

## ***RENEWABLES FOR ELECTRICITY – ENERGY TRANSITIONS IN EUROPE, ESPECIALLY GERMANY***

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### **Overview**

Over the past decade, the energy landscape in Europe especially in Germany started to change. The issue was to significantly reduce CO<sub>2</sub>-emissions, to substitute fossil for renewable energy and to increase the efficiency of electricity generation. Connected to that, many investments were taken to primarily build plants for renewable energy generation, especially for wind, photovoltaic and biomass applications. Regarding this, the presentation will highlight the German electricity market with a focus on the technical implementation of renewable energies as an example for Europe.

### **Methods**

In general, electricity in Europe is mostly produced using coal, gas and nuclear resources. Renewable generation is different in every single EU-State. Spain, for example, due to their high solar radiation and a high proportion of direct radiation, focusses on the development of concentrating solar power (CSP - solar farm and solar tower power plants) and Greece is also going in direction of solar energy use. Great Britain instead has made large investments in wind energy on- and offshore. Austria uses due to its topography a large amount of hydroelectric power. In Germany, electricity is mainly generated using coal, gas and nuclear. However, the subsidies and the production of Germany's hard coal mining will end in 2018 and a nuclear phase out will be carried out by the end of 2022. For this reasons, Germany's government undertakes multiple acts to restructure the energy system (so-called "Energiewende") with a special focus on the implementation of wind and solar energies. The objective of this presentation is to briefly inform about the most important developments in renewable energy deployment with a focus on solar and wind in Europe and especially in Germany.

### **Results**

For the implementation of renewables, the German government started the renewable energy act in 2000, followed by many amendments. In 2010, Germany released targets for CO<sub>2</sub>-reduction of 40 % until 2020 and 80 % until 2050 related to the values of 1990. Additionally, the goals for implementing renewables into electricity generation were defined: 50 % until 2030 and 80 % until 2050 [1]

Besides biomass, Germany utilizes photovoltaic cells whose installed capacity has been rising in the last years, totalling about 43 GW in 2017. The worldwide installed capacity for photovoltaics was around 400 GW in 2017.

Due to high wind potential at Germany's coastline, wind energy should play a decisive role. Therefore, Germany's government plans to install around 6,5 GW of offshore wind parks until 2020 and 15 GW until 2030. By the end of the year 2017, the wind power installed capacity in Germany for offshore was around 5 GW and for onshore around 51 GW [2].

Renewable energy sources in Germany accounted in 2017 for an all-time record of about 33 % of the electricity generation. The percent share of wind energy in total renewable electricity generation in 2017 was 16 %, there of biomass was 7 %, photovoltaic cells 6 %, hydroelectric power 3 % and municipal waste (also counted as renewable energy) was 1 %.

### **Conclusions**

The high fluctuating power generation by wind and photovoltaic power plants in Germany result in essential additional expansion in the electricity grid – especially in north to south direction, due to the installed wind capacity in the north and the missing capacities of decommissioned nuclear power plants in the south. To keep the high security of electricity supply in Germany, about 2,800 km high voltage grid should be newly build until 2020. Due to the fact that wind and solar energy supply fluctuates, there is a need for energy storages or back up capacity to bridge times where wind and solar resources are not available. Until now the installed capacity of storages is not enough, therefore fossil power plants have to be used as back up. For example the German government foresees the use of available Lignite Power Plants as reserve capacity. This idea is under strong discussion and it is expected the

further introduction of battery technologies. In order to develop renewable energies in Europe to its full potential, it is necessary that the EU-States further integrate their energy systems by means of grid expansion and coordinated support schemes.

## References

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## Further publications

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