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

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Executive summary

The EMPOWER project proposes a fundamental shift in energy market designs, from centralized grid architecture based on large centralized generation assets toward an increasingly decentralized electrical grid that makes use of distributed energy resources, local energy markets. An important enabler but also barrier in regard to the implementation of this shift is the regulatory environment. While the market design (WP6), the business models and prosumer acceptance (WP2), as well as the testing (WP7) have been developed based on profound consideration of energy policy, this report discusses important linkages of EMPOWER business models and regulation, provides an overview of important regulations across European country and outlines, based on the examples of Germany and Italy, opportunities for implementation. As this reports shows – and this was also a strong feedback from the stakeholder surveys that have been conducted in WP8 - the management of energy policy is bi-directional: one the one hand, for implementation and exploitation, EMPOWER business models in each country and instances, need to be adapted to the local regulation in place. On the other hand, the EMPOWER project also provides information for policymakers and encourages some of the proposals of the EU winter package to develop regulations that supports the implementation of local electricity power markets; the latter facilitating the integration of renewable energy and thus helping the EU and the EU member states to achieve important sustainability development goals.

1 Work towards D2.4

1.1 Ongoing work in EMPOWER

Within the EMPOWER project, a detailed market design for local retail power markets has been developed, which outlines how electricity neighbourhoods can balance themselves and which roles and mechanisms are important in this regard and how communities and local dynamics are to be defined (WP6). The distinct business models to realize such novel market design have been developed in WP2, beyond the state-of-the art and novel business models for flexibility provision that had been previously suggested (Helms, Loock, & Bohnsack, 2016). The business models have been further defined considering broad benchmarking studies and investigations of prosumer preferences. As an important facilitator of EMPOWER business models in the envisioned market design, a specific software has been developed (WP5). To test the implementation of the business models and the required resources (e.g. processes, hardware and software), the requirements for the implementation of the EMPOWER concept have been tested in three pilot sides. Based on close collaborations and workshops, business awareness has been created (WP8 and 9) and market interest of the EMPOWER concept has been further diffused in award winning activities such as the foundation of a venture for exploitation (Newtility) and through winning a start-up competition with eight local utility companies in Germany.

While these activities all acknowledge and consider the important role of policy in shaping and exploiting the EMPOWER concept, it has been foreseen in the DOA that some of the important linkages of EMPOWER based business models and the regulatory environments have to receive distinct consideration in this report (D2.4). However, it was important in the work so far to focus on ideal-type development of the EMPOWER market design, business models and tests to showcase the feasibility of local power markets. As regulation can be an enabler but also a barrier, innovation projects provide an opportunity to protect these innovation activities from incumbent regime rules (Geels, year), which is an important precondition of innovation. However, in the next step, in which after conclusion of the EMPOWER project the EMPOWER concept will be integrated into business, a profound overview of the sensitivity of EMPOWER in regard to policy is warrant.

1.1 Goal of Deliverable 2.4

The main objective of Deliverable 2.4 is to support the dissemination and implementation of EMPOWER. In such, the main goal of deliverable 2.4 is to inform managers and entrepreneurs, that are interested in picking up the EMPOWER concept and setting up a local power market, how to go about it and current regulations to consider. A subsidiary role is also to point to opportunities for optimizing regulation for policy makers to design efficient guidance for the implementation of local power markets.

The final task looks into the factors that enable and constrain the successful diffusion of decentralized, prosumer-oriented business models. It specifically defines key areas of regulation relative to local electricity markets and smart grids. It monitors and evaluates the countries' practices in those areas of regulation. Finally, it seeks to assess the effect of the regulatory environment on the successful diffusion of smart grid-related business models. To do so, we conduct desk research to identify the key areas of regulation. We also conduct empirical research to look into the effect of regulation on the adoption of smart grid-related business models.

To support this ambition, the sub-goals of the deliverable present different sub-tasks which contain an overview of important aspects of the EMPOWER concept in regard to regulation. They provide an overview and assessment of the regulatory environments of EU member states in regard to EMPOWER to provide detailed insights into two policy regimes (Germany and Italy) and, as a blueprint, outline detailed opportunities for how to manage implementation through considering local regulation.

Work in D2.4. has been conducted through accomplishing different sub-tasks: In ST2.4.1, we review and classify important results of EMPOWER so far to consolidate the work in EMPOWER. Desk research has been conducted to uncover the most critical areas of regulation when it comes to local electricity markets and their effect on the level of adoption of smart grid-related business models. The particular task involves the following steps: assess key areas of regulation, evaluate selected countries practices in each area of regulation, assess relationships between regulatory frameworks and the level of adoption of smart meters at the country level, and assess relationships between regulatory frameworks and utilities' attention to smart grid-related technologies. Based on these analyses, we will be able to uncover the critical aspects of regulation that may promote or hinder the successful diffusion of smart grid-related business models. On this basis, we will be able to derive implications for management and for policy makers, as specified next. Inputs for this task are derived from

WP2, WP6, the test beds (WP7) and activities of business awareness creation and communication (WP8 and 9). Outcomes are an overview of regulatory contingencies and specifics of EMPOWER business models and EMPOWER business modelling.

In ST2.4.2 we derive implications for management. In particular, we conduct a sense-making processes of EMPOWER from a management perspective. In particular, we leverage the processes underlying the venture creation of Newtility based on the learnings gained throughout the EMPOWER project and dissemination efforts. As outcomes, we present a blueprint of a management process tool to develop EMPOWER business models. This tool can be applied based on a country map which we develop and present here that uncovers the relative attractiveness of EMPOWER business models with respect to the regulatory framework in place for different countries.

In ST2.4.3, we have derived implications for policy that especially have been presented in the two research papers for the journal Energy Policy (Helms et al, 2016; Kubli et al 2017). This task translates the insights of the previous task to recommendations for energy policy and management. This task is conceptual work and develops a set of measures that transfer the insights from WP2 to energy-policy. Important outcomes are policy recommendations to facilitate EMPOWER business models. Sub-task ST2.4.4 refers to the write-up and final review of this report with contributions to management and policy.

1.2 Structure of this deliverable

The deliverable is structured as follows: First, we discuss important features of the EMPOWER concept. These foundations leave us to consolidate essential aspects of the EMPOWER concept and project, and outline starting-points for a detailed investigation of the role of current and future policy. Second, we provide an overview and conduct an assessment of the regulatory environments across the EU member states. We integrate this assessment with the findings of our multi-country prosumer acceptance study (D2.3.) to give a guideline for market attractiveness in regard to EMPOWER. Third, we provide a detailed discussion on the regulatory environments in Germany and Italy. We have chosen the focus on Italy to accommodate the work of an intern that has been visiting the EMPOWER project from Turino, Italiy, under kind support of the Shape programme (which supports mobility among Horizon2020 researchers) Italian perspective. We go into details in the German regulatory environment as the market exploitation beyond Norway is most mature in Germany (as the high appreciation of Newtility shows). Based on the regulatory contingencies and the feedback from exploitation and business awareness creation, we present an implementation management model based on different phases that can be used to implement EMPOWER under the constraints of current and changing regulation. Finally, we draw implications for management and policy.

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

2 Important features of the EMPOWER concept

A key component of the EMPOWER market concept and of the business models to enact and supple EMPOWER markets, is the Smart Energy Service Provider (SESP). D2.2 has specified generic business models to realize the SESP and how either local utilities or local energy cooperatives can take over the SESP role. The development and implementation of business models to enable the SESP (as specified in D2.3. and the EMPOWER ecosystem), are less of a challenge in regard to regulation, as provision of services, hardware and software is feasible without problems. Also, it appears that whether it is utilities or energy cooperatives that take over the SESP role, is not a real regulatory problem. However, some specifics may apply as different organizations have to fulfill different regulatory requirements.

As WP 6 clearly states, the SESP role was defined as a “stack of functions” that can easily be separated to fit different legislative regimes. This implies that in some regimes a combination of some functions could work, while in other different combinations may be required. The whole SESP concept is not likely to be edible for any regime unless it is, at least, distributed among different players. This could imply that one entity becomes the community manager, a third the local market operator, a third – an insourced battery owner, a fourth an aggregator and so on. In regard to regulation, some of the regulatory challenges which are important when considering to implement the SESP are easily perceived, as detailed below.

First, the SESP role is based on the integration of electricity metering, distribution, selling and purchasing, as well as trading. All services are cloud based with open data transfer. In such, the SESP role challenges unbundling requirements as well as privacy regulations for gateway administrators. Also, in some European countries (e.g. Norway), billing of grid usage and electricity supply is separated, while in other countries (e.g. in Germany), it is not. This has to be taken into account when looking at the implementation of EMPOWER across countries. Important to consider are regional specifics unbundling rules, e.g. as referred to in the de-minis-article in regard to "unbundling" as specified in Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC article 26.4.: „Member States may decide not to apply paragraphs 1, 2 and 3 to integrated electricity undertakings serving less than 100 000 connected customers, or serving small isolated systems." http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0072. This option has been for instance taken up in the German energy law EnWG § 7: http://www.gesetze-im-internet.de/enwg_2005/__7.html. An overview in regard to unbundling in different countries can be found for instance here: https://www.ceer.eu/documents/104400/-/-/8f18879a-411e-2fd8-c367-1fa66e3739ed

Second, a central service of the SESP and potential business models, is flexibility provision and leverage. However, in current energy market designs, the TSOs require a minimal bid size of 5 MW for participation in balancing electricity markets (tertiary control). While these mechanisms and corresponding products have been optimized to fit the needs of centralized energy market design, adjustments are wanted to support the implementation of decentralized market designs, such as EMPOWER. Suggestion would be adjustment in terms of minimum bid volume, long balancing energy call windows, restrictions for the pooling of processes, short lead time in case of calls and very low variations of load (http://smartinnovationnorway.no/wp-content/uploads/2017/11/CHRISTIAN-KUNZE_Smart-Innovation-Norway.pdf). The specifics of the prequalification are also to be taken into account and the implementation of EMPOWER requires to look at ways of how to reach the minimal bid size and how to form balance groups and proof responsibility for balance groups. While existing prequalification processes are often long and partly not transparent, simplification and standardization would support the implementation of EMPOWER

An important question to consider are financial responsibilities for failures in the delivery of electricity and who is accounting for it. In such, one question that arises is whether compensation payments can and have to be newly distributed among service suppliers (e.g. if, for instance, shifts are required to transfer the payments from the grid company to the IT company that supplies the SESP, it is of interested to understand the regulatory requirements for this transfer). While the implementation of EMPOWER market designs and its aggregated demand response mechanisms are associated with costs, the returns on balancing markets are in parts unclear (as in regard to community-level balancing) or low in general. Also, it is important to consider that balancing schemes differ across countries. While in most current market designs, considering the SESP as a flexibility operator, would require permission of a balancing group responsibility, these processes are not well organized yet and require additional policy guidance.

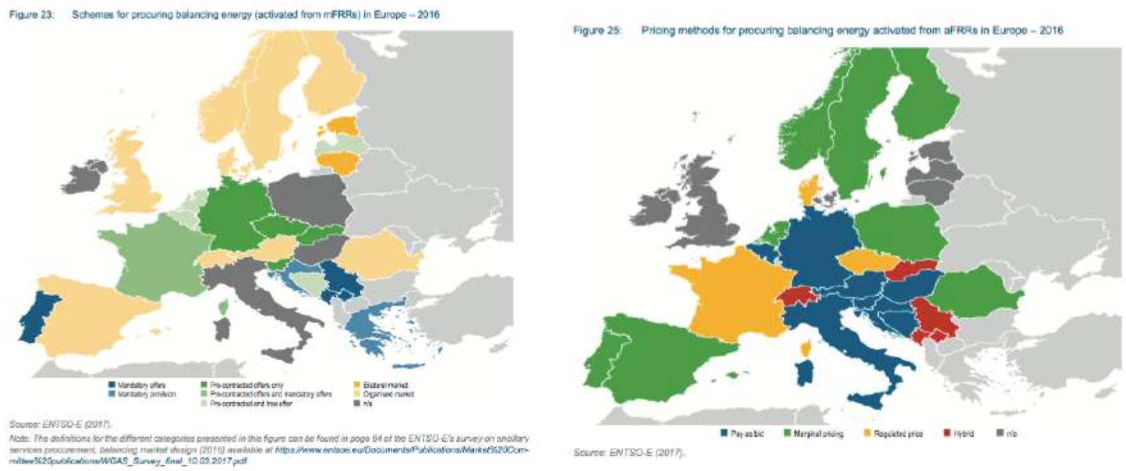

Figure 2: Country specific difference on balancing schemes.

Source:
https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Market%20Monitoring%20Report%202016%20-%20ELECTRICITY.pdf

Third, while a core output of EMPOWER is local and short-term flexibility markets, prices for this service hardly exist. So, it is a question of how (other than through, for instance, the avoidance of grid infrastructure) these incentives evolve. Most likely TSO and DSO will be issuing respective markets, but the regulatory preconditions of launching such new products are affecting implementation efforts of EMPOWER. Most of the flexibility products with a profitable incentive are optimized for large bidders (monthly and weekly bid size of 50-10 MW). Thus, an opening towards EMPOWER adjusted biddings (that are smaller and more flexible) is desired.

Overall, the main objective of the EMPOWER project is defined briefly as “To develop and verify a local market place to encourage active participation of prosumers to exploit the flexibility”. It is important to consider the community aspect and its local, social dynamics (see e.g. WP6 and D8.3) and to also identify the regulatory setting required to fulfil such an objective. In this context, in order to have a local market which facilitates trades between prosumers, their neighbors, and the central electricity market, a set of issues need to be analyzed, and when required, improved. Flexibility (to be considered as a product), self-consumption and storage options, unbundling mechanisms and compensation systems are among the most important subjects to be discussed when developing a local electricity market.

It is important to emphasize that the objectives defined for EMPOWER provide guidance to narrow the scope on how the local energy market and the SESP provide value (see also WP6). Especially the need to increase RES capacity suggested to us the development of long term contracts and deal with short term variations in terms of flexibility. This suggests that EMPOWER might become especially important in regimes where distributed renewable resources have not been very much developed yet. An ambition in EMPOWER was to increase investment in renewable energy resources. In countries like Germany and Spain this is maybe of an issue. Consequently, there are already biases built into EMPOWER that does not necessarily lends itself that well to such countries. This was emphasized by WP6 and WP8 leader Bernt Bremdal for instance during the mid-term review.

3 Regulations in EU countries

Considerable changes in the way energy is produced and consumed are needed to meet the bold energy targets set by the European Union. These targets are set for 2030 and include a 40% cut in greenhouse gas (GHGs) emissions compared to the 1990 levels, a share of renewable energy consumption that reaches at least 27% and savings in energy of 27% or more compared to a business as usual scenario[1]. A significant reduction in GHGs emissions and an increase in energy efficiency can be realized through local energy markets, in which citizens not only consume but also produce energy, or in other words become prosumers[2]. These local markets are established in a local community and based on micro-market concepts that consist of consumers and prosumers of different kinds, as well as of storage facilities. These different market players are then connected through various forms of smart grid enabled

[1] https://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy
[2] University of St. Gallen 2015, EMPOWER - Local Electricity Retail Markets for Prosumer Smart Grid Power Services. Available from : <https://www.alexandria.unisg.ch/id/project/241390> [2 September 2016].

services[3]. To promote the deployment of local electricity markets and by default, of smart grids, policy makers are today faced with many challenges given that a shift from central energy production to a more local one is seen by some as a threat to grid reliability and as a cause of revenue erosion and cost-shifting for energy incumbents. Nonetheless, it is nowadays crucial to establish a clear regulatory framework to deploy smart grids and to leverage the contribution of prosumers in the energy market given that they are a key vehicle for addressing the goals of the 2030 Energy Strategy established by the European Union. Indeed, regulations regarding smart grids and local electricity markets can have a strong influence on how welcoming one country is to their implementation and deployment.

This report aims to look at what regulations are key to the implementation of smart grids and local electricity markets and to compare those across the twenty-eight European countries plus Norway in order to determine which jurisdictions are currently the most interesting to their implementation. Moreover, given that smart meters are crucial to the deployment of local electricity markets, this report will also evaluate if a high degree of implementation of smart meters comes together with the best regulatory framework established.

As a preamble to this report, four aspects are key to be raised. The first one is that one must be aware that a one-size-fits-all regulatory approach cannot be used across all European countries as one must take into account the very diverse national conditions across the different countries. In this way, one limitation of this report is that regulations are not evaluated correspondingly to the particular national conditions of each country but in regards to specific best practices criteria established in the report. The second aspect to note is that regulation best practices may depend on the stakeholder point of view. For example, choosing policies that enable prosumer scale up can be seen as very positive for prosumers and advocates of local energy production and consumption, but these policies may at the same time put pressure on the economic viability of existing utility systems and infrastructures. The pressures may then force governments to change policies abruptly and retroactively, such as in Spain. This regulatory uncertainty can in turn discourage investments and have a devastating effect on the development of local electricity markets over the long-term. In short, the sustainability of regulations was taken into account in this report. The third aspect to keep in mind when reading this report is that given that the aim of this report is to get an overview of regulation across all European countries plus Norway, an in-depth comparison of all regulations such as

[3] http://empowerh2020.eu/wp-content/uploads/2016/05/D6.1_Market-design.pdf

specific tax credits, incentives and so on was not conducted here but could be the subject of further research.

As mentioned in earlier, it is important to note that a one-size-fits-all approach cannot be used across all European countries. In other words, it is not possible to set up a unique regulatory framework and apply it to all countries given that one must take into account very diverse national conditions across jurisdictions. Different regulatory approaches are, to a large extent, determined by the market structures of each country in terms of the degree of competition among the various market players. For example, in the UK, where there is a large number of utilities and competitive markets, incentives can be given on the basis of competition, which is expected to lead to efficient solutions, while in markets where competition is low, such as in Portugal where only a single DSO governs, the regulator must negotiate incentives and monitor its progress directly with the DSO[4.] Another interesting example is Finland, where a very simple self-consumption system exists, without self-consumption incentives in place, and where a competitiveness gap is compensated with tax credits and similar incentives. This framework may be effective in reality for this country, but based on overall practices established in Section 4, this country may not be considered an optimal regulatory framework.

This task is structured as follows. Section 1 assesses the principal regulations that have an impact on the implementation of smart grids and local electricity markets. Section 2 identifies key criteria to narrow down the choice of regulations that should be investigated further. Section 3 specifies some background information about the key regulations selected. Section 4 provides an overview of the status of each regulation for the European countries and evaluates each of them. Finally, Section 5 gives a review of the status of the roll-out of smart meters in the twenty-nine countries.

3.1 Assessment of key areas of regulations

The bold energy targets set by the European Union have prompted new investment needs and have required new ways to plan, build and operate network infrastructures throughout Europe. Regulations have an important role to foster a favourable environment that stimulates investments in innovation on behalf of utilities and at the same time encourage consumers to invest in producing their own energy, or in other words, becoming prosumers. Furthermore, "the EMPOWER concept aims to encourage and enable the active participation of citizens that

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[4] Crispim et al., Smart Grids in the EU with smart regulation: Experiences from the UK, Italy and Portugal, p.9

consume and produce energy in the electrical system." In this way, regulations aiming at allowing consumers to take an active role in the energy markets are key to the implementation of the EMPOWER concept. Moreover, it is also important to look at the effect of regulations on the investment into smart grids given that smart technologies are crucial in helping consumers manage their energy consumption and self-production (Energy Union Package (n 4)). Smart Grids require a deep transformation of the energy industry and in turn large investments to enable a more efficient allocation of resources while encouraging the integration of prosumers into the market.

To find which regulations are essential to the implementation of local electricity markets and smart grids, five key sources have been selected: the European Commission, the Council of European Energy Regulators (CEER), the Agency for the Cooperation of Energy Regulators (ACER), Eurelectric, the International Energy Agency (IEA) and the European Consumer Organisation (BEUC). This selection has been made to get an overall view from different stakeholders who have diverse and sometimes conflicting interests.

In this section, regulations noted as important by the different sources selected are listed. Each area of regulation is detailed in every section based on the author's view. As a result, for the same area of regulation, different ways to regulate the matter can be observed

Sources	**Areas of regulation**

IEA[5]	• Connection of prosumers to the grid: permission to interconnect with the grid, interconnection rules, interconnection application and review fees, interconnection cost recovery and interconnection transparency
	• Feeding of excess electricity into the grid and compensation for it
	  o As most prosumers are faced with the issue of low self-consumption, being able to feed excess energy generated into the grid is key to make self-generation attractive.
	• Compensation for electricity fed into the grid
	  o Amount and level at which it will be compensated (e.g. Net-metering, Feed-in tariff)
	  o Revenue certainty is key to incentivize individuals to produce their own energy. Different compensation levels can lead to different level of certainty:
	    ⇨ Fixed contracts: prosumers are promised a fixed price payment for their production. Typically, Feed-in-tariffs (FiTs) have a fixed price component
	    ⇨ Retail compensation: prosumers are compensated at the retail rate. Given that those rates are subject to change, revenue from self-generation may fluctuate
	    ⇨ Wholesale competition: prosumers are compensated at a rate based on wholesale prices. In this case, prosumers could face considerable revenue uncertainty because of price volatility.
	• Retail rate design:

[5] International Energy Agency – Renewable Energy Technology Deployment (IEA-RETD) : Reseidential Prosumers – Drivers and Policy Options (RE-PROSUMERS), September 2014

	○ If the retail rate design is based largely on volumetric charges, it gives high value to prosumers given that they are only charged for the volume they consume, while utilities may in this case suffer from revenue erosion as a result of decreasing sales. ○ Instead of a pure flat volumetric rate, retail electricity tariffs can include time varying pricing such as time-of-use (TOU) and hourly real-time pricing. This would allow prosumers to be rewarded for the electricity they produce at a rate that is closer to the value they bring to the electricity system and so cutting down cross-subsidies. • Ratemaking: ○ Different ratemaking reforms have been put in place to dampen the effect of energy efficiency on the revenue of regulated utilities. Those reforms have been done to end the relationship between volume of sales and earnings. • Efforts to reduce soft costs for the installation of self-generation systems ○ Lower system costs can promote investments in self-generation • Reviewing taxes and levies ○ To enable prosumer growth, some jurisdictions have removed taxes from solar PV components and others have used tax incentives such as investment tax credits. However, in the medium to long run, taxes on prosumers may be needed, even where jurisdictions support prosumer growth, as the industry adjust to a general shift toward decentralized energy markets.
Eurelectric[6] [7]	• Network tariffs ○ The net amount of electricity sold by utilities is reduced when a consumer becomes a prosumer. In the majority of European countries, grid tariffs for small and medium size customers are based mainly on volumetric charges. This means that prosumers contribute less to the costs of the grid. Moreover, the fixed network costs are not expected to decrease with the increase in decentralised generation because of peak demand. This means that the difference in revenue will then have to be financed by increasing tariffs for consumers who are non-prosumers (cost-shifting). ⇨ The regulatory framework should then ensure that grid costs are fairly allocated between consumers (non-prosumers) and prosumers to avoid cost-shifting. Capacity-based network tariffs would be one solution as it would give incentives to consumers and prosumers to optimise their capacity needs. • DSO regulation to incentivize investment in innovation ○ The regulations regarding DSOs need to be revised to incentivise long-term investments and to enable R&D and pilot projects in smart grids. Today, most DSO directors say that current regulations impede innovation. ○ Incentives to DSOs are needed to make efficient long-term investments rather than focus on short-term optimisation ⇨ Rewarding instead of penalising innovation ○ Incentives for CAPEX and OPEX should be treated equally ○ A higher rate of return and a risk adjusted depreciation period for risky projects should be given • Regulatory framework for smart metering ○ Being able to forecast how much prosumers generate is key. Smart meters allow both the identification of prosumers imbalance and good quality forecasting. • Liberalisation of the energy market ○ A market-based regulatory framework accurately value electricity and stimulates innovation, which allows for competitive offers. It also allows consumers to react to market signals. • Deregulation of end-user prices

[6] Eurelectric – Electricity Distrubution Investments : What Regulatory Framework do we need?, May 2014 & Prosumers – an integral part of the power system and the market, June 2015
[7] Eurelectric – Prosumer – an integral part of the power system and the market

	o Market-based business can grow only when prices are not regulated. • Optimising the production and consumption o It is key to avoid creating artificial incentives for prosumers that lead to market distortions o Several European countries have schemes that have led to incentivising systematic feed-in to the network independently of the state of the power system, which leads to inefficiencies • Enabling market integration of prosumers o The integration of prosumers into the market require them to be able to produce energy o The indirect support for distributed generation such as non-market-based net-metering schemes obstruct the market integration of prosumers ⇨ The regulatory framework should change to permits costs to be borne where created • Reviewing taxes and levies o Taxes and levies should not be collected through the electricity bill given that it does not allow for the sound development of the electricity market • Definition of new role for DSOs o The role of DSOs is getting broader as they need to act as neutral market facilitators and encourage efficient technological innovation.
European Commission (EC)[8 9 10]	• Contribution to the grid o Renewable electricity that is self-consumed is usually exempt from grid costs and other system charges given that it does not touch the public network. But unless the self-generated energy is produced during peak hours, the costs of DSOs may not decrease. Given this, concerns have been raised about the impacts of large-scale deployment of self-consumption on revenue of DSOs and on the tariffs for consumers (non-prosumers) especially where high volumetric tariffs are in use o Network charges model: ▪ Capacity tariffs depend on peak load given that grid costs are mostly capacity driven. This means that consumers with high peak loads pay the highest network costs. Different models of capacity tariff exist: flat, variable, time-of-use ▪ Volumetric tariffs are charged for each kWh of electricity consumed from the grid and are easier to implement with conventional meters. ▪ Hybrid models combining both capacity and volumetric tariff also exist. • Valuing self-consumption o Prosumers may need to feed the non-consumed electricity into the grid and receive value for it in order for the project to be viable o Approaches on how to value excess electricity: ▪ *Self-consumption and feed-in tariff/premium approach:* prosumer receives support for non-consumed electricity that is fed into the grid. To encourage consumers to increase their direct consumption of self-generated electricity over injecting it into the grid, only electricity self-consumed above a given rate can receive a premium tariff. However, it is important to monitor the development of renewable energy markets closely to adjust tariffs to the declining costs of production to avoid overcompensation ▪ *Net metering:* here, excess electricity injected into the grid can be used at a subsequent time to make up for consumption when onsite renewable generation is not sufficient, so consumers use the grid as a backup system for their excess power production.

[8] European Commission - COMMISSION STAFF WORKING DOCUMENT - Best practices on Renewable Energy Self-consumption, July 2015

[9] European Commission, Commission Staff Working Document, Best practices on Renewable Energy Self-Consumption, 2015, p.10-11

[10] As a result, it cannot be used as a best-practice for now

	The billing period can be from one hour over long periods of time. From the consumer point of view, net energy metering is appealing, but, from a system perspective, net metering raises concerns when large deployment levels are reached because remuneration of the excess production from onsite renewable energy systems is made at a retail price that in most cases exceeds its true value. Another approach is used by the Italian 'net billing' scheme that calculates the value of the excess electricity fed into the grid at wholesale price and this value can be used as a credit for later periods or is paid to the consumer. These difficulties show why a number of countries have started limiting their net metering schemes. • Self-consumption and market value approach: ○ Through the reform of the market, further self-consumption deployment will occur on a pure market basis meaning that the electricity that is not self-consumed but injected into the grid would be rewarded at a market price. A lower tariff for electricity injections into the grid during certain parts of the day could motivate consumers to increase their self-consumption ratio. This may then help to decrease the need for upgrades and investments. From the point of view of policies, this approach may be the most sustainable and from a consumer perspective, it can be attractive for commercial and industrial customers that can reach high self-consumption rates, however, more research is needed.

CEER[11] [12]and ACER[13] [14]	• End-user prices
	  ○ Regulated end-user prices are considered not compatible with establishing a liberal competitive energy market
	• Empowering customers to engage actively in the energy market
	  ○ Facilitating consumers' engagement and switching
	  ○ Building customer trust and ensuring data privacy and security
	  ○ Need to address the needs of prosumers as active participant
	  ○ Protection of consumers
	• DSO regulations
	  ○ Regulatory incentives may be considered to incentivize DSOs to respond to new challenges and opportunities and to encourage innovation and R&D. Distribution tariffs should then be reviewed and incentive schemes put in place
	• Establishing competitive retail markets and unbundling rules
	• New role for DSOs need to be redefined
	  ○ New services will appear in the space presently occupied by DSOs and to facilitate the development of these services, the core role of DSOs needs to be clarified
	• Protection of smart metering data
	  ○ Systems need to be in place to protect smart metering data while at the same time allowing customers to take advantage of third-party services and efficient network operation
	• Network tariff

[11] CEER - CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions ("Smart Regulation"), February 2014,
[12] CEER - CEER Response to DRAFT THINK REPORT: "From distribution networks to smart distribution systems: Rethinking the regulation of European DSOs", May 2013
[13] ACER - Energy Regulation: A Bridge to 2025 Conclusions Paper - Recommendation of the Agency on the regulatory response to the future challenges emerging from developments in the internal energy market, September 2014 & European Energy Regulation:- A Bridge to 2025 Public Consultation Paper, April 2014
[14] ACER - Energy Regulation: A Bridge to 2025 Conclusions Paper - Recommendation of the Agency on the regulatory response to the future challenges emerging from developments in the internal energy market, September 2014, p.23

	The structure of network tariff should not hamper efficient price signal
BEUC[15] [16]	• Incentives for prosumers o To fully take advantage of self-generation, stable and predictable support schemes are necessary to offset market failures and distortions o Support schemes must be created in a fair way, meaning that benefits need to be accessible to different consumer groups, including vulnerable ones, while the costs are distributed evenly amongst all final customers • Network tariffs o Revision of consumption-based network fees towards more capacity-based fees could be used to address the fair sharing of network fees and to incentivise flexibility of electricity generation. But since capacity-based network fees might increase the burden for small consumers and discourage energy efficient behaviour, such a revision would require additional compensating mechanisms, including measures for vulnerable households • Liberalised energy market o Retail electricity prices must reflect wholesale prices. To make sure that consumers have access to fair pricing, price asymmetries should be avoided. Price asymmetries primarily occur due to high concentration of incumbents, lack of competition and consequent low switching rates. As a result, clear unbundling of DSOs as set by the EU legislation needs to be urgently implemented. o Variety of energy offers • Data protection • Facilitating consumers' transition into prosumers o A remuneration scheme for electricity fed into the grid is needed o Grid operators should grant priority grid access without setting any caps and the procedures to obtain a permit should not be lengthy and grid fees low to avoid a prohibitive effect o Consumers (non-prosumers) should not be charged with inadequate costs related to a possible market split into prosumers on the one side and consumers on the other side o Providing an easy and reliable framework for consumers' self-generation is key

Table 1: *Areas of regulation important to EMPOWER*

[15] BEUC - A Welcome Culture For Consumer' Solar Self-Generation - Policy recommendations, January 2016
[16] BEUC - Current practices in consumer-driven renewable electricity markets, January 2016, BEUC – Building a consumer-centric Energy Union – BEUC position paper, July 2015

	IEA	Eurelectric	EC, ACER, CEER	BEUC
Connection of prosumers to the grid	✓	✓	✓	✓
Feeding of excess electricity produced by prosumers	✓	✓	✓	✓
Compensation for electricity fed into the grid	✓	✓	✓	✓
Reduction of soft costs for self-generation systems	✓			
Network tariffs	✓	✓	✓	✓
Regulations to incentivize investment from DSOs into innovation		✓	✓	
Regulatory framework for deployment of smart metering		✓	✓	✓
Liberalisation of the energy market		✓	✓	✓
End-user prices		✓	✓	
Reviewing taxes and levies on renewable energy	✓	✓	✓	
Definition of new role(s) for DSOs		✓	✓	

Table 2: Summary of key area of regulations matched with sources

The deployment of smart meters is of course also key to the implementation of local electricity markets. However, the status of deployment of smart meters in the different jurisdictions will be used in Section 5 to see if there is a link between best practices and the diffusion of smart meters in each jurisdiction.

3.2 Defining criteria to select regulations for further investigation

Three criteria have been defined to select the areas of regulations to investigate further. The three criteria are as follows: (all criteria are on a scale from 1 to 3)

1. **Impact on implementation**: Depending on their impact on the implementation of smart grids and local electricity markets, some areas of regulations may be more or less interesting to investigate. A score of 3 is given if it is very important currently and a score of 1 is given if considered not very important at the moment.
2. **Degree of comparability between countries**: Some areas of regulations are in their developing stages or other may depend to a too large extent on national conditions. This may then cause comparison between different countries to not be possible. A score of 3 will be given if the area of regulation is highly comparable and a score of 1 if not comparable yet.
3. **Relevance to the particular case of the Empower project**: Given that this analysis is aimed at evaluating in which jurisdictions the EMPOWER project can

be implemented, a score of 3 is given if the area of regulation is very relevant to the EMPOWER project and a score of 1 if only somewhat relevant.

4. **Popularity**: The more an area of regulation has been mentioned by different sources, the more important it may be considered. In this way, if an area of regulation has been indicated by 3 or more of our sources, it receives a score of 3, a score of 2 if mentioned by 2 sources and a score of 1 if raised by one source only.

Note: a score of 9 or above qualify an area of regulation to be investigated further

	Impact on implementation	**Degree of comparability between countries**	**Relevance to particular case of the EMPOWER project**	**Popularity**	**Total Score**
Connection of prosumers to the grid	3	3	3	3	12
Feeding of excess electricity produced by prosumers	3	2	3	3	11
Compensation for electricity fed into the grid	3	2	3	3	11
Reduction of soft costs for self-generation systems	2	2	2	1	7
Network tariffs	2	1	2	3	8
Regulations to incentivize investment from DSOs in innovation	3	2	2	2	9
Liberalisation of the energy market	2	2	2	3	9
End-user prices	2	3	2	2	9
Reviewing taxes and levies	2	1	2	3	8
Definition of new role for DSOs	2	1	1	2	6

Table 3: Determination of key areas of regulations

3.3 Linking prosumers to the grid

If prosumers can connect to the grid, then they can buy electricity when their own production is too low and sell when they generate excess energy. Allowing interconnection to the grid is key to the well-functioning of local electricity markets.

Moreover, application procedure and fees need to be fair in order not to be prohibitive for prosumers.

- ⇨ *Best practice*:
  - ✓ interconnection is allowed
  - ✓ interconnection procedures are easy to follow to simplify application procedures
  - ✓ costs are not prohibitive

Allowing prosumers to feed excess energy produced back into the grid avoid inefficiencies caused by low self-consumption and may often be the only way to make self-generation profitable. Furthermore, guaranteeing priority access to assure the economic viability of prosumers is key presently as the current competition environment between prosumers and established power plants.

- ⇨ *Best practice*:
  - ⇨ allowing the feeding of excess electricity into the grid
  - ⇨ giving priority access to renewables given that self-generation is not playing on the same level than incumbent power plants yet (this may depend on national discussions, however as mentioned in the introduction, it is one of the limitation of this report)

3.4 Compensation for electricity fed into the grid by prosumers

Different regulations exist for the remuneration of spare energy fed into the grid: on one end of the spectrum, it is not remunerated at all, and on the other end, a net-metering scheme is in place, meaning that all self-generated electricity is remunerated. Feed-in tariffs (FiT) are being used for renewable generation in many member jurisdictions. This type of tariff removes all incentives to adapt generation depending on the supply-demand side situation. The goal of feed-in tariffs is to offer cost-based compensation to renewable energy producers, providing price certainty and long-term contracts that help finance renewable energy investments. The key barrier for flexibility is that feed-in tariffs are paid even during hours with negative market prices. In this way, FiT are attractive for prosumers but may not sustainable for a large scale deployment. As for net metering, it is interesting from a consumer standpoint because it is easy to apply, however from a system perspective, net metering raises concerns when large deployment levels are reached. This is the case because compensation of the excess production from local electricity production is made at the retail price, which is, in most cases, higher than the value of that generation to the electricity system. In this way, in the long-term, net metering tariff may not be sustainable on a large scale. Moreover, national RES subsidies, aimed at specific technologies, may create major market distortions. Indeed, non-market-based net-metering schemes may lead to indirect subsidies and prosumers cannot then be considered to be “integrated” in the market per say. For that matter, the European Commission is looking to see if financial support mechanisms could be replaced by market-based arrangements.

The issues just raised explain why different European countries have put different forms of limits to their net metering programs. As the electricity market is getting reformed, the electricity that is not self-consumed but injected into the grid would be rewarded at the market price. Offering a lower tariff for excess generation during some part of day would incentivize individuals to consume more of their electricity onsite. If price-based incentives are sufficiently high, they could lead individuals to generate and consume energy in a way that is more optimal for the grid by deferring or even avoiding grid infrastructure expansion and upgrades. From a policy point of view, this solution may be the most sustainable and from a customer standpoint, it can be interesting for commercial and industrial consumers if they can reach high self-consumption rates.

- ⇨ Best practice: As seen in the previous section, depending on the stakeholder’s point of view, opinions vary with regards to incentive’s schemes for prosumers. Given the current state of competition, prosumers enter the playing field under completely different conditions than incumbent stakeholders. For example, one cannot expect prosumers to act like well-informed commercial utilities. In that context, for jurisdictions to be currently interesting for local electricity markets, schemes need to be in place to encourage their integration using priority access and a support schemes. However, ill-designed schemes that do not allocate costs where created should be phased-out. EMPOWER bears the potential to significantly increase prosumer power, so that decentral prosumers (instead of powerful incumbents) will shape energy markets according to their needs. In such, data processing and data intelligence of the SESP supports a democratization development in the power market re-design.

3.5 End-user prices

A regulated price is a price subject to regulation by a public authority. A non-regulated price is on the contrary set solely by supply and demand. Price regulation can take different forms, such as the setting or approval of prices, price caps or combinations of these. Regulating prices has an impact on the introduction of competition in the energy markets as it has distorting effects on the market. Regulated end-user prices do not necessarily prevent all type of price differentiation but in general, it cannot be expected that market prices will be passed through to end-customers. Regulated end-user prices put obstacles to new market entrants and so, in turn, deprive consumers of their right to choose the best energy provider on the market. In this way, unregulated end-user prices are a key element for prosumers to become active actors in the energy market given that consumers need to be able to make an objective and well-informed choice between different offers. The latter can only be done if competition exists between the different energy suppliers. [17]

⇨ *Best practice:*
  - ✓ non-regulated prices

3.6 Regulations to incentivize investment from DSOs into innovation

For this area of regulation, we base our reasoning on the papers written by Cambini et al. (2015) and Ruester et al. (2013). In their paper, Cambini et al. (2015) note that "an effective and successful regulatory scheme should strike a balance among the goals of consumer affordability, investment incentives, the quality of supply and the economic viability of the DSO"[18]. In this way, when considering new investments for the implementation of Smart Grids, regulators are faced with new challenges. Under the traditional system, the operator was only interested in grid innovation to the extent that it provided an investment opportunity or helped reducing the costs in the maintenance of the grid. However, today regulators need to supplement existing regulation with

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[17] Butenko, Anna and Cseres, Kati, The Regulatory Consumer: Prosumer-Driven Local Energy Production Initiatives (November 2015). Amsterdam Law School Research Paper No. 2015-31; Amsterdam Centre for European Law and Governance Research Paper No. 2015-03. Available at SSRN: http://ssrn.com/abstract=2631990 or http://dx.doi.org/10.2139/ssrn.2631990

[18] Cambini et al., Market and regulatory factors influencing smart-grid investment in Europe: Evidence from pilot projects and implications for reform, July 2015, p.37

compelling incentives for energy efficiency and decarburization among other goals[19]. The rise in distributed energy sources is driving considerable changes in the planning and operation of the power system and these changes create challenges for incumbent stakeholders such as DSOs when it comes to revenue erosion and increasing volatility of demand[20].

A key aspect to encouraging DSOs to innovate is a special mechanism that recognizes investment in innovation. An absence of R&D costs recognition during the regulatory period can hamper innovation. However, there is a matter of social acceptability of such expenses as consumers may not accept the tariff increases, which can derive from high R&D investments. Regulators need to find appropriate solutions, such as the use of specific mechanisms or the allocation of subsidies. Moreover, over time, the delay between investments and their long-term recovery through tariffs can cause significant financing issues for DSOs. Their ability to advance cash for such investments depends on the regulatory and contract stability, and on the capital remuneration level. DSOs should invest in innovative ideas but to do that, regulatory mechanisms need to facilitate this process and avoid an undue bias towards CAPEX. In this way, rewarding network companies for cost-efficient grid and R&D investments is key. Regulations should give a stable long-term regulatory framework, which provides network operators with a fair rate of return for investments that promote innovation. The introduction of such new tariffs may incentivize more efficient network use and more investments into the development of smart grids. However, in most European countries, regulation treats R&D and pilots like any other costs meaning that no specific compensation exist for the risks involved in testing new technologies and processes.

We will evaluate the regulations in each country based on the types of regulation models and specialized incentives they have in place for DSOs:

1. Types of regulation model for DSOs: Here, we follow the criteria used by Cambini et al. (2015) and choose three large categories of regulatory models currently used by

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[19] Crispim et. Al, Smart Grids in the EU with smart regulation : Experiences from the UK, Italy and Portugal, p.88

[20] Ruester et al. From distribution networks to smart distribution systems: Rethinking the regulation of European electricity DSOs, p.1

different European countries to promote cost efficiency or productivity[21]. The regulatory models are as follows:

- *Incentive-based*: models where the regulator empowers certain pricing decisions to the firm and where the firm can take advantage of increases from cost reduction.
- *Cost-based*: regulates a permitted rate-of-return on investment and changes the firm's price as its costs change to secure a fair opportunity to earn the authorized return
- *Hybrid*: follows a cost-based approach for the treatment of CAPEX and an incentive-based approach for the treatment of OPEX.

⇨ *Best practice based on the conclusions from Cambini et al.'s (2015):*

  - ✓ Incentive based regulation may be the most favourable scheme to encourage the deployment of smart grids' innovations and the matching investments.
  - ✓ A hybrid model could also be good for encouraging investments in smart grids but not as effective as an incentive based scheme

One explanation for that is given by Marques et al. (2014), which says that incentive-based regulation grants investors to keep part of the gains they got from such reductions. In this way, the more smart grids decrease costs, the more incentive regulation is effective in promoting investment in smart technologies and the less cost-based regulation is effective.

<u>Specialized Incentives to encourage DSOs to invest in innovation</u>: Here, we differentiate between jurisdictions that recognize the extra risk of investing in R&D and pilot projects against those that treat investments in innovation like any other costs. The different cases can be defined as follows:

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[21] Cambini et al., Market and regulatory factors influencing smart-grid investment in Europe: Evidence from pilot projects and implications for reform, July 2015, p.40

- *No incentives*: Countries where the investments in innovation are treated like any other costs meaning that no premium is offered to compensate for the risk involved
- *Extra WACC:* Countries where a higher rate of return is offered to compensate for risks involved with investing in innovation
- *Adjusting Revenues*: Countries where arrangements are made to give extra allowance or to adjust of revenues within the regulation period
  - ⇨ *Best practice based on the conclusions from Cambini et al.'s (2015):*
    - ✓ Using specialised incentive mechanisms such as an extra WACC or adjusting revenues are favourable to triggering investments in Smart Grids

3.7 Liberalisation of the energy market

The degree of retail market liberalization and competition is still very heterogeneous across EU members and insufficient unbundling leads to one of the most serious obstacles to competition in many distribution markets. Launched in 1996, the liberalization process in the energy sector has had the aim to give consumers the possibility to choose freely their energy suppliers on the basis of competitive offers. Indeed, competition is key for producing lower energy prices, obtaining a level of security of supply that is sufficient and stimulating innovation, which, the latter, is central to the development of smart grids and local electricity market. In this way, the European Commission has called for more market exposure to be imposed on renewables producers given that competitive energy markets should drive energy production and investment decisions efficiently and cost effectively. Indeed, for consumers to become more involved, electricity retail prices and grid tariffs must reflect the actual market value so consumers can answer to actual market signals. Moreover, according to BEUC, to ensure that consumers have access to fair pricing, the market should not be concentrated and consumers should be able to actively drive competition by switching their electricity suppliers.

- ⇨ *Best practice:*
  - ✓ Low concentration
  - ✓ High switching activity
  - ✓ Existence of competition

4 Overview and evaluation of countries' practices

The evaluation for each individual section is based on best practices outlined in section 3 and follows the following evaluation scale:

Best practice: promotes the deployment of smart grids and local electricity markets	3	
Good practice: somewhat encourage the deployment of smart grids and local electricity markets	2	
Neutral practice: hinders the deployment of smart grids and local electricity markets (high regulatory uncertainty leads to a red)	1	

Best overall practice	2.5 - 3 points	
Good overall practice	1.5 - 2.5 points	
Neutral overall practice	1 -1.5 points	

Table 4: Evaluation scale

The following evaluation provides an analysis that might be useful in assessing on which countries dissemination activities in the future should focus on. The evaluation is not read in such that it comments on the quality of the regulation per se, but evaluates it from a marketing and sales perspective of EMPOWER. In such, some of the findings are contradictory to the learnings of the EMPOWER concept in the project management phase, in which implementation seemed to be for instance quite straight-forward in Norway but more demanding in Germany and Malta. In such, the report provides a heuristic step and suggest to monitor regulations and also to monitor smart meter roll-out. Both aspects serve as a proxy that signals different degree of market openness for EMPOWER. However, it is not to be read that a lower rating hinders implementation, it is more a high rating might justify prioritization.

In addition, it is also very important to acknowledge that the different regulatory regimes differ in regard to how adaptive they are. For instance, during the EMPOWER project we have been observing, that Smart Energi is moving forward with the blessing of the Norwegian regulator while things were more difficult in Germany for at least 2 years. Some of the stakeholder interviews that we have conducted with EMPOWER project partners support this observation:

- *Quote from interview with EMPOWER project partner: "I think the Norwegian regulator has been, like the Nordic regulators been very inspired by the developments in general and the possibilities. I think they are very much influenced by the Danish regulators that have been pioneering different aspects* *of how to manage the intermittent production by means of wind and solar power for years now and that of course influences also the mind-set of the Norwegian and the Swedish and the Finnish regulator. So in the Nordic countries I think we do have a set of regulators that are quite forward leaning in a sense compared to some others however they're small countries and the hierarchy in these countries is not that extensive so we need managers and leaders and politicians and government ministers in different settings that allows us to lobby and to present our concerns and ideas in a fairly straightforward manner and that of course also brings about a movement and I think that is hard to do in countries like Spain and Germany because those are much bigger countries and they also have a culture style where authorities are considered more remote than I think in our country."*

Below the evaluations per country are detailed. The data for each country was gathered in the Fall 2016 and take into account not only regulations for PV but for all RES-E.

	Austria	Belgium	Bulgaria
Connection of prosumers to the grid	Prosumers are allowed to connect to the grid but[22] long and costly approval procedures exist[23].	Prosumers can connect to the grid and the administrative procedures are simple[24] but retroactive fees for self-generators have created an unwelcoming environment.	Self-generators can connect to the gird in practice but complicated procedures exist. Grid restrictions are a major concern for the future.[24]
Feeding excess electricity produced by prosumers into the grid	Electricity from RES must be given priority transmission when grid capacity is not sufficient to meet all requests for use of the grid.[22]	Renewable energy plants must be granted priority connection unless grid security is at stake.22	The right to priority connection was abolished by the latest amendment to the ERSA. Plant operators are only entitled to non-discriminatory access.22
Compensation for electricity fed into the grid by prosumers	Electricity generated from RES is supported mainly through a FiT. The producers of RES are entitled to the conclusion of a contract on the purchase of the electricity they produce unless the promotional volume for the FiT is exhausted.22	In the Brussels-Capital region, small prosumers of RES are entitled to net-metering. In Flanders, all RES renewable with a capacity ≤10 kW are eligible for the net-metering scheme. In the Walloon region, small self-producers of	Electricity from RES is promoted through a FiT. Producers of electricity from RES are contractually entitled against the grid operator to the purchase and payment of electricity at a guaranteed price.[22]

[22] http://www.res-legal.eu
[23] PV Grid, Final Project Report, 2014
[24] BEUC - A Welcome Culture For Consumer' Solar Self-Generation - Policy recommendations, January 2016, p.14-15

	Austria		Belgium		Bulgaria
		However, the access is limited and remuneration schemes for small installations are not well-suited.24		RES are entitled to net metering. [28] However, multiple changes in regulations have led to regulatory uncertainty.[30]		However, newly introduced reductions in FiT and measures aimed at decelerating growth in the renewables sector have led to sharp decreases in investments[23].
Regulations to incentivize investment from DSOs into innovation: Types of regulation model		Incentive – based mechanism[25]		Cost-based mechanism[25]		Incentive-based mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives		Revenues are adjusted[25]		No innovation-stimulus mechanisms[25]		No innovation-stimulus mechanisms[25]
Liberalisation of the energy market		Completely liberalized but high concentration and low switching activity[24]		High concentration but high switching activity[24]		Market is dominated by the Bulgarian Energy Holding and the national electricity supply company Natsionalna Elektricheska Kompania EAD (NEK), 0% switching rate[26]
End-user prices		Non-regulated prices[27]		Non-regulated prices[27]		Regulated prices[27]
Overall evaluation		2.57 points		2 points		1.57 points

Table 5:Austria, Belgium and Bulgaria

	Croatia		Cyprus		Czech Republic
Connection of prosumers to the grid		Prosumers can connect to the grid but prohibitive costs exist[24].		Prosumers can connect easily to the grid but costs for grid extension may be prohibitive[24]		Prosumers can connect to the grid but there is risks that grid operators refuse connection approval without substantial explanation[23].
Feeding excess electricity produced by prosumers into the grid		Generation of electricity from RES are given priority by the transmission or distribution system operator, if the technical conditions allow it and if there is no danger of overloading the system 22		No priority access is given22		Plant operators are entitled against the grid operator to priority connection of a renewable energy plant to the grid. 22
Compensation for electricity fed into the grid by prosumers		Until the end of 2015, RES were supported through a		Net-metering scheme is now in place. This scheme		A FiT can only be granted to operators of RES plants with an installed capacity up to

25 Cambini et.(2015) al. Table 1
26 European Commission, Country Report- Bulgaria, 2014
27 Sweco, Study on the effective integration of Distributed Energy Resources for providing flexibility to the electricity system, 2015

	Croatia		Cyprus		Czech Republic
		FiT but beginning 2016, the new RES act came into force and introduced a premium tariff support scheme. Only authorised producers of electricity from RES can now receive a premium and this new scheme is not fully in place yet. This change in policy goes against the growth of prosumers and regularity uncertainty discourage further investment.[22]		concerns the connection of PV plants that operate under a net-metering scheme.[22] Given that schemes have been changed several times, regulatory uncertainty exists[24].		100 kW. PV and biogas plants are only eligible if put into operation before 2014. Wind, hydro or biomass plants are eligible only if the building permit was issued before October 2013. This means that a significant reduction in FiT allowances has been put in place. These changes in regulations can have a strong negative impact on investment.[28]
Regulations to incentivize investment from DSOs into innovation: Types of regulation model		Cost-based mechanism[25]		Cost-based mechanism[25]		Hybrid mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives		No innovation-stimulus mechanisms [25]		No innovation-stimulus mechanisms[25]		No innovation-stimulus mechanisms[25]
Liberalisation of the energy market		Competition in energy market is still very limited. Opening of the market is needed to improve the investment climate and create incentives for new entrants[28].		No switching possible because dominated by monopolist (highly centralised) even though officially liberalised		Market competition is fair[25] with medium switching activity[29]
End-user prices		Regulated end-user prices[30]		Regulated end-user prices[31]		Non-regulated prices[27]
Overall evaluation		1.57 points		1.42 points		2 points

Table 6:Croatia, Cyprus and Czech Republic

	Denmark		Estonia		Finland
Connection of prosumers to the grid		Easy access to becoming prosumers. [24].		Prosumers can connect to the grid. Small-scale plants		Prosumers can connect to the grid. Procedures to

[28] European Commission, Country Report- Croatia, 2014
[29] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_czechrepublic.pdf
[30] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_croatia.pdf
[31] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_cyprus.pdf

	Denmark	Estonia	Finland
	Procedures to becomes a supplier are easier than in other jurisdictions given that suppliers do not need licences.	must follow a less complex procedure.	becomes a supplier is easier than in other jurisdictions given that suppliers do not need licences.
Feeding excess electricity produced by prosumers into the grid	No priority access is given22	No priority is given to RES. The grid operator must respect the principle of non-discrimination when providing grid services to the market participants 22	No priority is given to RES.22
Compensation for electricity fed into the grid by prosumers	Net-metering scheme in place.[22] However, the net-metering scheme is on hourly basis, which is somewhat prohibitive.[24]	No FiT or net-metering schemes. Only premium tariff in place but as the RES sector development has been faster than planned and with the currently applicable support system, Estonia is expected to exceed its foreseen targets for 2020. The Government is currently in the process of reforming the system. The draft of the new legislation is currently being reviewed.[22] Regulatory changes may have a strong negative impact on investment and further development of local production.	No FiT or net-metering schemes, only premium tariff.[32]
Regulations to incentivize investment from DSOs into innovation: Types of regulation model	Hybrid mechanism[25]	Hybrid mechanism[25]	Hybrid mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives	Revenues are adjusted[25]	No innovation-stimulus mechanisms[25]	Revenues are adjusted[25]

[32] Note: as mentionned in the introduction, simplifications were needed to conduct this cross-country analysis. In this way, even though a premium tariff scheme in Finland with corresponding tax credits and incentives may be effective, based on overall best-practices, a lower score has to be given.

		Denmark		Estonia		Finland
Liberalisation of the energy market		Market is liberalized but competition level is low and switching rates are moderate[25]		Competition is limited by the dominant position of Eesti Energia AS, which accounted for 88% of the total electricity production in 2012 and switching rate are very low.[33]		Low concentration and medium to high switching rates[34]
End-user prices		Regulated prices[27]		Regulated prices[27]		Non-regulated prices[27]
Overall evaluation		2.3 points		1.57 points		2.57 points

Table 7:Denmark, Estonia and Finland

		France		Germany		Greece
Connection of prosumers to the grid		Prosumers can connect to the grid but waiting times to obtain permit can be very time-consuming and high grid connection costs exist[23].		Easy procedures to connect to the grid exist and connection is guaranteed.[24]		Easy process to connect to the grid for small generators are in place but connection fees are costly[24]
Feeding excess electricity produced by prosumers into the grid		Electricity generated from RES is not given priority.22		Plants for the generation of electricity from RES must be connected to the grid as a priority, 22		In general, RES plants are not given priority grid connection. Priority processing only applies to certain technologies22
Compensation for electricity fed into the grid by prosumers		The generation of electricity from RES sources is promoted through a FiT. Operators of RES are contractually entitled against the suppliers to payment for electricity exported to the grid. The distribution grid operator is obliged to enter into agreements on the purchase of electricity at a price fixed by law22 The tariff is paid to 100% of output from the system.23		Small RES plants up to 100 kW which were put into operation after the end of 2015 are promoted by FiT. Plant operators can switch on a monthly basis between FiT and a market premium or may benefit proportionately from the FiT or the market premium.[22] The FiT scheme is appropriate given that consumer substitue self-generation with expensive retail electricity.[24]		Plant operators are guaranteed payment of electricity exported to the grid. The grid operator is obliged to enter into these contracts. The amount of FiT varies for each electricity generation technology. Net metering scheme for PV and small wind power plants are also in place.22 However, net metering and FiT schemes are limited and unstable.23
Regulations to incentivize		Incentive based mechanism[25]		Incentive based mechanism[25]		Cost-based mechanism[25]

[33] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_estonia.pdf
[34] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_finland.pdf

		France		Germany		Greece
investment from DSOs into innovation: Types of regulation model						
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives		No innovation-stimulus mechanisms[25]		Incentive based mechanism[25]		No innovation-stimulus mechanisms[25]
Liberalisation of the energy market		Retail market 100% liberalised, consumers have choice between different market offers but the power market as a whole is still highly concentrated[35]		Market concentration is low[25] and high switching rates exist[36]		Officially liberalized but monopolistically dominated[25] and low switching rates[37]
End-user prices		Regulated prices[27]		Non-regulated prices[27]		Regulated prices[27]
Overall evaluation		2 points		3 points		1.43 points

Table 8: France, Germany and Greece

[35] Deloitte, https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-merket-reform-france.pdf
[36] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_germany.pdf
[37] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_greece.pdf

	Hungary		Ireland		Italy	
Connection of prosumers to the grid		Specific processes in place for self-generators. The grid operator is obliged to make sure that the connection procedure is transparent [22].		RES are connected under the so-called Group Processing Approach (GPA). The GPA aims to speed up the connection of renewable energy plants by providing standardized procedural steps, and to increase connection security. [22] The grid operator must connect RES without discriminating between any persons or classes of persons		Authorization procedures are quite simple and applications for small generating plants are processed faster.
Feeding excess electricity produced by prosumers into the grid		RES have priority access and the Hungarian Energy and Public Utility Regulatory Authority must give priority to renewable energy plants when authorising new plants.22		The regulatory authority may decide that the connection of renewable energy plants shall be given priority (no mandatory priority access) [22]		Applications for the connection of RES must be given priority treatment and must also be given priority connection 22
Compensation for electricity fed into the grid by prosumers		The TSO is obliged to purchase electricity from RES and pay a guaranteed price. Household-sized power plants with a capacity of maximum 50 kVA can benefit from net metering. The electricity surplus injected to the grid is remunerated by the electricity supplier with the electricity retail price.[22]		The entities entitled to the FiT are those suppliers that purchase electricity from renewable sources from generators with whom they have entered into a Power Purchase Agreement. This regulatory system incentivizes the generation of electricity from renewable sources. [22]		RES are promoted through several kinds of FiT (ended in 2012 for PV generators) and premium tariffs. PV installations are promoted through a guaranteed payment ("ritiro dedicato"). Other renewable technologies may be promoted under a tendering scheme, a feed-in or a premium model. Furthermore, the Gestore dei Servizi Energetici can manage the sale of renewable energy on request, and interested parties can make use of net-metering.[22]
Regulations to incentivize investment from DSOs into innovation: Types of regulation model		Incentive-based mechanism[25]		Incentive-based mechanism[25]		Hybrid mechanism[25]

Regulations to incentivize investment from DSOs into innovation: Specialized Incentives		No innovation-stimulus mechanisms[25]		Revenues are adjusted[25]		Extra WACC[25]
Liberalisation of the energy market		Medium market concentration[25] and very low switching rates[38]		High market concentration[25] and high switching rates[39]		Fully liberalized. Medium market concentration[26] and medium to high switching rates[40]
End-user prices		Regulated prices[27]		Non-regulated prices[27]		Regulated prices[27]
Overall evaluation		2.3 points		2.7 points		2.6 points

Table 9:Hungary, Ireland and Italy

		Latvia		Lithuania		Luxembourg
Connection of prosumers to the grid		According to the grid regulator, the plant operator is entitled to non-discriminatory treatment. No specific processes for small generating plants exist.		Procedures to connect to the grid are lengthy and difficult.		The operators of RES do not need to apply for authorisation to produce. 22 Plants must be connected to the grid according to objective, transparent and non-discriminatory criteria.
Feeding excess electricity produced by prosumers into the grid		RES is not given priority. According to the grid regulator, the plant operator is entitled to non-discriminatory treatment.22		RES producers are entitled to priority connection to the operator's grid 22		RES are not eligible for priority connection. 22
Compensation for electricity fed into the grid by prosumers		The feed-tariff is currently on hold until 01.01.2020. Net-metering is in place. Customers have to apply for an offer from the responsible grid operator for injecting electricity to the grid. For small scale clients, energy costs only apply to the net electricity consumption.		RES is promoted through a FiT. The operators of RES are entitled to payment for electricity exported to the grid[22]		Electricity generated from RES is promoted through a FiT. The operators of RES are entitled against the grid operator to the conclusion of a contract on the purchase of the electricity they produce for the defined price.[23]

38 https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_hungary.pdf
39 https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_ireland.pdf
40 https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_italy.pdf

	Customers must pay a grid use charge[23]		
Regulations to incentivize investment from DSOs into innovation: Types of regulation model	Hybrid mechanism[25]	Incentive-based mechanism[25]	Incentive-based mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives	No innovation-stimulus mechanisms[25]	No innovation-stimulus mechanisms[25]	No innovation-stimulus mechanisms[25]
Liberalisation of the energy market	Medium market concentration[25] and 0% switching rates (for households)[41]	High market concentration[25] and changing electricity supplier started being permitted in 2013 but no switches were actually made[42]	Medium market concentration[25] and very low switching rates**¡Error! Marcador no definido.**
End-user prices	Regulated prices[27]	Regulated prices[27]	Non-regulated prices[43]
Overall evaluation	1.6 points	2 points	2.4 points

Table 10: Latvia, Lithuania and Luxembourg

	Malta	Netherlands	Norway
Connection of prosumers to the grid	Small generating plants do not need a license, which simplifies the application procedure.	Prosumers can connect to the grid easily but can sometimes be refused access[24]. Plants must be connected according to non-discriminatory criteria.	Grid connection is not guaranteed [24] Non-discriminatory criteria in place.
Feeding excess electricity produced by prosumers into the grid	Electricity from RES is granted priority connection 22	RES are not eligible for priority connection to the grid.22 Clients need to apply for an offer from the responsible grid operator for injecting electricity to the grid and are required to pay a grid use charge[22].	No priority access granted for renewables.22
Compensation for electricity fed into the grid by prosumers	A FiT is paid for the production of RES from solar PV installations. In May	A premium tariff (premiums on top of the wholesale price) has been introduced	Promotion of RES is done through a quota system

[41] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_latvia.pdf
[42] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_lithuania.pdf
[43] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_luxembourg.pdf

	Malta	Netherlands	Norway
	2016, the regulator for energy and water services has announced that the FiT for solar PV installations greater than 1 kWp and less than 40 kWp has been oversubscribed and is no longer open for applications. [22]	to promote the generation of electricity from renewable energy sources. [22]	including a certificate trading scheme.[23] In this way, there is no proper remuneration scheme in place.
Regulations to incentivize investment from DSOs into innovation: Types of regulation model	Cost-based mechanism[25]	Incentive-based mechanism[25]	Incentive-based mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives	No innovation-stimulus mechanisms[25]	No innovation-stimulus mechanisms[25]	No innovation-stimulus mechanisms[25]
Liberalisation of the energy market	High market concentration[25] (only one power supplier but given the size of the country, it might not reflect an issue of lack of competition)	Market is highly concentrated but switching activity is high[24]	One of the first country to liberalise its energy market. Low market concentration[25] and high switching rates[44]
End-user prices	Regulated prices[45]	Non-regulated prices[27]	Non-regulated prices[27]
Overall evaluation	1.9 points	2.1 points	2 points

Table 11: Malta, Netherlands and Norway

	Poland	Portugal	Romania
Connection of prosumers to the grid	Grid operators must connect RES to their grids without discriminating against certain groups of plant operators.[22] Procedures are lengthy and there is no guarantee that the query will end successfully[23]	Prosumers can connect to the grid through a process tailored to them but the process is lengthy and difficult. Connection to the grid must be granted according to the principle of non-discrimination. Grid connection capacity restraints exist.[24]	Operators of small plants have access to a simplified procedure. Non-discrimination in place.
Feeding excess electricity produced	Prosumers can feed excess energy into the grid. The grid	Priority access must be given to RES 22	No priority to RES is given when connecting to the

[44] http://www.nordicenergyregulators.org/wp-content/uploads/2013/02/Nordic_Market-report_2013.pdf, p.5
[45] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreport_malta.pdf

	Poland	Portugal	Romania
by prosumers into the grid	operators must give electricity from RES priority.[22]		grid but RES are guaranteed priority access to the grid as long as the national energy system is not at risk22
Compensation for electricity fed into the grid by prosumers	The main incentive for RES is a quota system, which is combined with a certificate trading scheme. The current plan mentions that on 1 July 2016, the current quota system was to be substituted by an auction system. There will be a FiT for installations with the capacity between 3 kW and 10 kW. [22]	The most important means of promotion is a FiT for existing installations. For new small production installations, a remuneration regime has come into force in 2015. This remuneration regime is based on a bidding model in which producers offer discounts to a reference tariff. [22] This new set of regulations that has been introduced focuses on self-generation but compensation for excess energy is too low[24]	The main means of promotion is a quota system based on quota obligations, tradable certificates, and minimum and maximum prices. [22]
Regulations to incentivize investment from DSOs into innovation: Types of regulation model	Hybrid mechanism[25]	Hybrid mechanism[25]	Incentive based mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives	No innovation-stimulus mechanisms[25]	Extra WACC[25]	No innovation-stimulus mechanisms[25]
Liberalisation of the energy market	Medium market concentration[25] and very low switching rates[46]	Market is officially liberalized but dominated by a monopolist[24] and high switching rates exist[47]	Medium market concentration[25] and very low switching rates[48]
End-user prices	Regulated prices[27]	Regulated prices[27]	Regulated prices[27]
Overall evaluation	1.9 point	2.1 points	1.9 points

Table 12: Poland, Portugal and Romania

[46] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_poland.pdf
[47] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_portugal.pdf
[48] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_romania.pdf

		Slovakia		Slovenia		Spain
Connection of prosumers to the grid		Operators of small renewable installations up to 10 kW are entitled to a simplified grid connection procedures.These producers must be guaranteed a free connection to the distribution grid.[22]		Prosumers can connect to the grid. The grid operator cannot refuse to connect RES plants22		Lengthy process to be awarded a permit exist. Network fees are too high. Problems with the concession of access and connection to the corresponding transmission or distribution grid also exist[23]
Feeding excess electricity produced by prosumers into the grid		The grid operator must ensure the priority connection of RES.22		RES generators are entitled to priority connection to the grid22		Renewable energy plants must be given priority connection22
Compensation for electricity fed into the grid by prosumers		RES is supported mainly through a FiT.[22]		The generation of electricity from RES is supported through a FiT. Producers of electricity from RES using plants of up to 1 MW can decide whether or not they would like their electricity to be purchased at a fixed price. As an alternative, licensed generators may opt for a premium on top of the electricity price that they achieve on the free market.[22] However, large cuts have been made to those schemes and new tendering system is not operational yet.[24]		Price regulation (suspended). The generation of electricity from RES was promoted through a price regulation system[22] Numerous retroactive changes have been made and all the support schemes have been stopped. No regulation is in place to help self-generators to sell excess electricity into the grid. Self-generators need to negotiate their sale at the wholesale market.[24]
Regulations to incentivize investment from DSOs into innovation: Types of regulation model		Incentive-based mechanism[25]		Incentive-based mechanism[25]		Hybrid mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives		No innovation-stimulus mechanisms[25]		Revenues are adjusted[25]		No innovation-stimulus mechanisms[25]
Liberalisation of the energy market		Medium market concentration[25] and		Market is entirely liberalized and healthy competition exists[24] with		Market is not fully liberalized but a high switching activity exists[24]

		Slovakia		Slovenia		Spain
		medium switching rates[49]		medium switching rates[50]		
End-user prices		Non-regulated prices[27]		Non-regulated prices[27]		Regulated prices[27]
Overall evaluation		2.6 points		2.9 points		1.6 points

Table 13: Slovakia, Slovenia and Spain

		Sweden		The UK
Connection of prosumers to the grid		Plants must be connected to the grid without certain plant operators being discriminated against.22 The procedure to become a supplier is easier than in other jurisdictions given that suppiers do not need licences.		Prosumers can connect to the grid. Relatively easy procedures exist.[23] The grid operator is obliged to connect plants to its grid according to non-discriminatory criteria.[22] Eligible RES plants with a capacity of up to 5MW must generally go through an accreditation process, which may differ according to plant size and energy source[17]
Feeding excess electricity produced by prosumers into the grid		Renewable energy is not given priority[22]		Electricity generated from renewable energy sources is not given priority.22
Compensation for electricity fed into the grid by prosumers		The main incentive for the use of RES is a quota system.[22]		Once the plant has been accredited, the electricity exported to the grid by the plant is bought by a FiT licensee.This system only applies in Great Britain.[22] Appropriate FiT scheme with guaranteed remuneration for excess generation fed into the grid exist[24]
Regulations to incentivize investment from DSOs into innovation: Types of regulation model		Incentive-based mechanism[25]		Incentive-based mechanism[25]
Regulations to incentivize investment from DSOs into innovation: Specialized Incentives		No innovation-stimulus mechanisms[25]		Revenues are adjusted[25]
Liberalisation of the energy market		Low market competition[25] and high switching rates[51]		Market is fully liberalized with high switching level and medium market concentration[24]
End-user prices		Non-regulated prices[27]		Non-regulated prices[27]
Overall evaluation		2.3 points		2.9 points

Table 14: Sweden and UK

The following map summarizes the practice performance:

[49] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_slovakia.pdf
[50] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_slovenia.pdf

[51] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_sweden.pdf

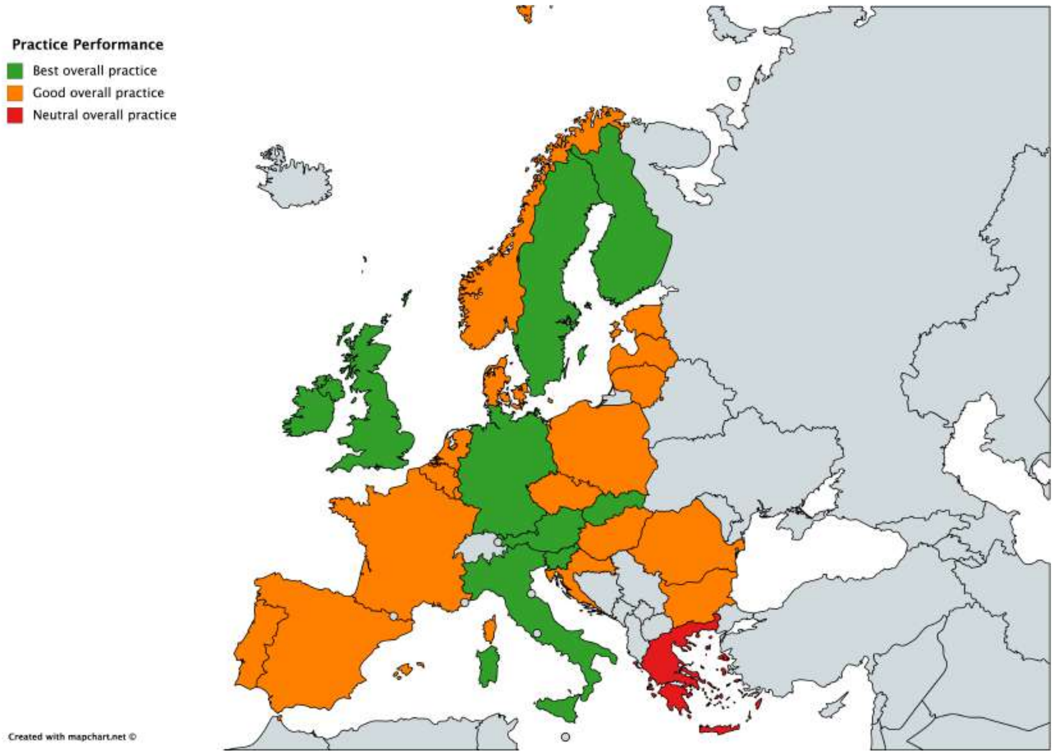

Figure 3: Outcome of the evaluation based on regulation criteria

4.1 Status of implementation of smart-meters in the different jurisdictions

The engagement of the European Union to focus on sustainability of the energy sector requires a grid that is more flexible. In this way, three fundamental drivers emerge as key benefits that depend upon the implementation of smart grids: integration of RES and distributed generation (DG), promotion of demand response and optimization of new end-uses of electricity[52].The implementation of smart grids at the European level has not been done as fast as planned and has been deployed at very different pace across Member States. To ensure a coordinated effort, several programs have been developed and a special task force was created at the EU level to help with the sharing of information, best practices, and lessons learnt across experiences[53].

Smart meters are key to the implementation of local electricity markets given that forecasting prosumers' generation is turning out to be more and more crucial as their

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[52] Crispim et al., Smart Grids in the EU with smart regulation: Experiences from the UK, Italy and Portugal, p.86
[53] Crispim et al., Smart Grids in the EU with smart regulation: Experiences from the UK, Italy and Portugal, p.4

number grows. Moreover, smart metering is the area where the most significant progress has been made throughout Europe when it comes to smart grids development. Smart metering roll-outs and large-scale pilots account for most of the total investment of the projects surveyed by the Joint Research Center[54]. Hence, using the deployment of smart meters as a parameter to evaluate the status of smart grid deployment across the different European countries was chosen.

Respective Status	Rating
Full roll - out of smart electricity meters mandated and already or almost completed[55]	5
Large - scale roll-out of smart electricity meters by 2020 in motion and expected diffusion over 80% by 2020[55]	4
Positive CBA conducted but only step by step roll-out is being made or the full roll-out has not been implemented yet	3
Negative CBA conducted and no wide-scale roll-out mandated but pilot projects are ongoing or investments are being made to deploy smart meters	2
Negative CBA conducted or no CBA conducted at all and no wide-scale roll-out and no investment or pilot projects are being made presently	1

Table 15: Evaluation scale

Country	Smart-Metering full roll-out status[56]	Result
Austria	Has begun to roll-out smart meters, with a plan to cover 95% of energy customers by 2020	4
Belgium	Has not yet decided on whether smart meters will be rolled out on a full scale but several small scale pilot projects are taking place. CBA conducted was negative.	2
Bulgaria	Has not yet decided to roll out smart meters to all customers but EVN Bulgaria plans to invest €34.8 million over a period of three years to deploy 373,000 smart meters in its service area. The outcome of the CBAs is not yet available nor any information regarding the full-scale roll-out	1
Croatia	Has not yet decided to go for a full roll-out of smart metering. However, Croatia has already invested €3 million since 2013 in the introduction of smart meters. Given it is a new Member State, no data is available regarding CBA conducted.	2
Cyprus	Has not yet mandated a full roll-out but half a million people in Cyprus have smart meters. The outcome of the CBA and the intentions regarding the implementation of large-scale smart metering roll-out has not been made available to the EC.	2
Czech Republic	Has decided not to roll out smart meters for now but a second cost-benefit analysis is planned for 2017. CBA was conducted but the outcome was negative.	1
Denmark	Planning to install smart meters at all 3.28 million metering points in the country between 2014 and 2020	5
Estonia	The legislation states that all electricity meters must be replaced with smart meters by January 2017. Mass installation took place in March 2013 and by the middle of 2014, over 263,000 meters were installed, leaving approximately 357,000 meters still to go	5

[54] Joint Research Center Science and Policy Reports, Smart Grid Projects Outlook 2014
[55] Note: independently of if the CBA was negative or positive
[56] http://my-smart-energy.eu/my-country

Finland	Roll-out is almost complete. From the beginning of 2014, about 97% of Finland had automated daily meter readings, generated from about 3.2 million smart meters.	5
France	By 2020, 95% of French households will have a smart meter. This project has already started with a speed of at around 7 million meters a year.	4
Germany	Not yet clear on how the government will proceed with smart metering. Most likely the average household consumer will not get a smart meter in the very near future or may get an "adapted" smart meter with fewer functionalities. But it is expected, that by 2032, 15.8 million (or 31%) of all metering points will have a smart meter.	2
Greece	Planning to provide 80% of all households with a smart meter by 2020.	4
Hungary	Has not yet made a definite decision on whether to roll out of smart meters	1
Ireland	Aiming to roll out smart meters to all residential customers and the majority of SMEs, beginning in 2018.	5
Italy	Began in 2001 its roll-out of smart electricity meters, as one of the pioneers in Europe. Almost all Italian households now have a smart electricity meter.	5
Latvia	The roll-out of smart meters has been announced by the principal grid operator, independently of an official government decision. The operator plans to equip 80% of electricity consumers with smart meters by 2020, and 100% by 2023.	4
Lithuania	Has decided that it will not roll out smart meters to regular consumers for the moment.	1
Luxembourg	Smart meters will be installed between 2015 and 2020 and will cover 95% of the population.	4
Malta	Almost 80% of the population has a smart meter already, and soon this will be 100%.	5
The Netherlands	As of 2015 and until 2022, the country will install 7.6 million electricity and gas meters. Customers have the choice to refuse a smart meter, or to have its "smartness" switched off.	4
Norway	The legislation states that all electricity meters must be replaced with smart meters by 2017[57]	5
Poland	Has decided to roll out smart electricity meters to 80% of electricity consumers, but has not yet implemented the decision into national law. Several hundred thousand consumers already have smart meters.	3
Portugal	A nationwide roll-out has not yet been approved by the government, but there are many pilot projects underway across the country.	2
Romania	A roll-out has begun, adding up to 1,717,000 million meters by 2020, and with the aim to being completed by 2022.	4
Slovakia	Has not yet made a decision on whether it will roll out smart meters or not but considering a partial roll-out to about 600,000 customers	2
Slovenia	No government legislation to roll-out of smart meters, but some of the DSOs have decided to work on voluntary roll-outs. Slovenia has now installed smart meters for 19% of its electricity consumers, with the aim to deploy to 47% of its population by 2020.	2
Spain	Full smart meter roll-out across Spain underway and to be completed by 2018.	5
Sweden	Has completed its roll-out of smart meters, which began in 2009. By 2020, Sweden will have 5,462,000 smart meters installed.	5
The UK	Smart meters have been installed in over 1 million households. In total, the government has decided to roll out 53 million smart meters to 30 million homes and businesses by 2020.	4

Table 16: Evaluation summary

The evaluation for each country is based on the following rating:

High deployment	4-5 points	(green)
Medium deployment	2-3 points	(orange)

[57] http://www.berginsight.com/reportpdf/productsheet/bi-sm9-ps.pdf

Low deployment	1 point	

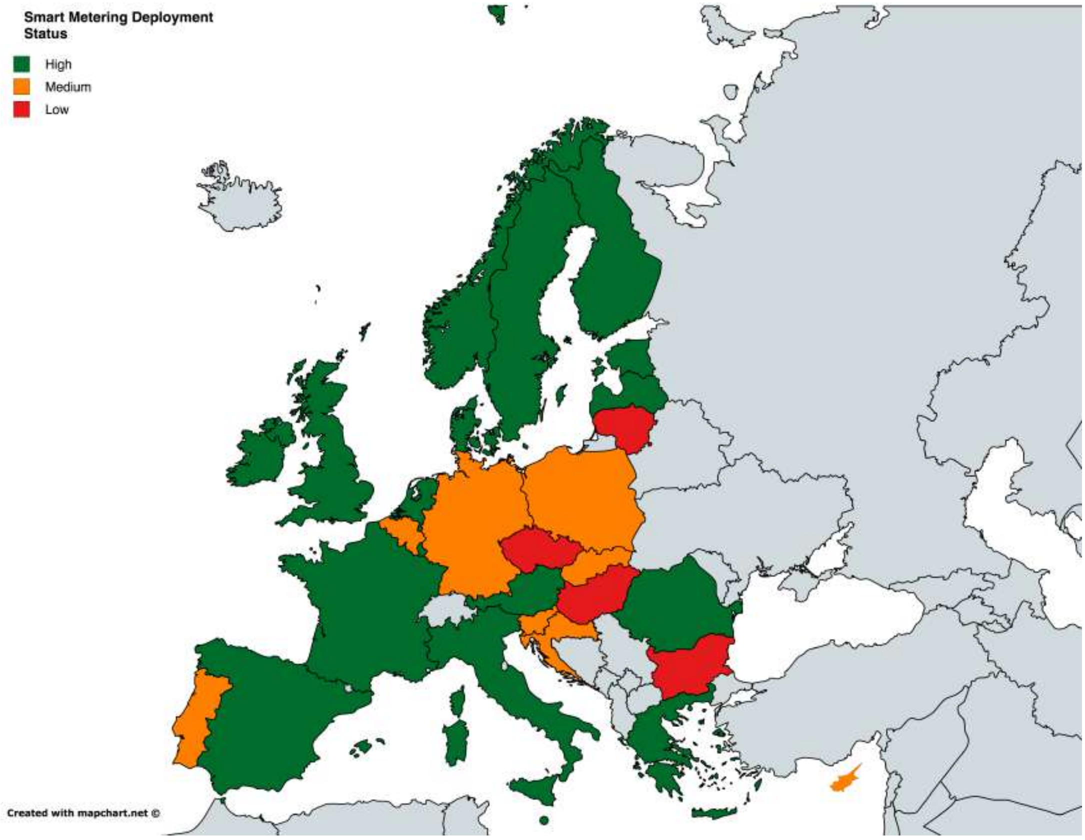

Figure 4: Overview of the evaluation by country

4.2 Conclusion

This paper reports an analysis of key regulations that matter for the implementation of local electricity markets and smart grids, and the determination of jurisdictions that are most interesting to their implementation on a regulatory basis.

After establishing which regulations are key and established best practices for each area of regulation, we listed the status of the selected regulations for the twenty-eight European countries plus Norway. Subsequently, based on these best practices, we determined that Austria, Finland, Germany, Ireland, Italy, Slovakia, Slovenia, Sweden and the UK are the most interesting jurisdictions while Cyprus and Greece appeared to be the least interesting on a purely regulatory basis. As mentioned in the introduction and in Section 4, it is crucial to note that these results have been established while keeping the “national conditions” variable constant.

In Section 5, we looked at the status of the implementation of smart meters in the different jurisdictions to as smart meters are crucial to the implementation of local electricity markets, and may thus indicate favourability to the latter.

As acknowledged in the introduction, our analysis was subject to certain limitations, the most important one was that the variable “national conditions”, which has been kept constant. After conducting this report and looking at the results, one can ponder if it is reasonable to rank different regulatory frameworks ignoring the national conditions of each country. This question is opened to discussion and may be the subject of further research.

Finally, it is essential to note that there is a knowledge gap regarding the adaption of regulatory frameworks to prosumer growth. Currently, there is a lack of a dedicated legal framework concerning prosumers, which is illustrated, for instance, by the fact that prosumers are most of the time required to abide by the same rules as incumbent stakeholders. This put them to a clear competitive disadvantage and refrain them from becoming better involved and integrated in the energy market.

5 Case study on the regulation in Italy

The fast-growing share of renewable energy resources (RES-E) and local energy producers (prosumers) in Italy, makes this country a perfect fit to be studied. In fact, in the recent National Energy Strategy document published by the Italian Government, it has been predicted that renewables will have a 55% share of total electricity generation by 2030 (SEN, 2017). Therefore, integration of RES-E into the electricity market seems inevitable. However, flexibility and security issues can rise with a market with high penetration of renewables. Measures need to be taken to solve or improve the corresponding outcomes. Implementing a local market for not only trading electricity but also flexibility as a product can be a solution.

In this context, following the objectives of the EMPOWER project, this report will survey current relevant regulations in the Italian electricity market to analyze the possibility of implementing a local market in Italy.

Regulations regarding unbundling, self-consumption, compensation and supporting schemes, storage and electricity sale to neighbours and balancing market will be reviewed and discussed.

Unbundling: Italy has fully unbundled transmission and generation ownership (IEA, 2016). Following the Directive 96/92/EC by the European commission, the Legislative Decree 79/99 was set by the Italian authorities to start the market liberalization process in the Italian electricity sector. As a result of this decree, in 1999 electricity generation and import were liberalized while the retail markets followed the same trend in 2007. Another important aspect of the Decree 79/99 was to provide the requested network access for everyone under the so called “third party connection obligation” (Q&A, 2017).

Decree 79/99 also included a part related to unbundling of functional and accounting activities of firms active in the energy sector. The functional unbundling rule aims to separate generation, transmission and distribution activities. The accounting unbundling type requires the firms to separate their accounts for different activities they perform. While the two types of unbundling are applicable to the gas sector, only the functional one is being applied to the electricity sector. As the result of the functional (corporate) unbundling rule, Terna (Trasmissione Elettricità Rete Nazionale) was developed to carry out transmission activities (De Angelis, 2010). Before this decree, the former monopolist, Enel, was in charge of generation, transmission and distribution of electricity. Currently, there are more than 13 generator companies, 11 transmission companies and 5 distribution companies active in the Italian electricity market (Q&A, 2017). In addition, as a part of Decree 79/99, an antitrust threshold was set to further encourage competition on the supply side. No companies should produce or import more than 50% of Italy’s total generation and import of electricity (Q&A, 2017).

Furthermore, new provisions on functional unbundling was issued by the regulatory authority in 2015. The functional unbundling which was previously applied for distribution companies with more than 100000 connected consumers, will now be integrated to all distribution companies regardless of their size (AEEG, 2016). In addition, new unbundling requirements in relation to communication and brand policies were introduced for distribution companies regardless of their size (AEEG, 2016).

Self-consumption: In Italy, self-consumption for PV plants is allowed (IEA-PVPS, 2016; IEA, 2016). A summary of regulations related to PV self-consumption in Italy is presented in Table 1. (IEA-PVPS, 2016).

			Italy
PV Self-consumption	1	Right to self-consume	Yes
	2	Revenues from self-consumed PV	Savings on the electricity bill
	3	Charges to finance T&D	Yes, above 20 kW
Excess PV electricity	4	Revenues from excess electricity	SSP, net-billing based on energy and services; market price for selling
	5	Maximum timeframe for compensation	Self consumption, real time; SSP, advance payment twice per year
	6	Geographical compensation	On site (meter aggregation is allowed for some specific SSP cases)
Other System characteristics	7	Regulatory scheme duration	Unlimited
	8	Third party ownership accepted	Yes, with conditions for SSP
	9	Grid codes and additional taxes/fees	None
	10	Other enablers of self-consumption	None
	11	PV System Size Limitations	Self-consumption, none (below 20 MW for SEU); SSP, up to 500 kW
	12	Electricity System Limitations	None
	13	Additional features	None

Table 17: Italy's self-consumption schemes. Source: IEA-PVPS, 2016.

Compensation and supporting schemes: Several RES supporting and compensation systems have been developed and used in Italy in the past decade. For PV generators, the feed-in tariff scheme started as 'conto energia' in 2009 and ended in 2012 (CMS, 2015). Since 2009, for plants with a capacity up to 200 kW, the net metering system changed to a plan called 'Scambio Sul Posto (SSP)', (GME, 2017). Since 2015, the capacity measurements for this plan changed to plants with a capacity between 20 kW and 500 kW (IEA-PVPS, 2016; IEA, 2016; Ministerial Decree, 2016). Under this system a combination of self-consumption and net billing is applied to PV generators (IEA-PVPS, 2016). Customers will be contributed based on the amount of electricity exchanges with the grid (injections and withdrawals) in a given calendar year and surpluses can be carried over to subsequent years (IEA, 2016). Currently this is the only existing scheme for PV generators. However, a tax incentive has been predicted for PV systems which in 2015 was equal to 50% of PV system costs (to be tax deductible) and as of 2016 it has been reduced to 36% (IEA, 2016). As for other renewable sources than solar, the 'tariffa omnicomprensiva' program (the all-inclusive feed-in tariff) is accessible for plants with real power less than 1.0 MW for a period of 15 years (IEA, 2016; AEEG, 2016; Ministerial Decree, 2016).

Storage and electricity sale to neighbours: under current regulations, no storage permission has been predicted for PV owners. The same is true regarding potential sales of on-site generated electricity to neighbours. In fact, PV generators can only self-consume their electricity production on-site.

Balancing market, pre-qualification, bidding: Terna, the Italian transmission operator, is responsible for the ancillary services and the balancing market, called the Ancillary Services Market (Mercato per il Servizio di Dispacciamento (MSD)) (CMS, 2015). Terna is required to ensure real-time balance between the injections and withdrawals in the national power system and also to provide secondary control services (GME, 2017).

Only authorised units can participate in the Ancillary Services Market (GME, 2017), of which RES-E are not among them. The bidding blocks are hourly on the intraday market and the gate closes 5 hours before real time which can cause imbalance problems (IEA, 2016; AEEG, 2016). Offer/bids accepted in the MSD are valued at the offered price (Pay as bid) (GME, 2017).

With the increasing number of renewable sources, which are not flexible by nature, balancing will require further efforts and costs. In this context, Terna has the responsibility to forecast the potential generation by the renewable resources. To assist Terna in the forecasting process, wind farms are required to install data collection systems, while Terna itself uses a wind forecast system to be able to predict and plan more accurately (ERRA, 2013).

Currently, regulations regarding the participation of storage facilities and renewable electricity resources into the balancing market are neither clear nor sufficient. Under the current regulation, intermittent RES and small generation units under 10 MW cannot participate in the balancing market (EFET, 2014). In fact, several studies have emphasized the importance of reforms to the current system (EFET, 2014; ERRA, 2013). In particular, reforms related to gate closure in the day-ahead market and participation of RES-E in the ancillary market are encouraged (ERRA, 2013; EFET, 2014). In the response to a public consultation by the Italian regulation authority for electricity and gas in 2012, Terna suggested that RES-S producers with a power over 10 MW to participate in balancing markets (IEA, 2016).

In June 2017, the Italian Government opened another public consultation about the country's National Energy Strategy for the goals to be reached by 2030. The consultation was closed on September 2017 and the final document was published in November 2017. In the final draft, it has been indicated that in a scenario with high penetration of renewables, to increase system security and flexibility, a solution can be opening up the dispatching and balancing market to the storage systems, non-programmable RES-E producers and distributed generations (SEN, 2017). Therefore, it can be expected that, in the near future, current regulations will change as a means to improve flexibility and reliability of the electricity system.

For the local markets to be implemented in the Italian electricity sector, certain aspects need to be changed or at least improved. Some insights are given as following. Although self-consumption is allowed under current regulations, selling electricity to neighbours is not authorized for PV owners. This is an important aspect which needs to be changed in order to implement the EMPOWER project and local electricity markets in the Italian territory. PV owners should be given the right to not only store their excess production but also to exchange it with their neighbours. Storage permission can also act as an incentive for the traditional consumers to become prosumers. In addition, self-consumption and storage capability can increase system's flexibility and security as well.

Regarding the balancing market, current regulations do not permit participation of RES-E, distributed generations and storage systems. These electricity sources, which are now growing quickly, are considered to be an important source of flexibility and security issues. The solution can be allowing these sources to participate in the ancillary and balancing market and to let them trade flexibility as a market product. By doing so, flexibility and reliability of the electricity system can be improved. Furthermore, one of the key aspects of the EMPOWER project, which is to consider flexibility as a market product, will be fulfilled.

- IEA, 2016. 'Energy policies of IEA countries: Italy, 2016 Review'. Available at: https://www.iea.org/publications/freepublications/publication/EnergiePoliciesofIEACountriesItaly2016Review.pdf

- ???, 2017. 'Electricity regulation in Italy: overview'. Practical Law Country Q&A, Available at: https://uk.practicallaw.thomsonreuters.com/4-525-4301?transitionType=Default&contextData=(sc.Default)&firstPage=true&bhcp=1

- De Angelis, L., 2010. 'Unbundling of Energy Undertakings and Multi-Utility Strategies in Italy'. Amministrazione in cammino, Rivista elettronica di diritto pubblico, di diritto dell'economia e di scienza dell'amministrazione cura del Centro di ricerca sulle amministrazioni pubbliche "Vittorio Bachelet" - Luiss Guido Carli. Available at: http://amministrazioneincammino.luiss.it/app/uploads/2010/03/1444.pdf

- AEEG, 2016. 'Annual Report to the Agency for The Cooperation of Energy Regulators and to the European Commission on the Regulatory Activities and the Fulfilment of Duties of the Italian Regulatory Authority for Electricity, Gas and Water.' Report 431/2016/I, 28 July 2016, Available at: https://www.autorita.energia.it/allegati/relaz_ann/16/annual_report2016.pdf.

- IEA-PVPS, 2016. 'IEA PVPS TASK 1, REVIEW AND ANALYSIS OF PV SELF-CONSUMPTION POLICIES'. International Energy Agency, 2016, Available at: https://nachhaltigwirtschaften.at/resources/iea_pdf/reports/iea_pvps_task1_review_and_analysis_of_pv_self_consumption_policies_2016.pdf

- CMS, 2015. 'CMS guide to electricity – Italy'. LEXOLOGY, September 2015. Available at: https://www.lexology.com/library/detail.aspx?g=79911a4e-f750-443f-9617-aab6f2042b11.

- EFET, 2014. 'Italian power market: towards the achievement of the EU Target Model'. European Federation of Energy Traders position paper, 16 October 2014. Available at: http://www.efet.org/Files/Documents/Electricity%20Market/General%20market%20design%20and%20governance/Executive-summary-Italian-power-market.pdf.

- ERRA, 2013. 'Regulatory Practices Supporting Deployment of Renewable Generators through Enhanced Network Connection'. Energy Regulators Regional Association (ERRA) issue paper, October 2013. Available at: https://erranet.org/wp-content/uploads/2016/03/Regulatory_Practices_Supporting_Deployment_of_Renewable_Generators_ENG.pdf.

- SEN, 2017. 'Strategia Energetica Nazionale'. National Energy Strategy, Ministero dello sviluppo economico, November 2017. Available at: http://www.sviluppoeconomico.gov.it/images/stories/documenti/testo_della_StrategiaEnergeticaNazionale_2017.pdf.

- GME, 2017. Gestore Mercati Energetici, Electricity Market. Accessed on 20.11.2017: http://www.mercatoelettrico.org/En/Mercati/MercatoElettrico/MC_QuadroNormativo.aspx

- Ministerial Decree, 2016. 'DECRETO 23 giugno 2016: Incentivazione dell'energia elettrica prodotta da fonti rinnovabili diverse dal fotovoltaico'. Il Ministro dello Sviluppo Economico, Italy, 23 June 2016. Available at: http://www.gse.it/it/salastampa/GSE_Documenti/Decreto_MiSE_23giugno2016_Incentivi_rinnovabili_diverse_da_fotovoltaico.pdf.

Table 18: *References regulation with relevance for EMPOWER in Italy*

6 Basic outline of the EEG compensation mechanism

In order to displays opportunities of how EMPOWER based business models can comply and can be integrated in current regulatory regimes, we now look at the case of Germany and provide here a basic outline of the German renewable energy law (EEG) and its compensation mechanism. The figure below depicts this mechanism.

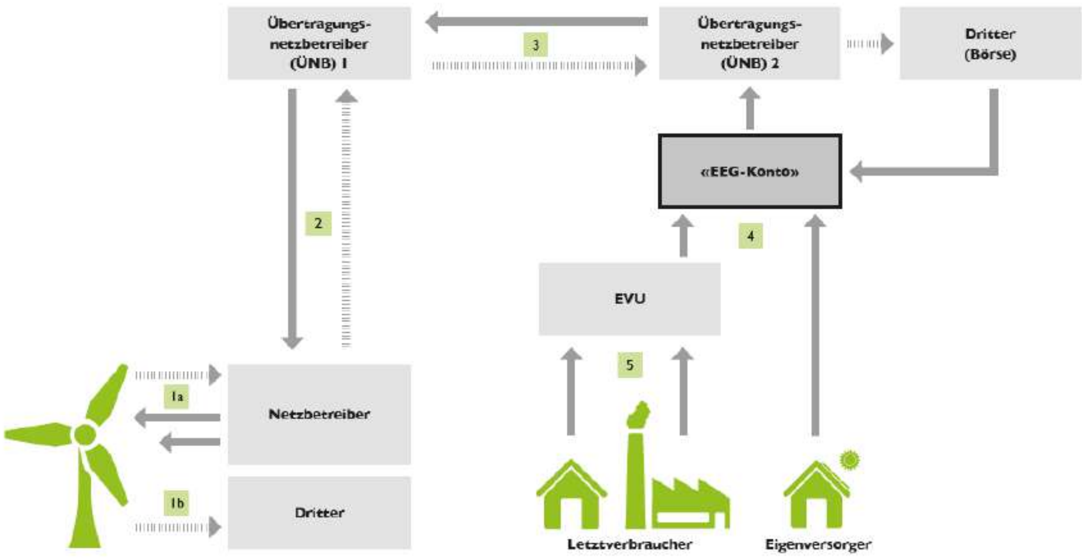

Figure 5: EEG scheme in Germany

Electricity is either sold to the grid operator (1a) or under the so-called direct marketing, to a third party (1b). The grid operator receives financial support from the grid operator according to the EEG, in the form of a feed-in remuneration (in the case of 1a) or if certain conditions are met in form of a market premium (1b). The grid operator sells the purchased electricity to the upstream transmission system operator (TSO) and receives the financial support that was paid out to the plant operator, deducting the so-called avoided network charges, determination as per § 18 section 2 and 3 of the Electricity Fee Order (2). The electricity is then be balanced between the four TSOs operating in Germany (TransnetBW, Tennet TSO, Amprion und 50Hertz Transmission), so that each TSO bears the same burden with respect to the volumes of electricity supplied to final consumers in its control area (3). The electricity is subsequently sold on the stock exchange by the TSOs. Metaphorically speaking, the proceeds from this sale flow to an "EEG account", from which the remuneration payments are made to the plant operators, amongst other things (4). Since the proceeds from the sale are usually lower than the paid EEG remunerations, the "EEG account" generally has a shortage. This balance is allocated to the total amount of electricity supplied to final consumers in the Federal Republic of Germany and partly to the amount of electricity consumed by the consumer, the so-called EEG surcharge (5).

6.1 Integration of newtility into the EEG compensation mechanism

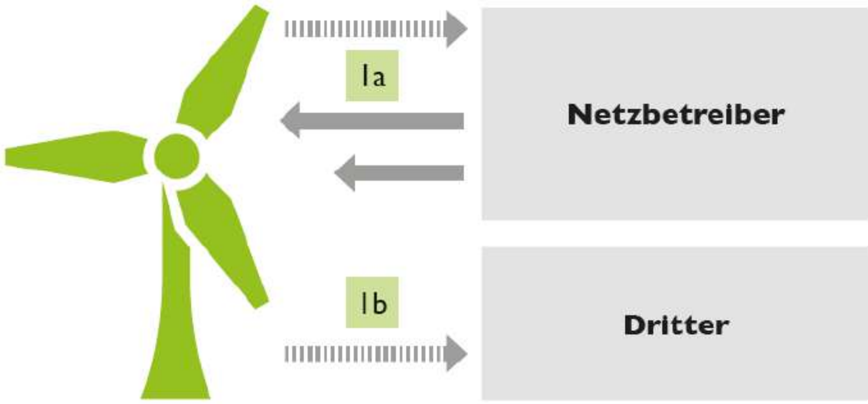

Figure 6: Integration of EMPOWER into the EEG scheme in Germany

According to the process flow as depicted in the graphic above, Newtility integrates an offer to market electricity from renewable energy-plants (such as from farmers):

a) directly to third parties, e.g. household customers who are customers of the farmers

b) Ideally, this happens in the local environment, i.e. the customer lives in the immediate vicinity of the renewable energy-producer.

Direct marketing of third parties is regulated in the German market. According to § 19 EEG 2017, operators of plants in which exclusively renewable energies or mine gas are used for the electricity generation, have a claim against the grid operator to get a market premium according to § 20, a feed-in remuneration according to § 21 section 1 and 2 or a renter surcharge according to § 21, section 3. The prerequisite for granting the feed-in remuneration to plant operators is that they provide the grid operator with the entire electricity generated in this plant, which is not consumed in the immediate vicinity of the facility and is passed through the grid.

Conversely, this means that plant operators are not entitled to a feed-in remuneration if they do not pass on the generated renewable energy electricity to the grid operator in the total production volume, but instead, market it to third parties.

Alternative constructions, for example, to market electricity from renewable energy-plants compensated with feed-in remuneration, are excluded by EEG 2017 (§ 80 Double Marketing Prohibition). Electricity from renewable energies (...) must not be sold multiple times, must be transferred to others or sold to a third person, contrary to § 56. Consequently, a partner cooperating with Newtility must opt for direct marketing of the total amount of electricity from a renewable energy plant.

A special case is local direct marketing. Case b) represents the idea of local direct marketing of electricity to third parties. In case of regional direct marketing, end customers are supplied with electricity from plants in the region or the surrounding area, which have a spatial link. According to the ordinance on the implementation of the Electricity Tax Act (§12b, section 5), the spatial link comprises "sampling points within a radius of up to 4.5 kilometers around the respective power generation unit".

However, under certain conditions, direct regional marketing has given rise to electricity tax advantages, which reduce the fees for the system operator in comparison to "conventional" direct marketing. The electricity tax of up to € 20.5 / MWh can be saved under the following conditions, which are listed under § 9 para 1, no. 3 b) StromStG:

- regional connection between producer and consumer (maximum within a radius of 4.5 kilometers),
- maximum system size of 2 MW,
- directing the electricity produced through the public network to the consumer,
- proof that the electricity sold to the end customer was consumed at the same time as the production.

But, for renewable energy systems that are funded under the EEG, the new EEG 2017 has eliminated the possibility of electricity tax exemption for regional direct marketing. However, CHP systems or other decentralized systems, that are not receiving state support, can continue to use regional direct marketing if they fulfil the listed conditions.

7 Phase concept of the EMPOWER implementation

It is important to have a closer look on the regulatory environment to then develop an implementation strategy for EMPOWER based business models. Within the Newtility dissemination activities, we have developed a phase based implementation route for implementing EMPOWER based business models in a specific region in Germany (Westmünsterland) and which we will present in the following. This phase-based approach can potentially also guide the EMPOWER dissemination in other countries. The different phases have been designed to comply with the specific needs of local utilities. Modifications apply for fitting the needs of energy cooperatives.

7.1 Phase 1: Regional farm electricity

In the first phase, Newtility enables a novel regional power tariff which makes it feasible to design energy tariffs based on regional farm electricity. Figure x depicts phase 1.

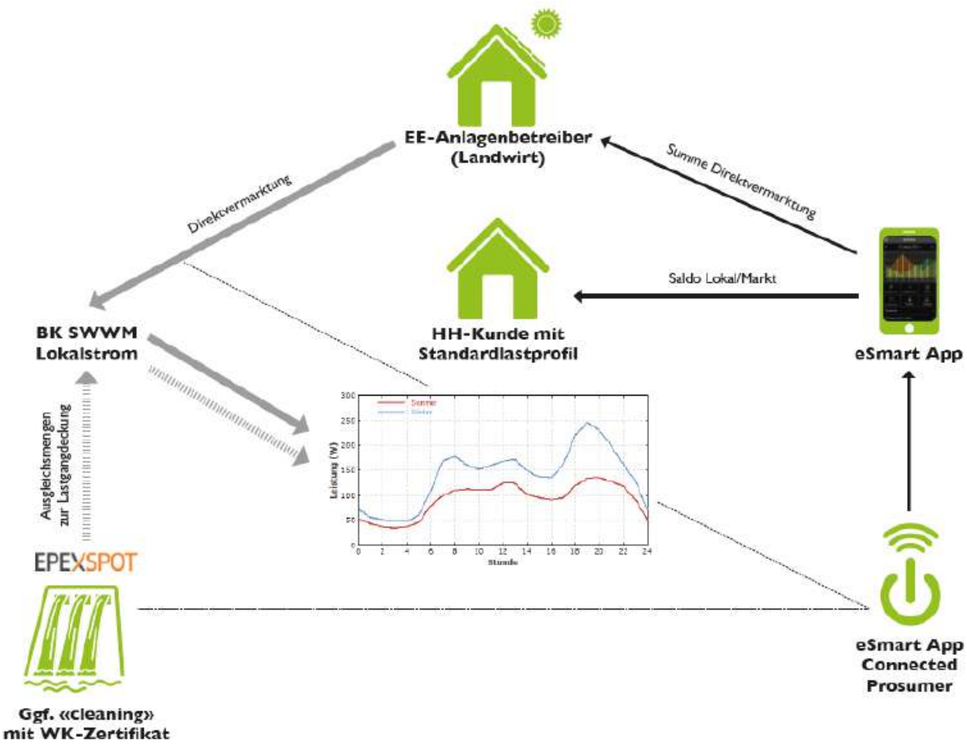

Figure 7: Phase 1 implementation

In a first step, a PV renewable energy plant operator decides to directly market its production to the local utility / Newtility. Second, the local utility / Newtility sets up a «local electricity» balancing group to which the renewable energy plant operator delivers directly. Third, the household customer with standard load profile is supplied «local electricity» from the balancing group. Third, shortages for delivery from the balancing group «local electricity» (e.g. at night) are procured on the market and fed into the balancing group «local electricity», to balance them. In order to offer a pure green electricity product, the purchased quantities are, for example, "cleaned" by hydropower certificates. By means of the EMPOWR software system (eSmart Connected Prosumer Software), the electricity volumes flown by the renewable energy plant operator into direct marketing and the acquisitions on the market are recorded. Finally, the renewable energy plant operator can use the EMPOWER FlexApp to get a real-time overview of his directly marketed quantities; the household customer receives a real-time visualization regarding the balance of regional and market-related electricity.

7.2 Phase 2: Expansion with additional renewable energy plant operators

In the second phase of the EMPOWER implementation, additional renewable energy plant operators and household prosumers and customers will be involved in the project. See figure xy.

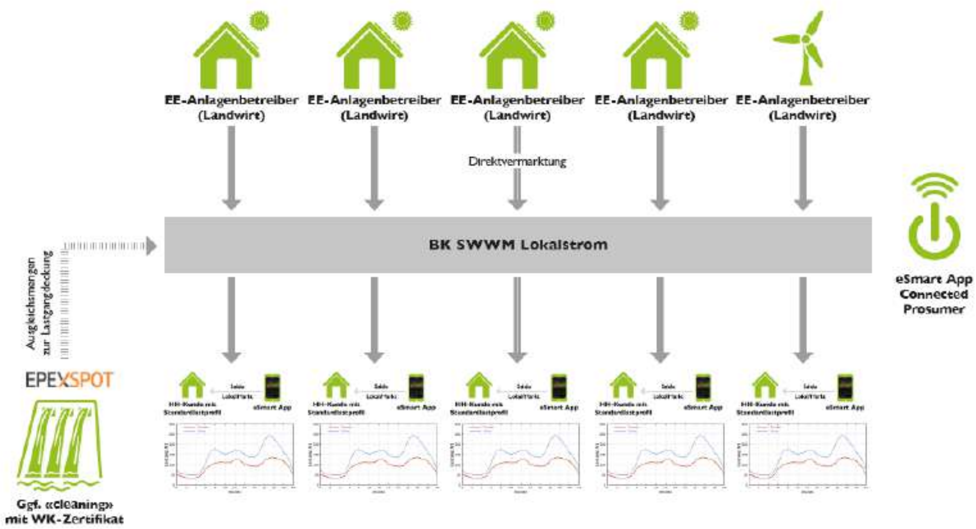

Figure 8: Phase 2 implementation

By means of the targeted integration of additional RE-plants outside the PV-area (e.g. Wind, biomass), the share of non-local generation procured on the market is gradually reduced.

7.3 Phase 3: Expansion of the pilot with storage options

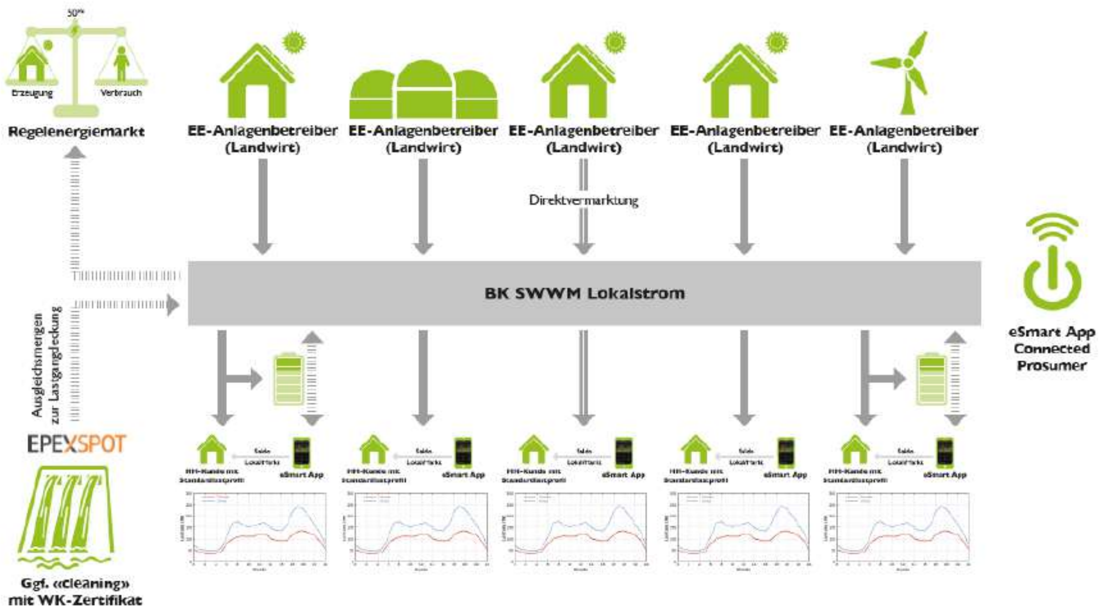

Figure 9: Phase 3 implementation

In the third phase of the implementation, eSmart's Connected Prosumer Software will additionally integrate controllable storage batteries into the system. These can be on the one hand, as in the Norwegian pilot, decentral community batteries. On the other hand, it can be smaller modules installed at prosumers households. Using the eSmart app, the renewable energy plant operator receives his «Electricity balance» and the current balance of his stored production quantities minus any technical storage losses.

By means of the targeted integration of storage options, it will be possible to specifically capture renewable energy generation during off-peak periods and to store it in times of heavy load in order to further expand the autonomy of external sources of electricity.

In addition, it is already possible in this expansion stage to use the storage options, for instance, in order to make control energy available to the DSOs or TSOs to increase system stability. The analysis and system flexibility calculations required for this purpose are performed by the EMPOWER software package.

7.4 Phase 4:Expansion towards a local electricity community

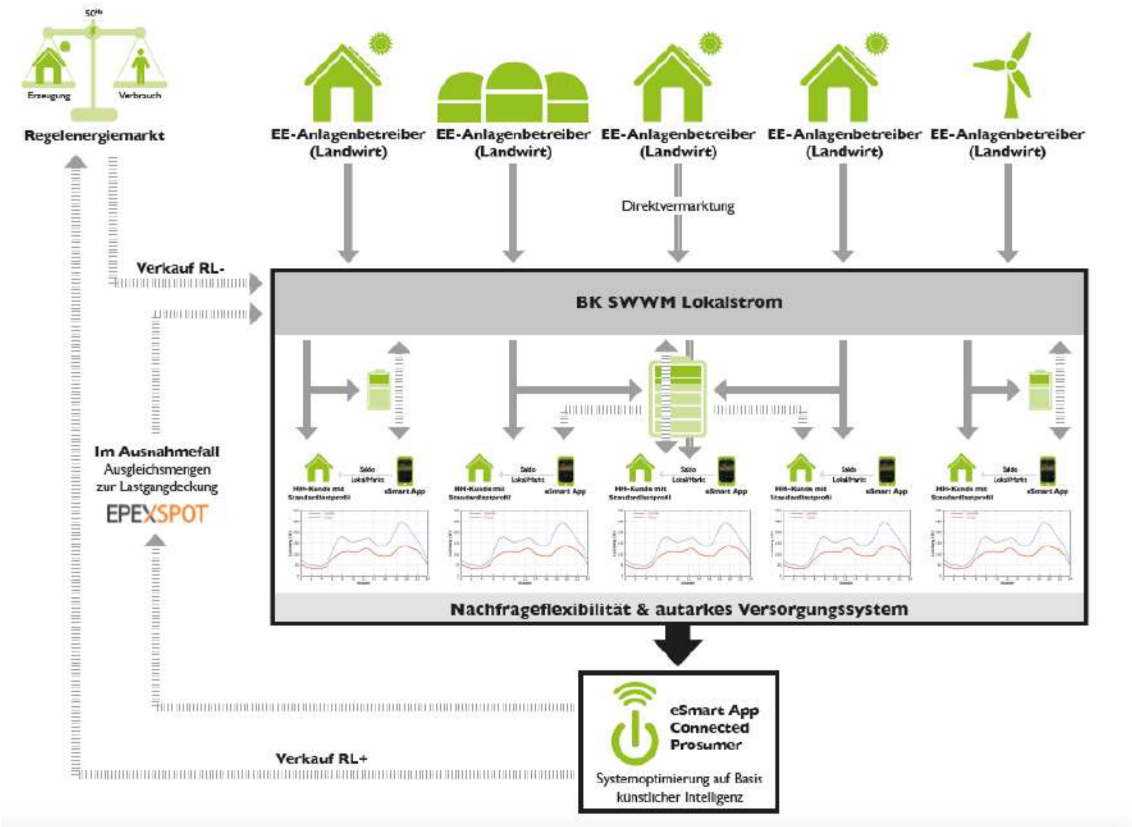

Figure 10: Phase 4 implementation

In the final expansion stage of the system, the EMPOWER software packages calculates the demand and supply flexibility at any time (see figure xy). It will be possible to supply the prosumers and consumers who are integrated into the community independently. Compensation quantities have to be procured outside the community only in exceptional cases. The increasingly broad integration of memory components makes it possible to offer both positive and negative balancing power to the DSOs and TSOs. A highly self-sufficient, self-regulatory system has been created.

7.5 Potential analysis for direct marketing to third parties

While the phase model is appealing, it is necessary to analyse the potential for direct marketing to third parties in the supply area of the local utility. Different regulations affect this analysis. Above all, the following economic factors have to be considered. First, the termination of the EEG subsidy: The first question to answer to is which year the EEG subsidy will expire and for which renewable energy systems. This could create an incentive for the plant operator to offset some of the lost EEG revenue through direct marketing. Second, the current level of feed-in remuneration: it must be ascertained from which year onwards reduced EEG compensation rates have been applied for the various types of renewable energy that make direct marketing more economically viable for the operators than the use of a feed-in remuneration.

For the case of photovoltaics in Germany, the following aspects, with regards to these points, need to be considered.

The year 2000 is considered to be the year of commissioning in the EEG for old plants, even if the plant was built before April 2000. Thus, the EEG remuneration will not be paid until 2014, for example, in an installation built in 1994, but until the end of 2020. Therefor no photovoltaic system expires before January 2021 from the EEG remuneration. If another compensation scheme expires beforehand, the operator will also be entitled to the EEG compensation according to the commissioning year 2000, hence till the end of 2020.

For old systems, which were put into operation before 1.1.2009, self-consumption is financially not worthwhile usually because the feed-in remuneration is approximately 46 Ct / kWh and higher (see for instance here: http://www.jm-projektinvest.com/de/photovoltaik/einspeiseverguetung.) However, for installations under current compensation schemes, the economics look more beneficial in regard to the EMPOWER offer.

Inbetriebnahme im Monat	Anlagentyp	Nennleistung der PV-Anlage (kWp)	Einspeisevergütung (Cent/kWh)	Kürzung gegenüber Vormonat
August 2017	Anlage auf Wohngebäuden und Lärmschutzwänden	bis 10	12,30	0,00%
		>10 bis 40	11,96	
		>40 bis 100	10,69	
	Sonstige Anlagen	bis 100	8,51	
September 2017	Anlage auf Wohngebäuden und Lärmschutzwänden	bis 10	12,30	0,00%
		>10 bis 40	11,96	
		>40 bis 100	10,69	
	sonstige Anlagen	bis 100	8,51	
Oktober 2017	Anlage auf Wohngebäuden und Lärmschutzwänden	bis 10	12,30	0,00%
		>10 bis 40	11,96	
		>40 bis 100	10,69	
	sonstige Anlagen	bis 100	8,51	

Table 19: Current remuneration levels in Germany

Source: https://www.solaranlagen-portal.com/photovoltaik/wirtschaftlichkeit/einspeiseverguetung

Aspects	**Important features of direct marketing**
Arguments for direct marketing	Electricity price-oriented optimization of renewable energy systems Integration in regional models Exhibition of regional origin proofs Participation in the standard energy market Remuneration of a management premium for renewable energy plant operators who are direct marketers
Access to plants	By ripple control receiver through the grid operator Alternatively: separate channel for direct marketing service provider by means of a separate control box or integrated direct marketing interface from the metering point operator. However, the exact technical connections vary depending on the solution used, which is why you cannot make a blanket statement here.
Costs of a direct marketing service provider	Metering point operation: no additional costs, as this must be guaranteed and paid without direct marketing. If the remote control is implemented via the metering point operator, separate fees for the Internet connection are usually not required. Otherwise, the Internet connection can be used on site or a connection via mobile phone is used. The cost of the data connection is between 2 - 10 € / month. Tax box and license costs: initial costs are usually between 70 and 550 Euros. (EnBW) Marketing or service charge for the direct marketing service provider
Compensation for curtailment	In the event of a reduction of the feed-in capacity by the direct marketer, the plant operator is compensated for the non-fed electricity (outage work); normally according to a flat rate procedure as per guidelines to the EEG feed-in management of the Federal Network Agency. The amount of compensation is calculated by multiplying the default work by the performance weighted average of the assets to be invested in the reduction period. If the grid operator regulates a plant as part of a feed-in management measure, the plant operator may demand compensation for damages within the framework of the statutory provisions. According to the EEG, 95 percent of the lost revenue will be replaced. If the electricity prices are reduced in times of negative electricity prices, these so-called lost costs will be charged accordingly. If the compensated income exceeds one percent of the total annual income, the remaining measures will be 100 percent compensated. In the case of deductions outside of the feed-in management, claims for compensation must be examined separately and assessed on a case-by-case basis.
Duration of direct marketing contracts	Contract terms are three to five years by default and automatically renew for another year, unless terminated. During this period, a predetermined marketing fee will be charged by the direct marketing service provider. In the case of longer-term contracts, individual marketing fees are calculated on the basis of uncertainties, especially with regard to the future feed-in profile of a photovoltaic system and the related profile value (value of electricity fed compared to the average monthly market value).

Aspects	Important features of direct marketing
Direct marketing of subsets of production	Basically, only the electricity fed into the grid is marketed directly. If at one point, 30 percent of the production is consumed locally and 70 percent is fed into the grid, these 70 percent are directly marketed. If no consumption takes place in the next hour, the full system output is marketed accordingly. However, the plant operator does not have to worry about management or forecasts. The direct marketers take over for him.
Economic lower limit for direct marketing	Basically, the profitability of direct marketing depends on the amount of electricity fed in, and thus, on self-consumption and the installed plant output. The general rule: the larger the plant and the lower the own consumption, the more economical the direct marketing. Another factor can be the type of meters installed, as direct-market registration requires a registering load profile measurement. Therefore, if currently no load gear measurement is installed, it must be converted to this, which usually leads to higher metering fees. If an investment is placed in direct marketing as part of a regional revenue model, it can generate additional revenue. If necessary, this can compensate for the poorer profitability of pure direct marketing.

Table 20: Features of direct marketing

8 Implications for the EMPOWER project

8.1 Managerial implications

From this report we derive several important implications for managers and entrepreneurs to implement local electricity retail markets for smart grid power services.

First, the implementation of EMPOWER business models requires a distinct policy analysis for the country and region for which the EMPOWER business model shall be implemented. The report gives an overview of important features that have to be considered and points to the relevant sources where the information can be obtained. As the cases of Italy and in particular Germany shows, a detailed investigation on the country specific energy laws (and related laws) have to be taken into consideration. It is mandatory to rely on these “original” texts.

Second, this report suggests to specify the distinct linkages and requirements between the regulation in place and the EMPOWER concept. Important aspects, as this report reveals, are for instance regulation in regard to unbundling. The SESP role within the EMPOWER framework integrates grid services and electricity distribution, which makes it important to look for opportunities to meet existing unbundling requests (e.g.

interesting in this regard might be de minimis rules that exclude smaller utility companies serving less than 100.000 from unbundling). Another example that showcases the linkages between EMPOWER and current regulation, has been shown in this report by pointing to the EGG mechanisms in Germany and how different remuneration levels help to identify market segments that might be attracted by EMPOWER based business models.

Finally, this report suggests to design a phase-based approach to implement EMPOWER based business models that comply with local regulation. This phase-based implementation is superior to a implementation strategy that targets to implement 100% EMPOWER right away. The phase-based approach sets up a process, in which the different phases help existing structures to adjust to the EMPOWER concept, which in fact complies with European energy policy (e.g. as spelled out in the “winter-package”) but which is in some parts quite challenging for current energy market designs to implement). The phase-based approach helps a step-wise adaption to such a radical market change. In a first-phase, EMPOWER based business model enable to integrate novel prosumer tariffs in existing balancing group structures and provide novel local power tariffs. The respective subsequent steps enlarge the services up to the fourth-phase in which the EMPOWER market design is implemented and local balance of demand and supply is established.

8.1 Policy implications

In regard to policy implications we see two general directions. One the one hand, it is important for implementation to adapt towards the regulation that is in place. This will lead to changes in the EMPOWER business model design to comply with regulation at the local level. On the other hand, policymakers can also react and adjust existing regulations to more effectively support EMPOWER market designs. This latter view is an important result of the EMPOWER project. Several quotes that have been collected through interviews with key stakeholders of the EMPOWER project (WP 8) support this view:

Quote of the senior manager of EMPOWER partner I: *"...if you communicate with regulators and try to convince them from the solutions, it could be a valid point."*

Quote of the senior manager of EMPOWER partner II: "*that will also become a very good note for the regulators in the European Countries, what kind of regulation needs to be changed ...* "

Quotes of the senior manager of EMPOWER partner III: "*We also think that it's important to challenge the regulations and try to make it more customer friendly. So, I think if we have a very nice cooperation with the regulator (...)* "

"Then in the space of research and development projects there are more room for trying out new stuff that might bend the regulation a little bit I think."

"If you have a good idea that's not within a regulation, we have to seek a dialogue with the regulator and try to make understanding that we want to do this, first of all in research and development project, and we see if our business case or our idea actually is what it seems to be. And then if we do the findings that we hoped for, then we can challenge the regulations."

Overall, we see a number of regulatory challenges to facilitate the integration of EMPOWER markets and respective opportunities for policy makers to mitigate these challenges. The table below depicts these challenges. These suggestions complement existing roadmaps, such as formulated by the Council of European Energy Regulators https://www.ceer.eu/documents/104400/-/-/db9b497c-9d0f-5a38-2320-304472f122ec.

The suggestions have been contained in a presentation by Smart IO and presented to key stakeholders of the EMPOWER project during a final workshop in Norway (see WP8) based on the EMPOWER learnings http://smartinnovationnorway.no/wp-content/uploads/2017/11/CHRISTIAN-KUNZE_Smart-Innovation-Norway.pdf. The following table displays current challenges and opportunities for policy makers of how to remedy these challenges.

Existing regulatory challenges for implementing EMPOWER	**Opportunities for policy makers to mitigate these challenges**
High opportunity cost for DSM implementation – low balancing market returns	DSM subsidy schemes (i.e. subsidize services for subsidized renewable generation)?
Pre-qualification process is long, time consuming and not always transparent	Process simplification and standardization required
Reduction of required bid volume during the previous years (tertiary control = 5 MW). Balancing market design is	Adjustment in terms of minimum bid volume, long balancing energy call windows, restrictions for the pooling of processes, short lead

Existing regulatory challenges for implementing EMPOWER	Opportunities for policy makers to mitigate these challenges
historically related to centralized generation units	time in case of calls, very low variations of load are required
Central market role of BGRP: intermediary between consumer, supplier, grid operator • Flexibility operator requires the permission of the BGRP to conduct DSM activities	Standardized short-term consumer schedule adjustment processes and prices are required
Savings of up to 90% of grid tariffs for companies, if: - Peak consumption occurs outside the peak load periods of the local grid - Demand is relatively flat and characterized by a high number of grid utilization hours	Adjustments required as higher grid tariffs exceed in many cases flexibilisation revenues
Interruptible load decree («Abschaltbare Lasten Verordnung (AbLaV)») • Tenders for interruptible loads of large consumers that are connected to the high or highest voltage grid • Relatively high compensation for a limited target group of bidders (initially min. 50 MW (now 10 MW) monthly (now weekly) bid size	Opening of this market segment to smaller, flexible loads is required
Integration of flexibility provisions into energy management measures • Continuous energy efficiency measures and energy audits in German companies • Flexibility / DSM potential and effect is not yet integrated into audits	Integrate flexibility potential into energy audit DIN EN ISO 50001 and/or. DIN EN 16247-1 a
Different approaches to flexibility products and markets across Europe	Development of an integrated and synchronized framework

Table 21: Important policy recommendations

In addition to these recommendations, two research articles have been published (Helms et al.) and (Kubli, Loock, & Wuestenhagen, 2017) are under review in the Journal Energy Policy. In particular, these publications spell-out further details on how energy policy is impacted by salient findings of the EMPOWER project.

References

Helms, T., Loock, M., & Bohnsack, R. (2016). Timing-based business models for flexibility creation in the electric power sector. *Energy Policy, 92*, 348-358.

Kubli, M., Loock, M., & Wuestenhagen, R. (2017). The flexible prosumer: Measuring the willingness to co-create distributed flexibility services. *Energy Policy (under 2. round review)*.