Changes in Policy and Market and Network Regulation to Increase Power Generation by Renewables and DG in the EU

By Frits van Oostvoorn and Adriaan van der Welle*

Background

Recently the importance of "Large scale DER integration" has increased as means to meet the ambitious 2020 EU policy objectives and targets for RES, emissions reductions and energy efficiency. Increasing the role of RES & DG (DER) in supply is also highly beneficial for reducing EU dependency on gas and oil imports. In this EU context, it is important to review the current barriers, support policies and network regulation for integration of more DG, RES and small scale CHP in the power systems.

Several studies conducted for the EU and led by the ECN reveal that currently, in some, mainly new, Member States, the contribution of RES & DG is still very low. However, in coming decades the share of variable RES-E sources should become much larger in many EU countries. See Figure 1. Note that 20% RES in a country in 2020 implies a share of electricity supply by RES of about 30% or more. Currently countries like Denmark and Spain, already experience such a large contribution of (mostly intermittent type) renewables and this is already negatively impacting power system costs. Now the question arises can we increase the contribution of RES to the power supply beyond 20-30% without raising system inefficiency and what changes in system conditions and market and network regulation are necessary to efficiently absorb large volumes of so called intermittent RES supply resources.

Based on findings from several large EU projects promoting the role of RES & DG in the power supply, we discuss and present the different barriers and solutions that should facilitate meeting the ambitious EU policy targets for RES in 2020. See Figure 1.

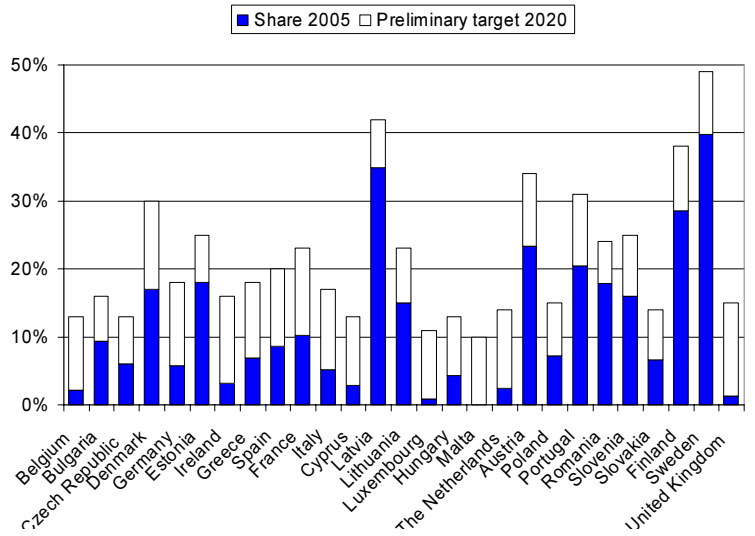

Figure 1 Shares of RES in Final Consumption, EU Countries
Source: EC

Current Policy Drivers and Support in EU

In the last decade, electricity markets in EU have been liberalized, meaning the vertical power supply chain has been unbundled in most countries and transmission and distribution networks are regulated businesses.

In that context decentralization of power generation through connecting Distributed Energy Resource (DER), including generation options such as small scale CHP and wind turbines, were promoted in many countries. According to the EU Electricity Directive, distributed generation includes all power plants connected to the distribution system. Each different type of distributed generation has, however, its own technical and commercial characteristics.

In fact, the connection of DER technologies for generating electricity has been promoted by several EU countries for environmental and industrial policy reasons. In countries like Spain, Germany, Denmark and Netherlands this type of power generation has received much extra policy support through favorable (compared with conventional fossil fuel fired plants) tax exemptions, subsidies and price interventions. In fact, over the last decade, different types of production support schemes have been set up and implemented in all EU member states. Feed-in support schemes have been very effective in increasing wind and PV generation in Germany, Spain and Denmark. However, for meeting the recently formulated policy targets of the EU for RES and climate change, large wind parks connected to the transmission network are also becoming a key option. Clearly meeting the ambitious EU target for RES electricity supply requires a complete redesign of the power systems in many EU countries.

However, a first step in that process should be to look critically at current support schemes in so far as these still serve their initial purpose (i.e., getting RES

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See footnotes at end of text, www.solid-der.org and references

& DG off the ground) and see if these support schemes can be modified into more economic and market based systems and thus can be more efficient instruments for promoting RES & DG. The success of the favorable (for the DER investor) subsidies has led to high shares of PV and wind technologies without considering the costs to society of these support schemes and their implications for other players in the power system, networks, capacity reserves, etc. System cost burdens can be reduced by the development of alternative instruments such as RPS & Green Trade Certificates.

Feed-in tariffs and direct investment subsidies for power generation by DG and RES that have led to a high penetration of a less flexible and less controllable power supply with increasing system costs, should be replaced by feed-in premiums, including market power prices. Additionaly, for cross border trade in RES, power supply harmonization among the various country support instruments requires urgent EU action.

Clearly balancing the increasing costs of support with the declining efficiency of the overall power system needs to be addressed soon in those countries that were most successful in enhancing the share of DG and renewables in electricity supply. A fair sharing of both the costs and benefits between producers, networks and consumers and the introduction of more market based incentives into the support schemes is necessary. If support schemes like renewable portfolio standard with tradable green certificates or feed-in premiums are implemented, DER is (partially) subject to market and system conditions (like wholesale and balancing markets), see M ten Donkelaar et al. (2008).

Barriers and Solutions for Take-off

First it should be realized that the contribution shares of DG & RES power generation differs greatly among EU countries, consequently barriers and recommendations to improve the system for stimulating more RES & DG vary by country. For simplicity, the situation of all EU countries is grouped into two stages of RES & DG development in supply, i.e, a situation of a very small contribution (at the take-off) of RES & DG and another with already a large share of RES & DG for the power supply.

In the first group of countries having an almost zero role of DG & RES in supply the main network connection barrier seems to be the lack of streamlining of rules and the compliance with rules by all parties. Clearly heavy and very complicated administrative and legal procedures hamper new connections, e.g., Poland, Czech Republic, making grid access of new DER time-consuming and costly. Lack of standardization of network access regulation increases this effect. Finally we should mention that network access by DG & RES is also often obstructed by insufficient unbundling of production and supply networks. While the networks are generally legally unbundled, in practice incumbent power producers are still able to (tacitly) influence the DSO network access policy through affiliated companies (see also Frias et al., 2008).

Network access of DG & RES is also often obstructed by insufficient unbundling of production and supply networks. However, more advanced forms of unbundling are likely to be implemented due to a forthcoming guideline of the European Commission. This might somewhat diminish the chance of incumbent power producers to (tacitly) influence the DSO network access policy through affiliated companies. It is an open question; whether this form of unbundling is strong enough too enable connection of DER owned by independent companies (non-DSOs) to the grid.

Generally, if energy companies are no longer, or only to a small extent, state-owned, more competition between generators gradually diminishes large plant margins (overcapacity). So if countries are moving gradually to more market liberalization, putting in place support schemes for RES & DG has a positive impact on investments in DG & RES. But the many administrative barriers and lack of transparency in rules and procedures should be reduced. In this case investment permits should be handled via a so called one shop-stop procedure.

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Increasing System Costs by More Intermittent RES & DG Based Power Supply

The current architecture and functioning of electricity networks have mainly been developed in the last three decades and was designed for supporting the connection of large-scale centralized generation to higher voltage levels during the last fifty years. Therefore, the power flow goes largely through trans-

mission and then to distribution networks, and then on to the final consumers via a series of voltage transformations, i.e., in a unidirectional mode. DER (DG & RES) generators are currently mainly connected to lower voltaic levels, with PV units mainly connected to the LV distribution network, while onshore wind turbines and biomass units are connected to either MV or HV distribution networks. Figure 2 shows the changes in the power flows and network architecture in the power system as whole as much larger volumes of power supply are generated by RES & DG.

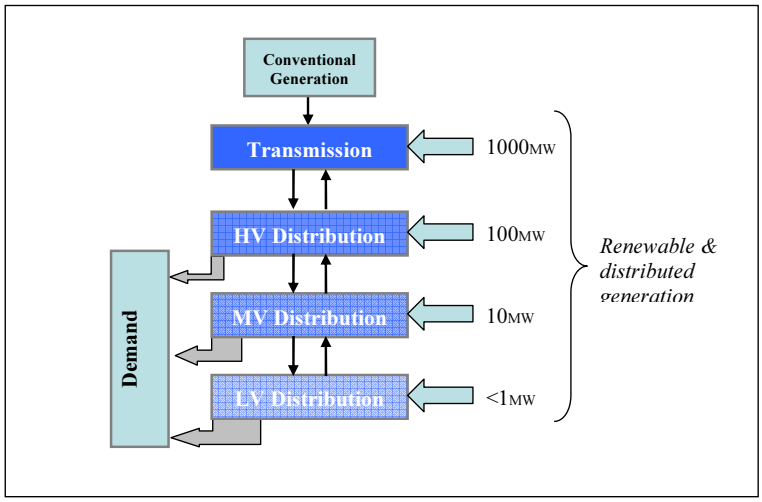

Figure 2. Connection of various forms and sizes of distributed generation to distribution networks (HV: High Voltage; MV: Medium Voltage; LV: Low Voltage).
Source: RESPOND, www.respond-project.eu.

Consequently in this second phase of integrating more and more DG & RES, particularly if by intermittent type technologies, there are substantial technical and economic impacts on the functioning of a power system designed in the past. In the group of countries with already or soon expecting large shares of (mainly intermittent type) RES and DG electricity generation, an increasing negative impact on system costs caused by all kinds of measures securing the safety and supply security (extra need for flexible generation and balancing markets, etc.) build up new thresholds for increasing further integration of RES & DG now and in the future. See Figure 3 with an overview of system costs impacts.

As became clear from experiences in Denmark, Spain, and Germany and from different (EU and IEA) studies in recent years, the rapid growth of RES and DG, if rising above certain shares of generation capacity in a country, causes impacts that will gradually increase overall system costs. This challenges the feasibility of meeting the EU RES targets for 2020 and, therefore, needs to be resolved soon. Measures and options identified and observed in these EU countries generally concern an additional need for market and balancing market flexibility and network controllability.

Demand for more flexibility in the system drives up peak prices and gives generators the opportunity to achieve a higher rate of return by deploying more flexible generation technologies like hydro and gas based generators in the generation mix. An alternative for enhancing generation flexibility is the option of interconnection contracting. The benefits of interconnection depend on price differentials between markets.

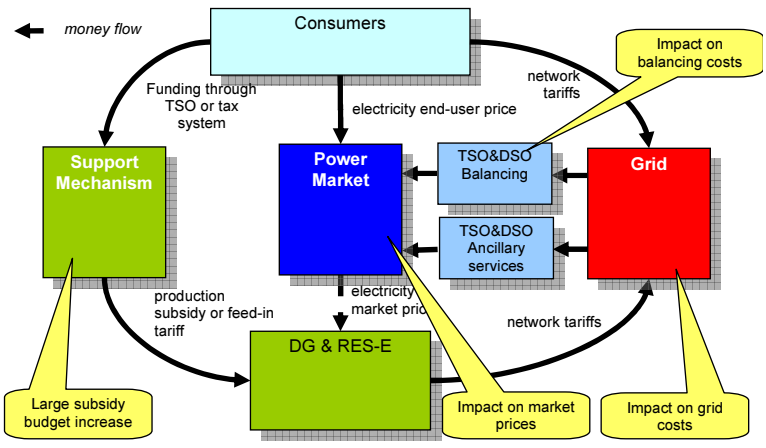

Figure 3 Increase of system costs by large scale connection of RES & DG

Also the options that are able to mitigate (part of) the increase of the demand for balancing (by the increasing variable RES-E supply by wind turbines and PV) are possible if using demand response, provision of balancing services by DER, improvement of wind power prediction models and extension of (available) interconnection capacity. The Demand response is a concept that seeks to lower demand during specific, limited time periods, by temporally curtailing electricity usage, shifting usage to other time periods, or substituting another resource for delivered electricity (such as self-generation), focusing on when energy is used and its cost at that time. With application of demand response the increased demand of DER for balancing can be met without endangering system operation.

Diminishing forecast errors of wind supply by prediction methods and models decreases the need for balancing and is already practiced in Spain and Denmark. Improved wind power output forecasting accuracy also implies that less interconnection capacity has to be reserved to absorb unexpected wind power flows and resulting loop flows. Finally reduced network controllability in lower voltage networks may, in

the long run, be solved by implementing active network management and (related) options like flexible deployment of DER, demand response and storage by DSOs. In summary, all compensating measures increase, or will increase in the future, overall system costs. The question is how to minimize these while maintaining an economic power system.

Summary of Recommended Policy and Regulatory Measures

All recommended measures both on support policies, system rules and regulation are focused on creating new or other system conditions that promote the efficient economic development of sufficient market, balancing and generation flexibility and network control.

For increasing generation and market flexibility member country support schemes for renewable production needs to be harmonised among the states, at least to some extent, to insure that RES, i.e., wind turbines are deployed optimally across Europe. Also the introduction of a single European market for tradable guarantees of origin is of utmost importance for steering investments in an efficient way to countries with the highest resources or potentials to meet the EU renewable targets for 2020. While capacity allocation can be enhanced by using market based mechanisms like implicit and explicit auctions for cross-border trading, improved coordination between TSOs is also needed. For the day-ahead and intraday time frames implicit auctions are most efficient and, therefore, have to be encouraged.

To increase balancing market functioning the introduction of balancing responsible parties (BRP) is advised. This should limit the size of the imbalance between scheduled and real production and demand, and result in the TSO having less power to dispose of to fulfil his system balancing task. Also DER balancing responsibilities should be given to the TSOs. Furthermore use demand response as a balancing mechanism. Adding balancing services by DER through VPP is already in use in some member states (Germany, The Netherlands) and expected to be a valuable option for other countries in the near future. However, the required minimum size for provision of balancing services varies a lot, country to country.

Improvement of wind power predictions can be furthered by BRP as well as by shortening the gate closure time (GCT) of the day-ahead market. Through implementation of balancing responsible parties, generators and suppliers receive an incentive to improve their wind power predictions and limit their imbalance exposure. Reducing the gate closure time of the day-ahead market is also strongly advised to limit the demand for balancing services due to intermittent generation.

Measures to increase network controllability for distribution networks (DSOs) include active network management, i.e., a higher visibility of distribution network components, generation and load. A consequent steering of distribution network flows will reduce system integration costs of DG in most cases. In the short term, in most countries monitoring and controlling of a part of distributed generation and load seems to be enough to reduce system integration costs. Implementation of regulatory rules enabling DSOs to be indifferent between new investments and deployment of DG for network planning is advised. This should take into account the impact of unbundling on the development of other flexibility enhancing options like storage for flexible network operation, when separating networks from commercial activities. Rationalize the different congestion management methods for allocation of cross-border capacity currently applied across Europe. Create more coordination between TSOs for cross-border congestion management in order to increase the efficiency of the allocation and foster the integration of RES generators. Legal provisions need to be implemented on a European level. Apply time-of-use network pricing for both large generators and load is advised for maximising the use of the existent network capacity, thereby limiting the system integration costs of renewables.

Footnotes

[1] See reports SOLID-DER, website www.solid-der.org.

[2] Part of the country-specific impacts are derived from Blazic et al. (2008)

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