Journal of Cleaner Production xxx (2017) 1–9

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives

Kaisa Matschoss*, Eva Heiskanen

University of Helsinki, Finland

ARTICLE INFO

Article history:
Received 29 April 2016
Received in revised form
28 February 2017
Accepted 6 March 2017
Available online xxx

Keywords:
Climate initiatives
Local experiments
Intermediaries
Experimentation
Societal transition

ABSTRACT

Local climate experimentation is a topical issue as cities and rural municipalities are increasingly engaging in various local energy experiments in order to act against climate change. There are high expectations toward experimentation among the policy makers, funders and local actors. Intermediary organisations have an important role as facilitators, brokers, instigators and network builders in low-energy and low-carbon experiments. However, there is still limited understanding of exactly what is the work of an innovation intermediary in contributing to local experiments. Our paper focuses on how intermediaries aggregate lessons and transfer knowledge across experiments. We study how the intermediary activities also help in going beyond existing practice and make a difference beyond the experimental context. Our analysis is based on three empirical case studies in Finland: Smart Kalasatama in Helsinki, Skaftkärr in Porvoo and HINKU with a focus on joint purchase of solar panels. Our research shows how intermediaries balance diverse demands, such as immediate benefits vs. radical change or societal learning, in order to render local climate initiatives more experimental.

© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

1. Introduction

Climate change requires urgent solutions to decarbonize energy supply and demand. Although technological innovation is important, research has shown that it takes decades for a technological innovation to reach mainstream (Geels et al., 2008) due to lock-in to high-carbon technologies (Unruh, 2002). This means that innovations now might not benefit us if they cannot be swiftly tested, improved and deployed in real-life environments. Thus, to support and accelerate the adoption of innovations in the fight against climate change, there are increasing expectations among policy makers toward a 'culture of experimentation', that is, accelerated testing of innovations in real-life conditions (cf. Goh, 2002; Hajer, 2011). This is reflected especially in local climate experimentation as cities and rural municipalities are increasingly taking the initiative in leading on climate action (adaptation and mitigation, e.g. renewable energy, sustainable urban infrastructures) by engaging in various local experiments (Bulkeley and Castán Broto, 2013).

The literature on sustainability transitions has recently begun to emphasize the important role of intermediary organisations as facilitators, brokers, instigators and network builders of climate experiments (Geels and Deuten, 2006; Hargreaves et al., 2013). Intermediaries can offer a stage for ambitious experiments specifically in the energy field, since intermediaries connect local initiatives to infrastructure that is not otherwise available, such as newly built urban environments where several cutting-edge low-carbon technologies and services can be combined. They also bring actors together that might otherwise not have cooperated, and thus introduce novelties and ways of working that might not otherwise have been considered.

Our paper studies the way intermediary organisations facilitate experiments in the context of local initiatives to deploy energy related technological innovations. Intermediaries and their roles in sustainability transition have been studied before and there are quite comprehensive listings of intermediary tasks and roles (Kivimaa, 2014). However, there is still limited understanding of exactly how intermediaries work in the facilitation of local climate experiments. Do their practices merely facilitate the work of other actors, or do they also challenge and disturb the status quo and work to break institutional lock-ins of the dominant regime? If they do challenge existing practices, how do they do this? Our research questions are: (1) how do intermediaries aggregate lessons and support social learning across and within experiments, (2) how do

* Corresponding author.
E-mail address: kaisa.matschoss@helsinki.fi (K. Matschoss).

http://dx.doi.org/10.1016/j.jclepro.2017.03.037
0959-6526/© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

intermediaries deviate from existing practice and (3) how do they work in making local initiatives relevant beyond the experimental context?

We study the work of innovation intermediaries in making local climate initiatives more ambitious, i.e., experimental in a greater number of dimensions than ordinary urban development projects, while acknowledging that all projects involve some degree of innovation and learning. We do so on the basis of three Finnish case studies of nationally acclaimed local experimentation. They feature distinct intermediaries, which have been central in influencing the direction of the experiment. *Smart Kalasatama* in Helsinki has been chosen as a national pilot project in new solutions in renewable energy and smart grid technology in an urban area. *Skaftkärr* in Porvoo has been a leader in introducing energy into spatial planning. *HINKU* is a programme for carbon-neutral municipalities, which originally engaged small municipalities to work toward reducing their CO_2 emissions by 80% by 2030. We show how intermediary organisations contribute to governing the co-production and the diffusion of low-carbon technologies by gaining legitimacy through their facilitating, but occasionally also deploying this legitimacy to push the boundaries of existing solutions.

Our paper contributes to research on experimentation in societal transitions by specifying how the work of intermediary organisations enables the scaling up and integrating innovative niche solutions. Our analysis of experimentation is based on the lived experience of experiment producers and users in their daily work. The second section of this paper introduces the related literature. The third section describes the methods, data and presents the cases scrutinised. The fourth section presents our findings and in the fifth section we discuss our contribution to climate related experimentation, intermediaries and transition literature, as well as the limitations of the data and of the approach, while the last section summarizes our conclusions.

2. Conceptual framework: experimentation and intermediaries in societal transitions

Local climate initiatives can be conceptualized as experiments in strategic niches that can contribute to wider societal transitions (Hodson and Marvin, 2010; Castán Broto and Bulkeley, 2013). This line of thought draws on the multilevel perspective on socio-technical transitions (Kemp et al., 1998; Geels, 2005; Schot and Geels, 2008), where transitions are seen to take place if the dominant regime (i.e. existing institutions, actors, rules and regulations) is challenged simultaneously by pressures from a landscape level (i.e. exogenous factors such as climate change) and from new innovations escaping to mainstream from protected niches (e.g. Kemp et al., 2001; Geels, 2002, 2005). Experiments have a central role in sociotechnical transitions, because they entail learning about new technologies in protected niches (Geels, 2005). Such learning is crucial, since immature technologies struggle to compete with the existing (unsustainable) regime. Due to regulations, infrastructure, user practices and maintenance networks that are aligned to the existing technology, it is difficult for radically new technologies to break through to the mainstream (Geels, 2002, 2014). New solutions - not necessarily only technical ones - that have the potential to change the system may emerge in protected niches where they can be nurtured and matured until they may challenge the existing regime and become part of a new regime (cf. Kemp et al., 2001; Geels, 2005, 2011; Geels and Schot, 2007; Smith et al., 2010). This perspective emphasizes the role of local experimentation, which often takes place in niches, as a source of variation and selection (i.e., "testing") of relevant technologies and retention of the most successful ones through aggregation of lessons learned (Raven et al., 2008).

However, there is a lively debate on how genuinely experimental local climate initiatives actually are: Are they more about local deployment of existing solutions, or do they create genuine variety and novelty (Brown and Vergragt, 2008; Evans, 2011; Heiskanen et al., 2015; Smith et al., 2016). While experiments can bring local sustainability benefits, the expectation that they also might render lessons that can be more generally valuable are the reason why they are interesting from the perspective of broader societal transitions.

Local initiatives can be experimental in several ways. Castán Broto and Bulkeley (2013) define urban experiments as purposive interventions in which there is a more or less explicit attempt to innovate, learn or gain experience. Kivimaa et al. (2015) identified four dimensions of experiments: technology development focused niche creation experiments, market creation experiments aiming to scale particular solutions, spatial development experiments creating new physical environments and societal problem solving and change process experiments. Common features here are novelty in terms of new knowledge and skills (i.e, technology), new institutional arrangements deviating from existing practice and the generation of lessons that matter beyond the local context. We thus define such initiatives as experimental in more ways than one if they include the dimensions of *1) aggregating lessons within and across sites, 2) deviating from existing practice by introducing new practices and 3) impacts beyond the experimental context*.

Aggregation of lessons is a key assumption in the strategic niche management perspective: in order to be experimental in this sense, local climate initiatives should not only develop and adapt solutions locally, but interact and share lessons with other projects within the same emerging trajectory. Typically such aggregation activities include formal and informal activities such as standardization, model building, handbook writing, or site visits, in order to share not only technical skills, but also meanings and institutional arrangements (Geels and Deuten, 2006; Raven et al., 2008; Raven and Geels, 2010). We recognize that such aggregation of lessons is not necessarily innocent, but can create new sources and forms of power as well (Flyvbjerg, 2004). Pooling of different experiences and expertise can also be required within local initiatives, where various expertise and local forms of knowledge and social interests need to be constantly negotiated and effectively integrated (Hodson and Marvin, 2010).

As concerns the *disruption of existing practice*, Raven and Geels (2010) stress the importance of deviation from existing rules in strategic niches: their interpretation of the evolutionary concept of "variation" captures both technical and non-technical novelty. Indeed, Bulkeley and Castán Broto (2013) suggest that the main purpose of some local climate initiatives is to contest existing sources of authority. In fact, experimentation can be used to encourage the emergence of diverse views and values through the engagement of various actors having their own interests and agenda. Thus, experiments can also be regarded as a means through which policies diffuse in order to introduce socio-technical transformations.

Finally, if local initiatives are to make a *difference via impacts beyond the local circle of participants*, they need to be made mobile, transferred and (potentially) scalable. The mechanisms for these processes, however, are not only based on rational data accumulation, but also on collective interpretation and sensemaking (Raven and Geels, 2010). The mechanisms of scaling can also entail advocacy for the locally derived solutions and lobbying for support and facilitation on a broader societal level (Hargreaves et al., 2013). This is particularly the case for climate initiatives focusing on the energy sector, where local and user innovations are often fragmented and struggle to gain societal momentum (Hyysalo et al.,

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

2013; Matschoss and Kahma, 2015; Matschoss et al., 2015).

We would like to stress that local initiatives can be experimental even if they do not meet all the criteria set out above. For example, they can be valuable sources of learning even if they are not scaled up and do not have an influence on broader socio-technical trajectories. However, if experiments are to contribute to socio-technical transitions, at least some of them should make (at least some kind of) difference beyond the circle of people involved in the experimentation. Hence, our interest is in experiments that combine new knowledge and experience, radical departures from existing practice, and some form of influence (either in terms of emulation, avoidance or perceptions of the need to further develop particular solutions) outside the circle of participants.

Concerns for the aggregation of lessons, scaling up and the broader impacts of experiments are often linked to the need for intermediaries (Geels and Deuten, 2006; Hargreaves et al., 2013). While the term has a long tradition in finance and management research, we define intermediaries specifically *as agents in the innovation process between two or more stakeholders creating or supporting a domain for innovation with a task in technology transfer* (Howells, 2006). Intermediaries are expected to enable the formalization of informal collaborations between actors and help to transform their ideas and knowledge, and thus provide solutions that are new combinations of existing ideas. Intermediary organisations act as a medium for the articulation of societal demands for innovation (e.g. Stewart and Hyysalo, 2008; Boon et al., 2011), catalyse innovation in a facilitating capacity (Klerkx and Aarts, 2013), aggregate lessons, provide institutional infrastructure and guide knowledge flows, as well as broker and manage partnerships with actors (Geels and Deuten, 2006; Stewart and Hyysalo, 2008; Hargreaves et al., 2013). These activities are deemed necessary for local climate initiatives to be experimental and to bring about new combinations of local and non-local knowledge and skills that produce socio-technical variation which leads to novel solutions or changes the direction of the transition (Geels and Raven, 2006; Raven et al., 2008; Kivimaa, 2014). Thus, intermediaries are expected to link niches to regimes by offering a domain for innovation (Kemp et al., 1998).

Most of the literature on intermediaries in innovation and sustainability transitions has focused on their roles (Klerkx and Leeuwis, 2009; Boon et al., 2011; Hargreaves et al., 2013; Kivimaa, 2014), which are diverse and sometimes contradictory. Boon et al. (2011, 250) see the position of intermediary organisations as contested because they interact with a heterogeneous set of actors, and their objectives and functions are not as well defined as those of other actors in the innovation system. One of the issues subject to contestation is the neutrality of intermediaries: intermediaries need to be able to maintain a relationship with different actors and in order to be regarded as a serious, credible interaction partner, they need to balance the interests of their organisation with an impartial role in interactions (Klerkx and Leeuwis, 2009).

There is less close-up research on intermediary practices, although there is extensive research on intermediary roles. The practices include how intermediaries negotiate between diverse local interests and how they negotiate between local and non-local interests (Smith, 2007; Hodson and Marvin, 2010; Weber and Rohracher, 2012), as well as between supporting the status quo vs. disrupting or destabilizing it (Kivimaa, 2014). Since intermediaries have several ambiguous and even paradoxical roles (Boon et al., 2011; Klerkx and Leeuwis, 2009), we expect to find various ways, in which local intermediaries balance these roles when working to make local climate initiatives experimental. One potentially interesting concept in this context is that of 'robust action', which refers to transformative action that embraces ambiguity, focuses on short-term accomplishments ("small wins") and adapts to oblique (rather than linear) movement toward sustainable transitions (Etzion et al., 2017). This concept derives from a notion of change drawing on local experimentation and generation of novelty, but focuses in particular on how organisations with weak formal authority accomplish processes of change.

3. Methods, data and case descriptions

3.1. Method and data

Our empirical research is based on comparative case study analysis of three highly visible examples of local climate initiatives in Finland, which has recently made "a culture of experimentation" part of its government programme (Government Programme, 2015). Our three cases represent examples of local climate initiatives in which intermediaries have a distinctive administrative position: the smart district of Kalasatama in Helsinki (2009-ongoing), the capital of Finland, the integration of energy in planning, construction and building use in Skaftkärr, Porvoo (2008–2014), a small town on the south coast, and HINKU (2008-ongoing), which started as a network of 5 small rural municipalities (and now includes more than 30 municipalities, including larger ones). With a focus on climate mitigation rather than adaptation, they represent a prevalent form of local sustainability and low-carbon experimentation in Europe (see Bulkeley and Castán Broto, 2013). The cases were selected because:

(1) they have generated interest and emulation in the Finnish context,
(2) they feature distinct intermediaries which have been central in influencing the direction of the experiment and
(3) they derive from three different kinds of empirical contexts: a metropolitan area, a small city and (originally) rural municipalities, with different resources and original levels of connectedness to globally circulating novel solutions and notions of "experimentation".

These three conditions rendered them the most suitable candidates for testing the theoretical propositions concerning the role of intermediaries in making local initiatives "experimental". Our data collection sought answers to these questions:

1. How intermediaries aggregate lessons and transfer knowledge across and within experiments?
2. How the intermediary activities disrupt existing practice by introducing new practices?
3. How the intermediaries make a difference beyond the experimental context?

The data were derived through semi-structured interviews that were recorded and transcribed (Table 1). The interviews focused on understanding the case from the different participants' perspectives, and the participants' perceptions on the role of the intermediary in raising the level of ambition of the project in terms of content, diversity, novelty and communications. The HINKU interviews were originally collected with a more open focus (stakeholder and intermediary perceptions of the project), but included rich data on the role of the intermediary. In addition, previous research (Mickwitz et al., 2011; Heiskanen and Matschoss, 2016; Heiskanen et al., 2015; Saikku et al., 2016), project reports, press releases, newspaper articles and websites of the projects were used as complementary data sources (see Annex 1 for more details on interviews and complementary data).

The data were analysed using thematic coding, integrating data-driven codes with theory-driven ones (see Fereday and Muir-

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

Table 1
Data collection through interviews.

Smart district of Kalasatama	Skaftkärr residential area	HINKU carbon-neutral municipalities
- experiment organizers: 5 - local politicians and officials: 8 - residents: 14 - funding bodies and potential aggregators of lessons: 5	- experiment organizers: 4 - local politicians and officials: 4 - residents: published survey - funding bodies and potential aggregators of lessons: 2	- initiators/organizers: 4 - local politicians and officials: 6 - local residents: 20 - funding bodies and potential aggregators of lessons: 4

Cochrane, 2006) based on our review of the literature. We focused on intermediary practices, the effects of intermediary action as perceived by themselves and other stakeholders, and similarities and differences in expectations and interpretations among intermediaries and other stakeholders. Themes were then further clustered into second-order themes summarizing the three main forms of intermediary work of interest (aggregation of lessons and transfer of knowledge, changes and breaches in existing practice, transfer and scaling up beyond the experimental site).

3.2. Description of the study cases

An experimental innovation platform to co-create smart urban infrastructure and services in close co-operation with residents, city officials and other stakeholders has been created within the new *Kalasatama district* of Helsinki. The original focus of the experiment was on developing business models based on urban smart grids utilising experimental infrastructure for smart metering and control. The incumbent energy company has also had ambitions in developing solar power, district cooling and energy storage. Since the innovation intermediary, Forum Virium Helsinki, was engaged in 2013, the focus has turned more to smart living, including intensified co-development of services (open data, transport and sharing economy) together with users and startup businesses. Examples of newly introduced practices include a *Programme for Agile Piloting* enabling small pilots by user-innovators and a *Developers' Club* networking different actors (such as bigger and smaller firms, city officials and residents).

Skaftkärr is a newbuild area in Porvoo, on the south coast of Finland. It represents an experiment in the integration of energy and climate in spatial planning and new construction. The nationally working intermediary Sitra and the local intermediary Posintra have facilitated different aspects of the initiative: a novel type of town plan reducing carbon dioxide emissions, a new way of allocating land, issuing building permits and training home-builders, as well as experimentation with energy monitoring and control equipment. Other innovative ideas were also explored, though not all implemented. The Skaftkärr project resulted in a model for creating an energy efficient town plan, which has been integrated into local town planning, while energy efficiency has been made part of the overall city strategy and its business development strategy. Several permanent structures were retained as a consequence of the experiment: for example, a permanent working group for different branches of the local administration and stakeholders like the energy, water and waste companies, a system of requirements and incentives for developers purchasing municipal land (including a discount for developers committing to stringent energy targets) and a scheme for issuing permits to single-family home self-builders, where the builders are offered intensive training in energy efficiency.

HINKU, a programme for carbon-neutral municipalities, was launched in 2008 to engage small municipalities as “change laboratories” for new solutions to climate change. The initiative arose from co-operation between a business social responsibility group and the intermediary, the Finnish Environment Institute (Syke). They originally invited five small rural municipalities, which pledged to decrease greenhouse gas emissions from the 2007 level by 80 per cent by 2030 (the number of participating municipalities has since grown to more than 30). One of the main goals of HINKU has been to engage the municipal officials and politicians and gain their commitment to leadership in climate policy. The project has stressed a bottom-up process of change, where solutions are

Table 2
Summary of cases.

	Intermediary	Experiment	Actions	Stakeholders
Kalasatama	Forum Virium Helsinki (FVH) (an innovation intermediary owned by the City of Helsinki)	Creation of an open innovation platform for piloting smart energy services, (niche and market creation experiment, Kivimaa et al., 2015)	Supporting projects and agile piloting, networking of different actors, branding the area and making it interesting to new innovators, encouraging resident participation, focusing on service design, transferring the lessons learned through international visits, speed up the removal of barriers created by old structures in administration, reveal lock-ins in city administration	Residents, city officials, industry, SMEs, researchers
Skafskärr	Sitra, a national innovation intermediary Posintra, a local economic development unit (municipal and local business owned)	Opportunity to develop and demonstrate a new, more energy-aware model of spatial planning, (spatial development experiment, Kivimaa et al., 2015)	Developing, testing and integrating climate-aware spatial planning (including requirements and incentives for private developers), a new model for the building permit processes (anticipatory guidance), testing of real-time energy use metering and monitoring, breaking up administrative silos, new methods for public engagement, exploration of several innovative solutions (e.g. solar thermal district heating)	City of Porvoo administrative units, energy company, local businesses, residents
HINKU	Finnish Environment Institute (Syke) (state-owned)	Developing of models for joint purchasing, (societal problem solving and change process experiments Kivimaa et al., 2015)	Organizing information meetings and public events for local residents and stakeholders, conducting energy audits and detailed technical analyses Development of new organizational forms for distributed renewable energy (e.g. joint heating systems, purchasing of solar panels)	local citizens, businesses and municipal officials, administrations and politicians,

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

explored together with local citizens, businesses and municipal administrations. While most of the projects have been about deploying and adapting cost-effective technologies, HINKU has played an important role in a more innovative endeavour: the development of models for joint purchasing. Early efforts in developing small co-operative heating systems were not successful, but a breakthrough was made with the joint purchasing of solar panels. This has been innovative in the Finnish context, where solar power is still very marginal. Through successive steps in improving and scaling up the scheme together with other intermediaries at other sites, this scheme has accelerated the diffusion of solar power in the country (Saikku et al., 2016) and qualitatively changed the market by creating greater transparency and comparability and stimulating demand for turnkey solutions. Table 2 shortly summarizes these cases.

4. Findings

Our interest is in how local initiatives can exhibit several dimensions of experimentation by combining the aggregation of lessons and transfer of knowledge across sites, deviations from existing practice by introducing new practices, and making a difference beyond the experimental context. In the next sub-sections, we analyse how intermediary practices have contributed to these aspects of experimentation.

4.1. Aggregating lessons within and across sites through action

Aggregation of lessons is relevant in order for local climate initiatives to be experimental in the sense of engendering novel combinations of non-local and local knowledge and skills that produce socio-technical variation leading to new solutions (Raven et al., 2008; Kivimaa, 2014). We identified three different ways in which intermediaries worked in local climate initiatives to pool and transfer experience and lessons: (1) pooling of knowledge and experience from diverse participants, (2) drawing in new non-local knowledge from research and experts and (3) collecting knowledge and exemplars from other sites. A common feature in these practices was the tendency to aggregate lessons via enabling action (forums with new actor configurations, piloting, arranging study visits) and bringing parties together, rather than the intermediaries themselves attempting to synthesize the knowledge in reports.

Pooling of knowledge and experience from diverse participants was accomplished mainly via novel ways of organizing face-to-face meetings between participants. This was exemplified most intensively in the work of Forum Virium Helsinki in the Smart Kalasatama case, where the intermediary supports experimentation through the recognition of new ideas, bringing them and the actors behind them together and developing them further. In this case, the intermediary not only employed events and meetings, but set up a new network for co-creation, a *Developers' Club*, which represents a new kind of district-based experimental form of co-operation bringing together residents, diverse businesses working in the area (startups, established companies), civil society actors and city administrators to regularly share news and get information about future projects, which makes it easier to find collaboration partners and plan projects together. Similar innovative forms of collaboration featured somewhat less prominently in the Skaftkärr case, where the intermediaries Sitra and Posintra organized workshops to engage residents, developers and civil servants (before the formal hearings related to spatial planning), and created a forum for the different branches of administration (as well as outside experts) to work concurrently (rather than sequentially, as had usually been the case) on the experimental new district. In HINKU, pooling of knowledge and experience from participants was originally rather piecemeal, with intermediary representatives travelling from one municipality to another to convene diverse locals (civils servants, residents, local businesses) in events like *Energy Evenings*. Later, a HINKU Forum was established, where civil servants and other activists meet regularly to exchange experiences. Additionally, a scheme called *HINKU deed of the month* was established, where best practices were awarded and showcased in order to facilitate the transfer of innovative practices.

Intermediaries have brought *new knowledge, from research and technical experts*, into the local context, thus serving to raise the ambition level of the local initiative. This has been most prominent in the case of Skaftkärr, where the intermediary Sitra contracted several nationally renowned experts as consultants to the project in order to develop calculation methods and principles for climate-adapted urban plans. In the case of HINKU, the coordinator Syke (Finnish Environment Institute) has brought in experts and researchers from its own organisation and extensive research networks to perform calculations, social and economic analyses, and bring in the latest research findings and novel ideas for how to organize local climate initiatives. These experts have also been invited to organize talks and do research studies in the HINKU municipalities. Smart Kalasatama has engaged scientists to design smart and energy efficient lighting system in the district and organized research seminars and initiatives and invited scientists to bring in new findings, e.g., concerning low-energy buildings, smart grid solutions and novel ways to create low-carbon districts.

Collecting knowledge and exemplars from other sites has featured in all cases. In the Skaftkärr and HINKU cases, operating models invented elsewhere were actively repurposed and redeveloped to meet local needs. In Skaftkärr, one example is a model for "anticipatory guidance of self-builders", which was originally developed in a larger city. The model entails organizing energy efficiency training sessions for homebuilders before they submit their permit application, resulting in high uptake of energy efficient solutions. The intermediary Posintra took up this model and coordinated a project where the model was further tested and developed in the much smaller town of Porvoo, as well as integrated into an annual cycle of land allocation and permitting in order to allow training to be delivered cost-effectively to groups of builders. In HINKU, the intermediary Syke also took up an idea developed elsewhere (joint procurement of solar panels, originally with a strong DIY focus) and developed it through a series of experiments (Saikku et al., 2016) into a purchasing model for turnkey solar solutions for "ordinary" households and municipalities (including leasing as the newest addition to the concept). In Kalasatama, the intermediary has actively followed international smart city developments taking as an example especially the area of *Stockholm Royal Seaport* in Sweden and the *Connecting Copenhagen* project in Denmark.

Aggregation of lessons and experience is what intermediaries are expected to do (e.g. Geels and Deuten, 2006; Stewart and Hyysalo, 2008; Hargreaves et al., 2013) and it fits quite well into notions of intermediaries as 'neutral'. However, as the following section shows, it also entails that intermediaries make choices about whose knowledge and skills to include, and how to combine established and novel ideas, in order to challenge the status quo via experimentation without antagonizing important stakeholders.

4.2. Disrupting existing practice to introduce new practices

Kivimaa (2014) have emphasized the important role of low-carbon experimentation in challenging existing institutions and locked-in practices and undermining the legitimacy of the current regime, and Kivimaa (2014) has suggested that some intermediaries may play an important role in this process. In our case studies, we found three ways in which the intermediaries worked

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

to challenge and partly even disrupt existing practices: (1) focusing beyond technology to establish new institutional arrangements, (2) identification and challenging of institutionalised practices that obstruct new practices and (3) introduction of new actor configurations. While deviation from existing practice is not confined to local climate experiments (Garud and Karnoe, 2001), the temporary space created by a local experiment makes such deviations more acceptable.

A "beyond-technology" focus is a way to challenge the technocratic approach present in several local climate initiatives, given that the destabilisation of the regime is not so much a matter of introducing new technologies but instead a new organisation of actor roles and the creation of new institutional arrangements. In our case studies, we found diverse practices that aimed to develop new social and organizational practices to complement and even critically examine new technologies. This refocusing beyond technology was most visible in Kalasatama, where both the *Programme for Agile Piloting* and the *Developers' Club* organized by the intermediary have worked to complement ideas of the smart grid with non-technological solutions, including a 'smart living area' and 'smart transportation' in the form of new services (such as Toop described above and Piggy Baggy, which is a new kind of service for delivering and receiving packages).

Intermediaries also worked to *identify and challenge existing institutions* that obstruct the introduction of new practices. This was particularly visible in the Skaftkärr case, where the intermediary Sitra introduced a new model for energy spatial planning, thus reconfiguring the highly formalised conventions of planning, which do not easily adapt to novelties. This was started by the intermediaries as an open-ended process where planners, people in charge of land-use allocation, permitting and infrastructure development worked concurrently for the first time in an open-minded development project of a new residential area, rather than in their conventional silos. Identification and challenging of existing practices was also an important outcome of the work of the intermediary in the Smart Kalasatama case, where experimental work ran into administrative obstacles, which have made the piloting, testing and diffusion of innovations as well as their spreading extremely slow. Thus, the realisation of any small new idea takes much time, and there the intermediary organisation sees as its concrete task to try to speed up the removal of administrative barriers, such as working to remove an outdated norm or 'releasing a stuck IPR' from the administration of an organisation. Old dependencies seem to be the biggest obstacles and the intermediary organisation attempts to open new interfaces, where processes could be done differently. These cases show that experimentation is an effective way of showing lock-ins and revealing places where things could be done differently.

Established practices could also be challenged by *introducing new actor configurations*. In Smart Kalasatama, our interviews have shown that the activities of the intermediary aiming to facilitate a new kind of smart living area in a novel and experimental way have led to new kinds of collaborations between small and large companies and between new entrants and the incumbent energy company, as expressed by the intermediary and the incumbent company representatives. These collaborations might not have been emerged otherwise as it was pointed out in the interviews that such active networking has influenced the competitive balance of the market. The new collaborations have challenged the incumbent and 'changed the rules of the game' as was explained by a representative of the incumbent company and a city official (cf. Matschoss and Heiskanen, 2016). By bringing in new companies and user innovators, the intermediary has challenged existing alliances between large corporations. Thus, it appears that by 'forced networking' the intermediary has brought the experiment in this area beyond existing practice.

New actor configurations disrupting the existing power balance were also found in the HINKU case, where several attempts have been made over the years to support user-driven distributed energy systems that challenge established centralized energy systems (Heiskanen et al., 2013, 2015). After much experimentation, the intermediary finally made a breakthrough with the solar panel purchasing initiative (Saikku et al., 2016). Joint purchasing is obviously a novel approach to address the consumer disempowerment in energy markets by creating collective market power by pooling the demand of several buyers. While solar panels are not a novelty internationally, grid-connected solar power was still very experimental in Finland in 2012 (EurObserver, 2012). The public events organized by the Syke intermediary in HINKU to recruit participants have proven significantly more popular than any other kind of energy event, reaching hundreds of consumers, farmers and small businesses with hands-one advice and creating a community of interest (Saikku et al., 2016).

In our cases, intermediaries had to balance between "being useful" (incremental improvement to existing practice providing immediate benefits to participants) and "being experimental" (disrupting existing practice in order to introduce novel practices). In our case studies, intermediaries worked to disrupt several kinds of existing practices, such as established business alliances (Smart Kalasatama), established conventions of land-use planning and building regulation (Skaftkärr) and established ways of relying on conventional, centralized energy solutions (and leaving energy policy to the national level) in municipalities (HINKU). The slightly 'outsider' role of intermediaries, without a strong commitment to established practices or interests, enables such experimentation with not only new technologies, but new practices and actor configurations, as does the 'experimental' and perhaps even temporary role and mandate that they have. These novel practices have been introduced gradually, in co-operation with the participants, and in ways (and using arguments) that deliver benefits to participants and thus balance and complement disruption with support.

4.3. Making a difference beyond the experimental context

Local climate initiatives are primarily aimed to change local practices and infrastructures, and are not hence inimically experimental on a large scale. Among others, Hargreaves et al. (2013) have suggested that intermediaries could help to scale up small local projects and make them more policy relevant. In our cases, we found several practices that the intermediaries commonly engaged in which served to give the local initiatives broader impact: (1) documentation and dissemination, (2) scaling up by removing administrative barriers for their own initiative and hence also for all similar initiatives and (3) active promotion via inspiring "real-life examples".

Documentation and dissemination flows quite naturally from the intermediary role, since the intermediaries in our cases developed projects and obtained external funding for the local initiative, and were hence even obliged to write reports, press releases and disseminate the results of their projects through events and networking, thus rendering the results of local experiments more mobile. This was most marked in the Skaftkärr case, where the intermediaries have disseminated all three projects (spatial planning, anticipatory advice and smart metering) widely, both nationally and internationally. Several reports have been produced on climate-conscious spatial planning (e.g. Lylykangas et al., 2013) and Skaftkärr has hosted study visits. For example, Sitra gained significant nation-wide attention for the results of the Skaftkärr initiative through a press-release claiming that Finland could save 250–450 million € annually in infrastructure costs, if all municipalities were

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

to follow the example of Skaftkärr. In the HINKU initiative, reports showing that the participating municipalities have reduced their greenhouse gas emissions by almost 20% and a map service showcasing various innovative measures taken in the participating municipalities are examples of intermediary work to disseminate experimental solutions nation-wide, while not disregarding the importance of face-to-face communication.

Scaling up can also occur via removal of barriers experienced initially by the initiative itself, but which are obstacles to others wishing to introduce novel practices. This was most visible in the work by the intermediary Forum Virium Helsinki. The Kalasatama project is an important pilot experimentation for introducing a new model of urban innovation in Helsinki and beyond. There, the intermediary does not perceive itself as a sustainability actor, rather as an innovation intermediary, which has worked hard to reveal and overcome administrative barriers within the city obstructing innovative solutions for 'smart living'. These include administrative rules, for example in spatial planning (building standards requiring a certain amount of parking space, barriers to open data, slow and bureaucratic administrative practices). Similar ambitions were also present in the Skaftkärr case, where the intermediary Sitra was interested in removing administrative barriers to genuinely climate-conscious design of built environments nation-wide. In this case, several ambiguities in national legislation were revealed, for example concerning whether municipalities can mandate particular heating systems in spatial planning (Lylykangas et al., 2013), but these have not as yet been resolved.

Active promotion via inspiring "real-life examples" is an intermediary role that is quite different from the classical, scientific experiment, which is expected to critically test particular hypotheses. Through their involvement in local climate experimentation, intermediaries become spokespersons and advocates for solutions developed in the local initiative. For example, in Smart Kalasatama, the intermediary is seeking to widely transfer the information created in the experiment through frequent visits from international and national 'smart city tourists', as the area is of great interest internationally. Similarly, Skaftkärr has been visited by urban planners from all parts of the country and beyond, and has contributed to several other initiatives ongoing in Finland to develop new ways of climate-conscious spatial planning, land allocation policy and building design. In HINKU, the fact that the intermediary has managed to spread the concept from 5 small municipalities in 2008 to more than 30 by 2016 is in itself evidence of significant scaling up. However, scaling up also depends on collaboration with other intermediaries and selection of projects where a difference can really be made (Saikku et al., 2016). For example, the flagship case of joint purchasing has reached its impact through collaboration with other intermediaries, like the Climateinfo intermediary in the metropolitan area. Through such collaboration, the joint purchasing initiatives and the public calls for tenders organized by Climateinfo appear to have contributed significantly to qualitative shaping of the solar market by forcing companies to offer turnkey services and improve the quality and comparability of their offerings. Whereas in 2013, seven companies offering solar systems were identified in the Finnish market (Tekes, 2013), by 2015 there were 30 companies offering turnkey services (Finsolar, 2015).

Making a difference beyond the experimental site entails both conventional, seemingly 'neutral' intermediary roles and advocacy to promote solutions found. In our cases, all intermediaries worked to actively scale up by promoting the novel solutions developed in their local experiments (see Smith et al., 2010), albeit relying on diverse strategies. Forum Virium Helsinki worked within the city administration to remove barriers not only for Smart Kalasatama, but also for other similar endeavors in the making. Sitra, as a national intermediary has attempted to further develop the results from Skaftkärr at other sites, whereas Posintra as a local intermediary has mainly worked to further institutionalize them in Porvoo. Syke has successfully worked to both multiply the HINKU concept in several other sites, and scale up particular practices like joint procurement to a national level. Even though the cases reveal somewhat different ways of working, a common balancing challenge (in our interpretation) pertains to what and when to scale up. Experiences from local experimentation are not scientific evidence that a particular course of action is the best one; rather, they rely on personal experience and the power of the exemplar.

5. Discussion

Our findings extend the existing view of intermediaries as having several potential roles in societal transitions (Klerkx and Leeuwis, 2009; Boon et al., 2011; Kivimaa, 2014). While previous literature has focused on intermediary roles (cf. e.g. Kivimaa, 2014), we have attempted to analyse the work intermediaries actually engage with. We identified several practices (Table 3) that intermediaries engage in making local climate initiatives more diversely experimental, including some expected and conventional ones, such as e aggregation and dissemination of lessons learned (Geels and Deuten, 2006), but also practices that serve to disrupt existing power bases and scale up new solutions through advocacy and lobbying to remove administrative barriers to new practices. While Kivimaa (2014) has initially identified such disruptive practices, the context of local climate experimentation was not investigated. In our local cases, intermediaries typically worked to produce new knowledge and practices through face-to-face, gradual and incremental engagement with local participants and outside stakeholders. However, for intermediaries, the choice of who to engage with and how was shown to entail choices that are not necessarily neutral or incremental in their consequences. Intermediary work thus is not about value-free knowledge creation, but closely tied to the creation of new forms and sources of power (Flyvbjerg, 2004).

Schot and Geels (2008) note that in many strategic niche management experiments, networks have tended to be too narrow and

Table 3
Identified intermediary practices to make local climate initiatives experimental.

Aggregation of lessons and experience through action	Aggregation of experience and lessons from diverse participants (co-creation, events, meetings, novel forums bringing together diverse participants, awards)
	Drawing (locally) new knowledge from research and experts
	Collecting knowledge and exemplars from elsewhere (other countries, other experiments)
Deviation from existing practice and introduction of new practices	Beyond-technology focus, establishment of new practices to match new technologies
	Identification and challenging of institutionalised practices that obstruct new practices
	Introduction of new actor configurations
Practices enabling the initiatives to make a difference beyond the experimental context	Documentation and dissemination
	Scaling up by removing barriers for the individual initiative, as well as for others
	Active promotion via inspiring "real-life examples"

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

focused on accumulation of facts and data, and the experimentation has followed an excessively technology push approach, considering consumers with given needs and preferences (cf. also Bos and Brown, 2012). In our empirical cases, the experimentation has not merely focused on finding mismatches between technology features and presupposed needs of users, but it has attempted to include a variety of actors which are usually not involved in innovation. Introducing new and diverse knowledge and providing permanent domains for the exchange of ideas, the intermediary work may influence the direction of transition through the change in the cognitive rules of the stakeholders (cf. Geels and Raven, 2006). As our findings show, the regime actors have also been involved in these experiments, which has enabled a deeper institutional embedding of the new practices.

Our three empirical cases reveal tensions between neutrality and advocacy in local intermediation. Our interviews highlighted that a public intermediary may need to be perceived of as neutral in order to be regarded as a reliable and legitimate (cf. Hodson and Marvin, 2010) and thus valuable to a critical range of stakeholders. This is the case especially when there are several actors involved in the experiment that initially have possibly conflicting interests, such as in Kalasatama. Yet, all the cases show how intermediaries step out of their seemingly neutral, conventional roles, and engage in regime-challenging actions, like creating markets for new energy solutions in HINKU or breaking down administrative silos and supporting new solutions with active land-use policy in Skaftkärr. Organizing such projects requires choices in who to engage and what to promote.

Our interview data also show that bringing together new actors that otherwise might not have chosen to cooperate entails tensions. In the Kalasatama-case, the incumbent energy company is challenged by novel entrants offering similar kinds of smart energy solutions through the change in the market powers and balance. The role of the intermediary in this case can be two-fold. It can mediate between conflicting interests and create trust between the actors and strengthen the activities taking place within a protected niche of experimental environment. Yet, at the same time, it can act as a force that destabilises the existing regime by forging partnerships (like in the *Developers' Club*) that have the potential to challenge the power position of incumbent organisations. Like the joint purchase of solar panels case and the programme for *Agile Piloting* shows, intermediary practices can empower citizens to become active participants in energy production or in the provision and design of smart energy solutions. New combinations of partnerships may have a key role in sustainability transitions as they also have the potential to challenge existing market configurations, incumbent companies and dominant regime practices (cf. Klerkx and Leeuwis, 2009).

In addition, our findings suggest that intermediaries derive their influence and power from balancing diverse interests and time frames. Our cases show that intermediation involves a balancing between perceived neutrality and advocacy, the engagement of new actors and the development of new practices, and support and facilitation for existing actors and existing practice (Klerkx and Leeuwis, 2009; Klerkx and Aarts, 2013). Intermediaries in local climate experiments draw on their facilitating role and the bounded, temporary nature of the experiment to gain legitimacy. Similarly, they draw on quick wins and the ambiguity of large and complex local projects to engage stakeholders, thus exhibiting 'robust action' (Etzion et al., 2017). These sources of legitimacy and their practical usefulness put the intermediaries in a position where they can also occasionally find opportunities to push the boundaries or existing practice and make small disruptive moves vis-à-vis the existing regime. Our findings contribute to existing research on intermediaries by suggesting that some of the challenges that intermediaries encounter (Klerkx and Leeuwis, 2009; Klerkx and Aarts, 2013) are also their sources of power and influence. Through their balancing acts, intermediaries engage niches with regimes, not only through the aggregation of lessons, but also by appropriate levels of novelty and tactical steps and alliances to scale up their local achievements (cf. Etzion et al., 2017).

There are some limitations to our study. Our data derive from only three case studies revealing both commonalities and differences, in one particular country in which experimentation has high legitimacy (Government Programme, 2015): intermediary practices might be different in other country contexts. Our case studies are delimited to geographically local experiments, which is not the case with all kinds of climate experimentation, and we make no claims about the sustainability of the solutions developed in the cases. We have developed our analysis of intermediary work in promoting various types of experimentation by combining insights from the literature with observations from three cases: a deeper analysis of how intermediaries engage with various interests and contribute to the developments of new forms of knowledge and power is merited, based on in-depth and more ethnographic case studies. Hence, further work on intermediary practices, and particularly their disruptive potential, is called for. Our perspective also emphasizes the work and role of intermediaries; hence, verification of our findings would require counterfactual analysis that investigates whether similar forms of experimentation are present also in the absence of intermediaries.

6. Conclusions

Our research has focused on studying the work of intermediaries in contributing to the ambitions and types of experimentalism in local climate initiatives. We have questioned the view that the main task of intermediaries is only the facilitation of the work of other actors. We have found, based on our empirical research, that intermediaries use certain practices in order to balance between the diverse and often conflicting interests of stakeholders involved. Although they need to keep a range of critical actors satisfied, through their special position and particular ways of working they are also able to challenge and disturb the status quo and work to break existing institutional lock-ins of the dominant regime.

Through identification of practices that support experimentation, our study offers direction for further work in the field. Our findings contribute to the previous knowledge on the roles of intermediaries in societal transitions, which has mainly focused on their role in helping and connecting other actors. Our cases show that the mechanisms through which intermediaries serve to make local climate initiatives experimental are the aggregation of lessons and transfer of knowledge across sites, the deviation from existing practice and the scaling up of novel solutions, thus making a difference beyond the experimental context. In this, intermediaries draw on practices of aggregating knowledge from diverse actors (including local and non-local ones) in collaborative forums, developing new actor configurations and institutional arrangements rather than merely technological solutions, challenging established practices that obstruct these new arrangements, disseminating lessons learned, and advocating for locally found solutions based on individual inspiring examples. In this, intermediaries draw on this facilitating role in developing solutions that are directly helpful for local participants. Through the legitimacy gained by being useful to local actors in this way, they can also occasionally push the boundaries of existing practice and experiment with novel solutions.

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037

Acknowledgements

The authors acknowledge the funding provided by the Academy of Finland (TRIPOD, grant 290288) and Strategic Research Council (Smart Energy Transition, grant 293405). We also thank the anonymous reviewers for their invaluable comments that helped to improve the manuscript considerably.

References

Boon, W.P., Moors, E.H., Kuhlmann, S., Smits, R.E., 2011. Demand articulation in emerging technologies: intermediary user organisations as co-producers? Res. Policy 40 (2), 242–252.

Bos, J.J., Brown, R.R., 2012. Governance experimentation and factors of success in socio-technical transitions in the urban water sector. Technol. Forecast. Soc. Change 79 (7), 1340–1353.

Brown, H.S., Vergragt, P.J., 2008. Bounded socio-technical experiments as agents of systemic change: the case of a zero-energy residential building. Technol. Forecast. Soc. Change 75 (1), 107–130.

Bulkeley, H., Castán Broto, V., 2013. Government by experiment? Global cities and the governing of climate change. Trans. Inst. Br. Geogr. 38 (3), 361–375.

Castán Broto, V., Bulkeley, H., 2013. A survey of urban climate change experiments in 100 cities. Glob. Environ. Change 23 (1), 92–102.

Etzion, D., Gehman, J., Ferraro, F., Avidan, M., 2017. Unleashing sustainability transformations through robust action. J. Clean. Prod. 140 (1), 167–178.

EurObserver, 2012. Photovoltaic Barometer 2012. Available at. http://www.eurobserv-er.org/photovoltaic-barometer-2012/ (Accessed 28 February 2016).

Evans, J.P., 2011. Resilience, ecology and adaptation in the experimental city. Trans. Inst. Br. Geogr. 36 (2), 223–237.

Fereday, J., Muir-Cochrane, E., 2006. Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development. Int. J. Qual. Methods 5 (1), 80–92.

Finsolar, 2015. Aurinkoenergian Palvelu- Ja Rahoitustarjonta. (Service and Finance Market for Solar Energy). Finsolar. Available at: www.finsolar.net (Accessed 23 April 2016).

Flyvbjerg, B., 2004. Phronetic planning research: theoretical and methodological reflections. Plan. Theory Pract. 5 (3), 283–306.

Garud, R., Karnoe, P., 2001. Path Dependence and Creation. Lawrence Erlbaum Associates, Publishers, Mahwah, NJ.

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res. Policy 31 (8), 1257–1274.

Geels, F.W., 2005. Processes and patterns in transitions and system innovations: refining the co-evolutionary multi-level perspective. Technol. Forecast. Soc. Change 72 (6), 681–696.

Geels, F.W., 2011. The multi-level perspective on sustainability transitions: responses to seven criticisms. Environ. Innov. Soc. Transit. 1 (1), 24–40.

Geels, F.W., 2014. Regime resistance against low-carbon transitions: introducing politics and power into the multi-level perspective. Theory Cult. Soc. 31 (5), 21–40.

Geels, F., Raven, R., 2006. Non-linearity and expectations in niche-development trajectories: ups and downs in Dutch biogas development (1973–2003). Technol. Anal. Strateg Manag. 18 (3–4), 375–392.

Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways. Res. Policy 36 (3), 399–417.

Geels, F.W., Hekkert, M.P., Jacobsson, S., 2008. The dynamics of sustainable innovation journeys. Technol. Anal. Strateg Manag. 20, 521–536.

Geels, F., Deuten, J.J., 2006. Local and global dynamics in technological development: a socio-cognitive perspective on knowledge flows and lessons from reinforced concrete. Sci. Public Policy 33 (4), 265–275.

Goh, S.C., 2002. Managing effective knowledge transfer: an integrative framework and some practice implications. J. Knowl. Manag. 6 (1), 23–30.

Government Programme, 2015. Finland, a land of solutions. In: Strategic Programme of Prime Minister Juha Sipilä's Government 29 May 2015. Available at: http://valtioneuvosto.fi/documents/10184/1427398/Ratkaisujen+Suomi_EN_YHDISTETTY_netti.pdf/8d2e1a66-e24a-4073-8303-ee3127fbfcac (Accessed 23 April 2016).

Hajer, M., 2011. The Energetic Society. In Search of a Governance Philosophy for a Clean Economy. PBL Netherlands Environmental Assessment Agency.

Hargreaves, T., Hielscher, S., Seyfang, G., Smith, A., 2013. Grassroots innovations in community energy: the role of intermediaries in niche development. Glob. Environ. Change 23 (5), 868–880.

Heiskanen, E., Johnson, M., Vadovics, E., 2013 Jun 30. Learning about and involving users in energy saving on the local level. J. Clean. Prod. 48, 241–249.

Heiskanen, E., Matschoss, K., 2016. Consumers as innovators in the electricity sector? Consumer perceptions on smart grid services. Int. J. Consum. Stud. 40 (6), 665–674.

Heiskanen, E., Jalas, M., Rinkinen, J., Tainio, P., 2015. The local community as a "low-carbon lab": promises and perils. Environ. Innov. Soc. Transit. 14, 149–164.

Hodson, M., Marvin, S., 2010. Can cities shape socio-technical transitions and how would we know if they were? Res. Policy 39 (4), 477–485.

Howells, J., 2006. Intermediation and the role of intermediaries in innovation. Res. Policy 35 (5), 715–728.

Hyysalo, S., Juntunen, J., Freeman, S., 2013. User innovation in sustainable home energy technologies. Energy Policy 55, 490–500.

Kemp, R.P.M., Rip, A., Schot, J.W., 2001. Constructing transition paths through the management of niches. In: Garud, R., Karnoe, P. (Eds.), Path Dependence and Creation. Lawrence Erlbaum, Mahwah, NJ, pp. 269–299.

Kemp, R.P.M., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. Technol. Anal. Strateg Manag. 10 (2), 175–198.

Kivimaa, P., 2014. Government-affiliated intermediary organisations as actors in system-level transitions. Res. Policy 43 (8), 1370–1380.

Kivimaa, P., Hildén, M., Huitema, D., Jordan, A., Newig, J., 2015. Experiments in Climate Governance. Lessons from a Systematic Review of Case Studies in Transition Research (No. 2015-36). SPRU-Science and Technology Policy Research, University of Sussex.

Klerkx, L., Leeuwis, C., 2009. Establishment and embedding of innovation brokers at different innovation system levels: insights from the Dutch agricultural sector. Technol. Forecast. Soc. Change 76, 849–860.

Klerkx, L., Aarts, N., 2013. The interaction of multiple champions in orchestrating innovation networks: conflicts and complementarities. Technovation 33 (6), 193–210.

Lylykangas, K., Lahti, P., Vainio, T., 2013. Ilmastotavoitteita Toteuttava Asemakaavoitus. In: City Planning Implementing Climate Goals, vol. 13. Aalto-yliopisto. Aalto-yliopiston julkaisusarja, Helsinki.

Matschoss, K., Heiskanen, E., 2016. Do intermediary organisations challenge the incumbent?. In: Conference Paper at SPRU 50th Anniversary Conference, Brighton, 7–9 September 2016 Available at: kaisa.matschoss@helsinki.fi.

Matschoss, K., Kahma, N., 2015. Service interest and cluster membership–Who are the pioneering users in energy efficiency service markets? Nordic J. Bus. 2, 139–159.

Matschoss, K., Kahma, N., Heiskanen, E., 2015. Pioneering customers as change agents for new energy efficiency services—an empirical study in the Finnish electricity markets. Energy Effic. 8 (5), 827–843.

Mickwitz, P., Hildén, M., Seppälä, J., Melanen, M., 2011. Sustainability through system transformation: lessons from Finnish efforts. J. Clean. Prod. 19 (16), 1779–1787.

Raven, R.P.J.M., Geels, F.W., 2010. Socio-cognitive evolution in niche development: comparative analysis of biogas development in Denmark and The Netherlands (1973–2004). Technovation 30 (2), 87–99.

Raven, R.P., Heiskanen, E., Lovio, R., Hodson, M., Brohmann, B., 2008. The contribution of local experiments and negotiation processes to field-level learning in emerging (niche) technologies meta-analysis of 27 new energy projects in Europe. Bull. Sci. Technol. Soc. 28 (6), 464–477.

Saikku, L., Tainio, P., Hildén, M., Antikainen, R., Leskinen, P., Koskela, S., 2016. Diffusion of solar electricity in the network of private actors as a strategic experiment to mitigate climate change. J. Clean. Prod. 141 http://dx.doi.org/10.1016/j.jclepro.2016.11.003.

Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol. Anal. Strateg Manag. 20 (5), 537–554.

Smith, A., 2007. Translating sustainabilities between green niches and socio-technical regimes. Technol. Anal. Strateg Manag. 19 (4), 427–450.

Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M., Seyfang, G., 2016. Making the most of community energies: three perspectives on grassroots innovation. Environ. Plan. A 48, 407–432.

Smith, A., Voß, J.P., Grin, J., 2010. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. Res. Policy 39 (4), 435–448.

Stewart, J., Hyysalo, S., 2008. Intermediaries, users and social learning in technological innovation. Int. J. Innov. Manag. 12 (03), 295–325.

Tekes, 2013. Finnish Solar Energy Cluster. Report prepared for Tekes by Pöyry Management Consulting. Online at. http://www.tekes.fi/ohjelmat-ja-palvelut/recently-ended-programmes/groove/aineistot/.

Unruh, G.C., 2002. Escaping carbon lock-in. Energy Policy 30 (4), 317–325.

Weber, K.M., Rohracher, H., 2012. Legitimizing research, technology and innovation policies for transformative change: combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework. Res. Policy 41 (6), 1037–1047.

Please cite this article in press as: Matschoss, K., Heiskanen, E., Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, Journal of Cleaner Production (2017), http://dx.doi.org/10.1016/j.jclepro.2017.03.037