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"Integration of renewable power generation into the transmission grid and the power market in the context of energy policy"

Abstract. The environmentally friendly, reliable and affordable supply of electricity is one of the most important tasks to ensure everyday personal and social life today, as well as one of the greatest challenges of the 21st century.

As part of its energy strategy of 20101, the Federal Government has set very ambitious and pioneering political objectives. According to the formulation of objectives, the greenhouse gas emission of developed countries should be reduced, at least, to 80% - in comparison to levels in 1990. The share of renewable energy in terms of gross final consumption is expected to rise to 60% by 2050. The contribution of renewable electricity will then be at 80% of gross electricity consumption.

A high level of security of supply, an effective climate, environmental protection and an economically viable energy supply require a transformation of the existing power system into an electrical energy system of the future. This applies both to the transmission grids, as well as the electricity market, on a national and international level.

This results in a steady increase in the renewable electricity infeed with highly fluctuating generation characteristics, and a long-range geographical partially decentralized distribution. This renewable electricity must be integrated into the transmission grids on all voltage levels and in the power market with high liquidity in short-term time periods.

As a result of these tasks, new challenges are emerging to ensure a secure network operation; for example, an increasing need for congestion management measures, urgent grid development and an increased need for control energy and alternatives for the provision of existing ancillary services of conventional power plants.

On the side of the electricity market, the challenge of creating a liquid and efficient European Internal Energy Market (IEM) as well as the Europe-wide introduction of market coupling (MC) with innovative short-term trading products. Doing so will require interdisciplinary interactions with other energy markets (such as gas, oil and coal) and environmentally related trading products (CO2 emission and green certificates). The introduction of new (storage-) technologies, such as e-mobility, virtual power plants, power to gas, battery storage, etc. allowing a more flexible operation of grid and market is a prerequisite.

In the medium term, a complete transformation of the power system (grids and market) will result in the energy system of the future for the energy-turn-around implementation. Modern information and communication technology (ICT) provide an important basis for this in order to guarantee new challenges in energy data management. In the field of higher education, the future base of application-oriented research and teaching, with high interdisciplinary between energy engineering and energy with the inclusion of an international policy environment, is to be created.