Reclaiming Post-growth Energy Communities: Tensions in AI Systems Design

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1 ENERGY COMMUNITIES AS POST-GROWTH INITIATIVES

The unsustainable production and consumption of energy have immense consequences for our planet [1]. To combat this, political entities have started to explore alternative ways of organizing energy systems – one example is **energy communities**, embraced by the European Union [3]. In energy communities, citizens and institutions collectively produce and consume energy locally and independent of grid companies. Energy communities share commonalities with central ideas of post-growth [14] through a focus on commons-based ownership of local energy. The commons-based ownership is envisioned to foster new relationships with energy outside of its material use in domestic contexts, sharing of expertise, involvement of citizens in sustainable transitions, and energy savings [12].

The real-world implementation of energy communities uses AI systems to automate energy storage and distribution [11, 16], including eco-feedback displays (figures 1 and 2) to inform citizens about energy situations in the community [5]. In this paper, we analyze an example energy community AI system by turning to the energy community value framework by Jensen and Jensen [7] to reveal tensions between AI systems' socio-technical manifestations of energy community values and the post-growth ideals of energy communities.

2 ENERGY COMMUNITY ARTIFACTS

As described, energy community AI systems can be divided into two main types. Back-end algorithms control the distribution and process energy data into meaningful information about the energy community, while front-end eco-feedback systems are used to display this information for energy management in the community [4].

Energy community algorithms. We focus on the algorithmic system proposed by Zhu et al. [16], which follows many trends in AI systems for energy communities. This system predicts the energy consumption and solar energy production of homes in a community. Based on these predictions, algorithms match homes that produce excess energy with homes in energy deficits and schedule energy transmissions to minimize energy loss [16].

Public eco-feedback systems. These systems represent the go-to way of displaying energy data in an energy community system's front-end (see figure 1 and 2). Figure 1 shows a public eco-feedback display at a burgeoning energy community's train station, displaying current and historical energy production from the train station's solar cells. Figure 2 shows a

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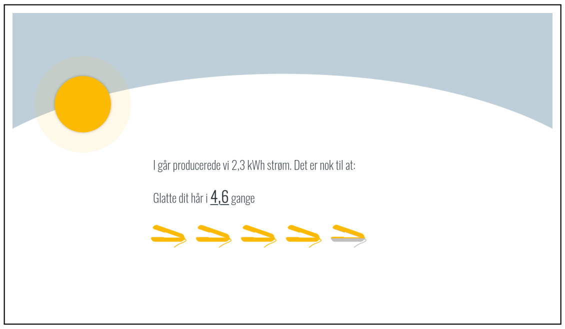
Fig. 1. Eco-feedback display at a train station in a Danish energy community.



I går producerede vi 2,3 kWh strøm. Det er nok til at:

Glatte dit hår i 4,6 gange

Fig. 2. Eco-feedback display designed for a high school in a Danish energy community.

public eco-feedback display prototype for the same energy community, wherein the local high school had implemented solar cells. The text on the display of figure 2 compares the energy production of the school's solar cells to the energy consumed by a hair straightener.

3 POST-GROWTH TENSIONS IN AI-SUPPORTED ENERGY COMMUNITIES

In this section, we draw on the principles of post-growth [14] and the energy community values framework [7] to discuss the tensions that arise in the design and use of AI systems in energy communities.

Equal Ownership of Energy. The back-end of AI systems in energy communities uses algorithmic energy distribution (section 2) to maintain a reliable energy distribution compliant with rules fixed in algorithms. Sustainability as a value is promoted through the transmission of self-produced solar energy for economic gains [7]. Further, procedural justice is enacted through "intra-community collaboration" [7, p. 5], where community members share their energy to benefit their own community.

While AI systems' algorithmic energy distribution is clearly a relevant avenue for fostering energy community values, this also poses a central tension. Energy communities have rich local histories built around an existing urban area [7], and such histories should be recognized as defining the circumstances of an energy community. However, AI systems' algorithms do seemingly not recognize a specific history in a community, but instead see all citizens' contributions and deficits as equal in all energy communities (e.g., [16]). But what if we had to recognize a "community's historical inequalities" [7, p. 6]? We believe this is central to ensure truly commons-based ownership of energy, where all citizens feel connected to and accountable for energy, despite their many differences.

Reimagining Data in Energy communities. The eco-feedback displays described in section 2 aim to foster data transparency and allow citizens to participate in the energy community [7]. Further, as the eco-feedback display in figure 2 is designed to be placed inside a high school, this can build students' competencies related to energy. This placement may also build a communal culture around communal energy data where students "take ownership" [7, p. 4] of energy transitions. AI systems' representation of energy data is central to building procedural justice.

Eco-feedback systems are imagined to be central in embodying these energy data; however, through principles such as comparison and optimization with regards to price, these technologies might both appeal to and legitimize growth-oriented energy actions, e.g., consuming increased energy due to recent energy production of solar cells. As this persists, energy communities are limited in their ability to foster simpler, less intensive living conditions [14], which must become a design consideration. We need to move beyond the growth-oriented manipulation and representation of energy. Researchers have previously provided insights about how to reimagine environmental data through principles of tangibility [13], engagement [10], and design games [6]. Energy communities encompass a large number of very diverse people with varying competencies, abilities, and motivations to understand the data that flows within the community. We believe that a first step is to find new ways of using data in energy community systems, which enable people to act toward not just energy consumption but *energy tranquility*.

Moving on from Capitalist Markets. All AI system elements described in section 2 in some way focus on the current capitalist nature of energy markets. Comparing energy consumption to monetary gains and losses is expected to enable data transparency and participation through eco-feedback, while optimizing for monetary gains can foster economic sustainability by distributing profits to the energy community [7].

The idea of reducing involvement in capitalist markets is central to the post-growth mindset [14] and also central in energy communities, but energy community citizens may inadvertently come to participate in capitalist energy markets. Eco-feedback systems that consistently compare energy data to monetary measures, and algorithmic energy distribution that focus on capitalizing on the energy community may force participation in capitalism [8].

Not only is autonomy from surrounding markets important; autonomy in relation to politics and regulations should also be considered. Based on studies of digital waste management technologies, Comber and Rossitto [2] discuss how these technologies become entangled in policies that can ultimately redefine their purpose when developed for environmental protection. A finding that stresses the importance of HCI engaging with policy at different levels – echoing previous SCHI endeavors (e.g., [9, 15]). We argue that it is paramount, if energy communities are to remain a post-growth idea, that autonomy from both surrounding market forces, and laws and regulations that redefine central aspects of these communities is carefully considered from the side of policy-making institutions.

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