Participation in Energy Transition. The Potential and the Coordination of Energy Communities

THESIS

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by

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Participation in Energy Transition

The Potential and the Coordination of Energy Communities

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Management Summary

The Swiss electricity sector aims to have a future that is greener, cheaper, fairer and more reliable. With the approval of the new Energy Act (EnA), politicians and society anticipate a more participative role of Swiss households concerning such major energy-related aims. However, the question arises whether such expectations are actually justified.

This thesis relativizes major expectations regarding a more participative attitude of Swiss householders living in low-density suburban areas. Despite a broader range of energy-related decision-making being linked to energy prosumption and new organizational forms of energy provisions, such as local Energy Communities, the research results show that Swiss householders do not intent to significantly change their contribution behaviour towards common energy goals. Moreover, there seems to be no current alternative than to reward/incentivize energy-related contribution; oblige participation in energy transition, although beneficiary for everyone, seems not a promising energy governance approach to tackle energy-related challenges.

However, refined research results also suggest that individual variables (Social Value Orientation), social variables (group composition of Energy Communities) and the interaction of these variables influence energy-related contribution intention. Thus, expectations regarding increased Swiss households participation are only justified when controlled for different social psychological variables.

The energy transition is anything but self-driven. It requires fundamental knowledge on how individual and social variables interact and finally affect participation in energy transition. The thesis suggests that market and governance designs actively should amplify participation-enhancing attitudes. The thesis also provides insights on the role of energy service providers and on how they provide services to households engaging in energy transition.

Acknowledgement

Writing a PhD thesis is like a treasure quest in uncharted territory: you are sure that there is something out there worth searching for, but the path to it is highly adventurous. Along such a quest, frustration, disorientation and solitude alternate with pride, curiosity and joy. The fact that I finally finished the quest is also due to many persons that supported me along the trail. There are some ‘trail angels’ that I would like to express my sincere thanks to.

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List of Abbreviations

ANOVA	Analysis of Variance
CFC	Consideration of future consequences
DER	Distributed Energy Resources
DG	Distributed Generation
DOEC	‘Difference between own and expected contribution’
DSM	Demand Side Management
ECMF	Energy Community Management Framework
EnA	Energy Act
ES 2050	Energy Strategy 2050
EQ	Eliminatory Question
ENFK	Konferenz kantonaler Energiefachstellen*
EVG	Eigenverbrauchsgemeinschaft*
iGSL	intelligent Generation-Storage-Load Infrastructure
MuKEn	Mustervorschriften der Kantone im Energiebereich*
RE	Renewable Energy
REScoop	Federation of Groups and Cooperatives of Citizens for Renewable Energy in Europe
RKGK	Regierungskonferenz der Gebirgskantone*
SEB	Sustainable Energy Behaviour
SVO	Social Value Orientation
QE	Questionnaire Experiment
VSE	Association of Swiss Utilities

‘*’ no official English abbreviation, wording or name.

1 Introduction

"We need to make participation in energy transition trendy, fashionable, and exciting"
- Bertrand Piccard, Chairman of the Solar Impulse Foundation[1]

Bertrand Piccard's call at the Berlin Energy Transition Dialogue in March 2017 reveals an inconvenient truth for policy-makers, businesspersons and scholars likewise: despite enormous technological progress, decreasing prices for renewables and increasing environmental challenges, the energy transition seems not to have gained as much traction as desired. Simultaneously, green energy advocates like Piccard argue that the shift from a fossil- to a renewable energy system is of unprecedented importance, not only for our planet but also for the species that affects the earth like no other species: *homo sapiens*.

Human behaviour plays a crucial role in this transition. The current energy transition is inherently social and requires broad societal participation. The achievement of energy goals that were defined along this transition are related to individual contributions for a greater societal benefit. Energy-related contributions like individual investments, behavioural adjustments and increased sense of responsibility are needed to reach a sustainable energy future. Although everyone in Switzerland would benefit from such a future, its contributions are costly, remain voluntarily, and might be even free-ridden by other individuals.

This doctoral thesis is an intellectual contribution towards a greener energy future. It aims to deliver new academic knowledge on how to increase participation and reduce freeriding behaviour in the context of the Swiss energy transition using measures from social psychology. As pointed out by the literature (e.g. Geels 2011), energy transitions are susceptible to face insufficient provision of individual support. Energy transitions and their goals are *Public Goods*, which allow freeriding behaviour and may finally lead to a *Social Dilemma*, i.e. a situation in which selfish reasoning leads to collective losses. Next to classical economic instruments, social psychological measures are shown to be efficient alternatives to solve such dilemmas.

[1] Quoted in: Amelang and Wehrmann (2017).

The thesis investigates the potential of new emerging forms of energy market designs from a social psychological point of view. It compares the potential effect of ‘energy communities’ on the householders’ intention to contribute to the energy transition compared to the current energy market design baseline. In a second step, it sheds light on how such energy communities need to be designed and energy-related contributions coordinated in order to increase the social acceptance of such energy market designs.

The first part, ‘The Potential of Energy Communities’, investigates how social identification affects the intention to contribute to the Swiss energy transition. This part is characterized by replication of acknowledged social-psychological research and concepts. More precisely, it analyses if the anticipated effect of social identification, confirmed in other Social dilemma situations, are replicable in an energy-related dilemma, i.e. Swiss energy transition. According to two empirical investigations, the results suggest a rather nuanced effect of social identification on energy-related contribution intention.

The second part, ‘The Coordination of Energy Communities’, follows a more data-driven approach and considers governance-related and managerial aspects of energy communities. Research outcomes highlight new insights on how such energy markets designs should coordinate energy-related contributions in order to maximize social acceptance. Research results suggest that a fragile dominant design regarding energy community-coordination occurs.

1.1 Aim of the Thesis

The general aims were mentioned earlier. Subsequently, the examination process behind the general aims are described. Specific aims, and examination processes of both parts of the thesis, 'The Potential of Energy Communities' and 'The Coordination of Energy Communities', are presented separately.

The Potential of Energy Communities

The aim of the first part is to identify the potential of energy communities regarding changes in Swiss householders' intention to contribute to the Swiss energy transition compared to the current market design. Given identified research gaps, a first guiding question was stated:

Do energy communities amplify energy-related contribution intention among traditional electricity end-users?

In a first step, two different forms of energy communities with salient social identity were identified: (A) 'Energy Neighbourhoods' and (B) 'Energy Clubs'. Energy neighbourhoods constitute an *organized purpose community of neighbours in low-density suburban areas, which collectively contribute to energy goals or energy-related goals for all members*. Energy clubs constitute the same community but with important changes in its composition: *an organized purpose community of service club members, which collectively contribute to energy goals or energy-related goals for all members*. According to social-psychological literature, it is expected that both forms of energy communities would amplify energy-related contribution intention compared to the baseline design with an anonymous group composition, 'Anonymus'. More precisely, group compositions with salient social identification showed to have positive effects on the level of contributions of individuals with an individualistic and competitive Social Value Orientation (Cremer and van Vugt 1999). The level of contributions of individuals with a prosocial Social Value Orientation should remain unaffected to changes in group compositions since their default choice is already of a cooperative nature.

In order to answer the first guiding question, several hypotheses were stated. Given the replication-based approach and the comparative nature of the guiding question, hypotheses were replicated and adapted from the original literature (cf. Cremer and van Vugt 1999).

H1A resp. H1B: Social identification scores in the condition 'Energy Neighbourhood' (resp. 'Energy Club') are higher than the social identification scores in the condition 'Anonymus'.

H2A resp. H2B: A main effect for SVO is expected such that a greater proportion of prosocials than individualists and competitors intend to contribute to the community goals.

H3A resp. H3B: A main effect for social identification is expected such that average contribution intention scores in 'Energy Neighbourhood' (resp. 'Energy Club') are higher than in 'Anonymus'.

H4A resp. H4B: In the condition 'Energy Neighbourhood' (resp. 'Energy Club'), individualists and competitors will contribute more than individualists and competitors in the condition 'Anonymus'.

To verify or reject the research hypothesis, data from a questionnaire experiment, using a Posttest-Only Control Group Design, were obtained and analysed. Data collection took place in spring 2017 for (A) Energy Neighbourhoods and in in spring 2018 for (B) Energy Clubs.

The Coordination of Energy Communities

The aim of the second part of the thesis is to generate new insights on how such energy market designs should coordinate energy-related contributions in order to maximize social acceptance of such. Hence, this part combined research from social psychology and research on governance. Given identified research gaps, a second guiding question was stated:

To which degree do traditional electricity end-users want to institutionalize energy-related contribution behaviour among energy community members?

A potential solution to increase contribution in an Energy Neighbourhood or an Energy Club are rules. Rules lead on one side to a functional community with ensured collective outcomes (Ostrom 1990). On the other side, rules deprive community members from individual freedoms and decision-making. To increase the social acceptance of energy communities, rules must be well designed and adapted to the community members' needs.

This part of the thesis followed a data-driven research approach, for which theoretical knowledge is missing. Data were obtained and analysed by/through the same elicitation method like the first part. The guiding question is finally divided into four research questions:

- **Question 1: '*Which energy-related tasks will be regulated by an energy service provider and to which degree?"***
- **Question 2: '*How do householders differ in their characteristics?'***
- **Question 3: '*What are the different justifications to regulate energy-related tasks?*'**
- **Question 4: '*What is the role of an energy service provider in a setting of energy-related interdependence?''***

1.2 Structure of the Thesis

Figure 1 provides an overview over the thesis' structure. The thesis comprises three main stages. Each stage includes stage-dependent research objectives. The chapters within a particular stage deliver single outcomes for the correspondent stage's objectives. Moreover, each chapter systematically explains its raison-d'être by pointing out a) its content (what), b) its approach (how) and c) its relation with the stage objectives (why). The chapters' content-related outcomes are transferred to the following chapter and therefore guarantee a congruent research process.

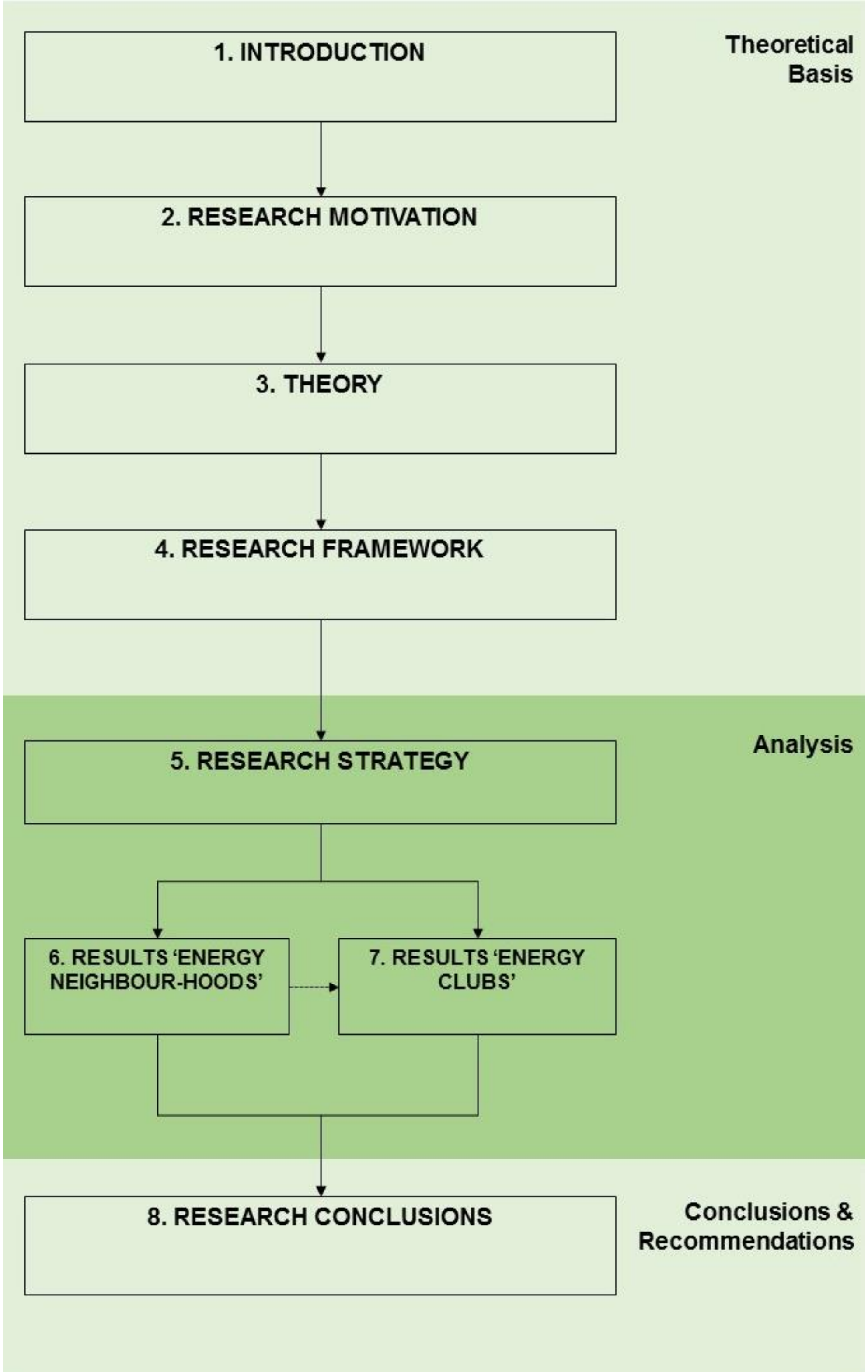


Figure 1: Structure of the Thesis

First stage: Theoretical Basis

The first stage constitutes the theoretical or scientific basis of the research process. Again, the objectives of the theoretical basis rely on the scientific outcomes of the first four chapters as shown in Figure 2. Next to the chapters' outcomes for the stage's research objective (horizontal arrows in Figure 2), each chapter generates content-related outcomes that are incorporated in the subsequent chapter (vertical arrows). Content-related outcomes will be specified in the inherent conclusion sections.

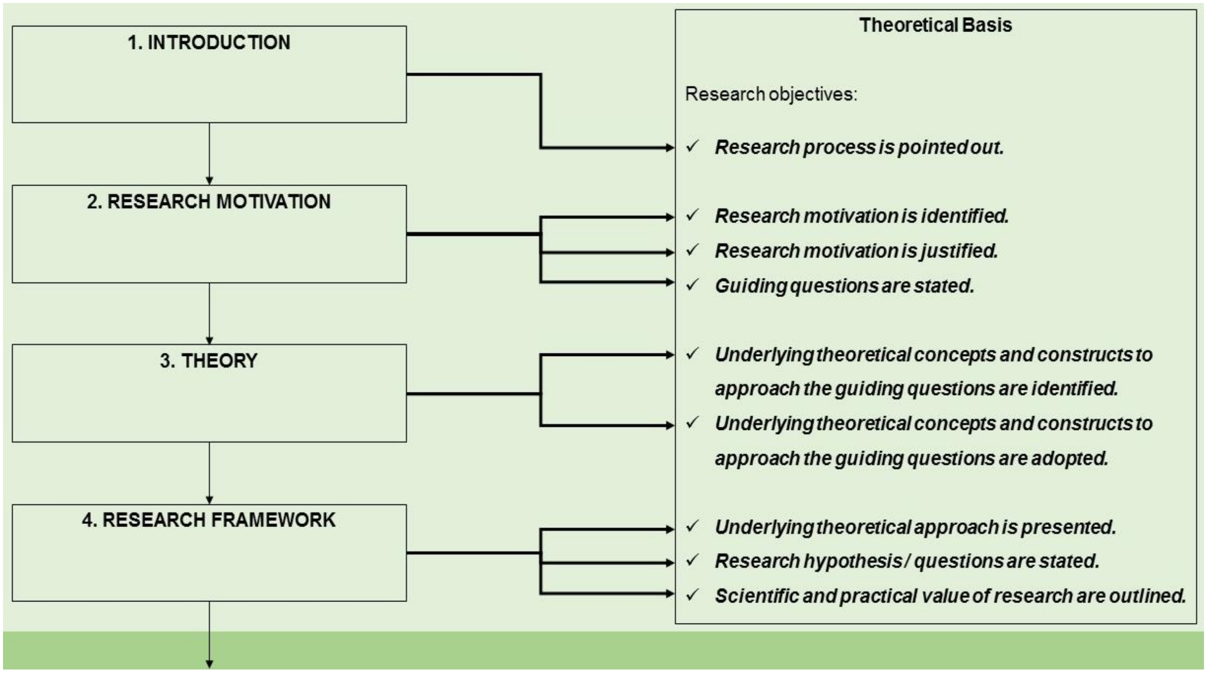


Figure 2: Research Objectives of the first stage

The first chapter of the thesis is the introduction. Its content (*what*), approach (*how*) and c) its relationship with the stage objectives (*why*) were already described earlier and do not require further specification.

The second chapter's scientific objective is to identify and justify the research motivation as well as to state first guiding questions (*why*). The chapter sets the scope of research, reviews literature, demonstrates limits of current research approaches, and introduces a more suitable research approach (*what*). Finally, the chapter identifies 'Energy Prosumerism' and 'Energy Communities' as potential outcomes of the Swiss energy transition, reviews scholars' expectations of both constructs, demonstrates important limits of independent energy behaviour research in regards to participation in energy transition, and introduces energy-related contribution behaviour as a more suitable approach to investigate participation in energy transition (*how*).

The third chapter identifies and adopts the underlying theoretical concepts and constructs to approach the guiding questions (*why*). It sets the scope of the research from a theoretical perspective, provides a roadmap in terms of language, and sets the research claim (*what*). The chapter introduces the reader to the 'interdependency theory' and related social-psychological concepts, clarifies and explains decision-making processes in social dilemma situations, and highlights the underlying functioning of the 'goal-transformation' hypothesis (*how*).
The fourth chapter presents the underlying theoretical approach, states the research hypothesis/questions, and outlines the scientific and practical value of the research (*why*). It lays the theoretical foundation for an empirical investigation and reifies the point of view of the research investigation (*what*) by combining the theoretical scope of research and the research motivation (*how*).

Second stage: Analysis

The second stage constitutes the analytical stage of the research process. The analytical stage relies on the scientific outcomes of chapters 5 to 7 as shown in Figure 3. The horizontal arrow between the two results-chapters illustrates that the research endeavour 'Energy Clubs' chronologically resulted after the initial research intention ('Energy Neighbourhoods').

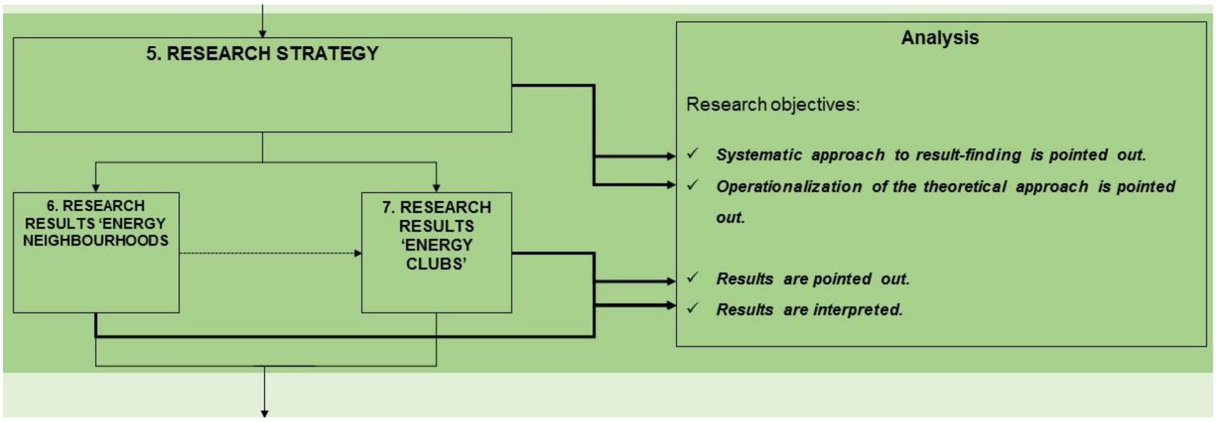


Figure 3: Research Objectives of the second stage

The fifth chapter points out the systematic approach for result finding and operationalizes the theoretical approach (*why*). It states the research strategy (*what*), by describing, explaining and justifying its components by highlighting the interrelation between the different components, and by assessing the final research quality (*how*).

Chapter 6 and 7 are identical in terms of content, approach and their relationship with the stage objectives. Both chapters highlight the results of the empirical investigation as well as interpret them (*why*). Both chapters distinguish (*how*) between results and positivist/postpositivist interpretation (*what*).

Third stage: Conclusions and Recommendations

The third stage constitutes the final stage of the research process (see Figure 4).

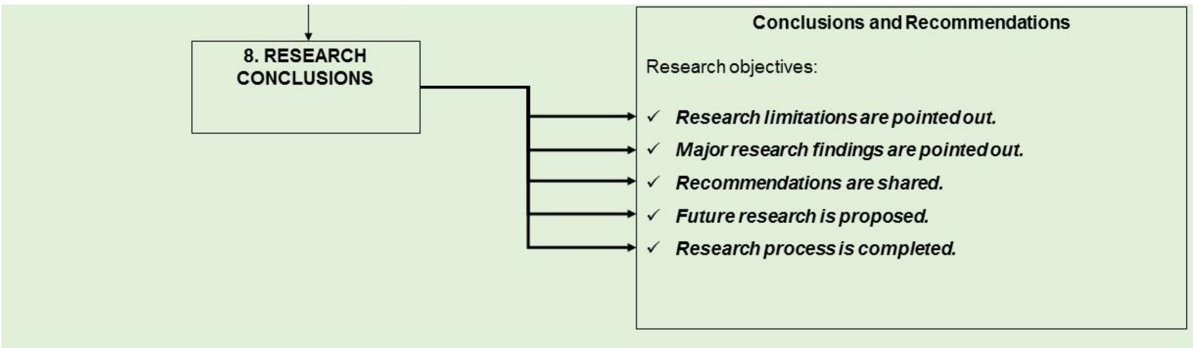


Figure 4: Research Objectives of the third stage

Finally, the last chapter points out the major findings, shares recommendations, points out the limitation of the research, and completes the research process (*why*). It recaps the results and interpretation linked to the research hypotheses/questions, recapitulates unintended and interesting research results, reviews the research process, and systematically suggests further research propositions (*what*). The chapter recaps the research results and interpretation from a positivist/postpositivist point of view, critically reviews the entire research process and divides future research propositions into different categories (*how*).

1.3 Reader Guidance and Definitions

This thesis aims to meet scientific claims that go along with the *philosophiae doctor* as well as to provide new scientific knowledge to people that are generally interested in the researched topic. To meet both claims, the thesis makes use of boxes. The blue boxes are complementary to the full text and describe or illustrates certain phenomena in more details (see Table 1). The aim of the blue boxes is to provide helpful background information and to illustrate examples of theoretical concepts. The orange boxes constitute mostly the 'description'-part of the 'description-explanation-justification' chain of reasoning. The introduction of the orange boxes has three goals.

First, it allows non-scholars to receive information that else would have been either put in the appendix chapter or found in the thesis in the form of a side note. Second, their complementary nature enables scholars, who already understand such phenomena to focus on thereon constructing chain of reasoning, i.e. explanation and justification. Finally, the introduction of description boxes is expected to improve the reading flow.

The Energy Strategy 2050	*provides* background information about the Energy Strategy 2050	Chapter 2.1
The cases of • 'Anna & Bob', • 'Claudia & Thierry' and • 'Bonnie and Clyde'	All three cases *illustrate* different examples of situations of interdependence. Based on these, social psychological phenomena are further *explained*.	Chapter 3.1
• Research Design • Overview of Experiments • Overview of Experimental Design • Principles of Sampling • Principles behind Construct Validity	Six components of the Research Strategy are *described* in form of boxes. After *describing* these, the chosen methodological approach is further *explained* and *justified*.	Different sections in Chapter 4

Table 1: Overview of Boxes

Terms and Definitions

Terms and theoretical and operational definitions will be highlighted in the appropriate chapters and sections. However, to further increase the comprehension of the used terminology and to delimit such from other definitions, Table 2 provides an overview over the most prominent terms as well as their definitions. Hereinafter, 'energy' might be used interchangeably with 'electricity' to allude to the general challenge of the Swiss energy transition. The author is aware that from a technical and scientific perspective, the terms differ to a very important degree. The thesis consciously excludes any technical aspects along the energy transition, which dominates the worldwide energy research focus (Sovacool 2014) but emphasize the social aspects of it. If not otherwise stated, definitions are research outcomes by the authors. Possible multiple naming for the same content issues are excluded by an early mentioning of the definitions.

Term	Definition
Energy Prosumers	"energy consumers which are directly or indirectly, individually or collectively, completely or partially self-sustaining in terms of energy and should the occasion arise, share its own produced energy surplus with other energy consumers." (Hellmann 2018, p. 507)
Energy Citizens	"active participants to be democratically engaged in sustainable energy transitions."(Ryghaug et al. 2018, p. 288)
Energy Community	'an organized purpose community of individuals, which collectively contribute to energy goals or energy-related goals for all members'.
energy-related contributions	'all kind of capital needed to achieve the collective energy-related goal. This includes both, onetime and continuous contributions, as well as financial investments and changes in energy conservation behaviour'.
Energy Service Provider	'An energy service provider fulfils the by the community defined duties to coordinate and orchestrate energy-related behaviours of all energy community members for the common goal'.
The Potential of Energy Communities	describes 'the relative positive effect of 'social identification' within an energy community on an individualists'/competitors' energy-related contribution intention'.
The Coordination of Energy Communities	refers to 'the competence allocation of energy-related decision-making between an individual and an energy service provider'.

Table 2: Terms and Definitions

2 Research Motivation

In a first step, the ongoing energy transition is highlighted from a sociotechnical point of view. This allows the identification of major drivers of the transition and in a second step, the identification of anticipated changes for the sociotechnical regime of electricity provision in Switzerland. The third section points out particularities of the Swiss energy transition and scrutinises expectations regarding the anticipated changes. It does so by questioning the expectations regarding the new public role as 'energy citizens' rather than 'energy customers' from an interdependent energy behaviour-point of view. The fourth section highlights the changing type of energy governance along the transition. Figure 5 provides an outlook of the chapter.

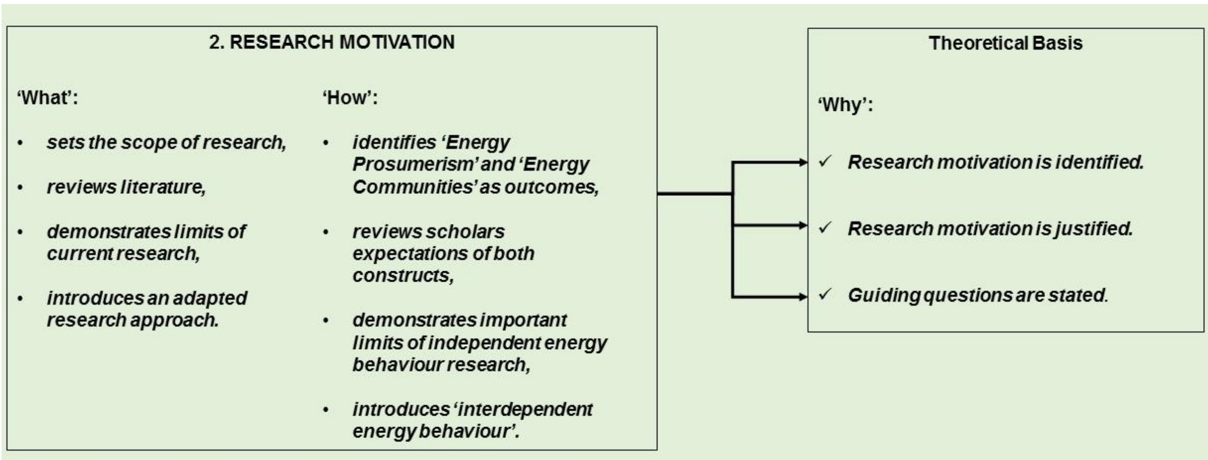


Figure 5: Chapter two, Outlook

2.1 The Energy Transition

In 2017, households accounted for 27.8% of Switzerland's final energy consumption and were after the 'traffic'-group for being the most important customer of energy. Electrical energy accounted for 24,8% of Switzerland's final energy consumption (BFE 2018k).[2] Statistically, Switzerland could cover approximately 97% of its electricity consumption through domestic production (BFE 2018j). However, since seasonal electricity production cannot cover the domestic electricity demand, Switzerland depends periodically on important electricity imports. Households constitute with 19'228 GWh, or 32.9% (even 34% in winter), the largest group of electricity consumers (BFE 2018j). Hence, households' electricity consumption accounts for approximately

[2] Only fuel as energy carrier was with 49.2% even more important than electricity.

8.15% of Switzerland's final energy consumption and is after fuel-based traffic (34%), and households' fuel consumption (9%) the third largest customer group of energy consumption (BFE 2018k).

At first look, 8.15% seems to be a negligible number. However, the focus on households as customer group and electricity as energy source plays a crucial role in the energy transition. In 1980, fuel accounted for 164,890 Terajoule (TJ) or 68% of the households' total energy consumption, while electricity added up to 36,270 TJ or 15%. In 2017, only 76,210 TJ of fuel (32.3%) was consumed, while electricity and renewables (sun, wind, biogas, environmental heat) accounted for 69,220 TJ (29.4%), and 15,440 TJ (6.5%) respectively (BFE 2018k). Although similar trends are observable in other customer groups, e.g. industry, services, and agriculture, the household customer group experiences within the last decades important changes in its energy mix. Contrary to the households, the electrification of the traffic customer group lags behind: heavy motors, missing charging stations, and cheap fuel prevented a mainstream electrification of the group (Paquier 2010).

Since individuals are responsible for a substantial share of the total energy consumption in Switzerland, achieving the societal goals of the energy transition also requires reduction of individual energy and electricity consumption (Burger et al. 2015). Compared to other forms of energy use, electricity consumption is mostly a conscious choice of appliances and of their duration and modes of use (Fischer 2008), which again can be understood by mere individual factors.

Simultaneously, households increasingly use solar power to produce electrical energy themselves. Within the last six years, electricity production through solar power increased six fold (BFE 2018l). Consequently, electricity use and production through households experienced important dynamics that are, worth a closer look.

Hence, electrical energy is indispensable for all modern societies. Electrical energy not only covers basic needs, but it also represents the backbone for the vital functioning of most societal parts in modern life, especially in living and housing. As such, a pure technological comprehension of electrical energy or other forms of energy sources (e.g. water, heat, gas, fuels, coal, or wood) is too short-sighted. Although the energy sector can be understood as a *technical regime*,[3] its trajectories, definition and development are influenced by societal actors, e.g. users, policy makers, societal groups, suppliers, scientists, capital banks etc. (cf. Geels 2002).

By including societal actors, a *sociotechnical regime* can be understood as a set of semi-coherent rules carried by the autonomous but interdependent actors that finally coordinate and reproduce various elements, such as culture, structure and practices of the electricity sector (Geels 2002, 2004; Nevens et al. 2013). Sociotechnical regimes are dynamically stable, meaning that the prevailing rules within the regime account for lock-ins and stability and only ‘produce’ incremental changes (Geels and Schot 2010). A regime’s trajectory remains therefore continuous and predictable. However, the trajectories of a sociotechnical regime may also experience important turbulences either by increasing momentum of niche technologies and/or by strengthened exogenous pressure (Geels 2014).

Niches are protected and insulated from the regime’s set of rules and act as an incubation room for radical innovations (Schot 1998). Niches provide locations for learning processes and provide at the same time important social networks that support the expensive and low-performing niche technology (Geels 2002).

The sociotechnical *landscape* can be described as the “exogenous environment beyond the direct influence of niche and regime actors” (e.g. macro-economics, deep cultural patterns, macro-political developments, and changing political concerns) (Geels and Schot 2007, p. 400). Thus, changes in the landscape occur slowly.

The interaction of all three levels finally explains technological breakthroughs in mainstream markets (cf. Geels 2002; Geels et al. 2017). The alignment of niche innovations and exogenous pressure with a sociotechnical regime goes beyond just new technology adoption, but it leads to new infrastructures, establishment of new markets, development of new social preferences, and adjustment of user practices which finally adjust the regime as a whole (Geels et al. 2017). Figure 6 illustrates the interaction of all three perspective.

[3] A technical regime is defined as “a rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems; all of them embedded in institutions and infrastructures” (Rip and Kemp 1998, p. 340.

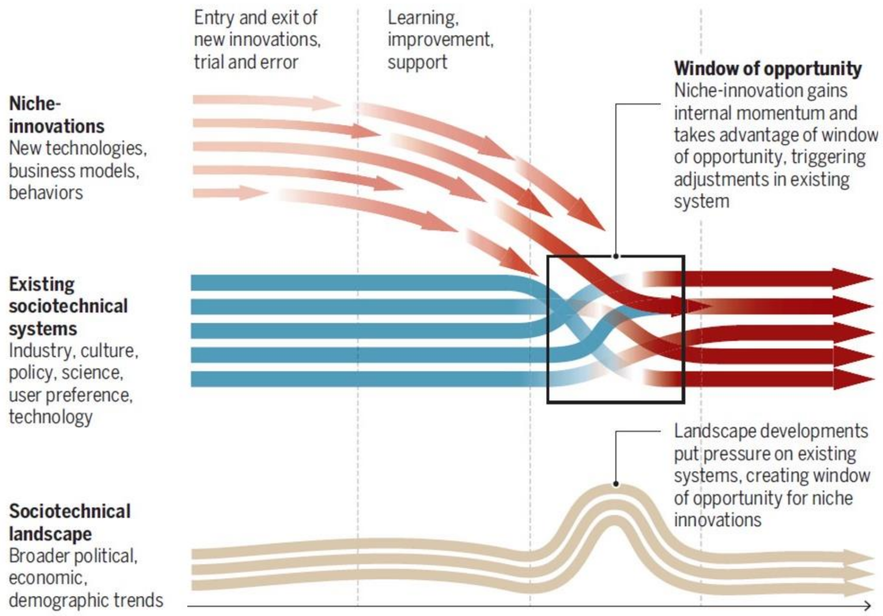


Figure 6: Sociotechnical Transition

Source: adapted from Geels et al. 2017[4]

The sociotechnical regime of electricity provision in Switzerland is currently undergoing such adjustments. Although worldwide sociotechnical regimes of electricity provision experience the same endeavours, a snapshot of the Swiss regime and its particularities, will be provided in the following paragraphs. Further, current niche innovations of and landscape pressure on the sociotechnical regime of electricity provision in Switzerland are shown.

Niche Innovations

Along with other countries, Switzerland feels an ongoing urge to decarbonize its energy sector and reduce its amount of fossil fuels-based energy production. On a global scale, Switzerland ratified different agreements that directly or indirectly oblige to adjust and reconfigure its energy production.[5] Such sociotechnical landscape pressure goes along with the advancements of distributed Renewable Energy (RE) generation technologies. Such technologies enable the connection of a renewable electric power source directly to the distribution network or on the customer site of the meter (Ackermann et al. 2001). Hence, electricity generation based on solar, wind, hydro,

[4] Note that the authors used the word ‘system’ and ‘regime’ interchangeably.

[5] e.g. the 1987 ‘Montreal-Protocol’, the 1992 ‘United Nations Framework Convention on Climate Change-treaty of Rio de Janeiro’, the 1997 ‘Kyoto-Protocol’, and the 2015 ‘Paris-Agreement’.

and biomass energy occur across different small-scale power plants. The technologies as well as their adaption are situated in different stages of development (DNV 2014; Puttgen et al. 2003). Nevertheless, distributed RE technologies are considered to cover an important amount of Switzerland's future electricity demand (BFE 2018b).

Sociotechnical Regime

Contrary to other countries, the sociotechnical regime of electricity provision in Switzerland has a long tradition with decentralized and renewable electricity production (Kupper and Pallua 2016). Although many future electricity provision scenarios exist (Hojčková et al. 2018; VSE 2012), the potential formation of a sociotechnical regime that integrates previously mentioned technologies and orchestrates electricity provision based on an increasing amount of distributed RE technologies must seriously be considered. Next to the historical arguments of decentralized or distributed electricity provision in Switzerland (see: Kupper and Pallua 2016), other reflections regarding the current characteristics of the sociotechnical regime support this standpoint:

- **Topography** – The Alps account for approximately 60% of surface in Switzerland. The mountainous elements of the country are the origins of some of Europe's largest rivers and serve at the same time as natural containment for water. Given such characteristics, power generated by 650 river power plants, storage plants, and pump storage plants account for 57% of Switzerland's electricity production (BFE 2018f). An important amount of the hydropower (63%) originates from the four mountain cantons in Uri, Grisons, Ticino and Valais. Consequently, the sociotechnical regime for electricity provision in Switzerland is already characterized by a) decentralized and b) renewable electricity provision.
- **Direct democratic system & appeal options** – In accordance with federal and cantonal constitution, citizens in Switzerland are equipped with wide political rights, like appeals, objections, or legislation amendment. Building law projects can therefore easily be slowed down or even cancelled. Larger projects of utilities regularly faced such oppositions.[6] Accordingly, the sociotechnical

[6] e.g. 'Windpark Schwyberg' (Aebischer Karin 2016), 'Windpark Bilten' (Linth gegen Wind 2018), and nuclear waste repository in Wolfenschiessen (Frey et al. 1996.

regime for electricity provision in Switzerland is shaped by active citizen participation and civil co-determination.

- **Spatial limits** – as a small country with high population-density in the ‘Mittelland’, Switzerland has only limited spatial capacities for large utility projects. Contrary to other European countries, Switzerland has less spatial capacities for larger offshore/onshore wind parks or solar farms. Thus, spatial restrictions lead to RE production on a micro or a small scale. At the same time, the missing spatial capacities for larger RE projects also explain why per capita RE production through wind and solar power in Switzerland is below average when comparing with other European countries (Bandhauer and Nipkow 2018). Accordingly, the sociotechnical regime for electricity provision in Switzerland attracts micro- and small-scale RE production solutions.
- **Federal energy policy** – Currently, approximately 700 utilities ensure the provision of electrical energy in Switzerland (BFE 2017). The large amount of utilities can be explained the general federal structure in Switzerland. Swiss cantons and municipalities have, compared to other comparable political entities within European countries, greater political freedom. Such delegation of political rights, i.e. the subsidiarity concept, is also reflected in the Swiss energy policy. Each of the 26 cantons can to some large degree define energy-related policies and agendas. The devolution of such rights leads to differing elaboration of energy policy-relevant aspects, measures, and strategies among the different cantons and municipalities (Kammermann and Ingold 2018; Widmer and Strebel 2011). However different channels, e.g. ‘Konferenz kantonaler Energiefachstellen’ (EnFK), ‘Mustervorschriften der Kantone im Energiebereich’ (MuKEn), ‘Regierungskonferenz der Gebirgskantone’ (RKGK), and different regional domain expert conferences, facilitate policy diffusion on the cantonal level. Further, the implementation of cantonal energy policies can be delegated to the municipalities themselves (Widmer and Strebel 2011). Consequently, Swiss cantons and municipalities are also often majority shareholders of diverse utilities that provide electricity (as well as other forms of utilities) within the respective political borders.

  Finally, along with other types of regimes (e.g. healthcare, police and security, and education) the sociotechnical regime for electricity provision in Switzerland incorporates multiple regional and even local sociotechnical regime for electricity provision. The fragmentation of the regimes in combination with direct democratic principles reflects the citizens' interests and acceptance of energy policies and technologies. Accordingly, some regional or local regimes are more willing to include, test, and apply new niche technologies, solutions or policies on a small scale than others.[7] Therefore, the federal energy policy promotes micro- and small-scale RE production solutions.

Considering these four points, the adoption of distributed RE technologies, as niche innovations, through the sociotechnical regime for electricity provision in Switzerland is facilitated. Consequently, the future sociotechnical regime for electricity provision in Switzerland will likely be reconfigured and partially shaped by distributed RE production.

Sociotechnical landscape

Even though the internal factors positively influence the sociotechnical regime for electricity provision in Switzerland to adopt niche technologies, external socio-technical pressure is needed to create a 'windows of opportunity' for niche technologies to trigger adjustments in the current regime (cf. Geels 2014; Geels and Schot 2007).

The most recent pressure arising from the sociotechnical landscape was at the same the most accentuated since it democratically legitimizes the regime to adopt RE technologies: The popular referendum on the Energy Act (EnA) on 21 May 2017. With the acceptance of the referendum, the majority of the voters support the total revision of the EnA and the Energy Strategy 2050 (ES 2050). The three strategic goals of the ES 2050 are to a) increase energy efficiency and reduce energy consumption, b) increase the use of renewable energy and c) withdraw from nuclear energy (BFE 2018b). The ES 2050, its chronology and its content are highlighted in Box 1.

[7] e.g. in 1979 the canton of Basel-Land was the first Canton that enacted an energy law, while the last cantons only had such legislation after 2011. The canton of Valais is one of the leading Swiss Canton when it comes to distributed RE production and REresearch.

Box 1: The Energy Strategy 2050

Milestones (non-exhaustive list):

- 23 March 2011 until Winter Session 2011: Federal Council and Parliament debate on progressive withdrawal from nuclear energy production (The popular vote ‘For an orderly withdrawal from the nuclear energy programme’ (‘Atomausstiegsinitiative’) will be rejected five years later).
- Spring Session 2013: Parliament approves the action plan for ‘Coordinated Energy Research Switzerland’. In doing so, the Confederation boosts its financial support for energy research in the years 2013 to 2016. Energy research becomes one of the most well-funded research areas in Switzerland and the Swiss Federal Office of Energy (BFE) becomes one of the largest research promoters for energy research (CORE 2016).
- 21 March 2013: The Parliament decides on a partial revision of the EnA.
- 04 September 2013: The Federal Council adopts Dispatch to Parliament on new EnA.
- 30 September 2016: Final vote in parliament
- 01 January.2017: Entry into force of the Federal Energy Research Masterplan for the period of 2017-2020.
- 21 May 2017: Referendum of the new Energy Act of 30.09.2016 was accepted (58.2% ‘yes’-votes)
- Entry into force of revision of applicable legislation.

The Referendum

- Goals and major measures of the referendum:
  - *Increase energy efficiency* and *reduce energy consumption* by a) subsidizing the cost of the energy-saving renovation of buildings (‘Building Programme’), b) demolitions that are needed to be made to improve a building’s energy efficiency will be tax-deductible (investments in a building’s energy efficiency are already tax-deductible), c) tightening emissions specifications for motorised vehicles, and d) competitive tenders support programmes and projects which contribute towards more economical energy consumption in the industry (BFE 2018g).
  - *Increase production through RE* by a) increasing feed-in remuneration to a maximum of 2.3 centimes per kilowatt of electricity production through solar and wind energy, as well as geothermal and biomass energy, b) granting one-off financial covers for the installation for small photovoltaic installations, c) support existing large-scale hydro-electric power plants, d) granting the use of RE production the same weight as for the protection of the landscape in court rooms, and e) shortening the approval procedures for the production of electricity from renewable energies (BFE 2018h).

   - *Withdrawal from nuclear energy* by changing the law on nuclear energy. More precisely, by a) prohibiting further ‘construction of new power plants’ permits and by b) banning the reprocessing of spent fuel (BFE 2018a).
   - Further measures: upgrades and renewals of the distribution network are accelerated by limiting access to the Federal Court (BFE 2018i). Further, a) the establishment of SwissEnergy, b) the promotion of pilot, demonstration and beacon programmes, and c) the active role of the Confederation as an energy role model did not need changes in legislation and is therefore continued (BFE 2018e).

- Political recommendations before the referendum (Tresch et al. 2017):
   - Recommendation for ‘yes’ vote : Federal Council, Parliament, left parties, centre parties, and different NGOs (e.g. *WWF*, Association of Swiss Utilities (VSE), trade association (‘Gewerbeverband’), union)
   - Recommendation for ‘no’ vote: right parties (*SVP, EDU*), taxpayer association
   - No Recommendations: *economiesuisse,* homeowner association
   - ➢ **Large acceptance of the sociotechnical electricity provision regime in Switzerland for the energy transition before the referendum.**

- Composition of results (Tresch et al. 2017)
   - 58.2% ‘yes’ votes, 22 cantons of 26 voted ‘yes’.
   - High acceptancy in French-speaking parts
   - Low acceptancy in conservative cantons (Glarus, Schwyz, Obwalden) and canton of Aargau (where three out of five nuclear power plants are)
   - The referendum was perceived of larger importance than previous referendums, especially for women and citizens in the Latin part of Switzerland.
   - The referendum was perceived as ‘rather complicated’ compared to previous referendums, especially among citizens that support middle-right and right parties.
   - Trust in the Federal Council and in environmental association correlated with approval of the referendum.
   - Attitude towards environmental protection and rejection of nuclear power correlated with approval of the referendum
   - RE were framed majorly framed from an ‘environmental’ rather than from an ‘economic’ perspective.

According to the typology of sociotechnical landscape changes of Suarez and Oliva (2005), the popular referendum can be described as an ‘avalanche’ (see Figure 7). Typically, as an ‘avalanche’ the ES 2050 does not solely affect the electricity provision regime, but also related ones, e.g. ‘mobility’ or ‘transport’. However, its speed of impact on the sociotechnical regime for electricity provision in Switzerland cannot be solely described as ‘fast’ since important measures are effective only in some years.

Frequency	Amplitude	Speed	Scope	Type of environmental change
Low	Low	Low	Low	Regular
High	Low	High	Low	Hyperturbulence
Low	High	High	Low	Specific shock
Low	High	Low	Low	Disruptive
Low	High	High	High	Avalanche

Figure 7: Attributes of Change and Resulting Typology

Source: Suarez and Oliva 2005

Figuratively speaking, the popular vote on 21 May 2017 can be understood as a released landscape pressure (‘avalanche’) that was built-up during several years. Resource-conservation and visions of sustainable energy production for example have held since the oil-crisis in the 1970’s (Lund 2007). The nuclear catastrophe in Chernobyl (1986) and Fukushima (2011) maintained and even reinforced such visions, but they had less significant impact on the electricity provision regime in Switzerland. The effects of ‘Fukushima’ in Switzerland were not negligible but had compared to Germany less direct impacts on the national energy provision regime, e.g. rejection of the popular vote ‘for an orderly withdrawal from the nuclear energy programme’ (‘Atomausstiegsinitiative’) on 27 November 2016 (BFE 2018c). It was only after the popular vote on the EnA that the sociotechnical landscape put pressure on the regime and at the same time legitimized the mainstream use of distributed RE technologies (Meier and Gusewski 2018). Interestingly, the popular vote was supported by important regime actors, e.g. Federal Council, Parliament, citizens and end-users, utilities, as well as NGOs (see also Box 1), in order to create such exogenous pressure on the regime they partially form. Such procedure can be interpreted as such that a) the regime actively searched for political and societal legitimization for future trajectories and that b) the transition could not be enacted through the regime itself.

2.2 The Implications

From all the RE sources for distributed electricity production, i.e. solar, geothermal energy, wind, wood, and biogas, electricity production through solar energy has the largest growth potential in Switzerland (BFE 2018b). In 2016, the share of solar energy for the national electricity production structure (2.1% negligible) was lower than the average score for EU-28 countries (3.5%) (BFE 2018j). In the ES 2050's set of measures, different financial and administrative incentives were elaborated to increase solar energy production in Switzerland (see Box 1). Majorly, the measures aim to increase to amount of micro- and small-scaled solar production units (< 100kW) (BFE 2018d). Although the share of solar electricity production remains low, the long waiting list for cost reimbursements of solar panels built in 2018 (2 years) indicate that the new financial incentives had a visible effect (cf. BFE 2018d). Curtius and colleagues even describe Switzerland as "one of Europe's fastest growing solar markets" (Curtius et al. 2018, p. 598). Next to this tangible trend, further platforms and initiatives were created in order to especially encourage households to invest in solar energy production (e.g. Sonnendach.ch, EnergieSchweiz, Swissolar.ch, Swiss Energy Tour, Energy Challenge). Finally, the ES 2050 is now boosting what has been suggested for some years: energy prosumerism.

Energy Prosumers

The 'socio-logic' behind energy prosumerism is widely discussed in literature and recent research proposals (e.g. Comor 2011; Hellmann 2016, 2018; Ritzel 2018). The aim of this thesis is not to deepen the ongoing terminological discussion, but to understand 'energy prosumers' as an important actor of the ongoing energy transition. Hellmann (2018) describes *energy prosumers* as follows:

> *"energy consumers which are directly or indirectly, individually or collectively, completely or partially self-sustaining in terms of energy and should the occasion arise, share its own produced energy surplus with other energy consumers"*[8] *(Hellmann 2018, p. 507)*.

Hellmann's definition places the enlarged scope of action linked to self-production and sharing/selling energy in the centre of what energy prosumers *do*. This perspective on the new opportunities of *doing* (producing, selling, and sharing energy) allows energy consumers to expand their role within the *technical regime*. However, the central role

[8] Considering the ongoing technological advances in distributed storage technologies (cf. Chang 2017), energy prosumers also can store energy surpluses and reuse such in times of energy shortages.

of the prosumer in the ongoing energy transition only becomes evident when considering a prosumer's abilities to *engage* in *sociotechnical* participation processes. However, this perceived importance may also lead to possible overstatement of the power and influence of prosumers, raising concerns whether the expectations towards prosumers are justified or realistic.

Jeremy Rifkin for example, predicts that energy prosumers overthrow the power concentration of big utilities and banks in the energy sector, initializing a third industrial revolution, i.e. collaborative consumption (Rifkin 2014b). Political and social scientists (e.g. Rommel et al. 2018; Szulecki et al. 2015; Tomain 2015) argue that a prosumption-based energy provision system, thus a stronger participation of traditional end-users, leads to a 'democratization' of energy choices. Such democratization relies on the idea of an enlarged understanding of the end-user's role in the sociotechnical energy transition. The sociotechnical role of electricity end-users along the energy transition has also been described as more 'active' (Gross and Mautz 2015), 'participative' (Radtke et al. 2018), 'aware' (Devine-Wright 2007), 'engaged' (Gangale et al. 2013), or 'smarter' (see for discussion Hellmann 2018) compared to the 'passive' understanding of end-users (Geelen et al. 2013; Hertig and Teufel 2016a). These descriptions suggest a new and alternative view of end-users of electricity in relation to energy, emphasizing a social and political role rather than solely a 'customer' and 'energy user' role (Devine-Wright 2007).

In the course of the ongoing energy transition, the presented expectations were pooled, conceptualized and finalized as what is known as 'energy citizenship' (Devine-Wright 2007; Paulos and Pierce 2011). The basic idea of energy citizenship builds on a view of people as:

"*active participants to be democratically engaged in sustainable energy transitions*" (Ryghaug et al. 2018, p. 288).

Hence, energy prosumers are not only conceived as people using distributed RE technologies but, analogous to the concept of energy citizenship and civic duties (cf. Hoffman and High-Pippert 2010), also as people exercising rights and fulfilling certain energy transition-related responsibilities such as climate change mitigation, energy justice or reducing ecological footprints (cf. Devine-Wright 2007). Yet, 'energy citizens' actively engage in financial, industrial, political, civil, and social forms of participation (Radtke et al. 2018), and therefore differ from the traditional role of 'users' and 'consumers'. Table 3 summarizes the perception of the public in relation to energy along the energy transition.

Set of beliefs about 'Energy Citizens'
• decentralized energy technologies can foster new ways of thinking and behaving about energy, ways that may be difficult to conceive within the mind-set of the centralized system, • individuals may feel excited and positive about new energy technologies, rather than apathetic and disinterested, • individuals will want to take a more active role in generating heat and power, in supplying energy and in co-managing local distribution supply networks, • individuals are able and motivated to engage with the wider energy system via new energy technologies such as 'smart meters', • individuals value at least a degree of self-sufficiency from the centralized system, as fostered by domestic and local 'power stations', or local 'micro-grids', • motivation to adopt micro-generation is at least in part based upon awareness of environmental problems such as climate change, and ascription of personal responsibility to respond to such problems in a way that will make a difference and feelings of moral obligation to act, • individuals will be motivated and able to participate in local to national level political processes such as consultations on new energy policies, • individuals will wish to participate in local planning consultations concerning proposed energy developments, • local communities will accept renewable energy developments, if such developments are conducted in a manner that gives local people some degree of control as well as economic benefit.

Table 3: Set of Beliefs about 'Energy Citizens'

Source: adapted from Devine-Wright 2007

The scholars' expectations of 'energy citizenship' adequately describes the sociotechnical co-creation possibilities of upcoming energy prosumers, which go further than solely infrastructural co-creation, i.e. adoption of RE technologies and materialized participation. Energy prosumers also depict forms of political, social, business-related and civic participation along the energy transition and are therefore understood as a distinctive form of energy citizens. Therefore, energy citizens respectively energy prosumers, are expected to be important stakeholders for the transition towards distributed RE provision (cf. Geels et al. 2016; Magnani and Osti 2016; Schot et al. 2016).

Energy Communities

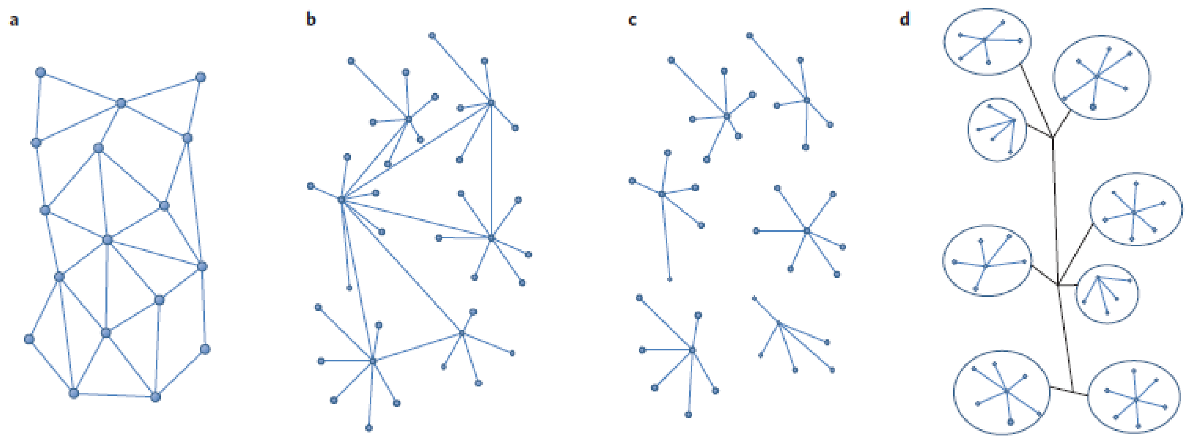
As mentioned earlier, an increase of distributed RE production in Switzerland seems realistic. However, the network-related embedment of energy prosumers remains yet unsolved. Thus, the question arises: how can electricity prosumers be integrated in the current electricity system?

Two general scenarios regarding such integration were introduced by Parag and Sovacool (2016). The first scenario assumes that millions of prosumers manage their energy production and consumption autonomously. Such an ‘island-scenario’ requires individual maximization the energy production through RE, ensured storage possibilities, investments in smart-home technologies, as well as important energy consumption reductions (Luna et al. 2016; Parag and Sovacool 2016; Zinaman et al. 2015). Hence, such a scenario is also known as a ‘standalone’ or ‘off-grid’ solution (Hojčková et al. 2018). This scenario goes along with a strong aversion for the current system (Hojčková et al. 2018) and a radical *transformation* of it (cf. Zinaman et al. 2015). Given important financial, geographical and technical claims, such a scenario is realistic to only a few agents (Meier and Gusewski 2018).

The second scenario predicts that energy prosumers will be connected to the prevailing grid. Given the size of the power plants (i.e. micro and small size), energy production and provision to the grid will occur on a low-voltage level. Hence, energy production and provision along the grid will no longer be solely undertaken by utility companies but through an increased amount of energy prosumers. Such a scenario leads to an *evolution* of the current system (cf. Zinaman et al. 2015).

In the Swiss context, the second scenario for energy prosumer integration seems from a historical and a strategic point of view more plausible. With the economic boom and with the electrification of the post-war society, the sociotechnical regime for electricity provision in Switzerland was forced not only to increase the amount of electricity production but also to expand its grid nationwide (Marek 2006). Additionally, the central location of the country and its large hydropower-related potential plays an important role within the pan-European energy provision concept. From an international perspective, Switzerland can also be seen as ‘energy battery of Europe’, compensating volatile production of RE technologies in European countries with domestic hydropower and storage capacities (cf. VSE 2011). Consequently, the prevailing Swiss electrical grid plays an important national and international role. More recently and from a strategic point of view, the Federal Parliament decreed important investments in the further expansion and renovation of the grid and realigned its ‘Electricity Grid Strategy’ to the ES 2050 (Federal Council 2016, 2017b). Such strong political commitment indicates a co-evolution of energy prosumers and the grid rather than a strict separation of both. Hence, it can be assumed that energy prosumers will be integrated in the current electricity provision structure.

Next to the organizational integration, different models of market integration of energy prosumers exist. Such models differ in structural attributes of energy prosumer markets (Parag and Sovacool 2016). Figure 8 depicts the different models of market integration of the energy prosumer according different structural attributes.



Note: Dots represent energy prosumer agents; lines represent a transaction of prosuming service; circles represent an organized group of prosumers.

Figure 8: Structural Attributes of Energy Prosumer Markets

Source: Parag and Sovacool 2016, p. 3

The first model (a) depicts a ‘peer-to-peer’ energy prosumer market. Inspired by sharing economy principles, this market allows energy producers and energy consumers to provide and bid electricity or electricity-related transactions on a peer-to-peer platform, e.g. energy storage capacities (Zhang et al. 2017). Such a market form is highly organic and relations between seller and buyer can be long lasting as well as *ad hoc*. The lack of control and responsibility in such a market may hinder reliable energy provision (Parag and Sovacool 2016).

The second model (b) constitutes a ‘prosumer-to-interconnected micro grids’ market. A micro grid can be described as: “a cluster of loads, Distributed Generation (DG) units and Energy Storage Systems operated in coordination to reliably supply electricity, connected to the host power system at the distribution level at a single point of connection, the Point of Common Coupling” (Olivares et al. 2014, p. 1906). Such aggregated control of multiple energy producers, consumers, and prosumers depicts a ‘peer-to-peer’ micro grid energy market (Mengelkamp et al. 2018). Given the micro grid structure, reliability and control of energy provision is enhanced. Further, the interconnection of micro grids incentivizes individuals to produce as much electricity as possible and to sell electricity surpluses to other micro grids.

The third model (c) depicts a ‘prosumer-to-islanded micro grids’ market. In such a model load, electricity storage and electricity production need to be optimized locally in order to ensure reliable electricity provision. Excess electricity generation is an advantage only if enough local storage capacities exists.

Finally, the fourth model (d) constitutes an ‘organized prosumer group’ market. Such a market-model emphasizes the organized pooling of prosumer resources for a collective goal (Espe et al. 2018; Hertig and Teufel 2016b; Rathnayaka et al. 2015; Teufel and Teufel 2014). The nature of such collective goals goes further than providing reliable energy provision but also include related social, economic, political, strategic, environmental and behavioural aspects (Gui and MacGill 2018; Heiskanen et al. 2010; Schweizer-Ries 2008; Sloot et al. 2018; van der Schoor and Scholtens 2015). Accordingly, the concept requires a broader understanding that emphasizes the social and collaborative nature of ‘organized prosumer groups’.

Detached from its pure market-fixation, the ‘organized prosumer group’ design represents ‘energy communities’. Such are characterized by open and participative processes, i.e. high degree of involvement of local people, and by local and collective outcomes (Walker and Devine-Wright 2008). Further, such communities depict local forms of collective and social actions, i.e. collective contributions, related to energy goals (Coenen and Hoppe 2018; Parkhill et al. 2015). Thus, energy communities depict a radical change to current energy-related processes and outcomes. Implying the centrality of social and collective actions (cf. Parkhill et al. 2015), energy communities can be defined as follows:

“An organized purpose community of individuals, which collectively contribute to energy goals or energy-related goals for all members.”

Energy communities depict the highest form of citizen participation, since members explicitly engage in the energy transition by utilizing different assets, e.g. competences, knowledge and values (Gstrein 2016), applying social practices bottom-up (Gui and MacGill 2018), and defining rules for collective energy-related decision-making (Gui et al. 2017) for a common energy-related goal. An energy community presents new opportunities for neighbourhoods and other local entities to adapt the energy transition, taking in account local needs and circumstances (Dóci and Vasileiadou 2015; Dóci et al. 2015).

Compared to the former question on how to integrate the energy prosumer in the electricity system, the market integration of energy prosumers is not an ‘either-or’ question. In the Swiss context, the different forms are already emerging. An example for the peer-to-peer market (a) is Change 38. The virtual peer-to-peer platform connects prosumers and consumers all over Switzerland (Change 38 2018). An example of a ‘prosumer-to-interconnected micro-grids’ design (b) is the ‘Eigenverbrauchsgemeinschaft’ (EVG). EVGs are based on a new legal regulation that enables house owners to sell self-produced electricity directly to tenants in the same building. Only electricity excesses are fed in the grid (VSE 2018). Both designs are well developed and have overcome legal barriers. Finally, ‘organized prosumer group’ market designs (d) or energy communities depict the less developed model in Switzerland. Currently and to the author’s knowledge, only the micro-grid in ‘Schwemmiweg’, a neighbourhood in Walenstadt, represents such a design based on organized pooled resources (Quartierstrom 2018). However, this project is still in its pilot phase, and actual prosumer involvement and preferences are currently investigated.

Community-based designs like ‘Quartierstrom’ enable decentralized solution-approaches as well as decentralized governance of the energy transition. Hence, it applies the attributes of individual energy citizenship on a collective level, i.e. energy community. Moreover, it was argued that major beliefs about the prosumer as energy citizen (see Table 3) can be amplified within energy communities (cf. Ciuciu et al. 2012; Hoffman and High-Pippert 2010; Korjonen-Kuusipuro et al. 2017; Miller et al. 2013;

Rathnayaka et al. 2014; Rogers et al. 2008). The federal energy policy in Switzerland is believed not only to facilitate the integration of RE technologies (see Chapter 2.1) and energy prosumerism but also to encourage decentralized decision-making and decentralized governance.

Although energy communities as a structural form to integrate energy prosumers and as an amplifier for 'energy citizenship' are currently only niche innovations, expectations of such regarding the Swiss energy transition are high. Given such expectations, questioning the energy communities' potential to amplify beliefs about 'energy citizenship' is indispensable and needs to be investigated as will be shown in the following section.

Figure 9 visualizes the Swiss energy transition. It highlights the interactions of landscape pressure and niche innovations-momentum on the current sociotechnical regime of electricity provision in Switzerland. 'Energy citizenship/prosumerism' as well as 'Energy Communities' were shown to be likely outcomes of the transition.

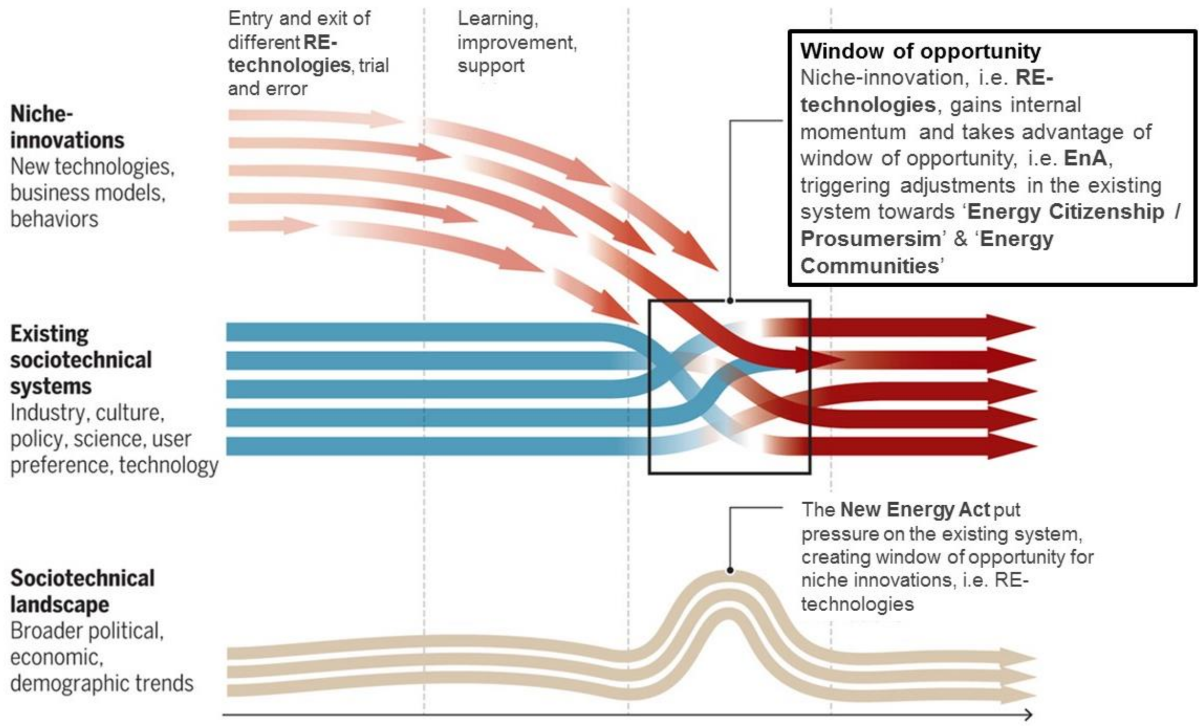


Figure 9: The Energy Transition in Switzerland

Source: adapted from Geels et al. 2017

2.3 Contribution in Energy Transitions

Energy transitions are a societal process in which the change of energy-related structures, behaviour and practices reflects a common goal for a wide range of actors (Frantzeskaki et al. 2012; Nevens et al. 2013). Although interests, resources, and beliefs regarding a sociotechnical transition might be opposed (Sovacool 2016), ‘co-creation of heterogeneous resources’ (Karnøe and Garud 2012), ‘shared learning’ (Smith 2007b) and ‘common expectations’ (Geels and Schot 2007) occur in any transition. Hence, a sociotechnical transition heavily relies on the successful cooperation among different regime actors (cf. Gui and MacGill 2018; Verbong and Geels 2007). As Federal Council Doris Leuthard, head of the Federal Department of Environment, Transport, Energy, and Communication announced during her official press conference shortly before the national referendum, the Swiss energy transition constitutes no exception (Federal Council 2017a).

Next to the participative fundamentals of any sociotechnical transition, the current energy transition and its focus on distributed electricity provision, decentralized decision-making, and decentralized governance are based on a profound ‘participative’ attitude of electricity end-users, i.e. beliefs about electricity end-users. Compared to former energy transitions (cf. Verbong and Geels 2007), the current transition implies an important co-creational role by end-users. Two peculiarities of the current energy transition are revealed.

First, ‘co-creation’ manifests itself in different efforts an individual has to make when contributing to the ES 2050 goals or the energy transition in general. The transition from passive electricity users to energy citizens (see Table 3) implies an activation of individual efforts; investments in RE technologies, change of behaviour and habits, engagement in political processes, responding with increased responsibility, or participation in local energy planning. Accordingly, the expectations regarding a more secure and cleaner energy future rely on the premise that households are willing to engage in co-creation for a greater societal good, which at the same time implies short-term costs for each contributing en-user.

Second and in terms of sustainable transitions, Geels pointed out that “private actors have limited incentives to address sustainability transitions, because the goal is related to a collective good (‘sustainability’), which implies free rider problems and prisoner's dilemmas” (Geels 2011, p. 25). Geels’ argument shows a second important issue of the current energy transition: not only are end-users expected to engage in costly efforts but the same efforts may be meaningless if not collectively reciprocated (cf. Bauwens 2017).

The expectations regarding energy prosumers as change initiators were earlier shown to be courageous, and their potential for sustainable and secure electricity provision was justified but also fragile. The expectations rely on the assumption that traditional electricity end-users are willing to a) bear efforts, investments, behavioural adjustments etc. to engage in co-creation at the first time, and that b) the efforts' benefits are exclusive to the co-creating prosumer only. The issues related to not-reciprocated or even freeridden efforts are well-known difficulties on a global level (Florini and Sovacool 2009; Ostrom 2010b; Walker et al. 2009), but they remain a niche approach on individual energy-related decision-making.

Samuelson's (1990) review of social dilemma properties of residential energy use was one of the first articles that questioned both assumptions. In the context of energy conservation, he firstly argued that individuals face situations of 'collective traps' and 'collective fences' (Messick and Brewer 1983). In *collective traps*, individuals take an action that benefits themselves but imposes costs (negative externalities) on other persons, while collective fences represent situations in which individuals fail to perform a 'costly' behaviour that would require a personal sacrifice that would benefit other groups (positive externalities).

The energy transition requires overcoming such traps and fences. An example of a collective trap is unrestrained energy consumption: The positive consequences of enhanced convenience and comfort accrue only to the single individual, while the single individual and the others bear the costs of higher energy prices, increased coal-based energy imports or increased dependence from nuclear energy, and increased risks of brownouts. An example of a collective fence are investments in RE technologies, e.g. solar panels: The single individual bears important financial costs, but others and the individual would benefit from green electricity supply, local value creation, accelerated technology-related learnings, and reduced electricity imports.

The second dimension of Samuelson's argument emphasizes the temporal dimension of consequences of individual choices. Both mentioned examples produce (positive and negative) outcomes that are differently distributed in time. While the comfort and convenience-related gains of unrestrained energy consumption have immediate positive effects for the single individual, the negative social effects may not be felt in months or even years. The collective benefits of RE investments can be immediate (green energy supply) as well as delayed (e.g. local value creation and accelerated technology-related learnings). In economics (Fehr 2002; Frederick et al. 2002) as well as in social psychology (Platt 1973) it is known that the time dimension of consequences influence individual choices; choices are more attractive when positive consequences are immediate, compared to choices with delayed positive consequences.

Devine-Wright's (2007) beliefs about energy citizenship (see Table 3) ignore not only the social fences and traps that go along with a more social and political role of electricity end-users, but also neglect the temporal dimension of consequences of individual choices. Thus, expectations that end-users engage in energy transition are based on an unsubstantiated and highly normative foundation that needs to be scrutinised. Hence, the shift from users towards contributing energy citizens requires deeper understanding of *energy-related contribution behaviour*.

2.3.1 Energy-related Contribution Behaviour

The most important scientific journals regarding the sociotechnical aspects of energy transition and energy behaviour include a vast ocean of multidisciplinary knowledge in regards to understanding and changing human behaviour related to energy-choices (see the following for an overview: Abrahamse et al. 2005; Burger et al. 2015; Sovacool 2014; Sovacool et al. 2018; Stern 2017). Current research on human energy choices relies heavily on the assumption that energy-related outcomes (e.g. investment in RE technologies, energy conservation etc.) result in *independent* settings. In other words, energy outcomes result only through single individual behaviour. Although social features may influence the decision-making (e.g. Nolan et al. 2008; Schultz et al. 2007), the energy-related outcome depends solely on the individual's choice and is unaffected by the behaviour of other decision-makers. Hence, the presence of negative or positive spill-overs related to decision-making is ignored. Given the lack of a strategic dimension in independent settings, e.g. to freeride or to be freeridden by others, such are not sufficiently applicable to understand or change energy-related contribution behaviour, respectively participation in energy transition.

Yet, the co-creational aspects of the ES 2050 require knowledge on how individuals behave in *interdependent* settings, i.e. when energy-related outcomes result through the interaction of several interrelated behaviours. Insights on energy-related behaviour that incorporates the interaction with choices of other humans (i.e. interdependent settings) consider 'strategic' aspects of energy choices (Breukers et al. 2011). Thus, the presence of negative or positive externalities related of energy choices are emphasized.

Energy-related contribution behaviour frames energy-related decision-making from a 'Public Good' and 'Collective Action' point of view. The ES 2050 goals/energy transition were shown to be collective actions (see also Coenen and Hoppe 2018; Geels 2011). As such, the outcome depends on at least two individuals. If individual 'A' contributes to the energy transition by reducing his/her energy consumption, the energy transition is not yet successful. The outcome depends also to which degree individual 'B' is reducing/increasing his/her energy consumption. Moreover, A's choices may or may not lead to behavioural spill overs and affect the behaviour of B. Interdependent settings analyse energy-related choices from a social-interaction point of view and are therefore better suited to understand and change energy-related contribution behaviour. Simultaneously, a more strategic and interdependent approach allows the often observed attitude-behaviour gap in independent settings to be explained (Gupta and Ogden 2009).

Since the ES 2050 lacks a binding set of rules that regulates energy-related contributions towards the energy transition, its outcome will largely depend on the individuals' willingness to contribute to such goals.[9] The necessity of behavioural research within interdependent settings was indicated (Geels 2011; Frederiks et al. 2015; Wilson and Dowlatabadi 2007) and expressed (Adger 2003; Cotton et al. 2016; Ohnmacht et al. 2017; Samuelson 1990) on a conceptual level, yet it remains an empirically under-investigated research area in social energy sciences.

From an economic point of view, different instruments can be introduced to increase individual contribution to energy transition/ES 2050 goals. The energy market already knows price mechanisms for producing/consuming electricity. Yet, the purchase of one

[9] Goldthau and Sovacool argued that the missing authority (global) authority for energy issues depicts a uniqueness: An overarching institution that 'takes care' of energy by binding its members (like in health, proliferation, or migration) is not in sight (2012).

'unit' of electricity does not internalize all related externalities (Borenstein 2012), nor does the production of one 'unit' of renewable electricity (Magnani and Vaona 2013; Noailly and Shestalova 2017). Market mechanisms that internalize externalities of electricity consumption as well as internalize (the majorly positive) externalities of RE production would probably lead to higher utility costs and lower purchasing costs for RE technologies. Other economic instruments are Pigou taxes, Coasian allocation, environmental certificates, or (emission) trading. The economic instruments aim to send strong price signals after the costs-by-cause principle and are therefore expected to have positive effects on the energy transition/ES 2050.

However, the introduction of such mechanisms is complicated since potential spill over effects need to be quantified. Scholars need to prove causal effects for the Swiss context (e.g. investments in RE technologies lead to local value creation, or energy-efficiency measures leads to reduced dependence from energy imports). Proper monetary estimations of the spill-over effects (e.g. the monetary value of local value creation, or independence from imports) is a further necessary task to introduce market mechanisms for contributions. Both tasks become even more complex when considering the differing externalities of different energy sources, the intergenerational aspects of the externalities (Bithas 2011), or different or hyperbolic discounting preferences (Frederick et al. 2002).

Next to these methodical complications, politico-economic arguments exacerbate economic instruments. A sharp increase of utility prices (through market mechanisms or taxes) would probably gain no political support, or politicians would procrastinate such a decision to the disadvantage to future generations.

From a welfare economics point of view, it is questionable if market mechanisms for both, RE production and electricity consumption would be fair. RE production as a meritorious good would become cheaper. Potential benefiters would be homeowners, especially those having properties with good solar irradiance or facilitated access to geothermal energy, while tenants could not benefit. On the other hand, electricity consumption would become more expensive and disproportionally strain tenants, multiple family households, and households that are unable to produce their own electricity. Finally, cost-by-cause principles may lead to further undesired outcomes and even aggravate the achievement of ES 2050 goals. If internalizing the probably expensive externalities of local electricity production (mainly hydro or nuclear power) in Switzerland is too expensive, electricity production can be outsourced in countries, where local externalities are cheaper in monetary terms but do not necessarily contribute to the ES 2050 goals (coal production in Czech Republic or Poland).

The cost-by-cause principles in which either the market or government stimulate energy-related contributions have important limitations and uncertainties. Detached from economic and fiscal decision-making, social psychology considers non-fiscal choices (Cialdini 2018) and emphasize values, beliefs, norms and other social factors in human decision-making (Parks et al. 2013). Thus, principles from social psychology make use of social interaction instruments rather than market or fiscal instruments.

Some social-psychological research results demonstrate that individuals consider social interaction and strategic considerations when making energy-related choices. Moreover, the research results suggest that social-psychological factors heavily influence energy behaviour, which could not have been tested within *independent* settings.

The research results of Cotton and colleagues (2016) demonstrate the necessity of such energy behaviour research in settings of interdependence and simultaneously serve as an example of human choices in interdependent settings. They investigated the *locus of control* (the extent to which respondents felt that they could influence events around them) and sense of responsibility towards sustainable energy transition among 1,136 British university students. While 76% of the responders felt that their own energy use made a difference to the national energy situation, only 19% trusted the government to act on energy issues. On a qualitative basis, they also found out that contribution efforts, e.g. energy conservation, were found to be irrelevant when students expected freeriding behaviour of others. Such discrepancies in responsibility outline that individuals consider strategic options in energy choices. Further, the results emphasize the urge to understand energy behaviour from an *interdependent* point of view. Similar strategic behaviour was observed in energy saving behaviour (Ohler and Billger 2014), environmental behaviour (Berger and Corbin 1992; Ellen et al. 1991), boycott behaviour (Shin and Yoon 2018), and green product purchases (Gupta and Ogden 2009).

Carmi and Mostovoy (2017) analysed energy consumption of 116 Israeli students living in three different dormitories, framing it from a ‘communal’ or interdependent point of view. They changed the setting by telling the students that instead of individualized electricity billing and due to technical problems, the electricity bill of the dormitory will for 5 weeks be equally divided among all habitants. The experiment of Carmi and Mostovoy confronts decision-makers with a shift from making energy choices when the outcome is *independent* (i.e. individualized electricity billing) to making energy choices when the outcome is *interdependent* (i.e. communal electricity billing). Within a field experiment, they observed that individual energy consumption increased by 28.9% when changing the electricity billing from an independent to an interdependent energy outcome. After re-individualizing electricity billing, energy consumption decreased again. The authors found out that *group size*, *missing efficacy* and *weak interpersonal trust* significantly led to an increase of energy consumption/higher electricity bill, when energy choices became strategic. Their findings support the evidence that individuals behave differently when facing interdependent outcomes and that social-psychological factors influence their choices. In regard to the energy transition as an interdependent energy outcome, findings of Carmi and Mostovoy suggest that further policy measures are needed to counteract the effects when individuals face interdependence.

A group of Swiss researchers (Wemyss et al. 2018) framed energy savings as either a collaborative or a competitive contribution towards the energy transition. During 3 months, 108 households formed groups of households. Each household group had either a collaborative or a competitive energy conservation goal. Compared to a control group with no framing, both treatment groups reduced their energy consumption. Wemyss and colleagues proved that the *decision-frame* of an interdependent setting, i.e. cooperation or competition, had a significant impact on the household energy behaviour.

Bolsen and colleagues (2014) used and experiment survey to analyse the effect of communication on interdependent energy outcomes. They found out that the self-reported willingness to contribute (i.e. reduce energy consumption) to the collective energy outcome (i.e. success of the US energy policy) increased when communication emphasized individual responsibility in settings of interdependence and collective environmental benefits. Bolsen and colleagues' findings demonstrate the different communicative frames of interdependent settings lead to different levels of contribution intentions. Regarding the energy transition, energy policy developers should therefore emphasize both individual responsibility and collective benefits.

Insights from an institutional level demonstrate that energy-related contribution behaviour in settings of interdependence is not lot limited to households (Yi et al. 2017). Yi and colleagues analysed why local governments in the United States have adopted various energy and climate change policy instruments despite the non-excludability of energy-related and climate benefits. Reasons vary, but the authors emphasize that structural condition as well as personal incentives to implement local energy instruments facilitate energy-related contribution behaviour among local politicians.
These research results suggest that many social psychological factors explain energy-related choices that otherwise would have been undetectable within an independent setting. Simultaneously, social-psychological principles were shown to be efficient instruments to steer individuals in a desired direction. Hence, understanding energy behaviour from an interdependent point of view has two important advantages. First and from an academic viewpoint, it complements research results from independent settings and therefore leads to a comprehensive understanding of energy-related behaviour. Second and from a practical viewpoint, understanding energy-related behaviour from an interdependent point of view allows understanding and changing participation in energy transition and contribution in ES 2050 goals.

2.3.2 First Guiding Question

Research on energy-related contribution behaviour and understanding energy-related behaviour in settings of interdependence are promising approaches to elicit the potential of energy citizens and energy communities regarding the ES 2050 goals. Both constructs are believed to significantly contribute to a cleaner, safer and 'more Swiss' energy future for Switzerland. Compared to the traditional role of electricity end-users, energy citizens are believed to engage more actively in the co-creation process of the Swiss energy transition. Moreover, energy communities are expected to intensify the co-creation process by legitimizing a bottom-up approach for the energy transition. The first general research question arises:

Do energy communities amplify energy-related contribution intention among traditional electricity end-users?

2.4 Transition of Energy Governance

Energy governance refers to any of the myriad processes through which a group of people set and enforce the rules needed to shape individual behaviour in order to enable the group to achieve desired energy-related outcomes (Florini and Sovacool 2009; Sovacool 2011). The governance of energy systems based on increasing distributed RE production becomes more complex. The use of different core technologies (e.g. wind solar, biomass) leads to a mix of established utilities and new energy businesses, changes user behaviour, depends on different regulations and subsidies, and makes unfamiliar demands upon existing institutions in planning control, skills provision, infrastructure investment and control systems (Smith 2007a). Given such complexity, distributed energy systems are a) difficult to direct with hierarchical governance measures like planning and b) did not originate from traditional governance schemes. With increased distributed electricity generation and empowered end-users, national energy systems also face an important shift in governance (Bomberg and McEwen 2012; Bornemann et al. 2018; Lange et al. 2013).

2.4.1 Shift of Type of Governance

Over the past decades, scholars across different social sciences have sought to describe the changing types of governance across western societies. Change in energy governance was also advocated by social scientists, e.g. by Johnson and Hall: "any serious effort to develop a decentralised energy system will inevitably require a different set of institutional arrangements to that which supports centralised energy production" (2014, p. 161).

The ongoing change of energy governance is drawn on the seminal research of Hooghe and Marks in types of governance and authority allocation (Hooghe and Marks 2001; 2003; Hooghe 2002; Marks and Hooghe 2004). With regards to arguments of more efficient public good provision, facilitated innovation and experimentation (Gray 1973), and increased credible policy commitments (Majone 1998), Hooghe and Marks (2001) argued for governance across multiple jurisdictions, i.e. *multilevel governance*, rather than a central state monopoly. They distinguish two types of multilevel governance.

Type I Governance

Federalism, i.e. sharing of decision-making among a limited number of jurisdictions, is the intellectual home of Type I Governance. Authority is decomposed into different 'packages' among pre-existing sub-central agencies (Confederation, Canton, and Municipality for the case of Switzerland). Those sub-central agencies exert a wide spread of functions and represent *general-purposes jurisdictions*. *Jurisdictions* have mutually *exclusive territorial boundaries*. Hence, authority is usually exercised mutually and exclusively within defined geographical boundaries. Intersection of authority is inexistent. If *general-purposes jurisdictions* and *jurisdiction with mutually exclusive territorial boundaries* are given, Type I Governance shows following characteristics:

- *Limited number of jurisdictional levels*. Governance is usually organized at just a few levels and follow the principle of ordered and clearly defined authorities.
- *System wide, durable design*. The aim of Type I Governance is to achieve a systemic functioning with general-purpose, nonintersecting, and nested jurisdictions. As such, governance becomes durable and reliable and prevents any form of radical creation, abolishment, or adjustment. Changes in the number of jurisdictional levels is rare.

Type II Governance

An alternative type of multilevel governance is one in which the number of jurisdictions is vast rather than limited, in which jurisdictions operate at diverse territorial scales rather than aligned on a few levels, in which jurisdictions are functional rather than multi-task, and in which decision-making is flexible rather than fixed. Further, Type II Governance depicts a form of task-specific agency. Type II Governance has the following characteristics:

- *Territorially overlapping jurisdictions*. Authority is exercised across political borders. Type II Governance follows a networked regionalism rather than an ordered one. This characteristic lay the base for 'polycentric governance' (Andersson and Ostrom 2008) which will be explained later.
- *Large number of jurisdictions*. The number of jurisdictions is larger since each public good problem shared by a group of people gives rise to new jurisdictions.
- *Many jurisdictional levels*. Public goods and services are provided by the jurisdiction that effectively internalizes its benefits and costs rather than

conceiving authority to pre-defined local, regional, national or international levels. Hence, hierarchy tiers are less pronounced than in Type I Governance.

- *Flexible system*. Given changing citizen preferences and functional requirements, the system becomes flexible rather than permanent. Governance is only established when needed, may change in size, and disappears when redundant (Frey and Eichenberger 1996).

Table 4 provides an overview over the main characteristics of both multilevel governance types.

Type I	Type II
• Well-ordered, nested responsibilities distributed across multi-functional agencies. • Clear demarcations and lines of accountability. • Analogous to ordered regionalism: clearly defined territorial tier.	• Fluid, sector specific networks with memberships intersecting across levels. • Accountabilities less clear, but dynamism permits problem-led experimentation. • Analogous to networked regionalism: problem-focused governance for region.

Table 4: Type of Governance, Overview

Source: Smith 2007a, p. 6268

The current energy governance in Switzerland depicts a multilevel type of governance (Hofmann and Richert 2015; Schmid and Seidl 2018; Widmer and Strebel 2011).
On one hand, characteristics of Type I Governance are widespread. The Swiss governance system is shaped through its federal structure and hierarchical organization. The principle of subsidiarity, i.e. decision-making and authority-allocation on the lowest-possible jurisdictional level, allocates responsibilities along the federal structure (e.g. subsidies of RE technologies, liberalization of the energy market and energy policy legislation are within the range of competences of the Confederation, application of laws are within the Cantonal scope, and energy strategy application and evaluation of measures are divided between Confederation, Cantons and Municipalities). Competences are distributed across multi-functional agencies with clearly defined territorial applications. Systemic functioning is improved by horizontal and vertical coordination (Hofmann and Richert 2015).
On the other hand, certain characteristics of Switzerland’s energy governance show Type II Governance resemblance. Swiss municipalities have far-reaching liberties,

which permit problem-led experimentation with RE technologies (cf. Hofmann and Richert 2015). Further, financial grants and logistic support for municipalities were increased in order to create local ‘policy labs’ (Energie Schweiz 2018b). To meet the complexity of the energy transition and to amplify the beliefs about energy citizenship, the ES 2050 promotes a slow but steady shift of governance from Type I towards Type II.

Type II Energy Governance has been widely been acknowledged as ‘polycentric energy governance’ (Bauwens 2017; Goldthau 2014; Moroni and Tricarico 2017; Smith 2007a; Sovacool 2011). Polycentric governance can be understood as governance beyond market or regulatory forces (Ostrom 2010a). Polycentric approaches facilitate the achievements of benefits at multiple scales as well as experimentation and learning from experience with diverse policies (Ostrom 2010b), and it can encourage plurality, promote dialog, ensure redundancy, and enhance accountability (Sovacool 2011). However, a polycentric approach goes beyond multi-level analyses of hierarchy, autonomy and accountability and incorporates the notions of inclusion and learning (Goldthau 2014). Hence, a polycentric energy system relies not only on distributed energy production, but on the fact that energy production units are subject to numerous, different and autonomous forms of local groups’ self-governance (Moroni and Tricarico 2017). Accordingly, energy communities as defined in Chapter 2.2 embody major characteristics of polycentric energy governance (Scotti et al. 2018):

- *Coalition of common interests*. Energy communities pool not only tangible inputs, e.g. investments in RE technologies, but ideally also interests and expectations of participating community members. Analogous to similar communities, e.g. homeowner associations or neighbourhood associations, energy communities constitute intentional communities that represent the very specific interests of the community members. The pooling of interests increases the representation and the enforcement of such against market players and regulators (Rathnayaka et al. 2014).
- *Problem-focused governance*. Lacking trust in the regulator (Mumford and Gray 2010) and a suspicious attitude towards utilities (Ebers and Wüstenhagen 2016) are well known drawbacks of the traditional type of energy governance. The formation of an energy community can therefore be seen as a willing act to tackle energy-related challenges with trustworthy people that share common

interests (Bauwens 2016; van der Schoor and Scholtens 2015). Further, Seyfang and colleagues (2013) showed that energy communities are flexible rather than durable and systematic: the average age of energy cooperatives in the UK was 4.2 years.

- *Learning and experimentation*. Energy communities based on distributed RE technologies involves local resources like human capital and contextual knowledge (Moroni and Tricarico 2017). Hence, renewables are *per se* site-specific. As such, energy communities enable different kinds of local knowledge (Jensen et al. 2007): codified scientific, innovation-related and technical knowledge, as well as informal learning and experience-based know-how. Further, energy communities constitute technological niches that enable experimentation (Seyfang and Haxeltine 2012). Experimentation however, is only possible if the type of governance protects such local experiments. If successful, energy communities may serve as ‘global carriers’ of best practice, standards, institutionalized learning, and other intermediating resources such as networking and lobbying (Rip and Kemp 1998; Schot and Geels 2008).
- *Network relations*. Within a polycentric system, energy communities constitute an intentional community with relations towards other authorities, market actors, or communities. Two concepts emphasize the network environment of energy communities. From a business perspective, Gstrein (2016) argued that energy communities break up traditional value chains related to energy production and distribution. Instead, energy communities require and simultaneously foster value networks, which also deliver energy services to the single community member as well as to the community itself (see also: Facchinetti 2018). Van der Schoor and Scholtens (2015) described the network relations of energy communities from a local ‘network for technical-change’ perspective (cf. Law and Callon 1992). Their empirical results on local energy initiatives in the Netherlands show that such communities engage in important co-creation processes with other network entities. From the 13 analysed energy initiatives eleven engaged with local governments, seven initiatives had a relation with other community groups (schools, village communities), six initiatives a direct relationship with the business community, and four initiatives had a contact with a regional or national non-governmental organisation. Recent results for energy

cooperatives in Switzerland showed similar patterns (Rivas et al. 2018). However, the network is flexible rather than institutionalized; energy communities can create as well as cancel relations to other actors, depending on the current need for problem-solving (Coenen and Hoppe 2018). Hence, energy communities engage in new and flexible networks rather than within institutionalized structures.

- *Local management*. Research showed that local RE projects, i.e. energy communities, are widely accepted if ruled by the community members themselves (Giddings and Underwood 2007; Kellett 2007; Upham and Shackley 2007). Simultaneously and according to the 'Federation of Groups and Cooperatives of Citizens for Renewable Energy in Europe' (REScoop), third parties play a crucial role in the community's ambitions for self-governance (REScoop 2017). Technological and administrative third parties, i.e. energy service providers, support the community with their expertise in planning, monitoring, coordination, and price setting in order to achieve the community's goals. An energy service provider's set of activity may range from simple sending of newsletters to informing households on their energy consumption and even regulating it (REScoop 2017). Given the technological complexity of prosumer groups (Smart Grid Coordination Group 2012) and their orchestration, third-party integration into self-governance of energy communities is indispensable and simultaneously a new emerging business model (Facchinetti and Sulzer 2016).

2.4.2 Second Guiding Question

The legitimisation of energy communities as amplifiers of 'energy citizenship' rest upon a more polycentric energy governance. Such is believed to reinforce the energy transition by "giving power to the people" (van der Schoor and Scholtens 2015, p. 666) rather than to traditional decision-makers. This raises the question of whether Swiss households can define and implement a collective set of rules within an energy community, which promotes the shift towards 'energy citizenship' at the local level. Hence, a second guiding question arises:

To which degree do traditional electricity end-users want to institutionalize energy-related contribution behaviour among energy community members?

2.5 Conclusion

This chapter focused on the current Swiss energy transition. It used a sociotechnical approach to identify two anticipated changes in the sociotechnical regime that gained legitimization after the popular referendum on the new EnA: Energy Prosumerism and Energy Communities.

Energy prosumerism was detached from its technical definition and understood as a pronounced belief about energy citizenship, describing households that actively contribute to the energy transition. Energy Communities were framed as organisational form to integrate energy prosumers in the energy market. Energy Communities were detached from their purely technical and market-driven definitions, and described as a form of polycentric governance, which amplifies beliefs about energy citizens and energy prosumers.

After reviewing the literature, the chapter challenged major expectations about both concepts. Considering energy-related outcomes, e.g. ‘being a prosumer’ or ‘engaging in the energy transition’, from an interdependent point of view, energy-related contribution behaviour was identified as an important approach to scrutinise these expectations. Energy-related contribution behaviour frames energy-related outcomes as a strategic outcome of interdependent energy choices.

Finally, the two guiding questions address the questions of whether ‘energy communities amplify energy-related contribution behaviour among traditional electricity end-users’ and whether ‘traditional electricity end-users want to institutionalize energy-related contribution behaviour among energy community members’. Both questions serve as guides and are further operationalized in the next chapters.

3 Theory

The aim of this chapter is to *set the scope* of the research endeavour in terms of theory and constructs. This chapter also *provides* a roadmap in terms of language and *defines* the theoretical approach of the thesis. The used 'theory', 'constructs', 'language' and 'approach' will characterize all following chapters of the thesis.
The academic claim of this thesis is to replicate and test the 'goal-transformation' hypothesis (Cremer and van Vugt 1999) in a non-clinical setting. Consequently, this chapter *introduces* systematically the reader to its theoretical fundaments and correlations. Figure 10 provides an outlook of the chapter.

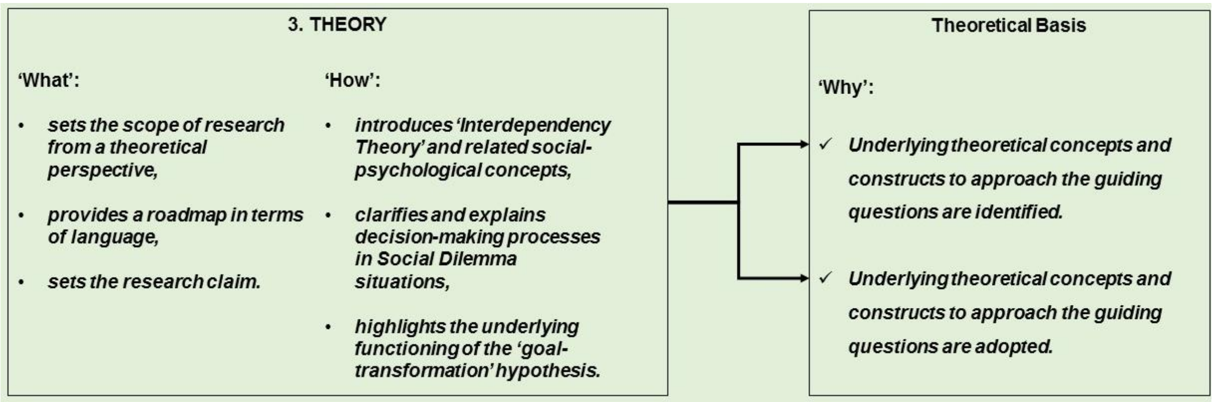


Figure 10: Chapter three, Outlook

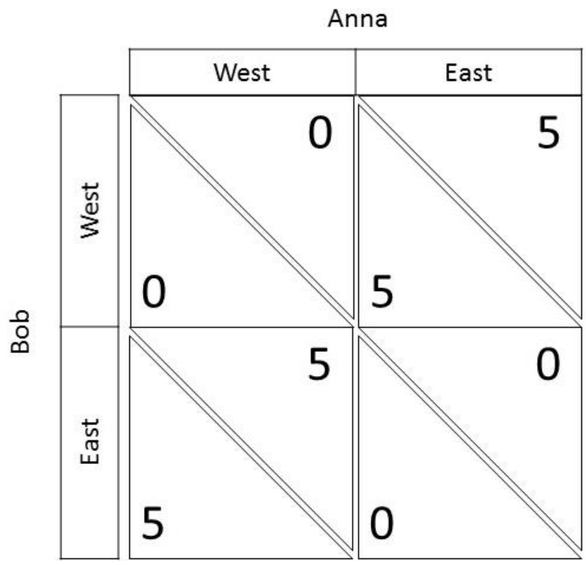
3.1 Interdependence

Numerous human traits have their origins in interpersonal and social situations. This means that the outcome of such situations depends on at least two interdependent decision-makers. Kurt Lewin, founder of modern social psychology, explained interdependence as follows: "A change in the state of any other subpart [of the group or dyad] … Every move of one member will, relatively speaking, deeply affect the other members, and the state of the group" (1948, pp. 68–88).
Each interdependent outcome has its own 'attractiveness' and solely depends on the coordination of the decision-makers. Since the work of Kelley and Thibault (1959), 'attractiveness' of interdependence outcomes are illustrated in 2*2 matrices (interdependence matrices, in which Person A and Person B has two choices each). Each person's outcome occurs as a result of Person A's as well as on Person B's

choices and interests in an interdependent setting. Interests can be corresponding or conflicting, as shown in the following examples (Box 2 and Box 3).

Box 2: Corresponding Interests, the Case of Anna and Bob

Anna and Bob drive to a remote meadow to observe birds. To get there, Anna and Bob drive their SUV along on a forest road. Due to windy conditions during the night before, a tree trunk fell on the road. The tree trunk blocks the whole road and lays from west to east. Since no help can be expected, the couple has to remove the trunk themselves. Since neither one has the strength to lift the trunk alone, both need to take care of the situation simultaneously.



Note : each number indicates the individual level of attractiveness for each situation's outcome.

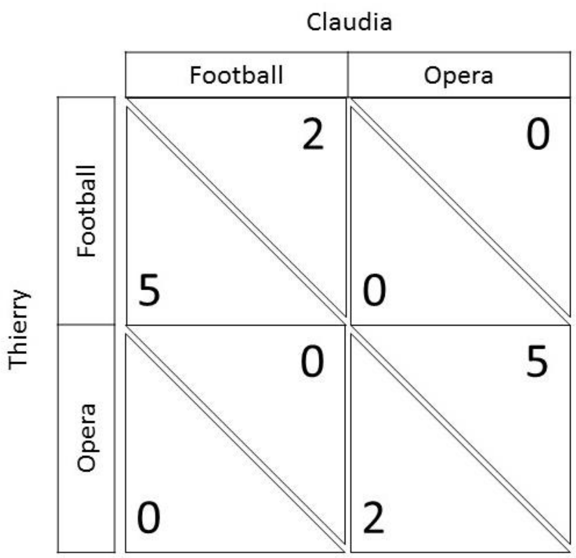
Figure 11: Corresponding Interests

Figure 11 shows the outcome matrix for Anna and Bob. Anna has two options: lift the trunk on the west side, or on the east side. Bob has the same options. Each square shows a combination of choice by Anna and by Bob, with a corresponding positive outcome for each (upper right for Anna and, bottom left for Bob). According to the interdependence matrix, the collective effort is only successful when Anna lifts the trunk on the east end and Bob on the west end, or vice versa. The positive correlation between respective outcomes shows that Anna and Bob share corresponding interests, i.e. removal from the trunk. Given the corresponding interests and the simple task, coordination between Anna and Bob remains easy. The interdependence problem can be solved by their joint efforts and they have a common interest in creating such an interaction.

The second example, also known as 'Battle of the Sexes', shows an interdependence problem with conflicting interests.

Box 3: Conflicting Interests, the Case of Claudia and Thierry

Claudia and Thierry just married. They agreed to meet tonight, but cannot recall whether they wanted to attend the opera, or a football game. Claudia would prefer to visit the opera, while Thierry wants to support his local football team. Further, they prefer to go to the same place rather than different ones. However, they cannot communicate with each other.



Note : each number indicates the individual level of attractiveness for each situation's outcome.

Figure 12: Conflicting Interests

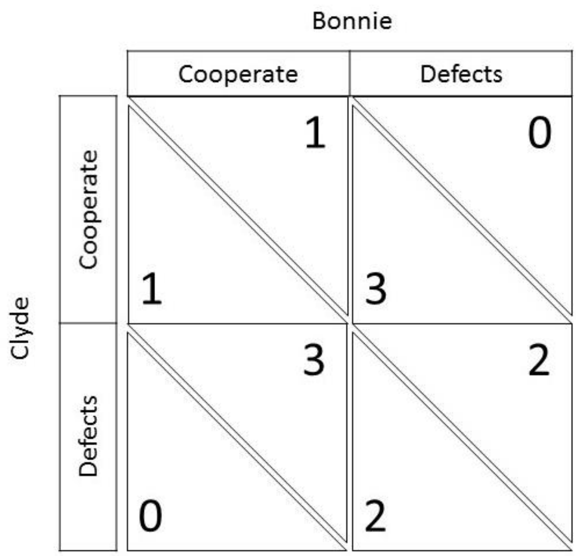
Figure 12 shows the outcome matrix for Claudia and Thierry. Due to conflicting and even opposed interests, outcomes differ for each combination of choices. It is unclear if Claudia and Thierry will meet at the same place. Due to differing choices and the interaction effect of choices on outcomes, different levels of 'attractiveness' for Claudia as well as for Thierry exist.

Interdependent outcomes may result in collective actions. A collective action exist when at least two individuals purposeful engage in a setting of interdependence in order to achieve a common (collective) goal, e.g. moving a trunk from a road (Box 2) or meeting at the same place (Box 3). Engagements in collective actions take the form of outcome-relevant contributions. Such contributions can have different forms of ‘capital’. Most contributions have a ‘give some’- (give money, time, effort, or resources) or ‘take less’-nature. Collective actions are unstable actions since they do not prevent selfish behaviour. This is in particular true in situations in which the benefits of the collective goal are not excludable and therefore ‘consumable’ by everyone. In other words, individuals face a mixed-motive situation, i.e. individual rationality leads to socially irrational outcomes (Bates 1988).

The conflict between selfish and the opposed collective reasoning is also called the social dilemma (van Lange et al. 2013). If a critical amount of group members follows the selfish and rational reasoning, the whole benefits of rational outcomes vanish and the whole group loses. An example for a social dilemma in a dyad is the ‘Prisoner’s Dilemma’.

Box 4: The Prisoner's Dilemma, the Case of Bonnie and Clyde

Imagine the police caught Bonnie and Clyde. Both have a common goal, which is to receive the lowest punishment. Each would be interrogated separately and have no possibilities to speak to each other. The police officers offer them two choices: either they cooperate and admit a crime, or they deny a crime (defects). The outcome matrix presents the following outcome scenarios, representing a social dilemma.



Note : each number indicates the individual amount of years in prison for each situation’s outcome.
The lower the number, the higher the level of attractiveness.

Figure 13: Prisoner's Dilemma

Bonnie and Clyde are in a situation of interdependence: each person's outcome depends not only by own choices, but also from the partner's and the structure of the situation. From a collective reasoning point of view, Bonnie and Clyde should both cooperate with the police and bear the consequences to be imprisoned for one year each. However, both prisoners have strong incentives to defect their partner. For example, Bonnie would face no charges when she denies the crime and Clyde confesses (and vice versa). Collective and selfish reasoning are at odds.

Social dilemmas occur in what economists call 'public good' situations. Public goods are defined by two characteristics: non-excludability and non-rivalry. This means that anyone can benefit from the 'good' (*non-excludability*) and one person's use of it does not hinder another person's use of it (*non-rivalry*). Examples of 'public goods' are public broadcasting, national defence, or clean air. Such public goods need to be recapitalized (by money, time, effort, or resources) over time, whereby 'public good' provision becomes continuous. On the other hand, 'one shot public goods' do not necessarily need continuous provision of capital, e.g. a public firework.

Proponents of rational choice theory argue that it is personally better not to contribute to the provision of public goods or to the maintenance of the collective effort, but to freeride on the others contributions (Cornes and Sandler 2003; Samuelson 1954). Real-life examples (Fehr et al. 2014; Gebremedhin et al. 2003; Ostrom 1990) as well as empirical studies (Fehr and Fischbacher 2003; Fehr and Gächtner 1999) demonstrate that rational choices barely guides human behaviour. Although provision of collective efforts remains suboptimal, some people set aside their immediate self-interest and cooperate in the interest to maintain or contribute to a publicly beneficial good. In the following sections, major theories, principles and research on why people put aside their self-interests and cooperate are reviewed.

3.2 Interdependence Theory

Interdependence Theory (Kelley and Thibaut 1978, 1959; Kelley et al. 2003) is the foundation for nearly all classic themes in social psychology, e.g. emotion, social conflict, morality, personality, status and power. Kelley and Thibaut (1959) were the first who combined two innovative and influential theories of their time - social exchange theory (Homans 1950) and game theory (Luce and Raiffa 1950), in order to provide a social exchange analysis of interactions and relationships between individual-based outcome matrices as empirical tools (van Lange and Balliet 2015). With their second book, *Interpersonal relations: A theory of interdependence* (1978), Kelley and Thibaut demonstrated the importance of the people's tendencies to transform a given matrix (preferences based on self-interest) into an effective matrix (preferences based on broader and subjective considerations) and thus rejecting rational choice theory.

3.2.1 Interdependence Structure

Kelley and Thibault used interdependence matrices to "describe the way in which two persons control each other's outcome in the course of their interaction" (1978, p. 3)[10]. Cells within the interdependence matrix describe an interpersonal event and therefore demonstrate the interdependence structure. In Interdependence Theory, the interdependence structure receives a lot of attention, since it allows the proper defining and comparing of different interaction scenarios between Person A and Person B. Thus, the structure reliably influences interaction behaviour. To predict what will transpire when Person A and Person B interact, four basic assumptions of Interdependence Theory must be considered and analysed (van Lange 2012):

1. **The Principle of Structure (The Situation)**
   The interdependence features of a situation are essential for psychological processes (motives, cognition, and affect). Features of an interdependent situation are, for example, degree of interdependence, mutuality of dependence, information availability or temporal structure.

2. **The Principle of Transformation (What People Make of the Situation)**
   The interaction situation (see first assumption) may affect psychological processes and finally lead to transformations. Transformations can change social preferences (in terms of outcome for self and other) as well as temporal preferences (immediate and future consequences).

3. **The Principle of Interaction**

[10] The examples of Anna and Bob, Claudia and Thierry, and Bonnie and Clyde are examples for applying Kelley and Thibault's interdependence matrices.

Interaction (*I*) can be understood as a function of Person A, Person B, and the objective features of the situation (*S*), i.e. $I = f\ (S, A, B)$ (Kelley et al. 2003). The situation may activate different psychological processes for Person A and/or Person B and, by their behavioural response, activate a particular interaction pattern.

4. **The Principle of Adaptation**

   Repeated social interaction leads to relatively stable orientations and transformation patterns. Such adaptations reflect (a) differences in orientation between people across partners and situations (dispositions), (b) orientations that people adopt to a specific interaction partner, and (c) rule-based inclinations shared by many people to respond to a particular situation in a specific manner (culture and social norms).

Based on these assumptions, researchers can analyse the effects of small changes in experimental structure and link behaviour to changes in individual motives, cognition and effect. Changes in the outcome structure in a prisoner's dilemma situation, such as less conflict potential between Person A and Person B, lead to more cooperative behaviour (Komorita et al. 1980). Also, Cohen and colleagues (1996) found out that situations resembling to the 'Chicken Game' yield in interactions centred on dominance and reputation. Accordingly, the four basic assumptions on interdependence structure are of crucial importance for research in social interaction.

3.2.2 Dimensions of Interdependence Structure

Based on the structure of the interdependence, two further clarifications can be drawn: the degree and type of interdependence, and the structural dimensions (cf. Kelley and Thibaut 1978). The structure of interdependence can be discerned with respect to degree and type of interdependence by examining the following:

a) Actor control – the impact of each person's actions on his/her own outcome of the situation,
b) Partner control – the impact of each person's actions on the partner's outcome, and
c) Joint control – the impact of the partners' joint actions on each person's outcomes.

An across-cell association between outcomes allows to examine covariations of interests, i.e. the extent to which the partners' outcomes are correlated. This allows defining five further structural dimensions of interdependence (cf. Kelley et al. 2003). The dimensions of interdependence structure can be described as a continuum with extreme and intermediate values (e.g. high level of actor control, degree of corresponding versus conflicting interests) which affect human motives. From a practical point of view, each interdependence can be described by its standing and create a taxonomy of situations. Kelley and Thibault's six dimensions of interdependence situation were more recently interpreted by Paul van Lange and Dan Balliet (van Lange 2012; van Lange and Balliet 2015). Their interpretations (Figure 14) are well suited for helping understand the dimensions.

Situation dimension	*Relevant Motives*
1 Level of dependence	Comfort versus discomfort with dependence; and Comfort versus discomfort with independence
2 Mutuality of dependence	Comfort versus discomfort with vulnerability (as dependent) Comfort versus discomfort with responsibility (as power holder)
3 Basis of dependence	Dominance (leading) versus submissiveness (following) Assertiveness versus passivity
4 Covariation of interests	Prosocial versus self-interested motives (rules for self) Trust versus distrust of partner motives (expectations about others)
5 Temporal structure	Dependability versus unreliability Loyalty versus disloyalty
6 Information availability	Openness versus need for certainty Optimism versus pessimism

Figure 14: Dimensions of Interdependence

Source: van Lange 2012, p. 347

1. **Level of Dependence**

   Level of dependence describes the degree to which an actor relies on an interaction partner, i.e. to which degree Actor A's outcome is influenced by Actor B's choices. All mentioned examples, Anna and Bob, Claudia and Thierry, and Bonnie and Clyde, have high degrees of dependence. Increasing dependence tends to cause increased attention to situations and partners and more cognitive activities (cf. Fiske 1993; Fiske et al. 2002). Dependence and independence influence an actor's comfort or discomfort with the situation, which again can affect his/her behaviour as well as such of the partner.

2. **Mutuality of Dependence**

   In all three examples of interdependence, dependence was mutual, i.e. both actors were equally dependent on one another. However, if, for example Thierry feels comfortable watching a football game without Claudia (2;0 instead of 0;0, see Figure 12), he would exert greater control over decisions, be less dependent and hold greater power over decisions. However, Claudia would carry a greater burden of dependence and develop motives such as vulnerability, anxiety, insecurity and general discomfort. Such nonmutual dependence can again lead to changing motives of the power-primer, such as responsibility. Mutual dependences tend to feel safer, are more stable and strengthen coercion (Attridge et al. 1995).

3. **Basis of Dependence**

   This dimension refers to the possibilities in which actors influence each other's outcome, i.e. relative importance of partner versus joint control. Partner control refers to situations in which actor A's outcome rests in actor B's hand. Joint control entails contingency-based coordination of actions and demand important initiatives, strategic skills and coordination (van Lange and Balliet 2015). Depending on the basis of dependence, motives like dominance (and submissiveness) and assertiveness (and passivity) may arise.

4. **Covariation of Interests**

   Interests can be either corresponding (e.g. Anna and Bob) or conflicting (e.g. Claudia and Thierry). Corresponding interest simplifies interaction: by doing what's best for themselves (pursuing own interests), Anna and Bob produce outcomes which are good for both. Opposed interests (e.g. Claudia and Thierry) tend to generate negative emotions, like fear or greed, and yield in active information-seeking (van Lange et al. 1997c). Expression of cooperation versus competition and trust versus distrust are important motives arousing in interdependence situations with conflicting interests.

5. **Temporal Structure**
   The temporal structure highlights sequential processes and dynamics. As a result of an interaction, certain subsequent behaviours and outcomes may be made available or eliminated. For example, Claudia and Thierry finally met at the opera and Thierry recognizes that he enjoyed the show as much as if he would have gone to a football game. If they have to coordinate again in the near future, disloyal to his former choices, going to the opera may have higher level of attractiveness for Thierry (e.g. ‘5’ instead of ‘2’). Yet, the temporal dimension of interdependence affects an individual’s loyalty/disloyalty of choices.

6. **Information Availability**
   Information availability focuses on about if the actors do possess certain versus uncertain information about (a) the impact of each of actor’s actions on both actors’ outcome, (b) the goals and motives guiding each actor’s action, and (c) the opportunities that will be made available (or eliminated) because of their actions. Information collection on the other actor and the situation or reflecting a person’s own beliefs on others when incomplete information about the other person is given, can be allocated to such structural dimension (Vuolevi and van Lange 2009). Thus, uncertain information affords, among other things, the expression of openness versus a need for certainty, as well as optimism versus pessimism (van Lange and Balliet 2015).

Those six structural dimensions reliably affect human interaction motives. Although social settings of interdependence have a common underlying structure, small differences in structure and understanding can lead to different motives and different behaviours. The proper assessment of structural features in settings of interdependence becomes more important.

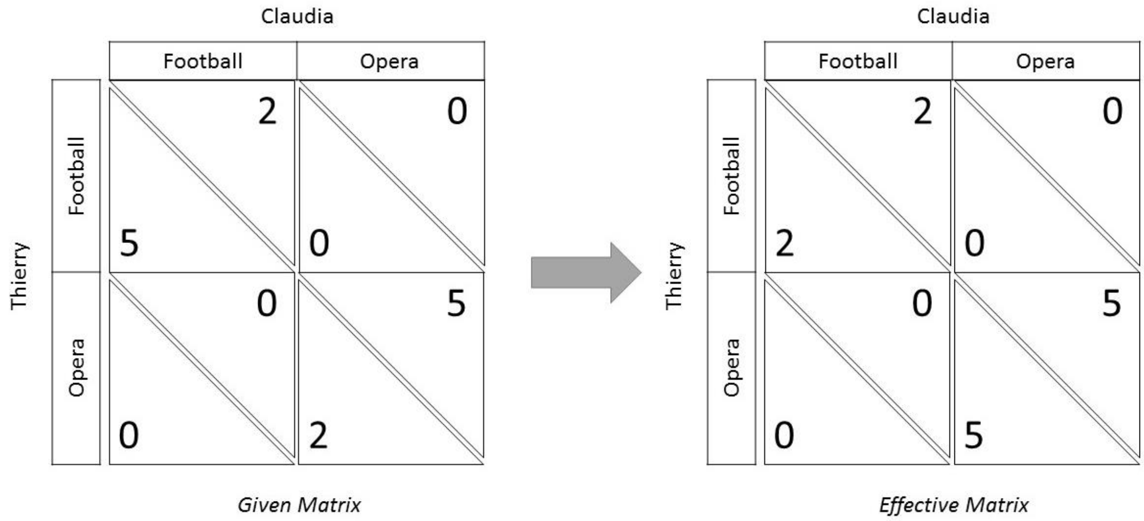
Nevertheless, Actor A and Actor B can interpret the interdependence structure differently. Thus, even an objective outcome structure can be construed individually. Kelley and Thibault not only pointed out the importance of the structure of interdependence using outcome matrices, but also showed that these were subject to subjective processing and transformation.

3.2.3 Transformation of Interdependence Processes

Interdependence theory assumes that actors in an interdependence setting transform a *given matrix* of outcomes into an *effective matrix* of outcomes. Kelley and Thibault define the *given matrix* in the sense “that the behavioural choices and the outcomes are strongly under the control of factors external to the interdependence relationship itself” (1978, p. 16). Thus, each outcome in each square of the matrix is given by the specifications of the structural and physical environment and the relevant properties of the two actors. Environmental factors and institutional arrangements in combination with personal factors (e.g. needs and cognitive skills) determine the given matrix. Deviations from rational choice theory construe that preferences are not given but transformed. However, also given preferences can occur in simple interdependence situations, where broader considerations are irrelevant (e.g. Box 2), when actors lack ability and/or motivation to consider broader considerations, when the situations involve time pressure, and when actors have constrained cognitive capacities (Finkel and Rusbult 2008).

On the other hand the *effective matrix* reflects the contingencies that are operative at the time the actual behaviour occurs (Kelley and Thibaut 1978). The effective matrix reflects an actor’s consideration of broader considerations (e.g. the partner’s interests), long-term goals, or strategic considerations (van Lange and Joireman 2008; van Lange et al. 2013). The shift of motivation from the given matrix to the effective matrix is also known as psychological transformation. Such transformation often occurs when a given situation dictates one type of behaviour (e.g. rational choice), but personal traits, values and experiences dictate another one. Therefore, choices are generally both taken and evaluated within the effective matrix and not in the given matrix.

The interdependence situation of Claudia and Thierry (Box 4) should now serve as an illustrative example to explain human behaviour in such settings. The given matrix illustrates the given situation of the situation, i.e. its physical and structural environment and the relevant properties of Claudia and Thierry. Based on the environment, transformational processes may occur. Let us assume that Thierry knows that Claudia had a rough day and wants only the best for her. By having such personal emotions, Thierry’s choice depends only on Claudia’s well-being and shows a transformation of motivation. Thus, the effective matrix represents a situation with corresponding interests (Figure 15). Such an intrapersonal process changes Thierry’s evaluation of the *given situation* and rebuilds a new and *effective matrix*, in which he pursues another choice: *effective preference* to go to the opera.



Note : each number indicates the individual level of attractiveness for each situation's outcome.

Figure 15: Illustration of the Transformation Process

Thierry's affection for Claudia finally resulted not only in a simplification of the interaction relation between the young couples, but it also rejects human decision-making based on given matrices and more important rational choice theory. Humans are social animals exhibiting social choices. But what leads to effective social choices, and how can such be promoted?

3.3 Decision-making Processes in Social Dilemmas

Kelley and Thibault emphasized on a solid basis the importance of psychological transformations in settings of interdependence but did not point out what causes such transformation. With the seminal work of Kelley and Thibault, social psychologists possess a solid theory on which they could answer such questions.

What leads to transformation of motivations? A good starting point is the integrative model of decision-making of Parks and colleagues (2013). Their article *Cooperation, Trust and Antagonism – How Public Goods are Promoted* provides an overview over acknowledged psychological principles and their relationship with theory of interdependence. The nucleus of Parks and colleagues' model emphasizes Kelley and Thibault's findings on the 'Transformation of Motivation' (Figure 16).

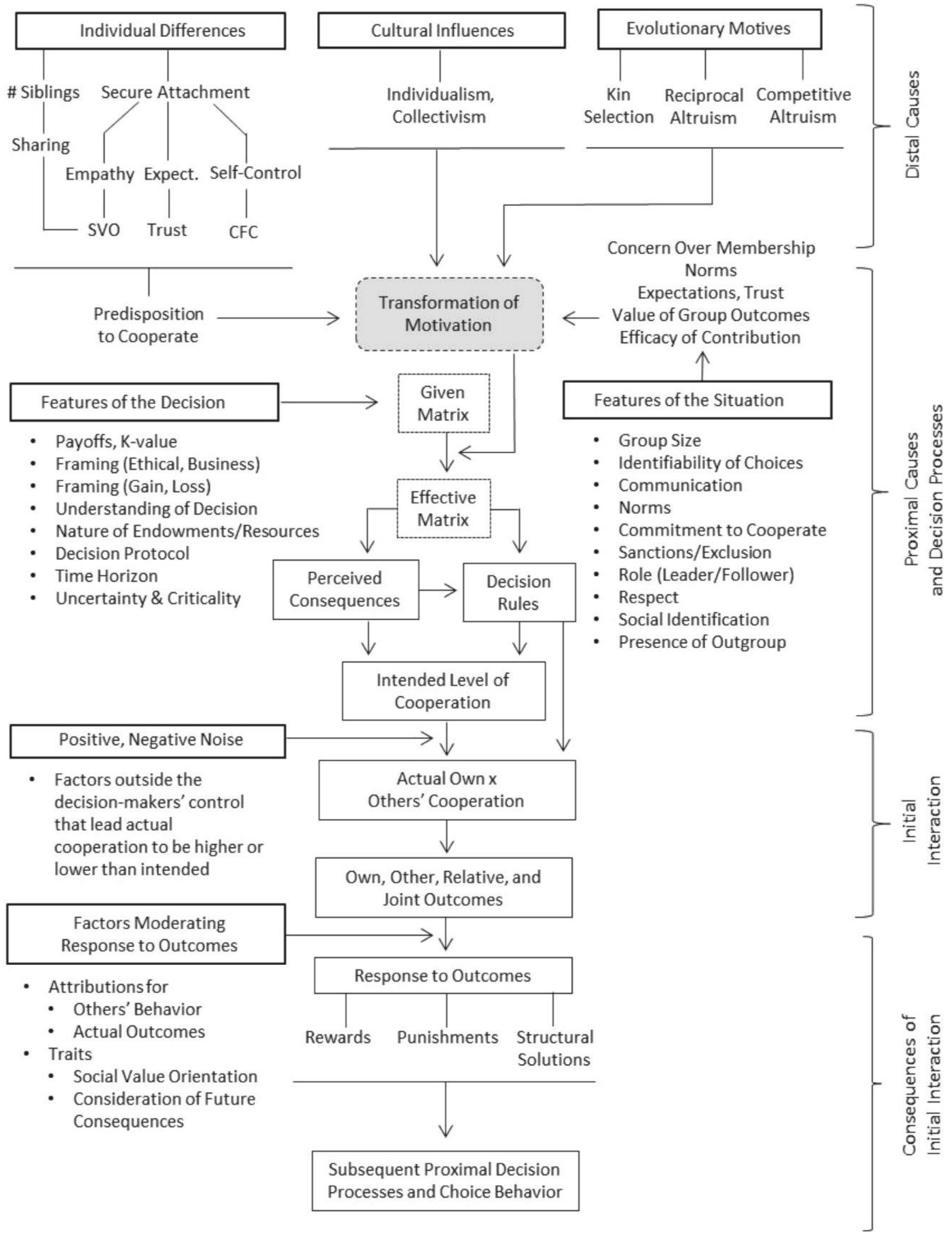


Figure 16: Integrative Model of Decision-making in Social Dilemmas

Source: Parks et al. 2013, p. 130

The authors highlight factors that affect the *given matrix* (i.e. features of the decisions itself), which is a re-worded construction on van Lange's interpretation (2012) of Kelley and colleagues' (2003) dimensions of interdependence structures (see also Chapter 3.2.2).

Parks and colleagues also highlight factors that lead to the transformation from a given to an effective matrix. They identify distinct distal (e.g. personal histories, culture, and evolutionary motives) as well as proximal causes (e.g. immediate social situation of interdependence) for transformation.

1. **Distal causes for transformation** – emphasize factors within a decision-maker's larger context. Distal causes are in no relation with the interdependence situation itself, but they reliably influence the transformation of motives (e.g. Balliet and van Lange 2013; Gächter et al. 2010; Nowak 2006; van Lange 1999). Distal causes can further be segmented into three different categories:
    a. *Individual differences in predisposition for cooperation* – This category highlights different distinct personality traits, which give rise to cooperation in social dilemmas: *Social Value Orientation* (SVO), i.e. the weight people assign to their own and other's outcomes in settings of interdependence (Messick and McClintock 1968; van Lange 1999), *trust*, i.e. expectations that the others are honest and trusting them is not too risky (Yamagishi 1986), and finally the person's *consideration of future consequences* (CFC), i.e. the importance attached to immediate vs. delayed consequences of one's actions in settings of interdependence (Joireman et al. 2001; Strathman et al. 1994). SVO, trust and CFC are rooted in the decision-maker's early experiences, whereby they remain quite stable over time.
    b. *Cultural Influences* – Different studies show that the cultural belonging influences a decision-maker's choice in settings of interdependence (e.g. Cox et al. 1991; Oyserman et al. 2002; Parks and Vu 1994). The belongingness to either an individualistic or a collectivist culture is behind the person's sphere of influence and remains therefore stable over time.
    c. *Evolutionary Motives* – refer to, among others, sociobiological precursors for altruism. Kin selection theory (Hamilton 1964) explains why people are more likely to help relatives than strangers (Burnstein et al. 1994). Evolutionary motives for cooperation include important temporal considerations, e.g. experienced reciprocity (cf. Schino 2007; Trivers

1971), as well as strategic considerations for future cooperation, e.g. reputation-building through competitive altruism (Hardy and van Vugt 2006; van Vugt et al. 2009).

Distal causes like individual differences, cultural influence and evolutionary motives are important precursors for cooperation and finally cause a subjective interpretation and transformation of a given matrix. However, distal factors can be moderated by more proximal causes for decision-making.

2. **Proximal causes for transformation (immediate social situation)** – contrary to the features of the decision, the features of the situation do not give rise to changes in the payoff structure of the given matrix, but they likely impact the transformation from a given matrix to an effective matrix. Social factors are likely to produce such transformations. Complementary to such statement, Parks and colleagues summarized the most important social factors that lead to a transformation and their impact on cooperative behaviour in social dilemmas (see Figure 17).

Feature of situation	Impact	References
Group size	Cooperation and effort toward group tasks is lower in larger groups.	Brewer & Kramer, (1986); Hamburger et al. (1975); Karau & Williams, 1993; Komorita & Lapworth, 1982
Identifiability of choices	Cooperation and effort toward group tasks are enhanced when choices are identifiable.	De Cremer et al. (2001); Fox & Guyer (1978); Jerdee & Rosen (1974); Karau & Williams (1993); Van Vugt & Samuelson (1999)
Communication	Communication enhances cooperation, with the effect larger for spoken (vs. written) communication and in large groups.	Balliet (2010)
Norms	Cooperation is enhanced when cooperative norms are present, especially when normative group is similar to self.	Bicchieri (2002); Biel & Thøgersen (2007); Cress & Kimmerle (2007); Parks et al. (2001)
Stated commitment to cooperate	Pledging a commitment to cooperate enhances cooperation.	Chen (1996); Chen & Komorita (1994); Kerr et al. (1997); Kerr & Kaufmann-Gilliland (1994)
Sanctions	Rewards for cooperation and punishments for noncooperation enhance cooperation, especially in iterated dilemmas involving same partners.	Balliet et al. (2011)
Threat of exclusion	Cooperation is enhanced when exclusion from the group is possible.	Cinyabuguma et al. (2005); Kerr et al. (2009)
Role in group (leader or follower)	Leaders take more of a common resource than followers, with differences larger among appointed leaders and among proselfs.	De Cremer & van Dijk (2005, 2008); Stouten et al. (2005); van Dijk & De Cremer (2006)
Respect and justice	Cooperation is enhanced when group members are shown respect and treated fairly by leaders	De Cremer (2002); De Cremer & van Knippenberg (2002, 2003)
Social identification	Cooperation is enhanced when decision makers strongly identify with group, especially among proselfs.	Brewer & Kramer (1986); Buchan et al. (2011); De Cremer & Van Vugt (1999); Kramer & Brewer (1984); Wit & Kerr (2002)
Presence of out-group	Intragroup cooperation is enhanced when competing against an out-group, especially among men.	Bornstein et al. (1989); Gunnthorsdottir & Rapoport (2006); Van Vugt et al. (2007)

Figure 17: Features of the Situation influencing Cooperation in Social Dilemmas

Source: Parks et al. 2013, p. 134

The integrative model of Parks, Joireman and van Lange includes two further stages of decision-making. First, the 'initial interaction' stage emphasize 'noise' as a factor that leads to differences between intention and actual level of cooperation. Most literature focuses on 'negative noise', i.e. actual level of cooperation is lower than intended (Brucks and van Lange 2007, 2008; Kollock 1993; van Lange et al. 2002). It also focuses on consequences of initial interaction, which emphasize a group's response possibilities to reciprocate cooperation and punish by setting up structural solutions (cf. Fehr et al. 2002) or common rules (Ostrom 1990).

Park and colleagues' approach is useful to not only understand the processes behind human behaviour in settings of interdependence, but it can, in accordance to the theory of interdependence, also be useful to design solutions in case a dyad or a group fails to achieve a beneficial outcome.

3.4 Promoting Cooperation in Social Dilemmas

Quite often, decision-makers can resist short-term motives to freeride on other contributions and the group can solve the dilemma without further intervention. On the other hand, it is easy to imagine a dyad or a group that fails to accomplish cooperative patterns. Often, only one 'bad apple' contaminates the whole 'basket' with its destructive interests. A single bad apple can lead to cooperation-obstructing feelings of other group members, like anger, antagonism and mistrust. Consequently, not only do the mutual benefits of the collective goods vanish, but it also disturbs the social cohesion of the group.

To avoid such and to promote cooperation, different solutions are conceivable (cf. Parks et al. 2013; van Vugt 2009): (a) *Structural solutions* that alters the structure of the interdependence situation as to stimulate cooperative behaviour, (b) *psychological solutions*, which aim to change thoughts and feeling among members, and (c) *third-party interventions* that coordinate constructive problem-solving.

3.4.1 Structural Solutions

Structural solutions have three distinct forms: changing the outcome structure, increasing the comprehension of the structure, and changing the decision structure.

A real-life example of changes in the outcome structure is the Dutch government's attempt to reduce traffic congestion by carpooling (cf. Geels 2007). To discourage individual car use and to achieve mutual benefits of less congestion on Dutch highways, the government implemented a carpool lane. The carpool lane could only be used by car-poolers and had less congestion than classical lanes. Consequently, the Dutch government actively changed the outcome situation of the given matrix, by increasing the individual benefits of cooperative behaviour, i.e. carpooling. However, the expected change of behaviour did not occur, because car drivers were unable to find passengers, i.e. change to carpooling (van Vugt et al. 1996b). Furthermore, such rewards (or incentives) for cooperative behaviour are not undisputed since they may undermine intrinsic cooperative motivation (Frey 1994; van Vugt 2009). Changes of the outcome structure can also result by punishing individuals that do not behave in the desired way. Punishment solutions were widely researched by prominent psychologists and economists (Fehr and Gächtner 1999; Fehr et al. 2002; Yamagishi 1986, 1988). Punishments decrease the attractiveness of selfish outcomes, as rewards increase the attractiveness of socially desired behaviour outcomes. A meta-analysis involving 187 effects sizes exhibited a statistically equivalent positive effect on cooperation for rewards as well as for punishment (Balliet et al. 2011). The effectiveness of changing the outcome structure was based on two reasons (Parks et al. 2013). First, by setting up a reward or a punishment structure, mixed-motives in social dilemmas dissolve, i.e. ‘to cooperate’ becomes equally attractive as ‘to freeride’, or ‘to cooperate’ even yields in higher attractiveness for the decision-makers. Second, a change in the outcome structure stabilizes expectations regarding the other’s willingness to cooperate (cf. Ostrom 1990), increases self-efficacy of contributions (Kerr 1989, 1992), and increases the situation’s perceived ‘fair’ distribution of outcomes (Fehr and Schmidt 1999).

The second form of structural solutions emphasizes the decision-makers understanding of the structure. Hopthrow and Adams (2010) showed that demonstrability of the structure increases cooperation, especially for individuals with non-cooperative preferences. Further, the same effects were found when decision-makers have initial information about the other’s choices (Sell and Wilson 1991; Shang and Croson 2009). Finally, pro-environmental behaviour was shown to be promoted when people understand the physical and social environment (van Vugt and Samuelson 1999). The comprehension of the structure is based on the individual’s set of information about his/herself, the others, and the situation in general, which finally reduces uncertainty in settings of interdependence (cf. van Vugt 2009).

The third form of structural solutions entails changes in the decision structure. Changes in the decision structure are quite effective if a group repeatedly failed to solve a social dilemma (Cremer and van Vugt 2002). A group can elect leaders, mediators or regulators that would make decisions for the entire group. In the case of Bonnie and Clyde (see Box 4), both could benefit if a lawyer would take over the process and decision control (cf. Sheppard 1984). Indeed, a major task of governments, companies and professions is to acquire decision authority for groups in mixed-motives situations (see also Chapter 3.4.3). Nevertheless, not only are authorities unable to regulate all forms of interpersonal behaviour, but people directly concerned are themselves quite able to manage their group effectively (Ostrom 1990).

3.4.2 Psychological Solutions

Next to structural solutions, which aim to increase cooperation by changing the structure of the outcome matrix in setting of interdependence, psychological solutions aim to change the persons' beliefs, emotions and thoughts. Although structural solutions also lead to behavioural changes, psychological solutions target the mere psychology of persons and interpersonal relations.

Most theories on cooperation emphasize *trust* as an important factor to promote and sustain cooperation (Parks et al. 2013). Weak self-control, fear of nonreciprocal moves by others, and negative noise can undermine trust (cf. Kollock 1993). Often small errors lead to a reduced level of interpersonal trust, e.g. being stuck in a traffic jam and coming late for an appointment. In small-scale real-life examples, trust can be restored by prompt communication, e.g. apologizing for being late for an appointment. The positive effect on trust of communicating generosity when cooperating (Parks and Stone 2010; Piff et al. 2010; van Lange et al. 2002), and communicating apology and forgiveness when acting non-cooperative (McCullough et al. 1997; McCullough et al. 1998; McCullough et al. 2002) were shown on several experimental occasions. Further, Kramer and Goldmann (1995) suggested that identification with a group, i.e. social identification, increases cooperation by amplifying interpersonal trust.

Literature emphasizes the positive effect of *social identification* on cooperation, which forms a second psychological solution to solve social dilemmas (e.g. Brewer and

Kramer 1986; Brewer and Schneider 1990; Cremer and van Vugt 1999; Kramer and Goldmann 1995; Simpson 2006; Turner and Oakes 1986). The concept of social identification describes those aspects of a person’s self-concept based upon their group memberships together with their emotional, evaluative and other psychological correlations (Turner and Oakes 1986). Hence, social identification reduces a decision-maker’s tendency to draw distinctions between his or her own and others’ welfare and also reduces psychological distance between group members (Tajfel and Turner 1986; Turner 2010). Following this, social identification gives rise to the transformation of motivation (cf. Kelley and Thibaut 1978). Another explanation emphasizes that social identification increases trust among the individuals (Brann and Foddy 1987; Kramer et al. 1996; Kramer and Goldmann 1995). Trust is an important factor, since it increases reciprocity between the involved individuals (cf. Pruitt and Kimmel 1977). According to this explanation, cooperation is improved by rising expectations that other individuals reciprocate cooperation as well.

The concept of social identification can be described as ‘anti-individualistic’ and contradictory to rational choice theory, because social identity theory observes increased weight for collective outcome choices in individual decision-making (Brewer 1979). Feelings of group identification are crucial when a group faces a social dilemma and several real-life cases confirm such (e.g. Bogaert et al. 2012; Bonaiuto et al. 2008; Buchan et al. 2011; Cremer et al. 2008; Penn 2003; van Vugt 2001).

3.4.3 Third-party Solutions

The third solution yields to solve the social dilemma by letting a *third-party* (or an institution (van Vugt 2009)) intervene in the decision-making process. The third party’s characteristics can be defined differently. If a father intervenes in the argument between his two sons, his role has an unofficial problem-solving characteristic, since the two brawlers did not ask for mediation. On the other hand, official problem-solving characteristics can be observed when a third party contractually mediates between two or more parties, e.g. the United Nations or peace talks offered by the Swiss Government (Greminger 2007).

Sheppard (1984) defined four different roles a third party can acquire, jointly based on the extent of process control, i.e. the degree a third-party presents and interprets relevant evidence of the situation, and decision control, i.e. the degree a third party can control for outcomes. Among these four roles, the mediational role is the most used one (e.g. Bazerman et al. 2000; Carnevale and Pruitt 1992; Esser and Marriott 1995; Lewicki et al. 1992). Mediating third-party exercises only process control, whereby decision control remains in the hand of the conflicting parties. Thus, control over the outcome of the situation results by the choices of the parties themselves. It was shown that the mere presence of a third party's can already affect individual decision-making and generate agreements between conflicting parties (Manzini and Mariotti 2001). Another reason for its popularity is that a mediator facilitates communication between the conflicting parties (Jehn and Bendersky 2003) and reveals antecedent reasons of Actor A's and Actor B's choices.

Fair and unbiased execution of rules are crucial for any intervention in decision-making. Thus, third-party involvements are no panacea either. Trust-related concerns regarding a third-party's fair mediating function were observed on several occasions (Cremer and Tyler 2007; Tyler and Degoey 1995; van Vugt et al. 1996b).

3.5 Interaction between distal and proximal causes

Different solutions to solve social dilemmas exist. However, their efficiency remains dependent from other individual's motives, e.g. SVO. The distal factor SVO can moderate more proximal ones, e.g. 'frame of the situation'. 'Give-some' dilemmas are known to yield in lower cooperation rates than in 'take-some' dilemmas (van Dijk and Wilke 1995, 2000). However, such framing effects are inconsistent since prosocials tend to increase the rate of cooperation in 'give-some' dilemmas compared to 'take-some' dilemmas while individualists decreased it (Dreu and McCusker 1997). This explains the effect from changing the frame of the dilemma led to different 'transformation of motives' (cf. Kelley and Thibaut 1978): individualists amplified selfish motives if facing a loss-situation, while prosocials reinforced social ones.

The former example showed how two factors interact and affect the dependent variable, i.e. cooperation rate. Hence, the level of cooperation depends not only on 'Factor A' and 'Factor B' but also on how both factors interact. Subsequently, a well-known psychological interaction effect in social dilemmas, the 'goal-transformation hypothesis' (Cremer and van Vugt 1999), will be presented and discussed. The goal-transformation hypothesis explains the interaction effect of the distal factor 'SVO'

(Chapter 3.5.1) and the proximal factor ‘social identification’ (see Chapter 3.4.2) on cooperation rates in settings of interdependence.

3.5.1 Social Value Orientation

People differ in fundamental ways in how they approach social dilemmas. The personality variable that gained most attention in the last 50 years of social dilemma research is ‘Social Value Orientation (SVO)’ (van Lange et al. 2013). SVO is a personality variable that explains individual differences in the weight people assign to their own and other’s outcomes in settings of interdependence (Messick and McClintock 1968; van Lange 1999). The pioneering work of Messick and McClintock laid focus on the measurement of various social motives in settings of interdependence using decomposed game techniques (1968). In decomposed games, participants choose different options that offer values/points/token/money to him/herself as well as to another person. The other person remains anonymous, whereby other consideration can be excluded, e.g. strategic considerations or information on the other person. Figure 18 shows an example of a decomposed game offering three different allocation options.

	Options		
	A	B	C
Points to Self	500	600	500
Points to Other	500	200	0

Figure 18: Decomposed Game

Rational choice theory would predict that participants would always choose an option that maximizes their own utility only (i.e. allocating 600 ‘points’ to Option ‘B’ in Figure 18). However, personal differences in predisposition to cooperation show that social motives, e.g. maximize joint outcomes and equality (van Lange 1999), affect the choice in decomposed games too. Consequently, various social motives exist and different social orientations are possible (Griesinger and Livingston 1973). Yet, literature distinguishes between three types of SVOs:

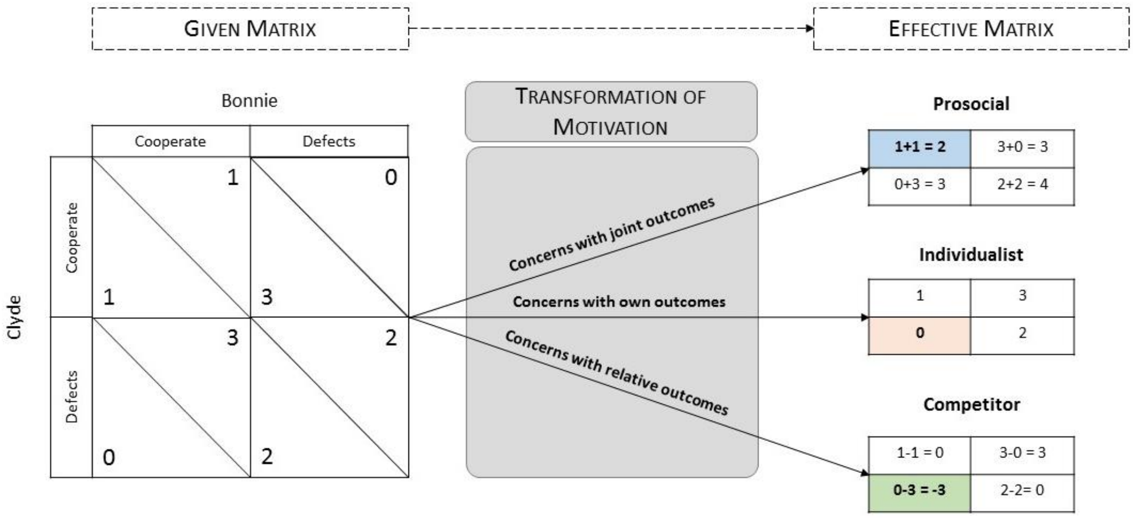
- *prosocial orientation* – individuals who maximize joint outcomes and equality (i.e. Option ‘A’),
- *individualistic orientation* – individuals who maximize their own outcome with no regard for the outcome of others (i.e. Option ‘B), and

- *competitive orientation* – individuals who maximize relative outcomes (i.e. Option 'C').

The latter two orientations are often combined and form a group of with a '*proself*' orientation (Brewer and Kramer 1986; Cremer and van Vugt 1999; Kramer et al. 1986; van Vugt et al. 1995).

Social dilemma review literature shows that SVO reliably influences the transformation of a given matrix, which finally leads to different responses in social dilemmas (Bogaert et al. 2008; van Lange et al. 2007b): prosocials are more likely to cooperate in social dilemmas than proselfs (for meta-analysis, see: Balliet et al. 2009). Using the prisoner's dilemma of Clyde (Box 3), the transformative power of SVO is shown in Figure 19. The objective outcomes of all interactions with Bonnie are given in the *given matrix*. The three different SVOs lead to different motives to transform the *given matrix*, which again leads to three different subjective and *effective matrices*.

If Clyde has a prosocial inclination, his motivation to achieve joint outcomes, measured in years in prison, leads to an *effective matrix* in which the top-left outcome would be the most attractive. Regardless what Bonnie chooses, the top row, i.e. to cooperate, is always more attractive than the bottom row, i.e. to defect. On the other side, if Clyde is categorized as an individualist or competitor, the bottom-left outcome is the most attractive one, and regardless Bonnie's moves, Clyde would always choose to defect. However, each choice is based on different motives, i.e. achieving the most attractive outcome for himself (as an individualist) and as a competitor, achieving the most attractive outcome for himself relative to Bonnie's, which again leads to different effective matrices.



Note: each number indicates the individual amount of years in prison for each situation's outcome.
The lower the number, the higher the level of attractiveness.

Figure 19: SVO and Transformation of Motivation

Results from experimental and field research showed that prosocials are systematically more cooperative than proselfs, i.e. individualists and competitors. Further, Table 5 also shows that SVO is used in a variety of settings of interdependence in different research areas.

Research Subject	Author(s)	Observations
Resource Conservation	Kramer et al. 1986	Prosocials consume less than proselfs.
Helping Behaviour	McClintock and Allison 1989	Prosocials help more than proselfs.
Negotiation Behaviour	de Dreu, Carsten K. W. and van Lange 1995	Prosocials exhibit lower levels of demand, exhibit greater levels of concessions, and ascribe greater levels of fairness and considerateness to the other person.
Commuting Behaviour	Joireman et al. 1997; van Lange et al. 1998; van Vugt et al. 1996a	Prosocials have greater overall personal preference for public transportation than proselfs.
Intimate Relations	van Lange et al. 1997a	Prosocials are more willing to sacrifice in relationships.
Environmental Behaviour	Ackermann et al. 2014; Cameron et al. 1998; Gärling et al. 2003	Prosocials engage more often in proenvironmental behaviour than proselfs.
Corporate Citizenship	Nauta et al. 2002	Prosocials exhibit greater concern for goals of other departments.
Coordination and Synchronisation	Lumsden et al. 2012	Prosocials engage more often in synchronization than proselfs.

Youth and Trust	Derks et al. 2014	Young adults with a prosocial disposition to cooperation are more trusting than proselfs.
Information Sharing	Utz et al. 2014	Prosocials share information more often than proselfs.
Donations	van Lange et al. 2007a	Prosocials are more willing to help for noble causes.
Participation in Experiments	van Lange et al. 2011	Prosocials are more willing to participate in psychology experiments than proselfs.
Helping Refugees	Böhm et al. 2018	Prosocials are more willing to provide costly help to refugees than proselfs.
Tax Morale	Brizi et al. 2015	Prosocials have a higher tax morale than proselfs.
(a) Energy Conservation Behaviour	McCalley and Midden 2002	Prosocials conserve more energy when energy goals are assigned (and not self-defined) than proselfs.
(b) Energy Conservation Behaviour	Sütterlin et al. 2013	Prosocials perform energy conservation behaviour based on curtailment more often than proselfs.
(c) Energy Conservation Behaviour	Tanaka et al. 2017	Given the possibility of an electrical outage, prosocials conserve more energy than proselfs.
Energy Consumption Behaviour	Jingchao et al. 2017	In a Chinese context, prosocials choose more often high-quality coal (is more expensive and has less environmental impact than low-quality coal) than proselfs.

Table 5: Applied SVO Research

SVO is a distal cause for individual transformation of motivation (Parks et al. 2013). As such, it moderates more proximal causes, i.e. decision processes and proximal causes. Hence, having a prosocial, individualist, or competitive inclination towards cooperation leads to an interaction effect with the focal variable. A well-known interaction effect between two variables will be presented in the next section.

3.5.2 The 'goal-transformation' Hypothesis

The overall positive effects of social identification on cooperation were mentioned earlier (see Chapter 3.4.2). Typically, identification with group members motivates people to contribute to the collective welfare (Edney 1980). However, the underlying processes that arise when social identification is salient remained, despite longstanding research, vague and unknown.

The two mentioned explanations in Chapter 3.4.2, i.e. social identification leads to a *transformation* of motives versus social identification *increases trust*, are opposed and based on different assumptions (Cremer and van Vugt 1999). The former explanation, *transformation*, relies on the premise that the 'transformation of motivation' affects only individuals who would normally not contribute, i.e. proselfs, but not individuals that would contribute, i.e. prosocials. With salient group identification, proselfs transform their selfish reasoning into a social reasoning. Therefore, attention and goals shift from individual towards collective outcomes, i.e. '*goal-transformation*'. The latter explanation, *trust*, predicts that group identification affects only individuals that are already concerned with a group's welfare and therefore are genuine cooperators, i.e. prosocials. Consequently, individuals with a competitive or individualistic disposition to cooperate would not be affected. Yet, salient group identification should amplify trust only among individuals with 'collective goals' and enhance cooperation only among prosocials, i.e. '*goal-amplification*'. According to the two explanations, Figure 20 depicts the differing relationship between social identification and SVO on cooperation.

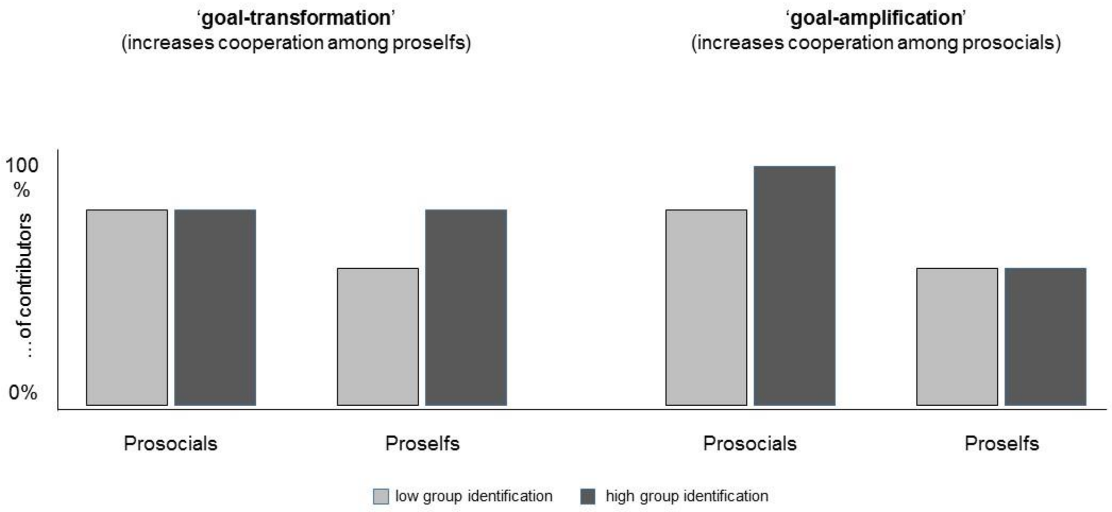


Figure 20: Interaction between SVO and Social Identification

Source: adapted from Cremer and van Vugt 1999

Both explanations stress the importance of SVO as a moderator variable on social identification. Thus, the level of cooperation depends on how social identity affects cooperation intention among different SVOs. David de Cremer and Mark van Vugt's article '*Social identification effects in social dilemmas: A transformation of motives*' (1999) empirically supports the former explanation, i.e. 'goal-transformation' hypothesis. Their three experiments showed that when group identification was enhanced, proselfs contributed significantly more than when identification was low. Their findings on the disentangled effects of social identity on cooperation are without a doubt important for psychological social dilemma research. Building on these results, new insights were gained in the areas of 'Leadership' (e.g. Cremer and van Knippenberg 2002; Hirst et al. 2009; van Knippenberg et al. 2004), 'Environmental Psychology' (e.g. Bonaiuto et al. 2002; Fielding et al. 2008; van Vugt 2009) and 'Social Identity' (e.g. Cremer 2002; Hogg et al. 2017; van Vugt and Hart 2004). Yet, the impact of Cremer and van Vugt's work is not limited to psychology research alone as shown in a Web of Science®-citation report (Figure 21).

Figure 21: Citation Report of Cremer and van Vugt 1999

Source: Web of Science®, retrieved on 14.06.2018

Numerous articles refer to the results of Cremer and van Vugt by emphasizing the overall positive effect social identification on cooperation but neglect the 'goal-transformation'-hypothesis *per se*. Nevertheless, some articles explain the 'goal-transformation' hypothesis more precisely or corroborate the authors' hypothesis:

- Cremer and van Dijk 2002 *extended* the experiment of Cremer and van Vugt by a multi-round experiment, which supported the 'goal-transformation' hypothesis. Further, they showed that the interaction effect of SVO and social identification on the level of contributions was missing when performance feedback is provided to the experimental units: "when a group fails, contributions increase if group identity is salient, but decrease if personal identity is salient, regardless of a person's social value orientation" (Cremer and van Dijk 2002, p. 435).
- Cremer et al. 2008: *duplicated* the experiment of Cremer and van Vugt and supported the 'goal-transformation' hypothesis by demonstrating that social

identification "was mediated by participants' sense of collective self, and not by their expectations" (Cremer et al. 2008, p. 1562).

- Bogaert et al. 2012 surveyed a sample of employees of a Belgian university. They showed that cooperative climate had a stronger positive effect on affective commitment for proselfs than for prosocials. To the author's knowledge, Bogaert and colleague's article is the first and only attempt to *apply* the 'goal-transformation' hypothesis in a non-laboratory setting.

Social identification is decidedly a promising factor to solve social dilemmas. Yet, its transformational impact is limited to proselfs only. The fact that prosocials, and therefore the majority of humans, remain insensitive to social identity manipulations is of fundamental importance for policy-making. Policy-makers need to acknowledge that individual differences and sensitivities in settings of interdependence moderate the effect of cooperation-enhancing solutions. Hence, policy development must not only acknowledge such differences but also integrate the interpersonal dimensions in policy-making to effectively increase cooperative behaviour. On the other hand, social psychologists need to expand and apply their principles tested in laboratory settings in less clinical environments. Therefore, one claim of this thesis is to replicate and test the 'goal-transformation' hypothesis in the field of energy-related policy development.

3.6 Conclusion

The preceding sections of this chapter provided a common basis on major social-psychological principles in settings of interdependence. Referring to three different examples, the chapter focused on reasons why humans cooperate, even though they would benefit from non-cooperative choices. Based on the 'Theory of Interdependence' (Kelley and Thibaut 1978, 1959; Kelley et al. 2003), the parts outlined the different dimensions of interdependence structures and emphasized the subjective 'psychological transformation' that leads to cooperative choices. These reflections were complemented with an integrative model of decision-making in social dilemmas (Parks et al. 2013), which summarizes the most acknowledged factors influencing the decision-making process. Although most people's behaviour contradicts rational choice theory, three instruments were suggested to increase cooperation (structural solutions, psychological solutions, and third-party intervention). Accordingly, special attention was given to the 'goal-transformation' hypothesis (Cremer and van Vugt

1999), which clarifies and disentangles the positive effects of social identification on cooperation. The academic claim of the thesis was defined, as to test the ‘goal-transformation’ hypothesis in the broad field of ‘energy-related policy development’.

4 Research Framework

The aim of this chapter is to *present* a research framework, which lays the foundation for an empirical investigation. To do so, the framework *combines* insights gained in the chapter 'Research Motivation' with the acknowledged observations from the previous chapter 'Theory'. The research framework *emphasizes* the concrete angle of interest regarding the stated problems. Further, anticipated academic and practical value are *outlined*. Figure 22 provides an outlook of the chapter.

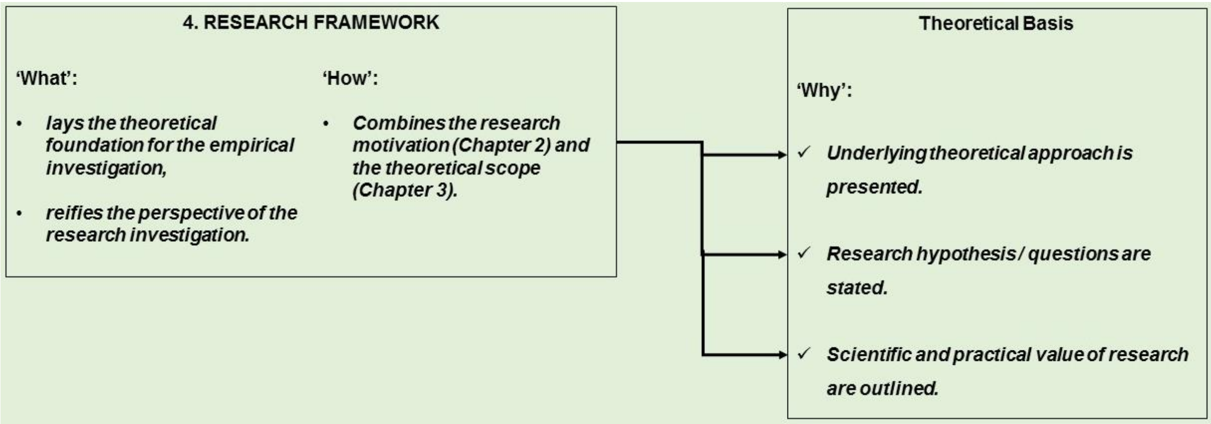


Figure 22: Chapter four, Outlook

4.1 Research Framework of 'The Potential of Energy Communities'

The first academic claim is to test and apply the 'goal-transformation' hypothesis in energy-related policy development. The following parts will *introduce* and *define* the field of application, as well as *state* the research hypotheses for the first part of the thesis.

4.1.1 The Social Dimension of Energy Communities

To this point of the thesis, main gaps in the field of research (Chapter 2) and theoretical principles (Chapter 3) to respond to such were presented separately. As hypothetically argued in the second chapter, energy communities can contribute to the goals of the ES2050 by amplifying energy-related contribution behaviour. This part of the thesis (a) *explains* how social-psychological models and principles from social dilemma research are integrated in the field of energy communities and energy-related cooperation and (b) *frames* energy-related decision-making from an interdependent point of view.

Setting of interdependence

Energy goals and energy transition depend on different individuals, whereby their achievement is a result of a collective effort. The outcome is by default social and characterized by settings of interdependence, i.e. energy goal achievement depends on Actor A, Actor B, and the situation's structure. Consequently, different levels of interdependence are possible. The highest level of interaction results when the situation prescribes collective goals that depend solely on Actor A and Actor B, e.g. both actors form the most extreme form of an 'islanded situation', like formulating energy goals in a 'prosumer-to-islanded micro grids' market. In reality, weaker but still strong interdependence prevails. Even individual energy goals, e.g. reducing utility bills, have forms of weak interaction.[11] The structure of interdependence (see also Chapter 3.2.2) in energy communities is proposed straightforward, and all community members face equal settings of interdependence, i.e. no unequal distribution of dependence:

(a) equal impact of each community member's actions on his/her own outcome,
(b) equal impact of each community member's actions on the community's outcome, and
(c) equal impact of the community members' joint actions on each other's outcomes.

Conflicting interests

Energy goals target a desired outcome related to the way energy is produced, distributed and consumed. To achieve energy goals, additional efforts are needed. Simultaneously, energy goals involve different and opposed interests. Interests can be of a social nature and driven by long-term considerations, e.g. '*I want for my children a better future*'. Interests can also be selfish and driven by short-term considerations, e.g. '*I want comfort and convenience'*. Accordingly, one interest rules out the other.

[11] Utility prices depend not only on an individual's energy consumption but also on the average energy consumption of the population. Thus, individual utility bill savings may vanish if average utility prices increase.

Collective Action

Energy goals depict a collective action, in which involved parties purposely contribute to its achievement in settings of interdependence. The ES 2050 is a collective action on a national scale, while energy communities form local or group-specific collective actions (cf. Coenen and Hoppe 2018). The kind and extent of contribution may vary regarding the goal itself. Any kind of contribution depicts some form of (short-term) costs. Energy conservation goals typically involve contributions linked to behavioural changes in energy use or investments in energy-efficient devices. Green-energy supply goals additionally involve monetary contributions in the form of purchasing energy production units. Hence, 'energy-related contributions' are defined as follows:

'All kind of capital needed to achieve the collective energy-related goal. This includes both, onetime and continuous contributions, as well as financial investments and changes in energy conservation behaviour'.

Social Dilemma

Energy goals depict a social dilemma, i.e. a 'mixed-motives' situation. Selfish and collective reasoning are opposed and since contributions are voluntary and benefits are non-excludable, freeriding occurs. Table 6 provides a non-exhaustive list of potential group-specific and non-excludable benefits of energy communities, according to the different social dimensions of energy (Hertig and Teufel 2016a; Stern and Aronson 1984). Some benefits like 'savings' and 'additional income' could also be seen as 'private goods' (i.e. with excludable and rivalrous benefits) and therefore change the structure of interdependence abruptly. Consequently, all benefits need to be framed as non-excludable, in order to guarantee an unbiased structure of decision-making among the different potential benefits.

Dimension	Non-excludable benefits
Energy as a Commodity	• savings • additional income • local value creation
Energy as a Social Necessity	• reducing energy poverty • increased energy justice • affordable energy

Dimension	Non-excludable benefits
	• local job creation
Energy as an Ecological Resource	• green energy supply • reduction of ecological footprint • reducing impact on landscape
Energy as a Strategic Material	• energy autonomy and self supply • reduced network disturbances • reduced dependence from traditional utilities
Energy as an Interpersonal Construct	• strengthened social cohesion • social learnings
others	• reputation gains • technological learnings
For review of energy community related benefits, see also: Brummer 2018; Busch et al. 2019**.**	

Table 6: Non-excludable Benefits arising from Energy Communities Goals

The collective reasoning would prescribe to contribute to energy goals (and bear costs), in order to attain an outcome that would be beneficiary to anyone. On the other hand, selfish reasoning relies on the premise that outcomes of the energy goals are uncertain and regardless of the other members' behaviour, selfish choices are preferred. However, benefits from selfishness are only possible as long as other members do not behave selfishly too. Thus, the achievement of the energy goals is only successful when an important amount of people chooses to contribute to it, and it fails when too many pursue a selfish strategy. Referring to the large literature on SVO (cf. Chapter 3.5.1), prosocials are expected to contribute more to energy goals, when framed with non-excludable benefits, than individualists and competitors.

Energy Communities as Structural Solutions

Energy communities can serve as structural solutions for energy-related decision-making in settings of interdependence (cf. Chapter 3.4.1). More precisely, energy communities emphasize *group-specific* instead of *national* energy-related goals and benefits and therefore change the outcome matrix for given preferences. By dimensioning and breaking down the outcome, *criticality of cooperation* and *self-efficacy of contributions* are expected to increase (cf. Au et al. 1998; Chen et al. 1996).

Thus, an energy community changes the specifications of the structural and physical environment for energy-related decision-making.

Energy Communities and third-party Interventions

Given the technological complexity of achieving energy-related goals (cf. Smart Grid Coordination Group 2012) and of coordinating the members' behaviour, the energy-related social dilemma can be mediated by a third party, hereinafter referred to as 'energy service provider' or 'service provider'.

'An energy service provider fulfils the by the community defined duties to coordinate and orchestrate energy-related behaviours of all energy community members for the common goal'.

Hence, an energy service provider supports the community efforts to overcome the energy-related social dilemma. The degree of intervention to which a service provider may intervene in the dilemma depends on the allocated process- and decision control competences towards a service provider.

Energy Communities as Psychological Solutions

An energy community can also affect the transformation from a given to an effective matrix, by changing the social and contextual features of energy-related decision-making in settings of interdependence (cf. Chapter 3.4.2). Compared to national energy goals, the concept of energy communities is expected to constitute a smaller group with a higher social identification between members. Social identification influences contributions in social dilemmas, (see Chapter 3.4.2, and 3.5.2). Thus, it is anticipated that the changing features of the situation, especially the shift from reserved to salient social identification of the group, leads to observable (positive) changes in energy-related contribution intentions.

4.1.2 The ‘goal-transformation’ Hypothesis in energy-related Decision-making

In order to test the potential of energy communities as a psychological solution to increase energy-related contributions towards the energy transition, certain requirements need to be assumed:

1. Energy goals need to be defined as a collective action, which requires different kinds of capital to be contributed, i.e. energy-related contributions. Possible market and price mechanisms and regulatory frames are therefore excluded.
2. All energy-related contributions are costly, and their benefits are non-exclusive.
3. The ‘psychological solution’ of energy communities results only through changing one feature of the situation, e.g. social identification of the group.
4. The effects of the factor ‘social identification’ is measured by comparing the scores for energy-related contribution intention of individuals contributing to an energy community with salient social identification with the scores for energy-related contribution intention of individuals contributing to an identical energy community but with no social identification.

Considering these four assumptions, the ‘goal-transformation’ hypothesis can be applied into energy-related policy development (see Figure 23). The first condition depicts a situation in which individuals form a ‘community’ with an anonymous setting, i.e. the group is composed of strangers. The group composition is assumed to inhibit any form of group identification and will further be referred as to ‘Anonymus’. The second condition depicts a situation in which individuals form an energy community with other members of an already existing community, e.g. neighbours, club members, colleagues, family, etc. Based on the existing group membership, it can be assumed that such an energy community is characterized by salient social identification. Accordingly, the thesis will mention such energy communities as ‘Energy Neighbourhoods’ or ‘Energy Clubs’ and emphasize its social composition based on prevailing relationships between members, i.e. neighbours, respectively club members. While neighbourhoods constitute a community mainly on geographical criteria, associations represent relation-based communities, i.e. regrouping individuals with similar motivations, values and interests.

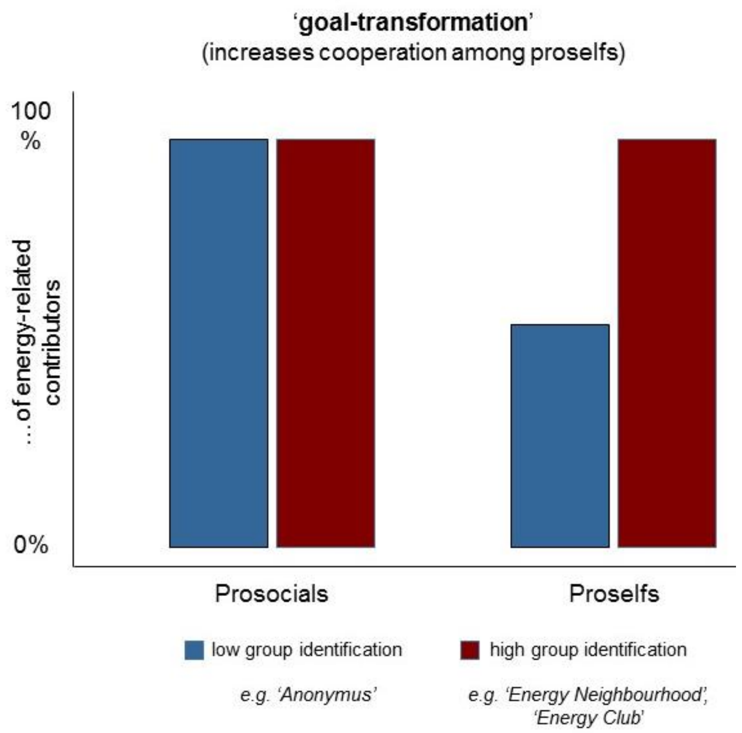


Figure 23: 'Goal-transformation' Hypothesis, Energy Communities

Based on the findings of Cremer and van Vugt (1999), it can be assumed that energy-related contribution intention among proselfs is higher in the condition with high group identification, i.e. 'Energy Neighbourhood' or 'Energy Club', than in the condition with low group identification, i.e. 'Anonymus'.

4.1.3 Research Hypotheses 'The Potential of Energy Communities'

In order to test the energy related 'goal-transformation' hypothesis, research hypothesis are kept similar to those of Cremer and van Vugt (1999). The main focus of the thesis is on the transformational power arising from neighbourhood identification, i.e. neighbours form an energy community, and follows therefore the 'community of place' concept (cf. Haf and Parkhill 2017). Complementary, Energy Clubs, i.e. club members form an energy community, will be investigated also. The research hypotheses are:

H_{1A}: Social identification scores in the condition ‘Energy Neighbourhood’ are higher than the social identification scores in the condition ‘Anonymus’. H_{1B}: Social identification scores in the condition ‘Energy Club’ are higher than the social identification scores in the condition ‘Anonymus’.
H_{2A}: A main effect for SVO is expected such that a greater proportion of prosocials than individualists and competitors intend to contribute to the community goals. H_{2B}: A main effect for SVO is expected such that a greater proportion of prosocials than individualists and competitors intend to contribute to the community goals.
H_{3A}: A main effect for social identification is expected such that average contribution intention scores in ‘Energy Neighbourhood’ are higher than in ‘Anonymus’. H_{3B}: A main effect for social identification is expected such that average contribution intention scores in ‘Energy Club’ are higher than in ‘Anonymus’.
H_{4A}: In the condition ‘Energy Neighbourhood’, individualists and competitors will contribute more than individualists and competitors in the condition ‘Anonymus’. H_{4B}: In the condition ‘Energy Club’, individualists and competitors will contribute more than individualists and competitors in the condition ‘Anonymus’.

Table 7: Research Hypotheses

4.1.4 Anticipated Academic Value of Research

The novelty of the research is based on three aspects. First, the thesis emphasizes the dimension of interdependence in energy-related behaviour, i.e. embedding social interaction approaches to energy-related decision-making. Second, it does so by acknowledging and including a more participatory electricity end-user, i.e. energy prosumer. Third and most important, it integrates and combines social-psychological principles of social dilemma research for tailored energy-related policy development and energy services. Several outcomes with academic value are anticipated:

- To the author's knowledge, this research endeavour is the first attempt to replicate the 'goal-transformation' hypothesis (Cremer and van Vugt 1999) in energy policy development. Research duplication and extension is of great importance to the research community, since it allows generalizing and developing existing theories.
- This research will shed light on what factors influence Swiss households to contribute to the energy transition, if its benefits are non-excludable. More precisely, it tests if SVO, social identification, or a combination of both factors have an influence on the intention to contribute to group-specific energy goals related to the energy transition.
- Based on the outcome mentioned before, the thesis outlines recommendations for energy community development based on social-psychological principles.

4.1.5 Anticipated Practical Value of Research

Next to the academic claim of the thesis, the author emphasizes the practical value of this research endeavour, especially for energy policy developers and utilities in Switzerland.

- Considering the forthcoming challenges for energy policy development, this thesis will deliver insights on how to design a cooperation-enhancing energy market. Thereby, insights rely on two dimensions.
    - Individual level: the thesis will demonstrate how to increase energy-related cooperation among individuals with different predispositions to cooperate.
    - Collective level: the thesis will identify cooperation-enhancing forms of communities.
- Given the challenges for energy policy developments to adapt to a more complex value network for utilities, and to develop efficient policy-instruments, respectively efficient energy services, behavioural aspects gain in importance.

The thesis will therefore illustrate the efficiency of social-psychological manipulations on an individual's energy-related contribution intention.

4.2 Research Framework of 'The Coordination of Energy Communities'

As in other collective actions, energy-related contributions may be stipulated by guidelines, rules, or by, as Ostrom stated, 'design principles' (Ostrom 1990).[12] Such principles define the geographical boundaries of the community; describe the way contributions are defined, regulated and enforced; and state responsibilities of the individuals. Generally speaking, an energy community design describes the 'rules of the game' for all participating members in the energy community. Rules apply on different levels of community design, ranging from the operational and a collective to a constitutional level (see Figure 24).

According to Ostrom (1990, p. 52) operational rules "directly affect the day-to-day decisions made by appropriators concerning when, where, and how to withdraw resource units, who should monitor the actions of others and how, what information must be exchanged or withheld, and what rewards or sanctions will be assigned to different combinations of action and outcomes." Therefore, the operational rules define the operational choices (e.g. energy-related tasks within an energy community *per se*) of community members.

Operational rules are affected by *collective-choice rules*. *Collective-choice rules* are 'policy-making' rules enforced by community members, their officials or external authorities on how to manage the community. *Constitutional rules* determine who is eligible to design collective rules, which in turn affects the operational rules. Finally, Ostrom reveals three different levels of rules, which are directly linked to each other.

[12] An updated version of Ostrom's design principles can be found in Appendix 1.

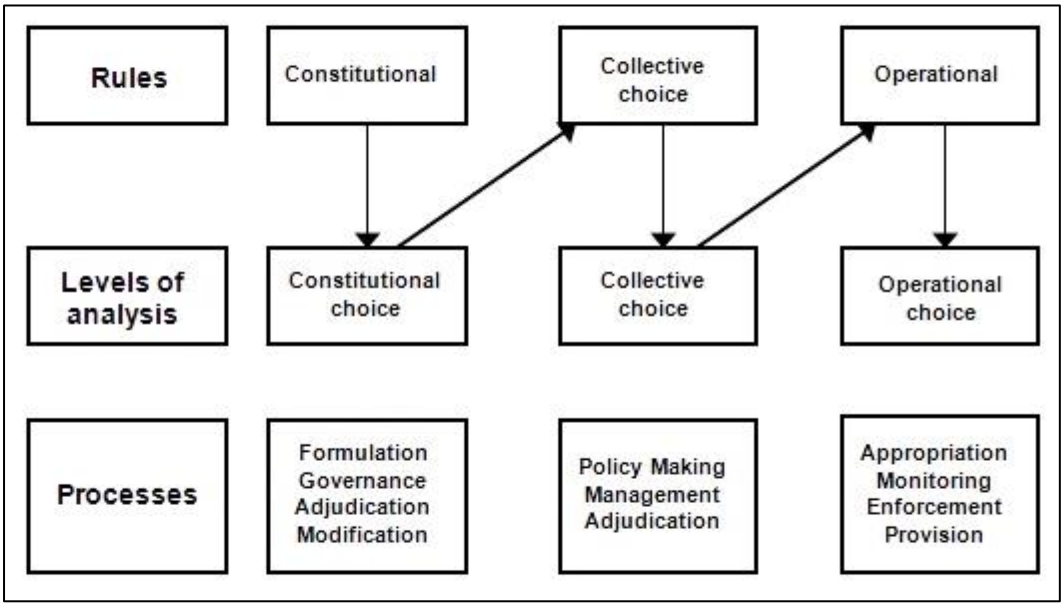


Figure 24: Linkages among Rules

Source: Whaley and Weatherhead 2014 adapted from Ostrom 1990

Thus, rules are always nested and interrelate on different levels. For the purpose of analysis, linkages between the three different rules are divided. The focus in this part of the thesis lays solely on the operational level of analysis, e.g. energy-related tasks necessary to ensure the community goals, and how the participants imagine those to be regulated. Operational energy-related tasks in energy communities have different forms, ranging from investments in intelligent energy Generation-Storage-Load (iGSL) infrastructure (Teufel and Teufel 2014) to management of infrastructure, e.g. load reduction.

Ostrom (1990) and Cox and colleagues (2010) highlighted that a group of humans can endorse rules that bring (short-term) costs for each group member, in favour of social and long-term benefits, and certain design principals are crucial for it. Thus, the same question raises in the field of energy communities: would people define group-specific rules that restrict their own liberty in order to ensure the achievement of the group-specific energy goals?

Research neglected antecedent factors that facilitate or hinder individuals to cede decision-making competence to a third party that implements and monitors the adherence of design principles in new-arising settings of interdependence (cf. Thaler 2015). Typically, field research analyses communities that dealt with such settings for decades and centuries, e.g. alpine farming communities (Netting 1981). In such long lasting communities, community design results through long-standing learning about the common resource, community members, and finally efficient design principles. Such communities always level off a certain design, in which alternatives are always inferior. However, energy communities depict emerging communities with incomparable experiences in terms of governance. Community members have to define a set of rules for not only a new resource, i.e. energy, but also for its salient collective management. In the absence of experience value, different design-preferences may emerge. Thus, considering the different preferences for designs, energy community designs will differ and probably not instantly lead to efficient designs that other communities yielded over long periods of learning. The involvement of householders becomes more important in order to establish energy communities that specifically cover the needs of its members and increase their social acceptance.

Consequently, the thesis aims to complement institutional research on communities, by *including* individual preferences for community design, by *defining* antecedent factors for energy community design, and by finally *label* householders, third-party roles and design principles of emerging communities. Contrary to the first part of the thesis, ‘The Coordination of Energy Communities’ does not replicate acknowledged theories and principles. Accordingly, an additional conceptual model is needed to frame the research endeavour.

4.3 The ‘Energy Community Management’ Framework

With increasing personal, technological and societal complexity, formal rules become inevitable (Sull and Eisenhardt 2015). This applies in particular in the context of ‘Energy Neighbourhoods’ (see for argumentation: Bornemann et al. 2018; Hertig and Teufel 2018).

However, numerous collective actions are successful even though formal rules are missing. Collective actions like silence in open space offices, group assignments, etiquette, clean school hallways, peace at night or domestic childcare are some examples for which the collective actions between colleagues, students, residents or family members do not (or to a small degree) make use of formal rules or Ostrom’s design principles. Often the mere presence of norms, communication possibilities, threats of exclusion, trust, social identification or other social features (see also: Parks et al. 2013) are sufficient and substitute formal rules.

On the other side, formal rules are necessary to guarantee safe roads, tax income or national defence. Thus, formal rules emphasize the necessity and urgency of contribution to the collective action especially in larger settings. Formal rules can also complement existing situational factors, i.e. littering and disposal rules or company statutes.

Hertig and Teufel 2018 conceptualized these thoughts and clarified the relation between the social features of a community and the degree of decision-making allocation towards a third party. Their 'Energy Community Management Framework' (ECMF) was used to understand a third-party's role in energy-related settings of interdependence for orchestrating energy-related tasks. Derived from the service provider's role, the ECMF also allows the labelling householders and whole communities. In a first step, the ECMF allows for the identification of the justification for third-party intervention in energy communities (see Figure 25).

- Hertig and Teufel (2018) explained that third-party interventions might be *redundant* if community members perceive the social features of a neighbourhood as sufficient cooperation-friendly. For example, most modern families do not use formal rules for housework to keep the household clean. Accordingly, third-party intervention is redundant, and the community strives for self-organization of the collective action. Hence, rules for energy communities might be redundant too.
- Even though social features of a neighbourhood are perceived as sufficiently cooperation-friendly, formal rules still may be perceived as necessary. For example, most student flat-sharing communities have some living statutes, even though the social feature of the flat is cooperation-friendly. Accordingly, formal rules and a functional design of 'Energy Neighbourhoods' can in this case be justified to *consolidate the neighbourhood/consolidate the social features*. Such a justification can also be seen as appreciation and consolidation of the current *status quo*.
- Formal rules are based on another justification, when social features do not promote cooperative energy-related tasks. Compulsory military service is such an example; without the formal rule to contribute to the national defence of Switzerland, young men would probably not choose to serve the homeland. Accordingly, formal rules for an 'Energy Neighbourhood' *change*

behaviour/change choices in a desired way which cannot emerge endogenously, e.g. by the group itself and its social features. With the absence of social features and preferences for formal rules, people express their discontent with the current *status quo*.

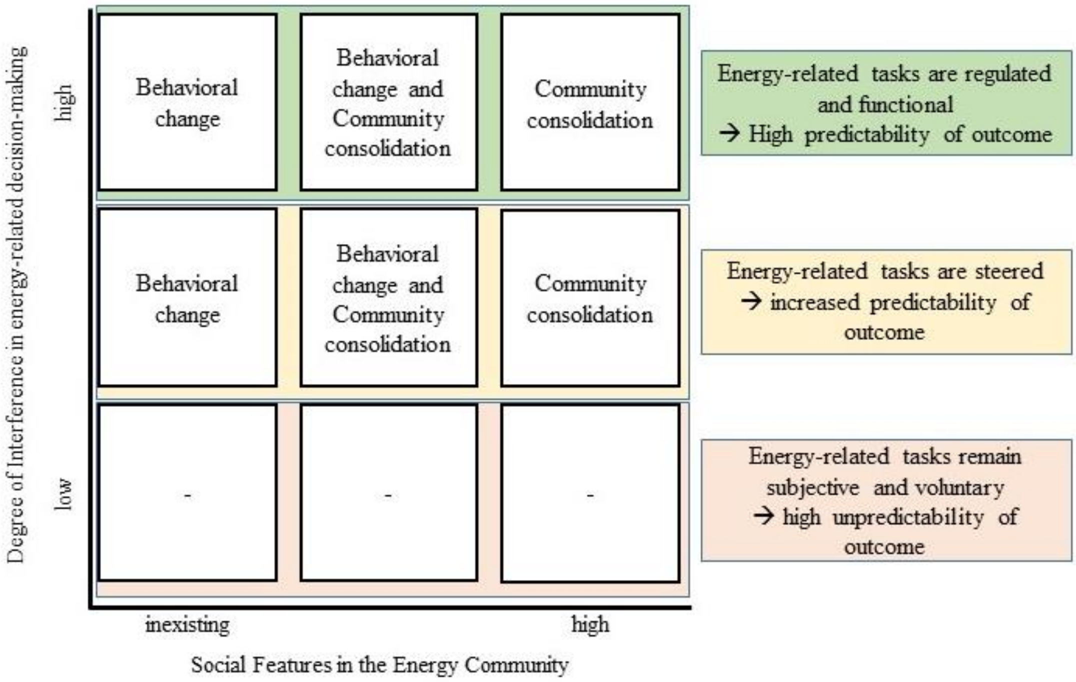


Figure 25: The Energy Community Management Framework (ECMF)

Source: Hertig and Teufel 2018, p. 41

According to Figure 25, the role of an energy service provider results through the combination of the ECMF's horizontal and the vertical dimension. First and as mentioned before, the perceived social feature of the community defines the role of a service provider (i.e. horizontal dimension, which explains *why* a third-party intervention is needed). Two main justifications for intervening in individual decision-making were presented: *desire to consolidate the community* (if social features are present) and the desire for *behavioural change among community members* (if social features are missing).
Second, both justifications further depend on the depth of their expression (i.e. vertical dimension, which explains to which degree a third-party should intervene). According to Hertig and Teufel, the degree to which a third-party can intervene in energy-related tasks reveals the actual design of a community.

- **Subjective design**. If a service provider has low or no competences at all to intervene in energy-related decision-making, a *subjective design* emerges. Such a 'laissez faire' policy would imply that each community member can exert energy-related tasks without any organizational restrictions. Consequently, the outcome matrix in settings of interdependence remains unchanged. Energy-related contributions to the common goal remain voluntary. Since no obligation to contribute exists, the goal achievement is uncertain. The responsibility of achieving common goals are solely bore by the single community members. The coordination problem of the collective action remains unsolved.
- **Signalling design**. If a service provider changes the outcome matrix of the setting of interdependence by using rewards for cooperative choices (or punishments for selfish choices), a *signalling design* emerges. The 'new' outcome matrix for energy-related tasks promotes cooperative outcomes (and hamper selfish outcomes) without regulating individual decision-making. The manipulated outcome matrix serves as a moral compass and signals 'the right thing to do'. The responsibility of achieving the energy goals remains on the community members' shoulders. However, the members are steered towards collective choices, which again can increase the probability of goal achievement. The coordination problem remains, but the outcome matrix promotes cooperative choices.
- **Functional design**. If a service provider deprives community members of their freedom of decision-making, a *functional design* emerges. A functional design prevents any kind of free riding behaviour. The regulation of energy-related tasks leads to an agreed level of outcome, i.e. high predictability and efficient outcomes (cf. Ostrom 1990). Referring to Gstrein (2016), the functionality of an energy community refers to the necessity to perform energy-related tasks collectively rather than individually. Such a binding and contractual design was already proposed in terms of energy communities (Moroni 2014). With the deprivation of individual decision-making, solely the service provider is accountable for the achievement of the energy goals. Thus, the coordination problem in settings of interdependence is solved. The communities analysed by Ostrom were all characterized through their functional designs.

The energy service provider's role in settings of interdependence results when combining both dimensions of the ECMF together. For example, the top right corner of Figure 25 depicts a functional energy community design in which community members expect that community consolidation is imposed. Accordingly, the service provider regulates energy-related tasks in order to consolidate the community. The middle left scenario depicts a situation in which community members expect an energy service provider to steer community members towards the behavioural change.

Based on the members' preferences for the degree of interference in individual decision-making through a third party and its corresponding justification, different designs are possible. The thesis highlights and further explore these. Further, by applying the ECMF, different types of community members will be identified.

4.3.1 Research Questions 'The Coordination of Energy Communities'

Based on the ECMF, following research questions are drawn for the 'The Coordination of Energy Neighbourhoods' part:

- **Question 1: '*Which energy-related tasks will to which degree be regulated by an energy service provider?*'**

Householders may have different design expectations when it comes to the coordination of an 'Energy Neighbourhood'. It is also quite conceivable that not all energy-related tasks are regulated in a uniform manner. For example, infrastructure purchases for local energy goals might be more/less regulated than tasks related to infrastructure management. The first research question investigates potential coordination discrepancies among different energy-related tasks.

- **Question 2: '*How do householders differ in their characteristics?'***

The second research question considers not only different types of householders according to the two dimensions of the ECMF but investigates further covariances with other important variables. The clustering of householders will therefore be complemented with a more detailed description of householders, allowing the identification of potential co-varying factors for the two ECMF dimensions.

- **Question 3: '*What are the different justifications to regulate energy-related tasks?*'**

The third research question illustrates the householders' overall design preferences. Next to the actual design preference, this part of the thesis highlights and labels the different prevailing justifications for the correspondent designs.

- **Question 4: '*What is the role of an energy service provider in a setting of energy-related interdependence?''***

The final research question deals with the role of the service provider. Based on the previous research question, the service provider's 'raison d'être', as well as potential business solutions for energy communities, are revealed.

4.3.2 Anticipated Academic Value of Research

Although field research on self-organized communities may set some normative benchmark on how communities should be designed, less is known on how decision-makers expect energy communities to be coordinated. Therefore, the thesis will highlight potential discrepancies between the desired and the normative efficient design, i.e. functional design. Generally speaking, this part of the thesis is, to the author's knowledge, the first research endeavour that analyses social psychological design-principles in a) new emerging and b) technology-driven communities.

4.3.3 Anticipated Practical Value of Research

"Offering customised solutions for local energy communities" and "deploying solutions promoting the self-consumption of local renewable energies" were recently defined as new business opportunities along the energy transition (Facchinetti 2018, pp. 24–25). The new business opportunities however, remain quite superficial in their descriptions. Nevertheless, such business opportunities come quite close the definition and the role of a service provider (see Chapter 4.1.1). In order to offer such business solutions to community members, insights from potential customers, i.e. householders, are ineluctable. The following practical outcomes for this part of the thesis are anticipated:

- Identification of different types of energy community members according to their coordination expectations (customer segmentation).

- Demonstration of potential scope of actions of third parties that engage with energy communities (range of business opportunities).
- Identification of different kinds of solutions to coordinate an energy community.

This part of the thesis also allows practical insights for energy policy developers. Even though energy communities remain currently a footnote on the Swiss energy landscape, regulatory indications, e.g. ES 2050 or consumption communities (BFE 2015a), legitimize and enable energy communities. Given the ambitious ES 2050 goals, energy policy developers must develop organizational frameworks that incentivize Swiss householders to contribute to such goals. An organizational framework among others to do such is the coordination of energy-related efforts. Accordingly, this part of the thesis generates valuable insights, by presenting and labelling current expectations of Swiss householders regarding the coordination of energy-related efforts. Based on such a bottom-up approach, energy policy developers can further adopt measures to stabilize or increase energy-related efforts.

4.4 Conclusion

For the first part of this thesis, previously presented theoretical observations from social dilemma theory were combined with the field of research in order to state the research hypotheses (Chapter 4.1.3). For the second part, a new conceptual model was presented (ECMF, (Hertig and Teufel 2018)) in order to answer the research questions (Chapter 4.3.1).

The first part of the dissertation analyses the transformational power of energy communities on the individuals' intention to contribute to collective energy goals in settings of interdependence. Collective energy goals, e.g. energy transition or local energy goals, depicts a 'mixed-motive' situation in which collective and selfish reasoning lead to an energy-related social dilemma. Accordingly, this research applies social interaction theory in order to investigate the potential of differing group compositions regarding participation intention in energy transition. Concretely, this part of the thesis applies acknowledged principles from social dilemma research in the field of energy transition. By applying Cremer and van Vugt's 'goal-transformation' hypothesis on energy-related policy development, the author expects that householders with an 'proself' orientation towards cooperation increase their intention to cooperate with other group members when social identification prevails, compared to a more anonymous group composition.

The second part deals with the coordination of energy community members in settings of interdependence. Unlike the field research on existing communities, this part analyses emerging communities, for which members do not have concrete experiences with community design principles. Thus, the research has a more explorative character, aiming to define and label community design principles based on the preferences of potential energy community members. Such principles are classified in accordance to the 'Energy Community Management Framework' (Hertig and Teufel 2018). Consequently, this part of the research will explore a) to which degree an energy service provider can interfere in individual energy-related decision-making in settings of interdependence and b) what justification underpins such interference.

5 Research Strategy

This chapter *describes*, *explains* and *justifies* the implemented research strategy, allowing backtracking the methodological procedures. The following sections describe, explain and justify each component separately. The *description* of the components' content is presented in short boxes, while the *explanation* and *justification* are presented in full text. The order of the components is presented in a traditional way. All components of the research strategy are referring to the main survey 'Energy Neighbourhoods'. The second survey, 'Energy Clubs', followed the same strategy with minor contextual changes (see also Chapter 5.9). Figure 26 provides an outlook of the chapter.

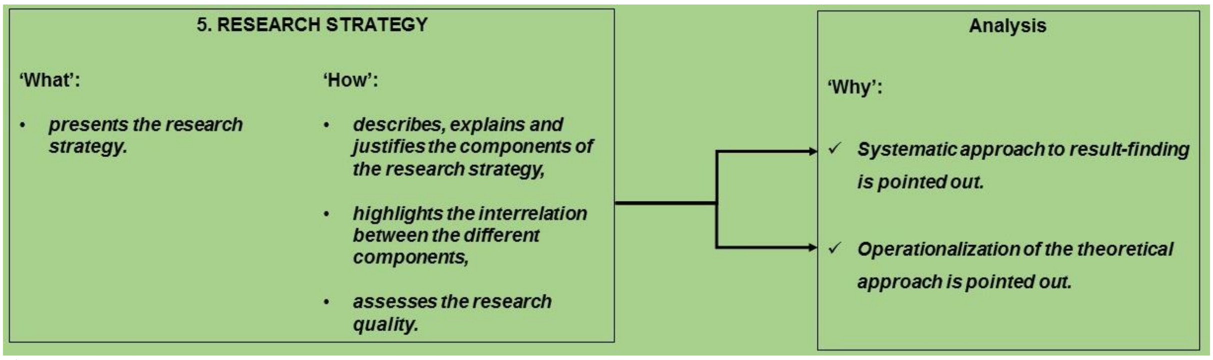


Figure 26: Chapter five, Outlook

5.1 Type of Research

Across most sciences, research endeavours can be distinguished in three different types: quantitative, qualitative and mixed method research. Each type has different aims, leading to different preconditions and procedures. In social and economic sciences, quantitative research aims to test hypotheses and quantify observations, while qualitative research tries to gain new understanding of reasons or motivations (Byrne 2016). Mixed methods combine both approaches. The fundamental differences across these research types reflect also different ways of how research questions are set, theory is used and developed, research strategy is implemented and how findings are presented and discussed. Hence, given such differences each type of research has its own characteristics.

5.1.1 Research Characteristics of the Thesis

This thesis can be characterized as quantitative research. Thus, major thesis' aims, preconditions, and procedures result through the interaction of quantitative research characteristics and the research topic. Table 8 shows the characteristics for quantitative research and their integration in this thesis.

Characteristics	**Integration**
builds on/tests theories	✓ Chapter 3, 'Theory'
answers quantitative research questions/hypotheses	✓ Chapter 4.1.3, 'Research Framework'
underpinned by positivist/postpositivist set of belief	➢ Chapter 5.2, 'Research Paradigm'
draws on a quantitative research design	➢ Chapter 5.3, 'Research Design'
uses methods that generate quantifiable data	➢ Chapter 5.4 'Research Method'
tries to use probability sampling designs for generalization purposes	➢ Chapter 5.5, 'Sampling Strategy'
draws heavily on data analysis techniques to examine the collected data	➢ Chapter 5.6, 'Data Analysis'
assesses the analysed data on its quality	➢ Chapter 5.7, 'Research Quality'

Table 8: Characteristics for Quantitative Research

In general, three different types of quantitative research exist, i.e. *replication-based*, *theory-driven* and *data-driven* quantitative research (see Figure 27). Replication-based research involves a certain degree of reanalysis of an already existing study, aiming to verify and increase robustness of findings (Ben-Nun 2008). Although replication-based research is of great importance in social sciences, perfect replication remains impossible. On one side, changing external factors makes it impossible to replicate findings perfectly, i.e. replicate identical sampling, measurement, and methods. On the other side, if the original author does not previously describe such, research replications fail because of communication or financial barriers. Replication-based research follows three different routes: *duplication*, *generalization* and *extension*, which will further be explained in the next section.

Theory-driven quantitative research emphasizes the theoretical contribution in research. Theory-driven research *tests* new theories, *combines* well-established ones or *builds* new theories.

Data-driven quantitative research does not test/build on existing theories, but analyses uncovered antecedents of empirical regularities/patterns. Most data-driven research starts as an *empirical-focused* research endeavour of empirical patterns (e.g. ‘do people behave differently in public good situations?) and then *theoretically justifies* the antecedents of such patterns (e.g. different inclination towards contributions, cultural and evolutionary aspects of contribution behaviour). Interpretation and conclusions of data-driven research are broader and less precise than replication-based research.

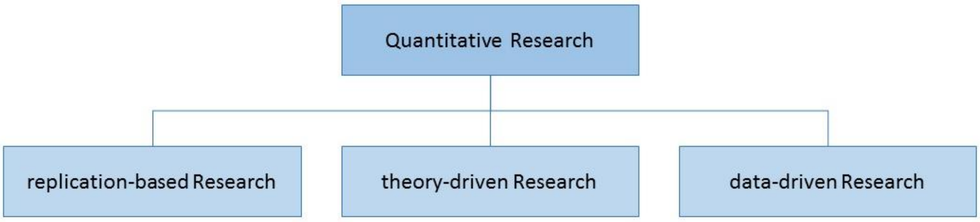


Figure 27: Types of Quantitative Research

This thesis has two different characteristics, strictly separated. The ‘Potential of Energy Communities’-part can be associated with replication-based quantitative research. It aims to replicate previous findings (e.g. Cremer and van Vugt 1999). The ‘Coordination of Energy Communities’ part has data-driven research characteristics. The part’s aim is to present different empirical patterns, e.g. expectations and types of community management services. The interpretation, implication and conclusion of each part is different; the former part follows a theory-narrow interpretation, implication and conclusion, while the data-driven part allows presenting the result in a broader angle.

5.1.2 Research Routes of the Thesis

Replication-based research depicts three different routes to knowledge creation (see Figure 28). In most cases, replication-based research is associated with duplication. Generally speaking, *duplication* refers to a repetition/imitation of a published research with the aim to obtain identical results. In some cases, the research is narrowed down to a single re-test of the analysis technique in order to demonstrate the accuracy of the previous research. The justifications for duplicating are data analysis problems in the former study or availability of new data analysis techniques to improve previous findings. Duplications studies, even though important for the research community, are rarely published in academic journals. Therefore, most articles which include duplications also *extend* or *generalise* previous findings, giving replication-based research a wider sense (see also Pesaran 2003).

Extension refers to changes of single research strategy parts of the original study, e.g. research design, constructs/variables, or data analysis. 'Extending' studies often aim to extend/refine current theories via new constructs and variables (Pablo 2010). Generally, two types of extension exist: *population and context-driven extension*, and *methods and measurement-driven extensions*.

- *Population and context-driven extension* - The former type of extension adds new constructs and variables to the original study, but it also modifies or deletes them. It does so because former constructs or variables may not fit to the analysed population or context. For instance, the relationship quality between a customer and a salesperson depends on different changing population and context-related factors. The constructs used in an original study (Crosby et al. 1990) focusing on retail customers needs to be extended if population differs (e.g. Boles et al. 2000).
- *Methods and measurement-driven extensions* - The second type of extension aims to increase construct quality by modifying variables or using other methods. For instance, instead of using numerical categorization measures to determine SVO (Triple-Dominance Measure of SVO (e.g. van Lange et al. 1997b)), Murphy and colleagues introduced a continuous measurement procedure (SVO Slider Measure (Murphy et al. 2011)) to increase research efficiency, reliability and validity.

Generalization studies aim to examine whether findings from previous studies hold across different populations, contexts, treatments and time. Contrary to the empirical generalization, i.e. drawing findings of a sample on an entire population (Tsang 2014), theoretical generalization aims to test the transferability of findings under changed circumstances, i.e. population, (Firestone 1993). Research design and measurement procedures are kept as similar as possible to the original study.

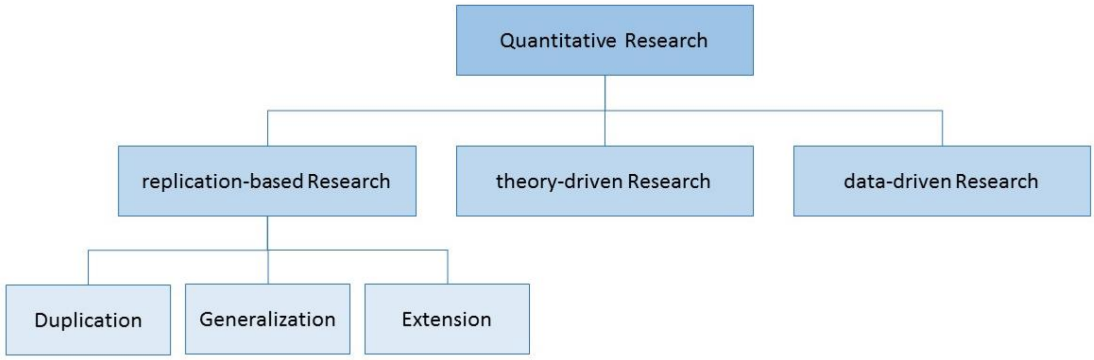


Figure 28: Research Routes

The 'Potential of Energy Communities' part of the thesis aims to test the 'goal-transformation' hypothesis (Cremer and van Vugt 1999) on energy-related contribution intention. Therefore, from a 'research route' point of view the aim of the thesis is to *generalize* previous findings on a new context and a new population. Ideally, only these two factors, e.g. context and population, differ from the original study in order to test the theoretical generalizability. Practically, changes in context and population require important modifications ('*extensions*') from the original study. Table 9 compares the characteristics of the original study with the thesis' main research endeavour and therefore illustrates the specific routes for each part of the research strategy.

	Cremer and van Vugt 1999	**'Potential of Energy Communities'**	**Route of Research**
		General	
Research Goals	Test 'goal-transformation' hypothesis	Test and apply 'goal-transformation' hypothesis	Duplication/Extension
Research Context	'neutral' contribution behaviour	Energy-related contribution intention	Generalization
Research Hypothesis	See original study	Adapted, see Chapter 4.1.3	Duplication/Extension
Research paradigm	Positivist/postpositivist	Positivist/postpositivist	Duplication
		Research Design	
Research Design	Economic Experiment	Questionnaire Experiment	Extension
Experimental Design	Posttest-Only Control Group Design	Posttest-Only Control Group Design	Duplication
Experimental Treatment	Manipulation of Group Composition	Manipulation of Group Composition	Duplication

	Cremer and van Vugt 1999	**'Potential of Energy Communities'**	**Route of Research**
Design Specification	Between-subject design	Between-subject design	Duplication
Research Method			
Research Method	Laboratory Experiment	Questionnaire	Extension
Sampling			
Target Population	Undergraduates from University of Southampton	Registered householders in low-density suburban neighbourhoods in Switzerland	Generalization
Frame/Survey Population	Volunteering undergraduates from University of Southampton	Registered householders in low-density suburban neighbourhoods in and around Fribourg	Generalization
Sampling Design	Non-probability design	Non-probability design	Duplication
Data Analysis			
Data Analysis Techniques	'comparing'-techniques	'comparing'-techniques	Duplication
SVO-Measurement	Nine-item Decomposed Game (Messick and McClintock 1968; van Lange and Kuhlman 1994)	Six-item SVO Slider Measure (Murphy et al. 2011)	Extension

Table 9: Route of Research for 'Potential of Energy Communities'

The data-driven part of the thesis, 'The Coordination of Energy Communities', focuses on empirical patterns when it comes to categorizing different types of expectations and different types of community management services based on same antecedents' analysis. This part of the dissertation cannot rely on past theoretical findings but focuses strongly on empirical patterns for a given data set. Nevertheless, results will be embedded in the ECMF (Hertig and Teufel 2018). Hence, the research route of the 'Coordination of Energy Communities' part begins empirically focused and ends theoretically justified by integrating the data according the ECMF. Figure 29 illustrates types and routes of research for both parts of the thesis.

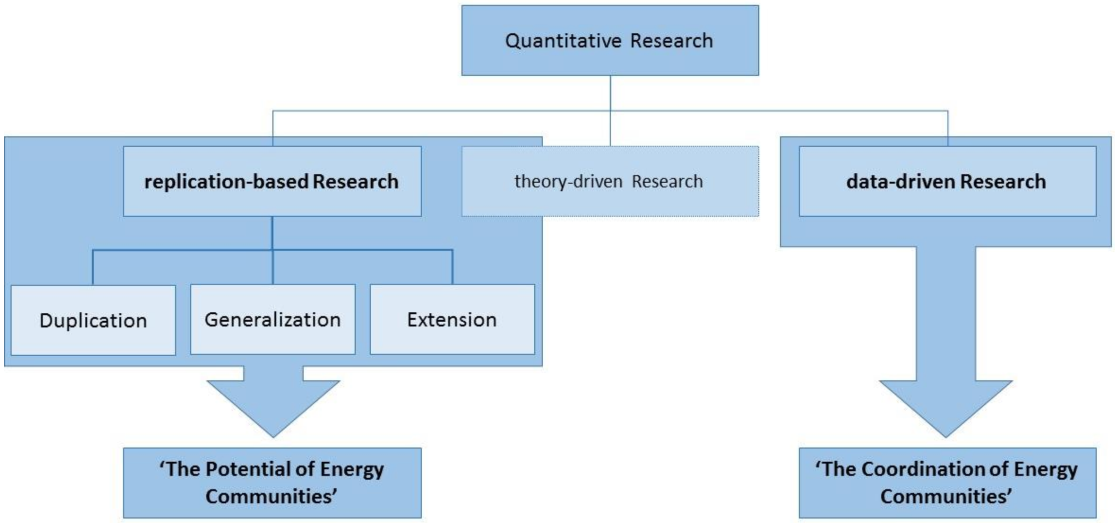


Figure 29: Applied Types and Routes of Research

5.2 Research Paradigm

A research paradigm can be understood as "a loose collection of logically related assumptions concepts" (Bogdan and Biklen 1998, p. 22) of systematic investigations and inquiries (Burns 2000). Broadly speaking, a research paradigm explains the author's basic set of beliefs. Thereof, without explicit reference to the underlying paradigm "there is no basis for subsequent choices regarding methodology, methods, literature or research design" (Mackenzie and Knipe 2006, p. 194).

Based on the quantitative nature of the thesis, this work follows a 'positive/postpositivist' research paradigm. Most quantitative research comprises a positive/postpositive research paradigm with similar language methods and data collection tools (see for discussion: Mackenzie and Knipe 2006). Positivists aim to test a theory "through observation and measurement in order to predict and control forces that surround us" (O'Leary 2004, p. 5). Positivism is based upon the view that scientific findings represent the truth. Hence, positivists assume that the reality is objectively given and is measurable using properties that are independent of the researcher and his or her instruments; in other words, knowledge is objective and quantifiable. Postpositivists have a similar set of beliefs but further stress the possible effects of observers on the observation, i.e. observational biases (Robson 2009). Postpositivist's findings represent only the probability of truth. Hence, postpositivism is a less strict form of positivism, or as Crotty recognized: "no matter how faithfully the scientist

adheres to scientific method research, research outcomes are neither totally objective, nor unquestionably certain” (2015, p. 40). Both research paradigms emphasize the uniqueness and the neutrality of reality, the observation and the measurement of a verifiable truth and the objective nature of knowledge (Chilisa 2012).
The justification for the chosen research paradigm follows theoretical reasons. The thesis generalizes and extends findings, appropriated to the ‘positive/postpositivist’ research paradigm of the main analysed literature and therefore needs to be coherent.

5.3 Research Design

A research design describes the general plan to conduct research and especially the strategy to test and validate research questions of interests (Kalaian 2008). Given the vast possibilities of validation, research designs differ in terms of problem-statement, access-difficulties to the field and the complexity of hypothesis (Atteslander 1991). Yet, a research design “constitutes a blueprint for the collection, measurement, and analysis of data” (Cooper and Schindler 2011, p. 140). As a ‘blueprint’, a research design affects the empirical validity and reliability, e.g. empirical quality, of the final results (Schade 2005). Finally, a research design always follows the research’s nature (e.g. research characteristics and research routes, cf. Chapter 5.1.1 and 5.1.2) and not the other way around. This chapter aims to provide a detailed view on how the thesis’ hypotheses are empirically validated from a research design point of view.

5.3.1 Descriptors of Research Designs

A first description of the thesis’ design according Cooper and Schindler’s (2011) eight categories of research design descriptors is shown in Box 5. Box 5 also explains the author’s option choice, if a category depicts different options.

Box 5: Descriptors of a Research Design

Category	Options	Choices
1. The crystallization of the research question	• **Exploratory Study** • **Formal Study**	Given the mixed nature of the research (replication-based for the 'Potential'-part, data-driven for the 'Coordination'-part) an 'exploratory-formal'-study is adequate.
2. The method of data collection	• Monitoring • **Communication study**	Given the research interest on general human behaviour/preferences, the 'communication study' option has been selected.
3. The power of the researcher to produce effects in the variables under study	• **Experimental** • Ex post facto	The application of the 'goal-transformation hypothesis' requires control over the stimuli 'social identification'. Therefore, this thesis can be categorized as an experiment.
4. The purpose of the study	• **Reporting** • **Descriptive** • **Causal**	Given the differing research characteristics/routes, the study pursues different aims.
5. The time dimension	• **Cross-sectional** • Longitudinal	Like the original literature, the study is carried out once and analyses data from statistical units at a specific point in time.
6. The topical scope of the study	• Case • **Statistical study**	Given the theory-replicability claim of the thesis, a statistical study design is needed.
7. The research environment	• ***High dynamics*** • *Low dynamics*	Given the research's context, the author conducts research under high dynamics conditions.
Note: bold options indicate the chosen research design options. Options in italic were adapted in order to create a uniform language.		

Source: adapted from Cooper and Schindler 2011

5.3.2 The Experiment's Characteristics

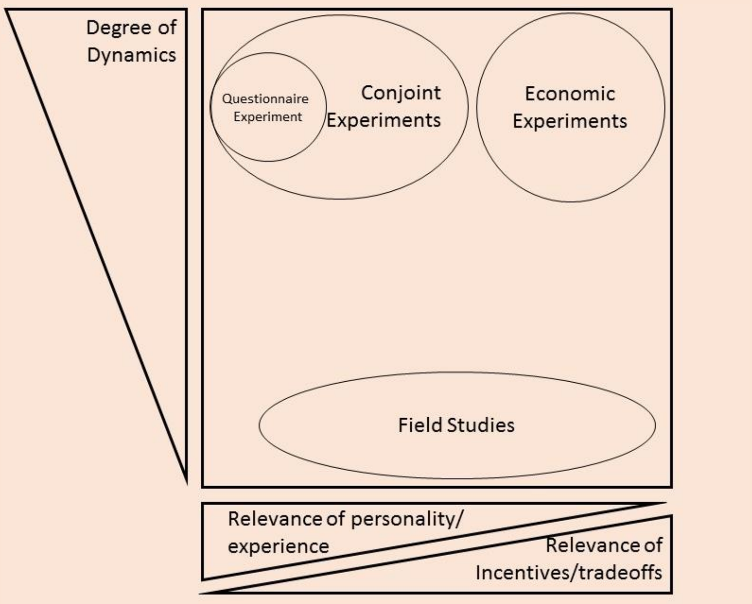
Many descriptors shown in the former section seem plausible in their explanation while others are more ambiguous, e.g. the option '*Experiment'* for the descriptor '*3. Power of the Researcher*', need further specification. Experimental research has three requirements (Schnell et al. 2005):

- tests a hypothesis,
- performs a controlled testing of the treatment,
- and controls the research condition in order minimize the effects of variables other than the independent variable.

Given these requirements, experiments allow a systematic control over confounding variables and are therefore the soundest approach to the generate knowledge within the field of quantitative research (Campbell and Stanley 1963; Cooper and Schindler 2011; Schnell et al. 2005; Vaus 2013). Box 6 *describes* and *explains* potential forms of experiments, including advantages/disadvantages.

Box 6: Overview of different Experiments

As an approach, experiments emerge in different forms for different use cases. In social and economic sciences, forms of experiments typically differ by the research environment, i.e. low dynamics vs. high dynamics, and by the relevance of incentives/trade-offs vs. the relevance of personality traits. Schade (2005) offers a simplified but useful framework in order to better understand the use-cases and the different forms of experiments:



Source: (Schade 2005)

The degree of dynamics, i.e. the research environment, has been mentioned before. The relevance of 'personality/experience' is typically higher within social, educational and psychological sciences than in mere economic research. Such focuses primarily on the use of incentive-compatible mechanism to elicit individual preferences, i.e. use real monetary consequences.

Field Studies:

According to Schade (2005), field studies are well suited for research within a low-dynamics environment. Field studies have typically larger external validity, when dynamics remain constant and low over both the, treatment and control group. Of the analysed literature, Elinor Ostrom's research can be attributed to such forms of research. However, external validity is threatened when dynamics increases and cannot be controlled, resulting in lower internal and external validity. Hence, research with replication claims will face important barriers when reproducing knowledge with a field study approach. Furthermore, field studies claim important financial and time-related efforts.

Economic Experiments

If a study claims new knowledge within a high-dynamics environment by analysing individual behaviour using monetary incentives, economic experiments are a well-suited form for an experiment. Given such real-world incentives, economists try to improve or adapt economic theory. Economic experiments have superior internal and external validity. Nevertheless, some important critics should also be emphasized. The laboratory setting of such experiments leads on one side to an increased research quality, but it may analyse behaviours diverging from the human's natural environment. The incentives and their behavioural consequences are judged as more important than a 'real-life setup' (Starmer 1999), which leads to important biases along the experimental units. Such are typically aware of the ongoing research setting, react to it, and finally modify their behaviour in response to their awareness of being observed. Such behavioural deviations are known as the 'Hawthorne effect' (Noland 1959). Further, an incentive compatible design of an experiment is not guaranteed when the population consists of units with different levels of income (e.g. students, employees, managers). Researchers avoid such problems by conducting experiments with homogenous low-income units, i.e. students, which again lead to other problems (cf. Gerlach 2017). The 'goal-transformation' hypothesis by de Cremer and van Vugt (1999) was an economic experiment with undergraduate students.

Conjoint experiments and questionnaire experiments

Conjoint experiments and questionnaire experiments are to be preferred, when dynamics are high, and the research focuses on personality traits. Conjoint experiments estimate complex issues (e.g. product properties) by decomposing the units' preferences for singular aspect of the issue (i.e. single treatment). A questionnaire experiment (QE) is designed to capture a unit's personality/personality traits. Lind defines personality as "the dynamic organization of the individual's mind that determines his or her interaction with the social environment at a particular level of development" (1982, p. 139). Given these dynamics, QEs are better suited to answer research questions that are linked to personality variables e.g. risk attitude, fairness, environmental or social value orientation, then a field study. QEs are typically used outside the laboratory and contain no incentive-based measures. Among others, QEs can also form the basis for more concrete decision-making frameworks (Schade 2005); QEs can also be used before or after field/laboratory studies.

Given the research goals of the thesis, the research will be conducted with a questionnaire experiment (QE) design. The following reasons were considered:

- *high-dynamic research environment*. Given the highly dynamic environment of human behaviour, technology and energy transition, a field study was excluded from the beginning.
- *Complicated creation of homogenous incentive-compatible mechanism*. In economic experiments, real monetary incentives with monetary consequences are used to observe human behaviour in order to test economic theories (Smith 2010). The final amount of money invested, retrained, bid or bargained reflects a unit's decision under game-specific conditions. An important advantage of such an approach is that 'money' is a neutral, impartial, easily measurable and observable object for an experiment. Monetary incentives lay the foundation for Smith's 'Induced Value Theory' (1976) guaranteeing experimental control for economic experiments. The social construction of 'money' is uniform and cannot easily interpreted in different manner, e.g. the perception of the object '10 Swiss Francs' remains for every experimental unit the same. The marginal value of losing or gaining money is assumed to be the same for every unit. Thus, individuals do not know any feeling of satiety and prefer constantly more 'money' to less.[13] The consequences of losing or gaining 'money' within an economic experiment are among all experimental units understood in a consistent and unbiased way. Thus, money is well suited when testing behaviour with an incentive-compatible setup (Friedman and Sunder 2002).

  Contrary to 'money', 'energy' has no singular social perception (Hertig and Teufel 2016a; Stern and Aronson 1984). The multiple and even opposed dimensions of it complicates not only a uniform valorisation of the object but also hinders the introduction of a universal incentive-compatible mechanism. The differing valuation of energy can be interpreted as an external factor beyond the experimental control, jeopardizing and changing the unit's decision in an unknown way. Thus, the object energy may violate Smith's dominance condition

[13] 'Money' guarantees the monotonicity condition for experimental economics. The monotonicity condition says that individuals must prefer more payment to less (Smith 1976).

for economic experiments (Smith 1976).[14] A laboratory experiment would therefore require a group of units with a singular perception of energy. However, to the knowledge of the author, no elicitation method regarding such exists.

- *Novelty of research field*. Economic experiments use incentive-compatible mechanisms to elicit preferences within an experimental market in order to adapt, correct or improve economic models or prediction (Friedman and Sunder 2002). Such a congruent theory is missing for energy-specific contribution behaviour. Thus, an important foundation for an economic experiment is missing. Consequently, a QE is better suited.
- *Anticipation of important Hawthorne effects within laboratory research*. It is assumed that an important amount of the population has no experience when it comes to laboratory research, i.e. economic experiments. This lack of experience may be a potential threat to the research's validity. Contrary to students, the research population is not confronted with research projects, like observations, on a regular basis. It was anticipated that the units would significantly modify their contribution intention and diverge from actual contribution intention (cf. Beramendi et al. 2016; McCambridge et al. 2014). Further, the digital environment of the laboratory research might also have an impact on units with no regular use of computers, i.e. elderly people.
- *Self-Selection Biases*. Self-selection bias arises when characteristics or personality traits cause people to volunteer in surveys or laboratory experiments. If such an effect arises, the representativeness of the research intention is jeopardized (Harrison et al. 2009). SVO, for example, has such an effect; prosocials volunteer more often than individualists in experiments (van Lange et al. 2011) and tend to be overrepresented in the analysed sample. The effect is amplified when further efforts for the individuals are required. These efforts are anticipated to be smaller with a QE sent to the units' home addresses. Contrary, voluntary participation within a university correlates with additional time and travel efforts for the researched population, which would further discourage individualists' participation. Therefore, the research design should

[14] Dominance condition: changes in the utility level of the respondent must (primarily) result from the experimental payments and not from any other factors that are beyond experimental control (Smith 1976).

demand the least possible efforts in order to ensure the representativeness of the conducted research.

- *Practical issues*. It was anticipated that the cost of a laboratory experiment with the given population would exceed the project's budget, while costs for a QE remain relatively low. Next to the conceptual problems of a homogenous incentive-compatible mechanism for the analysed population, important financial ones hinder laboratory research with this population. The researched population has socio-geographic similarities, i.e. they live in the suburban neighbourhoods, but they are not necessarily homogenous in terms of revenue or leisure time. Given that heterogeneity, a coherent incentive-compatible mechanism seems challenging.

5.3.3 The Experimental Design

The experimental design differs from the research design by pointing out the research's approach towards units, observation and treatment. Hence, the experimental design allows a first assessment of the research quality. Independent from the research design, experimental design affects the validity of the empirical evidence. Though quite old, the work of Campbell and Stanley (1963) still a solid guidance when it comes to assessing different experimental designs (see Box 7)

Box 7: Overview of Experimental Designs

Campbell and Stanley present six different experimental designs and their potential threat of internal and external invalidity. They further represented each design graphically; an 'X' represents the measured treatment(s), 'O' represents the observation(s) and 'R' indicates a randomized sample(s). The graphical representation of the designs emphasizes the temporal order of the treatment(s) and the observation(s) (interpreting the experiment horizontally from left to the right) as well as the sequence of possible simultaneous use of treatment(s) and observation(s) (interpreting the experiment per rows). The authors distinguish experimental designs in what they call 'Pre-Experimental Designs' and 'True Experimental Designs'. Contrary to the latter, the former ones (designs 1. – 3.) miss a controlled environment to test the treatment ('X') and violates important experimental requirements (Schnell et al. 2005). Further Campbell and Stanley list the major threats to internal and external validity. A '+'/'-' indicates low/high jeopardy arising from the factor. A '?' indicates uncertainty. Blank cells show no correlations between the factor and the research's validity.

	Sources of Invalidity											
	Internal								External			
	History	Maturation	Testing	Instrumentation	Regression	Selection	Morality	Interactions	Interaction of Testing and X	Interaction of Selection and X	Reactive Arrangements	Multiple X Interference
1. One-Shot Case Study **X O**	-	-				-	-			-		
2. One-Group Pretest - Posttest Design **O X O**	-	-	-	-	?	+	+	-	-	-	?	
3. Static Group Comparison **X .... O** **O**	+	?	+	+	+	-	-	-		-		
4. Pretest-Posttest Control Group Design **R O X O** **R O O**	+	+	+	+	+	+	+	+	-	?	?	
5. Solomon Four-Group Design **R O X O** **R O O** **R X O** **R O**	+	+	+	+	+	+	+	+	+	?	?	
6. Posttest-Only Control Group Design' **R X O** **R O**	+	+	+	+	+	+	+	+	+	?	?	

The remaining three experimental designs (4. - 6.) handle potential threats in a proper manner, but they differ in the experimental effort. The 'Pretest-Posttest Control Group Design' and the 'Solomon Four-Group Design' are sophisticated, including multiple observations and samples. A 'Posttest-Only Control Group Design' achieves the same research quality with less effort.

The ‘goal-transformation’ hypothesis was conducted with a ‘Posttest-Only Control Group Design’ (see Cremer and van Vugt 1999). Therefore, the same experimental design was chosen and is graphically replicable as follows:

$$\begin{array}{ccc} \boldsymbol{R} & \boldsymbol{X} & \boldsymbol{O_1} \\ \boldsymbol{R} & & \boldsymbol{O_2} \end{array}$$

The left-to-right dimension indicates the temporal order. The vertical alignment of R’s and O’s therefore indicate simultaneity. The two lines indicate a randomized (*R*) between-subjects experimental design with no temporal distinction in both observations (O_1 & O_2). Only one group was exposed to the experimental treatment (*X*), i.e. manipulation of group composition.

5.3.4 Between-subject Design

A ‘Posttest-Only Control Group Questionnaire Experiment’ treats one randomized group with a treatment, while the other remains without. Hence, the thesis uses a between-subject design approach. In a between-subject design experiment each individual is exposed to only one treatment, while in a within-subject design, each individual is exposed to more than one stimuli (Charness et al. 2012). For a between-subject design experiment causal estimates are obtained by comparing the behaviour of those in one experimental (i.e. treatment) condition with the behaviour of those in another (i.e. control condition). The most important advantage of a between-subject design is that the author does not need to worry about the order exposure of the treatment affecting the units since only one treatment is tested (Charness et al. 2012). Further, between-subject designs analysis is simpler than within-subject designs. However, a lower statistical power is a common drawback of between-subject design experiments (Bellemare et al. 2014). Given the approach of Cremer and van Vugt (1999), the same design was adopted.

The manipulation of the group composition, i.e. forming a group with salient social identification, was the experimental treatment. Thus, the treatment group depicted an energy community with salient social identification, while the control group had an anonymous group composition. Such an approach is also called minimal group paradigm, which does not distinguish between identification at the group level and identification on an interpersonal level (Tajfel 1970).

5.4 Research Method

Given the research goals, the experiment's characteristics and it's design, a questionnaire with closed questions is the most appropriate research method to ensure quantitative results. The construction of questions and answers were given by the research hypotheses as well as by the research characteristics. The different social construction of the term 'energy', the different approaches regarding energy-related challenges and the anticipated lack of knowledge of these would exacerbate the interpretation of the answers within an a more open research method. Furthermore, a questionnaire experiment design requires a controlled environment to test the effect of the experimental treatment (cf. Schnell et al. 2005). However, even a Posttest-Only Control Group Questionnaire Experiment with closed questions cannot exclude the impact of other factors influencing the decision-makers answers.

Due to sampling and quality reasons, a paper-based questionnaire experiment was preferred over an online version. Considering the research quality of the thesis, the following arguments were pondered:

First, web surveys are used more and more in non-academic environment and can be perceived by the responders as commercial and unprofessional (Schnell et al. 2005). Such might lead to confusion and low response rates. On the other hand, a paper-based questionnaire has a more personal and professional message.

Second, the mobile use of ICT devices, like smartphones, enables the consumption of web-based content, e.g. online surveys, at any time. Thus, online surveys involve the danger that the replies are made in moments of hurry or apathy, without deeper consideration of the research topic, leading to precipitated answers. Paper-based questionnaires are typically sent to the responders' home address. This approach allows responders to complete the survey in a well-known environment without any time pressure. Hence, a paper-based survey is anticipated to have answers that are more reliable.

Finally, considering the sampling frame (see also Chapter 5.5.1), mailing paper-based surveys are better suited to target the population. In the case of the target population, lists of physical addresses of the survey population are more easily to obtain than a list of email addresses.

Given the hypothetical construct of Swiss energy communities, behavioural intentions are retrieved from the questionnaire. Testing intentions rather than actual behaviour is not undisputed. Ideally, self-reported behavioural intentions in the future derive from past and actual behaviour. However, this ideal conception corresponds not necessarily to the actual future behaviour of the experimental units. The literature describes this problem as the ‘Intention-Behaviour Gap’. Such a gap can be explained by volition (Gollwitzer 2012), i.e. the strive to reiving a set goal, factors influencing self-regulation (Kanfer et al. 2012) or changes in perceived self-efficiency (Bandura 2012). Behavioural intentions are stable predictors, but they cannot explain 70-80% of variances in actual behaviour (Wiedemann 2014). Theory of reasoned action (Fishbein 1979; Fishbein and Ajzen 2015) or theory of planned behaviour (Ajzen 1985, 1991) integrates ‘intention’ to the behaviour prediction model but allow no statement regarding the psychological processes to reduce the gap (Wiedemann 2014). Even after 30 years of research, the influence of behavioural intention on actual behaviour is heavily discussed.

Given the fictional scenario of energy communities and that behavioural intention is still considered as an important antecedent of behaviour (Ajzen 2002), a paper-based ‘Posttest-Only Control Group Questionnaire Experiment’ with rank-ordered answer-possibilities to elicit energy-related contribution intentions as well as intention regarding the design of energy communities was designed.

For the data-driven part of the dissertation, ‘Coordination of Energy Communities’, a more open structured questionnaire would have been also practicable. Yet, if structuring the questionnaire more openly, hypotheses of the first part of the dissertation would have been difficult to verify. Therefore, both parts are based on the same research method.

5.4.1 Layout and Structure of the Questionnaire Experiment

The construction of the questionnaire included an introduction, the main analytical section and an ending part. The introduction part included a cover page with all relevant information regarding the survey as well as an analytical entry point for the responders. The main analytical part contained all relevant aspects of the research endeavour. The ending expressed the questionnaire's end. The questionnaire included seven analytical sections for both the control and treatment group. The first three sections were uniform in wording, structure and layout. Sections 4, 5, and 6 were adapted to each group (see Figure 30).

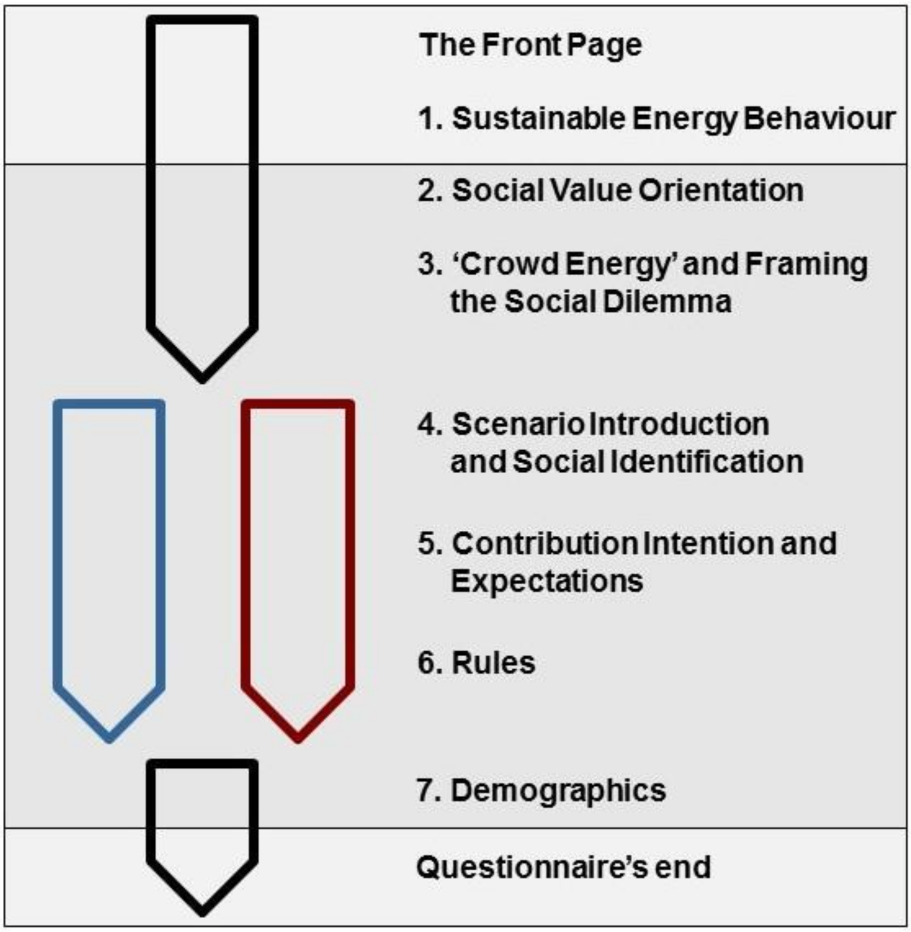


Figure 30: The Questionnaire's Structure

The questionnaire comprised 15 pages. The layout of the questionnaire was entirely created by the author. The A4-questionnaire was colour-printed on both sides. The two main colours, green and blue, were used for the questionnaire: each section had either a blue or a green background. Visual aids were used complementary to the questionnaire's instructions. Clarity of words, explanatory notes and comprehensive terminology were of great importance due to the novelty of the research object for the survey population. Thus, next to the instructional texts, explanatory messages were used. In general, both types of texts were optically separated. Important instructions or messages were written in bold. All these layout characteristics were held constant throughout the entire questionnaire (see Figure 31).

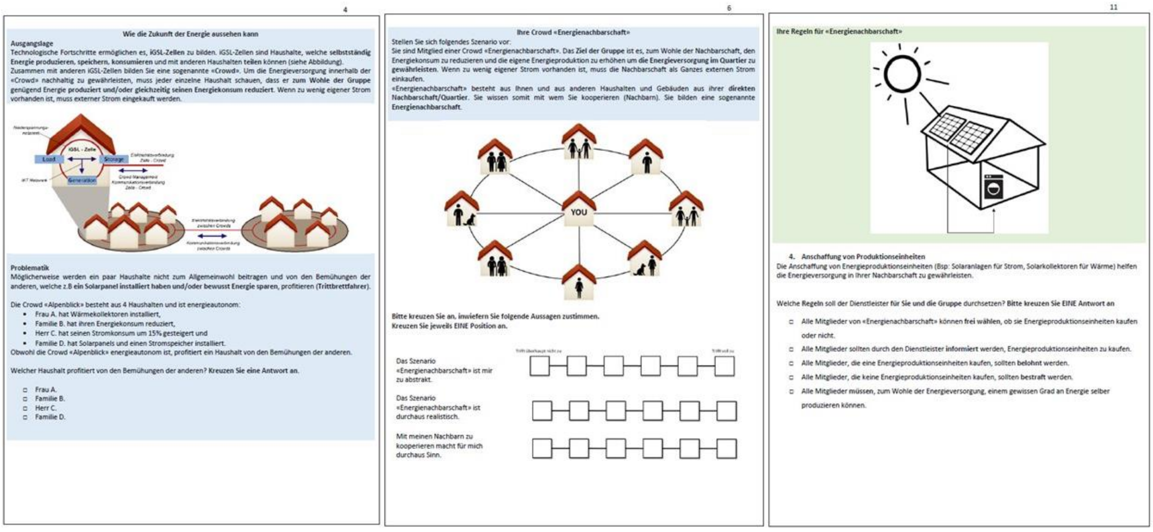


Figure 31: The Questionnaire's Layout (German Version)

Due to the newness of the topic, some sections of the questionnaire were novel scientific work, while others included already tested elicitation methods and items. The questionnaire was structured as follows:

The Front Page. The front page included information about the general topic, the goal of the survey, the anticipated length of the survey in minutes and contact possibilities for further information. Recipients were informed that the handling of the answers follows the principles of anonymity and confidentiality. Additionally, the recipients were informed on the cooperation between the respective municipality, the label 'Energiestadt' and the international institute of management in technology.

1. **Sustainable Energy Behaviour**. The first section of the survey served as an easy entry point, allowing responders to frame the research. The section contained eight items regarding the recipients' sustainable energy behaviour based on curtailment (SEB). The items were already used in other literature (Brosch et al. 2014; Poortinga et al. 2003; Sütterlin et al. 2013). All eight items were presented as statements. On a 6-point Likert scale, recipients could choose between 'never' (1) and 'always' (6) behaving in the stated manner. Low scores report unsustainable energy use at home.

2. **Social Value Orientation Analysis**. Section 2 used a paper-based version of Murphy et al.'s SVO Slider Measure to determine to recipient's Social Value

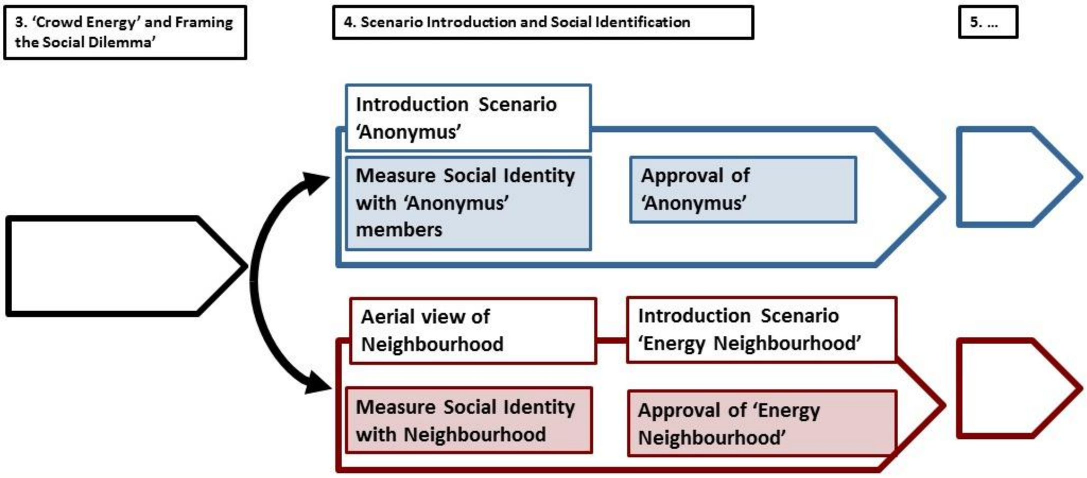
Orientation (see also Chapter 5.6.5). The exercise's instruction was slightly adapted from Murphy' original instructions (Murphy 2018). Contrary to the first section, this section demanded a higher cognitive effort from the responders.

3. **'Crowd Energy' and Framing the Social Dilemma**. Section 3 presented 'Crowd Energy' (Teufel and Teufel 2014) as a 'bottom-to-bottom energy provision' concept (Hertig and Teufel 2016b). It contained two parts.
   First, the informative part of this section included general information on the technical requirements of the Crowd Energy concept, as well as its underlying functioning. Further, the Crowd Energy concept was framed as a social dilemma and presented as a self-organized entity with freeriding possibilities. Contribution intention depends not only on the personal values, e.g. SVO, but on several other factors framing the decision-making. To control these, the social dilemma had to be presented in a simple and in a least normative way.
   The social dilemma was framed as a '*give-some*' dilemma (Kramer and Brewer 1984) with immediate collective consequences (Messick and Brewer 1983). Give-some dilemmas emphasize the contribution-dimension rather than the benefit-obtaining-dimension in collective actions. Comparing to 'take-some' dilemmas, give-some dilemmas yield generally in lower cooperation levels (van Dijk and Wilke 1995, 2000). Literature for the temporal dimension of collective consequences shows mixed results for cooperation levels (see Parks et al. 2013).
   In the questionnaire, local energy supply has been framed as collective action. Local energy supply has been described as the community's capacity to cover its energy demand with its own produced energy. It was further mentioned that local energy supply was only possible if every member contributed to it ('*give-some*' dilemma). In periods with supply shortages, the community as a whole would need to buy the missing capacities. No further technological, temporal or market-related aspects were mentioned. In the case when the energy community failed to autonomously provide itself with energy, all members bore financial consequences equally (immediate financial consequences of failure). In case the collective action was successful, all members benefit equally from local energy supply. The local energy autonomy has several benefits that can

be valued differently (cf. Bolderdijk et al. 2012; Poortinga et al. 2016; Steg and Vlek 2009) and were consciously not outlined. Highlighting a specific benefit of local energy autonomy would have allowed distortions, given the different dimensions of energy (Hertig and Teufel 2016a; Stern and Aronson 1984).

The second part of the section stated the potential free rider-threat. It was mentioned that individuals that install a PV panel and/or reduce their energy consumption for the common wealth of the group could be freeridden by others. A fictional crowd ‘Alpenblick’ involving four households was presented. To each household a small amount of information regarding its contribution behaviour has been provided; three households were contributing to the community goals, and one was freeriding. Recipients needed to identify the free rider. Therefore, this section included an eliminatory question.

4. **Scenario Introduction and Social Identification**. Both groups, treatment and control, faced the same social dilemma. The treatment group was informed that they form an energy community composed of neighbours, named ‘Energy Neighbourhood’. The control group was introduced to the scenario ‘Anonymus’, an energy community composed of anonymous people. Both groups had the same energy-related goal: ensure the community’s energy provision. Four items concerning the recipient’s social identification with the accorded group were introduced. The four items were transformed as statements of the social identification questions in Cremer and van Vugt 1999. On a 6-point Likert scale, recipients stated their approval of the statements (1 = not at all, 6 = very much). Low scores report low social identification.
   The last part contained three items regarding the general approval of the bottom-to-bottom concept, i.e. ‘Anonymus’ for the control group, ‘Energy Neighbourhood’ for the treatment group (1 = not at all, 6 = very much). Figure 32 visualizes the mentioned structure of Section 4 and its particularities.



Note: Elements with highlighted backgrounds indicate questions. Blank elements are explanatory elements of the questionnaire.

Figure 32: Structure of Questionnaire Experiment, Section 4

5. **Contribution Intention and Expectations**. In Section 5 the recipients stated to which degree they intended to contribute to the community's energy goal. The statements were presented as follow: '*I would [contribution effort] and [bearing costs related to the contribution effort] in order to ensure the energy supply within [the concrete energy community]*.' The four contribution efforts were *energy conservation*, *purchase of energy efficient devices*, *purchase of energy production units*, and *purchase of energy storage units*. The costs related to the contribution effort were framed either as behavioural (for energy conservation) or financial (for efforts related to purchases). The community members were named 'Anonymus' for the control group, and 'Neighbours' for the treatment group. On a 6-point Likert scale, recipients could choose between the options 'not at all' (1) and 'very much' (6).

   The same structure and scale were given for the 'Expectations'-part: '*The majority of [concrete community members] would [contribution effort] and [bearing costs related to the contribution effort] in order to ensure the energy supply within the [concrete energy community].'*

6. **Rules**. The title of this section was 'You choose the rules!', indicating that the responder's opinion regarding the design of the energy community matters. It was explained that rules were necessary to ensure energy supply within the

community. It was mentioned that an energy service provider applies the rule to all community members. Further, the legal form (SME, big firm, cooperative, association) of the energy service provider would have no impact on the energy service's quality. In total, seven sub-domains were presented in which the recipient could choose to apply rules.

The seven sub-domains were the following: *purchase of energy-efficient devices*, *load reduction*, *load shifting*, *purchase of energy production units*, *purchase of energy storage units*, *sharing stored energy,* and *sharing unused storage capacities*. It was mentioned that contributions in these domains would facilitate energy supply for the community. To each domain, a short description as well as a visual reference has been presented separately. The possible answers/ design choices were the following: *'[sub-domain] should not be regulated'*, '*people should be informed to contribute to the [sub-domain]'*, '*rewarding [sub-domain] contributions'*, '*punishing the [sub-domain]'s free riders'*, *and '[sub-domain] should be regulated'*.

7. **Demographics**. The demographic variables were age, gender, household size, duration of living in the same neighbourhood, property situation, and politics (measured by the approval/refusal of EnA).

   Questionnaire's end. On the last page of the questionnaire, responders were thanked for their participation. Further instructions regarding the return of the questionnaire were given.

None of the participants was engaged in a pre-test. A first version of the questionnaire was provided to approximately 20 persons that did not have prior information about the research project. The output had no analytical purpose, but it helped improve the comprehension of the questions and the structure of the questionnaire. None of the 20 participants lived in the mentioned neighbourhoods and therefore were not re-tested.

5.4.2 Between-subject Design Specification

Participants were randomly assigned to either the control or the treatment group. The manipulation of the group composition should lead to two different testing conditions: 'low-identification condition' and 'high-identification condition'. The control group was confronted with a low-identification energy community scenario. Participants were told that they form an energy community with anonymous members and that they had no possibilities to gather information on the other members. This condition was called 'Anonymus'.

The treatment group, 'Energy Neighbourhood', represented the high-identification condition. Participants in the treatment group were told that they form an energy community with their neighbours and therefore participants knew with whom they form a group, i.e. residents in the neighbourhood. Additionally, an aerial image of the neighbourhood was placed next to the explanatory text (see Appendix 2). Table 10 shows the summarized and communicated wording differences between both groups.

	Control Group	**Treatment Group**
Description	low-identification condition	high-identification condition
Goal of Survey	Determine individual energy-related potential	Determine energy-related potential of different neighbourhoods
Name of Energy Community	'Anonymus'	'Energy Neighbourhood'
Energy Community participants	'Members'	'Neighbours'
Frame of Cooperation	'Group'	'Neighbourhood'

Table 10: Differences, between-subject Design

5.5 Sampling Strategy

The requirements for a sampling strategy are given by the thesis' goals, the research design and the research methods. Furthermore, the sample strategy directly affects the research quality as well as the use of the findings, i.e. research conclusions. If a sample represents a subset of a studied population, then a sampling strategy reveals the plan on how the sample represents the population in terms of units.

5.5.1 The Principles of Sampling

Given its explanatory power of findings, sampling plays an important role in quantitative research: "Sampling is the science and an art of controlling and measuring the reliability of useful statistical information through the theory of probability" (Deming 1985, p. 2). In a first step, major principles of 'sampling' are *described* (see Box 8). In a second step, the same terms will be applied to *explain* and *justify* the thesis's sampling strategy.

Box 8: The Principles of Sampling

A first important term is 'population'. In the research and theory of sampling, the word '**population'** is used differently than what we use under normal circumstances. The studied units with identical characteristics compose the population. The units can be people, cases or pieces of data. A population consists of one or more units, depending on how population is defined.

Further, a population can be separated in a **target population** and in a **frame/survey population**. **Target population** refers the entire set of units for which the survey data are to be used for generalization purposes (Cox 2008). The **frame/survey population** refers to the set of units potentially accessible to the author, i.e. the units with chance of survey inclusion (Cox 2008). Traditional telephone, online or email surveys have a frame/survey population of households with landline telephone service, internet access or email address but typically are used to make inferences to target populations of all households, regardless of telephone service, internet access or email address. Hence, two important notes are necessary.

The **sample size** is the number of units within the survey sample. Survey samples further have to declare the 'sampling frame', representing "a list of the target population from which the sample is selected" (Hall 2008, p. 791).

Sampling lists can be frames like a list of households within an area, random-digit dialling (RDD) or more generally every other list framing the targeted population. Therefore, sampling frames vary with the research topic and the sample *per se*. Ideally, a sampling frame lists each unit of the frame population once, and just once. A sampling frame can overcover/undercover units, i.e. ineligible units are surveyed or eligible units are missed. Such over- and undercoverage may jeopardize external validity (see also Chapter 5.7.2).

A last term, which requires special attention, is '**sampling bias**'. Sampling bias occurs "when a sample statistic does not accurately reflect the true value of the parameter in the target population" (McCutcheon 2008, p. 785). Non-probability sampling techniques are prone to such bias, resulting in the jeopardy of external validity.

Target Population: *registered householders in low-density suburban neighbourhoods in Switzerland*. Even though the target population includes specifications, further explanations are necessary, given the human- and socio-geographical elements of it.

- A '*registered householder*' is the statistical unit. Registered householders are the official representative of a household, whether he/she is a tenant or owner of the housing unit, known by the municipalities' residents-office. In case of multi-person households, the household is also the head of the family. This traditional view simplifies the sample framing and solely serves for definitional purposes.[15] Registered householders are either permanently settled or have, according to Swiss law, a status as 'weekly-resident'.
- '*Suburban*' refers to residential areas located beyond a city's outskirts. Such residential areas differ mainly in site density: from 'low-density housing' (single-family homes), 'mid-density housing' (multi-storey apartment houses) to 'high-density housing' (apartment blocks). Hence, the socio-economic characteristics (i.e. income, criminality, ownership situation, etc.) correlate with the site density (Bowden and Doughney 2009; Schnore 1963). The target population lives in low-density housing areas. Given building and construction laws, low-density areas are well suited for solar-powered electricity production. The roof surface per capita is higher than in high-density areas, and further, house roofs and fronts are less likely to be shadowed by other buildings. Next to building and construction law-related characteristics, human-geographical peculiarities label low-density areas. In Switzerland, such areas are denoted by a high housing ownership ratio (Fries et al. 2017), which implies three important traits of target population. First, living in an area with high ownership ratio, the units tend themselves to be housing unit owners. Second, in Switzerland owners have a less restricted energy-related decision-making than tenants do (Alberini et al. 2013). Finally, buying a housing unit for living purposes is associated with reduced mobility of the owners and reflects a mid/long-term commitment to the area (cf. Gilbert 1999). Concluding, the characteristics of the target

[15] The author's definition does in no way suggest or express the author's beliefs in terms of gender or family affairs, nor was such integrated in the questionnaire.

population is influenced and specified by human-geographic elements emerging in low-density areas.

- ‘*Neighbourhoods*’ refers not only to a specific geographical area but to a spatial entity with face-to-face interaction by and through people (Schuck and Rosenbaum 2006). Neighbourhoods form place-based communities. Geographical and spatial peculiarities promote or hinder face-to-face interaction of residents. Spatial criteria indicate if interactions by and through people are potentially prominent in a specific geographical area. A first criterion is the existence of spatial boundaries. Clear spatially defined boundaries facilitate the sense of belonging to a neighbourhood and facilitate in-group interaction of residents (see for discussion: Paasi 2003), by demarcating oneself from other neighbourhoods. Typical borders in Swiss low-density suburban areas are main roads, rail tracks, untilled parcels, forests or creeks. Municipal borders are not necessarily hindering neighbourhoods. A second spatial criterion is neighbourhood size. Large neighbourhoods enable face-to-face equally like small ones (50-200 householders), but they exhibit less social control and offer other communication alternatives. The last spatial criterion is common infrastructure. Common infrastructure like a single low-velocity access road, wide sidewalks, playgrounds, or benches enable interaction on common grounds. Concluding, the characteristics of the target population are further specified by social-geographic elements emerging in low-density areas.

The quantification of the target population is difficult. In 2016, the amount of living units in Switzerland reached a total of approximately 4,500,000 units (BFS 2017a), with empty units distorting the number. Further and more important, no statistical information regarding the number of living units in low-density suburban neighbourhood exists. The lack of information regarding the size of the target population aggravates the claim for generalisation (see also Box 9 in Chapter 5.5.2).

Frame Population/Survey Population: *registered householders in low-density suburban neighbourhoods in and around Fribourg/Switzerland*. The population available to the author is geographically concentrated in and around Fribourg. Fribourg is the main city of the Canton of Fribourg. The City of Fribourg counted in 2016 38,489 inhabitants and was in 2014 the 13th largest city in Switzerland (SSV & BFS 2016). The suburban municipalities counted in 2016 43,337 inhabitants (StatA 2016).[16] The majority of the suburban population is French speaking. The number of householders in low-density suburban areas is estimated to be around 4,000.

The yellowish area in Figure 33 represents the urban part of Fribourg. The urban area does not necessarily follow the municipality's borders but is defined by natural peculiarities or land-use standards. Along the east side, urban and suburban areas are separated by a river valley, forming a natural border. The west border of the urban area abuts agricultural or industrial land-use zones. Several low-density suburban areas exist in and around Fribourg. The frame/survey population are registered householders living in the dark blue neighbourhoods.[17]

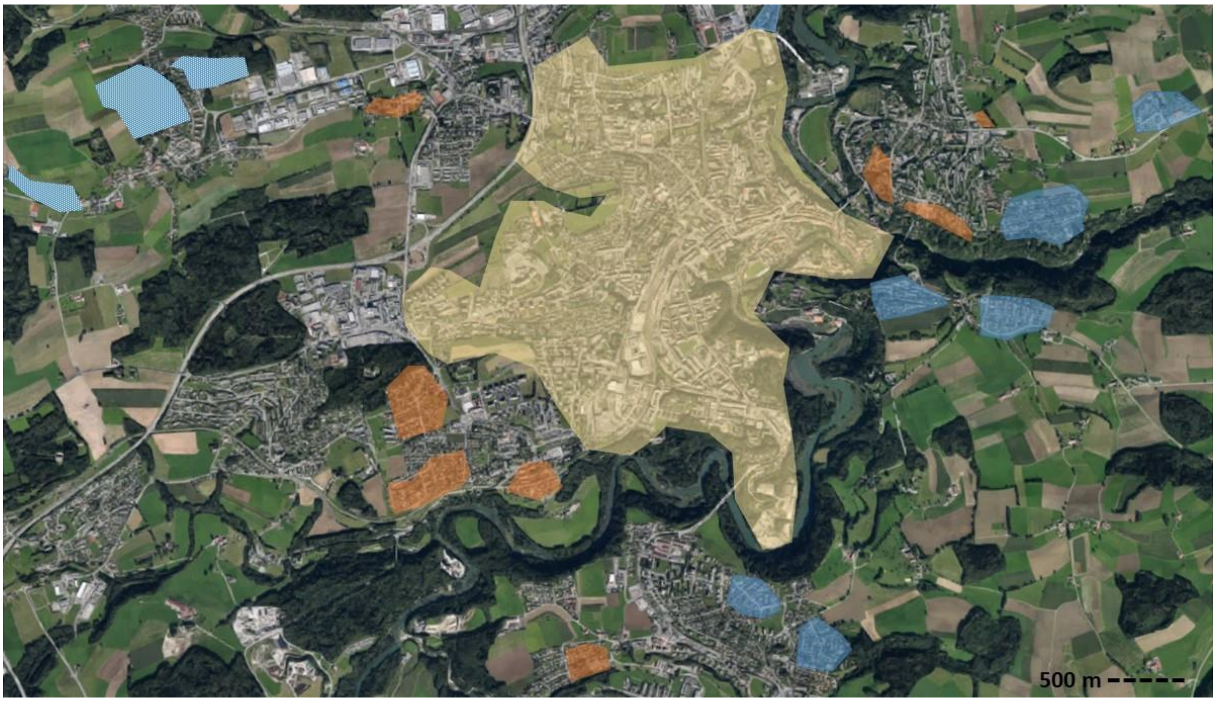


Figure 33: Suburban Neighbourhoods in/around Fribourg

The orange areas are low-density suburban areas too, but they did not fully meet the criteria of 'neighbourhood'. The light blue areas in the northwest met the criteria, but

[16] The suburban area consists of areas in the municipalities of Marly, Granges-Paccot, Givisiez, Villars-sur-Glâne, Tafers, Düdingen, Belfaux and Corminboeuf. The border municipalities Pierrafortscha and St. Ursen include more rural than suburban elements and were therefore not counted.

[17] The suburban areas within the municipality borders of Düdingen are northeast of the urban area and not perceptible on the figure.

the municipality, Corminboeuf, did not want to provide lists of the corresponding residents.

The question regarding the portability of the findings by geographically narrowing the population is justified: can the findings from the frame population, i.e. registered householders in suburban neighbourhoods in and around Fribourg/Switzerland, be generalized for the target population, i.e. registered householders in suburban neighbourhoods in Switzerland? The approach may jeopardize the external validity if the frame population is systematically and significantly different from the target population. Potential differences between the populations could be the following:

1. Cultural differences regarding energy-related behaviour of registered householders, e.g. the frame population has a systematically different energy behaviour based on curtailment.
2. Cultural differences regarding contribution behaviour, e.g. frame population systematically contribute less/more in public good games.
3. Significant differences in Social Value Orientation, e.g. frame population is systematically more individualistic/prosocial inclined than target population.
4. Differing human- and social-geography aspects, e.g. 'neighbourhood' and 'neighbours' are perceived differently.
5. Differing demographics.

The last point can and will partially be verified. The other potential differences however, remain unknown. A database regarding energy behaviour (1.) with similar populations exists (Alberini et al. 2013; Jakob 2007; Soland et al. 2017; Sütterlin et al. 2011, 2013). However, the authors did not follow related research questions or did not mention/focus on cultural differences. This may also indicate that no differences were obvious. To the author's knowledge only two studies considered energy behaviour-related differences between the French- and the German-speaking part of Switzerland (i.e. Bruderer Enzler and Diekmann 2015; Hess et al. 2018). The results of both studies were contradictory and did not as a whole approve nor decline cultural energy behaviour-related differences within Switzerland. Further, behavioural distortion resulting from differences in varying electricity prices can be excluded, i.e. electricity prices among the researched neighbourhoods are similar to the average price in Switzerland (ElCom 2018).

Although cultural differences regarding contribution behaviour (2.) (Gächter et al. 2010) and SVO (3.) (Bogaert et al. 2008) were observed in previous studies, it is not expected for these to be salient, since general cultural differences within Switzerland seem negligible.

Finally, to the author's knowledge no literature regarding differing human- and social-geography aspects, nor language-related differences between target and frame population exists (4.).

Thus, a fundamental assumption of this research endeavour is that the frame/survey population did not differ significantly nor systematically from the target population in terms of the researched fields.

The selection of the frame/survey population was due to not only practical but also quality reasons. The implementation of the research frame involves important time efforts, e.g. negotiations and on-site visits for list handovers.[18] These efforts were reduced by cooperating with municipalities geographically close to the University of Fribourg. Further, the author's knowledge about the suburban neighbourhoods in/around Fribourg simplified the identification of those.

Sampling Frame: *list of addresses of registered householders*. The municipalities willing to cooperate delivered official lists of the registered householders for each living unit within the researched neighbourhoods.

Units: *registered householders*. The municipality of Marly was the only one, which did not follow a 'head of family' communication strategy: In case of multi-person households, e.g. family or couples, paired householders were communicated to the author.

Sampling bias: *existing*. Given the sample technique (see next section), sampling biases existed.

[18] Most municipalities do not provide lists of registered householders via email-attachments due to possible information security concerns.

5.5.2 Sampling Technique

Different data collection procedures, i.e. sampling designs, exist and influence the research quality. According to Antonius a sampling design "is a detailed plan for coming up with a sample, which specifies the type of sample used, the list of units from which the sample is going to be selected, the number of units needed, and the precise method of selecting them" (Antonius 2004, p. 108).

Literature emphasizes two sample designs: probability sampling and non-probability sampling. Within a probability sampling design, units are randomly selected, while within a non-probability sampling design, units are not randomly selected, e.g. selected by the researcher (Schnell et al. 2005). Box 9 provides an overview of both sample designs.

Box 9: Overview of Sampling Designs

	Probability Sampling Design	**Non-probability Sampling Design**
Sampling Techniques (non-exhaustive)	• Simple random samples • Systematic samples • Cluster samples • Stratified random sample	• Quota samples • Convenience samples • Judgment samples • Samples of volunteers
Design Advantages	• Improved research quality	• Does not necessarily need a quantifiable target population. • Practicalities
Design Disadvantages	• Characteristics and size of target population must be definable and quantifiable.	• Cannot guarantee representability/generalizability of the frame population. • Sampling bias
Sources: Schnell et al. 2005; Vehovar et al. 2016		

Since the current target population is not quantifiable, i.e. no target population list exists, the author was forced to apply a non-probability sampling design approach. Thus, research quality is limited from a sampling design point of view. As mentioned earlier, units were excluded not via a probability approach, but through a conscious act. The researched units are registered householders that sent back the questionnaire and live in municipalities that agreed to share the units living addresses. Such a sampling technique is known as self-selection sampling. Self-selection sampling describes a technique in which the inclusion or the exclusion of the units is determined by the units themselves, either explicitly or implicitly (Sterba and Foster 2008). The self-selection sampling appears on two levels.

First is the individual level. Observations base on registered household that participated in survey, i.e. send back the questionnaire. This may lead to some important biases (see Chapter 5.3 and 5.7.2). Therefore, the thesis excluded observations from the mailed paper-based questionnaire experiment of non-responders, i.e. units that did not send back the questionnaire.

Second, self-selection biases can also be found on the municipality level. The municipality of Corminboeuf was not willing to share the participants list and therefore explicitly excluded ‘their’ registered households from further analysis. Municipalities played a gatekeeper role within the whole sampling procedure. Assuming that elected local politicians in a direct-democratic system express perfectly the values of the voters, a municipality’s unwillingness to share a participants list reflects the same biases as mentioned on the individual level. However, this assumption is somehow very theoretical and difficult to verify.

Although the sample was not randomized, the application of the experimental treatment on the sample was randomized. Each unit had the same probability of being assigned to the control group or the treatment group.

5.6 Data Analysis

The aim of this chapter is to describe the process of obtaining raw data and converting them to useful and relevant information. The data analysis process emphasizes six different phases.

5.6.1 Data Requirements

Given the research framework, the experimental units are registered householders within low-density suburban neighbourhoods in and around Fribourg. Further, the data source are householders within suburban neighbourhoods in and around Fribourg for which contact information were available. Access to the data sources was granted through via different municipalities. Meeting this requirement was inevitable but time-consuming. Further, the operational theories of the construct and the research design require two different testing conditions, i.e. control condition and treatment condition, which are tested simultaneously. There was no time-related discrimination between the two conditions for a given neighbourhood. Finally, requirements regarding the tested/measured variables for the 'Potential of Energy Communities' part were pre-defined by the goal of the thesis and also by the literature (cf. Cremer and van Vugt 1999).

5.6.2 Data Collection

Data regarding the addresses of the units were collected via the housing department in the mentioned municipalities in spring 2017. According the Cantonal Data Protection Law (Canton of Fribourg/Freiburg 1994), the author guaranteed the proper handling of these data. An information letter was sent to the units one week before they received the questionnaire. The information letter's aim was (a) to introduce the units to the upcoming questionnaire and to reduce surprising-effects, (b) delete units from the list that were unwilling to participate, and (c) increase the response rate of the final questionnaire.

For the main survey 'Energy Neighbourhoods', 981 paper-based questionnaires were distributed between 05.06.2017 and 30.06.2017 per mail. The quite large timespan is due to different administrative responses and employee vacancies among the different municipalities. That led to a staggered distribution of the information letter/questionnaire and a longer data collection period. Householders, which did not respond to the first questionnaire distribution, received a second and identical questionnaire. Data collection took place from 09.06.2017 to 24.08.17, which corresponded to 12 weeks (see Figure 34). In total, 414 replies were sent back to the author, representing a response rate of 42.2%. 23 units were sorted out due to important ambiguous data entry (see Chapter 5.6.4). Another 391 completed the questionnaire in large parts and in an unambiguous manner. Of the units, 389 were clearly assignable to a neighbourhood, which represents a net response rate of 39.6%. All data were communicated primary data.

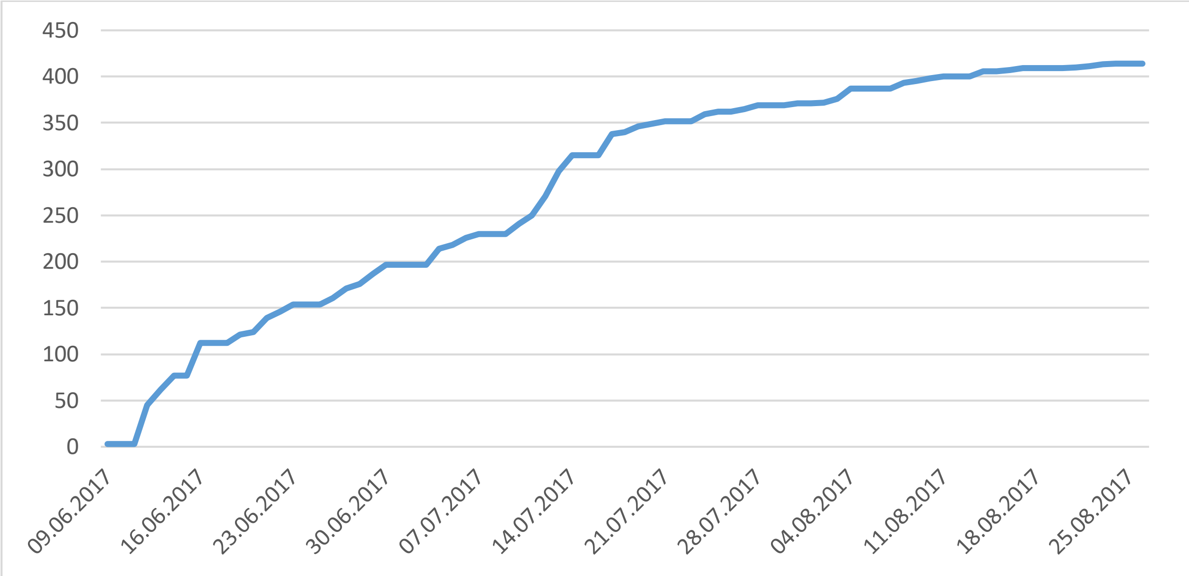


Figure 34: Data Collection

5.6.3 Data Processing

The data record included 61 variables. Of these, 12 variables were computed or pre-defined by the author. The pre-defined variables were the recipients' ID, the treating condition and the neighbourhood affiliation. The other 49 variables were communicated data. The data record was incomplete due to missing data entries through the recipients. The entire list and the description of the variables is attached (see Appendix 3).

The data entry was completed with Microsoft Excel®. The data transfer from the paper to the software's spreadsheet was conducted manually and was double-checked. A random sub-sample of 40 questionnaires (1,960 manual entries) showed that only three inputs (0.15%) were flawed. Finally, simple mean scores as well as the assignment of an individual's SVO (see Equation 1, page 129) were computed on Microsoft Excel®. The primary software for statistical analysis was IBM® SPSS® Version 24 and 25.

5.6.4 Data Cleaning

Paper-based questionnaires have an increased probability for flawed data determination. Responders may fill out the questionnaire in an inconclusive way, e.g. illegible and ambiguous answers, or they do not adhere to the questionnaire's instructions, e.g. multiple-entries. Only distinct and determinable data were analysed.

There were 23 units that either showed patterns of systematic illegibility and ambiguity or did not respond to large parts at all. Finally, within the remaining data set of the 391 no perceptible or systematic errors, duplicates or incompleteness were found. Further data cleaning was not necessary.

5.6.5 Data Analysis Techniques

The data set enabled different descriptive/correlational data analyses, which does not need further explanations. However, to test the four hypotheses for the 'Potential' part more sophisticated data analysis techniques were used.

Measurement of SVO

To assess the participants' SVO, a paper version of Murphy et al.'s SVO Slider Measure (2011) was introduced. The SVO Slider Measure originally consists of six primary and nine secondary items. Only the first six items were to be answered by the participants. Within the primary set of items, participants evaluated each of the items sequentially and for each one indicated his/her most preferred joint distribution. The secondary set of items is explicitly designed to disentangle the prosocial motivations of joint maximization from inequality aversion (Murphy et al. 2011). The secondary set of items was, because of time and content-related reasons, excluded. Compared to the Triple-Dominance Measure (van Lange et al. 1997b) and the Ring Measure (Liebrand 1984), the SVO Slider Measure has good test-retest reliability results, i.e. $r = .915$ (Murphy et al. 2011; Murphy and Ackermann 2014).

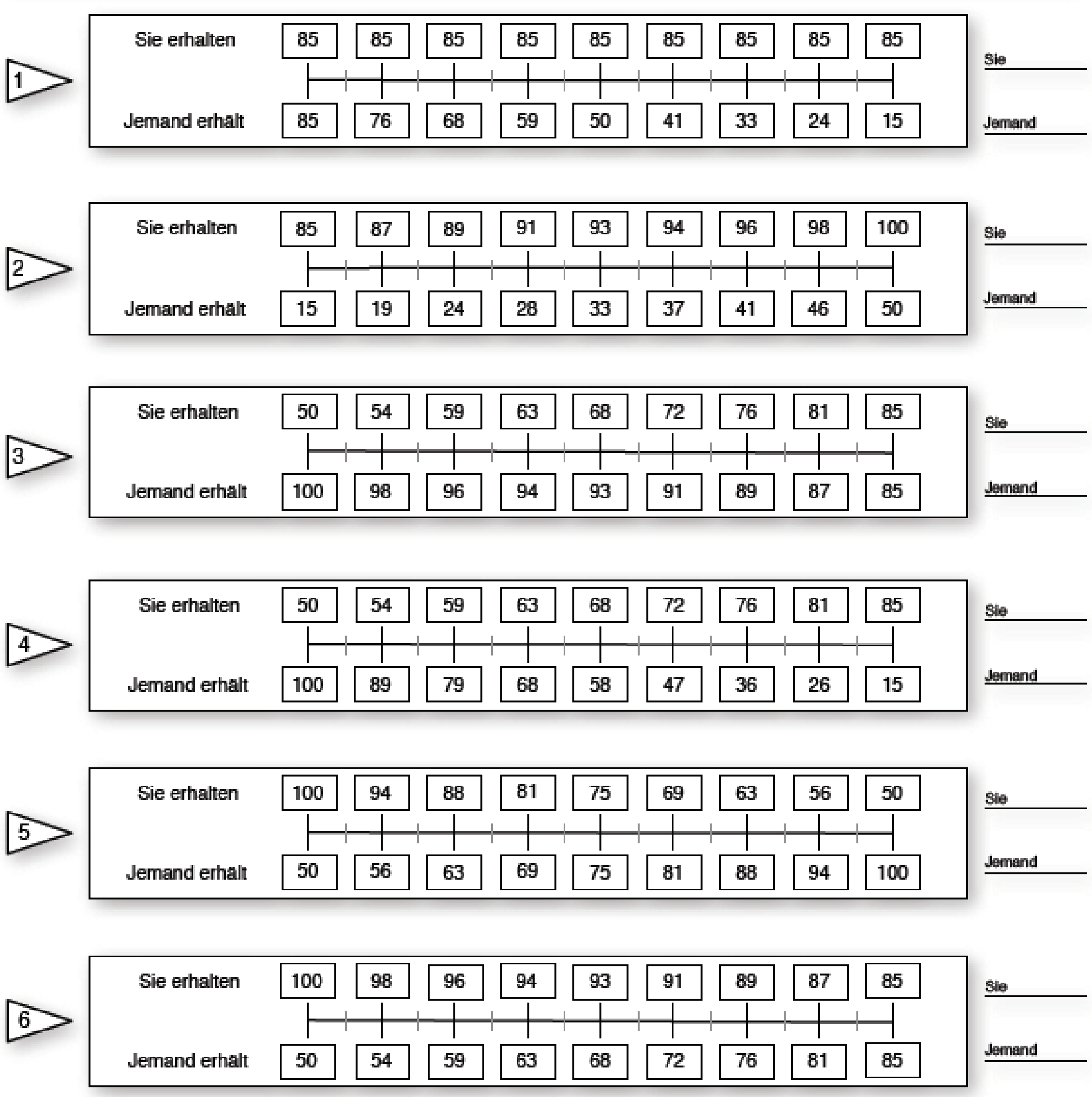


Figure 35: German Version ‘A’ of the six primary items of the SVO Slider Measure

Source: Murphy 2018 adapted from Murphy et al. 2011

The six primary items of the SVO Slider Measure (see Figure 35) depict all possible choices between the commonly observed inclinations in literature, e.g. altruism, prosociality, individualism, and competitiveness. The recipient evaluates each combination/item sequentially. Each item constitutes different joint-contribution choices between two different SVO inclinations (see Figure 36). Whereby, six items generate a single set of responses.

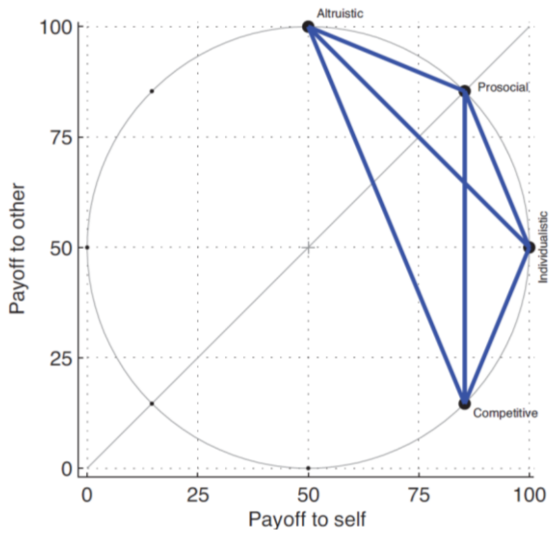


Figure 36: Allocation Plane of SVO Slider Measure

Source: Murphy et al. 2011

The set of responses can be scored to yield a final value for an individual's social preferences (see Equation 1).

$$SVO° = \arctan(\frac{A_o - 50}{A_s - 50})$$

Equation 1: SVO° Measurement

A_o represents the mean of the payoffs a decision-maker allocates to the other person throughout the six primary items. A_s, on the other hand, is the mean of the payoffs a decision-maker allocates to him/herself. The base of the allocation plane, i.e. the centre of the circle, is not the Cartesian origin but (50;50). Therefore, 50 is subtracted from mean payoffs. The inverse tangent of the ratio of the mean of the payoffs allocated to the other minus 50 and the mean of the payoffs allocated to the self, minus 50 gives the final SVO angle. Murphy and colleagues recommend following categorical scheme for SVO assessment:

- Altruism: SVO° > 57.15°,
- Prosociality: 22.45° < SVO° < 57.15°,
- Individualism: –12.04° < SVO° < 22.45°
- Competitiveness: SVO° < –12.04°

Although the SVO Slider Measure's most important advantage compared to the other measure is the continuous measurement of SVO (Murphy and Ackermann 2014), the author makes use of the categorical scheme for SVO assessment. Given the research hypotheses and the settings of the main literature, SVO was defined, if not mentioned otherwise, as a categorical variable and not as a continuous one, i.e. SVO°.

Two-way Analysis of Variance

In order to test H_{4A} and H_{4B}, a two-way Analysis of Variance (ANOVA) is conducted. The two-way ANOVA is used to determine whether there is an interaction effect between two independent variables on a continuous dependent variable, (i.e. if a two-way interaction effect exists).

The two independent variables were the SVO with three manifestations levels found in the sample ('Prosocials', 'Individualists' and 'Competitors') and the testing condition with two manifestations ('Anonymus' and 'Energy Neighbourhood'). This methodological approach is also referred to as a 3 x 2 ANOVA. The dependent variable is 'Mean Contribution Intention', which was a computed variable, resulting through the mean score of the 'Contribution Intention' variables (i.e. CI_01 – CI_04, see Appendix 3). The 3 x 2 ANOVA had three aims:

a) Finding a main effect of SVO: Determine if the different manifestations of the SVO had a impact on the dependent variable 'Mean Contribution Intention'. → Test H_{2A} and H_{2B}.
b) Finding a main effect of testing conditions: Determine if the different testing conditions had a impact on the dependent variable 'Mean Contribution Intention'. → Test H_{3A} and H_{3B}.
c) Finding an interaction effect between SVO and the testing condition: Determine if the effect of the condition was different for prosocials, individualists and competitors. → Test H_{4A} and H_{4B}.

In many ways, the two-way ANOVA can be considered as an extension of the one-way ANOVA, which deals with just one independent variable rather than the two independent variables of the two-way ANOVA. A two-way ANOVA has important requirements and assumptions. Literature emphasizes three basic model requirements and three assumptions related to the sample (Bleymüller and Weißbach 2015; Field 2015). The model requirements are the following:

1. Dependent variables must be measured at the continuous level.
2. Each independent variable consists of two or more categorically independent groups.

3. There is no relationship between the observations in each group of the independent variable or between the groups themselves. This assumption is also known as 'Interdependence of Observations'.

Further, the three sample assumptions and the related measures in case of violation are:

4. No significant outliers in the analysed sample. If this assumption is violated, outliers can be excluded from the sample (Field 2015).
5. Residuals are normally distributed. An ANOVA is quite robust, and small violations of the normality assumption can be tolerated. Data sets with similar skewed distribution and a big enough sample size can still provide valid results (Field 2015).
6. Homogeneity of Variances. If variances of the dependent variable are unequal in all combinations of groups of the independent variables, Type I Errors occur, i.e. 'false positive' findings. If the ratio between the largest group variance to the smallest group variance is less than 3, an ANOVA is still considered robust (Jaccard 2005). Otherwise, 'variance-stabilizing transformation' (Draper and Smith 1998; Kaufman 2013) should be applied to equalize variances.

Alternatively, rank-based non-parametric tests, like the Kruskal-Wallis H test (Kruskal and Wallis 1952), can be used if the data fails the mentioned assumptions. However, IBM® SPSS® Version 24 & 25 cannot run a Kruskal-Wallis H test with two independent variables.

5.7 Research Quality

Every research has limitations and its results may be jeopardized through different threats. The generalisation goal of the thesis depends highly on the degree the hypotheses are externally valid. *External validity* is not a standalone factor to assess research quality, but also a result of other experimental factors like *internal validity, extraneous variables, construct validity, reliability* and *objectivity* of the author. Therefore, this chapter aims to present all factors through which external validity and specifically research quality is assessed. Each factor will be explained separately, and potential threats according to the factors are explained.

5.7.1 Internal Validity

Internal validity refers to extending a conclusion based on a study that can be justified: "The internal validity of a study is the basic minimum without which any experiment is uninterpretable" (Campbell and Stanley 1963, p. 5). A wide range of threats to internal validity exist, which are widely discussed in literature (Campbell 1963, 1969; Campbell and Stanley 1963). Experimental research designs provide the greatest support for knowledge claims by reducing these threats (Campbell and Stanley 1963). As already mentioned (see Chapter 5.3.3), threats to internal validity are reduced by using a 'Posttest-Only Control Group' experimental design. Nevertheless, further explanations to some potential threats are necessary.

- A first factor that could potentially jeopardize internal validity is 'History'. Events outside of the survey may affect the participants' behaviour or values (Campbell and Stanley 1963). Since the questionnaire had different parts, dealing with different topics such as SVO, energy-related contribution intention, and preferences for rule-settings many events may affect the internal validity. No particular important events, such as important blackouts, unusual meteorological events, unforeseen increase of utility prices, or neighbourhood festivities occured in the interviewed region. Contrary to other votes, media coverage flattened shortly after the EnA voting day. However, the author observed a higher advertising effort (TV spots, newspaper advertisements or mailing ads) by different utility companies after the acceptance of EnA. It is unclear if the utilities' efforts affected the participants' behaviour and in which direction those influenced the participants. Further, assessing if scattered personal events, like disputes with neighbours, experienced cooperation and freeriding problems or increased problem awareness, changed the individuals' values, seemed impossible.
- A second factor threating the internal validity is 'Maturation'. Slack and Draugalis define maturation as a "threat can operate when biological or psychological changes occur within subjects and these changes may account in part or in total for effects discerned in the study" (2001, p. 2175). Since maturation threats longitudinal studies and no other questionnaire was conducted in these neighbourhood, threats seem negligible for the study in general. However, filling out the fifteen pages of the questionnaire might have

been a cognitive effort for some people, which might have resulted in an increased level of fatigue.

- Another threat is 'Testing'. Testing threats occur when changes in scores result because of repeated testing. The questionnaire included no repeated testing, such as a pre-test for the participants. Therefore, testing threats seem negligible. However, participants might have felt they were being repeatedly tested within the paper-based questionnaire. It cannot be excluded that responders adapted their answers to former choices, i.e. checking for former choices by turning back the pages of the questionnaire and adjusting current choices. The participants' drive to produce an aligned set of answers was a potential drawback of a paper-based questionnaire, threating its internal validity.
- 'Selection' refers to a potential bias, on how participants were selected in a two-group design. A random sample with randomly assigned groups reduces such bias. Participants were randomly assigned to either the control group or the treatment group. Each participant had the same chance to be either in the control or in the treatment group.

Given the Posttest-Only Control Group research design, internal validity is to some large degree guaranteed. Further threats have been mentioned but constituted, to the author's opinion, no major threat.

5.7.2 External Validity

Since the research design eliminates major threats on the internal level, common threats to external validity are minimized. External validity asks the question of generalizability: "To what populations, settings, treatment variables, and measurement variables can this effect be generalized?" (Campbell and Stanley 1963, p. 5). However, there might be some threat arising from the selection bias for external validity. Overrepresentation of certain individual values represented such threats to the external validity. Participation in the study was voluntary and no prominent incentives were given.[19] This might have led to an overrepresentation of individuals that either are highly interested in the topic, had enough leisure time or have prosocial and altruistic reasons to participate. The latter problem was researched by economists

[19] The second questionnaire contained a more explicit invitation to participate and sweets for the recipient.

(Falk et al. 2013; Cleave et al. 2013; Slonim et al. 2012). Cleave and colleagues as well as Falk and colleagues found no evidence that self-selection of more prosocial students into laboratory experiments is a major issue. The results of Slonim and colleagues (2012) not only objects to these findings, but they further revealed that students with low income, students with a lot of leisure time, students with interests in the experimental topic, risk averse students, and patient students were overrepresented in laboratory research. For this thesis, participation efforts for participants were kept consciously low. Admittedly, there might be similar issues with the generalisation goal of the research. Nevertheless, these potential threats are quite common for observations based on volunteering. The generalisation claim of the thesis may also be jeopardized by differences between the target and frame/survey population (see also Chapter 5.5.2).

5.7.3 Extraneous variables

Variables that are not intentionally studied by the author are called extraneous variables. Extraneous variables can threat the internal validity of a study and therefore need further attention. When such variables systematically change the intended variables (e.g. independent variables and the dependent variables), we speak of confounding variables (van der Weele and Shpitser 2013). Confounding variables provide an alternative explanation for the relation between the intentional variables.
Taking the intentional variables to approach H_{2A} and H_{2B}, i.e. 'SVO' as the independent variable and 'Mean Contribution Intention' as the dependent variable, extraneous variables may disturb the measurement. Extraneous variables can potentially influence the dependent variable as well as the independent variable. The independent variable, SVO, was reliably measured (Murphy et al. 2011). Therefore, there is only a negligible risk of confounding. However, the dependent variable, Mean Contribution Intention, could have been object to threats as shown *ex post* remarks of the questionnaire's participants:

- Extraneous variables that emphasize the future belonging and changes in the composition of the group could have influenced the dependent variable. *Ex post*, two householders in the 'Energy Neighbourhood' condition mentioned that they were moving to another neighbourhood within the next months and therefore did not want to contribute to their current neighbourhood goals. Three elderly women highlighted the fact that their neighbourhood is composed of elderly people with low life expectancy.[20] Therefore, they did not intent to contribute. The five participants were excluded from further analysis due to obvious confounding threats.

- Moral Self-Licencing effects (Monin and Miller 2001). Moral Self-Licencing effects occur "when past moral behaviour makes people more likely to do potentially immoral things" (Merritt et al. 2010, p. 344). In other words, people can behave more selfishly, when they behaved prosocial first. Two householders referred to important current house isolation efforts undertaken when the survey took place. Such behaviour could be interpreted as 'past prosocial behaviour'. Nevertheless, the responders' scores for the dependent variable did not confirm effects of moral self-licencing.
- Although the questionnaire did not mention any technical details and anticipated no technical knowledge about energy generation and storage, there could have been some distortions of the dependent variable. Several persons reported that (a) their contribution depends on the technology used or (b) that they did not know how to answer the question due to lacking technical knowledge. The responders' scores for the dependent variable did not show uncommon patterns. Further, it is unclear if technological knowledge hinders or promotes the dependent variable.

Yet, it is unknown if such variables truly confounded the dependent variable. Only a handful of participants mentioned such. Furthermore, paper-based questionnaires incentivize participants to comment on parts of the questionnaire by writing comments on the questionnaire. The consequences of extraneous variables could have been reduced if an incentive-compatible research design would have been chosen. However, such a design was, given the research goal and time/cost restraints, not desired. Furthermore, it can be assumed that if variables have satisfactory reliability coefficients, extraneous variables did not have an important impact on the decision-making.

[20] The mentioned neighbourhood is 'Montivert' in Marly. The average age of householders is not significantly different from that in other neighbourhoods.

5.7.4 Construct Validity

In a first step, major principles of construct validity are *described* (see Box 10). In a second and final step, applied principles are *explained*.

Box 10: Principles behind Construct Validity

Construct validity is an overarching term to assess the validity of a measurement procedure (i.e. questionnaire) for a given construct (i.e. Social Value Orientation, energy-related contribution intention, preferences for community design, etc.). According to Messick (1987), construct validity incorporates other forms of validity that help to assess a given construct, namely **content validity**, **convergent and divergent validity,** and **criterion validity**.

Content validity "is the degree to which elements of an assessment instrument [measurement procedure] are relevant to and representative of the targeted construct for a particular assessment purpose" (Haynes et al. 1995, p. 239). Certain constructs are one-dimensional and have a well-defined operational definitions, e.g. the construct 'age' is measured in 'years', while others are multi-dimensional. Regarding its measurement, a multi-dimensional construct needs a clear 'Operational Definition'. An operational definition defines a construct by its operationalization, i.e. measurement procedure. The aim of operational definitions is to operationalize an abstract concept by assigning it appropriate indicators. Therefore, operational definitions are fundamental when collecting types of data and indispensable if the construct is (a) not directly observable and (b) is multi-dimensional. From a definitional point of view, constructs may have various theoretical and operational definitions, depending on the academic discipline respectively the operationalization of the construct.

Convergent and **divergent validity** are ways to assess a measurement procedure's construct validity (Campbell and Fiske 1959). Convergent validity allows establishing construct validity when two different measurement procedures or research methods were used to collect data about a construct. The idea behind convergent validity is that despite the fact that two different measurement procedures or research methods are used, a construct's scores should converge. Divergent validity allows establishing construct validity by differing the main construct from other constructs that might be presented in the same study.

Criterion validity "is the general term to describe how well scores on one measure (i.e., a predictor) predict scores on another measure of interest (i.e., the criterion)" (Borneman 2010, p. 292).

Content Validity

'Sustainable Energy Behaviour based on curtailment', 'Social Value Orientation' and 'Social Identification' are constructs well defined in the literature. The operational definitions of these constructs were also adapted from the literature. On the contrary, the thesis also uses several constructs yet unknown to the literature. Therefore, not only the theoretical definitions but also the operational definitions of the most important constructs are presented in Table 11.

Construct	Theoretical Definition	Operational Definition
'Sustainable Energy Behaviour based on curtailment' (SEB)	'SEB refers to energy conservation behaviours that an individual has to perform repeatedly and that require a change in one's everyday energy use habits' (Aarts and Dijksterhuis 2000; Black et al. 1985; Karlin et al. 2012; Steg et al. 2016)	'Self-report measure of frequency of one's everyday energy conservation habits' (see also: Sütterlin et al. 2013).
Social Value Orientation (SVO)	'SVO refers to the terms of the weight people assign to their own and others' outcomes in settings of interdependence' (Messick and McClintock 1968; van Lange 1999).	'A continuous [or categorical] construct, as it corresponds to the quantity of how much a decision-maker is willing to sacrifice in order to make another decision-maker better off (or perhaps worse off) in settings of interdependence' (see also: Murphy et al. 2011).
Social Identification	'Social Identification describes those aspects of a person's self-concept based upon his/her group membership' (Turner and Oakes 1986).	'Self-report measure of an individual's common interests, feelings of affiliation and belonging with a group, and knowledge about group members'(see also: Cremer and van Vugt 1999).
Energy-related Contribution Intention	'Energy-related Contribution Intention refers to an individual's intention to bear financial and/or behavioural costs related to the purchase of infrastructure or curtailed energy use habits for a common energy-related goal in a setting of interdependence'.	'Self-report measure on an individual's intention to bear financial costs of purchasing energy-efficient devices, energy production/storage units and behavioural costs of curtailed energy use for a common energy-related goal in a setting of interdependence'.
Potential of Energy Communities	'Potential of Energy Communities describes the relative positive effect of 'social identification' on an individualists'/competitors' energy-related contribution intention'.	'Measurement of the interaction between SVO and Social Identification for energy-related Contribution Intention'.

Construct	Theoretical Definition	Operational Definition
		→ goal transformation regarding energy-related contribution intention
Coordination of Energy Communities	'Coordination of Energy Community refers to the competence allocation of energy-related decision-making between an individual and an energy service provider'.	'Self-report measure of the individuals' intention to allocate tasks related to iGSL-infrastructure provision and infrastructure management towards an energy service provider'.
Role of Energy Service Provider	'Role of Energy Service Provider refers to the extent and the justification of/for third-party intervention in individual energy-related decision-making based on the preferences of potential community members' (Hertig and Teufel 2018).	'Self-report measure of potential energy community members according the EMFC'(Hertig and Teufel 2018).

Table 11: Theoretical and Operational Definitions of Constructs

Logically, all constructs can be subject to other definitions and operationalization. The potential of energy communities for example could be defined from different perspectives, i.e. 'Acceptance of Renewables' (Wüstenhagen et al. 2007), 'Environmental Value Orientation' (Poortinga et al. 2016) or Marketing Theory. Both types of definitions always reflect an interdependence-point of view on the different constructs. To test the consistency of the operational definition and the content validity, Cronbach's alpha tests (Cronbach 1951) will be conducted.

Convergent and divergent validity

Divergent validity to assess construct validity for the construct 'Social Value Orientation' was automatically adopted by using only the six primary items of the 'SVO Slider Measure' (cf. Murphy et al. 2011). Convergent validity assessment was not carried out since only one measurement procedure (i.e. questionnaire) was used.

Criterion Validity

Both, predictors and criterions are novel in terms of contextual use, but they refer to same prediction processes as in the literature (see operational definitions of the criterions). Though measurement procedures and context are different, the thesis adapts traditional ‘Public-Good’ prediction processes (e.g. Cremer and van Vugt 1999). In such prediction processes, relations between predictor and criterion are well known. Further criterion validation was not performed.

5.7.5 Reliability

Like validity, reliability is a quality assessment of the measurement procedure used to collect data in survey. Reliability “is the ability of the measure to produce the same results under the same conditions” (Field 2015, p. 13). Typically, the test-retest measure is the most commonly used instrument to test a measurement procedure. A variable’s true score consists of the actual score (i.e., score of householders) and an error component (i.e. variation of the actual score). To assess the reliability of the measurement procedure (i.e. questionnaire), four sections of the questionnaire were submitted to a small test-retest on separate days (see Table 12).

Section in questionnaire	Value of reliability coefficient
Sustainable Energy Behaviour (SEB)	0.94
Social Identification	0.97
Energy-related Contribution Intention	0.97
Energy-related Expectations	0.98
Rules	0.95

Table 12: Reliability Test

The value of the reliability coefficient varies between ‘0’ and ‘1’. A ‘1’ constitutes a perfect reliable variable, i.e. the actual score equals the true score (‘no error’). A ‘0’ shows a perfect unreliable variable (‘error’). For example, the reliability coefficient for SEB indicates that the tested individuals showed 94% regularities between the indicated scores of the first and the second test.

5.7.6 Objectivity

Contrary to critical or interpretative research paradigms, positivist/postpositivist researchers stay distanced, in personality, values and beliefs, to scientific truth (Payne and Payne 2004). An acceptable level of objectivity can be achieved through increased validity and reliability of the research, appropriate research design, research methods, objective sampling and proper data analysis (Cohen et al. 2013).

Given the research method (i.e. structured questionnaire sent by post), experimenter-bias was reduced. According to the pre-test feedback, the questionnaire *per se* had no subjective connotation. Data collection took place shortly after the vote on the EnA. Therefore, a non-judgemental approach towards ‘renewables’ was even more important and ensured neutrality in wording.

5.8 Research Ethics

Ethical requirements refers “to moral standards for research practices that involve humans” (Roche and Roche 2010, p. 337). The main ethical principles in research are (1) minimizing the risk of harm, (2) obtaining informed consent (3) protecting anonymity, (4) avoiding deceptive practices and (5) providing the right to withdraw. The author did not violate or neglect any of these. The author signed a rigid agreement with the gatekeepers, e.g. municipalities, guaranteeing an ethical handling of the data of the researched units.

The only ethical issue that seems worth mentioning occurred with the sampling frame. The list of participants received from the municipalities mainly excluded women householders if multiple householders existed, e.g. family or coupled households.

5.9 Research Strategy for ‘Energy Clubs’

The research strategy for evaluating the ‘Potential’ and the ‘Coordination’ of ‘Energy Clubs’ is almost identical with the research strategy for ‘Energy Neighbourhoods’. Most importantly, the research design (see Chapter 5.3) as well as the research method remained identical (see Chapter 5.4), whereby, the research process and the research quality remain similar. Minor differences in the research strategy are due to changes of the surveyed sample.

Target population: *full-aged active members of local associations or clubs in Switzerland*. In 2016, 42.3% of permanent citizens in Switzerland were active-members in at least one association or club (BFS 2018). This corresponds to approximately 3,500,000 active members in Switzerland. The federal statistical office defines *active members* as individuals that actively contributed at least once in the last twelve months in an activity of the corresponding associations or club (BFS 2018). Certain associations, i.e. service clubs, explicitly request active membership of the members. *Local* associations and clubs regroup individuals within a certain geographical area, which can range from a neighbourhood up to a regional scale.

Frame Population/Survey Population: *members of service clubs in the region of Fribourg and Bern/Switzerland*. Service Clubs are associations that aim to cultivate personal and professional relations between its members as well as to serve society (Gull 2011). The most prominent service clubs in the region of Fribourg and Bern are the approximately 100 local subsidiaries of Rotary Club, Lions Club, and Kiwanis. A local service club comprises between 20-50 members. Each member enters the club based on a recommendation of a club member. Thomas Gull depicts service clubs as 'exclusive' since their members (mostly men with leading position in business, administration, politics or academics) form a homogenous socio-demographic group (2011). The members meet on a regular basis for the purposes of relationship cultivation. All service clubs participate or even create local, national, or international charity projects. Similar to less exclusive associations and clubs, service club members form a community based on relations in which the members share common values and interests. Although the geographical similarities are non-negligible, such communities can primarily be described as relation-based communities. All three service clubs stand for values and ideals, which can be described as 'serving the neediest', 'give back to the society' but also 'liberalism' and 'open society'.
From the fifteen contacted service clubs, only three replied to the research-request. None of them supports a charitable project that has a link to the research topic.

- Rotary Club Freiburg-Sense – a service club in the Swiss German part of the Canton of Fribourg, in which only male members are admitted. Members meet weekly for mandatory lunches. The service club recently supported a local charity projects in favour of dementia patients. N = 52.
- Lions Club Bern Metropolitan – a service club that constitutes members, men and women, living in the greater area of Bern. Members meet weekly for dinners. The service club supports local charity projects in favour of visually impaired people. N = 30.
- Lions Club Worblental – a service club that constitutes members, living in the eastern part of the suburban area of Bern. Only men are admitted. The service club supports different local charity projects. N = 33

The question regarding the portability of the findings by choosing service clubs as a frame/survey population is justified. The social and charitable goals of service clubs might lead to a sampling bias, i.e. surveying individuals that have an inclination to help other people. Otherwise, most other associations and clubs share implicitly similar values or at least exhibit helping behaviour and volunteering. Further, service club members have probably above average buying power compared to other association and club members. However, the economic, social, and demographic situation of service club members is anticipated to be similar with those of the frame/survey population the ‘Energy Neighbourhoods’ inquiry, i.e. homeowners. Accordingly, demographic similarities allow comparison between both samples.

Sampling Frame: *list of addresses of service club members*. The three service clubs willing to cooperate delivered internal lists of their members.

Units: *service club members*. None of the three service clubs has passive-members. Subsequently, the statistical units will be referred to as ‘club members’.

Sampling bias: *existing*. Given the same sample technique, which was used as in the ‘Energy Neighbourhood’ study, sampling biases exist.

Layout and structure of the Questionnaire Experiment (QE): In general, layout and structure of the questionnaire remained identical. Nevertheless, two adjustments were made. After pre-test feedbacks, the aerial view of the community’s border was removed. Since the club members did not live in a specific neighbourhood, the visual aid was redundant. Second and most importantly, Chapter 6 (‘Rules’) included a randomized configuration of response possibilities in order to avoid regression to the mean, i.e. choosing always the response possibility in the middle of the range. The questionnaire for ‘Energy Neighbourhood’ included a rank-ordered configuration of response-possibilities.

Between-subject design specification: Identical to the QE used for ‘Energy Neighbourhoods’, the elicitation method was a ‘Posttest-Only Control Group Questionnaire Experiment’. Table 13 shows the summarized and communicated wording differences between both groups.

	Control Group	Treatment Group
Description	low-identification condition	high-identification condition
Goal of Survey	Determine individual energy-related potential	Determine energy-related potential of different associations
Name of Energy Community	'Anonymus'	'Crowd [Name of the local Service Club]'
Energy Community participants	'Members'	'Club Members'
Frame of Cooperation	'Group'	'Service Club'

Table 13: Differences, between-subject Design

Data Collection: the addresses of the units were transferred to the author in spring 2018. In return, two service clubs (Rotary Club Freiburg-Sense and Lions Club Bern Metropolitan) demanded the author to present the research topic during their weekly meetings. The description of the research project was made purposely general and did not aim to incentivize the units to participate nor aim to manipulate the units before they actually received the questionnaire. According the Cantonal Data Protection Law (Canton of Fribourg/Freiburg 1994), the author guaranteed the proper handling of the addresses of all the club members. No information letter was sent to the units. The 115 questionnaires were sent to club members by mid-May 2018. By mid June 2018, 40 questionnaires were sent back. All 40 questionnaires were completed to large parts by the participants. The net response rate was 34.8%.

Pre-test: In order to test the structure and the layout of the questionnaire experiment, a pre-test was conducted with the 'Männerchor Saanegruss' in mid-September 2017. The sample consisted of 25 members of a male chorus living in the city of Fribourg. None of the members had any difficulties to completing the questionnaire. Due to important differences in demographics and period of elicitation, results were not included in the 'Energy Club' inquiry.

5.10 Conclusion

Table 14 summarizes the research strategy, presenting the most important information regarding the single components.

Research Strategy Components	Information
Research Characteristics	Quantitative research including replication-based research ('The Potential of Energy Communities') and data-driven research ('The Coordination of Energy Communities')
Research Routes	Predominantly Generalisation and Extension
Research Paradigm	Positivist/postpositivist
Research Design	Questionnaire Experiment
Experimental Design	Posttest-Only Control Group Design, between-group design
Experimental Treatment	Manipulation of group composition
Experimental Units	'registered householders in suburban neighbourhoods in and around Fribourg/Switzerland', and 'members of service clubs in the region of Fribourg and Bern/Switzerland'
Elicitation Method	Paper-based questionnaire
Sampling Technique	Self-selection sampling technique
Data Analysis Techniques	SVO Slider Measure, and predominantly analysis of variances, ANOVA
Research Quality	Only minor threats
Research Ethics	No violations

Table 14: Conclusion, Research Strategy

6 Results ‘Energy Neighbourhoods’

This chapter comprises the results of the thesis’ main research inquiry, i.e. ‘The Potential of Energy Neighbourhoods’ and ‘The Coordination of Energy Neighbourhoods’. The former part can be categorized as replication-based research. As such, clear research hypotheses were stated and tested. Additionally, results, interpretation and conclusions are presented as close as possible to the original literature (i.e. Cremer and van Vugt 1999). Results, interpretations and conclusions are presented separately. For usability purposes, main conclusions will be highlighted in boxes.

The second part of the thesis is data-driven and cannot rely on the same profound theoretical background as replication-based research. Considering that, this part builds on new research questions instead of replicated hypotheses, whereby explanations and interpretation of results are broadened. For usability reasons, results and interpretations for each research question will be highlighted separately.

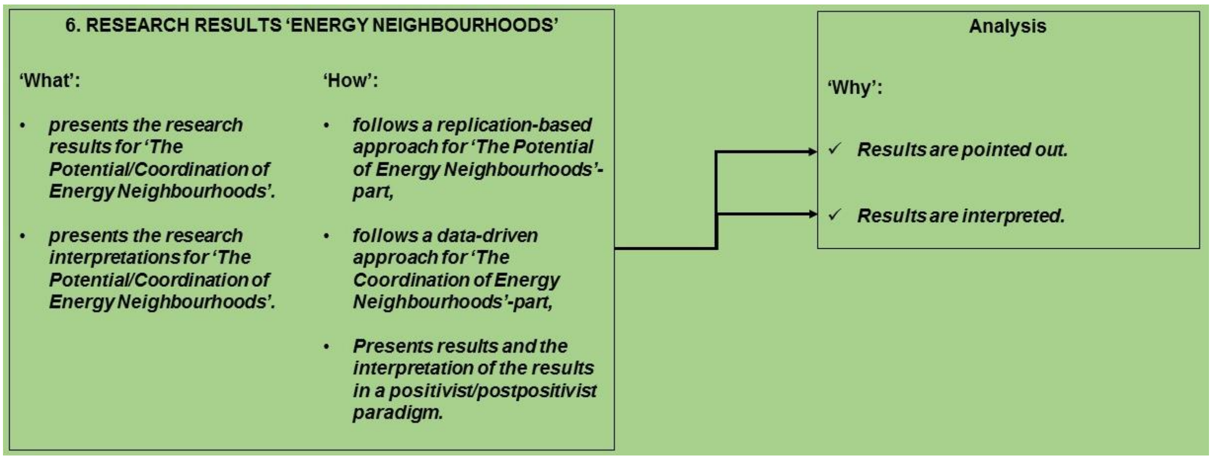


Figure 37: Chapter six, Outlook

6.1 Results ‘The Potential of Energy Neighbourhoods’

First, an overview of the composition of the results across questionnaire sections, neighbourhoods and units is presented. This allows a first overview of the survey/frame sample and its general characteristics.

Afterwards, more specific, energy-related features of the sample will be highlighted. A comparison between the different neighbourhoods is needed to identify potential research relevant between-group differences.

Finally, H_{1A} – H_{4A} are tested. The interpretation of the results will follow in the next chapter (Chapter 6.2). The interpretation of the results remains close to the research framework and compares the research results with similar observations.

6.1.1 Composition of Results

The composition of the results sheds light on the general composition of the sample. First, the result composition will be presented according to the different sections of the questionnaire. Afterwards, the sample composition is analysed regarding the incoming responses across all ten neighbourhoods. Finally, response composition was analysed from a demographic point of view.

Composition of Results after Questionnaire Sections

The initial recipients of the survey comprise 981 contacts. 414 replies were send back, representing a response rate of 42.2 %. Of these, another 391 completed the majority of the questionnaire. 389 were clearly assignable to a neighbourhood, which represents a net response rate of 39.6%. According to Shih and Fan (2008) such a response rate is satisfactory.

The survey encompassed seven sections. Each part showed different rates of response due to different cognitive claims. Table 15 illustrates the composition of the survey and repeats the sections’ content. As expected, section one was a simple entry point for the experimental units. 96.14% of the units successfully accomplished the ‘sustainable energy behaviour’ part. Except for section two, the other sections showed similar rates. These figures demonstrate that the questionnaire was well designed and that the visual aids and explanatory texts helped the experimental units. It was also expected that the SVO measurement, Section 2, was a more a challenging task: only 310 persons or 79.7% of the experimental units successfully exhibited their preferences. Previous studies had similar rates (van Lange et al. 1998; van Vugt et al. 1996a). Further attention is given to section three: 314 persons (80.7%) successfully identified freeriding behaviour in the fictional ‘Crowd Alpenblick’. Unfortunately, no benchmark regarding freeriding identification rates exists.

	1. Sustainable Energy Behaviour	2. SVO-Analysis	3. Crowd Energy	4. Scenario-Introduction	5.1 Contribution	5.2 Expectations	6.Rules	7. Demographics
Participants Guiding		Introduction to SVO Slider Measure	Introduction to Crowd Energy, Introduction to freeriding problem within a social silemma	Introduction to scenario (‘Anonymus’ or ‘Energy Neighbourhood’)			Introduction of Crowd-Rules	
Measures	Eight items concerning energy behaviour	paper-based SVO Slider Measure (six items)	Comprehension question concerning energy-related social dilemma	Three general questions concerning the approval of the scenario, Four items concerning group identification	Four items concerning contribution intention	Four items concerning contribution expectations of other group members	Seven items concerning different ‘Crowd’ rules	General demographics questions
Number of returned answers Total N= 389	n= 374	n= 310	n= 361 (314 correct answers)	both n=379	n= 379	n= 380	n =364	n=376

Table 15: Composition of Results after Questionnaire Sections

Composition of Results after Neighbourhoods

Table 16 provides an overview of the general composition of results across different neighbourhoods. The sample consisted of four majorly German-speaking neighbourhoods, five majorly French-speaking and one bilingual neighbourhood. Questionnaires were sent in the neighbourhood's most spoken language.

Neighbourhood/*Municipality/ Language (d/f)*	**Contacts**	**Share of contacts**	**Responds (N)**	**Response rate of Neighbour-hood**	**Share of N**
Bourguillon East/*Fribourg/f*	79	8%	26	33%	6.6%
Bourguillon West/*Fribourg/f*	109	11%	37	34%	9.5%
Palatinat/*Fribourg/f*	57	6%	18	31.5%	4.6%
Montivert/*Marly/f*	76	8%	37	48.6%	9.5%
Rte du Centre/*Marly/f*	54	6%	25	46.3%	6.4%
Alpenweg/*Düdingen/d*	123	13%	54	43.9%	13.8%
Sandacher/*Düdingen/d*	165	17%	71	43%	18.2%
Riedlistrasse/*Düdingen/d*	115	12%	51	44.3%	13.1%
Kleinschönberg/*Tafers/d & f*	112	11%	36	32.1%	9.3%
Menziswil/*Tafers/d*	91	9%	34	37.3%	8.7%
	981	**100%**	**389**	**39.6%**	**100%**

Table 16: Composition of Results after Neighbourhoods

The three largest neighbourhoods had above-average response rates, which led to some concentration of observations. 45% of the total observation results came from the neighbourhoods Alpenweg, Sandacher and Riedlistrasse. French-speaking neighbourhoods accounted for 38% of the sample, German speaking neighbourhoods for 54% and the bilingual neighbourhood of Kleinschönberg for approximately 9%. The final share for each neighbourhood (Column 'Share of N') was similar to the initial share of contacts. No neighbourhood was significantly overrepresented compared to the initial representation.

Demographic Composition of Results

The demographics of the sample are presented in Table 17. Most of the registered householders were men (N=295, 78.5%). Compared with the national level (49.49% (BFS 2016a)), men were overrepresented in the survey. The average age was 57.3 (SD= 14.1), which is quite similar with other energy-related surveys addressing homeowners in Switzerland (e.g. Alberini et al. 2013; Jakob 2007). The average household size was 2.87, which is higher than the Swiss average (2.25 (BFS 2016b)). As expected (see Chapter 5.5.1), 90.4% (N=340) were homeowners. The sample overrepresented the proponents of the Energy Act (EnA) voted on 21 of May 2017; there were 76.8% (N=198) 'yes'-voters versus 58.2% 'yes'-voters on a national level (BFS 2017b). However, no further information regarding the voting behaviour of Swiss homeowners were available. In total, seven neighbourhoods showed in-group patterns for the amount of years living in the same neighbourhood.

Neighbourhood/*Municipality*	**Average Age** *(in years)*	**Gender**	**Average household size** *(in persons)*	**Largest group[21]** *(in years living in the same neighbourhood)*	**Share of owners**	**Approval of EnA**
Bourguillon East/*Fribourg*	54.8	Men: 51.4% Women:48.6%	3.5	11-20 years (81.8%)	95.5%	68.8%
Bourguillon West/*Fribourg*	56.1	Men: 94%, Women: 6%	3.00	no pattern	91.4%	76%
Palatinat/*Fribourg*	62.7	Men: 78.6% Women:21.4%	2.65	no pattern	78.6%	66.7%
Montivert/*Marly*	58.5	Men: 71% Women: 29%	3.02	More than 20 years (63%)	94.8%	78.6%
Rte du Centre/*Marly*	55.8	Men: 78.3% Women: 21.7%	3.43	16-20 years (60.9%)	100%	80%
Alpenweg/*Düdingen*	54.5	Men: 81% Women: 19%	2.74	More than 20 years (44.8%)	94.8%	80%
Sandacher/*Düdingen*	58	Men: 75.6% Women: 24.4%	2.81	More than 20 years (54.5%)	87.9%	80%
Riedlistrasse/*Düdingen*	56.4	Men: 90.2% Women: 9.8%	2.80	More than 20 years (45%)	82.4%	83.9%
Kleinschönberg/*Tafers*	63.5	Men: 75.7% Women: 24.3%	2.65	More than 20 years (59.5%)	91.9%	52.3%
Menziswil/*Tafers*	55.3	Men: 68.8% Women: 31.2%	2.47	no pattern	84.4%	77.8%

Table 17: Demographic Composition of Neighbourhoods

[21] The five possible answers for participants were: 0-5 years, 6-10 years, 11-15 years, 16-20 years or >20 years. A large group fulfils following criteria: one reply was chosen by >40% of the participants and the other four replies by <60%. If this is not the case, two replies next to each other needed to represent >65% of all replies. If this is not the case, a neighbourhood shows no patterns for a dominant group.

6.1.2 Sustainable Energy Behaviour

374 out of 389 units filled out the first section of the survey. Participants were asked to which degree they perform energy curtailment behaviour. Curtailment behaviour refers to energy conservation behaviours that an individual has to perform repeatedly and that require a change in one’s everyday energy use habits (Brosch et al. 2014; Poortinga et al. 2003; Sütterlin et al. 2013). For further analysis, energy conservation behaviour based on curtailment will be referred to as sustainable energy behaviour (SEB). Mean scores and standard deviations for each SEB-item are shown in Table 18. Items marked with an ‘*’ were used with identical wording on a similar population and showed similar scores (full-aged residents in Switzerland, online survey, probability sampling design (Sütterlin et al. 2013)).

Items	**M**	**SD**
Watch out for energy-efficiency labels if buying devices	4.89	1.24
Turning down/off heating before leaving for holidays*	4.57	1.74
Turning off standby on electronic devices*	3.77	1.70
Filling the washing machine	4.78	1.15
Taking short shower (< 5 minutes)	4.69	1.35
Usage of energy-saving bulbs	4.92	1.17
Avoidance of dryer usage	3.99	1.81
Switching off the light in unused rooms	5.42	0.88
Total	**4.62**	**0.74**
Cronbach’s α = 0.62 Note: The scale ranges from 1 (‘never’) to 6 (‘always’). SEB items are not expected to correlate: they measure different energy behaviours of differing levels of difficulty. Therefore, alpha scores below .70 seem plausible.		

Table 18: Sustainable Energy Behaviour, Units

Further, a one-way ANOVA showed that there was no statistically significant difference in SEB scores for the different neighbourhoods $F(9, 365) = 1.78$, $p= 0.80$, N=300. A Bonferroni Post Hoc test showed that residents in Bourguillon West (M= 4.37, SD=0.84, N= 33) had significantly ($p< 0.05$) lower SEB scores than the residents in Kleinschönberg (M= 4.98, SD=0.68, N= 36). Figure 38 shows the average score for SEB for each neighbourhood, highlighting the scores for ‘Bourguillon West’ and ‘Kleinschönberg’.

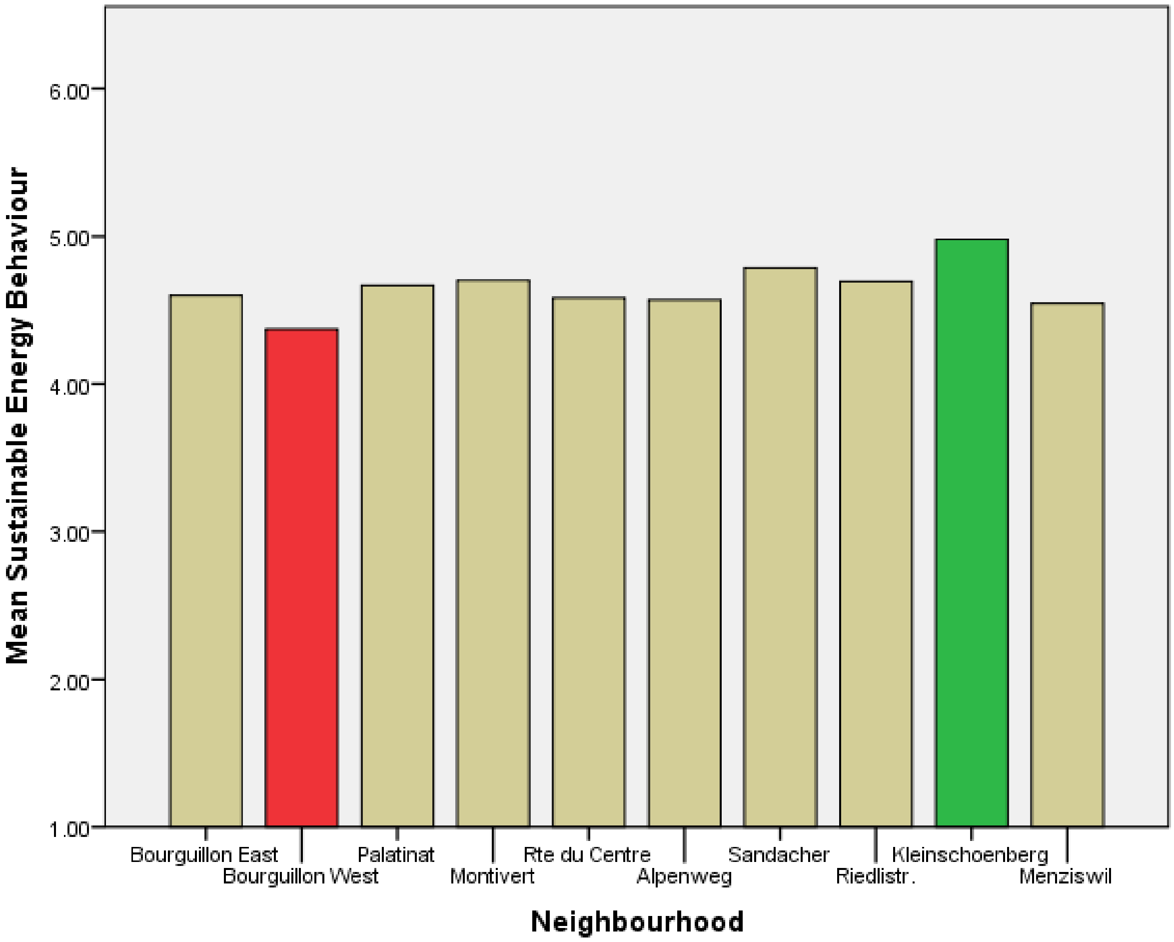


Figure 38: Sustainable Energy Behaviour, Neighbourhoods

6.1.3 Social Value Orientation

To assess the participants’ SVO, a paper version of Murphy et al.’s SVO Slider Measure was introduced. 20.3% failed to fill out the six primary items, which resulted in 310 valid replies. The relatively high failure rate has been observed in other studies too (see results of Gärling et al. 2003; van Lange 1999). The remaining sample consisted of 228 prosocials (73.5%), 71 individualists (23%) and, 11 competitors (3.5%). Similar compositions were found in the study of Sütterlin et al. 2013 and van Vugt et al. 1996a (see Table 19).

	Current study	Sütterlin et al. 2013	van Vugt et al. 1996a
Population	Registered householders in suburban neighbourhoods in and around Fribourg/Switzerland.	Full-aged residents in Switzerland.	Employees of a publishing company in the Netherlands.
Context	Energy-related contribution behaviour	Sustainable Energy Behaviour	Commuting Behaviour
Measurement	SVO Slider Measure, six items	Decomposed Game, nine items	Decomposed Game, nine items
Sample Size	310	1'209	192
Prosocials	73.5%	70.4%	73.4%
Individualists	23%	13.4%	16.1%
Competitors	3.5%	7%	5.2%
Unclassifiable	-	9.2%	5.2%

Table 19: Social Value Orientation, Comparison

Untreated mean scores for SVO after neighbourhoods were similar if measured on a continuous scale, i.e. SVO°. Mean scores for SVO° did not differ systematically across different neighbourhoods (see Figure 39).

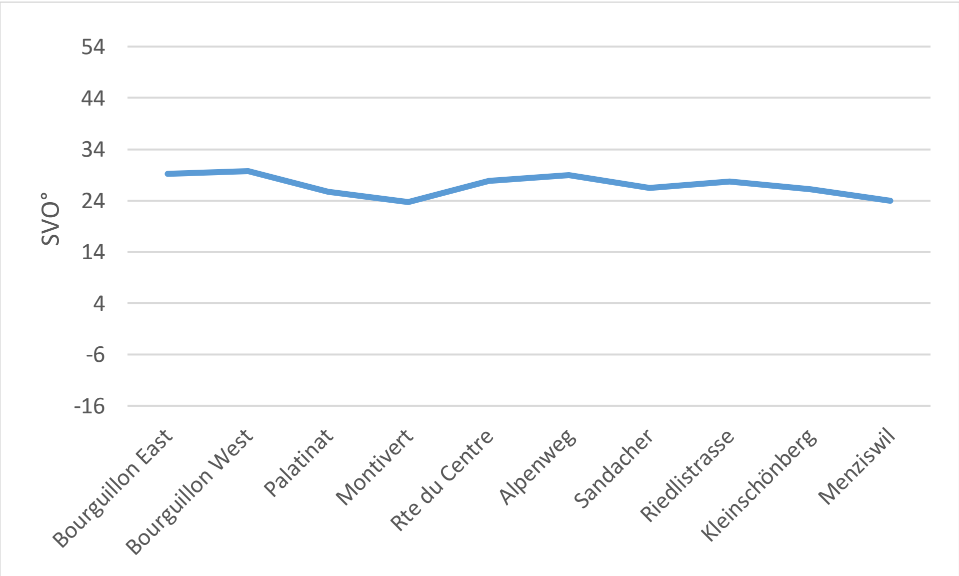


Figure 39: Social Value Orientation, Neighbourhoods

Mean SVO° scores for smaller neighbourhoods, e.g. Palatinat or Rte du Centre, reacted stronger to outliers than larger ones. Outliers were units with extreme values in SVO°, e.g. competitors having SVO° values of <12.04 or highly altruistic individuals. One unit of the small neighbourhood of Palatinat had a competitive inclination reducing the neighbourhood mean score (25.7) by 3.5 points, while the single competitor in the larger neighbourhood Riedlistrasse reduced the group score (27.7) only by 1 point. Nevertheless, the ten neighbourhoods seemed not to differ systematically in SVO°.

6.1.4 Sustainable Energy Behaviour and Social Value Orientation

Former results suggested that the SVO is a factor, influencing energy conservation behaviour based on curtailment (Sütterlin et al. 2013). Sütterlin and colleague’s work revealed that prosocials report higher energy conservation behaviour scores than individualists and competitors. However, the sample did not differentiate between homeowners and tenants, although both have different reasons and incentives to save energy (see also: Black et al. 1985; Brandon and Lewis 1999; Kastner and Matthies 2016; Sardianou 2007).

A one-way ANOVA was planned to be conducted to assess the effects of an individual’s SVO on SEB (as measured by the mean of all eight items, see Table 18). The sample included only units that exhibited SVO and SEB (N=300). All eight SEB items strongly correlated to each other, which allowed averaging them into one identification score. SEB was normally distributed for competitors, but not for individualists and prosocials, as assessed by the Shapiro-Wilk (1965) test. The dependent variable was not normally distributed in each group and therefore violated a main assumption of a one-way ANOVA.

A nonparametric alternative was chosen, Kruskal-Wallis H Test (1952), which does not require the assumption of normality. The Kruskal-Wallis H test can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable. Like most non-parametric tests, the Kruskal-Wallis H Test bases on ranked data (Field 2015).

There were no outliers, according to a box-plot inspection. The Kruskal-Wallis H test showed no statistically significant difference in SEB scores between the different SVO, $\chi^2(2) = 1.478$, $p = 0.477$, N=300 with a mean rank SEB score of 153.82 for prosocials, 142.85 for individualists and 128.90 for competitors. The level of sustainable energy behaviour (as measured by the mean of all eight items) decreased slightly from prosocials (*M* = 4.66, *SD* = 0.7, N=222), to individualists (*M* = 4.54, *SD* = 0.79, N=68), to competitors (*M* = 4.32, *SD* = 1.00, N=10). Contrary to a former study (Sütterlin et al. 2013) with a similar population, the experimental units did not differ in SEB between the different SVOs (Prosocial, Individualist and Competitor). An interpretation of these results will follow (Chapter 6.2).

6.1.5 Eliminatory Question

In order to ensure a sample that understood and realized the social dilemma characteristics of energy-related efforts, an eliminatory question was introduced. If not said mentioned otherwise, participants, which were unable to answer this question correctly, were excluded from further analysis. Participants that answered correctly to the eliminatory question (EQ) will hereinafter be referred as ‘*EQ-participants*’. 75 participants (19.3%) either chose the wrong answer or did not answer at all, while c answered correctly.

Neighbourhood	Units (N)	% of N	EQ-participants (n)	% of n
Bourguillon East/Fribourg	26	6.6%	19	6.0%
Bourguillon West/Fribourg	37	9.5%	31	9.9%
Palatinat/Fribourg	18	4.6%	13	4.1%
Montivert/Marly	37	9.5%	33	10.5%
Rte du Centre/Marly	25	6.4%	20	6.3%
Alpenweg/Düdingen	54	13.8%	52	16.5%
Sandacher/Düdingen	71	18.2%	53	16.8%
Riedlistrasse/Düdingen	51	13.1%	39	12.4%
Kleinschönberg/Tafers	36	9.3%	29	9.2%
Menziswil/Tafers	34	8.7%	25	8.0%
Total	**389**	**100%**	**314**	**100%**

Table 20: Eliminatory Question, Results

No obvious differences between the German- and French-speaking neighbourhoods emerged, as shows Table 20. Furthermore, no neighbourhood was over- or underrepresented for further analysis.

6.1.6 Manipulation of Group Composition

Two manipulations were executed in order to create a low identification and a high identification group. In the low-identification group participants were told that goal of the survey was to determine the individual’s energy potential. The high-identification group was told that that the goal of the survey was to determine the energy potential of different neighbourhoods. The questionnaire did not include any test for this manipulation.

The second and main manipulation was done by changing the group composition, i.e. social scenario in which the participants would cooperate. Within the control group, participants were told that they are members of the group “Anonymus”, forming a group with anonymous members. Those participants were told that a) they don’t know any other member of the group, b) they receive no information about the other members and c) there is no possibility to communicate with each other. Within the treatment group, participants were told to be members within the group “Energy Neighbourhood”, forming a group with households of the same neighbourhood in which they live.

The distribution of prosocials, individualists, competitors and unidentified participants were similar between the “Anonymus” condition (64.5% prosocials, 19.7% individualists, 2.6% competitors and 13.2% unidentified) and the “Energy Neighbourhood” condition (60.8% prosocials, 20.3% individualists, 2.6% competitors and 16.3% unidentified) as shows Table 21 shows.

Social Value Orientation	**Anonymus**	**Energy Neighbourhood**
Prosocials	98	93
Individualists	30	31
Competitors	4	4
Unanswered	20	25
Total	**152**	**153**

Table 21: Composition of Groups

To test H_{1A}, four item statements regarding ‘common interests’ with the group, ‘affiliation’ and ‘attachment’ towards the group as well as ‘knowledge on group members’ were tested (see Table 22). All four items strongly correlated to each other, which allowed averaging them into one identification score, ‘Social Identification’ (see: Appendix 4).

Items	**Anonymus**	**Energy Neighbourhood**
Common interests	3.73 (SD 1.7)	4.43 (SD 1.29)
Affiliation	3.13 (1.7)	4.23 (1.41)
Attachment	2.12 (1.26)	4.15 (1.50)
Knowing group members	1.89 (1.21)	4.3 (1.82)
Cronbach's α = 0.82 Note: The scale ranges from 1 ("totally disagree") to 6 ("totally agree").		

Table 22: Scores for Social Identification, Units

Consequently, a one-way ANOVA assessed the effects of the two conditions ('Anonymus' and 'Energy Neighbourhood') on the mean social identification score. The individuals with unidentified SVO (n=45) were included in the analysis. Levene's Test showed that equal variances could be assumed (*p*=.317) There was a significant difference in the mean group identification score for the different conditions $F(1, 303) = 145.02$, $p < .001$. Participants within the 'Anonymus' condition had lower mean identification scores (M = 2.71, SD = 1.07, N=152) than participants within the 'Energy Neighbourhood' condition (M = 4.27, SD = 1.18, N=153). Scores for each SVO in each condition are presented in Table 23. Thus, manipulation of both groups was successful and **H_{1A} was confirmed**.

Condition	**SVO**	**Mean**
Anonymus	Prosocials	2.72
	Individualists	2.93
	Competitors	1.37
Energy Neighbourhood	Prosocials	4.33
	Individualists	4.08
	Competitors	4.06

Table 23: Scores for Social Identification, SVO & Condition

H_{1A}: Social identification scores in the condition 'Energy Neighbourhood' are higher than the social identification scores in the condition 'Anonymus': confirmed

A one-way ANOVA showed that the SVO had no impact on the level of the identification score Welch's $F\ (2, 17.85) = 0.567$, $p = 0.577$, N=260. Individualists had slightly similar identification scores (M = 3.52, SD = 1.40, N=61) as prosocials (M = 3.50, SD = 1.33, N=191) and higher than competitors (M = 2.72, SD = 2.04, N=8). Scores for social identification differed among neighbourhoods (see Figure 40).

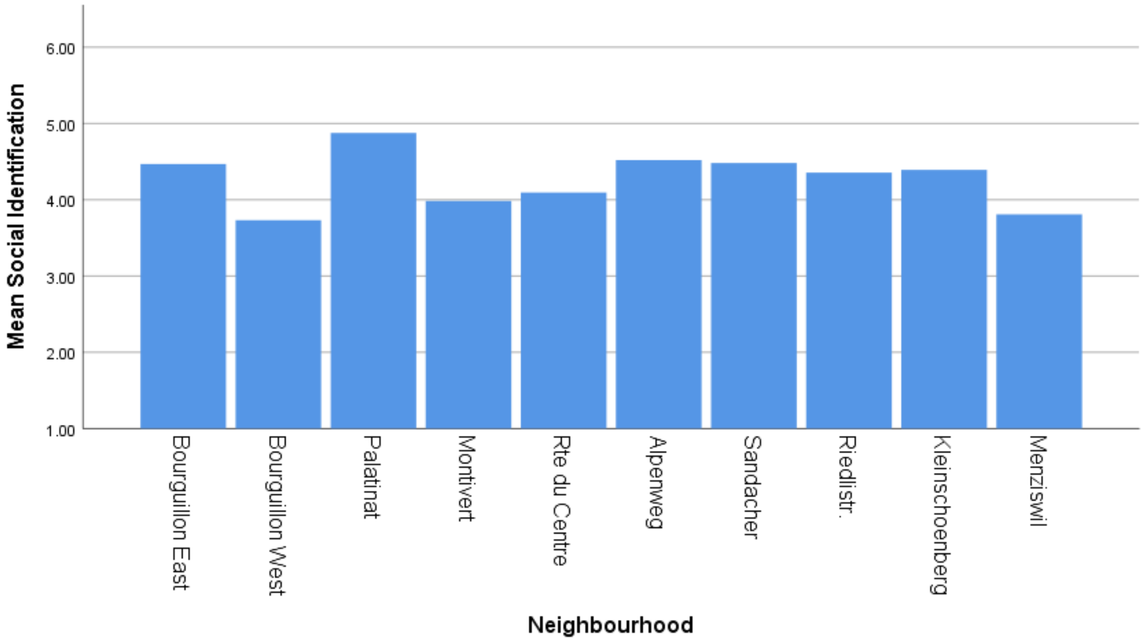
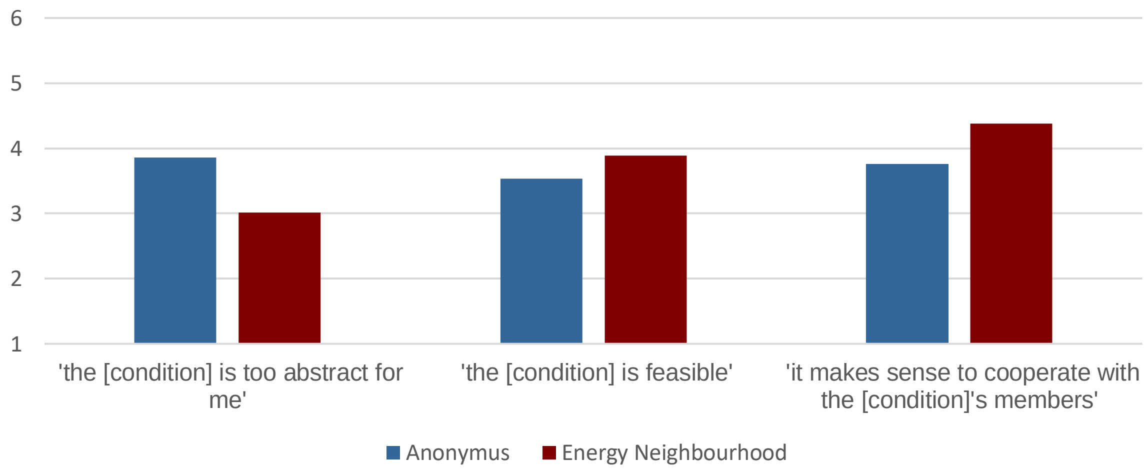


Figure 40: Scores for Social Identification, Neighbourhoods

6.1.7 Approval of the Condition

The participants (N=256, only *EQ-participants* with an assignable SVO) were asked on their approval and comprehension of the two different bottom-to-bottom conditions. Figure 41 provides a first overview of the results:



Note: The scale ranges from 1 ('totally disagree') to 6 ('totally agree').

Figure 41: Approval of Condition

Level of abstractness - Participants were asked to which degree the presented energy community condition seems to be too abstract for them. High agreement scores (6 = ‘totally agree’) for the statement indicated high levels of perceived abstractness of the condition, while low scores (1 = ‘totally disagree’) represented low levels of perceived abstractedness.

The level of abstraction scores was significantly higher ($F(1, 254) = 16.8$, $p < .05$, partial $\eta^2 = 0.062$) in the ‘Anonymus’ condition ($M = 3.86$, $SD = 1.74$, N = 133) than in the ‘Energy Neighbourhood’ condition ($M = 3.01$, $SD = 1.59$, N = 123). Further, a two-way (SVO, Condition) ANOVA revealed no significant interaction effect of SVO and condition on ‘Level of abstractness ‘$F(2, 250) = 0.152$, $p = .859$, partial $\eta^2 = .001$.

Scores for ‘level of abstractness’ in the treatment group differed among neighbourhood affiliation (see Figure 42). Due to unequal sizes of the sub-samples, the author decided against performing a comparative analysis.

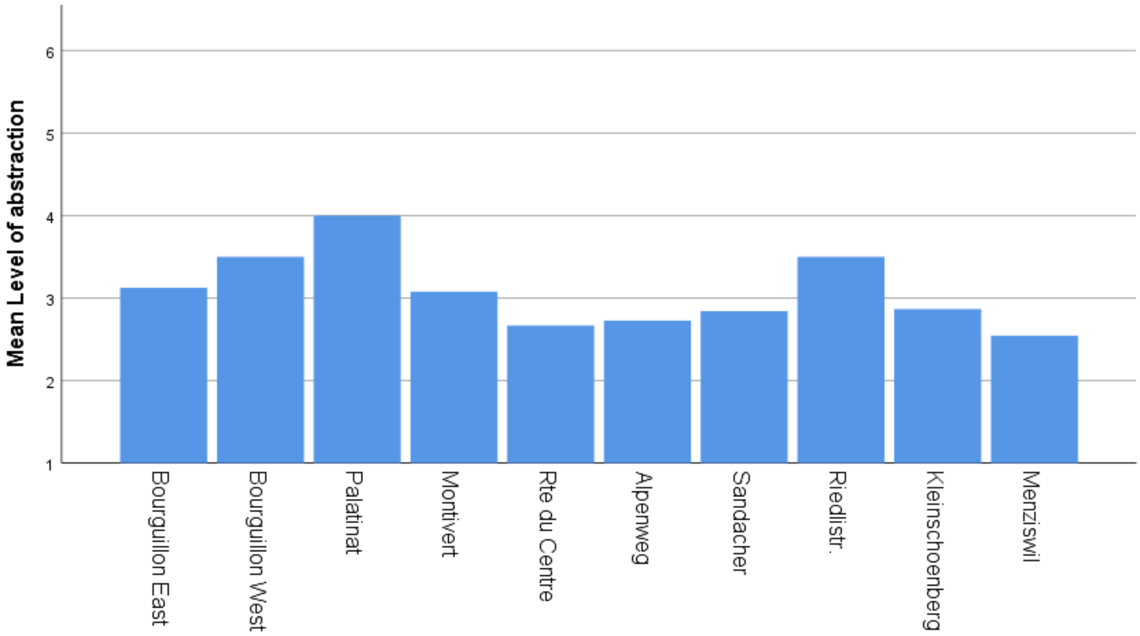


Figure 42: Level of Abstraction, Neighbourhoods

Level of perceived feasibility of the energy community – the statement was designed purposely multidimensional and did not state any particular ‘feasibility’ reference, e.g. technical or economic feasibility. High agreement scores (6 = ‘totally agree’) for the statement indicated high levels of perceived feasibility for the condition, while low scores (1 = ‘totally disagree’) represented low levels of perceived feasibility.

The mean feasibility score for the ‘Anonymus’ condition (*M* = 3.53, *SD* = 1.61, N = 133) was lower than the score for the ‘Energy Neighbourhood’ condition (*M* = 3.89, *SD* = 1.40, N = 123). However, no significant results were found ($F(1, 254) = 3.45$, $p = .064$, $\eta^2 = 0.013$).

Scores for ‘level of perceived feasibility in the treatment group differed among neighbourhood affiliation (see Figure 43). Due to unequal sizes of the sub-samples, the author decided against performing a comparative analysis.

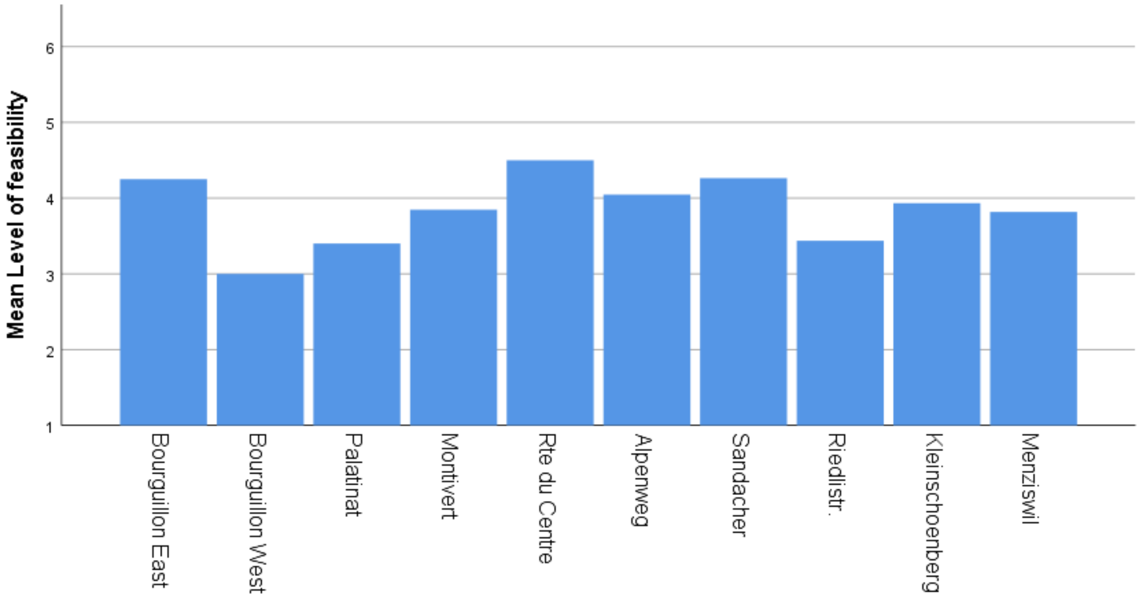


Figure 43: Level of Feasibility, Neighbourhoods

Meaningfulness of cooperation - It is expected that people prefer to cooperate with people they know, rather than with unknown people. High agreement scores (6 = ‘totally agree’) for the statement indicated high levels of perceived meaningfulness of cooperation, while low scores (1 = ‘totally disagree’) represented low levels of perceived meaningfulness of cooperation.

As anticipated, individuals rated the meaningfulness of cooperation within the high-identification condition (*M* = 4.38, *SD* = 1.32, N = 123), higher than the meaningfulness of cooperation within the low-identification condition (*M* = 3.76, *SD* = 1.62, N = 133). The scores differ significantly ($F(1, 254) = 11.21$, $p < .05$, $\eta^2 = 0.042$).

Results among neighbourhoods for ‘Meaningfulness of Cooperation’ within the condition ‘Energy Neighbourhood’ differed (see Figure 44). Registered householders in ‘Bourguillon East’ (M = 4.88, SD = 0.83, N = 8) confirmed the meaningfulness to cooperate with neighbours more distinctly than the residents in

Riedlistrasse (M = 3.81, SD = 1.5, N = 16). However, differences between neighbourhoods are not significant. Moreover, within-group responses were highly heterogeneous, showing a rather personal reflection on 'Meaningfulness of cooperation' than a social one. Due to unequal sizes of the sub-samples, the author decided against performing a comparative analysis.

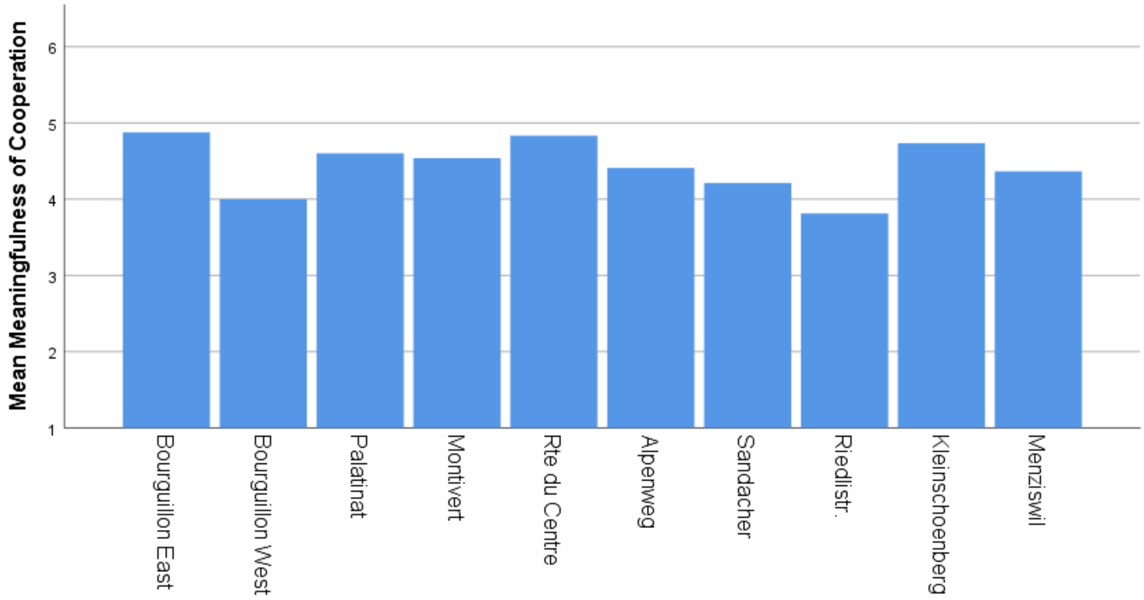


Figure 44: Level of Meaningfulness of Cooperation, Neighbourhoods

Further, a Spearman's rank-order correlation was run to assess the relationship between 'Meaningfulness of Cooperation' and the amount of years living in the same neighbourhood in 'Energy Neighbourhood' units. Somehow surprisingly, there was a weak negative correlation between 'meaningfulness of Cooperation' and amount of years living in the same neighbourhood, rs(122) = -.204, *p* = .024.

6.1.8 Contribution Intention

In Section 5.1 of the questionnaire, responders stated to which degree they intended to contribute to the community's energy goal (i.e. 6-point Likert scale recipients with options between 'not at all' (1) and 'very much' (6)). The sample included only EQ-participants with an assignable SVO that filled out all four items of Section 5.1 in the questionnaire. One prosocial outlier in the Energy Neighbourhood condition was excluded from the sample after a boxplot examination (see Appendix 5). Table 24 provides an overview over both group compositions (N=260).

	Anonymus (N=132)	Energy Neighbourhood (N=128)
Prosocials (n=190)	**98**	**92**
Individualists (n=62)	**30**	**32**
Competitors (n=8)	**4**	**4**

Table 24: Contribution Intention, Group Compositions

The four items measuring energy-related contribution intention were strongly correlated and had a good Cronbach’s alpha score, α = 0.8 (see Appendix 6). The four single variables could therefore be computed to a single variable, mean contribution intention.

A two-way (SVO, Condition) ANOVA was conducted. Scores for mean contribution intention were normally distributed among almost all groups, as assessed by the Shapiro-Wilk test (α > .05). Only the score for mean contribution intention of prosocials within the anonymous condition was significant negativly distributed (see Appendix 7). There was heterogeneity of variances, as assessed by Levene's test for equality of variances, $p < .05$ (see Appendix 8). Variance stabilizing measures (Draper and Smith 1998; Kaufman 2013) were not successful (see Appendix 9). Since the ratio of the largest group variance to the smallest group variance was less than 3, ANOVA results still remain robust and could therefore be run for analytical purposes (Jaccard 2005). Figure 45 shows the interaction between SVO and Condition for Mean Contribution Intention.

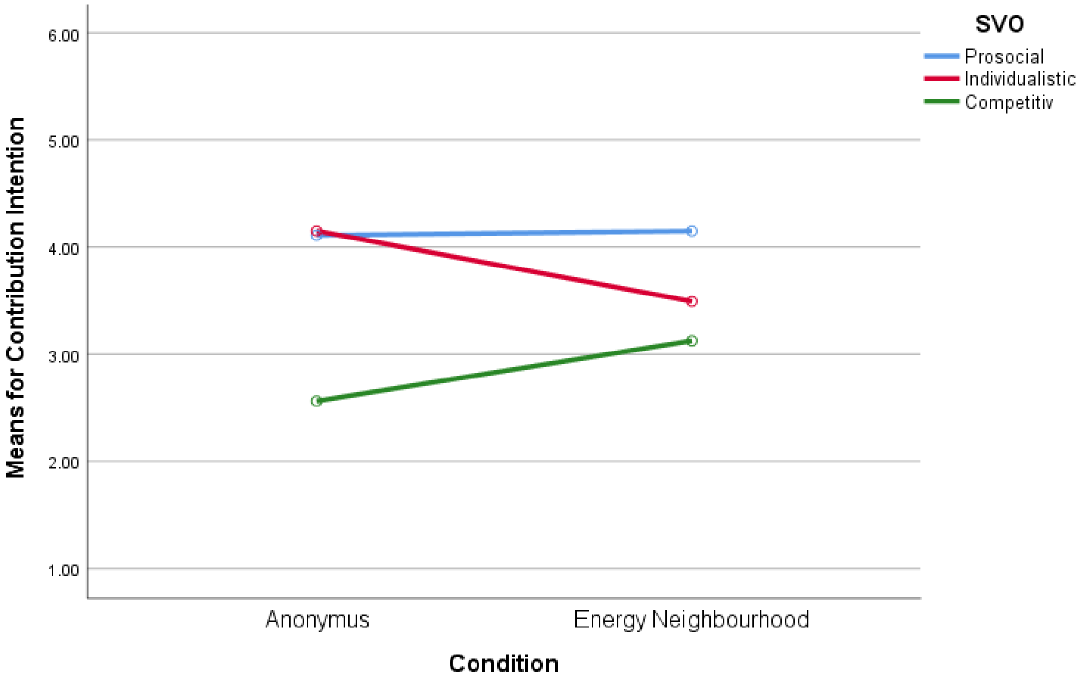


Figure 45: Interaction between SVO and Condition for 'Contribution Intention'

Although Figure 45 suggests an interaction effect, there was no statistically significant interaction between SVO and Condition for ‘Mean Contribution Intention’ score, $F(2, 254) = 2.829$, $p = .061$, partial $\eta^2 = .022$. Table 25 shows the estimated marginal means. This indicates that the effect of condition on the dependent variable, i.e. ‘Mean Contribution Intention’, depends not on the level of the other independent variable, i.e. SVO. **H_{4A} has to be rejected**.

Condition	SVO	Mean
Anonymus	Prosocials	4.11
	Individualists	4.15
	Competitors	2.56
Energy Neighbourhood	Prosocials	4.14
	Individualists	3.49
	Competitors	3.12

Table 25: Estimated Marginal Means, Contribution Intention

H_{4A}: In the condition ‘Energy Neighbourhood’, individualists and competitors will contribute more than individualists and competitors in the condition ‘Anonymus’: rejected

There was a statistically significant main effect of SVO, $F(2, 254) = 6.754$, $p = .001$, partial $\eta^2 = .050$. The unweighted mean contribution intention score for prosocials, M = 4.13 (SE = 0.08), was higher than the individualists’, M = 3.82 (SE = 0.14) and the competitors’, M = 2.84 (SE = 0.38). All pairwise comparisons were run for each simple main effect with reported 95% confidence intervals and p-values Bonferroni-adjusted within each simple main effect. One statistically significant mean difference of 1.28, 95% CI [0.35, 2.23], $p = .003$ between prosocials and competitors was found. **H_{2A} was confirmed**.

H_{2A}: A main effect for SVO is expected such that a greater proportion of prosocials than individualists and competitors intend to contribute to the community goals: confirmed

There was no statistically significant difference in ‘Contribution Intention’ score for the two different conditions, $F(1, 254) = 0.005$, $p = .947$, partial $\eta^2 < .001$. The unweighted mean contribution intention in the anonymous condition, M = 3.6, was similar to the unweighted mean contribution intention in the EN condition, M = 3.59. **H_{3A} has to be rejected**.

H_{3A}: A main effect for social identification is expected such that average contribution intention scores in ‘Energy Neighbourhood’ are higher than in ‘Anonymus’: rejected

Examining simple bar charts (Figure 48), no important differences across neighbourhood affiliation on mean contribution intention were found.

6.1.9 Expectations

The sample included only EQ-participants with an assignable SVO that filled out all four items of Section 5.1 and all four items in Section 5.2. Boxplot examination showed in total five outliers (see Appendix 10): four prosocials and one individualist. However, none of the outliers was excluded from further analysis. Literature emphasized heterogeneous expectations among prosocials (Pletzer et al. 2018; Kelley and Stahelski 1970a, 1970b; van Lange 1992). From a theoretical point of view, outliers with a prosocial inclination are therefore quite common. The unit with an individualistic inclination (SPSS©-ID: 193) had an unusually high score for expectations, but also for contribution intention. Hence, the unit remained in the final sample (N = 260).

The four items measuring energy-related expectations were strongly correlated and had a good Cronbach’s alpha score, $\alpha = 0.84$. The four single variables could therefore be computed to a single variable, ‘Mean Expectations’.

A two-way (SVO, Expectations) ANOVA was conducted. Scores for mean expectations were normally distributed among all groups, as assessed by the Shapiro-Wilk test ($\alpha > .05$). There was homogeneity of variances, as assessed by Levene's test for equality of variances, $p > .05$. Figure 46 shows the interaction between SVO and Condition for Mean Expectations.

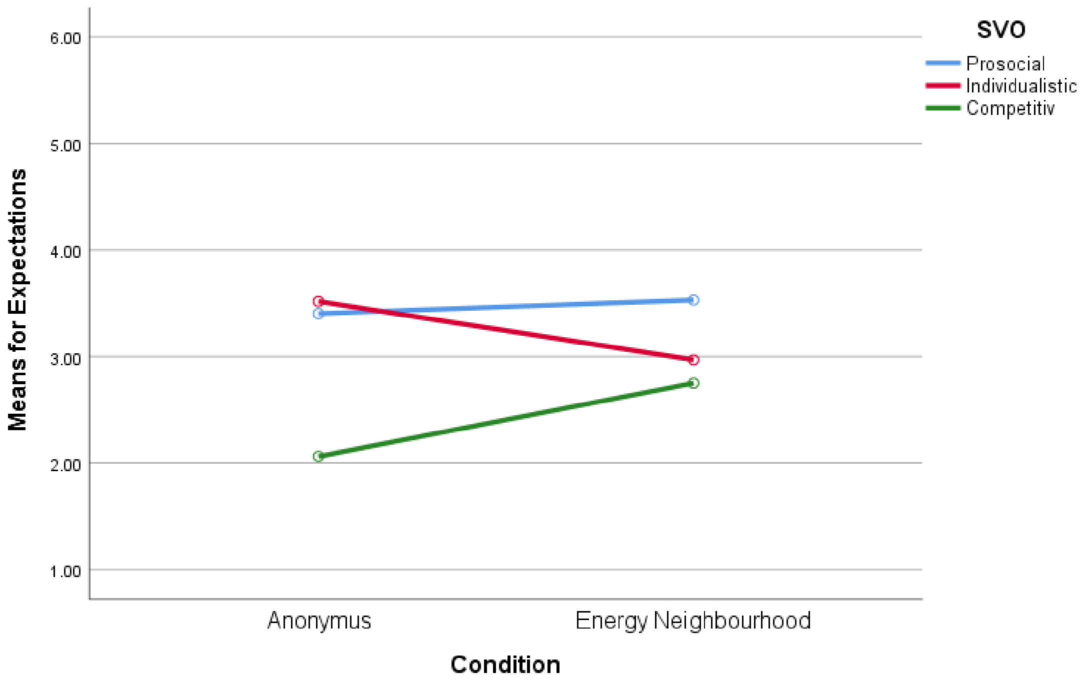


Figure 46: Interaction between SVO and Condition for 'Mean Expectations'

There was a significant interaction effect of SVO and Condition on Mean Expectation $F(2, 254) = 3.206$, $p = .042$, partial $\eta^2 = .025$ (see Means in Table 26).

Condition	**SVO**	**Mean**
Anonymus	Prosocials	3.40
	Individualists	3.51
	Competitors	2.00
Energy Neighbourhood	Prosocials	3.53
	Individualists	2.96
	Competitors	2.75

Table 26: Estimated Marginal Means, Expectations

A simple main effect for SVO, i.e. the effect of SVO at each level of condition, was observed. There was a statistically significant difference in the 'Mean Expectations' score for individualists between the two conditions of ‘Anonymus’ and ‘Energy Neighbourhood’, $F(1, 254) = 4.703$, $p = .031$, partial $\eta^2 = .031$. For individualists in the condition ‘Anonymus’, the ‘Mean Expectations’ score was 0.548 points, 95% CI [0.05, 1.04] higher than for individualists in the condition ‘Energy Neighbourhood’ (see Figure 47).

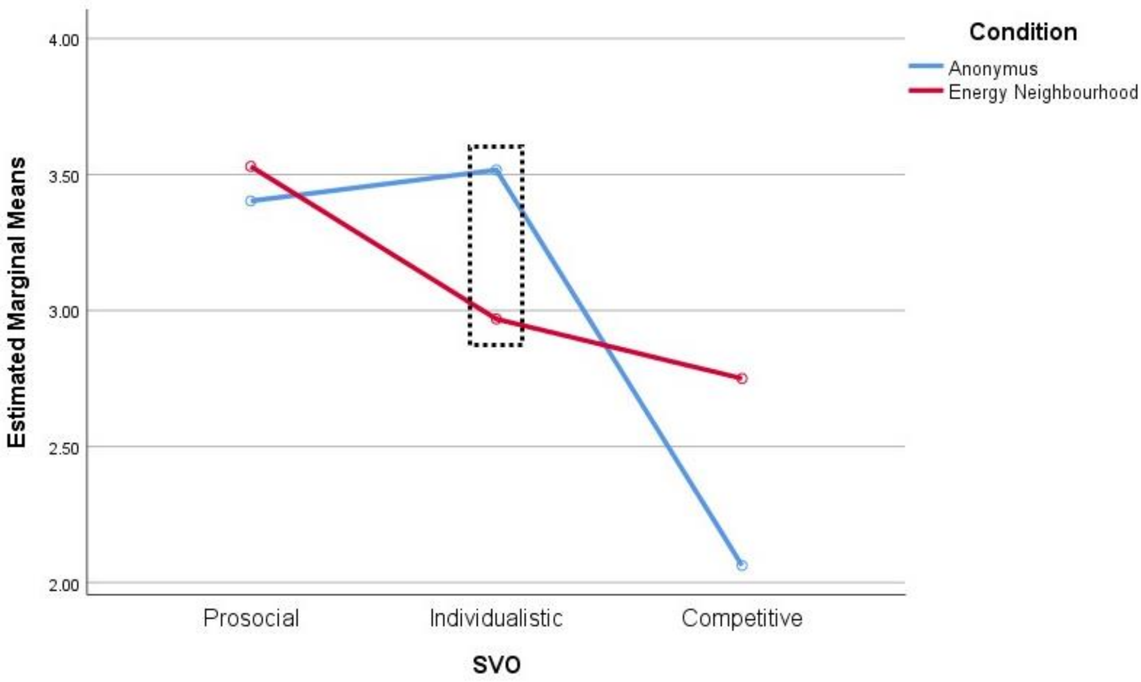


Figure 47: Simple Main Effect for SVO, Expectations

A simple main effect for condition, i.e. the effect of condition-belonging at each level of SVO, was observed. There was a statistically significant difference in 'Mean Expectations' scores between ‘Energy Neighbourhood’ units with either a prosocial, individualistic or competitive SVO, $F(2, 254) = 4.572$, $p = .01$, partial $\eta^2 = .011$. the prosocials’ ‘Mean Expectations’ score in ‘Energy Neighbourhood’ was 3.53 (SD = 0.1) and 2.96 (SD = 0.17) for individualists, showing a statistically significant mean difference of 0.56, 95% CI [0.069, 1.053], $p = .019$. No significant differences in 'Mean Expectations' scores for prosocials and competitors between both conditions was found.

Further, there was a statistically significant difference in 'Mean Expectations' scores between ‘Anonymus’ units with either a prosocial, individualistic or competitive SVO, $F(2, 254) = 3.817$, $p = .023$, partial $\eta^2 = .023$. Prosocials (M = 3.4, SD = 0.1) and individualists (M = 3.5, SD = 0.18) had significantly higher scores (1.34, 95% CI [0.118, 2.563], $p = .026$ for prosocials, and 1.45, 95% CI [0.179, 2.730], $p = .019$ for individualists) for ‘Mean Expectations’ than competitors (M= 2.0, SD= 0.49). No significant differences in 'Mean Expectations' scores in ‘Anonymus’ between prosocials and individualists were found.

Additionally, there was a strong positive correlation between an individual’s own contribution intention and the expected contribution intention of others, $r(128) = .371$, $p < .005$, with contribution intention explaining 54.9% of the variation in expectations. Results across different neighbourhoods showed also that on average, units within the treatment group 'Energy Neighbourhood' condition, had constantly higher scores for 'Mean Contribution Intention' than for 'Mean Expectations' (see Figure 48).

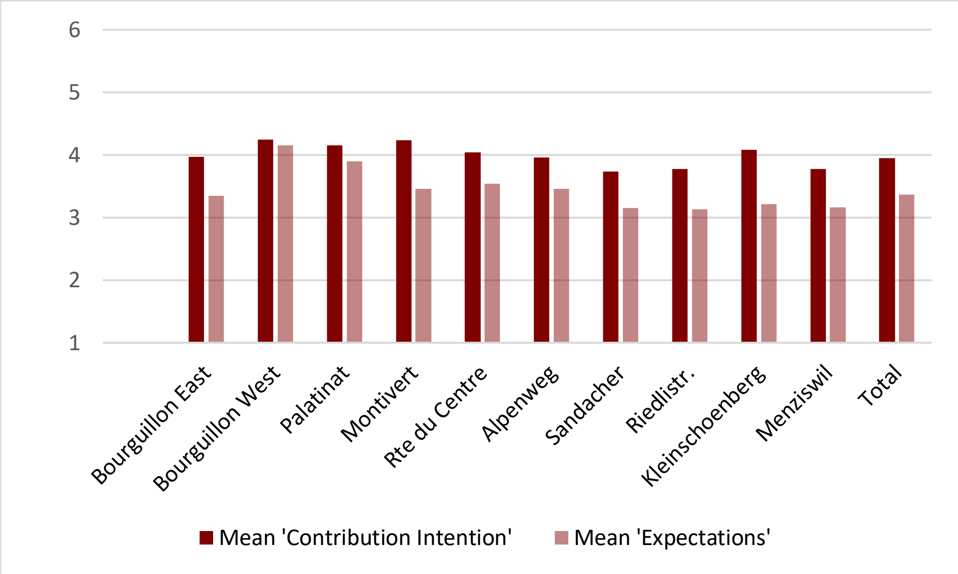


Figure 48: 'Contribution Intention' and 'Expectations' scores across Neighbourhoods

Units in Bourguillon West (M = 4.25, SD = 0.96) and Sandacher (M = 3.73, SD = 1.0) showed the highest and the lowest score respectively for 'Mean Contribution Intention'. Bourguillon West (M = 4.15, SD = 1.07) and Riedlistrasse (M = 3.13, SD = 1.11) had the highest and the lowest score respectively for 'Mean Expectations', while Bourguillon West (∆ 0.1) and Kleinschönberg (∆ 0.86) showed the least and the most discrepancies respectively between 'Mean Contribution Intention' and 'Mean Expectations'. Due to unequal sizes of the sub-samples, the author decided against performing a comparative analysis.

6.2 Interpretation of 'The Potential of Energy Communities' Results

Before interpreting the previous main results (testing H_{1A} – H_{4A}), the studied sample's characteristics are emphasized. The sample consisted of a quite homogeneous group of neighbourhoods in the studied terms as summarized in Table 27.

Characteristics	Findings
Sample Composition	• No significant changes from a neighbourhood's share of total contacts (sample frame) to share of final responds. • 45% of responds are from units living in three largest neighbourhoods, 55% of responders live in the remaining seven neighbourhoods. • Demographics: the sample of units and neighbourhoods are quite homogenous in terms of age, gender (majorly men), ownership situation (majorly owners), household size (majorly multi-person households) and politics (majorly supporters of EnA). • SVO: 73.5 % prosocials, 23% individualists, 3.5 % competitors. Similar with other research (see Table 19). No important differences across neighbourhoods were found.
Eliminatory Question	• 80.7% of sample units identified a fictional free rider in terms of energy-related contribution behaviour. No important differences across neighbourhoods were found.
Group Composition	• The control group consisted of 64.5% prosocials, 19.7% individualists, 2.6% competitors and 13.2% unidentified, N = 152. • The treatment group consisted of 60.8% prosocials, 20.3% individualists, 2.6% competitors and 16.3% unidentified, N = 153.
Approval of Condition	• Small and insignificant differences across neighbourhoods existed within the treatment group (see Figure 42 - Figure 44).
Mean Contribution Intention/Expectations	• Small and insignificant differences across neighbourhoods existed (see Figure 48).

Table 27: Sample Characteristics, Overview

As mentioned earlier, results from Chapter 6.1.4 are opposed to those of Sütterlin et al. 2013. While Sütterlin and colleagues found a significant effect of SVO on sustainable energy behaviour (e.g. prosocials exhibited more often daily 'housing' energy behaviour based on curtailment), none was found in the currently studied sample. Although samples, elicitation methods and elicitation items were to some degree similar, three possible explanations for the differing results are presented.

- The first explanation emphasizes the small but important differences among the sample composition. The sample of Sütterlin and colleagues consisted of full-aged residents in Switzerland. They did not differentiate among different ownership situations, while the researched sample is majorly composed of house owners. Jakob (2007) concluded that missing market incentives and diverging interests between tenants and landlords lead to fundamentally different energy behaviour. Owners may have strong selfish reasons for sustainable energy use (i.e. savings), because they can frame the decision as a market- or more precisely as a ‘private good’ decision. Thus, even owners with an individualistic inclination for cooperation would self-report sustainable energy use because of selfish reasons. Depending on the billing contract, tenants may frame sustainable energy use as a ‘public good’ decision, whereby individualists would self-report lower contributions than prosocials (Sütterlin et al. 2013). Since most of the experimental units are homeowners, the absence of a significant effect of SVO on SEB seems comprehensible.
- The second explanation highlights differences among the implemented research strategies and analysis techniques. Both inquiries differed among several elements that may explain the differing results: the quasi-probability sampling design for Sütterlin and colleagues versus the non-probability sampling design of the current thesis, large sample vs. medium sample, ‘unknown aim of survey’ vs. ‘your energy potential’, second section of the questionnaire vs. first section, seven SEB-items vs. eight SEB-items, decomposed game for SVO assignment vs. SVO slider measure, and parametric analysis technique (ANOVA) vs. non-parametric Kruskal-Wallis H Test.
- A third explanation suggests important temporal and seasonal differences among both studies. Sütterlin et al.’s data collection took place from mid-November 2009 to the end of January 2010, while the current study collected data from June 2017 to August 2017. The energy scarcity in the winter-season (aggravation of the social dilemma), respectively the energy abundance in the summer (mitigation of the social dilemma) might had have different impacts on the different SVOs. However, to the author’s knowledge no empirical investigations on such phenomenon exist, whereby this

argument remains a mind game. More concrete, worldwide general energy awareness increased after the Fukushima event (Rifkin 2014a). In Switzerland, the debate on environment- and energy-related topics intensified after the Japanese catastrophe (see also: BFE 2015b; Fischer 2012; Golder et al. 2017). Such an increase of problem-awareness is known to have a positive effect on contribution efforts (Nordlund and Garvill 2003) and contribution intentions (Bamberg and Möser 2007) and therefore reduce the impact of SVO on SEB.

Furthermore, the current study shows that scores in SEB for competitors are lower than for individualists, which is a contrary finding regarding the results of Sütterlin and colleagues. The author explains that selfish reasons of individualists, i.e. energy savings, were more pronounced than the potential 'competitive altruism'-considerations (Hardy and van Vugt 2006) of competitors.
Finally, an interaction effect of SVO and Condition on Expectations was found. Prosocials expected more energy-related contribution intentions from their neighbours than individualists and competitors. The results goes hand-in-hand with the result of a recent meta-analysis on expectations (Pletzer et al. 2018).

Interpretation of Main Results of 'The Potential of Energy Neighbourhoods'

H_{1A}: Social identification scores in the condition 'Energy Neighbourhood' are higher than the social identification scores in the condition 'Anonymus'.

The manipulation of the group composition was successful and **H_{1A} was confirmed**. The results were not surprising since similar treatments were already tested in other studies and showed similar results (Kerr 1992; Cremer and van Vugt 1999; Kramer and Brewer 1984). Referring to Turner and Oakes' definition of social identity (1986), members of the treatment group do self-conceptualize themselves more upon their group membership 'neighbourhood' compared to units in the control group, which show lesser self-conception with the corresponding group membership 'Anonymus'.

H_{2A}: A main effect for SVO is expected such that a greater proportion of prosocials than individualists and competitors intend to contribute to the community goals.

The results show that SVO had a small but significant impact on energy-related contribution intention in settings of independence (**H_{2A} was confirmed**). The study showed that prosocial individuals (M = 4.13) revealed higher cooperative intention than individualists (M = 3.82) and competitors (M = 2.84). Thus, the results go along with other real-life social dilemmas (e.g. Ackermann et al. 2014; Bonaiuto et al. 2008; Derks et al. 2014; McClintock and Allison 1989; van Lange et al. 1997a; van Lange et al. 2007a).

Contrary to the literature, the results showed no significant differences between prosocials and individualists, and individualists and competitors. A possible explanation can be found in the between-subject design of the thesis. First, the statistical power of between-subject designs tend to be lower than in within-between designs (Bellemare et al. 2014). Second, the small differences between the different SVOs may become more salient if the sample size would have been larger (see for argumentation: Lindley and Scott 1984). Third, small differences in between-subject design arise when a small group (i.e. individualists) reacts in one particular condition stronger than in the other condition compared to another large group (i.e. prosocials, which remained insensitive).

H_{3A}: A main effect for social identification is expected such that average contribution intention scores in 'Energy Neighbourhood' are higher than in 'Anonymus'.

The results show that average energy-related contribution in the condition 'Energy Neighbourhood' (M= 3.6) was not significantly higher than in the condition 'Anonymus' (M= 3.59) (**H_{3A} was rejected**). The missing significance may result through the unchanged contribution intention of prosocials. As suggested, prosocials remained cooperative across both conditions. Thus, 73% percent of the sample showed no signs of intentional change.[22]

[22] Cremer and van Vugt (1999)' share of prosocials in their studied sample was only 64%, and they found a significant effect for 'condition' on contribution.

The particular high scores for contribution intention in the condition ‘Anonymus’ may result through another decision-framing than in the condition ‘Energy Neighbourhood’. Group size was clearly defined by the neighbourhood borders for the treatment group, whereby units could define the numbers of participants too. Therefore, decision-making is framed as contribution intention in a certain fictional scenario with a clear notion on group size (57-165 households per neighbourhood) and group composition. However, within the ‘Anonymus’ condition, the decision-making frame could have been perceived differently. The visual aid on page 6 of the questionnaire (see Figure 49) may have framed ‘Anonymus’ as a group with nine members, which is distinctly smaller than every studied neighbourhood size. It cannot be ruled out that the positive effects of small group sizes (for empirical work, see: Brewer and Kramer 1986; Sato 1988; Yamagishi 1992) cancelled the negative effects of anonymous group composition.

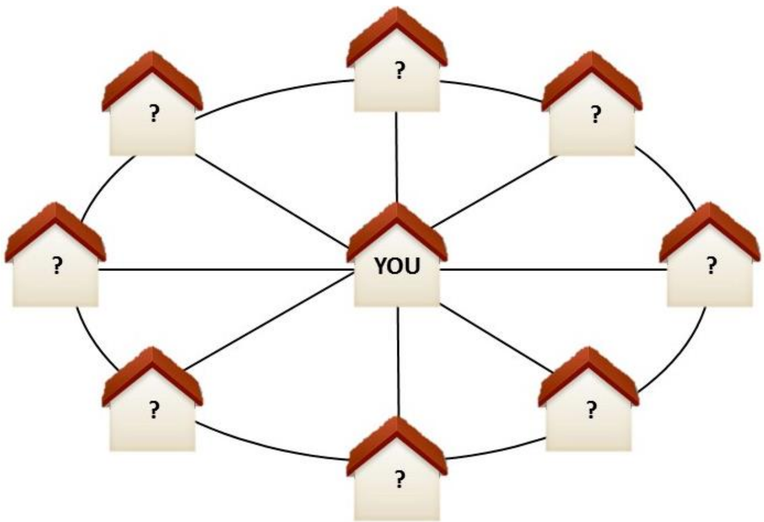


Figure 49: Visual aid, Anonymus

The type of social identity may also explain the small differences between the groups. The used approach, minimal group paradigm, does not distinguish between nor measure *politicized identity* and *non-politicized identity*. Both forms of identity play a crucial role in social movement participation- and social protest literature (Simon and Klandermans 2001; Simon et al. 1998; Stürmer and Simon 2004). Politicized identity can be described as a form of collective identity that underlies group members’ explicit motivations and interests to engage in a political struggle (Stürmer and Simon 2004), e.g. identification with a the feminist movement. Non-politicized identity does not include the ‘political’ notion for collective identity, e.g. identification with a disadvantaged group, in this case women. Politicized identity better predicts willingness to contribute to a Collective Action than non-politicized identity (Hercus 1999; Simon et al. 1998; van Zomeren et al. 2008). This is consistent with the transformation of motivation theory (Kelley and Thibaut 1978): Politicized identity goes hand in hand with a stronger obligation to contribute to the collective good. Accordingly, politicized identity on a neighbourhood scale (i.e. identification with neighbourhood association, neighbourhood energy association or neighbourhood watch) would probably had have a greater impact on energy-related contribution intention than non-politicized identity. According to the results, a significant *transformation of motivation* (Kelley and Thibaut 1978) was not found. The findings showed that the level for energy-related contribution intention within a group with salient social identification did not significantly differ from the level for energy-related contribution intention within a group with no social identification.

H_{4A}: In the condition ‘Energy Neighbourhood’, individualists and competitors will contribute more than individualists and competitors in the condition ‘Anonymus’.

Finally, the results showed that individualists and competitors in the condition ‘Energy Neighbourhood’ did not have significantly higher scores in ‘Contribution Intention’ than individualists and competitors in the condition ‘Anonymus’ (**H_4, and therefore the ‘goal-transformation’ hypothesis for energy-related contribution intention was rejected**). There is no evidence that social identification significantly raises energy-related contribution intention among individuals with an individualistic or competitive inclination for cooperation. It must be assumed that the manipulation of group composition does not significantly lead to a desired transformation of motivation among individualistic or competitive individuals.

Despite the missing significance interaction effect, it is important to acknowledge the opposing tendencies of energy-related contribution intention scores among different SVOs (see: Figure 45).[23]

Prosocials remained largely cooperative and insensitive for the group composition manipulation. Thus, the findings tend to support at least one element of the goal

[23] Since further interpretation of results are based on non-significant but descriptive results, wording will be adapted: ‘tendencies’ and ‘tend to’ describe phenomena that are purely descriptive.

transformation hypothesis, e.g. prosocials do not react to salient social identification. Simultaneously, the findings reject an important element of the ‘*goal-amplification’ hypothesis* (Kramer and Goldmann 1995) (according to the goal-amplification hypothesis, prosocials would react more sensitively than proselfs on ‘social identification manipulations). Social identification does not enhance trust in others and does not amplify the cooperative energy-related contribution intention of people with a prosocial orientation when cooperating with neighbours for an energy-related goal.

Opposed to the goal transformation hypothesis, **individualists** tended to reduce their energy-related intentions, when cooperating with neighbours. Thus, the opposite of the anticipated behaviour was observed: not only does the group composition of ‘Energy Neighbourhood’ fail to incentivize individualists to be cooperative, but if the group is composed of neighbours, individualists even tend to reduce energy-related contribution intention compared to an anonymous group composition. The group composition of ‘Energy Neighbourhoods’ fails to transform the individualists’ motives for cooperation into more social ones by valuing group outcome, but it even reinforces rational reasoning and individual outcome in social dilemmas. Although individualists identified with the group (see results in Chapter 6.1.6), an energy community composed of people from the same neighbourhood tends to be an inappropriate social vessel to motivate individualists for energy-related contributions. Two explanations frame these observations.

First and as already mentioned, identity was not politicized. Although no empirical results regarding politicized identity effects on individualists exist, it can be assumed that the *transformation of motivation* (Kelley and Thibaut 1978) would have been even more prominent, if identity included a more political aspect.

Second, the unsuitability of the social vessel might not only be due to the group identity but to the group size, another important feature of the situation when it comes to transformation of motives (e.g. Parks et al. 2013). Compared to the laboratory study of Cremer and van Vugt, group size was larger in this survey. The missing transformation of motives may be due to the large group size, which reduces the individualist’s perception of his/her personal and collective efficacy (see also Olson 2003; Stroebe and Frey 1982; van Zomeren et al. 2008). Accordingly, individualistic householders may have felt it was relatively difficult to provide energy-related contribution and that their contribution would not make a noticeable difference (e.g. Bandura 2012; Carmi and Mostovoy 2017; Kerr 1992; Messick and Brewer 1983). Next to efficacy-related considerations, individualists might also be freighted by the reduced ability of group members to engage in reciprocal strategies (Komorita et al. 1992). Thus, individualists’ tendencies to reduce energy-related contribution intention might be due to the limited capacities of the factor ‘social identification’ to guarantee efficacy in large groups. However, the validation of the explanation remains difficult. Comparing the contribution intentions of individualists across different neighbourhoods can be interpreted incorrectly, since the particular sample sizes are susceptible to outliers.

Contrary to individualists, **competitors** tend to increase energy-related contribution intention when social identification is salient. A possible explanation for this phenomenon is *competitive altruism*. Competitive altruism is “the process through which individuals attempt to outcompete each other in terms of generosity” (Hardy and van Vugt 2006, p. 1403). Competitive altruism emerges when the long-term benefits of selfish reasons for altruism, i.e. reputation or status, outperform the short-term costs of cooperation (Penner et al. 2005; van Vugt and van Lange 2006). Therefore, prosocial behaviour results not only through a prosocial motive but through relative advantages over other group members, e.g. competitive reasoning (van Vugt et al. 2009), and strategic reputation building (Stanca 2009). Competitive reasons for altruistic behaviour flourish in social dilemmas in which visibility and identifiability are salient. Such behaviour was already observed in real-life social dilemmas (Smith and Bird Bliege 2000; Wright 2000). Accordingly, compared to energy-related contributions in the ‘Anonymus’ condition, visibility and identifiability of contributions are more distinct in ‘Energy Neighbourhood’, since the energy community is composed of households living in the same local area. It can therefore be assumed that competitors tend to increase their contribution intention, when forming an energy community with neighbours, because the condition encourages competitive altruism among competitors.

6.3 Conclusion ‘The Potential of Energy Neighbourhoods’

Measured by the incentive effect, there was no significant proof that the social identification with a group composed with neighbours affects individualistic and competitive householders’ energy-related contribution intention in settings of interdependence (N=260). The anticipated positive effect of ‘social identification’ for groups composed of neighbours on individual energy-related contribution intention was absent.

Although no significant evidences for the verification of the energy-related goal-transformation hypothesis was found, it seems that energy-related cooperation possibilities with neighbours tend to have different effects. Table 28 summarizes the most important research findings and implications.

Finding 1: Social Value Orientation had a small but significant impact on energy-related contribution intention. *Prosocials contribute more than individualists and competitors.* **Implications:** • Efforts addressing future collective challenges, i.e. Energy Strategy 2050, must consider different orientations. • To increase/consolidate energy-related contributions, the following instruments should be applied: ○ **Individualists**: Instruments should frame contributions as individual benefits (i.e. economic gain or gains related to energy autonomy). ○ **Competitors**: Instruments should highlight the visibility of contribution relative to others, e.g. increase of own reputation (i.e. competitions or awards). ○ **Prosocials**: Instruments should highlight the morality and the collective benefit of contributions.
Finding 2: There was no statistically significant difference in 'Contribution Intention' scores in settings of interdependence for the two different conditions 'Energy Neighbourhood' and 'Anonymus'. *A group composed of neighbours does not have significantly higher scores for energy-related contribution intention than a group composed of anonymous persons.* **Implications:** • The social vessel 'neighbourhood', as it is today, is inappropriate to transform energy-related motivation, e.g. increase energy-related contributions. Two suggestions are drawn:

- ***Change in-group composition***. Instead of designing energy communities based on geographic features, e.g. ‘community of geography’, energy communities should be composed with members of ‘communities of relations’ in order to increase energy-related cooperation, i.e. family, friends, club members, members of associations or communities of interest. Such groups are composed of members that share the same interests and values, which may facilitate transformation of motivation. The potential seems particularly strong, when the group already has topic-related linkages.
- **Empower neighbourhoods**. The results of the thesis are a ‘snapshot’ of a learning and dynamic social group at a current state. Neighbourhoods, as a social entity, can over time learn how to promote energy-related cooperation (cf. Johnson and Johnson 2013; Ostrom 1990). Given the changing socio-technical aim of a neighbourhood, the transition from a ‘living’ neighbourhood to a ‘living and energy’ neighbourhood requires time and efforts to transform motivations (cf. Markard et al. 2012). Accordingly, from a solely behavioural point of view, neighbourhoods should cultivate and extend social antecedents for energy-related cooperation as well as tightening the social network (cf. Penn 2003). Social events that foster interactions and social identification (i.e. neighbourhood markets, parties, reunions, and assemblies) may result in a more efficient transformation of motivation. Such may also be achieved by fostering prosocial behaviour through forms of competitive collective efforts (i.e. competitions that reward the ‘greenest’, ‘most sustainable’ or ‘most innovative’ neighbourhood). Further, transition-supporting elements may also affect the behavioural transformation. Such elements could yield implementing shared pools/resources (i.e. ‘neighborhubs’ (Swiss Living Challenge 2018), pooled gardening, car-sharing, school road companionship) or the implementation of relevant showcases (i.e. self-sufficient homes).

Finding 3: The insensibility of individuals with a prosocial disposition regarding the manipulation of the group composition supports at least one element of the goal-transformation hypothesis.

Prosocials in the ‘Anonymus’ condition had the same level of energy-related contribution intention as prosocials in the ‘Energy Neighbourhood’ condition.

Implications:

- A group composed of neighbours does not amplify already existing prosocial intentions (e.g. goal-amplification hypothesis).
- A large part of the population (prosocials), will not likely be responsive on social ‘cues’ if energy-related contributions take place in an ‘Energy Neighbourhood’ setting.

Finding 4a: Individualists tend to reduce their energy-related contribution intention in ‘Energy Neighbourhood’ compared to an anonymous group composition. *

In ‘Energy Neighbourhood’, individualists tend to have lower scores for energy-related contribution intention than in ‘Anonymus’.

Implications:

- If cooperating with neighbours reinforces the ‘rationality-prescribes-not-to-contribute’ notion (Cremer and van Vugt 1999) among individualists, further measures are needed to reverse such effects. The general aim of such is to merge individual and collective interests. The proposed social-psychological interventions are known as the ‘four I’s’ to overcome the common dilemma (van Vugt 2009; see also: Ostrom 1990).
    - **Information**. Accurate social or environmental information is fundamental for transformation of motives among individualists. Awareness (Groot and Steg 2009) and perception of severity (van Vugt and Samuelson 1999) of the situation, which has their root in accurate information, increase cooperation. The aim of this intervention is to reduce social and individual uncertainty. More important for individualists, information is necessary to assess the efficacy of individual efforts. If efficacy of energy-related contributions is given, individualists would probably shift their motivation and favour collective outcomes. Therefore, social or

environmental information should be used to reveal and enhance the efficacy of contributions.

- **Identity**. The need for positive social identification or belonging improves and broadens an individualist’s sense of community. This intervention goes hand-in-hand with the measures related to ‘empower neighbourhoods’ in ‘Finding 2’.
- **Institution**. The presence of a legitimate institution for mentoring, managing and coordinating purposes has several advantages (Ostrom 1990). First, it reduces uncertainties by eliminating freeriding possibilities, and collective outcomes become more certain, which finally increases the efficacy of efforts. Second, institutions legitimize the collective efforts and emphasize their necessity. Third, if adapted to the specific needs of the neighbourhood, institutions may even reinforce the group’s identity.
- **Incentives**. Monetary incentive schemes (see also ‘Finding 1–Implications’) are widely used to subsidize prosocial behaviour. With a reward/punishment mechanism, prosocial behaviour results through self-enhancing. However, economic incentives may remain irrelevant for individuals with more complex motives (Steg 2005; Steg and Vlek 2009; van Lange et al. 1997b; van Vugt 2001), and it may even be counterproductive if they undermine other cores (information, identity and institutions) (Tenbrunsel and Messick 1999), undermine autonomy and intrinsic motivation (Deci and Ryan 2000; Ryan and Deci 2000), reduce persistence in cooperation (Cardenas et al. 2000) and undermine trust in others (Chen et al. 2009). However, incentives do exploit their full potential, when other cores are missing (van Vugt and Samuelson 1999).

* However, there are no significant differences.

Finding 4b: Competitors tend to increase their energy-related contribution intention in ‘Energy Neighbourhood’ compared to an anonymous group composition. *

In ‘Energy Neighbourhood’, competitors tend to have higher scores for energy-related contribution intention than in ‘Anonymus’.

Implications:

- Visibility and identifiability of choices in ‘Energy Neighbourhoods’ seem to incentivize competitors to engage in prosocial behaviour. In order to increase competitors’ contribution, the competitive motive behind prosocial behaviour needs to be amplified. Status and reputation are particularly important for competitors and such should be promoted:
    - **In-group competition**. Status and reputation of competitors can increase, if they can compete against other neighbours. By making contributors and free-riders public, competitors can compare their own behaviour. While striving for status and reputation within the group, competitors exhibit ‘competitive altruism’ (cf. Barclay 2004; Smith and Bird Bliege 2000; Wright 2000). A more ‘silent’ form of competition was tested by Schultz et al. 2007. Schultz and colleagues found out that energy consumption was reduced, when a ‘smiley’ or ‘frowney’ on the energy bill compared the individual’s average energy consumption to the neighbourhood’s average energy consumption. It is acknowledged that ICT is an important means to develop energy community-related games, competitions, campaigns and rewards (Deterding et al. 2011; Johnson et al. 2017; Mattern et al. 2010). Such is anticipated to amplify competitive motives for prosocial behaviour.
    - **Presence of an out-group**. The presence of an out-group reinforces the competition-notion of energy-related contributions. The presence of an out-group encourages in-group identification and increases cooperation (Bornstein et al. 1989; Gunnthorsdottir and Rapoport 2006), especially among competitors (Cremer and van Vugt 1999), and men (e.g. 'male warrior hypothesis'; van Vugt et al. 2007). In-group attachment and identification, e.g. ‘in-group love’, provides at the same time fertile ground for antagonism and distrust of those outside the group’s borders, e.g. ‘out-group hate’ (Brewer 1999). Energy-related competitions between neighbourhoods seem to be a powerful motivation to engage in

	energy-efficiency and energy conservation measures (City of Takoma Park 2018; Energy Neighbourhood 2008).
* Small sample, no significant differences though.	

Table 28: Conclusion 'The Potential of Energy Neighbourhoods'

6.4 Results ‘The Coordination of Energy Neighbourhoods’

First, descriptive results for each energy-related task necessary to achieve the collective goal are presented. The first part deals with directly observable variables and answers the following question:

- **Question 1: ‘*Which energy-related tasks will be regulated by an energy service provider and to which degree?*’**

The second part of this chapter tries to categorize the experimental units based on a modified ‘Energy Community Management-Framework’ (ECMF) (Hertig and Teufel 2018). The conceptual ECMF uses a bottom-up approach to discover and to cluster preferences for energy-related task regulation in energy communities. Following the ECMF, this chapter allows to answering of the two questions:

- **Question 2: ‘*How do households differ in their characteristics?’***
- **Question 3: ‘*What are the different justifications to regulate energy-related tasks?*’**

Third, based on the results of the second part, this part defines the role of an energy service provider.

- **Question 4: ‘*What is the role of an energy service provider in a setting of energy-related interdependence?*’**

6.4.1 Design of Energy Neighbourhoods

In the sixth section of the questionnaire (Rules), participants could select among different rule-designs for different energy-related application domains in order to ensure the collective goal. The rules ranged from ‘*no rule settings*’ to ‘*obligation to…*’ for the community members and for the corresponding energy-related task. The five different rule-designs, e.g. ‘*no rule settings*’, ‘*inform households to*...’, ‘*reward households*’, ‘*punish households*’ and ‘*obligation to…*’, correspond to different degrees of intervention in the individuals’ decision-making. The rule design ‘*obligation to…*’ depicts a massive interference in each individual’s decision-making. This leads to a uniformed behaviour across all neighbourhood members, i.e. a *functional* energy community design. ‘*inform households to…*’, ‘*reward households*’ and ‘*punish households*’ represent choices for a *signalling* design. Finally, ‘*no rule setting*’ represent a choice of a *subjective* energy community design.
The application domains for the rules were divided in two main domains: infrastructure *per se* (iGSL-infrastructure (Teufel and Teufel 2014)) and the management of infrastructure. Both domains aim to achieve individual as well as collective energy autonomy. The first domain considers the *purchases of energy efficient devices, energy production-* and *energy storage-units*. The infrastructure management domain contains the sub-domains *load reduction* and *load shifting* for the load management section. Both domains aim to achieve individual energy autonomy. *Stored energy sharing* and *sharing storage capacities* were the sub-domains within the storage management part and aim, in addition with the other domains, to ensure collective energy autonomy. The different sub-domains, as well as their visual representation in the questionnaire are shown in Figure 50.

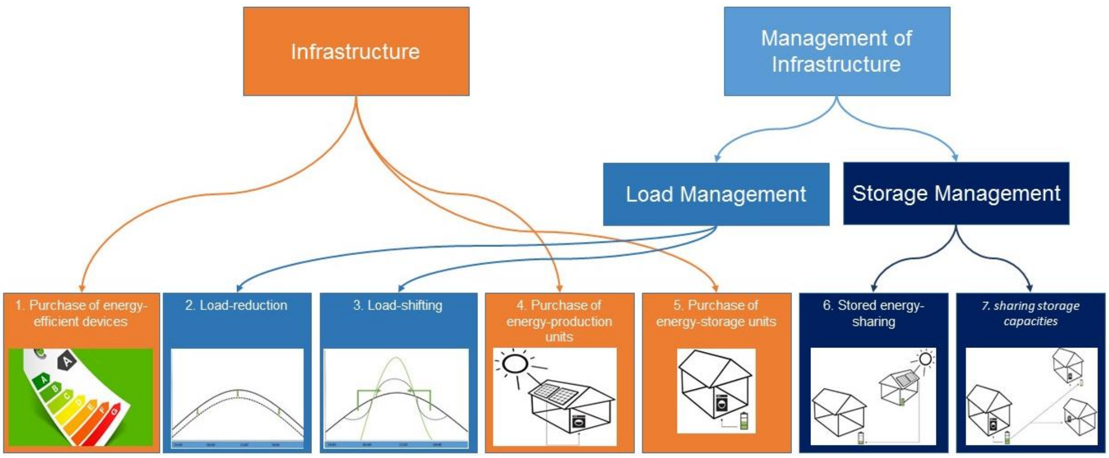


Figure 50: The sub-domains, Rules

The sample (N=148) contained only *EQ-participants* that expressed preferences in all seven sub-domains for the condition ‘Energy Neighbourhood’. Section 6 of the questionnaire contained no randomized design for both order of presented sub-domains and order of answers. Further, the sample included only participants that expressed their own contribution intention as well as their expectations of others across all eight items (Section 5.1 and 5.2 in the survey).

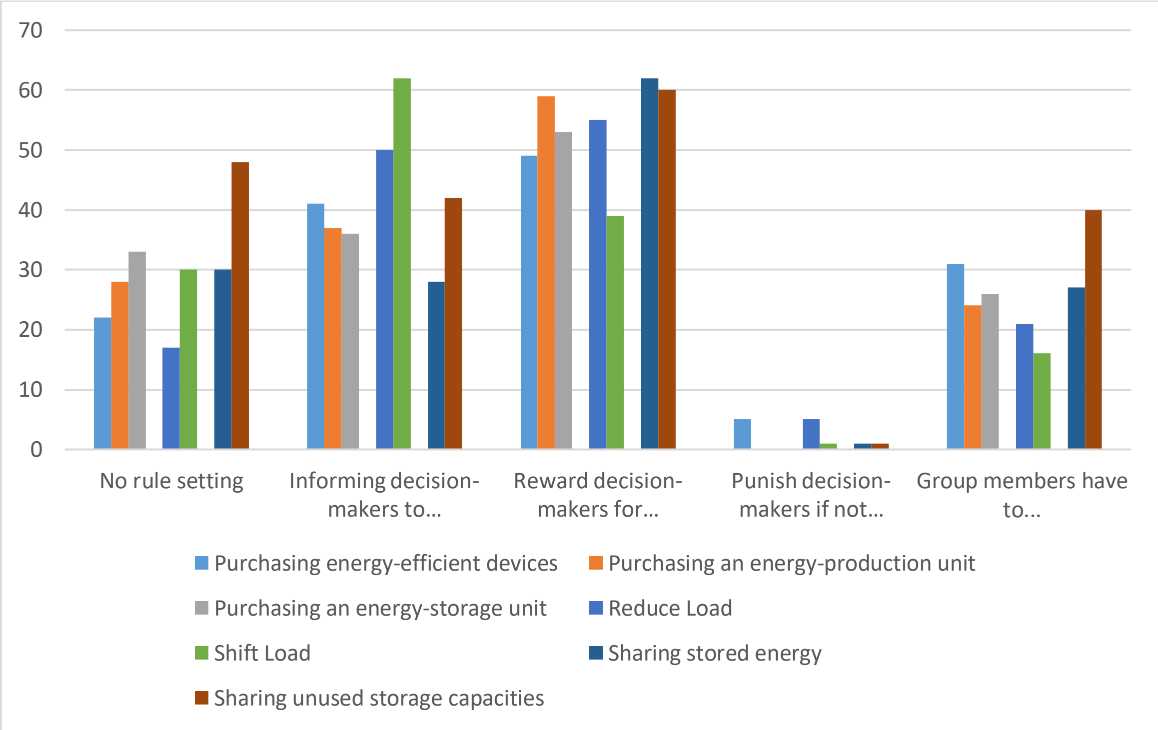


Figure 51: Rules for Energy Neighbourhoods

Figure 51 shows the heterogeneous claims for rules for the condition ‘Energy Neighbourhood’. An important number of participants are in favour, at least to some degree, of placing mechanisms that encourage or even functionalize energy-related behaviour within the neighbourhood, i.e. signalling community design. More precisely, we observe very high acceptance over all sub-domains to reward decision-makers for cooperative behaviour (representing 35.5% of all answers) and very low acceptance for punishing designs (1.3%). Informing people to act in a cooperative manner was also largely accepted (27.6%). A not negligible number of participants (17.7%) can imagine giving up individual freedom and allocating decision-making to a third party, in order to ensure a collective outcome, i.e. functional design. Participants that accept a ‘laissez-faire’ culture within an Energy Neighbourhood (18.0%) constitute not a small group too, i.e. proponents of a subjective design.

Expanding on Figure 51, the results of Section 6 are rank-ordered in Table 29, which provides an overview of the answers related to the different rule designs. A clear preference for rewards-based incentives over punishment-based approaches can be observed across all rule sub-domains. While the rewards-based rule design has the largest approval among all designs for six sub-domains, a punishment-based design constitutes no feasible alternative. Sub-domains that are linked with (costly) financial investments, like those in the infrastructure domain, tend to be handled with more individual freedom. This also counts for the load management part; the number advocating for regulated load management is distinctly smaller compared to the regulation-proponents of other sub-domains. The tendency for individual decision-making is lightly mitigated in the storage management sub-domains; both poles seem to converge in numbers. The two most supported rule-designs in each sub-domain represent more than 60% of the participants’ choices in all seven sub-domains.

	No rule setting	Informing decision-makers	Reward decision-makers	Punish decision-makers, if not…	Oblige decision-makers
Infrastructure					
Purchase of energy-efficient devices	4. 14.9% (22 answers)	2. 27.7% (41)	1. 33.1% (49)	5. 3.4% (5)	3. 20.9% (31)
Purchases of energy storage unit	3. 18.9% (28)	2. 25% (37)	1. 39.9% (59)	5. 0% (0)	4. 16.2% (24)
Purchase of energy production unit	3. 22.3% (33)	2. 24.3% (36)	1. 35.8% (53)	5. 0% (0)	4. 17.6% (26)
Management of Infrastructure					
Load reduction	4. 11.5% (17)	2. 33.8% (50)	1. 37.2% (55)	5. 3.4% (5)	3. 14.2% (21)
Load shifting	3. 20.3% (30)	1. 41.9% (62)	2. 26.7% (39)	5. 0.7% (1)	4. 10.8% (16)
Sharing of stored energy	2. 20.3% (30)	3. 18.9% (28)	1. 41.9% (62)	5. 0.7% (1)	4. 18.2% (27)
Sharing of unused storage capacities	4. 17.6% (48)	3. 21.6% (42)	1. 34.5% (60)	5. 0.7% (1)	2. 25.7% (40)
In Total	18.0% (186)	27.6% (286)	35.5% (368)	1.3% (13)	17.7% (183)

Table 29: Detailed Results for Rules in Energy Neighbourhoods

Explanation and Implications

According to the rule-design preferences, none of the analysed sub-domains are perceived as distinctly *functional*, *signalling* or *subjective*. The heterogeneous preferences show rather different shades of grey than a clear white or black picture when it comes to the functionalities within an 'Energy Neighbourhood'. However, some descriptive findings show some tendencies. Table 30 provides an explanation of the findings as well as their implications.

Tendency 1: The widespread preferences to reward decision-makers for cooperative behaviour show that potential exists for all sub-domains to strive towards a ‘signalling design’ by making use of positive stimuli.

Explanation:

- The cooperation-enhancing effects of positive stimuli are widely acknowledged (see for meta-analysis: Balliet et al. 2011). Also, a recent study conducted with a representative sample in Switzerland showed that energy policy instruments that incentivize RE technology adaption were the most preferred instrument (Ingold et al. 2018).

  At the same time, the author pointed out earlier that incentives may also have some important drawbacks (see also Finding 4a, Chapter 6.3). The large acceptance of a rewarding system for an ‘Energy Neighbourhood’ is not surprising since cooperative behaviour is encouraged but not imposed. Further, a reward system gives orientation, signals the morally right thing to do and serves as guideline for indecisive members. Nevertheless, a rewarding-system resembles an ‘opting-in’ choice for cooperative behaviour, which has less impact than an ‘opting-out’ design, i.e. punishing people for selfish behaviour (cf. Johnson et al. 2002).

  Over one third of the studied sample favoured a rewarding system when it comes to the exertion of energy-related tasks. These guidelines do not prevent freeriding but manipulate the outcome situation for each member towards cooperative behaviour: By signalling such, exclusive individual benefits to each contributing member arise. Contrary to the public good ‘contribution to energy goal’, the good ‘reward’ is a private good, and its use is rivalrous and excludable. By granting contributing members exclusive rewards, the private good (reward) is tied to the public good contribution for energy goals (cf. Cornes and Sandler 2003).

  The implementation of a reward system is not straightforward. On one side, its funding, if considering monetary incentives, remains unsolved. On the other side, a well-designed reward system needs to integrate heterogeneous claims and motives, i.e. SVO (see also Finding 1a, Chapter 6.3), different social constructions of energy (Hertig and Teufel 2018; Stern and Aronson 1984) and, different environmental concerns (Stern et al. 1993). Even though the nature of rewards (monetary or social) is unknown and contrary motives may hinder an effective rewarding system, one important recommendation regarding the design of an ‘Energy Neighbourhood’ can be drawn:

Implication:

- **‘Smart incentives’**: The collective action can be flanked by a rewarding system in which contributors can obtain exclusive privileges for contributing to the collective goal. In Switzerland, several collective actions make use of rewarding designs for example, to lower healthcare costs, increase donations, or increase pension savings. Referring to the work of Vasauskaite et al. 2017, a smart reward system should be incentive-compatible for individuals with different motives in order to foster collective welfare and prosocial behaviour. It is therefore conceivable and recommendable that the communication of the ‘smart incentives’ happens in a very individualized manner: a competitive householder can participate in a related competition, environmental benefits would be provided to households with strong environmental value, individualists could receive monetary benefits, etc.

Tendency 2a: Householders with preferences for a subjective ‘Energy Neighbourhood’ constitute a not negligible number across all sub-domains.

Explanation: Individuals refusing forms of collective rules constituted 18% of the surveyed sample. Three possible motives could explain such preferences: lack of awareness of consequences, status-quo bias, and anti-authoritarian preferences:

- **Lack of awareness of consequences** is not only known to hinder cooperative behaviour (Fehr et al. 2014; Stern et al. 1993; Nordlund and Garvill 2003), but also to exacerbates collective strategies (cf. Ostrom 1990). Awareness of consequences itself depends on many antecedents (see also Stern et al. 1999), like knowledge about the situation (Fox and Guyer 1978) or potential benefits of contribution (Komorita et al. 1980).

Negative consequences of failed public good provision arise on an individual, collective and environmental level (Hansla et al. 2008). Thus, lacking awareness of ‘laissez-faire’ proponents may explain their choices. Further, Elinor Ostrom’s ‘design principles’ for self-organized groups rely implicitly on the group’s awareness of rules (Ostrom 1990).

- The **status quo bias**. The current baseline on energy-related task regulation is quite liberal and individual decision-making remains unregulated. The possibility to regulate such relates to a new alternative. If the unregulated baseline is taken as a reference point, any change from that baseline can be perceived as a loss, even if such is objectively superior than the current situation (cf. Kahneman et al. 1991; Samuelson and Zeckhauser 1988).
- The third motive, **anti-authoritarian preferences**, provides another explanation of why householders do not want any kind of regulation. Perceived over-regulation of the daily life (cf. Buomberger 2015), lack of trust in the regulator (Lange and Gouldson 2010), costly mentoring of the regulator (cf. Okada 2008), existing trust in neighbours (Artaz and Hertig 2018), and general rejection of authority may explain preferences for ‘laissez-faire’ designs for ‘Energy Neighbourhoods’.

Implications:

- **Awareness-raising**. As many other environment-related campaigns, energy-related awareness campaigns in Switzerland are no longer rare. With the idea of ‘Energy Neighbourhood’, the socio-technical aim of a ‘neighbourhood’ is changing. To accelerate it, members need to be informed about the technical and social functioning, the individual, collective and environmental benefits and disadvantages, and the necessity of energy-related contribution of energy communities. Classical awareness campaigns (i.e. ‘Energy Challenge 2018’ (Energie Schweiz 2018a)) fall too short, since such miss to point out the mentioned contents. Similar to ‘smart incentives’, awareness campaigns have to adapt their message regarding the different motivations and inclinations of people.

◦ **Learning and trialability**. Major technological and socio-technological paradigm shifts can lead to widespread fear, incomprehension, resistance and even panic among people (Burns 2015; Rooney 2011). Consumer resistance was often experienced (cf. Ram 1987), and is anticipated to be the case for 'Energy Neighbourhood' too. To counteract resistance, the author recommends a 'learn and trial' approach for 'Energy Neighbourhoods', in which members can learn about the technological/social functioning and experience the local collective action. The other way around, experiences from such trials may then be implemented in a more concrete and final version.
Tendency 2b: Householders with preferences for a functional 'Energy Neighbourhood' do not constitute a negligible number across all sub-domains. **Explanation:** Individuals agreeing to set up strong forms of collective rules constitute 17.7% of the survey sample. Two possible motives could explain such preferences: sound awareness of consequences and risk aversion. • Contrary to the former group, these individuals may have sound awareness of consequences if the group fails to provide the public good. Thus, proponents of a functional 'Energy Neighbourhood' recognize the necessity of collective-binding rules. • Collective rules reduce risks. Rules reduce exploiting behaviour (freeriding), provides stability of expectations (Ostrom 1990), strengthen the community and finally reduces the negative impact of failed public good provision on an environmental level. Avoiding such risks by functionalizing the community can be interpreted as general risk aversion.
Tendency 3: A functional design ('obligation to' choices) was preferred over an opting-out design ('punish' choices). **Explanation:** Although a punishing design still allows (costly) non-contribution, participants still prefer a functional design, in which non-contribution is not possible at all. Such preferences can be explained by the widespread aversion of

losses and punishment compared to the reception of gains (cf. 'Prospect Theory', Kahneman and Tversky 1979). The word '*punishment'*, which was also used in the questionnaire, may have signalled a loss of individual energy-related decision-making much more prominently than '*have to*'.

Table 30: Explanations and Interpretation, Question 1.

6.4.2 Member Categorization & Design Justification

Using a modified ECMF, justifications for different community designs were assessed. The analysed sample (N=148) was the same as in the previous section. The vertical axis of the ECMF remained identical with the original and will be measured by the mean score of the seven energy-related subdomains' regulation-scores (see also Figure 50 and Figure 51), i.e. degree of interference. Since Hertig and Teufel did not specify the measurement of the social features, these had to be defined separately. Therefore, the author computed a variable '*Joint Contribution*', which added the mean score for contribution intention (section 5.2. in the questionnaire, see also Chapter 6.1.8) to the mean score for contribution expectations (Section 5.3 in the questionnaire, see also Chapter 6.1.9).

Using 'Joint Contribution' to define the social feature in the neighbourhoods is problematic, because scores within the middle third of the horizontal axis can occur for two different reasons. First it can occur, when an individual shows reserved contribution intention and anticipates the same behaviour by the others. Second, when an individual has an opposite contribution intention than the expected contribution intention of the others or vice versa. If the second case occurs, joint contribution depicts the mean score of two opposite scores, which finally distorts a coherent measurement of the social feature.

Thus, to figure out what reasons let to such scores, a further analyse with a further variable was computed: '*Difference between own and expected contribution*' (DOEC). If subtracting the score for 'expectations' from the score for 'contribution intention', opposite scores for contribution intention and expectations led to DOEC scores higher or lower than zero. Scores higher than 0, indicated that the responder thinks that he/she contributes more than the others. Values below 0 indicated that the others contribute more to the responder. If the score for both variables was equal, a 0 resulted.

The sample had satisfactory scores for the variable ‘*Difference between own and expected contribution* (DOEC)’ (*M* = 0.68, *SD* = 0.84, *min*. = -1.25, *max*. = 4.0, N = 148), indicating that the scores in the middle third of the horizontal axis resulted majorly through identical scores in ‘mean contribution intention’ and ‘expectations’ and not through opposite or unequal behaviours (see Figure 52). 50% of the responders obtained a DOEC score within the range of 0 and 1, demonstrating that scores for ‘contribution intention’ and ‘expectations’ were quite similar for the sample’s majority. Further, the largest group, 23 responders (16%), anticipated no difference between their own and the others’ contribution intention. The four outliers (SPSS® ID 38, 72, 29, 20) were excluded from the sample.

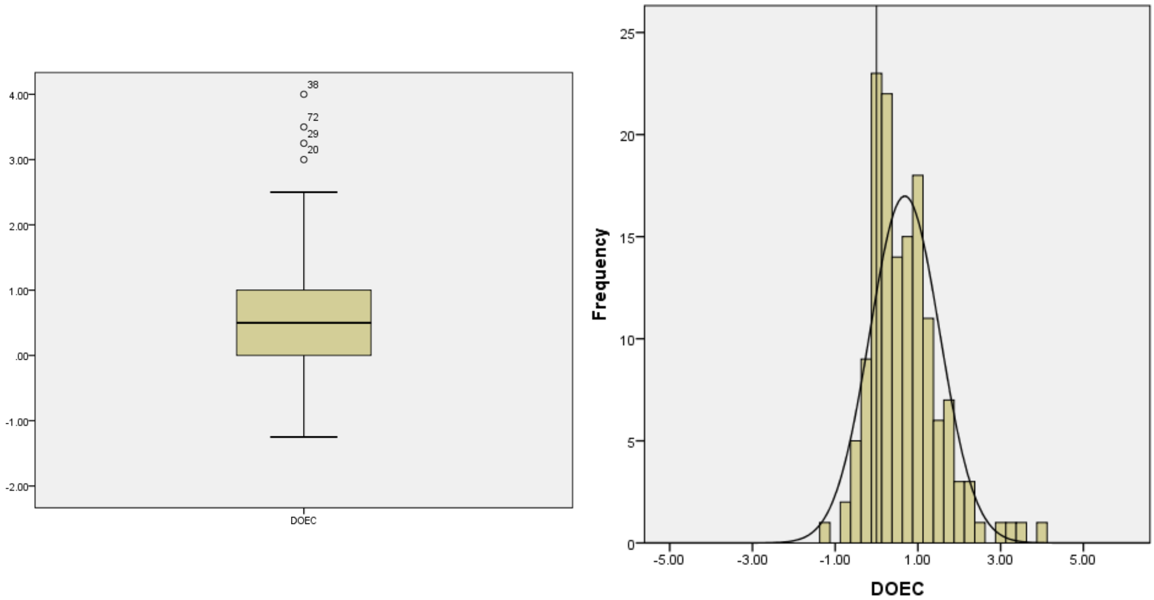


Figure 52: Differences between own and expected Contribution Intentions

A hierarchical cluster analysis with a variance method strategy, Ward’s Method (1963) with squared Euclidean distance to cluster centres, was conducted to classify the responses, according the ECMF. With Ward’s Method, total within-cluster variance is minimized. According the ‘3*3 matrix’ of the ECMF, the predetermined number of clusters is nine.

Figure 53 shows the nine different clusters. As expected, the nine different clusters differ from the rigid ECMF grid design. Nonetheless, some categories fit perfectly to the respective square (Cluster ‘4’, ‘8’ and ‘9’) while others (Cluster ‘1’, ‘3’ and ‘7’) have tendencies to interpret the respective square more generously.

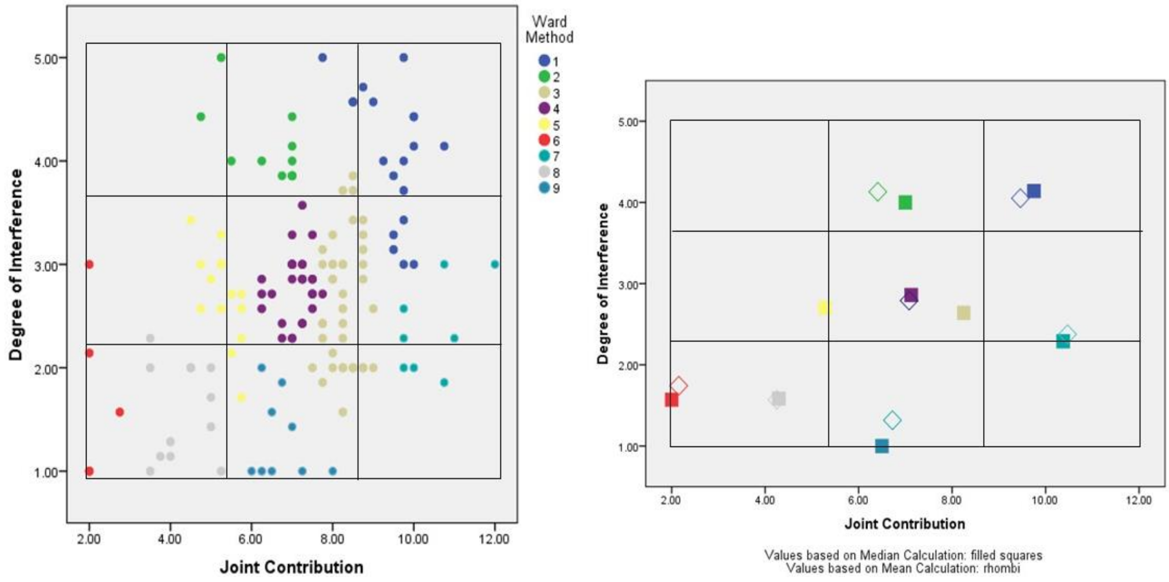


Figure 53: Clusters

By calculating the median and mean vector point of each cluster, we recognize how differently the clusters were distributed (Figure 53, right side). No cluster occupied the upper left square of the matrix. The median values for cluster number 7 laid on the border of the bottom right square and the middle right square. Because mean values in ‘joint contribution’ and ’degree of interference’ for cluster 7 were slightly higher than the median values, cluster 7 will further be mentioned as ‘middle right cluster’ and not as a ‘bottom right cluster’. We further recognize that mean points did not differ dramatically from the median’ ones. Only cluster 2 and 9 seem to have some deviations. There is not square shift due to the difference between the mean and the median point.

A first preliminary analysis by visual scatterplots showed monotonic relationships between both variables, ‘Joint Contribution’ (Appendix 11) and ‘Degree of Interference’ (Appendix 12) and other variables. All variables were used in a Spearman’s rank-order correlation test. Unlike Pearson’s correlation, the non-parametric Spearman’s correlation requires no normality and is therefore less vulnerable to outliers (Field 2015). The results of the correlation tests (Table 31) combined with the descriptive results of the clusters’ characteristics (Table 32) allows novel insights on potential energy community members. Unfortunately, the small numbers of data (144 responders divided in 9 clusters) made it difficult to find causal relationships that would be better suited to characterize the cluster.

	Joint Contribution	**Degree of Interference**
Joint Contribution	r_s = 1	r_s = .335**
Degree of Interference	r_s = .335**	r_s = 1
SVO	r_s = .032	r_s = .223*
Level of Cognitive Complexity	r_s = -.336**	r_s = -.274**
Level of Feasibility	r_s = .454**	r_s = .279**
Meaningfulness of Group Composition	r_s = .515**	r_s = .272**
Gender†	r_s = .159	r_s = -.095
Age	r_s = -.040	r_s = -.084
Politics (refusal of EnA)	r_s = -.217**	r_s = -.293**
Social Identity	r_s = .254**	r_s = .059
SEB	r_s = .295**	r_s = .214**
Living in the same neighbourhood (Duration)	r_s = -.075	r_s = -.064
Household size	r_s = -.009	r_s = .078
Ownership situation†	r_s = .067	r_s = .040

Notes: * = Correlation is significant at the 0.05 level (2-tailed).
** = Correlation is significant at the 0.01 level (2-tailed).
† = binary variables.

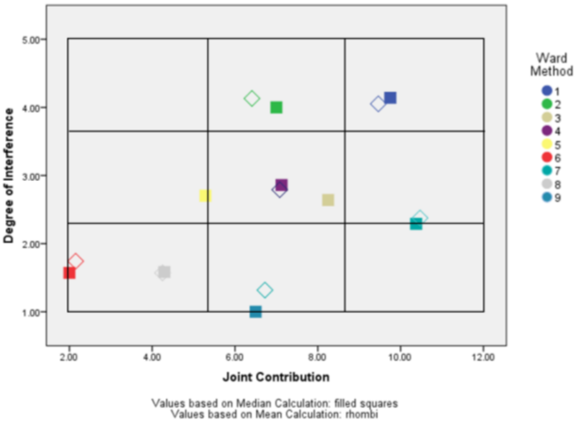
Table 31: Rank-order correlation for 'Joint Contribution' and 'Degree of Interference’

Table 31 shows that most variables significantly co-variated with the horizontal as well as with the vertical axe of the ECMF. First, correlations with ‘Joint Contribution’ are presented.

The strongest relational effects were found with the variables of Section 4 in the survey: the approval variables. A negative correlation between cognitive complexity of a bottom-to-bottom system and the perceived social feature of the community existed. On the other hand, the perceived technical feasibility of the system as well as the meaningfulness of the group composition correlates positively with the perceived social feature for cooperation. The strongest effect size was found for the correlation between ‘Joint Contribution’ and ‘Meaningfulness of Group Composition’. Similar results for the perceived social identity with the group and the individual’s energy behaviour were detected. Further, the ‘politics’ variable, respectively the refusal of the EnA, correlates negatively with the level of anticipated joint contributions. No correlation between Social Value Orientation and levels of joint contribution was found.

For ‘Degree of Interference’ a positive correlation with SVO was detected. More precisely, ‘Degree of Interference’ correlates positively with SVO°. Individuals with low values for SVO°, have lower scores for ‘Degree of Interference’. Thus, prosocials tend to accept rules, while proselfs reject them. ‘Social Identity’ did not correlate with the ‘Degree of Interference’. The same correlations with variables were found as presented in the paragraph before, although effect sizes for these correlations were smaller.

The descriptive comparison between the clusters are shown in Table 32. Cluster ‘3’ and ‘4’ are the largest groups, representing 45% of the participants in the treatment group. Both clusters have moderate preferences for third-party interference and anticipate a reserved environment for cooperation. No essential differences in the cluster composition are discernible. Scores in the groups’ composition for ‘SVO’, ‘General Questions’, ‘Gender’ and ‘Age’ show similarities. Cluster ‘3’ has higher scores for ‘Social Identity’ and ‘Sustainable Energy Behaviour’, while cluster ‘4’ constitutes a very young group (M = 46.4 years).

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8	Cluster 9
N=	19	11	38	28	14	5	8	12	9
Description									
Joint Contribution[2]	high	moderate	moderate	moderate	low	very low	high	low	moderate
Degree of Interference[1]	high	high	moderate	moderate	moderate	low	moderate	low	very low
									
SVO[2]									
Prosocials	68.4 %	54.5 %	71 %	67.9 %	50 %	20 %	62.5 %	41.7 %	44.4 %
Proselfs[3]	10.5 %	36.4 %	15.8 %	17.9 %	35.7 %	60 %	25 %	50 %	22.2 %
Unknown	21.1 %	9.1 %	13.2 %	14.2 %	14.3 %	20 %	12.5 %	8.3 %	33.3 %
General Questions[1,2,4]									
Complexity	2.47	3.09	3.11	2.79	3.36	6.0	2.0	4.36	3.33
Feasibility	4.53	4.0	3.92	3.93	2.92	1.0	4.88	2.27	3.67
Meaningfulness of Group Composition	5.16	4.0	4.55	4.5	3.64	1.6	5.25	2.83	3.89
Demographics[4]									
Gender (Men)	78.9 %	81.8 %	76.3 %	82.1%	85.7 %	100 %	50 %	83.3 %	66.7 %
Age (years)	56.1	64.2	58.5	46.4	52.2	60.0	56.1	62	59.3
Approval of EnA[1,2]	84.2%	54.5 %	52.6 %	46.4 %	50 %	0 %	50 %	33.3 %	44.4 %
Others[4]									
Social Identity[1]	4.59	4.0	4.57	4.16	4.14	2.1	4.63	4.02	4.2
SEB[1,2]	4.98	4.7	4.79	4.33	4.45	3.85	5.04	4.15	4.43

Notes:

[1] = correlations found with ‘Joint Contribution’.

[2] = correlations found with ‘Degree of Interference’.

[3] = Proselfs are individuals with an individualistic or competitive Social Value Orientation according Murphy et al. 2011.

[4] = mean scores; for further information on scale ranges see Appendix 3.

Table 32: Descriptive Comparison between Groups

The sample included two opposite groups on the ECMF matrix; cluster ‘1’ and cluster ‘6’. Cluster ‘1’ consisted of 19 persons (13.1%) supporting strong interferences in individual decision-making while anticipating a cooperation-friendly environment. Cluster ‘6’ represents not only the opposite vision, but reflected only 3.4% of the sample. Except for ‘Age’, differences in the groups’ composition are the most obvious within the whole sample.

The nine different clusters were further merged in groups with similar patterns. Correlational and comparing analyses were used to define similarities, respectively differences among the clusters.

A significant positive correlation between scores for ‘Joint Contribution’ and ‘Degree of Interference in decision-making’ (r_s = .335, p < .001, n = 144) was found (see Appendix 13). According to Cohen (1992) the effect size was medium. Any cluster, apart from cluster 2, 4 and 9, differed significantly in their scores for ‘Joint Contribution’ (see Appendix 14). For ‘Degree of Interference’, results were more interesting: Bonferroni-Tests revealed three significantly different groups (see Appendix 15); a group of householders with high scores (1 and 2, n = 30), moderate scores (3, 4, 5 and 7, n = 88) and low scores for ‘Joint Contribution’ (6, 8 and 9, n = 26). Cluster 7 is quite different from the other clusters in the same group, since it has distinctly higher scores for ‘Joint Contribution’. Thus, a first distinction regarding the different justifications for interference can be drawn by reducing the number from nine (clusters) to four (groups) (see Table 33).

Size of Group	**Clusters**	**Degree of Interference**	**Joint Contribution**	**Justification for Interference, according to Hertig and Teufel 2018**
30 (20.8%)	1 and 2	high	moderate-high	impose community consolidation
80 (55.5%)	3, 4 and 5	moderate	moderate	signal community consolidation and behavioural change
26 (18.0%)	6,8 and 9	low	low-moderate	refusal of interference
8 (5.6%)	7	moderate	high	signal community consolidation

Table 33: Justification for Interference, Overview

Explanation and Interpretation

According to the results shown in Table 33, justifications for an energy service provider to intervene in individual energy-related decision-making and to regulate energy-related tasks were different and partially opposed. Among the nine clusters, four different groups of potential ‘Energy Neighbourhood’-members were identified and will further be described in Table 34.

Tendency 4a: 55.5% of the surveyed sample justified moderate forms of interventions (signalling/steering) for mixed reasons (community consolidation and behavioural change). **Description:** This group aims to change the status quo by using moderate forms of intervention. Thus, energy-related tasks remain subjective, but steering mechanisms should signal the morality of contributions. The moderate social feature of the community, measured by the level of ‘Joint Contributions’, showed a perceived social reservation among the community. The social factors to foster energy-related contribution are not sufficiently developed, whereby steering mechanisms could serve as a compass. The design gives orientation and signals the individual benefits of cooperation, respectively the individual costs of non-cooperation. Such group members can be described as ‘*Signal-seekers*’.
Tendency 4b: 20.8% of the surveyed sample justified energy-related intervention by imposing community consolidation. **Description:** This group aims to consolidate the social status quo, which all group members perceive as cooperation-friendly. Despites the over average scores for perceived social features of the community, members demand a functional community design. Thus, the rules strengthen the prevailing social expectations regarding the community. Such expectation-stabilising and reassuring motives are well-known functions of rules (cf. Ostrom 1990; Moroni 2014). Members of this group can be described as ‘*Stability-seekers*’.

Tendency 4c: 18.0% of the surveyed sample denied any form of interference in individual energy-related decision-making. Thus, a justification for intervention is non-existent. **Description:** These members share a hostile attitude towards regulations. Multiple reasons for such opposing preferences are possible (see also ‘Tendency 2a’). Regarding potential regulation of an energy community, this group can be described as ‘*The Opposition’*.
Tendency 4d: 5.6% justified moderate or weak forms of interventions (signalling/steering) for community consolidation. **Description:** Members of this group have exceptionally high scores for ‘Joint Contribution’, which indicates a highly cooperation-friendly environment. The social features of the community are accompanied by a weak signalling rule setting. This relation between perceived social feature and the preferences for interference in energy-related decision-making is particularly for the studied sample. Contrary to the other three groups, for which a correlation between ‘Joint Contribution’ and ‘Degree of Interference’ exists, scores for ‘Joint Contribution’ are distinctively higher than the scores for ‘Degree of Interference’. Thus, members of this group place great relative importance to the social sovereignty of the neighbourhood. This can be interpreted as general trust in the existing social features of neighbourhood, which again is an important factor for self-organization. Nevertheless, the group accepts moderate or weak guiding interventions to sustain the community. Members of this group can be described as ‘*moderate stability-seekers*’.

Table 34: Tendencies and Descriptions, Question 3

6.4.3 The Role of the Energy Service Provider

The role of the energy service provider regarding the coordination of an Energy Neighbourhood is defined bottom-up, i.e. by the preferences of potential Energy Neighbourhood members. According the results, several criteria must be acknowledged and considered in order to define an energy service provider’s role within an Energy Neighbourhood:

- The seven energy-related tasks constitute a single group. All tasks are interfered to the same degree by the energy service provider. Differing degrees of interventions across the tasks are not possible, nor where such empirically found (see Chapter 6.4.1).
- An energy service provider provides the same energy solutions and intervenes in individual energy-related decision-making for all neighbourhood households in a uniform manner.
- A service provider can justify the energy solution differently, according to the different expectations (Chapter 6.4.2).

Consequently, and according to the three identified types of justification for an energy service provider to intervene in individual decision-making, three roles were identified.

The ‘Initiator’ role

An energy service provider, which meets the needs of ‘signal-seekers’, enables and supports community members to act in a cooperative manner. The entrusted competences towards energy service provider should yield in an expected shift of motivation on an individual level. Yet, the initiator emphasizes the individual benefits of cooperation, using rewards, serves as a moral compass, or reinforces the social features of the community. Responsibility for energy-related tasks remains solely individual. The service provider acknowledges such, but at the same time facilitates cooperative choices actively. The community members empower the service provider to initiate a change of the *status quo*.

Given the overwhelming reception of that role (55.5% of the surveyed sample), the initiator role represents, at least from the potential members’ point of view, the *dominant design* regarding energy communities (cf. Schilling 2008).

Provided community management solutions aim to manipulate the outcome situation in favour for ‘cooperation’ for each community member. To achieve such manipulation, smart steering mechanisms need to be put in place. Thus, the ‘initiator’ offers an individualized and customized design, encouraging welfare-improving behaviour and investments on an individual level. To initiate such, following the instruments are proposed:

- **Market mechanisms** – price signals can lead to behavioural changes, especially when price elasticity for demand is high, by reducing/increasing willingness to pay of consumers. However, demand and substitution for utilities are quite inelastic (Sorrell 2007), whereby market mechanisms for an Energy Neighbourhood might be limited if targeting solely on the willingness to pay. Market mechanisms can further go along with normative and paternalistic messages and emphasize the concept of need, rather than the willingness to pay. Prices and price changes can be used to signal meritorious dimensions of ‘goods’, respectively the demeritorious dimensions of ‘bads’. Prices for tobacco and alcohol (‘bads’) for instance, are artificially kept high, while education and vaccinations (‘goods’) are tried to be kept cheap (cf. Fiorito and Kollintzas 2004). The essence of such policy is to reduce information failure among the consumers by making use of taxes for ‘bads’ and subsidies for ‘goods’. In the case of Energy Neighbourhoods, market mechanisms based on the concept of need should signal the necessity to perform energy-related tasks. Such paternalistic market mechanisms are conceivable in both domains, i.e. infrastructure and infrastructure management, as well as on the supply and the demand-curve of ‘energy’: for example, subsidizing infrastructure purchases (‘goods’) or taxing energy consumption (‘bads’). Therefore, financial incentives and normative price setting may steer householders across all seven sub-domains and can be one instrument for an initiator.
- **Alternative reward systems** – market mechanisms constitute implicit rewards for cooperative behaviour. Incentives that are more explicit, like rewards, can complement or substitute such. Rewards can be coupled within the scope of other energy-related tasks, e.g. lower infrastructure purchasing costs for householders that reduce energy consumption. Rewards can also be decoupled from the energy topic, e.g. householders, which perform a required energy-related task, benefit from discount rates at local businesses. In Switzerland, decoupled rewards for meritorious behaviour become present in the health insurance sector (e.g. Helsana) for customer retention reasons. Other rewards may also increase the contributor’s reputation within a

community or allow other forms of non-financial benefits. Ideally, benefits target highly elastic and/or demanded goods, in order to maximize the incentive effects for energy-related contributions. Both reward systems refer to energy-related contributions as exchangeable goods. The exchangeability of energy-related contributions enables individual and exclusive benefits for contributing householders, which again promote cooperative behaviour.

- **Strengthen social features** – next to the individual level (market mechanisms and alternative rewards), the initiator may also operate on the collective level, by reinforcing the social features of the neighbourhood. Such includes community management principles like participation, exchange possibilities and co-creation (Edelenbos et al. 2016; Edelenbos et al. 2017). Consequently, an energy service provider initiates a change of the *status quo* by strengthening the bonds between Energy Neighbourhood members.

The Community Maintainer role

The role of the energy service provider is to preserve the well-functioning of the community and to maintain the cooperation-friendly environment. Yet, the *status quo* remains unchanged. Instead of initiating a change (see initiator role) a community maintainer ensures behavioural continuity. The community provider orchestrates a community, in which freeriding is neither expected nor accepted. Not the single community members, but the energy service provider has the responsibility to ensure the community's goal. To sustain the community and to provide stability, a community maintainer has far-reaching competences to bind community members and acquire energy-related decision-making. A community maintainer regulates energy-related tasks to prevent unexpected freeriding-behaviour.

An energy service provider's entity of interest is the community and not the single decision-maker. The energy service provider actively regulates energy-related tasks on a collective level, i.e. micro-grid level. The used instruments are of technical and regulatory nature. The far-reaching competences of the community maintainer allows service providers to control the sum of iGSL-infrastructure of the local micro-grid. Thus, a service provider exerts explicitly the role of an infrastructure and network manager in order to maintain the community. Therefore, energy control, i.e.

Demand Side Management (DSM) and Distributed Energy Resources Management (DER), are areas of responsibility for community maintainer.

The Self-organization Facilitator role

An energy service provider, which deals with *moderate stability-seekers* must support the members’ efforts for self-organization. The service provider ensures the facilitation of such by using weak forms of guiding mechanisms, and therefore has, contrary to the two former roles, limited capacities to intervene. A self-organization facilitator sets the right framework conditions to maintain continuity within the neighbourhood. Hence, its role is of purely supporting nature. Contrary to the community maintainer role, a service provider facilitates self-organization but cannot be hold accountable for the community’s goals. As the social features of the neighbourhood seem to allow energy-related self-organization, the service provider provides supporting information, coaching and consulting services to the community. A self-organization facilitator makes use of recommendation- as well as of feedback-tools, offers individualized advices, fosters knowledge and experience exchange between members and organizes collective workshops and assemblies. ‘injunctive norms’ (Cialdini et al. 2006) and ‘nudges’ (Thaler and Sunstein 2009) are promising approaches to support the community’s efforts towards self-organization. Table 35 provides an overview of the most important characteristics of the three identified energy service provider roles.

Initiator	Community Maintainer	Self-organization Facilitator
enables change and serves as a compass,	ensures behavioural continuity,	sets the framework condition for the community’s effort for self-organization,
is expected to initiate a shift of motivation on the individual level,	is expected to maintain the cooperation-friendly environment,	is expected to facilitate and support self-organization
facilitates cooperative choices,	institutionalizes cooperative choices,	does not actively intervene in individual choices,
changes the status quo, and	status quo remains unchanged, and	status quo remains unchanged, and
uses market mechanisms, alternative reward systems, and strengthens social features.	controls infrastructure and network of the whole community.	has limited capacities to intervene, e.g. make use of ‘nudges’.

Table 35: Characteristics of Energy Service Providers

Explanation and Interpretation

The research results emphasize once more that the requirements regarding the orchestration of the decentralized energy market become more complex. Within low-density suburban neighbourhoods around Fribourg, heterogeneous claims regarding the management of local energy-related initiatives exist. Accordingly, different roles of energy service providers regarding community management were identified. Yet, ‘one size does not fill all!’.

The majority of the surveyed sample expects a service provider to set up steering mechanisms, which incentivize members to act to contribute to the local energy goals, i.e. energy service provider as an initiator. Opposed to the mainstream role, two further roles were identified. Proponents of profound interventions in energy related decision-making expect a service provider to maintain the community’s social features, while a minority of the sample expects to be supported in their attempt of self-organization, by setting framework conditions. Further, a not negligible number of householders are opposed to any form of intervention in individual energy-related decision-making.

Differing and opposing roles regarding energy community management are not surprising. The roles are based on differing preferences to allocate energy-related competences towards a third party as well as on differing justification to do so (Hertig and Teufel 2018). Explanations for such were presented (see: Chapter 6.4.2). Referring to Rogers’ work on innovation adaption processes (2003), socio-technical innovations like energy communities in Switzerland are situated within the knowledge stage on the societal decision-making process. In such a stage, the need for innovation is not necessarily given and basic comprehension of the innovation and its consequences might be vague and unclear for the majority of users (Rogers 2003). In such an early stage of innovation diffusion, individuals lack major experiences with the attributes of innovations (i.e. relative advantages, compatibility, complexity, trialability, and observability). Further, differing and opposing roles regarding energy community management may result through different approval of the social transition of neighbourhoods (cf. Mulugetta and Urban 2010; Roseland 2000). Accordingly, multiple configurations of energy communities and their management are construable at this stage of innovation.

To the author’s knowledge, the orchestration of mutually dependent and value-creating individuals facing energy-related collective action challenges is a unique business model. Although some business models incorporate autonomous co-creation (e.g. Wikipedia) or sponsored co-creation (e.g. P&G or IBM) (Zwass 2010), providing support to a co-creation community that faces a social dilemma challenge is an uncovered need. Since such business model is yet unknown to the energy sector in Switzerland, incumbents do not exist. Nevertheless, the different requirements for a service provider to exert its role will encourage or inhibit the entrance of different types of businesses and NGOs into the energy market. Competences in consultancy, mediation and platform management seem promising for the exertion of the initiator and the self-organization facilitator role. The challenge to steer a group of individuals towards a desired output without taking control over the necessary tasks for output achievement demands profound co-creation orchestration abilities. A community maintainer role, exerting infrastructure and network management, chiefly encourages companies with such competences, e.g. utilities, energy providers and network operators.

6.5 Conclusion ‘The Coordination of Energy Neighbourhoods’

This chapter concludes the ‘The Coordination of Energy Neighbourhoods’ by briefly summarizing the main results.

1. *Which energy-related tasks will be regulated by an energy service provider and to which degree?*

Energy-related tasks will not be *functional*. However, over one third of the participants can hope to reward decision-makers for cooperative behaviour. Choices for ‘*signalling tasks*’ were the most prominent (35.5%) followed by ‘*subjective tasks*’ (18%) and ‘*functional tasks*’ (17.7%). The heterogeneous claims can exacerbate the coordination of Energy Neighbourhoods.

2. *How do householders differ in their characteristics?*

In order to define the households’ characteristics, the surveyed sample was categorized according the Ward’s Method into nine different clusters using ‘Degree of Interference’ and ‘Joint Contribution’ as selection variables. Not only do the households differ in both variables, but differences in variation of other variables were also observed (see for overview: Figure 54).

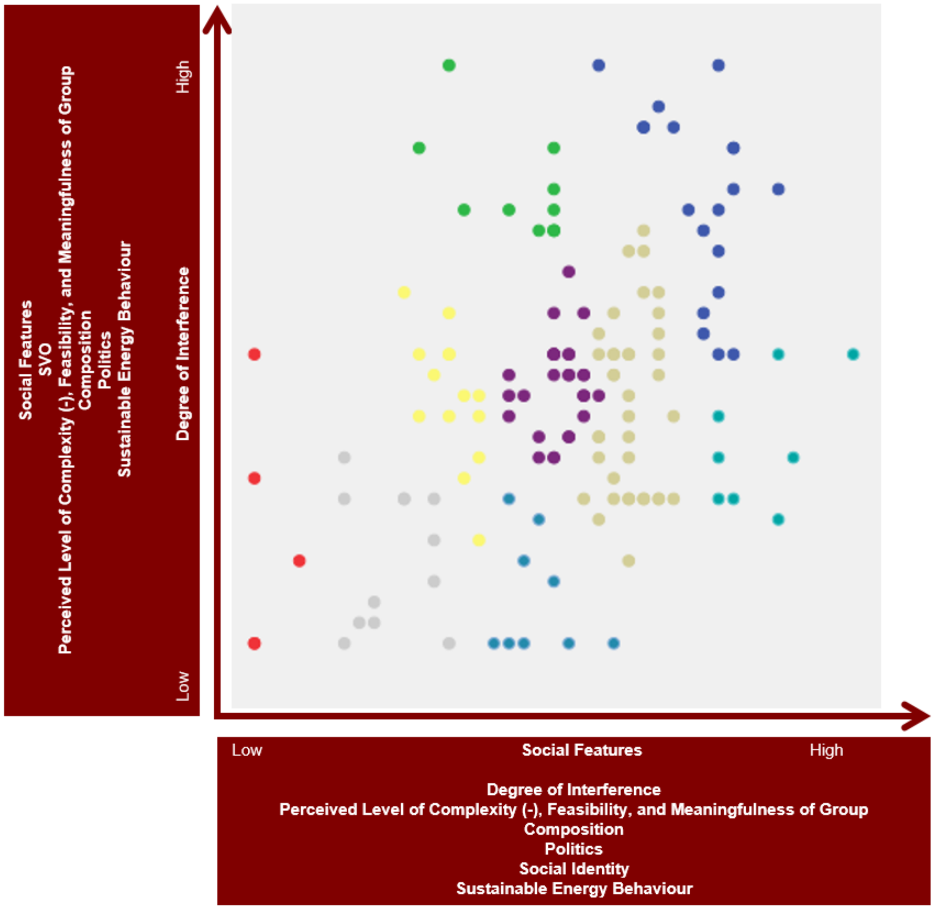


Figure 54: Characteristics of Householders

3. *What are the different justifications to regulate energy-related tasks?*

In settings of interdependence, different reasons justify different depths of service provider interventions in energy-related decision-making (cf. Hertig and Teufel 2018). Next to one group, which was opposed to any form of intervention (18.0% of the survey sample, ***The Opposition***), three further groups were identified:

- ***Signal-seekers***: 55.5% of the sample justifies moderate forms of interventions (signalling/steering) for mixed reasons (community consolidation and behavioural change).
- ***Stability-seekers***: 20.8% of the sample justifies substantial forms of interventions (obligations) for community consolidation reasons.
- ***moderate Stability-seekers***: 5.6% of the sample justifies moderate forms of interventions (signalling/steering) for community consolidation reasons.

4. *What is the role of an energy service provider in a setting of energy-related interdependence?*   Three different roles according to the depth and the justification for interventions were identified. In descending order of importance, the attributed roles of an energy service provider to coordinate Energy Neighbourhoods are the following: • **Initiator role**: the service provider enables and supports community members to act in a cooperative manner by using market mechanisms, alternative reward system, and reinforcing the social features of the community in order to guide and steer individual decision-making.   • **Community Maintainer role**: the energy service provider has far-reaching competences to bind community members and acquire energy-related decision-making in order to maintain the status quo and continuity.   • **Self-Organization Facilitator role**: The service provider ensures the facilitation of the community's attempt for self-organization by setting up the right framework conditions, and therefore has, contrary to the two former roles, very limited capacities to intervene in the individual decision-making.

Table 36: Conclusion 'The Coordination of Energy Neighbourhoods'

6.6 Learnings from the 'Energy Neighbourhoods' Inquiry

The main survey 'Energy Neighbourhoods' elicited some unexpected and interesting results, especially in its first part 'The Potential of Energy Neighbourhoods': a geographical community does not increase energy-related cooperation intention among individualists compared to an anonymous baseline scenario. Considering this surprising fact, a further inquiry was launched one year after the main survey, analysing the potential of service club affiliation on energy-related contribution intention.

7 Results ‘Energy Clubs’

This chapter presents the results from the second research inquiry. The setup of this results chapter is identical with the previous one (Chapter 6). Unless otherwise stated, same methodological procedures were undertaken. This chapter provides an overview of the sample results in general terms (uniform to Chapter 6.1.1 - 6.1.7). The most relevant results are separately presented in Chapter 7.1 and Chapter 7.2. Chapter 7.3 interprets the results. Chapter 7.4 concludes both research inquiries.

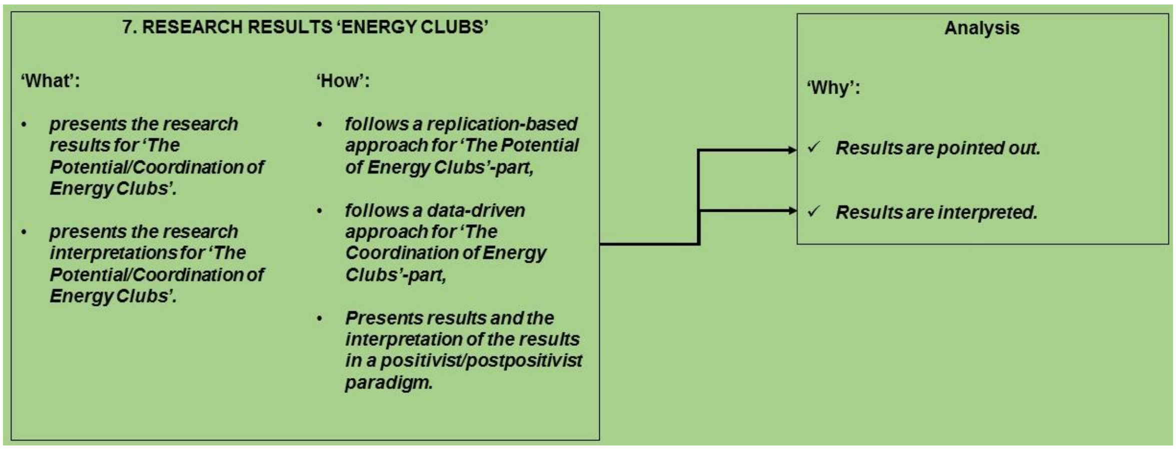


Figure 55: Chapter seven, Outlook

Composition of Results

As Table 37 shows, the sample was significantly smaller than the previously analysed sample. Compared to the former study, responses rate among the different groups were more balanced. The responses rate of the frame/survey population itself was lower than in the previous study (34.8% vs. 39.8%).

Service Club/*Language (d/f)*	**Contacts**	**Share of contacts**	**Responds (N)**	**Responses rate of Service Club %**	**Share of N**
Rotary Club Freiburg-Sense/*d*	52	45.2%	17	32.7%	42.5%
Lions Club Bern Metropolitan/*d*	30	26.1%	12	40%	30%
Lions Club Worblental/*d*	33	28.7%	11	33%	27.5%
	115	**100%**	**40**	**34.8%**	**100%**

Table 37: Composition of Results after Service Clubs

The small sample constituted a serious challenge for the comparison between the two populations and scrutinises the use of the data analysis techniques. Nevertheless, results are reported.

The demographic composition was to an important degree identical with the previous sample (especially 'ownership situation', 'average household size', and to some degree 'average age' of the units; see Table 38). Thus, a first criterion to compare both survey populations was met. Hardly surprising, the sample consisted of majorly male units (cf. Gull 2011). The low approval rates for the EnA can be explained by the quite large timespan between the vote on EnA (21 May 2017) and the enquiry period (May-June 2018). The rate of approval corresponds to the number of units that remembered that they voted in favour of the EnA. The remaining units either voted against the EnA or did not remember/did not want to share information on their voting behaviour.

Service Club/*Language* *(d/f)*	**Average Age** *(in years)*	**Gender**	**Average household size** *(in persons)*	**Service Club member since** *(in years)*	**Ownership Situation**	**Approval of EnA***
Rotary Club Freiburg-Sense/*d*	61	100% men	3	15.8	88.2%	53%
Lions Club Bern Metropolitan/d	54.5	83.3% men	2.9	6.4	91%	36.4%
Lions Club Worblental/d	60	100% men	2.7	16	91%	45%
*Average Lions Club Switzerland***	*60*	*88.7%*	-	*21.3*	-	-
Average Neigh-bourhoods	*57.3*	*78.5% men*	*2.87*	-	*90.4%*	*76.8%*

* voting on EnA was on 21.05.17. 25% of the units did not remember how they voted

** Source: Lions Club 2018

Table 38: Demographic Composition of Service Clubs

Sustainable Energy Behaviour

The entry-point to the questionnaire experiment did not constitute a cognitive challenge for the service club members: 97.5% of the sample filled out the first section completely. Service club members had lower scores for energy conservation behaviour based on curtailment than the previous sample (see Table 39). Further, the Cronbach's α score for the eight items had decreased from 0.62 to 0.57.

Items	**M (M $_{Neighbourhood}$)**	**SD (SD $_{Neighbourhood}$)**
Watch out for energy-efficiency labels if buying devices	4.53 (4.89)	0.88 (1.24)
Turning down/off heating before leaving for holidays	4.07 (4.57)	1.75 (1.74)
Turning off standby on electronic devices	3.05 (3.77)	1.62 (1.70)
Filling the washing machine	4.56 (4.78)	1.0 (1.15)
Taking short shower (< 5 minutes)	4.28 (4.69)	1.57 (1.35)
Usage of energy-saving bulbs	4.76 (4.92)	1.15 (1.17)
Avoidance of dryer usage	2.74 (3.99)	1.63 (1.81)
Switching of the light in unused rooms	5.00 (5.42)	1.08 (0.88)
Total	**4.13 (4.62)**	
Cronbach's α = 0.57 Note: The scale ranges from 1 ('never') to 6 ('always'). SEB items are not expected to correlate: they measure different energy behaviours of differing levels of difficulty. Therefore, alpha scores below .70 seem plausible.		

Table 39: Sustainable Energy Behaviour, Units

The SEB-scores differed among the different service clubs (see Figure 56). Members of Lions Club Worblental had slightly higher scores than the two other service clubs. Given the small sample size, no comparative analysis was done.

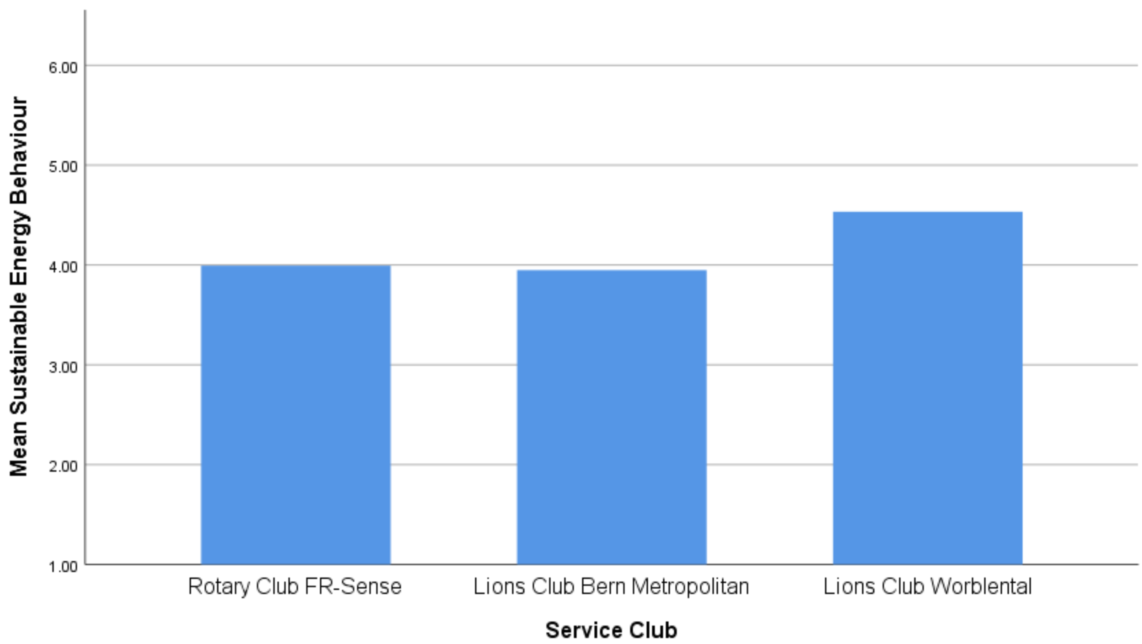


Figure 56: Sustainable Energy Behaviour, Service Clubs

Social Value Orientation

92.5% of the sample assessed the six primary items of the SVO Slider Measure completely, which led to 37 valid responses (see Table 40).

	Energy Clubs	**Energy Neighbourhoods**
Population	Members of service clubs in the region of Fribourg and Bern (Switzerland).	Registered householders in suburban neighbourhoods in and around Fribourg (Switzerland).
Measurement	SVO Slider Measure, six items	SVO Slider Measure, six items
Sample Size	37	310
Prosocials	18 (48.6%)	73.5%
Individualists	17 (45.9%)	23%
Competitors	2 (5.4%)	3.5%

Table 40: Social Value Orientation, Units

The group composition was different compared to the previous sample. Individuals with a proself inclination towards cooperation constituted a bare majority among service club members. Such group characteristics are uncommon and do not represent a representative sample of humankind, at least when comparing with other research. On the other hand, a charitable group consisting predominantly of proselfs is not necessarily contradictory (see Chapter 7.3 for argumentation). Comparing the scores for SVO°, members of Lions Club Worblental on average tend to have a more prosocial inclination than members in the other service clubs. Moreover, average SVO° scores of members of Lions Club Worblental were comparable with these of the former study (see Figure 57).

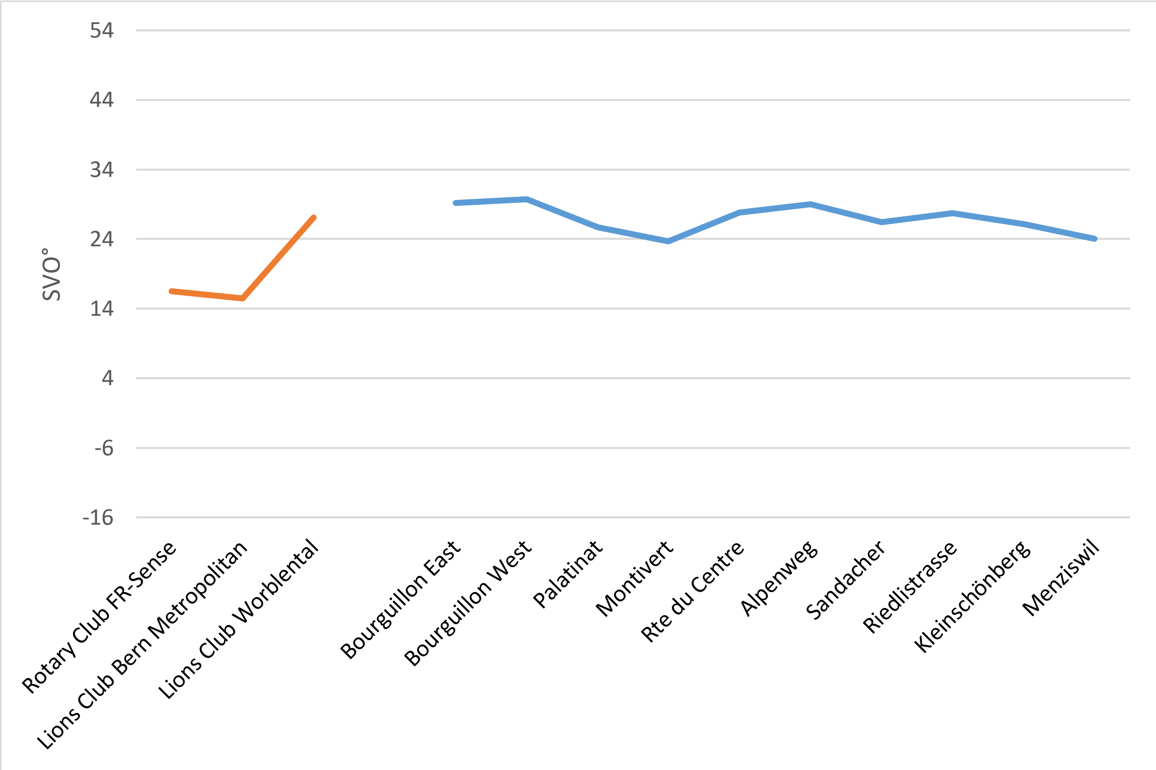


Figure 57: Social Value Orientation, Service Clubs

Eliminatory question

90% of all service club members identified correctly 'Mister C.' as the only free rider in the 'Crowd Alpenblick'-scenario. Compared to the 80.7% in the former study, the sample of service club members had less difficulty to identifying a fictional free rider.

Service Club	Units (N)	% of N	EQ-participants (n)	% of n
Rotary Club Freiburg-Sense	17	42.5%	17	47.2%
Lions Club Bern Metropolitan	12	30%	10	27.8%
Lions Club Worblental	11	27.5%	9	25%
Total	**40**	**100%**	**36**	**100%**

Table 41: Eliminatory Question, Results

Manipulation of Group Composition

The distribution of prosocials, individualists, competitors and unidentified participants differed between the Anonymus condition (55.5% prosocials, 44.5% individualists) and the Energy Club condition (33.3% prosocials, 44.5% individualists, 11.1% competitors and 11.1% unidentified). As shown in Table 42, the Energy Club condition had a more individualistic inclination towards cooperation than the Anonymus group. Only EQ-participants were counted (n=36).

Social Value Orientation	**Anonymus**	**Energy Club**
Prosocials	10	6
Individualists	8	8
Competitors	0	2
Unanswered	0	2
Total	**18**	**18**

Table 42: Composition of Groups

As shown in Table 43, both conditions had, compared to the former study, on average higher scores for social identification.

Items	**Anonymus**	**Energy Club**
common interests	4.17 (SD 1.58) *3.73 (1.7)*	5.35 (SD 0.58) *4.43 (0.29)*
Affiliation	3.95 (1.74) *3.13 (1.7)*	5.45 (0.60) *4.23 (1.41)*
Attachment	2.16 (1.26) *2.12 (1.26)*	4.85 (0.98) *4.15 (1.50)*
Knowing group members	2.00 (1.37) *1.89 (1.21)*	5.00 (1.07) *4.3 (1.82)*
Cronbach’s α = 0.85 Scores in italics represent the score for the Energy Neighbourhood survey. Note: The scale ranges from 1 (‘totally disagree’) to 6 (‘totally agree’).		

Table 43: Scores for Social Identification, Units

Consequently, a one-way ANOVA assessed the effects of the two conditions (‘Anonymus’ and ‘Energy Club’) on the mean social identification score, SI. The two individuals with unidentified SVO were included in the analysis. Levene’s Test showed that equal variances could be assumed (p = .106 based on median scores) There was a significant difference in the mean group identification score for the different conditions $F(1, 34) = 51.497$, $p < .001$. Participants within the Anonymus condition had lower mean identification scores (M = 3.01, SD = 1.04, N=18) than participants within the Energy Club condition (M = 5.19, SD = 0.75, N=18). Scores for each SVO in each condition are presented in Table 44. Thus, manipulation of both groups was successful and **H_{1B} was confirmed**.

Condition	SVO	Mean
Anonymus	Prosocials	2.95
	Individualists	3.09
Energy Club	Prosocials	5.45
	Individualists	5.30
	Competitors	3.89

Table 44: Scores for Social Identification, SVO & Condition

H_{1B}: Social identification scores in the condition ‘Energy Club' are higher than the social identification scores in the condition ‘Anonymus’: confirmed

A one-way ANOVA showed that the SVO had no impact on the level of the identification score $F(2, 33) = 0.397$, $p = 0.676$, N=36. Prosocials had identical identification scores ($M = 3.9$, $SD = 1.54$, N=16) as competitors ($M = 3.89$, $SD = 1.23$, N=2). Individualists had the highest score ($M = 4.31$, $SD = 1.37$, N=18). Scores for social identification differed slightly among service clubs (see Figure 58).

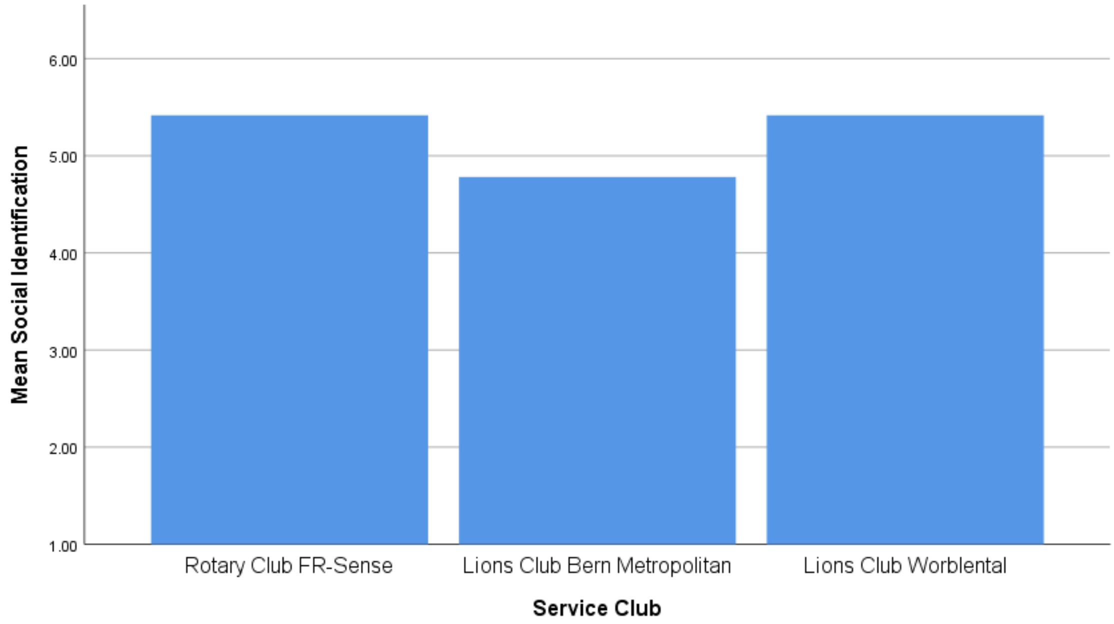


Figure 58: Scores for Social Identification, Service Clubs

Approval of the condition

The participants (N=34, only *EQ-participants* with an assignable SVO) were asked about their approval and comprehension of the two different conditions. Figure 59 provides an overview of the results and compares them with the results from Energy

Neighbourhood inquiry. Compared to the former survey, energy club members approved the energy community concept more distinctly.

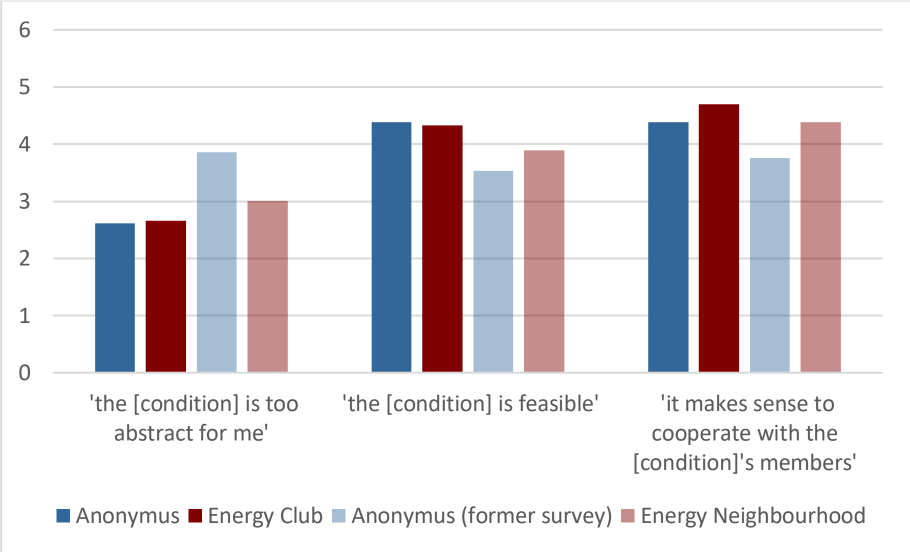


Figure 59: Approval of Condition, Comparison

7.1 Results ‘The Potential of Energy Clubs’

The sample included only EQ-participants with an assignable SVO that filled out all four items of section 5.1 (N=35, see Table 45).

	Anonymus (N=18)	Energy Neighbourhood (N=17)
Prosocials (n=16)	10	6
Individualists (n=17)	8	9
Competitors (n=2)	0	2

Table 45: Contribution Intention, Group Compositions

The four items measuring energy-related contribution intention had an acceptable Cronbach’s alpha score, α = 0.73 (see Appendix 16). The four single variables could therefore be computed to a single variable, mean contribution intention.

H_{4B}

A two-way (SVO, Condition) ANOVA was conducted. According to boxplot examination, the sample had no unusual outliers (see Appendix 17). Levene's Test for equality of variances was insignificant, p > .05. Figure 60 shows the interaction between SVO and Condition for Mean Contribution Intention. There was no statistically significant interaction between SVO and Condition for the ‘Mean Contribution Intention’ score, $F(1, 30) = 0.48$, $p = .49$, partial $\eta^2 = .016$.

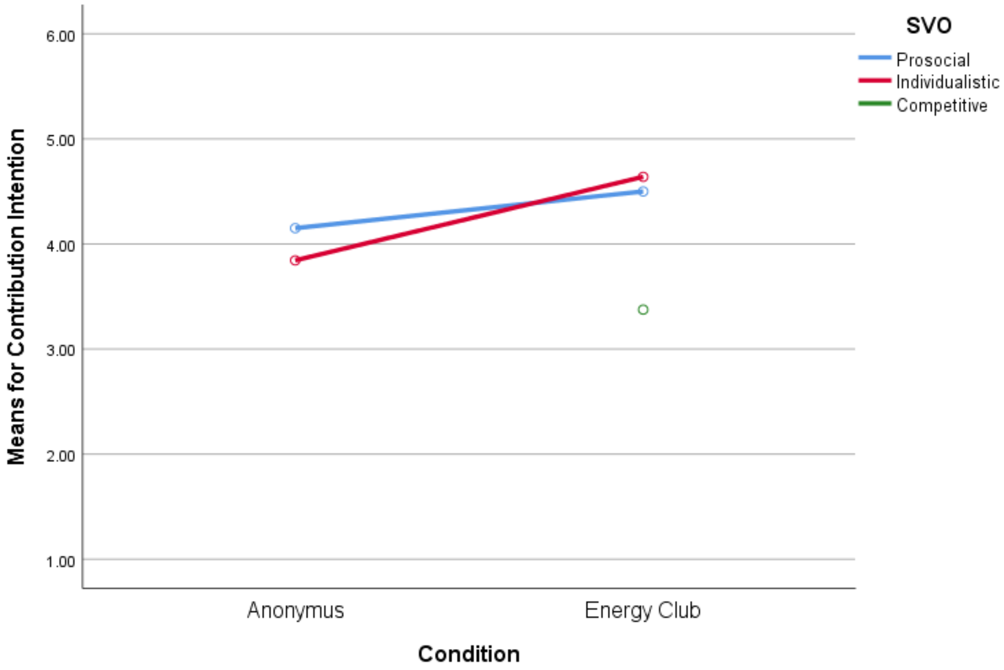
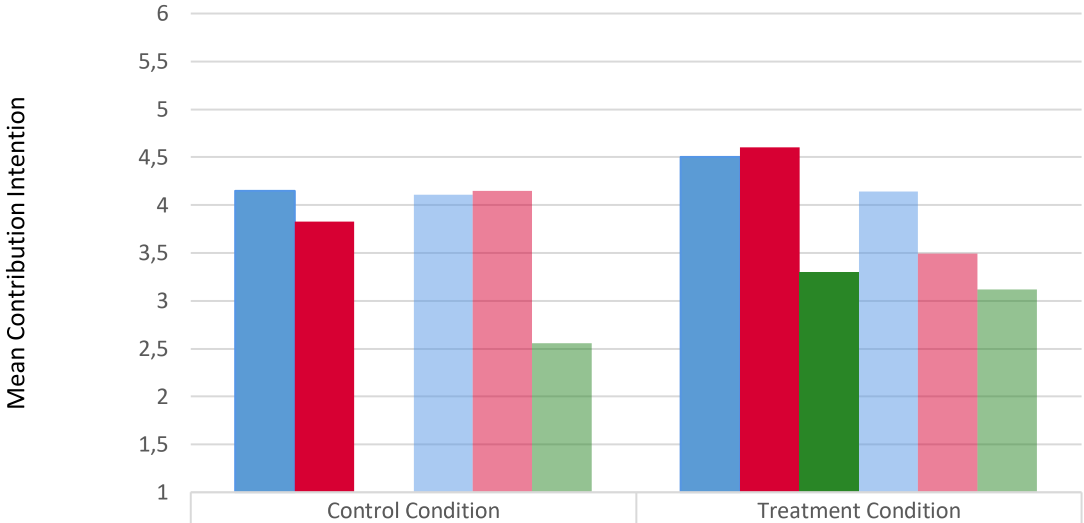


Figure 60: Interaction between SVO and Condition for 'Contribution Intention'

Although no significant interaction effects for both samples existed, different reactions, or at least ‘reaction tendencies’, on the treatment variable ‘social identification’, compared to the former study were discernible. First, both largest groups (individualists and prosocials) tended to react positively on the treatment. Second, individualists reacted tendentially stronger than the prosocials to the treatment. In the former study, only individualists reacted (negatively). Nevertheless, since the interaction effect is not significant, **H_{4B} has to be rejected**.

H_{4B}: In the condition ‘Energy Club’, individualists and competitors will contribute more than individualists and competitors in the condition ‘Anonymus’: rejected

Figure 61 compares both samples. In both samples, similar control condition scores for mean contribution intention for individualists and prosocials were found. This indicates that the setting ‘Anonymus’ represented a reliable anonymous baseline for energy communities for individualists and prosocials. No competitor was surveyed in the control condition for Energy Clubs. By tendency, ‘social identification’ had a general positive effect on energy-related contribution intention for communities of relations. For neighbourhoods, the treatment affected only the small group of competitors in the desired direction.



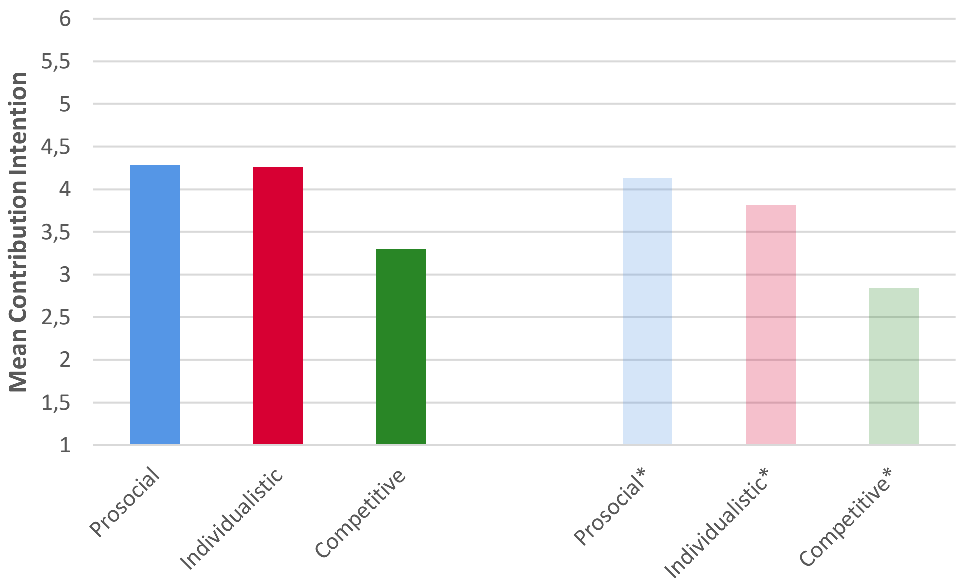
	Control Condition	Treatment Condition
Prosocial	4,15	4,5
Individualistic	3,83	4,6
Competitive		3,3
Prosocial*	4,11	4,14
Individualistic*	4,15	3,49
Competitive*	2,56	3,12

Note that individuals marked with ‘*’ are surveyed units of the ‘Energy Neighbourhood’ inquiry.

Figure 61: SVO, Social Identification, and Mean Contribution Intention, Comparison

H_{2B}

Figure 62 shows the mean contribution intention scores regarding different SVOs. There was no statistically significant main effect of SVO, $F(2, 32) = 0.88$, $p = .425$. The unweighted mean contribution intention score for prosocials, M = 4.28 (SD = 0.87), was like the scores of individualists, M = 4.26 (SD = 1.00) and higher than those of the competitors’, M = 3.37 (SD = 0.17). **H_{2B} has to be rejected**.



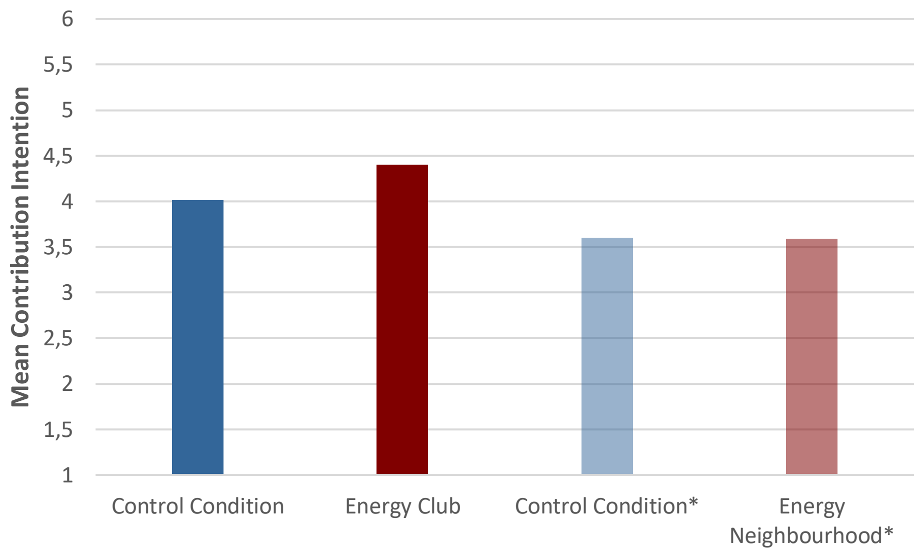
Note that individuals marked with '*' are surveyed units of the 'Energy Neighbourhood' inquiry.

Figure 62: SVO and Mean Contribution Intention, Comparison

H_{2B}: A main effect for SVO is expected such that a greater proportion of prosocials than individualists and competitors intend to contribute to the community goals: rejected

H_{3B}

Figure 63 shows the mean contribution intention scores regarding different conditions. There was no statistically significant difference in 'Contribution Intention' score for the two different conditions, $F(1, 33) = 1.9$, $p = .17$. The unweighted mean contribution intention score in the anonymous condition, M = 4.01, was lower than the unweighted mean contribution intention score in the 'Energy Club' condition, M = 4.4. **H_{3B} has to be rejected**.



Note that individuals marked with ‘*’ are surveyed units of the ‘Energy Neighbourhood’ inquiry.

Figure 63: Condition and Mean Contribution Intention, Comparison

H_{3B}: A main effect for social identification is expected such that average contribution intention scores in ‘Energy Club’ are higher than in ‘Anonymus’: rejected

Expectations

The sample included only EQ-participants with an assignable SVO that filled out all four items of Section 5.1 and all four items in Section 5.2 (N=35). According to boxplot examination, the sample had no unusual outliers. (see Appendix 17**Fehler! Verweisquelle konnte nicht gefunden werden.**). The four items measuring energy-related expectations had a good Cronbach’s alpha score, α = 0.88 (see Appendix 18). The four single variables could therefore be computed to a single variable, ‘mean expectations’.

A two-way (SVO, Expectations) ANOVA was conducted. Levene's test for equality of variances was insignificant, $p > .05$. There was no statistically significant interaction between SVO and Condition for the ‘Mean Expectations’ score, $F(1, 30) = 0.137$, $p = .714$, partial $\eta^2 = .005$.

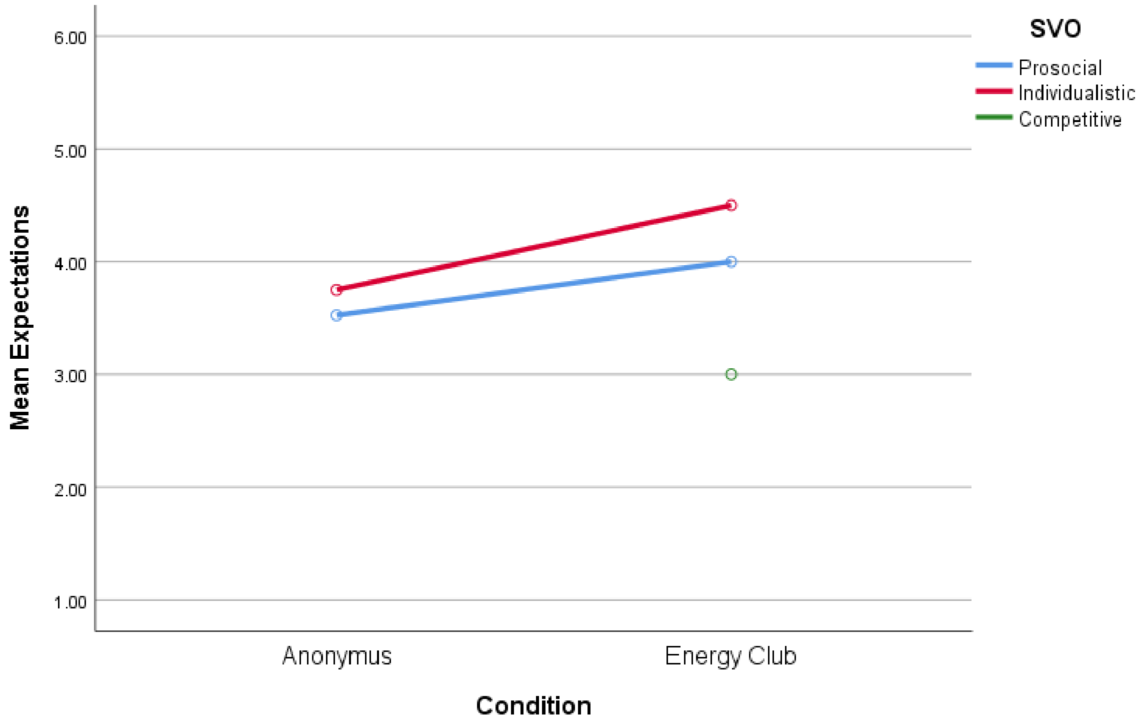
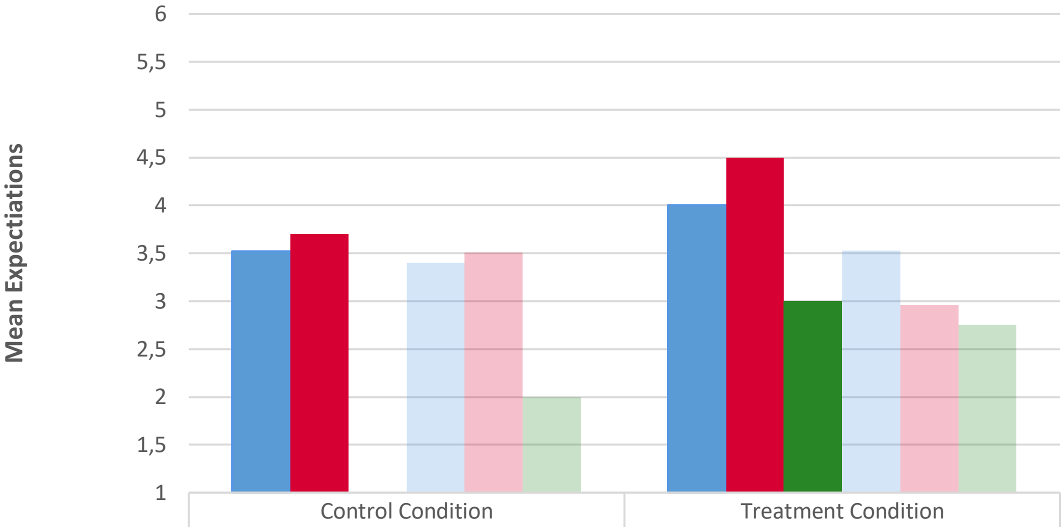


Figure 64: Interaction between SVO and Condition for Mean Expectations

Figure 64 shows the weak interaction effect of SVO and condition on scores for mean expectations. Individualists had a slightly higher increase in scores than prosocials. Again, individualists and prosocials in both samples had similar expectations regarding anonymous persons in the control conditions (see Figure 65). On the other hand, service club members with an individualistic and a prosocial inclination towards cooperation expected massive higher contribution efforts from their club members, than neighbours expect from other neighbours. Moreover, individualistic service club members expected from other members an increase in energy-related efforts, while individualistic neighbours expect decreasing contribution efforts. From an expectations-point of view, it seems that relation-based communities possess important advantages compared to communities of place, e.g. neighbourhoods.



	Control Condition	Treatment Condition
Prosocial	3,52	4
Individualistic	3,7	4,5
Competitive		3
Prosocial*	3,4	3,53
Individualistic*	3,51	2,96
Competitive*	2	2,75

Note that individuals marked with ‘*’ are surveyed units of the ‘Energy Neighbourhood’ inquiry.

Figure 65: SVO, Social Identification and Mean Expectations

7.2 Results ‘The Coordination of Energy Clubs’

The sample (N=17) contained only *EQ-participants* that expressed preferences in all seven sub-domains for the condition ‘Energy Club’. Given the small sample, only descriptive results could be presented. Section 6 of the questionnaire had a randomized design for the order of answer possibilities across all seven sub-domains. Further, the sample included only participants that expressed their own contribution intention as well as their expectations of others across all eight items (Section 5.1 and 5.2 in the survey).

Design of Energy Clubs

According to Figure 66, the energy-related tasks in most of the seven sub-domains will be of a *signalling* nature. Members forming an ‘Energy Club’ showed clear preferences to reward energy-related contribution in the infrastructure and the storage-management domains. On the other hand, contributions in the load management domain were less regulated, i.e. a distinct majority has a more *subjective* design. Like the previous sample, we also find a clear preference for regulations of energy-related tasks over punishing free riders.

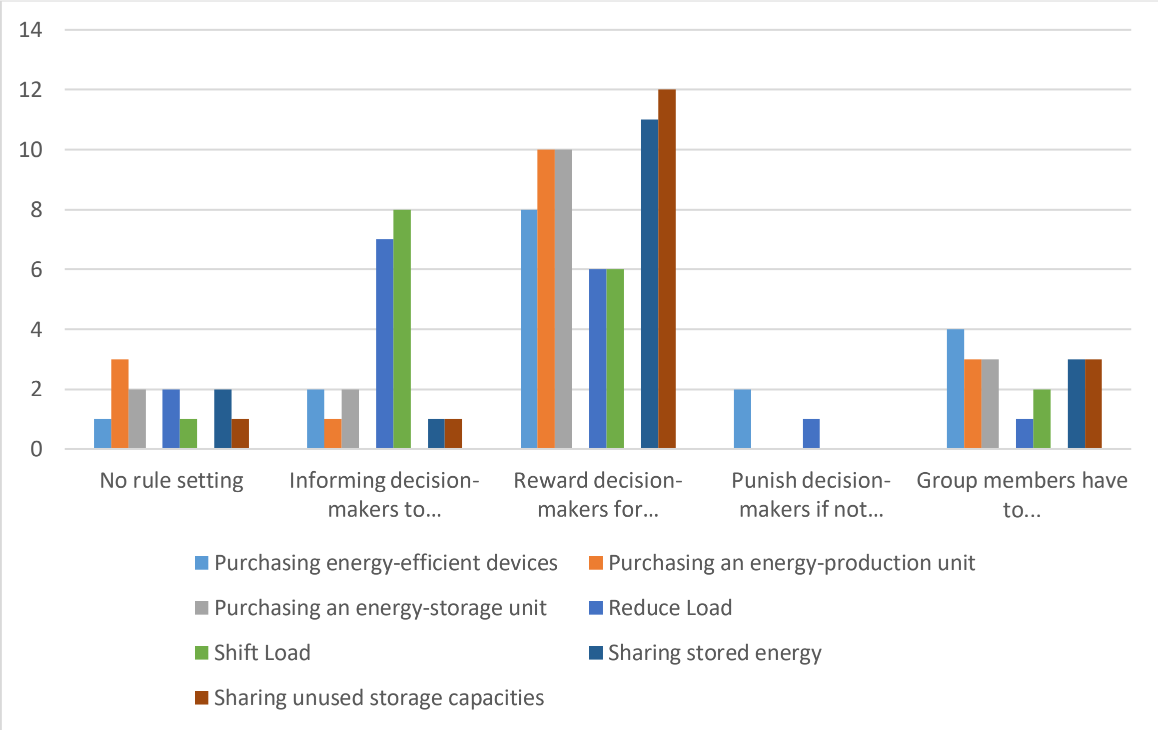


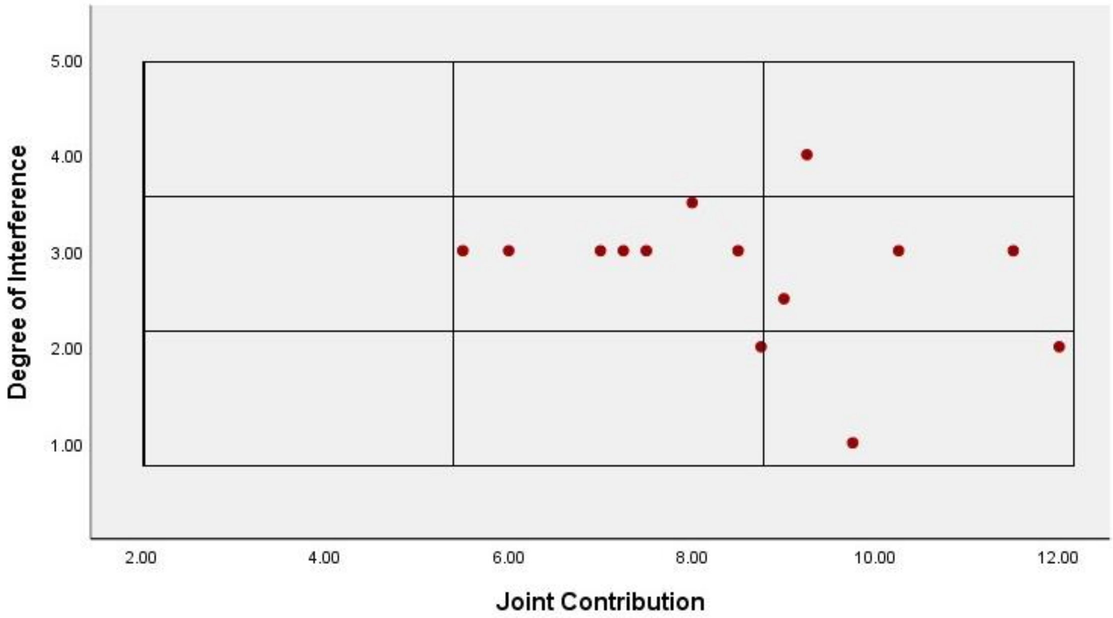
Figure 66: Rules for Energy Clubs

Taking a general view on ‘Energy Club’ design, strong preferences for a design that rewards decision-maker (53% of all responses) followed by ‘informing decision-makers’ (18.5%), ‘obligation to’ (16%), ‘no rules’ (10%), and ‘punishing decision-makers’ (2.5%) were found.

Member Categorization

In order to categorize on the Energy Club members according the ECMF, same procedures were undertaken as in Chapter 6.4.2. DOEC scores (*M* = 0.29, *SD* = 0.76, *min*. = -1.00, *max*. = 1.75, N = 17) were better than in the previous study (*M* = 0.68, *SD* = 0.84, *min*. = -1.25, *max*. = 4.0, N = 148): service club members believed that their contribution intention is on average only 0.29 points higher than the expected contribution intention scores of other members. 17.6% of the members had a DOEC score of ‘0’, indicating they expect the same contribution intention from their members as their self-reported own contribution intention. More problematic was the sample’s 29.4% of the sample having a DOEC score of ‘1’.

Given the small sample, cluster-building and member categorization was aggravated. Figure 67 provides an overview of the sample according to the ECMF. However, no comparative results based on member categorization can be drawn.



Note that a single dot can represent different overlapping units.

Figure 67: Energy Club Member Categorization

According to Figure 67, service clubs members had sketchy tendencies towards a *signalling* design, based on either 'community consolidation' or 'behavioural change and community consolidation' justifications. Further interpretations were not possible due to missing clustering possibilities (since N=17).

There was no significant correlation between the variables 'Degree of Interference' and 'Joint Contribution' $r_s = -.321$, $p > 0.05$. Based on further Spearman's rank-order correlation tests for 'Joint Contribution' and 'Degree of Interference', significant positive correlations were found for 'Joint Contribution' with different other variables but not for the 'Degree of Interference' with other variables. The strongest correlation was found between the variables 'Joint Contribution' and 'Social Identification' $r_s = .732$, $p > 0.01$ (see Table 46).

	Joint Contribution	Degree of Interference
Joint Contribution	r_s = 1	r_s = -.321
Degree of Interference	*rs = -.321*	r_s = 1
SVO	*rs = -.205*	r_s = .443
Level of Cognitive Complexity	*rs = -.440*	r_s = -.309
Level of Feasibility	*rs = .646***	r_s = .030
Meaningfulness of Group Composition	*rs = .573**	r_s = -.140
Gender	-	-
Age	*rs = .477*	r_s = -.168
Politics (refusal of EnA)	*rs = -.144*	r_s = -.009
Social Identification	*rs = .732***	r_s = -.286
SEB	*rs = .537**	r_s = -.194*
Service Club membership	*rs = .581**	r_s = -.090
Household size	*rs = -.226*	r_s = .327
Ownership situation†	-	-
Notes: * = Correlation is significant at the 0.05 level (2-tailed). ** = Correlation is significant at the 0.01 level (2-tailed).		

Table 46: Spearman's rank-order correlations for 'Joint Contribution' and 'Degree of Interference'

7.3 Interpretation of 'Energy Club' Results

The aim of the study 'The Potential and the Coordination of Energy Clubs' was to test the energy-related 'goal-transformation' hypothesis in relation-based communities. Accordingly, members of three regional service clubs were surveyed. The interpretation of the results is aggravated since the sample size was quite limited (N=40). The (mostly) statistically insignificant results are interpreted carefully. Statistical comparison to the much larger sample of the former study, 'Energy Neighbourhoods', is not possible. Descriptive comparisons are only interpreted to call attention to certain relevant points, e.g. demographics.

As anticipated, the sample's demographics are akin to the sample of 'Energy Neighbourhoods'. The high degree of homeowners (88.2-91%) and the average age (59 years) across the three service clubs corresponded to the former sample. The demographic resemblance of both samples is important, since it allows comparison of individuals with potentially the same range of energy-related decision-making.

Further, there was no evidence that the three surveyed service clubs demographically differed from other service club compositions in Switzerland (see Table 38).

The quality of responses among service club members was highly satisfying. Cognitive sophisticated sections in the questionnaire (e.g. SVO assessment and eliminatory question) were mastered nearly without problems compared to the former study. Higher cognitive capacities, more leisure time, and greater interest in the topic the club members are potential but untested reasons for such.

The surveyed sample comprises an over-average amount of 'proselfs', i.e. 51.3%. Such a high percentage is unusually high if comparing with other studies including SVO assessments (see also Chapter 3.5.1), but it is not surprising for service club members. As mentioned earlier, one aim of joining a service club is to do charity work and help other people. Such goals depict a form of social behaviour. This indicates that individualists and competitors exhibit social behaviour under the right circumstances and actively search for such. Service club affiliation reduces individual search costs for helping services, increases personal and collective efficacy of contribution, and increases visibility of individual contributions. Compared to individual charity work, belonging to a service club facilitates contribution through changes in the 'features of decision' and the 'features of the situation' (cf. Parks et al. 2013). Further, service club membership produces 'private goods', like building or maintaining a professional network. Both points not only demonstrate why 'proselfs' join a service club, but also why 'proselfs' engage in social behaviour.

Social identification scores with other group members were distinctly higher than the social identification scores within neighbourhoods. Since entering a club or an association is an active and deliberate act to join a group with a set of values and beliefs, these results were expected. Such value-centric arguments are probably of only secondary importance when settling down in a neighbourhood, where place-linked arguments are more important. Moreover, being an active member and engaging in an association's set of values leads to and results in a stronger and more salient form of 'collective identity' than engaging with neighbours where such sets are less pronounced or even non-existent (cf. Simon and Klandermans 2001). Accordingly, group composition manipulation, $\mathbf{H_{1B}}$, **was** successful and **confirmed**.

Interpretation of Main Results of ‘Energy Clubs’

Of the three remaining research hypotheses, $\mathbf{H_{2B}}$, $\mathbf{H_{3B}}$, and $\mathbf{H_{4B}}$, **none were confirmed**. The missing significance levels are probably due to the small sample and group (SVO, conditions) sizes. Interpretation of insignificant results based on small samples are problematic, since it does not necessarily rely on reliable observations but on mere hazards. The scientific truth, the aim of positivist/postpositivist research, cannot be revealed on such premises. Further, the two testing conditions, ‘Anonymus’ and ‘Energy Club’, had differing group compositions: The ‘Energy Club’ testing composition was distinctly more individualistic than the anonymous one.

Nevertheless, if comparing to the former study, the ‘Energy Club’ inquiry revealed some contradictory tendencies that need further research attention. The following observations need further consideration.

- The social vessel ‘Service Club’ tends to increase energy-related contribution intention among individualists and prosocials. Both processes, ‘goal-amplification’ and ‘goal-transformation’, were perceptible but not statistically detectable. Individualists reacted stronger to the group composition manipulation. Comparative results for competitors were not possible since such were allocated in the treatment group only.

  Further, the ‘goal-transformation’ hypothesis showed to have some important limitations when considering multiple ‘collective identities’. Identity based on geographic characteristics, e.g. ‘a habitant of neighbourhood XY’, did not necessarily lead to some promotion of cooperation, whereas identity referring to club/association membership, e.g. ‘a member of the association YZ’, seemed to have a generally positive effect. The fundamental attitude towards members of such communities seemed to differ and finally influence individual contribution intention.

  A possible explanation for the differing results may lay in way units construed ‘trust’ and ‘expectations’. Construing expectations and trust on a generalized level promotes a cooperation-friendly environment (cf. Stolle 1998). On the other hand, linking expectations and trust to single individuals and individualized experiences may lead to important negativity-biases (cf. Haizlip et al. 2012; Sutherland 2011). However, it remains unresolved how and which experimental units actually construed expectations and trust differently. Nevertheless, the results go hand-in-hand with recent literature that also showed that not every kind of social identification necessarily leads to an increase in cooperation (cf. Jans et al. 2018; Reese et al. 2018).

- The prevailing positive relations between club members seem to be fertile soil for energy-related cooperation in settings of interdependence. Club members tend to have distinctly higher scores for social identification, intend to contribute more to the community’s goals, and expect higher contribution efforts from other members. Relations between members of place-based communities tend also to have an impact on energy-related cooperation but did not have the desired effect.
- The coordination of ‘Energy Clubs’ tends towards a *signalling design*. Further member categorization and design justification analysis according to the ECMF were not possible.

7.4 Conclusion ‘Energy Clubs’

Measured by the incentive effect, there is no significant proof that the social identification with a group composed of members of a service club affects individualistic and competitive householders’ energy-related contribution intention in settings of interdependence (N=35). However, overall scores for energy-related contribution intention were higher in the Energy Club condition than in the anonymous condition (for individualists and prosocials). In light of the ES2050, these findings are highly encouraging and desired. On the other side, given the small sample size, no important statistically significant results were found.

Nevertheless, in combination with the former survey, this part of the thesis generates important value for research as well as for energy policy development, even though significant results are missing. Three main conclusions can be drawn (Table 47).

Finding 5a: Differing features of the interdependence situation affect energy-related contribution intention.
‘Contribution Intention’ scores in the conditions ‘Anonymus’, ‘Energy Neighbourhood’ and ‘Energy Club’ differed.

Implications:

In order to implement the ES2050 successfully, energy policy developers need to consider the social features in energy-related decision-making. Similar insights were recently gained by other authors (e.g. Jans et al. 2018; Frick et al. 2017; Reese et al. 2018). Yet, this thesis showed that scores for contribution intention differed not only between the control and the treatment group (in which group identification was made salient), but also between different treatment groups. Consequently, contributions to the ES2050 goals depend, among other reasons, on the group composition. If contributions towards the ES2050 are framed as a local public good, mean contribution scores remain identical to mean contributions in an anonymous setting. However, if contributions towards the ES2050 are framed as a public good situation for a group composed of the same-minded people (clubs or associations) contribution scores tend to increase. The feature of the interdependence situation, i.e. the mere social aspects in settings of interdependence, seems to have a different impact on an individual’s energy-related contribution intention.

Conclusions:

Energy policy developers need not only to acknowledge the social dimension behind ES2050 contributions, but they also need to create conditions that allows energy communities to be formed based on prevailing social relations, which promotes energy-related cooperation. That requires a clear commitment for market liberalization, to foster new business models, which empower energy communities. Such business models should support ‘social energy spaces’[24] that are based on prevailing social relations between its members. Further, the potential of energy communities will only be fully exploited when policy-makers recognize the energy communities’ minimal right to organize and to define their ‘social energy space’.

Finding 5b: Differing features of the interdependence situation affect energy-related contribution intention of individuals with different SVO differently.

[24] The concept of ‘social energy spaces’ refers to the sociological definition of social spaces (cf. Bourdieu 2018). Social energy spaces reflect particular conditions and regulative mechanisms which are shaped by and recognizable in the energy-related behaviour and energy-related judgment of the individual.

Prosocials, individualists, and competitors reacted differently when cooperating with anonymous persons, neighbours, or club members towards common energy goals.

Implications:

Even though significant interaction results were missing, the treatment variable led to different reactions among the different SVO. Compared to the control condition, prosocials had identical contribution intentions when cooperating with neighbours, individualists decreased, and competitors increased their contributions. When cooperating with other service club members, prosocials and individualists tended to increase their contribution intention. Consequently, individual evaluation of the ‘social energy space’ differed and might even provoke opposing reactions.

Conclusions:

Accordingly, salient social identification activates different energy-related decision-making processes among different SVOs. Social identification does not necessarily lead to a transformation of energy-related goals. Under certain conditions, even the opposite seems more realistic. Accordingly, next to the importance of the social aspects of the energy transition and the creation of social spaces for energy-related cooperation (Finding 5A), individual evaluation of such is equally fundamental (Finding 5B). The individual reactions to different group compositions does not simplify the ongoing energy transition. Policy-makers need to acknowledge potential differing effects of social identification on energy-related contribution intention and therefore implement additional mechanisms to steer individual behaviour in a desired direction.

Most likely, there will always exist some individuals that remain immovable to changes of the interdependence feature or even reject such. A policy framework that a) enables testing and learnings of/from different features and b) is congruent to community needs in order to elaborate ‘social energy spaces’, is necessary to increase energy-related cooperation.

Finding 6: The expectations regarding the coordination of energy communities lag the optimal degree of allocation of energy-related decision-making towards a third party in settings of interdependence.

Energy-related tasks are not perceived as ‘functional’ but as ‘signalling’, whereas an energy service provider will exert a role that cannot impose cooperation, but it rewards individuals that behave so.

Implications:

In both research inquiries, only a minority recognizes the necessity to allocate energy-related decision-making towards a third party in order to guarantee an ensured collective outcome. The optimal allocation and referring to the work of Elinor Ostrom (1990), would be from a community point of view, to implement a *functional* design, that clearly dictates how the members have to contribute to the energy goals. However, the subjective expectations differ from the normative community design principles. Householders prefer a *signalling* community design, in which energy-related tasks are encouraged but not imposed. Accordingly, energy goals can only be achieved if the rewards (or punishments) constantly incentivize community members to contribute. The discrepancy between the desired energy community design and the normative ideal solution has some important implications. Such discrepancy reflects a typical socio-political challenge in which citizens must on one side carry progressively more responsibility for societal and environmental purposes and on the other side restrict their own freedom of individual decision-making. Given the still well-functioning current energy system and the absence of important energy-related issues in Switzerland, e.g. blackouts, terrorist attempts on power plants, massive increase of utility prices, etc., the challenge to persuade society to contribute to remote energy goals becomes even more demanding. Energy policy developers must initialize a societal discourse, inform citizens on potential consequences, and create societal awareness in order to ensure a sustainable energy system based on functional energy communities.

Conclusions:

The citizens’ preferences for the design of energy communities tend towards a *signalling* design. Given the rather reserved energy-related contribution intention (especially in the condition ‘Energy Neighbourhood’) the achievement of common

energy goals remains uncertain. From a normative point of view, a functional design is needed to guarantee such. The discrepancy between the actual householders’ preferences for energy community designs and the normative design of energy communities poses an important challenge in the ongoing energy transition. Influencing householders’ preferences towards a functional energy community design will be of crucial importance for energy policy developers.

Table 47: Conclusions 'Energy Communities'

8 Research Conclusions

The chapter reviews the research's limitation and the research results, presents applicable recommendations, and finally discusses future research options. Figure 68 provides an outlook of the chapter.

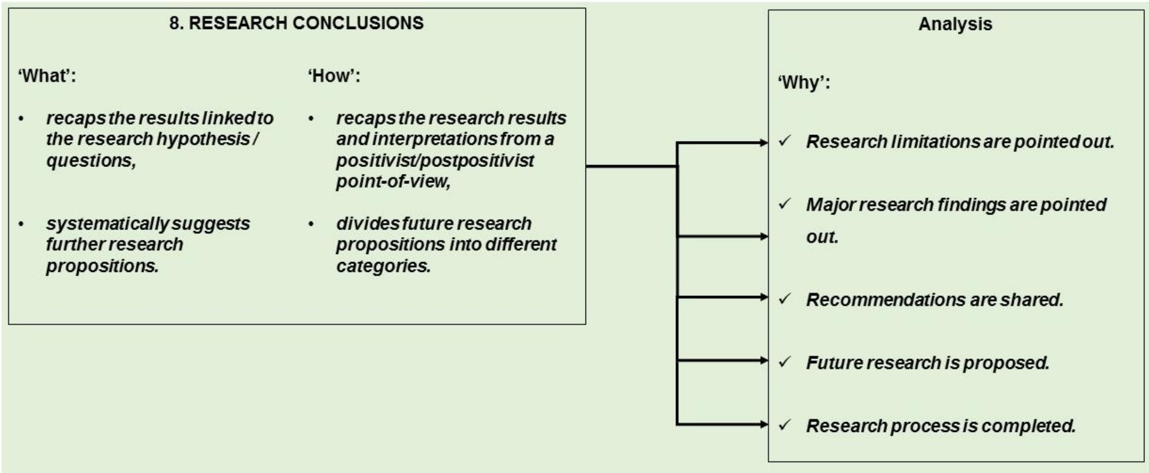


Figure 68: Chapter eight, Outlook

8.1 The Research's Limitations

A first limitation is the validity and robustness of findings that were linked to the 'Energy Community Management Framework' (ECMF) from Hertig and Teufel 2018. The ECMF describes the role of an energy service provider as a third party intervening in an energy-related dilemma. The role is categorically defined by the degree of interference in individual energy-related tasks and by its justification to do so. The framework is inspired by real-life observation for which the authors deduced different motives for third-party interventions. However, such interpretation was not verified nor pre-tested. A qualitative pre-test would have allowed testing the concept and to compare the author's and the sample's interpretation of a third party's role. Such comparisons would increase the EMCF's validity and robustness dramatically. On the other side, the EMCF was used within a data-driven research endeavour. In such, uncovering stylized facts, e.g. surprising and undocumented facts, is the main purpose. Accordingly and in light of the selected type of research, the application of the ECMF nevertheless allowed the identification of patterns (as shown in Chapter 6.4.2 and 6.4.3) as well as to reveal actual stylized facts. The empirical validation of different patterns and stylized facts would allow investigating the ECMF concept in more concrete and replication-based research.

A second limitation of this thesis is, as in most replication-based research, linked to potential threats of extraneous variables. Although threats were categorized as ‘low’ (see Chapter 5.7.3), some ex-post comments of responders gained the author’s attention. Given the small but important differences in the original study (see Table 9) further control variables could have been integrated in the questionnaire, which would also explain energy-related contribution intention. Table 48 highlights a non-exhaustive list of such.

However, two arguments were opposed to including such control variables. First and from a ‘research claim’-point of view, the inclusion of further control variables would have led to significant deviation from the original study (cf. Cremer and van Vugt 1999). The aim was to reproduce the ‘goal-transformation’ hypothesis as closely as possible. Although context and population-driven extensions needed to be made, the author decided consciously to neglect certain control variables in favour of the research claim. Further, introducing such variables would have led to different analysis techniques, which again would have led to a detachment of the research claim. Second and from a ‘questionnaire structure’-point of view, further queries would have lengthened the questionnaire, which again, would have increased maturation effects on the result’s internal validity.

Variable	**Description**	**Potential impact on dependent variable**
Living Expectancy	Do units plan to leave the neighbourhood?	Plans to leave the neighbourhood in a foreseeable future lower commitment to the neighbourhood and may decrease contribution intentions.
Club Expectancy	Do units plan to leave the Service Club?	Plans to leave the association in a foreseeable future lower commitment to the association and may decrease contribution intentions.
Member of Neighbourhood association	Are people members of a neighbourhood association?	Politicized identification with the neighbourhood may reinforce commitment and increase contribution intentions.
Type of Residence	Is the address of the housing unit main or secondary residence of decision-maker?	Decision-makers in secondary residences may feel less committed to the neighbourhood and decrease contribution intention.

Energy-related investments	Did the decision-maker already invest in energy-related investments (e.g. PV panels, solar collectors, insulations)?	The effect of previous investments on contribution intention is unknown.

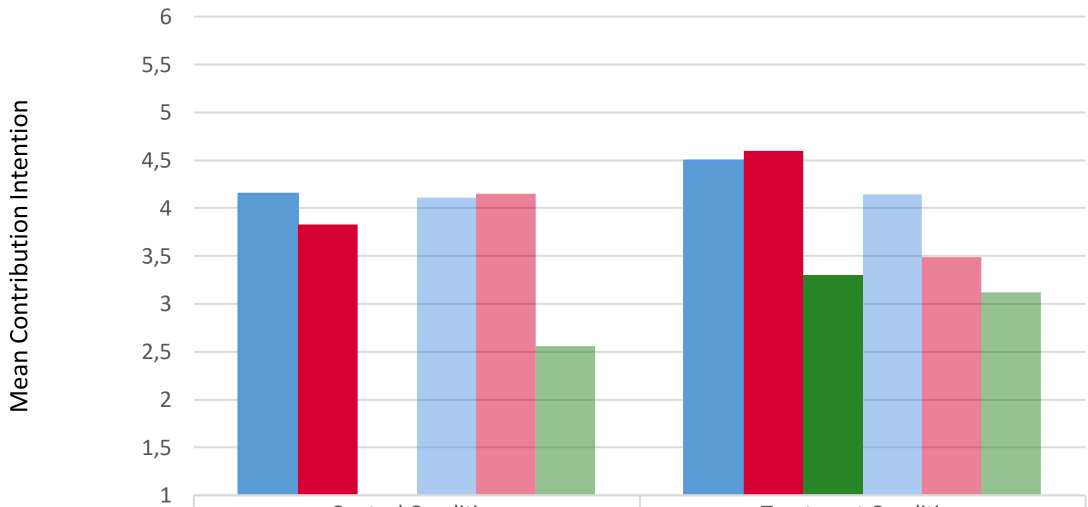
Table 48: Potential extraneous Variables

Finally, the author points out that the claim of result-generalization is limited to the peculiarities of the surveyed sample. First, householders in low-density suburban areas in Switzerland are depicted as a very defined and narrow target sample. Their socio-demographic characteristics as well as their socio-geographic circumstances in which they live reflect a specific frame for energy-related efforts. From a spatial planning view, the sample contained important advantages regarding the efficient use of RE technologies compared to other Swiss householders. Therefore, the insights gained cannot be generalized for the overall Swiss population.

Second and as mentioned earlier, the portability of the findings by geographically narrowing the population in and around low-density neighbourhoods in Fribourg/Switzerland may be problematic. Currently, no article or dataset would neither approve nor reject the similarities between the target and the surveyed population. The assumption that both populations differ may be challenged by future research. Both arguments also count for the second surveyed population. Not only are the socio-demographic characteristics of service club members quite specific, but the portability of the findings is equally difficult, if not even more problematic than in the previous sample. Despite potential demographic differences between the target (full-aged active-members of local associations or clubs in Switzerland) and the surveyed sample (members of service clubs in the region of Fribourg and Bern/Switzerland), such are less pronounced if comparing both survey samples, i.e. householders and service club members. This in turn enables certain comparisons of both surveyed samples.

8.2 Major Findings

Facing an energy-related social dilemma under different social circumstances, Swiss householders showed different contribution intention patterns. According to a between-design questionnaire experiment, average contribution intention scores were distinctly higher when Swiss householders had to contribute to energy goals together with people that already shared common values (N=40), e.g. service club members, compared to if Swiss householders had to contribute to energy goals together with members of the same low-density suburban neighbourhood, in which they live (N=389). If contributing to energy goals together with members of the same low-density suburban neighbourhood, average scores for contribution intentions were identical to the when contributing together with anonymous people. Further, energy communities based on geographical features have different and opposed effects on individuals with either a prosocial, individualistic, or competitive inclination towards cooperation.



	Control Condition	Treatment Condition
Prosocial	4,15	4,5
Individualistic	3,83	4,6
Competitive		3,3
Prosocial*	4,11	4,14
Individualistic*	4,15	3,49
Competitive*	2,56	3,12

Note that individuals marked with '*' are surveyed units of the 'Energy Neighbourhood' inquiry.

Figure 69: Results 'The Potential of Energy Communities'

These findings emphasize the tendentially differing effects of differing social contexts in combination with different Social Value Orientation on participation intentions to the Swiss energy transition. Although such were anticipated (cf. Cremer and van Vugt 1999), the effects found during this research were to some degree counter-theoretical. The assumption that 'social identification' increases cooperation among 'proselfs' was challenged in the main research endeavour. Moreover, the research results suggest that not every form of social identification leads to increased energy-related cooperation. Two main findings can be drawn.

First, individual inclination towards cooperation affects Swiss householders' intention to contribute to the energy transition/ES 2050 goals. Consequently, social psychological insights that relate to situations of interdependence explain, to some degree, participation in energy transition. On the other hand, more complex social psychological concepts, e.g. 'goal-transformation' hypotheses, could not be confirmed. This research showed that such concepts constitute no panacea, nor perfect instruments for behaviour prediction. Thus, the applicability of such (mostly experimental) concepts reach their limits when tested in less clinical sections.

Second, the fact that different individuals show tendencies to behave differently in changing social situations demonstrates that insights from social dilemma research have their raison d'être in the broader field of energy behaviour and should therefore gain further attention. Simultaneously, the research results suggest that Cremer and van Vugt's theory, as well as other social psychological principles, can benefit if applied in non-clinical settings.

Regarding the coordination of an Energy Neighbourhood, three different service-provider roles were identified (see Figure 70). The most expressed expectation towards the institutional design of an Energy Neighbourhood was a design that rewards energy-related contributions but does not impose such. According to the ECMF, 55.5% of the surveyed sample expect a '*signalling*'-design for an Energy Neighbourhood.

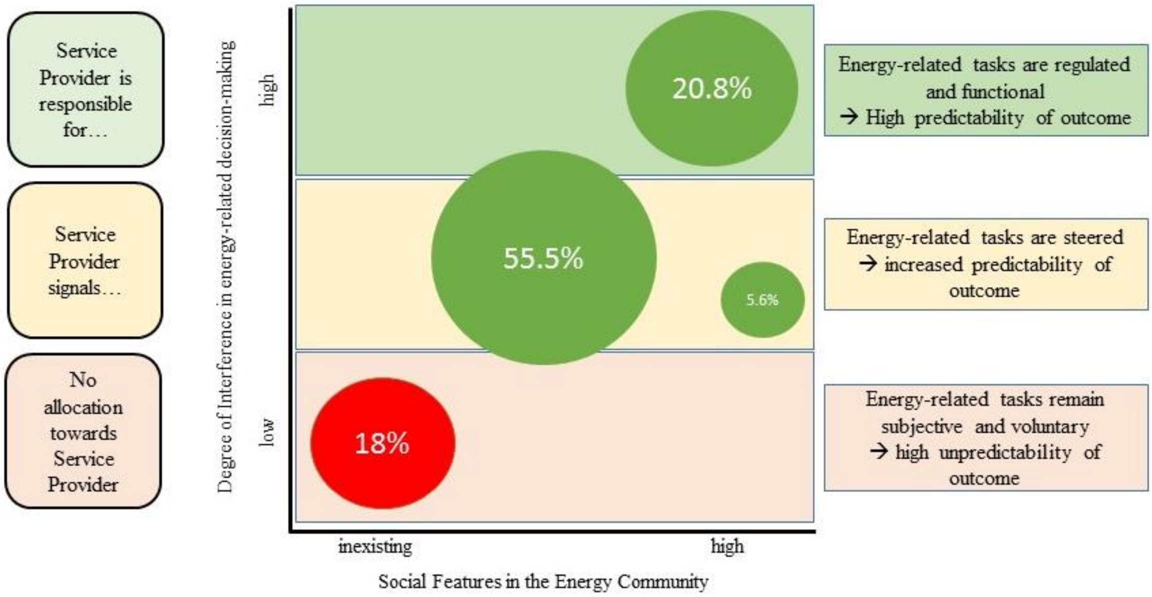


Figure 70: Results 'The Coordination of Energy Communities'

Source: adapted from Hertig and Teufel 2018

A bare majority of the surveyed sample was in favour of a set of rules, which incentivizes members to engage in energy-related efforts but does not regulate energy-related tasks *per se*. Accordingly, energy service providers are recommended to use ‘opt-in’ mechanisms to encourage collective efforts. The introduction of market mechanisms, alternative reward systems, and reinforcing the social features within the community were presented as possible *signalling* instruments. However, such dominant design is regarding the extent of interferences in energy-related decision-making, its underlying justification, and regarding the recommended choice of instruments opposed to the three other revealed design expectations. Therefore, no uniform preference regarding an energy service provider’s role or community design preference emerged.

By comparing the different energy community design preferences, differing characteristics of the households were found. The differing design preferences significantly differed in the decision-maker’s SVO, sustainable energy behaviour, political orientation, social identification, and in acceptancy of such energy communities. Such results indicate that Swiss householders translate individual predispositions, values, and perceptions into concrete design expectations. This empirical research supports recent conceptual thoughts on energy governance (Bornemann et al. 2018), as well as first qualitative results from Switzerland (Defila et al. 2018).

Further, energy-related tasks that need to be performed to achieve a common energy goal are expected to be regulated in a uniform manner. Surprisingly, type-specific design claims were non-existent and contradicting recent thoughts on energy governance (Bornemann et al. 2018).

8.3 Recommendations

The first section provides recommendations rooted in observed phenomena of the first part of the thesis, 'The Potential of Energy Communities'. The second section provides recommendations rooted in observed phenomena of the second part of the thesis, 'The Coordination of Energy Communities'.

8.3.1 Recommendations 'The Potential of Energy Communities'

The suggested recommendations for this part of the thesis address energy policy developers.

FRAME-CUSTOMIZATION OF ENERGY-RELATED EFFORTS

Research Results:

- Social Value Orientation has an impact on energy-related contribution intention.
- Prosocials intend to contribute more towards ES2050 goals than individualists and competitors.

Energy Policy Developers are recommended to do the following:

- **Frame** energy-related efforts as **individual benefits for individualists**. Messages should address the financial benefits or gains related to individual energy autonomy.
- **Frame** energy-related efforts as **competitive tasks** with high visibility of relative efforts **for competitors**, by making use of competitions and awards.
- **Frame** energy-related efforts as a **moral and collective task for prosocials**, by awaking their social personality traits.

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EMPOWER AND CREATE SOCIAL ENERGY SPACES

Research Results:

- Under changing social circumstances, energy-related contribution intentions tend to vary.
- Relation-based communities tend to have higher potential to change behaviour, than place-based communities or anonymous settings.

Energy Policy Developers are recommended to do the following:

- **Create** and **capacitate** Social Energy Spaces that promote energy-related contributions among its members.
- **Foster** social energy spaces that are based on commonly shared values and interests between its members.
- **Empower** and **strengthen** geographical communities and the social bonds between their residents.

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INDIVIDUAL EVALUATION OF SOCIAL ENERGY SPACES

Research Results:

- Under changing social circumstances, individuals tend to react differently.
- Certain individuals perceive the same Social Energy Space as cooperation-friendly, while others perceive it as more negative.

Energy Policy Developers are recommended to do the following:

- **define** the target individuals, for which behavioural-change interventions are planned, at a very early stage.
- **elaborate** appropriate Social Energy Spaces for the specific groups.

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Table 49: Recommendations 'The Potential of Energy Communities'

8.3.2 Recommendations ‘The Coordination of Energy Communities’

The suggested recommendations for this part of the thesis address energy policy developers as well as energy service providers.

PREFERENCES FOR A SIGNALLING 'ENERGY COMMUNITY'-DESIGN (ENERGY POLICY DEVELOPERS) Research Results: • Regarding the coordination of an energy community, '*Signal-seekers'* constitute the largest group, • 55.5% of the sample claims individual rewards for energy-related efforts. **Energy Policy Developers** are recommended to do the following: • **Initiate** change by incentivizing households. • **Promote** change by implementing market mechanisms, alternative reward schemes or by reinforcing the social features within the community.
PREFERENCES FOR A SIGNALLING 'ENERGY COMMUNITY'-DESIGN (ENERGY SERVICE PROVIDERS) Research Results: • Regarding the coordination of an energy community, *Signal-seekers* constitute the largest group. • 55.5% of the sample claims individual rewards for energy-related efforts. **Energy Service Providers** are recommended to do the following: • **Understand** traditional electricity end-users. • **Apply** incentive-compatible rewards. • **Position** as enabler of individual and collective change-initiator.

Table 50: Recommendations 'The Coordination of Energy Communities'

8.4 Future Research

Considering the statements of all sections in the conclusion chapter, three different categories of future research suggestions can be drawn. The first category of research suggestions addresses current limitations (Chapter 8.1) and typically includes inabilities, problems, and limitations along the research process. The second category recommends basic research. Finally, the third category outlines concrete issues that were identified during the research process. Based on statements of the limitations section, the following research suggestions aim to eradicate certain limitation of the presented research process:

1. *Validate the ECMF*. Both, empirical patterns and stylized facts were discovered while using the ECMF (cf. Hertig and Teufel 2018). Regarding the data-driven research characteristics, the use of the framework was successful. Nevertheless, further tests of the ECMF's reliability and validity would allow replicating ECMF findings and use it as an empirical tool to determine an energy-service provider's role. Therefore, the author suggests a qualitative research design including open interviews with random responders of the same neighbourhoods/service clubs to enhance the explanatory power of the model. Further attention should also have been given to the horizontal axis, 'social features of the community', of the framework. Responders themselves should define variables that correspond adequately to their interpretation of the axis.
2. *Include more control variables*. Confounding variables can be eliminated if the elicitation method controls for such. Accordingly, the author recommends to *replicate* the research process and to *extend* it with further possible explanation (see also Table 48).
3. *Further population-driven extension*. Given the narrow definition of the samples, research results consider only a minority of residents in Switzerland. The energy-related 'goal-transformation' hypothesis should also be tested with other samples, which are more representative. However, given the high probability of analysing a heterogeneous sample, in terms of demographics, range of energy-related decision-making or socio-geographic inclusions, new confounding variables would emerge.

The second category of research suggestions consider basic research in social psychology, economics and business science. The recommendations aim to further specify and sharpen the whole research process. The author recommends following research efforts:

4. *Re-evaluate the effect of social identification on cooperation*. The research showed that the effect of social identification had ambiguous effects on

energy-related contribution intention. The author indicated several explanations regarding the possible influence of the actual composition of the groups. Accordingly, the concept of ‘social identification’ needs further investigation. The author proposes to refine the term ‘social identification’ and test the concept along different identifications, especially politicized, relation-based, geographical identification. Concretely, the author suggests to *duplicate* and *extend* the research process of Cremer and van Vugt’s research and conduct same experiments with politicized, relation-based, and geographical groups and observe for positive or negative interaction effects. The insights gained from such research allows replicating the research process in the field of energy policy development and simplifies the identification of promising group compositions for energy communities.

Associated with the *duplication* and *extension* of the research process, the author further suggests re-evaluating the effect of social identification on cooperation under differing cultural aspects. For example, Swiss citizens are not especially known for their openness, and they have quite an individualistic, power-distant and indulgence culture (Hofstede 2011, 2018). Thus, the question arises whether such cultural characteristics further moderate the interaction effect of SVO and ‘Social Identification’ on cooperation. Accordingly, the potential of energy communities could be compared between different countries.

5. *Third-party intervention preferences*. As shown earlier, service providers will have distinct roles when coordinating energy-related efforts. The observations also showed that some variables co-variated with the degree of third-party interference in individual decision-making. Yet, causal relations remain unknown and the question of how such preferences are construed, remains unanswered. In regard to *functionalize* energy-related efforts, a deeper understanding regarding the formation of preferences becomes inevitable. The author supposes that individual (personality traits, expectations, and demographics) and social factors (norms, trust and, group composition), decision features (cf. Parks et al. 2013), as well as the structure of interdependence (Chapter 3.2.1) influence individual acceptance of third-party interventions. The determination of such would facilitate the integration of third parties in not only energy-related social dilemmas but in other real-

life dilemmas too. It further would also allow identifying ‘third party intervention’ opponents more easily and drafting specific measures to incentivize such.

6. *Business Science*. Business-related concepts that integrate new socio-technical phenomena (e.g. Prosumers, Commons, Co-Creators, Sharing Economy, and Circular Economy etc.) in general management topics are quite underdeveloped. Regarding the disruptive potential and the rapid spread of such, classical business theories are outdated (Rifkin 2014b). For example, the amalgamation of ‘Production’ and ‘Consumption’ brings up the question: what is the societal benefit of companies in times of ‘prosumerism’? (cf. Toffler and Toffler 2007). Acknowledged and robust business theories could further frame the whole research process for the ‘Coordination’ part of the thesis and sharpen its practical recommendations.

Finally, the third category of research suggestions emphasize issues that emerged during the research process, which would complement the presented research.

7. *Social dimension of ‘energy’*. As frequently mentioned, ‘energy’ is not only a science-related phenomenon, but also a social one. As such, its construction and comprehension differs (cf. Hertig and Teufel 2016a; Stern and Aronson 1984). Considering the different and also opposed interests of the differing dimensions of ‘energy’, energy policy-related development is slowed down (Stern and Aronson 1984). In order to accelerate the urgently needed changes in the energy sector, the authors suggest empirical investigation of these dimensions. First, appropriate operational definitions and measurement items to elicit different dimensions are needed. Second and based on proper elicitation items, future research can focus on factors influencing the perception of the dimension, as well as investigate the influence of the perceived construct on energy-related behaviour and efforts. The author supposes that the individual construction of ‘energy’ is somehow also a personality trait that reflects an individual’s energy-related preferences for policy-making, as do other personality traits (conservative vs. liberal, left or right values) in classical political decision-making, or SVO (prosocial vs. proself) in settings of interdependence. Accordingly, the determination of such personality traits, allows a better understanding of energy-related

behaviour, and further allows implementing individualized measures/messages/incentives regarding the energy turnaround.

8. *Energy-related efforts*. As a last research suggestion, the author recommends to further investigate factors that influence energy-related contributions. The impact of SVO and 'Social Identification' on energy-related contribution intention showed that individual as well as social factors played an important role. A structural equation model could shed light on individual (e.g. demographics, values, and personality traits), social (e.g. norms, presence of outgroups, group compositions, communication), and other variables (e.g. price of energy, RE technologies used, spatial-planning regulations) that influence energy-related contributions. Not only is research regarding energy-related decision-making in social dilemma settings a promising research area, its results may generate a widespread sustaining impact in energy policy development and energy management.

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10 Appendix

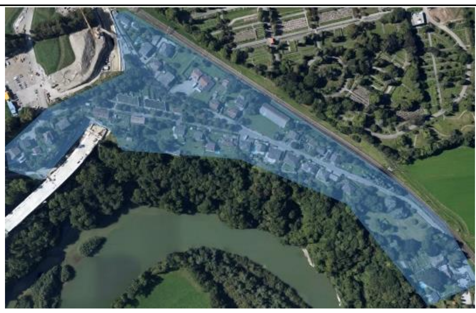
The appendices include all supplementary information and sources of this thesis.

10.1 Appendices related to the Content and Questionnaire Comprehension

Design Principles for Common Pool Institutions
1A. Clearly defined user boundaries: Individuals or households who have rights to withdraw resource units from the common-pool resource (CPR) must be clearly defined. 1B. Clear boundaries of resource system: The boundaries of the CPR must be well defined. 2A. Congruence with local conditions: Appropriation and provision rules are congruent with local social and environmental conditions. 2B. Benefits of appropriation and provision inputs are proportionate 3. Collective-choice arrangements: Most individuals affected by the operational rules can participate in modifying the operational rules. 4A. Monitoring users: Monitors who are accountable to the users monitor the appropriation and provision levels of the users. 4B. Monitoring the resource: Monitors who are accountable to the users monitor the condition of the resource. 5. Graduated sanctions: Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and the context of the offense) by other appropriators, by officials accountable to the appropriators, or by both. 6. Conflict-resolution mechanisms: Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials. 7. Minimal recognition of rights to organize: The rights of appropriators to devise their own institutions are not challenged by external governmental authorities. 8. Nested enterprises: Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Appendix 1: Design Principles

Source: updated by Cox et al. 2010 originally published by Ostrom 1990

 Bourguillon East, Fribourg	 Bourguillon West, Fribourg
 Palatinat, Fribourg	 Montivert, Marly
 Rte du Centre, Marly	 Alpenweg, Düdingen
 Sandacher, Düdingen	 Riedlistrasse, Düdingen
 Kleinschönberg, Tafers	 Menziswil, Tafers

Appendix 2: Aerial view on the Neighbourhoods

Appendix 3 lists the variables of the ‘Energy Neighbourhood’ survey.

Variable Name	Variable Description or Statement	Values
ID	Identification of Respondent	According participants list
Group	Belonging to condition; 2 Values	1 = Anonymous, 2 = Energy Neighbourhood
Neighbourhood	Belonging to Neighbourhood; 10 Values	1 = Bourguillon East 2 = Bourguillon West 3 = Palatinat 4 = Montivert 5 = Rte du Centre 6 = Alpenweg 7 = Sandacher 8 = Riedlistr. 9 = Kleinschoenberg 10 = Menziswil
En_Beh_1	Watch out for energy-efficiency labels if buying devices	1 ‘never’ – 6 ‘always’
En_Beh_2	Turning down/off heating before leaving for holidays	“
En_Beh_3	Turning off standby on electronic devices	“
En_Beh_4	Filling the washing machine	“
En_Beh_5	Taking short shower (< 5 minutes)	“
En_Beh_6	Usage of energy-saving bulbs	“
En_Beh_7	Avoidance of dryer usage	“
En_Beh_8	Switching off the light in unused rooms	“
En_Beh_Mean	Computed variable: Mean Scores for En_Beh_1 - En_Beh_8	1 - 6
SVO_type	Social Value Orientation of responders according Murphy et al. 2011	1 = Prosocial 2 = Individualistic 3 = Competitive
SVO_Item_01_self	Allocation of resources in corresponding item to oneself	See Figure 35
SVO_Item_02_self	“	“
SVO_Item_03_self	“	“
SVO_Item_04_self	“	“

Variable Name	Variable Description or Statement		Values
SVO_Item_05_self	“		“
SVO_Item_06_self	“		“
SVO_Item_01_other	Allocation of resources in corresponding item to other person		See Figure 35
SVO_Item_02_other	“		“
SVO_Item_03_other	“		“
SVO_Item_04_other	“		“
SVO_Item_05_other	“		“
SVO_Item_06_other	“		“
Test	Social Dilemma comprehension variable		1 = Mrs. A 2 = Family B 3 = Mr. C (correct answer) 4 = Family D.
SI_01	Identification with group	I identify myself with the [group OR neighbourhood].	1 ‘not at all’ – 6 ‘very much’
SI_02	Belonging with group	In feel a belonging to the [group OR neighbours].	“
SI_03	Group attachment	In general, I feel stronger connected to [group OR neighbours] than with other people.	“
SI_04	Knowledge on group members	In general, I know [group members OR neighbours] better than other people.	“
MEAN_SI	Mean Scores for SI_01 - SI_04 (computed variable)		1 - 6
GQ_01	Level of perceived abstractedness.	The scenario [Anonymus OR Energy Neighbourhood] is to abstract.	1 ‘not at all’ – 6 ‘very much’
GQ_02	Level of perceived Feasibility	The scenario [Anonymus OR Energy Neighbourhood] is quite feasible.	“

Variable Name	Variable Description or Statement		Values
GQ_03	Level of perceived meaningfulness of cooperation	To cooperate with [group members OR neighbours] makes sense	“
CI_01	Energy conservation intention	I would save energy and adapt my consumption behaviour in order to ensure the energy provision of the [group OR neighbourhood]	1 ‘not at all’ – 6 ‘very’
CI_02	Intention to replace old devices with energy efficient devices	I would replace old devices with energy efficient devices in order to ensure the energy provision of the [group OR neighbourhood]	“
CI_03	Intention to produce energy	I would produce energy on my own and buy an energy production-unit in order to ensure the energy provision of the [group OR neighbourhood]	“
CI_04	Intention to store energy	I would store energy and buy an energy storing-unit in order to ensure the energy provision of the [group OR neighbourhood]	“
MEAN_CI	Computed variable: Mean Scores for CI_01 - CI_04		1 - 6
Exp_01	Expectations regarding the others’ energy conservation intention.	[group members OR neighbours] would save energy and adapt their consumption behaviour in order to ensure the energy	1 ‘not at all’ – 6 ‘very much’

Variable Name	Variable Description or Statement		Values
		provision of the [group OR neighbourhood]	
Exp_02	Expectations regarding the others' device replacement intention.	[group members OR neighbours] would replace old devices with energy efficient devices in order to ensure the energy provision of the [group OR neighbourhood]	"
Exp_03	Expectations regarding the others' energy production intention.	[group members OR neighbours] would produce on their own energy and buy an energy production-unit in order to ensure the energy provision of the [group OR neighbourhood]	"
Exp_04	Expectations regarding the others' energy storage intention.	[group members OR neighbours] would store energy and buy an energy storing-unit in order to ensure the energy provision of the [group OR neighbourhood]	"
MEAN_EXP	Computed variable: Mean Scores for Exp_01 - Exp_04		1 - 6
Rules_01	Rules for the [group OR neighbourhood] concerning the purchase of energy-efficient devices; 5 values		1 = no rules concerning [Rules_01] 2 = informing D-M to [Rules_01] 3 = rewarding D-M for [Rules_01] 4 = punishing D-M for not [Rules_01]

Variable Name	Variable Description or Statement	Values
		5 = oblige [Rules_01]
Rules_02	Rules for the [group OR neighbourhood] concerning load reduction; 5 values	“
Rules_03	Rules for the [group OR neighbourhood] concerning load shifting; 5 values	“
Rules_04	Rules for the [group OR neighbourhood] concerning energy production-unit purchases; 5 values	“
Rules_05	Rules for the [group OR neighbourhood] concerning energy storage-unit purchases; 5 values	“
Rules_06	Rules for the [group OR neighbourhood] concerning the sharing of stored energy; 5 values	“
Rules_07	Rules for the [group OR neighbourhood] concerning the sharing of unused storage capacities; 5 values	“
MEAN_Rules	Computed variable: Mean Scores for Rules_01 - Rules_07	1 - 5
Joint_contribution	Computed variable: [MEAN_CI + MEAN_EXP]	2 - 12
DOEC	Computed variable: [MEAN_CI - MEAN_EXP]	-5 - 5
Demo_Age	Age of respondent	18-99
Demo_gender	Gender of respondent; 2 values	1 = Male 2 = Female
Demo_hh_size	Household size of respondent; 7 values	1 = 1 resident 2 = 2 residents 3 = 3 residents 4 = 4 residents 5 = 5 residents 6 = 6 residents 7 = more than 6 residents
Demo_Living	Number of years living in the neighbourhood; 5 values	1 = 0-5 years 2 = 6-10 years 3 = 11-15 years 4 = 16-20 years 5 = more than 20 years
Demo_ownership	Property situation of respondent; 2 values	1 = homeowner 2 = tenant

Variable Name	Variable Description or Statement	Values
Demo_politic	Respondent's voting decision for Energy Act (EnA); 3 values	1 = 'yes' 2 = 'no' 3 = 'did not vote', 'did not remember', 'don't want to reveal opinion'
CLU_9	Cluster belonging, according Ward's Method	1 - 9
Median_horizontal	Median point of a cluster along the horizontal axis (computed variable)	2 - 12
Median_vertical	Median point of a cluster along the vertical axis (computed variable)	1 – 5
Mean_horizontal	Mean point of a cluster along the horizontal axis (computed variable)	2 - 12
Mean_vertical	Mean point of a cluster along the vertical axis (computed variable)	1 - 5

Appendix 3: Variables

10.2 Statistical Appendices

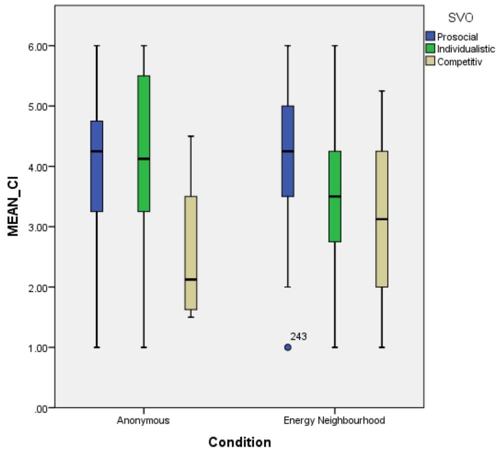
The complete statistical analysis as well as the original data for both surveys set can be found on the CD.

Correlations

		Identification_Interests	Common_interests	Affiliation	Knowing_persons
Identification_Interests	Pearson Correlation	1	.635**	.389**	.311**
	Sig. (2-tailed)		.000	.000	.000
	N	305	305	305	305
Common_interests	Pearson Correlation	.635**	1	.609**	.486**
	Sig. (2-tailed)	.000		.000	.000
	N	305	305	305	305
Affiliation	Pearson Correlation	.389**	.609**	1	.819**
	Sig. (2-tailed)	.000	.000		.000
	N	305	305	305	305
Knowing_persons	Pearson Correlation	.311**	.486**	.819**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	305	305	305	305

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 4: Correlation Results 'SI'



Appendix 5: Boxplot examination Mean_CI

Correlations

		Intention_Suff	Intention_Eff	Intention_G	Intention_S
Intention_Suff	Pearson Correlation	1	.517**	.436**	.389**
	Sig. (2-tailed)		.000	.000	.000
	N	260	260	260	260
Intention_Eff	Pearson Correlation	.517**	1	.426**	.391**
	Sig. (2-tailed)	.000		.000	.000
	N	260	260	260	260
Intention_G	Pearson Correlation	.436**	.426**	1	.830**
	Sig. (2-tailed)	.000	.000		.000
	N	260	260	260	260
Intention_S	Pearson Correlation	.389**	.391**	.830**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	260	260	260	260

**. Correlation is significant at the 0.01 level (2-tailed).

Reliability Statistics

Cronbach's Alpha	N of Items
.801	4

Appendix 6: Correlation and Cronbach's α Results 'CI_01'-'CI_04'

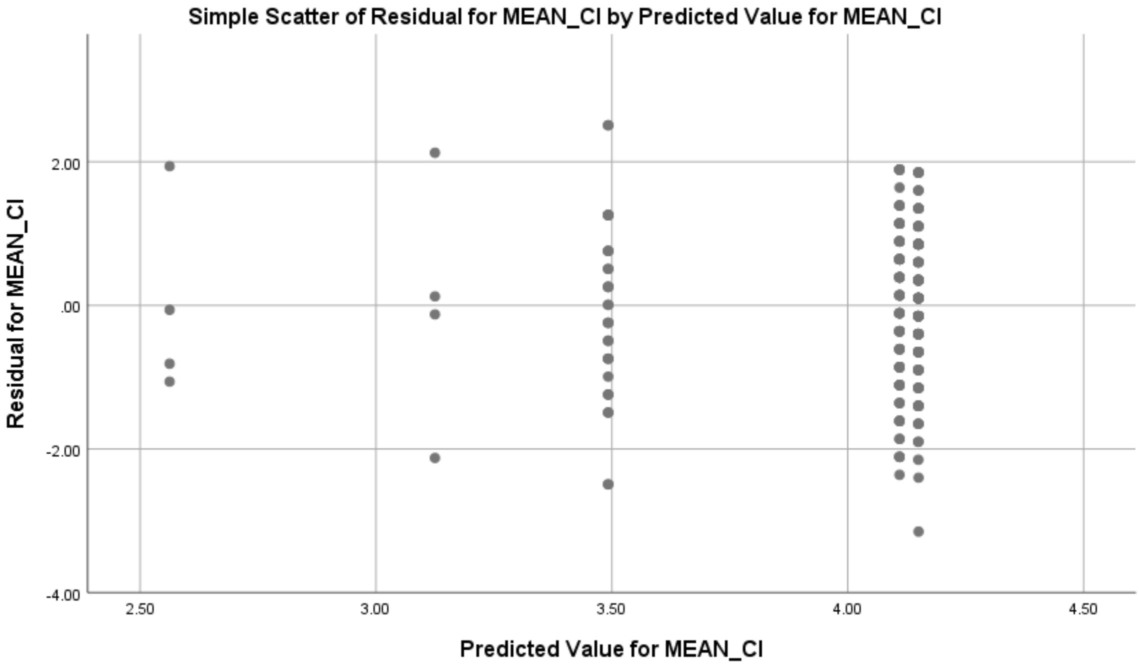
Tests of Normality

Condition	SVO		Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Anonymous	Prosocial	Residual for MEAN_CI	.100	98	.017	.973	98	.039
	Individualistic	Residual for MEAN_CI	.139	30	.142	.946	30	.129
	Competitiv	Residual for MEAN_CI	.268	4	.	.862	4	.267
Energy Neighbourhood	Prosocial	Residual for MEAN_CI	.096	92	.036	.975	92	.078
	Individualistic	Residual for MEAN_CI	.089	32	.200*	.976	32	.688
	Competitiv	Residual for MEAN_CI	.221	4	.	.968	4	.832

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Appendix 7: Shapiro-Wilk Test



Appendix 8: Scatterplot Examination Mean_CI

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Ln_MEAN_CI	Based on Mean	4.864	5	254	.000
	Based on Median	3.660	5	254	.003
	Based on Median and with adjusted df	3.660	5	166.720	.004
	Based on trimmed mean	4.516	5	254	.001

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Ln_MEAN_CI

b. Design: Intercept + Group + SVO_type + Group * SVO_type

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Lg10_MEAN_CI	Based on Mean	4.864	5	254	.000
	Based on Median	3.660	5	254	.003
	Based on Median and with adjusted df	3.660	5	166.720	.004
	Based on trimmed mean	4.516	5	254	.001

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Lg10_MEAN_CI

b. Design: Intercept + Group + SVO_type + Group * SVO_type

Levene's Test of Equality of Error Variances[a,b]

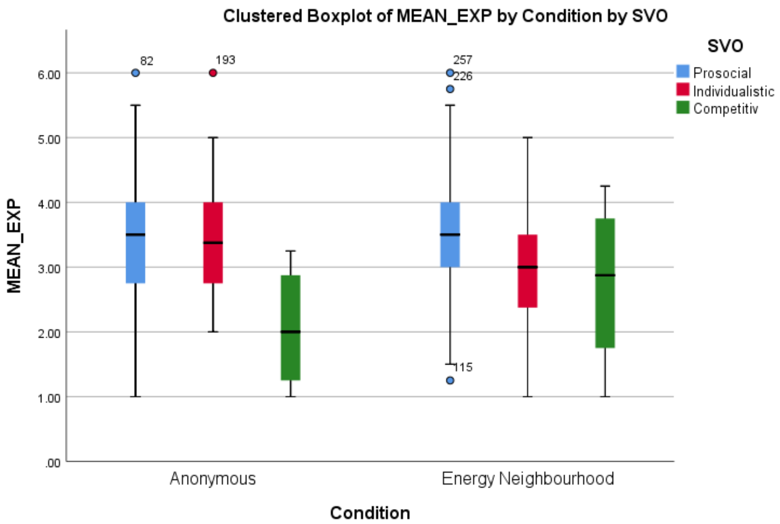
		Levene Statistic	df1	df2	Sig.
square_MEAN_CI	Based on Mean	3.170	5	254	.009
	Based on Median	2.739	5	254	.020
	Based on Median and with adjusted df	2.739	5	229.432	.020
	Based on trimmed mean	3.152	5	254	.009

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

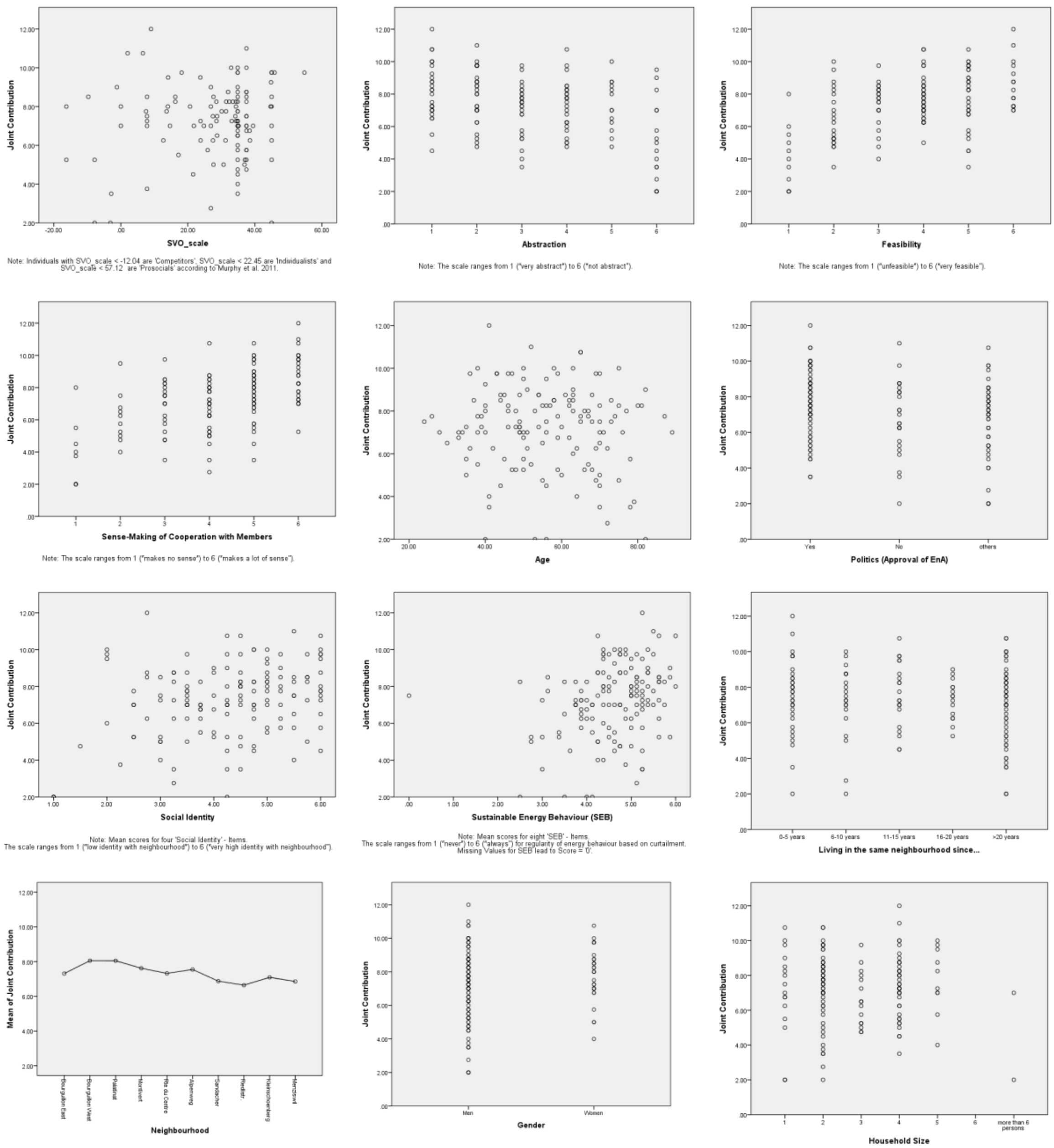
a. Dependent variable: square_MEAN_CI

b. Design: Intercept + Group + SVO_type + Group * SVO_type

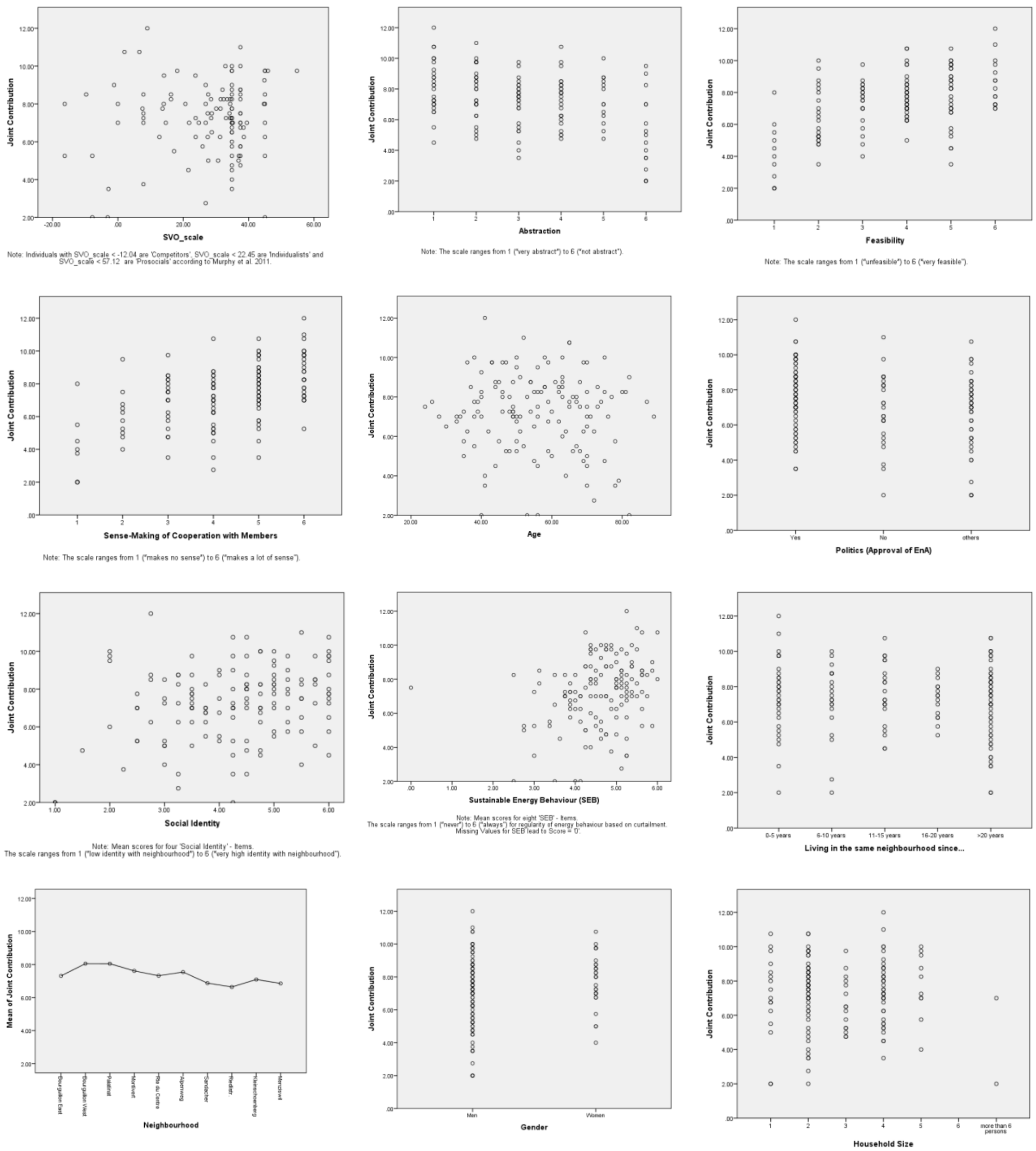
Appendix 9: Variances-stabilizing Measures



Appendix 10: Boxplot Examination Mean_EXP



Appendix 11: (monotonic) Relations between different factors and 'Joint Contribution'



Appendix 12: (monotonic) Relations between different factors and ‘Degree of Interference’

Correlations

			Joint Contribution	Degree of Rules
Spearman's rho	Joint Contribution	Correlation Coefficient	1.000	.335**
		Sig. (2-tailed)	.	.000
		N	144	144
	Degree of Rules	Correlation Coefficient	.335**	1.000
		Sig. (2-tailed)	.000	.
		N	144	144

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 13: Correlation Test 'Joint Contribution' and 'Degree of Rules'

Multiple Comparisons

Dependent Variable: Joint Contribution

Bonferroni

(I) Ward Method	(J) Ward Method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1	2	3.05144*	.20915	.000	2.3686	3.7343
	3	1.19079*	.15511	.000	.6844	1.6972
	4	2.38017*	.16409	.000	1.8445	2.9159
	5	4.17481*	.19445	.000	3.5400	4.8096
	6	7.31053*	.27748	.000	6.4047	8.2164
	7	-1.00822*	.23267	.001	-1.7678	-.2486
	8	5.16886*	.20356	.000	4.5043	5.8334
	9	2.73830*	.22339	.000	2.0090	3.4676
2	1	-3.05144*	.20915	.000	-3.7343	-2.3686
	3	-1.86065*	.18901	.000	-2.4777	-1.2436
	4	-.67127*	.19644	.030	-1.3126	-.0299
	5	1.12338*	.22243	.000	.3972	1.8495
	6	4.25909*	.29776	.000	3.2870	5.2312
	7	-4.05966*	.25652	.000	-4.8971	-3.2222
	8	2.11742*	.23044	.000	1.3651	2.8697
	9	-.31313	.24813	1.000	-1.1232	.4969
3	1	-1.19079*	.15511	.000	-1.6972	-.6844
	2	1.86065*	.18901	.000	1.2436	2.4777
	4	1.18938*	.13749	.000	.7405	1.6382
	5	2.98402*	.17259	.000	2.4206	3.5475
	6	6.11974*	.26263	.000	5.2624	6.9771
	7	-2.19901*	.21474	.000	-2.9001	-1.4979
	8	3.97807*	.18280	.000	3.3813	4.5749
	9	1.54751*	.20465	.000	.8794	2.2156
4	1	-2.38017*	.16409	.000	-2.9159	-1.8445
	2	.67127*	.19644	.030	.0299	1.3126
	3	-1.18938*	.13749	.000	-1.6382	-.7405
	5	1.79464*	.18070	.000	1.2047	2.3846
	6	4.93036*	.26802	.000	4.0554	5.8054
	7	-3.38839*	.22131	.000	-4.1109	-2.6659
	8	2.78869*	.19048	.000	2.1669	3.4105
	9	.35813	.21153	1.000	-.3325	1.0487
5	1	-4.17481*	.19445	.000	-4.8096	-3.5400
	2	-1.12338*	.22243	.000	-1.8495	-.3972
	3	-2.98402*	.17259	.000	-3.5475	-2.4206
	4	-1.79464*	.18070	.000	-2.3846	-1.2047
	6	3.13571*	.28761	.000	2.1968	4.0747
	7	-5.18304*	.24467	.000	-5.9818	-4.3843
	8	.99405*	.21718	.000	.2850	1.7031
	9	-1.43651*	.23586	.000	-2.2065	-.6665
6	1	-7.31053*	.27748	.000	-8.2164	-6.4047
	2	-4.25909*	.29776	.000	-5.2312	-3.2870
	3	-6.11974*	.26263	.000	-6.9771	-5.2624
	4	-4.93036*	.26802	.000	-5.8054	-4.0554
	5	-3.13571*	.28761	.000	-4.0747	-2.1968
	7	-8.31875*	.31472	.000	-9.3462	-7.2913
	8	-2.14167*	.29385	.000	-3.1010	-1.1823
	9	-4.57222*	.30792	.000	-5.5775	-3.5670
7	1	1.00822*	.23267	.001	.2486	1.7678
	2	4.05966*	.25652	.000	3.2222	4.8971
	3	2.19901*	.21474	.000	1.4979	2.9001
	4	3.38839*	.22131	.000	2.6659	4.1109
	5	5.18304*	.24467	.000	4.3843	5.9818
	6	8.31875*	.31472	.000	7.2913	9.3462
	8	6.17708*	.25198	.000	5.3545	6.9997
	9	3.74653*	.26825	.000	2.8708	4.6223
8	1	-5.16886*	.20356	.000	-5.8334	-4.5043
	2	-2.11742*	.23044	.000	-2.8697	-1.3651
	3	-3.97807*	.18280	.000	-4.5749	-3.3813
	4	-2.78869*	.19048	.000	-3.4105	-2.1669
	5	-.99405*	.21718	.000	-1.7031	-.2850
	6	2.14167*	.29385	.000	1.1823	3.1010
	7	-6.17708*	.25198	.000	-6.9997	-5.3545
	9	-2.43056*	.24343	.000	-3.2253	-1.6358
9	1	-2.73830*	.22339	.000	-3.4676	-2.0090
	2	.31313	.24813	1.000	-.4969	1.1232
	3	-1.54751*	.20465	.000	-2.2156	-.8794
	4	-.35813	.21153	1.000	-1.0487	.3325
	5	1.43651*	.23586	.000	.6665	2.2065
	6	4.57222*	.30792	.000	3.5670	5.5775
	7	-3.74653*	.26825	.000	-4.6223	-2.8708
	8	2.43056*	.24343	.000	1.6358	3.2253

*. The mean difference is significant at the 0.05 level.

Appendix 14: Bonferroni Test for Joint Contribution and Clusters

Multiple Comparisons

Dependent Variable: Degree of Rules

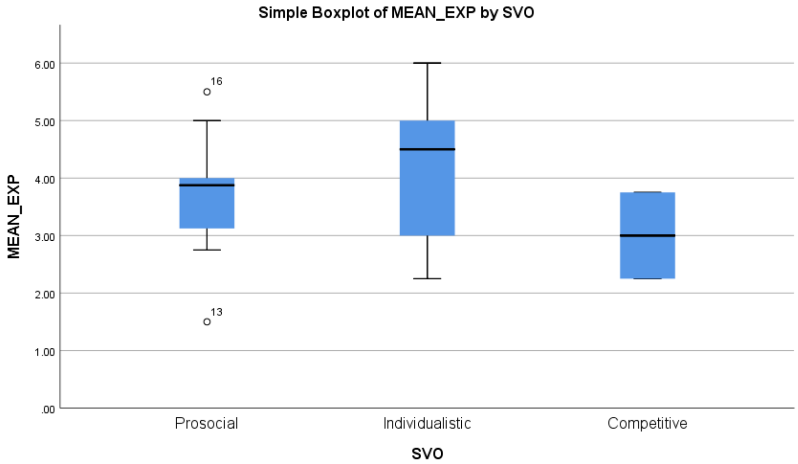
Bonferroni

(I) Ward Method	(J) Ward Method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1	2	-.07724	.19429	1.000	-.7115	.5571
	3	1.39850*	.14409	.000	.9281	1.8689
	4	1.26182*	.15243	.000	.7642	1.7594
	5	1.34855*	.18063	.000	.7589	1.9382
	6	2.30977*	.25776	.000	1.4683	3.1513
	7	1.67763*	.21613	.000	.9720	2.3832
	8	2.46930*	.18909	.000	1.8520	3.0866
	9	2.73517*	.20751	.000	2.0577	3.4126
2	1	.07724	.19429	1.000	-.5571	.7115
	3	1.47573*	.17558	.000	.9025	2.0489
	4	1.33905*	.18248	.000	.7433	1.9348
	5	1.42579*	.20662	.000	.7512	2.1003
	6	2.38701*	.27659	.000	1.4840	3.2900
	7	1.75487*	.23829	.000	.9769	2.5328
	8	2.54654*	.21406	.000	1.8477	3.2454
	9	2.81241*	.23049	.000	2.0599	3.5649
3	1	-1.39850*	.14409	.000	-1.8689	-.9281
	2	-1.47573*	.17558	.000	-2.0489	-.9025
	4	-.13668	.12772	1.000	-.5536	.2803
	5	-.04995	.16033	1.000	-.5734	.4735
	6	.91128*	.24396	.010	.1148	1.7077
	7	.27914	.19948	1.000	-.3721	.9304
	8	1.07080*	.16981	.000	.5164	1.6252
	9	1.33668*	.19011	.000	.7160	1.9573
4	1	-1.26182*	.15243	.000	-1.7594	-.7642
	2	-1.33905*	.18248	.000	-1.9348	-.7433
	3	.13668	.12772	1.000	-.2803	.5536
	5	.08673	.16786	1.000	-.4613	.6347
	6	1.04796*	.24898	.002	.2351	1.8608
	7	.41582	.20558	1.000	-.2553	1.0870
	8	1.20748*	.17694	.000	.6298	1.7851
	9	1.47336*	.19650	.000	.8318	2.1149
5	1	-1.34855*	.18063	.000	-1.9382	-.7589
	2	-1.42579*	.20662	.000	-2.1003	-.7512

	3	.04995	.16033	1.000	-.4735	.5734
	4	-.08673	.16786	1.000	-.6347	.4613
	6	.96122*	.26717	.016	.0890	1.8335
	7	.32908	.22728	1.000	-.4129	1.0711
	8	1.12075*	.20174	.000	.4621	1.7794
	9	1.38662*	.21910	.000	.6713	2.1019
6	1	-2.30977*	.25776	.000	-3.1513	-1.4683
	2	-2.38701*	.27659	.000	-3.2900	-1.4840
	3	-.91128*	.24396	.010	-1.7077	-.1148
	4	-1.04796*	.24898	.002	-1.8608	-.2351
	5	-.96122*	.26717	.016	-1.8335	-.0890
	7	-.63214	.29235	1.000	-1.5866	.3223
	8	.15952	.27297	1.000	-.7316	1.0507
	9	.42540	.28604	1.000	-.5084	1.3592
7	1	-1.67763*	.21613	.000	-2.3832	-.9720
	2	-1.75487*	.23829	.000	-2.5328	-.9769
	3	-.27914	.19948	1.000	-.9304	.3721
	4	-.41582	.20558	1.000	-1.0870	.2553
	5	-.32908	.22728	1.000	-1.0711	.4129
	6	.63214	.29235	1.000	-.3223	1.5866
	8	.79167*	.23407	.034	.0275	1.5558
	9	1.05754*	.24919	.001	.2440	1.8710
8	1	-2.46930*	.18909	.000	-3.0866	-1.8520
	2	-2.54654*	.21406	.000	-3.2454	-1.8477
	3	-1.07080*	.16981	.000	-1.6252	-.5164
	4	-1.20748*	.17694	.000	-1.7851	-.6298
	5	-1.12075*	.20174	.000	-1.7794	-.4621
	6	-.15952	.27297	1.000	-1.0507	.7316
	7	-.79167*	.23407	.034	-1.5558	-.0275
	9	.26587	.22613	1.000	-.4724	1.0041
9	1	-2.73517*	.20751	.000	-3.4126	-2.0577
	2	-2.81241*	.23049	.000	-3.5649	-2.0599
	3	-1.33668*	.19011	.000	-1.9573	-.7160
	4	-1.47336*	.19650	.000	-2.1149	-.8318
	5	-1.38662*	.21910	.000	-2.1019	-.6713
	6	-.42540	.28604	1.000	-1.3592	.5084
	7	-1.05754*	.24919	.001	-1.8710	-.2440
	8	-.26587	.22613	1.000	-1.0041	.4724

*. The mean difference is significant at the 0.05 level.

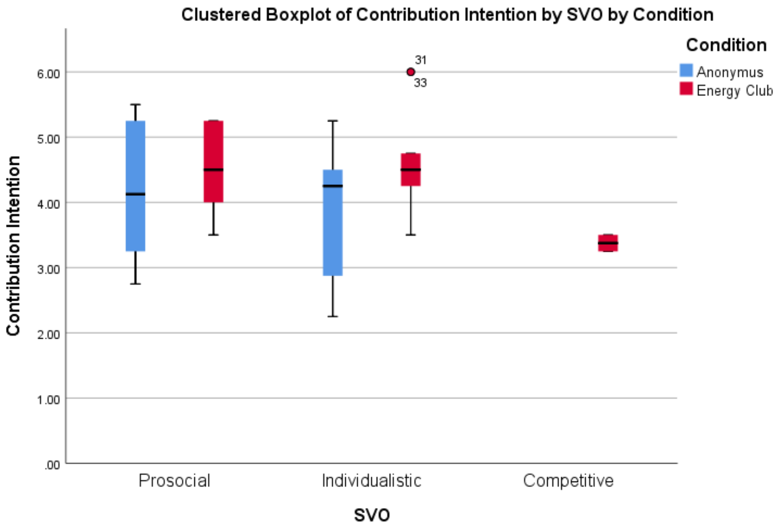
Appendix 15: Bonferroni Test Degree of Interference and Clusters



Reliability Statistics

Cronbach's Alpha	N of Items
.731	4

Appendix 16: Cronbach's α results for 'CI_01' - 'CI_04', Energy Clubs



Appendix 17: Boxplot Examination CI, Energy Clubs

Reliability Statistics

Cronbach's Alpha	N of Items
.883	4

Appendix 18: Cronbach's α results for Rules, Energy Clubs

10.3 Questionnaire

The following questionnaire was used to survey German-speaking residents (treatment group) in Kleinschönberg.

Die Zukunft des Energiemarktes

klopft an Ihre Haustür

Crowd Energy

© iimt

Um was geht es?

Neue Technologien erlauben es, dass Haushalte **selbstständig Energie produzieren, speichern und teilen** können.

Kooperation

Die Umfrage wird in Zusammenarbeit mit dem international institute of management in technology (iimt) und der Energiestadt Sensebezirk, welcher auch die Gemeinde Tafers angehört, durchgeführt.

Ziel der Umfrage

Ihre ganz persönliche Meinung interessiert uns!

Wir wollen das Energie-Potenzial von verschiedenen Nachbarschaften eruieren. Haben Sie und Ihre Nachbarn das Potenzial, den Energiemarkt zu verändern?

Energiestadt Sensebezirk
Die Region mit Energie

iimt
University of Fribourg
international institute of management in technology

Dauer

Das Ausfüllen des Fragebogens dauert rund **15 Minuten.**

Weitere Informationen

Falls Sie weitere Informationen wünschen, zögern Sie nicht uns zu kontaktieren.

iimt@unifr.ch

+4126 300 84 33

www.iimt.ch

Ihr Beitrag

Sämtliche Antworten werden **anonym** und **vertraulich** behandelt.

Sie helfen uns dabei, die Zukunft der Energiebranche aktiv mitzugestalten.

2

Ihr Energieverhalten

Bitte beantworten Sie folgende Fragen zu Ihrem **Energieverhalten.** Inwiefern treffen folgende Aussagen zu. **Kreuzen Sie jeweils EINE Position an.**

	Nie					Immer
Ich achte beim Kauf von Geräten auf die Energieeffizienz.	☐	☐	☐	☐	☐	☐
Ich schalte die Heizung ab (oder drehe sie runter), bevor ich in die Ferien gehe.	☐	☐	☐	☐	☐	☐
Ich schalte an meinen Geräten den Stand-by-Modus aus.	☐	☐	☐	☐	☐	☐
Ich fülle meine Waschmaschine komplett mit Kleidern.	☐	☐	☐	☐	☐	☐
Ich dusche mich zu Hause nicht länger als 5 Minuten.	☐	☐	☐	☐	☐	☐
Ich benutze Energiesparlampen.	☐	☐	☐	☐	☐	☐
Ich vermeide die Benutzung eines Wäschetrockners.	☐	☐	☐	☐	☐	☐
Ich schalte das Licht in den unbenutzten Zimmern ab.	☐	☐	☐	☐	☐	☐

In naher Zukunft können Sie Ihren **Strom mit anderen teilen…** doch zuerst interessieren wir uns, wie Sie fiktive **Geldbeträge teilen** würden.

In dieser Aufgabe werden Sie bestimmen, wie Sie Geldbeträge zwischen Ihnen und «Jemand» aufteilen möchten. Diese/r Jemand ist eine Person, welche Sie nicht kennen und gegenseitig anonym bleiben wird.
Ihre Entscheidungen werden jeweils sowohl Geld für Sie wie auch für die andere Person generieren. Im untenstehenden Beispiel hat sich eine Person entschieden, das Geld so aufzuteilen, dass sie 50 Franken erhält während die anonyme andere Person 40 Franken erhält.
Es gibt keine richtigen und falschen Antworten in dieser Aufgabe. Wenn Sie Ihre Entscheidung gefällt haben, **kreuzen Sie die entsprechende Position an.**

Sie erhalten	30	35	40	45	50	55	60	65	70	Sie 50
Jemand erhält	80	70	60	50	40	30	20	10	0	Jemand 40

Wie würden Sie die Geldverteilung handhaben? **Bitte kreuzen Sie in allen 6 Punkten die jeweils entsprechende Position an.**

Die Beantwortung des Abschnittes dauert rund 4'. Die nächsten Fragen sind deutlich schneller zu beantworten.

1

Sie erhalten	85	85	85	85	85	85	85	85	85	Sie ____
Jemand erhält	85	76	68	59	50	41	33	24	15	Jemand ____

Bitte kreuzen Sie die jeweilige Position an.

2

Sie erhalten	85	87	89	91	93	94	96	98	100	Sie ____
Jemand erhält	15	19	24	28	33	37	41	46	50	Jemand ____

Bitte kreuzen Sie die jeweilige Position an.

3

Sie erhalten	50	54	59	63	68	72	76	81	85	Sie ____
Jemand erhält	100	98	96	94	93	91	89	87	85	Jemand ____

Bitte kreuzen Sie die jeweilige Position an.

4

Sie erhalten	50	54	59	63	68	72	76	81	85	Sie ____
Jemand erhält	100	89	79	68	58	47	36	26	15	Jemand ____

Bitte kreuzen Sie die jeweilige Position an.

5

Sie erhalten	100	94	88	81	75	69	63	56	50	Sie ____
Jemand erhält	50	56	63	69	75	81	88	94	100	Jemand ____

Bitte kreuzen Sie die jeweilige Position an.

6

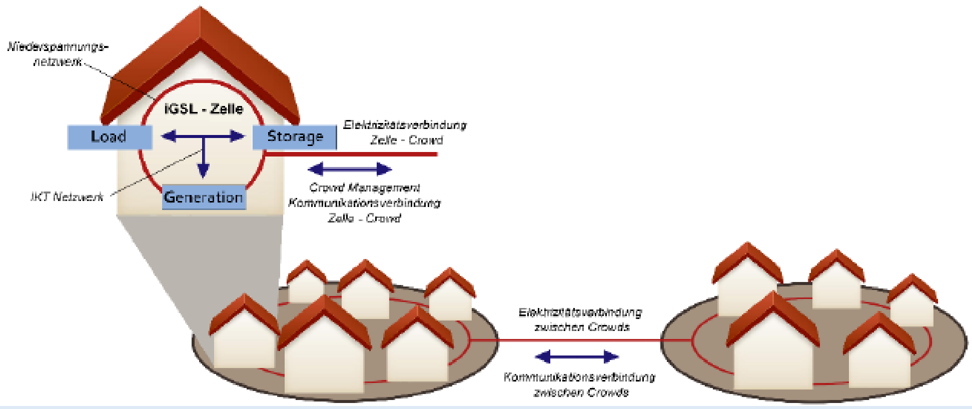
Sie erhalten	100	98	96	94	93	91	89	87	85	Sie ____
Jemand erhält	50	54	59	63	68	72	76	81	85	Jemand ____

4

Wie die Zukunft der Energie aussehen kann

Ausgangslage

Technologische Fortschritte ermöglichen es, **iGSL-Zellen** zu bilden. iGSL-Zellen sind Haushalte, welche **selbstständig Energie produzieren, speichern, konsumieren** und mit anderen Haushalten **teilen** können (siehe Abbildung).
Zusammen mit anderen iGSL-Zellen bilden Sie eine sogenannte **«Crowd»**. Um die Energieversorgung innerhalb der «Crowd» nachhaltig zu gewährleisten, muss jeder einzelne Haushalt schauen, dass er **zum Wohle der Gruppe** genügend Energie **produziert und/oder gleichzeitig seinen Energiekonsum reduziert.** Wenn zu wenig eigener Strom vorhanden ist, muss externer Strom eingekauft werden.



Problematik

Möglicherweise werden ein paar Haushalte nicht zum Allgemeinwohl beitragen und von den Bemühungen der anderen, welche z.B. **ein Solarpanel installiert haben und/oder bewusst Energie sparen,** profitieren (**Trittbrettfahrer**).

Die Crowd «Alpenblick» besteht aus 4 Haushalten und ist energieautonom:

- Frau A. hat Wärmekollektoren installiert,
- Familie B. hat ihren Energiekonsum reduziert,
- Herr C. hat seinen Stromkonsum um 15% gesteigert und
- Familie D. hat Solarpanels und einen Stromspeicher installiert.

Obwohl die Crowd «Alpenblick» energieautonom ist, profitiert ein Haushalt von den Bemühungen der anderen.

Welcher Haushalt profitiert von den Bemühungen der anderen? **Kreuzen Sie eine Antwort an.**

- ☐ Frau A.
- ☐ Familie B.
- ☐ Herr C.
- ☐ Familie D.

Ihr Quartier

Bitte kreuzen Sie an, inwiefern folgende Aussagen auf Sie zutreffen.
Kreuzen Sie jeweils EINE Position an.

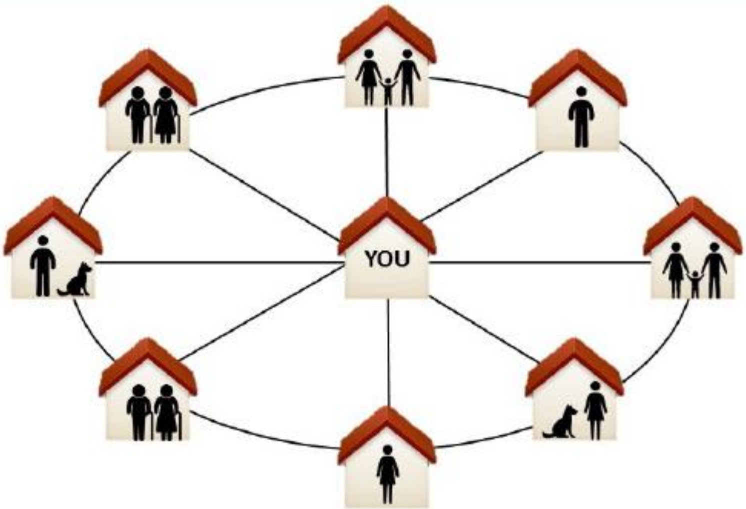
	Trifft überhaupt nicht zu					Trifft voll zu
Im Allgemeinen identifiziere ich mich mit den Interessen des Quartiers.	☐	☐	☐	☐	☐	☐
Ich empfinde ein gewisses Zugehörigkeitsgefühl zu meiner Nachbarschaft.	☐	☐	☐	☐	☐	☐
Ich fühle mich im Allgemeinen stärker mit meinen Nachbarn verbunden, als mit Menschen aus einem anderen Quartier.	☐	☐	☐	☐	☐	☐
Ich kenne meine Nachbarn grundsätzlich besser, als Menschen aus einem anderen Quartier.	☐	☐	☐	☐	☐	☐

Ihre Crowd «Energienachbarschaft»

Stellen Sie sich folgendes Szenario vor:

Sie sind Mitglied einer Crowd «**Energienachbarschaft**». Das **Ziel der Gruppe** ist es, zum Wohle der Nachbarschaft, den Energiekonsum zu reduzieren und die eigene Energieproduktion zu erhöhen, um **die Energieversorgung im Quartier** zu **gewährleisten.** Wenn zu wenig eigener Strom vorhanden ist, muss die Nachbarschaft als Ganzes externen Strom einkaufen.

«Energienachbarschaft» besteht aus Ihnen und aus anderen Haushalten und Gebäuden aus ihrer **direkten Nachbarschaft/Quartier.** Sie wissen somit, mit wem Sie kooperieren (Nachbarn). Sie bilden eine sogenannte **Energienachbarschaft.**



Bitte kreuzen Sie an, inwiefern Sie folgenden Aussagen zustimmen.
Kreuzen Sie jeweils EINE Position an.

	Trifft überhaupt nicht zu					Trifft voll zu
Das Szenario «Energienachbarschaft» ist mir zu abstrakt.	☐	☐	☐	☐	☐	☐
Das Szenario «Energienachbarschaft» ist durchaus realistisch.	☐	☐	☐	☐	☐	☐
Mit meinen Nachbarn zu kooperieren macht für mich durchaus Sinn.	☐	☐	☐	☐	☐	☐

Ihre persönliche Beitragsabsicht zu «Energienachbarschaft»

Bitte kreuzen Sie an, inwiefern folgende Aussagen im **Szenario Crowd «Energienachbarschaft»** auf Sie zutreffen. **Kreuzen Sie jeweils EINE Position an.**

	Trifft überhaupt nicht zu					Trifft voll zu
Ich würde **Energie sparen** und meine **Konsumgewohnheiten anpassen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐
Ich würde **alte Geräte durch energieeffiziente Geräte ersetzen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐
Ich würde **Energie selber produzieren** und eine **Energieproduktionseinheit kaufen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐
Ich würde **Energie speichern** und eine **Speicheranlage kaufen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐

Einschätzung der Beitragsabsicht Ihrer Nachbarn.

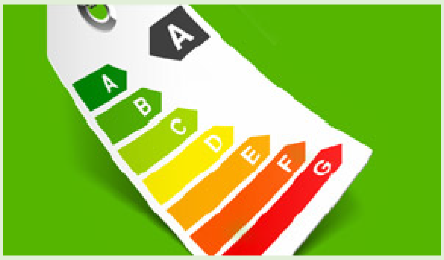
Inwiefern glauben Sie, wie die **Mehrheit Ihrer Nachbarn** im **Szenario «Energienachbarschaft»** folgende Aussagen beantworten würden?
Kreuzen Sie jeweils EINE Position an.

	Trifft überhaupt nicht zu					Trifft voll zu
Meine Nachbarn würden **Energie sparen** und ihre **Konsumgewohnheiten anpassen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐
Meine Nachbarn würden **alte Geräte durch energieeffiziente Geräte ersetzen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐
Meine Nachbarn würden **Energie selber produzieren** und eine **Energieproduktionseinheit kaufen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐
Meine Nachbarn würden **Energie speichern** und eine **Speicheranlage kaufen,** um die Energieversorgung in der Nachbarschaft zu gewährleisten.	☐	☐	☐	☐	☐	☐

Sie bestimmen die Regeln!

Um die die Energieversorgung in «Energienachbarschaft» sicherzustellen sind Regeln nötig. **Diese Regeln gelten sowohl für Sie als auch für die anderen Gruppenmitglieder.** Ein Energiedienstleister wird dann die Regeln umsetzen. Die rechtliche Form des Dienstleisters (Gross-, Kleinunternehmen, Genossenschaft, Verein, usw.) hat keinen Einfluss auf die Qualität der Dienstleistung.

Welche Regeln sollen für Sie und für die anderen Gruppenmitglieder gelten?



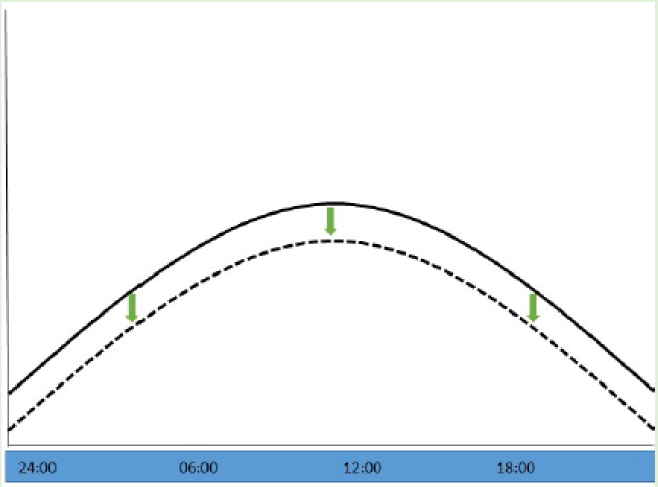
1. **Anschaffung energieeffizienter Geräte**

Die Anschaffung energieeffizienter Geräte hilft, die Energieversorgung in «Energienachbarschaft» zu gewährleisten.

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an.**

- ☐ Alle Mitglieder von «Energienachbarschaft» können **frei wählen**, welche Energieeffizienz-Standards sie beim Kauf von Elektrogeräten berücksichtigen.
- ☐ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, energieeffiziente Geräte zu kaufen.
- ☐ Alle Mitglieder, die energieeffiziente Geräte kaufen, sollten **belohnt** werden.
- ☐ Alle Mitglieder, die «Stromfresser» anschaffen, sollten **bestraft** werden.
- ☐ Alle Mitglieder **müssen**, zum Wohle der Energieversorgung, energieeffiziente Geräte anschaffen.

Ihre Regeln für «Energienachbarschaft»



2. **Energie sparen**

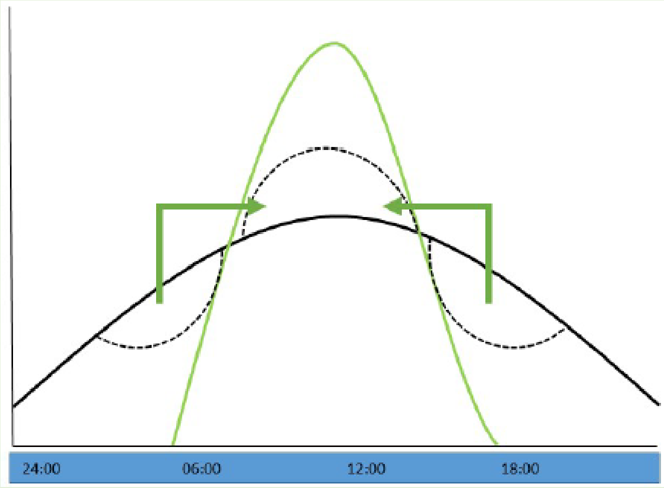
Ein geringerer Energiekonsum hilft, die Energieversorgung in Ihrer Nachbarschaft zu gewährleisten.

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an.**

- ☐ Alle Mitglieder von «Energienachbarschaft» können **frei wählen**, wieviel Energie sie konsumieren wollen.
- ☐ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, wie sie den Energiekonsum reduzieren können.
- ☐ Alle Mitglieder, die ihren Energiekonsum reduzieren, sollten **belohnt** werden.
- ☐ Alle Mitglieder, die ihren Energiekonsum erhöhen, sollten **bestraft** werden.
- ☐ Alle Mitglieder **müssen**, zum Wohle der Energieversorgung, den Energiekonsum zu gewissen Zeiten reduzieren.

10

Ihre Regeln für «Energienachbarschaft»



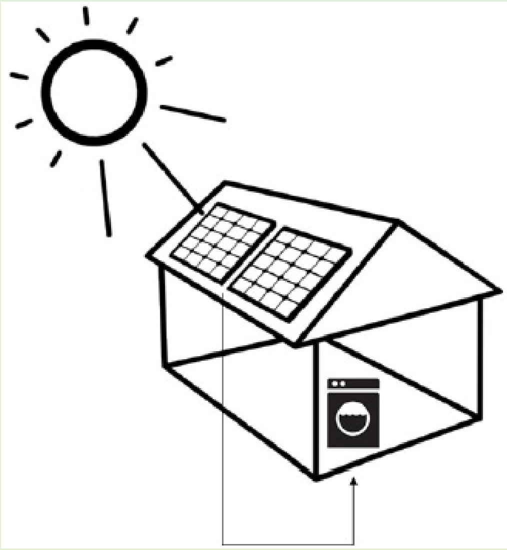
3. **Umverteilung des Energiekonsums**

Den Zeitpunkt des Energiekonsums an den Zeitpunkt der Energieproduktion anzupassen, hilft die Energieversorgung in Ihrer Nachbarschaft zu gewährleisten. Bsp.: Wenn am Mittag viel Strom durch Solarpanels produziert wird, dann soll dann auch Strom verbraucht werden (siehe Abbildung).

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an**

- ☐ Alle Mitglieder von «Energienachbarschaft» können **frei wählen**, wann sie Energie konsumieren wollen.
- ☐ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, wie sie Energiekonsum verteilen können.
- ☐ Alle Mitglieder, die ihren Energiekonsum verlagern, sollten **belohnt** werden.
- ☐ Alle Mitglieder, die den Energiekonsum nicht verlagern wollen, sollten **bestraft** werden.
- ☐ Alle Mitglieder **müssen**, zum Wohle der Energieversorgung, den Energiekonsum teilweise an die Energieproduktion anpassen.

Ihre Regeln für «Energienachbarschaft»



4. Anschaffung von Produktionseinheiten

Die Anschaffung von Energieproduktionseinheiten (Bsp.: Solaranlagen für Strom, Solarkollektoren für Wärme) helfen, die Energieversorgung in Ihrer Nachbarschaft zu gewährleisten.

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an**

- ▫ Alle Mitglieder von «Energienachbarschaft» können **frei wählen,** ob sie Energieproduktionseinheiten kaufen oder nicht.
- ▫ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, Energieproduktionseinheiten zu kaufen.
- ▫ Alle Mitglieder, die eine Energieproduktionseinheiten kaufen, sollten **belohnt** werden.
- ▫ Alle Mitglieder, die keine Energieproduktionseinheiten kaufen, sollten **bestraft** werden.
- ▫ Alle Mitglieder **müssen,** zum Wohle der Energieversorgung, einen gewissen Grad an Energie selber produzieren können.

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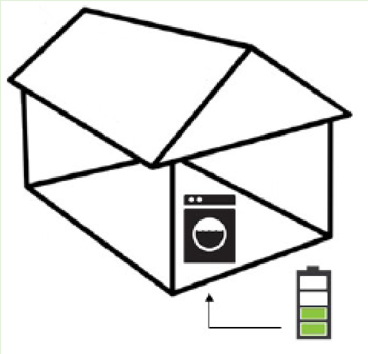
Ihre Regeln für «Energienachbarschaft»



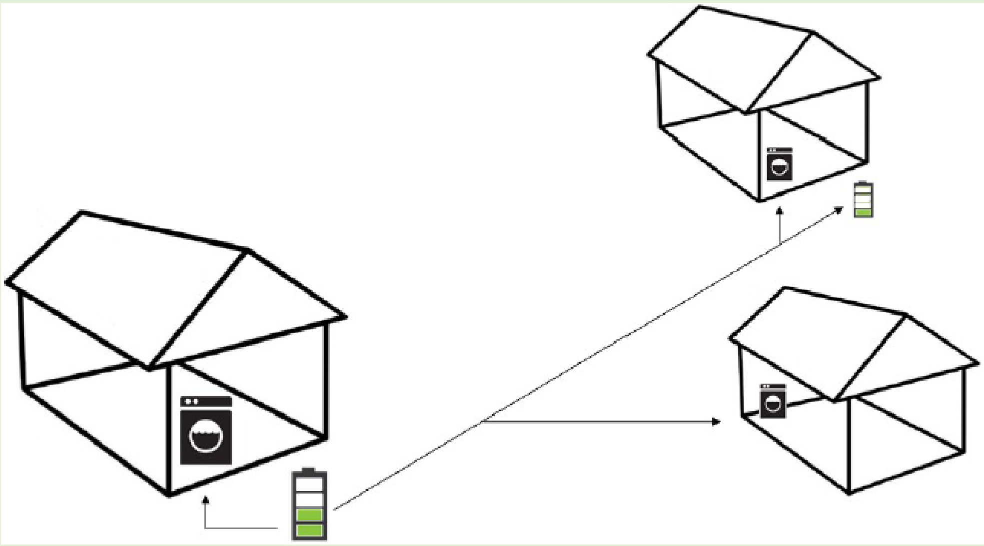
5. **Anschaffung von Speichereinheiten**

Die Anschaffung von Energiespeichereinheiten (Strom- und Wärmespeicher) helfen, die Energieversorgung in Ihrer Nachbarschaft zu gewährleisten.

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an**

- ▫ Alle Mitglieder von «Energienachbarschaft» können **frei wählen**, ob sie Energiespeichereinheiten kaufen oder nicht.
- ▫ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, Energiespeichereinheiten zu kaufen.
- ▫ Alle Mitglieder, die eine Energiespeichereinheiten kaufen, sollten **belohnt** werden.
- ▫ Alle Mitglieder, die keine Energiespeichereinheiten kaufen, sollten **bestraft** werden.
- ▫ Alle Mitglieder **müssen**, zum Wohle der Energieversorgung, einen gewissen Grad an Energie selber speichern können.

Ihre Regeln für «Energienachbarschaft»



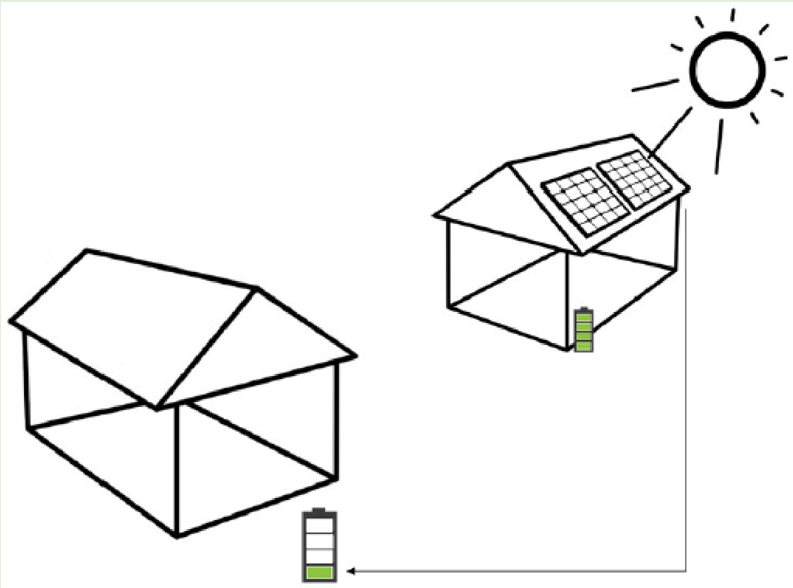
6. **Abgabe von gespeicherter Energie**

Die von Ihnen produzierte Energie kann gespeichert und von Ihnen und Ihren Nachbarn wieder bezogen werden. Wenn Ihre Nachbarn die Energie in Ihrem Speicher beziehen können, hilft dies, die Energieversorgung in Ihrer Nachbarschaft zu gewährleisten.

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an**

- ☐ Die Mitglieder von «Energienachbarschaft» können **frei wählen,** ob sie die gespeicherte Energie der Gruppe zur Verfügung stellen oder nicht.
- ☐ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, dass sie gespeicherte Energie der Gruppe zur Verfügung stellen sollten.
- ☐ Alle Mitglieder, die gespeicherte Energie der Gruppe zur Verfügung stellen, sollten **belohnt** werden.
- ☐ Alle Mitglieder, die gespeicherte Energie der Gruppe nicht zur Verfügung stellen, sollten **bestraft** werden.
- ☐ Alle Mitglieder **müssen,** zum Wohle der Energieversorgung, einen gewissen Teil der gespeicherten Energie der Gruppe zur Verfügung stellen.

Ihre Regeln für «Energienachbarschaft»



7. **Füllen von Energiespeicher**

Private Energiespeichereinheiten können vom Eigentümer und von Ihren Nachbarn «gefüllt» werden. Wenn Ihre Nachbarn die Energie bei Ihnen kurzfristig speichern können, hilft dies, die Energieversorgung in Ihrer Nachbarschaft zu gewährleisten.

Welche **Regeln** soll der Dienstleister **für Sie und die Gruppe** durchsetzen? **Bitte kreuzen Sie EINE Antwort an**

- ◻ Die Mitglieder von «Energienachbarschaft» können **frei wählen**, ob Sie Ihren Energiespeicher der Gruppe zur Verfügung stellen oder nicht.
- ◻ Alle Mitglieder sollten durch den Dienstleister **informiert** werden, dass sie den Energiespeicher der Gruppe zur Verfügung stellen sollten.
- ◻ Alle Mitglieder, die den Energiespeicher der Gruppe zur Verfügung stellen, sollten **belohnt** werden.
- ◻ Alle Mitglieder, die den Energiespeicher der Gruppe nicht zur Verfügung stellen, sollten **bestraft** werden.
- ◻ Alle Mitglieder **müssen**, zum Wohle der Energieversorgung, einen gewissen Teil Ihres Energiespeichers, der Gruppe zur Verfügung stellen.

Demografische Angaben

Bitte kreuzen Sie die jeweilige Antwort an.

Alter

____ Jahre

Geschlecht

- ◻ Männlich
- ◻ Weiblich

Haushaltsgrösse

◻ 1 ◻ 2 ◻ 3 ◻ 4 ◻ 5 ◻ 6 ◻ Mehr als 6 Personen

Seit wie vielen Jahren wohnen Sie bereits im Quartier?

◻ 0-5 ◻ 6-10 ◻ 11-15 ◻ 16-20 ◻ Über 20 Jahre

Besitzerverhältnis, ich bin...

- ◻ Haus-, Wohnungseigentümer/in
- ◻ Mieter/in

Wie haben Sie am 21. Mai 2017 bzgl. der Abstimmung zum Energiegesetz (EnG) abgestimmt?

- ◻ Ja
- ◻ Nein
- ◻ Habe nicht abgestimmt / weiss es nicht mehr / will ich nicht sagen

Sie haben es geschafft!
Vielen herzlichen Dank für Ihre wertvolle Teilnahme.

Sie können nun den Fragebogen im bereits frankierten Umschlag uns zukommen lassen.
Ihre Antworten werden anonym und vertraulich behandelt.
Die Resultate der Umfrage werden bald durch Ihre Gemeinde kommuniziert.

10.4 Publications

During research at the iimt, several papers related to the topics were published. The relevant publications are presented in ascending order.

- Hertig, Yves; Teufel, Stephanie (2016): Prosumer Involvement in Smart Grids. The Relevance of Energy Prosumer Behavior. In Petr Doucek, Ales Novak, Björn Paape (Eds.): 35th International Conference on Organizational Science Development. Sustainable Organization. Portoroz, March 16-18, 2016.
- Hertig, Yves; Teufel, Stephanie (2016): Prosumer communities: Electricity as an interpersonal construct. In: 2016 International Conference on Smart Grid and Clean Energy Technologies (ICSGCE). Chengdu, China, October 19.-22. Piscataway, NJ: IEEE Press, pp. 89–94.
- Hertig, Yves; Teufel, Stephanie (2016): Prosumer cooperation behavior. Implications for prosumer community design. In Journal of Electronic Science and Technology 14 (4), pp. 298–310.
- Gstrein, Mario; Hertig, Yves; Teufel, Bernd; Teufel, Stephanie (2016): Crowd Energy – das Kooperationskonzept für Smart Cities. In Andreas Meier, Edy Portmann (Eds.): Smart City. Strategie, Governance und Projekte, vol. 9. Wiesbaden, Germany: Springer Vieweg (Edition HMD), pp. 277–303
- Hertig, Yves; Teufel, Stephanie (2018): The 'Energy Community Management' Framework for Energy Service Providers. In: International Conference on Smart Grid and Clean Energy Technologies. ICSGCE. Kajang, Malaysia, 29.05.-01.06. Beijing, China: Institute of Electrical and electronics Engineering, inc., pp. 38–42.
- Artaz, Nadine; Hertig, Yves (2018): Lokale Energienetzwerke und das Vertrauensproblem. In Verbands-Management 44 (2), pp. 61–67.
- Thalmann, Lara; Hertig, Yves (2018): Profitability of RE-Technology Regarding the Economic Environment. A Case Study of Swiss SME. In Journal of Electronic Science and Technology 16 (4), pp. 351-366.

10.5 Declaration

I hereby declare that I wrote this thesis on my own and followed the principles of scientific integrity. The thesis does not include already published parts, which are not clearly cited as such, nor does the thesis include contributions from former co-authors, which are not clearly cited as such.

Fribourg, the 31.03.2019

Yves Hertig