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Policymakers' views on sustainable end-user innovation: Implications for sustainable innovation

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Abstract: This paper seeks to ascertain why the role of end-user (consumer) within sustainable innovation remains largely overlooked by policymakers in spite of their significant potential in driving socio-technical transitions. Drawing on 25 in-depth interviews with policymakers, the paper finds that conceptual vagueness and a lack of clear definitions within the field have led to a myriad of terms being used to refer to the engagement of end-users in the sustainable innovation process. This lack of clarity has generated a confused policy narrative when discussing the role of end-user in sustainable innovation, making it difficult for insights to be shared with and drawn from others and resulting in a fragmented policy toolset. In addition to this ambiguity, the interviews revealed that policymakers often take a traditional view of innovation and its main actors, wherein end-users are seen as playing the role of ‘the informed consumer’ who drives the demand side but does not contribute to supply. Thus, despite significant evidence to the contrary, policymakers remain apprehensive about the potential of end-users driving sustainable innovation. The paper concludes that existing policy concerns are less about whether end-users innovate or not than whether this form of innovation can actually translate into public goods. The key takeaway for proponents of sustainable end-user innovation is that, from a policy perspective, the larger impact and business case has yet to be made.

1. INTRODUCTION

Conceptions of the role of consumers (or end-users) within innovation have undergone a marked shift in recent years, with end-users no longer seen as merely passive recipients of producer-made goods and services but as active participants in the entire innovation process from initial ideation to dissemination (von Hippel, 2005). This form of innovation, driven by individual end customers or a community of end-users (Bogers et al., 2010), has also received increasing attention within the literature on sustainable innovation, where end-users are increasingly seen as crucial for initiating, accelerating and stabilizing transitions to sustainability (Schot et al., 2016). In this view, end-users not only independently come up with innovative solutions to a range of sustainability-oriented challenges but are also involved in facilitated processes as they are “critical to accelerate the rate of innovative solutions penetrating the market” (Sopjani et al., 2018, p. 2). This critical role results from end-users’ ability to translate “sticky information” related to practices, behavior and needs into novel solutions to context-specific situations, often freely sharing these insights (Hyysalo et al., 2017). Finally, end-user involvement within the domain of sustainable innovation also generates further benefits in terms of steering innovation trajectories towards more sustainable socio-technical regimes as the co-creations process generates further end-user expectations and legitimacy (Seyfang and Haxeltine, 2012). Hereafter I refer to such sustainable innovation driven by end-users as *sustainable end-user innovation* (SEI) (Nielsen et al., 2016).

Despite evidence showing the potential of SEI, policymakers have been slow, or reluctant, to recognize and implement supporting policies (Nielsen et al., 2016). Instead, innovation policy has primarily targeted larger corporations and/or small and medium-sized enterprises (Henkel and von Hippel, 2005), while sustainability policy remains focused on efficiency improvements (Creutzig

et al., 2018) and on changing the behavior of established incumbents (Baldwin and von Hippel, 2011). The emerging role of end-users in innovation has thus not yet effectively reached policymakers (Watson et al., 2019). This is especially problematic in view of the fact that a wide range of studies suggest user innovation is a widespread activity that arguably deserves policy attention (Franke et al., 2016). The literature on sustainable innovation - understood to represent the advancement of a product or service that offers improved or the same economic performance with less externalities in the form of social and environmental hazards (Bos-Brouwers, 2010) - is thus also increasingly taking notice of end-user innovation and its potential for driving sustainable innovation (Boons and McMeekin, 2019), especially within the fields of sustainable home energy (Hyysalo et al., 2013a) and heating technologies (Heiskanen et al., 2011), wind power (Ornetzeder and Rohracher, 2013) and transportation (Ross et al., 2012). Given these observations regarding SEI's noted potential, the paper sets out to uncover the answer to the following RQ: Why are policymakers either unaware of or unwilling to create policy more aligned with the needs of sustainable end-user innovation? In order answer this RQ, the paper employs 25 semi-structured interviews with European policymakers to better understand their position.

The paper is structured as follows. Section 2 seeks to address the role of the end-user within the larger literature focused on sustainable transitions and innovation, in addition to defining and delimiting the term SEI. Section 3 introduces the qualitative research method employed in the paper, while Section 4 outlines and systemizes the findings as they relate to the RQ. Finally, Sections 5 and 6 discuss these findings and their subsequent implications for theory and practice before the study is finally concluded in Section 7.

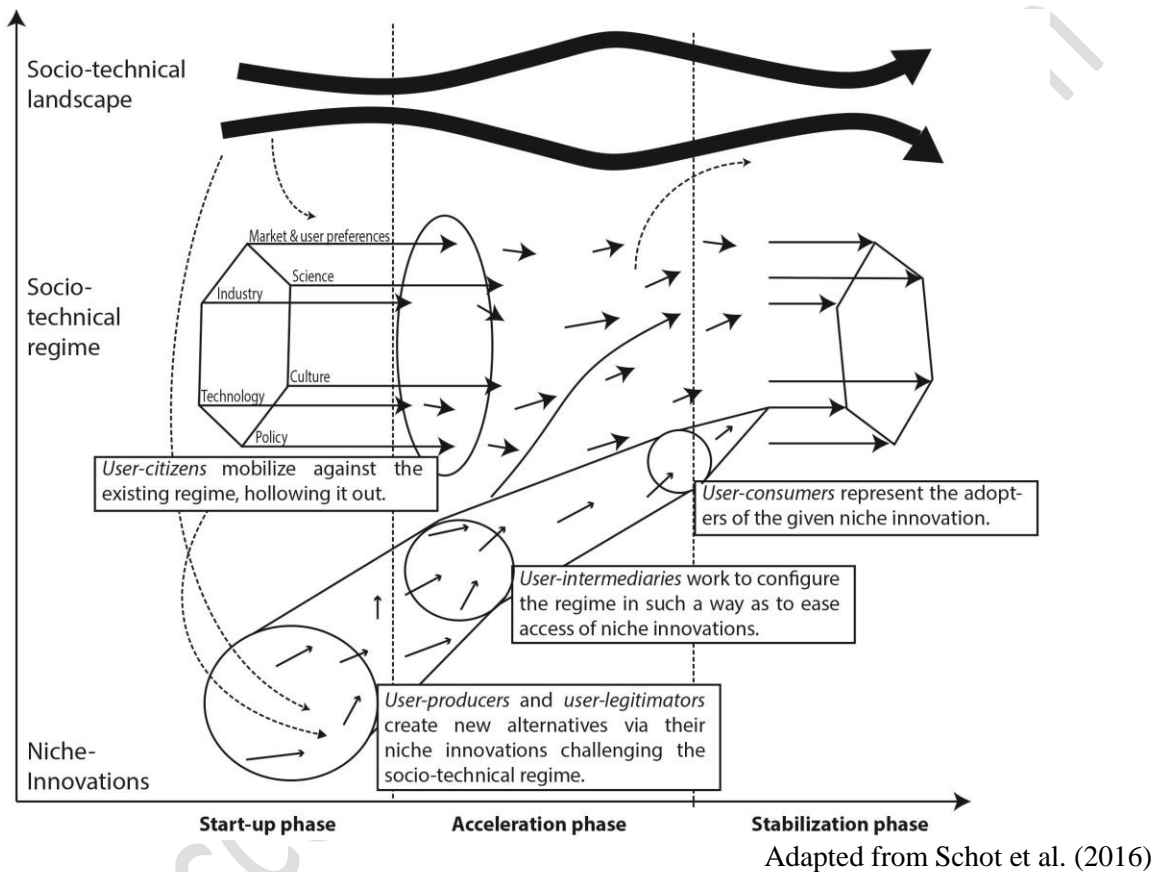
2. SUSTAINABLE TRANSITION AND END-USERS

Sustainable end-user innovation (SEI) is defined as sustainable innovation driven by an individual or group of consumers (users of consumer goods), either in an independent capacity or as part of a facilitated innovation process (Nielsen et al., 2016). These processes share the underlying assumption that the knowledge required for innovation is widely dispersed and hence often falls outside the realm of any one person, firm, or organization (West and Bogers, 2014). User insights can also help anticipate “uptake and usage of these innovations, and the ultimate magnitude and direction of societal impacts.” (Axsen and Sovacool, 2019, p. 2)

The paper employs the multi-level perspective (MLP) framework as a theoretical tool for highlighting the relevance of end-users in driving transitions towards sustainability (Wainstein and Bumpus, 2016) and specifically focus on the work by Schot et al., (2016) who note that end-users can take on a number of roles in this capacity, including that of user-producers, user-legitimizers, user-intermediaries, user-citizens and user-consumers. Each of these categorized end-users play separate but interlinking roles in steering innovation trajectories towards more or less sustainable socio-technical systems (Verbong et al., 2019). The theory conceptualizes that niche innovation actors, such as end-users (Schot et al., 2016), represent a significant source of radical innovation and are thus central for any socio-technical transition (Geels, 2011, 2010). It thus stands to reason that policies enabling this form of innovation agent would be highly welcome, and thus it is worthwhile endeavoring to understand why policymakers are either unaware or unwilling to create policy that would enable more SEI. Figure 1 illustrates the changing roles of the end-user in enabling socio-technical transitions, depending on where they are located: the early Start-up phase represents a point at which new radical ideas emerge; the Acceleration phase reflects the point at

which new ideas and innovations start to configure and challenge the existing regime; and the final stabilization phase represents the mainstreaming of radical ideas that create a new stabilized socio-technical regime context.

Figure 1. MLP and the role of the user



In terms of the MLP, and specifically the work of Schot et al. (2016), sustainable end-user innovation can thus be said to represent user-producers who are seen as niche inventors “that experiment with radical technologies, creating new technical and organizational solutions, articulate new user preferences, and enable new rules and/or routines” (Verbong et al., 2019, p. 244). In relation to this, the MLP theory would contend that socio-technical regimes, including policy, act to lock in socio-technical changes, while niche-level actors, like SEI, act as key sources of radical innovation that challenge the current socio-technical regime. The lack of observed policy

actions to enable SEI is thus consistent with the theory's expectations that policy would be aimed at enabling incumbents and the technology, rules, and practices that relate to them. This paper argues, however, in line with the literature on strategic niche management (Ruggiero et al., 2018), that while policy constitutes a part of the established socio-technical regime, it can also act as an enabler of niche innovation like SEI. For example, the electric windmill industry in Denmark was successful because it received political and ultimately policy support that significantly supported the now established industry (Karnøe and Garud, 2012). Despite these examples, however, policies aimed at enabling SEI (Nielsen et al., 2016) or user innovation (Bradonjic et al., 2019) remain rare.

2.1 Sustainable end-user innovation

Interest in the role of end-users has emerged within the literature on sustainable innovation at a later stage than within the general innovation field, with the first articles on the phenomenon being published during the mid-1990s (Nielsen et al., 2016). Despite this late emergence, the literature base has since expanded significantly, resulting in an empirically rich research stream (Feola and Nunes, 2014).

If we accept the observations of von Hippel et al. (2012) and Franke et al. (2016) that between 6 and 40 percent of end-users innovate for themselves, there is arguably a dearth of policies aimed specifically at this type of innovation. Instead, as previously noted, the majority of innovation policy targets larger corporations, universities and/or SMEs (von Hippel, 2005). For example, despite initial moves by the European Commission to implement policy aimed at open innovation (European Commission, 2018), these initiatives remain primarily focused on collaboration

between institutions,¹ with only a limited focus on end-users. The lack of policy aimed at SEI is even more pronounced. Here the majority of policies focus on efficiency improvements (Creutzig et al., 2018), on changing the behavior of established incumbents (Taylor et al., 2013), and – to a lesser extent – on changing individual behavior. Despite the significance of SEI within a range of fields, therefore, these developments remain largely neglected by sustainability-oriented policymakers (Nielsen et al., 2016). On the basis of these findings I make the tacit assumption that end-users can play a role in driving both sustainable and unsustainable innovation (Verbong et al., 2019).

In contexts where end-users play an independent role in enabling sustainable innovation (defined as independent SEI), I draw on the work of von Hippel (2005) in defining end-users as the final users of a product or service who develop or refine a given product or service to satisfy their own personal needs (Bogers et al., 2010). Such developments based on personal needs may in turn lead to a range of inventions that do not disseminate beyond the individual user. In cases where end-user inventions become commercially successful, however, these innovators transition from end-user innovators to user-entrepreneurs. User-entrepreneurs are characterized as “accidental entrepreneurs” who achieve an unplanned level of commercial success (Shah and Tripsas, 2007). This paper therefore interprets independent SEI as end-user innovation without any outside involvement, thus reflecting the conceptualization of end-users within traditional user innovation. Examples of independent SEI are well-documented within the literature on sustainable home energy technologies (Kotilainen et al., 2019), wind power (Ornetzeder and Rohrer, 2013), and transportation (Ross et al., 2012). Furthermore, Hyysalo et al. (2013b) show how end-users make

¹ The EU, universities, SMEs, local governments, and industry.

use of online forums to freely exchange ideas and offer advice on how to improve upon their inventions.

In other contexts, end-users are integrated within existing company-driven or project-driven innovation processes with the goal of offering important user-specific knowledge, though not with the aim of end-users driving the innovation process itself. This type of facilitated innovation process between a company or project and the end-user(s) is similar to the interactive “co-creation” process defined by Prahalad and Ramaswamy (2000). The incorporation of end-users in facilitated sustainable innovation processes is seen within a range of settings, including Living Labs initiatives (Liedtke et al., 2015), sustainable product development (Hoffmann, 2012), housing energy (Heiskanen et al., 2013), and green building initiatives (Rohracher and Ornetzeder, 2002). In these models of open innovation (Chesbrough et al., 2014), end-users engage in collaborative activities with a given firm, organization or project in which they “participate in the design phase [...] and not just during its refinement phase” (Weber, 2003, p. 153). Such facilitated SEI is thus understood as the significant integration of end-users within a company-driven or project-driven sustainable innovation process (Hoffmann, 2007).

In line with Verbong et al. (2019), the concept of SEI can thus both be an individual endeavor – as illustrated, for example, in the work of Hyysalo et al. (2017) on sustainable home energy technologies – or a collective endeavor where citizens’ collectives engage in community innovation, which may expand beyond their locality as a form of grassroots innovation (Smith et al., 2014). Whereas independent SEI represents a bottom-up driven process and facilitated SEI represents a top-down driven process, grassroots innovation is seen to inhabit an area somewhere

between these two idealized conceptualizations. Grassroots innovation represents neither a purely bottom-up process, since it often “seeks to expand community projects beyond their locality and, in doing so, offers the seeds of mainstream solutions” (Verbong et al., 2019, p. 242), nor a top-down process, since it relies on independent citizen action.

3. METHODOLOGY

In order to tackle the RQ, this paper employs insights from 25 semi-structured qualitative elite interviews with European policymakers. Firstly, the paper sought to gauge policymakers’ awareness and understanding of SEI to investigate whether they were aware of the phenomenon and to understand how they view the role of the end-user within sustainable innovation. In order to assess their respective needs and expectations, the interviewees were then asked to reflect on which policies they could conceive of as useful for enabling SEI. This approach was employed to investigate whether the lack of policy aimed at SEI stems from a lack of awareness or understanding of the phenomenon, whether it is due to a lack of policy tools available, or finally whether it was due to a belief(s) held amongst policymakers.

3.1. Interview design and guide

Given the difficulty of accessing policymakers, especially for follow-up interviews, significant effort was invested in creating the interview guide so as to ensure it would be encompassing and would require only a few iterative changes, as is typical for elite semi-structured interviews conducted with the aim of obtaining comparable insights (Berry, 2002). This interview guide was given to the interviewees in advance, together with background material on the study, as recommended by Harvey (2011). Sharing the guide and background material prior to conducting

the interviews served to assure policymakers that the interviewers were well-prepared, since elite interviewees “might consciously or sub-consciously challenge them on their subject and its relevance” (Harvey, 2011). The content of the interview guide was informed by a systematic literature review of the field (Nielsen et al., 2016) and was validated and iterated based on consultation with a variety of relevant actors, including entrepreneurs, policymakers and academics via an in-person workshop (see Table 1).

Table 1. Workshop participant composition by role

Workshop participants	
Role	Number of participants
Academic	7
Policymaker	4
Innovator	8
NGO	2
Total participants	21

The resulting interview guide was structured around four themes that served as categorization tool (Boyatzis, 1998). The interviews started by focusing on exploring policymakers’ views as to the purpose of policy and the role of consumers in the context of sustainable innovation before turning to assessing their awareness and understanding of SEI. Subsequently the interviews transitioned toward understanding their views on the key barriers to SEI and finally gauging insights as regards to their (the policymakers) needs and expectations regarding this alternative form of innovation.

3.1. Sampling design

The overall sample comprises interviews with 25 persons sorted into two distinct groups of respondents: policymakers (n=14) directly responsible for or involved in formulating policies at national or EU-level; and policy-shapers (n=11) indirectly involved in policy formation, typically

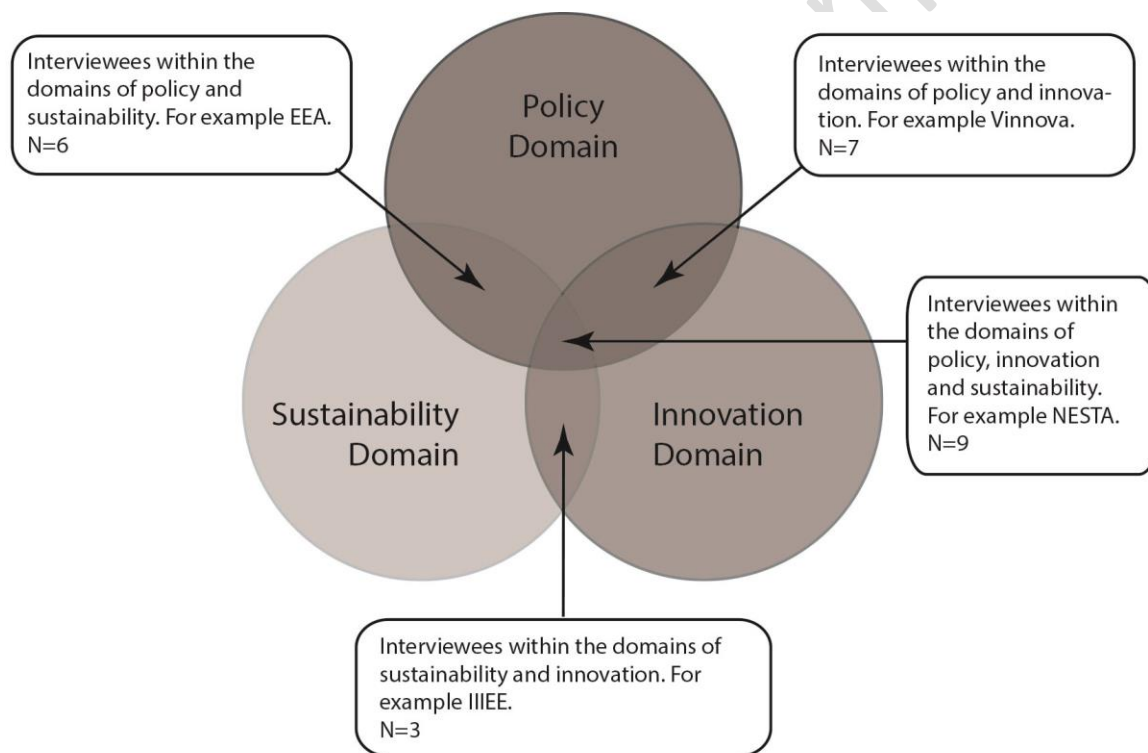
through their role as informants to governmental policymakers. Table 2 provides an overview of the interviewees, their policy roles, organizations and policy contexts.

Table 2. Overview of interviewees

Interview Identifier	Policy Role	Institution	Context
Alpha, Bravo	Policyshaper	British Retail Consortium (BRC)	Trade Organization United Kingdom
Charlie, Delta, Echo	Policyshaper	Climate KIC Nordic	Public-Private Partnership Nordics EU
Foxtrot	Policyshaper	Collaborating Centre on Sustainable Consumption and Production (CSCP)	Research Institution Germany
Golf	Policyshaper	DG Research and Innovation	European Commission EU
Hotel, India	Policyshaper	DG for Environment	European Commission EU
Juliett, Kilo	Policyshaper	DG Health and Consumer Policy	European Commission EU
Lima	Policyshaper	European Environment Agency (EEA)	Environment Agency EU
Mike, November	Policyshaper	Danish Board of Technology Foundation	R&D Agency Denmark
Oscar	Policyshaper	Ecologic Institute	Research Institution Germany EU
Papa	Policyshaper	Ministry for the Environment	Ministry Sweden
Quebec	Policyshaper	MindLab	Policy Innovation Agency Denmark
Romeo	Policyshaper	Ministry of the Environment and Food	Ministry Denmark
Sierra	Policyshaper	National Endowment for Science, Technology and the Arts (NESTA)	Innovation Foundation United Kingdom
Tango	Policyshaper	Nordic Innovation	R&D Agency Nordics
Uniform	Policyshaper	Technofi (Symple)	Innovation Consultancy France
Victor	Policyshaper	The International Institute for Industrial Environmental Economics (IIIEE)	Research Institution Sweden
Whisky	Policyshaper	Swedish Innovation Agency (Vinnova)	R&D Agency Sweden
X-ray	Policyshaper	Wuppertal Institut	Research Institution Germany
Yankee	Policyshaper		

In seeking to ascertain policymakers' awareness and understanding of SEI, the paper touches on three primary domains: the policy domain, the sustainability domain and the innovation domain. Ideally, the paper would identify policy-relevant individuals inhabiting all three of these domains; given the novelty of the field of SEI, however, only a few respondents matched all three criteria (as illustrated in Figure 2).

Figure 2. Distribution of interviewees within the three domains of policy, sustainability and innovation



In line with the focus on policy, I deliberately sought to limit the number of interviewees at the intersection between the domains of Sustainability and Innovation. The interviews themselves were carried out either as face-to-face (N=8) or phone interviews (N=17) and typically lasted between 35–45 minutes.

3.2. Coding

Given the general lack of theory within the literature focused on SEI, the thematic coding of the interviews was derived from the systematic literature review conducted by Nielsen et al. (2016). The purpose was to validate the themes derived from the scientific literature with the real-life experiences and reflections of the interviewees. Prior to the coding process, the codes were tested by pre-screening a data sample to assess whether a modification of the codes was needed. The recorded interviews were then listened to and screened for the presence or absence of the themes. After completing the coding process, all coding themes were once again reviewed to ensure the themes had been meaningfully coded. In instances where alterations of the coding themes were deemed necessary, the data was subsequently recoded.

3.3. Limitations

The aim of the study was to ascertain the extent of policymakers' awareness and understanding of SEI and to identify their needs and expectations regarding end-user innovation in order to uncover why SEI remains out-of-scope of most policy. Given the breadth of the topic, it should be noted that these observations and insights do not reflect the discourse of European policymakers in general; rather they represent the opinions of policymakers most likely to have insights within the field of study. The observations thus only represent expert knowledge within their respective domains, since the concept of SEI, as will be shown, currently remains far below the radar of most policymakers and policy-shapers. Furthermore, the general nature of SEI also results in a lack of concrete step-by-step guides as to how recommended policy recommendations should be implemented. For example, while there appears to be a consensus that funding opportunities should be more flexible, it remains unclear how this can be implemented in practice in order to avoid

fraud or misuse of public money. There is furthermore no opportunity to triangulate the findings, since the study only employs one methodology to study the RQ. This singular methodical approach was adopted due to the paucity of research focused on policy aimed at SEI (or at user innovation for that matter),² which made employing quantitative methodology difficult since it would require a testable proposition to be meaningful. Instead, an exploratory interview-based approach was deemed most fitting. Finally, the small sample size also means that regional and national differences are not reflected, especially given the northern and western European dominance within the sample. The observations of the policymakers and policy-shapers remain only exploratory, therefore, and should not be understood to reflect the actual policymaking domain.

4. RESULTS

Based on the 25 interviews, five areas were identified as particularly relevant for addressing the lack of policy aimed at SEI. Firstly, the lack of conceptually precise terminology has resulted in diverse and often confused understandings as to what role, if any, end-users could play in supporting sustainable innovation. Secondly, a significant number of policymakers showed a general lack of awareness regarding SEI, which was compounded by the vagueness of this concept. Thirdly, conceptual ambiguity and lack of awareness also appear to shape their views toward a more traditional conception of end-users as passive recipients of innovation. This lack of awareness often also shaped the interviewees' perceptions of the role of policy in promoting sustainable innovation as one of facilitating the uptake of sustainable options by end-users rather than of promoting the active involvement of end-users in their creation. Finally, policymakers were asked to reflect on any potential barriers to SEI, as well as to identify which of their needs and

² Utilizing Scopus and employing the string “policy” AND “user innovation”, only 33 peer-reviewed articles emerge that to some degree touch on policy aimed at user innovation.

expectations need to be addressed in order for them to see the value of supporting SEI and how to do so.

4.1. Conceptual vagueness

The interviewees in general often noted the lack of a clear definition of SEI, and this conceptual vagueness resulted in diverse notions of the role played by end-users in sustainable innovation. In general it was noted that a myriad of terms were used to refer to engagement with end-users in sustainable innovation processes, making reflection on the topic difficult. This observation was also found to apply within the academic literature on the field (Nielsen et al., 2016). Despite having been presented with a definition prior, the interviewees chose to use different terms to describe the role of end-users, including co-creation, social innovation and co-innovation. These terms also suffered from a lack of conceptual clarity, however, and were often used interchangeably.

“When I hear co-creation I get three to four ideas of what it could be.”

X-ray, VINNOVA Sweden

This confusion regarding the definition of SEI was further exacerbated by the looseness of the terms ‘sustainability’ and ‘innovation’, which also allow for broad interpretations and can be conceptualized in various ways (Basiago, 1995). This tendency was frequently observed during the interviews, with several interviewees citing the circular economy, the sharing economy and collaborative consumption as examples of SEI. While end-users certainly play an important role in these contexts, they are more often than not facilitated processes in which end-users are the receivers of a service rather than significant (co-)creators of innovation. The conceptual vagueness associated with SEI can be attributed either to the terminological challenges that stem from a uneven and siloed treatment academic literature, which have resulted in a proliferation of diverse

concepts denoting similar phenomena, or alternatively to a lack of familiarity with innovation terminology and with end-user integration in particular.

4.2. Awareness of SEI

The extent of the interviewees' awareness of SEI depended greatly on their different institutional backgrounds. While a minority of interviewees (e.g. Romeo and X-ray) had worked explicitly with end-user innovation, the majority of the sample had little prior awareness of the phenomenon from their work within the domains of sustainable innovation (e.g. Foxtrot & Whisky), environmental policy (e.g. Mike and Juliett) or sustainable consumption (e.g. Yankee & Golf). Awareness of SEI among the majority of interviewees was thus rather limited, with exceptions found typically among individuals working within the innovation domain who were able to distinguish between the different innovation terminologies. Even in these cases, however, only very few had actually worked with end-user innovation on a daily basis, and none within a sustainable domain.

Given that the majority of interviewees had little or no prior knowledge of the concept of SEI or its composite terminologies, most were unable to discuss the phenomenon in detail. This majority primarily comprised policymakers in the domains of sustainable consumption, environmental policy and consumer policy, and who had thus only worked peripherally with innovation. From a sustainability (and consumer) policy perspective, therefore, the role of end-users as drivers of innovation remained largely ignored. This overall lack of awareness leads us to assume that the role of end-users as potential drivers of sustainable innovation has yet to break into mainstream policy discourse as a source of sustainable innovation.

“The concept of consumer-led innovation is not a concept I was familiar with.”

This finding is also reflected in observations made by some interviewees that while awareness of sustainable innovation is on the rise among policymakers, the role of end-users remains largely neglected on the policy agenda. Indeed, several individuals stressed that the end-user perspective is largely off the radar of policymakers, who focus instead on incumbent businesses, universities and SMEs. Greater attention has been given in policy circles – especially recently – to SMEs, which are increasingly viewed as an essential source of economic growth and innovation. As a result, SMEs, unlike SEI, are gaining more prominence in new policy measures. The main role of consumers thus continues to be seen as that of recipients of innovation rather than as part of the innovating process.

“Consumers can push the market towards more sustainable and efficient products.”

The majority of interviewees regarded end-users (or ‘consumers’ as they were commonly referred to) as market actors, indicating that policy should be aimed at encouraging more “informed consumer” behavior from the demand side. Policy was thus seen as necessary in order to enable consumers to purchase more sustainable products and accept new business models better aligned with planetary boundaries (Steffen et al., 2015). Shifting consumer demand was seen as pushing supply towards more sustainable and efficient products. Some interviewees further perceived that the role of consumers was undergoing a change, with consumers becoming increasingly powerful actors in their own right, though not in terms of driving innovation directly but rather through their increasing ability to organize (typically via online platforms) and express an independent voice. While end-user involvement was thus apparently ignored by the majority of policymakers, some institutions did appear to seek to include more end-user involvement, especially those focused on

research and innovation. However, while these initiatives do provide evidence of end-user involvement in policymaking, as for example in the case of Denmark's MindLab, they appear to remain largely isolated and limited in scope. One interviewee did acknowledge the largely untapped potential of SEI and recognized that end-users could be a valuable actor in driving sustainable innovation. In general, however, the interviews revealed that awareness of SEI and policies aimed at enabling SEI remain limited: only a few examples were cited of existing policy measures involving end-users, and in most instances no such policy measures could be recalled.

“Whether at a national or EU-level, I cannot think of any specific policy geared towards consumers to support their engagement in innovation processes, either in companies, municipalities or society at large.”

Whisky, The International Institute for Industrial Environmental Economics

Among the interviewees who evinced some awareness and knowledge of SEI, there were conflicting arguments regarding the policymaking level(s) at which awareness of SEI was most prevalent. One interviewee argued that these initiatives remained overlooked at EU-level, whereas local politicians (in Sweden) are more aware and supportive of initiatives from end-users. However, another interviewee thought interest in SEI was higher at EU-level, where she observed end-users were becoming increasingly integrated, especially in research and innovation projects. These seemingly contradictory observations could stem from reference to two different concepts of SEI: independent SEI and facilitated SEI. The interviewees in general showed greater awareness of facilitated SEI, perhaps because of the commonly noted perception that sustainable innovation comes about as a result of processes initiated by SMEs and incumbent firms. This could explain why there was greater awareness of end-users being integrated in facilitated innovation processes led by firms or SMEs.

“In regard to independent SEI, policymakers are less aware.”

Victor, Technofi (Symple)

Alternatively, this greater awareness may reflect the fact that firms – especially larger firms – already have policymakers’ attention. Indeed, a number of interviewees were aware of large companies known to be integrating end-users at an increasing rate, citing the example of the Danish toy-company Lego. Again, given the profile of large companies in the global media and their political clout, they arguably have a greater likelihood of gaining the attention of EU-level policymakers than small grassroots (independent) innovators who are often local and outside the “system” (Seyfang and Longhurst, 2013). The local embeddedness of many independent SEI processes could also explain why there is greater awareness of SEI at the level of local policy than at national or EU-level. The fact that most of the interviewees were less aware of independent SEI was also reflected in the limited examples they were able to give of independent SEI. Although very few examples were identified, the case of Danish wind-power cooperatives was mentioned by two interviewees.

4.3 Purpose of policy

As noted above, all of the policymakers interviewed regarded policy as having an important role to play in enabling sustainable innovation; and while a majority expressed some skepticism and lack of awareness about SEI, most agreed that policy could play a supportive role. Whether resources should be extended to this domain, however, was a matter of debate. Firstly, the interviewees noted that policy can play a key role in enabling, facilitating and advancing sustainable innovation, for example by providing favorable framework conditions for SEI. Policy interventions can provide a general ‘push’ towards a sustainable economy (‘circular economy’ was also commonly cited) by establishing binding rules.

“Policymakers have the responsibility of creating the favorable framework conditions for moving our social and economic system towards a real sustainable trajectory.”

Hotel, DG Research and Innovation

These rules could include the integration of the end-user and sustainability perspective into policy measures concerning infrastructure, regulations, standardization, the business environment, financial systems and public funding. Public funding schemes and environmental regulation, for example, could incentivize and facilitate engagement in end-user innovation. In addition, imposing new regulations to help spark sustainable innovation was widely regarded as a necessary policy intervention. One interviewee highlighted the potential of anticipated regulations to catalyze new innovations in companies by compelling them to adapt to changed market conditions. Implementing new sustainability-related regulation could thus push innovators toward focusing more on environmentally friendly products and services.

“The anticipation of legislation often comes as the main driver for companies to start doing something.”

Whisky, The International Institute for Industrial Environmental Economics

Despite agreement that imposing stricter environmental legislation upon businesses could drive innovation in a sustainable direction, a number of interviewees raised doubts as to the political feasibility of such legislation. One interviewee argued that support for such new environmental regulation at national and European level would only be forthcoming if the benefits of such regulation can be demonstrated in terms of increasing employment and economic growth.

Other interviewees warned that too many policy interventions in the domain of SEI would risk being overly meddlesome in the innovation process. This is partly because cases of independent

SEI are often regarded as ‘passion projects’, and therefore overly formal and inflexible policy requirements are seen as risking the exclusion of more radical innovations. According to some interviewees, policymakers ought to provide elastic framework conditions wherein end-user innovators can freely operate in order to maximize innovativeness and creativity. For example, the setting of fixed deliverable goals as a condition for receiving funding was seen as a potential obstacle to the iterative processes that characterize SEI.

“If you meddle too much, there is a risk that you select the users that are doing innovation, but not as radically.”

X-ray, VINNOVA Sweden

While the great majority of interviewees agreed that policy could play a role in enabling SEI, some questioned whether this necessarily implied that policy should play such a role. Firstly, some policymakers raised doubts as to how SEI – and especially independent SEI – can translate into businesses, jobs and welfare creation.

“The interesting issue is how such a concept would translate into a business model and how it could be seen to generate business, turnover, jobs, and welfare creation.”

Juliett, DG for Environment

Even if it is accepted that end-users are capable of innovating for themselves and translating these models into viable business models, it was argued, the question remains as to whether this should result in policy shifts aimed at promoting SEI. For example, it was asked whether policymakers should slacken existing intellectual property (IP) rules in order to encourage more end-user innovation by reducing fears of legal action. Here it should be documented not only that current IP legislation acts as a barrier to SEI, but also that the net positive effects of increased end-user

innovation as a result of changing IP legislation would not offset the detrimental effects that such change could have on the willingness of major companies to innovate.

Another interviewee questioned the relevance and appropriateness of policies aimed at enabling facilitated SEI, arguing that the integration of end-users and their ideas into company processes should be the responsibility of companies themselves. It was also noted that facilitated SEI is still largely aimed more at generating customizable products to fulfil customer needs rather than any sustainability aims. This interviewee thus saw policy as having only limited potential to promote end-user integration within firms – or within project-driven initiatives – since the incorporation of end-users in facilitated innovation processes was seen as being aimed at profit rather than at addressing social or environmental concerns.

4.4. Policymakers' perspectives on SEI

Finally, the paper sought to explore what the interviewees saw as the main barriers to SEI and their needs and expectations in terms of overcoming these barriers. Firstly, therefore, I summarized the key barriers identified by policymakers, subdividing them in accordance with the MOAB-model of Ölander and Thøgersen (1995). The application of this model was inspired by its successful application in the systematic review undertaken by Nielsen et al. (2016). In this model, 'motivation' refers to the underlying reason(s) that drive individuals to innovate, while 'ability' refers to an individual's personal competences and resources to innovate, and 'opportunity' refers to their surrounding external context.

Table 3. Overview of barriers to independent and facilitated SEI identified by policymakers

Independent SEI – Barriers identified by policymakers	
Motivation	<ul style="list-style-type: none">• Lack of financial mechanisms to motivate end-users to spend time and resources on becoming innovators.• Lack of feedback mechanisms to inspire end-user innovation.
Ability	<ul style="list-style-type: none">• Lack of technical and managerial skills and knowledge.
Opportunity	<ul style="list-style-type: none">• The innovation process is typically very time-consuming, forcing end-users to dedicate their working hours to such projects.• Need for financial support for innovating.• Lack of flexible and easily accessible funding schemes directed at end-users.• Lack of mechanisms to share innovations, leading to a lack of diffusion.
Facilitated SEI - Barriers identified by policymakers	
Motivation	<ul style="list-style-type: none">• Risks and excessive time involved in integrating end-users into a company's innovation process.• End-users may have reservations, since they have to dedicate time and effort without a defined reward to follow.
Ability	<ul style="list-style-type: none">• Lack of managerial experience of how to integrate end-users• Lack of technical know-how amongst end-users could limit their desirability as partners in innovation processes.
Opportunity	<ul style="list-style-type: none">• The integration of end-users into innovation processes generally requires a high level of company dedication.• Information processing and follow-up actions on end-user insights are labor-intensive.• The viability of including end-users in especially complex innovation process remains contested.

Interviewees suggested a number of policy actions that could help overcome these barriers and serve to facilitate SEI. One important policy area in need of revision, it was noted, is that of the infrastructure surrounding sustainable innovation. The majority of interviewees emphasized the need for local, national and international funding schemes to be less administratively burdensome and more adaptable so as to match the limited capacities of most end-user innovators. For example, one policymaker stressed the significant role played by financial institutions, not only in terms of providing funding but also in giving assistance and teaching management skills to innovators and

entrepreneurs. However, responsibility for facilitating knowledge and skills was generally thought to lie with national and local level institutions, which should fulfil this duty by establishing knowledge-sharing networks and databases of best-practice cases. ‘Maker Space’ initiatives and app-stores could be established, for example, to help end-users make prototypes and diffuse their innovations. Another interviewee emphasized the importance of national governments and EU institutions working continually to reform existing incentive systems that have been found to be unsustainable and that discourage sustainable action and innovation.

Many interviewees emphasized the need for policymakers to acquire greater knowledge of SEI and the need to improve their policy toolbox. At present, policymakers are not perceived to possess the necessary tools to advance SEI and to engage end-users in policy initiatives. Some interviewees linked this absence of appropriate policy tools to insufficient knowledge on the part of policymakers, thereby suggesting a need to educate policymakers and subsequently rethink available policy tools. Several policymakers called for greater interaction with and inclusion of citizens in the policymaking process. They considered the current process to be overly top-down, with citizens having only limited influence in establishing and implementing policies.

“The traditional way of establishing and implementing policy is very much top-down [...] in many fields of policy we do not yet use all the available tools to carry through reactive policy implementation.”

Juliett, DG for Environment

One policymaker declared that citizens are ‘the eyes and ears of society’ and therefore advocated involving them in the co-creation of solutions. Policymakers, in this view, should thus ensure greater inclusiveness of citizens in day-to-day policy-making processes. Other interviewees

proposed opening up more comprehensive communication channels to engage citizens and end-users. This would allow their opinions and voices to be heard in policymaking decisions, such as which kinds of research and innovation should be prioritized.

The limited knowledge of SEI among policymakers and the limited number of policy measures in place to address SEI was also attributed to the lack of clear business cases illustrating the potential and benefits of SEI. Policymakers called for more business cases to be developed in order to prove the economic and societal benefits of SEI, arguing that providing examples of best practices and how they affect society at large could act as a catalyst for the involvement of end-users both politically and in companies. Additionally, examples of SEI could help raise awareness of the concept and inspire end-users to innovate.

Several practical examples of current policy initiatives were provided by policymakers in the course of the interviews. One such example that addresses end-users is the EU's Horizon 2020 program, which places a high priority on involving citizens, including calls for ideas inviting citizens to submit proposals to the program. Other interviewees outlined examples involving idea competitions, which were generally perceived as a promising method for engaging end-user innovators and entrepreneurs. It should be noted, however, as one interviewee pointed out, that the ideas generated in such competitions are mostly incremental and rarely novel or systemic. Two other interviewees voiced skepticism as to whether end-user innovation alone would truly result in radical innovation. Instead, they argue, there is a need for closer collaboration – not only with end-users but also with businesses – in order to drive change on a larger scale. This collaboration

is needed, they argued, in order to garner support for the implementation of what were identified as ‘pull-strategies’ for radical sustainable solutions.

“You want to change the system [...] In order to change the system you need a paradigmatic change – not incremental.”

India, DG Research and Innovation

Finally, one interviewee highlighted an often overlooked but very promising aspect of integrating end-users in innovation processes, namely the ability to identify bad ideas more quickly, allowing policymakers and/or companies to shut down infeasible ideas at an early stage and progress with more promising ideas instead. Using co-creation or user-led activities could thus actually help reduce risks in innovation both in terms of costs and time.

To summarize, the policymakers made the following proposals to encourage SEI: (i) simplified funding processes for small end-user projects; (ii) the establishment of knowledge-sharing networks; (iii) greater engagement of citizens by the government; (iv) the development of best practice cases to serve as an inspiration for end-users and as a business case for policymakers; (v) more idea competitions; (vi) a more general shift away from push-strategies to pull-strategies for sustainable solutions; and, finally, (vii) using the insights of end-users both as drivers of new ideas and as problem-detectors.

5. DISCUSSION

The literature on sustainable end-user innovation is a nascent and compartmentalized field that has grown considerably over the last few years (Nielsen et al., 2016). As with the literature on user innovation, there is growing empirical evidence that end-users can play a significant role in driving

sustainable innovation (Verbong et al., 2019). Despite this evidence, however, policy aimed at enabling SEI remains lacking, much in line with observations from the larger literature on user innovation (Bradonjic et al., 2019). With the stated aim of uncovering why policymakers are either unaware of or unwilling to create policy more aligned with the needs of sustainable end-user innovation, the paper employed the multi-level perspective (MLP) as a theoretical tool to position and conceptualize the interaction between SEI and policy.

As proposed by the MLP, policy forms a part of the established socio-technical regime and is usually assumed to act as a barrier rather than an enabler of niche innovation, since it serves to maintain the current socio-technical arrangement and therefore established practices (Geels, 2011), which is an observation also reflected by the findings of this paper and earlier studies, given the lack of policy aimed at SEI. However, the findings also suggest that policymakers can act as catalysts for change by facilitating and aggregating innovations coming from the niche level, which in turn challenge and evolve the socio-technical regime itself. Whether policymakers decide to do so is of course another matter, as the policymakers interviewed voiced both a lack of clarity on what SEI was, what its actual impact is, and the need to satisfy the concerns of many stakeholders. Thus, rather than viewing policy as purely enabling incremental rather than radical innovation, as is arguably implicitly assumed in the existing MLP literature (Geels and Schot, 2007), we should instead conceive of a situation where policy can and does enable (and act as a barrier to) both. Certain policies create a context that supports incumbent and more incrementally oriented forms of innovation, while other policies serve to promote radical niche innovation and hence socio-technical change. For example, education is noted as a key driver of user innovation and serves to educate citizens on the growing environmental and social challenges we face, thereby

creating an impetus for action. However, as policymakers face positive demands from various stakeholders, a form of “organized hypocrisy” emerges that is not easy to overcome, since “success in one dimension often decreases success in another” (Brunsson, 2003, p. 204). At present, sustainable innovation policy seems to gravitate towards incumbents. However, this not only due to their scale and resources but also to lack of awareness among policymakers of SEI, as well as skepticism regarding the potential impact of these user innovators, and not least due to a policy logic oriented towards viewing consumers as demand-side actors rather than as potential suppliers of sustainable innovations.

If we review the literature on proposed policy tools for enabling end-user innovation, a diverse range of insights emerges from the literature, some of which were echoed by the policymakers interviewed. These include the need to incentivize the diffusion of user-developed innovation (de Jong et al., 2015a), the need to update legal rights so as to encourage user innovation (Torrance and Hippel, 2015), and the need to update statistical indicators to capture user innovation (Gault and von Hippel, 2009). In addition, policy can also act as direct enabler of or barrier to niche innovations by easing or restricting legal and infrastructure-based limitations on novel means of production (Blanchet, 2015). Bogers, Chesbrough and Moedas (2018) add to these proposals by arguing that there is a need to create better linkages between science and innovation, to embrace uncertainty by funding frontier science, to encourage private individuals to invest in higher risk innovation and, finally, to focus on creating a more open framework for emerging technologies that would otherwise typically enter highly regulated markets. However, if we compare these policy proposals with the perceptions of the policymakers interviewed, an apparent disparity emerges in their respective foci. For while studies on user and open innovation are dedicated to

identifying concrete initiatives for promoting end-user innovation, the respondents noted more immediate concerns. If end-user innovation – and specifically SEI – is to be the focus of policymakers, there is a need to raise awareness of SEI within policy circles. This awareness-raising process should involve establishing a clear conceptual framework, developing a database of best practices, and changing the perception of end-users from that of passive recipients to active participants of innovation. There is an urgent need for a more precise and conceptually clear framework that policymakers and laypeople can navigate more easily. The current abundance of theoretical definitions and concepts seeking to explain the involvement of end-users in sustainable innovation only serves as a barrier to the proliferation of the precise concept. To achieve more conceptual clarity, it is necessary to develop a more precise outline of the primary aim of the innovation process and the role of the drivers of this innovation process, i.e. end-users, firms and/or policymakers. This conceptual framework could be supported by a database of best practices, including examples of independent and facilitated SEI. This would allow end-users, companies and policymakers to gain a more practical understanding of the concept. Such best practice cases could additionally act as source of inspiration, spurring more end-user innovation and integration. A best-practice database could include subdivisions according to different sectors, specifying the scope and nature of the innovating organization and thereby enhancing the usefulness and relevance of the database. Such an approach may itself serve to challenge the prevailing perception amongst policymakers of end-users as passive recipients. This in turn could subsequently inspire the need to revisit existing policy measures with a view to better encompassing an active role for end-users. The more immediate concerns that policymakers raise with regards to SEI (or end-user innovation in general) include a lack of awareness of what SEI is, and more importantly how sustainable end-user innovation diffuses or is marketized. Without such awareness, SEI would be

a hard sell in most policy settings due to demands for a proven economic, social and/or environmental utility. Thus, while the role of end-users in driving sustainable innovation may be increasingly accepted within the literature on sustainable innovation (Boons and McMeekin, 2019), this has yet to spill over into the policy domain – especially among policymakers focused on sustainability.

Other areas highlighted by policymakers regarding ways to enable more SEI included ease of funding and diffusion mechanisms. Firstly, policymakers recognized the necessity of developing flexible funding schemes targeting SEI, an observation strongly echoed in academic literature. Heiskanen et al. (2013), for example, note that current funding schemes have been deemed too inflexible and burdensome to facilitate end-user innovation and integration effectively. Instead, it is proposed that political institutions should build funding schemes with limited formal requirements and complexity of application in order to provide easier access to funding for end-user innovators. In accordance with the proposed reduction in the scope and requirements of the funding process, funding schemes should mainly provide micro grants. This would reduce the initial financial barrier to SEI and thus encourage more end-user innovation. Policymakers could also draw upon the growth of the alternative finance sector (e.g. peer-to-peer lending and crowdfunding) and utilize it as a potential co-financier of sustainable projects and ventures. Secondly, policymakers identified the lack of diffusion mechanisms for sharing end-user innovation as a major barrier, confirming a finding of de Jong et al. (2015b). This lack of diffusion mechanisms not only acts as a barrier to pushing new ideas forward but also renders it difficult to keep end-users motivated by preventing them from seeing the real benefits of their actions. One opportunity could be the creation of online fora and portals for end-users to share their innovations

and ideas. At present, such portals are user-created and therefore typically limited to a relatively small group of individuals. However, policy actors could feasibly create larger platforms, potentially in cooperation with businesses. In addition, crowdsourcing innovation challenges could also be implemented as an effective means to elicit end-user insights to inform policymaking.

6. IMPLICATIONS

A growing body of literature illustrates the diverse ways in which end-users innovate towards sustainable ends in a diversity of fields, including heating (Hyysalo et al., 2017), energy (Heiskanen et al., 2013), food (Tencati and Zsolnai, 2012), and mobility (Ross et al., 2012). However, in spite of this, policy aimed at SEI has remained lacking, which arguably stifles the opportunity to fully exploit these niche innovation actors towards driving socio-technical regime change.

Employing the MLP to conceptualize the role of users and policy in driving socio-technical regime change, this article confirms that policy does at present appear to be aimed at maintaining the current socio-technical arrangement. However, the findings also suggest that policymakers can and do enable niche innovation, albeit rarely in the case of SEI because there is a mismatch between the insights emerging from the academic literature and those needed by policymakers in order to convince them that SEI is an innovation actor worthy of policy attention. The study thus proposes that we should seek to better understand the awareness and needs of the policymakers whom we are seeking to influence in order to avoid such mismatches. In the case of SEI this is apparent in the disconnect between the assumptions present within an increasing body of literature focused on sustainable innovation and the assumptions of policymakers regarding the potential of

end-user innovation in driving sustainable change. Research aimed at attaining better understanding of the needs of policymakers is thus strongly encouraged.

From a practitioner's perspective, the lack of policy action aimed at enabling SEI offers the potential for other actors to step in to fill the void. For example, incumbent industries could play a role as enablers of SEI, thereby serving as a possible source of innovation insights otherwise not available. The division between an incrementally oriented socio-technical regime led by incumbents and a radical innovative niche (Geels, 2011) creates a dichotomy that is not necessarily reflective of how a sustainable transition process could occur. Rather, there may from an early point be a symbiotic relationship between incumbents supporting niche innovation agents in various capacities (see, for example, Hockerts and Wüstenhagen, 2010). Hence not only can policy actors play enabler and barrier roles simultaneously, but policy itself is also enacted across various levels, resulting – for example – in certain incumbents supporting socio-technical change while others actively seek to oppose it. Further future research, not only into how individual incumbents tap into SEI, as exemplified by Goodman et al. (2017), but also into how this can be achieved systematically, for example through corporate venturing, would go a long way to creating a more supportive context for SEI.

Finally, and in line with the observations of Bradonjic et al. (2019), more in-depth case-based research would be welcome into how and why policymakers perceptions differ by policy sector and geographic area. Given the fact that research findings and technologies diffuse at different rates, a cross-country and cross-sector comparison could provide valuable insights into how

perceptions of SEI change and whether, as assumed in this paper, increased awareness translates into more tailored policy.

7. CONCLUSION

Demands on policymakers remain as great as ever, with multiple voices competing to highlight the value and importance of their specific areas of interest when, given finite resources and time, not all demands can be met and meeting one demand often challenges another (Brunsson, 2003). With such a multiplicity of interests lobbying for policymakers' attention, new ideas and insights are arguably at a disadvantage, since they not only need to compete with established discourses but must also initially prove their worth on multiple fronts. Indeed, this seems to constitute a significant policy hurdle for a concept such as SEI, which remains compartmentalized and conceptually vague. A second concern for policymakers is that the business case of SEI remains unproved in their eyes and important questions remain, including whether end-user innovation truly translates into radical innovation and whether such innovations can evolve into viable business models rather than remain a hobby for enthusiastic end-users. Even if these issues are addressed and settled with empirical evidence, however, there is also a need to prove the superiority of this type of innovation over other models, including the traditional incumbent innovation type characterized by the vertically integrated innovation model. If policymakers are to change legal regimes to encourage more end-user innovation, for example by slackening intellectual property (IP) rules, it is necessary both to show that IP acts as a barrier to end-user innovation and also that changing current legislation will yield a net positive result. From a policymaker's perspective, the key concern does not seem to be whether end-users are able to innovate for sustainable ends but whether such innovations can translate into viable business

models, i.e. models that justify policymakers' support in the context of limited resources and in competition with other stakeholders' interests.

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