SONNET – Social Innovation in Energy Transitions

Co-creating a rich understanding of the diversity, processes, contributions, success and future potentials of social innovation in the energy sector

GA#: 837498 / Funding type: RIA

Research report on LOCAL ELECTRICITY EXCHANGE in Switzerland
About SONNET: SONNET is a research project that aims to develop an understanding of diversity, processes, contributions and future potential of social innovation in the energy sector. It is co-funded by the European Commission and runs for three years, from 2019-2022. The SONNET consortium consists of 12 partners across Europe, including academics and city administrations. For more information, please visit our website: https://sonnet-energy.eu

Suggested citations: 
Musiolik, Jörg and Müller, Leticia (2021): LOCAL ELECTRICITY EXCHANGE. Research Report, SONNET: EU Horizon 2020 Grant agreements no: 837498

Acknowledgements: 
We would like to express our gratitude to all interview partners who offered their time and expertise to answer our questions with great dedication. Then, thanks go to Benjamin Schmid, Pascal Vögeli, and Samuel Klein, who provided helpful support in editing this report and in summarising the interviews.

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1 FOREWORD

SONNET (Social Innovation in Energy Transitions) brings diverse groups together to make sense of how social innovation can bring about a more sustainable energy sector in Europe. The project aims to co-create a rich understanding of the diversity, processes, contributions, successes and future potentials of social innovation in the energy sector (SIE). We define SIE as a combination of ideas, objects and/or actions that change social relations and involve new ways of doing, thinking and/or organising energy. As part of this work, we make use of an embedded case study approach to build a better understanding of the development of diverse SIE-fields (e.g. participatory incubation and experimentation, framings against specific energy pathways, local electricity exchange) over time. Our research questions that frame the case study work are:

How do SIEs and SIE-fields emerge, develop and institutionalise over time?

How do SIE-field-actors and other field-actors interact with the ‘outside’ institutional environment and thereby co-shape the SIE-field over time?

What are the enabling and impeding factors for SIE-field-actors and other field-actors to conduct institutional work and change the ‘outside’ institutional environment?

A SIE-field is an arena/space that includes a specific SIE as well as SIE-field-actors working on it and other field-actors enabling and/or impeding it. In this arena/space these actors take one another and their actions into account and have a shared (but not necessarily consensual) understanding of a SIE and of their relationship to other actors. They recognise (but not necessarily follow) shared norms, beliefs and rules. SIE-fields are often not homogenous but are composed of actors with diverse and contradictory aims and interests. An example: The UK cooperative energy field includes SIE-initiatives and SIE-field-actors (e.g. Brighton Energy Co-op, Cooperative UK, Community Energy England, UK Government, City of Brighton), who have a shared understanding of an SIE, which exists as ‘organising under cooperative principles to generate renewable energy’.
The structure of this report is as follows. Section 2 provides a summary of the SIE-field relevant for this report and lists some key insights. Section 3 outlines the boundaries of the SIE-field and shows how it has been studied in the country context. Section 4 shows a visual development of the SIE-field. Section 5 tells the historical development of the SIE-field over time, including analytical/interpretive reflections from the SONNET researchers and quotes from the actors involved in the field developments. Section 6 outlines key research findings, providing answers to the three research questions. Section 7 outlines recommendations for policymakers based on the findings. Finally, Section 8 outlines the methodological approach and includes a more detailed timeline of the SIE-field and its actors.
2 LOCAL ELECTRICITY EXCHANGE

In SONNET we investigate the development of social innovations in energy (SIE) and the SIE-field ‘local electricity exchange’. This includes institutional work and further activities derived from development of production, consumption, distribution, and trading of renewable energy locally (i.e. close to its point of generation). We study this SIE-field in France, Switzerland, and the United Kingdom (UK). The study of this SIE-field is important for understanding some of the changes around renewable energy, consumers’ and communities’ involvement, and evolving energy markets, because of energy transitions focusing on decarbonisation and decentralisation of the energy system.

Local electricity exchange as a broader field allows the inclusion of some of the innovative approaches that aim to match local renewable energy generation with local consumption resulting in new business models and new forms of collaborations that also allow engaging people in energy transitions. The SIE-field local electricity exchange is defined as multi-actor collectives (including multiple non-traditional energy players) experimenting with and implementing novel institutional, organisational, technical (digital) and business model innovations to enable grid-connected local/regional renewable energy exchange (which includes production, consumption, distribution and sometimes trading of energy). The SIE includes rather established models such as self-consumption communities, micro-grids but also more experimental set-ups such as peer-to-peer trading schemes or other forms of (virtual) platforms changing social relations in energy. The aim of the initiatives and other activities related to local electricity exchange is to involve further parts of society in the energy transition by creating space for new types of actor collectives with new solution-based ideas to contribute to decentralisation and the emergence of local electricity markets. The study started with exploring regulative changes and emerging entrepreneurial opportunities for local production and distribution in micro grids and in self-consumption settings. The boundaries were then expanded to include SIE initiatives testing and developing new types of local electricity trading like local peer-to-peer electricity exchange.
Key insights

For the SONNET project, the SIE-field of local electricity exchange is particularly interesting because through new institutional and organisational solutions for accelerating renewable energy uptake and involving further parts of society in the energy transition, it reveals a number of important issues for social innovation in energy transitions. In particular, it illustrates that:

- Regulative changes, partly lobbied by SIE-field actors, opened up new entrepreneurial opportunities for local electricity exchange
- In Switzerland the ZEV organisational model, was introduced. When a ZEV is formed, a new legal entity replaces the local utility and becomes responsible for energy supply, metering, and organising a community of end-consumers. This model therefore enables actors to invest in privately owned supply and distribution infrastructure to sell locally produced electricity to tenants of nearby properties
- The boundaries of the ZEV organisations and the local electricity exchange are currently contested in Switzerland, as new ideas for organising local electricity markets have evolved with blockchain and new peer-to-peer trading schemes
- ZEV organisations and peer-to-peer trading solutions changed social relations and have the potential to accelerate the diffusion of decentralised renewable energy in the housing sector. While end-consumers especially in multi-party building and districts due to split incentives, risk and uncertainties had problems to invest in solar plants and to consume locally produced electricity before, with the ZEV regulations there was a legal option to build up distributed self-consumption in broader areas
- The emergence of ZEV as a regulative institution and as an actor in the form of a legal entity changed social relations between real estate organisations and tenants, as the new institutions created incentives for both tenants and real estate holders to engage in local electricity production and consumption.
- Institutional work and changing institutions are of key importance for SIE and SIE-field development in Switzerland. The starting point were regulative changes, which
triggered new types of energy related activities. These led to new types of social relations and roles (ZEV organisations) and a formation of SIE-field actor communities, which develop further institutional structures (guidelines of best practices, vision of new forms of electricity exchange). These lead to further actions in terms of new pilot projects and thus, again, lobbying and regulative changes.

3 Introduction to local electricity exchange in Switzerland

The case study in this report covers the complex development and institutionalisation process of models of local energy production, distribution, and exchange as a social innovation process in energy. It includes new ways of thinking, doing and organising local electricity exchange and is embedded in the broader discussion of prosumerism, decentralisation, future energy systems and energy market reforms (Brown et al., 2020, Halle et al., 2020). Temporally, main developments before 2014 are taken into account, which helped set the stage for the emergence of the SIE-field. The field emergence and institutionalisation of the SIE-field from 2014 to 2019, and the digitalisation of the SIE-field from 2019 onwards starts with photovoltaic developments in a system of cost-covering feed-in compensation at the end of the 2000s towards developments and trails in digital technologies such as blockchain and peer-to-peer (P2P) trading.

In Switzerland, as in other countries, photovoltaics became the leading local energy production technology. While installing photovoltaics and producing electricity, different SIE initiatives emerged, testing and developing new schemes for local distribution and trading in a partly liberalised energy market. These initiatives originate from different backgrounds and are driven by different mindsets and incentives. They include actors from civil society, from the real estate sector, business, and the energy sector (c.f. Table 1). A key development for the SIE-field in Switzerland was the institutionalisation of ZEV (Zusammenschluss zum Eigenverbrauch) as an organisational model but also as a legal entity responsible for a self-consumption community. More specifically, this regulation
allows self-consumption of solar power beyond the building or property boundary (c.f. Figure 1). As ZEVs became well institutionalised, most of the identified SIE initiatives apply this model in various settings.

![Figure 1 Depiction of a ZEV according to the existing regulations (Source EnergieSchweiz, 2019)](image)

However, there are further initiatives, for instance, pilot projects which extend local self-consumption solutions and move towards new directions in terms of peer-to-peer trading or platform related trading schemes (c.f. Box 8). The boundaries of this SIE-field are, therefore, demarcated by existing schemes (microgrids, self-consumption models) and initiatives that are being tested e.g. new models/propositions trialled through regulatory 'sandbox' schemes.
### Table 1 Typical SIE initiatives in Switzerland

<table>
<thead>
<tr>
<th>SIE initiative type</th>
<th>Description</th>
<th>Institutional context / driver</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperatives and civil society</td>
<td>Deploy a ZEV organisation in order to organise joint production, distribution and consumption in local communities (tenants have often an active role)</td>
<td>Cooperatives and community movements and societal experiments in energy</td>
<td>Cooperative Rossfeld (c.f. Box 6)</td>
</tr>
<tr>
<td>Real estate companies</td>
<td>Deploy a ZEV organisation in order to cross sell further services such as energy supply to their tenants or to reach sustainability goals of the company</td>
<td>Real estate sector and sustainability goals in terms of requirements for awarding processes of property land from the state, requirements in terms of building standards</td>
<td>Swiss prime site, Axa insurances, Pension funds</td>
</tr>
<tr>
<td>Commercial enterprises</td>
<td>Deploy a ZEV organisation in order to increase the rentability of PV by accessing heterogenous consumption in a broader district</td>
<td>Business (profits, rentability), corporate social responsibility</td>
<td>Holzbau AG Lüsslingen</td>
</tr>
<tr>
<td>Energy service provider (landowner has given the right to organise ZEV to a service provider)</td>
<td>Deploy and manage a ZEV, micro-grids and renewable energy technology, storage in order to increase return by organising a full service in a district</td>
<td>New actors in energy experimenting with new business models and combination of roles</td>
<td>ADEV Erlenmatt Øst (c.f. Box 5)</td>
</tr>
<tr>
<td>Pilot project and experiments (sandbox trails)</td>
<td>Presence of research organisations, testing of digital solutions and new trading schemes locally</td>
<td>Regulative institutions are relaxed or contested (e.g. rules for deployment of grid, requirements for trading and market access)</td>
<td>Walenstadt blockchain project (c.f. Box 8)</td>
</tr>
</tbody>
</table>

Besides the SIE initiative representatives, a rather broad range of SIE-field actors evolved with the SIE-field. These actors have different competences and fulfil different roles. Table 2 depicts the identified actor roles in the SIE-field. Some of them are active in supporting the SIEs in realising, for example, self-consumption communities or (digital) pilot projects. Others (role 6-8), however, are rather involved in institutional work and in creating and
shaping supportive regulations and framework conditions for the SIE-field. The different roles are further explained and differentiated in section 5.

Table 2 Identified SIE-field actors and their roles (own depiction, based on interviews)

<table>
<thead>
<tr>
<th>SIE-field-actors/roles</th>
<th>Description of role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planning, installation and contracting companies</td>
<td>Do the planning, installation, maintenance of renewable energy technology, micro-grids, storage and ICT solutions for ZEV organisations, often own the hardware and deliver energy to ZEV organisations (contracting) (sometimes combine role 1, 2 and 4 in one business model, support the foundation of the ZEV organisation)</td>
</tr>
<tr>
<td>2. Meter and billing service companies</td>
<td>Deploy platforms of ICT companies, provide meter and billing services to ZEV organisations</td>
</tr>
<tr>
<td>3. ICT companies</td>
<td>Develop platforms and tools for administration, metering, billing, data transfer and controlling (self-consumption optimisation), develop new solutions for local trading (blockchain)</td>
</tr>
<tr>
<td>4. ZEV Organisation</td>
<td>Entity which bundles different owners, households, residents to build up broader (district) communities, is in charge of internal organisation (electricity production, distribution, metering, defining internal energy price etc.), establishes contracts with tenants, with role 1-3 and 5</td>
</tr>
<tr>
<td>5. DSOs / Utilities</td>
<td>Establish an energy delivery contract with the ZEV organisation, develop new ZEV services (roles 1-2)</td>
</tr>
<tr>
<td>6. Executive / policy</td>
<td>Develop the relevant laws (EnG), in exchange with other field actors (role 7 and 8)</td>
</tr>
<tr>
<td>7. Federal administration</td>
<td>Transfer of the laws into regulations (EnV) and instruments, communication between policy, association and intermediaries and field actors to adjust the rules</td>
</tr>
<tr>
<td>8. Associations and intermediaries</td>
<td>Lobby regulative changes in the policy process and the official consultation process, develop guideline reports, provide tools (profitability calculations, standard contracts) to shape the code of conduct in the field</td>
</tr>
<tr>
<td>9. Research organisations</td>
<td>Initiate pilot projects and the further development of local distribution and trading solutions, often in close cooperation with actor role 3</td>
</tr>
</tbody>
</table>
To sum up in Switzerland the boundaries of the SIE-field have the following shape:

- The SIE-field centres around photovoltaic technology, which is the most commonly used decentralised renewable energy production technology (in some case also micro hydrogen plants or combined heat power plants play a role)
- Self-consumption and micro-grids are the most commonly used concepts in Switzerland. In addition to that, there are some experimental projects in which new forms of trading, platforms or blockchain technologies are applied to test for example P2P trading. These projects are, however, less institutionalised
- The new way of organising ZEV, which is an entity which bundles different owners to form broader (district) communities to organise production, consumption and distribution locally is key in shaping SIE-field boundaries
- The SIE-field has evolved over time, leading to various SIE-field actors with distinct roles, which are combined in different ways in the SIE initiatives
- Typical SIE initiatives are founded and realised by housing cooperatives, real estate firms, industry and from energy service providers

**Box 1 'Outside' institutional environment shaping the development of the SIE-field**

In SONNET, we consider a SIE-field to be nested in a larger encompassing institutional environment, consisting of both formal and informal institutions. We are interested to understand how dominant institutions (regulative, normative, and cultural cognitive elements) within this ‘outside’ institutional environment influence the emergence and development of SIE within a SIE-field. For the emergence of the SIE-field of local electricity exchange in Switzerland, energy policy, in addition to the existing institutions in energy and the housing sector, is of key importance.

Switzerland’s energy sector provides an institutional setting which paves the development of the emerging paths of local electricity exchange. Key institutions are the Energy Act, the Electricity Supply Act and the Energy Strategy 2050. While the Energy Act...
regulates the framework conditions of the energy industry at national level, the Energy Supply Act regulates the electricity market and the Energy Strategy 2050 (ES 2050) provides a long-term vision/plan from the federal government for the transformation of the energy system. For example, market- and grid financing rules as well as metering regulations are defined in the Energy Act and the Energy Supply Act. In the current legislation the energy market is partly liberalised, meaning that end-consumers cannot select their energy supplier in the market and new distribution and supply business models have to cope with many barriers.

Of key importance for the recent policy development is the Energy Strategy 2050, a package of energy-related measures. Against the backdrop of the planned nuclear phase-out, it is intended to serve the country's long-term vision for supply of electrical energy. Among other things, the ES 2050 revised the role of the KEV system in place. KEV includes a “feed-in remuneration at cost” scheme, which provides incentives for investments in new renewable energy facilities. However, since its introduction in 2009 the KEV system was politically contested, as its core mechanism, the feed-in tariff, did not fit with the existing norms and beliefs in the political system (e.g. liberal & market orientation of most of the political parties). Subsequently, a move towards a more market-oriented funding and the de-facto removal of the option to receive KEV support after 2012 led to a decline in the number of solar installations. In this situation, further policy changes around the Energy Act and the Electricity Supply Act have been realised in order to promote renewables through indirect subventions through so-called self-consumption regulation. These measures pave the way towards entrepreneurial activities of local distribution and direct marketing of the electricity produced especially in the housing sector.

Second, the Swiss housing sector provides another important institutional setting that shapes the development of the SIE-field in Switzerland. Sustainability goals in terms of requirements for awarding processes of property land from the state and requirements in terms of current building standards, forced real estate actors such as pension funds to move towards projects of local energy distributions and self-consumption. As tenants are involved in such projects, the existing tenant law is highly decisive for the formation
of the SIE-field. If ZEV organisations are founded, rent protection regulations as well as the Energy Act and the Energy Supply Act apply, as tenants are also energy consumers. This means that local energy distribution and exchange projects in Switzerland have to be in accordance with several different legal areas, which in turn influence the development of the SIE-field.

To conclude, the aforementioned regulations are part of the ‘outside’ institutional environment and shape the development of the SIE-field as well as the focal SIE. The Energy Act and the Electricity Supply Act define the relationship between ZEV organisations and the local distribution system operators (DSOs) as well as the possible boundaries for local distribution and consumption. The tenant law, finally, defines the internal relationship between the operator of the ZEV-organisation and the tenants (e.g. the rights of the tenants to leave a ZEV).
4 Timeline of LOCAL ELECTRICITY EXCHANGE

The following offers a timeline detailing the most important events for SIE-field development of local electricity exchange in Switzerland.
In Switzerland, ideas and intentions of local electricity exchange existed and were also technically possible before the relevant regulations were put in place. Regulatory conditions, however, were extremely instrumental and indicate where clear phases of...
change occurred in the SIE-field. In Phase 1, we consider the emergence of the SIE-field to be closely linked with the system of cost-covering feed-in tariffs in place up to 2014. Problems with the cost-covering feed-in tariff system led to a revision of regulations, where in Phase 2, the SIE-field took shape with an explicit regulation on self-consumption. In Phase 3, regulations were further expanded, allowing for the institutionalisation of local electricity exchange by introducing new actors to the SIE-field through the ZEV organisation, allowing for self-consumption and energy production and distribution across properties. In phase 4, a clear shift to focus on digital innovations through peer-to-peer trading and experimental projects in using blockchain technology and testing virtual solutions emerged, leading to a potential contestation of existing SIE-field boundaries.

PHASE 1: Before 2014: Pre-field developments

In 2009 a system of “feed-in remuneration at cost”, known as KEV, was implemented in Switzerland, where electricity producers from renewable energy are compensated for the electricity they feed into the grid. This ‘feed-in-tariff’ accelerated the diffusion of decentral renewables and photovoltaic plants became the main technology for decentral local energy production (c.f. Figure 2). The introduction of KEV created high investment security for new renewable energy facilities, which led to different actors expecting that a new market for decentralised energy technologies and local electricity would emerge. As a result, new actors – including energy cooperatives, planning and consulting agencies, photovoltaic installation and contracting companies – and further intermediary actors, such as aggregators began to share ideas and recognise the synergies between their goals and what appeared to be the emergence of a shared social sphere of new actors entering the energy market. Due to the cost-covering feed-in compensations that were instrumental before 2014, there were however no incentives for local distribution and electricity trading. Nevertheless, the new actors in the energy market constantly tried to extend their roles and business models. On the business side, so-called aggregator business models emerged which attempted to bundle decentral production facilities in virtual power plants in order to organise and sell energy and flexibility (e.g. tiko Energy or fleco power). On the side of civil
society, actors tried to accelerate the energy transition by experimenting with new types of community energy projects (Lowitzsch et al., 2019). For example, Energiegenossenschaft Schweiz, the Swiss Energy Cooperative, developed a scheme for trading and exchanging certificates for renewable energy production. Members of the cooperative who could not install their own PV plant, could pay the owner of a plant a reward for the added value of renewable energy production. In addition, there were some initial activities to develop solutions for self-consumption in apartment blocks or small districts (c.f. Box 5 and Box 6). However, all these developments had to consider the established market rules of a partly liberalised energy market and critically depended on the goodwill and support of the local DSO.

To conclude, this first phase of SIE-field development was mainly characterised by the diffusion of solar energy and idea sharing for local energy exchange. While some early activities of distribution and selling of renewable energy certificates and flexibility in production were initiated, the SIE-field of local electricity exchange was not yet institutionalised, and initiatives were rather isolated and experimental. Feed-in remuneration at cost was important as both an impeding and enabling factor in the first phase. On one hand, the high investment security allowed for greater technological diffusion in renewable energy and allowed for a space to exist where new actors in the energy market could interact and share ideas around the future of local electricity exchange. At the same time, the low incentive to engage in local electricity distribution was an impeding factor for SIE. However, due to the economic costs and further problems of the support scheme, such as the long waiting list for new projects, the KEV system was at

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\[1\] Due to the feed-in system no regulative incentives for local electricity distribution and for direct marketing were in place.
some point politically no longer feasible. As result, the support scheme went through various reform processes leading to the second phase of SIE-field development.

Figure 2 Development of electricity production from renewable energy in Switzerland (excluding hydropower) since 2000 (GWh) (Source Swiss Federal Office of Energy SFOE)


Already in 2013, the parliament started to adopt an amendment to the Energy Act (based on parliamentary initiative 12.400 UREK-N). These amendments aimed at coordinating different measures and regulations to better implement the national energy strategy and to reform the KEV system towards direct marketing of locally produced electricity. The system of cost-covering feed-in compensation was changed towards one-off remuneration
of renewable energy projects. Part of the reform was an explicit regulation of self-consumption in 2014. Although the current Energy Act already provided a purchase-, but not a (complete) feed-in obligation, in practice, plant operators were de facto denied consumption of the energy they produced themselves. This was the case because DSOs could meter and bill all locally produced energy as it was fed into the grid even if it was consumed at the same location. With the new regulation, it was explicitly clarified that the self-consumption in the settlement between grid operators and producers is possible. At the same time, this meant that producers could purchase less energy from the DSO and thus, save on electricity procurement costs (grid usage and energy). In other words, self-consumption enables savings on electricity purchase costs and thus creates an incentive to produce energy or to install production facilities. The changes of the Energy Act can be summarised as follows:

- Self-consumption is permitted and has to be taken into account in the billing between grid and plant operators
- Per definition, self-consumption only takes place when the DSO’s grid is not used between the production plant and consumption
- Self-consumption is also assumed if electricity is generated with solar modules on a rented property; in this case, self-consumption exists though the electricity is actually consumed by the tenants

While self-consumption was explicitly mentioned in the Energy Act, the procedure of implementing a self-consumption project and the roles different actors would play in the emerging SIE-field were less clear. Especially incumbents such as DSOs and interested real estate actors lacked necessary know-how and experienced uncertainty at this time. In this situation, the Swiss Federal Office of Energy (SFOE) and different associations worked together to concretise the intention of the legislators. Guideline reports have been published by EnergieSchweiz an organisation supported by SFOE and with the help of the Swissolar association to provide information and tools within the emerging SIE-field. These included descriptions of actor roles, electricity and money flows in typical projects, tools for the calculation of the economic feasibility as well as check lists for project realisation.
(Energie Zukunft Schweiz, 2015). These activities led to further concretisation of self-consumption in multi-party properties or districts:

Self-consumption can take place in multi-party houses and districts. As long as the grid of the DSO is not used, landlords and tenants can organise themselves in so-called self-consumption communities, known as *Eigenverbrauchsgemeinschaften* (EVGs).

While the SIE-field development was pushed further, the Association of Energy Providers in Switzerland (VSE) communicated their recommendation for the implementation of self-consumption regulation including guidelines on how DSOs should handle self-consumption communities, in terms of metering, and payment of grid fees, as an example (Verband Schweizerischer Elektrizitätsunternehmen VSE / AES, 2014). These guidelines helped utilities and DSOs provide services to self-consumption communities and led to the launch of a service scheme called “praxismodell VNB”, or “DSO best practice model”.

**Box 2 Institutional work conducted by SIE-field actors and other field-actors**

SONNET applies the concept of institutional work to acknowledge that actors can be knowledgeable agents who are able to influence and change institutions. Institutional work refers to the activities of SIE-field-actors and other field-actors that aim to create, maintain, and transform institutions. We are interested in why, how, when and where actors engaged in such institutional work to better understand the different forms of institutional work, types of work conducted (boundary work, strategy work, etc.), actors who are engaged (or not) in this work, and enabling and impeding factors to be able to conduct this work.

Institutional work in the SIE-field of local electricity exchange mainly occurs in three ways: First, through joint advocacy of SIE-field representatives in the energy policymaking processes at the federal level; second, through the development of guideline (reports) through intermediary organisations; third, through framing, communication and
discourse activities in the SIE-field. While the latter two activities target the more informal and emerging norms and code of conducts in the SIE-field (internal field institutions), the former activities attempt to change existing regulative institutions such as the federal Energy Act.

First institutional work in terms of lobbying of regulative changes of the Energy Act and Energy Supply Act was reported in the interviews of the study. Stakeholder involvement in policy making is an integral part of the political system in Switzerland, as regulative changes are intensively discussed and reflected in a so called “Vernehmlassungsverfahren”. Therefore, key politicians with important roles in firms and associations of the SIE-field were involved in key commissions, working groups of the parliament, and in the “Vernehmlassungsverfahren” throughout the adaption process of the Energy Act between 2013 and 2018.

Second, guideline reports have been created by key associations of the SIE-field and financed by the Swiss Federal Office of Energy. The crafting of guidelines and information on best practices for project implementation have been of importance in two periods of SIE-field formation: i) the explicit mentioning of self-consumption in the Energy Act in 2014 and the introduction of the ZEV organisation and the further changes of the Energy Act in 2018 (Energie Zukunft Schweiz 2015, EnergieSchweiz 2019). In both situations, associations such as Swissolar, the association of the Swiss energy providers (VSE), etc. were involved to provide know-how, tools and legal recommendations including descriptions of actor roles, tools for the calculation of the economic feasibility as well as check lists for project realisation in order to facilitate the adoption of projects in the SIE-

2 See Box 4 and also https://www.fedlex.admin.ch/de/consultation-procedures/explanations-cp
field. However, by providing these guidelines, these associations shape the norms and the code of conduct to realise projects of local electricity exchange.

Third, the framing and naming process of the emergent SIE-field started with the term self-consumption community (EVG) which has colloquially been accepted as an umbrella term for shared solar production. In 2014, the term was officially mentioned for the first time in a parliamentary motion by Jürg Grossen, a key actor in the SIE-field, and subsequently became the standard term. However, as the term had no legal relevance framing was continued and Zusammenschluss zum Eigenverbrauch, ZEV, was introduced as a more narrowly defined legal term. When speaking of ZEV, we refer to the implementation of self-consumption since 1. January 2018 with private smart meters. The distribution system operator practice model (“praxismodell VNB”) is a type of solution that can be provided by DSOs in Switzerland and is a reaction from the incumbents towards these new service opportunities. If a EVG is implemented but the individual tenants remain direct customers of the DSO, this practice model applies. All these terms have been created by SIE-field actors and have named types of end-consumer communities and the subsequent emerging markets for local energy exchange.

*Figure 3 Evolution of concepts and terms of shared self-consumption in Switzerland (Source: [www.evg-zentrum.ch](http://www.evg-zentrum.ch))*
To conclude, all three areas of institutional work are of importance for SIE-field development. By changing formal regulations, new actors and business models became regulative institutions. Then, in a second step, guidelines and codes of conduct were needed to govern informal norms by streamlining and standardising project procedures and actor roles in the emerging SIE-field. However, as the boundaries of local electricity exchange are still contested, institutional work and lobbying for regulative changes might continue.

Box 3 Regulative, normative and/or cultural cognitive institutions

In SONNET, we differentiate between regulative, normative, and cultural-cognitive institutions that might shape the development of a SIE-field. Regulative institutions encompass laws, rules, standards, and policies; normative institutions are norms and value systems; and cultural-cognitive institutions include conceptions of reality, binding expectations as well as common beliefs.

Regulative institutions were particularly important in setting the policies and rules, which govern what is allowed in the SIE-field of local electricity exchange. Due to various legal limits across different sectors (for instance, the Energy Act, the Electricity Supply Act, and Tenant Law), actors must always consider existing regulative institutions and how these evolve. For pioneers, regulative institutions tend to act as impeding factors, as they limit the extent of experimentation allowed. This can be seen in various phases: For instance, the housing cooperative Rossfeld (c.f. Box 6), fought difficult uphill battles in establishing self-consumption communities, as laws and regulations made self-consumption difficult in the beginning. In phase 4, the SIE initiative shows that establishing blockchain technology for trading and billing is technically possible but impeded by regulative institutions. Changes in regulative institutions are therefore critical to enable activities in the SIE-field of local electricity exchange.

Normative institution also played a role in the SIE-field development as at the beginning
the procedure of how to found a ZEV organisation or how to realise a project of shared self-consumption among different properties was less clear. By developing experience in pilot projects in addition to the institutional work of associations and key networks of the SIE-field (c.f. Box 2), standard approaches (process models) for realising a ZEV project emerged.

![Figure 4 Example of a process model for realising a ZEV/EVG organisation, published by an intermediary organisation, own translation](Figure 4)

These approaches have the character of norms in the SIE-field as stakeholders expect that such steps evolve in such projects. However, still these processes have no binding character as no commonly accepted quality standards for project implementation have yet been created.

Finally, cognitive institutions such as collective expectations (Borup et al., 2006) are also very relevant for the SIE-field emergence and development. Due to the regulative changes, business opportunities for local distribution, metering and selling of energy emerged. This led to euphoria in the SIE-field and new actors entered the SIE-field excepting the new business models to grow.
Box 4 Policies and policy making

This box offers reflections on which policies were the most relevant for SIE-field development.

First, the Energy Act regulates the framework conditions of the energy industry at national level. Its aim is to ensure an adequate, diversified, secure, economical and environmentally compatible energy supply in Switzerland. The Energy Act is important for the SIE-field, as the law was adapted in terms of self-consumption, possibilities for local distribution, metering and billing, and the formation of the ZEV organisation.

Second, the Electricity Supply Act regulates the electricity market in terms of responsibilities of basic supply, management of contracts, non-discriminatory network access, and monitors network usage charges and electricity tariffs. It is important for the SIE-field as the law still defines the responsibilities of the ZEV organisation in terms of basic energy supply in addition to the market access and the relationship of the ZEV organisation with the DSO.

Third, Tenant Law regulates the rights and duties of the tenants and the contractual relationship with the landlords. It is important for the field as it defines the rights of the tenants in the ZEV organisation as well as the processes how a ZEV organisation can be founded.

If ZEV organisations for example are founded with tenants, rent protection regulations, the Energy Act and the Energy Supply Act apply, since tenants are both energy consumers and tenants at the same time. This means that local energy distribution and exchange projects in Switzerland have to be in accordance with several different legal areas, which in turn influences the development of the SIE-field. In addition to that, the SIE-field is impacted by market liberalisation and the grid financing and ownership rules, regulations, which are elaborated in the Energy Act and Energy Supply Act. How the grid infrastructure elements such as cables or transformers are transferred to ZEV
organisation in addition to how much grid fee that those engaging in self-consumption have to pay, determines the profitability of such projects.

In addition, these regulations also influence the future directions of the SIE-field as the use of the local distributions grid and selecting a supplier for end-customers is currently not allowed, influencing new concepts such as peer-to peer trading or virtual ZEVs.

Process of policy making in Switzerland

The “Vernehmlassungsverfahren” is a deliberative process quintessential to Swiss policymaking. When preparing any amendment to existing regulations, the cantons, political parties and interested parties (especially associations) are invited by the Federal Council to submit their comments. This is done by the competent body (usually the competent department) publishing a preliminary draft and an explanatory report. The preliminary draft and the explanatory report are often not prepared by the government or the responsible office itself, but by an expert commission appointed by the government. Such an expert commission consists of experts from the areas affected by the draft.

The aim is to contribute expertise and to be able to assess the chances of success of the project in the further legislative process. Particularly in view of a possible referendum, it is important in Swiss politics to consult all important interest groups during the consultation process, in order to be able to present so-called "referendum-proof" bills.

The responses of all participants in the consultation process are evaluated before the Federal Council determines the parameters of its proposal to parliament. The Federal Council discusses the draft in the knowledge of these consultation results. These are briefly summarised in the Federal Council’s message to parliament. As a rule, the responsible federal offices publish a more detailed summary of the results.
The regulative changes also opened up new possibilities for already active cooperatives and firms. For instance, the energy cooperative ADEV started to cooperate with the Habitat Foundation in order to plan and implement a self-consumption solution in the newly planned Erlenmatt Ost district in Basel. In this project a microgrid, photovoltaic plants and heat network had been installed in order to distribute and sell electricity, heat and mobility solutions through a contracting scheme to more than 700 tenants (c.f. Box 5).

<table>
<thead>
<tr>
<th>Box 5 Introduction to SIE-initiative Erlenmatt OST</th>
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</table>
| The district of Erlenmatt-Ost was one of the pioneering projects to apply the new regulations of self-consumption in Switzerland. Already in 2010 the Habitat Foundation purchased land in order to develop a new innovative and sustainable district in Basel. While developing an innovative concept, the foundation came in contact with the ADEV energy cooperative, which was a leading actor in financing and installing solar energy units at the time. ADEV was aware of the new regulative options of self-consumption due to the regulative changes in the Energy Act in 2014 and therefore suggested forming a self-consumption community (EVG) in this newly planned district. The Foundation agreed that ADEV would be responsible for the organisation of the self-consumption community. ADEV then realised the infrastructure (micro-grid) for more than 700 tenants including i) a heat network with heat pumps, ii) an electricity grid with a central connection to the medium-voltage grid of the DSO and iii) solar plants which together produce more than 700 MWh.

The aforementioned electricity and heating infrastructure were financed and installed by the ADEV cooperative and the subsequent energy supply concept was designed to increase the self-consumption in the district. ADEV therefore also implemented a digital solution, an energy management system which regulated the heat pumps in situations of solar overproduction. In addition, ADEV also wanted to implement and operate the metering infrastructure in the district. However, during the realisation of the project it was contested which actor had the obligation to install and operate the meters, |
resulting in the local DSO installing several hundreds of meters, which later had to be replaced with the meters operated by the ADEV cooperative.

Part of the project was also the founding of a self-consumption community, a ZEV organisation (which was called EVG at that time). In this case, the Habitat Foundation agreed that ADEV would take legal responsibility of the organisation of the EVG. Together with key stakeholders ADEV developed a contractual solution for the tenants to become part of the ZEV. Tenants which moved in the district had to agree in their housing contract, that ADEV will be their supplier of energy (heat and electricity). ADEV on the other side became the responsible party for the energy supply in the district and the organisation which coordinates the relationship with the DSO. As a result, ADEV became a microgrid operator with corresponding legal tasks (metering point operation, safety control, etc.) including the issuing of electricity bills. There is an annual electricity price approval by the Habitat Foundation for the internal price of energy in the districts (cost ceiling tariff of the local DSO in Basel). In general, a high level of trust between the ADEV and the Foundation led to this innovative and not yet regulative approved organisational solutions at the time.

After ZEV organisation and the definition of internal electricity price was implicitly regulated in the new Energy Act in 2018 ADEV expected new business opportunities in a new market of ZEV services. Based on the developed experience and know-how in the Erlenmatt Ost project ADEV became a leading service provider for the foundation of self-consumption and local electricity supply projects in Switzerland. Due to their interest in becoming a local electricity provider in districts they realised further innovative projects and also extend the possibility of self-consumption by a realisation of a vehicle to grid project in Erlenmatt Ost (Brown et al., 2019). In this project, batteries of electric cars are used to store solar energy and optimise the use of locally produced solar energy in the district (V2X project) in order to prevent external supply and costs of grid charges.
In another example the housing cooperative Rossfeld started to implement a self-consumption community by distributing electricity from PV-plants to nearby houses of the cooperatives (c.f. Box 6).

**Box 6 SIE-initiative Housing Cooperative Rossfeld**

The SIE initiative housing cooperative Rossfeld was a pioneer in setting up a self-consumption community with the installation of PV panels in all buildings and collected a lot of experiences and know-how in the process. This SIE initiative serves as an example of the difficulties that early initiatives in the SIE-field of local electricity exchange faced.

The cooperative Rossfeld was established around 2012 as a housing cooperative consisting of three buildings housing about 100 people (70 adults, 30 children). The motivation in the cooperative was value-driven, as their members cared about environmentally conscious behaviour and wanted to reduce their consumption of fossil fuel. With this, the cooperative discussed energy-specific renovations of their buildings and the installation of PV plants. Concepts of self-consumption and electricity exchange emerged in discussions with various actors, in the process of installing PV plants and as regulations started to change.

To make the installation of panels possible, a few motivated individuals founded the association NETZ, which became responsible for managing the full process as well as for funding. Once an offer was accepted from the Energiegenossenschaft Schweiz (the Swiss energy cooperative), the process moved quickly: the offer was made in 2014 and in early 2015 the first PV plants were already installed. In this process, the idea of self-consumption arose and two PV plants were built with feed-in points to the public network to make self-consumption possible in the future.
In the first phase, the main challenge was funding. As the whole concept was new and it was not clear whether it would be financially viable, members of the cooperative were rather sceptical. Through a process of communication, trust was built in the cooperative and individuals invested with varying amounts of capital in the project.

In the second phase, there were no technical problems with the energy supplier, and since trust had been built within the cooperative, financing became less of a burden. Energiegenossenschaft Schweiz was again very involved in sharing their know-how which allowed them to focus on creating a Eigenverbrauchsgemeinschaft (EVG) or self-consumption community. This however proved to be a complicated bureaucratic process. As the sole energy supplier, ewb perceived the forming of an EVG as a nuisance and there was no real incentive for supporting the initiative. Eventually a self-consumption community was formed, and it was agreed that ewb would manually check the energy meters and provide monthly invoices to the association NETZ, which managed bills within the community.

In 2018 several key changes occurred: First, new regulations at the federal level now allowed for self-consumption and trading of energy explicitly (c.f. Phase 3). Second, the association NETZ was dissolved and absorbed by the cooperative Rossfeld after a key neighbour moved away and it was agreed that the association was no longer needed. As interest rates were low, this did not come at a cost for the cooperative. Third, ewb introduced a new price model, which would have meant that the cooperative would make 7'000 CHF surplus per year and pay 4'000 CHF per year for the meters that ewb had installed. Due to high costs and lack of cooperation form ewb, the cooperative was not interested in continuing with this price model and explored different solutions.

In the same year, the cooperative was approached to participate in the pilot project Blockchain for Utilities (B4U), which aimed at simplifying energy billing, particularly for homeowners with solar generators (PostFinance, 2019). The pilot project was a partnership between the economic department of ewb (which tended to be more
innovative) and PostFinance. Through this pilot, energy measures would be collected every 15 minutes and the bills were sent automatically using blockchain technology to each household. For this, new meters were needed, which B4U installed at no cost, and in return, the cooperative was asked to mobilise a large number of participants.

When the pilot began, the cooperative experienced a lot of problems as the technology was not mature enough yet: There were persistent log-in problems and many mistakes were made in invoices. This was particularly problematic in the eyes of the cooperative:

“It was really important to us that the invoicing process worked smoothly. We didn't care much about whether other things like being able to check your energy consumption through the app worked properly. But when they didn't manage to provide correct invoices over multiple months, we decided to break off the pilot project. Our community trusts the cooperative a lot and we didn't want to break that trust” (Interviewee 6)

After the pilot was discontinued, the cooperative continued to depend on B4U to a certain degree, as they were using smart meters where energy measures were collected by B4U centrally and could not be read off the counters manually. The values provided by B4U were difficult to work with, as they collected data every 15 minutes and the cooperative only required the values once a year and when tenants changed. By undertaking the very cumbersome process of calculating the values themselves, the cooperative also found many problems in the way that B4U was calculating the values and found them to be generally untrustworthy. Because of this, the cooperative had to work with estimates of their energy consumption rather than exact data.

Due to the many problems they faced and the unreliable data, B4U (and therefore ew dé) took responsibility and agreed to not charge the cooperative for months where they could not provide reliable data. Since then, the cooperative decided to switch back to manual meters, which would be less labour intensive for such a small cooperative.
Most of these initial projects had to operate with a lack of experience and without established codes of conduct and thus were developed in a bricolage way (Garud and Karnoe, 2003). The organisation, calculation and management of local energy exchange, especially in multi-party buildings or districts turned out to be more complicated than expected (Interview 8). As every project was context specific and no standard solutions

| In hindsight, they found that both the soft- and hardware were not yet mature enough to be implemented. |
| "they approached the whole thing too euphorically, but they realised this over time themselves" (Interviewee 6) |
| What proved to be one of the biggest issues from the perspective of the cooperative, was the lack of continuity. In this time frame, the metering infrastructure had to be un- and re-installed approximately bi-yearly, which was simply not sustainable in the long term. As the cooperative Rossfeld has now fused with the *Eisenbahngenossenschaft*, a cooperative, it is unclear how self-consumption will be managed or extended in the future. |

This results in only a few founded projects in multiparty settings at the beginning. Mostly, only the general electricity, or a single apartment is connected to the PV system. As a consequence, other residents in the house cannot consume their own solar power, and the system falls far short of the expected profitability.
applied, problems evolved around questions concerning tenancy law, coordination of the end customers in new organisational structures, local boundaries of self-consumption and energy distribution, billing, metering and the role of the local DSOs. As a result, new service providers such as blockstrom and EVG-Zentrum were founded. These firms supported owners of real estate, housing cooperatives or real estate management companies by providing feasibility- and legal studies, concepts and technological solutions for energy production, metering and billing, as well as in the organisation of local collectives of end-consumers (Interview 1).

Accordingly, the concept of a self-consumption community (in Switzerland called EVG) emerged as an umbrella term for shared solar power in 2014 (c.f. Box 2). The scale of such communities varied from multi-party buildings to whole districts. An EVG is a group of electricity consumers who agree among themselves how they want to self-consume solar electricity. It organises how the internal calculations, billing and legal roles are regulated and is usually established by the owner of the real estate, a real estate management company or by a specific service provider. After the foundation, the EVG will only receive a single invoice from the energy supplier. How this invoice is passed on, and how expensive the solar power is in the end, is regulated internally by the EVG.

In general, this formation phase of the SIE-field development can be characterised by high levels of uncertainties but also by euphoria and positive expectations for market development. However, the realisation of projects depended on the DSOs cooperating or tolerating these initiatives, as the new actors did not have the right to install and operate their own meters. In addition, cooperation and support from the tenants was of equal importance as standardised contracts had not yet been established and an EVG as
organisation had no legal relevance during that time. Some interviewees mentioned that they experienced problems with the incumbents:

“the local utility said at that time that they will prevent the foundation of another EVG by all means” (Interviewee 6)

Consequently, there were controversies in terms of which actors took which role in addition to a contestation of local boundaries of possibilities to sell and distribute locally produced electricity in a partly liberalised market. However, while realising initial projects, new players and incumbents gained experience and knowledge and the solutions for local electricity exchange became well adopted and accepted in society (Interview 5). Different learnings took place leading to ideas for new business models and new regulative changes in a third phase of development.

PHASE 3: Take-off and institutionalisation of local electricity exchange (2018-2020)

Controversies between new actors and incumbents in addition to regulatory gaps, which were experienced in the formation phase, led to further regulative changes. On January 2018, the new Energy Act and the related ordinances entered into force, expanding again the possibilities for local electricity exchange. In line with the intended move away from the feed-in-tariff-system towards direct marketing, the following changes were implemented (and also partly lobbied by members from the SIE-field):

- Legalising self-consumption across property boundaries (adjacent properties)

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4 In some cases, detailed contracts had to be signed by each individual resident in order to be able to obtain local solar power. This increased the transaction costs and lead to the fact that many projects were not feasible in economical terms.
• Creating a new legal entity, the ZEV organisation, as a new actor in the SIE-field
• Regulations on how the internal price in the ZEV can be calculated and the conditions under which tenants could leave a ZEV
• Allowing the installation of private metering infrastructure and private grid infrastructure within the ZEV

The legal entities of ZEV became an actor in the energy market. Regulative changes, therefore, include the following specification for the ZEV organisations (Probst et al, 2019):

• A ZEV represents a single end-consumer in the sense of the Electricity Supply Act and has only one grid connection. The ZEV organisation takes into account the energy supply duties towards the tenants.\(^5\)
• The law and ordinance leave the legal form of the ZEV organisation open: It can be established as a legal entity by contract or by regulations.
• A ZEV can be formed across several adjacent properties, provided that the respective property owners participate in the ZEV, and as long as the local distribution grid is not used.
• For ZEVs with an electricity consumption of more than 100 MWh per year, access to the free electricity market is granted.
• When a ZEV is formed, tenants become participants in a ZEV. The landowners at the place of electricity production take on the responsibility of a basic electricity supplier and is therefore obliged to ensure electricity supply to the tenants of the ZEV. The internal legal relationships between the individual participants of the ZEV are

\(^5\) The ZEV organisation is responsible for the internal organisation (electricity production, distribution, metering, etc.). The provisions of energy legislation, the metering legislation and the code of obligations apply. The DSO shall in principle only perform its obligations towards the ZEV organisation. The participants therefore no longer have a direct contractual connection to the DSO.
governed by the provisions of the Energy Act and the Code of Obligations, for which the civil courts are responsible. The external relationship between the ZEV and the DSO (basic supply, network usage charge, etc.), on the other hand, is governed by the Energy Supply Act; and a regulator (ElCom) is responsible for this.

- Since 1. April, 2019, ZEVs can also extend across properties that are only separated by a road, a railway or a watercourse, as long as the respective landowner agrees to the crossing of their property.

By interconnecting several buildings on adjacent properties, the amount of self-consumed electricity can be further increased and thus the profitability of solar plants improved. ZEV on broader sites such as districts are therefore also relevant for the activation of new potentials for solar energy, especially for bigger solar plants. These regulatory developments coincided with increased digitalisation and the market entry of further actors.

Digital solutions such as energy management systems to increase self-consumption via better balancing of production, storage and consumption, and platforms providing metering and billing services were developed by different actors which facilitate the implementation and operation of ZEV organisations.

Again, these regulative changes were accompanied with the development of a guideline report and tools to accelerate project implementation. The association of the real estate owners (HEV), the tenants' association (SMV), the solar energy association Swissolar and the Association of Swiss Electricity Companies (VSE) worked together to clarify the internal foundation and organisation of ZEV as well as its relationship with the DSOs. This included suggestions of contracts of ZEV organisations with tenants, principles for metering, billing and the calculation of the internal electricity prize, and a checklist for the communication and coordination between ZEVs and local DSO. These recommendations led to a rather standardised approach for the founding of a ZEV organisation depicted in Figure 4.
Based on subordinary regulations of the Energy Act, the relationship with the DSO and the transfer of parts of the distribution grid infrastructures between DSO and ZEV was regulated. If the DSO's electricity lines and other installations (e.g. metering equipment) are no longer required when a ZEV is formed, they may be removed. However, if both parties agree, installations which are no longer required by the DSO may be transferred to a ZEV in return for financial compensation. In this case, compliance with current (technical) standards must be observed. As a rule, technical adaptations are required for this, in addition to the dismantling of installations that are no longer used at the expense of the ZEV organisation. Figure 5 below depicts such a situation: In previous regulations, house 1 and house 3 cannot connect form a ZEV. If the three real estate owners want to form a ZEV organisation to organise solar energy consumption and distribution internally, they have to remove the grid connection points of the houses and buy the electricity lines form the DSO, if the DSO agrees, or alternatively, install private ones. This additional infrastructure cost might kill the business case of most ZEV projects in the existing building stock (Probst et al., 2019).
While the first two phases were dominated by pioneer actors, in this third phase mainstream actors such as real estate companies, insurances or pension funds moved into the SIE-field. Sustainability goals in terms of requirements for awarding processes of property land from the state and requirements in terms of current building standards forced these actors into pursuing such projects. Examples include ZEVs and the distribution of energy among several family homes, several apartment buildings, or broader districts with a private microgrid (Probst et al., 2019). In some cases, private power lines have been installed in order to distribute electricity from solar energy to adjunct properties. However, most bigger ZEVs have been realised on new construction sides (new districts) because these properties are economically (e.g. no cost for the transfer of grid lines from the DSO, better system design towards self-consumption) and also socially (it is easier to organise ZEV organisations with new tenants moving in) more feasible.

In this phase the roles of specific service providers and the realisation of ZEV projects were further professionalised and standardised. The distribution of solar electricity across
property boundaries became an accepted option (Interview 5). Until 2019 more than 3,079 ZEV projects in various forms have been realised in Switzerland (c.f. Figure 6). Housing cooperatives and real estate companies as well as pension funds started to regularly deploy ZEV solutions. These SIE-field actors developed know-how in funding ZEV organisations and in distributing energy to tenants. In addition, strategic cooperation with specific service providers emerged as these actors provided metering and billing solutions, as an example, for certain housing cooperatives (Interview 1). In general, in this phase the importance of consultancy and initial feasibility studies decreased, as all SIE-field actors gained more own experience in realising projects of local electricity exchange (Interview 1).

<table>
<thead>
<tr>
<th>Type of system</th>
<th>Existing Stock on 31.12</th>
<th>Installed Capacity</th>
<th>Excess Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV units with self-consumption (single units)</td>
<td>73,840 units</td>
<td>1154 MW</td>
<td>695,825 MWh</td>
</tr>
<tr>
<td>PV units with self-consumption (ZEV)</td>
<td>3,079 units</td>
<td>124 MW</td>
<td>50,899 MWh</td>
</tr>
<tr>
<td>PV units without self-consumption</td>
<td>21,450 units</td>
<td>980 MW</td>
<td>917,394 MWh</td>
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</table>

*Figure 6 Stock of realised ZEV projects in Switzerland 31.12. 2019 (Source: Swiss Federal Office of Energy SFOE, 2019, own translation)*

To conclude, in this third phase further entrepreneurial opportunities for local electricity exchange emerged. However, with current regulation, distribution to end-customers is only allowed behind the ZEV meter. Trading among different local actors and the deployment of the distribution grid is not allowed (Interview 5). While incumbents such as DSOs still play an important role and control the local distribution grid, further extension of the SIE-field of local energy exchange is contested through new pilot projects in the fourth phase of development.
In the SIE-field of local electricity exchange, the contestation between incumbents such as utilities and DSOs and the new actors such as energy contracting, metering and billing companies is of key interest. The relationship between both types of SIE-field actors changed over time. While in the beginning it was rather cooperative and some DSOs worked together with new actors in testing new forms of local energy exchange, the relationship later on became more diverse including some DSOs defending the formation of ZEVs and others developing new services for these customer groups. In phase 3, however, a division of labour occurred where DSOs focused on providing solutions for ZEVs on the existing building stock, and new actors focused on providing solutions for newly established housing projects or districts. However, contestation between actors might continue to focus on areas such as the regulations of the distribution grid (access, use, financing mechanism) as well as the transfer of grid infrastructural elements towards ZEVs (c.f. Table 3).
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<tbody>
<tr>
<td></td>
<td>• Increasing competition between ZEVs and utilities on contracts with end-consumers</td>
<td>• Change of contracts of end-consumers, administrative processes</td>
<td>• Transfer of infrastructural elements of the distribution grid towards the ZEV</td>
<td>• Definition of “place of productions”</td>
</tr>
<tr>
<td></td>
<td>• Metering in ZEVs</td>
<td>• Discussion of the fairness of grid financing as ZEVs pay lower grid fees</td>
<td>• Requirement for the grid connection point of the ZEV</td>
<td>• Rules for the use of existing distribution grids</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• “DSO best practice model” as a fair model in the competition with ZEVs</td>
<td>• Design of the future grid fee, feed-in-tariffs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Rules for virtual solutions (e.g. local accounting of production and consumption)</td>
</tr>
<tr>
<td>Role of incumbents</td>
<td>• Initial project strongly depended on the support of DSOs</td>
<td>• Utilities develop the “DSO best practice model” to deliver services to ZEVs</td>
<td>• Utilities focus on services of ZEV projects in the existing building stock, new actor in newly established districts</td>
<td>• Innovative DSOs work together with new (digital) actors towards virtual and P2P solutions</td>
</tr>
<tr>
<td></td>
<td>• Small utilities defend ZEV foundations, bigger utilities start to develop services</td>
<td></td>
<td>• ZEV new actor which has to be mirrored in the process (e.g. grid management) of the DSOs</td>
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</tr>
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</table>
PHASE 4: 2019 to today: Digitalisation and contestation of the SIE-field boundaries

The current phase of SIE-field development is mainly driven by digitalisation and the contestation of the boundaries and regulation of ZEVs. This happens either through i) the introduction of new digital solutions in standard projects or ii) through testing of new radical regulative and technological innovations in pilot projects (so called sandbox approach), the communication of new concepts and ideas, and lobbying activities for different potential (regulative) changes.

Digital solutions are of key importance for the development of the SIE-field of local electricity exchange (Gmeiner et al., 2018). These include energy management systems to increase self-consumption (by better balancing production, storage and consumption), smart meters and digital platforms for metering and billing services, in addition to solutions for charging management of electric vehicles or aggregation of small local production (flexibility) for trading business models. While in the second and third phases digital solutions were mainly deployed in key pilot projects like the deployment of vehicle to grid and energy management systems in the Erlenmatt Ost project (c.f. Box 5), some digital solutions for ZEVs became more mainstream in phase 4 (Gmeiner et al., 2018). On the one hand, more and more actors entered the SIE-field and through market processes, standardised business models and solutions evolved over time. On the other hand, intermediary organisations such as EnergieSchweiz tried to facilitate the uptake of digital solutions by providing market-overview and guideline reports (Meier et al., 2020).

Other digital solutions such as peer-to-peer energy trading platforms are currently not mainstream solutions in Switzerland. Moreover, they are forbidden in the current regulative setting of a partly privatised energy market. However, some of these solutions are currently tested in pilot projects. In these projects, regulations which normally apply are relaxed and new technology and organisational solutions are tested, which might extend the SIE-field of local electricity exchange in the future. Among others, the “Quartierstrom” project was realised taking the ZEV regulation into account and extending it with a solution of a local
peer-to-peer energy market (c.f. Box 8). Peer-to-peer energy markets are expected to contribute to a green, local, and fair energy system in the future and might extend the possibilities of local energy supply.

In addition to the pilot projects, further developments and solutions are currently discussed within the community of the SIE-field actors. Most of them are ideas for new applications of self-consumption or propositions for regulative changes towards new entrepreneurial opportunities for local electricity exchange. These ideas and propositions are presented in conferences or communicated with politicians in the policymaking process through “Vernehmlassungsprozesse”. Others, however, are already fully developed concepts of new solutions for local electricity exchange. The following list gives an overview of examples mentioned in the interviews and the grey literature assessed (Probst et al., 2019):

- The local distribution grids should be able to be used for local electricity exchange: the grids of the DSOs could be used to connect the individual buildings of the ZEV for the transmission of the self-consumed electricity. Different field actors suggested a tariff for grid use that should be lower than the current grid costs (as locally consumed energy lead to lower grid costs in general).
- Virtual self-consumption: The idea is to compare the load profile, or consumption of electricity, with the amount of solar power produced. The consumer is only charged for consumption which cannot be covered by simultaneous solar production. The advantage of virtual self-consumption is that the DSO’s grid could continue to be used at no additional cost. This possibility would reduce the metering costs and would facilitate the selling of electricity locally.
- ZEVs of whole areas of municipalities: Different concept and feasibility studies have been developed by field actors. Examples include ideas of better coordination between prosumers and consumers within a municipality (e.g. project Change 38 in Basel) towards compressive approaches of fully developed local markets and energy trading.
Most of these ideas and possible solutions, however, are not feasible under current regulations, but indicate possible future directions of SIE-field development.

Box 8 Introduction to SIE-initiative Quartierstrom Walenstadt (Blockchain trail)

The pilot project “Quartierstrom” is a highly innovative project that provides an example of a possible direction the SIE-field may be moving to, particularly in terms of decentralised energy markets using new technologies like blockchain.

The idea of using blockchain technology in self-consumption communities was developed by researchers at two Swiss universities and dates back to 2016 but the project only fully materialised in 2018. The project was initiated as a joint project between different universities. In the beginning, it took a long time to find a DSO that agreed to participate in the pilot, as the concept was seen as “too revolutionary” (Interviewee 2).

For the project, a ZEV was created including 35 households and two commercial entities in Walenstadt. As the participating houses were not necessarily next to each other, however, the project was not abiding to the laws in place for ZEV and was completed with special permission from the SFOE and ElCom to be executed as a ZEV in a sandbox setting. Another particularity is that although it was legally conceived as a ZEV, consumption and trading occurred over the DSO grid and not a private grid, which under current regulation is also not possible.

A local electricity market was set up, where participants could sell their surplus solar power through peer-to-peer trading. Of all participating households, 28 had their own solar panels (prosumers) and 9 participated purely as consumers. The DSO would also trade in this market by buying surplus electricity for a predefined price and ensuring sufficient supply by complementing the solar shortages. To monitor the market and make adjustments to their price limits, a portal was set up. The idea was to have as much
of the locally produced electricity be consumed locally, by having a “bottom-up electricity tariff” where only local grid costs had to be paid, cutting grid costs in half and therefore favouring locally produced electricity. The price was the same for the consumer, regardless of whether the electricity was produced by a direct neighbour or was delivered over a further distance.

Lastly, this was the first project to test blockchain technology for local electricity exchange successfully.

“There aren't really any concepts like this one so far and the technology seemed fitting for our purposes, even if there might be technically easier solutions for a ZEV” (Interviewee 2)

The blockchain platform used, which was entirely developed by a local university, was adapted specifically for energy trading between neighbours and is based on Tendermint technology. Blockchain was seen as beneficial in this context, as it ensures data privacy and anonymity, keeps transaction costs low, and allows energy flows to be presented transparently. Charging stations for electric vehicles, batteries and decentral production could all be integrated in the blockchain system. Each producer represented a “node” and trades would take place through individual smart meters directly. Trades are completed every 15 minutes through “smart contracts” between producers and consumers.

The project was the first to test the possibilities and limits of an energy blockchain running on citizens' “smart meters” in real operation. The neighbourhood had a total capacity of 290 kWp and provides about 250'000 kWh electricity annually. The total budget for the project was around 1.6 million CHF and about 60% of the cost was covered by the Swiss Federal Office of Energy (SFOE). In 2020, over 35'000 transactions were completed through the platform. While the project was overall rather successful and showed that the technical capacities exist, various factors impede this model from
spreading more widely. For instance, for such projects to be financially viable, a serious scaling effort would be required. This, however, is not possible due to the current regulative framework which does not allow for ZEVs to operate virtually and use the DSO’s grid.

Box 9 SIE changing social relations

In SONNET we think of social innovations in the energy sector (SIE) as a combination of ideas, objects and/or actions that change social relations and involve new ways of doing, thinking and/or organising energy. In the SIE-field of local electricity exchange in Switzerland, the introduction of the ZEV organisational model changed social relations and supported the diffusion of decentral renewable technologies in the housing sector. While end-consumers especially in multi-party buildings and districts had problems investing in solar plants and consuming locally produced electricity due to split incentives, risk and uncertainties (Lang et al., 2015), with the ZEV regulations there was a legal option to build up distributed self-consumption in broader areas. On one side, self-consumption communities evolve building on the active role of tenants in investing, producing and finally also distributing electricity in, for example, districts of housing cooperatives (c.f. Box 6). On the other side, intermediary actors such as real estate companies or pension funds started to be active in local electricity exchange while creating ZEV organisations. These actors are forced to achieve common sustainability goals (in terms of requirements for awarding processes of property land from the state, and requirements in terms of building standards) and thus building up ZEV organisations to sell and distribute energy to their tenants. While many tenants were neither interested in local electricity production nor in buying local renewable energy before, with the introduction of the ZEV organisation a lever was created to accelerate investments in solar energy and to increase distribution of locally produced energy (Interview 9 and 7). In other words, these new social relations between real estate organisations and tenants improved the conditions for activating broader parts of the
society in the energy transition and implementing solutions for local energy production and distribution (Lang et al., 2015).

At the boundaries of the field these new social relations are further developed in pilot projects in Switzerland. For example, P2P electricity trading is at an early stage of development and has been tested in the Quartierstrom project (c.f. Box 8). While P2P is characterised by technological change (e.g. blockchain technology) it may lead to a reconfiguration of social relations as people directly trade electricity among each other within a ZEV organisation at a local level. However, as this innovation has only been tested in sandbox settings, the further uptake and diffusion in Switzerland is unclear.

Box 10 Key changes in the SIE-field over time

This box considers a key change that has particularly influenced the emergence and development of the SIE-field and/or co-shaped the SIE-field and ‘outside’ institutional environment: the formation of the legal entity ZEV.

The institutionalisation of ZEV was key in the formation of the SIE-field local electricity exchange, as it deeply influenced the type of actors in the SIE-field. In phase 1 and phase 2, the main actors were pioneers who experimented with different ideas within the tight boundaries of the law. The formation of ZEV as a legal entity meant that new mainstream actors in real estate, for instance, became important actors in the SIE-field. This was particularly important in shaping cultural-cognitive institutions by allowing ZEVs to move toward becoming a widely used option. Understanding institutions to be made up of regulative, normative and cultural-cognitive elements and their associated activities and resources (Lowndes and Roberts, 2013) and institutional work as relational practices connecting such activities has proven useful in understanding local electricity exchange in Switzerland. Most significant changes in the SIE-field become evident with regulative changes (such as the formation of ZEV as a legal entity allowing self-consumption across property boundaries). However, experimental practices...
In SONNET, power is broadly understood as the relational and structural (in)capacity of actors to mobilise resources and institutions to achieve a goal. Power relations in SIE refer to a) actors having different kinds/levels of power to mobilise SIE-related resources and/or to achieve SIE-related goals (incl. (in)equality and in/exclusion) and b) actors having power over others in SIE-related processes (including dependency, oppression and exploitation), and c) actors having power with other actors to achieve collective (SIE-related) goals.

For a long time, asymmetrical power relations between SIE-field actors (particularly pioneers trying to build self-consumption communities) and DSOs impeded SIE-field development. This is because DSOs have a lot of power over the grid infrastructure and management of electricity bills. This means that there was little incentive for them to cooperate in the SIE-field.

“There definitely wasn’t much interest from [the DSO’s] perspective. Here we’re talking about the governing sphere. They’re just used to how things are. We’re technically seen as customers but really, we’re just ‘takers’. We come to them and have no chance of doing things differently. They can do what they want, and we have to accept it. At this monopoly area, there’s not a lot of interest in change. It’s rather seen as a disruptive factor” (Interviewee 6)

Power to mobilise resources for local electricity exchange has generally been limited based on the regulative frameworks in place. However, pioneers in early years of SIE-field formation and those pushing the boundaries for trading today have been able to effect

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**Box 11 Power and power relations (power to + power over + power with)**

In SONNET, power is broadly understood as the relational and structural (in)capacity of actors to mobilise resources and institutions to achieve a goal. Power relations in SIE refer to a) actors having different kinds/levels of power to mobilise SIE-related resources and/or to achieve SIE-related goals (incl. (in)equality and in/exclusion) and b) actors having power over others in SIE-related processes (including dependency, oppression and exploitation), and c) actors having power with other actors to achieve collective (SIE-related) goals.

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Power to mobilise resources for local electricity exchange has generally been limited based on the regulative frameworks in place. However, pioneers in early years of SIE-field formation and those pushing the boundaries for trading today have been able to effect
change in existing institutions which in turn have enabled ZEVs to become part of the mainstream.

Once self-consumption communities could be formed, it allowed for tenants to have power with their landlords to achieve their collective goal of keeping electricity costs low by managing self-consumption in multi-party houses and districts.

6 Summary, synthesis and conclusions

6.1 How do SIEs and SIE-fields emerge, develop and institutionalise over time?

In SONNET we think of social innovation in the energy sector (SIE) as combinations of ideas, objects and/or actions that change social relations and involve new ways of doing, thinking and/or organising energy. The SIE-field of local electricity exchange in Switzerland examined in this report provides interesting insights into how SIEs and SIE-fields emerge, develop and institutionalise over time.

In Phase 1, we consider the emergence of the SIE-field was closely linked with the system of cost-covering feed-in tariffs in place up to 2014. Problems with the cost-covering feed-in tariff system led to a revision of regulations, where in Phase 2, the SIE-field took shape with an explicit regulation on self-consumption principles. In Phase 3, regulations were further expanded, allowing for the institutionalisation of local electricity exchange by introducing new actors to the SIE-field through the ZEV organisation, allowing for self-consumption and energy production and distribution across properties. In Phase 4, a clear shift to focus on digital innovations through peer-to-peer trading and experimental projects in using blockchain technology and testing virtual solutions emerged, leading to a potential contestation of existing SIE-field boundaries.
Precisely, this case shows how by a combination of new regulative opportunities (change of feed-in-tariff support system), entry of entrepreneurial actors (cooperatives, new services providers, real estate actors) and strong support by federal agencies and established associations (e.g. crafting guideline reports, shaping code of conducts for project realisations) the process of path creation (Garud and Karnøe, 2001) of a new SIE-field and the subsequent SIE evolved. This process included regulative changes, subsequent SIE-field actor activities, field improvements (results) or new perceived challenges and then further SIE-field actor activities and so on. Elements of this process again can be delineated in four phases and are summarised in Table 4.
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Law and regulations</td>
<td>System of cost-covering feed-in compensation (KEV)</td>
<td>◦ Slow changes of KEV system towards one-off remuneration, direct marketing ◦ Explicit anchoring of self-consumptions in energy law; producers can consume &amp; sell their energy at the place of production ◦ Introduction of the concept self-consumption community</td>
<td>Common self consumption and local energy distribution is explicitly regulated within the ZEV regulations in the Energy Act; new actors have the right to install &amp; operate own meters; energy distribution can be extended locally to surrounding buildings</td>
<td>Further development of energy law and regulations are contested</td>
</tr>
<tr>
<td>Activities of field actors</td>
<td>◦ Emergence of PV planning, installation and contracting companies ◦ Foundation of different energy cooperatives ◦ Some experiments with self-consumptions in apartment blocks (community energy) ◦ Trade and exchange of certificates of renewable energy production (called HKn)</td>
<td>◦ First-movers move into market service provider for internal billing &amp; solving of legal aspects ◦ Utilities provide a so-called “VNB praxis model” to provide services ◦ Associations and intermediaries publish guideline reports; provide tools to shape the uptake of local energy consumption and distribution ◦ Conceptual development of virtual accounting of local production and consumption (Change 30)</td>
<td>◦ New actor role of the ZEV organisation introduced ◦ Real estate, ICT, meter and billing service companies move into the field ◦ ZEV is implemented in new construction sites (new districts) ◦ Federal office of energy concretises and adopts the rules for the foundation and operation of ZEVs ◦ Associations publish further guideline reports</td>
<td>◦ Pilot projects with blockchain technology and local trading platforms ◦ Pilot projects in terms of virtual self-consumption, ZEVs at level of whole municipalities</td>
</tr>
<tr>
<td>Results / Challenges</td>
<td>◦ Diffusion of PV, also big PV plants ◦ Housing and energy cooperatives moved into the field of local energy production ◦ No incentives for direct marketing ◦ KEV waiting list too long, politically KEV no longer an option, no subsidies if it is unclear who buys the electricity</td>
<td>◦ Euphoria in the field, expectations for the development of a new market ◦ Experiments create know-how on process, code of conducts, and adoption of regulations ◦ Diffusion of PV on multi-party buildings ◦ Projects have to be tolerated by the local DSOs; new players do not have the right to install &amp; operate their own meters ◦ Local boundaries &amp; “place of production” contested ◦ But self-consumption option became well adopted and accepted in society (emerging path)</td>
<td>◦ Field actors have to cope with regulatory complexity ◦ Diffusion of bigger solar plants ◦ Incentives are designed for planning solar plants according to rentability reasons ◦ Initiatives can not use the local distribution grids; problems in realising ZEV in the existing building stock ◦ Distribution towards end-customers is only allowed behind the ZEV meter</td>
<td>Emerging institutional challenges: ◦ Definition of “place of production” ◦ Rules for the use of existing distribution grids ◦ Design of the future grid charge, feed-in-tariff ◦ Rules for virtual solutions (e.g. local accounting of production and consumption)</td>
</tr>
</tbody>
</table>

Table 4 Summary of the SIE field developments and institutionalisation processes in the four phases (own depiction, based on interviews)
Whether this path leads to a full functional market of decentralised energy production and local electricity exchange and trading cannot be said a priori. In the ZEV organisation, tenants get locked-in, as they can only leave the ZEV under specific circumstances, like if the ZEV organisation is not able to supply energy or if tariffs are too high. However, a full market liberalisation for example would have enormous influences on this path, as tenants could leave the ZEV. Therefore, it was undecided in the interviews if the evolving path of the local electricity exchange turns out to be success story or leads to a dead-end.

6.2 How do SIE-field-actors and other field-actors interact with the ‘outside’ institutional environment and thereby co-shape the SIE-field over time?

In SONNET, we consider a SIE-field to be nested in a larger encompassing institutional environment, and consisting of both formal and informal institutions. In the Swiss context, understanding the role of federalism as well as direct and consensus-oriented democracy helps understand how SIE-field actors and other field-actors interact with and co-shape the ‘outside’ institutional environment. SIE-field shaping occurs in four major ways: first, through pilot projects and experimentation with the local electricity supply, second, through joint advocacy of SIE-field actors in the policymaking process, third, through the development of guideline (reports) through intermediary organisations, and fourth, through framing, communication and discourse activities in the SIE-field. While the latter two activities targeting the more informal and emerging norms and codes of conduct in the SIE-field (internal field institutions), the former activities attempt to change existing regulative institutions.

Various formal institutions which shaped the SIE-field over time but were also shaped by SIE-field actors and other field-actors, include the three main regulatory institutions: The Energy Act, the Electricity supply Act, and the Tenant Law. The interactions between these three regulatory frameworks can either enable or impede the SIE. The Energy Act is important, as it regulates market- and grid financing rules as well as metering regulations.
The *Electricity Supply Act* is important for the SIE-field as the law still defines the responsibilities of the ZEV organisation in terms of basic energy supply in addition to the market access and the relationship of the ZEV organisation with the DSO. Third, *Tenant Law* defines the rights of the tenants in the ZEV organisation as well as the processes how a ZEV organisation can be founded.

If ZEV organisations, for example, are founded with tenants, rent protection regulations, the Energy Act and the *Electricity Supply Act* apply, since tenants are both energy consumers and tenants at the same time. This means that local energy distribution and exchange projects in Switzerland have to navigate the complex regulatory institutions, which ends up acting as an impeding factor, and forces SIE-field actors to develop activities and practices within the narrow space allowed by law. Through informal exchanges between different actor groups through, for example, research institutes, new ideas are formed and discussed, establishing normative institutions which then create pressure on regulations to change. This can be seen in the Swiss case by following how the principle of self-consumption became embedded in regulatory institutions over time.

As the number of ZEVs increases, they become embedded in the cultural context and thus, expectations for greater market development (e.g. local trading) to enable easier local electricity exchange increases, which creates pressure for changes in existing regulatory institutions.

Switzerland’s unique consensus-oriented democracy also means that stakeholders – which may be SIE-field actors and other field actors – are directly involved in the policymaking process. The iterative policymaking process therefore means that actors in the SIE-field shape the ‘outside’ institutional environment and adjust their activities according to the new regulations, creating a highly co-evolutionary relation.
6.3 What are the enabling and impeding factors for SIE-field-actors and other field-actors to conduct institutional work and change the ‘outside’ institutional environment?

During the study of the SIE-field development different enabling and impeding factors for SIE-field-actors to conduct institutional work and change the ‘outside’ institutional environment were present:

Enabling factors

- The policy system and the policy process: Switzerland is a consensus-oriented democracy, therefore the deliberative *Vernehmlassungsprozess* and other forms of participation in policymaking facilitated the institutional work of the SIE-field actors in changing regulative institutions.

- The role of the Swiss Federal Office of Energy: The SFOE strongly supported the development of the SIE-field by financing pilot projects, guideline reports and market studies; especially the institutional work on informal institutions such as the procedures of founding a ZEV organisation in addition to practical experience with new solutions (using blockchain technology like in SIE initiative *Quartierstrom*) would not have been possible without the support of the SFOE (Interviewee 2).

- Interests of the housing sector and fast entry of new actors in the SIE-field: Due to the development of the SIE-field, there was a fast build-up of an actor community which had extended the already existing associations and actors in the SIE-field of renewable energy; especially the entry of actors of the real estate and housing sector increased the relevance and (lobbying) power within the SIE-field (Interview 1).

- Acceptance of self-consumption and local electricity exchanges in Swiss society: While at the beginning the local electricity exchange was rather an experimental approach to implement elements of direct marketing in a partly liberalised energy market, the further development of the SIE-field showed that the society supported the approach (Interviewee 5).
Next to the enabling factors there were also impeding factors of institutional work mentioned in the interviews and documents analysed.

Impeding factors:

- **Existing regulations**: Current legislation of a partly liberalised energy market still puts incumbent actors at an advantage and limits the space of actions for the SIE-field actors.
- **Grid access and grid financing rules**: The distribution grid cannot be used for the exchange and distribution of locally produced electricity. In addition, ZEVs have to buy parts of the distribution grid if they want to use it for local distribution. While these regulations are currently contested, there are strong forces to keep the status quo.
- **Resistance of Incumbents**: DSOs and local utilities in Switzerland tried to impede ZEV projects, especially in the second phase of development.
- **Competing ideas and visions for the future development of the SIE field**: SIE-field actors are not united by coordinated visions. Some prefer the current path while others prefer more radical changes of the current status (grid access, role of DSO practice model, stronger support of renewables).

To conclude, the existing regulatory and political institutions on the one hand impede SIE-field development. On the other hand, due to institutional work conducted by stakeholders such as ‘experts’ who take part in deliberative policymaking processes, small changes in regulations do occur, which allow for SIE-field development.
7 Recommendations for our city partners, national and EU policy makers and SIE practitioners

SONNET city partners:

- If cities wish to support local electricity exchange, they may do this especially in two ways. Firstly, support of local pilot projects in which local planners and installation companies gain experience. Secondly, through pushing municipal utilities or DSOs towards supporting new projects or developing services for such new markets.

National and EU policy makers:

- In Switzerland the field of local electricity exchange evolved along a particular path in the setting of specific national institutions (consensus oriented, direct democracy, partly liberalized energy market). Many of the policies or learnings cannot be applied in other European countries. However, what can be learned from the Swiss case are the particularities of the path creation process of a new SIE field.
- Pragmatic adoption of regulations and support through federal agencies: With the ZEV regulations there was the attempt in Switzerland to support entrepreneurial activities and direct marketing in the national setting of a partly liberalized energy market. Part of the success story was flexible adoption of regulations in the parliament, a strong cooperation of the Swiss Federal Office of Energy (SFOE) with the SIE field actors and networks as well as a support of the SFOE in crafting know-how and tools for the entry of new actors in the SIE field (through the different guideline reports).
SIE-field-actors

- As many projects continue to emerge without coordination, it is strongly encouraged that existing projects share their experiences and know-how in order to encourage more involvement in local electricity exchange.
- Utilities and DSOs should continuously adapt their business models and should consider their strategic engagement with ZEVs, in order to prepare for greater market liberalisation, foster greater cooperation with ZEVs and avoid obsolescence.
8 List of references


Swiss Federal Office of Energy, (2014). Vollzugshilfe für die Umsetzung des Eigenverbrauchs nach Art. 7 Abs. 2 bis und Art. 7a Abs. 4 bis des Energiegesetzes (EnG; SR 730.0).


Parl. In. 12.400


9 Annex 1

Methodology

A total of ten interviews were completed for this case study. The interviews were all done online via Zoom software. If the consent of the interview partners was given, the interviews were recorded and then summarised or partly transcribed. A complete transcription was omitted due to the available funds.

The interviews were supplemented with a document analysis, using mainly documents from the interviewed intermediary organisations (based on website search of these organisations) and existing research literature on energy cooperatives in Switzerland.

The case selection of the three SIE initiatives studied was based on two main factors. Firstly, both ADEV and Rossfeld cooperative as well as the Quartierstrom project have been well known first mover projects in their specific area, which makes them interesting cases in terms of perceived challenges and developed solutions. Secondly, there were already established contacts to the three cases from previous research as well as through relationships of city partner Basel.
### Documents reviewed

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<td>Stellungnahme des Bundesrates</td>
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### List of interviewees
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List of meetings and events attended

Events attended

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<thead>
<tr>
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<th>Date of event</th>
<th>Who attended</th>
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<td>Erlenmatt Ost project meeting</td>
<td>ADEV</td>
<td>Project meeting, work shops</td>
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<td>Jörg Musiolik</td>
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### 10 Annex 2

**Detailed SIE-field timeline**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TYPE OF EVENT</th>
<th>DESCRIPTION OF EVENT</th>
<th>QUOTE &amp; SOURCE e.g. document, interviewee</th>
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<td></td>
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<td>PHASE 1: before 2014: Pre-field developments: Role of KEV in setting the stage for self-consumption</td>
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<tr>
<td>2002</td>
<td>Policy ‘event’</td>
<td>Liberalisation of the electricity market is rejected in referendum</td>
<td>Sager, 2014</td>
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<tr>
<td>2007</td>
<td>Policy ‘event’</td>
<td>Electricity supply act (partial liberalisation of electricity market: only for large consumers) &amp; Energy Perspectives 2035 as basis for federal energy strategy</td>
<td>Rieder &amp; Stotz 2018</td>
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<td>2009</td>
<td>Policy ‘event’</td>
<td>Introduction of federal feed-in tariff ‘Feed-in remuneration at cost’ (Kostendeckende Einspeisevergütung) KEV</td>
<td>Rieder &amp; Stotz 2018</td>
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<td>2010</td>
<td>SIE-field event</td>
<td>Habitat foundation buys land to implement the self-consumption principle (Erlenmatt Ost District)</td>
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<td>2011</td>
<td>External shock and trend</td>
<td>Fukushima nuclear accident</td>
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<tr>
<td>2011</td>
<td>Policy ‘event’</td>
<td>Federal government starts developing ‘Energy Strategy 2050’ (Energiestrategie 2050) including decision to phase-out nuclear power</td>
<td>Rieder &amp; Stotz 2018</td>
</tr>
</tbody>
</table>
Due to the limited financial resources available for the feed-in tariff KEV, there is hardly any prospect of KEV subsidies for new plants (waiting list too long).

Housing cooperation Rossfeld is founded and discussions around energy specific renovations began.

**PHASE 2: Formation of SIE-field 2014-2017**

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<th>Year</th>
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<td>First amendment of Energy Act</td>
<td>Parliament 12.400</td>
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<td>2014</td>
<td>Policy ‘event’</td>
<td>Introduction of ‘One-off investment grants’ (Einmalvergütung) as alternative to KEV support &amp; legal recognition and regulation of the right to self-consume of self-produced energy on site</td>
<td>Rieder &amp; Stotz 2018</td>
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<td>2014-2016</td>
<td>SIE-field event</td>
<td>Developments at the housing cooperative Rossfeld: First PV panels were installed (2014), founded an EVG (2015) First PV units are installed at the housing cooperative Rossfeld</td>
<td>Interview</td>
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<td>Erlenmatt Ost project will be implemented as a district self-consumption community in Basel</td>
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<td>EVG-Zentrum was founded</td>
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<td>2017</td>
<td>Policy ‘event’</td>
<td>First package of measures of Energy Strategy 2050 (including new Energy Act) is accepted in referendum</td>
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<tr>
<td>2017</td>
<td>SIE-field event</td>
<td>Blockstrom was founded</td>
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</table>
### PHASE 3: Take off and institutionalisation of SIE-field 2018-2020

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy ‘event’</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>Policy ‘event’</td>
<td>New Energy Act is in force</td>
</tr>
<tr>
<td>2018</td>
<td>SIE-field event</td>
<td>New regulation of self-consumption communities: ZEV (Zusammenschluss zum Eigenverbrauch) organisation created as legal entity</td>
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<tr>
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<td>Further service providers move into the field and provide metering solutions. Energie Zukunft Schweiz publishes a market overview.</td>
</tr>
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<td>2019</td>
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<td>ZEVs can extend across properties that are only separated by a road, a railway or a watercourse, as long as the respective landowner agrees to the crossing of their property</td>
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<td>2019</td>
<td>SIE-field event</td>
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<td>SIE-field event</td>
<td>More than 3079 ZEV projects in various forms had been realised in Switzerland</td>
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### PHASE 4: Digitalisation and contestation of SIE-field boundaries since 2019

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