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## Internationalization in electricity distribution networks required for technology innovation and sustainability objectives

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*With the liberalization in the electricity markets, more and more European citizens have the freedom of choice for their electricity suppliers. This implies unbundling the transport function from the production–sales function. The monopolistic nature of the transport function, facilitated by the electricity network infrastructure, did lead to strongly regulated governance while the production–sales functions are subject to less regulation as they operate in the commercial domain. However, regulatory developments are complemented by, on the one hand, technological developments that caused the advent of innovative decentralized electricity production and, on the other hand, environmental, sustainability concerns. In order to accommodate these developments, distribution networks should be made more responsive, that is, they have to become smart. To assure that this is implemented effectively (fit for purpose) and efficient (at an acceptable costs), harmonization and standardization is required. From a European perspective, this leads to internationalization, and requires precise and agreed definitions on smart grids and smart metering on a European level.*

At first sight internationalization of electricity networks primarily concerns cross border interconnectivity at transmission level. However, it also impacts distribution networks, not on cross border interoperability and interconnection aspects as is the case with transmission, but on standardization aspects in technology and on governance models. Internalization concerning distribution networks may sound far fetching. Why does it affect distribution network governance?

We have observed that technological innovation made possible cross border management and the accompanying control of networks. Main technological facilitator here is the combination of supervisory control and data acquisition (SCADA) and measurement of key parameters for governance accompanied by information exchange between actors founded on information and communication technology (ICT). This is certainly so for transmission networks, they are known to contain

intelligence or to use a more modernistic term, smartness. It is fair to state that transmission system operators networks are reasonably smart, contrary to distribution networks that, however, will have to become smarter; together with the transmission networks they will result in a so called 'smart grid.'

Distribution networks do not play a significant role in cross border interconnectivity, therefore internationalization seizes on other aspects such as standardization in applied technology and the associated governance models. Technological innovation did brought about decentralized electricity generation, for example by micro combined heat and power (CHP)—requiring gas as input and, hence, a connection to the gas distribution network is needed—, solar, micro wind, biogas combustion, etc. Nowadays decentralized generation gains increasing importance, not only from a sustainable point of view, but also from a security of supply perspective, and even from a commercial perspective as instigated by the liberalization. For instance, in the case of high electricity prices and comparable lower gas prices (in terms of MWh), it may well be beneficial to use gas in the micro CHP to generate, not only ones own electricity, but also to feed surplus electricity into the distribution network to gain advantage. Similarly, time of use contracting may also steer electricity usage in peak hours, the so called demand control, and as such helping to reach the European efficiency objective of 20 percent reduction on energy use by 2020, also in the context of sustainability.

The decentralized generation units are connected to electricity networks on a distribution level rather than the large central production units that feed in at transmission level. This implies that distribution networks should now be able to accommodate bidirectional electricity flows; the end customer can swiftly change from a user to a producer. As a consequence the distribution network should be able to accommodate this variety and the governance of distribution networks will in fact start to resemble the governance model of transmission networks, albeit with vastly different numbers of actors. Instead of a few large electricity producers (tens to hundreds of MWs), millions of very small producers (1kW or smaller) will feed electricity into the network. This brings the need for process control means similar to those of transmission networks, such as the in the process industry well established SCADA type systems, that will have to be introduced in the day-to-day management of the distribution networks. In addition, the advent of smart metering also supports governance of decentralized generation capacity in the distribution network. It is at this point where information technology enters the arena that inevitably will change the present distribution network governance model; distribution networks need to become smart. And being smart will be inextricably connected to information technology given the vast number of decentralized producers and smart meters. It was the notion of a smart grid that was extensively

discussed by Dutch policymakers, regulator and distribution network operators.

### Smartness in grids

According to Erik ten Elshof, from the Dutch Ministry of Economic Affairs, a set of questions can be posed to arrive at an operational context and nomenclature of smart grids. When a grid is smart? How stupid are the alternatives for a smart grid? How smart can we get? How to get smart? Various definitions of smart grids have been devised in the recent years. However, as standardization concerning technology and governance models of distribution networks will primarily seize on a European level, we adopt the definition of the European Technology Platform SmartGrids: 'A smart grid is an electricity network that can intelligently integrate the 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.' Although this definition may serve as a starting point, it does not say anything about how to make the transition from the present state distribution networks to smarter distribution networks. The platform indeed acknowledges this and did formulate a set of ten recommendations that will support the transition (see Table 7.1).

**Table 7.1:** Recommendations of the European Technology Platform Smart Grid

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| 1.  | Promote the SmartGrids Vision to all stakeholders  |
| 2.  | Encourage innovation by network companies and stakeholders   |
| 3.  | Encourage a pan-European approach to the SmartGrids project  |
| 4.  | Encourage early deployment of SmartGrids technologies and solutions through demonstration projects |
| 5.  | Further develop the SmartGrids Business Opportunities to build the case for deployment             |
| 6.  | Engage the demand side, include the end customer   |
| 7.  | Address technical standards in the electricity and telecommunications sectors                      |
| 8.  | Understand and manage the environmental impacts of network development                             |
| 9.  | Promote open access to network performance data  |
| 10. | Develop the skills base in the electricity networks sector   |
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One recommendation (n° 3) does set out the starting point for harmonization at the level of the European Union (EU); a uniform and agreed approach for implementation. Furthermore we observe that standardization (n° 7) and the technology aspects (n° 9) are addressed. However, information technology aspects, essential

part of the technology standards have not been mentioned yet. The authors argue that this will have to be addressed in order to enable proper harmonization at acceptable cost to serve. Furthermore, a specific set of possible inhibitors will have to be addressed to stimulate and promote the transition towards smart distribution networks. For instance, the underlying business case should be solid and transparent, and will have to comply with the current tariff structures and the current RPI-X type regulation. This is to be addressed by EU regulators who may consider to harmonize the present variety of regulation models. Hence we conclude that the current efforts by member states to arrive at a European regulator should not only concern transmission system operators (TSOs) but also distribution system operators (DSOs).

Concerning the transition towards smart grids, the present functionality of the distribution networks should not be jeopardized; thus the DSOs will have, to use a imaged expression, to redecorate while the shop is open. This brings about a number of issues to be solved as indicated by ten Elshof: how to organize the national process on the road to smart grids, in relation with the international road to smart grids? Which standards are essential for the development of smart grids, at what time, and how to deal with this in on a European level? And, from a policy maker and regulatory point of view: what kind of regulation optimizes the road to smart grids, and how does this relate to the regulation in all European countries? Is the current palette of regulation models; from rate of return to cost (plus) based, adequate to support the transition towards smart grids? It may well be that regulation models for distribution networks will have to be revisited.

### Internationalization

From the above reasoning we postulate that internationalization of infrastructures for distribution networks may at first sight be considered a second order phenomenon; but internationalization will have a similar impact on the governance of distribution networks as it has on transmission networks. Therefore we state that internationalization impacts distribution networks on standardization of technology and harmonization of governance. Indeed at this point we observe coevolution of technology and governance, that is, institutional arrangements that should be in place and aligned in order to secure integrity of the entire transport function consisting of both transmission and distribution. Hence these institutions ensure that critical technical functions in which the distribution networks play a significant role operate adequately.

More specifically, in the transition towards smart grids standardization is required to achieve exchangeability of technical assets and economy of scale in ap-

plied technology. Harmonization in operational governance is needed to allow both staff and procedures to be cross border exchanged and do not have to be invented locally over and over again. This requires supra national coordination on a European level in which policy makers and regulator will have to take initiative as above indicated. An example is smart metering, currently in the EU efforts are undertaken to arrive at a standard for the technical requirements of the smart meter functionality. This standardization provides economic advantages (economy of scale for the applied technology) and governance benefits (uniform governance processes in the roll out of smart meters). Comparable technical standards and a uniform economic clearing system for allocation of costs would provide a cost effective implementation of smart metering at EU scale. Legislation shows that by 2020, 80 percent of the EU end users are obliged to have remote meter reading, hence smart meters installed. This should be 100 percent by 2022. In this standardization, ample attention will have to be paid to harmonization of the involved information technology aspects, which to date has not been the case. For instance, next to technical codes, an information code at EU level may be considered.

Thus we state that, there indeed is a need for supranational regulation on both technology standards and governance. In addition this would form a solid and transparent foundation for the extensive stimulation programmes (among which subsidies) set out by governments in both United States and EU for decentralized electricity production and smart metering. Also these arrangements may stimulate international bodies that edict norms to achieve standardization.

### **Cross fertilization by information and communication technology**

It is observed that standardization did greatly benefit other sectors and specifically those industries that make extensive use of ICT. Distribution network governance will not differ from this as the functioning of the entire energy value chain is largely based on information technology. In the context of the transition towards smart grids from a European perspective one can pose the following questions. Which countries and which sectors were fast in introducing ICT in other infrastructures? What experiences did they gain by being frontrunners? How was dealt with standardization and information of technological devices in these sectors? As there is no clear cut blueprint for the transition towards smart grids, learnings may be obtained from other sectors that are heavily depending on information technology: telecommunication in which ICT did lead to the internet, in transport and logistics ICT enabled real time supplies procedures minimizing stocks, and water management where ICT led to high quality metering and safety control.

### **Conclusions and recommendations**

We conclude that in the transition to smart grids, standardization of both technology and governance of distribution networks on a supra national level is required. Justification for this is more effective governance at lower costs. Also the standardization for smart meter technology will allow to reap advantages from economies of scale. We recommend that the current efforts by member states to arrive at a European electricity regulator should not only concern TSOs but DSOs too. In addition, EU regulators should consider to harmonize the present variety of regulation models in order to reduce the required upholding effort. Finally, standardization of both technology and governance models should be taken up by an open dialogue at EU level between the electricity sector and the regulatory authorities, given the high importance of the electricity value chain for society as a whole.

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