



PROSEU

Prosumers for the Energy Union: mainstreaming
active participation of citizens in the energy
transition

Synthesis of incentive
structures: input for
Participatory Integrated
Assessment

(Deliverable N° 6.1)

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Summary of PROSEU

PROSEU aims to enable the mainstreaming of the renewable energy Prosumer phenomenon into the European Energy Union. Prosumers are active energy users who both consume and produce energy from renewable sources (RES). The growth of RES Prosumerism all over Europe challenges current energy market structures and institutions. PROSEU's research focuses on collectives of RES Prosumers and will investigate new business models, market regulations, infrastructural integration, technology scenarios and energy policies across Europe. The team will work together with RES Prosumer Initiatives (Living Labs), policymakers and other stakeholders from nine countries, following a quasi-experimental approach to learn how RES Prosumer communities, start-ups and businesses are dealing with their own challenges, and to determine what incentive structures will enable the mainstreaming of RES Prosumerism, while safeguarding citizen participation, inclusiveness and transparency. Moving beyond a case by case and fragmented body of research on RES Prosumers, PROSEU will build an integrated knowledge framework for a socio-political, socioeconomic, business and financial, technological, socio-technical and socio-cultural understanding of RES Prosumerism and coalesce in a comprehensive identification and assessment of incentive structures to enable the process of mainstreaming RES Prosumers in the context of the energy transition.

Summary of PROSEU's Objectives

Eight key objectives at the foundation of the project's vision and work plan:

- **Objective 1:** Document and analyse the current state of the art with respect to (150-200) RES Prosumer initiatives in Europe.
- **Objective 2:** Identify and analyse the regulatory frameworks and policy instruments relevant for RES Prosumer initiatives in nine participating Member States.
- **Objective 3:** Identify innovative financing schemes throughout the nine participating Member States and the barriers and opportunities for RES Prosumer business models.
- **Objective 4:** Develop scenarios for 2030 and 2050 based on in-depth analysis of technological solutions for RES Prosumers under different geographical, climatic and socio-political conditions.
- **Objective 5:** Discuss the research findings with 30 relevant stakeholders in a Participatory Integrated Assessment and produce a roadmap (until 2030 and 2050) for mainstreaming RES prosumerism.
- **Objective 6:** Synthesise the lessons learned through experimentation and co-learning within and across Living Labs.
- **Objective 7:** Develop new methodological tools and draw lessons on how the PROSEU methodology, aimed at co-creation and learning, can itself serve as an experiment with institutional innovation.
- **Objective 8:** Create a RES Prosumer Community of Interest.

PROSEU Consortium Partners

Logo	Organisation	Type	Country
	FCIENCIAS.ID ASSOCIAÇÃO PARA A INVESTIGAÇÃO E DESENVOLVIMENTO DE CIÊNCIAS	Private non-profit association	Portugal
	UPORTO FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO	University	Portugal
	ICLEI EURO Local Governments for Sustainability	Small and medium-sized enterprise	Germany
	CLIENTEARTH	Non-governmental organisation	United Kingdom
	UNIVLEEDS UNIVERSITY OF LEEDS	University	United Kingdom
	DRIFT for transition	University	the Netherlands
	UNIZAG FSB	University	Croatia
	LEUPHANA UNIVERSITÄT LÖNEBURG	University	Germany
	ECO-UNION	Non-governmental organisation	Spain
	IÖW INSTITUTE FOR ECOLOGICAL ECONOMY RESEARCH	Private non-profit limited company	Germany
	CE Delft Committed to the Environment	Small and medium-sized enterprise	the Netherlands

Executive summary

This deliverable develops a comprehensive overview of the incentive structures that shape the mainstreaming of RES prosumerism. The Incentive Structures Framework (ISF) presented here identifies and describes 17 key societal conditions, classified along the three clusters of regulatory-financial conditions, technological-material conditions and cultural-discursive conditions. The relevance is empirically substantiated through brief summaries of observations from PROSEU thematic work packages, Living Labs, and survey results. The ISF also clarifies how these societal conditions can give rise to different forms of RES prosumerism and to tensions and crossroads in the mainstreaming process. The ISF is substantiated through three analyses of political-economical, technological-infrastructure, and organisational crossroads in the mainstreaming process.

Building on insights from transitions theory, institutional theory, scholarship on societal innovation and literature on RES prosumerism, this integrative endeavour has been guided by the commitment to take transitions directionality seriously: The mainstreaming of RES prosumerism should not be confused for a singular innovation trajectory on which to accelerate and overcome barriers – it rather amounts to a complex crossroads of multiple possible RES prosumerism futures, with very different implications in terms of citizen participation, inclusiveness and transparency. The ‘incentive structures’ shaping the RES prosumerism process have been identified by considering RES prosumerism as a bundle of new actions, objects and ideas. Each of these innovation dimensions is shaped by particular sets of societal conditions. Gathering, classifying and merging data across the different PROSEU work packages, the framework has been fine-tuned into a comprehensive set of ‘incentives’. They cover the range of regulative, normative and cognitive institutions distinguished in institutional theory, and are in line with conceptualizations of RES prosumerism in terms of socio-technical practices or ‘niche’ innovations. The ISF combines and organises the thematic PROSEU analyses of business models, technologies, regulatory frameworks, as well as the data on RES prosumerism collectives and networks as gathered through the survey and in-depth analyses of Living Labs.

The ISF as developed highlights how RES prosumerism is incentivized and dis-incentivized through a range of financial, regulatory, technological and cultural societal conditions that change over time and across geographical contexts. This helps to understand the broad range of possible RES prosumerism futures that is sketched in recent literature, ranging from expectations of breakthrough to accounts of co-optation, commercialization, and retrenchment of dominant powers in the energy system. This multiplicity of possible futures has been elaborated through three explorations of directionality, each of which are written as stand-alone practice briefs. Each brief zooms in on a particular crossroad in the RES prosumerism mainstreaming process, these analyses elaborate in more detail how the identified societal conditions can make a difference. Systematically disclosing the range of possible RES prosumerism futures and clarifying the underlying societal ‘incentives’, the presented ISF provides important building blocks for the subsequent task of Participatory Integrated Assessment (PIA). Next to this key task of preparing for the PIA, the framework also serves broader project tasks of synthetic insight, reflection on possible data gaps, and connecting the partial analyses developed in other work packages.

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Glossary

CMB: A Community Municipal Bond (CMB) is a bond issued by a UK local authority direct to the public via a crowdfunding platform (Davis and Cartwright, 2019).

cRES: Controllable Renewable Energy Sources. These have the predictable and stable production of electricity that is almost the same as the power production using fossil fuels. Examples of cRES are biomass, hydro and geothermal. Because of their controllability, they are recognised as a possible replacement for coal-fired and gas-fired plants. See also vRES.

CHP: Combined heat and power, or cogeneration, is the simultaneous production of electricity or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy.¹

DSO: The Distribution System Operator is responsible for operating and maintaining the distribution electricity grid.²

ESCO: Energy Service Company, according to the European Commission this is a new intermediary in the changing energy market, different from the traditional energy consultants, equipment suppliers or energy utilities. They have evolved in response to the growth in renewable energy production, including prosumerism and may mediate between entities interested in prosuming and the financiers, project developers and energy utilities. (Joint Research Centre (EC), 2019)

ISF: The Incentive Structure Framework (ISF) integrates insights from the different PROSEU work packages, proving a comprehensive insight into the enabling and constraining conditions for the mainstreaming of Renewable Energy Sources (RES) prosumerism. The ISF is meant to answer the following question: What incentive structures will enable the mainstreaming of RES prosumerism and, in so doing, contribute to safeguarding citizen participation, inclusiveness and transparency in the Energy Union? Specific purposes of the ISF are:

- a) Increasing the understanding of incentives (theorized as enabling/constraining societal conditions) for the mainstreaming of renewable energy prosumerism (and its possible contribution to the energy transition)
- b) Synthesizing the empirical insights across different dimensions (financial, technological, regulatory, socio-cultural etc.), as developed in WPs 2-5 and 7.
- c) Developing heuristic power: The ISF is to provide comprehensive insight for research as well as for practice.

PIA: The Participatory Integrated Assessment (PIA) discuss the research findings of PROSEU with 30 relevant stakeholders and produces a roadmap (until 2030 and 2050) for mainstreaming RES prosumerism. The Participatory Integrated Assessment will develop options for new incentive structures for the upscaling and mainstreaming of prosumerism.

PV panels: Photovoltaic panels generate electricity from solar sources.

¹ Energy gov website 2019: <https://www.energy.gov/eere/amo/combined-heat-and-power-basics> (accessed December 2019)

² Energy wiki website 2019: [http://energywiki.eyp.org/view/Distribution_System_Operators_\(DSOs\)#cite_note-1](http://energywiki.eyp.org/view/Distribution_System_Operators_(DSOs)#cite_note-1) (accessed December 2019)

PPA: A power purchase agreement is a contract between a party selling electricity and a party looking to buy electricity.

Prosumer (in energy): the European Commission generally does not use this term, but it appears to equate the concept with its idea of an active customer and/or renewables self-consumer (see respective definitions in this glossary), as defined in the recast Electricity Directive and the RED II Directive. A 2016 review of prosumer collectives defines an energy prosumer as “a consumer of energy who also produces energy to provide for their needs, and who in the instance of their production exceeding their requirements, will sell, store or trade the surplus energy” (Ford, Stephenson, & Whitaker, 2016). This review alone mentions 20 definitions of prosumers but doesn’t touch upon the different interpretations in different legislations in EU countries.

RES Prosumer Initiative: in the PROSEU study a RES Prosumer Initiative is a collective energy actor that produces energy from renewable sources with the primary objective of providing in its own energy needs and/or those of its members, and in some cases selling excess energy to clients, thereby actively participating in the energy markets. Examples of such a collective energy actor are cooperatives; informal collectives; not-for-profit organisations (including socio-cultural or sports associations and NGO’s); companies in different sectors; public institutions (whether municipalities or schools and retirement homes) and public-private or other forms of partnerships.

RESCOOP: The Renewable energy community (according to the EU) is a legal entity:

- a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;
- b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;
- c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits. (RED II Directive) In the REScoop model (see below), community power or community energy initiatives are judged by higher standards, namely:
 - 1. Voluntary and Open Membership;
 - 2. Democratic Member Control;
 - 3. Economic Participation through Direct Ownership;
 - 4. Autonomy and Independence;
 - 5. Education, Training and Information;
 - 6. Cooperation among Cooperatives;
 - 7. Concern for Community.³ •

TSO: A Transmission System Operator (TSO) is an entity entrusted with transporting energy in the form of natural gas [1] or electrical power on a national or regional level, using fixed infrastructure.⁴

³ REScoop website 2019: <https://www.rescoop.eu/the-REScoop-model> (accessed December 2019)

⁴ <https://ec.europa.eu/energy/en/topics/market-and-prices/wholesale-market/electricity-network-codes>

UoS: Use of System (UoS) or distribution charges are the costs for operating and maintaining a distribution network.

vRES: Variable renewable energy sources can provide electricity at unpredictable intervals. Examples of vRES are sun and wind energy. See also cRES.

List of abbreviations

CHP	Combined heat and power
CMB	Community Municipal Bond
cRES	Constant Renewable Energy Sources
DSO	Distribution System Operator
EV	Electric vehicle
EU	European Union
EU ETS	EU Emission Trading Scheme
ESCO	Energy Service Company
FIP	Feed-in premiums
FiT	Feed-in tariffs
GHG	Greenhouse gas
kW	KiloWatt (power)
kWh	KiloWatt-hour (energy)
kWp	KiloWattpeak (power)
MW	Megawatt (power)
PIA	Participatory Integrated Assessment
PV	Photovoltaic
PPA	Power Purchase Agreement
RE	Renewable Energy
RES	Renewable Energy Sources
RESCOOP	Renewable Energy Cooperative
TSO	Transmission System Operator
UoS	Use of System
vRES	Variable renewable energy sources

1. Introduction

This deliverable is related to PROSEU Work package 6, Task 6.1 and provides a comprehensive synthesis of incentive structures for the mainstreaming of prosumerism. The developed Incentive Structure Framework (ISF) integrates insights from different PROSEU work packages regarding the enabling and constraining conditions for the mainstreaming of Renewable Energy Sources (RES) prosumerism.

The **target group** are specifically PROSEU researchers since it serves as input for the development of roadmaps for the mainstreaming of prosumerism through Participatory Integrated Assessments (PIA) in PROSEU Work package 6, Task 6.2 and on the way sheds light on the current state of research in PROSEU and highlights possible gaps to be addressed in the forthcoming period. Beyond, this deliverable is also meant for an informed audience interested in the enabling and constraining factors for mainstreaming prosumerism.

Specific **purposes** of the ISF are:

- Increasing the understanding of incentives (theorized as enabling/constraining societal conditions) for the mainstreaming of RES prosumerism (and its possible contribution to the energy transition)
- Synthesizing the empirical insights across different dimensions (financial, technological, regulatory, socio-cultural etc.), as developed in WPs 2-5 and 7.
- Developing heuristic power: The ISF is to provide comprehensive insight for research as well as for practice. Specifically, it should guide the participatory development of a roadmap for the mainstreaming of prosumerism.

As indicated in the description of work, the overall **research question** of the PROSEU project, that also the ISF contributes to answer is the following:

What incentive structures will enable the mainstreaming of RES prosumerism and, in so doing, contribute to safeguarding citizen participation, inclusiveness and transparency in the Energy Union?

In fact, RES prosumerism is already in the process of mainstreaming. Much of current discussions do not ask *if* the mainstreaming will happen, but rather raise issues of where the further process will be leading. Will it transform energy systems and revolutionize current power relations, or will it remain a transient turbulent phase that will be followed by a re-entrenchment of the current incumbent actors (Brisbois 2019)? Will it remain limited to some isolated ‘add-on’ technological innovations, or also comprise broader social and institutional transformations (Burke & Stephens 2018; Hewitt et al. 2019)? Will the earlier phases of mainstreaming be followed by a further expansion, or has a peak – at least in some European countries - already been reached (Hewitt et al. 2019; Brown et al. 2019)? The underlying perspective on which the ISF is built, takes the following as a starting point:

- RES prosumerism refers to a **broad set of innovations** (differing in technical respect, but also involving different innovations and changes on social dimensions);
- there are **multiple values** to be safeguarded (arguably extending beyond the three values indicated), and there may be tensions and trade-offs between them;
- RES prosumerism is ‘incentivized’ or rather shaped by **various societal structures**, and

- RES prosumerism will not become mainstreamed through a singular trajectory with a known end-stage. The mainstreaming refers to a multitude of *uncertain processes*.

Before presenting the ISF and its practical implications for RES prosumerism mainstreaming, we further describe the underlying theoretical considerations in section 2 – which is therefore also written with an academic audience in mind. The mainstreaming of RES prosumerism is viewed as part of a broad, long-term **transition** process, and we need to take the **directionality** (the multiple possible development paths) of this transition process seriously. Our unfolding of the relevant ‘incentive structures’ is therefore attentive to the multitude of socio-technical forms that RES prosumerism can take, the diversity of ways in which involved actors may appraise them, and to the dynamics of the mainstreaming process (**section 2**).

Next, we present the ISF as a synthesis of insights from other PROSEU work packages. Unpacking RES prosumerism as a bundle of new ideas, actions and objects, we take stock of the relevant enabling, constraining or ambiguous societal conditions that shape its mainstreaming (**section 3**).

In order to ensure the provision of concrete and practically relevant inputs to the subsequent task of Participatory Integrated Assessment (PIA), these general ISF insights are elaborated in the form of three themed practice briefs. The briefs show how the RES prosumerism mainstreaming process can go in different directions, depending on the incentive structures identified. They will discuss three important crossroads that are arising about the political-economical, socio-technical and organisational aspects of RES prosumerism⁵. This shows more concretely how the identified incentive structures matter. As stand-alone outputs for an informed policy and practice audience, the briefs will address how RES prosumerism mainstreaming hovers between community economy and commercial opportunity (**section 4**), between ‘Energy islands’ or fully interconnected installations (**section 5**), and between inclusiveness and privilege (**section 6**).

We conclude with reflections on the methodological approach, and on the comprehensiveness of the Incentive Structure Framework. Also considering how these insights can be applied in further PROSEU research, we pay specific attention to the subsequent task of the PIA. It will validate the outcomes of the ISF and enlarge the pool of experts that is consulted on these incentive structure. Ultimately, the goal is to arrive at a temporalised version of the incentive structures, i.e. a roadmap for 2030/2050. This roadmap will present strategic insights on how to mainstream RES prosumerism in a participatory, inclusive and transparent way, as part of the Energy Union (**section 7**). The ISF and the practice briefs will stand on their own as analyses of relevant incentive structures, but they will not provide outspoken recommendations for practitioners. Such recommendations would run ahead of the PIA.

⁵ These three foci cover the insights of WPs 2-5, and 7, and they allow for a comprehensive communication of the set of relevant societal conditions identified in the Incentive Structure Framework.

2. Conceptualizing RES prosumerism ‘incentive structures’

2.0 Introduction

This section 2 of the deliverable provides the theoretical considerations underlying the ISF and is meant for an academic audience. The ISF is meant to contribute towards answering the following PROSEU research question:

What incentive structures will enable the mainstreaming of RES prosumerism and, in so doing, safeguarding citizen participation, inclusiveness and transparency in the Energy Union?

The question contains several concepts. If we are to arrive at relevant insights, each of the constituting terms needs to be unpacked: What incentive structures will enable the mainstreaming of RES prosumerism and, in so doing, safeguarding citizen participation, inclusiveness and transparency in the Energy Union? In the following, we first situate the question within the broader pursuit of sustainability transitions, underlining the ‘directionality’ of transitions processes – the mainstreaming process can evolve into different forms of RES prosumerism (**section 2.1**). Next, we develop specific understandings of RES prosumerism as a combination of ideas, objects and activities (**section 2.2**), incentive structures as enabling, constraining or ambiguous factors (**section 2.3**), mainstreaming as a dynamic process and the phase where an innovation starts to set standards (**section 2.4**), the normative yardsticks involved in energy transitions (**section 2.5**). Taken together, the different concepts provide a perspective on how to understand the mainstreaming of RES prosumerism (as a broad set of different innovations), safeguarding different normative orientations, along enabling, constraining and ambiguous societal conditions and as open-ended uncertain processes. We opted for discussing each of the concepts separately, while these of course are closely related, where possible we cross-reference through footnotes to highlight these interconnections. These concepts form the ground on which to stand for the work in sections 3-6, although, in the light of readability and different target audiences, we might not refer to them one-on-one in these other sections.

2.1 Energy transition: taking directionality seriously

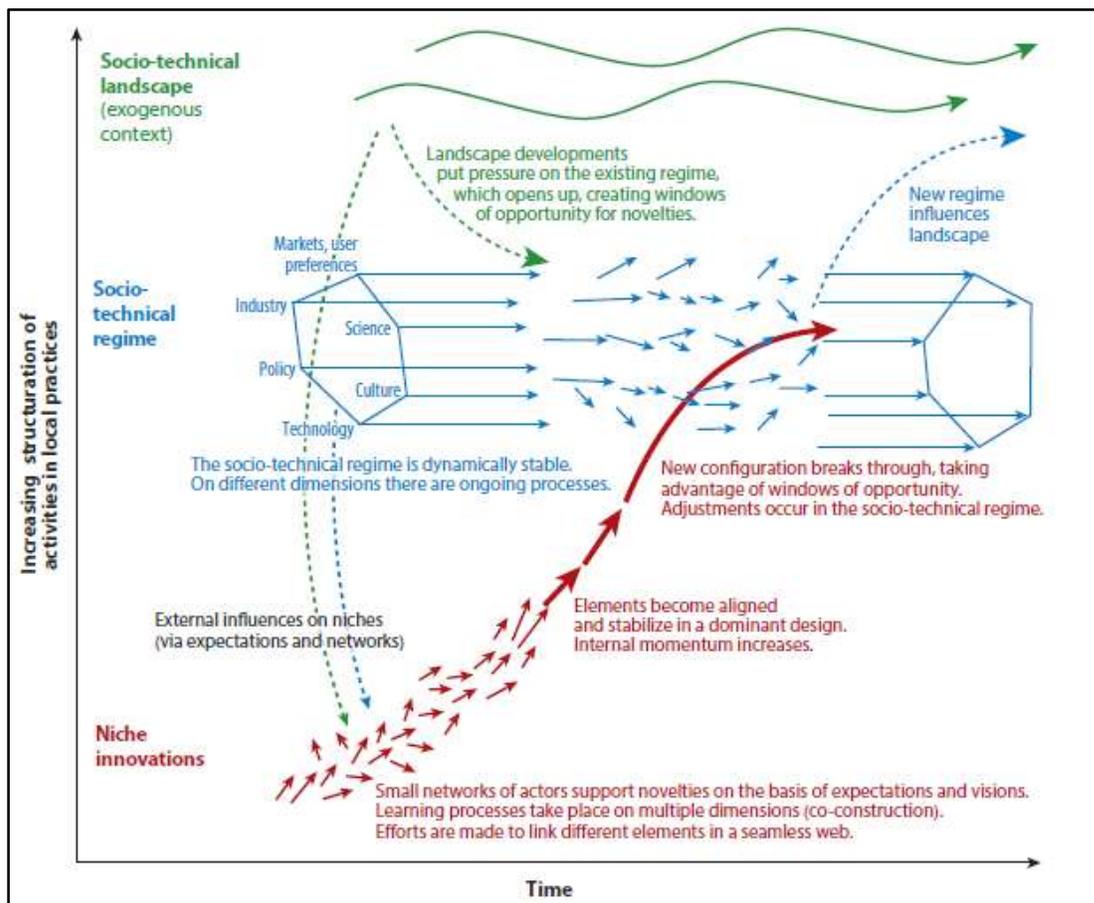
The key challenge in answering the PROSEU research question is that ‘RES prosumerism mainstreaming’ does not refer to a singular and well-known mainstreaming trajectory, i.e. a marked path to follow. As theorized in studies of sustainability transitions (Grin et al. 2010), we need to conceive of it in terms of a long-term⁶, complex, dynamic innovation process in which multiple innovations and societal changes interact.

RES prosumerism has emerged – and will further evolve – within a broader **energy system that has strongly institutionalized in modern societies**. Much investment has gone into current energy infrastructures, and this creates incentives towards continued exploitation. Consumers in developed countries have grown accustomed to the highly reliable provision and are accordingly less inclined towards undertaking risky experiments. Highly specialized expertise has been developed on the operation of existing energy infrastructures and technologies, and alternative approaches (with new forms of renewable energy production) still tend to appear less ‘realistic’ considering the existing knowledge and procedures. Strong and long-term alliances have been developed between utility companies, investors, developers, and governments, and these actor networks have developed

⁶ Such transition processes generally take some 30-40 years. This process aspect is addressed further in section 2.6.

a certain closure vis-à-vis new entrants. Elaborate structures of taxation and regulation have been developed to allow transparent and efficient energy markets to emerge, and like all formal institutions they are difficult to adapt. Meanwhile, various informal institutions (consumer cultures, the development of energy-related skills, habits of energy use) have developed in which the current centralised energy production is assumed to be the normal way in which the energy system is managed. Within this energy ‘regime’ (cf. Verbong et al. 2012), RES prosumerism has emerged as a set of⁷ evolutionary ‘niches’ – radical alternatives that deviate from the rules and incentives of the dominant socio-technical system.

Figure 1 Multi-Level Perspective on Transitions. Source: Loorbach et al. (2017)



The **Multi-Level Perspective (MLP) on transitions** depicts transition processes through a multitude of interacting innovations and changes – such as the interactions of regime and niches (see Figure 1). It underlines that if nothing changes, the RES prosumerism ‘niches’ will simply evolve in line with the incentives posed by the dominant energy regime. The normal course of its mainstreaming process is that it will largely reproduce the dominant features of the energy regime (Geels & Schot 2007): centralised governance, continued reliance on

⁷ Transitions research indeed helps to understand that RES prosumerism is not a singular innovation, but rather a cluster of (interrelated) alternative forms of energy production/consumption. The different niches are bound to go through different processes of mainstreaming.

fossil fuels, brought in line with prevailing technologies and procedures, catering for unquestioned energy demands, and being developed by the currently leading players on the energy market. If RES prosumerism is to become a transformative development that sets the standards for a more sustainable and desirable⁸ (and less centralised) energy regime, a process will have to be set in motion in which the existing 'regime' gradually becomes adapted to these sustainable alternatives. Transitions research has brought out that this generally occurs through combinations of 'niches' that institutionalize and diffuse (e.g. PV installations becoming increasingly competitive), 'regimes' that open up to alternatives due to internal tensions (e.g. the disenchantment with nuclear energy), and the occurrence of broader societal shifts ('landscape' developments) that increase the pressure on 'regimes' – e.g. climate change policies, calls for energy democracy, technological breakthroughs, and the occurrence of disasters and accidents. Niches such as RES prosumerism are understood to be both changing, and changed by, the regimes whose 'incentive structures' they seek to change.

Considered through a transitions-theoretical perspective, RES prosumerism mainstreaming forms part of a broader fundamental shift in the energy system. The multitude of arrows in Figure 1 reminds that transitions are not one-off revolutions, but rather gradual evolutionary processes (Rotmans et al. 2001). Involving interactions (co-evolution) between a multitude of changes and innovations, such processes are difficult to predict and control. The governance model of transition management therefore emphasizes the importance of steering clear from blueprint visions and associated attempts at social engineering, proposing instead participatory visioning processes in which 'baskets' of multiple visions are generated (Loorbach 2007). Complexity, unpredictability and experimentation are taken as starting points for governance (Avelino & Grin 2016).

The RES prosumerism mainstreaming process could lead to a broad range of futures. This '**directionality**' of transitions, the multiplicity of possible development paths with different societal implications, is widely acknowledged within the research field. However, it is seldom accounted for to the full extent. As pointed out by Stirling (2011), transitions research and associated practices are still too often gripped by 'racetrack' understandings of transition processes. Eager to boost and accelerate mainstreaming processes, one easily loses sight of the many junctures in the innovation trajectory. Focusing on the 'barriers' erected by the prevailing regime, it is easily forgotten how the regime itself is evolving and coping with internal tensions, and how the 'niches' to be boosted are co-evolving with these ongoing changes. If one remains preoccupied with blueprints of the future, the capacity to seize opportunities and adapt to circumstances is only diminished. Minding only the cultivation of new technologies and the associated ways forward, one forgets about the other side of the coin – the phasing out or 'exnovation' (David 2017) of existing technologies and routines.

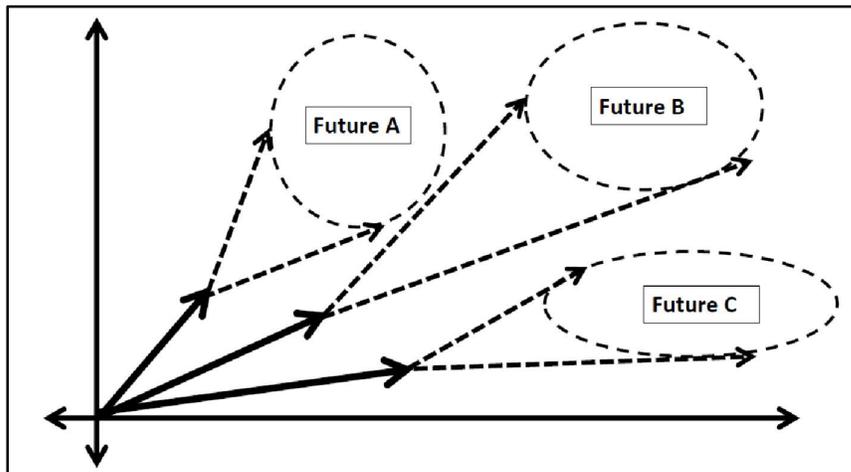
Yet even when understanding that **mainstreaming processes will have their twists and turns**, we often imagine and depict them through overly linear, orderly pictures, phase models and 'roadmaps' – which reinstate illusions of *given* trajectories and *controllable* 'projects' (Stirling 2016; 2019). In the process of mainstreaming, 'niches' can eventually emerge as the new 'dominant designs' and the 'new normal' of a drastically more sustainable system, yet they can also be co-opted, 'captured' and absorbed by the prevailing regime. They can take many forms in-between, often even splintering into more radical and more domesticated variations of the original (Smith 2007; Pel 2016). In terms of outcomes, these changes in the direction of the mainstreaming processes are essential. Normatively, they reveal how socio-technical innovations like RES prosumerism tend to be very ambiguous advances, which can be made to fit in with various societal orders. If failing to take transitions directionality seriously, important questions of *why* and *what for* certain 'sustainable technologies' should be promoted recede into the background (Bening et al. 2015; Schlaile et al. 2017) – precisely those ethical

⁸ See section 2.5 on 'normative yardsticks' for a discussion of this important but complex normative dimension of RES prosumerism.

considerations of how to ‘safeguard citizen participation, inclusiveness and transparency in the Energy Union’ (see section 2.5).

This awareness of transitions directionality is particularly important for emergent, still ongoing and not yet settled innovation processes like RES prosumerism mainstreaming (Pel 2019). Taking transitions directionality seriously, we will seek to identify *which* forms of mainstreaming can be distinguished, and *where to* the mainstreaming processes⁹ may lead us. Rather than as a singular innovation trajectory, RES prosumerism is approached as a *set of possible prosumerism variations*, which can be reached through various mainstreaming processes. Figure 2 below gives a basic indication of this view on RES prosumerism mainstreaming: Shaped by opposing societal forces (the X and the Y axis), a range of RES prosumerism configurations can be distinguished (further elaboration of this scheme is provided in section 3.5).

Figure 2 Transitions directionality: Multiple variations of RES prosumerism



Within the interdisciplinary field of sustainability transitions research, the directionality of transitions is widely acknowledged, but seldom given prominence (Bening et al. 2015; Köhler et al. 2019). It has been addressed in rather fragmented way. Transitions directionality has thus far been addressed mainly through three disciplinary angles – each of which emphasises particular aspects of it (Pel et al. *under review*). These theoretical strands will help to unpack what RES prosumerism is, how its mainstreaming can be understood, what kinds of ‘incentive structures’ we are talking about, and what ethical values and normative yardsticks are in play.

- **Science & Technology Studies (STS): Socio-technical multiplicity.** One of the key disciplinary origins of transitions research is STS, and its strands of history of technology, actor-network theory, social construction of technology, and science-society co-production. STS work typically brings out how innovations like RES prosumerism are in fact bundles of interlinked and mutually shaping innovations in technologies and social relations. Considering these interlinkages between innovations on different dimensions, innovations need to be understood as complex socio-technical processes: As technological possibilities, user behaviours, regulatory frameworks and political agreement mutually

⁹ Also, regarding the Participatory Integrative Assessment roadmaps, it will be useful to attend to the multiplicity of possible futures and the junctures in the transition pathways (see section 7.3).

shape each other, emergent innovations can evolve in various directions. STS angles on RES prosumerism mainstreaming highlight how its mainstreaming could give rise to a multitude of socio-technical forms.

- **Political theory: Diversity of appraisals and translations.** Transitions research revolves around transformative, radical innovation in societal structures, and therefore they are deeply political matters (Avelino et al. 2016). Transitions scholars in political sciences, governance studies and institutional theory have highlighted that innovations like RES prosumerism involve not only technological innovations, but also innovations in power relations and institutions (Loorbach et al. 2017, Kern 2011, Voss et al. 2009). The mainstreaming of such high-stake innovation is likely to involve struggles between challengers and incumbent actors. It is bound to involve processes in which actors adapt, appropriate, modify ('translate') RES prosumerism according to their particular views and interests (Smith 2007; Pel 2016). Moreover, political theory work on sustainability transitions highlights the diversity of normative appraisals and political priorities at issue. Involved actors appraise technological options along different normative yardsticks and ideologies (Brown et al. *unpublished*). They strike different balances between matters of energy security, affordability, sustainability, citizen participation, inclusiveness, transparency, etc.
- **Innovation theory: Process dynamics.** Apart from the above socio-technical and political analyses, transitions directionality has also been analysed through innovation-theoretical, process-oriented approaches (Fuenfschilling & Truffer 2014). These can be considered the mainstream of transitions research. This work, in the tradition of evolutionary economics, history of technology, and institutional change literature, approaches directionality as a process-analytical matter of studying innovation dynamics: *Which critical turns and branching points* (Foxon et al. 2013; Rosenbloom et al. 2018) *in the mainstreaming process can be identified or anticipated in the future?* This work on transitions directionality sensitizes us to the dynamic nature of the RES prosumerism mainstreaming process, and to the different stages of mainstreaming RES prosumerism has already gone through in several countries. Moreover, this attention to process dynamics helps to remember that combinations of (changing) incentive structures may steer the mainstreaming first in one direction, and then in another. The mainstreaming process will display changes in pace and in direction.

As will be shown in the next subsections, these insights into transitions directionality help to develop a more precise understanding of RES prosumerism mainstreaming. After this conceptual work, further empirical unpacking and substantiation is done through the various empirical insights, analytical differentiations and typologies that already have been developed in PROSEU work packages (section 3).

2.2 RES prosumerism: ideas, objects and actions

RES prosumerism is often understood as a technological innovation. Revolving around the implementation of renewable energy sources and sustainable technology, its mainstreaming is often imagined as a matter of technology diffusion, of upscaling, and of increasingly widely rolled-out implementation (Hewitt et al. 2019). Such technology diffusion is important considering acute challenges to shift towards sustainable energy technologies. Yet as transitions research underlines, the energy transition involves multiple changes in socio-technical 'regimes' (cf. section 2.1). Likewise, the RES prosumerism 'niches' involve innovations on various social, cultural, institutional, technological and infrastructural dimensions.

Underneath the basic appearance of RES prosumerism as a set of sustainable technologies (objects), there is a greater **socio-technical multiplicity of innovations** – RES prosumerism refers to different kinds of innovations

(see section 2.1). Within PROSEU, it is studied in terms of new organisational forms (WP2), as new modes of governance and citizenship (WP3), as new business models (WP4), and as new technologies of energy generation, storage and provision (WP5). Through our participation in Living Labs, we also gain more experiential knowledge on the ways in which RES prosumerism involves cultural changes, different lifestyles, and different social relations (WP7).

RES prosumerism involves interrelated developments on all these dimensions of innovation. It is a certain socio-technical 'configuration', practice theorists (e.g. Shove et al. 2009) would argue, i.e. a bundle of social and technological elements that together constitute the practice of prosumption. STS work underlines that such introduction of new practices involves the reconfiguration of socio-technical networks, involving a dynamic interplay between the interests of multiple actors and the possibilities provided by technologies (Bijker & Law 1992). New practices and new ways of thinking tend to evoke each other, work on science-society co-production has elaborated further (Jasanoff 2004; Chilvers & Longhurst 2016). In line with the recent understandings of RES prosumerism as a vehicle for energy justice and energy democracy, there are even good reasons to conceptualize RES prosumerism as primarily a form of *social* innovation: It is innovative in bringing forward new social relations and modes of governance. As specified in social innovation work by Haxeltine et al. (2017) and Avelino et al. (2019), RES prosumerism can thus be unpacked as innovations in doing, organising, framing and knowing.

Whilst acknowledging the often-overlooked social innovation dimensions, the development of renewable energy systems still relies heavily on technological improvements, on the availability of reliable infrastructures, on efficient storage and transmission. The decentralised energy system will crucially rely on information and communication technologies that continue to evolve. The above-cited work highlights that RES prosumerism comprises both 'technological' as well as 'social' innovation: it should be taken as a *socio-technical* innovation. A particularly useful way of understanding its socio-technical nature has been brought forward by Czarniawska & Joerges (1996). RES prosumerism is an innovation that exists in the forms of *ideas*, *objects* and *actions*. Importantly, the innovations on these three dimensions tend to inform and incite each other: **The striving for decentralised, sustainable energy production (*ideas*) calls for solar panels, transmission lines, grid connections, roof space etc. (*objects*), and requires joint investments, installation and maintenance work, and the development of organisational forms appropriate to purposes (*actions*).** Distinguishing these dimensions of innovation, it already becomes evident that the mainstreaming of RES prosumerism is a very dynamic process:

- **Ideas travel fast.** Whilst the implementation of innovative actions and objects remains a matter of hard work and adaptation to local circumstances, ideas tend to circulate relatively fast and easily – especially nowadays, in the internet age. The various local implementations of RE systems (objects) are connected and supported through the *translocal* formation of political lobbies, shared identity, handbooks, and communications about prosumerist lifestyles.
- **Contextual constraints and uneven phases in mainstreaming.** Even if the prosumerist ideas may circulate freely, the associated actions and objects may hit upon locally unfavourable conditions that pose hard constraints. Climate conditions continue to determine the scope for RE technologies, regulations and investment opportunities also differ across contexts. The mainstreaming process may thus even reach its peak in some European contexts, whilst RES prosumerism is simultaneously emerging in others: Given their political history, Central and Eastern European countries, for example, are as yet not witnessing the mushrooming of RES cooperatives (REScoops) as a main organisational form of RES prosumerism as seen in Northwest Europe (cf. Hewitt et al. 2019, Horstink et al. 2019).

- **A broad range of ‘incentive structures’.** The ideas, actions, objects heuristic reminds that RES prosumerism collectives are involved with different kinds of innovations simultaneously. Accordingly, a broad range of ‘incentive structures’ is relevant for RES prosumerism mainstreaming process (see section 2.3). Considering RES prosumerism *ideas*, attention is raised to the enabling informal institutions (e.g. changing cultures of self-sufficiency and collaboration, discourses on energy democratization and justice). Considering RES prosumerism in the form of objects and actions, a range of formal institutions and infrastructures comes to the fore that may enable or constrain certain forms of RES prosumerism.

2.3 Incentive structures

While the Incentive Structure Framework is meant to provide a comprehensive account of the incentives shaping the mainstreaming of RES prosumerism, the very concept of ‘incentives’ generally refers to a rather narrow range of influencing factors. The term is used **generally to refer to economic-financial stimuli** towards RES prosumerism, and the associated societal conditions under which prosumer initiatives thrive. The WP4 work on business models is already covering much of these economic-financial conditions and opportunities (Cf. Brown et al. 2019). These conditions are of obvious importance, but not the only relevant conditions. Yet even when various ‘non-financial’, ‘socio-cultural’ incentives are considered as well, and even when minding the counterpart of *disincentives* as well, the analysis is likely to remain limited to such behavioural stimuli.

As indicated above, and broadening this up, we take a transitions research perspective on ‘incentives’. RES prosumerism is understood as a set of ‘niche’ innovations that could eventually come to transform the energy ‘regime’ (Grin et al. 2010; Verbong & Loorbach 2012). At the same time, RES prosumerism develops within the current energy regime. In evolutionary terms, the latter is the selection environment for RES prosumerism. It sets the rules for energy production, storage and consumption through dominant beliefs, infrastructures, administrative routines, dominant technological designs, codified skills, et cetera. This idea of a systemic ‘regime’ that shapes agency follows the tradition of institutionalist thinking: the ‘incentive structures’ are understood as the societal conditions and rules that shape (incentivize) the ideas and actions of RES prosumerism initiatives. In line with institutional theory, we thus conceive of an energy regime that involves formal and informal institutions, i.e. both regulations and cultures. Somewhat different from conventional institutional theory, transitions theory underlines that many societal rules are ‘sedimented’ or hard-wired into technologies and infrastructures: Metering devices effectuate a whole set of agreements and rules that bind consumers and producers, and centralised infrastructures materialize equally centralised modes of governance. **Incentive structures will thus be understood broadly as all enabling and constraining societal conditions – technological and social – that shape prosumerism. And as RES prosumerism comprises new ideas, actions and objects, it is shaped by an accordingly wide range of societal conditions.**

When conceiving of RES prosumerism as being shaped by a dominant energy ‘regime’, it is important to realize that this is just a shorthand to describe a broad range of relevant ‘rules of the game’. The energy ‘regime’ is not a monolithic structure, i.e. a set of institutions fully orchestrated to drive RES prosumerism in a particular direction. Even if a well-integrated energy ‘system’ has come to exist that strongly favours some innovations and discourages others (off-grid activities, for example), it also remains a bit of a ‘patchwork’ of different institutions. Some of these institutions may be very stable, whilst others are under pressure. **Some aspects of RES prosumerism may be governed by several institutions at the same time, and these may conflict with each other. Like all regimes, also the energy regime contains ‘cracks’ and internal contradictions.** Due to this institutional complexity, even established systems cope with uncertainty and internal conflict. Thanks to

institutional complexity, the prevailing societal rules tend not to be fully determining the mainstreaming of alternatives (Fünfschilling 2019).

It is important to realize that the energy ‘regime’ is only a semi-coherent ‘patchwork’ of institutions – it doesn’t fully *determine* the course of RES prosumerism mainstreaming. In the same vein it is important to realize that RES prosumerism is not only a matter of energy production and consumption. As is increasingly becoming evident, it is also driven by societal struggles for democracy, justice, inclusion and gender relations. Accordingly, RES prosumerism is more than a set of technological ‘niches’ in the ‘energy regime’, and also could be thought of rather as ‘social niches’ in prevailing systems of governance, economics, dominant discourses, and structures of identity formation. **As far as it is unleashing a transition, this will be a transversal transition: RES prosumerism interacts with the energy regime and with other societal institutions.** Whilst the transitions perspective tends to focus on the incentives posed by the energy regime, the importance of the latter ‘non-energy’ institutions is highlighted in various streams of critical social theory. For the mainstreaming of RES prosumerism, they constitute a set of ‘incentive structures’ that is bound to shape the direction of the process. As indicated by Stirling (2019), innovations like RES prosumerism should be imagined as ‘niches’ shaped not by ‘regime’-like blocks of institutions, but rather by a myriad of overlapping ‘configuring fields’.

Transitions processes revolve around the ways in which ‘niche’ innovations adapt to the rules of the prevailing socio-technical, whilst at the same time seeking to bend them. Smith & Raven (2012) speak of ‘fit-and-conform’ and ‘stretch-and-transform’ patterns. In any case, the rules are contested, and constantly in evolution. Accordingly, incentives are not stable – the very structure of incentives (towards certain technology options and practices) is under negotiation. Institutions like feed-in-tariffs may incentivise towards one course of action in one policy and incentivise towards another in a next phase of the mainstreaming process. Furthermore, there is the circumstance that RES prosumerism is shaped by a range of social, technological, institutional conditions that do not always incentivise in the same direction. The change-oriented, evolutionary perspective of transitions research is thus warning against modes of analysis in which ‘incentives’ (and actor preferences) are portrayed as givens. **In line with this dynamic view on ‘incentives’, we will therefore seek to avoid a binary listing of either constraining or enabling conditions. Next to those, we will be attentive to the many societal conditions that do appear to be relevant for RES prosumerism mainstreaming – yet without clearly steering the mainstreaming process in a particular direction.**

2.4 Mainstreaming: Divergent translations & dynamic processes

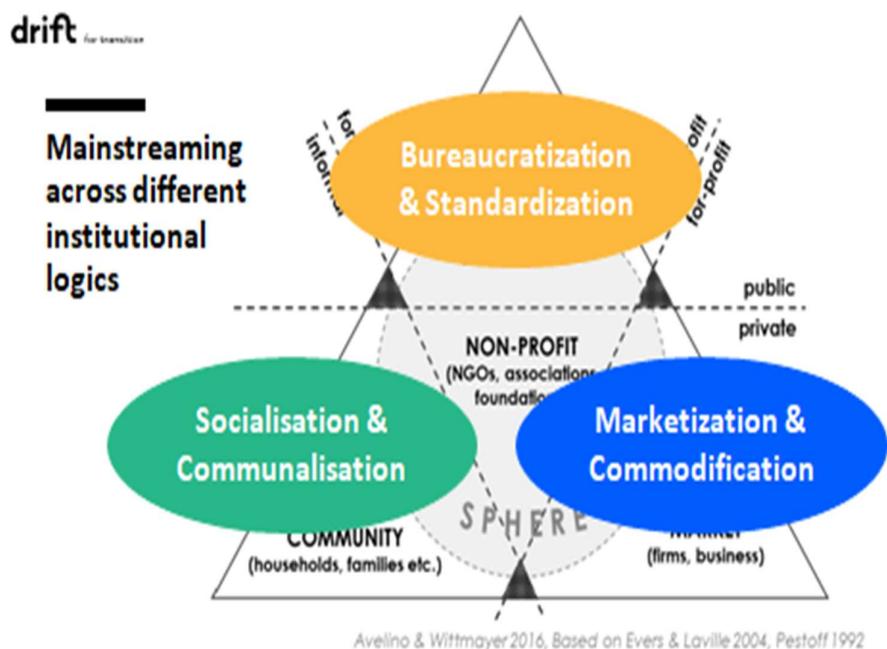
The term ‘mainstreaming’ expresses usefully that RES prosumerism refers to yet unusual practices, which more often than not diverge from the mainstream of centralised organisation of energy production¹⁰. As discussed above, it is an innovation of the radical rather than incremental kind. **In transitions-theoretical terms, ‘mainstreaming’ refers to the innovation phase in which innovative ‘niches’ are no longer just adapting to the prevailing ‘regime’ rules, and instead are starting to set some standards themselves.** Transitions research challenges the common-sense understanding of ‘mainstreaming’ however, in which it means little more than ‘becoming normal’. Transitions research – and the calls to take its directionality seriously underline this – conceives of mainstreaming as a deeply political process.

The transitions perspective conceives of mainstreaming as a **contested process** in which radical ‘niche’ innovations are fighting their way into dominant ‘regime’ structures (see section 2.1). Under favourable

¹⁰ While there remains the pathway towards a centralistically governed RES prosumerism system by a small number of “aggregators”.

circumstances, RES prosumerism would introduce new technological standards, business models and administrative routines in the centralised energy ‘regime’. The regular course of its innovation trajectory would rather be one of system reproduction, however (Geels & Schot 2007): The RE technologies would become integrated into the centralised infrastructures, remaining marginal ‘add-ons’ rather than forming an altogether reconfigured energy infrastructure. Likewise, the institutional changes of prosumerism would remain limited to the emergence of some marginal community energy initiatives, with most prosumerism initiatives being bought up by utility companies or new energy market entrants that largely perpetuate the existing market-driven consumer-producer logic. Transitions research has shown how similar co-optation, appropriation or ‘capture’ keeps occurring to radical ‘niche’ innovations – whether in the energy system or in systems of mobility, agriculture, or healthcare. One can think of intelligent transportation systems that reproduce present ‘car cultures’, or green, biological agriculture that keeps relying on excessive transportation of goods. As conglomerates of infrastructures, administrative routines, business models and cultures, ‘regimes’ have developed a strong capacity to absorb and neutralize radical novelty – the prevailing ‘rules of the game’ keep reasserting themselves, over and over again. Transitions research clarifies why there are good reasons for sceptical and sobering accounts of RES prosumerism mainstreaming (Cf. Burke & Stephens 2018 and Hewitt et al. 2019 in section 1): **In the process of becoming more or less mainstream, RES prosumerism is likely to lose some of its radical-innovative potentials (e.g. for energy democracy and energy justice, for radical fossil fuel phase-out) through processes of co-optation or appropriation with the existing institutional context.** The mainstreaming of RES prosumerism – if happening at all - could amount to its breakthrough, or to its dilution. This is of course not a matter of either regime transition or continued business as usual. Innovation sociologists and work on the politics of transitions highlight how many in-between outcomes are possible (Smith 2007; Pel 2016). As RES prosumerism is an innovation that many individuals and organisations are interested in one way or the other, it will be actively appropriated and developed.

Figure 3: Mainstreaming across institutional logics Source: Wittmayer et al. (under review)



Focusing on the diversity of societal interests that RES prosumerism is arousing, its mainstreaming should not be imagined as a process of ‘diffusion’, of prosumerist actions and ideas becoming the new normal, or of ‘scaled up technology’. This is not to deny that diffusion and economies of scale matter greatly, but socio-technical innovations like RES prosumerism do not spread like gases, staying the same in the process. Do-it-yourself citizens, grid operators, developers of energy services, municipal authorities, utility companies and tax departments have their own stakes in it. **RES prosumerism will therefore be appropriated, modified, reframed, adjusted and ‘translated’ in various ways** (Akrich et al. 2002). This translation may be very much in line with the radical ‘niche’ innovation that energy transition and social innovation advocates see in it, but instead it may also entail, neutralization, hollowing out and purely instrumental use. The RES prosumerism mainstreaming process is bound to display alternating moments of such ‘capture’ and radicalization (i.e. attempts to revive the potentials for energy transition). These highly political dynamics tend to generate a certain diversification. **The various ‘translations’ will create different variations and forms of RES prosumerist ideas, actions and objects:** It could come exist simultaneously as business opportunity, as vehicle for community development, or as strategic priority for local and regional authorities, and take different material-technological forms.

Possibly even more than radical ‘niche’ innovations in general, especially RES prosumerism is bound to undergo such politics-laden process of translation. It will be pulled at from different societal quarters. After all, the very concept of ‘prosumerism’ indicates a hybrid form of agency within the energy system, holding the middle between traditionally separated roles of consumers and producers. The Multi Actor Perspective (Avelino & Wittmayer 2016) provides a more systematic view on this hybridity (see Figure 3).

This perspective unpacks the mainstreaming process as follows:

- **Multiple translations.** State, market and community actors have partly overlapping but also different and potentially clashing interests in RES prosumerism. RES prosumerism is translated through the institutional logics of states, markets and communities. Market, state and community logics ‘incentivise’ each in their own ways. Accordingly, RES prosumerism mainstreaming will be shaped by different processes of e.g. commoditization, formalization and bureaucratization.
- **Multiple actor roles.** Depending on the combination of institutional logics through which it is translated, RES prosumerism can take shape through many different actor roles. Individuals in RES prosumerism initiatives can form close and trust-based communities, business-like alliances of convenience, or participative citizens drawn into government programs. Not all these actor roles will be satisfying to RES prosumerism members; the mainstreaming is bound to entail certain role conflicts (Taylor Aiken 2019).
- **Institutional Hybridization.** While prosumerism is different from consumerism, it could still take various different forms. Resulting from institutional hybridization, its further mainstreaming will also be enabled or constrained by the *combinations* of market, community and state logics that prevail in a certain country or region. Importantly, there are already many institutionally hybrid governance arrangements that could accommodate RES prosumerism (e.g. social entrepreneurship, participative governance, public-private governance, responsive regulation). Minding the many hybrid forms in between the ideal types of market, state and community logic, we get a better view of the many different directions that the RES prosumerism mainstreaming could take (Wittmayer et al. *under review*).

A further insight from transitions studies is that the mainstreaming needs to be understood as a dynamic process, a phase in a transitions process that unfolds over decades rather than months or years. As indicated by Hewitt et al. (2019), the mainstreaming process has already gone through different stages of citizen mobilization and technological development – whilst coming close to its peak in some European regions, the mainstreaming is only starting in others.

Taking transitions directionality seriously, transitions are acknowledged to be deeply complex evolutionary processes (Cf. section 2.1). Whilst focusing more on static incentive structures than on future developments, and without aiming to run ahead of the subsequent disclosure of RES prosumerism futures in the Participatory Integrated assessment, the ISF does need to develop a dynamic view on incentive structures. Whilst actual roadmaps and possible pathways will be developed through the Participatory Integrative Assessment, the **ISF should articulate to some degree how the mainstreaming process may display changes in pace and in direction:**

- **Breakthroughs and setbacks.** The RES prosumerism mainstreaming process can go through phases of acceleration and breakthrough, thanks to mutually reinforcing changes and innovations. These virtuous cycles could also work the other way, however – which are the indications of slowed down growth, or even decline? How do the various societal conditions change over time, and across contexts?
- **Critical turns and branching points.** As RES prosumerism gets translated and appropriated through different institutional logics, the direction of its mainstreaming process is constantly under negotiation. During this contested process, decisive moments may occur (e.g. the start of the ‘post-subsidy era’ as discussed by Brown et al. (2019)). The mainstreaming process may display notable junctures, changes of course, or critical turns (Pel et al. 2017) – or involved actors foresee that such branching points (Foxon et al. 2013; Rosenbloom et al. 2018) will occur further on in the mainstreaming process.
- **Uncertainties.** A pervasive characteristic of the mainstreaming process is the uncertainty about further developments.

2.5 Normative yardsticks

The ISF is to identify incentives for RES prosumerism mainstreaming that safeguard ‘citizen participation, inclusiveness and transparency’ (cf. section 1). This proviso reflects the current policy consensus that the pursuit of affordable, reliable and clean energy comes with certain ethical-political obligations. More generally, it expresses how RES prosumerism is increasingly taken as a move towards energy democracy, energy justice and broadly conceived sustainability – well beyond the pursuit of eco-efficiency and narrowly understood sustainability¹¹. This normative-ethical dimension of sustainability is also gaining more attention in transitions research more generally (Köhler et al. 2019). In fact, the argued approach of ‘taking transitions directionality seriously’ is placing these ethical issues at the heart of the analysis. As it could lead into various kinds of energy system changes, RES prosumerism is not to be promoted per se. ***On what grounds are particular forms of RES prosumerism to be mainstreamed? By which normative yardsticks are certain outcomes of the mainstreaming process to be evaluated?***

¹¹ Petrick et al. (2019) have similarly discussed how prosumerism could evolve in a sustainable way (in economic, environmental and social terms).

This section focuses on normative yardsticks in terms of evaluation criteria that could be derived from policy or social goals as norms that shape mainstreaming processes. This attentiveness to normative yardsticks reminds that the above ‘citizen participation, inclusiveness and transparency’ are just a few of the many normative yardsticks (or RES prosumerism ‘performance criteria’) that may be relevant to the actors involved. **Considered more systematically, indeed a very broad range of values and normative commitments appears to be relevant to the mainstreaming of RES prosumerism, which are all differently shaped through combinations of state, market, and community logics** (section 2.4). Accordingly, as indicated by Brown et al. (under review), the process will be guided by the normative yardsticks, a broad range of performance criteria as they prevail in these logics. Apparently focusing on matters of democratic procedure, the normative yardsticks of ‘citizen participation, inclusiveness and transparency’ seem to reflect an institutional logic of states, for example – whilst also reflecting elements of community logic. By contrast, market logic rather brings forward normative yardsticks of efficiency, individual choice and profitability. Furthermore, community logic tends to revolve around various other normative considerations of trust, authenticity and reciprocity. When identifying enabling and constraining conditions for RES prosumerism mainstreaming, it is therefore important to mind two aspects:

- **Diverse normative yardsticks.** As indicated, the mainstreaming along different institutional logics will bring along evaluations and choices along different normative yardsticks. These will often coincide (for example, shared commitments to efficient energy systems), but they are not always fully compatible or commensurable. Actors in the energy system may have quite fundamentally different values and worldviews. Even within one individual actor, there may be considerable tensions between different roles one plays in society, e.g. as energy consumer, NGO supporter or voter. RES prosumerism is about system-wide sustainability, but also about ownership, about ways of living together, and about satisfactory gender relations.
- **Tensions and trade-offs.** There is a broad range of normative yardsticks at issue, and ‘good’ forms of RES prosumerism are already available that do well by (nearly) all standards. Still it is likely that tensions and trade-offs occur between principles that are notoriously difficult to fully reconcile: Participation vs efficiency, environmental performance vs affordability, group empowerment vs the inclusion of third parties. Many of these normative trade-offs have been discussed in political theory work on associative democracy and in Third Sector studies: REScoops, for example, have to balance commitments to *mutual* benefit with commitments to *public* benefit, for example (Bauwens & Defourny 2017).

3 Incentive Structure Framework

3.0 Introduction

While section 2 has provided the conceptual basis for an ISF and the subsequent work on the PIA, this section presents the actual ISF. The following sections 4-6 will then elaborate the insights of the ISF in stand-alone briefs and show how the RES prosumerism mainstreaming process can go in different directions, depending on the incentive structures identified. The briefs will discuss three important crossroads that arise about the political-economical, socio-technical and organisational aspects of RES prosumerism, and in doing so convey in more detailed, concrete and practically relevant ways how the ISF unpacks the mainstreaming process as a complex crossroads of RES prosumerism futures.

The ISF presented in this section comprises a set of 17 key societal conditions that shape the earlier discussed directionality of the RES prosumerism mainstreaming process. Before explaining and substantiating the various societal conditions, a brief methodological account is provided. This clarifies what the ISF comprises, how its categories have been developed, and how it integrates the empirical insights developed in the various PROSEU work packages (**section 3.1**). In line with our understanding of RES prosumerism as a bundle of innovative actions, objects and ideas we distinguish regulatory & financial conditions (**section 3.2**), technological/material/natural conditions (**section 3.3**), and cultural-discursive conditions (**section 3.4**). For the sake of overview, the identified societal conditions will be gathered in a synthesis section, which also highlights how the identified societal conditions matter: Depending on the development of these conditions, the RES prosumerism mainstreaming process will take different directions (**section 3.5**). Identifying three sets of opposing directions for the mainstreaming process, this forms the basis for three themed practice briefs following in sections 4-6.

3.1 Incentive structures Framework: Methodology

Taking transitions directionality seriously, we have developed a refined and theoretically informed understanding of incentives (section 2). Whilst providing a comprehensive set of ‘incentives’, ‘drivers’ and ‘barriers’, the ISF also clarifies how these societal conditions give rise to certain tensions and dynamics in the mainstreaming process – and ultimately to different possible RES prosumerism futures.

The framework of 17 societal conditions (see Table 1) has therefore been built up as follows.

- **Multiple innovation dimensions: Actions, objects and ideas.** Transitions research and related insights on socio-technical change have helped towards a broad, systemic perspective on the ‘regimes’, selection environments and institutional contexts within which RES prosumerism develops – and within which RES prosumerism initiatives undertake alternative, irregular and to a certain extent deviant practices. Eliciting how RES prosumerism amounts to a bundle of innovative actions, objects, and ideas, these perspectives have also provided a systematic way to identify the corresponding societal conditions: Regulatory & financial conditions, technological/material/natural conditions, and cultural-discursive conditions. Importantly, this comprehensive perspective helped to develop basic categories for the ISF, whilst at the same time reminding how the distinct categories are strongly intertwined in practice. RES prosumerism comprises ideas, actions and objects, and is shaped by combinations of the identified societal conditions.

- Inductive subcategories.** The actions, objects, ideas heuristic has a rough correspondence with the PROSEU work package structure and with the expertise gathered in the project (Cf. section 7). Aiming for an empirically adequate integration of PROSEU findings, this heuristic has been used initially as a set of ‘sensitizing concepts’ to classify various empirical inputs on enabling, constraining, or ambiguous societal conditions. Google docs have been used to gather 1) WP proceedings, 2) observations on the PROSEU Living Labs observations, and 3) insights from RES prosumerism literature. In grounded theory fashion, these accounts of ‘societal conditions’ have subsequently been coded and classified under initial sub-categories. Considering the relative saturation or emptiness of subcategories, these have been split, or merged with others. In a few cases, subcategories have been maintained based on theoretical considerations rather than the availability of empirical materials (Cf. section 7). The bullet point structure indicates how the set of 17 conditions could easily be expanded into a more differentiated set. As this would detract from the heuristic value of the current ISF, no such further differentiation has been pursued.

Table 1: Overview of societal conditions shaping RES prosumerism mainstreaming

RES prosumerism dimensions	Societal conditions
RES prosumerism <i>actions</i>	Regulatory & financial conditions <ul style="list-style-type: none"> Electricity market regulations RES prosumerism policy Subsidies and taxation Public and private investment Administration & governance relations Social organisation of labour
RES prosumerism <i>objects</i>	Technological-material conditions <ul style="list-style-type: none"> Technological performance of RE generation installations Natural (climate/weather) conditions Built environment Storage technology Grid/infrastructure development Availability of expertise and skills
RES prosumerism <i>ideas</i>	Cultural-discursive conditions <ul style="list-style-type: none"> Discourses of decentralisation & energy democracy Environmental awareness Perceptions of political legitimacy Perceptions of reliability and competence Discourses of inclusion

- Dynamic societal conditions and translation.** It is usual to distinguish between either enabling or constraining societal conditions. In the process of gathering data from the PROSEU consortium, we have also asked project partners to consider ‘ambiguous’ conditions that cannot be classified easily as either enabling or constraining. In line with the attentiveness to transitions directionality, the twofold distinction between ‘enabling’ and ‘constraining’ has been dropped altogether, however. Just as the concepts of ‘drivers’ and ‘barriers’, this would make for a too ‘mechanical’ view on the mainstreaming process. As indicated, the societal conditions can shape the mainstreaming process and push it in various directions – just as actors from different institutional backgrounds tend to ‘translate’ RES prosumerism in various ways (Cf. section 2). As clarified in the next subsections, the

‘enabling’ or ‘constraining’ effects of certain societal conditions depends on their particular development in a country or region (e.g. the arrangement of taxation and finance). Societal conditions can provide yet uncertain or just quite ambiguous ‘incentives’ for RES prosumerism, and they can change over time: Feed-in tariffs can be introduced, phased out, or mitigated.

- **Multiple directions.** As discussed in section 2, the ISF has been developed in a way that helps to grasp the directionality of the mainstreaming process. Methodologically, we have therefore tested and applied the emerging set of societal conditions to several well-known tensions or crossroads in the mainstreaming process: Can the identified set of societal conditions explain these tensions? Can the tensions be retraced to the identified societal conditions? Section 3.5 describes this in more detail.
- **Comprehensiveness.** Finally, the crucial consideration has been whether the set of key societal conditions was sufficiently comprehensive. This will be discussed in more detail in section 7.
- **Empirical substantiation.** The identified societal conditions have been identified and substantiated through three data sources.

- 1) *Thematic empirical analyses* on RES prosumerism business models, policies and technologies (PROSEU work packages 3-5) have been the primary sources. The very point of the ISF is to integrate these thematic insights. This bundling of empirical insights has been done through online questionnaires, taking stock of observed ‘enabling’, ‘constraining’ as well as ‘ambiguous’ societal conditions. In addition to drawing on ongoing work to be shared via future deliverables, the analysis is based on the knowledge and work of the consortium that to date has been published in several deliverables, namely:

Work package 3: Toporek, M., & Campos, I. (2019). Assessment of existing EU-wide and Member State-specific regulatory and policy frameworks of RES Prosumers (Deliverable 3.1). <http://doi.org/10.5281/zenodo.2607939>

Work package 3: Petrick, K., Fosse, J., Klarwein, S. (2019). Strategies for Policy Coherence and Sustainability – Relevance of EU policies and frameworks for prosumers. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable 3.2).

Work package 5: Novosel, T., Pukšec, T., Kampman, B., Scholten, T., Naber, N., Gährs, S., & Knoefel, J. (2019). Prosumer technology database (Version v01) [Data set]. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable N° 5.1) <http://doi.org/10.5281/zenodo.2611147>

- 2) *Living Lab and survey data.* The baseline survey (WP2) and the Living Lab (WP7) observations have provided important additional information on the various ‘incentives’ experienced and perceived by members of RES prosumerism collectives. The analysis is based on the knowledge and work of the consortium that to date has been published in two deliverables, namely:

Work package 2: Horstink, L., Luz, G., Soares, M., & Ng, K. (2019). Review and characterisation of collective renewable energy prosumer initiatives. (Deliverable 2.1).

PROSEU: EU H2020- LCE-2017 Grant Agreement 764056. [http:// doi.org/ 10.5281/zenodo.3560960](http://doi.org/10.5281/zenodo.3560960)

Work package 2: Wittmayer, J.M., Fraaije, M., Horstink, L. & Avelino, F. (2019). A multi-dimensional typology of collective RES prosumers across Europe. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable N°2.2).

In addition, PROSEU partners work with 15 Living Labs on addressing institutional barriers in practice, these Living Labs are outlined in Table 2 below. For the work on each of these Living Labs, partners have shared preliminary insights to be used for drawing up the ISF.

3) *RES prosumerism literature*. The identification of relevant societal conditions has been validated against literature on the subject. Rather than aiming for a systematic review of ‘enabling conditions’, our analysis of literature has mainly served to critically reflect on empirical comprehensiveness and conceptual coherence.

Table 2: Overview of the PROSEU Living Labs (WP7)¹²

#	Country	Name	Description
1	Belgium	Getesnippers	Living Lab #1 Self-organised valorization chain of biomass in Belgium Setting up a valorisation chain in the ‘Gete region’ where sustainable wood chips are produced based on local biomass. This is an existing project that is partly subsidized by the VEA (Flemisch Energy Agency) and partly (co) financed by the municipalities (Linter, Geetbets, Zoutleeuw, Hoegaarden and Landen + possibly Tienen) and farmers. By the end of the project it is the intention that everything can be continued without external financing and can be fully taken over by a "local chain director". This LL can offer us a business plan to organise a self-supporting valorisation chain.
2	Belgium	Sustainable Sports Club	Living Lab #2 Community financing of RES prosumerism of a sports club in Belgium A new football field will soon be built at KDN United football club in the municipality of Holsbeek. The municipality finances the construction of the field. A new canteen with changing rooms must also be provided. The sports club itself is responsible for financing this infrastructure. There is interest in investigating whether there are innovative energy technologies, independent of the grid, that could possibly be installed. Solar panels with battery storage, heat capture network under the playing field. Participation may be requested from the members for financing. A business plan for this operation is currently missing. This LL can offer us a business plan to organise an energy installation.
3	Croatia	Zadruga za etičko financiranje	Living Lab #3 Ethical financing cooperative in Croatia ZEF (Cooperative for ethical financing) gathers some 1200 members (both individual and legal bodies) which work on the democratic, transparent and socially and environmentally responsible economy. One of the pillars of the cooperative is renewable energy with special focus on crowd-funding schemes that would engage

¹² The information about the PROSEU Living Labs was retrieved from the PROSEU website, <https://proseu.eu/living-labs> in December 2019.

			<p>various stakeholders enthusiastic in RES investments. Within PROSEU project special focus will be on establishing financing schemes and procedures for future prosumers and their bankable projects.</p>
4	Croatia	Island of Silba	<p>Living Lab #4 island movement for energy autonomy in Croatia</p> <p>Pokret Otoka (Island Movement), is a self-sustained network of islanders with a main purpose of connecting people or organisations through an idea of sustainable and responsible society. Within PROSEU project the focus will be on the island of Silba which faces severe water supply issues in peak season. A combination of desalination and small-scale PV installations could fix this issue.</p>
5	France	Enercop and Energies Partagees	<p>Living Lab #5 Citizens in action for prosumer business models in France</p> <p>Enercoop and Energies Partagées, the main citizens' actors promoting decentralised Renewable Energies in France, aim to develop a robust legal and business model for prosumers projects financed, constructed and operated through a third-party contract.</p>
6	Germany	SubWW	<p>Living Lab #6 Local heat grid with decentralised RES in Germany</p> <p>In Weyhe (district Leeste) near Bremen a low-temperature local heating grid with decentralised renewable energy production is to be developed. The goal is to combine the refurbishment in Leeste with an innovative heat supply, thus combining decentralised feed-in and local heat supply in order to achieve an efficient and resource-saving heat supply. The timeline is driven by the redevelopment of the area which is supposed to be finished by 2030. The initiative was started by a research project (led by TU Berlin) with the goal of implementing an innovative district heating grid, that gives the possibility for prosumers to feed their heat over-capacities into the grid (e.g. heat pumps) so that technologies can be used more efficiently and new buildings don't need their one heat production system. The municipality Weyhe engaged in this idea with their district Leeste, because big parts of the district will be rebuild in the next years and there are already big heating capacities in the district due to two schools. The municipality of Weyhe and the regional eco-centre act as the driver of the LL and many stakeholders will be involved in the process. For more information about the project in German.</p>
7	Italy	Group of Italian municipalities	<p>Living Lab #7 Municipality coalition for stakeholder motivation in Italy</p> <p>This Living lab is comprised of a group of Italian municipalities (coordinated by the mayors) on energy efficiency. Its goal is to expand the activities of the group beyond energy efficiency and to generate motivation among involved stakeholders. One of them is Comune di Santorso.</p>
8	The Netherlands	Local Sustainable Heat Provision in the Netherlands	<p>Living Lab #8 Local Sustainable Heat Provision in the Netherlands</p> <p>This Living lab focuses on supporting the development of local sustainable heat provision in the Netherlands. Its focal point is the newly founded initiative +31 Buurtwarmte. Started in 2018 by people coming from different existing neighbourhood initiatives on local heat provision and energy cooperations, their aim is to support citizens in developing, implementing and managing sustainable heat systems for their neighbourhood. In doing so they also hope to strengthen social relations between neighbours and different municipalities, as the social process – cooperation between parties and public acceptance - is currently a main barrier in the implementation of these systems.</p>

9	The Netherlands	Aardehuis	<p>Living Lab #9 Ecovillage Aardehuis in the Netherlands</p> <p>This 25-household Eco-village in the town of Olst aspires to become a self-sufficient ‘energy plus’ community, by generating their own electricity, and saving it at off-peak hours in batteries. Moreover, they are aspiring to install a smart grid, for which they have received a 10-year experimental status from the Dutch government. In light of this project, they are currently installing a communal battery, developing a solar-charging carport, and are working on taking energy-saving measures.</p>
10	Portugal	Energia Renovável na Vitivinicultura no Alentejo	<p>Living Lab #10 RES for sustainable viticulture in Portugal</p> <p>This Living Lab was initiated as a result of the joint work of PROSEU’s FC.ID team and the Wines of Alentejo (a private institution dedicated to certifying, controlling and protecting the Alentejo wine production). Together with local wine producers and other stakeholders the living lab aims to facilitate and support the integration of RES in the Alentejo viticulture sector as part of a wider sustainability plan for the region.</p>
11	Portugal	Co-creating a new energy community in São Luís village	<p>Living Lab #11 Community energy for energy autonomy in Portugal</p> <p>The Living Lab has been initiated as a result of the joint work of PROSEU’s FC.ID team, the Coopérnico energy cooperative and the S. Luís Transition Town initiative (an informal community that is leading the project of transforming S. Luís into a renewable energy community).</p> <p>São Luís has been working since 2011 towards achieving a higher level of energy autonomy by 2030, yet different pathways are possible. Together with a multi-stakeholder group, the community is co-creating a model (considering technological, economic, social and environmental factors) for setting up an energy community.</p>
12	Spain	Som Energy	<p>Living Lab #12 Cooperative for mainstreaming PV prosumerism in Spain</p> <p>Som Energy, a Renewable Energy Cooperative based in Girona, aims to mainstream local prosumerism under new Spanish legislation by launching a collective PV purchase & installation campaign and developing a sound business model for neighbour communities and SMEs.</p>
13	United Kingdom	Bristol Energy	<p>Living Lab #13 Bristol Energy in the UK</p> <p>This Living lab centres around Bristol Energy, a municipally-owned energy company founded in 2015 by the Bristol City Council. The company aims to mainstream prosumerism alongside fuel poverty objectives in Bristol. The LL is about testing a Heat as a service ESCo type business model which is designed to incentivize low carbon heat and energy efficiency.</p>
14	United Kingdom	Bristol Energy Coop	<p>Living Lab #14 Bristol Energy Coop in the UK</p> <p>This Living lab is an energy cooperative which owns several PV arrays in the city and revolves around operating a solar-as-a-service business model in Bristol.</p>

3.2 RES prosumerism actions: regulatory & financial conditions

Numerous shaping conditions emerge when considering RES prosumerism as an innovative form of action: Decentralised production of renewable energy deviates from the usual activities of consuming and producing. It changes customer-supplier relations, business models, administrative routines and social practices. The mainstreaming of RES prosumerism actions are shaped by various formal institutions that set the ‘rules of the game’ within which RES prosumerism initiatives and business models are developed. In the following sections

we distinguish electricity market regulations (**section 3.2.1**), RES prosumerism policy (**section 3.2.2**), subsidies and taxation (**section 3.2.3**), public and private investment (**section 3.2.4**), administration and governance relations (**section 3.2.5**) and the social organisation of labour (**section 3.2.6**).

3.2.1 Electricity market regulations

RES prosumerism mainstreaming takes place within a set of rules and institutions that govern energy production, transmission and consumption. An important set of rules are electricity market regulations. As these have been developed along with the development of the current centralised systems of energy provision, they are generally not very favourable to RES prosumerism. Regulations may vary across countries, however. Moreover, electricity market regulations are subject to changes, and their development is subject to lobbies and societal pressures from different societal quarters (see section 3.4 for societal conditions shaping RES prosumerism as an idea).

Specific conditions/developments in this regard are (Cf. Bray et al. (2018) and Brown et al. (2019)):

- **Network Charging.** The current Use of System (UoS) charging regime in all countries studied, was designed for a centralised hub and spoke model. Therefore, prosumers are not rewarded for the reduced use of networks when producing and consuming locally, and when trading/selling power over the public network. This has tended to promote behind the meter models which try and avoid these charges altogether. Regulators are now moving to prevent this through fixed rather than volumetric charging regimes. Both these situations are sub-optimal, and do not fairly reward prosumers for the reduced stress on networks, nor provide sufficient payment for the electricity grid as a public good/common pool resource. As reported by Living Lab #5 Citizens in action for prosumer business models in France, the French network charge (TURPE) is currently very unfavourable to prosumer initiatives, as it increases the pay-back time to over 20 years. This has seriously disincentivised prosumer initiatives.
- **Supplier Licensing.** Many EU countries require any entity which trades power on the public network to comply with the full set of licence codes as if they were a large-scale utility. This effectively prevents small scale 'local energy companies' from being created due to high transaction costs, and thus prevents local trading of electricity. This also prevents true peer-to-peer models as a licenced intermediary is always required.
- **Supplier Switching.** The liberalisation of electricity markets was predicated upon a competitive market and the right for consumers to switch supplier. This was codified into EU directives, requiring that consumers have the right to switch supplier within 28 days. While these regulations give more choice and flexibility to consumers, they can also hamper long term 'service-based' contracts where energy service companies provide hardware such as PV panels, batteries and heat pumps, but would need to recover the costs of these investments through energy bills.
- **Access to other markets.** Electricity markets were set up in an era of large centralised thermal generation. Subsequently, the wider markets and mechanisms that provide flexibility, voltage control and system balancing, were also designed with these actors in mind. The increased deployment of intermittent renewables will only increase the demand for these services, but in many countries, small scale actors cannot access these markets - due to how they are regulated. This is despite the fact that prosumers with heat pumps, batteries and EVs are likely to be a huge source of flexibility and system balancing in the future. Allowing new types of actors as aggregators may ease some of these access- related issues.

- **Lack of tariff differentiation/dynamic pricing.** This means that retail tariffs offered do not provide price signals to consumers, i.e. they are the same independently of the time of the day. This provides little incentive to use electricity in off-peak hours (or when renewable electricity is abundant (cf. Living Lab #9 ecovillage Aardehuis in the Netherlands).

3.2.2 RES prosumerism policy

RES prosumerism is developing within existing constraints (e.g. set by electricity market regulations, see section 3.2.1), but (national and supra-national) governments do develop specific policies for prosumerism. These policies may be intended to serve as ‘enabling conditions’, but in practice, they may only enable some forms of RES prosumerism while potentially discouraging others. Their ‘enabling’ and ‘constraining’ effects also depend on the specific range of activities that are stimulated as RES prosumerism, the elaboration into specific policy measures and regulations, and the degree to which the policies create clarity and certainty. Just like any other policies, RES prosumerism policies are not a stable societal condition.

Specific developments in this regard are:

- **Uncertainty about the legislative setting.** The current ‘changing and uncertain legislative setting’ is quoted amongst the key threats to RES prosumerism, as found by our survey results (i.e. Horstink et al. 2019, p.83: key threats indicated by respondents). For instance, one reported problem in Living Lab #10 RES for sustainable viticulture in Portugal is that current regulations do not enable RE prosumers to set up PPAs and sell or transfer their excess energy to other persons or local agents (buildings, companies, institutions) at an agreed price between both parties. Besides, current self-consumption law is not allowing for collective self-consumption. According to survey respondents, while Feed-in-Tariffs have been phased out in the UK; Germany, the Netherlands, and Belgium have complexified the rules for prosumers, while new legislation is still stabilising in countries such as Spain, Portugal, and Croatia (Horstink et al. 2019, pp. 82-83).
- **Regulatory complexity and instability.** Other Living Lab experiences indicate problems with ‘complicated’ or ‘frequently amended’ laws (Living Lab #6 Local heat grid with decentralised RES in Germany, Living Lab #9 Ecovillage Aardehuis in the Netherlands, Living Lab #12 Cooperative for mainstreaming PV prosumerism in Spain); with ‘frequent and various’ changes in the legislation on the funding of renewable energy cooperatives in Germany. Living Lab #9 Ecovillage Aardehuis in the Netherlands experiences unveiled ‘unclear rules on storage of energy’. Living Lab #12 Cooperative for mainstreaming PV prosumerism in Spain shows how instability can come along with expectations and hopes, which may overcome previous disappointments. This Living Lab has been created in a national context of hope for prosumer initiatives, as the 2019 Royal Decree on self-consumption opens new possibilities compared to the extremely unfavourable prior legal context - which de facto stopped self-generation projects connected to the grid between 2008 and 2018.
- **Lack of specific regulations on (renewable) energy communities.** Toporek & Campos (2019) have charted various constraining conditions for the mainstreaming of RES prosumerism. The lack of specific regulations on RE communities has been especially observed in Belgium and Portugal. Similarly, in Germany, energy communities are under the same regulations as individual household self-consumers. And, in Italy, there is insufficient regulation (in terms of legislative or policy framework) – not all relevant aspects are regulated.

- **(Lack of) acknowledgement of civic-focussed RES prosumerism.** A related issue is the persistence of unclear definitions and legal protection for prosumers, in particular more “civic-focussed” prosumers, as documented by Horstink et al. (2019) and Toporek & Campos (2019). The Clean Energy Package does not adequately solve legal ambiguities in terms of rights and obligations of collective prosumers. Although “civic-focussed” forms of RES prosumerism, i.e. energy communities or community/citizen-inspired initiatives, are highlighted, by empirical research, as the ideal actors for realising a decentralised, inclusive, democratic, and fair energy system. Nevertheless, the Clean Energy Package is not clear enough in distinguishing between civic-focussed, prosumer-focussed (i.e. energy developers) and profit-focussed prosumer initiatives. Thus, posing a risk that RES prosumerism will largely facilitates business as usual rather than a democratic and inclusive energy system. Besides, mounting pressure created by set targets such as those by the Paris agreement, arguably have led to a focus on centralised energy systems.¹³
- **Lack of embedding in cross-sector regulation.** The specificities of renewable energy communities/specific conditions for (renewable) energy communities are insufficiently recognised in different areas of law, e.g. in spatial planning, guarantees and warranties etc. (the Croatian experiences are particularly informative on this issue). In the French context, it has been observed that ‘citizens’ participatory energy aspects are not integrated systematically into national energy and climate policies’.
- **Stringent or lenient legal status for REScoops.** REScoop is short for renewable energy cooperative and “refers to a business model where citizens jointly own and participate in renewable energy or energy efficiency projects” (REScoop website 2019¹⁴), following seven cooperative principles. In countries with specific legal statutes for cooperatives, some organisations qualify in form but not in spirit nor in principles as a REScoop. In Belgium/Flanders, there are calls for a requirement that a developer of a (wind) project should offer a certain share for citizens to participate. Horstink et al. (2019) also discusses related issues, such as whether or not general expansion targets for RE should be capped to a maximum, whether direct marketing should be mandatory for REScoops, whether new RES projects should be mandatory for REScoops, whether the cooperative members’ private use of energy should be exempted from energy levies), and whether civic involvement should be mandatory in all future renewable energy projects. (Horstink et al. 2019, p. 46: ‘Legal uncertainties for RES prosumers’; REScoop 2017, p. 52)

3.2.3 Subsidies and taxation

The financial feasibility of RES prosumerism activities has been increased through technological improvements and associated efficiency gains (see section 3.3), but not by those alone. The financial playing field has been changing (through the introduction of feed-in tariffs and their replacement by auctions in some EU countries), and it will continue to do so (Banja et al. 2017). The forms of RES prosumerism that will prevail will be strongly shaped by the mixes of subsidies and taxation structures in place. These financial incentive structures will be charted in detail in the forthcoming work by PROSEU WP4, comparing the PROSEU countries with the past and current state of the following arrangements: Feed-In Tariff (FIT), Export tariff, Net metering, Fiscal incentives, Grant Schemes, and ‘other subsidy and tax initiatives. Earlier analyses by Toporek & Campos (2019) and

¹³ See for instance UNFCCC 2018, <https://unfccc.int/news/global-energy-interconnection-is-crucial-for-paris-goals> (accessed December 2019)

¹⁴ RESCoop website 2019: <https://www.rescoop.eu/the-rescoop-model> (accessed December 2019)

experiences with the PROSEU Living Labs have already brought forward a range of relevant observations in this regard:

- The beginning of the **‘post-subsidy era’**. As detailed in Brown et al. (2019) for the UK and later elaborated for other countries studied by PROSEU, the phase-out of subsidies is an important development shaping the mainstreaming process. If there is support, it seems to move away from production support (like FiT) towards investment support. In France a tendering system for large self-consumption projects is considered. In Germany, there is a specific legislative framework with rules on participation of energy cooperatives in auctions and providing a priority feed-in for renewables projects and financial incentives for RES installations operators.
- **(Perceived) Lack of specific subsidies/financial support.** Lack of special conditions (special prices) for prosumers and (renewable) energy communities (IT). No special financial incentives and tax exemptions for (renewable) energy communities (FR). Tenders not sufficiently benefiting (renewable) energy communities (FR). Lack of policy support in the form of subsidies and cheap access to capital and, in consequence, little financial aid for renewable energy communities (UK). By contrast, there are still various forms of financial support at different levels of administration for different kinds of initiatives aiming at the support of renewable energy production (DE).
- **Tariffs posing barriers.** Specific grid tariffs for collective self-consumption in France were set at too high levels and constituted a barrier in the end. Higher costs of licences for units with higher installed capacity – according to the law: installed capacity should match the local consumption needs (PT).
- **Certification schemes.** Green certificates support scheme (BE/Flanders) – although, in case of Flanders – currently not very profitable and not adequate for small solar PV self-consumers. Special tenders supporting renewable sources of energy (HR). Energy performance certificates for energy efficiency in buildings considering RES installations in buildings (GB)
- **Start-up subsidies.** Living Lab #8 Local Sustainable Heat Provision in the Netherlands concerns the rolling out of ‘Buurtwarmte’ (English: neighbourhood-heat) initiatives in the Netherlands. The business model for rolling out a Buurtwarmte process in a neighbourhood requires an initial investment to start the planning phase with a neighbourhood. This means that without a municipality prepared to engage with Buurtwarmte, a collective of cooperatives, in this planning phase, or without access to subsidies/grants from other sources, they cannot start helping a neighbourhood. In France, there is a specific public fund for preconstruction phases of projects (in the cooperation with the environmental agency).
- **Subsidies for batteries & storage.** Living Lab #9 Ecovillage Aardehuis in the Netherlands received a subsidy for the battery system, but it does not cover the 25,000 EUR worth of peripheral appliances (i.e. wiring system etc.). The current net metering policy of the Netherlands allows consumers to sell any surplus electricity to the grid. This policy does not provide incentives to innovate, as the net metering policy is more financially attractive than installing a battery at this point. This makes the battery system not scalable. Also, in Italy, a ‘high price of the storage system’ is reported.

3.2.4 Public and private investment

The mainstreaming of RES prosumerism obviously relies on the financial investments that can be directed towards it. This involves both public and private investments and is strongly influenced by the emerging trends towards ethical investment. Proceedings from Work Package 4 (notably Deliverable 4.3., due September 2020)

are focusing on this key societal condition that in itself indicates a broad range of directions for the mainstreaming process. Particularly relevant developments are the following:

- **Commercial investment and the ‘green gold rush’.** Trillions of dollars of investment are needed to combat the climate emergency. As Brown et al (2019) state, the literature on ‘green finance’ has tended to focus on high level flows of energy finance (Mazzucato and Semieniuk, 2018), or the challenges of funding large renewable energy projects (Blyth et al., 2015). Hall et al. (2016) also highlight the challenges of financing distributed energy systems, where differing national institutional contexts influence the financial solutions available. The role of private capital is controversial. As Janković & Bowman (2014) have persuasively argued, many private finance organisations have regarded climate breakdown as a “green gold rush”, seeing the emergence of environmental investment products as a way to boost revenues. In this sense, success is measured by profit margins and not primarily by the amount of carbon dioxide removed from the atmosphere. Given the scale of finance needed to decarbonize global economies by 2030 / 2050, commercial investors have a key role to play. But – as Mark Carney, Governor of the Bank of England revealed on 15 October 2019 – private companies have already secured financing from investors in global capital markets worth \$185 trillion in carbon-intensive stocks and bonds that will keep the world on a trajectory consistent with catastrophic global heating¹⁵.
- **Green bonds.** In such a context, one apparent success in redirecting both public and private investment has been **green bonds**, as a way for issuers to raise money specifically for environmentally friendly projects – such as renewable energy or clean transport. Municipalities are big issuers of green bonds. More than \$600 billion in green bonds have been issued worldwide in the past decade, according to Bloomberg NEF.¹⁶ The market is expected to keep growing, with Europe alone needing about 180 billion euros (\$203 billion) of additional investment a year to achieve 2030 emission targets set by the European Union in the 2015 Paris Agreement on climate change. The EU is now creating a Green Bond Standard, which will build on current market practices, such as the ICMA Green Bond Principles. Issuers from anywhere in the world will be able to cite compliance, providing their plans are independently verified by an EU-accredited assessor. The new standard will be voluntary, rather than legally-binding however. Although green bonds are a tiny fraction of the more than \$100 trillion global bond market, these developments signal their potential to scale up investment in mainstreaming prosumerism.
- **Social bonds.** Whilst green bonds are used solely for environmental goals, social bonds are dedicated to projects aimed at improving social welfare or helping disadvantaged populations – a key part of an inclusive transition. The range of socially conscious instruments keeps growing as more investors look to do good while making money, and regulators look to the instruments to influence policy and investment decisions (Davis and Cartwright, 2019). Might there be a way of combining the incentives and impact of these bonds at the community level in order to support the mainstreaming of prosumer initiatives? For example, Community Municipal Bonds (CMBs) are a new type of bond

¹⁵ The Guardian website 2019: <https://amp.theguardian.com/business/2019/oct/15/bank-of-england-boss-warns-global-finance-it-is-funding-climate-crisis> (accessed December 2019)

¹⁶ Bloomberg website 2019: <https://www.bloomberg.com/news/articles/2019-03-24/what-are-green-bonds-and-how-green-is-green-quicktake> (accessed December 2019)

product created in the UK enabling local municipalities to use investment-based crowdfunding as a way of raising finance for environmental and social projects (Davis and Cartwright, 2019).

- **Crowdfunding.** The global crowdfunding economy has grown rapidly, such that total flows in 2016 were worth roughly €260 billion, over €220 billion of which were in Asia, around €30 billion in the Americas, and roughly €10 billion in Europe (Ziegler et al., 2018). Crowdfunding is not just about sourcing the money though. Taking wind energy as an example, this approach can go some way towards engaging successfully with the community and ensuring renewable energy schemes also help to generate social value for communities through inclusive processes. Often this involves groups organised around a local geographical area, adopting ‘co-operative type’ legal structures. Typically, the number of shares (and votes) an individual can hold is limited (Yildiz, 2014). Projects are funded through a share issue. However, often these shares cannot be easily sold on, requiring long term commitment from project investors, who may value wider community benefits (Yildiz, 2014; Holstenkamp & Kahla, 2016). Community finance mechanisms are common for renewable energy, where in Germany, over 500 energy co-operatives with 80,000+ members have invested up to €800 million in solar PV (EEFIG, 2015).
- **Climate emergency and ethical investment.** More widely, the climate emergency is leading a movement towards impact investing, with 45% of UK investors claiming they would move their money to an ethical fund as a result of news about the environment. More than three-quarters (78%) of younger investors, aged 18-24, would be prompted to move their money to an impact investment fund in response to the climate emergency¹⁷. This is how we begin to see its transformative potential – as social relationships within a municipal region are redrawn, residents become more invested in their community (both financially and socially), and so new networks of trust build up at the local level. This has the potential to drive transformative innovation, shifting the balance of power so that mainstreaming prosumerism through financial innovation can deliver wider societal and environmental benefits. Given the strong municipal level governance models that exist across Europe, there would seem to be significant potential in mobilizing CMBs and other green/social bond structures to finance prosumer initiatives.

3.2.5 Administration & governance relations

RES prosumerism activities are shaped by various regulations, policies and financial arrangements. In practical terms, there are also various procedural, administrative societal conditions that may facilitate or rather constrain RE activities in particular places.

Relevant societal conditions and developments in this regard are:

- **Spatial regulations.** Prior to starting to produce, energy prosumers need to think about whether authorisation for placing RE installations is needed. Small installations of PV modules on rooftops do not require a building permit in most EU countries. However, in Croatia, the electricity operator must acquire a permit for PV construction on rooftops. In Slovakia, aspiring prosumers need a voucher that details the type of equipment, the manufacturer and the production type, the number of units, the total output, and the devices for electricity production, as well as the capacity of the batteries.

¹⁷ Triodos website 2019: <https://www.triodos.co.uk/press-releases/2019/climate-emergency-drives-growth-in-impact-investing> (accessed December 2019)

Except for issues with building permits, prosumers must pay fees for applying for energy production for self-consumption that include connection fees as well. These fees are regulated at national, regional and/or local level (Belgium Consortium, 2017). Still, most EU countries do not require payment of a fee for residential prosumers generating electricity if it is mainly used for their own consumption. In Belgium-Wallonia and Netherlands, PV installations usually do not require permitting, although a licence is needed if a prosumer wishes to sell electricity to other prosumers (Belgium Consortium, 2017). Access to and use of the grid are usually charged in all EU countries. Some countries have fixed costs of grid use (Belgium, Netherlands and Portugal), while other have variable costs (Bulgaria, Germany, Croatia, etc.) (Belgium Consortium, 2017). Based on the example of several EU countries, policy makers in each EU country put different “boundaries” to prosumerism. As presented, bureaucratic hurdles to become prosumer can still present a challenge (especially to households) even in countries like UK, Germany and Norway (Inderberg et al. 2018).

- **Complicated administrative procedures.** ‘Bureaucratic hurdles’ are a quite broadly shared experience amongst RES prosumerism initiatives (Horstink et al. 2019). In Italy this includes the uncertainty of the permitting process (for all renewable energy projects) as to whether and when the permit may be expected (Italy). While in Croatia, administrative complexity is faced not with government but with banks, namely the lack of uniform administrative procedures in commercial banks, with a lack of visibility and availability of green loans.
- **Relations with grid operator.** Living Lab #9 ecovillage Aardehuis in the Netherlands experiences raise attention to the difficulties in communicating with the grid operator which sometimes occur. According to two members of the initiative, a possible reason could be that the grid operator has no strategic advantage to respond/change the service for individual users/user groups. On the other hand, it has also been asserted that the grid operator may not have the capacity in its workforce to meet the requests of local initiatives regarding peak shaving projects.
- **Experimental status and exemptions.** The Living Lab #9 ecovillage Aardehuis in the Netherlands has an **experimental-status** from the Dutch government.¹⁸ The status provides a temporary lenience in regulatory space, allowing cooperatives and housing associations to diverge from the Electricity and Gas act¹⁹, and experiment with i.e. electricity self-consumption and distribution. The reason for the Aardehuis to apply for an experimental status, was so that they were able to install a smart-grid for the 25 households in their community. However, after they received the status, the members of the Aardehuis became more knowledgeable about installing a smart grid. They discovered they actually did not need the experimental status from the government to install their smart grid. Moreover, they found out that it was crucial for them to involve the local DSO in the process, which was not part of the experimental-status. Thus, the procedure was not as crucial to their aspired goal as the Aardehuis initially expected it to be. Moreover, the procedure was long and complex, taking up a lot of time and effort from the Aardehuis’ members. Thus, in the end, because of bureaucratic complexity and a learning curve of the initiative itself, the procedure was less relevant than expected. However, the two members of the Aardehuis that applied for the procedure did note that the application forced them to learn more about the process of installing a smart grid. In that way, it did facilitate them in their learning experience.

¹⁸ Dutch Government website 2019: <https://www.rvo.nl/subsidies-regelingen/experimenten-elektriciteitswet> (accessed December 2019)

¹⁹ Dutch Government website 2019: <http://wetten.overheid.nl/BWBR0009755/2016-07-01> (accessed December 2019)

3.2.6 Social organisation of labour

RES prosumerism activities imply that activities normally bought as services and goods are taken out of the hands of the producer and performed by the former consumers. No longer delegating these activities, prosumer individuals and collectives will need to fit in the energy prosumerism activities with their routines, and their organisation of work/leisure/household activities. This can be facilitated or complicated by the social organisation of labour, i.e. by the various formal and informal arrangements that govern the choices of individuals and households to do paid, voluntary or collaborative work. Considering the shifting of tasks, ownership and responsibilities that RES prosumerism entails, this set of societal conditions is bound to exert influence on the mainstreaming process.

Relevant societal conditions and developments in this regard are:

- **Generally felt need to professionalise.** Amongst the key threats to RES prosumerism, as revealed in the PROSEU survey results, is the risk of working with/as volunteers (Horstink et al. 2019). The dependence on volunteers may hamper the expansion of the prosumer initiative's activities, because of both time and knowledge constraints that are associated with volunteering. To mainstream prosumerism, there is an urgent need to professionalise operations. As one of the Dutch respondents sharply put it: we need to move from 'hobby to lobby' (Horstink et al. 2019, p.83). The need to professionalise to be able to upscale activities and/or adequately participate in the energy market (in particular in countries where licences are required to be able to function as an energy supplier), is creating opportunities both for freelance professionals, as well as for specialised companies such as ESCOs and project developers, or even large utilities that may offer to install RE technologies provided customers sign contracts with them. On the other hand, this is decreasing the percentage of labour with more stable contracts and increasing the marketisation of prosumerism.
- **Increased flexibility of the labour market.** In the Netherlands, more and more people become active as freelancers, using the ZZP legal structure (independent contractor without employees). For example, many former government employees are now working as independent contractors for cooperatives. This has allowed cooperatives to make use of professionals without needing to hire fulltime employees (which most cannot yet afford). A large pool of flexible professionals has emerged that can help cooperatives with communication, asset management, project development, etc. Now that cooperatives are growing, the first cooperatives with full or part time employees are starting to emerge.
- **Maintenance and safety.** The decentralised energy systems come with a significant flow of installation and maintenance activities. The quality and safety of installation depends on the professional, skilled and dedicated way in which it is undertaken. Much of the perceived reliability of RES prosumerism will therefore be shaped by regulations and procedures of installation, quality checks, maintenance requirements. Especially this aspect of longer-term management poses challenges for individual or collective RES prosumerism – as less strongly institutionalised and formalised modes of energy production.

3.3 RES prosumerism *objects*: technological/ material/ natural conditions

The mainstreaming of RES prosumerism is shaped by a wide of range of societal conditions. As a new form of action that changes the traditional division between energy producers and consumers, it is shaped by a host of formal institutions (section 3.2). Yet, RES prosumerism also involves innovation in the material, technological sense. Considered in terms of new objects, the mainstreaming of RES prosumerism is shaped by the following key societal conditions: The technological performance of RE generation installations (**section 3.3.1**), natural conditions (**section 3.3.2**), the built environment (**section 3.3.3**), storage technology (**section 3.3.4**), grid development (**section 3.3.5**), and the availability of expertise and skills (**section 3.3.6**).

3.3.1 Technological performance of RE generation installations

Societal choices regarding RES prosumerism are – quite obviously – shaped by the (changing) state of technology. The mainstreaming of RES prosumerism thus far has partly been driven by the increasing feasibility (profitability) of renewable energy generating installations. These technologies, involving different kinds of renewable energy generation, will continue to evolve. The techno economic data for prosumerism technologies have been elaborated by Novosel et al. (2019) and are referred to throughout this sub-section.

Specific developments in this regard are:

- **Solar – falling PV system costs:** Solar energy was the easiest and most viable option for someone to become prosumer. PV panels can be easily mounted on the rooftops of households, companies, factories, etc. The strong decline in PV system costs over the last years, from 1.8 \$/W in 2010 to 0.2 \$/W in 2019²⁰, makes distributed PV generation competitive to retail tariffs, and for larger installations even with wholesale tariffs. Specific investment cost in solar PV power plants depends on the installed power, but on average it ranges between 900 and 1,500 €/kWp according to data in 2015. Projections assume that specific investment PV prices will be 600-900 €/kWp in 2030 and 280-800 €/kWp in 2050 (Novosel et al. 2019). Not only have modules become substantially cheaper, in many cases also the installation itself because more efficient mounting systems allow for time-savings during installation. Moreover, new players in the supply chain (like Ikea) demonstrate the increasing commoditisation of PV systems. This effect has led to adjustments in policy frameworks, lowering substantially or even abandoning Feed-in-Tariff schemes. Therefore, lower installation costs do not necessarily mean more viable projects because the revenue for prosumers has also decreased. Nevertheless, the lower the technology costs are, the better new markets can be captured, especially since the upfront costs for prosumers are less prohibitive – in the end it makes a difference if one has to pay more than 3000 EUR or less than 2000 EUR per kW installed.
- **Solar: Performance increase of PV:** Next to the falling PV system prices, the performance of modules has increased 0.3% annually from 2003-2014 (IEA, 2014) projected to reach 20% efficiency in 2030 and 30% in 2050 (European Commission 2014), allowing for more power output per square metre of available roof or ground space. New materials are constantly researched and will most likely lead to further performance improvements. Apart from that, the inverter technology has also evolved,

²⁰ Bloomberg website 2019: <https://www.bloomberg.com/news/features/2019-09-19/solar-and-wind-power-so-cheap-they-re-outgrowing-subsidies> (accessed December 2019)

providing additional grid-related services as well as services to the consumer (like power monitoring).

- Wind:** Specific investment cost in wind turbines also depends on the installed capacity, but it is more affected by the position of wind farm, on-shore or off-shore. For large on-shore wind farms the specific investment cost in 2105 was between 1,100 and 1,400 €/kW, while at the same time off-shore wind farms had specific investment cost of 1,800-3,500 €/kW. The same sources project that in 2050 the specific investment cost in off-shore wind will be ca. 800-1,100 €/kW, while off-shore wind will be ca. 1,500-2,300 €/kW. In the period of 2015 to 2050 the energy efficiency of wind farms will not be improved significantly; it will remain to be between 40 and 50%.
- Market growth.** Increasing wind and solar power generation above a 30% share in annual electricity consumption dramatically increases flexibility requirements of the energy system. As an advantage of wind and solar over other RES is the increasing market growth (Gosens, Hedenus, & Sandén, 2017). Adopted markets growth in 2014 was up to 4.7 times faster for wind, and up to 16 times for PV compared to 1980. The analysis has also shown that per capita GDP still has the strongest effect on variable RES (vRES) market growth speed. Low income countries could speed-up vRES market growth only if some financial measures are applied like co-financing, carbon markets or some other subsidy forms.
- Controllable RES (cRES) vs. Variable RES (vRES).** cRES have the predictable and stable production of electricity that is almost the same as the power production using fossil fuels. For that reasons, biomass, hydro and geothermal are recognised as a possible replacement for coal-fired and gas-fired plants. Also, nuclear power plants might be even more decommissioned in future due to political unacceptability. A detailed review of RES types and their characteristics reveal that vRES have a higher potential to be invested in due to price decrease projections, compared to cRES. On the other hand, higher share of vRES in future energy system requires higher flexibility in grid operation. Therefore, cRES can solve that issues and open additional space for additional vRES integration. Future energy system will not only be based on price (i.e. using the cheapest technology), but rather on the complex integration of different RES technologies to meet the demand for electricity and to reduce their impact on the environment.
- Biomass.** Biomass has a wide potential for energy production primarily due to the diversity of its origin and available technologies of converting it into energy (Ekpeni, Benyounis, Nkem-Ekpeni, Stokes, & Olabi, 2014). Biomass can be directly utilised as a replacement for coal in existing power plants to gain GHG reduction. In 2015, the specific investment cost in cogeneration plant (combined heat and electricity production) using biomass wood chips was ca. 3,500 €/kW. The same projections estimate that even in 2050 the specific investment in such project will not decrease for more than 10%. The reason is the complexity of technology that does not create a space to reduce its price. Total energy efficiency of these projects also remain the same over time, around 80%. Another option of converting biomass to energy is using anaerobic digestion and production of biogas in the case of biodegradable biomass with low lignin content. Biogas can be used to produce heat and electricity, but also to produce methane-rich gas biomethane to substitute natural gas (Khan et al., 2017). Production of biogas using sustainable feedstock like agricultural residues, industry waste streams and food waste highly contribute to mitigation of greenhouse gas (GHG) emission and reducing waste landfilling. Biogas CHP has a slightly higher total efficiency compared to biomass CHP, of around 90% (Hakawati et al. 2017). The specific investment cost in biogas CHP is very similar to biomass CHP and does not decrease significantly over time.

- Hydropower.** Hydropower plants are considered as most advantageous source of energy since it has negligible social and environment impacts as compared to other forms of renewable energy (Singh & Singal, 2017). According to Eurostat, hydropower is Europe’s largest renewable energy source with shares of ca. 60% in total renewable electricity generation and almost 12% of the European net electricity generation. Hydropower generation is very efficient – 92%, with variable operational costs of almost 0. The specific investment cost in hydropower plants depends on the size and type of powerplant. For run-of-a-river powerplant the specific cost ranges between ca. 1,000 and 8,000 €/kW, with no clear decrease rate in the future. Dam and reservoir hydropower plants have some lower specific capital investment of ca. 1,000 to ca. 6,000 €/kW. Again, projections assume that the specific price of investment in dam and reservoir hydropower plants will not decrease in future.
- Other technologies:** Besides PV there are other technologies that have improved over the last years and that support the uptake by prosumers. This includes energy monitoring technologies (apps and other tools), the availability of electric vehicle models, renewable heating systems, roll-out of smart meter technology, virtual power sharing systems, storage technologies (see below), grid monitoring capabilities of network operators, digitalization in general, etc. Especially the possibilities of instantaneous power exchange, peer-to-peer trading and technologies like block-chain offer new opportunities.
- Additional costs:** While certain technical and regulatory requirements will lead to additional costs (e.g. if inverters or other components need to provide grid services that were not required before), it can be assumed that PV and other RE technologies in the prosumer field will continue to become more cost-efficient and higher performing. Active support of governments in research and development as well in creating new markets will accelerate cost reductions.

3.3.2 Natural (climate/weather) conditions

Across European countries, RES prosumerism takes different technological forms (see for example Hewitt et al. 2019 for an overview). Apart from being shaped by other relevant *societal* conditions, these different emphases on solar, wind or hydro energy sources reflect different climate and weather conditions. Compared to various institutional and cultural conditions, these natural conditions may not change that fast. Still, they may push RES prosumerism mainstreaming in different directions, through particular local natural conditions. Also considering that RES prosumerism can involve other renewable energy sources as well, there are significant differences in local natural conditions to take into account. So even if not constituting societal conditions that as such are open to change and purposive intervention, it is important to at least acknowledge these natural conditions²¹: They co-determine the scope for RES prosumerism, along with various other technological, economic and cultural conditions described.

Specific developments/circumstances in this regard are:

- Irradiation.** With regards to solar technologies, both for heating and electricity production, their utilisation depends significantly on the climate conditions which are tightly connected to the geographical location. Global horizontal solar irradiation decreases significantly when going from southern Europe towards northern Europe, leading to higher potential for solar technology

²¹ This explicit accounting for natural conditions is unusual in studies of socio-technical transitions (Cf. section 2). On the other hand, it fits well with such systemic perspective on socio-*technical* change, as natural conditions mediate the interactions between social structures and technologies. This mediation is even at the very focus of the related scholarship on *social-ecological* systems.

utilization in countries like Italy, Spain, Croatia, etc. In these regions, the average global horizontal irradiation is higher than 1400 kWh/m², with peak areas having the irradiation above 1900 kWh/m². However, in countries of central and northern Europe, the irradiation decreases significantly to average values of 1100 kWh/m² in central Europe and even below 1000 kWh/m² in Scandinavian countries.

- **Mitigating social, political and economic conditions.** Despite this, solar technologies are very well utilized in northern and central European countries, showing that even the low solar irradianations are high enough in order to utilize this energy source to a high extent and putting solar as one of the most significant RES prosumer technologies for achieving high shares of autarchy and significant decrease of environmental impact of the energy sector. Northern European countries even have a much higher share of solar in their energy system than some southern European countries (e.g. Croatia) due to various social, political and economic reasons. This is affected significantly by political decisions and the social status of potential prosumers, which presents certain barriers for this technology and will have to be tackled in order to increase their share in the future. However, solar will remain one of the most important RES technologies due to its high potential and decreasing prices in the future, as mentioned earlier, especially when taking into account that most of the countries have already achieved grid parity and that solar energy is cheaper than the grid supply.
- **Wind speeds.** When it comes to renewable energy production from wind, the climate/weather conditions have a much higher influence on its utilization. Similar to solar energy, wind potential can also be determined for different geographical areas. However, wind power technology can only be used when the wind speeds are higher than a certain threshold, usually 3m/s and again cannot be used if the wind speeds are above 25 m/s. Therefore, electricity can only be produced within a certain range of wind speeds. Usually the wind speeds are higher in coastal regions and islands and, opposite to the solar irradiation, in northern Europe. Nonetheless, some parts of southern Europe also have high wind speeds, especially the coastal regions. Next to wind speeds also its continuity has to be taken into account. Therefore, micro wind turbines can only be used in certain geographical areas since they are otherwise economically not feasible.
- **Air temperature.** One of the main climate related factors is the air temperature. It is one of the most significant factors when it comes to the performance of the air source heat pumps. Since the heat source for this technology is the outside air itself, its temperature significantly affects the coefficient of performance of the heat pump. For lower air temperatures the coefficient of performance decreases, meaning that for the same amount of heat produced the heat pump needs to consume more electricity. Therefore, in regions with milder winters the air source heat pumps will be a more feasible technology than in the areas with stronger/low temperature winters. However, other parameters can make heat pumps a competitive technology even in regions with lower air temperatures, e.g. the ability to use zero or even negative cost electricity for heat production in areas with a high share of variable renewable energy sources, which results in their excess production and therefore low and even negative prices on the market.
- **Geothermal energy.** Nonetheless, heat pumps do not use only outside air as the heat source, but rather a vast variety of sources like geothermal energy both from the ground itself and the subterranean waters, energy from water e.g. rivers, sea or lake, as well as from industrial sources, e.g. sewage sludge, flue gases, etc. Geothermal energy is one of the most interesting sources for the heat pump in the prosumer model since it is accessible by each consumer in his own backyard but also very sensible to the geographical location since the potentials for geothermal energy can vary

significantly in different parts of Europe. However, it is more difficult to spot a certain pattern since the geothermal potentials do not depend that much on the geographical and climate aspect.

- **Precipitation.** An important climate condition for prosumers can also be the precipitation, especially if small hydro power plants are used. In areas with higher precipitation the potential for hydro power plants will be higher due to higher amounts of water in the rivers. Nonetheless it has to be taken into account that in most European countries the hydro potential has already been utilized to a high extent and therefore only smaller rivers can be used for that purpose, which are more sensitive to the precipitation levels in the region.

3.3.3 Built environment

In close relation with the natural conditions, the built environment poses quasi-natural conditions for the direction of RES prosumerism mainstreaming. The built environment can be changed, but only at a high cost and generally not on the level of urban structures. It poses a relatively inert set of physical conditions. RES prosumerism will have to be fit in with these physical structures, which in turn can be adapted to enable certain forms of RES prosumerism.

Specific circumstances and developments in this regard are:

- **Available space.** One of the main factors for the increase of RES prosumerism is the available space for integrating the renewable technologies at the consumer side. Different technologies require different amounts of space, ranging from hundreds of thousands of cubic meters for seasonal thermal storages to just a couple of cubic meters for smaller electric batteries. In that regard, different technologies will have a higher potential for utilization in smaller rural cities, where the majority of buildings are individual houses and where there is a lot of free space between each building. For example, PVs and solar thermal collectors can in that cases be mounted in the yard of each house, as an addition to the ones on the rooftop, thus increasing the overall installed capacity and the self-sustainability of the household. This of course depends also on the country regulation since such installations are forbidden in some countries.
- **Rooftops: Dimensions, slopes and ownership.** However, in densely built cities, the only available area for the installation of solar technologies remains the roof. Furthermore, rooftops might not be utilized to the full potential due to other installations and therefore the share of roof for PV and solar thermal installations is reduced to significantly less than 100%. Especially in cases when the rooftop is not flat but rather sloped, the maximum available area decreases even further. However, technology advancements led to the possibility of integrating PV in the envelope of the building as well, which again increases the overall installed capacity. The integration of PV on the rooftops and envelopes of newly built buildings is incentivized by government regulations, in certain countries, e.g. France. Another issue when integrating different renewable technologies on the parts of the building is the ownership of the existing buildings, which can be a limiting factor for the uptake of prosumerism.
- **Integration technologies.** There are several innovative solutions for the integration of renewable technologies in the built environment. These include examples of wind power integration within the buildings themselves, and the building of integrated photovoltaic systems. It is certain that with further advancements of the technology, these solutions will be even more affordable in the future. When it comes to storage technologies, smaller thermal and electric storages can be placed in the

basements of existing buildings without the need for much additional space. However, when larger storage technologies need to be utilized, for example the seasonal thermal storage which usually requires tens and even hundreds of thousands cubic meters, additional space is required. This could be integrated in larger green city areas (if available), e.g. parks since the storage itself is placed underground. For larger electricity storage, the vehicle to grid technology could be used. This transforms the electric vehicle fleet into the battery for RES production, making it possible to communicate with the grid, store excess electricity and send it back to the grid when needed. This would not require additional space, except for the chargers. Most cities are already going towards banning diesel and petrol vehicles in the future, so such infrastructure seems to be built in any case.

- **Geothermal heat pumps; specific requirements.** Another technology which requires a larger amount of free space for its utilization is the geothermal heat pump. Even though the geothermal wells can be implemented in different ways, all of them require space for the drilling. Especially in cases of horizontal wells, it requires that the area where the heat pump circuit is placed is kept uncovered. Therefore, geothermal heat pumps have a much higher potential to be built outside of densely populated city areas. Only heat pumps which use air as the heat source require much less space and can be utilised even in dense areas. These barriers have to be taken into account when planning to integrate heat pumps in the heating system of buildings or neighbourhoods.
- **Biomass and micro CHP units.** One of the most popular renewable sources at this moment is biomass in its various forms. It can be used as fuel for producing heat and electricity. The advancements of the technology lead to reduced space requirements, especially with the introduction of micro CHP units which can be installed in the boiler room of existing buildings or their basement depending on the existing infrastructure. Even when the space requirement for the fuel, i.e. biomass itself is taken into account, no further modifications of the available area need to be done. It has to be taken into account that CHP units can also use other fuels, e.g. biogas and other biofuels, which is beneficial from the point of view that the sustainability of biomass use is a raising issue and will likely lead towards reduced use of this fuel in the future. In conclusion, micro CHP units have a high potential for prosumerism applications due to the low space requirements compared to the benefits of the system producing heat, electricity and possibly cooling (trigeneration) for the local use.

3.3.4 Storage technology

Apart from the state of energy *generation* technology, the direction RE mainstreaming is also shaped by the development of storage technology. This condition influences the relative feasibility of individual and collective RES prosumerism, and more generally the ways in which RES prosumerism installations will be integrated and connected with other technological systems. This condition is subject to change, considering the ongoing technological innovations in this area.

Specific developments/circumstances in this regard are:

- **Battery storage.** Certain battery providers like Sonnen or Tesla offer packs that also allow power sharing across the customer base in virtual power plant applications. For energy communities, larger battery packs could be imagined, even without own power generation. While most batteries are designed to optimize power consumption by increasing the self-sufficiency ration over the course of one or only a few days, the possibility to store electricity longer-term in the range of weeks can become possible, allowing prosumers to potentially even disconnect from the grid. However, this

option has its limitations (Petrick et al. 2019). In many countries the regulatory frameworks are not yet designed in a way that a wide-spread use of batteries is sufficiently well considered. That applies both to technical requirements as well as economic aspects; for instance, double taxing can occur, namely once the battery is charged and then again when it is discharged. This can make business cases unviable and can suppress innovative system support services.

- **Costs for battery storage systems.** The costs of battery storage have decreased substantially over the last years. This allows prosumers to install stationary batteries in homes at costs that make them – under certain circumstances – and in combination with PV systems a viable business case. These are supposed to drop 50% in costs for Lead-acid batteries and over 60% for Lithium-ion or Vanadium Redox Flow batteries. Therefore, battery storage becomes more and more economically feasible. However, the evolvement of battery storage is hugely dependent on the regulatory framework in the member states. In countries with a high electricity price and no or less levies on self-consumption there is a fast-increasing number of battery storage (e.g. Germany). If self-consumption does not really differ from electricity from the grid, there is not a big market for battery storage (e.g. the case of net metering in the Netherlands).
- In the **heat segment**, storages are well established but they get more important with power-to-heat technologies evolving. Heat production with these technologies gets time-independent from the actual needs for heating and therefore more storage has to be installed. This is especially relevant since the costs of the heat storage are significantly lower than the costs of any other form of storage.
- **Relation to grid.** Installation of energy storages has the advantage for prosumers to be more independent from the grid, which can be an important reason in areas with instable or no grid connection, but it is also an upcoming motive in regions where there is a lack of trust in established energy suppliers. Installation of energy storages can also be an advantage for the grid, if it is used to stabilize the grid or to store RE in times of overcapacities. Storages often come with a built-in management system, so that prosumers do not have a big influence on whether the storage provides some grid service, e.g. balancing energy, or if it primarily increases the self-consumption rate.
- **Electric vehicles.** Next to stationary batteries, the **mobile batteries of electric vehicles** are likely to be increasingly used in combination with electricity management in buildings. To do so, V2G (vehicle-to-grid) technology is required – a feature which is not widely available yet. These batteries would also allow intelligent charging based on the needs of the power system and the individual preferences of the owner.
- Lower battery costs also have an **impact on the required power generation** because certain back-up capacity (especially technologies that provide inertia through rotating masses like steam and gas turbines) may not be needed if batteries can provide fast response services. This in turn can also lead to different system infrastructure needs as certain transmission networks may become obsolete (see also next subsection).
- **Power-to-X:** Renewable electricity can also be transformed to hydrogen and then to methane, or to heat or cold which can be stored at small- or large scale heat or cold storage tanks (solar thermal energy can also be the source for heat and cold storage, see e.g. the Danish examples of solar thermal district heating). Hydrogen or renewable methane can be used in various applications, from industrial processes to cars, ships, trucks and planes. Energy communities could engage in the production of renewable gas or heat, for instance by contracting service providers in these fields. Similarly, to the use of batteries, adequate regulatory frameworks for P2X technologies are still in their infancy.

3.3.5 Grid/infrastructure development

RES prosumerism mainstreaming takes place within the constraints and opportunities provided by energy infrastructures, and notably electricity grids. Apart from various other societal conditions (regulations and discourses, as discussed in sections 3.2 and 3.3. respectively), there are also the physical conditions of grid capacity, capacity management, grid maintenance, and indeed the development of grids and infrastructures that favour some forms of RE mainstreaming whilst ruling out others. Especially as mainstreaming involves fast growth of RES prosumerism, these conditions become critical.

Specific developments/circumstances in this regard are:

- **Distribution grid.** The large-scale deployment of distributed generation will impact the distribution grids as at certain times power flows may be reversed, potentially requiring an overhaul of existing transformer stations and the reinforcement of electricity lines. The impacts have to be evaluated on a case-by-case basis because many factors play a role: Technical and economic RE potential in a certain area, age of the distribution system, current and future consumption levels, density, potential use of electric vehicles, etc. For instance, in urban areas and industrial zones it is quite likely that any renewable generation can and will be absorbed by the local demand. By contrast, in rural areas it is possible that more electricity gets generated than what is consumed, and this excess energy will either have to be transported to other parts of the grid, or to be stored, or otherwise be used (curtailment should be avoided).
- **Transmission grid.** Even in a prosumer-centred world it is quite likely that RE will have to be transported over large distances, e.g. from offshore wind parks or from locations with good renewable resources to demand centres. However, certain transmission lines may not be used to the same extent as planned if local prosumer projects generate and store large amounts of electricity for local use. Energy “cells” that are largely self-sufficient may require transmission grids only a few days per year, making them potentially less economically viable or even obsolete.
- **Generation capacity.** Prosumer projects can also affect other generation capacity, especially where RE systems have priority grid access, pushing generation from fossil fuels out of the system. As this affects existing business models, counter measures may be taken by incumbents. Lobby against distributed generation needs to be considered by prosumers because it can delay or even make prosumer projects impossible.
- **Gas grids:** Renewable gas may in future make use of the existing fossil gas grid. However, as studies have shown (see Ecofys/Navigant report on Gas 2017 or 2018), the potential for renewable gas (i.e. H2 from RES or sustainable biogas) is much lower than the current demand for fossil gas in Europe. Import and transport pipelines as well as LNG terminals will not be required anymore. Parts of the gas distribution grid will become obsolete once buildings have been upgraded to higher efficiency standards and cooking and hot water are provided through heat pumps. Currently the next Ten Year Network Development Plan (TYNDP) for the gas and electricity grid are being discussed, using new scenario modelling based on input from ENTSO-E and stakeholders such as CAN-E.
- **District heating and cooling:** As mentioned above under storage, prosumer-centred heating and cooling systems can become more attractive in the future, potentially allowing prosumers or energy communities to feed solar heat or heat produced with heat pumps into the system. These systems will also be in competition with the traditional gas grid.

- **Grid investments.** The old grid infrastructure which was designed to transport energy from large production facilities to small scale consumers limits the amount of RE that can be connected to the grid. Grid operators often hesitate to strengthen the grid for decentralised renewable energies in general and specifically prosumer, they also do not have any incentive to do so. Investment in the grid is often very expensive and comes with a lot of construction work, especially if the grid is installed underground. The unbundling strengthens this point because the grid operators do not have a direct connection with consumers. So, there is not a direct mutual benefit when connecting RE technologies to the grid.
- Further problems arise in the lack of **digitization** in the infrastructure. Grid operators are responsible for a safe energy system. So, the less they know about what is happening in the system and the grid infrastructure, the more restrictive they behave. In this regard, digitization provides the possibility for prosumers to monitor and manage their facilities, which leads to new services and business models. The fact that the digital systems that currently exist—such as digital trading and billing—are still in the hands of large energy companies, may effectively place a stranglehold on the transition towards renewable energy.
- As part of the third energy package, member states were asked to recommend undertakings to optimise energy by e.g. using smart meters or smart grids. On this basis most of the member states decided on a **smart meter rollout** which leads to an estimated penetration rate at EU level of 42% until 2020. But there are large differences between front runners (e.g. Sweden, Italy, Denmark, Spain) and slower movers (e.g. Germany, Croatia, Belgium)

3.3.6 Availability of expertise and skills

The above-mentioned technological conditions are of obvious importance to make RES prosumerism at all physically possible. However, most of these technological possibilities could very well be used along traditional consumer-supplier relations – especially if the associated technological expertise and skills are nearly exclusively available to the latter suppliers. RES prosumer initiatives themselves have identified this availability as a key condition for their development (Horstink et al. 2019, p. 81-82: ‘top perceived facilitating/hindering factors’: Knowledge of RES prosumerism technologies). Rather than necessarily posing necessary constraints, this condition can of course change—through governmental policies, or through knowledge exchange in RES prosumerism networks.

Specific developments/circumstances in this regard are:

- **Energy (policy) literacy and RES prosumerism skills.** For distributed RE technologies to flourish, a certain level of expertise and knowledge is required on a general level, i.e. citizens need to be aware of issues related to energy, the opportunities that RE can provide, and a certain understanding what their use entails. This kind of knowledge can be assimilated through the educational system (primary and secondary school, universities as well as professional education) or through media- and awareness-raising campaigns. Horstink et al. (2019, p. 83) also showed that citizens are often not aware of the opportunities that energy communities can offer. Living Lab #11 Community energy for energy autonomy in Portugal revealed that there is a lack of capacity with initiatives mostly relying on volunteers. The situation for prosumer initiatives is very complicated on many levels. While there is an increasing number of legislative measures in place supporting collective prosumersim, few regulatory enabling frameworks are yet existing and often require a high degree of knowledge about

energy markets. In addition, different technologies can be used depending on the situation and many actors have to be involved. This means that many skills are needed to initiate a prosumer collective, while this is a lot to ask as these are often motivated from an ecological point of view.

- **Knowledge deficit and network capital of prosumer initiatives:** When it comes to very concrete projects, (potential) prosumers or prosumer initiatives will encounter different problems that need to be solved and questions to be answered, ranging from technological solutions for certain roof shapes to impacts on tax regimes. By way of example, the Living Lab #9 Ecovillage Aardhuis in the Netherlands aims to install a solar carport. However, this might lead to different forms of taxing, and their limited knowledge on this issue severely limits their ability to install the carport. On the other hand, a member of the Aardhuis also indicated how the initiative may rely on certain network capital, i.e. access to a broad range of expertise through personal contacts: *“professional knowledge that we have ourselves, people who know their way around subsidy land, in technical installations, or can get solar panels for little money from the company they work at, that has helped to make it cheaper and easier.”*
- **Awareness raising and knowledge exchange.** Energy cooperatives are often active in awareness raising / awareness activities, promotion of RE and technical workshops, also helping to improve the acceptance of RE deployment. Support and information may also be actively provided via public regional energy agencies (Germany), through local governments or through ministerial projects aiming to stimulate local communities through facilitating knowledge exchange (Netherlands). The PROSEU survey revealed that more than two-thirds of RES prosumer initiatives offer additional services, of which the most popular were energy efficiency services and support for community organising and community investment (Horstink et al. 2019).
- **Skills development of installers and architects:** Professionals in the building sector require knowledge and skills to be able to provide solutions for the issues at hand. As these actors have a wide range of areas which are often not related to energy, it can be challenging to attract their interest and to provide education and training that fits their needs (especially since small firms often don't have the capacity to attend trainings over several days).
- **Learning and adaptation of policy makers and regulators.** Policy makers themselves are often not sufficiently aware and knowledgeable about the possibilities of RE, and more specifically about prosumerism. Urban planners, local administrations but also policy makers at national level need to be aware about the rights awarded to citizens by the new Clean Energy for All Package. The transposition and implementation on national and local level requires a good understanding about the technicalities and effects. The same applies to regulators that need to evaluate how prosumers will affect the energy system. Administrative procedures have to be aligned with technical possibilities including safety requirements; for instance, quality checks on solar panel installation.
- **Smart metering technology and information exchange.** Another important issue that consumers face on the way to becoming prosumers is that the energy devices they are using in everyday operation are not designed to respond to price signals or interface with smart metering technology. Bidirectional information exchange between all technological devices is crucial in developing local energy markets where RES prosumers can play and maximise their profit (Zepter et al. 2019). Current metering provides almost no data on consumption in real-time and therefore significant changes in infrastructure and technology used must be applied to enhance the potential of households to become prosumers (Römer et al. 2012).

3.4 RES prosumerism *ideas*: cultural-discursive conditions

The mainstreaming of RES prosumerism is enabled and constrained by a wide range of societal conditions. Involving innovative actions (section 3.2) and objects (section 3.3), it is shaped by various formal institutions and infrastructures. Yet RES prosumerism also involves less tangible innovation in the symbolic sense. Considered as a new idea, RES prosumerism challenges established roles of citizens as consumers in the energy system. Showing associative modes of governance beyond market and state, it conveys new narratives on sustainable development. Beyond the immediate activities of energy production, it evokes reflection on broader societal issues of entitlements, access, ownership, trust and inclusion. Accordingly, the mainstreaming of RES prosumerism ideas is shaped by various cultures, discourses and deeply held beliefs, i.e. by various informal institutions in society. Whilst being enabled and constrained by the conditions society sets for them, RES prosumerism initiatives can of course change these conditions to a certain extent—through political lobbying, knowledge exchange, and awareness-raising²². RES prosumerism ideas are shaped by the following societal conditions: Discourses²³ of decentralisation and energy democracy (**section 3.4.1**), environmental awareness (**section 3.4.2**), perceptions of political legitimacy (**section 3.4.3**), perceptions of reliability and competence (**section 3.4.4**), and discourses of inclusion (**section 3.4.5**).

3.4.1 Discourses of decentralisation & energy democracy

The rise of RES prosumerism as a decentralised mode of energy production has been carried (enabled) by a broader political shift in society towards less hierarchical and more ‘democratic’ modes of governance. Regarding the energy system, this is manifested through the calls for energy democracy. This ‘energy democracy’ discourse clearly forms part of broader democratising political movements (e.g. the cooperative movement, grassroots innovation, collaborative planning, participative governance, ‘Big Society’ and active citizenship).

Specific societal developments in this regard are:

- **Rise of the cooperative movement.** Living Lab #8 Local Sustainable Heat Provision in the Netherlands is a player in the cooperative movement. As part of the Dutch climate agreement, the cooperative movement has successfully lobbied for an increased share of citizen-owned RES. The agreement now includes the aim of achieving 50% local ownership for new RES projects. Although this mainly applies to solar and wind projects, this improves the climate for citizen initiatives. Despite scepticism by governments, the cooperative movement is also making a breakthrough. The number of energy cooperatives is growing quickly (from 400 in 2017, to 500 coops in 2018) (HIER opgewekt, 2019). And some large cooperative wind projects have shown that cooperatives are capable of handling larger projects. Moreover, lobbying efforts and cooperation between different cooperatives has increased, for example, through merging several representative and umbrella organisations under the header of EnergieSamen. A more confident and organised cooperative movement improves the general climate for new initiatives to start. This not only holds for the Netherlands but also across Europe,

²² ‘Collaborating and networking with others’ featured amongst the top perceived facilitating/hindering factors for the development of prosumer initiatives. (Horstink et al. 2019, p. 81-82)

²³ The various discourses will exert a stronger influence on RES prosumerism, the more they are formalized and materialized in the societal conditions listed in sections 3.2 and 3.3. Discourses on—for example—inclusion do shape RES prosumerism mainstreaming, but do not ‘drive’ it independently. This is important, as policy discourses and political visions on RES prosumerism are not always backed up by concrete measures.

where REScoop.eu, founded in 2013 already counts 1,500 energy cooperatives and communities across Europe as members.

- **Energy autonomy.** This refers to strivings for independence and autarky. Living Lab #11 Community energy for energy autonomy in Portugal developed together with the local group Transição São Luís shows that energy democracy seems to be an important goal for the community: ensuring the inclusive access to basic energy has come up during the discussions. Portugal is the third European country with a higher level of energy poverty, according to recent OECD data. This affects mainly rural areas, so energy poverty is a concern for Transição São Luís. If the goals of this community are achieved then the initiative would contribute to affordable, clean and safe energy for the village residents. As a pilot experience it can help trigger legislative changes in Portugal and inspire other villages and towns to pursue similar goals. The goal of autonomy and independence is also one of REScoop.eu's seven principles to which their members must adhere. Our European survey also revealed a strong desire to decentralise (half of respondents ticked this as a key motivation) and to achieve energy self-sufficiency (chosen by one quarter of respondents) (Horstink et al. 2019 p. 79).
- **Governmental devolution and re-municipalisation.** Alongside with more bottom-up developments towards a democratised energy system, there are also broader shifts in governance that drive towards RES prosumerism. National governments devolve responsibilities towards lower tier governments and envision local collaborations between civil society and participative local government. Municipalities aspire to have more control over their energy. Regional governments are similarly seeking to integrate RES prosumerism and governmental investments in sustainable energy (Cf. section 3.2.2) into broader policies of regional development.
- **Do-it-yourself lifestyles.** RES prosumerism forms part of a broader cultural trend towards do-it-yourself lifestyles. Emerging already decades ago, this cultural development appears to be going through a revival in recent years. The 'Cool factor', i.e. appeal of creativity, self-created novelty and experimentation, is one of the motivational backgrounds that could incentivise towards RES prosumerism.
- **Energy democracy and community empowerment.** Alongside concerns over the sustainability of the current centralised energy systems, there is an increasing dissatisfaction with 'the government' as not doing enough to achieve the Paris goals, which is symbolized by the Fridays for Future movement. Fuelled by a similar dissatisfaction, the members of Living Lab #8 Local Sustainable Heat Provision in the Netherlands also take matters into their own hand in terms of building a strong cooperative movement. Survey respondents classified 'creating a sense of community' in fourth place in terms of importance (Horstink et al. 2019)
- **Transforming consumer-supplier relations.** The (quasi-) monopolistic position of utilities and large-scale companies appears to be increasingly under pressure. Lack of responsiveness to consumer demands, lack of transparency and accountability, and rigid bureaucratic management styles are prominent subjects of dissatisfaction amongst consumers/citizens. Desires for more horizontal relations with governments are also mirrored in desired relations between consumers and suppliers – this includes the ability to share RES production among community, or also become a supplier (REDII). Whilst not being specific to the energy system, these developments do affect the mainstreaming of RES prosumerism as an innovation in social relations and ideas of appropriate, responsive governance.

3.4.2 Environmental awareness

Another important condition for RES prosumerism mainstreaming is the environmental awareness of governments, citizens and businesses. Historically, increasing environmental awareness has been an important push for the development of renewable energy, and it is considered a key force underlying the ‘first wave’ of community energy (Hewitt et al. 2019). It is likely to remain an important driver for RES prosumerism, but the environmental awareness may also involve resistance to certain forms of RES prosumerism with (perceived) negative externalities.

Specific societal developments in this regard are:

- **Sustainability pressures.** In Living Lab #10 RES for sustainable viticulture in Portugal, sustainability and Climate Change are perceived as the most pressing problems for wine viticulturists and wine producers. Viticulturists claim climate change impacts are already affecting the quality of grape production. Wineries feel an urgent need to act. On the other hand, viticulture uses a huge amount of energy, representing a high cost for producers, which they hope to reduce with RES. Also, as an important economic sector worldwide, the companies feel the pressing need to have a good ‘social image’, by adopting a more sustainable strategy as part of their business. A new recently published Portuguese law on energy communities, (i.e. DL 162/2019) which is expected in the coming months to be enforced as of January 2020, will be critical in accelerating the process (cf. Campos et al. 2019).
- **Fossil fuel phase-out: ‘Getting rid of natural gas’.** An important enabling condition has been the public debate around the use of natural gas, and the production related earthquakes, that emerged since 2012 and became increasingly pressing from 2014 onwards. This has opened up the debate about the use of natural gas for heating and has switched the discourse from ‘natural gas as safe, clean, and affordable’, to ‘getting rid of natural gas’. This has enabled new initiatives to emerge due to increased awareness among (frontrunner) residents and the national government (as identified by Living Lab #8 Local Sustainable Heat Provision in the Netherlands).
- **Catastrophic climate events** can accelerate the understanding that a quick change towards RE is required. On the other hand it can have an impact on public and private financial resources (if money is spent on adaptation and reparation measures), and people may also not be willing to invest in long-term assets (like owning PV panels) thinking that they may get damaged anyways or that one has to leave the area (e.g. people in coastal areas).
- **Resistance to RES prosumerism (especially wind energy):** It could be argued that a higher environmental awareness does not automatically result in a more open attitude towards (collective) prosumerism. In fact, a higher appreciation for the environment can result in more protests against e.g. wind farms or medium and large hydro dams set to flood environmental reserves and historic villages (in Portugal, Tua and Tamega dams). The key question is whether the socio-economic benefits of the e.g. cooperative wind farm, are enough to outweigh the environmental cost. (as identified by Living Lab #6 Local heat grid with decentralised RES in Germany).

3.4.3 Perceptions of political legitimacy

RES prosumerism involves new legal statutes and organisational forms, such as cooperatives. Generally operating as neither (pure) state nor (pure) market actors, RES prosumerism collectives may gain societal legitimacy and endorsement for their relative independence from ‘incumbent actors’ and ‘vested interests’. Perceived less as

representatives of the establishment, they relatively easily gain public trust as promoters of common interest. In this respect, societal perceptions of political legitimacy are generally enabling RES prosumerism mainstreaming. On the other hand, public perceptions of political legitimacy may also constrain RES prosumerism mainstreaming. Often taking institutionally hybrid shapes, RES prosumerism collectives are not typical figures in the institutional landscape. Mixing institutional logics of markets, communities and states, they may evoke doubts about their ‘true face’, i.e. their actual goals, their priorities, and the normative yardsticks that matter to them. The perceptions of political legitimacy make for rather ambiguous societal conditions: Whether it will enable particular forms of RES prosumerism, will also depend on the relative political legitimacy of other actors in the energy system. Reputations can decline suddenly through crises and scandals, but they can also recover.

Specific societal developments in this regard are:

- **Political recognition and acceptance.** Toporek & Campos (2019) indicate a lack of political recognition of the importance of energy communities (Croatia), little political attention to energy communities as a whole (Germany), and a lack of/insufficient public acceptance for renewable energy projects (Netherlands). The Living Lab #8 Local Sustainable Heat Provision in the Netherlands indicates a limited visibility for the potential of the cooperative movement among policy makers – and the potential of the Living Lab in being a competent business partner. As with many starting initiatives, the Living Lab has the problem of not being known enough, nor being able to get a seat at the table in some (government) coalitions/partnerships.
- **Mistrust regarding ‘true intentions’.** As reported by Living Lab #8 Local Sustainable Heat Provision in the Netherlands, municipalities and provinces do not see the initiative, or the cooperative movement more generally, as a movement that represents the public interest. It is regarded as a stakeholder with a ‘private’ interest. Municipalities identify the Living Lab’s interests as 1) representing the interests of residents and as 2) being commercially driven (even though they are non-profit and share knowledge under creative commons licenses). They are considered just another company or project developer that wants to build and exploit heat pump installations. On the other hand, municipalities regard consultancies (working on participatory processes or on energy topics) as ‘neutral’, since they would not have an ‘interest’ in a certain outcome (e.g. a private or a cooperative heating system).
- **‘Capture’ of organisational forms by commercial parties.** Related to the previous point are the legitimacy challenges experienced by REScoops. Indicated under the ‘Main threats to collective RES initiatives’ (REScoop 2017; 54-57, in Horstink et al. 2019, p. 46) is *“the growing number of purely commercial initiatives by project developers and increasingly also the larger energy companies. They often set up organisations that are legally indistinguishable from the collaborative forms, in particular cooperatives, but do not adhere to the cooperative principles and are not in citizens’ hands.”* A related development undermining the political legitimacy of RES prosumerism collectives is the *...“rigorous lobbying by large energy companies to make sure that community/individual RES projects stay small”.* (ibid).
- **RES prosumerism as ‘place branding’ asset.** On the other hand, RES prosumerism initiatives can gain political legitimacy by gaining recognition as an innovative, progressive or otherwise appealing initiative that contributes to the image or ‘place brand’ of the town or region in which it operates. An example is the Living Lab #9 Ecovillage Aardehuis in the Netherlands, acknowledged by the municipality for its *“[...] high cuddle factor: the municipality has facilitated them from the beginning*

and also benefits from it. [...] [The aardehuizen are] an example of high ecological building, [...] generates fame for the municipality. That has definitely helped us.”.

- **Community leadership.** The Living Lab experiences bring out how various forms of community leadership and connections between civil society and local authorities can affect the political legitimacy of RES prosumerism. The experiences in Belgium point out the strong motivation of the football club president -as well as the support of the stakeholders currently involved in the Living Lab-, ‘acting as main drivers’ (Living Lab #2 Community financing of RES prosumerism of a sports club in Belgium). Regarding Living Lab #7 Municipality coalition for stakeholder motivation in Italy, high personal motivation and capacity of the early group to involve other citizens, probably the size of the community helped as well. The informal group “buona pratica” gives life and support behind the scenes the municipality’s initiatives and is the real social cohesion engine of the activities.
- **Diverging public perceptions.** Finally, it is relevant to consider how RES prosumerism initiatives tend to be perceived and appreciated differently by different categories of stakeholders: For DSO/TSOs, RES prosumerism is particularly relevant in terms of reducing transmission and distribution investments; for energy producers, in terms of creating new business opportunities; for citizens, the economic, social and environmental benefits matter particularly strongly. Governmental actors see the relevance in terms of increased resilience of energy supply, improving energy security, and the achievement of (ambitious) RE targets. Even if this provides just a very rough sketch, this point reminds that perceptions of political legitimacy may vary widely in different societal quarters. Accordingly, this societal condition can push the mainstreaming process in different directions.

3.4.4 Perceptions of reliability and competence

Apart from public perceptions on the relative trustworthiness of actors in the energy system, there is also the issue of the degree to which they are considered reliable and competent. Especially as consuming households, businesses and public organisations have grown accustomed to reliable supply of energy, an important question on future alternative energy organisations is *whether they will deliver*. Involving relative newcomers, as relatively small organisations and as relatively less professionalised (or professional-seeming) organisations, RES prosumerism collectives are generally at a disadvantage compared to more established actors in the energy system. Accordingly, RES prosumerism mainstreaming will generally be constrained by perceptions of reliability and competence. That is, unless society becomes more informed about and convinced of the capacities of RES prosumerism collectives. This societal condition can change, and effective lobbying and awareness-raising of RES prosumerism initiatives and networks can help to change it.

Specific societal developments in this regard are:

- **Cooperatives as non-established ‘new entrants’.** The Living Lab #8 Local Sustainable Heat Provision in the Netherlands provide a telling example of the difficulty to gain acknowledgement as reliable partner-in-governance. In addition to being seen as not being ‘neutral’, the cooperative movement is also seen as not professional enough to be able to undertake such ventures. Generally they feel that they are not being accepted by the major actors/stakeholders in the Dutch energy transition as an important party in this transition, for example those involved in the national Dutch ‘climate accord’ (a multi-stakeholder platform that will result in a policy agenda on climate and energy for the coming years). Currently the role of citizens is not high on the agenda. Even though there will be

government money available for housing insulation and switching heating systems, most of this will go to housing corporations and commercial project developers.

- **Upholding corporate image.** Living Lab #10 RES for sustainable viticulture in Portugal is instructive on the need for RES prosumers to balance reliability and tradition with adaptation and societal responsibility: Winemakers associate RES prosumerism with keywords such as inclusion, innovation, and nature-based solutions. Some wine company CEOs and managers also referred to resistance to change and the notion that renewables are not yet capable of ensuring a continuous and safe supply. The meeting of tradition (traditional ways of producing wine) with innovation (using RES) appears as a dominant narrative. As regards sociocultural aspects, a key driver for change is to avoid a bad image of the company for not opting for clean energies. It is important for these stakeholders to meet society's expectations for a cleaner and more sustainable environment and subsequent socio-political pressure for energy transition. Also, as a company, they feel the pressing need to have a good 'social image', by adopting a more sustainable strategy as part of their business.
- **Transparency.** Coopérnico cooperative (a Living Lab stakeholder in Living Lab #11 Community energy for energy autonomy in Portugal) actively works on the transparency of its operations as a cooperative, in order to gain acknowledgement as a trustable and competent organisation. Coopernico can contribute to increasing the transparency in the Portuguese energy market. Since its creation, it has implemented a participatory mode of governance and has just become in October 2019 the first energy cooperative in Portugal to be an energy commercialiser, keeping all its members well updated on its financial needs and costs. In fact, transparency is a core pillar for Coopernico's mode of working since the relationship established with the cooperative's members, as well as its business model is based on trust. Coopérnico's role in São Luís (where a group of residents have been working in the past years towards developing the first renewable energy community in Portugal) has been to provide knowledge, information and potentially a means to fund future collectively owned RES installations in the village.
- **Collaboration with governmental partners.** Participation and engagement of public actors, such as municipalities, with collective forms of prosumersim can drastically increase the trust into the project and can facilitate further participation of citizens. Local governments especially have a great role to play in leading by example and acting as planners, mediators and enablers of collective prosumerism.
- **Trust in governments and experts.** A general societal trend regarding the perceived reliability and competence of RES prosumerism concerns the relative trust put in governments and experts – the 'establishment'. In the course of the development of traditional energy infrastructures, citizens have 'delegated' (or it has been delegated for them) energy production to state institutions, experts, and large technological systems. (Pel et al.2016). This historical background reminds that current perceptions of 'expertise' and 'experts' may not change so easily.
- **Misinformation and public claims of unreliability.** Among the 'main threats to collective RES initiatives', the authors of a REScoop report consider "the spreading of myths on the unviability of a RES future by opponents of the energy transition. "(REScoop 2017; 54-57, in Horstink et al. 2019, p. 46)
- **Perceptions of trust within a community.** Neighbours within a prosumer collective might be hesitant to share energy consumption data for the purpose of using a smart grid due to a fear of invasion of privacy. An interviewee from the Living Lab #9 Ecovillage Aardehuis in the Netherlands shared how sharing this data initially caused a fear of people checking each other's consumption behaviour.

3.4.5 Discourses of Inclusion

The mainstreaming of RES prosumerism is shaped by a wide range of discourses and perceptions. One prominent theme is its inclusiveness. Alongside broader societal debates about the elitism of initiatives towards sustainability, the leaving behind of socio-economically deprived groups and ethnic minorities, as well as the persistence of unequal gender relations has regained political weight in recent years. The various forms of exclusion are widely acknowledged to exert an important influence on the forms of RES prosumerism that will eventually prevail. The increasing attention to these issues in the literature on energy democracy and energy justice is clear, and similar signs of increasing attention can be witnessed in policy visions and mission statements of organisations in the energy sector. Yet, further analysis of the experiences with the PROSEU Living Labs will need to develop more concrete insights on how these societal conditions are developing – and on how they can be changed.

The following Living Lab accounts indicate different attempts and commitments towards somehow more inclusive RES prosumerism:

- **Gender, race, class inclusion.** No particular information from the Living Labs at this stage, other than that it is important to have a good balance. In general, gender, or race is not the primary criterion, but might gain importance as a project (or a Living Lab in our case) matures. Regarding Living Lab #2 Community financing of RES prosumerism of a sports club in Belgium: Most of the volunteers engaged in the football club are the mothers of the kids. Also, the president of the football club is a woman. Obviously, this is not due to prosumer reasons, but might have a positive impact in terms of gender for the project. Regarding Living Lab #7 Municipality coalition for stakeholder motivation in Italy: The aim of their activities is to inform and bring examples to proof that energy transition is possible for everybody.
- **Energy poverty.** Living Lab #11 Community energy for energy autonomy in Portugal: Energy democracy seems to be an important goal for the community, also ensuring the inclusive access to basic energy has come up during the discussions. The high level of energy poverty in Portugal, affecting mainly rural areas, makes energy poverty a concern for São Luís Transição - one of the key stakeholders in Living Lab #11 Community energy for energy autonomy in Portugal. This Living Lab has the goal of accelerating the process of creating the first energy community in Portugal. Ensuring an inclusive access to basic energy has frequently come up during the discussions, and one of the key issues being debated in the Living Lab activities is how to guarantee that low income households (who cannot either afford to participate in collectively funded RES installations and/or who frequently have a problem with paying their energy bills) can be included in community energy projects. Throughout the living lab activities, the community has tried to include all interested parties in all major decision-making processes. Recently the community has bought individual solar kits to be installed in various homes at a discount price made by a local cooperative *Minga* (which amongst other activities, also sells solar panels). This was only possible because Minga cooperative equally aims to contribute to a more democratic and inclusive energy transition and is solidary with São Luís's project. Minga has provided solar panels at a low price, while also coaching São Luís' residents in installing and maintaining their equipment. If the goals of this community are achieved then the initiative would contribute to affordable, clean and safe energy for the village residents. As a pilot experience it can inspire other villages and towns to pursue similar goals.
- Living Lab #12 Cooperative for mainstreaming PV prosumerism in Spain: The initiative pursues the values of an inclusive energy democracy and clean energy transition. Hence, the initiative is

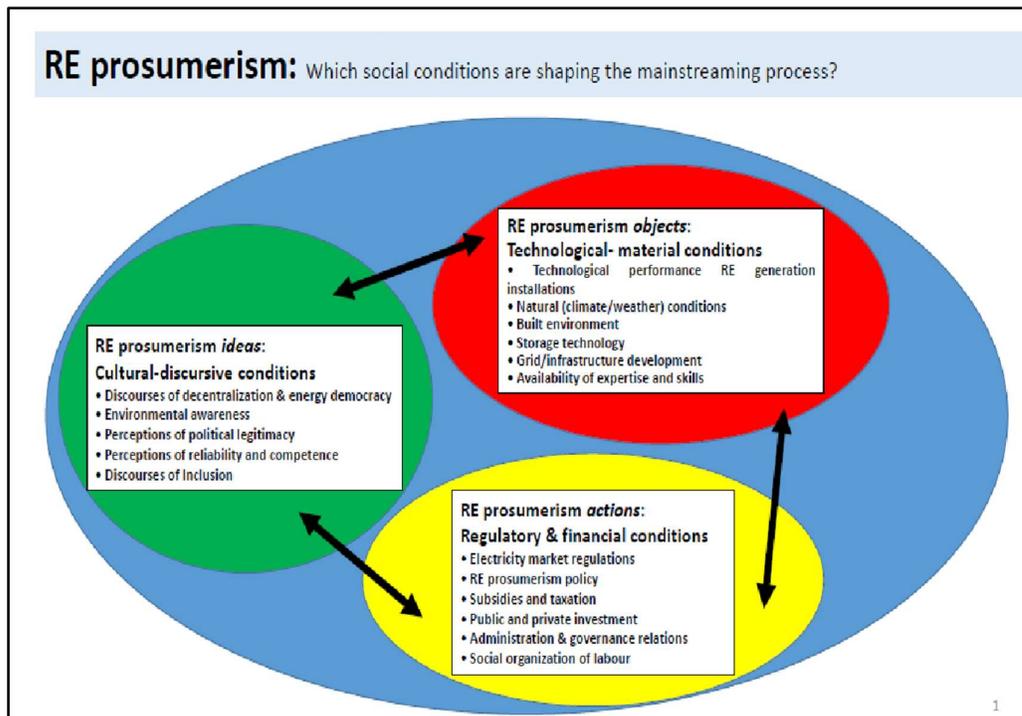
interested in solving the different barriers towards achieving this goal that come with class, by which community projects and support is considered essential; and gender, by which energy education is also considered essential.

- Living Lab #6 Local heat grid with decentralised RES in Germany: The major social task is to promote climate protection and the local energy transition. And to do that as a city in common and not leave the individual citizen alone. In particular, it focuses on implementing the heat transition in the city together with the citizens.
- Living Lab #1 Self-organised valorisation chain of biomass in Belgium: The Living Lab aims to be as inclusive as possible as the effective valorisation of wood assets requires the involvement of a significant number of stakeholders

3.5 Elaborating the ISF: The directionality of RES prosumerism mainstreaming

RES prosumerism constitutes a rather complex bundle of innovations. Considering these innovation dimensions of actions, objects and actions separately, the incentive structures for RES prosumerism mainstreaming have been charted comprehensively. As displayed in figure 4 below, the mainstreaming of RES prosumerism is shaped by regulatory and financial, technological-material, as well as cultural-discursive societal conditions.

Figure 4: RES prosumerism mainstreaming process: Three interrelated clusters of societal conditions



The figure conveys several insights, but also raises further questions:

- **Different kinds of societal conditions.** The relevant societal conditions comprise more than the immediate financial ‘incentives’ and technological constraints that are often highlighted in analyses of ‘drivers’ and ‘barriers’.
- **Differences across contexts.** The identified conditions differ greatly across national/regional contexts. For each of the countries analysed in PROSEU, different versions of the diagram could be drawn.
- **Differences across time.** All identified conditions change over time – sometimes fast (technological breakthroughs, sudden policy changes or changing political discourses), sometimes very slowly (natural conditions and the built environment). The figure could be elaborated in terms of faster and slower change, or through a series of incentive structures particular to a certain phase in the RES prosumerism mainstreaming process.
- **Isolating ‘factors’ of RES prosumerism mainstreaming.** The figure indicates various possibilities for analysing particular societal conditions in isolation of others (rather than in interaction with them) – thus bracketing the other societal conditions or assuming them as constants.
- **Linkages between societal conditions.** The figure unpacks the societal conditions into three clusters, distinguished by different colours. On the other hand, the three clusters of societal conditions are not operating in isolation: The various RES prosumerism policies, investments and regulations reflect various cultural-discursive developments, and the various technological conditions are themselves shaped by broader changes in society. As transitions theory (Cf. section 2) underlines, it is crucial to take a systemic perspective on the mainstreaming process and take heed of *interactions* (the double arrows in the diagram) between the distinguished societal conditions.
- **Directions of the mainstreaming process.** Whilst unpacking and listing the relevant societal conditions that shape it, the diagram does not express the so important directionality of the mainstreaming process, however. Depending on the development of the listed societal conditions, the mainstreaming process will take a different course. This directionality, as discussed in section 2, is largely implicit in the diagram. For the sake of practical relevance, and for the sake of a dynamic understanding of the mainstreaming process that informs the Participatory Integrated Assessment, this directionality needs to be made more explicit.

Elaborating the directionality of the RES prosumerism mainstreaming process.

Whether the identified 17 societal conditions are ‘enabling’ or ‘constraining’ for the mainstreaming of RES prosumerism, depends on the direction of the mainstreaming process that one envisions, or anticipates as a likely turn of events. Through our encounters with RES Living Labs, but also through the study of RES prosumerism literature and public discourse, quite a broad range of possible directions is asserting itself. As mentioned in the introduction, the broad quests for ways to support and accelerate the mainstreaming process have also evoked certain critical questions: Should RES prosumerism be mainstreamed at all, and if so, for what reasons, precisely? Should we aim for further mainstreaming, or rather confront the possibility that RES prosumerism has reached its peak?

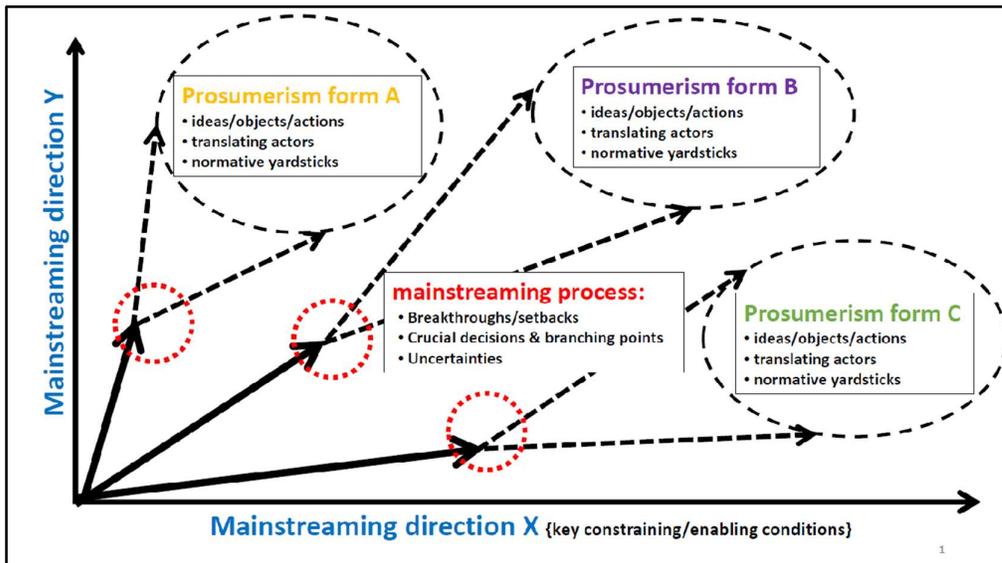
Throughout the development of the ISF as presented, the key test for it has been whether it can help us to grasp such key tensions and dilemmas surrounding the mainstreaming process. Guided by the theoretical insights on

transitions directionality, we have identified three key tensions and elaborated them (Cf. figure 5) into crossroads of two opposing directions. Opposing directions have been identified regarding the political-economical, socio-technical and organisational aspects of RES prosumerism. As such they run through the set of relevant societal conditions identified in the ISF, and the associated insights of the PROSEU work packages. The three sets of opposing directions will be developed in the following sections. Aiming for concrete, concise and accessible elaborations and relevant inputs for the PIA (Cf. section 7), these analyses will also be further shortened and published in the form of practice briefs as input for the PIA process.

- RES prosumerism mainstreaming between community economy and commercial opportunity (section 4),
- RES prosumerism mainstreaming: Energy Islands or fully interconnected? (section 5),
- RES prosumerism mainstreaming between inclusiveness and privilege (section 6).

For the sake of communicative value, the directionality of the mainstreaming process will be visualised and narrated along the model of figure 5 below:

Figure 5: Generic model RES prosumerism mainstreaming



The figure conveys the narrative structure that will be developed in all three explorations of directionality, comprising the following elements:

- **Opposing directions of mainstreaming process.** Depending on the development of the enabling, constraining and ambiguous societal conditions identified, the RES prosumerism mainstreaming process can take different directions. The three key tensions in the mainstreaming process will be described through two opposing directions that have been identified in PROSEU proceedings and in RES prosumerism discourse more broadly. These opposing directions indicate the borders of a possibility space, a particular range of RES prosumerism possibilities.

- **Constraining/enabling conditions.** The two opposing directions of the mainstreaming process result from particular sets of key societal conditions. These conditions provide ‘incentives’ that drive the RES prosumerism mainstreaming in different directions.
- **Forms of prosumerism.** In between the two extreme forms, the ‘opposite directions’, a broader range of possible outcomes can generally be distinguished. This range of RES prosumerism forms will be defined through their leaning towards one or the other opposing mainstreaming direction: they indicate various concrete in-between forms that the mainstreaming could lead to. The ‘forms of prosumerism’ indicate recognisable, imaginable, relevant, ideal-typical translations of RES prosumerism, made along particular normative yardsticks.
- **Mainstreaming process.** As indicated in section 2, the mainstreaming process should not be understood as a straightforward ‘racetrack’ trajectory on which to ‘accelerate’ and surmount ‘barriers’ – it is better thought of as a winding road that involves various twists and turns, uncertainties, and alternating phases of leaps forward and setbacks. These explorations will be particularly useful in connecting the identified societal conditions with the subsequent futures-scanning in the Participatory Integrated Assessment.

4 Prosumerism between community economy and commercial opportunity

4.0 Introduction: Mainstreaming renewable energy prosumerism in Europe

The production of renewable energy is on the rise in Europe²⁴. A big role is reserved for ‘energy citizens’, who could generate up to 45% of the European Unions’ electricity needs by 2050 – out of which 37% could be produced by collective projects and energy cooperatives²⁵. Individuals and collectives are no longer mere consumers of energy, already today many also produce renewable energy and actively engage in energy markets – they have become **prosumers**²⁶.

Taking these future projections as a starting point, we, the members of the PROSEU-consortium asked ourselves **what futures could emerge if renewable energy prosumerism becomes mainstreamed in Europe**. While such projections seem to suggest that mainstreaming prosumerism is a simple, linear process towards a clear and inherently desirable future state – what they actually harbour is a diversity of possible futures involving transition processes with winding roads and various junctures.

PROSEU is an EU-funded research project (Horizon2020, grant agreement N°764056, 2018-2021) that investigates the ways in which renewable energy prosumerism can be mainstreamed across Europe. This brief is part of a series in which we identify societal conditions that are relevant for such a mainstreaming of renewable energy prosumerism. Its objective is to open up imagination and action by demonstrating how different (sets of) conditions lead to different forms of prosumerism. In 2020, the briefs also inform a process involving policyworkers, practitioners and researchers in co-creating a roadmap towards mainstreaming prosumerism.

The briefs are informed by the different conceptual and empirical research outcomes of the PROSEU project – ongoing and finalized. You can find relevant deepening of the different societal conditions discussed in our report *“Synthesis of incentive structures: input for Participatory Integrated Assessment”* and all other materials under www.proseu.eu.

We explore these possible futures and their winding roads along three main questions – each of which has a practice brief dedicated to it:

1. Will the mainstreaming of prosumerism follow more a community logic or a market logic?
2. Through which infrastructures will prosumerism be mainstreamed?

²⁴ Currently rising with about 0,5% per year, reaching 17,5% in 2017; see [Eurostat](#)

²⁵ Kampman et al. (2016) [The potential of energy citizens in the European Union](#). CEDelft: Delft.

²⁶ Horstink, L., et al. (2019). Review and characterisation of collective renewable energy prosumer initiatives. PROSEU-Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy Transition (Deliverable 2.1).

3. And, will the mainstreaming contribute towards more inclusivity of energy systems or remain an undertaking of insiders and privileged groups?

This particular brief focuses on **the ways prosumerism can develop following a community or a market logic**. Taking this as a starting point, we will paint two essentially different and opposed futures of a mainstreamed prosumerism. We continue by highlighting the key societal conditions that enable or constrain the mainstreaming towards either one of these. Then, we show the shapes of prosumerism that fall in-between the two extremes. Finally, we point to some key dynamics that may occur in the mainstreaming process, such as setbacks, acceleration moments or branching points.

We invite readers to use these briefs to navigate the winding roads and junctures in the mainstreaming of prosumerism and to engage in discussions and actions towards shaping their desired future.

4.1 The tension between community economy and commercial opportunity

This practice brief describes how in mainstreaming prosumerism there is a tension between the two extremes of either moving towards prosumerism as a **'community-based economy'** or an energy system focussed around prosumerism as a **'commercial opportunity'**.

These are two ends of a spectrum along which prosumer initiatives and business models can develop and mainstream over the coming years. Which side of the spectrum will become dominant depends on societal conditions such as financing, subsidies, taxes and grants, legislation and policies, and the cultural landscape in which prosumerism takes place.

Community economy based prosumerism: seeing renewable energy as a common good, a resource that belongs to everyone managed through an institution of collective action. Prosumerism involves harnessing this resource and managing it in an inclusive and transparent manner with as goal to meet energy needs. Prosumerism is organised along community lines, citizens, households, and companies to invest in collectively owned and managed RES. Prosumers are driven by a variety of incentives and mainly engage in prosumerism in a collective manner. Ideally, this type of prosumerism also ensures an equal distribution of costs and benefits between individual members, the community, companies, and government. Examples of prosumerism as community economy include energy cooperatives with a strong focus on local and/or regional membership and managed in an inclusive manner, initiatives such as ecovillages, or other types of citizen initiatives.

Prosumerism as a commercial opportunity: takes renewable energy as a commodity. In this extreme, prosumerism is organised according to a market logic considering energy as a good to be traded between prosumers, producers, and users. Prosumers, individual or collective, are driven by financial incentives and an economic rationale. New entrants and start-ups drive the adoption of innovative technologies, products and services towards a 'distributed market logic', emphasising cost-efficiency and consumer choice²⁷. The main goal is to maximize profit, and this can lead to an unequal division of costs and benefits between the different actors

²⁷ OVO Energy and Imperial College (2018). Blueprint for a post-carbon society: how residential flexibility is key to decarbonising power, heat and transport. Accessed December 2019, at: <https://www.ovenergy.com/binaries/content/assets/documents/pdfs/newsroom/blueprintforapostcarbonsociety-2018.pdf>

involved. Examples of prosumerism as a commercial opportunity include, individualized prosumerism by households, participation in commercial aggregation, or solar PV lease schemes run by (large) energy companies.

4.2 Key societal conditions

Particular (sets of) key constraining, enabling or ambiguous societal conditions provide ‘incentives’ that drive the mainstreaming of prosumerism in different directions, shaping it into different forms of prosumerism. In this section, we look at how societal conditions such as electricity market regulations, renewable energy prosumerism policy, subsidies and taxation, public and private investment, discourses of decentralisation and energy democracy, and grid infrastructure and development influence the mainstreaming of prosumerism. Clearly, these categories can overlap, e.g. a certain regulation can describe a tax or subsidy scheme and is related to a certain policy.

4.2.1 Electricity market regulations

The regulation of the electricity market can enable and/or constrain either a more community-based or a more commercialized form of prosumerism in a variety of ways. The former can, for example, be supported through simplifying regulatory requirements or bureaucracy such as the UK energy regulator did in 2009 by introducing a derogation/exemption from compliance with full supplier license codes for small suppliers (<2.5MW). Or, as Germany did, by setting specific community energy requirements in renewable energy auctions. Although the amount of broad community groups participating in the auctions, for now, remains limited with most projects involving only a small set of local people. Developing a clear legal status for community-based forms of prosumerism can support their development such as the one required by the new EU Renewables Directive. The Directive obliges member states to put in place an ‘enabling framework’ to promote and facilitate ‘renewable self-consumption’ and ‘renewable energy communities’ in a way accessible to all consumers, including low-income and vulnerable households (Directive 2018/2001). Already the simple fact that the EU has developed legislation on renewables self-consumers and renewable energy communities (mainly Art.21 and 22 of the new Renewables Directive 2018/2001) is a step towards developing community-based prosumerism.

Possibly the most constraining factor for community-based prosumerism is the fact that the current energy market was designed for a centralised system with large suppliers and with a disconnection between production and consumption. Hence, in most EU countries, energy supply codes and licences were designed for large, well-resourced actors. This effectively prohibits small actors from becoming ‘local suppliers’, and thus hampers the formation of local energy markets and peer-to-peer models.

Another hindering factor for community-based prosumerism is the number of rules, regulations, and required paperwork required for energy production and collective forms of prosumerism²⁸. Other constraining factors include complicated or frequently changing regulations, not having an official definition nor having specific or robust regulations for energy communities. The lack of acknowledgement and robust regulations from all policy areas, regarding renewable energy communities constrains the development of such communities (see part one of D3.2.). Also, a lack of regulation on, or an outright ban of, selling, sharing, trading energy, and/or self-consuming energy is clearly a restriction to collective forms of prosumerism. Furthermore, the cost of licensing for renewable energy systems can be restrictive. For example, in Portugal, there are higher costs of licenses for

²⁸ Vansintjan, D. *The energy transition to energy democracy. Power to the people.*; REScoop 20-20-20 Intelligent Energy Europe project: Belgium, 2015; p. 76;

units with higher installed capacity, the idea being that installed capacity should match local consumption needs. On the one hand, this is a general restriction on the development of prosumerism. Still, it could also support more community forms of prosumerism that only focus on meeting energy needs and not on profit generation. This makes the effect of the cost of licensing on the development of prosumerism more ambiguous.

Prosumers providing flexibility services are expected to become increasingly important in providing system stability as more intermittent sources are connected to the grid. However, in many EU countries, these flexibility markets can only be accessed by those with supply licenses or by large, sophisticated actors. This effectively prohibits small actors from participating in these markets – or makes them dependent on a range of emerging aggregators who may capture much of this value for themselves. However, in some countries, flexibility markets are becoming more open to small scale actors. The inclusion of prosumers in flexible markets promotes aggregators – service companies that provide flexibility services – which pushes mainstreaming towards prosumerism as a commercial opportunity. Thus, in this context, aggregators and energy companies, can access wholesale, balancing and flexibility markets using their current licenses and are able to purchase smaller firms to add special skillsets required to operate and offer prosumerism services to households. Hence, for such actors, prosumerism is a commercial opportunity within the energy sector²⁹.

Finally, there are also regulatory factors whose effect on the development of prosumerism towards either a community economy or a commercial opportunity is ambiguous. This can include, for example, regulations that hinder the development of renewable energy in general, and regulations that support large-scale centralised use of renewable energy (which does not involve prosumerism) by either government or private investors. For example, in the Netherlands the development of onshore wind was, and still is, severely hampered in several regions because of either outright bans or restrictions – such as only allowing new wind turbines when they replace an existing turbine.

4.2.2 RES prosumerism policy

Next to formal, often national regulations, there are various ways in which governments, especially local governments, set boundary conditions for making the mainstreaming of prosumerism lead to more community or market-based forms. Specifically, the way in which (local) governments view community energy, and the role of citizens in the energy system in general, is very influential. For example, a continued striving for participative governance, and active citizenship by governments will also promote more citizen and community engagement in prosumerism. Also, developments such as integration with regional development policies, a shift towards a more 'social-entrepreneurial state' and the desire by municipalities to have more control over their energy are trends that can contribute to more community-based forms of prosumerism. Municipalities are doing this, for example, through approaches that emphasise the universal provision of essential services and prioritise those most at need using municipal energy suppliers³⁰, energy service companies (ESCOs)³¹, and retrofit programs³², aiming to mitigate fuel poverty, health issues and distributional equity. Although this supports a non-market

²⁹ See for example the case of OVO energy in the UK in: Brown, D, Davis, M, Hall, (Under review) What is prosumerism for? A reflection on competing normativities in the prosumer energy transition. ERSS.

³⁰ Hiteva, Ralitsa and Sovacool, Benjamin (2017) *Harnessing social innovation for energy justice: a business model perspective*. Energy Policy, 107. pp. 631-639. ISSN 0301-4215

³¹ Hannon, Matthew J. & Bolton, Ronan, 2015. "UK Local Authority engagement with the Energy Service Company (ESCO) model: Key characteristics, benefits, limitations and considerations," Energy Policy, Elsevier, vol. 78(C), pages 198-212

³² Brown, D., Sorrel, S., & Kivimaa, P. (2019). Worth the risk? An evaluation of alternative finance mechanisms for residential retrofit Volume 128, 418-430.

approach to renewable energy, it also does not necessarily support community-based prosumerism. Instead, it takes a government logic and sees energy as a public good (see section 4 of this brief).

More general, social engagement and participation in energy and climate action³³ also support a more community-based version of prosumerism, since it actively involves citizens and communities in the development of the energy system. For example, in the Netherlands, a ‘climate agreement’ was developed in partnership between the government and many societal stakeholders. Although citizen representatives only had a smaller role in this process, one of the conclusions agreed on was to strive towards 50 percent ‘local’ ownership of new onshore renewable energy systems. This has a large potential in pushing prosumerism mainstreaming towards more community economy-based forms.

4.2.3 Subsidies and taxation

Access to financial resources by prosumers has an influence on whether and how prosumerism develops and if it will be more market or community oriented. This can include access to financing (e.g. loans), incentives and subsidies, and grants, and the way taxation of prosumerism is organised. This section looks at subsidies/incentives and taxation, while the next section looks at the related public and private investment. Financial enabling conditions for the development of prosumerism in the direction of ‘community-based economy’ are numerous but differ per country.

Until recently, many EU countries had Feed-in-Tariffs (FiTs), and some still do, which provide(d) prosumers with a fee per produced amount of electricity. In general, this has helped drive innovation and cost reduction for distributed renewable energy systems (particularly solar PV) and supported especially small-scale prosumers. At the same time, too high FiTs can “crowd out” more socially and environmentally oriented investments. For example, in Germany profit motive was significantly stronger in solar PV focussed energy cooperatives between 2009 and 2012, when solar PV received still high FiTs while PV costs had already decreased substantially, than among energy cooperatives established before and after this period³⁴.

Other incentive schemes such as volumetric charging and net-metering also provide a financial advantage to prosumers. Historically, network charges and energy taxes in many EU countries (UK & NL, for example) have been priced volumetrically. This has benefited small scale (residential) prosumers who can increase consumption behind the meter, or have the meter run backwards, and avoid these charges. At the same time, a reduction in FiTs and net-metering schemes increases the financial incentive to maximize self-consumption rather than sell to the grid and in doing so, promote the use of small-scale electricity storage. Many countries also have other types of tax exemptions or tax reductions on renewable energy, for example, in the Netherlands households can get their VAT on solar PV purchases reimbursed.

However, there are also subsidy, network charges and taxation related factors that constrain the development of community-based prosumer collectives. For example, in France projects for collective self-consumption are currently not economically viable due to an unfavourable grid charge and tax scheme (introduced with the new energy law in 2017), which lengthens payback times of investments to over twenty years³⁵. In Belgium, there is

³³ e.g. co-produced road mapping, neighbourhood initiatives, broad stakeholder processes, and regional climate commissions -

³⁴ Holstenkamp, L. & Kahla, F. 2016. What are community energy companies trying to accomplish? An empirical investigation of investment motives in the German case. *Energy Policy* 97:C 112-122

³⁵ See for example the Pegasus project in Saint-Julien de Quintin: <https://pegasus.interreg-med.eu/what-we-achieve/deliverable-library/>; <http://www.acoprev.centralesvillageoises.fr/> (accessed December 2019)

a support scheme for renewables, the ‘Green certificates support scheme’ (Belgium/Flanders), however, in Flanders it is currently not very profitable and not adequate for small solar PV self-consumers.

In addition to specific measures also the general tax system, in which the marginal tax rate on capital is lower than labour, has tended to promote corporatist and profit seeking approaches to service provision, due to increased returns to capital vs. labour. Thus, not for profit organisations have tended to struggle against those who are able to offset operating costs against taxes and to remunerate staff through share offers and dividend packages. This does not only constrain the development of prosumerism as part of a community economy but also enables prosumerism as a commercial opportunity.

In general, many subsidies that support the development of renewable energy could be ambiguous in what type of prosumerism they support and could facilitate both. For example, direct subsidies, such as the SDE+ (feed-in tariff) in the Netherlands, support larger RE projects, but these could be owned by a community, a commercially run prosumer initiative, or by traditional energy suppliers. Or, an investment premium and a feed-in tariff for small scale individual self-consumption and a tendering system for big self-consumption projects such as they exist in Croatia supports the development of prosumerism but does not push the mainstreaming into a particular direction.

4.2.4 Public and private investment

In the PROSEU survey of prosumer collectives in Europe, it emerged that in general prosumer collectives find access to finance, subsidies, and grants a facilitating factor in their development³⁶. Support in access to finance is arranged differently in different EU countries. For example, in France, projects that include local authorities and citizens receive a premium price (€/MWh) in tendering procedures. In Germany, there is a specific public fund to support community projects during the preconstruction phases of projects. In several countries, such as the UK, we see that the democratisation of energy finance is slowly gaining ground, for example, through investment-crowdfunding, peer-to-peer trading of energy, green bonds for municipalities, and community shareholders providing equity finance to develop projects that deliver ‘local value’. This is coupled to a lowering of barriers to entry into democratic energy finance – e.g. €5 minimum investment into ‘green projects’ on offer by the ‘Abundance investment’ platform in the UK. Similar developments are taking place in the Netherlands with several new ‘crowd-investment’ initiatives emerging over the past years and investment through energy cooperative membership becoming increasingly wide-spread.

At the same time, there are also societal factors related to financing, subsidies, taxes, and grants that are constraining the development of prosumer collectives in the direction of ‘community economy’. For example, in 2019, the UK FIT scheme was ended, and an export tariff which guaranteed prices for exported power was stopped. These policy changes have presented a major challenge to the business model of community energy groups in the UK. Although the capital cost of renewable energy has come down significantly since the FiTs were introduced, long payback periods combined with uncertainties surrounding the level of self-consumption has rendered many projects uneconomic. In response, community energy actors have been exploring new business models, which allow for greater self-consumption of renewable generation ‘behind the meter’. Also, private grid and micro-grid arrangements are getting more attention.

³⁶ Horstink, L.; Luz, G.; Soares, M. & Ng, K. (2019). *Review and characterisation of collective renewable energy prosumer initiatives*. PROSEU-Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable N°2.1). Horizon 2020 (H2020-LCE-2017) Grant Agreement N°764056. (pp. 67-68)

Although in the UK decentralised storage (e.g. for peak-shaving uses or maximizing own use of electricity) might now become more popular due to the end of the FiT, storage is not yet financially attractive in many EU countries. For example, the PROSEU Living Lab Ecovillage Aardehuis in the Netherlands is installing a novel ‘sea-salt’ battery even though delivering back to the grid is financially more attractive due to the net-metering system. Although net-metering, overall, is supportive of small-scale prosumerism, as described above, this at the same times hinders the development of storage capacity, which could play an important role in grid balancing.

Another important financing related barrier for community-based prosumerism is the fact that local RE projects usually require long planning phases, especially if this is done through co-creative social process –e.g. capacity building, energy literacy, technical support, etc.- aimed at citizen activation in neighbourhoods. This means that large upfront investment is required for the guidance of this process. This is generally seen as a barrier, even if in some countries counter measures are taken, for instance as mentioned above, Germany is providing some funding for pre-construction phases.

While PROSEU Living Labs, the island movement for energy autonomy in Croatia, experienced that it was hard to gain the necessary financing for investment in renewable energy systems and that the involved administrative processes were complicated which was restricting especially smaller prosumer initiatives that do not have much knowledge of such procedures. Similarly, in the PROSEU Living Lab Community energy for energy autonomy in Portugal, financing methods were also found to be an issue, especially when initiatives did not want to use traditional bank loans.

At the same time, societal conditions related to public and private investment can also function to enable or constrain the mainstreaming of prosumerism towards more market-oriented forms. The main enabling societal condition that pushes a more market based and commercialized version of prosumerism is the fact that the market model of governance is still prevailing in many EU countries. The lock-in in this system means that there is a strong pull to continue to develop along the design principles of the existing system, which generally prefer centralised, vertically integrated, and commercial solutions to provide energy. Therefore, we increasingly see technology firms, platform providers, and aggregators, which function according to those principles, develop alongside the existing energy suppliers. The outcome is that the market share of traditional energy utilities is captured by a range of challenger firms, instead of citizen prosumers, who can profit from the provision of prosumer energy systems³⁷.

4.2.5 Decentralisation & energy democracy; reliability & competence

In addition to societal conditions related to regulation, policy and finance, there are cultural factors such as discourses and larger societal trends which influence the mainstreaming of prosumerism. For example, having historical precedents for energy cooperatives and community energy from a wider cooperative movement either in the energy sector, or in other sectors such as textiles, agriculture, and brewing (for example in the UK or Germany) can support the emergence of cooperative and community-based prosumerism. There are countries with a general tendency to value larger commercially driven companies, such as for example, in the Netherlands, where the government for a long time preferred working with large energy companies, not only for reasons of existing ties, easier financing, and the ability to do larger projects, but also simply because large companies were seen as professional parties that are capable of ‘doing the job’. This hampered the development of community-based forms of prosumerism, since for a long time the expertise of energy cooperatives was not recognized, and

³⁷ Richter, M. (2013). Business model innovation for sustainable energy: German utilities and renewable energy. *Energy Policy*: 62.

small energy projects were seen as irrelevant. Although this is changing, our living lab interactions show that this bias against energy cooperatives seems to still exist.

4.2.6 Grid infrastructure and development

Grid infrastructure and its development influences the mainstreaming of prosumerism. However, it is generally ambiguous as to whether it pushes more towards a community or market-based version. For example, grid interconnections between EU member states are steadily increasing and transmission system operators are increasingly operating transnationally. For example, the Dutch state-owned transmission system operator TenneT is also operating part of the German high-voltage grid. Although this generally increases grid flexibility and thus allows larger uptake of renewables, it supports renewable energy at large, and not specifically prosumerism.

At the same time, grid congestion and lengthy procedures involved in expanding grid capacity in rural areas can limit the amount of new wind and solar parks, as is currently the case in the Netherlands. Although it thus hinders the development of renewable energy in general, it might favour community and/or household prosumerism in those places where congestion occurs since they usually use smaller rooftop-PV systems or single wind-turbines.

4.3 Forms of prosumerism

In this brief, we singled out two ideal types of prosumerism based on either a community or a market logic. However, often, the reality lies somewhere in between. For example, forms using a government logic, seeing energy as a public good, or hybrids forms which combine these different logics.

Figure 6 below outlines the two opposed mainstreaming directions of prosumerism as community economy and prosumerism as commercial opportunity, and hybrid forms between these two logics. The graph below summarises characteristics of three examples of hybrid forms of prosumerism: local municipalities as prosumers, prosumerism as a social enterprise, and prosumerism as a public-private enterprise.

Examples of prosumerism as community economy

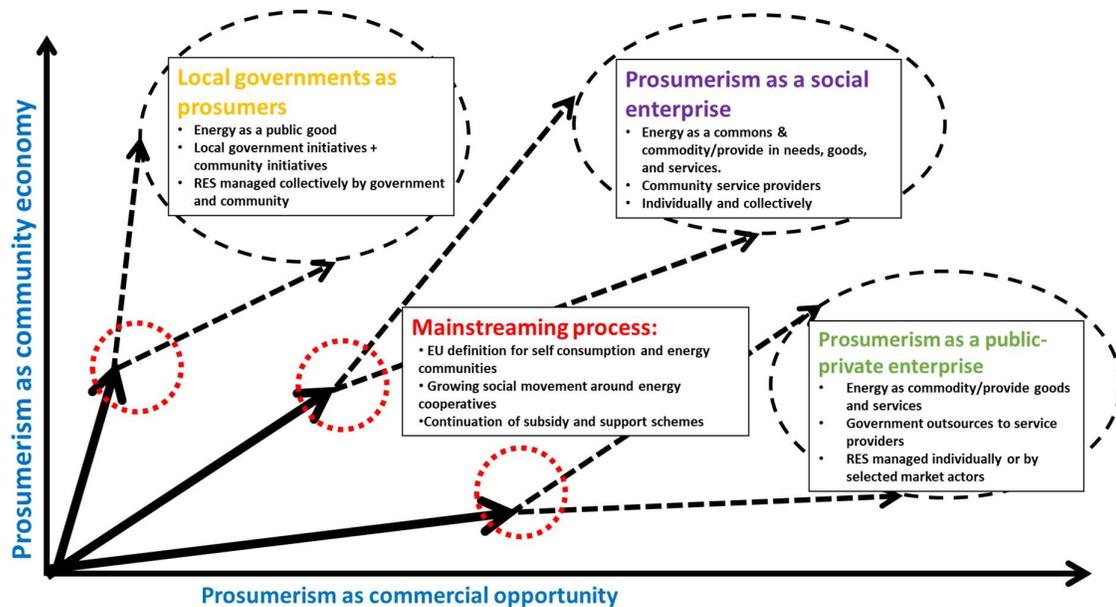
In prosumerism as community economy the idea of ‘energy as a commons’ – a collectively owned and managed resource that should be open to all in the community – is the dominant way of looking at energy. The goal of such initiatives is to provide in the energy needs of the participating community members. It touches on the discourse of decentralisation and energy democracy, but also environmental awareness, perceptions of reliability and competence, and discourses of inclusion. When it comes to actors involved, this will be mainly different types of community prosumer initiatives. For example, those characterized by the PROSEU survey, which includes energy cooperatives, informal collectives, and ideologically motivated communities such as ecovillages.

Examples of prosumerism as a commercial opportunity

In prosumerism as a commercial opportunity the idea of ‘energy as a commodity’ – an undifferentiated good that produced by multiple producers that can be freely traded and is valued by its price on the market – is dominant. This changes the primary goal of producing energy from meeting needs to generating profit for the producer. In addition to viewing energy as a commodity, it will also increasingly see energy as a ‘service’. For

example, actors that operate according to this logic could be commercial aggregators that provide services to household prosumers allowing them to operate in flexibility markets, and/or optimizing the use of their home-storage systems.

Figure 6: RES prosumerism mainstreaming between community economy and commercial opportunity



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Hybrid forms of prosumerism

Hybrid forms fall somewhere in between the spectrum of community vs. market logic. The sections below provide three examples of different hybrid forms of prosumerism (see also figure 6).

Local governments as prosumers

In the government logic, energy is seen as a public good; energy is made available and accessible to all (under the same criteria) by the government. Although it could be questioned whether this form falls under the header of prosuming – producing energy for own use – or whether it is more like the current energy system, centralised, large-scale, and with a separation between producer and consumer. The only difference is that in the public good situation it is publicly owned companies instead of privately-owned companies that are providing the energy. However, given that the government is ‘all of us’ and should serve the public interest it could also be seen as a more indirect form of prosuming.

A hybrid form could involve both a government and a community logic (or a government and market logic). This could be for example (semi) public institutions that partner up with citizens to provide energy and at the same time promote the regional economy. For example, in an eastern region of the Netherlands, several municipalities founded an energy cooperative, it has both the municipalities as citizens, companies, and NGO’s as members. In this sense, it combines a community logic, trying to include as many community actors and supporting the local economy, with a government logic of providing a public good (sustainable energy).

Prosumerism as a social enterprise

Social enterprises combine being for-profit with a strong community, social, and/or environmental motivation. They are a good example of a hybrid form of prosumerism that mixes the community and market logics. An example of how a social enterprise can function as a prosumer collective is a local heat district organised in a limited liability company but with a clear local connection and sustainability goal.

Prosumerism as a public-private enterprise

Prosumerism as a public-private enterprise could for example occur when the state or state-owned enterprises take an important role in the energy system but outsource many activities to market actors. For example, when a state-owned grid manager contracts aggregators or other market parties to deliver flexibility services.

4.4 Conclusion: mainstreaming renewable energy prosumerism

It should be clear by now that the mainstreaming process should not be understood as a straightforward ‘racetrack’ trajectory on which to ‘accelerate’ and surmount ‘barriers’ – and it is better thought of as a winding road that involves various twists and turns, and alternating phases of leaps forward and setbacks.

In many EU countries the mainstreaming of prosumerism has known both leaps forward and setbacks. For example, many have known incongruity in support measures with subsequent governments starting, revising, or ending government support for renewable energy and prosumerism. In some countries, such as for example Spain, there has been clear setbacks such as the tax on solar PV introduced in 2009, while other countries such as Germany, with historically high consumer prices for electricity, have had a more gradual rise in renewable energy and prosumerism. Even within countries the mainstreaming process can be varied, for example, in the Netherlands some regions actively support new wind turbine development whereas others have banned or severely restricted their development.

All in all, if we look at the different societal conditions described in this brief, and how they either restrict or enable the development of prosumerism, it is not evident in which direction prosumerism in Europe is heading. Some conditions clearly support a community economy based prosumerism, such as the new EU definitions on self-consumption, or local ownership policies such the one enacted in the Netherlands. However, many of these conditions could also promote commercialised forms of prosumerism, as they support renewable energy production in general. On the other hand, most of the restricting societal conditions, such as limits or termination of FiTs and similar subsidies, regulatory restrictions, bans on new renewable energy projects, and unfavourable tax regimes, generally limit both more commercialised and more community-based forms of prosumerism.

For now, it appears that the main tension that the societal conditions are leading to is one between having prosumerism and renewable energy versus not having it at all. The tension within prosumerism between more community and more market based forms does exist, but when it comes to mainstreaming most societal conditions that support prosumerism tend to support multiple forms of prosumerism, and the societal conditions that hamper the development of prosumerism tend to obstruct most forms of prosumerism.

5 Energy Islands or fully interconnected? Mainstreaming prosumer infrastructure

5.0 Introduction: Mainstreaming renewable energy prosumerism in Europe

The production of renewable energy is on the rise in Europe³⁸. A big role is reserved for ‘energy citizens’, who could generate up to 45% of the European Unions’ electricity needs by 2050 – out of which 37% could be produced by collective projects and energy cooperatives³⁹. Individuals and collectives are no longer mere consumers of energy, already today many also produce renewable energy and actively engage in energy markets – they have become **prosumers**⁴⁰.

Taking these future projections as a starting point, we, the members of the PROSEU-consortium asked ourselves **what futures could emerge if renewable energy prosumerism becomes mainstreamed in Europe**. While such projections seem to suggest that mainstreaming prosumerism is a simple, linear process towards a clear and inherently desirable future state – what they harbour, is a diversity of possible futures involving transition processes with winding roads and various junctures.

PROSEU is an EU-funded research project (Horizon2020, grant agreement N°764056, 2018-2021) that investigates the ways in which renewable energy prosumerism can be mainstreamed across Europe. This brief is part of a series in which we identify societal conditions that are relevant for such a mainstreaming of renewable energy prosumerism. Its objective is to open up imagination and action by demonstrating how different (sets of) conditions lead to different forms of prosumerism. In 2020, the briefs also inform a process involving policyworkers, practitioners and researchers in co-creating a roadmap towards mainstreaming prosumerism.

The briefs are informed by the different conceptual and empirical research outcomes of the PROSEU project – ongoing and finalized. You can find relevant deepening of the different societal conditions discussed in our report *“Synthesis of incentive structures: input for Participatory Integrated Assessment”* and all other materials under <https://proseu.eu/>

We explore these possible futures and their winding roads along three main questions – each of which has a practice brief dedicated to it:

1. Will the mainstreaming of prosumerism follow more a community logic or a market logic?
2. Through which infrastructures will prosumerism be mainstreamed?
3. And, will the mainstreaming contribute towards more inclusivity of energy systems or remain an undertaking of insiders and privileged groups?

³⁸ Currently rising with about 0,5% per year, reaching 17,5% in 2017; see [Eurostat](#) (accessed December 2019)

³⁹ Kampman et al. (2016) [The potential of energy citizens in the European Union](#). CEDelft: Delft.

⁴⁰ Horstink, L., et al. (2019). Review and characterisation of collective renewable energy prosumer initiatives. PROSEU-Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy Transition (Deliverable 2.1).

This particular brief focuses on infrastructure and technology configuration issues of prosumerism. Taking this as a starting point, we will paint two essentially different and opposed futures of a mainstreamed prosumerism. We continue by highlighting the key societal conditions that enable or constrain the mainstreaming towards either one of these. Then, we show the shapes of prosumerism that fall in-between the two extremes. Finally, we point to some key dynamics that may occur in the mainstreaming process, such as setbacks, acceleration moments or branching points.

We invite readers to use these briefs to navigate the winding roads and junctures in the mainstreaming of prosumerism and to engage in discussions and actions towards shaping their desired future.

5.1 The tension between energy islands and full interconnection

This brief starts from the assumption that prosumerism will become more mainstream in the future. What direction that may take however, depends on many factors, decisions and uncertainties. In this section, we focus on the questions ‘what are the opposing trends in which prosumerism might be mainstreamed, in terms of infrastructure and technology?’. We describe two extremes: one towards self-optimisation, in which disconnected energy islands are independent from the main energy system and their participants “stay among themselves”, and the opposite direction towards an optimised system that connects people who generate their own energy to a public, fully interconnected system.

Extreme 1: Energy Islands

The first extreme direction concerns the optimisation of separate, decentralised energy cells. These islands of prosumerism would by definition be rather small units: any energy consumption unit would be part of an "energy island". Such an island could consist of individual buildings, a few buildings, a neighbourhood, a village or a district in a larger city. In this scenario, the energy cells would be ‘off-grid’ (full grid defection), and the cells would have individual battery storage at their disposal. Such ‘energy autarkies’ lead towards a disconnected future, in which prosumers optimise their own energy provision. Such a course of the mainstreaming process would be characterised by isolation rather than connectivity, and locally confined innovations. This direction of the mainstreaming process would render centralised technological and infrastructural systems unnecessary. In this extreme form, grid operators might not exist anymore, or at least have a significantly different role. Ideologically, some may consider this course of the mainstreaming process a matter of ‘staying true to principle’ - and possibly as a desirable way of uncoupling from ‘vested interests’.

Technological developments provide empowerment to people seeking to be energy-independent, for instance through making energy sharing within a community accessible, easy and cheap. Prosumers would pursue the optimisation of their own energy demand and supply, relying on batteries and other energy storage systems. Long- and short-term thermal energy storage systems likely play an important role, since they are the cheapest form of electrical storage and provide the possibility of balancing the energy production by integrating power to heat technologies.

In terms of climate change adaptation, these units may be particularly resilient as they would not be dependent on a central energy system, which may be vulnerable to shut down in case of for instance an extreme weather event. Energy islands allow prosumers to have full control over their system - or at least within their “energy cell”, as the balancing and use of energy would not be controlled by actors such as utilities, aggregators or other service providers at a higher hierarchical level. As such, the risk of hacking energy systems would be reduced.

Nevertheless, it can also be argued that energy islands would be inherently unresilient, as there is no back-up should the system in an energy island break down.

Social groups might be empowered to start their own energy island, or become part of one, and regions (worldwide) could follow/adopt the knowledge and technology developed elsewhere. Prosumers in this set-up would need to be knowledgeable in energy matters, as they would have to invest in batteries, potentially long-term storage, system balancing, etc. Alternatively, companies may emerge that provide this expertise to the prosumers.

Extreme 2: Full interconnection with a central system

The other extreme that mainstreaming could move towards is a scenario of full integration of prosumers into central energy systems on a national, and even European, or global scale. In this case, prosumers would be connected to a central infrastructure and grid. Every prosumer initiative would contribute to the entire energy system. As such, prosumer installations would become absorbed into large energy networks. While they continue to exist as decentralised arrangements, the installations are not independent in their operations as in the 'energy islands' arrangement.

In this case of decentralised renewable energy production, the organisational part of prosumerism is centralised. Energy companies might own the prosumer's solar panels rather than the individual households themselves. This direction may lead to less control over energy production and use, as the 'central system' decides when to self-consume, store or feed-in energy produced. This requires full data exchange, as energy is traded between large numbers of prosumers, suppliers, consumers, companies and sectors. Prosumer technologies become part of a technological web and are integrated into the main infrastructures, making maximum use of economies of scale, technological efficiency, and synergies with other systems, such as mobility. In the process, it will lose its distinctly decentralised character, and ownership/governance is likely to shift away from communities/grassroots.

The rise of prosumerism, in its different forms of renewable energy, including solar, wind and hydropower, depends strongly on a range of broader changes in the energy system. Energy production technologies have become more efficient and affordable, relevant knowledge has become available, feed-in-tariffs and other policy incentives have been introduced in some countries, and solutions for more efficient storage and connection have been created. Nevertheless, certain limits to growth seem to exist. Continued decentralisation leads to problems of infrastructure instability and increases the need for infrastructure expansions that take time and political will to implement. Connection to the grid needs to be technically, financially, and socially possible and desirable. Growth may be facilitated by connecting with other systems such as electric vehicles, but such expansion in turn calls for further societal conditions that allow it to happen.

5.2 Key societal conditions for the mainstreaming of energy islands or full interconnections

What road the mainstreaming process of prosumerism will wind down depends on a range of societal conditions - some of a technological-material nature, some rather discursive or political-economical including governance, ownership, and fiscal regime. In this section, we discuss a selection of key constraining and enabling conditions which might push society towards either one extreme of the mainstreaming spectrum. The conditions mentioned here are not unidirectional in enabling or constraining a certain direction of prosumerism: how these societal conditions influence the mainstreaming of prosumerism exactly cannot be predicted. Nevertheless, we do

project what might be likely enabling or constraining factors, based on current observations and developments in Europe.

5.2.1 Electricity market regulations and policy

Regulations and policy are important factors influencing the development of electricity infrastructure and technology. In this section, we describe several policy and regulation issues that enable the mainstreaming of prosumerism to move either towards the extreme of energy islands, or system configuration.

First, it appears that the mounting pressure to meet the Paris agreement, and to meet the targets of energy efficiency and emission reduction more generally, are introducing governmental quests for control and reliance on large-scale, centralised solutions.⁴¹ As such, these high level ambitions and plans arguably enable mainstreaming in the direction of ‘system reconfiguration’. At the same time, national level performance on renewable energy integration into the energy mix, would be boosted by an increase of prosumer collectives. This might lead to pressure for grid operators to invest in system reconfiguration and planning or implementation of expansions and infrastructure quality.

Second, a condition that might be a constraining factor for moving towards full interconnection, is the role specification of grid operators. Whereas grid operators are an important player in a centralised system, they also provide an important connection for prosumers in terms of fostering energy islands. This is because prosumers who want to go off-grid are essentially aiming to create their own energy storage and/or microgrid. In so doing, they reduce the societal cost of grid congestion. Grid operators are currently the only actor in the system who have a financial interest in reducing grid congestion. For this reason, prosumers seek financial investment from the grid operator on becoming more independent, such as is the case with Aardehuis Olst.⁴² However, legally, the grid operators’ main responsibility remains managing the publicly owned electricity grid. As cited by an interviewee from the Dutch government as part of a PROSEU living lab study, this rigid definition increasingly becomes a tension: *“Network operators are not allowed to trade in electricity because they manage a collective good - the networks. If they did act, they would compete with other suppliers and producers”*.⁴³

Third, yet, it is simply not allowed by law to be off grid in many EU countries. This clearly undermines energy island tendencies. Unclear regulation, such as on the storage of energy may also discourage grid defection. Besides, a lack of regulations or even discouragement by law to sell excess energy from self-consumption installations to the grid is detrimental for a development towards full system interconnection.

5.2.2 Taxation and finance

Financial incentives through taxation and finance are paramount in determining the direction of mainstreaming for prosumerism.

First, as of today, being completely off grid is still an expensive undertaking, unless you are on an actual, physical island. Private wires, meaning local grids connected to private electricity generation are therefore typically trialled on small island grids, or as part of new developments where the private network and its ownership can

⁴¹ See for instance UNFCCC 2018, <https://unfccc.int/news/global-energy-interconnection-is-crucial-for-paris-goals> (accessed December 2019)

⁴² PROSEU Living Lab Ecovillage Aardehuizen-Oolst, 2019, unpublished

⁴³ PROSEU Living Lab Ecovillage Aardehuizen-Oolst, 2019, unpublished

be designed into the project. Such models are likely to be more problematic for existing locations where the network between meter points is owned by a distribution network operator.

Second, there are few tax incentives found for prosumers across Europe. For instance, in the Netherlands, prosumers do not receive tax discounts from collectively generating electricity, as was stated by a government employee: *“When experimenting so far, it appears that collectives are mainly preoccupied with reducing energy taxes. The amendment of that law could therefore be a good idea”*.⁴⁴ Should technological improvements be made quickly, renewable energy technologies are likely to become cheap enough for everyone to want to start using them, and private citizens might be able to deliver the capital needed. While arguably the system costs of an integrated connected system might be lower at first glance compared to energy islands, this is not a guarantee, as grid expansion might be a necessity.

5.2.3 Natural conditions and built environment

Certain geographical conditions, or aspects in the current built environment and existing energy infrastructure (e.g. electricity grid), influence the direction of mainstreaming. First, having enough space to implement certain technologies might be an issue, e.g. a lack of space for wind turbines, or enough solar installations. These conditions might push towards full system interconnection in order to provide for sufficient energy across geographies.

Second, the degree to which renewable capacity in the built environment can be maximised is also of influence. If roof-tops or other suitable locations remain “under-used”, it may not be possible to increase renewable energy production fast enough to sufficiently mitigate climate change. Therefore, the capacity of any solar (or other renewable) energy installation in the built environment should ideally be maximised to make the most use of the entire (suitable) space at a given location. This means that the self-consumption ratio should not be the leading indicator for prosumers, as it may lead roof owners to design their PV plants to be smaller than they otherwise could be. Roof owners, however, will only invest in larger installations if they receive a fair remuneration for the energy fed into the grid or if they can easily share or store excess generation. Currently many governments rather tend to promote self-consumption schemes that try not to produce excess energy. These developments discourage full system interconnection.,

5.2.4 Grid, technology and storage development

Decisions and opportunities in grid and infrastructure development are societal conditions that determine the direction of mainstreaming developments. First, we see that in terms of technology, many recent collective prosumers tend towards using solar PV and storage facilities, in contrast with the dominant trend up until now, which favoured wind and hydro. Biomass is also gaining in popularity⁴⁵. If this trend perseveres, prosumer households will need grey batteries. For energy islands, storage of energy will become a technical challenge, especially in climate zones that are more dependent on long term storage (over several days). Besides, smart- or micro-grids would play an important role in a world where energy islands are dominant, as these technologies allow the prosumer to use their self-generated electricity most efficiently.

⁴⁴ PROSEU Living Lab Ecovillage Aardehuizen-Oolst, 2019, unpublished

⁴⁵ p. 65 in Horstink, L.; Luz, G.; Soares, M. & Ng, K. (2019). Review and characterisation of collective renewable energy prosumer initiatives. PROSEU-Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable N°2.1). Horizon 2020 (H2020- LCE-2017) Grant Agreement N°764056

Second, support to develop secure hardware like inverters, encryption methods (such as block-chain) and safe energy-related applications could support the emergence of energy islands. Standardised and certified hardware and software could be made available to prosumer initiatives so that they can avoid investing their own time in solving data security issues. Other data-related issues concern developing appropriate methods for calculating energy use, deployment of appropriate metering devices, and low threshold ways to prepare a technical analysis for connecting prosumers to a publicly owned system. Internet of Things and block-chain technology can also contribute to system consolidation, through aggregators or connecting different actors. These technologies can also contribute to expansion of deals between aggregators and prosumers which would leave the management of their systems to such actors.

Third, future electricity networks could be adapted in such a way that certain parts can potentially disconnect from the main grid and go into islanding mode. Currently, this is being avoided, as a sudden loss of load can destabilise the entire grid. Innovative technical solutions are needed to allow islanding, which can be beneficial in case of hacker attacks that aim to cause wide-spread black-outs, or extreme weather events. Policy makers can incentivise prosumer projects with back-up power possibilities which develop technical solutions that can be applied at a larger scale for increased overall resilience of the energy system.

5.2.5 Perceptions of reliability

The fifth societal dimension highlighted in this brief is ‘perceptions of reliability’, by which we understand reliability in a broad sense: reliability of networks, technology, as well as people and organisations.

First, having to rely on technology can be perceived as a loss of autonomy in decision making. Taken from the Aardehuis case study in the Netherlands, prosumers of the ecovillage worry about the loss of their autonomy with the arrival of the smart technology: *“You don’t want your washing machine to go on, and think the system is preventing me to cook right now”*.⁴⁶ Besides a perceived loss of autonomy in decision making, the perception of the smart grid as an insecure way for transactions is another constraint for the implementation of smart grids. On the one hand, being an energy island might be perceived as preferable for emergency situations, as people might feel that they can fend for themselves when the grid is down, especially when they own a battery system. On the other hand, the absence of a grid to rely on in an emergency might be considered as a vulnerability.

Second, there seems to be a perception that local and off-grid systems are most efficient. One inhabitant of the Aardehuizen ecovillage states: *“Efficiency is mainly: try and do it mostly locally [...]. You don’t want to move electricity around too much because that leads to losses.”*⁴⁷

Third, perceptions of smart grids as complex constrain a move towards energy islands. Ways of enabling learning about smart grids might be a way to counter this perception. For instance, intermediary organisations can support in spreading knowledge, offering installation packages, bearing installing risks, and taking up advocacy. This might lower the threshold for individuals to initiate or take part in local RES prosumerism initiatives. Ministerial projects or support and information via public regional energy agencies aiming to stimulate local communities through facilitating knowledge exchange, might also play a role in this regard.

⁴⁶ PROSEU Living Lab Ecovillage Aardehuizen-Oolst, 2019, unpublished

⁴⁷ PROSEU Living Lab Ecovillage Aardehuizen-Oolst, 2019, unpublished

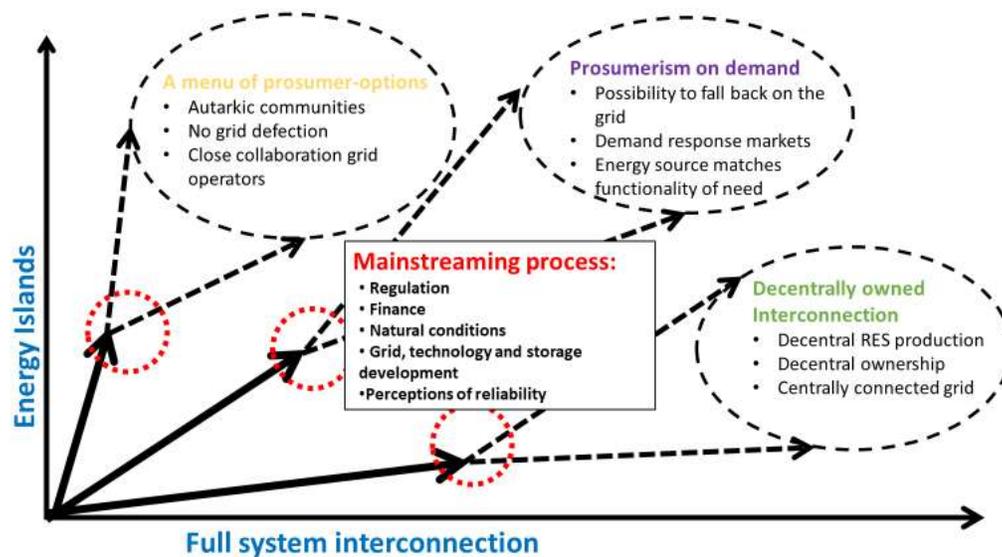
Increased energy competence and literacy of citizens might on the one hand lead to more energy islands, as citizens are knowledgeable enough to disconnect. On the other hand, it could also lead to a more integrative system, because citizens would better understand that sharing energy over larger distances can also be efficient and beneficial for society. If, however, citizens do not get more interested in energy and prefer keeping energy matters outsourced to energy companies/utilities, then mainstreaming also moves towards system integration.

The fourth element of this societal conditions is the perception of trust within a community. Often there might be a hesitancy to share data with neighbours in a smart grid and a fear of having individual behaviours checked, which is a constraining factor for moving towards energy autarky. An interviewee from the Ecovillage Aardehuis Living Lab linked the fear of neighbours checking each other’s sustainable behaviour to the fear of a “groceries police” – people checking each other’s consumption habits. However, because of communication amongst inhabitants of the ecovillage and learning about the technology, inhabitants overcame their initial scepticism towards smart grid technology, as well as towards the prying eyes of one’s neighbour to deliver on expectations.⁴⁸

5.3 Forms of prosumerism

This brief is framed around the tension between full system interconnection and energy islands. Above, we discussed how societal conditions can enable mainstreaming towards either extreme. Taking note of these societal conditions, we identify at least three ‘in-between-forms’ of mainstreamed prosumerism, as outlined below.

Figure 7: RES prosumerism mainstreaming between energy islands and full interconnectiveness



⁴⁸ PROSEU Living Lab Ecovillage Aardehuizen-Oolst, 2019, unpublished

Decentrally owned interconnection

In this scenario, the organisational part of prosumerism is decentralised, while prosumers do profit from each other's energy production outside of their direct community. Energy companies do not own the RES installations, but these are rather owned by individual households. Governance and ownership are decentralised, while the decentral energy production is fully interconnected through smart technology and democratic facilitation. Renewable energy production, energy storage, consumption also remains decentralised.

Prosumerism on demand

This form constitutes the middle of the spectrum between energy islands and full system configuration. While there is on the one hand a high amount of autarky, on the other hand, a possibility to fall back on the grid connection remains, as prosumer communities are still connected to the central grid. Through planning, legislative actions, and the implementation of new technologies, opportunities are created for demand response markets. Prosumers would draw benefits from participation in such integrated energy system (i.e. when charging an electric vehicle at home, one is more prone to be in the "energy island", but when charging at work or elsewhere, one would draw benefits from their energy "stored in the grid" through smart metering or other business models).

In more isolated areas with older electricity distribution infrastructure, such prosumerism can help to stabilize the network. Users confronted with relatively frequent black outs would look favourably to this solution, which is more affordable than grid defection, which requires investments in storage etc.

In terms of implementation dynamics, it might be expected that the first pilot and demonstration projects address isolated systems, e.g. energy islands. On many locations users might prefer staying in a network with limited number of participants, creating energy islands, but as novel approaches are implemented, different sites become integrated and contribute in a different way, towards system consolidation.

Prosumerism on demand means a freedom to choose the solution for energy supply: when offered various new technologies, users will choose in accordance with their purchase power, knowledge and interests, different solutions and deals available on the market. This might lead to a very heterogeneous system, which consists of actors which are inclined towards prosumer peninsulas or towards system consolidation.

A menu of prosumer-options

In this form of prosumerism, energy islands are the main focus, however, there is no grid defection. In this form, prosumers can choose whether they want to remain grid connected. To manage this, grid operators remain in close contact and collaboration with prosumers as is already being demonstrated in Living Lab #9 Ecovillage Aardehuis in the Netherlands with grid operator Enexis.

5.4 Conclusion: Mainstreaming renewable energy prosumerism

The mainstreaming of renewable energy prosumerism is not straightforward, but rather a winding road in which stakeholders have (limited) agency to push for certain directions. Besides, apart from factors that actors might have an influence on, other transition dynamics such as climate catastrophes or major social unrest may push the mainstreaming of prosumerism in either one direction. However, and as highlighted in this brief, there are multiple societal conditions that stakeholders need to consider when developing mainstreaming strategies.

One critical branching point will be regulatory obligations to stay connected to the grid pushing mainstreaming in the direction of ‘full interconnection’. Currently, regulation makes it difficult to share energy. Arguments to not change legislation might be rooted in security arguments, efforts to protect incumbents, or ways to avoid additional investments in the energy infrastructure. In that case, people may just do the minimum, some will disconnect, while others may become prosumer, but just for themselves. Overall, the mainstreaming of prosumers may rather stop if regulations are not adjusted accordingly.

Another critical issue concerns a push for secure technology. If technology proves to be vulnerable to hackers getting into “smart” buildings’ energy management systems, or cause users to end up without electricity or unjustified bills, people may want to really disconnect from the grid.

While there is no telling what the most persuasive conditions will be pushing the infrastructural mainstreaming to either one direction, the insights in this brief can support decision makers and practitioners in taking decisions and positioning themselves.

6 In or out? Prosumerism between inclusiveness and privilege

6.0 Introduction: Mainstreaming prosumerism in Europe

The production of renewable energy is on the rise in Europe⁴⁹. A big role is reserved for ‘energy citizens’, who could generate up to 45% of the European Unions’ electricity needs by 2050—out of which 37% could be produced by collective projects and energy cooperatives⁵⁰. Individuals and collectives are no longer mere consumers of energy, already today many also produce renewable energy and actively engage in energy markets – they have become **prosumers**⁵¹.

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Taking these future projections as a starting point, we, the members of the PROSEU-consortium asked ourselves **what futures could emerge if renewable energy prosumerism becomes mainstreamed in Europe**. While such projections seem to suggest that mainstreaming prosumerism is a simple, linear process towards a clear and inherently desirable future state – what they harbour is a diversity of possible futures involving transition processes with winding roads and various junctures.

We explore these possible futures and their winding roads along three main questions – each of which has a practice brief dedicated to it:

1. Will the mainstreaming of prosumerism follow more a community logic or a market logic?
2. Through which infrastructures will prosumerism be mainstreamed?
3. And, will the mainstreaming contribute towards more inclusivity of energy systems or remain an undertaking of insiders and privileged groups?

This particular brief focuses on the **ways prosumerism can bring inclusiveness, but also new forms of privilege and exclusion**. Taking this as a starting point, we will paint two essentially different and opposed futures of a

⁴⁹ Currently rising with about 0,5% per year, reaching 17,5% in 2017; see Eurostat (accessed December 2019)

⁵⁰ Kampman et al. (2016) [The potential of energy citizens in the European Union](#). CEDelft: Delft.

⁵¹ Horstink, L., et al. (2019). Review and characterisation of collective renewable energy prosumer initiatives. PROSEU-Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy Transition (Deliverable 2.1).

mainstreamed prosumerism. We continue by highlighting the key societal conditions that enable or constrain the mainstreaming towards either one of these. Then, we show the shapes of prosumerism that fall in-between the two extremes. Finally, we point to some key dynamics that may occur in the mainstreaming process, such as setbacks, acceleration moments or branching points.

We invite readers to use these briefs to navigate the winding roads and junctures in the mainstreaming of prosumerism and to engage in discussions and actions towards shaping their desired future.

6.1 The tension between inclusiveness and privilege

This brief asks important questions about the ways in which RES prosumerism can make social relations between actors more inclusive, perpetuates the *status quo* or increases differences between people. Since, in addition to bringing about technological innovation, RES prosumerism also implies **changes in social relations** between those individuals, collectives, organisations and public bodies that are the players in our energy systems. There are numerous crossroads on the winding road towards mainstreaming prosumerism that relate to questions such as: who participates in the game, who has to watch from the side-lines, or who is ill-equipped to engage in the first place? ***Will only those with money, expertise and time be able to become prosumers? Or will prosumerism be designed in a way that spreads the benefits across communities?*** The question of the extent to which certain social arrangements are designed as such is valid to be asked about national energy systems as well as about groups of people that jointly produce and consume energy.

The **opposing futures** that we want to highlight here are those between inclusive prosumerism on the one hand and privileged prosumerism on the other. In **inclusive prosumerism**, collectives engaging in producing and consuming energy take the public interest as a leading motivation. They ensure, that beyond a narrower circle of initiators and shareholders, a wider community benefits from the activities. Diversity in the composition of (advisory) board and executive committees are actively encouraged as well as (community) members empowered to participate and share skills and expertise. There is commitment to democratic decision-making and the voices of those seldom heard are involved and taken account of.

Inclusiveness is a guiding principle and often practiced within these prosumer collectives such as energy cooperatives of community energy initiatives, as such they are practicing their vision of an ideal society within these small collectives. However, taking an energy system perspective, the question arises about their role in making these systems more inclusive or whether they are perpetuating some of the exclusionary and privileging tendencies of today's societies, especially in these largely unregulated spaces. There are voices that highlight how prosumer collectives are exclusive to the extent that they are favouring the participation of men and require financial means to be involved as well as certain amounts of expertise and time to be able to influence decision-making⁵². Cooperatives specifically can be oriented towards the general public or community good but can also be focussing on benefitting the narrower circle of members⁵³.

This brings us to **privileged prosumerism**, where individuals take their own interest or collectives take the mutual interest and benefit of a smaller group as the starting point for redistributing benefits within this group. They rely on financial means, expertise and networks that they accumulated with successful careers. The community

⁵² Johnson, V. C., et al. (2014). Community energy and equity: The distributional implications of a transition to a decentralised electricity system. *People, Place and Policy*, 8(3), 149–167.

⁵³ Bauwens, T., & Defourny, J. (2017). Social capital and mutual versus public benefit: The case of renewable energy cooperatives. *Annals of Public and Cooperative Economics*, 88(2), 203-232

they form is one of mutual convenience, and thus serves as an extension of self-interest – namely secure, affordable and renewable energy supply. These initiatives may start from and reproduce existing ‘old boys’ networks or otherwise networks of existing leaders. Mainstreaming privileged prosumerism leads to benefits for the happy few and could increase energy prices for the rest.

RES prosumer collectives can thus be very inclusive, serving broader communities, and contributing to more inclusive social relations. However, at the same time they can also have excluding tendencies—oriented towards their own group or shareholders. Obvious dividing lines thus exist between those who are benefitting, and those who are not. Beyond this immediate issue, there are also other issues of who is included, who decides, and who is being listened to. In the context of energy transitions, often neglected divisions arise amongst others regarding gender, social class, ethnicity or expertise. It becomes clear that mainstreaming prosumerism can take on many different organisational forms and involve many kinds of ‘inclusive’ or ‘not so inclusive’ social relations within and beyond collectives.

6.2 Key societal conditions

Current policy discourse aims towards ensuring inclusive, ‘just’ and democratic energy systems. However, given the high cost of storage technologies, the experimentalism of demand-side management schemes, and the need for supportive national legal frameworks, collective RES prosumer initiatives still rely on ‘in-crowd’ and resourceful individuals. In general, inclusive RES prosumerism is easier preached than practiced since many societal conditions favour more privileged forms.

There is a wide range of aspects that are relevant (in terms of enabling or constraining) to a discussion of mainstreaming prosumerism across Europe⁵⁴ – and specifically for the discussion on the inclusiveness of energy systems, including considerations about gender, ethnicity, social class, knowledge or participation and the intersection of all these. In this brief, we zoom in on policy and subsidies, the social organisation of labour, discourses of inclusion as well as decentralisation and energy democracy.

6.2.1 *Renewable energy prosumerism policy*

Next to formal, often national regulations, there are various ways in which governments set boundary conditions for making the mainstreaming of prosumerism more inclusive or privileged. Most of the following focuses on local governments, while also other levels of government play an important role.

Specifically, through their own **procurement** – governments in general seem to support more privileged forms of prosumerism. This is particularly evident in countries where the right to exploit local renewable energy resources is tendered or auctioned. In Portugal, for instance, it is more often than not foreign multinationals that offer the lowest price for the energy eventually produced and therefore win tenders to exploit large renewable energy installations (of 100 Mega Watts or more). It is questionable whether these multinationals have mechanisms to include the local populations—such a government contracting in either case excludes locally-based collectives since they do not have the financial means for the large investments needed. On the contrary, in France, tendering procedures for energy projects ensure a premium (€/MWh) for projects including local

⁵⁴ See Section 3 of this deliverable: Pel et al. (2019) Synthesis of incentive structures: input for Participatory Integrated Assessment. PROSEU-Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy Transition (Deliverable 6.1).

authorities and citizens rather than being taken on by private firms only. The latter—especially when they carry out large scale projects—are also required to comply with certain corporate social responsibility standards, focusing on non-economic benefits, such as employing marginalised people (e.g. disabled persons), providing eco-certified products and running low-carbon operations⁵⁵.

On the local governance level, municipalities facilitate prosumerism through different **policies**. Enabling more inclusive prosumerism, municipalities set up *energy agencies*, which guide citizens, households and collectives in questions around energy production, consumption and efficiency. Barcelona, for example, links housing services to social services to explicitly reach more vulnerable populations through energy advising points with the goal to save energy and detect/prevent energy poverty⁵⁶.

Other municipalities take an *area-based approach*, focusing on making specific areas more sustainable. The Netherlands for example has adopted a neighbourhood-based approach towards getting their country off gas. Here, controversies arose around the questions of which neighbourhoods go first. Rotterdam for instance has selected neighbourhoods with a high number of social housing. Such neighbourhoods are considered as easier to tackle for local governments since they only negotiate with a handful of social housing companies rather than with individual house owners⁵⁷. The extent to which also tenants of these social housing blocks also get a say is crucial for the inclusiveness of such approaches.

Municipalities also increase their influence and establish favourable conditions for more inclusive energy systems by taking up *ownership*: through re-municipalising energy utilities or establishing energy service companies. Examples abound in France and Germany, although more recently have also been emerging in the historically neoliberal UK. Various municipal authorities such as London, Nottingham and Bristol amongst others, have become more active in the local energy space; including a range of initiatives aimed at promoting prosumerism. These have included new municipally owned energy supply companies, as well as experiments with new forms of energy service provision. What these initiatives share is a focus on vulnerable customers and reducing fuel poverty through demand side measures and building integrated renewables. Unlike more market-led approaches, these schemes have tried to reduce or eliminate the financial hurdles of prosumerism, through grant-funded programs and service-based business models – such as the Energiesprong initiative⁵⁸. Whilst these models are in many cases still in nascent form, numerous cities are now putting distributed and prosumer energy systems at the centre of their climate change mitigation plans⁵⁹.

6.2.2 Subsidies

Financial means are necessary to invest in renewable energy technology—individuals need money to invest in solar PV on their roof or to pay membership fees or to buy shares of a prosumer collective.

Many subsidies target individual households and homeowners. These either receive *incidental subsidies* to lower their investment costs and to enjoy lower energy bills as a consequence, or they are incentivised via feed-in

⁵⁵ Petrick, K., et al. (2019). Strategies for Policy Coherence and Sustainability – Relevance of EU policies and frameworks for prosumers. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (D3.2).

⁵⁶ City of Barcelona 2019, <https://habitatge.barcelona/en/housing-services/problems-paying-your-home/energy-rights> (accessed December 2019)

⁵⁷ Visser, V., Minkman, E., Van Popering-Verkerk, J. & Van Buuren, A. (2019). Governance of the local energy transition: bottom-up co-creation or top-down implementation? Abstract NIG Annual Work Conference 2019, Amsterdam.

⁵⁸ Energiesprong 2019, <https://energiesprong.org/> (accessed December 2019)

⁵⁹ Bristol Energy Service 2019 <https://www.energyservicebristol.co.uk/cityleap/> (accessed December 2019)

tariffs (FIT) to deliver renewable energy back to the grid. Many countries have adopted a FIT and some are in the process of phasing them out. What many of these schemes require is that individuals own a house, roof or a physical site where to mount PV systems, wind turbines or the like. As such, these schemes, while boosting the production of renewable energy, do tend to privilege the more affluent – who have the assets as well as the financial means to invest.

Certain prosumer collectives aim to provide opportunity for those not owning a house, roof or physical site to participate in the production of renewable energy. Cooperatives such as Blijstroom in the Netherlands or Coopernico in Portugal, thus open up the benefits associated with the production of renewable energy to a broader group of people. How broad this group of people is depending on the orientation of the cooperative⁶⁰. There are cooperatives that redistribute benefits to their members or shareholders—they are thus directed at the mutual benefit of those having paid a certain deposit. While others are oriented towards general benefit and have the public good in mind—the latter enables a more inclusive form of prosumerism. Community benefit societies in the UK are a legal form putting the latter principle into practice.

In terms of *support schemes for prosumer collectives*, these are less common across the studied countries. Examples are the postcoderoos subsidy in the Netherlands, which exempts collectives from the tax over the energy that they produce with an installation that is installed within a certain postal code area. RES prosumer collectives often combine different financing sources, with public funding only ranking third (after membership fees and bank loans)⁶¹. New developments towards alternative financing schemes, such as crowdfunding, or financing through ethical banks enable to finance a more diverse set of initiatives. Some of these financing schemes rely on the openness of the initiatives towards sharing their benefits with a broader group⁶². Even when RES prosumers use third- party finance, this has tended to privilege those with a favourable credit history and collateral⁶³. This makes the type of finance in terms of public or private capital an important factor.

Also, *funds for regional development* are (in some countries and regions) on the rise to embed renewable energy prosumerism in broader regional development objectives, and to involve whole constituencies. They enable mainstreaming of more inclusive forms of prosumerism (especially if inclusiveness is one of the guiding objectives, and procedures are in place to secure participation). The AGEM initiative in the Netherlands is a quite strong example of how inclusiveness can be developed stepwise⁶⁴.

Local governments also aim to reach their energy transition goals through providing financial incentives via retrofit programmes⁶⁵. These include a range of dedicated grant funds, low cost loans, along with advice and support for households in upgrading the energy performance of their homes. Increasingly, these initiatives are moving beyond single energy efficiency measures towards comprehensive deep energy renovations, involving solar PV, heat pumps and smart home technologies⁶⁶.

⁶⁰ Bauwens, T., et al. (2019). Understanding the Diverse Scaling Strategies of Social Enterprises as Hybrid Organisations: The Case of Renewable Energy Cooperatives. *Organisation & Environment*, 1086026619837126.

⁶¹ Horstink et al. (2019)

⁶² Davis, M and Cartwright, L (2019) Financing for Society: Assessing the Suitability of Crowdfunding for the Public Sector. Report. University of Leeds.

⁶³ Davis and Cartwright (2019)

⁶⁴ More information at: <https://agem.nu/> (accessed December 2019)

⁶⁵ Brown et al., (2019) Worth the risk? An evaluation of alternative finance mechanisms for residential retrofit Volume 128, 418-430.

⁶⁶ EEFIG (2015) Energy Efficiency – the first fuel for the EU Economy. How to drive new finance for energy efficiency investments.

6.2.3 Social organisation of labour

Participating in RES prosumerism activities means taking the time to engage with the idea as well as associated activities, such as screening options, selecting, installing and tending to a solar PV, or to initiate or become a more or less active member of an energy cooperative. However, time availability is massively differentiated across class, gender and age⁶⁷, associated with the stereotype of the well-off male senior citizen with ample time and technical expertise to spare.

In combination with the fact that many of the RES prosumer collectives are run by or with the help of volunteers—people engaging in their ‘free’ time—makes the time availability a condition that plays into privileging tendencies of RES prosumerism. In many cases, prosumer initiatives—notably community energy in the UK—have tended to attract actors who have spare time to invest in attending meetings, and in the governance of renewable energy cooperatives⁶⁸. These volunteers, especially when actively engaging in shaping the collective, spend many hours discussing, communicating and explaining – both within the decision-making organs and with the broader community that they engage with. It is only through spending this time connecting with one another that “you also have people who really want to join. They have intrinsic motivation to cooperate. More commitment and more change.” as put by an initiator of the housing community in PROSEU Living Lab Ecovillage Aardehuis in the Netherlands. Also, many RES prosumerism collectives run by volunteers’ state that this comes with many challenges—an important one being “to safeguard continuity: from hobby to effective lobby and from volunteer-based organisation towards professionalization”⁶⁹.

Such prosumer initiatives also tended to attract those with spare capital to invest⁷⁰ or those with extant expertise in energy and engineering issues, often more likely to be male than female⁷¹. Such prosumer collectives are thus privileging groups who are both time and cash rich—often older and retired individuals⁷². In turn, this reveals the importance of societal conditions such as the demographic trend towards an increasing concentration of wealth and home ownership in the ‘post-war’ generation, as well as an ageing population⁷³.

6.2.4 Discourses of inclusion

Many organisations, public or private, pay at least ‘lip service’ to the necessity of energy transitions to contribute towards more inclusive energy systems and thereby enable more inclusive forms of prosumerism. An example is the Energy Union strategy of the European Union, which sets out to ensure energy is secure, sustainable, competitive and affordable to all Europeans. This aspect of affordability directly relates to energy poverty, which is one of the priorities of European energy legislation. Almost 50 million Europeans are energy poor, which means that they cannot adequately meet their energy needs at affordable costs⁷⁴. To date, tackling energy poverty is

⁶⁷ Adam, B. (2001) When time is money: Contested rationalities of time and challenges to the theory and practice of work. School of Social Sciences Working Papers Series, vol.16. Cardiff: Cardiff University

⁶⁸ Creamer, E., et al. (2018). Community energy: Entanglements of community, state, and private sector. *Geography Compass*, 12(7), 1–16.

⁶⁹ Horstink et al. 2019

⁷⁰ Johnson et al. (2014)

⁷¹ Łapniewska, Z., 2019. Energy, equality and sustainability? European electricity cooperatives from a gender perspective. *Energy Res. Soc. Sci.* 57, 101247.

⁷² Johnson et al. (2014)

⁷³ Heffernan, E., Pan, W., Liang, X., de Wilde, P., 2015. Zero carbon homes: Perceptions from the UK construction industry. *Energy Policy* 79, 23–36.

⁷⁴ ENEA (2019) EnR Position Paper on Energy Poverty in the European Union. Online available here: <http://enr-network.org/wp-content/uploads/ENERGYPOVERTY-EnRPositionPaper-Energypoverty-Jan-2019.pdf> (accessed December 2019)

not yet one of the main goals motivating the start of prosumer collectives⁷⁵, however there are exceptions. In Portugal, one of the energy poorest countries in Europe, a rural community, São Luís Transição which includes members of the local “Transition Towns” initiative, as well as local Parish administrators and other stakeholders, pilots inclusive access to energy and aims to trigger legislative changes in Portugal as well as inspire other villages and towns to pursue similar goals. Although the aim is not to fight energy poverty, the goal of having a first renewable energy community in Portugal is understood as part of a broader process to fight land abandonment in rural areas, support local economic development and ensure the participation of all, providing economic and social benefits for local communities.

Also, awareness raising campaigns and capacity building measures (e.g. the energy advising points in Barcelona mentioned above)⁷⁶ are enabling more inclusive forms of prosumerism. They provide information or guidance on alternative ways of producing and consuming energy⁷⁷. Playing into discussions on ‘women in energy’ are networks and cooperatives that are discriminating positively, such as for example Xenergia, a women-led Spanish cooperative⁷⁸, or the also Spanish “Women Network for an Ecofeminist Energy Transition”⁷⁹. Such networks are then meant to counter the fact that it is men who tend to dominate prosumer collectives often due to their disproportionate representation in science, technology, engineering and mathematics subjects⁸⁰. They also aim to provide opportunities to participate for those that are not included in existing formal and informal networks.

6.2.5 Discourses of decentralisation and energy democracy

A broader political shift in society towards less hierarchical and more democratic modes of governance has enabled decentralised renewable energy production and prosumer collectives.

When such decentralised prosumer collectives start formalising, they are confronted with a range of legal forms that allow for different degrees of democratic governance. By way of example, the cooperative as a legal form, allows collectives to have a membership base that has considerable voting rights – and thus allows for inclusiveness within organisations. However, as already discussed, a cooperative can be oriented towards member benefit as well as general public interest and can thus be ambiguous in relation to enabling inclusive or privileged prosumerism. In addition, our survey of about 200 RES prosumer collectives across nine countries found that 40% of these collectives do not have any formalised criteria for members to join and therefore offer opportunity for a range of people to participate⁸¹.

Public discourses around energy democracy voice the idea that people should take back the power over their energy systems. Energy democracy goes along well with ideas around the ‘energy commons’. Buurtwarmte, an intermediary based in the Netherlands considers renewable energy as a commons that belongs to everyone. It is their “dream that in 10 years all the financial streams from the government aimed at increasing sustainability are no longer predominantly going to businesses, but to citizens” as outlined by one of their initiators.

⁷⁵ Horstink et al. 2019

⁷⁶ Petrick et al. 2019

⁷⁷ Petrick et al. 2019

⁷⁸ More information online via: <http://xenergia.org> (accessed December 2019)

⁷⁹ More information online via: <https://twitter.com/rmx1tee> (accessed December 2019)

⁸⁰ Łapniewska, Z., 2019

⁸¹ Horstink et al. (2019, p. 74)

6.3. Forms of prosumerism

This brief is framed around the tension between inclusive prosumerism and privileged prosumerism and in it we have discussed societal conditions that enable either one or the other. Clearly, besides these two extremes, there are more forms of prosumerism which lie in between both extremes.

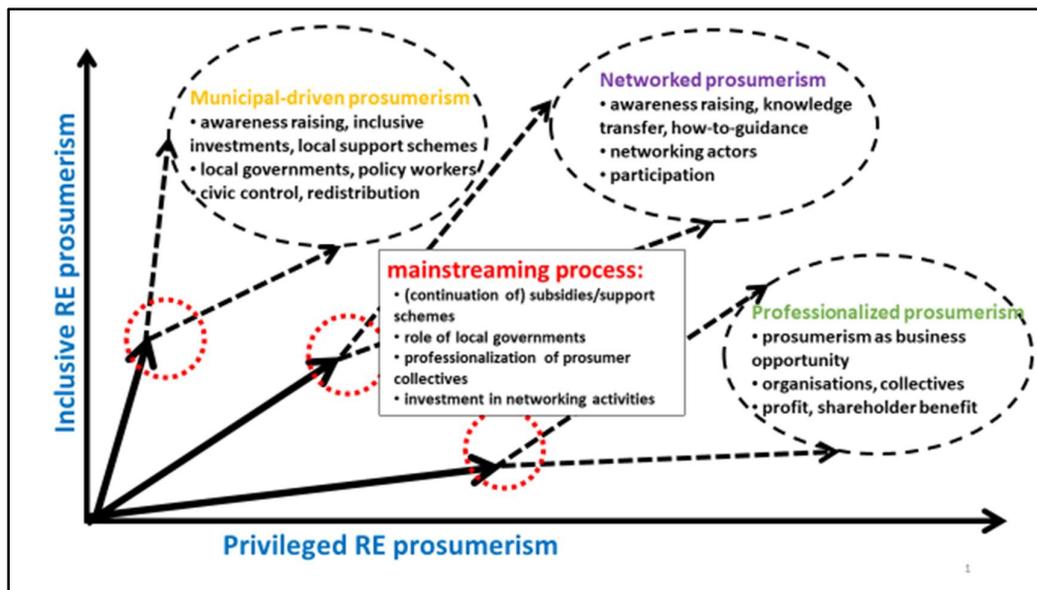
Municipal-driven prosumerism

This form of prosumerism takes civic control, decentralisation and attention for vulnerable populations as a leading motivation. Here, municipalities and local policy workers are key actors driving a more inclusive form of prosumerism on a local scale, taking the general benefit of all their constituents (and beyond) into account.

Emancipating prosumerism

This form of prosumerism takes the mutual interest and benefit to a vulnerable or excluded group as a leading motivator and ensures redistribution within that group, but specifically also on aiming to getting this group more included in the overall redistribution: Examples are cooperatives/networks focusing on women.

Figure 8: RES prosumerism mainstreaming between inclusiveness and privilege



Professionalised prosumerism

This form of prosumerism takes the benefit of the organisation, rather than the collective or the public as a leading motivation. These organisations are managed by paid professionals that organise efficient structures and procedures ensuring the survival and thriving of the company for shareholders gain. These organisations ensure a certain degree of inclusiveness and accessibility of the organisation for reasons of corporate social responsibility and market share.

Networked prosumerism

In this form of prosumerism individuals and organisations aiming for more inclusive energy systems find each other in this overarching aim and mutually support each other in living up to their potential. Different organisational forms including cooperatives are promoted and awareness about prosumerism is raised in parallel, providing clear guidance and action perspectives.

6.4. Conclusion: Mainstreaming renewable energy prosumerism

As has become clear by now, the mainstreaming of renewable energy prosumerism is not a straightforward 'racetrack', but more of a winding road with various twists and turns. Renewable energy prosumerism does not in itself stand for inclusive energy systems, rather it is a trend that provides opportunities towards making energy systems more inclusive that need to be ceased. Such an inclusive prosumerism requires a combined bottom-up, i.e. prosumer collectives creating local value, and top-down approach, with governments making equal access a strong requirement. However, there are strong tendencies towards more privileged forms of prosumerism. Given the investment required, level of knowledge and expertise demanded as well as time needed for interaction and networks to engage in renewable energy prosumerism, it is less likely that the established collectives will be inclusive along many of these lines.

Important junctures are ahead. Many governments have favourable **subsidies and support schemes** for renewable energy prosumerism – both for households and collectives – in place. The continuity thereof however is questionable, since for example many countries, have phased out or are about to phase out their feed-in-tariff schemes. There is thus a question of whether financial benefits can be made available for all by considering renewable energy prosumerism as part of a broader societal imaginary that foregrounds social and ecological values

Especially **local governments** play a decisive role in creating enabling conditions for more inclusive renewable energy prosumerism – since their mission is to serve all their constituents. They do so, amongst other activities, through facilitating prosumer collectives in a diversity of ways, or partnering with them to reach their energy ambitions. Through becoming an active player in energy systems themselves, such as through ceasing public ownership of energy utilities and marrying market orientation with public duties, an important crossroad can lead to more inclusive RES prosumerism. Local governments can also resolve the professionalisation and volunteer gap by providing expertise, a dedicated paid team, while still including other local citizens as well as groups or organisations in decision-making and certain activities.

A remaining uncertainty and possible branching point is the question of **professionalisation** of prosumer collectives – many of which are currently run or greatly supported by volunteers. The question being on how societal discourses around the need for professionalisation or the appreciation of volunteer work are developing. Will the renewed interest into one of our basic needs stay with a broader group of people who are civically motivated to participate or actively engage with energy in different ways, or will there be another wave of professionalisation and of delegating our energy agency to experts since it costs much time, patience and effort that is difficult to maintain over time. This is closely connected with the degree of take-up of, as well as desire for often more time-consuming participatory governance models within prosumer collectives and energy systems as a whole. Middle ways are emerging here, where the more motivated run day-to-day activities and where a critical mass enables cooperatives or communities to share the burdens more equitably.

A final branching point is whether **networking activities** for more inclusive RES prosumerism gain foothold. This concerns formalised networks, such as Rescoop.eu, or cooperatives focusing on public interest, such as

Coopernico in Portugal or Eco-Power in Belgium, which aim to create local value and keep the profits in the community, reinvesting in new projects. In addition, they often help other cooperatives to be set up to support the replication of the cooperative model.

Clearly, continuing the current road will enable more privileged forms of prosumerism, in which case renewable prosumerism becomes a factor that increases social inequalities. However, if more inclusive forms are deemed desirable then decisions need to be taken and actions unfolded in concerted actions.

7 Conclusion: Reflection and outlook

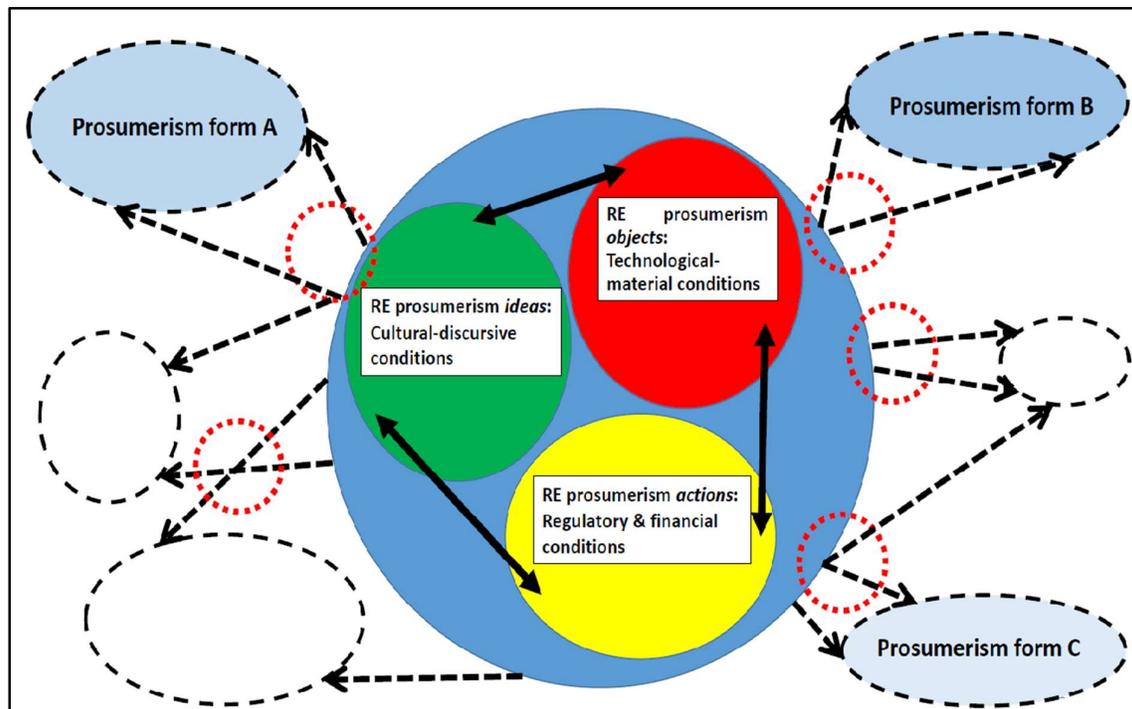
7.0 Introduction

We conclude this deliverable with brief reflections on the solidity, coherence and practical implications of the presented ISF insights. After considering the comprehensiveness of the ‘incentive structures’ framework (section 7.1), we consider the further application of our findings (section 7.2), with specific regard to the subsequent WP6 task of Participatory Integrated Assessment (section 7.3).

7.1 Incentive structures: comprehensiveness and coherence

The presented synthesis of incentive structures comprises 17 key societal conditions that shape the RES prosumerism mainstreaming process. The three previous sections showed in more detail how these societal conditions matter – they may push the RES prosumerism mainstreaming process in different directions. Taking the 17 societal conditions and the subsequent elaborations of the mainstreaming process together, Figure 9 below visualizes the Incentive Structure Framework in its expanded form.

Figure 9: Societal conditions and directions of RES prosumerism mainstreaming process



The ISF aims to cover a comprehensive set of relevant ‘incentive structures’. This comprehensiveness, and the coherence of the framework, can be evaluated along the following elements of the diagram:

- **Multiple dimensions.** The analysis along the dimensions of new actions, objects and ideas is an unusual way of approaching the identification of ‘barriers’ and ‘enablers’, and as such it is good to

consider what dimensions of the mainstreaming process it neglects. The actions/objects/ideas heuristic does correspond with similarly holistic analyses of socio-technical systems in transitions research, STS, and practice theory. Furthermore, the identified clusters of societal conditions (the yellow, red and green ovals) roughly correspond with institutional-theoretical distinctions of regulative, normative and cognitive institutions. From more specialized points of view (e.g. business models, or engineering) it could be maintained that the holism has distracted from detailed and comprehensive analysis of business models or technologies. Arguably, this multiple-dimension approach does add comprehensiveness to the many studies focusing on only one or two of these dimensions.

- **Multiple outcomes.** Another measure of comprehensiveness is the range of RES prosumerism forms and outcomes covered. As indicated through the different ‘forms of prosumerism’ and substantiated in the previous sections, the 17 societal conditions can generate a broad range of more and less desirable outcomes of the RES prosumerism mainstreaming process. Beyond the three pairs of opposing directions, not that many in-between forms and hybrid forms have been identified, however. This reveals how the comprehensiveness could be increased by building on more fine-grained typologies and distinctions as developed within and beyond PROSEU. More importantly, it merits critical consideration which other crossroads in the mainstreaming process can be identified – these could in turn point out overlooked forms of RES prosumerism and sets of relevant societal conditions.
- **Ambiguous societal conditions.** The ‘incentives’ are often used as binary concepts, indicating pairs of enabling conditions/constraints (for example, high or low feed-in tariffs). The approach taken rather indicates 17 continuous variables or ‘sliding scales’. In principle they are thus covering a broad range of ‘incentivizing’ or stimulating societal conditions. On the other hand, the various shades of grey are not elaborated in much detail. The diagram visualizes how one particular form of RES prosumerism could be taken as the focal point of analysis (or as normative ideal), in turn raising specific questions on the enabling or constraining role of each of the identified 17 conditions.

7.2 Further applications

The ISF integrates intermediate proceedings from several PROSEU work packages, whilst also serving to support further work. As a first indication of further applications, table 3 below provides a rough sketch of the correspondence between societal conditions and PROSEU work packages: This overview already indicates further applications pertaining to the synergy between WPs, to the identification of data gaps, and to the contextualization of WP findings.

Specific further applications and elaborations are the following:

- **Contextualization of WP findings.** The table brings out how work packages tend to focus on 1 or 2 of the RES prosumerism dimensions. Insights into the ‘object’ dimensions (as mainly developed by WP5) can thus be deepened through insights on the ‘idea’ and ‘action’ dimensions as developed by other WPs – and vice versa. The practice briefs have brought out how RES prosumerism mainstreaming processes are typically shaped by *combinations* of the three groups of societal conditions. Contextualizing WP findings, the table helps to move beyond one-dimensional findings and recommendations.

- **Synergy between work packages.** The overview brings out how (the mainstreaming of) RES prosumerism can only be understood well by bringing the insights from different work packages together.
- **Identification of data gaps.** On some of the identified key societal conditions, detailed insights have already been developed. RES prosumerism in terms of actions and objects is well covered by WPs 3, 4 and 5. By contrast, the ideational/discursive dimension seems to call for additional analyses – mainly by WPs 7 and 3.

Table 3: ISF and corresponding PROSEU work packages

RES prosumerism dimensions	Societal conditions	Work package activities
Actions	❖ Electricity market regulations	❖ WP3 & WP4
	❖ RES prosumerism policy	❖ WP3
	❖ Subsidies and taxation	❖ WP3 & WP4
	❖ Public and private investment	❖ WP3 & WP4
	❖ Administration & governance relations	❖ WP3 & WP2
	❖ Social organisation of labour	❖ WP2 & WP7
Objects	❖ Tech. performance RE generation installations	❖ WP5
	❖ Natural (climate/weather) conditions	❖ WP5
	❖ Built environment	❖ WP5
	❖ Storage technology	❖ WP5
	❖ Grid/infrastructure development	❖ WP5
	❖ Availability of expertise and skills	❖ WP5 & WP7
Ideas	❖ Discourses decentralisation & energy democracy	❖ WP7 & WP3
	❖ Environmental awareness	❖ WP7 & WP3
	❖ Perceptions of political legitimacy	❖ WP7 & WP3
	❖ Perceptions of reliability and competence	❖ WP7 & WP3
	❖ Discourses of Inclusion	❖ WP7 & WP3

- **Reaching beyond the dataset.** The ISF has been also strongly conceptually driven. Whilst being substantiated through the inputs from the various PROSEU work packages, it has eventually reached beyond this dataset. Some of the identified key societal conditions are clearly corresponding with an extensive pool of data and detailed analysis, others are relatively briefly described and mainly developed through RES prosumerism literature or related social science literatures. Certain societal conditions are notoriously difficult to observe, constituting blind spots for researchers and/or researched actors – yet the relative lack of data on gender, race, class and other issues of inclusion within PROSEU to date does not mean that they should be discounted as relevant societal conditions.
- **Empirical detail.** The identified societal conditions obviously invite more detailed empirical analysis – systematically distinguishing between national contexts. Triangulating against literature sources, this could be developed into much more detailed accounts of relevant societal conditions – in turn eliciting relevant distinctions and subcategories that would lead to a more fine-grained ISF. (The consideration here has been that increased detail would go at the price of conciseness and overview).

- **Quantification.** The development of the various societal conditions could in principle be specified through quantitative data of past changes or through prospective analyses. Both are available, both within PROSEU and in RES prosumerism scholarship more broadly. Quantitative analyses tend to focus on the relatively more measurable dimensions of RES prosumerism, however (cost and economic parameters; technological efficiency and environmental performance; growth rates of prosumerism initiatives; breakdowns of legal forms), possibly neglecting other aspects (the discursive-ideational dimension alone is notoriously difficult to quantify).
- **Causality.** The notion of ‘incentives’ hints at certain causal relations between stimuli and their effects. With regard to several easily quantifiable variables, it remains relevant to substantiate how certain forms of RES prosumerism can be simply ruled out through hard technological-material constraints, or elusive business cases. There are certain areas in the three ‘directionality diagrams’ that can be effectively ruled out through policy choices or market developments – others may remain possible but only attractive for the few. More attention to these ‘mainstreaming mechanics’ can generate insight into the incentivizing and dis-incentivizing political choices that can be made. On the other hand, the three explorations of directionality have already conveyed how the various formal institutions, technological-material circumstances and discursive structures work are co-shaping the mainstreaming process. It is very problematic to attribute incentivizing and causation to isolated factors.
- **Practical relevance.** The practical relevance of the ISF could arguably be increased if limiting its scope to the identification of ‘enablers’ or supporting instruments towards a particular form of RES prosumerism. On the other hand, the chosen approach has clarified how RES prosumerism is not a practice to cultivate, but rather a complex innovation process to navigate. Much practical value resides in further strategizing the distinguished directions of the mainstreaming process, considering the degrees of freedom in the underlying societal conditions and especially the range of political choices at issue. Practical concretization will be done mainly through the Participatory Integrated Assessment.

7.3 Towards Participatory Integrated Assessment

The main further application for the ISF is the Participatory Integrated Assessment (PIA). The presented set of key societal conditions provides several elements that feed the PIA:

- Identification of crossroads in the mainstreaming process
- A dynamic understanding of the societal conditions that shape RES prosumerism futures
- Identification of multiple forms of RES prosumerism
- Reflection on the branching points and turns in the mainstreaming process that could occur in the short and middle term.

The objective of the PIA as explained in the original Description of Work, is to *“Discuss the [ISF] research findings with relevant stakeholders in a Participatory Integrated Assessment and produce a roadmap (until 2030 and 2050) for mainstreaming RES prosumerism. The Participatory Integrated Assessment will develop options for new incentive structures for the upscaling and mainstreaming of prosumerism.”*

The aim of the PIA process is to validate the outcomes of the ISF and enlarge the pool of experts that is consulted for these incentive structure. Ultimately, the goal is to arrive at a temporalised version of the incentive structures, i.e. a roadmap for 2030/2050. This roadmap will present strategic insights on how to mainstream RES prosumerism in a participatory, inclusive and transparent way, as part of the Energy Union. The roadmap functions to raise awareness among stakeholders, including policy workers, financial institutions and other individuals involved in the energy transition, and to trigger discussion and dialogue on designing interventions.

The PIA consists of three invite-only workshops with experts and frontrunners in the field of prosumerism. The workshops follow the three thematic areas of the ISF briefs. The PIA series is concluded with a fourth and final concluding workshop, in which the inputs are collated and assessed. Whereas the ISF provides input on future diversification and directionality of transitions, the PIA focuses on backcasting from a specific vision of a desired future. During the workshops, the ISF briefs are used as a starting point to problematise the current situation and cast a broad spectrum of possible futures. Together with the group, desirable future images are then further developed. Importantly, sets of societal conditions are then analysed to determine how a roadmap to such a future might look like.

References

This section contains the references from sections 1-3 and 7. Since sections 4-6 should be able to stand-alone, the references in these sections have been included in footnotes.

Akrich, M., Callon, M., Latour, B., & Monaghan, A. (2002). The key to success in innovation part I: the art of intersement. *International journal of innovation management*, 6(02), 187-206.

Avelino, F. & Wittmayer, J.M. (2016), Shifting Power Relations in Sustainability Transitions: A Multi-actor Perspective. *Journal of Environmental Policy & Planning*, 18:5, 628-649

Banja M., Jégard M., Monforti-Ferrario F., Dallemand J.-F., Taylor N., Motola V., Sikkema R., (2017) Renewables in the EU: an overview of support schemes and measures, EUR 29100 EN, Publication Office of the European Union, Luxembourg.

Bauwens, T., & Defourny, J. (2017). Social capital and mutual versus public benefit: The case of renewable energy cooperatives. *Annals of Public and Cooperative Economics*, 88(2), 203-232.

Bening, C. R., Blum, N. U., & Schmidt, T. S. (2015). The need to increase the policy relevance of the functional approach to Technological Innovation Systems (TIS). *Environmental Innovation and Societal Transitions*, 16, 73-75.

Bijker, W. E., & Law, J. (1992). *Shaping technology/building society: Studies in sociotechnical change*. MIT press.

Blyth, W., McCarthy, R., & Gross, R. (2015). Financing the UK power sector: Is the money available?. *Energy Policy*, 87, 607-622.

Bray, R., Woodman, B., Connor, P., (2018), Policy and Regulatory Barriers to Local Energy Markets in Great Britain

Brisbois, M. C. (2019). Powershifts: A framework for assessing the growing impact of decentralised ownership of energy transitions on political decision-making. *Energy Research & Social Science*, 50, 151-161.

Brown, D., Davis, M. E., Hall, S (under review), What is prosumerism for? A reflection on competing normativities in the prosumer energy transition. (Unpublished)

Brown, D., Hall, S., & Davis, M. E. (2019). Prosumers in the post subsidy era: an exploration of new prosumer business models in the UK. *Energy Policy*, 135, 110984.

Burke, M. J., & Stephens, J. C. (2018). Political power and renewable energy futures: A critical review. *Energy Research & Social Science*, 35, 78-93.

Campos, I.; Marín-González, E.; Luz, G.; Barroso, J.; Oliveira, N. (2019) Renewable Energy Prosumers in Mediterranean Viticulture Social–Ecological Systems. *Sustainability*, 11, 6781. <https://doi.org/10.3390/su11236781>

Chilvers, J., & Longhurst, N. (2016), Participation in transition (s): Reconceiving public engagements in energy transitions as co-produced, emergent and diverse, *Journal of Environmental Policy & Planning*, 18(5), 585-607.

Czarniawska, B., & Joerges, B. (1996). *Travels of ideas*. (p. 13-48). Göteborg University-School of Economics and Commercial Law/Gothenburg Research Institute

David, M. (2017). Moving beyond the heuristic of creative destruction: Targeting exnovation with policy mixes for energy transitions. *Energy Research & Social Science*, 33, 138-146.

Davis, M and Cartwright, L (2019) *Financing for Society: Assessing the Suitability of Crowdfunding for the Public Sector*. Report. University of Leeds.

DGRV (2019). DGRV annual survey of energy cooperatives.
<https://www.dgrv.de/en/services/energycooperatives/annualsurveyenergycooperatives.html>

EEFIG (2015) *Energy Efficiency –the first fuel for the EU Economy*How to drive new finance for energy efficiency investments. Final report. European Union.

European Commission (2014). *Energy Technology Reference Indicator projections for 2010-2050*.
<https://publications.jrc.ec.europa.eu/repository/bitstream/JRC92496/Idna26950enn.pdf>

Foxon, T. J., Pearson, P. J., Arapostathis, S., Carlsson-Hyslop, A., & Thornton, J. (2013). Branching points for transition pathways: assessing responses of actors to challenges on pathways to a low carbon future. *Energy Policy*, 52, 146-158.

Fuenfschilling, L. (2019). An institutional perspective on sustainability transitions. In Boons, F. and McMeekin, A. (Ed.). *Handbook of Sustainable Innovation*. Edward Elgar Publishing. 219-236.

Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research Policy*, 43(4), 772-791.

GfK Belgium consortium, (2017) 'Study on "Residential Prosumers in the European Energy Union"', European Commission.

Gosens, J., Hedenus, F., & Sandén, B. A. (2017). Faster market growth of wind and PV in late adopters due to global experience build-up. *Energy*, 131, 267-278.

Grin, J., Rotmans, J., & Schot, J. (2010). *Transitions to sustainable development: new directions in the study of long term transformative change*. Routledge.

Hakawati, R., Smyth, B. M., McCullough, G., De Rosa, F., & Rooney, D. (2017). What is the most energy efficient route for biogas utilization: Heat, electricity or transport?. *Applied energy*, 206, 1076-1087.

Hall, S., Foxon, T. J., & Bolton, R. (2016). Financing the civic energy sector: How financial institutions affect ownership models in Germany and the United Kingdom. *Energy Research & Social Science*, 12, 5-15

Haxeltine, A., Pel, B., Dumitru, A., Avelino, F., Kemp, R., F., Bauler, T., Kunze, I., Dorland, J., Wittmayer, J., and Jørgensen, M. S. (2017), *Towards a TSI theory: a relational framework and 12 propositions*, (TRANSIT working paper 16)

Hewitt, R. J., Bradley, N., Baggio Compagnucci, A., Barlagne, C., Ceglarz, A., Cremades, R., ... & Slee, B. (2019). Social Innovation in Community Energy in Europe: A Review of the Evidence. *Front. Energy Res*, 7, 31.

- HIER opgewekt (2019). Lokale energie monitor 2019.
https://www.hieropgewekt.nl/uploads/inline/Lokale%20Energie%20Monitor%202019_DEF_28-11-2019_1.pdf
- Holstenkamp, L., & Kahla, F. (2016). What are community energy companies trying to accomplish? An empirical investigation of investment motives in the German case. *Energy Policy*, 97, 112-122.
- Horstink, L., Luz, G., Soares, M., & Ng, K. (2019). Review and characterisation of collective renewable energy prosumer initiatives. (Deliverable 2.1). PROSEU: EU H2020- LCE-2017 Grant Agreement 764056. <http://doi.org/10.5281/zenodo.3560960>
- Inderberg, H. J., Tews, K., & Turner, B. (2018) Is there a Prosumer Pathway? Exploring household solar energy development in Germany, Norway, and the United Kingdom. *Energy & Social Science*, vol. 42.
- International Energy Agency (IEA) (2014). Technology Roadmap - Solar Photovoltaic Energy 2014 edition.
- Jasanoff, S. (Ed.). (2004). States of knowledge: the co-production of science and the social order. Routledge.
- Kern, F. (2011). Ideas, institutions, and interests: explaining policy divergence in fostering 'system innovations' towards sustainability. *Environment and Planning C: Government and Policy*, 29(6), 1116-1134.
- Khan, I. U., Othman, M. H. D., Hashim, H., Matsuura, T., Ismail, A. F., Rezaei-DashtArzhandi, M., & Azelee, I. W. (2017). Biogas as a renewable energy fuel—A review of biogas upgrading, utilisation and storage. *Energy Conversion and Management*, 150, 277-294.
- Köhler, J. et al. (2019). An agenda for sustainability transitions research: state of the art and future directions. *Environmental Innovation and Societal Transitions*. <https://doi.org/10.1016/j.eist.2019.01.004>
- Loorbach, D. (2007). Transition management. *New mode of governance for sustainable development*. Utrecht: *International Books*.
- Loorbach, D., Frantzeskaki, N., & Avelino, F. (2017). Sustainability transitions research: transforming science and practice for societal change. *Annual Review of Environment and Resources*, 42, 599-626.
- Mazzucato, M., & Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting and Social Change*, 127, 8-22.
- Novosel, T., Pukšec, T., Kampman, B., Scholten, T., Naber, N., Gährs, S., & Knoefel, J. (2019). Prosumer technology database (Version v01) [Data set]. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable N° 5.1) <http://doi.org/10.5281/zenodo.2611147>
- Pel, B. (2016). Trojan horses in transitions: A dialectical perspective on innovation 'capture'. *Journal of environmental policy & planning*, 18(5), 673-691.
- Pel, B. (2019), Business models of energy prosumers: Energy and the institutional imagination, Blog Dutch Research Institute for Transitions, <https://drift.eur.nl/publications/business-models-energy-prosumers/>
- Pel, B., Raven, R.P.J.M. & van Est, Q. (under review), The Governance of Transitions Directionality: Cultivating Driverless Cars or Synchronizing Cooperative Systems?, *Technological Forecasting and Social Change*

Pel, B., Wallenborn, G., & Bauler, T. (2016). Emergent transformation games: exploring social innovation agency and activation through the case of the Belgian electricity blackout threat. *Ecology and Society*, 21(2).

Pel, B., et al.. (2017) The Critical Turning Points database; concept, methodology and dataset of an international Transformative Social Innovation comparison, (TRANSIT Working Paper # 10), TRANSIT: EU SSH.2013.3.3.2-1 Grant agreement no: 613169., <http://www.transitsocialinnovation.eu/resource-hub/the-critical-turning-points-database-concept-methodology-and-dataset-of-an-international-transformative-social-innovation-comparison-transit-working-paper-10-july-12th-2017>

Petrick, K., Fosse, J., Klarwein, S. (2019). Strategies for Policy Coherence and Sustainability – Relevance of EU policies and frameworks for prosumers. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable 3.2).

REScoop. (2017). RES202020-Report on financial barriers and existing solutions [Deliverable 4.1] [Intelligent Energy Europe Programme of the European Union].

Römer, B., Reichhart, P., Kranz, J., & Picot, A. (2012). The role of smart metering and decentralized electricity storage for smart grids: The importance of positive externalities. *Energy Policy*, 50, 486-495.

Rosenbloom, D., Haley, B., & Meadowcroft, J. (2018). Critical choices and the politics of decarbonization pathways: exploring branching points surrounding low-carbon transitions in Canadian electricity systems. *Energy Research & Social Science*, 37, 22-36.

Rotmans, J., Kemp, R., & Van Asselt, M. (2001). More evolution than revolution: transition management in public policy. *Foresight*, 3(1), 15-31.

Schlaile, M., Urmetzer, S., Blok, V., Andersen, A., Timmermans, J., Mueller, M., ... & Pyka, A. (2017). Innovation systems for transformations towards sustainability? Taking the normative dimension seriously. *Sustainability*, 9(12), 2253.

Shove, E., Trentmann, F., & Wilk, R. (Eds.). (2009). *Time, consumption and everyday life: practice, materiality and culture*. Berg.

Singh, V. K., & Singal, S. K. (2017). Operation of hydro power plants-a review. *Renewable and Sustainable Energy Reviews*, 69, 610-619.

Smith, A. (2007). Translating sustainabilities between green niches and socio-technical regimes. *Technology analysis & strategic management*, 19(4), 427-450.

Stirling, A. (2011). Pluralising progress: From integrative transitions to transformative diversity. *Environmental Innovation and Societal Transitions*, 1(1), 82-88.

Stirling, A. (2016) *Knowing Doing Governing: Realizing Heterodyne Democracies*. In Voß, J. P. & R. Freeman (2016) (eds) *Knowing Governance. The Epistemic Construction of Political Order*. Palgrave Macmillan, New York, pp. 259-286

Stirling, A. (2019), "How deep is incumbency? A 'configuring fields' approach to redistributing and reorienting power in socio-material change." *Energy Research & Social Science* 58 (2019): 101239.

- Taylor Aiken, G. (2019). Community as tool for low carbon transitions: Involvement and containment, policy and action. *Environment and Planning C: Politics and Space*, 37(4), 732-749.
- Toporek, M., & Campos, I. (2019). Assessment of existing EU-wide and Member State-specific regulatory and policy frameworks of RES Prosumers (Deliverable 3.1). <http://doi.org/10.5281/zenodo.2607939>
- Verbong, G., & Loorbach, D. (Eds.). (2012). *Governing the energy transition: reality, illusion or necessity?*. Routledge.
- Vladimir Janković & Andrew Bowman (2014) After the green gold rush: the construction of climate change as a market transition, *Economy and Society*, 43:2, 233-259, DOI: 10.1080/03085147.2013.791511
- Voß, J. P., Smith, A., & Grin, J. (2009). Designing long-term policy: rethinking transition management. *Policy sciences*, 42(4), 275-302.
- Wittmayer, J.M., Avelino, F., Pel, B. & I. de Campos (under review), *Hybridising Energy? Mainstreaming the Prosumerism of Renewable Energy across Institutional Logics*.
- Wittmayer, J.M., Fraaije, M., Horstink, L. & Avelino, F. (2019). A multi-dimensional typology of collective RES prosumers across Europe. PROSEU - Prosumers for the Energy Union: Mainstreaming active participation of citizens in the energy transition (Deliverable N°2.2).
- Yildiz, Ö. (2014). Financing renewable energy infrastructures via financial citizen participation—The case of Germany. *Renewable Energy*, 68, 677-685.
- Zepter, J. M., Lüth, A., del Granado, P. C., & Egging, R. (2019). Prosumer integration in wholesale electricity markets: Synergies of peer-to-peer trade and residential storage. *Energy and Buildings*, 184, 163-176.