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Building Social License for Automated Demand-Side Management—Case Study Research in the Swiss Residential Sector

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Abstract: Demand-side management (DSM) is increasingly needed for answering electricity flexibility needs in the upcoming transformation of energy systems. Use of automation leads to better efficiency, but its acceptance is problematic since it is linked with several issues, such as privacy or loss of control. Different approaches investigate what should be done for building community support for automation for the purpose of DSM, but it is only recently that literature has shown interest in the application of social license as a concept merging several issues traditionally treated separately. The social license concept emerged in the mining sector before being adopted for other problematic resources. It serves to identify different levels of community support for a project/company as well as various factors that influence it, such as economic and socio-political legitimacy and interactional trust. This paper investigates, through empirical evidence from eight case studies, what has been done in different contexts to build trust and legitimacy for an automated DSM project. Our findings suggest that patterns exist in respect of benefits, risks and rationale presented, the retention of control, information gathered, and inclusion and that these factors differ according to appliances/devices automated, operators of automation, and end-users targeted.

Keywords: social license; demand-side management; acceptance; energy; automation; smart grid

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1. Introduction

1.1. Background

The changes needed to meet the targets of the Paris Climate Accord require a major energy transition [1]. The energy landscape is transforming towards decentralised low-carbon energy systems with distributed energy resources [2]. These changes are seeing policymakers, energy users, and companies increasingly use language centred around the user. This discourse incorporates a more active role than merely addressing consumers, whereby users become prosumers investing in renewable energy technologies (e.g., rooftop photovoltaics) and storage capacities (e.g., batteries), therefore producing, storing, and exchanging energy services [3,4]. Transition towards renewable energy resources and electrification of energy demand-side leads to several electricity system issues [5], such as grid congestion due to additional total amount of electricity itself as well as additional power during peak times and network losses due to mismatch between stochastic and intermittent supply and demand, especially at the distribution level [6–8]. In order to avoid such issues, demand flexibility is emerging as increasingly important resource for electricity system operators to balance power systems specifically in the residential sector, mainly since that is where the potential of demand flexibility is high [9] as well as being highly needed [10]. Demand-side management (DSM), which refers to the measures that aim to influence magnitude and time patterns of energy demand, could constitute a major opportunity to provide demand flexibility in order to balance power systems [11]. These measures may require end-user manual response, as in the case of time-of-use tariffs, or real-time pricing without a firm commitment, where households respond to price signals [12]. Alternatively, DSM can be automated via (i) home energy management systems (HEMS) that households set up and (ii) other means such as direct load control (DLC), where a utility can switch on and off certain devices depending on the grid needs [12]. Considering the low response rate and/or reduced response in the long term to dynamic tariffs [13–16], automated DSM is increasingly considered as a more effective option to activate flexibility compared to pricing tariffs [17]. Indeed, response to price signals is limited since electricity consumption is inelastic and dependent upon timing of human activities rather than prices [15,18], and its end-users are also subject to inattention and decision fatigue [13]. On the utility side, automated DSM is recognised as a more "reliable and economic operation of power systems and electricity markets" [19] and a way to integrate renewable energies [20,21]. On the user side, it ensures a more economic and ecological usage of energy, avoiding efforts for end-users [22–24]. Nevertheless, despite the benefits for both consumers and utilities, the engagement in automated DSM programmes is low [25–27].

1.2. Previous Studies on Behavioural Barriers for Automated DSM Acceptance

In this section, we highlight several barriers or enablers for the exploitation of demand flexibility as discussed by diverse disciplinary origins, which can be summarised under six topics. Several researchers, specifically those with social practice theory perspective, indicate that (i) several researchers, specifically those with social practice theory perspective, indicate that providing demand flexibility (e.g., shift of energy use) is complex, as energy demand is directly linked to practices embedded in both social and temporal rhythms, such as working hours or meal times [28–30]. Therefore, configuration of how elements (e.g., norms, objects) of practices link together in and through performances across multiple temporal scales is a basis and a useful starting point for promoting demand flexibility [28].

Several researchers generally draw on a range of human-centred psychology to discuss various barriers and enablers for DSM. (ii) Researchers found that influencing energy demand may entail inconvenience, discomfort, or dangerous malfunctions, such as drop down of indoor temperature [31], bacterial proliferation [32], or potential fires [33]. These differ in their nature and their perceived intensity depending on practices where flexibility is provided [34] but also among the end-users targeted [35]. The socio-technical potential is derived from the technical potential focusing on devices/appliances with high amounts of energy consumption that can be technically postponed (e.g., heat pumps, EVs, wet appliances, and freezers compared to small appliances such as TV or iron) with consideration regarding acceptance likeliness (see [36]). Against this background, the literature suggests that appliances/devices with a fine balance of socio-technical potential for automated DSM are mainly washing machines [37], heating systems [38,39] or batteries (which include EV charging) [40–42]. It seems that the less that devices/appliances are embedded in social rhythms, the more likely they are to be accepted for DLC [43]. For example, washing machines are used in households when laundering activity occurs [44]; thus, altering washing machines' usage requires the end-user's willingness to change the timing of their activity. On the contrary, heating systems can be switched off in peak hours without occupants noticing the difference [28] thanks to building inertia or water tanks, which avoid any change in the household's activities. (iii) Literature identifies fear related to data security as another barrier for acceptance since energy data taken from smart meters (which are crucial for automated DSM) can be misused for multiple purposes [45–47].

(iv) These concerns are magnified even more when the control of these appliances that are closely linked to daily life and bodily comfort is to be delegated to third parties by offering to automate these appliances for households. Literature suggests that perception of the loss of control is the most influent element for acceptance [48]. This perception is shaped by the end-users' desire for ultimate control over devices they have paid for, especially thermostat controls for heating systems [49]. It differs according to personal sensitivities and socio-demographic characteristics; for example, households living in houses may need more control than those living in apartments, which are used to sharing control for heating systems or washing machines [43,50]. In fact, many studies have indicated that end-users are only ready to accept automated DSM if they feel they still retain control over automaton [31,51–53].

(v) Literature identifies trust (in both the technology itself and the actors operating for it) as vital for acceptance of automated DSM [25,52], especially since it impacts the perception of the loss of control, of data security, and of the benefits [31,53–55]. Trust in the technology related to smart grids (such as HEMS) is influenced by several elements such as household habits or ease of use [56,57], communication of the positive and negative outcomes [56–58], and salience or "observability" of pilots to increase social awareness and reduce concerns [58] but also trust towards its operator [57]. Nevertheless, this is critical since "people recognise a misalignment between their own ends (e.g., energy services) and those of energy companies (e.g., profit)" [49]. Trust towards utilities to roll out automated DSM is built progressively through the history of their interactions with end-users [59], which means utilities must be transparent and responsive to end-users' needs [60]. Moreover, trust requires horizontal relationships with free flow of information and familiarity, but large energy companies are mainly seen by people as inaccessible [61]. Therefore, trust involves matching the social norms and the vision of a desirable future between end-users and utilities [22,61].

Other researchers draw on behavioural economic theories to investigate the barriers and enablers. (vi) Studies focus on the motivations and incentives regarding the adoption of automated DSM programmes. They mainly identify those as monetary savings and the feeling of contributing to environmental issues [33,35,62,63] but also as other elements such as a better understanding of their energy consumption [63]. Behavioural economists investigated the effect of incentives/disincentives on the acceptance of automated DSM and concluded that acceptance increased as long as they were justified [64], minimal [65], and fair [31].

1.3. Aim and Objectives

It is evident that earlier research has focused on different elements separately, such as economic incentives, acceptance of socio-technical objects and people's perceptions and concerns related to them, household practices, and other topics such as trust, etc., depending on the different disciplinary origins.

In this paper, we consider automated DSM on a project basis, and we argue that there is more to getting end-users as either individuals or collectives on board than the questions of perceived inconveniences, practices, and social acceptability of artefacts when deploying automated DSM programmes. This is mainly because, given its nature, with the automated DSM, the complexity of asking energy users to cede the control of their appliances, which are closely linked to their daily lives, to a third party is amplified even more when the energy users do not rationalise why and for what reason the third parties operate such programmes in their homes, communities, or in the region. Therefore, arguments over social and political trust and legitimacy are likely to occur when actors are attempting to deploy automated DSM projects at the scale of an individual project or activity, the scale of the entire sector with its actors, and the overall concept of automated DSM.

Against this background, we conducted a case study analysis and explored the role that social license to operate plays in automated DSM projects in Switzerland. Our main aim in this paper is to investigate how social license for automated DSM projects has been granted and maintained in Switzerland, in particular, the perceptions of who grants an SLO and how actors work to obtain or maintain trust and legitimacy. For this, we first look at the existing conceptual frameworks of the SLO approach to explore which elements can be used for the automated DSM programmes. Then, we apply the adapted framework to eight Swiss case studies related to deployment of automated DSM programmes for household energy resources, such as EV charging, batteries, heating, or wet appliances (e.g., washing machines and dishwashers). By using the SLO concept as a bridging framework, we draw attention to the (mis)alignments and the negotiations between households with their practices, agency (examining the six main topics mentioned in Section 1.2 if relevant), their perceptions (examining legitimacy, trust), and the expectations of stakeholders as part of the energy system management using demand flexibility as a resource. We believe that this qualitative case study analysis through the social license to operate concept may be useful to energy policymakers and specifically actors that implement automated DSM programmes, such as grid operators and aggregators, for understanding public perceptions and considering them in deploying automated DSM projects and programmes.

2. Social License to Operate (SLO)

The concept of SLO emerged in the late 1990s in the mining industry as an answer to growing community opposition [66]. Since then, it has been widely used and spread among many other industries, including pulp and paper mills, forestry, wind power, or geothermal plants [67–72]. SLO is generally defined as "the ongoing acceptance and approval of an operation by those local communities affected by it and those stakeholder who can affect its profitability" [73–76]. It investigates community support by the observation of the perception of relationship quality between impacted communities and the company/project, which gives a rapid indication as to which elements are important or can be ignored in a specific context [68,77].

Originally a metaphor, it has been theorised and defined by different models, with the most adopted being the pyramidal model [78], which recognizes four factors that define the stakeholders' perception of legitimacy (economic and socio-political) and trust (interactional and institutionalised) as well as different levels of community support that are cumulative to a certain extent [73]. The pyramidal model is presented in Figure 1 and can be read as follows: on the left different colours are associated to a level of social license, and on the right the social license level (colours) is presented to which the four factors lead, with the boundary of each factor defined by blue and purple lines. With that, Boutilier and Thomson (2011) theorised that when a project represents nothing more than a financial transaction (economic legitimacy), it is more likely to be accepted than rejected but is subject to variation between these two states. When a company is seen as either listening, responsive, and keeping its promise (interactional trust) or as respecting the local way of life and contributing to the well-being of the region (socio-political legitimacy), acceptance is granted, but community support is likely to fluctuate between approval and withdrawal. If the project is seen as benefiting from all the three factors exposed above, the community support granted is mainly likely to fluctuate between approval and acceptance. The highest level of community support (identification to the project) is only reached when all the previous factors are present, and trust towards the company is institutionalised.

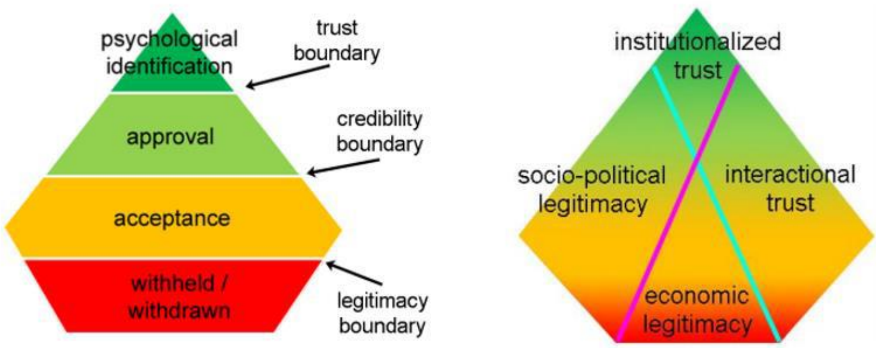

Figure 1. SLO's pyramidal model, established by Boutilier and Thomson [70].

Even though a social license is considered as an intangible concept [79], consultants and social-license practitioners take the four factors of trust and legitimacy to measure levels of community support, as exposed above [77,80]. These are sensitised through ethnographic and historical analysis of projects to produce an integrated notion of a project stakeholder's network and gives importance to stakeholder identification to address appropriately their fear and their expectations and to empower them [73,81–83]. Therefore, it can be used to provide guidelines about the ways to appropriately manage relationships as the project progresses [81], going from only maintaining a good reputation to communication and integration in the decision-making process [79,84]. Social license, social acceptance, and corporate social responsibility (CSR) are concepts that are interconnected and hard to differentiate [78,81,82]. Nevertheless, we argue that SLO is a much broader concept with deeper political ties compared to social acceptance although it as a feature of SLO [78,85]. CSR is even a broader concept that can be defined as "a movement to establish responsibility to corporations that goes beyond legal requirement", while SLO is more defined by "going beyond legal requirement" [78,86].

We argue that using the instrumental aspects of the SLO concept, which are largely concerned with the components of SLO, as an analytic lens to read public support of automated DSM might be useful for understanding how actors achieve and maintain the social support for automated DSM projects. We argue that the four factors of trust and legitimacy established by Boutilier and Thomson (2011) are particularly helpful in providing guidelines, as they merge all the identified barriers related to community support for automated DSM (see Section 1.2).

3. Methods

We conducted research on case studies covering "in-depth examination of particular subjects or phenomena (e.g., individuals, firms, cities, policies, adjustment to a new technology) as well as related contextual conditions, often using multiple sources of evidence" [87]. Literature reviews for each case study, covering reports, newspaper articles, public institution publications, and scientific articles, constituted empirical data for each case study. We did not directly interview participants in the case studies, but instead, we considered interview summaries as part of some case study reports. All the data collected were used to fill an analytical framework containing elements relevant to social license (it had been built in the frame of the SLA sub-task of the IEA and also used in [88] and presented in Appendix A). After the extraction of all information possible from the documentation, missing elements were obtained by presenting the analytical framework to project managers. We asked the project managers to fill in if there are elements missing and also to confirm whether the information filled in by the co-authors is correct. Here, it is important to note that every project manager received the same analytical framework questions for consistency. Eight case studies were investigated, with regard to providing similar and differentiated contexts (such as appliances automation, end-users targeted, and actors operating automation) to allow at the same time generation and strengthening of hypotheses.

In this paper, we focus our investigation on the factors established by Boutilier and Thomson (2011) given the specific issues related to automated DSM (Table 1). We observe how economic legitimacy, socio-political legitimacy, and interactional trust have been built depending on the context in case studies. In the mining sector, social license to operate discussions often centre around spectacular failures of trust. However, our case studies are more modest and do not provide evidence about shifts between different levels of community support (withdrawal, acceptance, approval, identification). Additionally, we do not directly investigate institutionalised trust, as it would require an in-depth assessment of the impact of several years of trust building and field practices between stakeholders and project managers (mainly utilities in the context of Switzerland and DSM [73].

Table 1. Adaptation of the SLO original concept to automated DSM (social license to automate—SLA).

SLO's Factors	Definition in the Original Concept (Based on [73])	Adaptation to SLA
Economic legitimacy	Refers to the perception that the project/company is beneficial to the perceiver.	Which benefits and costs have been communicated to the end-users as well as which indirect and direct monetary incentives have been used to convince the end-users.
Socio-political legitimacy	Refers to the perception that the project/company contributes to the well-being of the region, respects local way of life, meets expectations about its role in society, and acts according to stakeholder's view of fairness.	Which actors control automation, and how does the rationale of the project match with the end-users' interest and operator's expected role?
Interactional trust	Refers to the perception that the company and its management listens, responds, keeps promises, engages in mutual dialogue, and exhibits reciprocity in its interactions.	Which means were available for mutual dialogue (for listening, response, and inclusion)? Which information was shared through which channels to ensure promises are kept? How was end-users' sense of control dealt with (e.g., overriding)?

4. Case Studies

The selection of the case studies is limited strictly to those that used automated DSM (at least in part), were conducted within households, and benefitted from empirical results and open science. Different project managers were also consulted about their knowledge of pilot studies related to the criterion established above, who further on provided us a list of contacts in and potential projects related to automated DSM that occurred in Switzerland. We observed that the number of case studies is limited to eight Swiss case studies for the criterion established above. However, case studies are embedded in similar and differentiated contexts that allow us to confront the elements suggested in Section 1.2.

Table 2 presents the case studies investigated and their characteristics, such as project name, date, documentation, and context, including which appliances were automated and at which level (on a 5-point scale) and which were the stakeholders targeted and on which scale.

We distinguished levels of automation on a 5-point scale, considering the nature of automation (semi or full) and the possibility to override automations and to opt-out, inspired from [56]. We define semi automation as automation that can be influenced by end-users (i.e., with temperature or battery-level thresholds or any other factors), full automation as automation that cannot be influenced by end-users, opt-out as the possibility to leave the project and recover the previous settings (i.e., before opt-in), and the possibility to override automation as the end-user's possibility to choose to activate/deactivate automation (for full automation as well as semi automation). Therefore, we define that:

- A level of automation of 1/5 refers to semi-automation with a possibility to override automation at any time.
- A level of automation of 2/5 refers to full-automation with a possibility to override automation at any time.
- A level of automation of 3/5 refers to either full automation with a restricted possibility to override automation or semi-automation with a restricted or without any possibility to override automation.
- A level of automation of 4/5 refers to full automation without any possibility to override automation but the possibility to opt-out from the project.

A level of automation of 5/5 refers to full automation without any possibility to override automation or even to opt-out from the project.

Table 2. Case studies reviewed.

Project Name	Date	Documentation	Appliances Automated	Size/Scale	Core Stakeholders and Location	Actor Leading the Case Studies
Quartierstrom	2017–2020	[89,90]	Community battery (4/5)	37 households; 1 battery sized for 4 household	Virtual self-consumption community (SCC) in a village and including multi-family housing	Small DSO (WEW, supplying fewer than 10,000 consumers), University (ETHZ, Bits to Energy Lab)
WarmUp	2016–2018	[91–93]	Shared heat pumps for SH and DHW (5/5)	15 buildings with 22 hot water boilers fed by 9 HPs	Individual consumers living in a big city (Zürich) and in multi-family housing	Big DSO (EWZ, supplying more than 100,000 consumers)
Innovative self-consumption optimization for multi-family area development with local electricity exchange (ISCO-LEE)	2017–2022	[94–96]	Shared heat pumps for SH (3/5) and DHW (4/5); individual EVs, washing machines, and dishwashers (1/5).	35 households with 4 HPs, one EV charging station, and 70 combinations of washing machines and dishwashers.	Self-consumption community (SCC) in a village with only households living in multi-family housing	Small DSO (RTB Möriken-Wildegg supplying fewer than 10,000 consumers), University (Fachochschule Nordwestschwiez)
GoFlex	2016–2020	[97–100]	Individual heat pumps, electric boilers for DHW, and electric heaters for SH (4/5) and individual EVs (3/5, 1/5 de facto).	195 households (with control of HPs, resistive heating, and/or electric boilers); 6 EV charging stations and 9 HEMS	Individual consumers and prosumers living in a medium city (Sion) and in single-family housing	Big DSO (OIKEN, supplying more than 100,000 consumers), University (HES-SO Valais/Wallis)
Decentralised flexibility	2020–2022	[101,102]	Individual heat pumps and electric boilers for DHW (4/5)	45 HPs and electric boilers	Individual consumers living either in a medium city (Fribourg) or in villages and in single/multi-family houses	Big DSO (Group E, supplying more than 100,000 consumers)
Luggagia Innovation Community (LIC)	2018–2022	[103]	Individual electric boilers for DHW (2/5 in the first phase and 3/5 in the second phase) and centralised battery (5/5)	17 single-family households (incl. 3 prosumers); 1 kindergarten with rooftop PV	Self-consumption community (SCC) in a village with households living in single-family housing	Small DSO (AEM, supplying fewer than 10,000 consumers)
Tiko	2014—commercial	[104]	Individual electric boilers for DHW, heat pumps, electric heaters, and night storage heaters (3/5)	6000 devices (50% HPs)	Individual consumers in single-family housing across the country	Private aggregators
OKEE	2019–2021	No publication yet	Rented EVs (3/5)	2 smart charging stations with 2 EVs for sharing with V2G capabilities	EV renters in a big city (Basel)	Private aggregators

5. Results

In this section, we present how some sense of social license has been acquired in the case studies reviewed depending on the context in which they were embedded. First, we present how economic legitimacy was built by reviewing which risks and benefits were presented and how. Then, we present how case studies constructed the socio-political legitimacy of automated DSM, observing the rationale presented and the actor responsible for automation. Finally, we present how interactional trust was built by observing the level of control left to the end-users, information communicated to ensure promises are kept, and how end-users were included.

5.1. Economic Legitimacy

5.1.1. Economic Legitimacy—Benefits Presented to End-Users

Case studies show that the benefits end-users will receive are communicated under three categories: (i) monetary savings, (ii) increase in self-consumption and self-sufficiency, and (iii) improving the understanding and transparency of energy consumption. Additionally, the wider benefits of automated DSM to the region are also communicated, namely by (iv) contributing to environmental issues, (v) contributing to an innovative project and energy transition, and (vi) contributing to solving grid problems (such as blackouts, voltage, and frequency issues). Wider benefits are clearly associated with collective benefits and tend to pull end-users to the grid by making it cleaner and safer. Tangible benefits are associated with personal benefits for the end-users and are focused either on pushing them away from the grid (i.e., increased self-sufficiency) or encouraging them to stay (i.e., monetary savings, better understanding).

Table 3 shows the different identified patterns of benefits presented in the case studies as well as the context of each project with the appliances automated, the targeted end-users, and the actor responsible for automation, respectively.

Table 3. Benefits and incentives presented to the end-users.

Case Study	Context *	Tangible Benefits	Wider Benefits	Incentives
Quartierstrom	(a) Centralised battery (b) SCC (village) (c) Small DSO	Reduce the bill and increase local energy consumed (PV). Better visualization.	Participate in an innovative project. Contribute to environment. Increase the community feeling.	RTP (Indirect). Free installation.
WarmUp	(a) Shared heat pumps (b) Individual consumers (big city) (c) Big DSO	More economical heating.	More ecological heating.	Free installation.
ISCO-LEE	(a) Shared heat pumps (b) SCC (village) (c) Small DSO	Reduce the bill and increase local energy consumed (PV).	Contribute to energy transition and an innovative project.	RTP (Indirect).
GoFlex	(a) Individual heat pumps, electrical boilers, electric heaters, EVs, HEMS (b) Individual consumers, prosumers (medium city) (c) Big DSO	Better visualization (resulting in energy savings and monetary savings).	Participate in an innovative project. Participate in the Swiss Energy Transition.	Free installation.
Decentralised flexibility	(a) Individual heat pumps (b) Individual consumers (village/medium city) (c) Big DSO	None.	Solving grid and network problems.	Free installation and 3 cts/kWh discount for each device automated.
LIC	(a) Individual heat pumps, electrical boilers, centralised battery (b) SCC (village) (c) Small DSO	Increase self-consumption.	Contribute to the energy transition.	Free installation.
Tiko	(a) Individual heat pumps, electrical boilers, electric heaters (b) Individual consumers (all Switzerland) (c) Private aggregators	Monetary savings. Reduce CO_2 emissions.	Help to better manage network issues of the TSO.	Free installation.
OKEE	(a) Rented EVs (b) Individual consumers (Big city) (c) Private aggregators	Reduce the bill and increase local energy consumed (PV). Better visualization.	Participate in an innovative project. Contribute to environment. Increase the community feeling.	RTP (Indirect). Free installation.

* Appliances/devices automated (a), targeted end-users (b), automation's operator (c).

When end-users were part of a self-consumption community (SCC) (e.g., Quartierstrom, LIC, ISCO-LEE), increasing self-consumption was the main benefit presented to end-users, whereas for individual prosumers, this argument was not seen as convincing enough if proposed by the DSO [99]. Contributions to the environment or the Swiss Energy Transition were communicated in all case studies reviewed (except Decentralised Flexibility, which presented instead its contribution to help to solve grid issues). End-users seemed mainly satisfied by it being presented as a broad statement, as the GoFlex survey illustrates [100].

Projects led by private actors (Tiko and OKEE) are the only ones that presented environmental benefits as tangible (i.e., avoiding CO_2 emissions). Monetary savings are presented as one of the main benefits in all projects except two (Decentralised Flexibility and GoFlex), but none presented a target such as the savings expected. Decentralised Flexibility proposed monetary incentives instead and is the only project that did so. GoFlex, given that project managers feared a decrease of goodwill and negligible savings, presented energy and monetary savings as an outcome of a better understanding of energy consumption [99]. Incentives such as free installation are widely used, and dynamic pricing was presented in some SCCs as an incentive per se. Only GoFlex and Quartierstrom presented an improved visualization of energy consumption as a main benefit, which might be explained by the fact that it is the only tangible outcome for end-users and another way to increase self-consumption, respectively.

Building community, in the sense of enhancing social bonds between residents, was only emphasised in one SCC (Quartierstrom). Being part of an innovative project was presented in the project that occurred in a rural context or medium towns but not for end-users living in larger towns. Mainly, technological innovations were associated with different aspects, such as a local energy market (in Quartierstrom), smart meters (in GoFlex), or RTP (in ISCO-LEE).

5.1.2. Economic Legitimacy—Risks and Costs Communicated to End-Users

Case studies that automated HPs as electric devices for both SH or DHW presented discomfort as something that would never or be unlikely to occur and promised that comfort had priority over other objectives (e.g., cost savings). Data security was not observed as a high concern for the participants, as also observed for Swiss households in the literature [53]. In the case studies, it was addressed mainly by a consent form explaining how data will be managed safely (i.e., with a blockchain, by storing on local servers, ensuring that user data will not be used for a commercial purpose or shared with third parties). It seemed sufficient as illustrated in GoFlex, where most end-users disagreed to associate the project with an issue such as invading privacy [100]. Similarly, in the other case studies, no further complaint emerged related to data security.

5.2. Socio-Political Legitimacy and Interactional Trust

Table 4 indicates which rationales were presented, which information was communicated through which channels, and how the issue of control was dealt with. The rationales presented are linked to socio-political legitimacy and remaining control, while the information communicated and channels used are linked to interactional trust.

5.2.1. Socio Political Legitimacy—Legitimacy of the Rationale and the Operator

Case studies show that rationales presented to the end-users are communicated under four categories: (i) increase in self-consumption and self-sufficiency, (ii) solving grid issues, (iii) solving environmental issues, and (iv) increase in monetary savings.

Rationales such as "to maximise self-consumption and self-sufficiency" were used in each case study that targeted SCCs (i.e., LIC, Quartierstrom, and ISCO-LEE). Additionally, operating agents for automation were always small DSOs (supplying fewer than 10,000 consumers).

When case studies targeted individual end-users, solving grid issues was presented as the/one of the rationales of the project (except for WarmUp). While DSOs presented it directly (i.e., Decentralised Flexibility, GoFlex), Tiko, which is a private aggregator, presented it as a service sold to the TSO for grid balancing. Differences in communication might be explained by the fact that solving grid issues is the expected role of the DSO but not of a private aggregator. Some case studies operating with individual consumers presented a similar rationale, but additionally, they communicated the integration of renewables, especially PV (OKEE, GoFlex).

Table 4. Benefits and incentives presented to the end-users.

Case Study	Context *	Rationale Presented	Remaining Control	Information Channels (Information Shared)
Quartierstrom	(a) Centralised battery (b) SCC (village) (c) Small DSO	Decrease imports from the grid and exports of PV produced in the boundary of the microgrid.	Full automation. No overriding options. Opt-out possible.	Web interface, monthly mail (to inform about energy costs and consumption and PV production and self-consumption at the household and the community scale). Detailed billing (to inform about monetary savings). Information sessions (to introduce project and stakeholders). Phone line (to inform about to the interface in the beginning, then to express complaints). Interviews (to express future expectations, collect perceptions, and know if households did manual DSM).
WarmUp	(a) Shared heat pumps (b) Individual consumers (big city) (c) Big DSO	Increase efficiency; decrease CO_2 emissions and costs.	Full automation. No overriding options. Opt-out impossible.	Web interface (to inform about energy and power costs). Billing (to inform about monetary savings). Phone line (for any complaints). No interviews.
ISCO-LEE	(a) Shared heat pumps (b) SCC (village) (c) Small DSO	Increase self-consumption of PV in the eco-district.	HPs: Semi automation (choice of temperature thresholds). No overriding options. Opt-out possible. EVs: Semi automation (choice of departure time and journey planned). Possibility of overriding automation at any-time. Opt-out possible. Wet appliances: Semi automation (schedule). Possibility of overriding automation at any-time. Opt-out possible.	In-home interface (to inform about temperature, automation state, and electricity mix). Web interface and smartphone interface (to inform about market prices, temperature, energy consumption, PV production, and self-consumption/self-sufficiency at the device, the household, and the community scale and self-consumption/self-sufficiency at the household and the community scale). Detailed billing (to inform about monetary savings). Phone line (for any complaints). Surveys (to collect satisfaction related to comfort and prices and know if households used automation or did manual DSM).
GoFlex	(a) Individual heat pumps, electrical boilers, electric heaters, EVs, and HEMS (b) Individual consumers, prosumers, (medium city) (c) Big DSO	Better management of the grid (but a bit unclear for end-users); increase self-consumption (for prosumers).	Heating systems: Full automation. No overriding options. Opt-out possible. EVs: Semi automation (choice of departure time and journey planned, and schedule). Possibility of overriding automation at any-time (de facto, by not using the app where semi automation is made). Opt-out possible.	Smartphone interface for EVs (to inform about flexibility activation). Web interface for heating systems (to inform about flexibility activation, temperature, and energy consumption at the device scale). Billing (to inform about monetary savings). Phone line (for any complaint). Interviews (to identify preference related to benefits/rationale before the project and ask about perception related to discomfort and control as well as fear).
Decentralised Flexibility	(a) Individual heat pumps (b) Individual consumers (village/medium city) (c) Big DSO	Grid stabilization	Full automation. No overriding options. Opt-out possible.	Web interface (to inform about energy consumption at the device scale). Billing (to inform about monetary savings). Phone line (for any complaint). Interviews (to identify preference related to benefits/rationale before the project).
LIC	(a) Individual heat pumps, electrical boilers, centralised battery (b) SCC (village) (c) Small DSO	Increase self-consumption of PV and self-sufficiency of the community.	Battery: Full automation. No overriding options. Opt-out possible. Heating systems: Full automation. Possibility to override automation at any-time (phase 1)/restricted possibility to overriding automation (phase 2, confirmation needed from the DSO). No overriding options. Opt-out possible.	Web interface and biannual mail (to inform about energy consumption, PV production, and flexibility activation for the battery). Billing (to inform about monetary savings). Phone line (for any complaint). Interviews planned.
Tiko	(a) Individual heat pumps, electrical boilers, electric heaters (b) Individual consumers (all Switzerland) (c) Private aggregators	Helping the TSO by providing ancillary services	Full automation. Restricted possibility to override automation (for a day). Opt-out possible.	Web interface and smartphone interface (to inform about temperature, CO_2 avoided, and energy consumption at the device scale). Billing (to inform about monetary savings). Phone line (for any complaint). No interviews.
OKEE	(a) Rented EVs (b) Individual consumers (Big city) (c) Private aggregators	Help renewables integration and reduce power peak.	Semi automation (choice of departure time and journey planned). No overriding options. Opt-out possible.	Web interface (to inform about solar consumption). Billing (to inform about monetary savings). Phone line (for any complaint).

* Appliances/devices automated (a), targeted end-users (b), automation's operator (c).

WarmUp emphasised the rationale for automation as providing ecological and economic heating. Nevertheless, investigation showed that the distinction between benefits and rationale was sometimes not clear for end-users, which led to misunderstandings. It is particularly evident in GoFlex, where the interviews revealed that most end-users were thinking that the purpose of the project was to inform about energy use and to help use less energy with better visualization [100].

5.2.2. Interactional Trust—Management of End-Users' Sense of Control

Analysis of the case studies shows that the ways to deal with end-users' sense of control is highly dependent on the type of device automated. Solutions offering to increase the sense of control can be summarised under three categories: (i) opt-out, (ii) overriding options or semi-automation (including schedules, pre-request, temperature thresholds, etc.), and (iii) informing about flexibility activation (i.e., when the third party performs the automation such as turn on/off the targeted device).

In all case studies except WarmUp (i.e., too complex to provide individual opt-out from HPs, as the heating system was centralised), end-users had the possibility to opt out from automation to recover previous settings. Community batteries (CB), since they were not owned by end-users, were fully automated without overriding options.

For heating systems and electrical boilers, case studies that were led by private aggregators or that targeted SCCs all proposed either overriding options to the end-users (LIC, which were unlimited in the first phase, and Tiko, which were limited to veto day) or semi-automation with thresholds of temperature (ISCO-LEE and Tiko). In LIC, when end-users had the possibility to override automation at any time, it resulted in almost no flexibility activation. In ISCO-LEE, complaints related to discomfort still occurred, partly since some end-users did not see the effect of their actions but also partly due to misinformation. On the contrary, in WarmUp, GoFlex, and Decentralised Flexibility, no remaining control was left to the end-users (full-automation and no overriding options). In GoFlex, end-users were asked directly about their perception of control, while in every project, end-users were able to complain in the phone line, but it did not provide any evidence that end-users perceived more loss of control when they were proposed low remaining control solutions (full automation, no overriding options). This suggests that fear of loss of control is lower when a public utility operates automation, and end-users are not part of a SCC. Moreover, GoFlex informed about flexibility activation and communicated, as a central aspect of the project, a better understanding of energy consumption with visualization. This strategy was appropriate to manage loss of control, as most end-users felt that the project increased their control over their electrical consumption [100].

For EVs, semi-automation with the possibility to set departure time and journey planned was present in all case studies. The only case study that automated rented EVs (OKEE) did not provide overriding options for end-users since it was a car-sharing activity. ISCO-LEE proposed to schedule journeys in a calendar and to override automation at any time activation, but only two EVs were operating in the project, and therefore, it is difficult to reach certain conclusions. GoFlex did not directly propose overriding options, but by not using the smartphone interface linked to the charging station (where end-users must indicate type of EV, departure time, etc.), end-users were able to bypass the automated charging of their EVs. This led to almost no flexibility activation (only 1% of the charging sessions).

ISCO-LEE implemented the lowest level of control (semi-automation with the possibility to override automation at any time) for dishwashers and washing machines. These were activated automatically when there was an overproduction of PV but should be manually loaded by the end-users and set with a pre-request for overriding automation. Additionally, the end-users could indicate what time the washing machines and dishwashers should be finished by, and these appliances were never interrupted when they were on. With that proposal, 45% of the end-users made the choice to activate automation for dishwashers and 27% for washing machines [95].

5.2.3. Interaction Trust—Information Communicated and Interface Provided

Each case study that targeted SCCs (i.e., Quartierstrom, LIC, and ISCO-LEE) informed about self-consumption, production, and consumption (through load curves) of the community as a whole as well as the concerned individual households of the community. In each case study, end-users were able to know their actual savings through billing. However, few case studies (Quartierstrom and ISCO-LEE) provided detailed billings to simplify the understanding. Some case studies informed about monetary savings but also about current costs through an interface (i.e., Quartierstom, ISCO-LEE, and WarmUp). In the project that communicated it, actual savings remained mainly limited. In OKEE, the cost for energy usage decreased by 2.5%, and in ISCO-LEE, these decreased about 8%, while in WarmUp, energy costs (here, it is matter of block of energy traded) decreased on average about 2.7% even if power peak costs decreased on average about 10% for the DSO. End-users seemed mainly satisfied with monetary savings since almost no complaints were registered. However, one-third of ISCO-LEE's end-users claimed that their energy costs did not decrease [95]. Some case studies that included individual consumers presented load curves (which also inform about flexibility activation) through an interface (i.e., GoFlex, Tiko, or OKEE), while others did not (WarmUp, Decentralised Flexibility). For GoFlex, better visualization was one of the main aspects of the project, while for Tiko and OKEE, the fact that they were led by private aggregators might explain why a higher level of information with load curves was provided.

For community batteries (CB), LIC informed about flexibility activation, while Quartierstrom did not. Case studies led by private aggregators are the only ones that informed end-users about effective contribution to environment issues through CO_2 avoided (Tiko) or share of local PV consumed (OKEE). When a DSO operated automation, effective contribution to the environment was mainly not seen as necessary information to be communicated. This was explicitly stated in Go Flex surveys, where this information requirement was only in seventh place (out of ten) [100]. It is also suggested in WarmUp since, although environmental consumption and ecological consumption have been presented as benefits on an equal footing, end-users were only informed about money saved.

Discomfort related to temperature dropdowns is indeed subjective, and it was presented in many different ways in the case studies. For example, Decentralised Flexibility indicated "the automation of heat pump will not impact your comfort"; GoFlex, "the automation will guarantee maximum comfort"; and WarmUp, "we will improve your comfort" without any precise indications or metrics. To prove that discomfort did not occur, ISCO-LEE, GoFlex, and Tiko directly informed about discomfort through temperature in an interface. GoFlex and ISCO-LEE also asked end-users through interviews or surveys about perception of discomfort. They observed that most end-users did not experience discomfort such as temperature drop down but also that complaints related to discomfort blamed automation even when discomfort could be explained by other elements such as early phase of regulation, bad habits (e.g., not using blinds), or bad location (e.g., flat located under the roof). This highlights that not every end-user understood discomfort caused by automated DSM in the same way. Tiko also provided an alarm system informing when temperature was below threshold points according to the end-user's choice mode. WarmUp, Decentralised Flexibility, and LIC did not provide any information related to discomfort such as temperature.

5.2.4. Interactional Trust—End-User Reciprocity and Inclusion

The inclusion of end-users goes from listening to end-users' expectations and empowering and encouraging them to act towards pursuing DSM objectives. Several case studies provided an interface that informed about load curves (e.g., GoFlex, Quartierstrom, and ISCO-LEE) or current state of electricity mix (ISCO-LEE) and varying tariffs (ISCO-LEE and Quartierstrom) to encourage manual load shifting. In ISCO-LEE, more than 90% of the end-users claimed to do manual shifting [95]. Quartierstrom was particularly inclusive, as manual DSM was central, and end-users even had the right to influence market price.

In that configuration, many end-users actively doing manual DSM also talked about the project in a positive way to their friends [89].

Only two case studies asked end-users their expectations before starting. They did it to frame the most appropriate proposal related to the benefits and the rationale presented (GoFlex and Decentralised Flexibility) or related to incentives (Decentralised Flexibility). Quartierstrom set up a session to inform future end-users about the project and to answer their questions, which is one explanation for the high opt-in rate (90%) [89]. For automation of heating systems for SH and DHW, each case study provided the possibility to complain to the automation operator. It was crucial to evaluate discomfort and adjust regulation. Each case study that targeted self-consumption communities (ISCO-LEE, LIC, and Quartierstrom) went or planned to go further in listening to the end-users by interviewing them. This helped to understand fears and what end-users would like to see implemented or improved in the next phases. The case studies that targeted individual consumers mainly did not consider this option (only Decentralised Flexibility and GoFlex out of five). The latter includes all the case studies led by private aggregators.

6. Discussion

This paper provides insights from case studies in Switzerland regarding the way to build a social license in the field of automated DSM. In this section, we present first a summary of these findings, followed by the implications for policymakers and limitations as well as future work that can be associated with this paper.

6.1. Findings and Implications

The analyses of the case studies show that building the economic legitimacy of a project goes through the end-users' perception that their personal costs will be compensated by benefits whether they are personal or for the community. Review of the case studies showed that risks communicated were mainly focused on discomfort and as an element unlikely to occur, not impacting daily life, and that would be minimised. Focus on discomfort is not surprising since it is recognised as one of the main concerns for Swiss households [31,34]. The topic of data security was managed only by providing a consent form, which seemed enough for end-users. This suggests data security is a minor issue for Swiss households, as already suggested in the literature [53], and highlights a high level of trust in Swiss energy and wider institutions. The literature established that monetary savings is the first motivation to accept automated DSM [33,35,52,63] although literature investigating the questions in the minds of Swiss households observed that it is only one important element among others [34] but also that households can associate automated DSM to monetary losses [53]. Additionally, monetary savings, understood as a pure personal benefits, is an element on which importance should not be put on since it might abate end-users feeling that they are doing something positive by opting-in [105]. This last evidence agrees with the findings in the case studies in which monetary savings were presented in different contexts but not as a precise amount of savings. Indeed, end-users were communicated the potential monetary savings through various measures, including incentives or revenue from flexibility activation. The literature recognizes different sensitivity to benefits [35], which was also observed in the case studies. When targeting SCCs, increasing self-consumption was presented as the main benefit. When targeting individual consumers, contributions to solving grid issues and/or environmental issues were presented as the main benefits. When targeting end-users living in low-density areas rather than big cities, case studies emphasised benefits such as being part of an innovative project. Visualisation was emphasised either when it was the only tangible outcome or when increased self-consumption was central (i.e., for SCCs). Broman Toft et al. (2014) observed that both collective and personal benefits influence acceptance of automated DSM. Analysis of the case studies suggests first that, besides collective benefits (i.e., contribution to environment), individual consumers must feel they will receive personal and tangible benefits (i.e., monetary savings, better visualisation). The necessity of provide tangible benefits was also raised in [56,58], especially to build trust. Second, findings suggest that SCCs are mainly interested in benefits allowing them to be more independent from the grid, while individual consumers are mainly interested in using the grid in a more sustainable way (i.e., benefit from cheaper and cleaner electricity).

The analysis revealed that socio-political legitimacy is built by presenting a rationale for automation that must match end-users' expectations concerning both the role of the technology and the expected role of the actor operating it. For case studies targeting individual consumers, the main rationales presented were solving grid issues, which was often presented with integration of renewables. Surveys that investigated the acceptance of automated DSM in Swiss households mainly considered these two but rather with a focus on environmental issues [53,105,106]. When targeting SCCs, the rationale presented was always that of increasing self-consumption. This highlights the fact that SCC expectations are to increase their independency from the grid. Misunderstanding of the rationale occurred in some case studies, which is a concern also raised in the literature [107], and it might lead to a withdrawal and have a long-term effect on the social license if outcomes of automation do not lead to the rationale conceived by end-users. DSOs presented rationales such as solving the grid or environmental issues. Since few concerns emerged, we can conclude that end-users perceived those rationales as matching the roles expected from their DSO. Private aggregators only proposed rationales such as trading flexibility (suggesting they are only trusted for this), and only small DSOs proposed to increase self-consumption. However, since increasing self-consumption competes with one of the main expected roles of the DSO (selling energy), as pointed out in [49,60], it might suggest a particularly high degree of trust in DSOs, especially when compared to private aggregators. In fact, small DSOs are small entities, are well-established (thus having a certain history of relationships with end-users), and are public actors, which are all essential characteristics to build trust, while private aggregators are private actors and are emergent [34,59,61]. Building interactional trust requires ensuring that promises are kept, maintaining the end-users' perception of inclusion and being in control. However, efforts needed for this are highly dependent on the context.

The case studies relating to automated devices for which control was already shared (i.e., centralised batteries or centralised HPs) are the only ones that proposed full automation with no opt-out possibility. This might suggest that end-users used to sharing control over their appliances have a lower aversion to losing control, as highlighted in [43]. For devices providing SH or DHW, semi-automation with overriding options was proposed when the case study targeted SCCs or when a private aggregator was operating automation. Conversely, in the case studies including individual consumers and DSOs, informing about flexibility activation (with full automation) was enough to manage the end-users' perception of control and even more if combined with a communication of a higher control in another aspect. This supports that experience of control can be dealt with by only maintaining optimism and by diversion, and the statement exposed above could be summarised by this: "In conditions in which no objective control exists, a person's conviction that control is available is enough. . . " [48]. When case studies proposed to automate EVs and wet appliances, such as dishwashers and washing machines, only semi-automation with deliberate activation of automation was proposed. These observations suggest first that there is a hierarchy of aversion to losing control depending on devices/appliances automated, with wet appliances and EVs at the top and battery and heating systems at the bottom. This supports what was observed in [43]. Secondly, private aggregators are less likely to be trusted, and SCCs need more control than individual consumers.

No case studies provided information to show the contribution of automation to the grid issues. Only private aggregators provided information to prove the environmental contributions, which might suggest that DSOs do need to prove environmental contributions because, first. It is a role that they are expected to meet and, second, because as already suggested above, they are more likely to be trusted compared to private aggregators since ensuring promises is linked to trust, as exposed in Section 2. Many case studies informed about the temperature, but it did not prevent end-users from blaming automation for experiencing discomfort regardless of whether this really occurred or if automation was the effective cause of it. Moreover, ISCO-LEE showed that end-users might be disappointed about monetary savings. Those last observations indicate the need to provide transparency and better inform the end-users to increase consumer support, as stated in [60]. Quartierstrom, before starting, provided an information session for potential end-users to introduce the project as well as the stakeholders' part of it, which could be one explanation for a particularly high opt-in rate and is actually a recommendation for implementing a microgrid [108]. We argue that an information session before even starting the project might be a capital mechanism not only to build trust towards the automation operator but also to manage end-users' expectations by improving transparency.

Encouragements to pursue manual DSM were present in many case studies (especially when those targeted SCCs), but mainly, SCCs were considered for interviews and asked about elements they would like to include in the project. This might be an additional element that suggests that SCCs put more importance into being in control and, more widely, into independency compared to individual consumers.

6.2. Limitations and Future Work

Automated DSM is quite emergent in Switzerland. However, the number of surveys and pilot projects is still limited, and participants are primarily highly enthusiastic and technically literate early adopters of technology. The data analysed in this study were primarily secondary data sourced with the assistance of project proponents. This introduces potential biases to our findings. Furthermore, in the case studies, the level of acceptance reached was not measured, at least in the sense of Boutilier and Thomson (2011). Most field studies reviewed considered acceptance elements such as perception of benefits or influence of control options as secondary elements in their investigation.

As further improvements, we can suggest first to take part in the case studies at the earlier stages in order to be able to define metrics easily comparable among case studies (e.g., percentage of people asked that were ready to opt-in or monetary savings for households). This includes introducing surveys and/or interviews that investigate end-users' perceptions to remove a bias layer (project managers interpretation). This will additionally help to provide equal data access and quality. Finally, another alternative approach could be to include a greater number of cases worldwide that carefully consider the above-mentioned aspects and measured with similar metrics so as to perform a more comparative analysis to provide stronger evidence. Furthermore, we argue that our findings could be strengthened by building a case study centred on the social license concept, which incorporates measures (at different stage of the project) of control, discomfort, trust, benefit perception, and identification with the goals of the project.

7. Conclusions

This study provides an empirical investigation of the emerging concept of the social license to automate (SLA), which is an application of the social license to operate (SLO) in the field of smart grids and demand-side management (DSM). The concept of an SLO has become increasingly important to creating new supply resources for energy. This study has shown the value of the concept, and SLO literature has highlighted that the identification of stakeholders as well as economic legitimacy, socio-political legitimacy, and interactional trust are key elements in building community support. Indeed, these points bridge several elements traditionally considered separately in the literature that focused on acceptance of automated DSM.

We investigated empirical data from eight case studies that trialled automated DSM in Swiss households. Findings showed that recommendations for building consumer support are highly context-dependent, which is defined by which appliances are automated, which actor is operating the automation, and which end-users are targeted. The context has a considerable influence on the appropriate way to communicate the risks, the benefits, and the rationale but also on the appropriate way to manage the end-users' sense of control and the information communicated. Considering these elements, our findings suggest first that individual consumers' understanding of the rationale and hence the benefits of automated DSM will contribute to a safer, cleaner, and cheaper grid as well as that benefiting them is a key factor to engage them in automated DSM projects. For self-consumption communities (SCC), on the other hand, it is a fine balance of accepting that automation will increase their independence despite more control from third parties. Second, our findings suggest that devices producing space heating and domestic hot water as well as those where ownership is shared, distribution system operators (especially when those are small) and low-density areas together form a context in which efforts to acquire a social license are minimised. Therefore, we argue that this is the configuration that policies should concentrate on to build acceptance of automated DSM. We argue that our findings demonstrate the relevance of investigating consumer support of automated DSM through the lens of the social license. We think that this work can help to avoid withdrawal and build acceptance for new and current projects of automated DSM in the residential sector.

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Abbreviations

The following abbreviations are used in this manuscript:

CB	Community battery
DHW	Domestic hot water
DLC	Demand load control
DSM	Demand-side management
DSO	Distribution system operators
EV	Electrical vehicles
HEMS	Home energy management system
HP	Heat pump
IEA	International energy agency
PV	Photovoltaics
RTP	Real time pricing
SCC	Self-consumption community
SH	Space heating
SL	Social license
SLA	Social license to automate
SLO	Social license to operate
TSO	Transmission system operator
TCP	Technology collaboration programme
CSR	Corporate social responsibility

Appendix A

Analytical framework used to compare the project between them.

Appendix A.1. IEA DSM User-Centred Energy Systems TCP—Social License to Automate, Common Template

This template was developed in order to collect information on a number of aspects of running and completed demand-side management projects that are likely to be of relevance regarding end-user acceptance and the granting of a "Social License to Automate". It consists of eight sections:

Please address sections as appropriate for the project in question but try to cover as many of the points as possible. The descriptions at the top of each section can be used to as a guide for more open answers with the detailed questions below to be used as pointers for aspects to be considered.

Appendix A.2. Section 1: Project Details

This section concerns basic information around the project and should be fully completed.

1. Project name:
2. Project lead organization:
3. Project partner organizations:
4. Project funding bodies:
5. Project funding amount:
6. Project start date
7. Project end date:
8. Project website:
9. Contact name:
10. Contact role:
11. Contact email:
12. Project aim:
13. Research focus:
14. Data sharing: possibilities and constraints:
15. Number of cases within study:
16. Case description:
17. Case location (country, city/region):
18. For how long has the automation system been tested?

Appendix A.3. Section 2: Context, Aims, and Framing

This section of the template covers the local starting point including the regional energy system characteristics and the user segment involved, the automation goal, and the involvement of end-users to achieve it. This included the communicated rationale, expectations towards end-users, and opportunities provided for feedback and dialogue.

19. What are the characteristics of the local/regional energy system (including energy mix, status of the grid in the area)?
20. What are the characteristics of the energy users involved?
21. How were end-users recruited?
22. What was the rationale for automation communicated to end-users?
23. What is the purpose of the automation? (i.e., solve distribution grid congestion, transmission grid congestion, grid balancing, minimize network charges, minimize costs at day-ahead-market, maximization of self-consumption, innovation, etc.)
24. What is expected from them in the project?
    a. If this includes a change of energy practices, which practices were changed?
25. Which expectations and benefits are presented to end-users? Were costs and cons communicated as well?

26. Was a sense of fairness and reciprocity established, and if yes, how?
27. Was dialogue with consumers (ways to receive feedback, answer questions, etc.) enabled, and were consumers encouraged to give feedback?
28. Was accountability communicated to end-users, and if yes, how?
29. Which technical components to enable the automation were installed in the houses of clients, and which actor owns them? (i.e., smart meters, smart sensors, smart appliances, smart heating systems, batteries, EV charging systems, etc.)

Appendix A.4. Section 3: Involved Actors and Regulatory Aspects

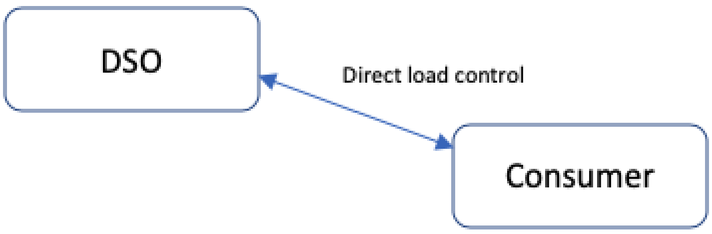
This section of the template covers involved actors, their roles and tasks performed within them, as well as establishment of relationships and interactions between stakeholders. Further addressed are regulatory framework, market framework, and any accountability-related protocols.

30. Who controls automated flexibility activation? (i.e., consumer/prosumer, aggregator/retailer, distribution system operator, etc.)
31. Which actors were involved?
    - Suppliers
    - DSOs
    - TSOs
    - Component manufacturers
    - Regulatory instances/authority
    - Aggregators
    - Other technology providers -> Please be precise:
    - Others: Please be precise
32. Which tasks did each actor performed/currently performs within the project?

Task/Role	Actor
Frequency control	
Congestion management	
Voltage control/regulatory	
Trading flexibility in day-ahead market	
Trading flexibility in intra-day market	
Providing power reserves	
Technology provider	
Other, please specify	
Frequency control	

33. With whom do the actors interact and why?

Option 1: Draw a diagram instead of answering yes or no, and write down the characteristics of the interaction. Example:



Option 2: Example:

Actor 1	Actor2	The Relation
DSO	Consumer	Direct load control
Aggregator	Consumer	Smart meter roll-out

34. How were the relationships between involved stakeholders established, and how are they governed? (i.e., on mutual regard, bilateral contracts, regulatory framework (protocols, etc.), market rules, others, etc.)

35. Briefly describe the regulatory framework for automation projects within the corresponding country context:
36. Briefly describe the market framework (e.g., rules) for automation project within the country context:
37. Are there any rules or protocols that hold energy companies accountable for their mistakes and unjust practices?

Appendix A.5. Section 4: Technical Parameters of Automatization and Impact

This section of the template covers the details of the implemented automation procedures including level of automation, load types to activate, restrictions around activation (frequency and duration), and communication of such restriction to end-users, advance notice of automation activation, and options for end-users to veto such processes. Further addressed is the expected impact of automated processes on end-users.

38. Which loads can be automatically activated? (i.e., in-home battery, community battery, heat pump, e-car, electric boiler, EV charging system, air conditioning, smart appliances, other: please specify)
39. Did you specify a uniform maximum duration per activation? (yes—same value for all participants, no—different values for each participant or choice, no—we did not specify this)
    - What was the maximum duration per activation? (hours)
40. Did you specify a uniform maximum activation frequency? (yes—same value for all participants, no—different values for each participant or choice, no—we did not specify this); If yes:
    - Which units were used to specify maximum activation frequency? (none, activations per year/month/week)
    - What was the maximum frequency using these units? (activations per unit)
41. Did you specify the time window when activations would take place? (yes—same value for all participants, no—different values for each participant or choice, no—we did not specify this)
    - During which time of the day were activations allowed? (please specify all allowed time windows)

Season	Weekday	Hour
Summer/Winter/Anytime	Weekday/weekend/anytime	1,2,...24, anytime

42. Did you specify how many times participants could veto activations? (yes—same value for all participants, no—different values for each participant or choice, no—we did not specify this); if yes:
    - Which units were used to specify maximum veto frequency? (none, vetos per year/month/week)
    - What was the maximum frequency using these units? (activations per unit)
43. Did you specify a minimum advance notice period? (yes—same value for all participants, no—different values for each participant or choice, no—we did not specify this)
    - What was the minimum advance notice period? (hours)
44. What is the automation level? (i.e., manual demand response, manual automation, consensual automation, monitored automation, full automation, etc.)
45. Is a home energy management system involved?
46. How does flexibility activation impact end-users? (Please provide details on fluctuation/availability impact and if measures have been taken to minimize that impact)

Appendix A.6. Section 5: Incentives

This part of the template covers questions surrounding consumer incentives such as if incentives were offered to consumers for initial participation, and if yes, of which type and size as well details on provided incentives for load shifting and the prize signals that served as base (TOU, CPP, RTP, etc.).

47. Was there an incentive for consumers/prosumers for initial program participation? (yes, no)
    - What form of incentive was chosen? (Bonus paid as reduction of monthly bill, shipping voucher, maintenance voucher, discount on purchase of new technologies but also sustainability reasons, curiosity (early adopters), etc.). If the incentive was monetary, how much/what was the value?
    - How high was this incentive?
48. What price signals were used to incentivize load shifting? (None, time of use pricing, critical peak pricing, peak time rebate, real-time pricing, spot market prices, balancing market prices, other: please specify)
49. What was the ratio between the highest price and the average price?
50. What are the overall achievable revenues of flexibility activation (for all stakeholders)? (i.e., EUR/activation, EUR/component/a, EUR/customer/a, % of costs)
51. How are the revenues split between stakeholders?
52. Have there been developed any business cases within the project? If yes, please describe them shortly.

Appendix A.7. Section 6: Information Provision and Data Sharing

This section of the template covers information and data provided to consumers and channels used to do so. This includes reasons for DSM (only to include if not already addressed before/if communicated per automation incident), status and process information, details provided on benefits, information on privacy and security measures, and options to access data.

53. Which information channels are used to communicate with end-users? (i.e., app, online portal, in-home display, alternative ambient display, SMS, e-mail, etc.)
54. Which general information on the automation does the system provide? (automation rationale, automation conditions, general expected benefits)
55. Does the system provide process information to end-users, such as automation status as well as post and planned automation?
56. Does the system provide specific information on gained benefits (e.g., money saved, reduced CO_2-emissions, etc.)
57. Does the system provide information on safety, privacy, and security measures?
58. Where is the consumer data stored and managed? (i.e., completely local, centralised cloud, decentralised cloud/blockchain, etc.)
59. Which consumer data was accessed, and which actors have access to the data?

	Which Actors Have Access to the Data?				
Data	**TSO**	**DSO**	**Aggregator**	**Technology Provider**	**Component Manufacturer**
Power demand (smart meter reading)		X			
Household temperature					
Hot water temperature					
Boiler temperature					
Photovoltaic production					
Battery charging level					
Charging levels of cars					

Appendix A.8. Section 7: End-User Interaction with the Automation System

This section covers questions regarding interaction offers provided to consumers such as if a system interface for end-users exists, forms of engagement implemented including active contacting of end-users, and choices offered to end-users through the system. Any available information regarding the use and evaluation of such interaction offers is of interest.

60. Does automation system provide an interface for end-users?
61. Are consumers actively contacted by the system, and if yes:
    a. For which reasons? (i.e., to inform about flexibility activation, for confirmation/rejection of flexibility activation, to suggest/request manual flexibility, etc.)
    b. How often? (i.e., multiple times a day, once a day, weekly, etc.)
    c. Is a response required?
62. Are end-users actively engaged through the system, and if yes, how? (i.e., self-monitoring and feedback, social comparisons, challenges, cooperation, rewards, etc.)
63. Does the system provide choices to end-users regarding:
    a. Opt-out
    b. Flexibility activation (e.g., interruption or adjustment)
    c. System personalization (e.g., comfort ranges)
    d. Data access
    e. Other
64. If available:
    a. Do end-users use the system actively?
    b. Did any aspects receive positive feedback?
    c. Did any system aspects receive negative feedback?

Appendix A.9. Section 8: Project Results (As Available)

This section of the template collects any information available regarding relevant results of the project. This includes the number of consumers who signed up, achieved flexibilization (in comparison to expected flexibilization), and any acceptance measures that were taken, such as overall satisfaction, specific positive and negative experiences, experiences usefulness and ease of use, and experienced trust. Further covered are if users' lives were experienced as changed, if users would like to continue within the program and why/why not, and any further lessons learned.

65. What were the main project results?
66. What percentage of invited consumers signed up for the project?
67. What was the average peak shifting that was achieved?
68. Was the desired automation outcome (e.g., shifts, peak-shaving) successfully achieved?
69. If acceptance of the system was directly measured:
    a. How was this done?
    b. Which acceptance factors were looked at? (such as usefulness, ease of use, trust, etc.)
    c. What were the results? (if possible, please rate considered acceptance factors on a scale of 1 = very low to 10 = very high in addition to your answer)
70. What has been learned so far?
    a. What was the overall experience of the users? (broadly positive, negative, or mixed)
    b. What are the strengths and weaknesses of the system?
    c. Did it work as expected, and if not, why?
    d. For whom did it work and for whom not?
    e. Other:
71. Has the system changed the users' lives, and if yes, how?
    a. Were energy practices changed?
    b. Were household/workplace dynamics impacted?
    c. Other changes?

72. Would users want to keep the automation after the demo?
    a. Reasons for continuing it:
    b. Reasons for quitting it:

References

1. United Nations. *Paris Agreement*; United Nations: New York, NY, USA, 2015.
2. IRENA. *Global Renewables Outlook: Energy Transformation 2050*; IRENA: Masdar City, United Arab Emirates, 2020; p. 291.
3. Knoeri, C.; Steinberger, J.K.; Roelich, K. End-User Centred Infrastructure Operation: Towards Integrated End-Use Service Delivery. *J. Clean. Prod.* **2016**, *132*, 229–239. [CrossRef]
4. IEA. *UsersTCP 2021 Annual Report*; IEA User-Centred Energy Systems Technology Collaboration Programme: Paris, France, 2022.
5. Sugiyama, M. Climate Change Mitigation and Electrification. *Energy Policy* **2012**, *44*, 464–468. [CrossRef]
6. Tévar, G.; Gómez-Expósito, A.; Arcos-Vargas, A.; Rodríguez-Montañés, M. Influence of Rooftop PV Generation on Net Demand, Losses and Network Congestions: A Case Study. *Int. J. Electr. Power Energy Syst.* **2019**, *106*, 68–86. [CrossRef]
7. Kumar, V.; Pandey, A.S.; Sinha, S.K. Grid Integration and Power Quality Issues of Wind and Solar Energy System: A Review. In Proceedings of the 2016 International Conference on Emerging Trends in Electrical Electronics & Sustainable Energy Systems (ICETEESES), Sultanpur, India, 11–12 March 2016; pp. 71–80.
8. Karimi, M.; Mokhlis, H.; Naidu, K.; Uddin, S.; Bakar, A.H.A. Photovoltaic Penetration Issues and Impacts in Distribution Network–A Review. *Renew. Sustain. Energy Rev.* **2016**, *53*, 594–605. [CrossRef]
9. Guerrero, J.; Gebbran, D.; Mhanna, S.; Chapman, A.C.; Verbič, G. Towards a Transactive Energy System for Integration of Distributed Energy Resources: Home Energy Management, Distributed Optimal Power Flow, and Peer-to-Peer Energy Trading. *Renew. Sustain. Energy Rev.* **2020**, *132*, 110000. [CrossRef]
10. Torriti, J.; Grunewald, P. Demand Response-A Different Form of Distributed Storage? In Proceedings of the 2012 International Conference on Smart Grid Technology, Economics and Policies (SG-TEP), Nuremberg, Germany, 3–4 December 2012; pp. 1–5.
11. Gellings, C.W.; Smith, W.M. Integrating Demand-Side Management into Utility Planning. *Proc. IEEE* **1989**, *77*, 908–918. [CrossRef]
12. Meyabadi, A.F.; Deihimi, M.H. A Review of Demand-Side Management: Reconsidering Theoretical Framework. *Renew. Sustain. Energy Rev.* **2017**, *80*, 367–379. [CrossRef]
13. Schneider, I.; Sunstein, C.R. Behavioral Considerations for Effective Time-Varying Electricity Prices. *Behav. Public Policy* **2017**, *1*, 219–251. [CrossRef]
14. Lund, P.D.; Lindgren, J.; Mikkola, J.; Salpakari, J. Review of Energy System Flexibility Measures to Enable High Levels of Variable Renewable Electricity. *Renew. Sustain. Energy Rev.* **2015**, *45*, 785–807. [CrossRef]
15. Torriti, J. Price-Based Demand Side Management: Assessing the Impacts of Time-of-Use Tariffs on Residential Electricity Demand and Peak Shifting in Northern Italy. *Energy* **2012**, *44*, 576–583. [CrossRef]
16. Torriti, J.; Hassan, M.G.; Leach, M. Demand Response Experience in Europe: Policies, Programmes and Implementation. *Energy* **2010**, *35*, 1575–1583. [CrossRef]
17. Pimm, A.J.; Cockerill, T.T.; Taylor, P.G. Time-of-Use and Time-of-Export Tariffs for Home Batteries: Effects on Low Voltage Distribution Networks. *J. Energy Storage* **2018**, *18*, 447–458. [CrossRef]
18. Faruqui, A.; Sergici, S. Household response to dynamic pricing of electricity—A survey of the experimental evidence. *J. Regul. Econ.* **2010**, *38*, 193–225. [CrossRef]
19. Asadinejad, A. Electricity Market Designs for Demand Response from Residential Customers. Ph.D. Thesis, University of Tennessee, Knoxville, TN, USA, 2017; p. 194.
20. Mathieu, J.L.; Haring, T.; Ledyard, J.O.; Andersson, G. Residential Demand Response Program Design: Engineering and Economic Perspectives. In Proceedings of the 10th International Conference on the European Energy Market (EEM), Stockholm, Sweden, 27–31 May 2013; pp. 1–8.
21. Finn, P.; Fitzpatrick, C.; Connolly, D. Demand Side Management of Electric Car Charging: Benefits for Consumer and Grid. *Energy* **2012**, *42*, 358–363. [CrossRef]
22. Ballo, I.F. Imagining Energy Futures: Sociotechnical Imaginaries of the Future Smart Grid in Norway. *Energy Res. Soc. Sci.* **2015**, *9*, 9–20. [CrossRef]
23. Goulden, M.; Spence, A.; Wardman, J.; Leygue, C. Differentiating 'the User' in DSR: Developing Demand Side Response in Advanced Economies. *Energy Policy* **2018**, *122*, 176–185. [CrossRef]
24. EPRI. *The Green Grid: Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid*; EPRI: Palo Alto, CA, USA, 2008.
25. Stenner, K.; Frederiks, E.R.; Hobman, E.V.; Cook, S. Willingness to Participate in Direct Load Control: The Role of Consumer Distrust. *Appl. Energy* **2017**, *189*, 76–88. [CrossRef]
26. Murtagh, N.; Gatersleben, B.; Uzzell, D. A Qualitative Study of Perspectives on Household and Societal Impacts of Demand Response. *Technol. Anal. Strateg. Manag.* **2014**, *26*, 1131–1143. [CrossRef]
27. Park, C.-K.; Kim, H.-J.; Kim, Y.-S. A Study of Factors Enhancing Smart Grid Consumer Engagement. *Energy Policy* **2014**, *72*, 211–218. [CrossRef]
28. Shove, E.; Cass, N. *Time, Practices and Energy Demand: Implications for Flexibility*; Lancaster University Management School: Lancaster, UK, 2018; p. 14.

29. Breedveld, K. The Double Myth of Flexibilization: Trends in Scattered Work Hours, and Differences in Time-Sovereignty. *Time Soc.* **1998**, *7*, 129–143. [CrossRef]
30. Blue, S.; Shove, E.; Forman, P. Conceptualising Flexibility: Challenging Representations of Time and Society in the Energy Sector. *Time Soc.* **2020**, *29*, 923–944. [CrossRef]
31. Soland, M.; Loosli, S.; Koch, J.; Christ, O. Acceptance among Residential Electricity Consumers Regarding Scenarios of a Transformed Energy System in Switzerland—A Focus Group Study. *Energy Effic.* **2018**, *11*, 1673–1688. [CrossRef]
32. Christensen, T.H.; Friis, F. Materiality and Automation of Household Practices: Experiences from a Danish Time Shifting Trial. In Proceedings of the Demand Centre Conference 2016, Lancaster, UK, 13–15 April 2016; p. 10.
33. Lackes, R.; Siepermann, M.; Vetter, G. Turn It on!-User Acceptance of Direct Load Control and Load Shifting of Home Appliances. In Proceedings of the Twenty-Sixth European Conference on Information Systems (ECIS2018), Portsmouth, UK, 23–28 June 2018; p. 19.
34. Kubli, M.; Loock, M.; Wüstenhagen, R. The Flexible Prosumer: Measuring the Willingness to Co-Create Distributed Flexibility. *Energy Policy* **2018**, *114*, 540–548. [CrossRef]
35. Annala, S.; Viljainen, S.; Tuunanen, J. Demand Response from Residential Customers' Perspective. In Proceedings of the 9th International Conference on the European Energy Market, Florence, Italy, 10–12 May 2012; pp. 1–7.
36. Vossebein, A.; Muster, S.M.; Betschart, U.; Kölliker, B. *Studie «Potential Demand Side Management in Der Schweiz»*; Bundestamt für Energie BFE: Bern, Switzerland, 2019.
37. Anderson, B. Laundry, Energy and Time: Insights from 20 Years of Time-Use Diary Data in the United Kingdom. *Energy Res. Soc. Sci.* **2016**, *22*, 125–136. [CrossRef]
38. Fischer, D.; Madani, H. On Heat Pumps in Smart Grids: A Review. *Renew. Sustain. Energy Rev.* **2017**, *70*, 342–357. [CrossRef]
39. Masy, G.; Georges, E.; Verhelst, C.; Lemort, V.; André, P. Smart Grid Energy Flexible Buildings through the Use of Heat Pumps and Building Thermal Mass as Energy Storage in the Belgian Context. *Sci. Technol. Built Environ.* **2015**, *21*, 800–811. [CrossRef]
40. Metz, M.; Doetsch, C. Electric Vehicles as Flexible Loads—A Simulation Approach Using Empirical Mobility Data. *Energy* **2012**, *48*, 369–374. [CrossRef]
41. Zhang, R.; Cheng, X.; Yang, L. Flexible Energy Management Protocol for Cooperative EV-to-EV Charging. *IEEE Trans. Intell. Transport. Syst.* **2019**, *20*, 172–184. [CrossRef]
42. Tan, Z.; Yang, P.; Nehorai, A. An Optimal and Distributed Demand Response Strategy With Electric Vehicles in the Smart Grid. *IEEE Trans. Smart Grid* **2014**, *5*, 861–869. [CrossRef]
43. Yilmaz, S.; Xu, X.; Cabrera, D.; Chanez, C.; Cuony, P.; Patel, M.K. Analysis of Demand-Side Response Preferences Regarding Electricity Tariffs and Direct Load Control: Key Findings from a Swiss Survey. *Energy* **2020**, *212*, 118712. [CrossRef]
44. Ramírez-Mendiola, J.L.; Grünewald, P.; Eyre, N. Linking Intra-Day Variations in Residential Electricity Demand Loads to Consumers' Activities: What's Missing? *Energy Build.* **2018**, *161*, 63–71. [CrossRef]
45. Beckel, C.; Sadamori, L.; Staake, T.; Santini, S. Revealing Household Characteristics from Smart Meter Data. *Energy* **2014**, *78*, 397–410. [CrossRef]
46. Sankar, L.; Rajagopalan, S.R.; Mohajer, S.; Poor, H.V. Smart Meter Privacy: A Theoretical Framework. *IEEE Trans. Smart Grid* **2013**, *4*, 837–846. [CrossRef]
47. McKenna, E.; Richardson, I.; Thomson, M. Smart Meter Data: Balancing Consumer Privacy Concerns with Legitimate Applications. *Energy Policy* **2012**, *41*, 807–814. [CrossRef]
48. Skinner, E.A. A Guide to Constucts of Control. *J. Personal. Soc. Psychol.* **1996**, *71*, 549–570. [CrossRef]
49. Fell, M.J.; Shipworth, D.; Huebner, G.M.; Elwell, C.A. Exploring Perceived Control in Domestic Electricity Demand-Side Response. *Technol. Anal. Strateg. Manag.* **2014**, *26*, 1118–1130. [CrossRef]
50. Xu, X.; Chen, C.; Zhu, X.; Hu, Q. Promoting Acceptance of Direct Load Control Programs in the United States: Financial Incentive versus Control Option. *Energy* **2018**, *147*, 1278–1287. [CrossRef]
51. Pidgeon, P.N.; Whitmarsh, D.L. *Transforming the UK Energy System: Public Values, Attitudes and Acceptability*; UK Energy Research Center: London, UK, 2013; p. 48.
52. Mert, W.; Suschek-Berger, J.; Tritthart, W. Consumer Acceptance of Smart Appliances. *Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)*. 2008, pp. 1–46. Available online: https://www.ifz.at/sites/default/files/2021-02/D5_5-Consumer%20acceptance.pdf (accessed on 12 October 2022).
53. Moser, C. The Role of Perceived Control over Appliances in the Acceptance of Electricity Load-Shifting Programmes. *Energy Effic.* **2017**, *10*, 1115–1127. [CrossRef]
54. Rodden, T.A.; Fischer, J.E.; Pantidi, N.; Bachour, K.; Moran, S. At Home with Agents: Exploring Attitudes towards Future Smart Energy Infrastructures. *Sustain. Energy* **2013**, 1173–1182.
55. Huijts, N.M.A.; Molin, E.J.E.; Steg, L. Psychological Factors Influencing Sustainable Energy Technology Acceptance: A Review-Based Comprehensive Framework. *Renew. Sustain. Energy Rev.* **2012**, *16*, 525–531. [CrossRef]
56. Karjalainen, S. Should It Be Automatic or Manual—The Occupant's Perspective on the Design of Domestic Control Systems. *Energy Build.* **2013**, *65*, 119–126. [CrossRef]
57. European Commission. *The Social Dimension of Smart Grids: Consumer, Community, Society*; Joint Research Centre, Institute for Energy and Transport: Luxembourg, 2013.
58. Stern, S.M. Smart-Grid: Technology and the Psychology of Environmental Behavior Change. *Chic.-Kent Law Rev.* **2011**, *86*, 23.

59. Ted Luor, T.; Lu, H.-P.; Yu, H.; Lu, Y. Exploring the Critical Quality Attributes and Models of Smart Homes. *Maturitas* **2015**, *82*, 377–386. [CrossRef]
60. Balta-Ozkan, N.; Davidson, R.; Bicket, M.; Whitmarsh, L. Social Barriers to the Adoption of Smart Homes. *Energy Policy* **2013**, *63*, 363–374. [CrossRef]
61. Mumford, J.; Gray, D. Consumer Engagement in Alternative Energy—Can the Regulators and Suppliers Be Trusted? *Energy Policy* **2010**, *38*, 2664–2671. [CrossRef]
62. Fell, M.J.; Shipworth, D.; Huebner, G.M.; Elwell, C.A. Public Acceptability of Domestic Demand-Side Response in Great Britain: The Role of Automation and Direct Load Control. *Energy Res. Soc. Sci.* **2015**, *9*, 72–84. [CrossRef]
63. Hargreaves, T.; Nye, M.; Burgess, J. Making Energy Visible: A Qualitative Field Study of How Householders Interact with Feedback from Smart Energy Monitors. *Energy Policy* **2010**, *38*, 6111–6119. [CrossRef]
64. Gamma, K.; Loock, M.; Cometta, C. *Paying for Flexibility: Increasing Customer Participation in Demand Response Programs through Rewards and Punishments*; Said Business School: Oxford, UK, 2014.
65. Gamma, K.; Mai, R.; Cometta, C.; Loock, M. Engaging Customers in Demand Response Programs: The Role of Reward and Punishment in Customer Adoption in Switzerland. *Energy Res. Soc. Sci.* **2021**, *74*, 101927. [CrossRef]
66. Cooney, J. Reflections on the 20th Anniversary of the Term 'Social Licence'. *J. Energy Nat. Resour. Law* **2017**, *35*, 197–200. [CrossRef]
67. Gunningham, N.; Kagan, R.A.; Thornton, D. Social License and Environmental Protection: Why Businesses Go Beyond Compliance. *Law Soc. Inq.* **2004**, *29*, 307–341. [CrossRef]
68. Edwards, P.; Lacey, J. Can't Climb the Trees Anymore: Social Licence to Operate, Bioenergy and Whole Stump Removal in Sweden. *Soc. Epistemol.* **2014**, *28*, 239–257. [CrossRef]
69. Hall, N.L. Can the "Social Licence to Operate" Concept Enhance Engagement and Increase Acceptance of Renewable Energy? A Case Study of Wind Farms in Australia. *Soc. Epistemol.* **2014**, *28*, 219–238. [CrossRef]
70. Carr-Cornish, S.; Romanach, L. *Exploring Community Views toward Geothermal Energy Technology in Australia*; CSIRO: Canberra, Australia, 2012; p. 22.
71. Corvellec, H. Arguing for a License to Operate: The Case of the Swedish Wind Power Industry. *Corp. Comm. Int.* **2007**, *12*, 129–144. [CrossRef]
72. Hall, N.; Lacey, J.; Carr-Cornish, S.; Dowd, A.-M. Social Licence to Operate: Understanding How a Concept Has Been Translated into Practice in Energy Industries. *J. Clean. Prod.* **2015**, *86*, 301–310. [CrossRef]
73. Boutilier, R.G.; Thomson, I. *Modelling and Measuring the Social License to Operate: Fruits of a Dialogue between Theory and Practice*; Center for Social Responsibiltiy in Mining; University of Queensland: Brisbane, Australia, 2011.
74. Moffat, K.; Lacey, J.; Zhang, A.; Leipold, S. The Social Licence to Operate: A Critical Review. *Forestry* **2016**, *89*, 477–488. [CrossRef]
75. Prno, J. An Analysis of Factors Leading to the Establishment of a Social Licence to Operate in the Mining Industry. *Resour. Policy* **2013**, *38*, 577–590. [CrossRef]
76. van Putten, I.E.; Cvitanovic, C.; Fulton, E.; Lacey, J.; Kelly, R. The Emergence of Social Licence Necessitates Reforms in Environmental Regulation. *Ecol. Soc.* **2018**, *23*, art24. [CrossRef]
77. Boutilier, R.G. A Measure of the Social License to Operate for Infrastructure and Extractive Projects. *SSRN* **2017**, *3204005*, 1–17. [CrossRef]
78. Conrad, J. The Social License to Operate and Social Contract Theory-Themes and Relations of Two Concepts–A Literature Analysis. Ph.D. Thesis, University of Iceland, Reykjavík, Iceland, 2018.
79. Nelsen, J.; Scoble, M. *Social License to Operate Mines: Issues of Situational Analysis and Process*; Departement of Mining Engineering, University of British Columbia: Vancouver, Canada, 2006; p. 22.
80. Thomson, I.; Boutilier, R.; Black, L. The Social License to Operate: Normative Elements and Metrics. In Proceedings of the First International Seminar on Social Responsibility in Mining, Santiago, Chile, 19–21 October 2011; p. 20.
81. Kuch, D.D.; Ellem, D.G.; Bahnisch, D.M.; Webb, S. *Social License and Communications Report*; Centre for Social Research in Energy and Resources, University of Newcastle: Newcastle, UK, 2013; p. 32.
82. Parsons, R.; Moffat, K. Constructing the Meaning of Social Licence. *Soc. Epistemol.* **2014**, *28*, 340–363. [CrossRef]
83. Wilburn, K.M.; Wilburn, R. Achieving Social License to Operate Using Stakeholder Theory. *J. Int. Bus. Ethics* **2011**, *4*, 3–16.
84. Parsons, R.; Lacey, J.; Moffat, K. Maintaining Legitimacy of a Contested Practice: How the Minerals Industry Understands Its 'Social Licence to Operate'. *Resour. Policy* **2014**, *41*, 83–90. [CrossRef]
85. Barich, A.; Stokłosa, A.W.; Hildebrand, J.; Elíasson, O.; Medgyes, T.; Quinonez, G.; Casillas, A.C.; Fernandez, I. Social License to Operate in Geothermal Energy. *Energies* **2021**, *15*, 139. [CrossRef]
86. Boutilier, R.G. Frequently Asked Questions about the Social Licence to Operate. *Impact Assess. Proj. Apprais.* **2014**, *32*, 263–272. [CrossRef]
87. Sovacool, B.K.; Axsen, J.; Sorrell, S. Promoting Novelty, Rigor, and Style in Energy Social Science: Towards Codes of Practice for Appropriate Methods and Research Design. *Energy Res. Soc. Sci.* **2018**, *45*, 12–42. [CrossRef]
88. Adams, S.; Diamond, L.; Esterl, T.; Fröhlich, P.; Ghotge, R.; Hemm, R.; Henriksen, I.M.; Katzeff, C.; Kuch, D.; Michellod, J.L.; et al. *Social License to Automate: Emerging Approaches to Demand Side Management*; IEA User-Centred Energy Systems Technology Collaboration Programme: Paris, France, 2021.
89. Ableitner, L. User Behavior in a Real-World Peer-to-Peer Electricity Market. *Appl. Energy* **2020**, *270*, 115061. [CrossRef]

90. Ableitner, L.; Bättig, I.; Beglinger, N.; Brenzikofer, A.; Carle, G.; Dürr, C.; Meeuw, A.; Proll, S.; Rosatzin, C.; Schopfer, S.; et al. *Schlussbericht: Community Energy Network with Prosumer Focus: Quartierstrom*; BFE: Bern, Switzerland, 2020.
91. Imhof, P.; Suter, A. *Schlussbericht: WarmUp Phase 3 Optimale Verwertung der Flexibilität von Thermischen Speichern*; BFE: Bern, Switzerland, 2018; p. 44.
92. Pfaffen, S.; Werlen, K. *Schlussbericht: WarmUp Phase 2 Pilotversuch zur Optimalen Verwertung der Flexibilität von Thermischen Speichern*; BFE: Bern, Switzerland, 2016; p. 69.
93. Pfaffen, S.; Werlen, K. *Schlussbericht: WarmUp Phase 1 Optimale Verwertung Der Flexibilität von Thermi-Schen Speichern*; BFE: Bern, Switzerland, 2013; p. 51.
94. Koller, M. *Eigenverbrauchsoptimierung in MFH Über Innovative Strombörse*; Fachhochschule Nordwestschweiz FHNW.; University of Applied Sciences FHNW: Windisch, Switzerland, 2017.
95. Zogg, D.; Gysin, H.; Zimmerli, D. *Schlussbericht: Innovative Eigenverbrauchsoptimierung Für Mehrfamilien-Arealüberbauung Mit Lokaler Strombörse in Möriken-Wildegg-Phase I: Inbetriebnahme Und Erste Messperiode*; BFE: Bern, Switzerland, 2020.
96. Zogg, D. Win-Win-Situation Für Alle Beteiligten. *HK-Gebäudetechnik* **2017**, *10–17*, 64–66.
97. Pierre, F.; Dervey, S.; Darbellay, G.; Barras, D.; Gabioud, D.; Roduit, P. *GOFLEX_D8.1_Requirement and Prosumer Analysis-Use Case 2 (Switzerland)*; The Innovation and Networks Executive Agency (INEA) and the European Comission (EC): Sion, Switzerland, 2017; p. 25.
98. Moix, P.-O.; Roduit, P. *GOFLEX_D8.2_Business Model Design and KPI Definition Switzerland-Use Case 2 (Switzerland)*; The Innovation and Networks Executive Agency (INEA) and the European Comission (EC): Sion, Switzerland, 2017; p. 81.
99. Barras, L.; Dervey, S.; Ferrez, P.; Forclaz, D.; Gabioud, D.; Gubler, O.; Pignat, M.; Roduit, P.; Moix, P.-O. *GOFLEX_D8.3_ Report on the System Prototype Implemented in the Field-Use Case 2 (Switzerland)*; the Innovation and Networks Executive Agency (INEA) and the European Comission (EC): Sion, Switzerland, 2018; p. 77.
100. Sidqi, Y.; Dervey, S.; Tauxe, D.; Udressy, M.-H.; Ferrez, P.; Gabioud, D.; Roduit, P.; Largey, G. *GOFLEX_D8.4_ Report on Demonstration Results Evaluation-Use Case 2 (Switzerland)*; the Innovation and Networks Executive Agency (INEA) and the European Comission (EC): Sion, Switzerland, 2020; p. 63.
101. Yilmaz, S.; Cuony, P.; Chanez, C. Prioritize Your Heat Pump or Electric Vehicle? Analysing Design Preferences for Direct Load Control Programmes in Swiss Households. *Energy Res. Soc. Sci.* **2021**, *82*, 102319. [CrossRef]
102. Yilmaz, S.; Chanez, C.; Cuony, P.; Patel, M.K. Analysing Utility-Based Direct Load Control Programmes for Heat Pumps and Electric Vehicles Considering Customer Segmentation. *Energy Policy* **2022**, *164*, 112900. [CrossRef]
103. Rivola, D.; Medici, V.; Nespoli, L.; Strepparava, D.; Rosato, F.; Maayan Tardif, J.; Buddhika Heendeniya, C.; Salani, M.; Corbellini, G.; Rossi, P. *LIC Project: Annual Report 2021*; BFE: Bern, Switzerland, 2021; p. 24.
104. Geidl, M.; Arnoux, B.; Plaisted, T.; Dufour, S. A Fully Operational Virtual Energy Storage Network Providing Flexibility for the Power System. In Proceedings of the 12th IEA Heat Pump Conference, Rotterdam, The Netherlands, 15–18 May 2017; p. 12.
105. Broman Toft, M.; Schuitema, G.; Thøgersen, J. Responsible Technology Acceptance: Model Development and Application to Consumer Acceptance of Smart Grid Technology. *Appl. Energy* **2014**, *134*, 392–400. [CrossRef]
106. Broman Toft, M.; Schuitema, G.; Thøgersen, J. The Importance of Framing for Consumer Acceptance of the Smart Grid: A Comparative Study of Denmark, Norway and Switzerland. *Energy Res. Soc. Sci.* **2014**, *3*, 113–123. [CrossRef]
107. Darby, S.J.; McKenna, E. Social Implications of Residential Demand Response in Cool Temperate Climates. *Energy Policy* **2012**, *49*, 759–769. [CrossRef]
108. Alvial-Palavicino, C.; Garrido-Echeverría, N.; Jiménez-Estévez, G.; Reyes, L.; Palma-Behnke, R. A Methodology for Community Engagement in the Introduction of Renewable Based Smart Microgrid. *Energy Sustain. Dev.* **2011**, *15*, 314–323. [CrossRef]