with an aim to experiment on, and learn from, the process of co-creation of future speculative urban renewable energy aesthetics.

The paper offers that 'citizen-designers' – the everyday people that unintentionally form and partake in design decisions through aesthetic practice in the urban realm – are in prime positions to influence these aforementioned making of values from the bottom-up (e.g. Sleeswijk Visser, 2009). The so-called 'citizen-designers' are referred to as such for the reason that they may not practise design professionally, yet they are designers for the reason that their lived experiences of the local context is crucial for future design decision-making processes. The underlying motivation of the paper is thus the idea that empathetic sharing and engagement of situated human experiences – in other words, 'putting people first' (Brown & Katz, 2011, p. 382) – can contribute to the meaningful everyday aestheticisation of renewable energy infrastructure in our cities.

Firstly, the paper begins with an elaboration of everyday aesthetics vis-à-vis renewable energy design with support from example cases. *Secondly*, the paper describes a case study in collaborative aesthetic experimentation with renewable energy through design thinking. The findings from the case study is also elaborated on. *Thirdly* and finally, a discussion section expands on the possible opportunities and challenges for utilising design thinking in the context of renewable energy design, and offers points of departure for everyday aesthetics in collaborative speculation and imagination of our collective energy futures. The paper and case study is guided by the research

question: How might a co-creative design thinking approach contribute to exploring everyday renewable energy aesthetics?

1 Background: aesthetics as situated experiences

Humans have long been sensitive to beauty and aesthetic dimensions, regardless of the level of technological development, socio-economic levels or cultural contexts (Postrel, 2003). For the scope of this paper, the *everyday aestheticisation* of renewable energy infrastructures emerges from the works of Dewey (1980), Folkmann (2013), Saito (2017) and Sartwell (2003). The main idea is based on that, ‘design can have a transformative effect on experience [and] it may point to a radical transfiguration of the structure of experience,’ (Folkmann, 2013, p. 26). Design here, referred to as both a tool and process, may affect the everyday aestheticisation of renewable energy infrastructure by facilitating meaning-making processes across material, people and networks in the urban built environment. The everyday aestheticisation of renewable energy infrastructures is considered a human-centred and experienced-based process, in which natural and serendipitous interactions between humans and the environment becomes a transactional affair. Both parties become, ‘equally productive in manifesting the ongoing struggle to endow our world with meaning and value,’ (McClelland, 2005, p. 46). This apt description of aesthetics as a struggle of power, affect and consequence in everyday meaning-making processes plagues all human and non-human agencies within the aesthetic experience. Here, everyday aesthetics serves to liberate aesthetic inquiry from a conventionally narrow focus on static beauty (Saito, 2021). Thus, the design of – and thinking behind – future urban renewable energy landscapes need to be examined as a part of our interactions with our surrounding environments, in order to understand and clarify the notion of ‘design’ as a ‘process that takes place as we live and act in an environment’ (Xenakis & Arnellos, 2013, p. 60).

Another way of thinking of aesthetics in design is through Buchanan’s (1992) four design orders, which are intertwined and contingent to one another: *symbols*, as things talking to a person; *objects*, as things a person interacts with; *interactions*, as groups of people and things in interaction; and *systems and environments*, as groups of people and things in interaction with other groups of people and things (Buchanan, 1992). These can be seen as independent of design practice or professions, but they can also be seen as interdependent fragments contributing to a larger whole. As such, they can be used as a framework for sense-making, narrating and re-constructing values of aesthetics in design, i.e. we see, do and reflect on certain things and not others. Design is not merely a practice of making things, it is a practice of transforming views of subject matter held by designers and others – and the material and immaterial things that are envisioned, planned and produced are expressions of those views (Buchanan, 1992).

1.1 Speculating alternative energy aesthetics

In relation to energy, previous works in the design world have explored everyday aestheticisation. An example is ‘*Static!*’ (Backlund, Gyllenswärd, Gustafsson, Ilstedt Hjelm, & Mazé, 2007), a design research project funded by The Swedish Energy Agency. *Static!* aims to critically reflect on society’s interactions with energy in daily life, in order to create more meaningful aesthetics. The research work draws upon the concept of affordances, which refers to the increased social experimentation, learning, and interaction with an object’s form and functionality to produce new uses and experiences, thus contributing to varied aesthetics of use that can form over time (Locher et al., 2010). One prototypical example that emerged from the project is *The Element*, which offers a re-thinking of the aesthetics of a radiator. The prototype was constructed from 35 light bulbs with approximately the same heating effect as a conventional electrical radiator (approximately 2000 W). Consequently, *Static!*’s research team expressed a common challenge in which aesthetics and engineering are seen as dichotomous categories in contemporary energy design:

‘Consider, for instance, how the ‘design problem’ of providing artificial light using lamps is split between the shaping of things like lampshades and fixtures on one hand and the systems for producing and distributing power on the other,’ (Backlund, Gyllenswärd, Gustafsson, Ilstedt Hjelm, & Mazé, 2007, p. 3).

Further research studies (e.g. Ernevi, Palm, & Redström, 2007) support and elaborate the notion that in working with new ways of designing for energy, the dissolution of the boundary between aesthetics and engineering needs to occur in order to explore a broader understanding of energy as material in – and experience of – design.

In the context of the urban realm, the designing of novel renewable energy aesthetics has also been explored by designers globally. Land Art Generator Initiative (LAGI), a design duo comprising artist Elizabeth Monoian and architect Robert Ferry, work actively to engage local communities worldwide to design public art installations with renewable energy, promoting their stance that ‘Renewable Energy Can Be Beautiful’ (Land Art Generator Initiative, 2019). Co-design processes that are embedded within local contexts are considered important to their work. In addition to their education and awareness programmes, they arrange annual competitions that call upon inspiring and speculative design projects in the field of renewable energy technologies. *A Field Guide to Renewable Energy Technologies* (Land Art Generator Initiative, 2019) summarises the plethora of entries that offer alternative forms of renewable energy aesthetics in cities globally. Examples such as *Beyond the Wave*, a dreamy wave-like design of organic thin-film solar cells that can be

utilised as a shading structure, exemplify novel everyday aesthetics that rebel against binary ways of thinking of art and function in our pursuit of clean energy futures.

Apart from being *just* speculations, the basis of many of the speculative aesthetics projects are grounded in real technological capacity and local social and spatial conditions. Beyond providing inspiration, the very real possibility of their logistical rollout provides sufficient reason to question the current and future renewable energy aesthetics in our cities. What type of city do we desire to live in, and how do we build a society to achieve this vision? More specifically, we should be questioning the role of renewable energy in these ideals. By *we*, this paper refers to the citizen-designers in every city globally that may illuminate these questions.

1.2 Co-producing energy aesthetic experiences ‘in the wild’

‘In the wild’ is a terminology referred to in the field of design to exemplify design(ing) outside of controlled environments (e.g. [Penin, Forlano, & Staszowski, 2012](#)). Citizen-designers affect these ‘in the wild’ experiences, as they are the everyday people that unconsciously form and partake in design decisions through aesthetic practice in the urban realm. One example is in experiencing urban spaces through walking ([Wunderlich, 2008](#)). When these citizen-designers are met with exceptional experiences that shift their way of thinking of a certain space, which may cause them to reflect on deeper issues, they are able to partake in that conversation and form opinions on that matter. This is significant for the matter of renewable energy aesthetics, that have primarily concerned – and been restricted to – pre-defined experts in the field (e.g. urban planners, energy engineers). Interventions of everyday energy aesthetics ‘in the wild’ have increased over the years, stimulating experiences apart from the mundane; play, fun and enjoyment (e.g. [Boucher et al., 2018](#)), to richer experiences such as reflection and fascination (e.g. [Leong & Brynskov, 2009](#)), social challenge and investigation (e.g. [Korsgaard & Brynskov, 2014](#)), and conviviality and serendipity through dialogue (e.g. [Liu, Ding, Liu, Lu, & Gu, 2016](#)). A delve deeper into some of these projects indicate how the embodiment of the physical and material forms can afford discussions and reflections on social and cultural values, as well as different meanings about energy. For example, the studies conducted by [Leong and Brynskov \(2009\)](#), [Korsgaard and Brynskov \(2014\)](#) and [Liu et al. \(2016\)](#) – whilst some do not mention aesthetics *per se* – discuss how both perceptions and values revolving around certain technology and energy can be explored with these aforementioned citizen-designers.

[Leong and Brynskov’s \(2009\)](#) study is of an urban video boot and broadcasting network, called *CO2nfession/CO2mmitment*, with the aim of engaging citizens in sharing and reflecting on how they could make changes on an

individual level in terms of reducing carbon dioxide emissions. The placement of the boot, in a public and occupant space, is regarded as one of the key factors. [Korsgaard and Brynskov's \(2014\)](#) study, a *City Bug Report*, deals with how urban media architecture/provotypes can act as touchpoints between city stakeholders, and a means for exploring the challenges and implications regarding different urban issues. It is seen as a design provotype to spur social challenge and investigation on how future technology could be appropriated by municipalities or others. The authors, however, discuss the challenge in knowing what is being prototyped; is it the technology, usage, adoption, quality, aesthetics or usability? In response to their own question, they conclude that it is perhaps time to begin urbanising technology, and exploring the prototyping of policies, as a means of providing insights on the challenges and implications of new technologies. Through an interactive physical eco-feedback display, called *ArchiExpression*, [Liu et al. \(2016\)](#) explore perceptions in crowds on energy-related issues through convivial discussion and serendipitous reflections. The term aesthetics is not explicitly used in this study, instead, the authors discuss the importance of the device being spatially situated – in other words, being present where people can interact with it. They discuss that the embodying physical and material form affords rich social and cultural meanings, and that, ‘people liked it and described it as high-tech and cool,’ (p. 8). This, they conclude, then is a style that is a good fit for such a space where people are concerned with computer or high-tech technologies.

Co-producing everyday energy aesthetics ‘in the wild’, however, offers to move beyond the designing of a ‘start-to-end’ curation of an experience: where an artefact – designed and planned in its entirety by expert designers – is only placed into an urban space when the expert designers consider it as ‘ready’. At which point, the artefact’s availability and access to the local realm is permitted. This means that the citizen-designers’ interactions and experiences with the artefact are presumably curated, to some extent, beforehand. An alternative way of designing would be to weave in a level of ambiguity and openness throughout the design process, through the early-stage inclusion of local points of view (i.e. co-designing for emerging renewable energy spaces in the city). Succinctly put forth by [Fallman \(2005\)](#), ‘[p]eople have a tendency to use artefacts in ways which were not intended and are not controlled by the designer. Mixing artefacts with people also brings the phenomenon of “now” into play,’ (p. 3). Thus, another way of experimenting with aesthetic experiences ‘in the wild’ is through the inclusion of citizen-designers (i.e. those with lived experiences of the local urban spaces) within the designing process.

Particularly on the topic of renewable energy, one example is *Solvåg*, implemented in Piteå, Sweden. *Solvåg* is a parametric design consisting of 117 double-sided solar panels on wooden stands formed in a spiralling and snaking fashion. It is considered the country’s first large-scale approach towards a solar panel park facility that is both productive and artistic in its approach. In

other words, apart from its effective electricity generation, the space serves as both a landscaping feature as well as an urban park for local inhabitants (Warm in the Winter, 2021). The project entailed a collaboration between Luleå University of Technology, Piteå municipality, Piteå Science Park and the Northern Research Institute, NORUT. Beyond that, the project also entailed a close collaboration with the people studying and working around the facility, at Campus Piteå, using prototypes and aesthetics as means of exploring collaborative designs based on the needs, desires and considerations of the local context (Rizzo, Ekelund, Bergström, & Ek, 2020).

Everyday aesthetics here arguably moves beyond a question of form and function, and instead focuses on the production of situated designs following bottom-up needs and desires. Lessons learnt from such participatory projects indicate that the explorations of everyday renewable energy aesthetics need to be rooted in context in order to provide meaning to its outcome. Furthermore, the citizen-designers' engagement early on in the design process – as well as their continued engagement throughout the design process – offers opportunities for empowerment, where local inhabitants are able to influence the making of their own urban energy futures. Supporting studies have also shown that rich and meaningful citizen engagement throughout a design process could potentially elicit a sense of belonging and ownership over the process, which could then further motivate change by design (Sleeswijk Visser, 2009). These examples and studies thus motivate the need for placing the citizen-designer front and centre, where they might inform and drive the everyday aestheticisation of renewable energy infrastructures.

2 Case study: co-creating urban renewable energy aesthetics through design thinking

This case study encompasses a design thinking workshop in which design thinking was utilised as a method to examine and explore citizen-designers' relations to renewable energy in the context of their city – in short, an 'action in context' (Hoolohan & Browne, 2020, p. 104). In the fall of 2018, a design thinking workshop was held with 15 participants as part of the course Climate, Landscape and Built-Up Areas at the Architecture Group in Luleå University of Technology. The motivation behind the workshop was to experiment on the utilisation of collaborative design thinking in exploring everyday aesthetics of renewable energy futures. This would enable the learning about the everyday aesthetics of renewable energy in context (speculative or not), and in turn, be able to contribute to future everyday aestheticisation. The participants were design and engineering students who were, at that time, also inhabitants of the case study neighbourhood, Porsön, located in Luleå, Sweden (i.e. they lived and studied within the neighbourhood). They were thus well acquainted with, and had lived experiences of, the urban public spaces within the neighbourhood. Akin to Ehn's (1993) reference to 'shop-floor experiences' (p. 46)

and Meroni's (2007) reference to the 'professionals of the everyday' (p. 9), the participants' local knowledges were deemed invaluable to this study. The challenge statement of the case study workshop was in line with that of this paper: How might a co-creative design thinking approach contribute to exploring the everyday aesthetics of urban solar photovoltaics (PVs) in the neighbourhood of Porsön?

In this study, Kelley and Kelley (2013) primarily informed the design thinking method, with the four phases of the workshop being: 1. Inspiration, 2. Synthesis, 3. Ideation and experimentation, and lastly 4. Implementation (see Table 1). The workshop spanned approximately 4 h, and data was collected through photographs, observation and field notes, as well as prototypes. The data was analysed through a thematic content analysis (Braun & Clarke, 2006).

3 Case study findings

This section offers findings from the case study in relation to the guiding research question. The main findings will be discussed under three overarching topics: the emergence of situated everyday renewable energy aesthetics, the articulation of (in)visible futures, and creative serendipity in a collaborative setting. Figures 1 and 2.

3.1 Emergence of situated everyday renewable energy aesthetics

The workshop was curated in a way that emphasised the centrality of local particularities in influencing the aesthetic sense-making process. It was found that this contributed to a process of aesthetic *emergence*, in that the everyday aesthetic production process reflected largely on the needs and desires emerging from a specific urban public space. In other words, the everyday aesthetic production process was developed from the ground up, where aesthetics answered to the space in question, as opposed to the space simply serving as a canvas to aesthetic production. The back and forth process between questioning and rationalising everyday energy aesthetics in a situated environment made the beauty or visual appeal of the solar photovoltaic systems take a backseat to the potential offerings of novel urban experiences.

One example of such aesthetic emergence was the redesign of local barbeque pits to offer shelter from winds through PV panel roofs and walls. The city of Luleå experiences a harsh climate with strong winds, causing great thermal discomfort in outdoor spaces at different points of the year. To address this – and the current lack of public gathering spaces – the participants deemed it important to target social gathering areas, such as the neighbourhoods' barbeque pits, and make them attractive for outdoor use, even during the winter months. The design included sheltered barbeque pits with PV roofs, modular and movable PV walls that could provide protection if and when

Table 1 Workshop outline

<i>Stages</i>	<i>Motivation</i>	<i>Activities</i>
1. Inspiration (Gallery Walk)	To provide inspiration for ‘what is possible’ through the showing of imaginative, innovative and game-changing solar panel design projects that have been established.	Participants were given 30 min to browse images and descriptions of different projects through a Gallery Walk. They were encouraged to document thoughts and insights anonymously on Post-Its beside the images. Some probing questions were provided: <ul style="list-style-type: none"> • What they liked/disliked about a design. • What they would do differently. • What challenges they anticipated, etc.
2. Synthesis	Problem framing and sense-making of the challenge at hand.	The participants were split into groups and within each group, they were provided with an A3 aerial satellite image over the area of Porsön. Each group was tasked to focus on a different area within Porsön. Referring to the Post-It’s from the first part of the workshop, they were encouraged to reflect on the ideas and insights and evaluate how and where these designs could be implemented in the local context. Some probing questions were provided: <ul style="list-style-type: none"> • To identify urban gathering spaces that they would like to improve. • Why and how they would improve them. • To locate areas with high solar access. • To propose the scale and intention of the installation. • The opportunities and challenges these designs would incur, etc.
3. Ideation and experimentation	To provide opportunities for creative serendipity through the rapid prototyping of ideas that are then worked on by others.	The groups were provided with a variety of prototyping materials: string, tape, Styrofoam, pins, markers, crayons, pens, cardboard, sketch paper, paint, and a variety of green embellishments for vegetation representation. This stage comprised two rounds: <ul style="list-style-type: none"> • In Round 1, each group had 45 min to develop and prototype a variety of ideas. They were encouraged to strive for quantity over quality. • In Round 2, the groups were rotated around the room, such that each group now had the opportunity to select and build upon the ideas of another group’s work. They then had 45 min to continue prototyping. After each round, the groups had the opportunity to present their ideas and take a brief break.
4. Implementation	To move from planning to action.	Due to time and logistical restraints, the ideas were not physically implemented in Porsön. However, time was allocated at the end of the workshop for a round-table discussion session on strategic steps that could be executed presently to jumpstart the participants’ desired solar energy futures for the neighbourhood.

needed, and heated benches. The participants expressed that it was important to them that the everyday aesthetic production primarily contributed to a comfortable microclimate for people to meet in during the colder periods of the year. The participants added that the heated benches could be maintained through the autonomous electricity generation from the solar panels on the roof and walls, which could further provide an additional source of warmth.

Everyday aestheticisation of urban renewable energy



Figure 1 Annotations on the Post-It's from the first phase of design thinking (foreground) feeds into the collaborative sense-making process in the second phase (background). Source: authors' own image



Figure 2 The provision of easily procured, everyday materials for rapid prototyping offered an accessible way for participants to tangibly explore aesthetics. There was no need for operating digital tools or heavy machinery. The materials included were string, tape, Styrofoam, pins, markers, crayons, pens, cardboard, sketch paper, and paint. Source: authors' own image

3.2 Articulation of (in)visible futures

In a majority of the participant groups, the ideas and prototypes indicated a desire for solar panels (in their different forms) to visibly stand out (as landmarks), rather than blend in to their surrounding environment. The participants referred to the renown urban designer Kevin Lynch, in his characterisation of cityscapes as a conglomeration of paths, edges, nodes, districts, and landmarks. Landmarks are thus considered socio-spatial points that are essential experiences to a city (Lynch, 1960). The versatile and modular nature of solar panels were considered to be an advantageous asset to the everyday aesthetic production process, where it was considered that anywhere these panels were installed signified a, 'bright future in renewable energy' (Participant, personal communication, November 20, 2018). The different participant groups ideated a plethora of eye-catching public art installations with solar panels through a combination of colours, textures, materials, forms and functions.

An example prototype with the intention to be a landmark for the neighbourhood was the creation of what the participants named as the ‘Big Bear’. The ‘Big Bear’ was conceptualised as a large public art installation, in the form of a geometric PV bear that would be located along the main university walkway in Porsön. The idea behind the design was that the bear would signify a playful take on the local energy transition, and act as an approachable and welcoming figure to all inhabitants. It would also absorb energy during the day and generate colourful lighting in the night, in a bid to brighten up the long, dark winters that are experienced in Luleå. The word ‘dark’ here, implying a dual meaning of literal darkness, and also the symptoms of winter depression commonly experienced during the long winters. The colourful lighting, described by the participants to promote a playful disco-like ambiance, could aid in improving the moods and overall well-being of local inhabitants through the provision of opportunities for fun and playful experiences.

3.3 Creative serendipity in a collaborative setting

In Phase 3 of the workshop, ideation and experimentation, aesthetics acted as an important medium of communication between the different participant groups. This is because the prototyping process paused after Round 1 and the groups subsequently moved around, so that a different group would continue another group’s work in Round 2. This meant that the only form of communication and continuation of ideas between the groups relied upon the halfway and haphazard prototypes made in Round 1. We observed that the swift change brought about a struggle in certain participant groups, to let go of their initial idea(s) and instead embrace the creative serendipity that was to follow by building on another group’s idea. By creative serendipity, we refer to it as the unintentional, ambiguous and open process of creativity that through the collaborative meeting of hands and minds, leads to spontaneous decision-making and a final aesthetic that embodies this organic process.

Creative serendipity also surfaced in the process of rapid prototyping, where the materials provided had set the boundaries for what was prototyped (e.g. on boundary objects vis-à-vis technology, see [Fox, 2011](#)). The provision of easily procured, everyday materials for rapid prototyping offered an accessible way for participants to tangibly explore everyday aesthetics. It required some navigation on the part of the participants, to select and mould the materials into the aesthetic makings they had envisioned. Thus, creative serendipity here entailed an active and dynamic relationship between the participant and materials, in which both iteratively influenced the aesthetic making process. The process appeared seemingly haphazard, but the trial-and-errors were considered necessary as part of the creative process. Akin to Donald Schön’s ‘reflective practicum’, the materials seemingly *talked back*, and propelled further reflection-in-action ([Schön, 1983](#); [Schön, 1987](#)).

Overall, the workshop showcased the potentiality of design thinking to engage with the everyday aestheticisation of renewable energy in three ways: a) in exposing tacit values, meanings and biases towards emerging energy infrastructures, b) in cultivating a motivation and sense for possible sustainable change, and finally, c) in enabling necessary conversations and critical reflection on current and future energy place-making processes. The participants had some prior knowledge of renewable energy systems that enabled extensive discussions about the possibilities for urban PV within the case study context. This may not always be the case in other design thinking efforts, and it is therefore important that the process is specifically curated to the participants involved. Some conversation topics that surfaced were maintenance issues presented by an arctic climate, potentially high investment costs, spatial limitations, technical concerns (e.g. grid access), land ownership issues, continuity of and sensitivity towards local cultures, and future responsibilities over implementations. These meaningful reflections and issue-based discussions can be deduced to have emerged largely from the participants' lived experiences and local knowledge of the space, which was a point of reference continuously revisited by the different participants.

4 Discussion within a wider discourse

This paper explores renewable energy infrastructures as complex socio-material assemblages, which move beyond current reductionist views that characterise these objects as purely utilitarian in their purpose. Beyond objectified representations of statistics, isolated and indifferent to its surrounding social context, these infrastructures have the capacity to influence social worlds in a meaningful way. Moreover, this becomes increasingly important as these technologies continue to permeate our urban everyday experiences. This section thus aims to discuss insights on the role design thinking plays in the everyday aestheticisation of renewable energy at different scales, as well as its implications and connections to wider society. To do so, we revisit the guiding research question: How might a co-creative design thinking approach contribute to exploring everyday renewable energy aesthetics? The discussion and reflections that follow aim to relate findings from the case study to pertinent wider discourses on ethics, sustainability, design and planning.

4.1 Communicating through aesthetics

If the everyday aestheticisation of renewable energy infrastructure is rooted in the situated meaning-making across peoples, things and environments, then the points of interaction and communication between these thresholds must be equally, or even arguably more important than the individual parts. Drawing from the case study workshop and the earlier readings, aesthetics can be considered the visible stage of any design operation (e.g. [Hunicke, Leblanc, & Zubek, 2004](#)), which makes it a crucial factor in the communication between expert and non-expert designers. Aesthetics is therefore a determining factor in

how people approach, react and use an artefact, application or conversation. Hence, there is good reason to prioritise aesthetics as a means to pry open typically unapproachable and complex topics, such as renewable energy design in the urban realm. Fun and playful interpretations, such as the ‘Big Bear’, indicate a certain tacit knowing and desire for an alternative social world, in which social dreaming and imagination translates into reality. Playful experimentation with aesthetics can thus be considered one inclusive way (out of many) to capture a greater audience that varies in age, skillset and background. Furthermore, the use of everyday materials make aesthetic issues accessible to a wider audience, and processes of rapid prototyping tend to reduce inhibitions and promote creative expression.

Thus, aesthetics has the capacity to democratise seemingly complex topics, which, at the wider societal level, may aid in co-learning and co-production of knowledge between energy experts and non-experts in the field. This is significant as it provides the opportunity for citizen-designers to ‘yield their own, context- and time-specific interpretations of sustainable development,’ (Eernstman & Wals, 2013, p. 1645), as well as reflect and envision different ontological worlds (Maggs & Robinson, 2016). While this may lead to different or conflictual interpretations or visions, Keshavarz and Mazé (2013) offer that ‘dissensus’ in design may be helpful in shifting engagement interventions away from solution-oriented goals and instead focus on open-ended co-learning. On a broader scope, such aesthetic inquiry into energy place-making can also be helpful in pinning down the otherwise ambiguous notion of ‘sustainability’, through a process of context-based need-finding and meaning-making. It is thus necessary for designers, who plan and curate co-creation settings with other citizen-designers, to be mindful of participation diversity and inclusion.

4.2 Design thinking in energy governance and planning

Design thinking rhetoric in itself is not new (e.g. Jones, 1979), but has seen refurbished ways of use in tackling wicked problems of our world today (Galera & Borzaga, 2009). Particularly in the case of social sustainability, design thinking has shown to help achieve enhanced social value within communities (Brown & Wyatt, 2015). Following design thinking’s core components of empathy and collaboration, expert designers are able to integrate themselves into the problem space and explore the local contexts that could offer solutions for the problems being tackled (Brown & Katz, 2011; Dorst, 2006). What results from this is a blurring of boundaries between expert and non-expert designers, to reveal a community of citizen-designers who co-create localised solutions together. Organised and networked coalitions of such citizen-designers can affect change in society and the environment at large (Booher & Innes, 2002).

What this means for energy governance and planning is that design thinking as a method may be used to tackle the socio-technical challenge of future energy place-making. Currently, renewable energy planning is primarily guided by overarching political agendas, for example, Agenda 2030 by the United Nations (Swedish Government Offices, 2020), the Energy Roadmap 2050 (European Climate Foundation, 2010), and at an artistic and aesthetic level, the New European Bauhaus (European Commission, 2021). These frameworks trickle down into governance initiatives at a regional, national and local level. For example, in the case of the Nordic region, New European Bauhaus efforts are initiated through several joint collaborations between the countries. For example, the Nordic Co-design effort primarily led by Finland (Ministry of Environment, 2021), and on a national level, an example is the Policy for Designed Living Environment in Sweden (Swedish Government Offices, 2018).

However, energy-planning efforts and on-the-ground implementation are often criticised to be ‘out of step’ (Scognamiglio, 2016, p. 631), without any ‘proper integration into regional spatial and landscape planning,’ (Scognamiglio, 2016, p. 631). Furthermore, energy design and policy has also been claimed to be decontextualised and disembodied (Wilhite & Wallenborn, 2013). Hence, many would argue a need for, ‘a decisive prerequisite [for] renewable energy application [to be] integrated in the urban planning process at the beginning,’ (Gagliano, Patania, Nocera, Capizzi, & Galesi, 2013, p. 865), so as to result in a holistic framework towards energy planning that infiltrates each stage of the municipal planning process.

This study thus builds upon research on design thinking for sustainability (e.g. Hoolohan & Browne, 2020), by utilising design thinking as a method to pry open energy conversations and render them accessible to a wider audience. The study shows this in two ways:

- a) Exploration of situated values through playful and speculative everyday aesthetics in the *early* stages of urban development projects
- b) Continued utilisation of everyday aesthetics in design thinking workshops catering to iterative citizen-designer engagement in future renewable energy projects

These conversations rooted in everyday aesthetics facilitate the democratisation of energy matters in a way that is truly inclusive to different local actor groups – by communicating a seemingly difficult or perceivably academic or technical topic through palatable day-to-day experiences that all can relate to.

4.3 At the nexus between aesthetics, ethics and activism

The everyday aestheticisation of renewable energy infrastructure should span beyond the realm of citizen engagement workshops. In other words, what

happens outside of these workshops could be considered even more important; empowering and enacting grounded change in mindsets and ideologies among local citizen-designers. Powerful co-creative approaches have shown potentialities in engaging people in neighbourhood energy transitions (Walker, 2008) and in operationalising energy democracy (Van Veelen & Van Der Horst, 2018). Thus, a point of departure is to consider the impact of design thinking in a wider discourse: Is it possible for design thinking to influence grounded innovation and change? How might everyday aesthetics contribute to the energy democracy movement?

In other words, the opportunity for expert and non-expert designers to explore everyday aesthetics in renewable energy moves beyond that of structured state processes, and extends into the potentially activist and artistic realm of bottom-up urban space utilisation and intervention. Initiatives by artists, citizen-designers, creators and innovators could spark conversation through a myriad of ways and lead the exploration of cultural values from the ground up, which may inform desirable situated futures. Further explorations into such initiatives is a way to promote processes of everyday aesthetic emergence and creative serendipity among citizen-designers at a larger and more complex scale, embedded within the urban context. This study thus calls for further explorations into embedded initiatives that utilise everyday aesthetics.

Finally, the ethical tensions in motivating such initiatives can be difficult. Saito (2017) proposes that those promoting sustainable futures have long recognised the power and potential of aesthetics. To some extent, sustainability experts have been advocating for the *nudging* of audiences towards a sustainable future through the persuasive power of marketing (Dobers & Strannegård, 2005). Reforming public identities and cultivating deep affection and emotional attachment to environmental causes might support society's move towards a cleaner future (Saito, 2017). However, the reality is that such persuasions are difficult to navigate – an alternative would be to simply realise the potential of everyday aesthetics, and then to end it there (Saito, 2017).

5 Conclusion

This paper offers a way forward for the utilisation of design thinking in the exploration of everyday aesthetics in renewable energy design. The case study offers several findings within three broad topics: the emergence of situated everyday renewable energy aesthetics, the articulation of (in)visible futures, and creative serendipity in a collaborative setting. The paper then zooms out into a wider discourse of ethics, sustainability, design and planning, to meaningfully situate this study within a complex and interconnected world. The following paragraphs summarise the takeaways for this study, as well as possibilities for future work.

Firstly, the paper offers a way to consider the everyday aestheticisation of renewable energy infrastructures through utilising aesthetics in design thinking. The possibilities of applying everyday aesthetics as a lens in design thinking towards renewable energy are diverse. Taking the form of workshop interventions for the engagement of citizen-designers, aesthetics in design thinking may promote inclusivity and plurality. Utilising such workshops in urban development processes – particularly by introducing them early on in the process – may aid in learning situated values and lifeworlds that are crucial to the design of future renewable energy projects.

Secondly, a co-creative approach via the inclusion of citizen-designers – everyday people with lived experiences of the urban spaces in question – is necessary in producing renewable energy design that is meaningful and responsive to local needs and context. The collaborative process of an aesthetic emergence and the creative serendipity in exploring future renewable energy environments might aid in informing investments in infrastructures that are viable as they are desirable. A human-centred and experience-based lens of designing energy aesthetics also shows potential in broadening the understanding of renewable energy infrastructure beyond the *now*, and towards *what could be*.

Thirdly, the ethical tensions within these approaches are multiple, and implications differ from context to context. Therefore, designers hold a significant responsibility in prying open conversations that need to be had, in leading collective reflections on space and use, and in paving the way forward by speculating future everyday aesthetics. The study offers avenues in which designers can better engage local citizen-designers and implement aesthetics in future renewable energy conversations and projects.

Lastly, this study calls for further explorations in bottom-up initiatives to offer alternative ways for communities to engage and communicate via everyday aesthetics. These initiatives of artist-activist nature may entail an evolving, emergent and open way for local citizen-designers to coalesce, engage and interact via unstructured aesthetic practice grounded in the urban realm.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The design thinking case study was supported by The Swedish Energy Agency (Energimyndigheten) through grant 46355-1. The workshop took place in the Architecture group at Luleå University of Technology, Sweden. The analysis

took place at the Design group, at Luleå University of Technology, Sweden, as part of an ongoing doctoral thesis. The authors would like to thank the participants of workshop for their invaluable feedback and stories that have made this research possible.

References

- Backlund, S., Gyllenswärd, M., Gustafsson, A., Ilstedt Hjelm, S., & Mazé, R. (2007). STATIC! The aesthetics of energy in everyday things. *Proceedings of Design Research Society Wonderground International Conference 2006* 1–4.
- Booher, D. E., & Innes, J. E. (2002). Network power in collaborative planning. *Journal of Planning Education and Research*, 21(3), 221–236. <https://doi.org/10.1177/0739456X0202100301>.
- Boucher, A., Gaver, B., Kerridge, T., Michael, M., Molline, K., Ovalle, L., et al. (2018). *Energy babble*. Manchester, UK: Mattering Press.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>.
- Brown, T., & Katz, B. (2011). Change by design. *Journal of Product Innovation Management*, 28(3), 381–383. <https://doi.org/10.1111/j.1540-5885.2011.00806.x>.
- Brown, T., & Wyatt, J. (2015). Design thinking for social innovation. *Annual Review of Policy Design*, 3(1), 30–35. <https://doi.org/10.2307/j.ctt1t8917t.13>.
- Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues*, 8(2), 5–21. <https://doi.org/10.5040/9781474282932.0019>.
- Dewey, J. (1980). *Art as experience*. New York: Perigee Books.
- Dobers, P., & Stranegård, L. (2005). Design, lifestyles and sustainability. Aesthetic consumption in a world of abundance. *Business Strategy and the Environment*, 14(5).
- Dorst, K. (2006). Design problems and design paradoxes. *Design Issues*, 22(3), 4–17. <https://doi.org/10.1162/desi.2006.22.3.4>.
- Eernstman, N., & Wals, A. E. J. (2013). Locative meaning-making: An arts-based approach to learning for sustainable development. *Sustainability*, 5(4), 1645–1660. <https://doi.org/10.3390/su5041645>.
- Ehn, P. (1993). Scandinavian design: On participation and skill. In D. Schuler, & A. Namioka (Eds.), *Participatory design: Principles and practices (first)* (pp. 37). Boca Raton: CRC Press.
- Ernevi, A., Palm, S., & Redström, J. (2007). Erratic appliances and energy awareness. *Knowledge, Technology & Policy*, 20(1), 71–78. <https://doi.org/10.1007/s12130-007-9007-7>.
- European Climate Foundation. (2010) *Roadmap 2050 – A practical guide to a prosperous, low-carbon Europe. Technical analysis, Vol. I*. Europe 100.
- European Commission. (2021). *New European Bauhaus*. Retrieved September 3, 2021, from Shaping more beautiful, sustainable and inclusive forms of living together website: https://europa.eu/new-european-bauhaus/index_en.
- Fallman, D. (2005). Why research-oriented design isn't design-oriented research. In . *Proceedings of NorDES conference – In the making, 1* (pp. 5). Copenhagen: Royal Danish Academy of Fine Arts, School of Architecture.
- Folkmann, M. N. (2013). *The aesthetics of imagination in design*. Cambridge, MA: The MIT Press.

- Fox, N. J. (2011). Boundary objects, social meanings and the success of new technologies. *Sociology*, 45(1), 70–85. <https://doi.org/10.1177/0038038510387196>.
- Gagliano, A., Patania, F., Nocera, F., Capizzi, A., & Galesi, A. (2013). GIS-based decision support for solar photovoltaic planning in urban environment. *Sustainability in Energy and Buildings*, 22, 865–874. https://doi.org/10.1007/978-3-642-36645-1_77.
- Galera, G., & Borzaga, C. (2009). Social enterprise: An international overview of its conceptual evolution and legal implementation. *Social Enterprise Journal*, 5(3), 210–228. <https://doi.org/10.1108/17508610911004313>.
- Hoolohan, C., & Browne, A. L. (2020). Design thinking for practice-based intervention: Co-producing the change points toolkit to unlock (un)sustainable practices. *Design Studies*, 67, 102–132. <https://doi.org/10.1016/j.destud.2019.12.002>.
- Hunicke, R., Leblanc, M., & Zubek, R. (2004). *MDA: A formal approach to game design and game research*. AAAI Workshop – Technical Report. WS-04-04.
- Jones, J. C. (1979). Designing designing. *Design Studies*, 1(1), 31–35. [https://doi.org/10.1016/0142-694X\(79\)90026-7](https://doi.org/10.1016/0142-694X(79)90026-7).
- Kammen, D. M., & Sunter, D. A. (2016). City-integrated renewable energy for urban sustainability. *Science*, 352(6288), 922–928. <https://doi.org/10.1126/science.aad9302>.
- Kelley, T., & Kelley, D. (2013). *Creative confidence: Unleashing the creative potential within us all*. United States: Crown Publishing Group.
- Keshavarz, M., & Mazé, R. (2013). Design and dissensus: Framing and staging participation in design research. *Design Philosophy Papers*, 11(1), 7–29.
- Korsgaard, H., & Brynskov, M. (2014). City bug report: Urban prototyping as participatory process and practice. In *ACM International Conference Proceeding Series*, 19–22-Nove (pp. 21–29). <https://doi.org/10.1145/2682884.2682896>.
- Land Art Generator Initiative. (2019). *A field Guide to renewable energy technologies*.
- Leong, T. W., & Brynskov, M. (2009). CO2nfeccion: Engaging with values through urban conversations. In *Proceedings of the 21st annual conference of the Australian computer-human interaction special interest group – design: Open 24/7, OZCHI '09, Vol. 411* (pp. 209–216). <https://doi.org/10.1145/1738826.1738860>.
- Liu, T., Ding, X., Liu, P., Lu, T., & Gu, N. (2016). ArchiExpression: A physical eco-feedback display in an outdoor campus space of China. In *ACM international conference proceeding series, 08-May-201*. <https://doi.org/10.1145/2948708.2948711>.
- Locher, P., Overbeeke, K., & Wensveen, S. (2010). Aesthetic interaction: A framework. *Design Issues*, 26(2), 70–79. https://doi.org/10.1162/DESI_a_00017.
- Lynch, K. (1960). *The image of the city*. London, UK: MIT Press.
- Maggs, D., & Robinson, J. (2016). Recalibrating the anthropocene: Sustainability in an imaginary world. *Environmental Philosophy*, 13(2), 175–194. <https://doi.org/10.5840/envirophil201611740>.
- McClelland, K. A. (2005). Aesthetic experience and artful conduct. *Education and Culture*, 21(2), 44–62.
- Meroni, A. (2007). *Creative communities: People inventing sustainable ways of living (first)*. Milan, Italy: Polidesign.
- Ministry of Environment. (2021). *Nordic co-design: New European Bauhaus*. Retrieved September 3, 2021, from Events website. <https://www.nordicbauhaus.eu/#/page=1>.

- Penin, L., Forlano, L., & Staszowski, E. (2012). Designing in the wild: Amplifying creative communities in North Brooklyn. In *Cumulus Helsinki Conference, 1–17*. Helsinki, Finland: Aalto University, School of Arts, Design and Architecture.
- Postrel, V. (2003). *The substance of style: How the rise of aesthetic value is remaking commerce, culture, and consciousness (first)*. New York, USA: HarperCollins Publishers.
- Rizzo, A., Ekelund, B., Bergström, J., & Ek, K. (2020). Participatory design as a tool to create resourceful communities in Sweden. In C. S. Costa, M. Mačiulienė, M. Menezes, & B. G. Marušić (Eds.), *Co-creation of public open spaces: Practice – reflection – learning* (pp. 95–107). Lisbon, Portugal: C3Places – Using ICT for Co-Creation of inclusive public Places.
- Saito, Y. (2017). *Aesthetics of the familiar: Everyday life and world-making (first)*. Oxford, UK: Oxford University Press.
- Saito, Y. (2021). *Aesthetics of the everyday*. The Stanford Encyclopedia of Philosophy, (Spring). Retrieved from. <https://plato.stanford.edu/entries/aesthetics-of-everyday/>.
- Sánchez-Pantoja, N., Vidal, R., & Pastor, M. C. (2018a). Aesthetic impact of solar energy systems. *Renewable and Sustainable Energy Reviews*, 98(August), 227–238. <https://doi.org/10.1016/j.rser.2018.09.021>.
- Sánchez-Pantoja, N., Vidal, R., & Pastor, M. C. (2018b). Aesthetic perception of photovoltaic integration within new proposals for ecological architecture. *Sustainable Cities and Society*, 39(January), 203–214. <https://doi.org/10.1016/j.scs.2018.02.027>.
- Sartwell, C. (2003). Aesthetics of the everyday. In J. Levinson (Ed.), *The Oxford handbook of aesthetics*. Oxford University Press.
- Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.
- Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions (first)*. San Francisco: Jossey-Bass.
- Scognamiglio, A. (2016). “Photovoltaic landscapes”: Design and assessment. A critical review for a new transdisciplinary design vision. *Renewable and Sustainable Energy Reviews*, 55, 629–661. <https://doi.org/10.1016/j.rser.2015.10.072>.
- Sleeswijk Visser, F. (2009). *Bringing the everyday life of people into design*. Delft University of Technology. ISBN: 978-90-9024244-6.
- Swedish Government Offices. (2018). *Policy for designed living environment*. Stockholm, Sweden.
- Swedish Government Offices. (2020). *The global goals and the 2030 agenda for sustainable development*. Retrieved November 24, 2020, from. <https://www.government.se/government-policy/the-global-goals-and-the-2030-Agenda-for-sustainable-development/>.
- Tarekegne, B. (2020). Just electrification: Imagining the justice dimensions of energy access and addressing energy poverty. *Energy Research & Social Science*, 70(June), 101639. <https://doi.org/10.1016/j.erss.2020.101639>.
- Van Veelen, B., & Van Der Horst, D. (2018). What is energy democracy? Connecting social science energy. *Energy Research & Social Science*, 46, 19–28. <https://doi.org/10.1016/j.erss.2018.06.010>.
- Walker, G. (2008). What are the barriers and incentives for community-owned means of energy production and use? *Energy Policy*, 36(12), 4401–4405. <https://doi.org/10.1016/j.enpol.2008.09.032>.

- Warm in the Winter. (2021). Solvåg. Retrieved August 31, 2021, from company projects website: <https://www.warminthewinter.se/projekt/solvag>.
- Wilhite, H., & Wallenborn, G. (2013). Articulating the body in the theorizing of consumption. In *ECEEE summer study proceedings* (pp. 2221–2228).
- Wunderlich, F. M. (2008). Walking and rhythmicity: Sensing urban space. *Journal of Urban Design*, *13*(1), 125–139. <https://doi.org/10.1080/13574800701803472>.
- Xenakis, I., & Arnellos, A. (2013). The relation between interaction aesthetics and affordances. *Design Studies*, *34*(1), 57–73. <https://doi.org/10.1016/j.destud.2012.05.004>.