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The roles of users in shaping transitions to new energy systems

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Current government information policies and market-based instruments aimed at influencing the energy choices of consumers often ignore the fact that consumer behaviour is not fully reducible to individuals making rational conscious decisions all the time. The decisions of consumers are largely configured by shared routines embedded in socio-technical systems. To achieve a transition towards a decarbonized and energy-efficient system, an approach that goes beyond individual consumer choice and puts shared routines and system change at its centre is needed. Here, adopting a transitions perspective, we argue that consumers should be reconceptualized as users who are important stakeholders in the innovation process shaping new routines and enacting system change. We review the role of users in shifts to new decarbonized and energy-efficient systems and provide a typology of user roles.

A key challenge in reducing carbon emissions is to understand how to unlock current energy-intensive and fossil fuel-based consumption patterns, thereby enabling transitions towards new forms of decarbonized and highly energy-efficient consumption. Despite progress toward more energy-efficient appliances, overall levels of energy consumption continue to rise. For some devices and services, such as information and communication technologies, this is simply because of an increase in their total usage[1,2]. In other cases the redefinition of existing products, an example being SUVs, has resulted in an overall increase in energy consumption[3]. Moreover, gains made by introducing more energy-efficient measures have been partly offset by a rebound effect, wherein money saved on energy consumption is spent on more consumption[4,5]. Meanwhile, economic development in emerging economies means that a growing part of the population is adopting the energy-intensive Western lifestyle characterized by high energy demands for living, food production and transport.

National and global policymakers have shown a keen interest in developing a range of policies for reducing energy consumption[6,7]. The deployment of countless awareness-raising campaigns, eco-labelling initiatives and energy efficiency programs has enabled relatively quick gains. For example, European greenhouse gas emissions have decreased by 19% since 1990, despite a 45% increase in economic output[8]. However, current government information policies and market-based instruments tend to have a relatively narrow view of the user as a consumer making conscious rational choices on the energy market from a set of pre-defined options. Although this approach enables the optimization of current user behaviour it does little to stimulate large-scale transformations of existing socio-technical systems. Yet this is exactly what is needed, because projected long-term reductions in energy consumption remain insufficient to achieve a low-carbon future[8].

Over the past two decades, the topic of (energy) system change has been extensively researched in the field of transition studies, which lies at the intersection of innovation studies, science and technology studies, evolutionary economics and the history of technology[9–11]. Energy transitions entail wide-ranging and long-lasting shifts from one socio-technical regime to another, resulting in the establishment of a new socio-technical system (see Box 1 for some basic concepts). The focus on system change over multiple decades enables an understanding of how existing technologies, regulations and stakeholders continuously generate routines that bias user choices towards existing unsustainable energy practices. It also provides an understanding of how the prevailing routines of energy use are destabilized, how new ones are created, how various elements of the emerging system are aligned and how they eventually become stabilized and reproduced in a new socio-technical system. This differentiates the transitions perspective from approaches that focus on the determinants of user behaviour in relatively stable conditions (Box 2).

Our approach here therefore puts the creation, sharing and reproduction of collective routines at the centre of the analysis[12,13]. We suggest that this shift in focus is necessary to understand how users contribute to transitions in energy systems. Although a considerable amount of work on user participation has already been conducted in the transitions field[9,14–16], the various findings have yet to be brought together and synthesized. In this Perspective, we summarize the main findings on user roles, complement them with insights from the broader innovation literature and integrate these observations into a comprehensive typology of different user roles in transitions processes. Note that although this Perspective focuses on user involvement in energy transitions, our approach is also likely to be applicable to system transitions in other areas, such as transport. We show that in both an individual and a collective capacity, users of energy play a crucial role in initiating, accelerating and stabilizing transitions. Our preference for the term 'user' above the notion of 'consumer' reflects the recurrent findings in the innovation literature that user participation extends far beyond making purchasing decisions and paying the bills. We argue that radical technological solutions, supporting institutional frameworks and new user routines are integral parts of the transition to a decarbonized and energy-efficient system. Therefore, our typology identifies the need for new types of policies aimed at mobilizing the potential of users for challenging, changing and stabilizing shared and collective routines.

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Box 1 | Basic concepts for understanding transitions as multi-level processes.

Socio-technical regime. A shared, stable and aligned set of rules or routines that guide the behaviour of actors on how to produce, regulate and use energy, transportation, food production or communication technologies. These rules are embedded in the various elements of a socio-technical system. Rules force energy provision to evolve along a specific trajectory of incremental innovation. The centralized system of energy production that is dominated by fossil fuels and energy-intensive practices is an example of a socio-technical regime that is guided by rules that favour large-scale production at the lowest possible costs, regulation through central government and individual use of abundantly available energy.

Socio-technical system. A configuration of technologies, services and infrastructures, regulations and actors (for example, producers, suppliers, policymakers and users) that fulfils a societal function such as energy provision. These elements are aligned and fine-tuned to each other, forming a system.

Niche. Protected from direct mainstream market pressures, a niche is a space in which radical solutions that compromise the logic of incumbent regimes are being developed. Compared with regimes, the actors in niches are few, their interrelations sparse, the focal technology immature and the guiding rules in constant flux. An example of a niche is a decentralized system of energy production based on renewables, challenging the dominant regime.

Socio-technical landscape. Exogenous macro-events and trends (such as wars, migration, urbanization and totality of infrastructures) that shape the dynamics between niches and regimes, but are not affected by the latter in the short or mid-term.

Transitions. Large-scale and long-term (50–100-year) shifts from one socio-technical regime and system to another, involving interactions between landscapes, regimes and niche dynamics. Examples include the shifts from sailing ships to steamships, or from horse-drawn carriages to automobiles. Transitions can be conceptualized as a sequence of three phases:

- Start-up. The internal problems of the regime are intensified by landscape pressure, creating a window of opportunity for novelties that, for the time being, emerge and mature in niches.
- Acceleration. Niches enter the mainstream market and start to compete with the incumbent regime. Increasing diffusion is accompanied by redefinition of rule sets, and thus also of user needs, leading to collective learning processes and eventually, if successful, to new stable rule sets.
- Stabilization. As the niche's actors grow in number, its technology matures and its guiding rules stabilize, the (now former) niche gradually establishes itself as a new regime. This allows for a sharp increase in adoption as the regime now provides a ready-made 'template' for largely routinized user behaviour.

Users building up niche markets

A core focus in the transitions literature is on how to nurture the wide-scale introduction of potentially disruptive technologies that are already available. The idea is that it is possible to facilitate the development of new niche markets through broader societal experimentation. For example, governments may create feed-in tariffs and green certificate schemes to support the uptake of solar photovoltaic (PV) and smart-grid pilot projects[17]. In the transitions literature, especially the subset focusing on niche construction, it is argued that if networks of policymakers, companies, civil society actors and users construct early markets appropriately, they will act as important building blocks for a broader energy transition, including new types of energy use and user routines[15,18]. Three processes have been identified that are crucial for niche construction — expectation building, network development and learning — and specific hypotheses have been formulated and tested for each process[17,19–21]. In this section we focus on expectation building and subsequent sections will discuss the rest.

The expectations of niche actors contribute to successful niche-building as they generate a sense of urgency and build a wider constituency for fundamental change. They also reduce uncertainty and generate belief in a new approach. Expectations are more forceful when they are stable and shared among producers, users, civil society actors and regulators[22,23]. A recurrent strategy of niche actors is to embed these expectations in larger societal narratives that provide broader cultural legitimacy[24–26]. Cultural legitimacy refers to a generalized narrative that niche developments are desirable[27]. An early example of such a narrative is the vision of Amory Lovins who sketched the outline of a soft-energy path based on distributed renewable energy sources that would match the scale and quality of human needs[28]. He argued that users do not need electricity or oil, but services such as a comfortable indoor climate and light. Meeting the needs of the users should be the starting point for an efficient soft-energy system, preferably using locally available resources and capabilities.

The important role of legitimation has also been discussed in innovation systems and grassroots innovation studies[14,29,30]. For example, the exceptionally high degree of legitimacy of renewable energy options significantly accelerated the diffusion of solar cells and wind turbines in Germany[31]. Users have been shown to be important generators of expectations, providing legitimacy for community energy projects and other local initiatives[32]. Here, they are what we will call user-legitimators. The grassroots literature also points out that the content of legitimation matters[33]. As legitimation can be focused around general socio-political visions that are anti-consumerist and anti-growth, grassroots activists may sometimes remain indifferent, or even hostile, to mainstreaming. However, this is not always the case; a shift from not-for-profit and voluntary activities to professional and profit-oriented initiatives has been observed for a number of niche technologies, such as car-sharing, solar thermal collectors and PV technologies[34]. This shift is accompanied by a diminished or changing role for the initial grassroots actors, as well as the decline of self-building activities.

Enabling social networks

Social networks are likely to contribute more to niche development if they are broad; that is, if they involve different stakeholders that represent producers, users and regulators. Social networks are also likely to contribute if they are deep; in other words, the people involved should also be able to mobilize a broader set of commitments and resources from incumbents[15,19,20]. The importance of user involvement in network building has now been established in a broad range of studies in relation to the development of thermal solar collectors, biomass heating systems, sustainable buildings and wind turbines, among others[34,35]. In these areas, users have been actively involved with constructing the technological devices, making it meaningful to speak of them as user-producers. In addition to modifying and improving existing systems these user-producers also designed and built completely new ones, such as special types of solar collectors, roof-integrated solar collectors, solar combi-systems for space-heating or electronic control systems and advanced safety systems for biomass heaters. Some of these innovations were later adopted by profit-oriented enterprises for commercial production.

Users also stimulate diffusion through bulk purchases and personal advertisement, the creation of user clubs and excursions and self-help systems. This led to a very high dissemination rate in the case of solar collectors in Austria, with about 40,000 solar heaters being equipped with self-built collectors in the 1990s, and Austria's industry playing a pioneering role in Europe[35]. In Denmark, users started the construction of modern wind turbines in the late 1970s; by 2000 they had already installed more than 2,000 (increasingly larger) on-shore wind turbines[36,37]. Users were also crucial in the case of car-sharing in Switzerland, in terms of initiating and developing a substantial niche market that since 1987 has grown to more than 125,000 users[15,38,39].

In all of these cases, the process of diffusion was not only about boosting the adoption of radical new technological options, but also about the build-up and alignment of various elements into a new, increasingly stable socio-technical system. It can be described as a co-evolutionary process driven by endogenous interactions between new technologies, user preferences and institutional frameworks. Users not only adopt the novelty, but also adapt and re-shape it: user needs and demands are actively constructed during the transition, rather than merely 'discovered' by producers[40].

The variety of actors, technologies and institutions involved in this process entails a high degree of uncertainty about the direction of the transition. Hence, there is a need for intermediary actors — a role that can be fulfilled by users[41]. This can take the form of user clubs and associations that are aimed at a mutual coordination of activities. The role is enacted in three ways: by facilitating, configuring and brokering. The first activity entails the creation of spaces for various actors, including producers, regulators and users, to meet and learn about the various dimensions of the system. Configuring involves tinkering with the design of the technology and setting rules and regulations on its use, thereby prioritizing specific usage and users. It also includes formulating interpretations of and expectations about the technology and its possible uses. Brokering is about representing individuals and communities, acting as their spokespeople and negotiating on their behalf[42]. For example, in the case of car-sharing, a Swiss traffic club called *Verkehrsclub der Schweiz* helped to expand the practice in two ways: it assisted the build-up of user groups in some locations and it established itself as a spokesperson for car-sharing and provided a 'translation interface' between the cooperatives and policymakers[15]. Similar organizations emerged in the Danish wind turbine case (the Association of Danish Wind Turbine Owners and the Association of Danish Wind Turbine Manufacturers) and for solar collectors in Austria (the Association for Renewable Energy)[34].

Box 2 | Transitions as regime-building.

The long-term focus of transitions research enables us to identify major shifts in the contexts in which various actors make their choices. For example, after the Second World War the car had become a rational choice for rural and urban, as well as short- and long-distance, passenger travel for the majority of Americans. This was predicated on a variety of factors, such as the extensively developed national road network, fundamentally redesigned urban spaces that were favourable for car traffic, the relatively weak position of urban public transport and so on. However, all of these factors, which could be considered 'contextual' as pertaining to the post-war era, had emerged as outcomes of intense inter-war political struggles between pedestrians, drivers, city authorities, civil engineers, the car and railway industries, national policymakers, automobile clubs and other stakeholders[71]. In the inter-war acceleration phase, the users were then heavily engaged with constructing the very regime in which the car could become the preferred choice of transport in the first place.

The distinctiveness of the transitions perspective emerges from its simultaneous attention to the following features:

- Co-evolution. Focus on the co-construction of the various elements of emergent niches — actors, technologies, rules — and their increasing coherence over time.
- Discontinuous change. Focus on regime shifts and radical innovations, rather than on regime optimization and incremental innovations.
- Multi-actor approach. Focus on the variety of stakeholders in bringing about systemic change. This involves the creation of markets and the construction of user needs — a process in which users themselves often play an important role.
- Degree of organization. Focus on the changing degree of organization within a specific stakeholder group, and between such groups, during the course of transitions. For example, users commonly mobilize into clubs and associations dedicated to a particular niche technology.
- Long-term view. Focus on the entire course of transitions, including the start-up, acceleration and stabilization phases.

Learning to rethink

Niche development, similar to network building, is stimulated by broad and deep learning. Broad learning means that the actors developing the niche are not strictly focused on just the technology, but also take into account user preferences, regulatory barriers, environmental and social impacts and so on. Deep learning can also be referred to as double-loop (or second-order) learning[43,44], which is achieved when niche actors purposefully encourage users to question their underlying assumptions — for example, about their energy needs and everyday energy consumption practices. This is in contrast to single-loop learning, which takes user needs for granted and simply tests new innovations against them. Deep learning among users is a necessary precondition for a transition to a decarbonized and energy-efficient system.

Deep learning can only follow from actual use. In various ways, this has been one of the recurrent findings in the innovation and technology studies literature, reflected in notions such as learning by using, learning by producing and learning by interacting[45,46], innofusion[47], domestication[48] and the co-construction of users and technology[49]. In addition, historians of technology have made users visible as co-designers and co-creators of modern technological societies[50–53].

The complexity of the deep learning process means that producers are never able to fully anticipate the outcomes of the adoption of radical technologies. This inability to predict also extends to users themselves. It is very likely that customers' knowledge of and experience with existing products will interfere with their ability to imagine new user preferences and needs[54]. However, this conclusion does not apply equally to all users: it has been argued that the involvement of so-called 'lead users', who have specific characteristics including competence, the ability to mobilize various resources and the incentive to innovate, may perhaps not lead to better anticipation, but is crucial to accelerate the learning process[55,56]. In any case, users need to be prompted to engage with their own assumptions about energy use. Users are not naturally inclined to question their assumptions about how much and which type of energy they need — they must be actively encouraged to do so[57,58]. If users engage in a process of deep learning, they become user-producers, developing new preferences and routines.

Another important insight concerns the creation of usage routines and the diffusion of newly emerging preferences among users.

A number of ethnographic case studies on how users actually adopt new technologies[48,59], including energy technologies[60,61], have shown that consumer behaviour involves much symbolic, practical and cognitive work beyond the initial purchasing decision. Users not only learn how to use the new technology, they also develop new usage practices and fit them to existing everyday routines, thereby gradually altering these routines. Users also express their status and identity by giving symbolic meanings to new technologies. Finally, as evidenced in the case of heating pumps in Finland, users are also instrumental in providing advice to other, less-experienced or would-be users[62]. This side of user activity is not captured by formal economic models, which tend to see the user mainly as a mere choice-maker in the market. In contrast, the literature on technology appropriation suggests that consumption is an active process in which a large group of consumers construct and share the meanings of new technologies and help to define new usage practices: such users we prefer to call user-consumers, following ideas introduced in refs 52 and 53. The activities of user-consumers help to consolidate and to stabilize new energy systems. After stabilization, however, many ordinary consumers indeed buy a product, plug it in and use it according to pre-defined meanings and preferences as configured by the early majority of creative user-consumers.

Changing dominant user preferences

Transitions are not solely driven by the process of creating something new. An important reason why the behaviour of new forms of low-carbon and energy-efficient use may not be diffusing more widely is that existing energy production and consumption patterns are deeply path-dependent and locked into socio-technical fossil-fuel and energy-intensive systems[63]. The importance of the influence of prevailing systems on the possibilities of unlocking such production and consumption patterns was recognized early in the transitions literature, and the so-called multilevel perspective (MLP) helped to conceptualize this idea[10]. The key insight of the MLP is that the breakthrough of niche-market innovations that can help to build more sustainable consumption patterns does not depend only on what happens within the niche, and thus on the production, legitimation and intermediary work done by users. Rather, these breakthroughs are subject to interactions with the prevailing socio-technical regimes and a wider socio-technical landscape, and it is through these interactions that their future is shaped.

The MLP conceptualizes the transition from one socio-technical system to another in a specific way: as a regime shift. Regimes are defined as sets of rules that guide and coordinate the behaviour of actors and that become embedded in problem definitions, user preferences, regulations, skills, products, infrastructures and cultural meanings[40] (Box 1). The current Western systems of energy production, characterized by large fossil fuel and nuclear power plants, large transmission and distribution grids and energy-intensive practices, provide an example of this. These energy systems have been gradually optimized in the twentieth century, for instance by continuously increasing the scale of operations. However, the emergence and local embedding of distributed generation (wind, solar, small hydro and so on) in the past two decades has started to challenge the logic of the incumbent regime, aided by the pressure of exogenous landscape developments such as climate change.

The MLP directs attention to the fact that prevailing regimes, including embedded user preferences, need to be actively destabilized. This is achieved by a highly contested and political struggle between actors on various sides: some lobby for a specific niche, some lobby against other niches; some attack the prevailing regime whereas others mobilize to defend it. As an outcome, incumbent regimes — including user preferences — are replaced or transformed in ways that are favourable to the niche innovation[17,64]. Demands for change are often initiated by social movements, and users play a large role as activists[16,65]. We argue here that they enact a user-citizen role, as also discussed in ref. 53. The uptake of problems with the regime pushed by these user-citizens in the media and through other channels leads to changes in policy, which in turn shape industrial strategies, eventually leading to altered user behaviour. A recent example is the pressure that the Guardian Environment Network and the Fossil Free movement are putting on financial institutions to disinvest in fossil fuels and, on a wider scale, on governments to close coal-fired power plants.

A typology of users

The above review has identified a number of different ways in which users can play an active role in facilitating transitions. In doing so we have defined users as individuals or groups that use energy, including elements of the systems (for example, solar panels) necessary to produce and distribute energy. In other words, we have focused on the role of end-users rather than, for example, firms using smart meters. On the basis of this discussion, we have derived five categories of user participation in transitions: user-producers, user-legitimators, user-intermediaries, user-citizens and user-consumers. Note that although not all of these categories are completely new (see, for example, refs 35, 38, 42, 49, 52 and 53), our aim is to synthesise a systematic typology across approaches. Furthermore, it makes an explicit connection between user roles and transition dynamics.

User-producers (or users-turned-entrepreneurs) invent, experiment and tinker with radical technologies, creating new technical and organizational solutions, articulating new user preferences and enabling new routines to emerge. This group is exemplified by the pioneers developing local energy systems using small-scale renewable technologies. User-producers play a pivotal role in the emergence of niches, and often act on their own. However, they might also obtain support from other actors such as governments, who provide subsidies, tax credits or other benefits.

User-legitimators shape the values and worldview of niche actors, providing meaning, purpose and rationale for their activities. They deliver forceful interpretations of developments at the landscape level, such as climate change. They help to anchor expectations and make them more socially robust regarding the viability and significance of a niche, as well as the impossibility of socio-technical regimes confronting and managing these new developments, which will shape investment opportunities. For example, from the 1970s the limits-to-growth narrative has provided meaning to the development of renewables and helped to shape expectations about their future[66]. User-legitimators play a salient role in the emergence of niches, interacting as much as possible with other actors to get them to share the user-legitimators' interpretations of current events and visions of the future.

User-intermediaries create spaces for the appropriation, shaping and alignment of the various elements of emerging socio-technical systems, such as products, infrastructures and regulatory frameworks. They configure the system by tinkering with the design of new technologies, setting rules and regulations on use, voicing expectations and interpretations of new technologies as well as their possible uses. In so doing, user-intermediaries also create representations of users, shape user needs and preferences, enrol new actors and broker contacts between them. Examples are national or regional organizations for renewables. User-intermediaries play an important role in the up-scaling and mainstreaming of niches. They tend to cooperate with firms, governments, non-governmental organizations and individual users.

User-citizens engage in regime-shift politics, lobbying for a particular niche and against the regime (or other niches). They aim to transmit niche-derived lessons about needed regulatory reform into a regime-shift process. They also work together and tap into wider social movements and elites that are interested in sustainability-oriented reform. They are involved in a struggle to

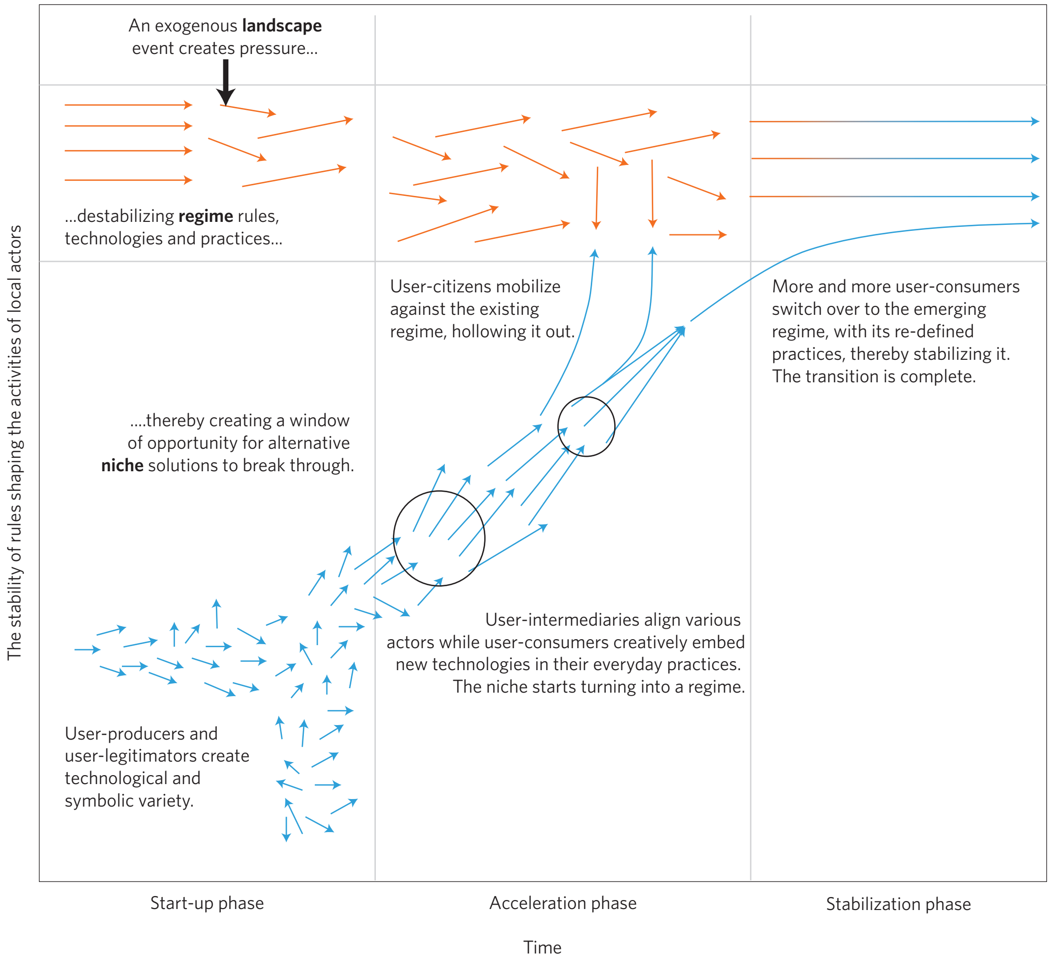

Figure 1 | User roles and transition dynamics. A stylized transition and the corresponding shift in the significance of various user roles. Transitions begin from the occurrence of landscape pressure (large black arrow), which destabilizes the alignment of regime elements. This in turn stimulates multiple local experiments with products and services by user-producers and the variety of cultural narratives created by user-legitimators (small arrows on the niche level). At first these experiments remain largely separate (signified by the diverse orientations of the arrows) and hence they do not yet add up to a new socio-technical system. This situation starts to change in the acceleration phase. Although the regime continues to be destabilized (indicated by diverging arrows in the central section) user-intermediaries become heavily involved in regime-building on the niche level, increasing its size and stability (represented as the circles 'filtering' the arrows). In parallel, creative consumers develop increasingly coherent and stable practices (denoted by the increasing length and converging direction of the arrows). At the same time, user-citizens increasingly contest the dominant regime, engaging in a 'battle of systems' (represented by opposing arrows from the niche and the regime). The single line entering the regime level in the third phase signifies the end result of these activities: the stabilization of re-defined user practices leading to habitual and imitative behaviour of a vast number of user-consumers. The parallel arrows on the regime level refer to the emergence of a new regime in which the elements of the socio-technical system have become aligned with each other again. Note that the extent of conflict between the emergent niche and the incumbent regime — as well as the degree to which one replaces another — differ from transition to transition, resulting in distinctive pathways[10].

overcome the defensive strategies of regime actors in government and businesses. Examples are individuals who are participating in green parties, environmental activists, grassroots movements and non-governmental organizations such as Greenpeace. User-citizens also play an important role in the up-scaling and mainstreaming of niches by confronting the incumbent regimes.

User-consumers not only buy products but also embed them in their daily practices, thereby defining their lifestyles. This process entails the creation of new usage practices, fitting these practices to existing routines and altering the latter when necessary. User-consumers express their status and identity by attributing symbolic meanings to new technologies. They might work together with other users in consumer organizations to test products and systems and share product- and service-related information. An example is the Dutch consumer organization MilieuCentraal, which offers up-to-date information on energy-saving options, energy-efficient appliances and solar panels to consumers. This information is based on knowledge and experiences from all stakeholders, including energy companies, consumers and governments. User-consumers play a crucial role in enabling the stabilization of new socio-technical regimes.

Our typology provides a differentiated and multifaceted view of the ways in which users can actively shape transitions. Moreover, it suggests that users play a role throughout the entire transition process, including start-up, acceleration and stabilization phases. We hypothesize that all of these roles are present throughout the entire transition, but expect that some roles will become more salient in specific transition phases (see Fig. 1).

Our proposed roles represent archetypes: in reality, users — as well as other actors — can enact several roles simultaneously. Moreover, as our survey purposefully focuses on the ways in which users contribute to energy transitions, we have largely excluded their role in blocking change. Finally, although we have occasionally discussed the relationships between users and other actors, such as industrial enterprises or regulators, further investigation and discussion of the interactions between them is required.

Outlook

We have argued that a transitions perspective yields unique insights into the dynamics of energy transitions. Although the work on the factors that influence individual environmental behaviour[67–69] has often highlighted users as consumers and activists (user-citizens in our typology), we have complemented this view by showing that users also participate in transitions as producers, legitimators and intermediaries. Furthermore, we have argued that in addition to making decisions as individuals, users also shape transitions as collectives. Finally, and perhaps most importantly, we have conceptualized new routines of energy use as an outcome of a long-term co-evolutionary process of transition, whereas for studies that focus on the behaviour of individuals, routines and habits form only part of the context shaping individual action. In other words, although the latter literature might be helpful in providing insights regarding the optimization of current energy systems, it fails to capture the role of users in disruptive system change.

The differences between these two approaches and the complementary insights of the transitions perspective can be illustrated nicely with the following example. Research on energy and environmental attitudes in Denmark, a front-runner country in terms of its active energy and climate change policies, has yielded a surprising finding: despite claiming awareness of a 'fair amount' of energy-related issues, its citizens actually score remarkably low on the energy literacy test[70]. Adopting the individualistic decision-making view one would expect that high energy prices and the high standard of living provide ample incentives to Danes to learn about various energy issues; however, this does not seem to be the case. Our perspective offers an explanation for this apparent paradox: we would argue that this is a phenomenon characteristic to the stabilization phase of transitions. New markets for renewables and an associated new socio-technical regime may have already stabilized to the extent that it has become possible for users to engage in sustainable practices in a habitual and non-reflective manner. That is, Danish users have become sustainable consumers precisely because the new regime allows them to do so without much effort, rather than because they have become informed enough to make continuous conscious choices pertaining to the energy market.

It follows that government policies should go beyond seeing users as consumers whose energy demands can be shaped by raising their awareness about their current energy needs and various prevailing energy options to satisfy them. Instead, policies could also act on consumers as active users and seek to identify ways of assisting them in constructing new energy demands. Policies could then be tailored towards specific user roles. User-producers can be stimulated through regular innovation policy, although this should focus more on stimulating innovation by users involved in the construction of new decentralized energy systems as these constitute promising niches for future energy-efficient and decarbonized systems. User-side innovative activities should be facilitated by providing access to finance, tax credits, knowledge and relevant networks. User-legitimators could be funded and stimulated through greater involvement in technology assessment, foresight activities and science and society policies, so that their narratives and expectations shape the decisions taken by investors and technology developers. User-citizens who are already confronting governments and trying to change their policies need to be able to participate in all policy-making processes that influence our energy future. Although user-intermediaries are crucially important for shaping supply and demand, and accelerating energy transitions, they are often not targeted in the policy process. We suggest that this is an area that needs a lot more attention from policymakers. The primary goal should be to assist users in the construction of mediation spaces, and even delegate certain tasks to them; for example, standard setting or communication with producers and individual users. The user-consumer can be addressed not only through awareness-raising campaigns and other information policies, but also through providing digital and physical fora that will help them to exchange experiences. The main thrust of our argument is not to limit policy-making to this type of intervention because users can be so much more than passive energy consumers. As the transitions perspective illustrates, users can be active participants in a process of socio-technical change, shaping the transitions to a sustainable energy system.

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Competing interests
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