Blockchain Stories. Narrative and Speculative Experiments for Value Discovery

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ABSTRACT

Climate change poses an existential threat to society and requires sweeping changes in resource allocation and (re)use. "Community energy projects" are small-scale initiatives aiming for the production of renewable energy while also reducing energy consumption. As such, they may play a positive role in addressing climate change. The integrated design of technological infrastructures, reward, accounting & licensing systems, and interfaces to manage energy communities plays an important role in the ways these communities can operate successfully and reach their goals, yet, so far, HCI research has only dealt scarcely with them.

We propose that an approach based on Value-Sensitive Design (VSD) may be especially beneficial, as energy communities are designed around technologies and interfaces that are not neutral enablers but could bring out particular desired or undesirable outcomes. For instance, distributed ledger technologies (DLT) and the blockchain have been identified as promising tools for managing local community platforms. Yet these same technologies may also end up promoting undesirable practices, such as "tokenization." To line up the affordances of new technologies with the desires of a particular community, we discuss our efforts to perform "value discovery" through narrative speculation, in the context of energy communities. To do so, we describe the design and public performance of a game ("Peak Shaving Time") and a speculative short film ("Alexandra").

Author Keywords

Blockchain; the commons; value sensitive design; value discovery; speculation; design fiction; energy community.

CCS Concepts

• **Human-centered computing~Interaction design theory, concepts and paradigms**

INTRODUCTION

Climate change poses an existential threat to society and requires sweeping changes in resource allocation and (re)use. Among the behaviors to rethink, it is particularly urgent to address how to produce and consume material resources such as electricity or water. In this respect, some matters are in the hands of national governments and large corporations, but local communities can productively tackle some others. This paper is part of [Anonymized], a research initiative to co-design community infrastructures that facilitate the sharing of resources and the self-management of governance processes towards more sustainable local economies.

Sustainability [14,90,92], bottom-up organization [43,70], and critical perspectives on the "sharing economy" [35,53,84] have already been the subject of various studies in HCI. However, if we consider the challenge of designing socio-technical systems for communities aiming at the local self-production of resources, we hit a gap in design knowledge. To identify it, we need to consider two conflicting trends. On the one hand, emerging technologies such as the blockchain and distributed ledgers promise solutions for many community problems, including accountability and record-keeping. On the other one, we observe a critical distrust of algorithmic technologies applied to governance, all the more so for complex social contexts such as residential communities sharing resources in the commons [73,74]. We lack a nuanced understanding of the characteristics of such communities. Ultimately, we lack design principles to create platforms that empower people to share and self-manage a variety of resources in ways that are granular, scalable, and respectful of values and social norms. In sum, how to enable people to be good neighbors and, at the same time, have a positive effect on the environment through sustainable activities?

Value-sensitive design [45,47,48] could be an essential element for resolving these tensions. However, the social complexity of these situations, together with the fact that we do not yet have fully-realized examples of these types of community platforms, makes it very difficult to discover and extract shared values [59]. We contribute a speculative methodology and two experimental artifacts that we used to perform value discovery in this domain and to synthesize them into narrative vignettes. Our process enabled us to gather rich and nuanced experiential insights from this domain, even in the absence of an actual community platform to test, and we offer our contribution to designers

and researchers in this field in the hope of kickstarting more work on this socially urgent topic.

COMMUNITY ENERGY PROJECTS

"Community energy projects" are small-scale initiatives aiming at reducing energy consumption and regaining agency in production of renewable energy. Energy communities are quite diverse, and the issues they address range from generating electric power locally to promoting behavior-change and more efficient infrastructures [85]. The climate crisis is perhaps the largest threat to our society, and mitigations or solutions - if possible - are necessarily complex. Although far from being “quick fixes” for a very difficult issue, community energy initiatives may still play positive roles in addressing it. So far, HCI has engaged with them only scarcely and yet there is the potential to have multiple positive contributions. First, community projects require participants to be informed, motivated, connected and empowered to contribute towards common goals, and a variety of digital products can support these fundamental activities [22,26]. Furthermore, recent work in HCI has addressed the ways in which publics can (self)organize around matters of concern, and has offered socio-technical tools towards this goal [36,37]. Finally and more fundamentally, computation has an inherent environmental cost in terms of energy consumption and CO2 production [3,11,68,98], and engaging with energy projects might be an occasion for HCI to self-reflect on its own societal effects at large.

Value Sensitive Design (VSD), a “theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process” [47], might contribute to addressing this issue. We point at this framework for its nuanced conceptualization of how different stakeholders relate to artifacts: communities are often diverse in their composition, and carefully designed technological platforms may be the key to maintaining a common ground and a shared ethos. VSD is at the center of our contribution, which pertains using speculative and experiential vignettes as a form of value discovery. Before zooming into the values that we extracted and synthesized, let us first present some context that is relevant for our research. To do so, we follow Friedman et al.'s tripartite model [47]: we will touch upon “the commons” and circularity (conceptual exploration), motivations in communities (empirical exploration), and distributed ledgers (technical exploration).

The Commons and the Circular Economy

In what follows, we provide an overview of how “the commons” (a type of informal governance practices) and “circularity” (a form of resource regeneration and upcycling) are conceptualized in relation to energy communities. This overview is a synthesis of a broader “conceptual exploration” [47] that we conducted to understand some economic relationships and supporting/hindering factors in this domain.

Community energy projects are timely, relevant, and urgent initiatives that could potentially contribute to the fairer and more sustainable management of natural resources. Often, those focusing on micro-production of energy treat their resources and infrastructure as a commons. The commons is a concept rooted in economics, sociology, and ecology, and it initially indicated a collectively managed pasture where several shepherds brought their animals. Seminal works in this field [73] generalized the principle of the commons, and analyzed sustainable communities relying on collective initiatives not driven by self-interest [74], as typically depicted in market economies. Differently said, the commons is based on self-organized social practices to manage resources for collective benefit in fair, inclusive, sustainable, and accountable ways [73,74], and it shows a connection between effective private governance and small-scale cooperation.

Although the word "commons" referred originally to shared meadows, not all commons pertain to natural and tangible resources. For instance, other definitions (e.g., "commons 2.0" or "immaterial commons") address collectively produced knowledge or code, such as free software [10,58,76]. Open-source initiatives like the Linux kernel suggest that publicly observable reputational mechanisms could overcome the free-rider problem and generate cooperation in the production and maintenance of public goods [34,82,83]. Energy communities, instead, are primarily invested in "artificial material commons," which refer to complex systems using peer production to build a resource pool [22,26,94]. In other words, community members collectively manage human-made infrastructure (e.g., wind turbines or bioreactors, among many others) and produce tangible resources such as recycled wood pellets, methane gas, or natural fertilizer.

Many sustainable practices adopted by, among others, energy communities challenge linear production processes in which resources are extracted, used, and disposed of. "Circular economies," on the contrary, identify economic and social systems where raw materials are used and then "upcycled" (i.e., reused in different forms), to contrast the depletion of natural reserves and foster locally-integrated loops: using waste to generate energy locally or sewage to produce phosphate-based fertilizer are examples of circular processes. Some institutions, such as the European Commission, as well as NGOs and think tanks, notably the Ellen MacArthur Foundation in the U.K., are championing the idea of circularity. Much related research to-date has prioritized consumer expectations of product lifetimes [49,96], perception of circular processes and business models [24,67], repair and maintenance activities [2,52], and product design for circular behavior [77]. There is also an emerging line of research - for instance, Franquesa, Navarro, and Bustamante [41,42], as well as Balestrini, Rogers, and colleagues [7] - looking at the commons as an enabler of the circular economy.

What Motivates Community-members?

For community energy projects to have a concrete and positive impact on the numerous societal challenges that we face in these years, they should be able to run reliably and for the long term. This is an important objective that has not been reached yet, and whose solution is likely complex and multi-faceted. Some existing studies and meta-reviews address motivations to joining sustainable energy communities, but in-depth explorations and implications for design are still scarce. With an “empirical exploration” [47], we looked at existing literature, and we complemented it with a preliminary round of stakeholder interviews.

Some have examined the motivations driving participants to contribute to, among others, volunteering organizations, peer-to-peer systems, time-banks, and other related systems, including the energy communities discussed so far. Extracting data from interviews and surveys, many of these studies offer frameworks with motivations [21,32], psychological roots [12], motivational dimensions [51], and functions served [30]. For instance, Collom [32] identifies "Economic/Instrumental motivations" such as obtaining services or goods that one would not otherwise be able to afford, "Ideological/Value motivations" like creating a better society, "Social motivations" such as meeting new people, or "Altruistic motivations" like helping people in need. Similarly, Bellotti et al. [12] code their data with terms such as "Provide service to others" (psychological root: Empathy / Altruism) or "Reputation" (psychological root: Status / Power). In sum, it emerges that motivations for taking part to energy communities are in general quite diverse, and seem to be mostly socio-economical rather than tech-driven.

In addition to this literature study, we supported it with a preliminary round of interviews conducted with seven experts – from community-organizers in living labs for the circular economy, to architects building community infrastructures and design ethnographers interested in the “energy transition.” These were initial activities that we organized to sensitize our research team, and yet they align with a growing body of work [27,29,40,66,91] that is skeptical of purely tech-driven solutions in this problem space. Practical design principles for governing the commons in community projects would be highly desirable, as they could be used to (co)design shared systems to tackle issues like overconsumption, unsustainable practices, or the unjust distribution of resources. It is not only a matter of developing the "right" technology but of having nuanced insights into what motivates participants to engage with sustainable community projects in the long term. We hypothesize that making “transparent” the values in a community might be a positive step in that direction.

Distributed Ledger Technologies

Finally, we turn to a "technical exploration" [47] examining distributed ledger technologies (DLT) and the blockchain, which have been hypothesized "to have deep social, technological, economic, environmental, legal and policy impacts over the next 10-15 years, from potential changes in commercial and financial models towards decentralised exchanges of assets and values, to the possibility of more inclusive, convivial, ethical, transparent or accountable digital societies" [39]. There is clearly a tension emerging here: our empirical exploration suggests a certain distrust for technological solutionism, and yet we notice DLTs being proposed as a basis for community platforms.

Zheng et al. [101] describe the key characteristics of blockchain as being decentralized (i.e., a transaction in the blockchain network can be conducted between any two peers without the authentication by a central agency), persistent (i.e., as nodes validate the data, falsifications are detected easily), anonymous (i.e., users can interact with the blockchain network with a generated address), and auditable (i.e., as each transaction is validated and recorded with a timestamp, the data is traceable and transparent). A blockchain is a distributed database with a growing list of data records that are confirmed by the nodes participating in a network [99]. When a transaction takes place, peer nodes validate it, and the data is recorded on a public ledger. Once all nodes have approved the data, the public ledger cannot be modified or deleted [71]. The “blocks” store a set of transactions of digital assets [78], and a blockchain grows with each additional block, becoming a complete ledger of all transactions carried out within the system [71].

These characteristics have initially supported cryptocurrencies, primarily Bitcoin, but the worth and significance of the blockchain do not depend upon their commercial success [63]. Instead, the blockchain is better understood as a new “general purpose technology” [55] in the form of a transparent, resilient, and efficient public record keeping. It can be applied to a wide variety of circumstances in which a community of players — whether in markets or commons — want reliable systems to manage their interrelationships on network platforms [75,76]. Because of its decentralized management of consensus, the blockchain routes around many of the challenges that typically arise with distributed forms of organization— issues such as how to cooperate, scale and collectively invest in shared resources and infrastructures [72]. Furthermore, DLTs may execute algorithmic rules ("smart contracts") following specific conditions and are capable of automatically processing data and transactions. For these reasons, they are regarded as promising for administering, managing and governing complex socio-economic systems.

In sum, the blockchain is moving away from being exclusively a financial instrument, and various researchers identify it as a general-purpose technology. Nevertheless, a measure of skepticism for technology-driven solutions remains, and it ultimately motivates our research. Embracing technologies such as DLT to build a community platform may motivate contributions through incentives and accountability, but it could also be counter-productive and undermine social cohesion. It is reasonable to expect that

participants to local initiatives understand and perceive the value produced, but are DLTs adequate to express it?

Dilemmas in Designing for Energy Communities

Having considered these conceptual, empirical, and technical explorations [47], the complexity of designing for energy communities that last in the long-term emerges clearly. The tension between human motivations (e.g., joining a community project because one wants to learn new skills and meet like-minded people [12]) and the affordances of the technologies that are supposed to enable these communities (e.g., the tendency of DLTs to flatten all transactions into exchanges of assets) seem to be in conflict. Designing for community platforms, as a general application domain, seems to share many commonalities with wicked problems, with no clear stopping point, where attempts to address one aspect of the problem may reveal or create other issues [23,25]. For instance, how much emphasis should a community platform give to the underlying economic value of the resources (e.g., solar power) that are collectively produced? Should participants be somehow "ranked" according to their contributions, expertise, seniority?... Should individual contributions be assigned a monetary value? Or should a community set up an alternative economy exchanging contributions for tokens and other non-monetary incentives (e.g., free coffee)?

We launched Project [Anonymized] 2018 in [anon. country] to investigate and test design principles for local digital platforms for community projects and circular economies. [Anonymized] is currently ongoing, and is engaging multiple communities from the [anon. location] region in a long-term co-design effort. Through an extensive conceptual exploration, [Anonymized] identified six "design dilemmas" that characterize designing technological intervention for community projects related to energy and the commons [reference anonymized].

These dilemmas are not so much binary options but instead ends of continua, and each community would have its preferences. **"Transparency vs. Privacy"** expresses the tension between the need to share one's data to be publicly accountable, and the desire to keep certain aspects private. **"Economic value vs. Social value"** refers to "tokenization" (e.g., assigning monetary value to goods or services), as opposed to giving other forms of value (i.e., being a good neighbor, a good citizen...). **"Quantified vs. Qualified values"** points at a tension between hierarchical/rigid social structures and more flexible or informal relations. **"Incentivisation vs. Manipulation"** expresses a conflict between being given tangible rewards and the possible negative effects, such as peer pressure. **"Private vs. Collective Interests"** points at the tension between pursuing one's own benefits and sharing them with the community. Finally, **"Human vs. Algorithmic Governance"** refers to who/what enforces the community's rule, and to how flexible are the algorithms that enact them. We understand that these continua are not universally solvable, but can be reconciled only for specific cases by finding a balance between conflicting values: different types of resources or circumstances would call for different answers.

VALUE DISCOVERY FOR DESIGN DILEMMAS

There is a fundamental tension between, on one side, the human needs and motivation for contributing to an energy community and, on the other, some negative consequences of the technologies potentially used in community platforms. For instance, systems for the circular economy could 'commodify' (i.e., assign a monetary value) individual contributions by measuring them at the micro-level and allowing users to exchange them for other objects of value. Of course, this could motivate contributions, but it could also be counter-productive and undermine social cohesion, as it brings formerly informal transaction in the social domain into a formal economic one [33]. Another related question touches upon who should take precedence in a local energy system if the solar panels are not running at full efficiency, and multiple users wish to do something energy-consuming like running a dishwasher. What criteria could the system apply? What underlying values can such platforms be based on, and what scenarios are conceivable and desirable? A second relevant point pertains to how to make the underlying values visible in the design of a platform. For potential users to take part in local initiatives, they must understand and perceive their value. To this end, it is essential that platforms communicate what value is produced (e.g., electric power), and how it is allocated and used by whom.

All this motivates us to leverage VSD for its ability of producing a nuanced understanding of stakeholders and their relationships. In this vein, we follow Le Dantec et al. [59] as they propose to “discover values,” or extract by engaging with stakeholders, rather than leveraging a known list [44,45,48]. They write, “We believe that […] value sensitivity is a commitment to an on-going reclassification [that] comes as a direct result of a more proactive engagement in value discovery, defamiliarization, and a reorientation toward values as they are lived in situ” [59].

How to probe for how these values are "lived in situ" remains an open question. To this end, we propose that a speculative approach can support researchers in extracting, synthesizing, and analyzing insights from community members. Concerning VSD, we offer it as a way of performing value discovery [59] that leverages narrative speculation and invites stakeholders to envision a variety of experiential scenarios and react to them. In what follows, first, we touch upon a technological domain we engage with (distributed ledger technologies), then we discuss the theoretical background for speculative and fiction-based methodologies.

Speculation, Design Fiction, and Experiential Vignettes

Abundant research exists in HCI and on speculation and fiction. However, we see a less-explored space of opportunity at the intersection of speculative/fiction-based research, value discovery for VSD, and the application

domain of community energy projects. This is where we situate our threefold contribution: we leverage different forms of narratives (an interactive story/game, and a design fiction film) to produce vignettes that are socially and culturally situated, and playful. In what follows, we briefly elaborate on the differences between existing approaches and ours. In what follows, we touch upon speculation and fiction, before detailing some characteristics and benefits of an experiential contribution.

Design researchers adopt speculative methodologies more and more frequently, and in a wide variety of material forms and scales. In the lively panorama of current speculative research in HCI, we find numerous points of contacts between our initiative and Blythe's works [15–17,20], especially for his use of story structures as tools for externalizing design ideas and construct arguments. Speculation may point at how current "socio-technical environments will develop, what new ones will emerge, enabling us to reason about what to design, what not to design and how to design" [81]. From home appliances with human emotions [80] to bioengineered animals for cleaning the city [31] and wearable technologies to share information by looking into each other's eyes [6], several thought experiments have been conducted to produce design insights without materializing a fully-developed and entirely plausible artifact. Lukens and DiSalvo [62] consider it an exploration of the space between culture, technology, and the designed environment. Bardzell and Bardzell [8] examine how "cognitive speculation," hypothetical elements grounded in rigorous science, may be applied to design to provide insights on "(a) what technologies and lived environments might characterize the future and also (b) what it would be like to live in such a world" [8].

Resonating with speculative approaches, also the notions of fiction and narrative are gaining relevance in design research: for instance, Tanenbaum [88] points out how "situating a new technology within a narrative forces us to grapple with questions of ethics, values, and social perspectives." Design fiction emerges from the intertwining of a speculative context and a fictional storyline, and have been described as "a recent manifestation of speculative design practice which overlaps with practices such as critical design or visionary or futuristic forms of architecture" [62] and "a way of materializing ideas and speculations" [13]. Design fictions are "the deliberate use of diegetic prototypes to suspend disbelief about change. […] The important word there is diegetic. It means you're thinking very seriously about potential objects and services and trying to get people to concentrate on those rather than entire worlds or political trends or geopolitical strategies. It's not a kind of fiction. It's a kind of design" [87]. Shortly after its first appearance in the academic discourse, design fiction has been rapidly and enthusiastically adopted by HCI researchers [4,9,15,50,61,62,89,92,93] and is gaining popularity as a generative method to "remove the constraints from the commercial sector that define normative design processes" [4], as a way for designers to access inner felt life aspects of user experience [19], or to facilitate co-design workshops [64].

For what pertains to experiential approaches to value discovery, we aim to access rich qualitative experiential data instead of broader corpora derived from interviews. Indeed, existing methods in this domain (from Le Dantec et al. [59] to Yoo et al. [100] and Chivukula et al. [28]) start from data collected through photo-elicitation, scenarios and ethicography, a type of linguistic coding. Differently, we construct "experiential vignettes," thus aiming to access more introspective and emotional insights. For the second point, in relation to social and context situatedness, we differ from Friedman et al. [45,48] as they ground their methodology on an *a priori* list of human values of ethical relevance (such as ownership, privacy, accountability...) that is not context-sensitive. Instead, our speculative approach addresses respondents from specific communities and empowers them to speculate referring particularly to their shared socio-cultural milieu. Thirdly and lastly, several data-collection methods used in other value discovery efforts [28,46,59,69,97] often take place in somewhat "institutional" locations, such as meeting rooms or workshop rooms. On the opposite, our proposed way of working aims at introducing a degree of spontaneous open-ended to the respondents' experience, making it more playful and, hopefully, less intimidating.

ARTIFACTS AND METHODOLOGY

In this paragraph, we describe Peak Shaving Time and Alexandra, two artifacts/experiments we used to "think through" some of the dilemmas, and to discover significant values from the communities that interacted with them. Then, we touch upon the methodology we followed in our study.

Peak Shaving Time

Peak Shaving Time (PST) is a "debate game" set in the near future, casting four players as residents of "De Harmonie," a fictional residential community. It aims to tease out attitudes and approaches toward negotiating shared resources, as part of the circular economy. People living in De Harmonie take part in a community energy project. They rely on an algorithmic system with a smart grid routing electricity to/from the various apartments and solar panels, and a distributed ledger that records their transactions (e.g., how much power is generated, how much is routed to the grid, how much is bought from external providers). The game is set in a moment when De Harmonie's power grid is under "Peak Shaving Time," a term that indicates that the system is under heavy load. In the past, this term only applied to public energy grids but, with the emergence of smart grids or private energy systems, private communities must address how to track, manage, and negotiate energy-saving behaviors. Additionally, third-party software linked to a smart grid can provide residents with real-time updates, including weather predictions, or fluctuations in the energy market: these

updates can help make decisions about how/when to either spend or save energy. These new technologies bring along with them many complex issues, including tensions between individual and collective decision-making, and between privacy and transparency. Additionally, residents may at some point want to 'opt-out' of agreements – how are these instances addressed, and governed?

Designing PST, we opted to remain as realistic as possible for what pertains to various mechanisms with which De Harmonie's protocols might encourage energy savings, while at the same time representing consumption in a slightly surreal/offbeat way. Players on stage receive large, brightly-colored shavers of cheap quality, chosen for their loud buzzing sound, and turning them on or off symbolizes drawing (or not) power from the shared grid – inspired in part by [79]. In some circumstances, De Harmonie's algorithm would also arbitrarily cut off power to a unit, and this was represented by the shaver suddenly turning off on its own. PST is designed to include also the general audience into the play activity: they were divided into pairs to promote discussion and received green/red signs to answer yes/no to questions posed by the game master.

Alexandra

Alexandra is a design fiction film [86] that explores the implications of algorithmic governance applied to mundane activities in communal domestic spaces. The short film takes its title from Alexandra, the main character, a humanoid representation of a decentralized autonomous organization (DAO), based on smart contracts and running on a distributed ledger. In the film's story-world, Alexandra is implemented in a household shared by two flat-mates Daniel and Vincent, and the plot explores and deconstructs the power relation between humans and the algorithms set up to govern a resource in the commons. The film explores Alexandra's functionality through drama and stylistic devices. She controls the electrical energy in their household, and she distributes it between them based on their contributions to the shared household, such as taking out the trash, cooking for both of them, or cleaning the apartment.

Alexandra keeps track of Daniel and Vincent's domestic contributions and energy usage and makes sure that they are perfectly balanced. Her programming allows exceptions to be set only if both users explicitly agree, and this is the primary plot device driving the story. In the first scene, Alexandra reminds Daniel that he is not contributing as much as Vincent. He objects that he has been sick recently, and Vincent agrees to allow an exception in the system: we see Alexandra close her eye and some lines of pseudocode appear on screen ("SYSTEM FRIENDSHIP MODEL RULE 9: If Daniel's workload equals, or is below, Vincent's workload, Daniel and Vincent can use an equal amount of electricity in the household."). The two residents, then, decide to revoke the exception as Daniel's health improves but, in the final scene, we see the lights in Daniel's room go off as he prepares for an exam because he has once again fallen behind in his chores and Vincent is not awake to agree to an exception. Daniel reacts by grabbing Alexandra's notebook from her hand and throwing it away, which causes the lights to go dark in the whole apartment, to which he says "I'm sorry." In the closing shot, we see the apartment lit once again, while Alexandra walks on a street, lights a cigarette, and logs herself off from Daniel and Vincent's apartment.

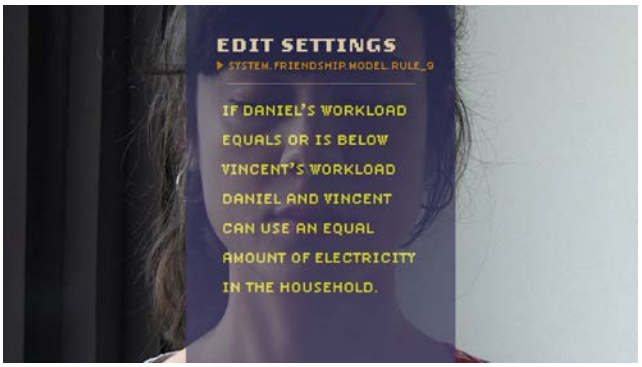

Figure 1. Alexandra changing the parameters of her algorithm

Methodology

The methodology we followed is manifold. Here we touch upon how the artifacts were designed, how we exhibited, which insights were collected and how, and how did we generate speculative vignettes to "think through" our data and discover values.

To reconstruct retrospectively our design work, we reflected on the iterative process of ideation, creation, and refinement that led us to materialize PST and Alexandra, and we used as primary data a collection of minutes from meetings and workshops, initial sketches, design diaries, and annotated intermediate results. These were archived throughout our design process, and organized and coded meeting after meeting. They include written accounts of work sessions, diagrams and sketches, as well as the conceptual, empirical, and technical explorations that we discussed above.

We now turn to how PST and Alexandra were exhibited (or played, or screened, as we recognize that these artifacts and their uses resist easy categorizations). First, we underline some commonalities between the two, and later we detail the differences. Since PST and Alexandra belong to different genres and prompt different modes of interaction, also the methodology we followed to capture and analyze insights from their public performance is also different. All the events that we organized to exhibit our experiments were free to attend and open to the public, hosted in venues in [city anonymized]. Most interactions took place in English or, secondarily, in [lang. Anonymized] and translated later. Part of the research team observed the attendees interacting naturally with the artifacts, while other researchers took more active roles in the two performances (for PST: leading the game; for Alexandra: introducing the screening and leading the role-playing activity). We collected data by note-taking, retrospective recollection, and audio/visual recording.

Figure 2. Peak Shaving Time at [anonymized]

PST was performed twice, at the [anonymized] festival (an open event about urban design, place-making, and civic participation) and at [anonymized], a cultural institution known for organizing events related to the circular economy. Both locations are well-known and significant for the public who attended the events, attracting participants invested in the themes discussed. PST took place in an auditorium-like room, with a projector, sound system, a stage with four chairs, plus many others for the audience. On the stage, four electrical shavers - cheap everyday models suitable for cutting one's hair or beard - were connected to a power strip, with switches so that they could be turned off remotely. One researcher played the role of the "game master" and invited four volunteers to come on stage to play. Behind the game master, a large screen was set up to show "in-game messages." Likewise, an audio system with speech synthesis broadcasted in-game messages to the participants.

Figure 3. Alexandra at [anonymized]

Alexandra was screened/exhibited in the spaces of [anonymized], a living lab and cultural center engaged in sustainability and circularity. The room was set up to accommodate a film screening (video equipment, chairs for the audience). Furthermore, we introduced more props and instructions to facilitate role-play activities. Participants were told that the screening would take place within the context of an "interactive performance," where all attendees would role-play the residents of an apartment complex from 2050, selected to participate in the beta testing of a new product. Within this narrative frame, the game masters played the roles of researchers/salespeople from the fictional "Alexandra corp," owner and developer of the speculative technology presented in the film. Indeed, the design fiction film was diegetically introduced as an orientation video and documentary, and the following discussion as an interview to decide whether the players were willing to set up an Alexandra system in their (fictional) apartment building.

Creating speculative vignettes was the last step in our research process. To this end, we collected all the insights from the previous experiments, clustered, and organized them. We also analyzed the two artifacts, with inspiration also from game studies and playful interactions in HCI [1,18] (for what pertains PST), and analytical tools – such as "diegesis" – originating in media studies [56] (for Alexandra). As a way of "thinking through" these outcomes, we connected them in a speculative storyline, forming eight narrative vignettes [95] that we present to convey out findings and, at the same time, to give a more experiential and life-like account of what could it feel like to interact first-hand with a variety of algorithmic technologies for energy communities. From these vignettes, we loop back to value discovery, and we isolate a number of values that are pertinent for the communities we engage with.

EXHIBITING PEAK SHAVING TIME AND ALEXANDRA

We will now describe some key features of the experience of interacting with PST and Alexandra.

PST lasted approximately an hour, and consisted of a series of predetermined events, each requiring players to choose whether to draw power from the communal grid and whether they accept the proposed incentives to save electricity. Each event was announced by De Harmonie's system, speaking in a synthesized computer voice, and by an email shown on the screen. In general, each prompt included a request for the community to lower their consumption, and either an arbitrary event happens (e.g., a unit is forcefully throttled down and given less power) or an incentive is proposed (e.g., a resident might receive a badge on the public leaderboard). The game master interviewed the players on stage, asking to think aloud as they reflect on their possible choice. Afterward, the questions were turned to the public, which was asked to comment on the strategies enacted by the players on stage, with the facilitation of the game master. Each player was assigned a character, all having a seemingly urgent reason to shave: for instance, one feels better when s/he is clean-shaven; another finally has a romantic date after many years or an upcoming job interview.

What follows is a sample of the various PST prompts:

- *"The current demand for power is exceptionally high. To meet our energy goals, unfortunately, we must interrupt the power supply to a number of households. One of your households has been*

selected today, on the basis of your user profile and recent activity."

- *"The current demand for energy is extremely high. To meet our energy goals, we can only guarantee power to a select number of households. The community may decide which household receives priority."*
- *"The current demand for energy remains high. The household that voluntarily waives power for the next half hour will receive a 'master energy saver' badge attached to their digital profile, as a reward."*
- *"The current demand for energy remains exceptionally high. The household that voluntarily waives power for the next half hour will receive five Harmonie-coins as a reward. These may be traded for services, for example free babysitting or window washing."*
- *"Because of unpredictably warm weather, the alpaca in the petting zoo De Farmonie must be shaved again. Which household would like to donate their power?"*

Figure 3. PST played at [anonymized]

The first screening of the Alexandra film was embedded in a larger interactive live performance, inspired in part to "speculative enactments" [38,93] and other fiction-based methods drawing from "live-action role-playing games" (LARP) [5,54,65]. Participants were welcomed, informed about the study, and told that they would take part in an orientation meeting about the possibility of installing an Alexandra in their apartment complex. Within the fiction of the performance, players were there to know more about the Alexandra system, to address worries/curiosities they might have, to decide whether they want it or not, and which conditions they would like to program into their system.

In the course of the performance, the short film was screened as if it was a documentary piece about the deployment of an early Alexandra prototype. Afterward, the general discussion was facilitated by the game masters/moderators by touching upon the following topics:

- *"Having seen the film, is Alexandra's functioning understandable? Could you be able to explain the rationale for her decisions?"*
- *"would a system like Alexandra be useful and desirable? What could the purpose of such an artifact be? Could anyone imagine a scenario in which an Alexandra could improve the experience of living in a community, at the scale of a residential complex, or of a single household?"*
- *"if you were to install an Alexandra in your building or your apartment, what common resource (e.g., electric power, water, waste production and recycling) would you like her to manage?"*
- *"if you were to install an Alexandra, would there be any off-limits parts? Would there be physical locations, or moments of the day, where she would not be allowed to intervene?"*

Finally, players/participants were given a chance to record a video-message to Alexandra's development team within the fictional world, or perhaps to Alexandra herself.

THINKING THROUGH SPECULATIVE VIGNETTES

To make the insights from the various experiments and exhibitions/workshop we organized more experientially rich, we turn to a series of narrative vignettes set in the fictional community "De Harmonie." What follows are micro-scenarios developed from insights collected through the PST and Alexandra experiments, and elaborated by the authors as an alternative way of discovering and synthesizing human values emerging from our explorations [59]. For each snippet, we propose a value [45,48]. After having presented the vignettes, we will tie together all the strands of our elaboration into a synthetic view.

Speculative Visions of De Harmonie

All the following vignettes contain from qualitative insights gathered by playing/exhibiting PST and Alexandra. We chose to experiment with synthesizing our findings in stories rather than in schemas or diagrams as a way to capture the nuanced "felt experience" imagined by our participants.

Conversation overheard in the shared kitchen. "First time here?" He nodded. "We'll get you sorted out in no time," said the speaker on the countertop. "I am the first-use introduction agent, there are a few points I need to verify. Is it OK if I ask some questions?" "Yes, it's OK." "What is your apartment number?" "I'm at 4B." "Is your name Casey Burke?" "No, Marc Blanc" "Marc Blanc, are you a temporary visitor?" "Yes." "Marc, welcome. Put your key fob on the table, I need to activate your guest account. Please don't move the fob until it stops blinking. Your ledger is now activated."

"This is the short introduction clip. Feel free to say Pause or Repeat anytime. This welcome agent follows the same privacy rules you have already accepted when you joined the community grid. De Harmonie is a collective that believes in leaving the planet in a better state than we found it. This is why we commit not to use more energy than we produce.

The light on the stovetop is glowing red: this means that now your methane allowance is not sufficient to cook here. You can increase it by depositing flour-based waste, like stale bread, in the biodigester in basement 3-1. Use your key fob or enter your pin code to have your deposit recorded in your ledger. Otherwise, you may use your Harmonie-coins to purchase a share of the collective methane production. The daily conversion rates are posted on the bulletin board." **Value:** Pragmatism.

From a handwritten message posted near the main gate: "Dear neighbors, next Friday night we'll have some friends over. Katja has passed her last exam, and this calls for a party. We promise to stop the music at 1. Everyone's invited. No need to chip in with Harmonie-coins but, if you feel like to bring an off-ledger gift, cold beers would be very welcome!!!" **Value:** Social care.

From a message sent to the internal bulletin board: "Hi everyone, sorry to bother you again. I think I managed to speak with all of you in person, but I thought I'd also write this mail to have it all in writing. I really think we should tweak the algorithm for the "good neighbor" rewards: now it's not really working. I don't care much to receive a percent of an Harmonie-coin every time I pick up a package for someone, I just think that's the right thing to do, it just feels awkward to be paid. On the other hand, I don't know if you've heard that someone is having troubles finding freelance work these days (I won't say who, it's not my business!)... What do you think, would everyone be OK with giving a discount on the monthly expenses to someone who's going through hard times? Let's talk about it in the next general assembly, and if we agree I can draft the new governance algorithm (remember to bring your key fob to vote!!!). Kisses, Maria" **Values:** Social care, Innovation.

From the leaderboard in the shared elevator: "Water usage. Apartment 1 (3 people): 399 liters. Apartment 2 (2 people, 1 dog): 251. Apartment 3 (1 person): 16 liters. Apartment 4 (5 people): 503 liters. Apartment 5 (2 people, 2 dogs): 272 liters. Apartment 6 (3 people): 960 liters. Apartment 7 (2 people): 208 liters. Shared garden (includes koi pond): 435 liters. Common areas: 87 liters. Community cafe: 2314 liters. CONGRATULATIONS TO KLAUS / APT. 3 - New water saving record!" **Value:** Identity.

From a post-it note next to the leaderboard: "Klaus stinks." **Value:** Identity.

Conversation overheard in the hallway: "Hey, is it a good moment?" "Yeah, sure." "I really don't like to sort of barge into your apartment like this, but the grid throttled power to my unit and I'm cooking..." "Ah, that's so annoying, can I help you?" "Yes, actually I was wondering if I could use your oven for a little bit. I've a trout filet in mine, but I can't push it to one-eighty degrees with my battery allowance..." "Wait, you want to bring your food into my oven?" "If it's not a problem..." "No worries, but maybe it's smarter if I transfer some energy from my battery to yours, I think I've enough." "Oh wow I didn't know it was possible." "Yeah, sure, just tell me again what's your ledger number and I'll do the transfer right now." **Values:** Pragmatism, Social care.

From a classified ad: "Sublet, 1 room, shared apartment, De Harmonie. The unit is a 3BR, 2BA, extreme energy efficiency. The other cool people living there are two tech-enthusiasts in the creative sector. We are saving the planet, and we're doing it with smart technologies. Future flatmates must agree to pre-emptive data-driven algorithmic optimization of energy consumption (the unit is running Alexandra 0.971b). Don't miss out, call now!" **Value:** Identity.

From the minutes of the bi-monthly residents' assembly: "In the last year, the smart grid's programming has been running mostly fine, although there were some isolated incidents. On 17 January, the battery pack of apartment 4 fell below 20% and had to be taken offline and recharged separately. Sam called maintenance, they say that the fault is probably due to incompatible conditions that he set into the customized smart contract running on his unit. The unit was restored to its factory defaults, and all custom programming wiped. Sam raises the point that he should be able to run complex rules on his unit. He proposes that the maintenance contract is terminated and all the computing modules upgraded. Discussion follows. The assembly votes against Sam's proposal for the time being. The assembly also decides to organize a refresher workshop on smart contract programming, to be held on 12 March in the common room." **Value:** Innovation.

Explaining Values through Narratives

Having presented some of the vignettes produced by elaborating on the insights that we collected through PST and Alexandra, let us tie together all the strands of our exploration and examine the values emerging through our experiments.

The value of pragmatism emerged from our participants' interaction with PST and Alexandra, as they commented positively on the need of making things work, of having procedures and systems that are well functioning, and of – to a certain extent – thriving in less-than-optimal situations. We chose to express this value in the vignettes "shared kitchen" and "hallway," representing situations in which both the technical infrastructure of the energy community and its inhabitants are in some way successful in reaching their immediate goals.

People participating to our exhibitions and presentations often expressed the value of social care when they imagined situations in which community-members look out for one another in an altruistic manner. This was often combined with a stated preference for non-monetary rewards, especially in terms of being a good neighbor, or doing the right thing, caring for fellow residents… We decided to visualize this value in the vignettes "Katja," "bulletin board,"

and “hallway.” These micro-narratives have in common the fact that characters support one another in certain activities.

The value of identity express the wish to emphasize one’s way of being, which public image is projected, and the effort that is put in constructing or maintaining it. Our participants commented often that taking part to sustainable or circular initiatives can sometimes be framed as “cool” and socially desirable, with the unintended consequence of turning it in a lifestyle that could sometimes be perceived as shallow. We decided to embed this value in the vignettes “leaderboard,” “note next to the leaderboard,” and “classified ad,” all of which deal with the construction of a positive (or negative, in Klaus’ case) image of certain community-members.

Finally, the value of innovation has often been expressed by our participants in terms of being future-looking and open to trying out new things. In some cases, being innovative was explained as the wish to tinker and experiment with an open mind and without a particular goal. In some other, participants referred to specific objectives to reach in the future. We chose to represent this value in the vignettes “bulletin board” and “residents’ assembly,” both proposing a plan to change the current state of things.

LIMITATIONS

Our study has produced results in the form of values discovered and synthesized from a quantity of interactions with community stakeholders and also, more broadly, of a more nuanced understanding of the possible experience of living in an energy community using a (not existing to date) blockchain-based platform to manage common resources. These results have been generative for us, inasmuch they have shaped our understanding and supported our ongoing design explorations, but it is also important to recognize and highlight some limitations of our approach.

First, the exhibitions and interactive performances of PST and Alexandra were expressly set up outside of a controlled lab space: this posed clear limitations to our capability of collecting comprehensive data from the whole audience. On the other hand, replicating the same experiences in a laboratory would have made them much less spontaneous, arguably intimidating our participants and making their qualitative contributions less rich. Second, the speculative/fictional vignettes were produced by extrapolating from our field-observations during the exhibitions, in a way that is not dissimilar from clustering qualitative data into an affinity diagram. This, together with transforming them into self-contained micro-narratives, is of course a subjective elaboration. On the other hand, we make no claim of quantitative objectivity: instead, it is exactly the subjective experience that we are looking for. Finally, producing a series of narrative vignettes is not per se a step towards designing more stable and better functioning energy community. However, we must remember that our contribution is clearly situated in a broader methodology (complementing VSD with value discovery exercises) and that is situated in a longer research trajectory.

CONCLUSIONS

As an application domain, the design of socio-technical HCI infrastructure for bottom-up initiatives and self-organizing communities invested in sustainable environmental practices is still understudied. This is not just an academic issue, but also a concrete and environmental one because community energy projects may offer concrete benefits against climate change and the depletion of natural resources. It is in this urgent domain that our study, and [Anonymized] as a whole, are situated.

Specifically, we pointed at the need for a more nuanced understanding of stakeholders' needs, desires, and dispositions concerning platforms to manage small communities and their resources in the commons. DLTs, the blockchain, and similar systems promise tech-centric solutions in this domain. However, applying them is not always easy or desirable, and each community is unique its characteristics. For these reasons, we argue that leveraging VSD (for its ability to produce significant stakeholder mappings) and value discovery (to tailor designs specifically to a community) is highly beneficial. To this end, our contribution has been to demonstrate a methodology that combines speculation and fiction with experimental artifacts, as a way to engage participants and collect rich experiential vignettes. As we do so, we complement the design dilemmas mapped out in [ref. anonymized], and we add a further piece in a methodology for designing for community energy projects.

In conclusion, we are aware that our results so far are merely a piece of a large and complicated puzzle, and that also other types of design methods will likely need to be re-thought in the context of community energy projects. For this reason, this is not the conclusion of our research trajectory but just an intermediate step, and we invite the HCI community to join us in examining this urgent societal problem space.

ACKNOWLEDGMENTS

With support from Anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized

Peak Shaving Time was made possible by anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized

Alexandra was made possible by anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized anonymized

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