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Integrating Distributed Generation: Regulation and Trends in three leading countries

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The set of renewable energy targets at regional and national levels accompanied by specific subsidies and incentive schemes, have contributed to the expansion and integration of distributed generation (DG). Due to this expansion, Distribution System Operators (DSOs) are facing technical challenges arising from the adaptation of their networks (from passive to active) due to the increasing levels of intermittent generation, but also regulatory challenges (in terms of grid access and charging methodologies). Thus, regulation plays an important role in setting the right economic incentives for the operation and connection of DG units in a cost-efficient way.

Three case studies have been selected based on the maturity of their regulatory framework related to renewable energy sources: Germany, Denmark and Sweden. Germany and Denmark are pioneers in the promotion of green technologies through the implementation of different support schemes (e.g., Feed-in Tariffs). Sweden, is also an interesting case with a high penetration of renewable generation, mainly from hydro resources, however, wind and solar PV are increasingly utilised. Germany and Denmark have both implemented sophisticated subsidy schemes that have been continuously adapted to changing circumstance. These schemes show a dynamic design over time, from simplistic (fixed rate) models to sophisticated support mechanisms that involve premiums, flexible digression rates, stepped tariffs and tendering. For instance, in the latest amendment of the Renewable Energy Sources Act (EEG 2014) in Germany, new plants with a capacity of at least 500kW are required to sell their electricity in the power market, thus direct subsidy (i.e. Feed-in Tariff) is no longer applicable and a tendering process will come into effect from 2017 onwards. The three countries have a decentralised structure characterised by a large number of (private and publicly owned) DSOs. This structure facilitates the connection of more DG units due to the willingness of small DSOs to attract DG into their networks.

In terms of grid access and the charging methodology for connections, regulation across the three countries differs. Germany is the country with the most favourable connection conditions. Renewable DG plants have priority connection to the grid and to the use of grid; this means that they must be connected ahead of conventional plants with priority in the purchase of electricity which is then exported into the grid. In addition, DG customers are not required to pay for reinforcement works (shallow connection) and do not pay use of system charges. Sweden has the least favourable conditions since DG customers might be required to pay any reinforcement costs (deep connection) and use of system charges. However the non-discriminatory principle applies, which means that grid operators are obligated to connect the DG plants regardless of technology. Germany and Denmark are where demand customers are the most negatively affected because reinforcement costs are usually socialised and reflected in the electricity bill.

Even though there are sophisticated subsidy mechanisms and specific initiatives that help with the integration of more DG (e.g. Udlingningsordningen in Denmark, AregV in Germany), reinforcement costs are still borne by customers through the electricity tariff. The use of smart solutions is not observed (as least as business as usual). We believe that smart solutions may contribute to a more efficient use of the distribution electricity infrastructure and to lower the reinforcement costs. However, less than 50% of EU member states have strategic roadmaps in place for the implementation of smart grids.

Finally, competitive mechanisms (e.g., auctions), which include connection costs in the ranking of bids for new DG units would bring added value to the current distribution business model. This would contribute to better network planning and thus, better use of the current electricity distribution infrastructure reducing the probability of network reinforcement. The US has a wide and well-documented experience in carrying out decentralised competitive mechanisms (e.g. Request for Proposals, Renewable Auction Mechanism) by electric utilities.

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