ENGINEERING AND ECONOMIC CHALLENGES OF WIND AND SOLAR ENERGY– EXPERIENCES IN EUROPE AND GERMANY

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Overview

Over the past decade, the energy landscape in the world especially in Europe started to change. The issue was to significantly reduce CO_2-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 European and especially German electricity market with a special look at the implementation of renewable energies.

Methods

There is no comprehensive coordination concerning the further development of the power generation in the EU. However, the EU defined not binding goals for the reduction of CO_2-emissions and the implementation of renewable energies for the whole EU. However, each state focusses on a federal policy and historically uses their available renewable energy sources and domestic non-renewable resources. In general, electricity in Europe is mostly generated by coal, gas and nuclear power. The renewable generation is different in every single state. Spain, for example, focusses on the development of concentrating solar power (CSP - solar farm and solar tower power plants), due to their high solar radiation and a high proportion of direct radiation. Great Britain has large investments in wind energy on- and offshore and Austria due to its alpine countryside uses a large amount of hydroelectric generation. Germany's electricity generation is dominated by coal, gas and nuclear generation. However, the subsidies for Germany's hard coal mining will end in 2018 and a nuclear phase out will be performed until the end of 2022. For this reasons Germany's government undertakes multiple acts to reconstruct the electricity generation with a special focus on the implementation of wind and solar energies.

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_2-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. [BMU_BMWI2010]

Due to high wind potentials at Germany's coastline, wind energy should play a decisive role. Therefore, Germany's government plans to install offshore wind energy of 6.5 GW until 2020 and 15 GW until 2030. By reason of financing difficulties, missing floating cranes and insufficient technical experiences in the past, until now 2,5 GW offshore wind energy is in operation. In 2014, 4 GW wind energy converters were new installed onshore, totally are about 40 GW installed. Besides biomass, Germany utilizes photovoltaic cells with a highly rising installed capacity in the last years, totally are about 38 GW installed.

This background results in portions for wind energy of 9 %, biomass of 7 %, photovoltaic cells of 6 %, hydroelectric power of 3 % and municipal waste (also counted as renewable energy) of 1 % for the year 2014. All renewable energy sources accounted for 26 % in total for the electricity generation, the all-time record.

Conclusions

The high fluctuating power generation by wind energy and photovoltaic cells result in essential additional installations in the electricity grid – especially in north to south direction, due to the installed wind capacity in the north and the missing capacities of decomposed 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 installed until 2020 – only 270 km are realized yet [EE2014]. Due to the fact that wind and solar energy supply is fluctuating, there is a need for storages or back up capacity to bridge times where wind and solar resources are not available. By now the installed capacity of storages is low, so fossil power plants have to be used as back up.

The presentation will show the engineering and economic challenges of the introduction of wind- and solar energy for electricity.

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