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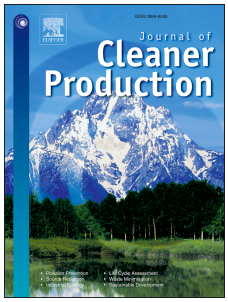

Everyday experimentation in energy transition: A practice-theoretical view

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Highlights:

- Experimentation opens up possibilities for participation for a wide range of climate policy actors

- Experimentation is linked to climate action initiatives and to ruptures and discontinuities in everyday life.

- Individuals hold potential to contribute to climate policy as locally embedded actors who can innovate and distribute low carbon solutions.

- Theories of social practice hold high relevance for understanding experimenting and local adaptation of generic technology

EVERYDAY EXPERIMENTATION IN ENERGY TRANSITION: A PRACTICE-THEORETICAL VIEW

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Abstract

Research on sustainable practices has attracted increasing interest as a way to understand energy demand and transitions towards sustainability. In this paper we elaborate on how practice theories can inform the discussion of experimentation. Practice theory suggests that the everyday life of people appears recalcitrant. Practices are robust, resilient and have multiple, historically formed constituents and are thereby difficult to destabilize and change quickly. The making and breaking of links inside and between practices is highlighted, as is the need for enduring, multi-sited change efforts. Practice theory further helps us to better understand the constitution of new, levelled forms of expertise, the distributed nature of experimentation and the enrolment of citizens as active participants in sustainability transitions. We have operationalized and examined these suggestions in a Finnish research project related to climate change mitigation and energy use in detached houses. We report specific modes of experimentation and innovation, including user innovations, and the shared resources of situated expertise, the collective and shared processes of empowerment and the ways in which normality is challenged by ruptures in everyday life. Based on the results, we derive suggestions for effective policy interventions. We also bring forward a set of generic suggestions for more sensitive, appreciative and effective public policies on sustainability transitions and cast experimentation in a particular and partial role in such policies.

Everyday experimentation in energy transition: A practice-theoretical view

1. Introduction

Overarching changes are needed in patterns of energy supply and consumption if climate change is to be mitigated. This requires investments both in energy efficiency and in new renewable energy technologies but arguably also changes the structure of consumption and production. While shortcuts to needed changes – such as heavy carbon taxation – are conceivable, their use appears hampered by the lack of a broad consensus. In much the same way, theories and approaches that build on individual choices summing up to a broad social change have been discredited (Shove & Walker, 2010; Hargreaves, 2011). More realistic policy options may be found by approaching climate change mitigation as a sociotechnical transition that consists of a gradual and polycentric change towards less carbon-intensive everyday practices (Brown et al., 2003; Hargreaves, 2011; Nevens et al., 2013; Shove et al., 2012).

Thus far, sociotechnical transitions research has highlighted how the requisite system change is characterized by gradual evolution in multiple overlapping areas that constitute the sociotechnical regime (Kemp et al., 1998; Geels & Schot, 2007; Weber & Rohracher, 2012). It has further outlined how technological niches can replace or reconfigure the dominant sociotechnical regime given simultaneous regime destabilization by landscape pressures (Geels & Schot, 2007). Together, the emergence of, growth of and support for niches have become a fervent area of research, including subareas such as the dynamics of grassroots innovation and their growth into the mainstream (Hargreaves et al., 2013; Ornetzeder & Rohracher, 2013), and the protection of novel alternatives in niches through shielding, nurturing and empowering them (Smith & Raven, 2012).

Experimentation and embedded forms of social learning have surfaced to form a new approach to instantiate and support change within sustainability transitions (Brown et al., 2003). Rather than building on informed choices towards sustainability, experimentation is deemed to offer opportunities to assemble, trial and gradually develop workable, suitably easy and more sustainable alternatives. Literature on experimentation has highlighted the importance of limited scale (Brown et al., 2003), extended duration (Brown et al., 2003), particular arenas of experimentation (Nevens et al., 2012), and the multiplicity and heterogeneity of different actors (Brown et al., 2003; Scott et al., 2012). Accordingly, new, more sustainable solutions may emerge through trial and error, gradual alteration, co-creation and open-ended experimentation.

Such a notion of experimentation requires a clear conceptual differentiation between *experiments,* as in behavioural sciences, and *experimentation,* as part of theories of sociotechnical transitions. It also requires empirical studies of the forms and outcomes of everyday experimentation. In this paper we develop such a distinction by using a version of practice theory that Shove and colleagues (2012) have developed. We ask the following questions: 1) How does social

practice theory guide researchers in the study of experimentation in sustainability transitions? and 2) What kinds of expertise does the practice-theoretical approach to sustainability transitions suggest, anticipate and allow? Beyond this conceptual effort we ask and provide empirical results on a further question: 3) What kinds of experimentation do citizens engage in in the area of low-carbon living?

The theory of social practices has gained increasing recognition as a frame for sustainability research and policy (Shove, 2003; Gram-Hanssen, 2011; Spaargaren, 2011; Hargreaves, 2011; Strengers & Maller, 2012; Shove et al., 2012; Strengers & Maller, 2014). These theories do not see society as consisting of human individuals and their attitudes, behaviours and choices (the implicit 'ABC' model of rational action theory [Shove & Walker, 2010; Shove et al., 2012]) but rather posit that it is practices – as intertwined configurations of material, competency, social relations and cultural meaning – that are the basic units of which society is made (Shove et al., 2012; Reckwitz, 2002; Nicolini, 2012). Practices are seen as relatively sustained and routinized ways of enacting a set of elements. It also follows that an overhaul of unsustainable practices faces great challenges as practices are often firmly anchored by multiple, overlapping ties to the social, technical and cultural fabric of everyday life. According to practice theory, much innovative and destabilizing work needs to be done before individuals can make choices towards sustainability in regard to their unsustainable practices (Scott et al., 2012).

Despite similarities and cross-referencing vocabulary, sociotechnical transition and social practices literatures posit a different outlook for experimentation. Sociotechnical transition calls for entrepreneurial niche–level actors to put forward alternative, more sustainable solutions. Even if authors such as Nevens et al. (2013) recognize citizens and users 'as a source of creation', innovation and experimentation are suggested to take place in niches, particular experimental sites or arenas and in conjunction with transition policies. Shove and Walker (2010) argue that as sociotechnical transition literature draws on innovation studies, it ends up endorsing a policy paradigm that centres around niche developments and the diffusion of technology. Transitions in practice, on the other hand, suggest that practices are performed and technologies are integrated into 'doable' and rhythmic mixes in everyday life (Jalas, 2006; Shove et al., 2012). Transitions in practice could be better argued to imply local innovative ways of taking technical solutions into use in everyday life rather than developing them in a particular (protected niche) selection environment, set apart from an everyday life context.

Practice theory may help create a new understanding of experimentation that complements existing literature. Aiming to develop this line of thinking in operational terms, we contribute to discussions on how to set up and organize research and engage with subjects and sites that are widely distributed and potentially contain the resources and solutions required for change. Such an aim affects the understanding of how to conceive of *experiments*, *experimenters*, *experimentation* and the knowledge created through experimentation. We anchor our discussion in a four-year research project 'Local adaptation and

innovation-in-practice in energy efficiency and carbon neutrality' (LAICA), which focused on energy practices in Finnish detached housing and developed six interlinked research positions on experimentation in climate policy from a practice-theoretical orientation.

2. Everyday practices, practice theory and experimentation

Practice theory suggests that the everyday life of people is recalcitrant to traditional scientific experimentation. Practices are robust, resilient and have multiple, historically formed constituents and are thereby difficult to destabilize and change quickly (Shove et al., 2012). Individuals, on the other hand, are conceptualized as the carriers of social practices (Warde, 2005; Shove, 2003; Hargreaves, 2011) and can hardly to be expected to lead and cause social change. Rather, the sources of the change of practices lie within the practices themselves and the way the elements of practices are available and configured (Warde, 2005; Shove et al., 2012). Yet, the role of experimentation remains open: if practices are robust, self-reproducing and gradually evolving, what is experimentation and who has a leverage point in experimentation on practices? Warde (2005) offers the following two distinct sources of change in practices, which both imply differently skilled practitioners hacking and remodelling everyday life: a) the cross-fertilization of practices as individuals carry out and participate in several practices, and b) differences in the will and skill to reproduce practices.

While these suggestions do not necessarily imply conscious and active experimentation in everyday life, practice-oriented design research is more explicit and offers tentative answers. A shift from products to practices emphasizes 'doings' of different kinds and the active, ongoing integration of the elements through which user needs arise and normality is defined (Scott et al., 2012; Pettersen et al., 2013). As the object of design is redefined to be integration and co-alignment within and between practices, creativity and design authorship are also transferred from professional designers to individuals who are 'practicing everyday life' (de Certeau, 1984; Hartswood et al., 2008; Botero & Hyysalo, 2013; Pettersen, 2015; Pettersen et al., 2013). In terms of the role of the (design) researcher, practice-oriented design underscores engagement with the change and stability in the (re)integration of the elements of practice. This includes, for example, identifying likely moments when routine practice has a high propensity to change and the sites in which this happens (Jalas, 2006; Scott et al., 2012); surfacing, articulating and supporting innovative alternatives (Botero & Hyysalo, 2013; Scott et al., 2012); facilitating the local adaptation of generic technologies (Törpel et al., 2009; Heiskanen et al., 2014); and the remodelling and reconfiguring of everyday routines and schedules to fit new alternative solutions (Scott et al., 2012; Pettersen et al., 2015).

These premises entail two tenents that have been central to pursuits in collaborative design. First, researchers have to rely on and amplify practitioners' capacity to take design into their own hands, either in part or wholly (Törpel et al., 2009; Hyysalo et al., 2016). Second, as Scott et al. (2012, 286) note, 'practice-

oriented design research should ideally be conducted using an iterative, dynamic, longitudinal form to support the ongoing development of practices in real life … over time'. Whilst designing for sustainable practices has thus far only envisioned such an approach and initiated limited, experimentations lasting a few weeks (Scott et al., 2012; Pettersen, 2013; Pettersen et al., 2015), more extended participatory design approaches have been pursued in other domains (e.g. Hartswood et al., 2000; 2008; Botero & Hyysalo, 2013). In addition to the elements outlined above, this research has stressed the importance of departing from the reality of existing practices, actively seeking out shoots and seeds for change, offering the means to cultivate and amplify them, the importance of addressing different elements of practice and of their interconnections in tandem and building (necessarily varied) mechanisms for dealing with continuity and contingencies in change. It follows that practitioners need to retain the driver's seat and remain as the prime experimenters in their everyday lives. The gradual and long-term transformation of practices *cannot be realized* but only augmented through design (or any other) experimentation or intervention (Hartswood et al., 2008; Botero & Hyysalo, 2013). Even though handles for seeking change may be many, experimentation in everyday life can be understood as the creative, situated coping with and gradual improvement of the everyday life that individuals are confronted with.

This position also helps to clarify a standing vis-a-vis behavioural theories. Instead of inquiring what kind of individually-held preferences and knowledge lead people to adopt sustainable solutions, individual choices are regarded to reflect and be conditioned by particular locations, moments in time and other contextual factors. 'Preferences' are thus not regarded as values held by individuals but as properties of and propensities brought about by practical arrangements. It follows that public policy can be made by changing the availability and circulation of the elements of practices and relations between practices (Shove et al., 2012). A practice-theoretical approach to experimentation could thus potentially focus on disruptions, challenges and changing conditions in everyday life as triggers of creative experimentation by individuals.

Who then qualifies as an experimenter? Theories of sociotechnical transitions tend to conceive of experimentation as more or less concerted efforts to assemble new, more sustainable solutions in particular niches and visionary settings. Even when citizens and users are included and invited to contribute, qualifications follow. For example, Nevens et al. (2012) suggest a concept of transition arenas that includes 'local frontrunners that are considered as engaged visionary people with diverse backgrounds'. Practice theory, in contrast, situates creativity in everyday life and does not pose such qualifications per se (Shove et al., 2007; 2012). This is not to say that citizens' everyday experimentation would not benefit from being organized – as it is in 'transition towns' or various 'labs' – rather than being left in the hands of a locally-situated individual hacking, developing and rethinking her or his practices. At least two reasons for this can be pointed out. Firstly, while creativity may be widely distributed, individuals depend on collective resources and communities of different kinds (Heiskanen et al., 2010; Hyysalo et al., 2013b; Hyysalo et al.,

2016), the details of which remain an empirical question. The second point is normative: the abilities to respond and adapt to issues such as climate change are certainly not evenly distributed, and public policies thus need to do more than push people to innovate local solutions by themselves and for themselves. Indeed, practice theory recognizes that others actors can make interventions. These include attempts to re-craft elements of unsustainable practices into more sustainable ones in order to seek to substitute an unsustainable practice with a more sustainable one or to change how practices interlock (Shove et al., 2012; Spurling & McMeeking, 2014). Practice theory opens up several handles for intervention: for each practice element and interlinkage, measures can be targeted to complicate unwanted practices, to protect or empower less resource-intensive ways of practicing and to intervene in the meanings, skills or things that aid in the re-crafting, substitution or interlocking process (see e.g. Strengers et al., 2014; Spurling & McMeekin, 2014; Bulkeley et al., 2014).

Concrete examples of interventions compatible with practice theory tend to use a mix of both the means to destabilise existing practices and to contribute to new ones. Strengers and Maller (2012) describe the restructuring of daily living in a hot climate ecovillage that utilizes natural drafts and shaded areas in such a way that managing with natural ventilation becomes part of a normalized routine more easily. Similarly Spurling and McMeekin (2014) illustrate how the introduction of congestion charges, the building of bike lanes, and bike and fast public transit hubs, together with campaigns to increase bicycling, are needed to gradually increase the share of car drivers who take up bicycling. All these interventions are targeted at multiple elements of practice at the same time in order to gather momentum, destabilize practices and make change happen.

All in all, practice theory sides with sustainable transition research with respect to aiming to destabilize resource-intensive practice complexes, to further less resource-intensive alternatives and to achieve systems level change. The two approaches have a further commonality in real-life experimentation, yet practice theory's potential repertoire for engagement is more fine-grained, versatile and anchored to the time–space of the concrete practices in question. It also places genuine trust in the inventiveness of practitioners themselves. However, approaching experimentation through such a lens requires particular research orientations and designs. We suggest that important policy-relevant distinctions appear when we consider 1) the differences in the perceived ability of citizens to innovate solutions for their everyday concerns and 2) the degree and way in which policies either challenge or build on existing practices. We shall next introduce both LAICA, as a practice-theoretical research project, and our case and then, in section 4, we shall elaborate on how practice theory informs empirical research on experimentation.

3. Calling for everyday experimentation in sustainable energy practices: The case of LAICA

LAICA was a research project funded by the Academy of Finland that ran from 2010 to 2014 and specifically departed from the reality of social practices. This practice theoretical maxim meant that research was purposefully targeted at

settings where ordinary people had already shown action or made initiatives towards more active and sustainable energy citizenship – be they old or emerging elements of practice. Moreover, the project sought to identify contextual factors that underlie and could support or even force experimentation in everyday life.

The focal area for LAICA was energy use in Finnish detached housing. Residential heating is responsible for a considerable part of household greenhouse-gas emissions (GHGEs) (Huppes et al., 2006). The detached house was also seen as a material and institutional arrangement that supported experimentation. Houses are sites of constant remaking and, despite regulation, relatively open to various modifications and innovations. The range of aspects in low-carbon living covers practices ranging from cooking, washing and indoor comfort all the way to the more technical modification of heating systems and improved insulation. The practice-theoretical orientation thus guided the project towards research foci that would allow paying attention to the links between the elements of practice and their potential for continuity and for reconfiguration.

Finally, LAICA engaged with an ongoing initiative by five Finnish rural and small town municipalities to significantly reduce their carbon emissions by 2030 (Heiskanen et al., 2015a). The Carbon Neutral Municipalities (CaNeMu) initiative offered a social setting in which the primacy of top-down governance had already been challenged and various new forms of local climate governance and climate action were anticipated and began to take form. The CaNeMu initiative thus provided insight into how such public initiatives impact and support experimentation in everyday life. The practice-theory sensitivity thus geared the project towards long-term experimentations, such as the CaNeMu initiative, which could provide continuity for reconfigurations of everyday life

4 Finding, supporting and prompting experimentation in everyday energy practices

Practice theory as an orientation led to specific views on social change. LAICA as a project purposefully targeted research at different aspects of practice: historical preconditions, everyday enactments, innovations and the most novel developmental directions. It accepted the contingent and uneven development of practices and that apt interventions would depend on ongoing changes in social practice, as well as on its relations with its neighbouring practices.

Table 1 summarises the LAICA project in terms of research positions and empirical topics of study regarding experimentation. In terms of the innovativeness and relative prominence of active change efforts, practitioners are categorized as either (1) ‘evolving local subjects’ or (2) ‘radical subjects’. On the horizontal dimension, research positions are organized in terms of how strong and visible a role policies are expected to play, varying from (A) practices with no direct link to policy, to (B) active attempts to amplify existing sustainable practices and finally (C) seeking out windows of opportunity and

ruptures in everyday life and making deliberate interventions to challenge citizens and initiate change.

Table 1: Practice-theoretical positions on experimentation and the empirical foci of the investigation and intervention in the LAICA project (2010–2014)

	Independent but potentially policy-aligned practices	Policy as amplification	Policy through interventions, destabilization and windows of opportunity
Evolving local energy subjects	**A1: Position** Practices change in an evolutionary way and have multiple, historically formed constituents **A1: Empirical focus** The evolution of heating practices - Solid-wood based heating - The domestication pathways of renewable energy technology	**B1: Position** The reconfiguration of practices requires empowerment, peer support and the concretization of the change in practice **B1: Empirical focus** Easy first steps for novices of climate action - Peer learning via open homes and energy walks - Joint purchases of PV equipment - Self-building courses for solar thermal collectors	**C1: Position** Practices are recalcitrant; disruptions can lead to practice change **C1: Empirical focus** Crises and disruptions - Electricity blackouts - Ownership changes - Weather events
Explicit change efforts by radical energy subjects	**A2: Position** Practices are locally reconfigured through innovation and local adaptation **A2: Empirical focus** User innovation in heat pumps, pellet-burning systems, solar heat and solar PV technology	**B2: Position** Dedicated material and social resources allow radical energy subjects to innovate **B2: Empirical focus** Peer-to-peer learning networks - Internet forums on heat pumps, pellet-burning systems and solar technology	**C2: Position** Long-term experiments create expectations and provide continuity for the reconfiguration of everyday life **C2: Empirical focus** Arising social expectations for climate action - Carbon neutrality targets and CaNeMu - The visualization of CO2 emissions on a village level

A1. Evolving local energy subjects: solid-wood-based heating systems and the domestication pathways of more novel energy systems

In Finland solid wood is the traditional way of heating detached houses during the cold periods of the year, from October through to April. A significant share of the stock of detached houses in Finland has been built with solid-wood heating systems as the primary source of heat (OSF, 2016), and the use of wood actually increased by 20% between 1994 and 2008 (Torvelainen, 2009).

To better understand wood-heating practices and the further potential they may hold for lower-carbon heating, Jalas and Rinkinen (2013) approached wood-fuelled heating systems as the sociotechnical ordering of time. Drawing from the research on the reconfiguration and temporal structuring of practices (Shove et al., 2012), they analyzed the sequences and rhythms that organize the work of domestic heating, its synchronization with other daily activities and tempos as the subjective experiences of time in these activities. The study was based on a large, pre-existing Finnish free-form diary collection. The results indicate that domestic energy technologies become useable and useful through gradual embedding that involves the temporal organization of everyday life. Moreover, the endurance of traditional, inconvenient practical arrangements can be understood and appreciated through the multiple links to everyday life that these entities have as they coordinate other practices and are coordinated by them. Solid wood thus holds the potential to grow as a heating form in settings where its practical arrangements build on tradition, but it is unlikely to be used in settings without such embedding.

Using a similar lens to that of the incremental change in heating systems, Juntunen (2014) studied the adoption of domestic energy technology. Drawing on interviews and Internet material from household and summer-cottage owners in Finland, the study shed light on how renewable energy technologies were adapted to everyday practices and local conditions. In the examined households' adoption processes, the acquisition of one renewable energy source was later followed by the addition of another energy renovation or technology. The domestication processes of multiple technologies thus became linked and led to the increasing use of new technologies without a stable final point. This process was conceived of as a domestication pathway. Albeit Juntunen addresses innovation and change, his view of change builds on and is conditioned by existing local material and the human aspects of energy practices. These findings on gradual reconfiguration pathways in regard to changing heating systems indicate the need for, for instance, commercial actors to use information on existing renewable energy systems to target their sales efforts.

A2. Distributed skills and expertise in heating: user innovation by radical energy subjects

As a project, LAICA was designed to study change and innovation arising from practice. Hence (and beyond the previously described view of incremental slow change) research efforts were directed at the innovative activities of locally situated house owners and users.

In the past, active groups of citizens have significantly impacted the development of renewable energy systems (e.g. Ornetzeder & Rohracher, 2006, 2013; Jorgensen & Karnoe, 1995; Sayfang, 2010). In the LAICA project Hyysalo et al. (2013a, 2013b) charted user inventions and modifications in renewable home heating systems: heat pumps, wood-pellet burning systems and solar technology in Finland (from 2005 to 2014). In total, 210 inventions or modifications were found that improved the efficiency, suitability, usability, maintenance or price of

the systems. The analysis clarified that these users were able to successfully modify, improve and redesign almost all of the subsystems in these technologies. In terms of experimentation, these citizens held considerable expertise in their domain areas and were active in technical experimentation with the heating systems in their local settings. Their practices or expertize needed no added policy measures. Raising the visibility of their actions in public and academia, however, has been inspirational for other citizens, policy makers and researchers in that it has countered the tendency to assume that citizens remain passive in energy matters.

Whether evolving subjects or radical, change-oriented subjects, both research positions A1 and A2 assume that the subjects are not driven by climate policy objectives. While their practices may be coherent with climate policy, the relationship is not tight. The findings may set examples for policy regarding what citizens can do regarding climate change. They may also help frame further experimentation, but the potential to directly support these actions with policy interventions appears limited. Next we move to discuss column B and individuals who are brought into contact with policy efforts towards the diffusion and amplification of best practices in domestic heating.

B1. Peer learning by novices

While LAICA hence demonstrated both the existing trajectories of change and some locally situated, more radical actors who were effective in technology development, the policy goal of making use of and distributing innovative, low-carbon energy practices called for attention to and modulation of the peer effects of the diffusion of such practices. Several interventions of LAICA sought to create critical mass and peer support for change.

Firstly, the insights from home heating practices were connected to an ongoing bottom-up initiative, CaNeMu, with which many of the researchers had worked before. The resulting interventions targeted multiple areas in moving towards more sustainable home heating practices. The lack of first-hand local peer experience of renewables was identified as one potential hindrance to energy renovations. Previous research results on the matter were fortified by the findings on the popularity of Internet forum peer advice (see B2 below). As a response, the project created a localized version of the Open Homes concept for Finland called ‘Energy Walk’, where local community members would give a guided tour around local houses that had volunteered to show the heating improvements they had made (Heiskanen et al., 2015b).

Secondly, LAICA worked towards the collective agency of citizens. While the project was ongoing, active citizens in the city of Lappeenranta organized a large joint purchase of solar panels from Germany to significantly cut panel and installation costs. This emerging good practice was augmented by organizing the second effort of CaNeMu in South-West Finland and creating a model for how it can be organized in the future.

Thirdly, LAICA researchers engaged in promoting collective DIY action around renewable energy sources. Leaning particularly on the Austrian success with self-building activities (Ornetzeder & Rohracher, 2006), Jalas and colleagues (2014) examined the role of vocational courses in building solar heat collectors. Based on a survey of several courses over a 12-year period, they claimed that courses offer an easy first step towards a gradually deepening involvement in renewable energy. The research project was thus engaged in promoting such courses in new locations by establishing connections between established teachers and new schools.

B2. Building up collective resources through platforms of peer learning

While research activities in the LAICA project had documented a wide range of user innovations in heat-pump technology, there was a key additional insight: their capacity to carry out their inventions and modifications owed much to their exchanges at user-run Internet forums (a new and proliferating type of digital setting). Hyysalo et al. (2013b) and Heiskanen et al. (2015b) found that discussion forums dedicated to specific renewable home heating technologies in the Finnish language[1] featured roughly 500 000 posts with a formidable amount of page views: over 150 million in an eight-year period. These online forums help otherwise dispersed and heterogeneous users to provide formidable peer support for scaling, choosing, comparing, maintaining and modifying these systems. These exchanges help some of the most motivated users to 'become inventive' and successfully pursue demanding modification and innovation projects on renewable home-heating technologies.

Many of the innovative users also gave the deepest layer of peer support to other users on, for instance, installations in non-standard settings and hybrid systems that combine multiple renewables to cover heating needs. In this capacity these active energy consumers and the Internet communities they have created have substantially aided the overall diffusion of distributed renewable energy technologies (Hyysalo et al., 2013a; Hyysalo et al., 2013b; Heiskanen et al., 2015b; Juntunen, 2014).

The CaNeMu intitiative, energy walks, self-building courses and the thriving Internet energy communities exemplify the possibilities of policies of amplification, which thrive on multiplying successful engagements with energy technology and climate policy (Hillgren et al., 2011). In other words, policies of amplification work on creating exposure to success stories, distributing 'the recipes' and granting legitimacy to new kinds of engagements by citizens. They help practitioners and organizations (such as municipalities) to gain new expertize and reconfigure the elements of their practice, and help them to join in and sustain their everyday experimentation with renewables.

[1]A relatively small language, spoken by 5.5 million people globally.

C1. Disruptions and the evolving energy subjects: electricity blackouts, weather events and ownership changes

The third column (C) of table 1 poses a new set of questions about the suitable occasions and conditions for novelties to emerge and be adopted, and for disruptions in everyday life to take place. While some conditions may be created by active policy (C2), conditions also include less controlled and even haphazard events (C1).

Prior research has proposed various moments of discontinuity and disruption crises as potential occasions and leverage points for changing energy practices (Shove et al., 2012; Strengers & Maller, 2011; Strengers et al., 2014; Ornetzeder & Rohracher, 2013; Marechal, 2010), largely stemming from the evidence from the landscape changes in energy consumption patterns that occurred in response to the '70s oil crisis (Ornetzeder & Rohracher, 2013).

Such crises can alter the conditions of everyday life practices. LAICA addressed natural crises, including special events in energy demand (cold days) and supply (blackouts). While severe crises cannot and clearly should not be planned, they nevertheless can be observed and they reveal knowledge about innovativeness and sustainability transitions. Moreover, while radical policy measures (such as the restriction of car use due to air pollution) exist, it is also becoming obvious that climate action includes measures of adaptation to increasingly radical changes and crises of a different kind.

To research the proposition that crises breed practice change on a more mundane scale, Rinkinen (2013) examined the discontinuities and disruptions in domestic heating during long blackouts and asked whether power failures could serve as an entry point to the transition dynamics of practice. Her interview results indicate that blackouts activate unused skills and resources, propose uncommon meanings for electricity and heat, and revive dormant practices. However, power cuts were not found to cause explicit, persistent changes in heating practices or heating systems. A similar finding was reported by Jalas and Rinkinen (2013) who examined heating practices on a cold winter day. It seems that temperatures below normal and small-scale crises (such as frozen water pipes) prompted little thinking about domestic energy technology or the need for change therein.

The next proposition in the LAICA project was that the ownership changes of houses could spur change in the energy configuration of the household. Even if not crises, they offer a particular window of opportunity: when an ownership change takes place, energy renovations are often considered and carried out (Rinkinen & Jalas, 2015). In line with this, another empirical analysis of ground source heat-pump investments in a major Finnish city over a period of four years showed that these investments occur disproportionally at the time of ownership changes (Heiskanen et al., submitted). These two studies thus clarified what might be the scope that is needed for disruption to lead to changes in energy practices. The ownership study further indicated direct points for further

intervention: targeting real estate agents and real-estate Internet portals for improved information on heating systems and renewal options.

C2. Creating a social context for change: a climate change initiative

Climate action is premised not only upon peer help and learning, and on make-do activities in the midst of crises and disruption but also on organized social interventions, which aim to raise concern and spotlight the need for climate change mitigation and facilitate the adoption of new low-carbon technologies and practices.

The project plan of LAICA was to engage in CaNeMu, a low carbon development initiative for rural municipalities in Finland. This involved both organizing climate activities in the municipalities as well as analyzing the effects of the initiative. Heiskanen and colleagues (2015a) inquired about the expectations of citizens and local politicians regarding a low-carbon initiative. CaNeMu, as a 'low-carbon lab', had exceeded its GHGE reduction targets and had been able to create expectations for low-carbon solutions and activities at a local level. Yet there was also some disappointment about the results achieved (Heiskanen et al., 2015a). LAICA researchers also organised a 'Competition of low-carbon villages': CO2 emission calculations were visualized on a neighbourhood level (Mattinen et al., 2014) and returned to the communities in order to spark collective climate action. All in all, visualizations of emission levels and future emission targets raise social expectations and provide legitimacy and continuity for efforts to seek more concerted and potentially more ambitious and innovative efforts in carbon reduction in everyday life. However, the results from CaNeMu also highlight that 'top-down' initiatives are localized because subjects quickly form new understandings and expectations about the experimentation, much in accordance with the premises of practice theory.

In the previous, we have suggested that quite different research positions can be drawn from practice theory. The differences revolve around how capabilities and resources for innovation are seen to be distributed in society and how policies should be organized in respect to everyday life. Table 2 draws together (1) the types of experimentation that emerged in each research position and 2) what was learned for climate policy intervention.

Table 2: The types experimentation found in LAICA (1) and the key learnings' policy interventions (2)

	Independent but potentially policy-aligned practices	Policy as amplification	Policy through interventions, destabilization and windows of opportunity

Evolving local energy subjects	**A1: Evolution of heating practices** 1) Citizens' competence in enacting, integrating and gradually reconfiguring situated heating practices 2) Policy interventions should simultaneously address multiple elements of practice over an extended period of time	**B1: Easy first steps for novices of climate action** 1) The willingness and ability to engage with new renewable alternatives 2) Practical carbon reduction initiatives are attractive can be multiplied in other locations	**C1: Crises and natural disruptions** 1) Only significant disruptions to everyday life trigger reconfiguration 2) Targeted measures should address identified disruption points: e.g. real estate agents and real estate sales portals
Explicit change efforts by radical energy subjects	**A2: User innovation** 1) Highly competent practitioners who are already experimenting 2) Interventions should recognise the uneven distribution of expertise amongst users	**B2: Peer-to-peer learning networks** 1) Citizens' competence in self- organizing and assisting each other regarding new energy technology 2) Carbon reduction initiatives can be locally developed, multiplied and varied	**C2: Arising social expectations for climate action** 1) Climate policy targets create expectations of and legitimacy and content for climate action 2) Climate policy can seek to create a context for more ambitious climate action

5 Discussion: reframing and rescaling climate policy

National governments have assumed a large responsibility for carrying out climate policy. This easily leads to policy approaches that address the issue within silos of policy sectors and that assume citizens follow the logic of top-down initiatives and change their lives accordingly. Experiments can also be viewed through this lens: they may appear as a necessary step to trial and develop effective policies. Yet such approaches may lack both leverage and legitimacy. As we have argued and demonstrated through our research, individuals hold potential to contribute to climate policy as locally embedded actors who can innovate and distribute low-carbon solutions.

Nevertheless, tapping into such potential requires the rethinking of policy and the role of experimentation. We began by calling for a theory that is sensitive to the situated nature of human action and can supplement and challenge those policy processes which rely on information dissemination. Theories of social practice are among the approaches that allow the examination of how climate change related action (and inaction) is constituted in everyday life (Shove, 2003; Shove et al., 2012). However, the explicit link between practice theory and experimentation has only begun to become articulated in full.

In this article we have outlined an extension to practice theory as a set of research positions regarding experimentation. Through this work we hope to enrich the repertoires available for research and intervention. The reasoning behind the need to pursue such a widening of repertoires lies in the fact that

debates between the relative merits of and compatibility of both behaviour-change and practice-theory interventions can, or at least should, only to some extent be resolved on theoretical grounds (cf. Shove, 2014; Strengers & Maller, 2014). Any assessment of the potential of practice theories in sustainability policies requires efforts to operationalize it. We do not seek to close the debate but hope we have succeeded in creating room for practice-theoretical interventions. At their core, such interventions depend upon a close-range view of citizens who are traditionally mere distant targets of policy. Viewed differently, and approached along the lines we have suggested, individuals can be seen to substantially contribute to sustainability transitions, they can be effectively supported in joining transitions and finally challenged to develop new capabilities.

Considering the premises of our work – essentially the brand of practice theory developed by Warde (2004) and Shove and colleagues (2012) – important insights ensue. Firstly, there is great variety in the capacity of individuals to rework their own practices. This is central to Warde's idea of change in practice. We substantiate such claims with empirical evidence drawn from different research settings. For some individuals, the deliberate hacking of existing technology and everyday routines is prevalent while others engage in finding creative new alternatives when the need arises. Yet, being less presumptive about the capabilities of individuals, they also depend on peer support and need easy first steps for enrolling in new practices.

The findings from the present research indicate many different active roles for citizens. They hold promise for *reframing* climate policy actions; not only diffusing the desired actions top-down to the assumed lives of consumers but also identifying the practices and practice elements that the targeted measures are likely to make a difference to. Both innovations-in-practice and barriers-in-practice exist but are 'hidden' in the current top-down discourse. Instead of diffusion, the challenge lies in finding, making visible, supporting and developing ways to upscale good practices. This strategy appears to have purchase: the number of experimenters and climate policy actors multiplies as more rationalities and forms of action are accredited, and new skills, resources and forms of capital are available for low-carbon transitions.

This would also allow the *rescaling* of climate policy. Certainly climate policy cannot be delegated to become the responsibility of individuals, citizen groups or municipalities alone. However, the development and adoption of climate mitigation measures calls for active ground-level actions to render mitigation efforts meaningful and effective in different local contexts. The overall thrust of the LAICA project was to view diffusion as a process of local reinvention: adjustment to local specifics is often necessary for technology to become accepted, useful and owned. It can also enhance quality, local applicability and new lines of development and even lead to user innovations. These offer ownership and local meaning to the abstract global problem of climate change mitigation: people can become active players (rather than victims), learn new skills and become empowered. Policy, it appears, needs to be reinvented through practice and ongoing experimentation at a local level.

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