D6.1 V1.0

Analysis of SOGNO results regarding standards and regulations

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Abstract

This deliverable provides a detailed analysis addressing the project results from the perspective of regulation and standardization, with regard to the expected market development in the coming 5-10 years. The most important measures in the context of the regulatory framework and standardization were identified and passed through the filter of consultations with stakeholders, so that the market can easily adapt to the technologies developed in SOGNO. The proposals presented in this deliverable are the concrete measures that need to be considered in the field of regulation and standardization in order to properly support the adoption and implementation of SOGNO services on the specific market.

Keyword list

SOGNO services, DSOs, Regulatory framework, Standards and regulations, Stakeholders consultations, TOTEX (CAPEX + OPEX), ICT chapter on existing NCs, European Energy Distribution NCs, Operating license

Executive summary

The power sector is once again evolving. A variety of distributed energy resources and improving computation, communication, and control technologies create an unprecedented degree of choice for DSOs and electricity consumers, choices that are poorly guided by incentives and other support measures from the perspective of regulations.

Cloud technology is helping companies in every industry to do more with less. The cloud can play a key role in pushing industries into successful digital integration. In the energy sector, legacy systems that rely on human involvement are now being replaced by automated systems that interact seamlessly with cloud platforms. The companies driving this shift report typical improvements such as higher efficiency and lower costs. Energy executives mostly aim to improve operational decision-making by using cloud-based software services as developed in SOGNO with reduced costs being a consequential benefit.

These represent practically the benefits and context of power network management software services, as proposed in the SOGNO project. The basic motivation of SOGNO was to reduce the potentially negative impact that extreme weather phenomena have on the quality parameters of the electricity distribution service provided by DSOs. High RES and e-vehicle penetration are part of the same motivational context for SOGNO services, which destabilize the grid and hence, require grid monitoring. Better network operation is increasingly needed in this context, by real-time grid monitoring, power control and quality evaluation, load & generation forecast, as well as faster fault location identification and service restauration.

Both the acquisition and implementation of SOGNO cloud-based software services by the DSOs and the positioning in the parameters of optimal operation and profitability of a business model associated with the potential provider of such services will be strongly influenced by the regulatory framework. An appropriate regulatory framework can encourage the market to move towards the adoption of these services and incentivize the implementation of solutions and services which bring added value and have a positive impact on the specific market.

The analysis of the SOGNO services and the associated business model integrating these services, from the perspective of a “go to market” process, reveals a series of necessary measures in the field of regulation and standardization. These were outlined in 5 regulatory proposals that are analyzed and presented in this deliverable. The analysis process was permanently running during the project implementation, by involving debates and consultations with all relevant stakeholder categories: DSOs (large, small and medium-sized), regulators, representatives of the European Commission and other policy makers as well as sector and regulatory organizations operating at European level.

Following the same framework of analysis and consultations, and starting from the overview of the standardization context, this deliverable presents the relevant aspect applicable in the field of standardization as well.

The last chapter of the deliverable briefly presents the recommendations developed within SOGNO project. This topic is addressed more detailed in deliverable D6.5 – Recommendations to policy makers, enterprises (business model design) and other stakeholder groups for designing regulatory frameworks and incentive systems, including CSR guidelines for business models in the energy sector.

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1. Introduction

The introduction part of this deliverable presents its main objectives, the structure of the report and information flow, including its position and role within SOGNO project context, and the interdependency relation it has with other deliverables and work packages.

1.1 Objectives of the Report

Starting from the analysis of SOGNO services and having the perspective of their correlation with the market requirements, this deliverable aims to identify and present concrete proposals to update and fulfill the regulatory and standardization framework, to facilitate the adoption and implementation of SOGNO services.

1.2 Outline of the Report

Following the introductory part, the chapter 2 of the deliverable provides a brief description of the SOGNO services, which are analyzed from the perspective of concrete measures to be considered in regulation and standardization.

Chapter 3 presents the analysis of the impact of SOGNO in regulations, starting from an overview of the general regulatory framework, and further on identifying and presenting the regulatory proposals as necessary measures to support the cloud-based software services market development for DSOs. Thus, the following proposals are analyzed and presented:

- Supporting “cost of service” in balance with CAPEX support (TOTEX approach) through the regulatory framework
- ICT requirements within existing energy distribution network codes
- European Electricity Distribution Code for the harmonization of the legislative provision at European level
- Differentiated operating licence depending on the DSO size
- Aggregator licence for the potential SOGNO integrated services provider

Chapter 4 has the same analysis framework as the previous one, but from the perspective of standardization, as the overview of the standardization context being followed by the presentation of relevant aspects in standardization to support SOGNO services.

The last chapter briefly presents the recommendations developed within SOGNO project, addressed to the main 4 stakeholder categories: DSOs, policy makers and regulators, consumer and environmental organizations. This topic is addressed more detailed in deliverable D6.5 – Recommendations to policy makers, enterprises (business model design) and other stakeholder groups for designing regulatory frameworks and incentive systems, including CSR guidelines for business models in the energy sector.

1.3 How to read this document

This report is the result of the activities carried out in WP6, which aims to identify market and regulatory parameters and to prepare the ground for a large-scale exploitation of the project results. The WP6 activities are closely related to WP7, which ensured the specific dissemination and consultation activities with the stakeholders, both from the perspective of the target segment for SOGNO solutions & services and the perspective of the regulatory and standardization framework. For this reason, the consultation of the WP7 deliverable *D7.2 - Report on fostering support for SOGNO codes and ancillary services* has a special relevance in this context.

From a functional perspective we could compare the activity carried out across WPs in SOGNO as an activity carried out in a company through its departments. The WPs 1-3 represent "production departments" providing SOGNO research concepts and solutions, meaning "the product". Further, the WPs 4-5 represent the "departments" running the test preparation and concrete testing of the "product". These tests allow to highlight "product features" - the added value of SOGNO solutions, in order to be able to carry out a projection of the "product" on the "target market". "Market research, packaging and launch of the product on the market" are carried out in the "marketing, compliance and sales departments" represented by the WPs 6-7 that act synergistically in this context.

In this sense it is relevant to read the deliverables belonging to both WPs 2 and 3 to understand how SOGNO research concepts were defined, as well as the deliverables belonging to the WPs 4 and 5, which provides information on the viability of SOGNO solutions.

All this information is used in WPs 6-7 on the one hand for defining business models by referring to the target market, as well as to prepare the ground for the adoption and implementation of SOGNO services.

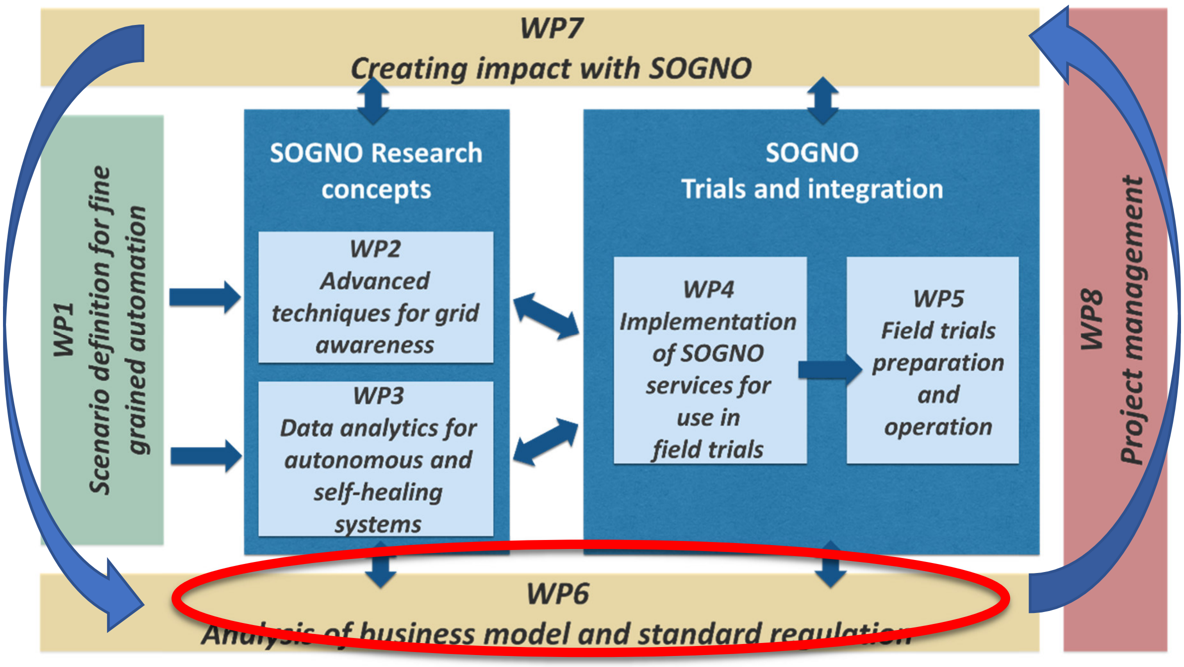

Figure 1 SOGNO Work Packages interconnection

2. SOGNO project results – SOGNO services to be analyzed in the context of regulations and standardization

2.1 State Estimation (SE)

The State Estimation (SE) service allows real-time electric grid monitoring. The goal of SE is to provide the operating state of the network at a given instant of time by processing the measurement information collected by the instrumentation available on the field. The monitoring data, output of the SE algorithm, can be used by grid operators to assess the performance of their network and to detect possible anomalies in the grid operation. In addition, they can serve as an input for more complex management/ control functions implemented by the DSOs to operate their network more efficiently and in a reliable way. An example of service deployed on top of SE is the power control (PC) service described at the point 2.5 of this report. Other services that could use SE results information, include (but are not limited to) network topology reconfiguration, V/VAr control and, in a future perspective, demand side management and demand response.

2.2 Power Quality Evaluation (PQE)

The concept of power quality in electric grids covers a broad range of phenomena that can potentially affect the "quality" of the power supply delivered to the final customer. Usually, power quality issues are defined as those phenomena, which lead the voltage supply in the grid to differ from its ideal characteristics. Classical examples of power quality issues include voltage (or current) unbalance, voltage (or current) harmonics, inter-harmonics and flicker. In a broader sense, power quality definition sometimes also incorporates other aspects that are responsible for the inefficient operation of the electric grid. As an example, low power factors (determined by the presence of relatively high reactive power with respect to the carried active power) are sometimes also considered as a power quality issue.

The Power Quality Evaluation (PQE) service designed in SOGNO aims at providing the identification and monitoring of the most important phenomena commonly associated to power quality issues. One of the most useful devices used for providing this service is the Advanced Power Measurement Unit (APMU). APMU is a low-cost device that is able to directly measure in the field some key parameters related to power quality, such as: phase voltages, phase current, harmonics, reactive power, power factor, unbalance factors (for both voltages and currents), neutral currents, etc. The information directly provided by the APMU can be optionally complemented by the results of SE or by additional post-processing algorithms implemented in the Virtual Substation (ViSA) cloud platform for the computation of other power quality indicators.

The goal of the PQE service is to provide the grid operators with situational awareness about the quality of the power supply in their grid and, in case anomalies are detected, to trigger suitable countermeasures to prevent asset stress or failures, and outages. The produced power quality information can be then used as input for more complex management and control functions used by the DSOs to efficiently operate their grid. In this regard, control or optimization functionalities built based on the PQE service can lead to:

- reduced costs by reducing outages and their associated regulator fines;
- reduced asset failures due to bad power quality;
- reduced time to identify outages related to poor power quality;
- improved service quality and efficiency of the power delivery.

2.3 Fault Location Identification and Service Restoration (FLISR)

The Fault Location Isolation and Service Restoration (FLISR) service is devised to automatically handle the emergency conditions that follow a fault event and aims at limiting the interruption of the power supply to a relatively small number of customers as well as at providing helpful information on the location of the fault, allowing its search and resolution in a shorter amount of time. The FLISR algorithm is based on processing measurements, and other data coming from the field, after a fault occurrence, to pursue, sequentially, the following goals: i) location of the point in the grid where the fault happened; ii) isolation of the faulty section by opening the switches immediately upstream and downstream the fault; iii) restoration of the power supply to all other customers connected to sections of the grid not directly affected by the fault and out of the previously isolated area, again by opening or closing remotely controllable switches. The deployment of an automatic FLISR service has the potential to bring significant advantages to customers in terms of reduction of number and duration of the outages, as well as to DSOs in terms of improvements of the indicators associated to the reliability of the power supply and the continuity of the service. Avoiding possible penalties applied to DSOs in case of bad indicators on the provision of power supply to the end customers, the use of FLISR turns into a clear business case for the DSOs and for this reason it is one of the most critical and important services to be considered when designing a fully-automated distribution grid.

2.4 Load and Generation Forecasting (LGF)

The Load Prediction (LP) and Generation Prediction (GP) algorithms aim at forecasting the future values of power consumption and injection, respectively, in order to give to the DSO the awareness on how the grid operating conditions are expected to evolve in the future. This service works by processing the historical data on the power consumption/injection of the customer, generator, or substation under analysis, and possibly considering other information that is likely to affect the power levels (e.g. like weather conditions, temperature, etc.). The forecast given by the LP and GP can refer to different time horizons and can have a different time resolution, according to the requirements of the DSOs and to the specific use of these algorithms. As an example, day ahead forecasts (for example with a time resolution of 15 minutes) can be generated in order to predict possible contingencies and, in case, to be prepared to take adequate countermeasures. Day ahead forecasts could be refined by shorter-term forecasts, e.g. a forecast referred to the next hour, which in general could be more reliable since it can be based on more recent information on the grid status. This could be, for example, a solution to apply preventive control schemes aimed at minimizing the risk of problems in the grid. On the other side, longer term forecasts (e.g. on a seasonal or yearly basis) are also possible and they can support DSOs in planning, and in supporting strategical decisions on managing and reinforcing the grid. In SOGNO, the focus will be on LP and GP algorithms with time horizon of the forecast within one day.

2.5 Power control (PC)

The Power Control (PC) service optimises the management of the power flows in the distribution grid (at both MV and LV level) for preventing possible contingencies, such as violation of the voltage limits, and overloading of grid components. The service also fosters a more efficient and reliable system operation. This is obtained through the smart control of the active and reactive power injected (or consumed) by converter-based components connected to the grid, such as Distributed Generation (e.g. PV plants, wind turbines) and energy storage units. For the management of the distributed generation based on renewable energy sources, an additional objective is to maximize the use of green energy while respecting the operational constraints of the electric grid, thus minimizing as much as possible the power curtailment of renewable generation. The use of a smart power control algorithm in a high-RES scenario is expected to significantly improve the efficient operation of the grid, the power quality, and the grid reliability. This service can be defined as an “active service”, since it actively acts on some of the power system components to modify their operation.

3. Analysis of the impact of SOGNO in regulations

The results and services developed within the SOGNO project proved to be useful tools for the DSOs on the way to the electricity distribution systems of the future. The implementation of these services is expected to have a major impact from the technical and financial (new business models, costs optimization and others) points of view. In the same context, based on the calculations, simulations, analysis, consultations with stakeholders, and tests performed during the project, several proposals for upgrading the regulatory framework have been defined.

3.1 Overview of the regulatory framework for DSOs

In the field of electricity networks there are two main areas:

- Transmission, and
- Distribution.

The power transmission sector is quite advanced on the road to creating a set of common rules and methods at European level for all TSOs from the EU member countries.

The European professional association of the TSOs: European Network of Transmission System Operators for Electricity (ENTSO-E) has been established in 2009, by merging several different organizations and institutions working at that time in different areas (technical aspects, regulatory, market and others) of the power transmission sector, at European level.

From the beginning ENTSO-E started to implement a sustained program for developing the regulatory framework and harmonize it at European level. Currently, there are eight network codes in force, grouped in three so called “families”, concerning the activities in the power transmission systems.

In the area of electricity distribution, the organizational advances have been more limited mainly because distribution is usually a much more local issue than transmission.

Currently there are several organizations dealing with different aspects of the electricity distribution activity, at European level. Among those, the most significant ones are the following:

- **The Union of the Electricity Industry** – EURELECTRIC is the sector association which represents the common interests of the electricity industry at pan-European level, plus its affiliates and associates on several other continents. Currently EURELECRTRIC has over 34 full members, representing the electricity industry in 32 European countries.
- **European Distribution System Operators’ Association** – E.DSO is the key-interface between Europe’s DSOs and the European Institutions and promotes the development and large-scale testing of smart grid technologies in real-life situations, new market designs and regulation. Starting as a Club of 11 CEOs, E.DSO is now gathering 42 leading electricity distribution system operators (DSOs) in 24 countries all over Europe, including 3 national associations, with a well-established secretariat in Brussels. That represents more than 350 million customers and no less than 7 million kilometres of distribution lines.
- **Transmission and Distribution in Europe** – T&D Europe is the European association of the electricity transmission and distribution equipment and services. The scope of the organization includes the complete range of products and services necessary to transmit and distribute electricity in high and medium voltages, between the producers and the end users. T&D Europe members provide all types of smart grid technologies, including advanced, smart systems suitable for interaction with renewable energies and ICT. The companies represented by T&D Europe account for a production worth over €25 billion and employ over 200,000 people in Europe.

In this environment, the regulatory framework concerning the electricity distribution has been developed mainly at national level, reflecting strictly the requirements and characteristics for each country. In Europe, there is a wide range of organizational structures of the electricity distribution activity (service). On one side, for instance, there is only one single company providing the electricity distribution service for the entire country in the Republic of Ireland. On the other side, there are hundreds of DSOs in countries like Germany and France. Obviously, the regulatory framework in the respective countries is developed in accordance with the existing realities and needs.

The lack of regulatory framework harmonization in different countries rises many operational issues especially for the large electricity distribution companies that have subsidiaries in more than one EU member states.

The European Commission (EC) has acknowledged this issue and started a process for improving the organizational aspects by issuing in 2016 the project: Distribution System Operators Observatory [2]. The aim of this project was to contribute to a better understanding of the challenges that the transition to a new energy system is posing to European distribution system operators and to elaborate solutions to address them.

Based on the results and findings provided by the above-mentioned project and other similar projects, the EC has decided last year to propose the creation of a European professional organization for the DSOs. The proposal was approved by the European Parliament and Council in June 5, 2019. According to that document, the newly created EU DSO entity has the goal to promote the completion and functioning of the internal market for electricity and to promote optimal management and a coordinated operation of distribution and transmission systems [3].

EU DSO is scheduled to be fully operational by the end of 2020. It is foreseen that one of the first priorities of the new organization will be the harmonization of the regulatory framework in the EU member states.

3.2 Regulatory proposals to support SOGNO services

The considerations, analysis and proposals presented in this chapter are based on the currently in force regulatory framework. As mentioned before, the regulatory framework for electricity distribution is not fully harmonized for all EU member states, therefore slight differences from country to country may occur in the exploitation and implementation of the SOGNO proposals.

The innovative services developed within SOGNO (SE, PQE, LGF, PC, FLISR), have been implemented and successfully tested during the field trials. The detailed results and analyses from the efficiency and business model point of view are included in the deliverables D6.2 – Evaluation of potential new business model opportunities, and D6.3 – Identification of economically feasible value chain designs, D6.4 CSR aspects (environmental and societal impacts) of the identified value chain designs and D6.5 Recommendations to policy makers, enterprises (business model design) and other stakeholder groups for designing regulatory frameworks and incentive systems, including CSR guidelines for business models in the energy sector.

3.2.1 Supporting "cost of service" in balance with CAPEX support (TOTEX approach) through the regulatory framework

In all EU member states the electricity distribution service has the legal status of "natural monopoly"[1]. The activities and/or services included in this category are reimbursed based on fully regulated tariffs, decided by the national regulatory authority. The fully regulated tariff must accomplish three equally important objectives:

- To be cost-reflective allowing DSOs to recover all the costs associated with the activity.
- To distribute the benefits of smart grid service utilisation in a socially just way between consumers and DSOs to avoid network tariffs and therewith high consumer electricity prices
- To transmit signals by providing incentives and/ or penalties, to direct the progress of the DSO's activity in the directions necessary for the economic activity support.

[1] A **natural monopoly** is a monopoly in an industry in which high infrastructural costs and other barriers to entry relative to the size of the market give the largest supplier in an industry, often the first supplier in a market, an overwhelming advantage over potential competitors. This frequently occurs in industries where capital costs predominate, creating economies of scale that are large in relation to the size of the market; examples include public utilities such as water services and electricity.

Aiming to implement the above-mentioned principles, the regulatory authorities have included in the electricity distribution tariffs, incentives for the development of the grid. The electricity grid development (installing new cables, building new substations, upgrading the capacity of the existing equipment etc.) was of outmost importance, especially in the beginnings of the electricity distribution systems, thus the decision to incentivize in the tariff the CAPEX volume.

On the same note, the regulatory authorities aimed to optimize the operational costs as much as possible by not incentivizing at all the OPEX volume.

Nowadays the economic environment is changing significantly towards service-oriented approaches and the priorities in the development of the electricity distribution systems are changing accordingly.

One of the main drivers of the change is the tremendous development of the software industry. Nowadays, it is in-conceivable to operate an electricity distribution system without the support of several software products, dealing with all the relevant activities: monitoring, decision support, operational measures implementation and others. Despite this well-known reality, the software products are yet not considered “assets” and the cost of their purchase it is not included in CAPEX but in OPEX.

The signal transmitted to the DSOs is strongly distorted in these conditions, and it is not reflecting the actual trends and evolutions both at economic and social levels. The experience accumulated in the last years by implementing the concept of smart grids proved that software products significantly improve the efficiency of the investments.

The positive impact of the new services implementation on the CAPEX efficiency, has been tested and proved in the field trials conducted within SOGNO project.

Considering all the above-mentioned aspects, the SOGNO team is proposing a more balanced incentive structure of OPEX and CAPEX compensation via the electricity distribution tariffs. The proposed new approach aims to incentivise the so called TOTEX (determined as a sum of the CAPEX and OPEX).

The EC has already provided a positive feed-back on this proposal and included this topic in the currently ongoing discussion and the public consultations.

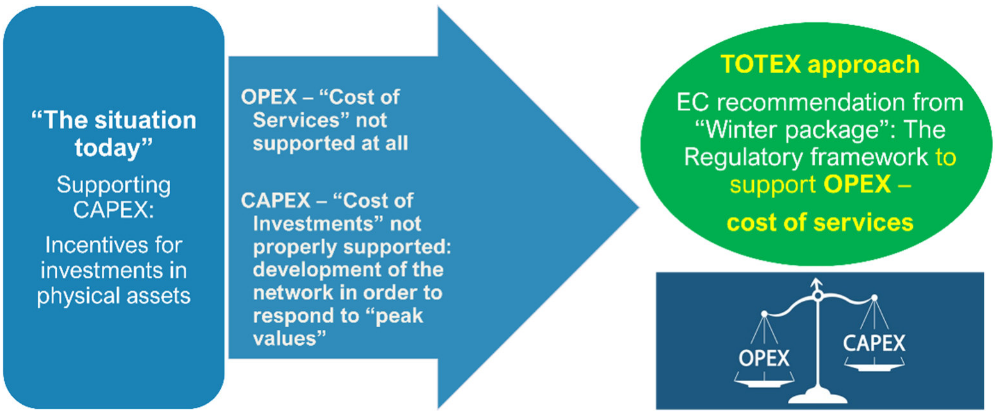

Figure 2 TOTEX approach – balanced CAPEX and OPEX

3.2.2 ICT requirements within existing energy distribution network codes

According to Distribution System Operators Observatory [2] “the rapid changes occurring in the distribution segment have brought this sector at centre stage of the debate. The increasing penetration of local renewable generation and the emergence of demand response enabling solutions are acting as main transformative forces in the power sector, making the distribution grids the primary recipient of all the new interactions initiated by these numerous distributed units (Glachant, Rious, & Vasconcelos, 2015).”[4]

The main driver of this changes is the distributed electricity generation. Distributed and intermittent electricity generation (by e.g. photovoltaic power plants), has a direct and relevant impact on the operation of the electricity distribution systems. Therefore, it is necessary to also update of the regulatory framework (network codes and similar) at distribution level besides the transmission level.

The management of distributed generation relies on wireless connections between the generation units' locations and the distribution system control centre. The implementation and sustained development of the wireless connections have been the foundation of the requirement to include specific regulations for ICT in the existing regulatory framework, at distribution level.

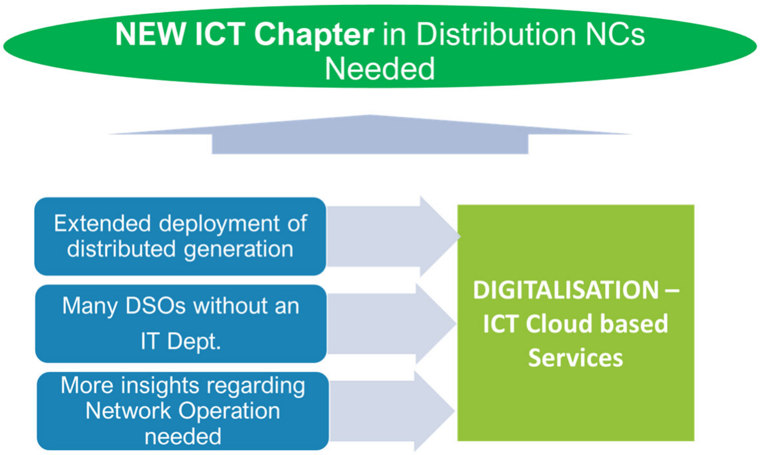

Figure 3 ICT Chapter in Energy Distribution NCs

The regulatory framework in the communication field is strongly developed nowadays but the content of the regulation is focused on the specific needs of the communication itself without any corroboration with the needs and requirements of the electricity distribution system operation. In these conditions it is rather difficult both for an information and communication specialist and for electricity specialist to identify and analyse the regulations fitted to each issue (possibly there is no suitable regulation implemented). The working team of SOGNO has a very well-balanced structure from the point of view of the expertise and specialization, grouping specialists form electricity sector and information and communication sector. During the project, it became clear that including specific requirements for information and communication in the regulation for electricity distribution, would be a major facilitator for further development of the distributed generation/ integration with a high share of RES.

On the same note, the collaboration in SOGNO revealed the necessity for a harmonization of the technical vocabulary. This also may be achieved by including ICT requirements in the network codes (or similar) for electricity distribution.

3.2.3 European Electricity Distribution Code for the harmonization of the legislative provision at European level

The activity performed in SOGNO benefited from the collaboration of specialists from different EU member states. This well-balanced state structure allowed the working team to identify the differences between legal and regulatory approaches and in force frameworks, in different states, highlighted in case of electricity distribution companies operating in more than one state (e.g. the member of SOGNO project – CEZ).

Supported by all SOGNO project members, the proposal for an Electricity Distribution Code unified at European level has been raised in several international conferences and events with the participation of the relevant stakeholders, organized during the project, and the feedback was overwhelmingly positive.

In this context, we are happy to ascertain that European Commission took steps forward and issued a new regulation which has been approved by the European Parliament and Council last year. In accordance with REGULATION (EU) 2019/943 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 [3], by the end of 2020, a new professional organization will be implemented at European level: EU DSO.

Among other important objectives of the newly created entity is: "Art. (60) – … The EU DSO entity should closely cooperate with the ENTSO for electricity on the preparation and implementation of the network codes where applicable and should work on providing guidance on the integration inter alia of distributed generation and energy storage in distribution networks or other areas which relate to the management of distribution networks. The EU DSO entity should also take into account the specificities inherent to distribution systems connected downstream with electricity systems on islands which are not connected with other electricity systems by means of interconnectors." [3]

3.2.4 Requesting "open source" characteristic for the software products used in the electricity distribution

According to the definition of the "open source" concept "open source software (OSS) is a type of computer software which source code is released under a license in which the copyright holder grants users the rights to study, change, and distribute the software to anyone and for any purpose. Open source software may be developed in a collaborative public manner. Open source software is a prominent example of open collaboration [5].

Open source software development can bring in diverse perspectives beyond those of a single company. A 2008 report by the Standish Group stated that adoption of open source software models has resulted in savings of about $60 billion (£48 billion) per year for consumers.[2] [3] "

This type of software has a limited acceptance nowadays among the relevant software producers, due to several main reasons:

- The mathematical solutions and algorithms developed based on them are a result of each company's research efforts. Therefore, for obvious market reasons, they are considered confidential information.
- The software products are upgraded frequently (usually on a yearly basis) and the software provider aims to preserve its clients pool by implementing a sort of "natural monopoly" in this respect.
- In case that a certain software user requires a tailored modification (a situation more and more often encountered in real life), the only possible solution is to ask the software provider to do it.

The results and findings of SOGNO proved without doubts that all the above-mentioned arguments are not sustained in practice, having a commercial rather than a technical character.

Within SOGNO, five different services were developed and implemented on four different software platforms. All the services and platforms have been developed as "open source" type.

The services implemented on different platforms have been successfully tested during the project, in several field trials organized in the existing electricity distribution grid of ESB NETWORKS Ireland, CEZ Romania, Electrilevi Estonia, and in the campus of RWTH Germany.

Based on the results of the comprehensive field trials and tests sets performed in the framework of SOGNO project, one may confidently conclude that "open source" type of software products can be fully compliant with the requirements of the electricity distribution field.

In order to support the exploitation of this proposal in the short term, an intermediate step may be appropriate: the inclusion of the "open source" as a biding criterion, by the DSOs and other relevant actors (e.g. electricity aggregators) in future software acquisitions. In case of a positive feedback after a certain period of implementation, the second step may be the implementation of this requirement in the regulatory framework as full-fledged requisite.

[2] Rothwell, Richard (5 August 2008). "*Creating wealth with free software*". Free Software Magazine. Archived from the original on 8 September 2008. Retrieved 8 September 2008.

[3] "*Standish Newsroom — Open Source*" (Press release). Boston. 16 April 2008. Archived from the original on 18 January 2012. Retrieved 8 September 2008.

3.2.5 Specific licence for electricity aggregators, including the type of SOGNO services

As, for instance, mentioned in the paper "Virtual Power Plants with combined heat and power micro-units" [6], published by IEEE in 2005, the concept of aggregation in the electricity field it is not new at all.

From 2005 to the present, the concept of aggregation has evolved significantly in time, closely related to the evolutions in the power sector. Increasing distributed electricity generation and the "prosumer" models has affected the definition of the electricity aggregation concept. According to BEUC – The European Consumer Organization [7], an electricity "aggregator is a new type of energy service provider which can increase or moderate the electricity consumption of a group of consumers according to total electricity demand on the grid. An (electricity) aggregator can also operate on behalf of a group of consumers producing their own electricity by selling the excess electricity they produce."

Currently, the definition of the aggregator as an electricity services provider is implemented in almost all the national regulatory frameworks, in EU member states. However, the understanding and responsibilities definition are different from state to state, and even from DSO to DSO.

Based on the SOGNO results, once implemented, and used in the proper way, SOGNO services have the potential to increase the efficiency of the electricity aggregator activity and the benefits of its customers. In these conditions, looking forward to the benefits of the citizens (most of them actual or future clients of the electricity aggregators), it is advisable to impose a certain level of service quality. The most effective way to achieve this goal is by issuing a specific licence for providing this type of service.

The purpose of the licence is to accomplish the following goals:

- Indicate the necessary minimal equipping level, concerning both hardware and software, to the potential entities interested in starting a business as electricity aggregators.
- Protecting the citizens, as potential future clients, against the newcomers as service providers, inadequately equipped and skilled.
- Protecting the citizens, as current clients, against the service quality reduction in time.

The format and content of the licence (considering the proposal will be implemented) must be harmonized at European level, to avoid potential incompatibilities in case one or more aggregators are supplying customers from different EU member states.

4. Analysis of the impact of SOGNO on standardization

4.1 Overview of the EU standardization context

Standardization has played a leading role in creating the EU single market. Standards support market-based competition and help ensure the interoperability of complementary products and services. They aim at reducing (e.g. transaction) costs, improving safety, and enhancing competition. Due to their role in protecting health, safety, security, and the environment, standards are important to the public. The EU has an active standardization policy that promotes standards to better regulation and enhance the competitiveness of European industry [8].

Standards are documents that set out specifications and other technical information with regard to various kinds of products, materials, services and processes. Standards provide a basis for mutual understanding among individuals, businesses, public authorities and other kinds of organizations. They facilitate communication, commerce, measurement and manufacturing. European standards bring benefits to businesses and consumers in terms of reducing costs, enhancing performance and improving safety. They also help to ensure the compatibility of different components, products and services, but also to enhance safety and performance, improve energy efficiency, and protect consumers, workers and the environment. They complement European and national policies and make it easier for businesses and other actors to respect relevant legislation.

European standardization is a key instrument for consolidating the single market and facilitating cross-border trade within Europe and with the rest of the world. It is a valuable tool for strengthening the competitiveness of European companies, thereby creating the conditions for economic growth. The European Committee for Standardization (CEN) is officially recognized by the European Union (EU Regulation 1025/2012) as a European Standardization Organization (ESO) responsible for developing and defining standards at European level. The Members of CEN are the National Standardization Bodies of 34 European countries – including all the member states of the European Union (EU) and other countries that are part of the European Single Market. CEN works with its Members to develop and define European Standards in response to specific needs that have been identified by businesses and other users of standards. Specifically, the European standards are developed by teams of experts who have knowledge of the specific sector or topic that is being addressed. The members of Technical Committees as well as sub-committees and working groups are nominated by the national standardization organizations. Each National Standardization Body that is part of the CEN system is obliged to adopt each European Standard as a national standard and make it available to customers in their country. They also must withdraw any existing national standard that conflicts with the new European Standard. Therefore, one European standard (EN) becomes the national standard in all 34 countries covered by CEN Members. Moreover, many European standards are also adopted as identical national standards by CEN Affiliates, which are the national standards bodies of 17 neighbouring countries, and by national standardization bodies in other countries around the world.

The European standards published by CEN are developed by experts, established by consensus and adopted by the Members of CEN. It is important to note that the use of standards is voluntary, and so there is no legal obligation to apply them. Around 30% of the European Standards published by CEN have been developed in response to specific requests (standardization mandates) issued by the European Commission. Many of these standards are known as 'harmonized standards'. They enable businesses to ensure that their products or services comply with essential requirements that have been set out in European legislation (EU Directives). In such cases, we can say that the standard provides 'presumption of conformity' with the essential requirements of the relevant legislation [9].

4.2 Standardization aspects to support SOGNO services

Due to the complexity of their integrated components, SOGNO services, in the context of potentially applicable standards, are analysed both from the perspective of ICT (software and telecommunication solutions) and hardware components (sensors, PMU, etc.), while considering the specific of the electricity field.

4.2.1 Existing standards specific to the context and implications of SOGNO services

4.2.1.1 IEC 61869 Series Standards overview

The new standard series IEC 61869 replaces the old IEC 60044 standard. It applies to all measurement transformers, including:

- Inductive voltage and current instrument transformers: the traditional measurement and protection transformers.
- Low power instrument transformer: the new generation of “sensors”. This section includes capacitive dividers and resistive dividers for voltage sensing, and Rogowski coils for current sensing.
- Accessories like merging unit: a digital interface for the conversion of the analogue sensor output.

The general structure of a standard of the IEC 61869 family is the following: standard scope, normative reference, terms and definitions, service conditions, ratings, design and construction, tests. Each element of this structure is described as follows:

Standard scope

This section describes on which devices the standard is applicable, for example IEC 61869-11 reports: “This document is applicable to newly manufactured low-power passive voltage transformers with analogue output having rated frequencies from 15 Hz to 100 Hz for use with electrical measuring instruments or electrical protective devices”

Normative reference

This section reports all the documents referred in the standard in such a way that some or all of their content is required for a correct interpretation of the standard.

Terms and definitions

This section contains a list of all the terms used in the standards with their definition. For example: “low-power instrument transformer (LPIT) arrangement, consisting of one or more current or voltage transformer(s) which may be connected to transmitting systems and secondary converters, all intended to transmit a low-power analogue or digital output signal to measuring instruments, meters and protective or control devices or similar apparatus.”

Service conditions

This section reports in which conditions the device will operate. These conditions include ambient air temperature, altitude, vibrations, solar radiation, pollution, air pressure, humidity, and system earthing.

For example, referring to system earthing, the following are considered:

a) Isolated neutral system
b) Resonant earthed system
c) Earthed neutral system
    i. Solidly earthed neutral system
    ii. Impedance earthed neutral system”

These conditions are often divided in categories, for example the conditions for indoor and outdoor LPIT are different.

Ratings

This section lists the ratings of the devices. These are divided in the following groups:

- Highest voltage for the equipment and rated insulation levels: reports at which voltage the device will operate, and which maximum voltage may be applied to it during a fault in the distribution grid. This is related to the level of insulation required for the device. Several categories are present.
- Rated frequency: the rated input frequency range of the device (e.g., 50 of 60 Hz)
- Rated output: the rated burden of the device (e.g., 2 MΩ // 50 pF).
- Rated accuracy class: this describe the accuracy of the sensor. Various accuracy classes are defined.

For example:

Accuracy class	Percentage of ratio error ± %			Phase error ±					
				Minutes			Centiradians		
	At voltage (%rated)			At voltage (%rated)			At voltage (%rated)		
	80	100	120	80	100	120	80	100	120
0.1	0.1	0.1	0.1	5	5	5	0.15	0.15	0.15
0.2	0.2	0.2	0.2	10	10	10	0.3	0.3	0.3
0.5	0.5	0.5	0.5	20	20	20	0.6	0.6	0.6
1.0	1.0	1.0	1.0	40	40	40	1.2	1.2	1.2
3.0	3.0	3.0	3.0	Not specified			Not specified		

Design and construction

This section contains a list of several requirements for the design and the construction of the device. The requirements are divided in various categories:

- Requirements for liquids, gases and solid materials used in equipment: for example, no liquid leaks are permitted;
- Requirements for earthing of equipment: for example, corrosion must be prevented on the earth connection;
- Requirement for external insultation: for example, it reports the creepage distance as a function of the rated insulation level and the pollution level;
- Mechanical requirements: it lists the static loads that the device must withstand;
- Electromagnetic compatibility: the requirements to ensure the operability of the device in its electromagnetic environment;
- Marking: it reports how the device shall be marked and which markings must be reported
- Connectors: it describes the allowed output connectors and pinout

Tests

This section lists the test, as the recommended tests setup and procedure to verify that all equipment made to the same specification complies with the requirements and the declared ratings. The tests are divided into:

- Type test: in general, type test is the test that impairs the properties or reliability of the test object or are too long or expensive to do it on every unit, for example a long-term corrosion test can't be performed to every unit produced, because of the test-time and cost;
- Routine test: the tests that shall be performed on every unit;
- Special test: other tests agreed on by manufacturer and purchaser [10].

4.2.1.2 SOGNO Power Quality Evaluation (PQE) Service

The SOGNO PQE service was validated with the APMU and the LV and MV sensors to meet the IEC 61000-4-30 and EN 50160 international standards in deliverable D2.3 "Validation of the techniques for grid awareness and their interfaces and services for grid awareness". The former standard lists and defines the parameters covering PQE, and it provides details on how devices must implement the relevant measurements; the latter standard specifies limits for voltage and frequency in the distribution network.

4.2.1.3 Advanced Power Quality Units (APMU)

The SOGNO APMU's are designed to provide 3-Tier security IoT communications in the link from the silicon of the devices to the SOGNO cloud services, following the Common Criteria for Information Technology Security Evaluation, which is an international standard (ISO/IEC 15408) for computer security certification (https://www.commoncriteriaportal.org)

- Tier 1 – is a secured microcontroller with a unique per-device one-time programmable encryption and a secure boot crypto-key.
- Tier 2 - Secure firmware which is encrypted using the Advanced Encryption Standard (AES) and requires each chip's unique crypto-key to run.
- Tier 3 - Transport Layer Security (TLS) to the Cloud services, using a "Hardware Certified Trust Centre" security chip to provide a Joint Interpretation Library (JIL) "HIGH" Rating. TLS is an Internet Engineering Task Force standard, first defined in 1999, and the current version is defined in RFC8446 (https://tools.ietf.org/html/rfc8446).

There are no commonly used standards for such 3-Tier end-to-end security for smart grid services in the power sector.

4.2.1.4 3GPP standard

3GPP standard was identified as specifically relevant for FLISR because it states stringent requirements for communications latency and reliability. However, FLISR was already considered and it was described in several 3GPP technical specifications. FLISR is elaborated in the following 3GPP technical specifications:

- 3GPP technical specification 22.804, Study on Communication for Automation in Vertical Domains, describes FLISR service functioning, challenges and potential requirements for the 5G systems.
- 3GPP technical specification 22.104, Service requirements for cyber-physical control applications in vertical domains, specifies service performance requirements for FLISR.
- 3GPP technical specification 22.261, Service requirements for the 5G system, describes FLISR service, communications requirements and challenges for the 5G systems.

4.2.2 Proposal for new standard for open-source software platforms

From the discussions with the representatives of EU standardization environment and the analysis of the SOGNO services components, in addition to the SOGNO related standardization aspects described in the previous subchapters, a proposal is outlined that is particularly relevant: a potential new standard for open-source software platforms.

The open source concept itself raises several requirements regarding a set of specifications and other various features, necessary to ensure uniformity and transferability, allowing users to reduce costs and enhance performance for a critical mass of users.

The standard should refer to all relevant aspects of a software product (platform), considering the following requirements and more:

- to be open source;
- to allow reception of information from the field;
- to allow storage and compilation of certain information;
- to include a minimum of services;
- to provide a minimum reporting.

The analysis and projection of this standard was analysed in the context of electricity distribution, nevertheless, the standards might be also applied to other types of software: gas distribution, aggregators, VPPs, etc.

5. SOGNO recommendations overview

For the sake of completeness, this chapter briefly summarises the SOGNO recommendations, as they are closely related to the results elaborated in this deliverable. The SOGNO Ddliverable 6.5 depicts the SOGNO recommendations in more detail.

Recommendations for Distribution System Operators

- Distribution system operators should consider the encouraging results of the early trials of cloud-based services based on integrating smart sensors as well as decision and optimization algorithms in an open and modular software architecture.
- Distribution system operators should investigate the potential of field-trial validated machine learning-based algorithms to optimize their measurement and analysis systems.
- Distribution system operators should investigate the potential of 5G services, currently being rolled-out throughout Europe, to provide low latency, highly reliable, secure wireless connections and edge-computing capabilities to the many measurement and control devices they will need to deploy in their networks in the coming years.

Recommendations for European Policy Makers and National Regulators

- National regulators should adopt the TOTEX model of the Clean Energy Package enabling distribution system operators to choose between distribution grid automation as a service or through the purchase of physical assets.

Recommendation for Consumer Organisations

- Depending on the respective national legal framework, consumer organizations should consider initiatives to promote the potential to reduce grid charges and electricity prices which the use of cloud-based smart grid services offers.

Recommendation for Environmental Organisations

- Environmental organizations should consider that the use of cloud-based smart grid services can increase the share of RES in the grid, reduce photovoltaic and wind energy curtailment and potentially alleviates the need for physical network expansion.

6. Conclusions

The proposals described in this deliverable are solutions for the completion and adaptation of the regulatory and standardization framework, in order to support the adoption and implementation of SOGNO services on the specific market.

They are the result of a complex process of internal analysis and close collaboration with the technical work packages of the project, corroborated with an intensive two-phases consultation program carried out through the project implementation period, in which all categories of stakeholders were involved: DSOs and TSOs, ICT service integrators that address electricity distribution operators, organizations at European and national level in the fields of regulations and standardization, sectoral non-governmental associations in the field of energy, organizations and representatives of the European Commission with responsibilities in formulating energy policies, etc.

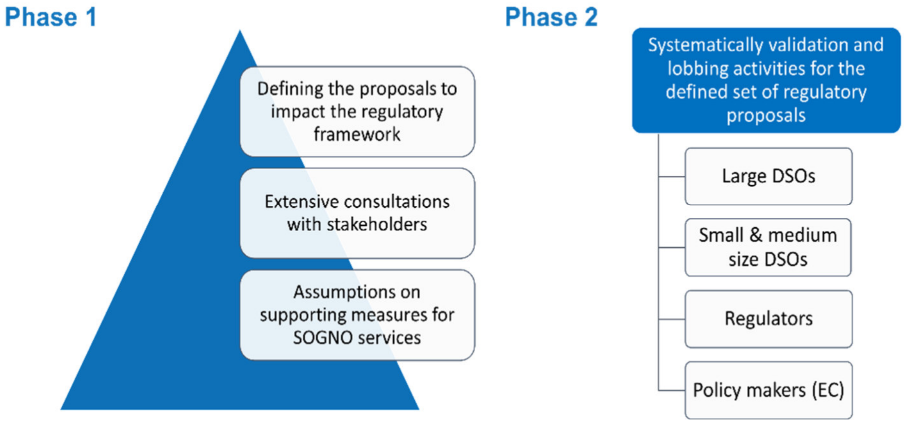

Figure 4 The two-phases consultation and dissemination process

The full report on the consultation events with the stakeholders is included in the D7.2 - Report on fostering support for SOGNO codes and ancillary services.

This consultation process, that in the last part of the project implementation was intended especially for the validation and dissemination of the final proposals in the field of regulation and standardization, continued even in the restrictive conditions generated by the Covid-19 pandemic, in the online environment. In this context, the webinar “Integrated Approach in the Management and Operation of Electricity Transmission and Distribution Networks” organized by CRE in April 30, 2020, registered a large international participation: over 220 participants from 35 European countries.

SOGNO's proposals in the field of regulation have not only been validated by stakeholders in terms of the potential positive impact they can have, but have already been included as recommendations in the policy-making process at EU level, as is the case with the proposal [Supporting “cost of service” in balance with CAPEX support (TOTEX approach)].

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9. List of abbreviations

ACER	Agency for the Cooperation of Energy Regulators
ANRE	Romanian National Regulatory Authority
CAPEX	Capital Expenditures
CEER	Council of European Energy Regulators
CEM WS	Customer Empowerment Work Stream
CRM WG	Customers and Retail Markets WG
E and G WG	Electricity and Gas WG
DSO	Distribution System Operator
ERRA	Energy Regulators Regional Association
FLISR	Fault Location Identification and Service Restoration
ICT	Information and Communications Technology
IRM WS	Innovation and Retail Markets Work Stream
LV	Low Voltage
MCE WS	Monitoring Consumer Empowerment Work Stream
MRM WS	Monitoring Retail Markets Work Stream
MV	Medium Voltage
NC	Network Code
OPEX	Operational Expenditures
PC	Power Control
PQE	Power Quality Evaluation
RMR WS	Retail Market Roadmap Work Stream
SE	State Estimation
SOGNO	Service Oriented Grid for the Network of the Future
TOTEX	Both CAPEX & OPEX
FNN/VDE	Technical regulator for power grids in Germany
WP	Work Package
WG	Working group
CEN	The European Committee for Standardization