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HYDROPOWER AND WIND ENERGY – TWO INSEPARABLE RENEWABLES FOR ENABLING THE ENERGY TRANSITION IN EUROPE

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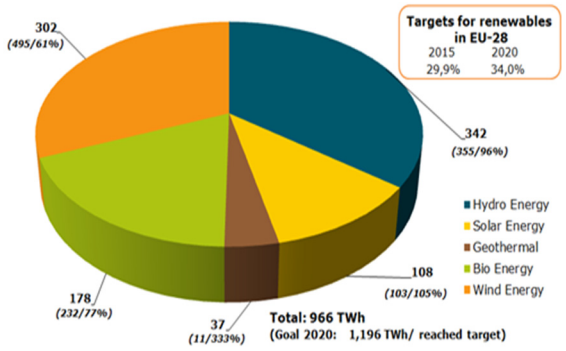
Abstract

The EU and their member states have set binding, ambitious targets to promote the expansion of renewable energy sources. Since the implementation of the EU Directive for climate protection and energy – often referred to as the "20-20-20 package" – adopted in December 2008, the share of renewables in gross final energy consumption has increased by an average of 6.5 % per year and reached 16.7 % in 2015, almost twice as high as in 2004 (8.5 %). For the electricity sector, the EU expects renewables to account for 34 % by 2020. Renewables, especially hydropower and wind energy, will also play a key role for the years following 2020 and both have a strategic relevance to achieve the EU goals. For this reason, the member states have agreed on a new EU target to increase the renewables in gross final energy consumption of at least 27 % by 2030.

Hydropower – An indispensable source of energy

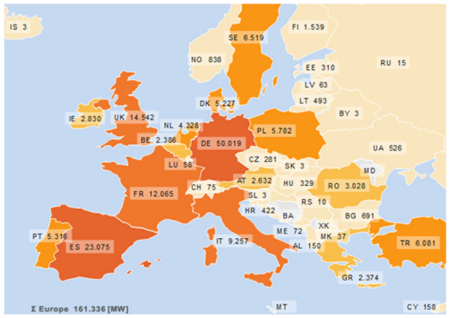


Hydropower is not only a reliable renewable energy source, but also a frontrunner in Europe in the generation of electricity from renewables. With a production of more than 342 TWh (see Fig. 1) – around 35.5 % of the electricity generated from renewable energy sources – hydropower makes a significant contribution to achieving the EU target of 34 % of electricity generation from renewables by 2020.

Figure 1: Electricity generation from renewables in EU (Source: Eurostat 2017; data base: 2015)

In addition to the predictable and constant generation of run-of-river power plants for base load coverage, the provision of reserve power and peak load to ensure security of supply and, in particular, control power to maintain grid stability in an increasingly flexible energy market is becoming more and more important. In Europe, these requirements are primarily met by high-efficiency pumped storage and storage hydro power plants with a total installed capacity of more than 47,443 MW.

Wind energy – A mainstay of the energy transition



In order to meet the EU targets for the energy and climate package by 2020, it is imperative to further expand the use of wind energy. In Germany at the end of 2016, around 27,270 wind turbines with a total capacity of 50,019 MW were in operation. At that time, the installed capacity of wind turbines in Europe was 161,330 MW (see Fig. 2) and worldwide 486,749 MW. A retrospective analysis of the wind turbine market reveals continuous further development of system technology, accompanied by increasing rated power, rotor diameter and hub height.

Figure 2: Wind power capacities in Europe end of 2016 in MW (Source: WindEurope)

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From the first small plants with an average output of around 30 kW and rotor diameters of less than 15 m in the mid-1980s, machines with a rated power of 8 MW and more as well as rotor diameters of 160 m have been developed. In addition to the consistent further development of system technology, the optimization of maintenance strategies in particular will play a decisive role in the future in order to increase technical availability and thus economic efficiency. Especially reliability, weight, costs and efficiency play key roles in this respect.

Security of supply – Contribution of wind energy

With regard to the contribution of wind energy to the security of supply, the development of the annual minimum values as a measure of the permanently available capacity over the year is revealing: These values have remained at an unchanged low level of 100 MW on average since 2010 (see Fig. 3), although the cumulative nominal capacity of the "German wind portfolio" has almost doubled within the same time. Obviously, the expectation that the minimum value would increase if more wind turbines are built throughout Germany and thus increasingly allowing for the replacement of conventional power plant capacity has not been met. The expansion of wind energy in Germany over the last seven years has replaced conventional – schedulable – power plant capacity of an average of 100 MW only.

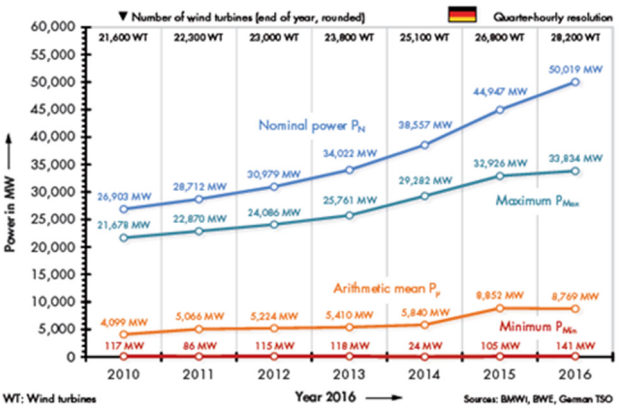

Figure 3: Electricity generation from wind power in Germany from 2010 to 2016 (Sources: BMWi, BWE, Germany TSOs, VGB (own calculations))

For comparison: In 2015, the maximum annual peak load on the German grid reached 78,200 MW at 5:30 p.m. on 24 November. The permanently available (secured) capacity of the "German wind portfolio" was therefore always below one percent of its nominal capacity. This information is also found in the transmission grid operators´ reports on the electricity balances from 2012 to 2016, which at the time of the maximum annual wind energy load in Germany assume that, despite the significant increase in installed capacity, the unavailability of wind energy will remain currently unchanged at 99 %.

Hydropower and wind energy – A strategic partnership for the energy transition

Wind energy makes a valuable contribution to the energy transition in Europe. Nevertheless, additional technologies are still needed to ensure security of supply. Various options are available along the value chain, such as making conventional power plants more flexible, electricity storage or demand side management.

In this context hydropower as a part of the renewable family is playing a key role. Hydropower is therefore not only an extremely efficient, reliable and storable form of energy, but also an indispensable renewable source of energy which has to be further developed within the framework of the energy transition.

Hydropower is offering a wide range of ancillary services and is making a substantial contribution to supply security and grid stability:

- Back-up and reserve capacity
- Black start capability
- Redispatch
- Regulation and frequency response (control)
- High change of capacity (load rate of change)
- Short-circuit power
- Synchronous condenser operation
- Quick start capability
- Peak load control
- Voltage support to control reactive power
- Rotating masses and Spinning reserve