LEGAL CHALLENGES FOR SMART GRID DEPLOYMENT IN THE EUROPEAN UNION

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ABSTRACT

The present paper focuses on the legal opportunities for Smart Grid deployment in the European Union, in the light of the recasts of the Internal Energy Market Directive (IEM) and Renewable Energy Sources Directive (RES). The paper assesses the EU policy context for Smart Grids together with the relevant legal framework. Technical aspects and components of a Smart Grid are addressed to understand some Smart Grid requirements. An American model of codification is presented before focusing on the key Smart Grid novelties offered by the recasts of the IEM and RES Directives. Finally, conclusions are drawn on the status quo and next steps from a regulatory perspective that can help deploy Smart Grids in the European Union.

INTRODUCTION

The European Union is a remarkable innovation in relations among states [1] and both the Union and the energy sector have equally evolved. It is without a doubt that "energy is essential for Europe to function" [2]. The traditional electricity grid is centralized. Electricity, simply put, is produced in power plants, is transmitted through high-voltage electricity lines and is distributed to consumers at low-voltage electricity lines. Typically, this chain involves a unidirectional flow of electricity from producers to consumers (as shown in Figure 1). Three main types of networks linking producers to consumers of energy can be found, namely:

- Networks linking the energy generation units (power plants) to the national grid;
- The national grid (transmission lines);
- The distribution grid (supplying electricity to final consumers).

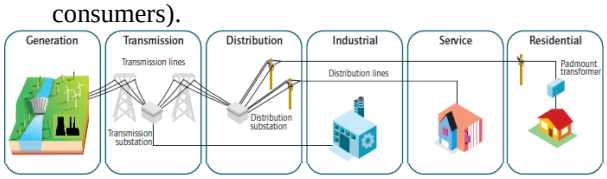

Figure 1: Overview of the traditional energy chain [3]

This structure is gradually changing as the European Union adapts to the environmental, economic, social, and technological realities. In order to find reliable, coherent, long-term, sustainable solutions to the current challenges in the energy sector, the European Union has adopted and is implementing a series of policy measures alongside a legal framework.

EU POLICY & LEGAL CONTEXT FOR SMART GRIDS

The relevant policy framework starts from the Europe 2020 policy that shall be continued by the 2030 framework for climate and energy, in the process of being approved by European institutions at the moment of submission of this paper, and the long-term overarching Roadmap 2050. These policies rely on previous results, reinforce and upgrade each other.

- **Europe 2020** aims to: reduce greenhouse gases by at least 20%, increase the share of renewable energy to at least 20% of consumption, and improve energy efficiency by at least 20%.
- **2030 climate and energy framework**, as proposed by the European Commission, sets a binding EU target of at least 40% reduction in greenhouse gas emissions, a binding target of at least 27% of renewable energy in the EU, an energy efficiency increase of at least 27% (potentially 30%) and electricity interconnection target of 15% through infrastructure projects.

From a legal perspective, these targets are legally implemented by a legal framework. Thus for the Europe 2020 policy there is with regards to GHG reduction and renewable share increase the RES Directive (Directive 2009/28/EC on the promotion of the use of energy from renewable sources), for energy efficiency increase there is the EED Directive (Directive 2012/27/EU on energy efficiency) and a particular case for increasing the energy performance of buildings within the EBPD Directive (Directive 2010/31/EU on the energy performance of buildings), with regards to the internal energy market there are the IEM Directives (Directive 2009/72/EC on common rules for the internal market in electricity and Directive 2009/73/EC on common rules for the internal market in natural gas). Additionally, the framework is completed by the Eco-Design Directive (Directive 2009/125/EC establishing a framework for the setting of eco-design requirements for energy-related products), Labelling Directive (Directive 2010/20/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy related products).

However, for the new policy targets following 2020, the legal framework will have to be adapted as well. To this end, at the end of 2016 the European Commission proposed to recast the IEM, RES and EED Directives.

THE EXISTING IEM & RES DIRECTIVES AND SMART GRIDS

In order to harmonize and liberalize the internal energy market, three legislative packages have been adopted between 1996 and 2009:

1. The *first energy package* was adopted in 1996 for electricity and 1998 for natural gas;
2. The *second energy package* was adopted in 2003 (main improvement of this package was that industrial and household consumers were able to freely choose energy suppliers);
3. The *third energy package* was adopted in 2009 and is the cornerstone for the implementation of the internal energy market, being comprised of two Directives and three Regulations.

The liberalization of the electricity market allowed all energy consumers the free choice of electricity supplier, non-discriminatory and transparent access to energy networks for both consumers and energy suppliers and has **legally separated the activities of production, distribution and supply** of energy with the aim of creating independent operators. This change of the organizational structure has led to two evolutions:

- entry of several actors on the energy market due to the liberalization of the energy sector;
- the production of energy from renewable energy sources instead of fossil fuels.

As such decentralized generation has been facilitated and the shift from final energy consumers to prosumers.

TOWARDS SMART GRIDS

The emergence of prosumers represents on the one hand a technical challenge, associated to *the balancing of the network* (where each energy output from the network must be directly offset by a similar energy input into the network), and on the other hand requires consideration to be given to the *role of prosumers as new market actors* in the management of the electricity system. These are addressed by the so-called „smart grids" and the new energy chain could look as shown below:

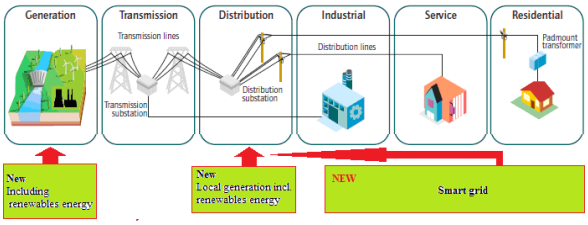

Figure 2: New energy chain

But what makes the grid "smart"? If typically "the grid, refers to the electric grid, a network of transmission lines, substations, transformers and more that deliver electricity from the power plant to your home or business, the digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart" [4].

From the point of view of the **energy flow**, the TSO is responsible only for balancing the transport network load and transmitting it at high voltage levels over long distances from major electricity producers to DSOs. The DSOs are required to distribute this load to energy consumers. Within this framework, a pivotal role is assigned to the DSO that must connect decentralized energy producers and manage the energy injected at DSO level, while delivering reliable and affordable energy to consumers. From the point of view of the **information flow**, the digitalization of the DSOs through advanced metering infrastructure (AMI) shall facilitate its new, modern role.

Nonetheless, the concept of a "Smart Grid" is not yet clearly defined in Europe, neither from a technical perspective, nor from a legal perspective.

The IEM Directive does not legally define the term of "Smart Grid", however preamble 27 of the Directive states that "*Member States should encourage the modernization of distribution networks, such as through the introduction of smart grids, which should be built in a way that encourages decentralized generation and energy efficiency*". A soft law definition of a Smart Grid is "*an upgraded electricity network to which two-way digital communication between supplier and consumer, intelligent metering and monitoring systems have been added*"[5]. The Smart Grid European Technology Platform (Smart Grid ETP) defines Smart Grids as "*electricity networks that can intelligently integrate the behaviour and actions of all users connected to it—generators, consumers and those that do both—in order to efficiently deliver sustainable, economic and secure electricity supplies"* [6].

From a functional perspective, Smart Grids should: facilitate the balance at the consumer level instead of the network, facilitate prosumer integration, improve energy efficiency, energy storage and use of intelligent equipment, facilitate the constant exchange of data on production and consumption.

From a legal perspective, the challenges appear at organizational level as well as operational level of the energy system. The main organizational challenges refer mostly to the new actors in the electricity network, while the main operational challenges refer to the maintenance and integrity of the infrastructure.

The typical understanding of Smart Grids in recent years focused on mainly two layers: electric distribution and communication infrastructures. Nonetheless, we can talk now about five overlapping layers: "Component", "Communication," "Information," "Function," and "Business" (Figure 3).

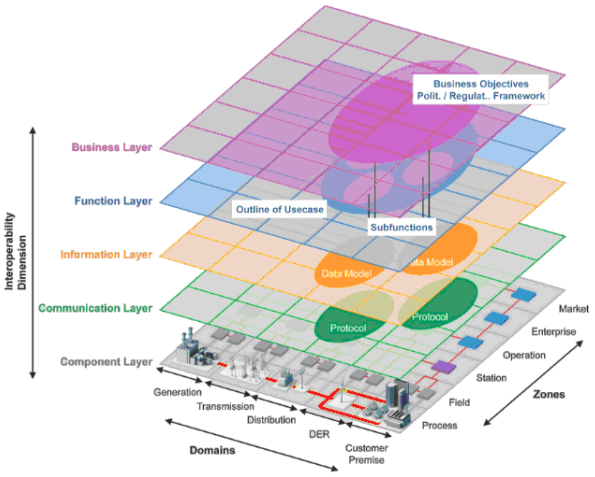

Figure 3: New Smart Grid Architecture Model [7]

THE AMERICAN MODEL

In the United States of America, a Smart Grid definition is provided by the U.S. Department of Energy (DOE): *"automated, widely distributed energy delivery network . . . characterized by a two-way flow of electricity and information and . . . capable of monitoring everything from power plants to customer preferences to individual appliances" that "incorporates into the grid the benefits of distributed computing and communications to deliver real-time information and enable the near-instantaneous balance of supply and demand at the device level"*[8]. The Energy Independence and Security Act (EISA-2007) provides a codification of a Smart Grid: "It is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth and to achieve each of the following, which together characterize a Smart Grid:

(1) Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid.
(2) Dynamic optimization of grid operations and resources, with full cyber-security.
(3) Deployment and integration of distributed resources and generation, including renewable resources.
(4) Development and incorporation of demand response, demand-side resources, and energy-efficiency resources.
(5) Deployment of `smart' technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications concerning grid operations and status, and distribution automation.
(6) Integration of `smart' appliances and consumer devices.
(7) Deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal storage air conditioning.
(8) Provision to consumers of timely information and control options.
(9) Development of standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid.
(10) Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services"[9].

THE IEM RECAST

The recasted IEM Directive, as proposed by the European Commission, introduces new actors:

- **"Active customers''** consume, store or sell electricity generated on their premises. Tariffs are separately calculated for the inserted and used energy. *The active consumer's equipment for generating energy can be managed by a third party in what the installation and management including metering and maintenance are concerned*.
- **"Local energy community"** is an association, a cooperative, a partnership, a non-profit organization or other legal entity which is effectively controlled by local shareholders or members, generally value rather than profit-driven, involved in distributed generation and in performing activities of a distribution system operator, supplier or aggregator at local level.
- **"Aggregator"** means a market participant that combines multiple customer loads or generated electricity for sale, for purchase or auction in any organized energy market.

From the point of view of the physical distribution network, new concepts are introduced:

- ***Energy storage***: means deferring an amount of the electricity that was generated to the moment of use, either as final energy or converted into another energy carrier. DSOs shall not be allowed to own, develop, manage or operate energy storage facilities, except in the case in which no other party is interested following an open and transparent tendering procedure.
- ***Recharging points for electric vehicles***: means an interface that is capable of charging one electric vehicle at a time or exchanging a battery of one electric vehicle at a time. DSOs may be allowed to own, develop, manage or operate recharging points for electric vehicles under certain conditions.
- ***Closed distribution systems***.

DSOs shall be responsible for ensuring the ability of the system to meet distribution demands, for operating, maintaining and developing a secure, reliable and efficient distribution system. DSOs can purchase services (such as distributed generation, demand response and storage) in order to enhance the efficiency of operating and developing the distribution system,

including local congestion management, based on a transparent network development plan.

THE RES RECAST

The RES Recast touches on the notion of Smart Grids, even though there is no mention per se, and introduces a few new features and concepts that can enable the further development of Smart Grids in the European Union and complements the IEM Recast.

New concepts that empower consumers:

- "**Renewable self-consumer**" means an active customer who consumes and may store and sell renewable electricity which is generated within his or its premises, including a multi-apartment block, a commercial or shared services site or a closed distribution system. *Their installation may be managed by a third party for installation, operation, including metering, maintenance.*
- "**Renewable self-consumption**" means the generation and consumption, and, where applicable, storage, of renewable electricity by renewable self-consumers;

The scope is to enable consumer to self-consume without undue restrictions and to be remunerated for the electricity they insert into the grid.

ONE-STOP-SHOP: one designated authority for granting permits for renewable energy projects (build, operate, associated transmission and distribution networks) with a maximum time limit.

Simple Notification to DSO for small scale projects: demonstration projects and installations with an electricity capacity of less than 50 kW to connect to the grid following a notification to the distribution system operator.

Renewable energy community: are entitled to generate, consume, store and sell renewable energy, including through power purchase agreements.

CONCLUSIONS

Smart Grids represent an unprecedented opportunity to move the energy industry into a new era of high security of supply, ensuring increased standards of quality and energy efficiency in an open market environment, effectively mitigating climate changes.

Smart Grids consist of millions of pieces and parts and time is needed for all the system to be installed, to function and to be perfected. Furthermore, once started the implementation in the European Union, it is compulsory to test and improve it in order to adequately adapt to the local requirements and it is without a doubt that it won't happen all at once. In addition, it is critical at the same time to highly improve consumer education and the shift to prosumers / active consumers.

At the same time, the interoperability between the layers of Smart Grids is essential (as we can now talk about five overlapping layers). In order to fully deploy Smart Grids, technical and functional requirements are needed (at least minimal standards), clear roles and responsibilities of the market actors, stable and coherent business opportunities and investments, financial incentives / support either at European level or Member States.

All of the above requirements can be tackled and solved through smart legal and regulatory policies as we must not forget the status quo. At present, in the European Union there is not a clearly defined legal definition of a Smart Grid. Within the actual legal framework and the upcoming legal framework (IEM Recast, RES Recast) there are only pieces / elements of the puzzle called Smart Grid.

Therefore it is required that consideration be given to the legal and regulatory framework to achieve Smart Grids. Union level action is an appropriate tool. The US example of legal codification shows it.

So what it is proposed by this paper is to bring at the level of the TFUE, in article 194, a clear provision for Smart Grids with further codification in a legislative piece dedicated to Smart Grids, complementing the actual legal framework and building upon it (for instance a Smart Grid Directive – SGD).

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