*local **E**lectricity retail **M**arkets for **P**rosumer smart grid p**OWER** services*

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Executive summary

Here we report from four acceptance studies which were conducted to help understand and incorporate demand-based factors into the design of EMPOWER business models. As such, D2.3. complements the work that has been done in the EMPOWER project so far (in particular D2.1-2, and WP5, WP6, WP7, WP8 and WP9), which has mostly incorporated a supply-based perspective, and provides a demand-based-perspective for the final refinement of the EMPOWER-related products, services, and business models. Overall, the acceptance studies in this report confirm the existence of broad market potential for the EMPOWER concept. However, it also appears that competing solutions are already emerging on the market which should be integrated into the EMPOWER business models. It also appears that the EMPOWER ecosystem needs to become more efficient with regard to sales and business deployment once the project ends.

The first acceptance study investigates prosumers' willingness to provide flexibility. Based on this study it is suggested that the EMPOWER technology integrates a higher degree of automatization than initially foreseen. The second acceptance study, a broad multi-country research project, investigates prosumer preferences in Spain, Germany, Norway and Switzerland. It appears that prosumer preferences differ across countries and segments. These differences should be considered in the refinement of EMPOWER business models in different local settings, with important implications. The third acceptance-related study reveals the preferences of energy cooperative members. While EMPOWER is of value to energy cooperatives if it supports them offering their own, co-created electricity tariffs, the energy cooperative business model requires a low-cost and low-software solution to be attractive to this audience. The fourth acceptance study looks at managerial acceptance and provides a road map for tracking down European company partners in the energy industry that are potentially interested in buying and implementing EMPOWER. An analysis of the different EMPOWER partner business models and the EMPOWER ecosystem in which the partners co-operate has identified important opportunities for optimizing partner-level deployment. Overall, the report provides detailed insights for EMPOWER business models, and a road map for the go-to-market. Moreover, it has distinct implications for the remaining active work-packages in EMPOWER. The multi-country study has been designed in a format that supports external communication, and is attached as a pdf in the appendix. The other studies were prepared for publication in leading energy and innovation journals.

1 Work towards D2.3

1.1 Ongoing work in EMPOWER

Three salient aspects of the work ongoing in EMPOWER find consideration in D2.3. First, advances in WP5 (software development) and WP7 (implementation and testing at the pilot-site) provide novel learning outcomes and refinement of the EMPOWER concept. For instance, management at the pilot sites in Germany and Malta appears to be fundamentally different to that of Norway. While this was anticipated to a certain degree, it also appears that, for example, the distinct requirements of some energy cooperatives (e.g. BESH in Wolpertshausen, Germany), will make special demands on the EMPOWER business model if it is to be accepted among German energy cooperatives.

Second, the ongoing work with exploitation and dissemination (WP8) and communication (WP9) has created novel learning outcomes that D2.3. should consider. For instance, in D2.1. and D.2.2. the business model composer-tool, containing a novel seminar concept and an EMPOWER case study were developed, both of which facilitate interaction with energy managers and future energy managers. Through such dialogue, stakeholders in workshops and seminars now provide much more detailed and focused input for the further development of EMPOWER-based business models. Additionally, it appears that the concept of local power markets is now finding greater acceptance in the business context. A stakeholder workshop during the *St. Gallen Forum for the Management or Renewable Energy* in May 2017 demonstrated the novel positive attitude of over thirty executives towards the EMPOWER concept. Moreover, the competitors that we are monitoring (as described in the EMPOWER case study database; see D2.1 and D2.2.) are increasingly refining their offerings towards local power markets. This market feedback now signals more precise expectations towards EMPOWER, a situation that is also reflected on in this report and the complementary activities of dissemination and business development in WP8.

Finally, the further development of the EMPOWER software, and the progress that has been made with the initial EMPOWER offerings (one landmark event was the successful Factory Acceptance Test of the eSmart System software on June 23, 2017 in Halden) now makes it feasible to test in more detail the market acceptance of some features of the EMPOWER concept. Such novel opportunities support this report's investigation of the acceptance of EMPOWER business models, and help with collecting customer and prosumer feedback for the purpose of refining and improving these offerings.

Overall, D2.3. integrates the important inputs from the other operating WPs (WP5, 7, 8 and 9) and builds on the EMPOWER business model foundations that were outlined in D2.1. and D2.2., and in the market design specifics that are described in WP6.

D2.3. involves taking further steps towards developing the foundational EMPOWER business models (D2.1. and D2.2) so that they are successful in terms of dissemination (WP8). As regards to this objective, the present report describes four large and ambitious acceptance studies with prosumers, which are presented in detail in the following chapters. All of the acceptance studies will be also published in different formats - partly in research publications, and partly in a report for practitioners (WP9). In addition to these four surveys, D2.3. processes monitoring data that is collected from the EMPOWER case study business models (involving thirty-one companies which have recently been complemented by blockchain-centred business models that use a competing technological solution to the EMPOWER approach, and which require that EMPOWER develop a strategy for integration or differentiation). Also – in tandem with work in WP8 – senior managers of the EMPOWER partners were interviewed, as their input will have important implications for the further refinement of the EMPOWER partner business models and their organization in an EMPOWER ecosystem.

D2.3. will impact the dissemination activities (WP8) of EMPOWER in an important way, and support further engagement of EMPOWER partners beyond the end of the core project period.

1.2 Goal of Deliverable 2.3

The main objective of Deliverable 2.3 and Deliverable D2.3. is to carry out a broad study of the social acceptance of the EMPOWER concept. As already acknowledged in the DOA, social acceptance is crucial for the diffusion of smart grid technology (Wolsink, 2012). In particular, business models are likely to affect whether and how prosumers accept a given technology, and how they employ it. Despite this fact, many research and innovation projects go no further than the development of technology, without testing for social acceptance, and without refining the related technology and business models based on feedback about their acceptance. The activity of D2.3., however, strongly differentiates EMPOWER from other projects, as EMPOWER puts significant emphasis

on understanding social acceptance and making refinements that are suggested by the demand-side.

Tasks conducted under 2.3 include running different experiments with a predefined choice of salient prosumers to test the acceptance of different business models and business model features that were developed within EMPOWER prior to T2.3. Tasks T2.1 and T2.2 propose a set of generic business models, but we assume that not all business models are accepted by prosumers (or groups of prosumers) in the same way. Moreover, we also assume that certain business models fit different prosumer segments better (worse). Tasks 2.3 elaborates on this assumption.

Work in D2.3. has been conducted through accomplishing different sub-tasks:

In ST2.3.1 we extracted single components of the ideal-type business models or services to be tested, and considered how the testing should be organized. Within this task, we specified the distinct surveys that were conducted in T2.3. Important inputs for this task include the work of WP6 and WP8 and WP7. Based on this input, four different acceptance studies were developed:

- Survey “T2.3. A”: This is an individual-level acceptance study, in the form of conjoint experimental research. The study explores the willingness to provide flexibility of prosumers with different technological set-ups (e.g. PV, heat pumps, and electric vehicles). It explores how different technological set-ups determine prosumers’ willingness to provide flexibility, and thus to participate in EMPOWER-based business models. Insights from Survey “T2.3.A” provide input for ST2.3.4 which reworked the EMPOWER business models to heighten prosumer acceptance, as examined through the survey “T2.3.A”. Based on the results of this survey and the respective business model re-design/ optimization in ST2.3.4, the implications also apply to the phase of exploitation (WP8).
- Survey “T2.3. B”: This is an organizational-level acceptance study that examines the drivers involved in the acceptance of the EMPOWER concept among managers and companies. The study identifies the drivers and signalling factors of utility companies that are relevant to the EMPOWER concept. The results provide input for ST2.3.4, and especially to the re-design of the DSO local business model that was developed in D2.2. Based on the results of this survey and the respective business model re-design/ optimization in ST2.3.4, implications also apply to the phase of exploitation (WP8).

- Survey “T2.3. C1”: This is an individual-level acceptance study similar to the research into stakeholder preferences during the pilot phase. We refer to this study as the multi-country study. Under investigation here are the different values that prosumers in different countries (Norway, Germany, Switzerland, and Malta) assign to EMPOWER. In particular, we investigate the importance of economic, environmental, technical/innovation, regional/community, functional and emotional values that people may assign to EMPOWER. We explore how different socio-demographic characteristics (e.g. country, etc.) explain differences in the values that people assign to EMPOWER. This survey processes input from WP8 that has revealed the idiosyncratic values that people in Norway assign to EMPOWER (e.g. high value awarded to state-of-the-art technology), which contrasts with what was reported by WP7 during the German pilot study to be an important driver (high value awarded to local and regional attributes). The results provide input for ST2.3.4 and especially the re-design of the Our Power business model that has been developed in D2.2. Based on the results of this survey and the respective business model re-design/optimization in ST2.3.4, implications also apply to the exploitation phase (WP8).
- Survey “T2.3.C2”: This is an individual-level acceptance study that investigates preferences at the pilot-site in Wolpertshausen, Germany, and in particular energy cooperatives. This is also a conjoint-based survey. The study identifies the drivers of prosumers who are part of energy cooperatives, and investigates how these individuals can be attracted by the EMPOWER concept. The results provide input for ST2.3.4 and especially the re-design of the DSO local business model that has been developed in D2.2. Based on the results of this survey and the respective business model re-design/optimization in ST2.3.4, implications also apply to exploitation (WP8).

In what follows, we present each of the acceptance studies in a single chapter that provides detailed insight into how to increase prosumer acceptance of EMPOWER, how to optimize business models and services, and what changes and modifications are required for the EMPOWER concept to be successful.

In ST2.3.2 we identified the salient stakeholders, hence the distinction between the individuals who were surveyed. The salient stakeholders were determined as: senior managers of EMPOWER stakeholder organizations; prosumers at pilot sites; individuals that are similar to prosumers at pilot sites; local utility companies; and, energy

cooperatives. The primary task is to identify the salient stakeholders more precisely and recruit them for participation in the four different acceptance studies (T2.3.1A-C2).

ST2.3.3 involved testing the single components of ideal-type business models or services, and basically covered the management and implementation of the surveys (Survey T.2.3.A-C2). Based on the surveys we map the preferences for EMPOWER services and business models from the perspective of the most salient stakeholders. For each of the four surveys, we also provide one map of preferences, and create a strategy simulation relating to how to optimize prosumer preferences. Each of these four strategies provide input for ST2.3.4.

In ST2.3.4 we processed the results of the acceptance study and depict the consequences for EMPOWER business modelling. To achieve this goal we have also complemented the surveys with an in-depth analysis of the perspectives of senior business development managers of the EMPOWER project (the interviews for this purpose were conducted in cooperation with WP8) and the cooperation and business ambitions of EMPOWER partners in the EMPOWER ecosystem. The data about acceptance have significantly helped refine the EMPOWER business models and distinct dissemination activities. As such, important implications for the go-to-market of the EMPOWER business models, as well as details about other important features (e.g. pricing) are clarified.

1.3 Acceptance studies and data sources for this report

The acceptance studies described in this report are grounded in rich data and allow us to clearly describe the salient acceptance-related features of the EMPOWER concept.

- Survey A: involving reports from 2408 choices that were collected from 301 prosumers in Switzerland. The survey provides a clear overview of the fundamental drivers of prosumers' willingness to provide flexibility. The study suggests that EMPOWER needs to integrate more automated services, because prosumers with PV-battery-systems assign little importance to flexibility. Comparisons and contrasts are clarified in relation to different types of prosumers.
- Study B: involving results of an analysis of an initial sample of 200 European companies, which was later narrowed down (because of data availability issues) to a final sample of 47 companies, from which 388 documents were analysed with data derived from approximately 950 pages (920 printed pages of text with 366542 words, and 30 pages of financial statements). This study applied a heuristic approach to

identifying potential partners and utility companies that may be attracted by the EMPOWER concept.

- Survey C1: involving reports from a multi-country study in Norway, Germany, Spain and Switzerland that surveyed 830 respondents from four countries and collected data using 38 questions and more than 100 items. The questionnaire was translated into five European languages (German, French, Norwegian, Spanish, and English), and the results include detailed suggestions about how to modify the EMPOWER business models (e.g. prices) across countries. A further important finding is that the age of the target groups has a significant impact on what EMPOWER features are considered valuable on the demand-side.
- Survey C2: involving reports from a conjoint experiment in which 160 choices of 20 members of German energy cooperatives revealed their preferences. This study helped in the creation of detailed suggestions concerning how to design a business model to target energy cooperatives. Important findings include that this requires a low-cost-software solution, involves high shares of self-prosumption, that the role of ICT-services should be downplayed, and that the offering should be coupled with sustainability attributes.

The survey data was complemented by 500+ pages of workshop and course materials on EMPOWER business modelling, 120+ pages of interview transcripts with EMPOWER executives, 31 core EMPOWER company cases and an additional 6 novel case studies, and 5 student theses. Implications for the partner business models were generated, and the EMPOWER ecosystem was shaped to comply with the distinct roles the different partners will have in the exploitation of the EMPOWER potential. Beyond the results presented in this report, data is subject to ongoing analysis.

1.4 Structure of this deliverable

The deliverable is structured as follows: First, we establish the theoretical foundations that indicate the importance of using acceptance studies in matching supply- and demand-side value perceptions. We then report on the different acceptance studies (as the multi-country study was prepared in a report-based format to facilitate dissemination, we only provide a short summary of it in the word text format below and refer to the whole study as a pdf in the appendix). We then depict the EMPOWER ecosystem and specify the partner business models and the distinct approaches to dealing with them in terms of dissemination. We conclude by outlining the important implications of D2.3. for

EMPOWER business models, the business models of the EMPOWER partners, and the commercial dissemination of EMPOWER and the specific role of all partners in the EMPOWER ecosystem. The appendix lists the academic papers that contain important contributions towards D2.3. The papers are also part of the work undertaken in D2.3., and are available on request.

2 Foundations

Many of the EMPOWER partners have a technical background. The partner survey conducted in WP8 demonstrated how partners with a technical background differ with regard to what they find important within EMPOWER compared to individuals with a business background (who also consider demand-based issues and customer expectations important). The acceptance studies described in this report (D2.3.) were designed to identify the way to balance technology-driven supply-side and customer focused demand side-value propositions. This chapter outlines some of the theoretical contributions for the acceptance-centered view that has been found to be essential in the deployment of sustainable energy technologies (Wüstenhagen, Wolsink, & Bürer, 2007) and especially for the commercialization of smart-grid-related products and services (Curtius, Künzel, & Loock, 2012).

2.1 Matching supply- and demand-side value perceptions

The acceptance studies in this report operate under the assumption that it is important to match supply-side value perceptions and demand-side value perceptions. Demand-side value perceptions are the value perceptions of suppliers that develop and offer products and services. According to the EMPOWER concept, for instance, an eSmart System can supply software products and services that enable prosumers to become local power traders. Additionally, Smart Energi is the supplier of all the components and services for establishing the SESP. The supply-side perception is thus that these products and services are of value and will find a market (or customers). The supply-side value perception guides the development of products and services and helps indicate the type and amount of investment that should be made into development. It integrates supply-side assumptions about what kind of functionality the EMPOWER-system should have (also partly based on input from WP6), how the distinct features should be designed

(e.g. what the FLEX app should look like), and what prices the system and the components should have (e.g. Smart Energi has already developed a detailed price list for single components). However, supply-side assumptions and value perceptions may not be correct. Figure 1 compares the value perceptions of the supply-side with the demand-side.

Figure 1: Different scenarios in matching supply- and demand-based value perceptions

Five different scenarios become apparent. According to the "optimal" scenario, supply-side value perceptions match exactly demand-side value perceptions. That is, customers assign the same value to products and services that the supply side has developed. In such an optimal scenario, success with exploitation and market diffusion is likely. Under the "over-priced" scenario, the supply side assigns a higher value to products and services than the demand-side. However, the demand-side perceives a level of value over a critical level of acceptance (the minimum value that is required for either the supply side or the demand side to become active). Under the "over-priced" scenario the supply-side is required either to drive down costs and prices, or work on increasing the value perception of the demand-side (e.g. based on value bundling, or educating and convincing customers how much more valuable the products and services are). In the "under-priced" scenario, the demand-side perceives that products and services have a higher value, and suppliers may be able to increase prices. The "over-priced" and "under-priced" scenario are both less efficient compared to the optimal scenario, but can both generally work because the critical perception of value passes some threshold from the perspective of both the supply- and the demand-side. More critical are the "over-developed" or "under-developed" scenarios in which either the demand-side or the supply-side do not evaluate products and services at above a critical level of acceptance.

Whereas the “over-developed” scenario suggests instances in which products and services were developed for which there are no customers, the “under-developed” scenario indicates market potential that no supplier is yet tapping into.

While within the EMPOWER project concept the supply-side is well covered, and products and services have already been developed, the ambition of this acceptance-related deliverable (D2.3.) is to incorporate demand-side value perceptions. In order to create the perfect fit between supply- and demand-based value perceptions, it is important that demand-based acceptance levels and the value that customers assign different EMPOWER-based products and services are measured and understood. It is also important to note that these value perceptions differ with regard to customer segments and national markets.

While the acceptance studies described in this report reveal some opportunities for improving business models and the related product and service offerings, it will also become apparent that some market segments are more challenging compared to others in regard to the uptake of the current EMPOWER concept (e.g. it currently appears that, for energy cooperative members, a cloud-based IT solution might be an overreach). Implications apply to the further exploitation of EMPOWER and the refinement of EMPOWER-related products and services (see the ‘exploitation pathways’ which are developed in WP8).

2.2 Design elements of EMPOWER business models

From a business model perspective, different design elements can be adjusted to match supply- and demand-side value perceptions. Table 1 gives an overview of a selection of salient design elements for the DSOlocal business model and the ourPower business model (both business models were developed and introduced in D2.2). Within the course of the EMPOWER project, different approaches to the design elements were developed. WP5 has specified value configuration features such as the software and user interface. Additionally, the required hardware was specified (WP7) and integrated into the software architecture (WP5). However, in the effort to match supply and demand-based perspectives the designs are only a first hypothesis that will be further tested with regard to demand-side acceptance. This deliverable and the respective acceptance studies are the first attempt at such a demand-based test.

Business model dimensions	**DSOlocal business models** (utility-centered)	**ourPOWER business model** (energy-cooperative-centered)

Value proposition	**Enabling a prosumer community and power-sharing:** products and services that are required so that members of a local community become prosumers and start sharing power at the local level **Community power tariff:** a tariff that incentivizes the local community to increase self-consumption, but also supplies power reserve	**Energy cooperative as a prosumer:** products and services that are required so that energy cooperatives not only produce power, but can also become consumers of "their own" electricity **Energy cooperative electricity tariff**: an electricity tariff offered by the energy cooperative.
Value configuration	**User interface:** An application that gives prosumers access to "their" local power market and helps them engage in monitoring, trading, billing and related services. **Technology (Hard- and Software):** A bundle of hardware and software that is required to set-up the local power market and integrate it into utility and gird operations. **SESP:** A set of contracts and services that are required to set-up and run the local power market	**User interface**: An application that gives energy cooperative management and members access to their community prosumption features **Technology (Hard- and Software)**: A bundle of hardware and software that is required for EMPOWER energy cooperatives to also become prosumers **SESP**: A set of contracts and services that are required to run an energy cooperative as a prosumer, and supply reserve power.
Monetization	**Software-as-a-service fees:** Fees for software usage. **Hardware sales:** Hardware that prosumers buy to participate in local power markets (e.g. PV modules, meters, controllers, readers, etc.) • **Reserve power surplus:** price premium for additional or reserve power supply	**Software-as-a-service fees:** Fees for software usage. **Hardware sales:** Hardware that the energy cooperative buys to become a prosumer. **Reserve power surplus:** price premium for additional or reserve power supply
Example	Smart Energi	BESH tariff

Table 1: Design elements of the two EMPOWER business models

However, competitors have also been active during the course of the EMPOWER project – some have already started to bring EMPOWER-related technology to the market (such as tiko´s customer interface for prosumption and flexibility provision)[1]. tiko and other companies are also processing market-feedback from their product and software development and integrating this into their solutions. Ongoing and detailed competitor analysis thus also provides a source of indirect-learning and complements the acceptance studies described in this report with regard to capturing demand-based value perceptions.

Important interface design features that are of value from the demand-side perspective can be seen from a comparison of the EMPOWER Smart Flex App and the customer interface by tiko. While supply-side features might be sufficiently provided by both apps,

[1] tiko is one of the business models in the EMPOWER case study data-base which the EMOWER project is following

it is apparent that tiko is more efficiently accommodating requests from the demand-side as concerns layout (more modern and elegant), functionality (more focused and limited to what prosumers really require) and availability (the App is easily available on the App store and Google Play). Figure 2 provides an overview of the apps.

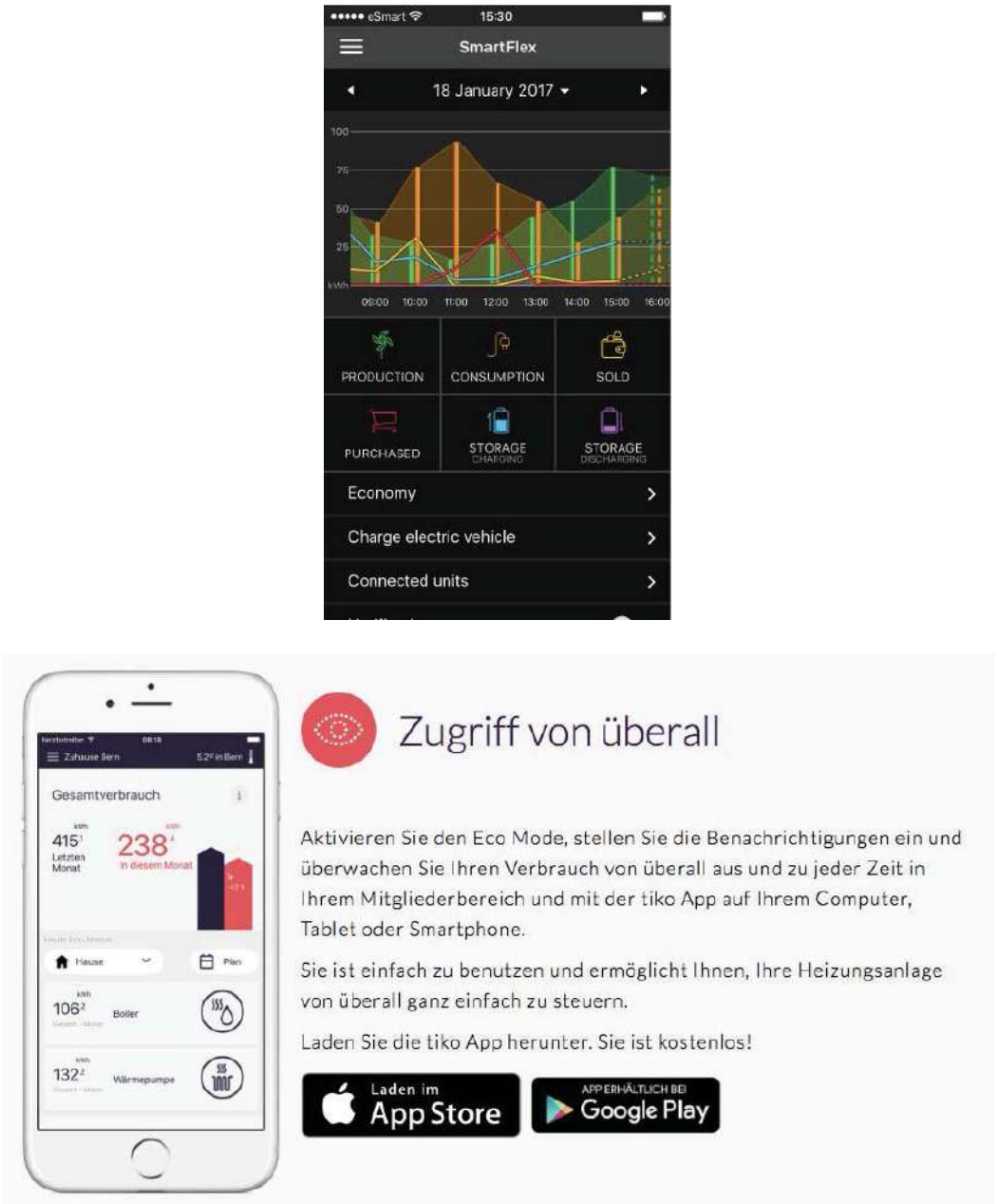

Figure 2: Smart Flex App (EMPOWER) vs. tiko app (https://tiko.ch/page/product_power/)

3 Prosumer willingness to provide flexibility

It is one of the central assumptions of the EMPOWER framework that prosumers are willing to take on a more active role in the power market. While many studies suggest that this is true, the EMPOWER concept centres around novel, flexibility-centered business models. D2.1. and D2.2. have developed some of the foundations of flexibility-centered business models, and a research paper on the same topic has been published in *Energy Policy*, the leading journal for energy-related innovation and policy (Helms, Loock, & Bohnsack, 2016). However, although interviews with prosumers from a pilot project in Norway (Hvaler) suggested that prosumers show flexibility about energy-related consumption patterns, what the antecedents and the nature of prosumer willingness to provide flexibility actually are has so far not been tested.

3.1 What drives prosumer willingness to provide flexibility?

In the first of the four acceptance studies, we reached out to 301 prosumers to investigate willingness to provide flexibility. The EMPOWER-related study (with prosumers that have, or are interested in having a PV-battery-system) was complemented by two further studies from related projects (the *HeatReserves* project examined flexibility based on the use of heat pumps, and another project investigated flexibility in a vehicle-to-grid context based on the storage capacity of electric vehicles). We first present the results of the EMPOWER study and then put it into perspective with the aforementioned studies. For publication purposes, the three co-authored independent studies by Merla Kubli, Rolf Wüstenhagen and Moritz Loock were grouped together. A first conference paper was presented at the International Association of Energy Economics and is now in preparation for submission to Energy Policy (the conference paper and the forthcoming journal paper are available on request from moritz.loock@unisg.ch).

In the EMPOWER acceptance study we investigated willingness to co-create flexibility based on PV-battery systems. A combination of solar PV and batteries (e.g. as provided by sonnen.de, a business model in the EMPOWER case study collection and which was analyzed in detail in T2.1 and T2.2.) enables prosumers to be active agents in EMPOWER market design (see DOA and WP6 deliverables). To investigate the willingness to provide flexibility of PV-battery-prosumers, we modeled a choice situation using the following focal question:

Imagine your utility company makes you the following offers in relation to contracting use of a battery as a supplement to your photovoltaic power plant. The battery would be installed in your basement. Monthly electricity costs would cover all your electricity needs, except for those already covered by direct self-consumption of your own photovoltaic electricity. We assume that your monthly electricity need is 375 kWh and you can cover about 30% of this with your photovoltaic power plant. The offers can only be distinguished based on the named attributes. Which offer would you choose?

The flexibility attribute defines the share of self-consumed PV electricity and the extent to which data is transmitted to the utility company. Here, we should explain and justify how we developed the flexibility attribute so that it fits this particular context. Table 2 shows the flexibility attribute and the different levels used in this acceptance-related study.

Super Flex	**Flex Medium**	**Flex Light**	**No Flex**
30% PV Self-Consumption; consumption data transmitted and used for forecasting	45% PV Self-Consumption; consumption data transmitted	60% PV Self-Consumption; only data about battery charging level transmitted	75% PV Self-Consumption; no data transmission

Table 2: Flexibility attributes for prosumers with solar batteries

Three hundred and one individuals participated in this study. Participants were drawn from a sample provider (market research company). Table 3 provides an overview of the sample.

	PV	**%**
Qualified	301	
Male	183	61%
Female	117	39%
Average Age	51.4	
PV - Owner (on my roof)	176	59%
PV - Interested	124	41%

Urban	72	24%
Agglomeration	167	56%
Rural	61	20%
Average Household Size	2.49	
Rental flat	71	24%
Rental house	9	3%
Own Flat	36	12%
Own House	183	61%

Table 3: Details of prosumer-willingness-to-provide flexibility study sample

The questionnaire was constructed and data analysis conducted using the Sawtooth software package, which is the standard software for this kind of acceptance study (a conjoint study). The results of this acceptance study are as follows: part-worth utilities were measured from the data generated by 301 participants through 2408 choice tasks[2]: The attribute "monthly electricity costs" was the second most important attribute based on the following levels (part-worth utilities): 110 CHF (-72.5), 90 CHF (-5.0), 70 CHF (30.0), 50 CHF (47.6). Use of flexibility was the least important attribute based on the following levels (part-worth utilities): SuperFlex (-14.9), MediumFlex (-7.5), LightFlex (6.8) and NoFlex (15.6). Electricity mix was the most important attribute based on the following levels (part-worth utilities): Uncertified electricity (-97.8), Nuclear Electricity (-74.6), Hydro Electricity (71.8) and Solar electricity (100.6). Contract duration was ranked the third most important attribute based on the following levels (part-worth utilities): 4 years (-25.9), 2 years (-1.5), 1 year (2.5) and always cancellable (25.0). Figure 3 displays the stated importance of the attributes.

[2] The method used to calculate the utility values is a standard procedure and is outlined in the technical paper in more detail. The part-worth utility indicates the average value of each tariff component to respondents.

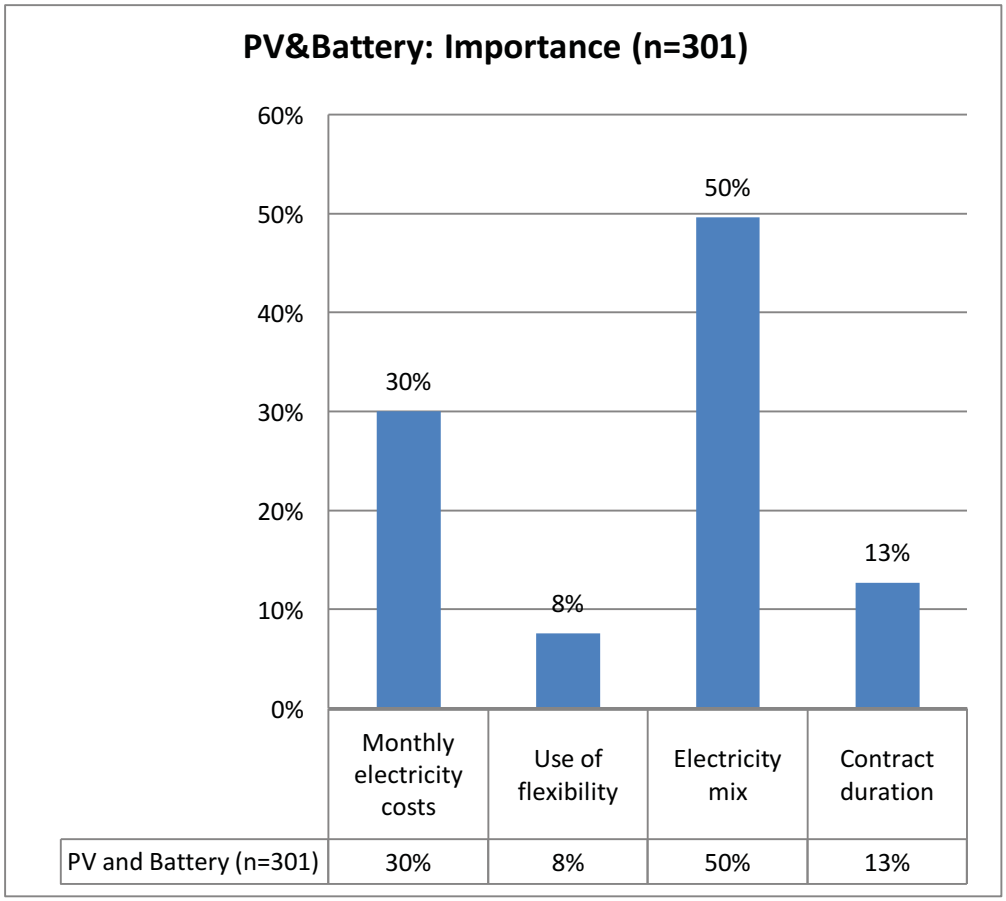

Figure 3: Importance of attributes for prosumers - solar batteries

The sample was split between actual prosumers (prosumers that already own a PV-battery system) and interested prosumers (prosumers that are interested in owning a PV-battery system). Table 4 displays the part-worth utilities for the different levels of the attributes: overall, and for the two sub-samples.

Attributes	Levels	PV and Battery overall, qualified (n=301)	PV Owners (N=176)	PV Interested (N=124)
Monthly electricity costs	110 CHF	-72.5	-63.9	-84.1
	90 CHF	-5.0	-5.0	-4.0
	70 CHF	30.0	26.3	33.5
	50 CHF	47.6	42.5	54.6
Use of flexibility	SuperFlex	-14.9	-10.1	-16.1
	MediumFlex	-7.5	-9.2	-6.4
	LightFlex	6.8	6.6	6.1
	NoFlex	15.6	12.7	16.4
Electricity mix	Uncertified electricity	-97.8	-107.3	-82.4
	Nuclear electricity	-74.6	-85.8	-81.3
	Hydro electricity	71.8	79.4	72.1
	Solar electricity	100.6	113.6	91.7
Contract duration	4 years	-25.9	-26.7	-28.6
	2 years	-1.5	-0.5	0.0

	1 year	2.5	4.1	2.5
	always cancellable	25.0	23.2	26.1

Table 4: Utilities of prosumers' willingness to provide flexibility

Figure 4 puts the EMPOWER acceptance study in relation to accompanying acceptance studies with prosumers that offered flexibility by operating a different technological system (heat pumps and electric vehicles). The figure has been drawn from a working paper by Kubli, Loock & Wüstenhagen (available on request). It appears that the preferences of PV-battery prosumers for flexibility is similar to the preferences of owners of an electric vehicle, but different to flexibility co-creation based on heat pumps and heat reserves. This finding suggests extending the EMPOWER concept to include vehicle-to-grid approaches, and integrating e-mobility solutions.

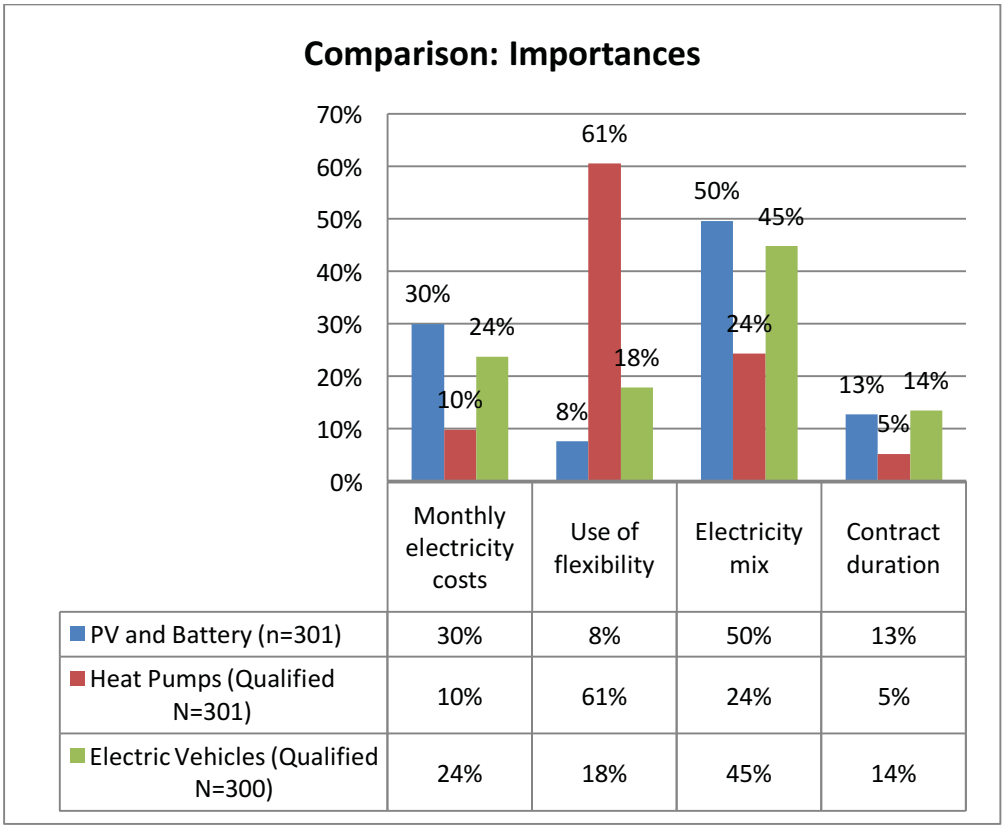

Figure 4: Comparison of importance findings with similar studies

What are the implications for EMPOWER-based business models?

This acceptance study finds that, in comparison to other features, prosumers with a PV battery system do not assign much importance to flexibility. The electricity mix (what kind

of electricity is used) and the cost of electricity are of higher importance for prosumers. This has the following important implications for EMPOWER business models:

First, the low importance awarded the flexibility attribute represents both a challenge and an opportunity for EMPOWER business models. It is a challenge as it indicates that it may be difficult to engage prosumers by actually providing flexibility. As of now, the use and provision of flexibility is not of high interest to prosumers. However, as consumers also seem to assign only little value to the use of flexibility, this is also an opportunity for flexibility use to be automated. Automated services can manage and steer prosumer flexibility, but in return for taking advantage of such flexibility, prosumers will not require significant remuneration. Due to this finding, it is advisable to increase automation in the EMPOWER-prosumer interface.

Second, prosumers with a PV battery system assign high importance to the electricity mix. It thus appears advisable to couple the EMPOWER concept with the energy mix. Basically, as already outlined in D2.1. and D2.2. and WP6, EMPOWER supports the provision of local energy. If local energy becomes another option in the electricity mix (alongside alternatives such as cheap electricity, or green electricity) this may increase prosumer acceptance.

Finally, one important attribute is the cost of electricity. If EMPOWER-related products and services can be linked to a reduction in cost, this would drive prosumer acceptance. However, for the current EMPOWER solution this is a challenge, as the implementation of the system generates additional costs. An opportunity may emerge if CO2 costs are also incorporated.

4 Cross-country study

4.1 How do prosumer preferences towards local energy market features differ across countries?

To study cross-country acceptance of EMPOWER products and services and related value, we conducted a large survey with 830 respondents from four countries. The results presented in this study are based on a survey, conducted in four countries, and with a representative sample of respondents, as follows: in Switzerland (total respondents: 210 – 99 female and 111 male); in Norway (total respondents: 211 – 118 female and 93 male); in Spain (total respondents: 203 – 103 female and 100 male); in Germany (total respondents: 206 – 119 female and 87 male).

The data were collected between May 2017 and June 2017 by respondi AG in Switzerland, Spain and Germany, and by Norstat in Norway. The data is balanced across the four countries; it is representative of gender (53% female respondents), and of living area (rural 39%; sub-urban 32%; urban 29%). Respondents are at least co-responsible for the financial concerns of the household. A survey sample constitutes a snapshot of the total population at a selected point in time. It is important to note that the sample for respondents of this study may be considered representative in some key dimensions, as highlighted previously, but may be considered over-/underrepresented in others. For instance, the respondents selected for the study met at least one of four conditions: 1). They owned a renewable energy installation (e.g. solar panel, heat pump, wind, biomass, battery), 2). They owned an electric vehicle, 3). They had gathered information on at least one of the renewable energy installations within the last 12 months, or 4). They had gathered information on electric vehicles within the last 12 months. For this reason, the respondents may be considered to be rather familiar with themes related to renewable energy and/ or electric vehicles. Furthermore, 88% of the respondents owned at least a flat or a house (95% in Germany; 94% in Switzerland; 84% in Norway and 80% in Spain) at the time of the survey. The average age of the respondents was 36 years (34 years in Germany; 37 years in Switzerland; 33 years in Norway; 40 years in Spain; that is, the sample incorporates a slightly older population from Spain. However, the analyses did not show any significant differences in the results reported herein regarding age).

4.1 How do prosumer preferences towards local energy market features differ across countries?

In order to facilitate dissemination of this acceptance study, we opted for a pdf layout. The full document and the results are part of D2.3 and are presented in the appendix. Here we only provide an executive summary of the report.

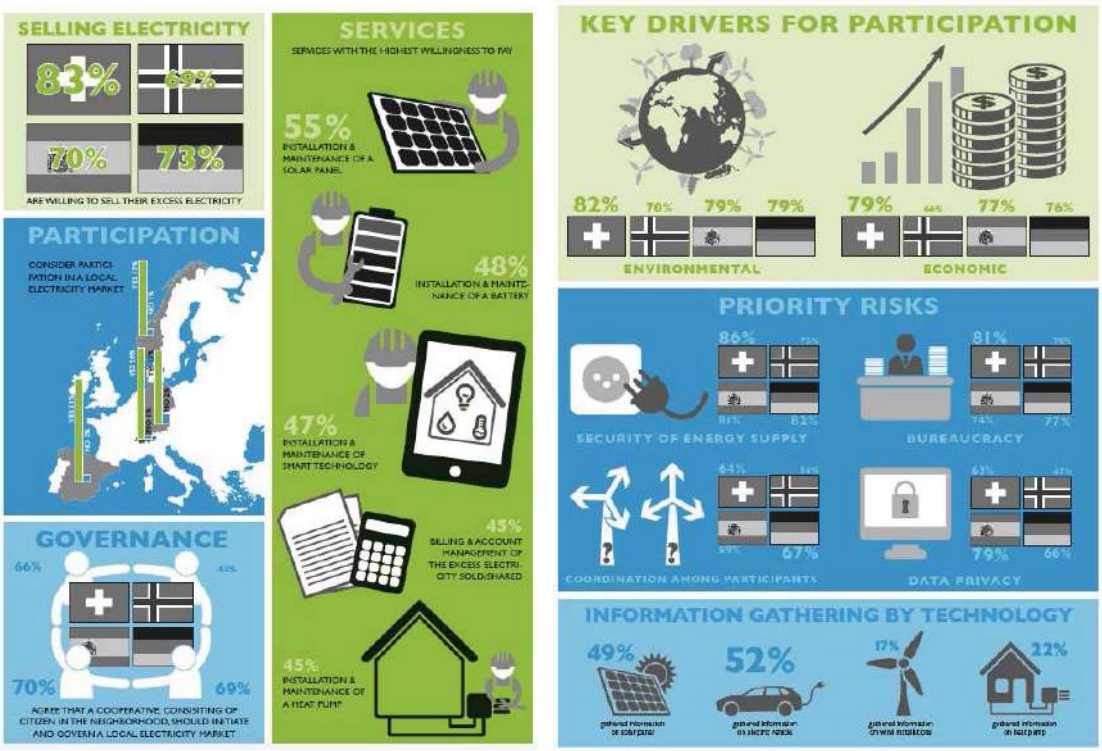

Figure 5: Executive summary of the cross-country acceptance study

Overall, it appears that across countries, the acceptance and willingness to participate in the local energy market is high. This indicates good overall market prospects for the EMPOWER concept. Prosumers welcome governance at the local, community level and are relatively open to using EMPOWER-related services. Key drivers for participation are environmental values (hence, the implementation of EMPOWER should help in the diffusion and accommodation of a large share of renewable energy that reduces CO2 emissions) and economic considerations. Of significant concern to prosumers is the risk related to the security of energy supply. A detailed and more in-depth review of the results presented here can be found in the appendix.

4.2 What are the implications for cross-European dissemination and business model design?

Important implications for the business model design arise relate to customer segmentation, marketing strategy, design, governance, and risks. For each of these we are able to suggest a priority agenda for action.

Customer segmentation: Citizens with high technology status (that is, with extensive technological equipment) in the household, who are younger, and have high energy knowledge/consciousness constitute the client segment with the greatest market potential for local electricity markets. Prospective customers may be more likely to participate through using solar panels (in particular, in Switzerland and Germany), smart technologies (in particular, in Switzerland, Spain, and Germany) and electric vehicles (Spain and Norway), than with heat pumps and wind technologies (except for in Norway).

Priority agenda for action: Target ideal-type customer segments: 1. interest in/ ownership of solar panels, 2. interest in/ownership of electric vehicles, 3. interest in/ownership of smart technologies, 4. interest in/ownership of wind (for Norway). These ideal-type segments are correlated to the country of origin of prospective clients. Electric vehicles are one of the technologies of greatest interest to customers, although respondents appear to be less aware of the market potential of storage capacities, thus there is a need to sensitize and inform prospective customers about the market potential of storage capacity. To attract customers with electric vehicles, inform and develop the density of charging station networks in the home country, provide information about the safety of electric vehicles, and provide information about repair and maintenance costs over the vehicle lifecycle (repair and maintenance costs are generally lower for electric vehicles).

Marketing strategy: Prospective clients share pro-environmental, economic, technological/infrastructural and political/ independence-related reasons for participating in local electricity markets. Prospective clients share risk concerns regarding the security of energy supply, bureaucracy, data privacy, and high levels of coordination among participants in local electricity markets. Both the energy knowledge/consciousness and the technology affinity of respondents tend to predict their willingness to participate in local electricity markets, as well as their interest in related technological applications.

Priority agenda for action: Target marketing strategies at prospective customers by defining clear customer segments. Pro-environmental, economic,

technological/infrastructural and political/ independence-related arguments should be included in any marketing strategy aimed at promoting local electricity markets. Develop ideal-type marketing strategies that center around: 1. Pro-environmental arguments, 2. Economic arguments, 3. Technology/infrastructure-related arguments, 4. Political/independence-related arguments for participation. Marketing strategies can, on the one hand, build on prospective clients' knowledge about energy, on their level of technology-related knowledge in general, or both, when outlining the specificities of local electricity markets. In order to capture novel market potential for local electricity markets, marketing strategies should be designed to attract higher shares of females in Switzerland, and of males in Norway. The market potential of storage capacity should be highlighted (particularly in Germany and Spain). The local origin of electricity, as well as its benefits for the local community need to be highlighted when marketing a local electricity market.

Design: In Switzerland, the preference for selling is greater than the preference for sharing. In Germany and Spain, preferences for participating with electricity (rather than storage capacity) irrespective of the desire to sell or share are higher. Findings suggest that respondents from Spain and Switzerland may be more willing to use and consume products than to offer products or services in the sharing economy. Market efficiency and the balance between the number of buyers and sellers in the market may strongly vary across countries.

Priority agenda for action: In Switzerland, platforms that enable sharing may be less densely adopted than platforms that allow for the selling of locally produced electricity. Local electricity markets should clearly differentiate themselves from the existing "energy cooperative" models by enabling real-time trading of electricity and storage capacity. The storage capacities of electric vehicles should become a critical marketing element of local electricity markets. In Germany and Spain, the market for storage capacity may be less intensively adopted than in Switzerland and Norway. Develop strategies to handle differences in the balance between the number of buyers and sellers in the market, when designing local electricity markets. Ensure high levels of digitalization in back-office processes in order to avoid coordination efforts among participants and high levels of bureaucracy. Innovative applications are particularly well suited to attracting the attention of younger citizen for electricity markets, and for electricity themes more generally. They represent a way of fostering energy consciousness and energy-related knowledge in a playful manner.

Governance: When designing the governance structure of local electricity markets, local and neighbourhood features (e.g. local origin of electricity; cooperative, governed by citizen in the neighborhood) are critical.

Priority agenda for action: Form cooperatives with local citizens (or citizens of the wider region) to initiate and govern local electricity markets. However, given that respondents are less willing themselves to be actively involved in cooperatives, it is important to ensure the commitment of selected local citizens. Alternatively, allocate the governance to a third party. Platforms like Airbnb or Uber are good examples of models whereby buyers and sellers connect via a platform that is hosted and governed by the founding company.

Risks: Security of energy supply should be guaranteed in local electricity markets, while bureaucracy and excessive coordination among participants should be avoided. While data constitute a particularly valuable asset in the design of ancillary or personalized energy services, data privacy is of particularly high concern for respondents from Spain.

Priority agenda for action: Local electricity market providers should cooperate with local electricity providers to develop solutions that respond to breaks in energy supply (e.g. insurance for energy supply, which may be charged at a premium). Digitalize back-office processes such as billing and account management, and relegate them under the control of a third-party service provider. Data privacy rules and regulations should be adapted to the local, national context. (Personalized) ancillary services should be offered in line with customers' privacy needs. Let participants consciously opt-in to such services.

5 Energy cooperative study

One of the generic business models that was developed for EMPOWER is the ourPower business model which targets energy cooperatives and enables their members to not only produce electricity, but also to consume the self-produced electricity. This study investigates the acceptance of such a business model to understand the levers for optimization.

In the database for the EMPOWER business models, important developments were made by the Dutch provider Vandenbron that should be considered in the ourPower business model. The design of the customer interface and the visualization of production assets represent benchmarks that should be appraised and which can be considered best in class.

Figure 6: Vandenbron visualization and functionality source: https://vandebron.nl/

To help prepare the acceptance survey, an initial meeting took place on February 28, 2017 in Wolpertshausen, with Arne Henn (NewEn), and Emma Reuter and Moritz Loock (UNISG). During the meeting, initial knowledge about local contingencies and the energy cooperative in Wolpertshausen (www.besh.de) was generated. It also became apparent that the EMPOWER concept which was developed with strong partners in Norway and which is under the strong influence of the local utility perspective (FEN) should be adapted and transposed to meet local needs in Germany and the particular needs of energy cooperatives such as BESH. For instance, the discussions in the initial meeting

and reflections on the learning outcomes from the pilot site in Wolpertshausen showed that members of the energy cooperative (mostly farmers) might be hesitant to assign value to software- and cloud-based service solutions. For instance, the micro-services of establishing and managing contracts between local producers and consumers of electricity (a central premise in the EMPOWER market design; see WP6) appeared only to be of heuristic value for members of energy cooperatives. One important piece of feedback from a cooperative representative was that, instead of a software-solution, a simple certificate issued by the TÜV would suffice. Such a certificate could indicate that a certain degree of self-consumption would be achievable within the technical infrastructure of the grid architecture of the pilot region. This finding was an important input for acceptance studies that are geared to identifying the demand-based value that the EMPOWER framework offers energy cooperative members. The acceptance study was designed based on this input.

5.1 What are preferences of energy cooperative members for EMPOWER?

Next to on-site input, further preparation and pre-study were conducted to understand what the preferences of energy cooperative members are for EMPOWER. Accordingly, five student groups worked with energy cooperatives over the course of four months to learn how the latter are interested in EMPOWER, and what distinct opportunities may arise for further developing energy cooperatives based on the EMPOWER concept.

The student groups worked together with following energy cooperatives: Bürger Energie Region Regensburg eG, and Bürger-Energie Bodensee eG (both in Germany) and energy cooperative Oberegg, Energiegenossenschaft Roggwil, and Solargenossenschaft Bichwil (Switzerland). The cooperative effort led to an increase in attention towards the EMPOWER project, and received broad recognition, such as articles in the local press (e.g.

ttp://www.suedkurier.de/region/kreis-konstanz/stockach/Student-stellt-Zukunftsvision-fuer-den-Energiemarkt-vor;art372461,9312862)

The pre-study with energy cooperatives in Wolpertshausen, Regensburg, Konstanz, Roggwil, Bichwil and Obergg helped in the preparation of the specific offering that can be developed based on the EMPOWER concept. In addition, it revealed the profound role of decentralized storage and suggested the need to urgently integrate storage solutions into the EMPOWER framework. It further showed how energy cooperatives can

either integrate with local utilities or even take over some of their existing services. For instance, active super-prosumers in energy cooperatives can supply more passive energy cooperative members with electricity. Overall, all forms of collaboration indicated the high level of interest of energy cooperatives in the EMPOWER concept and its prospects of facilitating presumption at the local community level. However, it also became apparent that energy cooperatives should be approached with different business models than those that target utilities.

In essence, it appeared that energy cooperatives might be attracted by the idea of offering their own electricity tariff that would allow members to buy locally produced electricity (or "Our power", as the tariff may be named). Different attributes are important components of this: First, the degree of coverage of locally produced electricity. While it is desirable to achieve 100% coverage, cooperation with energy cooperatives showed how difficult it is to achieve this high level of coverage. The second factor is the price of locally produced electricity. Prices in different European countries differ quite considerably (http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Electricity_prices,_second_half_of_year,_2014-2016_(EUR_per_kWh)_YB17.png). The acceptance study of energy cooperative relates to the German pilot site, we performed a price comparison around Wolpertshausen to determine acceptable levels of prices. Third, the EMPOWER system requires additional hardware (see the Smart Energi hardware list and prices). Similar offerings from companies in the EMPOWER case study also involve charging for hardware (e.g. tiko), thus based on the prices we have compiled the additional costs and linked the hardware prices to the duration of contracts. Cloud-based software architecture is a novel service for prosumers as concerns opportunities for visualization and the channel through which energy data can be monitored and steered. These services were integrated into the study to understand what kind of additional value they offer from the demand-based perspective. Finally, we incorporated an attribute about the certification procedure that certifies that the power that is consumed has been produced from a local-source. The EMPOWER offering, which is IT-based, competes with non-smart traditional ways of certification (such as certification by TÜV). Table 5 displays the different attributes and levels that were considered in the acceptance study.

Attribute	**Level**
Level of local electricity	100% cooperative electricity 60% cooperative electricity 30% cooperative electricity
Price (electricity)**	25 Cent / kWh 27 Cent / kWh 29 Cent / kWh

	31 Cent / kWh
Price (hardware)*	0 EUR (3-year contract) 100 EUR (1-year contract) 200 EUR (flexible contract)
Visualization	monthly daily in real-time
Channel	on utility bill on utility bill and online portal on utility bill, online portal and App
Certificate	none TÜV certificate Sustainability certificate Software-based certificate

Table 5: Attributes and levels in the energy cooperative study

Energy Cooperative members were presented with a choice situation in which they were required to answer the following question: Which of the following three options would you choose for the “our power” tariff, in which scenario the energy cooperative offers to buy its own electricity? The research methodology we employed was choice-based conjoint analysis, as provided through the Sawtooth software package. For the technical background and the specifics of the approach, and details about the software, we refer to the Sawtooth technical papers, as this method is well established and widely used (www.sawtooth.com).

Sixty-five members of energy cooperatives participated in the study, and we processed data from 160 choices that were provided in eight choice tasks (with three options and six attributes in each of the options) by twenty respondents who filled out the complete survey. The study is explorative in nature, and gives the first valuable insights into the acceptance and required modification of the EMPOWER offering for energy cooperatives.

It is important to note that some respondents declined to take part in the survey, as they were already participating in a competing scheme provided by Bürgerwerke eG in Heidelberg (https://buergerwerke.de/). This was important feedback, as it showed how important it is to consider and integrate pre-existing market approaches to the EMPOWER framework (it appears that EMPOWER offers an opportunity to improve the offering of buergerwerke.de; this finding was transferred to WP8 and integrated into the exploitation efforts).

Figure 7 displays the main results of the acceptance study, comparing the importance of the different attributes. Self-consumption and electricity price are the most two important

features for energy cooperatives. Visualization and novel channels are only of limited value to energy cooperative members.

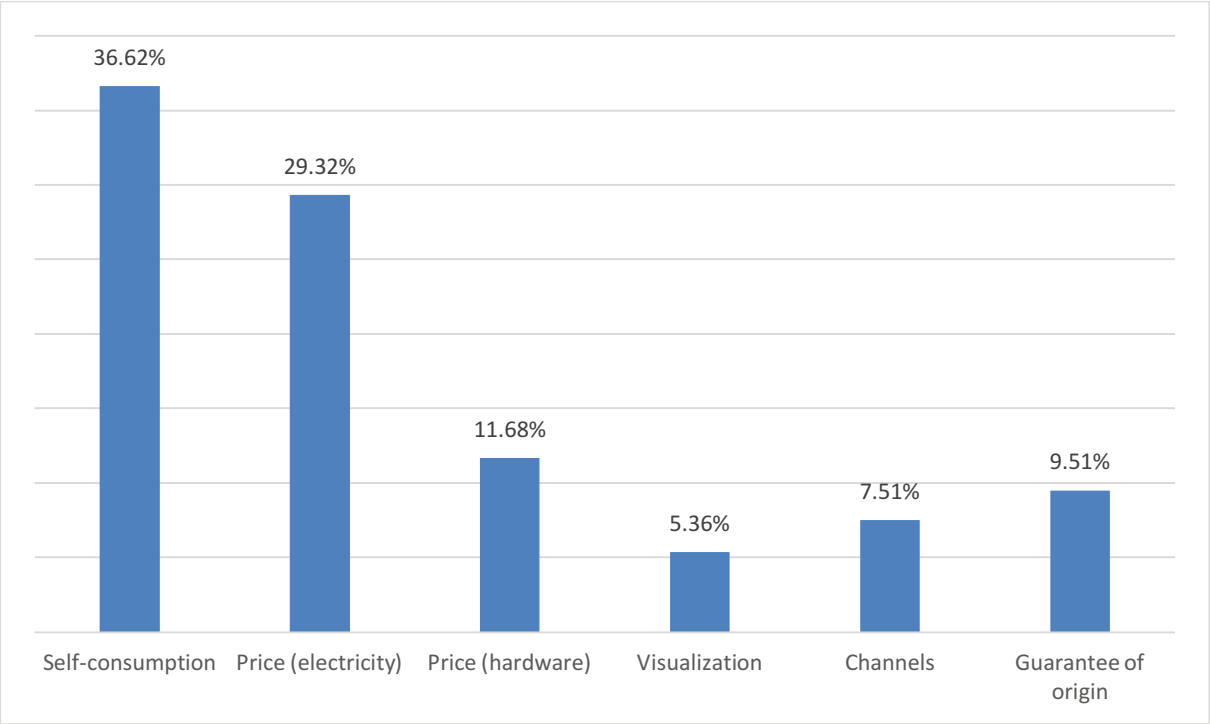

Figure 7: Attributes of the energy cooperative acceptance study

While the overview of the importance of the different levels gives a first overview, the following Table 6 provides more differentiated information about the utilities (the value contribution) of each of the levels per attribute. It is interesting to note that 100% coverage of locally produced electricity is of superior value to energy cooperatives. However, an electricity price of 29 Cent /kWh or higher has a strong negative impact on the choices of energy cooperative members. Services such as real-time visualization and an app have no relevant impact on stated preferences. With regard to certificates, the computer-based approach has a slightly negative impact, whereas sustainability certificates are perceived as partially important. Costs of hardware need to be handled with care, as significant hardware costs (200 EUR) can have a negative impact.

Self-consumption	**Utilities**	**Standard Deviations**
100% cooperative electricity	110.43	60.81
60% cooperative electricity	-12.65	32.29
30% cooperative electricity	-97.78	47.03
Price (electricity)		

25 Cent / kWh	82.98	51.68
27 Cent / kWh	15.5	39.26
29 Cent / kWh	-25.65	53.03
31 Cent / kWh	-72.82	48.78
Price (hardware)		
0 EUR (3 years)	13.91	26.99
100 EUR (1 year)	0.01	34.87
200 EUR (flexible)	-13.92	37.61
Visualization		
monthly	-6.01	23.18
daily	3.35	13.65
in real-time	2.66	19.16
Channels		
on utility bill	-8.35	31.02
bill + online portal	8.8	24.94
bill + online + app	-0.45	19.14
Certificate		
none	-3.9	27.17
TÜV certificate	-5.93	18.38
Sustainability certificate	13.16	28.19
Computer-based certificate	-3.32	31.84

Table 6: Utility values from the energy cooperative study

Figure 8 graphically displays the part-worth utilities of the different services (beyond share of electricity origin and electricity price). What is evident is that some of the core EMPOWER service offerings are only of limited value from the demand-perspective of energy cooperative members.

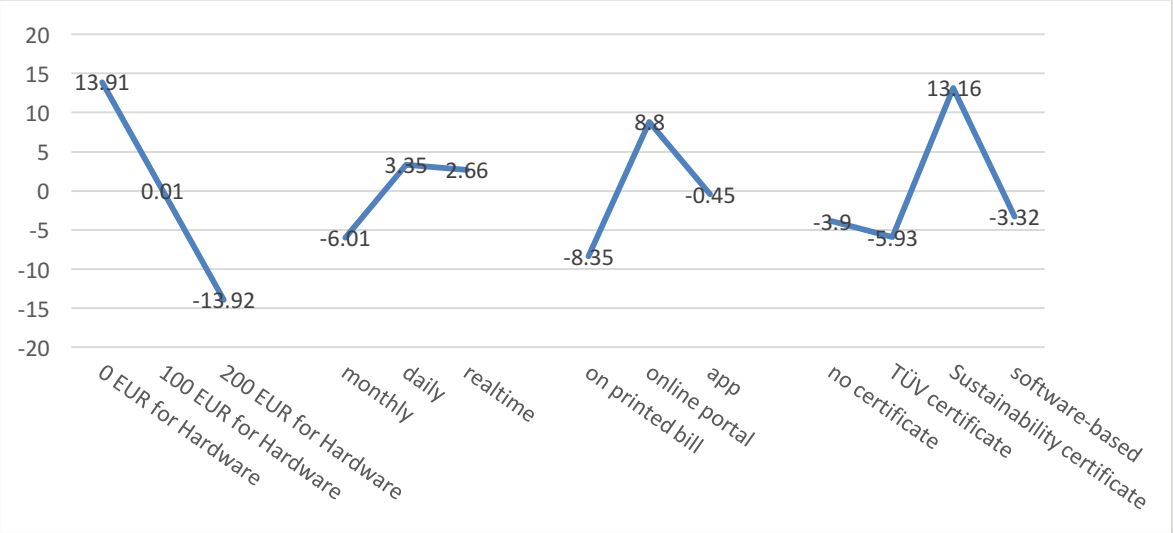

Figure 8: Value of selected EMPOWER services to energy cooperatives

We ran a market simulation analysis to analyse the share of preferences for distinct product-service bundles that can serve as blueprints for further shaping the business model for energy cooperatives. The study reveals that the most important attribute is self-consumption: if an offer was built around achieving 100% own consumption, it would be almost unimportant by which means this offer came about, and even if it were combined with nearly every product feature it would still be strongly accepted. The only restriction is electricity price: it is recommended that a price below 30 Cent / kWh is targeted (interestingly, the costs of hardware also seem to have only little impact).

However, these pre-studies showed how difficult it is for energy cooperatives to target 100% own consumption. Thus, we modelled product-bundles with 60% cooperative electricity. The table shows three product bundles: “our Power” combines high shares of preferences, but also requires that we downplay and eliminate some of the initial EMPOWER offerings. “EMPOWER (full price)” and “EMPOWER (reduced price)” are less acceptable in our market simulation. However, from these two options, “EMPOWER (reduced price)” is more acceptable as the share of preferences is higher and market acceptance is more likely. “EMPOWER (reduced price)” also incorporates important boundaries on price design in EMPOWER (e.g. as concerns the prices that were proposed for Wolpertshausen by Smart Energi).

Products	Shares of Preference	SE
“Our Power“ • 60% cooperative electricity • 27 Cent /kWh • 0 EUR (3 years min. contract) • daily • online portal • TÜV certification	50.09%	4.64%
“EMPOWER (reduced price)“ • 60% energy cooperative electricity • 27 Cent /kWh • 100 EUR (1 year min. contract) • real-time • App • Computer-based	38.10%	4.35%
“EMPOWER (full price)“ • 60% energy cooperative electricity • 31 Cent /kWh • 200 EUR (flexible contract) • real-time • App • Computer-based	11.81%	3.50%

Table 7: Share of preferences of three simulated business models

5.2 Can the EMPOWER idea be implemented with a low-cost software approach as a first step, and if so, how?

This acceptance study has important implications for the ourPower business model but indicates a paradox. It appears that one of the central premises of EMPOWER (to facilitate local presumption) is of high value to energy cooperatives. Despite this, some of the essential EMPOWER services (computer-based routines for matching supply and demand, an App, real-time data visualization) are currently only of little value to energy cooperative members. To develop a successful business model to serve energy cooperatives based on EMPOWER, this paradox has to be managed. It is advisable that energy cooperatives are targeted through a low-cost approach that avoids price premiums (which members of energy cooperatives are not easily willing to pay for IT-related innovation). Over time, the perception of the value of IT-related products and services can then be developed. The acceptance study also helps support some clear recommendations about pricing. For instance, electricity prices in Germany should be below 29 Cent /kWh, and, if possible, no hardware costs or at least costs no higher than 100 EUR should apply. An important lever for acceptance is the degree of self-consumption (providers like https://buergerwerke.de already market a 100% share of cooperative energy). It is recommended that the value proposition of the EMPOWER cooperative business model is coupled with the goal of achieving high shares of cooperative energy.

It is also of interest to consider the issue of certification, especially sustainability certification. If the EMPOWER business model could integrate a sustainability certificate (e.g. which would allow the claim that, based on EMPOWER, specific sustainability targets could be reached), this would positively affect market acceptance.

Overall, one important means of EMPOWER dissemination would be to establish cooperative agreements with buergerwerke and to integrate the EMPOWER solution into their offerings. On the other hand, it is advisable to utilize EMPOWER products and services by setting up an “Our power” tariff and approaching energy cooperatives with a view to their becoming prosumers. This acceptance study provides salient foundations for the design of this tariff. NewEn could be an excellent distributor of this tariff, and any eSmart System needs to develop a low-cost product that matches the special needs of energy cooperatives.

One additional opportunity that has so far been missed – based on the observation that that the role of SESP in energy cooperatives could be supplemented with an additional service – is to supply reserve electricity. Such a provision of reserve electricity could

provide an opportunity to cross-finance the required hardware and software costs which energy cooperative members currently assign only limited value to.

6 Firm acceptance study

In order to understand company acceptance of the EMPOWER concept we looked at forty-six companies across Europe to identify markers that help to differentiate organisations that can be attracted by the EMPOWER concept and others that might be more difficult to approach. The sample included companies from seventeen different countries. Figure 9 shows their distribution. A detailed list of the final sample of the utilities that were included in this study is available in the working paper.

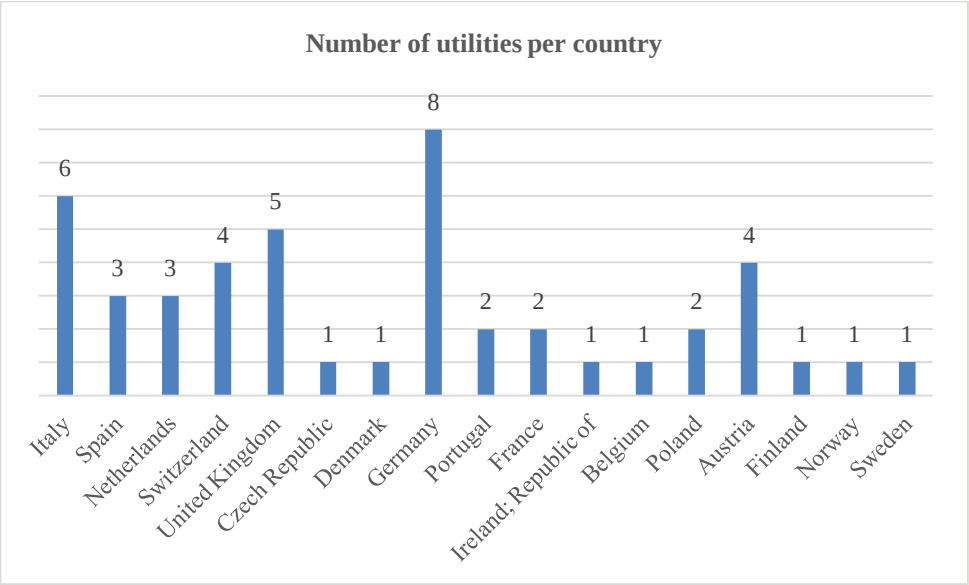

Figure 9: Number of utilities per country

6.1 What drives company acceptance of the EMPOWER concept?

Local electricity markets empower not only citizens to participate in such markets, but they also offer numerous opportunities for utilities to renew themselves in the face of a changing market landscape. In particular, the acceptance of local electricity markets by electric and multiline utilities in Europe is in focus here. The study is based on a sample of European and Swiss electric and multiline utilities. The time frame of the analysis is 2010-2015. In line with prior studies, we conducted keyword search analyses in company letters to shareholders in their published annual reports. Our aim was to uncover which

utilities in Europe have the most market potential for local electricity markets, which factors drive the acceptance of local electricity markets for utilities more generally, and which countries have the most market potential for local electricity markets in the European Union, Norway and Switzerland. Findings suggest that utilities' performance level, their leverage and the level of regulation in their home country play a significant role in predicting whether they accept digitalization- and decentralization-related innovation. Furthermore, utilities that are based in countries with high scores in the GGEI ranking are more likely to accept digitalization- and decentralization-related innovation. An agenda for action is outlined next, with specific measures for addressing this target group.

The working paper details the methodology by which we performed key-word analysis of the letters to shareholders and complemented it with key financial performance indicators. The method is commonly applied and we refer to the respective elaboration and references in the working paper for more information. Based on the analysis we arrived at financial indicators (e.g. Return on Equity (ROE), Equity-to-Debt ratio etc.) and measures for indicating openness towards the EMPOWER concept (e.g. a focus on decentralization and digitalization). Detailed results are contained in the working paper; in the following, we aggregate the findings.

6.2 How can we identify good partners for the exploitation of EMPOWER?

The company acceptance study revealed a set of simple rules for identifying potential partner firms for the exploitation of EMPOWER. It is recommended that these rules be considered when developing the dissemination strategy further (WP8). These rules relate to company features, and features of the country in which the company is operating. We first present the company specific rules for partner selection:

- Performance: The more the utilities' ROE is above those of their peers', the less likely they are to engage in digitalization- and decentralization-related innovation.
- Leverage: The higher the utilities' leverage (equity-to-debt ratio), the less likely it is that utilities are engaging in digitalization- and decentralization-related innovation.
- Regulation level: Utilities that are based in unregulated settings, or for which the core activities are unregulated, are more likely to engage in digitalization- and

decentralization-related innovation, compared to utilities that engage in regulated settings.

- International diversification: No effect for international diversification and the likelihood that utilities are engaging in digitalization- and decentralization-related innovation.

Performance, leverage and the level of regulation of the home country are key segmentation criteria for selecting utilities that may be interested in collaborating with EMPOWER. In this context, the following priority agenda for action is recommended:

Target marketing strategies at prospective utilities by defining utility segments. Opportunities for renewal and innovation should be highlighted in any marketing strategy. The EMPOWER concept constitutes a process for renewing the core business of utilities that are in decline. Target marketing strategies by highlighting the benefits and the innovation potential of EMPOWER for utilities, and how it remedies performance decline. The EMPOWER concept constitutes an area for innovation, in particular for utilities with high leverage potential. Target marketing strategies by highlighting the benefits of an investment in EMPOWER technologies for utilities which have the resources for exploratory initiatives. Target a dialogue with regulators to proactively shape regulation in the sense of liberalizing the market to allow decentralized energy production and supply. Target utilities that operate services in markets with the lowest level of regulation first, such as sale and supply of electricity.

The following rules apply to the selection of countries: The Global Green Economy Index (GGEI) of countries appears to be an effective heuristic for selecting countries for EMPOWER exploitation. The environment, favorable or unfavorable, in which a firm is operating is likely to have an impact on its strategy and on its decision to invest in new technology areas. This is especially true with respect to particular policies or regulations that may favor a push towards local power markets. We investigated the effectiveness of proxies for such favorable/ unfavorable regulations, and opted for the Global Green Economy Index (GGEI), which is a “data-driven analysis of how 80 countries perform in the global green economy, as well as how expert practitioners rank this performance” (GGEI, 2014). The performance index of the 2014 GGEI is defined by twenty-four underlying indicators, each contained within one of the four main dimensions of leadership and climate change, efficiency sectors, markets and investment and the environment (GGEI, 2014). The higher the index, the more the country is making progress towards a greener economy. The index was collected for all countries for the year 2014.

The Global Green Economy Index constitutes a particularly helpful segmentation marker for selecting countries to enter with the EMPOWER concept. The higher the score for the country in the Global Green Economy Index (from 2014) in which the utility is based, the more likely it is that the utility will accept decentralization and digitalization-related innovation. In particular, we found a positively significant relationship at the 5% level between the Global Green Economy Index from 2014 and the acceptance of decentralization and digitalization-related innovation. That is, the higher the score in the Global Green Economy Index from 2014 of the country in which the utility is based, the more likely it is that the utility will accept decentralization and digitalization-related innovation.

The following agenda for action is recommended: The EMPOWER concept constitutes an area for innovation for countries that are already actively progressing towards a green economy. Utilities that are based in the Netherlands, Germany, Austria, Sweden and Switzerland are particularly interesting in the diffusion of the EMPOWER concept, as they are already dealing with digitalization and decentralization themes in their strategies. Utilities that are based in Belgium, Portugal and Denmark are the most challenging in terms of the diffusion of the EMPOWER concept, as they are the least dealing with digitalization and decentralization themes in their strategy. Target utilities in Germany, the Netherlands, Austria, Italy, and Switzerland by highlighting digitalization as an area for innovation in marketing strategy. Target utilities in Switzerland, Germany, Austria, Italy, and the UK, by highlighting decentralization as an area for innovation in marketing strategy.

Country	Ranking	Digitalization**	Decentralization**
Austria		0.0385	0.0363
Belgium		0.0028	0
Czech Republic		0.0056	0.0096
Denmark		0.0068	0.0103
Finland		0.0104	0.0046
France		0.0088	0.0085
Germany		0.1009	0.0392
Ireland		0.0124	0.0025
Italy		0.0380	0.0320
Netherlands		0.0771	0.0097
Norway		0.0069	0
Poland		0.0077	0.0036
Portugal		0.0026	0.0083
Spain		0.025	0.0085
Switzerland		0.0273	0.0478
United Kingdom		0.0162	0.0189
Sweden		0.0084	0.0091

* as measured by the GGEI index, ** relative frequency of keywords

Legend	
Performance above 60	green
Performance between 50 and 60	orange
Performance below 50	red

Figure 10: Focus on EMPOWER-related topics by country

7 The EMPOWER ecosystem

7.1 Overview

Based on the interviews with the senior managers of the EMPOWER partners, we are able to develop a full picture of the different business models that each partner should aim to create. It is important to note that the different partner business models relate to each other in an ecosystem business relationship. The ecosystem offers the distinct products and services that are required to enable the SESP and to implement local power markets under the EMPOWER framework.

What is unusual for a business ecosystem, and represents a difference between the current EMPOWER ecosystem and other ecosystems, is that the central stock of the EMPOWER Hardware, Software and Services is still virtual, hence no distinct partner has officially taken on the role of a one-stop-shop that warehouses and supplies the EMPOWER hardware, software and the related services (for the pilot this is coordinated at the moment by Smart Energi, a daughter company of FEAS). A central product of EMPOWER is the EMPOWER ICT platform developed by eSmart Systems. However, eSmart Systems has so far only played a passive role in developing and supplying the software, and has not yet taken over additional services (such as business development and sales). Schneider has the potential to supply software, hardware and related services, but has not yet taken over this role. Moreover, hardware components (such as Develco products) are not sourced from Schneider, but from other partners (non-core project partners). The stock of EMPOWER hardware, software and services supplies the SESP.

Within the EMPOWER ecosystem, two versions of SESP are envisioned: the first version of the SESP is a spin-off, or a local variant of a local utility. This SESP targets local prosumers (e.g. a neighbourhood). This role of SESP is currently taken on by Smart

Energi. It has close relationship to local distributors and the local grid operator. Spill-over effects can be identified with both (e.g. avoidance of grid investment, customer retention, additional services and sales, etc.). The Norwegian pilot-site with FEAS incl. Smart Energi and Norgesnett is a role model for this version of the SESP. The FEAS group of companies could potentially take over additional services and play a more active role in 'selling' the EMPOWER concept to other utility companies. It would be interesting to establish FEAS as a training and distribution hub for local power market development in Europe. MIEMA could potentially take over a similar role in facilitating the implementation of the SESP approach in Malta.

The second SESP approach targets energy cooperatives and offers to expand their business model. While the role of SESP should be taken over from energy cooperative management, Smart Energi is currently also aiming to undertake this task. NewEn can become the multiplier and involve energy cooperatives throughout Germany and potentially across Europe to implement the EMPOWER SESP.

Three partners (ITCEA, smartIO and UNISG) are supporting ecosystem development, but – at least at the moment – do not have a commercial interest in exploiting EMPOWER. The figure below depicts the ecosystem. In the following, we outline the partner business models in more detail, and present suggestions for their deployment.

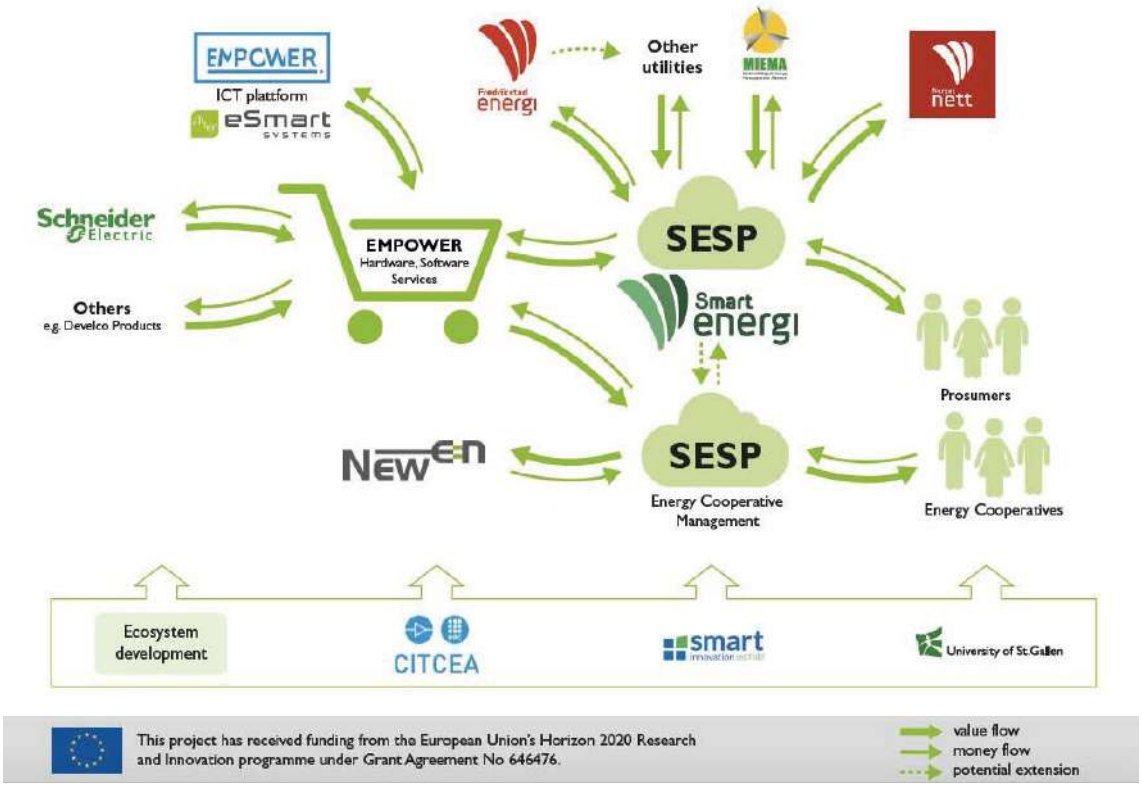

Figure 11: The EMPOWER partner ecosystem

7.2 EMPOWER partner business models

In the following we specify the different partner business models within the EMPOWER ecosystem. For each of the business models we outline challenges and requirements, along with the important elements of the business models and recommendations for the next steps.

7.2.1 eSmart Systems

eSmart Systems develops and supplies the core software solutions for EMPOWER. Activities in WP8 show that market demand exists as of 2017 and has developed throughout the duration of the EMPOWER project. The successful factory acceptance test (FAT) in June 2017 gives the EMPOWER system developed by eSmart Systems a first-mover position in the market, and has been a milestone for the eSmart System business model in terms of offering 'local power markets-as-a-service'. However, some challenges and requirements remain:

- Customization and agile development: The EMPOWER system as it is now is only a first extended-prototype system. On the one hand, it needs further development in line with the two generic business models that have been developed in WP2 (2.1 and 2.2.): DSOlocal (target group utilities) and ourPower (target group energy cooperatives). The acceptance studies described in this report show what the distinct requirements for both business models are. On the other hand, the system needs further development so it fits distinct regional and country-specific requirements. The multi-country acceptance study in this report suggests important directions for development.
- Reliability and functionality: EMPOWER market design requires the implementation of a broad range of functionality, such as services that center on metering, control and customer integration. A key problem remains reliability. Digital services shall provide the foundation for the reliable functioning of EMPOWER markets. Further work (now ongoing) is necessary to improve reliability and functionality. This work concerns not only the functionality of the system itself, but also the implementation routine. EMPOWER markets are very diverse and one key problem is to manage connectivity with the local technical infrastructure and the local regulatory and social environment for acceptance. The current implementation routine is still too complex and inefficient. A more structured implementation routine needs to be developed for

full roll-out. For instance, the registration of new prosumers appears to be very expensive and time-consuming in the current version, as it is performed manually, thus raising the level of automation is important.

- Go-to-market and sales: The eSmart System approach is currently better linked to research and innovation processes, instead of being sales driven. For instance, pricing and go-to-market strategies are unclear, and urgently need strategic definition.

While EMPOWER is heavily focused on prosumer involvement, the e-smart business model is a B2B business model that serves the SESP role, and potential customers of e-smart Systems are owners of the SESP role. It seems advisable to focus on two potential types of customers: (1) local utilities or spin-offs of local utilities (DSO local business model), and (2) energy cooperatives (ourPower business model). In the following table (Table 8) we sketch out business model features for both segments.

Business Model	Business model "Serving utilities"	Business model "Serving energy cooperatives"
Value proposition	-Provide standard EMPOWER software-as-a-service package for utilities. -Provide customization services. -Provide implementation services (e.g. screening, project management support). -Provide standardized equipment sourcing services that link to utility procurement processes. -Provide standard integration in utility customer interfaces. -Provide operation and maintenance services.	-Provide standard EMPOWER software-as-a-service package for energy cooperatives. -Provide customization services. -Provide implantation services (e.g. screening, project management support). -Provide standardized stand-alone equipment sourcing services. -Provide standard stand-alone customer interfaces. -Provide operation maintenance services.
Value configuration	Develop software in-house. Build-up ecosystem of partners (especially for the sourcing and logistics of hardware equipment, local project management and standardized services).	Develop software in-house. Build-up ecosystem of partners (especially for the sourcing and logistics of hardware equipment, local project management and standardized services).
Monetization	Set-up costs. Utility subscription fee. Pay-per use service fees. Project-specific fees.	Set-up costs. Energy Cooperation subscription fee. Pay-per use service fees. Project-specific fees.

Table 8: eSmart Systems business model elements

eSmart Systems is well connected in different project test-beds, and in the regional and European ecosystem. eSmart Systems has strong local ties (especially to FEAS) but at the same time has global ambition. However, we see potential for eSmart Systems to improve in regard to speed and lean project management, and with building up competitive marketing and sales capabilities. It also seems that eSmart Systems could improve their capabilities as concerns cooperation and ecosystem thinking. Ultimately, EMPOWER business model development requires a bit more top management commitment and attention. The Microsoft Azure toolkit appears to be fast and scalable and potentially could help to move eSmart Systems more towards becoming a sales-driven accelerator of processes and a problem-solution provider. We thus make the following recommendations:

- Set-up a sub-unit in eSmart Systems with agile programming resources for the "DSOlocal" business model (target: utilities) and for the "ourPower" business models (target: energy cooperatives).
- Set-up a workshop with UNISG and SmartIO about business model refinement (especially as regards setting up a structured sales process, trial version, pricing and implementation routine)
- Develop sales and go-to-market plan and targets

7.2.2 FEAS

FEAS is a key driving force behind the EMPOWER concept. It contributes foundational and sound energy-system thinking, and is a professional partner that adds security to the whole EMPOWER ecosystem. Central to the implementation of the EMPOWER market design are new services and product offerings to customers, as well as new interactions between customers and the SESP. Different challenges have evolved in relation to this ambition:

- From a European perspective, FEAS works in a market with a comparably low-penetration of distributed renewable energy. Other markets (e.g. in Germany) are more turbulent and challenging in this regard.
- Piloting and regulations: Effective implementation of pilots and their exploitation are crucial to the acceptance of customers and regulators of decentralized energy markets, and consequently, towards their diffusion and exploitation.
- Partnerships: Partnerships are key to adapting to changing market structures and customer demands. They are crucial to being able to offer new services quickly and efficiently, as well as to forming strategic relationships with new entrants.

- Customer relationships: Customer relationships are at the heart of the new business model for energy suppliers, as customers are becoming increasingly active in their energy consumption and supply process.
- Flexibility: The penetration of DER is increasing, which brings different challenges for electricity system management; however, if the flexibility of that DER is well managed, opportunities will arise for the coordination and further expansion of DER.

The problems translate into specific requirements that the EMPOWER business model for FEAS aims to address. With fast-paced changes and an uncertain regulatory framework, FEAS needs an agile mindset to accelerate time-to-market-readiness. Moving toward customer-centric solutions and DER is inevitable. To create the right products and services and market them in the most efficient way, FEAS seeks to understand its customers' needs very well. FEAS has already been actively working on this task in multiple ways, partly through actively integrating customer feedback into their services and product offers.

Continuing in this direction, FEAS first needs to adopt a menu-based approach to meeting the shifting demands of energy customers, offering a range of potential products and services to cater to an expanding array of customer preferences. This means that revenue streams have to be built on what customers value. As energy becomes increasingly democratized, increasing market segmentation becomes crucial: low-income households want reliable and affordable power, while middle-to-high income households are becoming increasingly environmentally conscious, and consequently want smart, green options and to be involved in the energy production process. C&I are looking for on-site generation, energy storage and DR. Moreover, customers who are looking to be more active require one-stop shopping. This means that the process of becoming prosumers needs to be very simple, which goal FEAS has already incorporated into its service and product offers. Second, with barriers to entry decreasing and the fast past of change, it is key to build an ecosystem of partners. FEAS is well placed to build such an ecosystem and to offer its benefits to customers or other companies. Moreover, FEAS will need this ecosystem to cater to the increasing variety of customer needs. It is thus advisable to work with emerging companies who can act as partners and innovators to help create incentive solutions. FEAS has already spun out a company, Smart Energi. It has also built a partnership with NCE smart energy markets. Third, opportunities lie in continuously shaping DER portfolios, embracing the rise of the digital prosumer and capitalising on platform opportunities for unbundled solutions. For this, FEAS needs to keep developing and understanding the value streams emerging from DER, expanding its network of partners, and adopting enabling technologies - given

that Norway expects all electricity customers will have a smart meter by the end of 2018. This will provide consumers with better information about their electricity consumption and prices, and facilitate opportunities for new energy-related services for FEAS. Fourth, with regard to regulatory barriers, FEAS needs to be proactive in putting forward proposals through different pilot projects to show regulators what is possible, as well as the value it brings to customers. Similarly to with the sharing economy, the regulatory framework may follow company initiatives.

One of the main regulatory barriers to the further exploitation of the EMPOWER concept for FEAS is the fact that one can currently only buy and sell from one energy provider, which means they cannot help developing peer-to-peer trading. FEAS could prepare ahead of possible regulatory approval and look into the use of blockchain technology for facilitating local markets between neighbours. Finally, it is very important for FEAS to keep initiating pilot projects: doing things at a small scale, adapting quickly, and seeing which of the seed projects can be effectively scaled up.

The proposed business model is one solution for ensuring customer retention, keeping pace with fast pace of technology development and new entrants, as well as having to work in an uncertain regulatory environment. Potential customers of FEAS are: (1) Consumers and prosumers, (2) Energy service providers (sellers of hardware and technological devices), (3) Government bodies.

Business Model	Business model "customers/prosumers"[3]	Business model "energy service provider"	Business model "government body"
Value proposition	-Offering VPP (leveraging resiliency)[4] -Offering micro wind turbines -Offering solar panels -Peak shaving -Data information[5] -Charging stations for EVs -Storage -Facilitating peer-to-peer trading	-Online market place for end-users and businesses	-Build microgrid (micro wind turbines and solar panels) -Offer VPP -Peak shaving -Data information -Facilitating peer-to-peer trading -Storage

[3] Within this category, further customer segmentation may be needed (low-income vs high income, etc.).

[4] Customers pay a monthly fee. The value proposition is security of supply. Batteries become available to customers on bad weather days.

[5] Providing alerts about how customers are using energy, and what type of equipment, products and services might be useful for them. Segmentation is key here for targeting the right customers.

Value configuration	-Build up ecosystems of partners -Meetings and web -Repeated pilot projects and demonstrations -Appropriation of new technologies	-Build up ecosystems of partners -Web	-Build up ecosystems of partners -Meetings and web
Monetization	Monthly subscription fee. Set-up costs. Pay-per use service fees.	Pay-per-use service fees.	-Project specific fees -Government funding

Table 9: FEAS business model elements

For power sale companies such as FEAS, which are unregulated companies, the opportunity to leverage innovative business models are multiplying. FEAS has been an early mover in terms of giving tools to consumers for them to self-produce electricity through simplified access to installation of solar panels, and integrating customers into the development of projects (community aspect). Moreover, it has experience developing products and services for customers and has already developed partnerships. FEAS currently has a customer base but needs be proactive before customers progressively switch. This is why value bundling is crucial to their business model. We thus recommend the following steps:

- Transfer EMPOWER insights into own products and service offerings (e.g. new prosumer tariffs)
- Consider and take over a more active role in marketing EMPOWER potential. One such direction would be increasing their ambition with regard to Smart Energi and become actively involved in selling the EMPOWER concept.

Norgesnett: Central to the implementation of EMPOWER market design is the ability to exploit the increasing penetration of RES and smart grid technologies while ensuring reliability. Different challenges are associated with this ambition:

- Reliability & Flexibility: the increasing penetration of RES necessitates additional efforts to steady the system both when power from RES is available, and when it is not. The main tool for ensuring security supply by DSOs has historically been to lay down more electricity cables, reinforce the grid, upgrade transformers, and so on. However, making the most of the flexibility offered by grid users might be a better solution.

Historically, regulations targeted to DSOs have not funded them to take risks. In this way, DSOs such as Norgesnett are currently missing the right regulatory framework to actively

turn towards innovation. For example, CAPEX and OPEX need to be treated equally in order to incentivize operating expenses instead of capital expenses, which corresponds to load reduction versus expanding the grid as one example. Currently, it is more beneficial for Norgesnett to make investments than to incur operating costs because CAPEX and OPEX are not handled in the same way. However, innovative investments related to smart grids for DSOs are mostly in technology, which means with operating expenditures rather than capital expenditures. Smart grid investments will then increase the weight of OPEX in the cost structure of the distribution activity. TOTEX approaches are more effective to encourage innovation as it allows the DSO to adjust investments strategies to the targets specified by the regulators in terms of cost efficiency and outputs[6]. Norgesnett needs to offer reliability of power. The question is to see how it can ensure this reliability while taking advantage of smart grid technologies to avoid being left out with stranded assets.

The above-described problems translate into specific requirements that the EMPOWER business model for Norgestnett needs to address. First, reliability is important. Norgesnett has made plans to expand to ensure security of supply. However, as more RES are interjected into the grid, grid operations must become smarter and so Norgesnett must embrace flexibility of services. Second, adaptability is key. Norgesnett must mitigate the risks of the energy transition by adapting to the changes in the industry. In other words, it needs an agile mindset in order to accelerate market readiness. It has already demonstrated this by being a pioneer of AMS and smart grid operations in Norway, and more recently by entering into an agreement with eSmart Systems for the delivery of the 'Connected Grid'. The first step for utilities that adopt smart grid technology is to automate certain functions such as handling outages and voltage faults in the grid. The next step is to utilize data that has been collected in intelligent grid operations. These two steps could be orchestrated by the SESP.

The business model must present a solution for dealing with increasingly distributed energy, its effect on the grid, and the planification of the latter. No new revenue is expected *per se*, given that Norgesnett is a monopoly-regulated company. This makes their value proposition different from the usual market value proposition. With more complex distribution systems and smarter components, DSOs will have to act as an integrator of DG units instead of just providing access to them.

[6] The Future Role of DSOs, A CEER Conclusions Paper

This way, the business model should specify how to reduce expenses, as well as how to offer new flexibility-based services through interaction with the SESP and adoption of new technologies. These two features go hand-in-hand. For example, Norgesnett could use the SESP to decrease and/or postpone investments and make use of reserve market/ storage to control the load. It could also take advantage of the introduction of smart meters to better control loads and reduce grid investment (AMI, distribution tariffs).

Business model elements	Business model "Flexibility and reliability"
Value proposition	Security of supply and quality of service[7] System flexibility services o Congestion management (better network capacity planning and congestion management to maximize grid DER hosting capacity while maintaining a high level of security and quality of supply) potentially using DESSs and VPP approach o Voltage control o Data management o Dynamic pricing[8]
Value configuration	Build-up ecosystems of partners (IT and telecommunications companies) Invest in new technologies
Costs	Investment in new technologies Hiring new talents specialized in innovation or new technologies
Monetization	Energy sales Generating revenue from data[9] (possibility to develop fees based on value to third parties, work needed with regulators) Expense reduction (through load shifting, dynamic pricing)[10]

Table 10: Norgesnett business model elements

Norgesnett has assets in different parts of Norway and has pioneered AMS and smart grid operations in Norway. Moreover, it has recently signed an agreement with eSmart Systems for the delivery of a Connected Grid, which is a core system for AMI reading and management. The Connected grid provides Norgesnett with decision support for operation, maintenance and the planning of grids with the ultimate goal of reducing cost, increasing efficiency, and providing a better service. This will help Norgesnett with providing a dynamic pricing tariff as the integration of new technologies is key to better

[7] Core responsibilities stay unchanged. However, the way Norgesnett is securing their supply will change.

[8] Dynamic price incentives may give customers insight into their own energy consumption patterns and related costs. They may also help them to obtain or maintain control over their energy consumption, thereby saving costs.

[9] Appropriate allocation of costs to those that gain the most value is important (similarly to with any other revenue for a regulated utility)

[10] Building a smarter grid has the potential to create operating efficiencies and cost savings. For example, replacing a cost with an investment can create a return and generate earnings

controlling the load. Moreover, as a DSO, Norgesnett has key insights into supply and demand across the grid.

On the other hand, as a monopoly-regulated company, Norgesnett does not have much room to innovate. In order to stay connected with the ongoing changes in the energy industry, Norgesnett will need to keep developing networks of partners throughout the value chain, as well as adopting new technologies, given that the benchmark for successful grid operations will increasingly move beyond the criteria safe, reliable and affordable to include clean, distributed and intelligent energy.

System flexibility services will lead to a shift from CAPEX to OPEX, and regulation should recognize this by accepting expenses that can be seen as riskier but which could also create a clear reduction in cost. Moreover, some flexibility services could be delivered through the SESP. Norgesnett is not looking to come into direct contact with customers but could use aggregated SMEs and aggregated household customers to achieve more flexibility in term of load.

With respect to the regulations needed for further exploitation, DSOs need to be proactive in putting forward proposals to regulators. Incumbents may not be able to wait for regulators to act because the pace of change is well beyond the speed they have been used to. We have the following recommendations in this regard:

- develop incentives to increase flexibility (e.g. incentives for reserve provision, certificates and labels about the reliability of EMPOWER-based balancing services, flexibility-based insurance concepts, etc.)

7.2.3 NewEn

While the Norwegian partners in EMPOWER form a cluster that is able to efficiently serve utility-centered business models, NewEn has the unique potential to develop EMPOWER-related business with energy cooperatives in Germany. In this way, the management of the pilot-site in Wolpertshausen is also a blueprint of a potential EMPOWER-based business model for NewEn. Different challenges arise in relation to this ambition:

- Regulation: The regulatory market environment in Germany is fundamentally different to other markets, such as the Norwegian market. As such, it is important that NewEn utilizes its knowledge about the German market to lead the adoption of the EMPOWER concept so that it can also work in Germany.

- The distinct value perceptions of energy cooperatives and members of energy cooperatives: Energy cooperatives are not like local utilities: Their members and their operating logic is different. The acceptance studies described in this report (e.g. the acceptance study in Wolpertshausen) provide important insights. For instance, members of energy cooperatives do not consider smart, cloud-based IT services to be valuable. The NewEn business model needs to consider these differences when developing an approach to marketing the EMPOWER concept to energy cooperatives.
- Translation and modification: Given the differences between energy cooperatives and local utilities, the NewEn business model should translate and modify EMPOWER business models so that they can be implemented with energy cooperatives. The conjoint design used in the Wolpertshausen acceptance study described in this report suggests how to develop and market own power tariffs for energy cooperatives. NewEn could offer to implement Own power tariffs for energy cooperatives in Germany.

The “NewEnergyMarket” business model for NewEn largely depends upon successful pilots and demo projects, and their visibility. On this basis, it may obtain the necessary knowledge for effective local implementation, as well as the necessary legitimacy.

Business Model	Business model “Energy cooperatives as prosumers”
Value proposition	-Help energy cooperatives to become prosumers -Provide all products and services that are needed to implement own power consumption tariff. -Solutions should comply with the current regulatory environment and contain a working business model.
Value configuration	-Link German energy cooperatives to the EMPOWER ecosystem. -Manage the required software modification as a mediator between German energy cooperatives and eSmart Systems programming resources -Either become an SESP provider or manage the relationship between the standard SESP provider (Smart Energi) and the energy cooperatives in Germany
Monetization	-Project-specific fees. -Success sales fee from e-smart systems. -Operational maintenance fee.

Table 11: NewEn business model elements

NewEn is in a unique position in the non-utility German market (especially between renewable energy projects and energy cooperatives in Germany and the EMPOWER ecosystem on the other hand). A key barrier to exploitation is the currently underdeveloped state of software (which is not yet specific enough to meet the

requirements of the German market and the distinct needs of energy cooperatives). Also, NewEn so far lacks “an appetite for sales”. This however, could relate to the currently under-developed product. Once the product (the EMPOWER software-hardware bundle) is more saleable, this appetite for sales might come. However, NewEn could also be a bit more proactive in fine-tuning the software and hardware design so that it fits the needs of the German market. The following recommendations thus apply:

- Develop cooperation with eSmart Systems and customize the EMPOWER product towards the requirements of German markets and the needs of energy cooperatives in Germany.
- Use this report, the learnings from Wolpertshausen and the acceptance study as input to develop the final product and go-to-market strategy.
- Contact all energy cooperatives in Germany and start making sales.

7.2.4 Schneider Electrics

Schneider is an international company with a broad product and service range that is relevant to EMPOWER. It has also obtained important process understanding as regards the implementation of EMPOWER in different European countries. However, Schneider does not yet realize the full potential of EMPOWER.

- Hardware and software portfolio: Schneider could provide all the hardware and software that is required to set-up an MPOWER market in-house. However, so far, none of the products and services that were developed in EMPOWER have been supplied by Schneider. That will change, and it is recommended that Schneider becomes a one-stop-shop for supplying local power markets. By doing so, Schneider will also become a competitor to eSmart Systems.
- Within-Schneider marketing sales of EMPOWER: The EMPOWER project has significant potential in terms of educating and training Schneider personnel. Ironically, the competitors of Schneider are interested in setting up a large, multi-year, in-house training programme-based on Schneider. It is thus advisable to develop Schneider-specific EMPOWER dissemination activities.

The “energy-as-a-service” business model largely depends upon local customer needs and a partnership with a data analyst specialist.

Business Model elements	Business model "one-stop-shop for local power markets"	Business model "Schneider in-house training based on EMPOWER"
Value proposition	-All state-of-the-art products (reliable, like all Schneider products) that are required to set-up and run local power markets from one source. -New, state-of the art technology and a Schneider-backed guarantee. -Provide standard EMPOWER energy-as-a-service packages. -Provide customized services that may be adapted to the local needs.	-Make Schneider management fit for adapting to the requirements of the future. -Train business model innovation, rejuvenation and disruption
Value configuration	Coordination of Schneider-internal resources to meet the needs that were identified in the EMPOWER project.	-Link the need for in-house executive education with the potential of partners in the EMPOWER-system -Set up in-house training for Schneider in St. Gallen
Monetization	-Hardware and services sales. -Maintenance fees. (eventually a local-market as a service solution with a subscription fee, similar to and in competition with e-smart systems).	Develop human resources

Table 12: Schneider business model elements

- Develop and market a one-stop-shop (differentiate to different target groups, small prosumers vs. large, industrial prosumers).
- Develop a one-stop-shop that empowers mid-size companies to become prosumers that supply private neighbours and offer local tariffs.
- Develop an EMPOWER-based, global in-house training concept for Schneider (under the leadership of HSG, as HSG has the resources for developing in-house leadership courses).

7.2.5 UNISG

Central to the exploitation of the EMPOWER market design is greater research and innovation into business modeling for local electricity retail markets. The challenge with these specific business models is the high level of uncertainty about future market demand and the regulatory framework. A 20-year or longer period of uncertainty, trial-and-error, and both success and many failures probably await energy players. Different problems are associated with this situation:

- Knowledge diffusion: the diffusion of knowledge on a large scale is of decisive importance to the development on a larger scale of local electricity markets. Given that a long period of trial-and-error awaits energy players, learning from the mistakes of others will be even more important.
- Ecosystem: Various competencies and expertise is/will be needed for the further exploitation of local electricity markets. A solid ecosystem made up of (the list is non-exhaustive) IT companies, utilities, software and hardware providers and universities consequently needs to be put in place.

These problems translate to specific requirements that the EMPOWER business model for UNISG aims to address. First, UNISG could share the experience is has gained during the EMPOWER project with students, MBA executives, businesses or governments. It could do so through seminars, lectures, workshops, consulting, and research projects. Second, the EMPOWER project highlighted the need for further research in the field of business models for local electricity markets. Given the fast space of technology development, the topic offers many opportunities for research. Finally, through its network UNISG is well positioned to connect different partners and diffuse awareness about local electricity markets.

Potential customers of UNISG are regular students, executive students, managers, investors and policy makers. These customers can be segmented into three distinct groups: (1) undergraduate and graduate students, (2) UNISG MBA students, (3) businesses and government agencies that use UNISG advisors. The following table sketches out the business model rules for the three categories:

Business model	Business model "undergraduate students"	Business model "UNISG executive education"	Business model "Businesses and governments using UNISG advisors"
Value proposition	Provide applied business modeling work to undergraduate students Provide workshops and materials containing innovative and hands-on concepts to students	Provide workshops and seminars based on business models developed for different energy stakeholders Provide material for stimulating critical thinking and business model development	Provide innovative and insightful expertise Create a network of partners (energy industry, IT, academic)

Value configuration	Develop courses and workshops	Develop courses and workshop Conferences	-Build on a network of partners -Ongoing research -Papers and other publications -Conferences
Monetization	Tuition costs	Tuition costs	-Research and project funding -Consulting fees

Table 13: UNISG business model elements

UNISG would be well positioned to offer expertise in business modeling for electricity markets given its combination of project experience, scientific work and teaching in both business modeling topics and renewable energies. Moreover, its extended and international network facilitates the greater diffusion of knowledge to a large variety of stakeholders (students, executives, policy makers, energy players). Finally, exploiting such timely information in teaching and research can potentially be extremely valuable to students and researchers.

7.2.6 Smart IO

Central to the implementation of the EMPOWER market design is the diffusion of knowledge and a strong ecosystem of companies with a variety of expertise. Different problems are associated with this goal:

- Knowledge diffusion: Pilot and research projects are being undertaken in different parts of Europe. Sharing the results and learning experiences is key to the further diffusion/ development of local electricity markets.
- Pilots and idea-testing: Going to market without having tested ideas first can be very costly in terms of money and in terms of reputation and negative repercussions from authorities. As a result, creating an environment for testing ideas is crucial.
- Ecosystem: For local electricity markets to function, numerous varied actors from different industries need to come together.

These problems translate into specific requirements that the EMPOWER business model for Smart IO needs to address. First, business models need to be tested before going to market or further research, and projects will no longer be receiving funding or support from authorities. Diffusion of knowledge and taking advantage of a “testing phase” could help to display the value of local electricity markets to authorities without jeopardizing further projects. Smart IO is well equipped to provide start-ups and established companies with a place in which they can test their ideas/business models. Second, to

exploit local energy markets, a range of expertise is needed. No single company can specialize in all areas, especially given the high rate of technological and market development. An ecosystem of firms is thus needed, and Smart IO is well positioned to offer this.

Business Model	Business model "incubator"	Business model "industry cluster"
Value proposition	Give opportunity for testing to validate business ideas Networking opportunities	Give opportunity for testing to validate business ideas Help companies break out of silos by connecting with individuals from other companies/ industries Provide tools for agile innovation Networking opportunities
Value configuration	Seminars Workshops	Seminars Workshops
Monetization	Equity Government funding	Fees for services Fees for joining cluster Government funding

Table 14: Smart IO business model elements

Smart IO has a strong regional network made up of IT companies, universities, Big Data and digital technologies, as well as links to international partners. Moreover, it has extended experience in research and innovation projects in the area of smart grids, smart storage, smart cities and smart communities. Furthermore, through offering the possibility to connect companies and municipalities, Smart IO can potentially provide government funding to companies that join its cluster.

- Develop the incubator business model and put additional focus on market dissemination (not only R&D projects).

7.2.7 MIEMA

Central to the exploitation of the EMPOWER market design is acceptance and adaptation to the new dynamics in energy production and exchanges of regulators, and the creation of a new ecosystem of partnerships and new energy service and product offerings to customers. Different challenges are associated with these issues:

- Piloting, exploitation and regulation: Effective implementation of pilot projects and their exploitation are crucial to fostering the acceptance of regulators of decentralized energy markets, and consequently towards their diffusion and exploitation. Pilot

projects need to showcase the benefits of local electricity markets to society to encourage changes in regulation.

- Ecosystem: Various competencies and expertise is/will be needed for the further exploitation of local electricity markets. A solid ecosystem made up of (the list is non-exhaustive) IT companies, utilities, software and hardware providers, and research centers consequently needs to be put in place.
- Innovation: Further and ongoing research and development are needed for the greater diffusion of local electricity markets.

The business model as it stands cannot be implemented in Malta for two reasons. First, because of the almost monopolistic power status of Enemalta, and second, because the exchange of energy between two prosumers is prohibited. These problems translate into specific requirements that MIEMA needs to address. First, to implement the project successfully, regulations and market conditions need to be improved. Showcasing the value of local electricity production and dissemination is thus crucial. Through its previous pilots, MIEMA has already noticed that when authorities get involved, dissemination becomes much effective (community aspects). Building strong ties with authorities, and increasing awareness of projects through promoting communication should be part of MIEMA's strategy. Second, a large and diverse ecosystem of partners need to be put in place (municipalities, associations, SMEs, and IT companies) to further disseminate local electricity markets. Even though the regulatory framework is not yet in place for implementing the business model as envisioned, building these partnerships and conducting pilot projects now has at least two advantages: first, the more stakeholders are involved, the higher the pressure on governments to change regulations, and second, it is important to be disruption- and possibly market-ready.

It is recommended that the pilots are extended to incorporate a wider range of customers, focusing on four potential customers: (1) Individuals (prosumers - individuals using their own premises to produce, individuals renting their premises to individuals who lack the space, individuals investing in PV through renting space), (2) SMEs, (3) Municipalities, and (4) Associations. In the following table we sketch out the business models for the four potential types of customers:

Business Model	Business model "Individuals"	Business model "SMEs"	Business model "Municipalities"	Business model "Associations"
Value proposition	Provide hardware (e.g. solar panels)	Provide hardware (e.g. solar panels)	Provide hardware (e.g. solar panels)	Provide hardware (e.g. solar panels)

	Energy monitor controls to allow for more flexibility Dynamic prices Peak-shaving IT infrastructure to support the exchange of energy Facilitate partnerships between those who want to invest and those who have the space Facilitate peer-to-peer trading	Energy monitor controls to allow for more flexibility Promote green/sustainable status Dynamic prices Peak-shaving IT infrastructure to support the exchange of energy Facilitate peer-to-peer trading	Energy monitor controls to allow for more flexibility Promote green/sustainable status Dynamic prices Peak-shaving IT infrastructure to support the exchange of energy Facilitate peer-to-peer trading	Energy monitor controls to allow for more flexibility Promote green/sustainable status Dynamic prices Peak-shaving IT infrastructure to support the exchange of energy Facilitate peer-to-peer trading
Value configuration	-Build network of partners, pilot and demonstration sites -Research	-Build network of partners -Pilots -Research	-Build network of partners -Pilots -Research	-Build network of partners -Pilots -Research
Monetization	-Sale of smart equipment -Subscription fees -Brokerage fees -Pay-per-use fees -Monthly fees	-Sale of smart equipment -Subscription fees -Brokerage fees -Pay-per-use fees -Monthly fees	-Sale of smart equipment -Government funding -Subscription fees -Brokerage fees -Pay-per-use fees -Monthly fees	-Sale of smart equipment -Project funding from industry -Subscription fees -Brokerage fees -Pay-per-use fees -Monthly fees

Table 15: MIEMA business model elements

MIEMA is well positioned to develop pilot and demonstration projects and to interact with authorities to encourage changes in the regulatory framework. Moreover, it is a one-of-a-kind institution in Malta.

Keys barriers to further dissemination include regulatory and market barriers. A key step is thus to conduct more pilot projects and increase awareness of the latter to showcase the value of local electricity markets to citizens, local businesses, tourism, municipalities and Malta as a whole. Key opportunities are to expand the pilot projects that have already been conducted to other potential customers such as SMEs, municipalities (e.g.

schools), associations (e.g. tourist-related). To achieve this, a stronger ecosystem needs to be put in place.

- MIEMA could prepare itself ahead of possible regulatory approval and look into the use of blockchain technology to facilitate local markets between neighbours.

7.2.8 **CITCEA**

CITCEA provides important technical expertise for further developing the EMPOWER ecosystem. Central to the exploitation of the EMPOWER concept is technical reliability and adoption to different local power systems. Different challenges are associated with this situation:

- Local grid typology between island and coupled-modes: Local grid typology varies widely and further technical expertise is required to understand how EMPOWER markets can be physically implemented in different local set-ups. Prior to implementation, testing is required in some instances, and even the development of novel technical solutions.
- Reserves for local power markets: On the local level, novel strategies are required to set-up reserves for local power markets. Doing this is a technical challenge, and it is important to further test and simulate such market features before implementation.

CITCEA provides the infrastructure and knowledge for physically testing energy market designs before implementing them. This can represent a valuable business model within the EMPOWER ecosystem.

Business Model elements	Business model “Testing special grid requirements”
Value proposition	-Test market design at the local level. -Reduce uncertainty, detect novel technological requirements and develop novel technological solutions. -Provide power engineering expertise and related consulting services, such as certification of local power markets and feasibility studies
Value configuration	-Provide a grid test center and state-of-the art technical expertise, as the physical requirements of local power markets. -Ongoing and repeated participation in piloting, and demo sites.
Monetization	-Grant applications with public administration. -Project funding from industry for the development of specific technical requirements. -Consulting fees. -Certification fees.

Table 16: CITCEA business model elements

- Develop certification services for local power markets (either in cooperation with existing certification provides such as TÜV, or independent certification providers).
- Develop a product for assisting with undertaking technical feasibility studies related to the establishment of local power markets, and approach local utilities and energy cooperatives to conduct such feasibility studies.

7.3 Competitors: Peer-to-peer vs. peer-to-platform

The EMPOWER concept facilitates a peer-to-platform approach, in which data management, contracts, and the whole service is realized using a centralised platform to support the local power market. However, blockchain based technology has recently been attracting more attention in the energy industry. Blockchain offers an alternative, peer-to-peer approach. While the EMPOWER software architecture could potentially also be extended to incorporate blockchain, it is important to monitor upcoming competitors to understand if there is a threat of substitution, and what implications should be drawn for the EMPOWER ecosystem and the exploitation of EMPOWER.

In relation to this objective, we have extended the EMPOWER case study database to include blockchain-based business models and projects. It appears that within the blockchain energy community, some quite tightly linked individuals and groups are already cooperating. Figure 10 depicts the emergent electricity blockchain ecosystem.

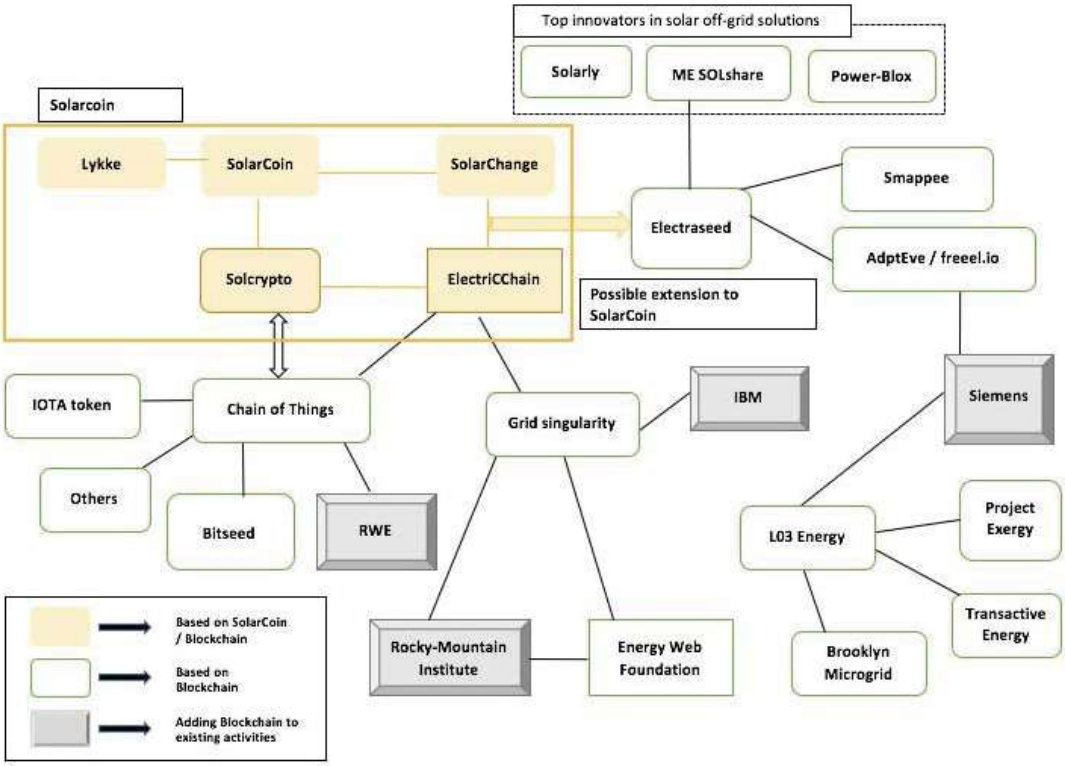

Figure 12: The complementary block chain ecosystem

A more detailed description and analysis of the individual players in the blockchain ecosystem is available on request. Our analysis has shown that blockchain technology will eventually offer an advantage in terms of the deployment of technology, and with regard to the speed of technology development. However, this threat could be mitigated if eSmart Systems also speeded up the required modification of the software and leveraged their early mover advantage. The close links between eSmart Systems and the FEAS cluster which allows rapid testing in a solid energy management and grid setting still provides a competitive advantage (especially if the linkages to Microsoft Azure can be expanded; Microsoft Azure is offering blockchain-as-a-service, which could also represent an additional means of protecting the competitive advantage).

However, the blockchain ecosystem is evolving very rapidly and is receiving significant attention from large players in the energy industry and beyond (blockchain is one of the hottest buzz-words in energy innovation at the moment, and some major players are part of the blockchain ecosystem - such as IBM and Siemens - and some of the most innovative business models such as solar coin, involving SAP, are central drivers of the energy blockchain ecosystem). As a result, exploitation and modification of EMPOWER needs to be fast and strategic.

7.4 Steps for ecosystem exploitation

A central bottleneck is the eSmart System software package. The FAT and the respective illustrations (a video presentation and sales-related power-point presentation by Stig Ottesen which outlines the functionality and components of the software system and the matching hardware) were a huge and important step towards successful exploitation of the EMPOWER concept. However, given the strong competitors and the important and critical feedback received from the acceptance studies, more work is needed. The following steps appear to be important.

1. An easy-to-implement and downloadable trial version is required to link potentially interested parties to the software, and to enable testing.
2. eSmart Systems should establish the organizational structure that supports further agile development and modification of the software. In particular, the development of two related software packages is needed: One for utilities in specific countries (as a starting point, Germany) and one for energy cooperatives. Follow-up projects that undertake the required modifications should be initiated (the project with Christian Kunze, Oliver Breig and Energiedienst Rheinfelden is a good illustration of such work). A similar approach is also needed for the energy cooperatives, ultimately in collaboration with https://buergerwerke.de. An ideal setting would be for EMPOWER partners to aspire to become sales representatives (eventually in agreement with eSmart Systems). eSmart Systems should also develop a sales mentality and create a software team capable of efficiently developing the software package.
3. A structured sales approach should be developed for targeting utilities who may buy EMPOWER software. Such a sales strategy should be developed in accordance with eSmart Systems and should be different to the more passive ‘workshop approach’ that is part of the EMPOWER project. Commercial interests drive sales activities.
4. Similar to the utility approach, business development with energy cooperatives should be intensified. The acceptance studies described in this report provide a roadmap for how to translate the EMPOWER project into an interesting product for energy cooperatives. NewEN and eSmart Systems should work together to shape the final product and negotiate an agreement so that NewEn can ramp-up sales activities.
5. The supply side of the EMPOWER project should be improved. For instance, it would be desirable for Schneider to investigate if they can offer the products and services that are required to set-up SESPs. Additionally, FEAS could consider whether it can take a more active role in distributing EMPOWER. FEAS might be interested in taking

over the warehousing and retailing activities and hosting and optimizing the provision of the products and services that are required to set-up a SESP.

6. Overall, it seems advisable to look for a larger sponsor and investor who can back the EMPOWER ecosystem. While Schneider – a large-international corporation – would have the potential to act as such a facilitator, other partners may be feasible as well. A potentially very interesting partnership would involve the more pro-active participation of Microsoft. Accordingly, a roadshow and presentation of the concept at Microsoft headquarters to top management is recommended (ultimately involving representatives from eSmart Systems and UNISG).

8 Implications for the EMPOWER project

8.1 Practical implications

The acceptance studies provide the foundation for understanding the demand-side view of the EMPOWER project. Such a demand-based perspective complements the supplier perspective in important ways, and points to the opportunities that are available for optimizing the current EMPOWER products, services and business model. In the following, we describe a selection of important practical implementation-related issues that arise from the findings of D2.3.

In general, the acceptance studies reveal broad prosumer interest in participating in local energy markets. However, the level and the particularities of acceptance differ - for instance, across countries (see cross-country study, 6) and with the technological set-ups the prosumers are prepared to accept (see the flexibility-related study and the comparison between prosumers with PV-battery equipment and heat pumps) and thus the respective market segments. A phenomenon accompanying this high level of general acceptance is an increase in competition. Strong complementary offers such as those by buergerwerke.de and Vandenbron should be considered when optimizing important business model elements, such as the design of the customer interfaces, and prices. Given the generally high acceptance of the EMPOWER concept and the increase in competition, the first important implication centres on sales: EMPOWER project partners and the EMPOWER business ecosystem should develop sales ambitions. In particular, we suggest:

> *Action item 1: improve ecosystem efficiency and sales capabilities. For instance, develop sales agreements among partners and define precise, saleable, product offerings.*
>
> *Action item 2: Set-up sales and development teams beyond the EMPOWER project. Create a sales force that will endure in time.*

Sustainability values are a strong motivational driver behind the acceptance of the EMPOWER concept. This fact become apparent from the multi-country study (p.14) and the energy cooperative study, which revealed that sustainability certificates would drive acceptance. It is advisable to position EMPOWER even more strongly as a facilitator of sustainability goals, such as by integrating into its product offering large shares of locally produced, renewable energy.

Action item 3: Calculate the distinct sustainability contribution of EMPOWER and integrate this contribution into the value propositions of the different EMPOWER business models (e.g. display how EMPOWER helps communities to achieve their sustainability goals)

The current acceptance studies reveal how important but also how difficult it is to transfer some of the core values that EMPOWER potentially offers to the demand side. Such value transfer is an opportunity to increase the willingness-to-pay for EMPOWER based service and offerings. Also, the value focus follows a trend which highlights the role of "system service capabilities of variable renewable energies" (IEA, 2016). However, acceptance studies, as for instance the energy cooperative study, point to the still dominant role of cost/price. In contrast the multi-country study of this reports reveals the potential of some of the important value drivers that customers would appreciate. These revealed value preferences (e.g. in regard to sustainability, locality, ease-of-use, reliability, independence) tie in and confirm some of the value propositions that have been developed for instance in D6.1, D6.3 and D6.4. and find reference in the recent conference publications about the EMPOWER concept (Bremdal, Olivella, & Rajasekharan, 2017; Bremdal, Olivella, Rajasekharan, & Ilieva, 2017). Based on the results of this report (D2.3) we recommend that the value added for the demand-side perspective is to be realized in three different ways:

Action item 4: Packaging added value bundles. When crafting the value proposition for EMPOWER participants need to be more carefully made aware how EMPOWER supports sustainability goals, strengthens the community, reduces the influence of foreign multi-national companies or supports a reliable local energy system. Through such packaging of values, EMPOWER products and services are becoming distinct from competing offers in the energy domain.

Action item 5: Sponsors, that have an interest in financing a multi-sided business model, can provide additional value and should be considered (for the concept and definitions of multi-sided EMPOWER business models see D2.1-D2.2.). For instance, large local companies might become a sponsor for the EMPOWER concept as they intend to increase local reputation by facilitating a local energy market (this opportunity has been developed in the preparation work for the energy cooperative acceptance study of this report). There is a large potential for such a local sponsorship, and local sponsors can become important facilitators of the EMPOWER concept and local power markets. In such, D2.3. supports from

a demand-side perspective the concepts of platforms and multi-sided business models which have been referred to and developed in D2.1, D2.2 and D6.3.

Action item 6: EMPOWER offers efficiency gains in regard to operation and maintenance that need to be highlighted. These efficiency gains can be particular valuable for energy cooperatives. The SESP can be beneficial in this regard by consolidating the needs and operations of multiple communities and energy cooperatives. This creates value, as EMPOWER can leverage economies of scale. Additional services can be developed, such as remote data diagnosis and all kinds of apps that can be downloaded from the cloud.

Costs and economics are important factors in the acceptance of EMPOWER. The multi-country study points to the role of economics as a profoundly important component of acceptance across different countries (p.6). Additionally, electricity prices differ considerably among EU member states, and the energy cooperative survey also indicates that the EMPOWER offering in Germany should not charge more than 100 EUR for hardware, and an electricity price of below 29 Cent / kWh, if a local electricity tariff is created.

Action item 7: Target a reduction in hardware and software costs, and build long-tail business models that are financed through economies of scale rather than high prices.

Action item 8: Modify the price list of Smart Energi for Germany to match the suggested price cap.

Action item 9: It is advisable to integrate a further price element that favours the EMPOWER concept. For instance, the value of CO2 reduction which EMPOWER provides could be factored in. For example, the EMPOWER offer should be coupled with a local CO2 certification scheme which would give it an economic advantage over incumbent systems.

The energy cooperative study showed that prosumers prefer a high degree of self-consumption (if possible, even 100%). However, case studies and business modelling projects with energy cooperatives revealed difficulties with meeting this ambition. One challenge is that nor all prosumers attribute high value to flexibility (see the study on willingness-to-co-create); another challenge is that the production capacity of distributed prosumers might not suffice for meeting the demand for high shares of local prosumption. In the work towards D2.3 and the respective business modelling workshops, two solutions to this problem emerged, which we refer to in the following suggestions:

Action item 10: Modification or variation of the DSOlocal business model should be considered so that local utilities target large prosumers (such as SME companies that are motivated to take over the roles of active energy-citizens). Such SMEs may be incentivized to install larger energy production assets (e.g. because this fits their sustainability targets). Based on integration with the EMPOWER software, these large prosumers can supply their excess electricity to local consumers.

Action item 11: The Our Power model for energy cooperative should differentiate between active and passive members of the energy cooperative. Active members can increase their investment and risk, and extend resources for energy production. Passive members will "only" purchase electricity from the cooperative. A business-modelling project with students from the city of Konstanz showed that roughly one-third of the members of an energy cooperative can be considered active, and two-thirds passive.

The multi-country study revealed that, although prosumers are generally interested in participating in local energy markets, their information-gathering process is centred on other topics, such as e-mobility and solar PV (see p. 6). The impact of this should be considered.

Action item 12: PV and electric-mobility should be stressed more intensively in communication with prosumers to attract them. It is even advisable to more strongly integrate e-mobility and vehicle-to-grid into the EMPOWER framework.

The acceptance study with energy cooperative members shows that cooperative members in Germany assign only limited value to the distinct offer of ICT-based services. However, the basic proposition of the EMPOWER concept is regarded to be of high value (local prosumption). As the acceptance study about prosumers' willingness to provide flexibility showed, one effective way of interacting with prosumers is through novel tariffs, such as tariffs for local electricity.

Action item 13: The EMPOWER concept should be used to offer a local tariff for energy cooperatives. This local tariff should consider a low-tech version of the EMPOWER concept. Marketing and sales should be realized through NewEn. Preparation work, while collaboration between NewEn and eSmart Systems is required.

It is an important aspect within the EMPOWER concept to look at the strategies of how to market flexibility (e.g. flexibility sold to the DSO vs. flexibility sold to the TSO).

However, the acceptance studies look of this report at the step before the flexibility can be brought to the marked and explore the willingness-of-prosumers to actually provide flexibility. The results support propositions that have been developed through the learning at the EMPOWER pilot-sides in which lead prosumers indicated that they would require a certain degree of automatization. In such, the acceptance studies underline the importance of initiatives in WP7 (conducted by Smart Energi) to provide gadgets to prosumers that organize the flexibility in an automatized way (within certain boundaries that prosumers define). Especially the acceptance study about willingness to provide flexibility shows that prosumers that are operating a PV-battery system assign only little importance to the use of flexibility. On the one hand, this suggests that prosumers do not require a high return in regard for their flexibility. However, it also suggests that prosumers are hesitant to take an active role in terms of providing their flexibility, and for instance engaging with EMPOWER functionality. Based on this, we suggest:

> *Action item 14: The EMPOWER services that enable trading and sharing electricity should be automated so that prosumers are not required to take an active role. However, prosumers should be given the choice to turn on (off) the automatic option, as some prosumers (e.g., those that provide flexibility based on heat reserves and heat pumps) assign high value to flexibility. For those prosumers, greater incentives are required so that they are willing to provide this flexibility.*

It will become important to work further on the integration of devices that are linked to automated flexibility provision for EMPOWER and home automation kits with EMS functionality that are already available (e.g. Apple Home Kit, NEST). The multi-country study of this report shows how high prosumers value ease-of use. Thus, seamless integration of the different systems will be important. Potential co-developments and integration with already existing devices could bring costs further down for the EMPOWER hardware, which would be important for market acceptance.

8.2 Implications for pricing

Here we look at the current pricing scheme (as suggested within WP7 by Smart Energi) and challenge it with a selection of results from the different acceptance studies conducted under T2.3. Based on this, we identify important implications for the further development of the EMPOWER concept and its dissemination, especially regarding pricing.

The acceptance studies indicate that the pricing and economic considerations of prosumers must be considered. However, as most prosumers currently lack full and expert knowledge about the value of local energy markets, it is important to translate EMPOWER-related products, services and prices into meaningful concepts for prosumers. Acceptance studies 1 and 3 identified the need to translate the EMPOWER offer into a power tariff, and suggested the construction of a feasible tariff design. As such, both studies developed ideal-type EMPOWER based tariff models. An important component of these tariffs is the capture of costs based on electricity prices (e.g. in cents / kWh). These prices differ considerably across European countries (http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_price_statistics).

One translation of the EMPOWER pricing scheme as developed in WP7 is as follows. The starting point is the current pricing scheme that was developed in WP7 (see table below).

Device	EUR
Gateway incl. ext. meter interface, EMI LED/IR, cable	136
Prosumer Meter	232
Smart Plug Mini	45
Smart Relay 30A	80
Software license E2U	47
Shipping, handling not included.	

Portal	EUR
Basic license and establishment of a module in end-user portal minside.smartenergi.com. Unit per EMPOWER pilot area.	3.000
Module for language adaption and translation of language for the project. Unit per EMPOWER pilot area.	
Registration and creation of new end-user in the portal, iot (internet of things) management system and the eSmart Systems platform	110
Usage license per month per end-user for minside.Smartenergi.com portal	9

Table 17: EMPOWER pricing scheme (WP7)

If we assume we allocate seventy prosumers per basic license (which allows us to equally allocate the costs of the basic license to each of the prosumers) the total instalment costs is 692.86 EUR per prosumer. Additionally, per consumer yearly costs for usage of 108 EUR apply. Hence, a one-year contract would cost 800.86 per prosumer (installation costs + usage costs for one year). A two-year contract would cost 908.86 EUR for two years (installation costs + usage costs for two years) and a three-year contract 1016.86 EUR, respectively. To translate this into a relevant measure for comparison from the prosumers' perspective (i.e. electricity costs per kWh), we divide

the EMPOWER price premium by the average electricity consumption of households (e.g. in Germany: 4.000 kWh), which gives the following price premiums per kWh:

- 1 year = 0.20 cents / kWh required EMPOWER premium
- 2 years = 0.11 cents / kWh required EMPOWER premium
- 3 years = 0.08 cents / kWh required EMPOWER premium

It is important to note that this price premium is required on top of the actual supply of electricity as it "only" covers EMPOWER-related hardware and software expenditure as listed in the WP7 pricing scheme.

It is further important to note that the acceptance studies conducted for T2.3. revealed that, even in countries with high electricity prices (like Germany), prices for electricity of above 29 cents / kWh have limited acceptance (see cooperative study). In conclusion, the required price premiums for the 1-year contract particularly, but also for the longer contracts, appear to be somewhat unrealistic.

Moreover, additional charges for hardware supply are faced with low acceptance in the currently suggested price range. Our acceptance studies indicate that hardware costs should not rise above 100 EUR.

In the following, we suggest different steps for mitigating this issue of pricing. We develop two scenarios: in the first scenario EMPOWER is able to bring down costs in a radical manner. In the second scenario, price decreases are modest. However, in both scenarios it appears inevitable that the current pricing (and the costs of supplying the EMPOWER hardware and software) are optimized.

Device	**EUR**
Gateway incl. ext. meter interface, EMI LED/IR, cable	50
Prosumer Meter	100
Smart Plug Mini	20
Smart Relay 30A	20
Software license E2U	0.5

Portal	**EUR**
Basic license and establishment of a module in end-user portal minside.smartenergi.com. Unit per EMPOWER pilot area.	3.000
Module for language adaption and translation of language for the project. Unit per EMPOWER pilot area.	

Registration and creation of new end-user in the portal, iot management system and the eSmart System platform	40
Usage license per month per end-user for minside.Smartenergi.com portal	3

Prosumer contribution	**EUR**
1-time prosumer contribution for hardware	100

Table 18: Suggested scenario 1: major revision of target prices

Based on the acceptance studies, it is advisable that prosumer payments for devices should not exceed 100 EUR, but that a price of 100 EUR may be levied[11]. Taking this into account (again, based on seventy prosumers per system), this equates to a cost of 173.36 EUR per prosumer.

- 1 year = 0.05 cents / kWh required EMPOWER premium
- 2 years = 0.03 cents / kWh required EMPOWER premium
- 3 years = 0.02 cents / kWh required EMPOWER premium

If this price premium is integrated into a system in which electricity costs (incl. the EMPOWER price premium) do not exceed 0.29 cent / kWh, market acceptance could be promoted. However, it is important to note that even this price level is only slightly less expensive than competing offers that already offer community power (e.g. for 27,50 Cents / kWh and 8.90 basic price per month ≈ 30.13 Cents / kWh https://buergerwerke.de/strom-beziehen/tarifrechner/#taca).

Scenario 2, with modest pricing adjustments, is a bit more challenging to realize, as it requires external sponsorship for re-financing additional hardware expenditure. Table 19 gives an overview of the target pricing for the modest pricing adjustment strategy. In the following, we outline two opportunities for accommodating the additional costs. Under the same assumptions as stated above, this pricing scheme generates costs of 322.86 EUR per prosumer.

Device	**EUR**
Gateway incl. ext. meter interface, EMI LED/IR, cable	90
Prosumer Meter	150
Smart Plug Mini	30

[11] Competing suppliers such as tiko also require that prosumers co-invest in hardware: https://tiko.ch/page/product_power/

Smart Relay 30A	50
Software license E2U	20

Portal	EUR
Basic license and establishment of a module in end-user portal minside.smartenergi.com. Unit per EMPOWER pilot area.	3.000
Module for language adaption and translation of language for the project. Unit per EMPOWER pilot area.	
Registration and creation of new end-user in the portal, iot management system and the eSmart System platform	40
Usage license per month per end-user for minside.Smartenergi.com portal	5

Prosumer contribution	EUR
1-time prosumer contribution for hardware	100

Table 19: Suggested scenario 2: modest revision of target prices

Sponsorship through a reserve electricity tariff[12]: One opportunity emerges through sponsorship based on reserve electricity supply and an additional reserve tariff. In such a scenario, two electricity supply tariffs would apply. The first is the local electricity supply. This tariff does not cover the EMPOWER premium. However, as it is difficult to target a 100 % supply of local electricity, reserve electricity is required, which comes at a higher price (and thus is able to cover the EMPOWER price premium). A model calculation looks as follows: A household covers 50% of its 4.000 kWh yearly energy consumption with local electricity (the local tariff: 29 cents / kWh, no EMPOWER price premium), which adds up to 580 EUR. The remaining "reserve electricity" contains the EMPOWER premium (the reserve tariff applies: e.g. 0.08 cents / kWh for the three-year contract duration). The costs of the reserve electricity are in this example calculation 720 EUR, adding up to a yearly electricity cost of 1300 EUR (in total: costs under tariff 1 and

[12] The opportunity for developing offerings around the flexibility that differentiate between a base offer and an extended offer (e.g. reserve electricity provision) has already been developed in other parts of EMPOWER, through the notion of combos (see WP6). A possible benchmark example relates to flight tickets (e.g. the SASGo ticket gives you a seat on a particular flight. It is usually very cheap. In contrast the SASPlus is a combo which is more expensive then SASGo, but provides additional value and allows for rebookin (flexibility) at any time, no need to pay extra for luggage or food. The price difference between SASPlus and SASGo basically reflects the value of flexibility and services on top of the basic fare). More information about these combos have been developed in the work of WP6 and D2.3. supports these kind of mechanics from a demand-based view.

2). This model potentially works, as the reserve provision provides additional value (e.g. the multi-country study showed that prosumers value security of supply), which can justify the premium from a demand-based perspective.

Sponsoring through CO_2 pricing: A second opportunity emerges through coupling the EMPOWER system with an additional, sustainability-related value proposition. It was revealed in all acceptance studies that sustainability attributes can be important drivers in terms of the acceptance of the EMPOWER market design. Accordingly, a solution may be designed which highlights the EMPOWER contribution to integrating renewable energy into the electricity mix. In countries with a relatively high share of CO_2-emitting energy production assets, this can be an idea worth consideration. The following calculation illustrates the value proposition: Each 1MWh of renewable energies contribute a reduction of 0.5t CO_2 emissions. EMPOWER facilitates the integration of renewables. If households consume 4 MWh of renewables facilitated by EMPOWER, the CO_2 reduction would be 2t. The total cost now depends on the pricing of the CO_2 emissions. If local governments placed a value on CO_2 of 30 EURs per t of $C0_2$ emission (https://www.bloomberg.com/view/articles/2017-02-20/europe-needs-a-higher-price-on-carbon), the $C0_2$ 'sponsorship' would bring down the system cost of the EMPOWER system considerably (0.05 cent / kWh premium).

8.3 Impact on the work of other WPs

We see major implications for WP5. First, to support short-term sales efforts, a trial version is required. Second, customer interfaces need to be improved rapidly. Other systems (e.g. vandenbron and tiko) set a high benchmark, which the current design of the customer interface does not yet match. Third, it is advisable to split up the software product into two different product lines: one supporting the utility business model (DSOlocal), and the other supporting the energy cooperative business model (Our power, with a low-cost hardware/software solution). Fourth, in order to support sales and facilitate ongoing agile development, the organizational structure should be adjusted to ensure that requirements for modification be realized quickly and efficiently. A good solution would be to assign a small project team of 5-7 people only to the commercialization and further development of the EMPOWER software. Fifth, sales agreements with knowledgeable and committed sales partners (preferably current project partners) should be drawn up in order to ramp up sales. However, an important precondition to ramping up sales is the guarantee that the required modifications will be realized in an efficient and timely manner. Sixth, we recommend involving a strong

additional partner to help with software development beyond the end of the project. Further funds will be required, which can be raised through follow-up projects. However, the more direct involvement of strong partners, such as Microsoft, would support sales.

We see major implications for WP8. The acceptance studies described in this report provide detailed guidance for the preparation of the final dissemination activities and the two important dissemination workshops that will be prepared and conducted under the leadership of WP8. Most important is the formation of the ecosystem and the awareness raising of different partners about the specific role that they should play within the ecosystem. Additionally, it has become apparent that throughout the remaining activities of WP8, sales capabilities at the partner level have to be stimulated. As of now, the EMPOWER partners are too hesitant about sales, and D2.3. highlights the need to increase sales efforts (e.g. based on the readiness of the market and the emergence of competitors).

We also see major implications for WP7. The fine work in WP7 has so far produced valuable routines and learning outcomes that are also relevant to exploitation. For instance, throughout WP7 a routine of evaluating pilot-side projects has been developed. In addition, distinct hardware products and solutions for mitigating problems that are associated with the installation of the hardware and the connection of the hardware to the cloud-based system have been developed. However, as of now the stock of knowledge is not efficient, and the more structured collection of information about which kinds of products and services (e.g. site assessment routines, hardware equipment) is needed to set-up the EMPOWER system is required. We suggest that these products and services are compiled in an ‘EMPOWER web-shop’ so that future projects can pick and choose products and services. The nature of the ownership of such a web-shop should also be agreed on in WP7. It appears that there can be two web-shops: one by FEAS (e.g. Smart Energi) and one from Schneider.

We also see major implications for WP9. The insights from the acceptance studies now need to be further developed into publications to effectively communicate the information to managers, policy-makers, prosumers and researchers across Europe. This work has already been initiated, and three technical papers have been developed and are in preparation at leading journals, such as Energy Policy, Research Policy, and Organization & Environment. Further, the multi-country study will be published as a stand-alone report – this is now in preparation.

Finally, the acceptance studies also have important implications for the ongoing work in WP2. The next step in WP2 is to look at the different regulatory environments and

examine the impact they have on business modelling. Accordingly, input on EMPOWER business models from the acceptance studies (D2.3.), the in-depth case collection analysis (D2.2.), and the conceptual modelling work (D2.1-2.3) will be complemented and combined with the policy-making perspective to suggest opportunities for the modification of Energy Policy to foster local power markets.

8.4 Theoretical implications

The theoretical implications of D2.3 are contained in four research papers that were developed using the work of D2.3 and are under preparation for publication. In the following, the abstracts of the three papers are described. All the papers in their current form are available from moritz.loock@unisg.ch

The acceptance perspective on business models required the development of a novel approach to assessing the quality of business models. The paper is titled "*How good are sustainable business models?*" and was authored by Moritz. It is now under review. Abstract: "This paper provides a novel view on sustainable business models as heuristics. This novel view allows to remedy an important gap in the current research and practice of sustainable business models: Earlier research has been surprisingly vague on business model quality. This is an urgent practical problem, because both start-ups and established firms often find themselves in positions that require designing or redesigning high-quality sustainable business models. Grounded in the study of business models the paper suggests a novel research agenda on how the quality of sustainable business models emerges from three pillars: (1) how the business model aligns different and even conflicting environmental, social and economic interests; (2) what kind of information and established power the business model ignores and considers; and (3) what goals and performances the business model aspires and actually achieves."

Further investigation of the EMPOWER case study collection and interviews with partners within the EMPOWER ecosystem has led to the creation of a novel perspective about how innovation is created in digital energy entrepreneurship. The related paper is titled "*How business models are spinning innovation in sustainability transitions*", and is co-authored by Moritz Loock & Anne_Lorene Vernay. Abstract: "While in sustainability transition research the distinction of interests and the competitive dynamics that occur from these distinctions are important, social innovation theory also points to co-creation and integration activities that business models are governing. However, it is unclear how business model innovation in sustainability transitions negotiates among different

interests. To remedy these gaps this paper develops a new framework to study nested business model innovation. Using this framework, an investigation of thirty-one digitalization-based business model innovations in the power sector reveals different activities of innovation spinning: (1) formation of innovation coalitions, (2) solution co-creation, and (3) configuring of distinct innovation topics, such as self-prosumption, sharing, community formation and linking. The different activities impact each other in such that innovation coalition impact co-creation and innovation topics and co-creation has an impact on innovation topics. Implications apply for micro-foundations of behavioural innovation in sustainable transitions and business models as innovation heuristics."

The willingness to provide flexibility acceptance study described in this report is taken into perspective with two associated studies from related projects: the *HeatReserves* project, which investigated reserve-provision based on heat, and an e-mobility project at HSG that investigated the linkages between e-mobility and the integration of renewable energy into the grid. All three studies are integrated in one publication co-authored by Merla Kubli, Moritz Loock and Rolf Wüstenhagen. The title of the paper is "*The flexibility prosumer: Measuring the willingness to co-create distributed ancillary services*". Abstract: "Flexibility is an increasingly important resource for power markets. However, so far it is unclear if and how consumers are actually willing to provide flexibility. We develop a model to measure consumers' willingness to co-create flexibility. Based on the analysis of 7.216 individual choices in a series of three choice experiments with 902 Swiss consumers in three domains of energy use, we measure differences in consumers´ willingness to co-create flexibility. In particular, our results shows that consumers with heat pumps exhibit a high level of aversion to flexibility, while consumers with electric vehicles or solar PV systems are more willing to provide flexibility. Our results give some indication in which customer segments business models for distributed flexibility are likely to be successful. Finally, we spell out implications for energy policy."

The company acceptance study is available as a working paper by Julia Cousse and Emmanuelle Reuter, entitled "*Social acceptance of local electricity markets by utilities and by countries*". It also contains the thesis of Julia Cousse. Introduction: "The current energy transition is unique in its speed, scope and complexity given that the technology and innovations are progressing at an exponential pace (Gaffney, Livinstone, & Vrins, 2016; Lawrence & Vrins, 2016). The rise of renewables and distributed energy resources, digital infrastructure and changing customer demands, among other factors,

are leading to a new era for energy utilities (Gaffney et al., 2016; Lawrence & Vrins, 2016), where they are forced to innovate. Europe, and more specifically the European Union, has been at the forefront of the electricity market reform over the past decade (ibid.). For these reasons, electric and multiline utilities in Europe are an appropriate setting, in which to examine the acceptance of local electricity markets. Moreover, utilities can occupy roles, which are essential to address some of the challenges that still exist in local electricity markets (e.g. security of energy supply), or to complement the more traditional products and services (e.g. ancillary energy services). Given this market potential for local electricity markets, the starting point of the following study was to uncover: (1) which utilities in Europe have the most market potential for local electricity markets, (2) which factors drive the acceptance of local electricity markets for utilities, (3) which countries have the most market potential for local electricity markets in the European Union, Norway and Switzerland".

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9 Appendix: Multi-country study