Barriers to the massive connection of DRES in Distribution Grids

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Short Description (Max. 50 words):

This document provides an overview of the results of the WP2 related to the barriers for connection of distributed renewable energy resources in distribution grids identified on the project.

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1 Introduction and scope of the document

1.1 Objective

The objective of the document is to describe the regulatory, technical and economical barriers encountered when interconnecting distributed renewable energy resources into the distribution network. In order to access these barriers, the current regulations and the power system's characteristics of the six European countries taking part in IGREENGrid project have been considered. As the barriers identified differ in the details from one country to another, the aim is to highlight the barriers common to Austria, France, Germany, Greece, Italy, and Spain.

1.2 Organisation of the document

The document is organized as follows:

- Section 2 presents a short description on how IGREENGrid demonstrators are used to identify barriers.
- Section 3 presents a short description of each barrier including their main characteristics.
- Finally, section 4 presents the barriers identified on other relevant European projects.

1.3 Notations, abbreviations and acronyms

DER	Distributed Energy Resources
DG	Distributed Generation
DRES	Distributed Renewable Energy Sources
DSO	Distribution System Operator
ICT	Information and Communication Technology
TSO	Transmission System Operator

Table 1 (Acronyms)

2 Methodology to access the barriers

The six local demonstrators led by the DSOs participating in IGREENGrid project are taken as the main reference for this study as these demonstrators have been developed to increase the integration of DRES in the distribution grid. Each DSO was asked to identify the barriers that they will face while implementing the smart solutions proposed by their demonstrator. The methodology for the analysis is illustrated following the Figure 1:

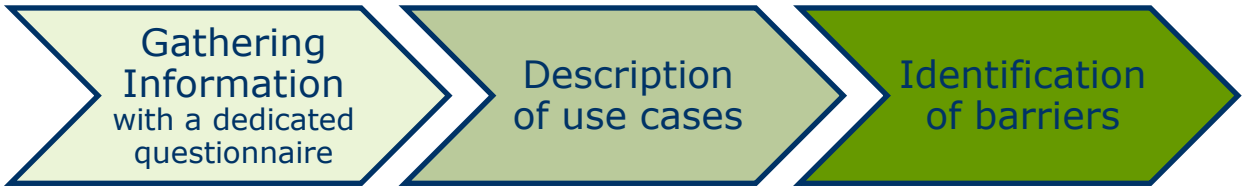

Figure 1 (Methodology main steps' for barriers identification)

First, a dedicated questionnaire was returned by each DSO in order to give:

- A general overview of the demonstrator;
- A description of the solutions tested on the demonstrators;
- The expected objectives of the project.

These descriptions were used to gather the different solutions according to defined use cases.
The final step of the methodology is the result of all partners' consensus taking into consideration their expertise.

This process has allowed IGREENGrid team to identify the main barriers for DRES integration in Europe that can be classified in three different categories:

- Regulatory;
- Economical;
- Technical.

These barriers are closely linked to the regulatory, economical and technical situation of each country.

3 Main identified barriers to the massive integration of DRES in the distribution network

Eleven main barriers have been identified and classified taking into account which aspect is defecting. The type of each barrier is summarized in Table 2.

Barriers	Type		
	Regulatory	Economical	Technical
Regulation does not allow DSO to control DER (including DRES)	X	-	-
Coordination between TSO & DSO is insufficient for the DRES integration	X	-	-
Lack of a proper regulation for the DRES connection	X	-	-
Lack of adequate remuneration of DSO services	X	X	-
DRES do not have any incentive to take part in the network operation	X	X	-
Rules for interaction with new actors are not clearly defined	X	-	X
Lack of standard “Smart Grid” solution components	-	X	X
Distribution network processed are not up to date with the realities of the integrations of DRES in European countries	-	X	X
Lack of experiences of DSO operating news devices systems	-	X	X
Unaffordable ICT solutions for telecontrol in remote area	-	X	-
Power system reliability affected by massive DRES penetration	-	X	X

Table 2 (Type of identified barriers to the integration of DRES in the distribution network)

The next chapters present a detailed explanation of each barrier.

3.1 Regulation does not allow DSO to control DER (including DRES)

In some countries the regulation disallows the DSO to request active or reactive power injection set points to DER injection, while other countries allow it to a certain extent. The capability for the DSO to have these rights will allow maintaining the network in a secure state when it operates close to

its constraints, for example by practicing curtailment on DG. The only other existing solution to maintain the future security of the network would be to realize network reinforcements. In order to prove the economic return of DSO controlling DER reactive and active power injections into the network, the network reinforcement costs should be compared to the curtailed energy costs.

3.2 Coordination between TSO & DSO is insufficient for the DRES integration

While managing its network, the network operators could affect the rest of the connected networks; therefore the cooperation between network operators (TSO/DSO) is necessary. In most countries the lack of communication between the TSOs and the DSOs leads to requirements for one party penalizing the others' network security. To overcome this barrier there is a need to:

- Define which information has to be shared between DSOs and TSOs in order to ensure the system's security;
- Improve and harmonize the relationships between DSOs and TSOs clarifying each role and responsibility.

A possible arrangement could be to assign the DSOs a role as market facilitator for DRES providing services at TSOs level.

3.3 Lack of a proper regulation for the DRES connection

The connection rules for DRES or DG into distribution networks vary from one country to another. In most countries, the connections approvals rely on studies taking into account the worst case scenario which maximizes the constraints and underestimate the hosting capacity of the network. The possibility of controlling the capabilities of the network could enable more connections. Moreover the heterogeneity of the regulations implies problems for a common definition of DRES hosting capacity.

3.4 Lack of adequate remuneration of DSO services

The development of the smart grid solutions requires an enlargement of the DSO's portfolio of services by new duties and functions. These new tasks require an advanced ICT infrastructure for monitoring and control, but today's DSOs remuneration does not cover the ICTs needed to deploy the Smart Grid, only conventional electrical assets are considered. In all considered countries, the current regulation does not encourage the investments needed for the development of this type of project.

3.5 DRES do not have any incentive to take part in the network operation

The inconvenience of DRES is their intermittent production and its effects on the network. However it is technically feasible for them to provide certain flexibility and ancillary services decreasing these effects on the network. These solutions could mean an income loss for the DRES owner and an impact on the installation's business plan. The support of these solutions could only be possible by an evolution of the regulations and a financial support framework in each country.

3.6 Rules for interaction with new actors are not clearly defined

The development of Smart Grids requires defining the responsibility of each new actor as stakeholders. Also the use of new devices implies the setting up of new regulations and new frameworks. For example, storage systems raise this problem as their exploitation and their belonging to DSO is in conflict with current unbundling regulations. The current regulation doesn't take into account the new Smart Grid devices and the new interrelations between the several actors; this is the reason why it is difficult to define the responsibility of each actor.

3.7 Lack of standard "Smart Grid" solution components

A large number of alternative solutions exist among Smart Grids projects which makes the standardization of the devices, of the transmission media or of the management system difficult. Also their setting up is affordable only if integrated with old systems. As a result, DSO will have to manage a power system using new and old devices with different characteristics and tripping profiles. To reduce DSO's costs for managing these multiple systems, the different components need to be standardized with similar functions and interoperability between products.

3.8 Distribution network processed are not up to date with the realities of the integrations of DRES in European countries

The integration of DRES into the distribution network brings more bring new operational conditions because of:

- Bidirectional power flows;

- Intermittency of the production;
- The management of topology changes.

In order to manage the operation, a higher overall monitoring of the grid is necessary and more frequent operations are required. As a consequence life expectancy of some devices will decrease and maintenance costs expected to increase. The costs of the increasing complexity of the operation should not be neglected.

3.9 Lack of experiences of DSO operating news devices systems

Smart Grids solutions require the supervision of advanced applications integrated in the control center. In order to monitor and handle the failure of the new devices, human resources will need training. The current lack of experience of the operator managing these applications is a risk in the case of failure events.

3.10 Unaffordable ICT solutions for telecontrol in remote area

Smart Grids solutions are based on DSO owned infrastructures using external telecommunication operators' networks. The problem of telecommunication is that its reliability depends on the area where it is needed. The market opportunity in low populated and remote areas would be unprofitable for telecommunication operators. In these areas of insufficient telecommunication performance the conventional Smart Grid approach is unfeasible. In highly and populated areas the technology is possible, but the ICT requirements for reliability, bandwidth and latency have to be controlled in order to maintain the communication link between the different devices. Additional studies should also pay attention to the close dependency between communication and electrical network

3.11 Power system reliability affected by massive DRES penetration

For the moment DRES do not provide ancillary services such as primary and secondary reserve. Therefore the requirements on power quality and security of supply have to be guaranteed by conventional generation units. Installed capacity on traditional power plants cannot be decommissioned because they provide a huge amount of backup capacity. DRES could potentially provide these ancillary services but their supports to the reserve depend on the technology used and the daily production forecasts. The two possible approaches to overcome this problem of reliability are:

- DRES could be forced by standards and technical regulations to provide ancillary services as an obligation like conventional generation units;
- The provision of this kind of service could be an activity that is incentivized only.

4 Barriers identified in other relevant European projects

Completed or ongoing European smart grids projects have also been used to identify barriers to the integration of DRES in the distribution network. The focus was made only on projects with enough information available at the moment and with a scope in line with IGREENGrid project.

4.1 ADDRESS

ADDRESS (Active Distribution Network with full integration of Demand and distributed energy RESsourceS) project is a 5 year project that is now finished. This project has identified regulatory, technical, economical and social barriers summarized in Table 4 that can sometimes be linked to one barrier previously identified by IGREENGrid demonstrators;

Barrier identified by ADDRESS		Barrier identified by IGREENGrid in link
Regulatory Barriers	Regulation does not allow the DSO to control the consumers' consumption by offering price based signals.	Regulation does not allow DSO to control DER (including DRES) (see chapter 3.1) Considering DRES as customer.
Technical barriers	Problems related to ICT infrastructure at the house and at the network level show the difficulty of remote control.	Unaffordable ICT solutions for telecontrol in remote area (see chapter 3.10)
Economical & Technical barriers	Each system is different depending on the resource considered. A large number of hardware and software systems have to be designed and developed almost from scratch	Lack of standard "Smart Grid" solution components (see chapter 3.7)
Social barriers	Difficulties for the recruitment of end-users wanting to participate in the demonstration project and difficulties for them to understand the complex device and to understand how to use it.	

Table 4 (ADDRESS barriers in link with IGREENGrid barriers)

4.2 More MicroGrids

More MicroGrids is a 3 year project extending the work accomplished in the MICROGRIDS project that focused on a single MicroGrid operating through laboratory experiments. The aim of this second project is to increase the penetration of micro generation in electrical networks using the MicroGrid concept. The project identified technical, regulatory and economical barriers summarized in Table 5 that can be linked to one barrier previously identified by IGREENGrid demonstrators.

Barrier identified by More MicroGrids		Barriers identified by IGREENGrid in link
Technical barriers	The effect of a massive integration of DRES is negative for the quality of the electricity that has to be monitored and controlled	Distribution network processed are not up to date with the realities of the integrations of DRES in European countries (see chapter 3.8)
Regulatory & Technical barriers	Arrival of new actors operating the network, the nature of the interactions have to be clearly defined	Rules for interaction with new actors are not clearly defined (see chapter 3.6)
Regulatory barriers	Lack of proper regulation for DSO concerning the distribution network management	Regulation does not allow DSO to control DER (including DRES) (see chapter 3.1) DRES do not have any incentive to take part in the network operation (see chapter 3.5)
Economical & Technical barriers	Lack of standardization of the components deployed in the smart grids solutions	Lack of standard “Smart Grid” solution components (see chapter 3.7)
Economical barriers	The available budget for investments in smart grids is too small	Lack of adequate remuneration of DSO services (see chapter 3.4)

Table 5 (MORE MICROGRIDS barriers in link with IGREENGrid barriers)

4.3 EcoGrid EU

EcoGrid EU is an on-going project that will finish on September 2015. The aim of this project is to demonstrate that it is possible to operate a power system with more than 50% of overall production from DRES. The innovation is to introduce a market-based mechanism close to the operation of the power system. The different barriers identified by the project are summarized in Table 6.

Barrier identified by EcoGrid EU		Barriers identified by IGREENGrid in link
Regulatory barriers	The current regulation is not in line with the market based mechanism introduced	
Social barriers	Difficulties for the recruitment of end-users wanting to participate in the demonstration project and difficulties for them to understand the complex device and to understand how to use it.	

Table 6 (ECOGRID EU barriers in link with IGREENGrid barriers)

5 Conclusions

The identified barriers are based on current problems encountered by the six IGREENGrid demonstrators extrapolated to a massive integration of DRES. In addition, the results of other European projects (ADDRESS, More MicroGrids and EcoGrid EU) have lead to the similar barriers. It is logical to find that, as new solutions the explored solutions will meet barriers to their implementations. IGREENGrid project challenge is to study the solutions in order to increase the DRES integration in the distribution network. Once these aspects are solved, the main problem will come from the current regulation that seems to be behind the real needs of the Smart Grids solutions. Some regulatory changes are a mandatory step to make the massive integration of DRES cost-effective.