WHITE PAPER

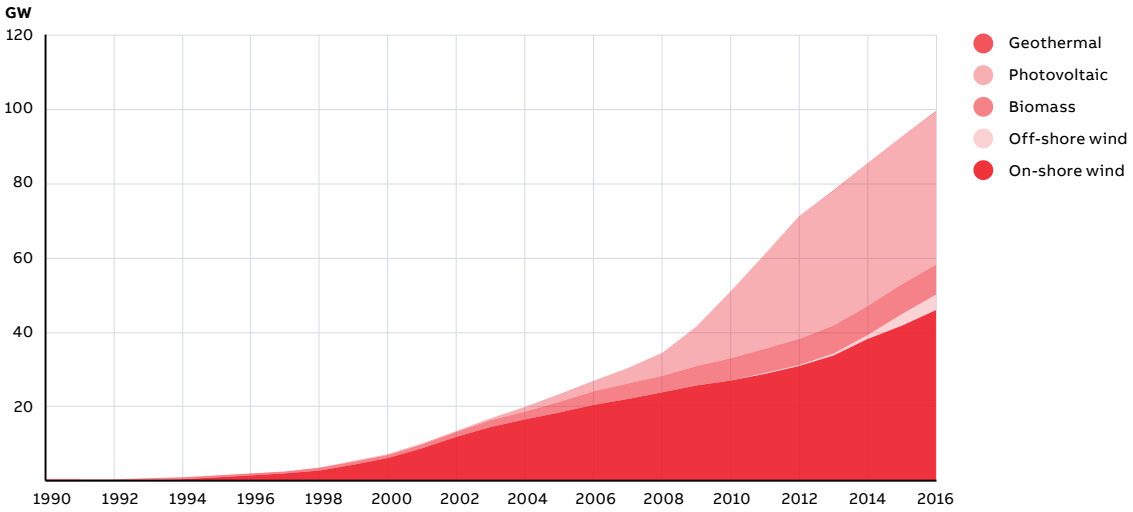
Renewable generation in Europe

The importance of long-term planning in short-term power operations

The rapid growth of renewable generation

In recent years, Europe has seen a real boost in the building of renewable generation capacity. Germany is a notable example of a country with significant growth in renewables. As shown in Figure 1 below, since 2000, the average annual growth of installed capacity in Germany has been more than 15 percent, reaching 18-20 percent between 2009 and 2010. For the most part, favorable conditions for the development of renewables have been caused by support schemes, previously based on feed-in-tariffs and competitive auctions. Now the country has reached a point where renewables account for around 53 percent of installed capacity and around 36 percent share in total electricity demand, already exceeding the 2020 target of 35 percent.

Figure 1
Development of renewable generation capacity in Germany, 1990-2016



Source: ABB Advisors

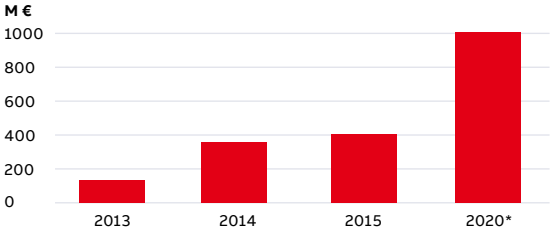
Power grid congestion and costs

Rapid growth of renewables, however, causes many problems for the power grid. A clear example of this is the congestion between the north of Germany (where rapid wind capacity development has taken place) and the industrialized south of the country (where high demand exists). The unscheduled flow of electricity between the north and south, and further to Austria, lead to congestion on north-south transmission lines.

In order to manage the congestion, German TSOs need to employ methods such as redispatch when high inflow of renewable power exists – for example, on windy days, when there is high wind power production in the north of the country where most of the generation is located. Since not all of the power produced can be consumed near the place it is generated, it needs to be transmitted (redispatched) to the south, where there is a high demand for power. When the power influx to the grid is in excess of transmission capacity, a network operator needs to balance the network. In such a case, the TSOs can request that the plants in the north reduce their output in order to allow wind energy to be supplied to the network. Typically, conventional plants' power output is reduced first, followed by wind generators being curtailed as the last resort because they have priority in access to the network. Parallel conventional power stations in the south are asked to increase their output in order to supply the power that could not be delivered by the north.

As we see in Figure 2 below, the costs of redispatch in Germany have been growing rapidly, reaching 400 million Euro in 2015. According to Bundes-netz-agentur, the cost of redispatch may rise to 1 billion Euro by 2020, unless some precautions are taken.

Figure 2
Redispatch costs – Germany



*BNetzA forecast

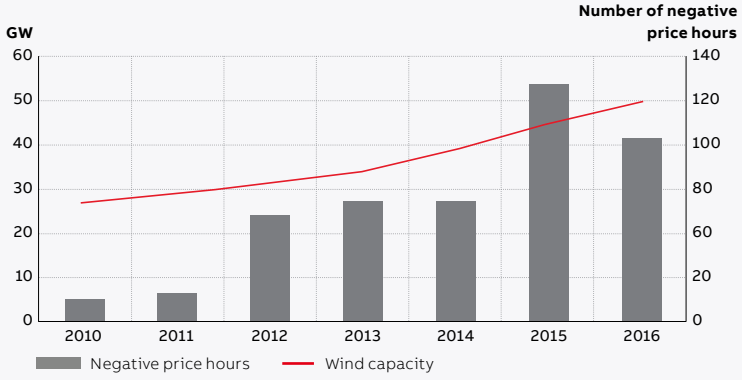
Source: ABB Advisors based on BNetzA data

Negative power prices

The dynamic growth of renewable capacity has allowed renewable generation to meet a growing percentage of the load, especially in hours with favorable weather conditions. When situations like these coincide with low demand, conventional

generation is required to ramp down, due to its higher variable cost (which places it further in the merit order) and the grid priority access that is guaranteed to renewable generators. This causes problems for inflexible generation units, some of which prefer to pay in order to stay online. The submission of these negative bids creates periods of negative prices. As more renewable capacity comes online, the number of hours with negative prices increases, which can be observed in the German market example in Figure 3.

Figure 3
Wind capacity and negative price hours in Germany



Source: ABB Advisors

Negative prices are part of a larger trend of low wholesale power prices. The dynamic growth of renewable generation with near-zero variable cost is one of the driving factors behind this trend. The result is a market environment that does not incentivize investment in new conventional capacity, which is needed for periods of high demand and relatively low renewables generation. In order to facilitate the development of such generation assets, countries are considering capacity mechanisms, which introduce payments for generators' availability to generate. For example, the first capacity market auctions have already been carried out in the UK with a portion of the contracts awarded to units that are yet to be built.

The timing gap between generation and transmission investments and the fundamental issues

Location and timing are two critical elements of transmission and generation investments. Rapid growth in renewable capacity is not always accompanied by rapid transmission expansion. The reason for the aforementioned issues in Germany is that north-south transmission network expansion lags behind the development of renewables in the north of the country.

Can we close this timing gap completely? The short answer is no, but regulators can better coordinate the proposed generation and transmission investments to minimize the timing gap. The fundamental issue results from the deregulation of the power industry, where transmission and generation owners can be completely different companies. Coordination between generation and transmission projects is never perfect because these projects have different owners, scopes, capital structures and construction durations. In addition, these projects are regulated by different state and local entities and have to go through various permitting procedures.

Improved IT structure to increase synergy between market players

The era of big data and cloud services is here. Examples include Microsoft® Azure, which can provide rapid and secure access to a common database, and hosted software solutions such as ABB's integrated energy solution, e7. This immensely improves analytics-driven decision-making, cooperation and synergy between TSOs and power plant operators. Such improvements in IT structure and comprehensive analysis capability more easily justify proposed investment approvals and better inform the bureaucratic process.

The role of planning software solutions

As mentioned above, using common planning software solutions can improve the communication and synergy between regulators overseeing the projects. Choosing the right software solution is one of the critical components of the long-term resource adequacy and transmission studies. ABB Capacity Expansion software can produce multi-year horizon resource plans to meet long-term resource reliability requirements. These generation plans can then be integrated into ABB PROMOD, a solution that incorporates extensive details in transmission grid topology and constraints, and creates economic transmission plans.

A green and bright future

The trend in the power industry is clear: there will be significantly more renewable capacity coming online in the next decade. Better cooperation between regulatory entities and more efficient long-term plans are needed to coordinate future generation and transmission investments. This will help ensure successful integration of renewables to the power grid while increasing real-time reliability of the grid and economic efficiency of generation and transmission investments. Software solutions and cloud services will play a key role in this integration process.

—

abb.com/enterprise-software
info.pges@abb.com

9AKK107045A1000