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## Energy Internet forums as acceleration phase transition intermediaries

Sampsa Hyysalo<sup>a,\*</sup>, Jouni K. Juntunen<sup>b</sup>, Mari Martiskainen<sup>c</sup>

<sup>a</sup> Aalto University School of Arts, Design and Architecture, Finland

<sup>b</sup> Aalto University School of Business, Finland

<sup>c</sup> Centre on Innovation and Energy Demand, Science Policy Research Unit (SPRU), University of Sussex, UK

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### ABSTRACT

Citizen users play important roles in the acceleration phase of energy transitions, during which small-scale renewable energy technologies (S-RET) become taken up more widely. From users' perspective, turning the early, and typically slow, proliferation into a more rapid and widespread diffusion requires not only the adoption of S-RET but also the adaptation, adjustment, intermediation and advocacy of S-RETs. These activities become necessary because S-RET face a variety of market, institutional, cultural and environmental conditions in different countries. New Internet-based energy communities have emerged and acted as key user-side transition intermediaries that catalyse these activities by qualifying market information, articulating demand and helping citizen users to reconfigure the standard technology to meet the specificities of different local contexts. In doing so, Internet communities foster an appreciatively critical discourse on technology. Such user intermediation is important in expanding the markets for S-RET beyond that of enthusiasts, environmentalists and other early adopters, to the early majority of adopters who demand more exposure, clearer information and less uncertainty about new technology options.

### 1. Introduction

The energy system is going through a transition towards an increased renewable energy generation. Many of the key renewable energy technologies – such as wind, solar photovoltaic (PV) and heat pumps – needed for the transition are already past the early start-up phase of transition, and are currently entering an acceleration phase where they begin to compete head-on with the incumbent fossil fuel-based technologies (Geels and Schot, 2007; Schot et al., 2016). In 2015, fuel share of renewables was 15% of global primary supply and renewable power capacity additions were over 160 GW, representing over half of global power generation growth (IEA, 2017a, 2017b). The growth rates and price reductions for key renewables continue to remain high, but they are only entering mainstream deployment and adoption in most markets (IEA, 2017a). In this situation consumers play an important part in the adoption and in the needed investments in small scale renewable energy technologies (S-RET), and consequently there has been a renewed interest in the roles that citizen users play in transitions, particularly after the early transition phases (Schot et al., 2016).

Research on the early phases of an energy transition has underscored the importance of citizen groups, such as community energy projects for example, working as activists and innovators, who initiate niche development in S-RET (Ornetzeder and Rohracher, 2006, 2013; Nielsen, 2016).

In the later phases of a transition, citizen users have been found to be key players as adopters of the now better-developed technologies (Mignon and Bergek, 2016) and equally as intermediaries and advocates for the adoption of S-RET by other users and legitimators (Smith, 2012; Hyysalo et al., 2013b; Schot et al., 2016). Heiskanen et al. (2014), however, suggest that wide diffusion in a specific market may require a protracted period where market, technology and institutional characteristics continue to develop in parallel. As part of this, citizen users continue to adapt to, innovate, adjust, and advocate S-RET alongside adoption (Hyysalo et al., 2013a, 2016). All in all, a wider range of civil society roles may be played by citizens beyond the roles of consumers making choices and voicing preferences during the take-off and acceleration phases of transition (Smith, 2012; Durrant, 2014). Yet, the existing literature has only begun to address this wider casts of citizen user roles in specific transitions contexts and the range of community forms that are associated with it.

In this paper, we examine the activities that citizen users perform in an energy transition, particularly focusing on their functions as user-side innovation intermediaries (Stewart and Hyysalo, 2008). Our enquiry focuses on Internet forums dedicated to S-RET that have become major catalysts for user activities and networking. These Internet-based, peer-to-peer discussion forums (*Internet forums* from now on) present a new type of 'energy community', which points to the emergence of new types of relevant user communities in addition to previously identified community

\* Corresponding author.

E-mail address: [sampsa.hyysalo@aalto.fi](mailto:sampsa.hyysalo@aalto.fi) (S. Hyysalo).

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energy and other grassroots innovation communities that have been important in the early phases of energy transitions (Smith et al., 2014; Smith et al., 2016b; Ornetzeder and Rohrer, 2013). We examine the overall importance of the Internet forums in order to understand how citizen users, through peer-to-peer interactions, contribute to an energy transition after the early take-off phase. In doing so, we use transitions research framing, as it allows spelling out the full importance of the Internet communities for the proliferation of S-RET and its importance for sustainability transitions. This also allows linking a wide set of related empirical findings, which the otherwise relevant but more narrow research interests of grassroots innovation (Hargreaves et al., 2013; Martiskainen, 2017; Smith et al., 2016a), user innovation (Ornetzeder and Rohrer, 2006; Hyysalo et al., 2013a, 2013b, 2016) and user involvement (Heiskanen et al., 2010) literatures do not allow.<sup>1</sup> More specifically we focus on the following three interrelated questions:

- 1) What does a user perspective reveal of transition dynamics in specific country contexts?
- 2) What do users contribute to S-RETs diffusion at the acceleration phase of a transition?
- 3) How do peer interactions mediated by Internet forums act as user-side transition intermediaries?

Our paper proceeds as follows. In Section 2 we deepen the discussion on transition dynamics, user roles in transition, market formation for emerging technologies, and user communities. We then introduce our methods and data in Section 3. Section 4 presents our findings, first establishing the relevance of intermediation by citizen users in the Internet forums for S-RET proliferation and then moving on to examining the contents of their activities in depth. Discussion and conclusions (Section 5) elaborate further the functions served by citizen users in energy transition.

## 2. Sustainability transitions and user intermediaries

### 2.1. Sociotechnical regimes and transition dynamics

Research on sustainability transitions has developed during the last two decades to address the long-term change of sociotechnical systems. These systems feature high interdependencies between technologies, infrastructures, institutions, markets and everyday practices (Kemp et al., 1998; Kanger and Schot, 2016). Such systems or ‘regimes’ feature strong path dependencies and the vested interests of incumbent players further contribute to the inertia and resistance towards change (Geels and Schot, 2007; Geels et al., 2016). In this view, achieving a socio-technical system transition is not only about better technological alternatives or market mechanisms but about gradual changes required in all aspects of the system – any one isolated change effort will only be partial and unlikely to succeed (Kemp et al., 1998; Schot et al., 2016).

Rotmans et al. (2001) differentiate four phases in the decades-long transition process – pre-development, take-off, acceleration and stabilisation. Schot et al. (2016) merge the earliest two phases into ‘start-up phase’, which is characterised by precarious early exploration and experimentation within ‘niches’ and relatively little interaction with, or impact on, the incumbent regime. Once the key new technologies and their institutional arrangements advance, they begin to challenge the incumbent regime, typically associated with a pressure for regime change from ‘landscape’ level. A contestation ensues between new and old technological, institutional, market and user practice arrangements (Geels and Schot, 2007; Geels et al., 2016). If the old regime does not manage to extinguish the new alternatives, the transition continues to the stabilisation phase where a new dynamic equilibrium is formed either through the incorporation of

new elements into the regime, reconfiguration of new and old elements or substitution by a new regime (Geels and Schot, 2007; Geels et al., 2016). How these dynamics play out depends on at least the extent of lock-in and path dependence in the regime in question, actor choices in different regime contexts and cross-system interlinkages in the sociotechnical system. The ensuing transition consequently plays out in an uneven fashion spatially and temporally for different technologies in different contexts and countries (Lovio et al., 2011; Sovacool, 2016; Geels et al., 2016).

### 2.2. Citizen user roles in transition phases

With respect to users in these transition phases, Schot et al. (2016) and Kanger and Schot (2016) propose a schematised typology of important user roles in transitions. They suggest that user producers and user legitimators contribute to the available technological variety and discourse in the start-up phase (e.g. Ornetzeder and Rohrer, 2006, 2013; Smith, 2012; Smith et al., 2014; Nielsen, 2016). In the acceleration phase, the number of adopters grows and ordinary “user consumers” become important as their consumption choices make niche markets to expand. At the same time, some users tend to play intermediary roles that help other user consumers to adopt the new technologies and their usage. Such “user intermediaries” can have a profound effect on how easy it is for others to acquire, appropriate, learn and maintain the new technological alternatives (see Section 2.3.) (Stewart and Hyysalo, 2018; Hyysalo et al., 2013b; Kivimaa et al., under review). Users also affect the acceleration phase as active citizens by mobilising against the existing regime, hollowing out its legitimacy and commercial strength (Smith, 2012; Schot et al., 2016). The combined effect of these user roles facilitates the stabilisation of the new regime, which takes place at the moment when it has become more natural and routinised for consumers to make the choice in the new regime than in the old (Schot et al., 2016; Kanger and Schot, 2016). This recent focus on user roles in the transition literature thus moves it beyond its earlier reliance on the diffusion of innovation literature, which assumes that citizens merely adopt the novelty while some may act as diffusion champions that show examples to others and generate minor local reinnovations (Rogers, 2010; Mignon and Bergek, 2016).

Users’ capacity to further the energy transition has been found to become amplified by peer interactions and communities. Research on community energy (e.g. Smith et al., 2014; Walker and Devine-Wright, 2008; Hargreaves et al., 2013) and energy-related citizen movements (e.g. Ornetzeder and Rohrer, 2006, 2013; Nielsen, 2016) has underscored how communities and movements create solutions that can be adopted into the mainstream, inflict change among dominant regime actors, and foster critical discourse and the practicing of technological and social alternatives (Smith et al., 2016b). Research to date has largely concentrated on community groups and movements that are united by an ideological commitment to alternative forms of energy and are often also geographically local (e.g. Kunze and Becker, 2015; Seyfang et al., 2014). Increasingly, community energy groups have also co-operated with each other, through shared learning and networking (Seyfang et al., 2014), often facilitated by national and regional intermediaries (Hargreaves et al., 2013). Such intermediaries include for example Community Energy England (Ehnert et al., 2017) and Community Power Scotland (Community Power Scotland, 2017) in the UK and Deutscher Genossenschafts- und Raiffeisenverband e. V. (DGRV) (German Cooperative and Raiffeisen Confederation) in Germany (Romero-Rubio and de Andrés Díaz, 2015). International platforms for cooperating are emerging, such as REScoop umbrella organisation for cooperatives, bringing together a network of 1500 European cooperatives and their million citizen members (Alarcón Ferrari and Chartier, 2017). Research has also highlighted emerging sociotechnical concepts such as community microgrids, which could be used to integrate more S-RET in to the energy system, though their application remains limited (Gui et al., 2017). While in countries such as Denmark and Germany community-owned energy cooperatives have become a new type of an energy market player (Herbes et al., 2017), their influence remains limited in others (Smith et al., 2016b; Ruggiero et al., 2018). In all,

<sup>1</sup> We anchor our discussion on heat pumps in Finland, even though user forums covering S-RETs are present worldwide with varying intensity as detailed in Sections 3.2 and 4.1

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