TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Exploring the transition potential of renewable energy communities

Citation for published version (APA):
Doci, G., Vasileiadou, E., & Petersen, A. H. (2014). *Exploring the transition potential of renewable energy communities*. (ECIS working paper series; Vol. 201406). Technische Universiteit Eindhoven.

Document status and date:
Published: 01/01/2014

Document Version:
Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy
If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

Download date: 09. Dec. 2021

Eindhoven Centre for Innovation Studies

Exploring the transition potential of renewable energy communities

Gabriella Dóci, Eleftheria Vasileiadou and Arthur Petersen

Working paper 14.06

Eindhoven Centre for Innovation Studies (ECIS),
School of Innovation Sciences,
Eindhoven University of Technology, The Netherlands

Exploring the transition potential of renewable energy communities

Gabriella Dóci[a,*], Eleftheria Vasileiadou[a,b], Arthur Petersen[a,c]

[a] *Institute for Environmental Studies, Vrije Universiteit Amsterdam, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands*
[b] *School of Innovation Sciences, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands*
[c] *PBL Netherlands Environmental Assessment Agency, P.O. Box 30314, 2500 GH The Hague, The Netherlands*

Abstract: Although in the last decades a transition toward a sustainable energy system with renewables has been advocated by many, it is still uncertain where the support and required investments for renewables can come from. In this article we introduce and analyze a special type of investor group: renewable energy communities, which are grassroots initiatives that invest in 'clean energy' in order to meet consumption needs and environmental goals and thereby – even unwittingly – conduce to the spread of renewables. The aim of the present study is to explore the potential of renewable energy communities, as social niches, to contribute to transitions in the energy system. To do so, we propose three indicators for measuring the transition potential of social niches, based on proxies for technological innovations derived from the literature. In addition, we reinterpret the notion of niches and the way transition occurs by arguing that niches are complex systems in which both technological and social innovations develop simultaneously and that during transition entire niches link up with the regime. Furthermore, we make a distinction between internally and externally oriented niches based on their orientation and application focus. Our results show that renewable energy communities in the Netherlands are internally oriented social niches that have the potential for upscaling and contribute to sustainability transitions. We use a comparative case study analysis complemented by a systematic literature and documentary review to show that these communities are already changing the Dutch energy system, by connecting to regime actors. Their further advancement depends on strengthening their links to established actors, but also on providing a favorable regulatory framework.

* corresponding author: gabriella.doci@vu.nl (+31 2059 89 551)

1. Introduction

Transition scholars commonly argue that the current way of energy production is not sustainable in the long run and that without a radical change favoring renewable energy, the negative impacts of climate change and depleting fossil resources cannot be avoided. The literature is less clear about how this future system would look like, who the agents of this change would be, and how transitions can be realized. Several theories have been developed for describing the way so-called socio-technical (ST) systems work and how innovations develop and take over incumbent technologies. Examples are strategic niche management, transition management and the multi-level perspective (MLP). However, these transition theories have been criticized for, among others, neglecting agency [1,2,3] and putting too much emphasis on technological niches [4,5]. In addition, grassroots initiatives are also somewhat neglected as potential niches, in which both technological and social innovations can develop [6].

The article introduces a special type of grassroots initiatives, namely renewable energy communities (RECs), which can be drivers of sustainability transitions. Such communities produce or invest in the production of renewable energy to cover their own energy needs, and they have become quite numerous over the last decade in many western countries[b]. Exploring the transition potential of such communities enables us to also take a new perspective into account, focusing not on the technological aspects, but on social aspects and the agents behind the sustainability transition.

The question we address in this paper is to what extent renewable energy communities, as social niches, have the potential to scale up and contribute to energy transitions. To answer this question, we introduce three proxies for measuring the transition potential of social innovations, based on Geels and Schot's [2] four indicators for measuring the transition potential of technological innovations, and we examine some of these communities. For our analysis, we use the results of a comparative case study, which focuses on four different cases in the Netherlands. The paper provides an overview of the state of RECs in the Netherlands, from both demand side and supply side perspectives, examining all the services, as well as legislation and policies in force that are related to them. In addition, through our cases we illustrate the heterogeneity of communities regarding their locations, size, technologies and motivations.

This paper shows that there is already an increasing number of different local investor groups in the Netherlands, around which a complete socio-technical infrastructure is building up. It argues that RECs are not a few homogenous groups who share the same values and needs, but that there are more and more

[b] http://www.rescoop.eu/rescoop-map

different communities investing in renewables locally for diverse reasons. Furthermore, technical, legal and financial infrastructure and other services are developing around them. As a result, these communities could survive the "valley of death", obstacles which are blocking the path between research/development and commercialization [7], and their embedding into the regime has already started. It is claimed that adequate governmental support would enable them to spread in the regime more easily.

In addition, this paper contributes to transition studies, by focusing on elements that are rarely taken into account, namely: demand side factors as well as the role of civil society in the transition. It further elaborates the notion of niches, in order to provide a comprehensive answer on how social innovations evolve and transform the incumbent energy system. Thus, besides studying the state of renewable energy initiatives in the Netherlands from the transition perspective, we also contribute to a better understanding of sustainability transitions.

2. Theoretical framework

2.1 Multi-level perspective

To study the transition potential of renewable energy communities we use the framework of the multi-level perspective (MLP), which helps us gain a better understanding of socio-technical transitions, how innovations emerge and how they shift the incumbent regime toward sustainability. The MLP distinguishes between three interdependent system levels through which transition occurs: the landscape, the regime and the niche levels. The three socio-technical levels are forming a nested hierarchy and their co-evolution is necessary for transition. Since the regime is in favor of only incremental changes, which reinforce the dominance of current actors and technologies, only radical changes can induce transition [8]. When mismatches occur at landscape level or within the regime they create 'windows of opportunity', where radical innovations (innovations that are radically different from solutions used by the incumbent regime) can break through and enter the meso-level of the ST system.

Accordingly, some time after new radical technologies have emerged in niches, they can leave these protected spaces, take over the place of the incumbent ones and, together with wider changes, form a new regime [9]. This process takes place step by step, when changes in one element of the regime (e.g. the emergence of a new technology) induce changes in other elements, thereby reconfiguring the entire system. Consequently, new regimes may grow out of old ones [10].

Landscape

The macro or landscape level represents external processes and factors that influence the regime, and it is beyond the control of the meso -level's actors. A distinction can be made between slow changes (such as macro-economic or macro-political developments, cultural or demographic changes, climate change) and relatively rapid developments that can create an external shock to the regime (such as wars, oil or economic crises, floods, extreme droughts, etc.) [5]. Changes at the landscape level either reinforce the incumbent trajectories or put pressure on the regime. This pressure destabilizes the regime's structure and creates windows of opportunity, where radical innovations can break through [11].

Regime

The *socio-technical regime* is a semi-coherent set of rules put into practice by different social groups and located between the landscape and niche levels [11]. Within the socio-technical regime several sub-regimes can be found (science regime, policy regime, socio-cultural regime and the users, markets and distribution networks regime), which represent different social groups and which are aligned to each other by rules. The ST regime, however, does not include the entirety of these regimes; it is rather a grammar or rule set among them [9]. In contrast, Safarzyńska et al. [12] define the regime as a combination of tangible and intangible elements that encompasses besides rules also material artifacts.

Thus, within the socio-technical regime, several sub-regimes representing different social groups are linked to each other by semi-coherent set of rules. These sub-regimes can be the financial network, the user groups, suppliers, research network, public authorities etc. The rules that connect them determine the development of innovations that, according to Geels [11], at the regime level are merely of an incremental nature. This provides stability to the regime, which is resistant to radical change.

Transition scholars agree that the regime is characterized by path dependence and lock-in [13], which reinforce the dominance of the incumbent actors, technologies, rules, institutions, practices and infrastructure, thereby stabilizing it in all dimensions.

Niches

Niches form the micro-level of the socio-technical system; they provide protected spaces for innovations [9]. Niches create special conditions for new technologies, which would not be able to succeed under market circumstances due to their low technical or economic performance. Thus, niche actors develop

innovations with the intention that they will be used in the regime or even that they become the dominant technologies in the regime [14].

Nevertheless, the MLP theory has been criticized by several scholars [15,16,17,18], among other reasons, for focusing exclusively on technology and neglecting thereby social and cultural aspects in transition [5] and for referring to innovations as technical artifacts without considering other options, such as social or grassroots innovations [19]. Thus the MLP underplays the effects of social and cultural aspects that co-evolve with technologies during a transition [20]. Addressing these criticisms, recent Strategic Niche Management literature makes a distinction between market niches (small market segments), technological niches (a sort of 'laboratories' for experimenting with new technologies) and social niches, which refer to specific social groups, such as NGOs, governmental organizations or local communities that develop new methods and solutions for their own social problems [21]. A social innovation that develops in a social niche is thus not simply an artifact as a technology, "… but a new way of doing business and solving a social problem driven by an emerging social group" [21, p. 672]. Technological innovations in this respect are not in the center of the niche, but they rather serve as tools for addressing social needs. Renewable energy communities can thus be regarded as social niches, introducing social innovations in the electricity market, because they combine production and consumption in the household segment, which results in new forms of organizations, business models and institutions [22].

Another shortcoming of much early MLP work is the assumption that all niches have the same purpose, and that the intention of niche actors is to induce transition. Geels and Raven [23, p.379] argue that the niche actors "… are willing to invest resources (money, people) in projects, if they have a shared, positive expectation of a new technology". Indeed in much early MLP and SNM work, the expectation is that niche actors develop innovations, which would break through the regime at a later stage [24]. However, in this latter case it is also possible that niche actors do not have the primary aim of 'sending' the technology into the regime. Indeed Smith et al., [1], when describing different transition contexts, suggest that regime transformation may be unintended, and uncoordinated, a contingent outcome of historical processes.

Building on this, we argue that niches can differ regarding their actors and their purposes. Niches created by market actors who want to invent and develop new technologies for later regime use are different from social groups which have specific needs that cannot be satisfied by incumbent regime products. This latter groups' (such as grassroots communities or the army) purpose with the niche creation is to nurture innovations that are able to meet their special needs, and it is possible that they only aim at internal use of the innovation. Consequently, a distinction can be made according to the orientation focus of niches, thereby defining *externally* and *internally oriented niches*. Furthermore, we can also differentiate them

regarding their application focus. The *externally oriented niches* are organized around a technological innovation and the other components of the niche are subordinated to it. Contrarily, in the *internally oriented niches* the emphasis is not on the technology itself: technologies serve more as tools that actors use for their special purposes. In this case social innovations can play as important a role as the new technologies. This distinction between internally and externally oriented niches, fits well the distinction of Witkamp et al. [21], in that most social niches are internally oriented, whereas market and technological niches can be externally oriented.

In section 3, we present renewable energy communities, which, as we will argue, form an internally oriented niche. These communities aim for clean energy production at local level, since they are driven by a common social need, namely to produce energy independently, and by different values, such as environment protection, patriotism by supporting the local economy, or the value of working for the community. Hence their primary goal is to meet these expectations, which the community has been set up for and innovations (both technical and social innovations) are the tools serving these purposes. Thus they have no direct aspiration to develop innovations for later regime use, but only for internal utilization. Consequently, RECs constitute an internally oriented, social niche. Even though internally oriented, RECs still have the potential to enter the regime and contribute to energy transitions, as argued also by Smith et al. (2005), for instance through a trajectory of emergent transformation of the regime or re-orientation of (technological) trajectories. We now turn to examine the transition potential of RECs as social niches, by introducing three indicators based on previous studies.

2.2 Transition potential

In order to answer our research question, first we have to define proxies according to which we are able to measure the transition potential of social innovations. Geels and Schot [2] introduced four indicators for technological innovations. The proxies are the following: "(a) learning processes have stabilized in a dominant design, (b) powerful actors have joined the support network, (c) price/performance improvements have improved and there are strong expectations of further improvement (e.g. learning curves) and (d) the innovation is used in market niches, which cumulatively amount to more than 5% market share" [2 , p. 405]. Even though these indicators are certainly useful, they are still oriented towards technological innovations. In case of social innovations the first two indicators are still relevant. In addition, we introduce a third indicator, namely the heterogeneity of the niche that, as we will argue, also influences the transition potential. These indicators then will be applied on RECs in section 3.

2.2.1 Stabilized learning processes at the global level

Geels and Schot's [2] niche interpretation is based on the MLP definition that sees niches as laboratories where technological innovations develop that leave this protected space when transition occurs. However, for assessing the potential of RECs to lead to transition, we need to avoid the exclusively technological focus at the niche level. Indeed RECs are not about developing a technological innovation, but introduce social innovations, new energy production practices, new behaviors for supporting and managing social groups and new solutions for solving energy autonomy problems. In order to include social and cultural elements in our interpretation of transition, we need a different understanding of niches. We see niches rather as complex systems that consist of all the system elements which can be found in the regime, for instance financial network, suppliers, producers, users, even if they are less developed and not articulated that well. In other words: in niches certain social groups can develop innovations, not only technological, but also social innovations: new strategies and practices that strengthen civil society and meet social goals [25].

In contrast to the incumbent regime actors, these social groups have a special interest in the innovation and that is why they are willing to invest money, time or energy and take also the risk of failure. Since the innovation might not survive in market circumstances, they have to create the needed physical and social infrastructure in order. Thereby a whole new system develops with all the system elements, similar to the socio-technical regime. Niche actors form the user and distributor network, which is built up around the innovations. The practices they use and the patterns they establish provide the socio-cultural elements of the new system. In case the niche reaches a certain size with a large number of actors or generates special features that cannot be regulated by the incumbent rules, or due to the strong advocacy power of the niche actors, the government can be expected to establish new policies specifically targeting them.

Geels and Raven [23] conceptualize niches as proto-regimes that have a structure similar to the regime, although they consider only the developing network among similar local niches that share the knowledge and practices with each other thereby forming a global level niche. Similar to our suggestion of niches as complex systems, Raven [24] modeled the development of the niche from a local to a global level in five steps, starting with 1) formation of local groups and 2) experimenting with socio-technical innovations, followed by 3) sharing of knowledge and practices with other local groups that lead to 4) the formulation of generic rules and lessons at the global level, resulting in 5) stable and institutionalized forms thereby creating a proto-regime. Markard and Truffer [15] also claim that niches are protected spaces, which are similar to the regime in its structure; although the level of aggregation and stability is much lower in this

case. Yet, these authors do not explain what happens to all these other dimensions when the innovation leaves the protected space and enters the regime. Do they disappear?

This question implies another interpretation of transition: niches might be also considered as not just protected spaces, but as still forming and unstable complex systems; elements of this complex system establish links to incumbent social groups and niches are thus able to influence and change regime elements through the networks they create and form. Consequently, niches that represent the rule set of new social groups and achieve a certain maturity level are able to enter the ST regime and create links to the other sub-regimes and shift them. This process may trigger changes in the entire ST system; however, it does not necessarily lead to its complete transformation.

In summary, niches at local level that share experiences, practices and knowledge can be considered as one global level niche, which thereby becomes a proto-regime [26]. Consequently, proto-regimes have the essential features to become a regime, which is a necessary but not sufficient condition for transition. Thus the common knowledge, the generic rules and lessons that local niches share at the global level correspond to the first indicator of transition potential that Geels and Schot [2] discuss.

2.2.2 Support by powerful regime actors

As Geels and Schot [2] suggest, to assess the transition potential of a niche, it is also important to examine the capacity of a niche to build many and strong links to the sub-regimes and thus gain the support of powerful regime actors, for instance, financial institutions, or policymakers, which – even when unintended – can trigger changes in the entire ST regime. As the MLP theory describes it: transition is a complex process, which requires transformations at all three system levels. Pressure on the regime level provoked by either external landscape processes or internal regime processes opens windows of opportunity where innovations can break through and become the dominant settings [9].

However, in contrast to the theory, we find that transition can also occur partially and in a different way: when the niche is able to make links with powerful social groups of the incumbent sub-regimes that are open for this change. Certainly, changes at landscape level and within the regime, as the MLP explains, trigger the opening up of these groups, but windows of opportunity do not arise in every part of the system and other segments can remain closed and resistant. The more and the stronger links (i.e. links of financial support, information exchange, education, political lobbying, etc.) the niche is able to set up, the stronger its position becomes in the ST regime, which is more likely to result in a successful transition. Consequently, the breakthrough of the niche and its transition can take place, if it is able to attract a large number of regime actors and to create strong links with social groups in the sub-regimes. By this means

the niche is partly building on the existing regime, but at the same time it alters it and shifts it to a new direction.

2.2.3 Heterogeneity

In addition to the first two indicators to assess the transition potential of social niches based on Geels and Schot [2], we introduce a third proxy, namely the heterogeneity of the niche. Heterogeneity is considered as a prerequisite for these communities to have the potential for scaling up [6].

Certainly, social groups that are different from the incumbent regime actors, because they share different values or social needs, can grow to their maximum capacity [27]. However, without attracting more actors from the regime, they will never break out of the niche level. Seyfang and Smith [6] distinguish two types of grassroots innovations. The first one does not seek to transform the regime and remains in the grassroots niche and the other one can diffuse and change the regime [27]. Grassroots innovations that position themselves in opposition to the incumbent regime and share a specific ideology, thereby forming homogeneous groups, have difficulties scaling up and attracting a wide range of actors from mainstream society. Those grassroots communities, which can create a new 'system of provision' generate transformation in production and consumption patterns and create new institutions that can provide better solutions for a large variety of actors within the regime, have the capacity for transition. According to Loorbach [28] the collaboration between niche and regime actors is essential; however, the regime consists of a more heterogeneous configuration of elements than is typically assumed for the niches [14]. Here we assume that only niches that are heterogeneous enough in terms of the variety of the actors, innovations they use (e.g., within the broad category of RECs, different groups can use wind, solar, biomass or other technologies depending on their special needs and resources) and the conditions they are operating under, have the potential for regime transformation.

This argument about the criterion of the heterogeneity of niches for determining transition potential relates to the suggestion by Hoogma et al. [29] that the breadth of the niche actor networks is important for learning to occur: networks dominated by regime insiders hinder second-order learning and niche development. Raven [24] also points to the important role of a diversity of actors and local sites in Danish wind energy niche building.

In summary, the indicators for measuring the transition potential of social niches are the following:

1) stabilized learning processes and generic rules that all the similar local niches share at the global level;

2) support of powerful regime actors through links with sub-regimes that strengthen the collaboration between niche and regime actors;

3) heterogeneity of the niche in terms of actors, innovations and conditions they are operating under.

The three dimensions we introduce are treated as analytically distinct, but they are actually mutually influencing each other, in a kind of feedback loop: for instance, the more heterogeneous the niches are, the more actors of the regime it can draw, and the stronger are the networking across the niches as well. In addition, the more heterogeneous the niches are, the stronger are the learning effects. There may also be negative feedback loops: the niche networking and learning process may endanger innovation, as it could lead to some sort of convergence, or closure of technological and behavioral solutions across the niches. However, the heterogeneity of the niches prevents such a convergence, and can ensure that learning leads to different and not uniform technological and behavioral solutions.

3. Analysis

3.1 Methodology

The empirical analysis is based on systematic literature and documentary review including reports and websites of organizations that deal with RECs in the Netherlands, collected in the period 2012–2013. This data was then examined using the three indicators outlined in the section 2. In addition, we conducted four case studies in the Netherlands based on 22 semi-structured interviews with members of RECs, both with the frontrunners that initiated and invested more time and effort in these projects, and with average members, whose contribution was smaller. In each case we had a contact person, who helped us to get in touch with other community members, so we could do face-to-face interviews usually by visiting people at their homes. The interview guide covered, among other things, the personal motivations for participating in a joint investment project, the way they organized the procurement of the technologies, the barriers they faced, the partners they cooperated with and the institutional help they received. In addition to the community members, we also interviewed companies and local municipalities that helped the communities. All the interviews were recorded and transcribed later, and our interviewees are anonymized for the purpose of this article.

The scope conditions for our research population were: 1) the community that invested in renewable energy is located in the Netherlands; 2) the investment is a citizen initiative; 3) the members of the initial investment community (people who bought the technology) live in the same location/region; and 4) all

the members of the investment community are shareholders in all or at least one of the technologies. We made a distribution-based case selection, since diverse cases of the population are likely to be representative for the full variety of cases. Consequently, we chose four cases from different locations (village, small town, city), with different sizes and with different technologies and resources (wind, solar, biogas, thermal water).

The selected cases are the following: 1) TexelEnergie, which grew into an energy delivering and producing company from a local citizen initiative, and which today has more than 3,000 shareholders; 2) a houseboat neighborhood in the area Amsterdam Zuid that conducted collective procurement of solar PVs; 3) a collective procurement of solar PVs in a dwelling house in the city of Leeuwarden; and 4) a community in the town Culemborg, which took over the local heating company and now provides heating to the district of Eva-Lanxmeer in the town.

3.2 To what extent do RECs share stabilized learning processes, forming thereby a global-level niche?

For assessing the transition potential of RECs we start with exploring whether separate RECs at local level network with each other, and to what extent they share the knowledge they gained, which can result in generic lessons and rules at a global level.

Citizen initiatives dealing with energy are rooted back to the end of the 80s in the Netherlands. There are no precise data on the number of Dutch RECs; however, we can estimate that it lies somewhere between 150–300 [30]. Although RECs usually work independently and try to develop their business plans for the procurement and installation of the renewable technology on their own, today there are already several platforms, networks and organizations that provide help for them and create websites, write newsletters and organize workshops or education clubs (*HIER opgewekt*, *Nieuwe Nuts Innovatie Netwerk, Wij krijgen kippen*, *LDEB*, *Rescoop*, *Organisatie voor duurzame energie*, *E-decentraal*, *Stichting ODE* and *Energie Plus*). Through these platforms communities can learn from each other and be up to date about all the important aspects and news that are necessary for their establishment and operation. In this way separate communities get to know each other, form a social network and learn how to adopt the best practices and how to cope with problems.

Moreover, there are several campaigns for collective procurement, which aim to incentivize people to buy solar PVs or windmill shares collectively (*Windvogel*, *Zeeuwind, Urgends*, *Betere Wereld*, *Natuur en Milieu*, *Vereniging Eigen Huis*, *ZonEffect*, *MetdeZon*, *Zutphense Energie Transitie* and *SolarBlitz*). *Nudge* has for example a specific campaign, in which they are looking for so-called district mayors, people who

would gather local citizens and organize the procurement of solar PVs for them with help from *Nudge*, thereby facilitating the creation of new RECs.

Other organizations (e.g. *Zon op Nederland*) facilitate communities whose members have no space for installing solar PVs on their own properties, to collaborate with farmers or institutions (schools, offices) that can have their roofs rented by the community. One example is *Energie van boer en buur*, a citizen initiative which, together with farmers, invests in solar PVs that are installed on the stables and sheds of the farmers. In its first version citizens contributed €250 to the project, for which they got vouchers in the value of €300 for which they could buy products from the farmers. In the second version of *Energie van boer en buur* there are 27 farms involved throughout the country and the community members invest €300 in exchange for shares and electricity supply [30]. In many cases these campaigns and organizations grew out of local initiatives, and solutions or procedures that a renewable energy community used once pass on to the others. In this manner they create patterns and new practices that become knowledge capital of the niche.

However, the most important and striking example showing that these communities form a global-level niche and share common goals, is the organized lobby work aimed at the government for the extension of the so-called 'saldering' law. Currently, people are not allowed to supply their own electricity without paying VAT and energy tax, if it is not produced behind their own meters. It means that, in case the electricity installation is not located on the property of the owner, but somewhere else, and the produced electricity is fed into the grid, the person has to pay VAT and energy tax on top of the electricity price that he could sell the energy for, when he buys it back. In case the electricity is produced on the owner's property, the producer is exempt from the taxes and VAT up to 5,000 kWh per year. This is called 'saldering' (which can be translated as: 'balancing'). However, the regulation hinders not only individual investments in case they lack space for the installation on their own property, but also collective energy production. Therefore, several RECs, together with networking organizations such as the *Wij krijgen kippen*, *Windvogel*, *Klimaatverbond* and *Amsterdam Stadsdeel Zuid*, and with the support of companies (e.g. *Greenchoice*, *Liander* and *ASN*) and university professors wrote a petition and lobby extensively for the extension of the *saldering* law for also collective self-supply.[c]

Reviewing all these examples we conclude that RECs in the Netherlands can indeed be regarded as a global-level niche, through stable learning processes organized by several platforms, which encompasses

[c] http://www.wijkrijgenkippen.nl/wp-content/uploads/2011/04/Green-Deal-verruimde-saldering-13-april-def.pdf

all the elements that can be found in the ST regime. They share common knowledge and become the locus of social innovations in the form of new practices and behavioral patterns.

3.3 To what extent do RECs have the support of powerful regime actors through links with sub-regimes?

In general we can state that RECs in the Netherlands are already in this process. There are numerous governmental and provincial measures to support the establishment of such communities or help their operation, suggesting that regional and, to an extent, governmental authorities are supporting RECs. Green Deals are especially targeting them by eliminating obstacles. Firstly, the government provides financial help for such initiatives through the MKB+ (*midden en kleinbedrijf* – small and medium business) Innovation Fund and tax deduction for research and development. Secondly, the government helps as mediator in matchmaking and negotiating with all parties involved in a community project. Finally, it tries to reduce unnecessary administrative burden and other legal obstacles. Furthermore, at provincial and local level we also find cases where the government contributes to the realization of community projects. The municipality of Amsterdam, for example, started a pilot project that provides an alternative solution for the lack of collective *saldering* law. The residents of an apartment complex can do virtual *saldering* for the electricity produced by their solar PVs set up on their roof.

And not only the government supports RECs, but also companies see the potential in this niche and establish links with it. *Greenchoice* and *Aliander*, for example, offer specific leases and loans, they help in the administration of local energy cooperatives, or also find alternative solutions for collective *saldering*. *Windvogel* supports local energy initiatives financially. *Trianel*, *Eneco* and *Anode* offer support services, act as intermediaries, use their formal and informal networks in lobbying for self-supply or make Green Deals with the communities. Moreover, in case a community is not able to organize the project itself and needs additional help, there are also several consultancies that are specifically helping local renewable energy projects, such as *Relocal*, *C8 foundation* and *Eversheds Faasen*. Finally, there are several banks, like *Triodos bank, Rabobank* and *ASN bank*, that give special loans and also services. *Rabobank* has specialists that support energy cooperations and *Triodos* organizes a master class about financial models for energy initiatives.

In our cases we also saw many examples of cooperation with regime actors. In Culemborg the local municipality invested €3,000 in the Thermo Bello project and it also gave a financial guarantee to the bank for the loan (€70,000); thereby the community could get a two percent lower interest rate from the bank. The alderman helped the community to lobby at the provincial level; thereby the Province of

Gelderland supported the necessary expansion of the pipelines for the distribution of the heat with €150,000. In the case of the dwelling house in Leeuwarden, the local government provided an expert who helped the community realize the project. When the residents from the houseboat area from Amsterdam wanted to invest in solar PVs, the technology supplier saw the potential in a community project and offered reduced prices, if the people did collective procurement. Finally, the community in Texel cooperated with a local energy company whose professional help was crucial for the realization of such a project.

As we see, there are different links established with the regime. The policy sub-regime regards RECs important enough to create policies for their support, and actors from different governmental levels provide financial and professional help for the investments. There are also actors from the market, distribution and financial sub-regimes that see the potential in these communities and help their establishment and operation by providing loans, support services, or by using their official and inofficial networks for lobbying in their favor to the government. Finally, NGOs and associations that operate in the socio-cultural sub-regime and try to change the carbon dependency of the ST regime from the inside, view RECs as a potential alternative to the fossil based energy system and therefore they support them and set them as examples for incumbent regime actors.

3.4 To what extent are RECs heterogeneous in terms of actors, technologies and conditions under which they operate?

Using the third indicator for determining the transition potential of RECs we turn our focus to the level of heterogeneity regarding the type of people, their motivations, the technologies they use and the conditions they are operating under. In general RECs in the Netherlands are different in their size (ranging from small communities with a few members to large communities having 3,000 members), in their location (an island, a house-boat neighborhood in Amsterdam, a district of a small town or a dwelling house), in the technology they use (solar PVs, water pumps, wind mills and a starting project on a biomass power plant) and in their motivations (financial, environmental, helping the local economy, being independent from big companies and the hedonic motivation of working together with fellow citizens on a joint project). We focus here on four example communities[d]:

[d] Our case selection is not representative in a sense of presenting typical renewable energy communities. It aims rather to demonstrate the heterogeneity of these communities, as mentioned already.

Case 1: The biggest community studied is located in Texel, an island in the north of Holland with a population of 13,644 inhabitants. Around one fourth of the inhabitants are members of the renewable energy community, which has grown into an energy company. TexelEnergie delivers renewable energy, electricity and gas to businesses and private clients in Texel and in the rest of the Netherlands. TexelEnergie buys and sells not only renewable energy, but also produces it from solar PVs and windmills. Currently the company is also working on a biomass and a smart-grid project. The idea of TexelEnergie was conceived by three local citizens who wanted to support the local economy and help the island to become sustainable. After the involvement of nine other residents, they started the energy initiative in 2007. The news spread on the island and by the end of the first year 600 people joined the project; now there are 3,000 shareholders of the company.

Case 2: A house boat neighborhood in Amsterdam Zuid constitutes the second renewable energy community studied, which has 50 members. Four local people started the project in 2008, when they wanted to buy solar PVs on their own, but they got an offer from a supplier that, in case they bought PVs in large quantities, they could get them at a reduced price. That is why the four initial citizens involved other people from the neighborhood, who found the option of environment friendly energy production attractive, and the project became a big success. Therefore, the collective procurement was repeated in the two following years.

Case 3: Our third case is a residential community in a dwelling house in Leeuwarden. Eleven households from the building participated in the project, which was initiated by two residents who wanted to make use of the large roof by installing solar PVs. The energy they produce is used by the whole building (association of the owners) and not by individual households; the rest of the energy is sold to the grid. Their main motivation was producing clean energy to protect the environment; besides that, they found it "exciting" to work together and they wanted to gain some profit too.

Case 4: Our final case is different from the previous ones in the sense that the community produces heat and not electricity from renewable energy. Thermo Bello is a district heating company owned by residents in the district EVA Lanxmeer, which is located in Culemborg, a small town near Utrecht. The story of Thermo Bello started in 2006, when Vitens, a public water company wanted to sell its subsidiary, a local heating system. The company distributed heat occurring in the process of cooling down drinking water. The director of Vitens wanted to sell the heating system as soon as possible. Since there was no big company interested in this system at that time, even though he offered it much under market price, he also asked the local municipality and the association of house owners whether they wanted to buy it. Although the municipality didn't show any interest, there were four residents who saw the potential in it and

decided to investigate the option of setting up a local energy company and taking over the heating system. Sixty-eight people from the neighborhood participated in the project and contributed either financially or actively to the process. They had diverse motivations. Firstly, they were afraid that Vitens would sell the heating system to a big company, which would then increase the heating price and not give the residents any control. Secondly, they saw it as a challenge and they found it exciting to realize such a project. Finally, they also had ecological reasons. Through a well-managed local community company they could save a lot of energy, which is good for the environment.

Our cases show also intra-case heterogeneity in terms of the participants in the projects. Firstly, we found individuals with heterogeneous motivations in each of the cases. Most of the people claimed that the protection of the environment was their main intention for participating in the project, but also the expected financial benefits played an important role in their decision. Besides that, people who actively participated in the organization process found it a good opportunity to get to know their neighbors and do an inspiring and creative project with them. Furthermore, newcomers found it a great opportunity to get accepted by the community and it made their integration easier.

Secondly, each case is rather heterogeneous in terms of the education level, financial capital and age of the people involved. The community in Amsterdam Zuid is the most striking example of this heterogeneity, with, on the one hand, old, mostly lower educated working-class residents that moved to the house-boats neighborhood in the 60s and 70s, because they did not want to fit in the framework provided by mainstream society. On the other hand, the community also includes a second generation, rather wealthy intellectuals that could afford to live in luxury house-boats in the capital of the Netherlands.

The variety of conditions (location and size of the community), type of people involved (regarding their age, education and financial capital), motivations and technologies shows that the niche of RECs is heterogeneous, encompassing diverse groups driven by different motivations. Consequently, participating in a renewable energy project at community level can be an option for many people. Hence, in our examples we found evidence for niches of RECs that have the potential to spread and gain an essential part of the user sub-regime.

4. Conclusions

The aim of this article was to explore the transition potential of renewable energy communities, as social niches, by using and further elaborating the analytical framework of the multi-level perspective. To do so,

we introduced three indicators of transition potential, extending earlier theoretical work, to study the transition potential of social innovations and thereby social niches by using the example of RECs. The first proxy is the generic rules and lessons learned at the global level that make similar but separate local niches to compose one global level niche. In the case of RECs in the Netherlands we showed that they indeed network and learn from each other and have all the system elements of the regime, thereby forming a proto-regime. The second proxy is the support of powerful actors and links built up with sub-regimes. We described how RECs attract numerous regime actors in the Netherlands, such as the government at the local and provincial level, financial institutions and companies; in such a way RECs thus create useful links to the regime. The third indicator that we introduced is the heterogeneity of the niche regarding its actors, their motivations, the technologies they use and the conditions they are operating under. The more heterogeneous the niche is, the more likely it can expand and become an influential part of the regime, which is the case for the examples of RECs in the Netherlands discussed in this article.

These three indicators of transition potential for social niches have been also discussed by earlier work, albeit not as systematically, or explicitly. The interrelation among these three elements can result either in positive feedback loops, reinforcing the transition potential (the more heterogeneous, the more learning potential and so on). But it may also result in hindering the transition potential (for instance, the more support from regime actors, the higher the pressure for closure towards traditional solutions and behaviors). Further work is necessary to clarify the interrelations among these three dimensions, and the different types of transition pathways that result from different types of relations among them.

Aside from elaborating the notion of transition potential of social niches, the paper aims to make further contributions to transition theory. We reinterpreted the notion of niches and transition paying special attention to social innovations and their role in sustainability transitions. Building on earlier work, we argued that niches are not just protected spaces for the development of innovations, but they constitute complex systems themselves, containing elements similar to those of the regime (actors, rules, material artifacts, practices, etc).

Furthermore, transition does not necessarily mean a complete shift to another regime, since the ST regime itself is not a unitary whole, but rather an interlinked system of several sub-regimes [20,21]. Thus, changes in some segments do not necessarily lead to the whole transformation of the regime and both technical and social innovations can coexist with incumbent technologies and practices. In addition, each sub-regime is further fragmented by different social groups that have different interests and orientations. Links between diverse social groups from diverse sub-regimes compose the structure of the regime and

during transition new links are established with niches, which thereby become a new segment of the entire system.

We made a distinction between internally and externally oriented niches based on their orientation and application focus arguing that the former do not primarily intend to develop innovations for later regime use, but rather to meet internal purposes without having the intention to induce transition. The lack of intention, however, does not necessarily prevent these niches from contributing to sustainability transitions. RECs can be considered as internally oriented niches, that, even without primarily aiming at transition, can build up links with the incumbent regime, and thus have the capacity to scale-up and trigger changes. Although this process does not inevitably lead to a complete regime shift, RECs have the potential for becoming an important part of the current energy system and play a role in the transition toward a sustainable market-economy.

Besides defining their orientation and application focus, we also claimed that RECs are social niches, where new practices, consumer and producer behaviors develop, thereby changing the traditional way of energy production and the role of civil society in the energy transition. Although the emphasis here is on the social and technological innovations that serve more as tools to meet internal needs, both innovations are present and nurtured by the communities that create adequate conditions for them, which are different from market expectations. In this regard, we see differences between social and technological innovations. While technological innovations developing in market or technological niches always entail the emergence of social innovations, such as new practices, generic rules and lessons, if social innovations are in the focus of the niche development taking place in social niches, this process does not necessarily require the presence of technological innovations (e.g. bio-agricultural communities, community development) too.

Even though in this article we provided an overview of these communities in the particular institutional and governance setting of the Netherlands, we have not specifically focused on the influence of institutions and governmental policies on the transition potential of RECs; this remains a point for further research. As a final remark, we have to note here that in case RECs spread in the regime and a very large number of communities decide to invest in renewables, it may result in problems in the operation of the electricity grid. The current energy system is tailored to centralized and large-scale energy production, which is not yet able to bear and balance fluctuating energy supply [31]. That is why without restructuring the whole system the large spread of renewables and thereby RECs is impossible in the future. The concept of ‘smart grid’ could provide a possible solution for this problem [32]. Further empirical

investigation can explore how the development of a ‘smart grid system’ could help the spread of RECs either in case of one national or several local ‘smart grid’ projects.

References

[1] Smith, A., Stirling, A., Berkhout, F.: *The governance of sustainable socio-technical transitions,* 2005. Research Policy 34, 1491-1510

[2] Geels. F., Schot, J.: *Typology of sociotechnical transition pathways,* 2007. Research Policy 36, 399-417

[3] Hoffman, J.: *Theorizing power in transition studies: the role of creativity and novel practices in structural change,* 2013. Policy Sciences

[4] Berkhout, F., Smith, A., Stirling, A.: *Socio-technological regimes and transition contexts,* 2004. In: Elzen, B., Geels, F.W., Green, K. System innovation and the transition to sustainability: Theory, evidence, and policy. Edward Elgar, Cheltenham, pp. 48-75

[5] Geels, F.: *Technological transitions and system innovations,* 2005. Edward Elgar Publishing, UK

[6] Seyfang, G. and A. Smith.: *Grassroots innovations for sustainable development: Towards a new research and policy agenda.* Environmental Politics, 2007. 16(4): p. 584-603.

[7] Gallagher, K., Holdren, J., Sagar, A.: *Energy-technology innovation,* 2006. Annu. Rev. Environ. Resourc. vol. 31, pp.193-237

[8] Elzen, B., Wieczorek, A.: *Tranition towards sustainability through system innovation,* 2005. Technological Forcasting and Social Change 72, 651-661

[9] Geels, F.: *From sectoral systems of innovation to socio-technical systems, Insights about dynamics and change from sociology and institutional theory,* 2004. Research Policy 33, 897-920

[10] Van den Ende, J., Kemp, R.: *Technological transformation in history: how the computer regime grew out of existing computing regimes*, 1999. Research Policy 28, 833-851

[11] Geels, F.: *Technological transition as evolutinonairy reconfiguration processes: a multi-level perspective and a case-study,* 2002. Research Policy 31, 1257-1274

[12] Safarzyńska, K., Frenken, K., van den Bergh, C.J.M.: *Evolutionary theorizing and modeling if sustainability transitions,* 2012. Research Policy 41, 1011-1024

[13] Unruh, G.: *Understanding carbon lock-in,* 2000. Energy Policy, 28, 817-830.

[14] Geels. F.: *The multi-level perspectiveon sustainability transitions: Responses to seven criticisms,* 2011. Environmental Innovation and Societal Transitions 1, 24-40ű

[15] Markard, J., Truffer, B.: *Technological innovation systems and the multi-level perspective: towards and integrated framework,* 2008. Research Policy 37, 596-615

[16] Vasileiadou, E., Safarzyńska, K.: *Transitions. Taking complexity seriously*, 2010. Futures 42, 1176-1186

[17] Smith, A., Voβ J.P., Grin J.: *Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges,* 2010. Research Policy 39, 435-448

[18] Kern, F.: U*sing the multi-level perspective on socio-technical transitions to assess innovation policy,* 2012. Technological Forecasting and Social Change 79, 298-310

[19] Seyfang, G., Haxeltine, A., Hargreaves, T., Lonhurst, N.: *Energy and communities in transition: Towards a new research agenda on agency and civil society in sustainability transitions,* 2010. CSERGE working paper EDM, No. 10-13

[20] Genus, A., Coles, A.: *Rethinking the multi-level perspective of technological transitions*, 2008. Research Policy 37, 1436-1445

[21] Witkamp, M., 2011. Strategic niche management of social innovations: the case of social entrepreneurship, Technology Analysis and Strategic Management 23, 667-681

[22] Arentsen M., Bellekom, S., 2014. Power to the people: local energy initiatives as seedbeds of innovation? Energy, Sustainability and Society 4:2

[23] Geels, F., Raven, R., 2006. Non-linearity and expectations in niche development trajectories: Ups and downs in Dutch biogas development (1973-2003)

[24] Raven, R., 2012. Analyzing emerging sustainable energy niches in Europe, In: Verbong, G., Loorbach, D., Governing the energy transition, Reality, illusion or necessity? Routledge Studies in Sustainability Transitions

[25] Mulgan, G., Tucker, S., Ali, R., Sanders, B.: *Social innovation: what it is, why it matters and how it can be accelerated*, 2007. Skoll Centre for Social Entrepreneurship, Oxford Said Business School

[26] Hielscher, S., Seyfang, G., Smith, A.: *Community innovation for sustainable energy*, 2011. CSERGE working paper EDM, No. 2011-03

[27] Seyfang, G. and A. Smith.: *Community Action: A neglected site of innovation for sustainable development?,* 2006. CSERGE working paper EDM, No. 06-10

[28] Loorbach, D., 2007. *Transition Management: New mode of governance of sustainable development*, PhD thesis, International Books, Erasmus University Rotterdam, Utrecht

[29] Hoogma, R., Kemp, R., Schot, J., Truffer, B., 2002. *Experimenting for sustainable transport: the approach of strategic niche management.* Spon Press, London, UK.

[30] Schwenke, A.M.: *Energieke BottomUp in Lage Landen*, 2012, AS I-Search

[31] Lund., H.: *Renewable energy strategies for sustainable development*, 2007. Energy 32, 912-919

[32] Grijalva, S., Tariq, M.U.: *Prosumer-based smart grid architecture enables a flat, sustainable electricity industry,* 2011, Innovative Smart Grid Technologies, IEEE PES