International Energy Systems in Transition
- Perspectives from Science and Industry -
The 15th IERE General Meeting & German Forum

Conventional Power Plants in an Electricity Market with a large Share of Renewables

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Keywords: *electricity market, renewables, conventional power plants, residual load*

Abstract
The German electricity market is an example for the rapid expansion of renewables. By 2050, the share of renewables in power generation is intended to amount to 80%. The basis of this expansion is formed in particular by wind (onshore and offshore) and solar (photovoltaics). Since the wind and solar electricity is not produced in line with the demand and is hardly available from time to time, a large fleet of conventional power plants continues to be required in the next decades even in such expansion scenarios. However, a different role is assigned to the conventional power plants resulting in a changed mode of operation. In their new role conventional power plants must balance the difference between electricity consumption and renewables-based generation, i.e. cover the so-called residual load. This load increasingly shows significant fluctuations. Times when renewables fully cover the electricity demand will permanently alternate with times when nearly no renewable electricity will be available and the entire power supply must be ensured by conventional power plants. This means that base load will disappear altogether and the complete fleet of conventional power plants will participate in balancing the residual load. Therefore, all power plant units will successively be affected by this operating regime.

Such an operation places high requirements on a conventional power plant. The constant alternation between full load, part load and downtime puts considerable strain on a power plant. Thus innovative technical measures are required to mitigate these strains. A crucial role is played here by new materials that make components more robust and flexible. Furthermore innovative methods for capturing and evaluating the lifetime consumption of components will also help. As start-up and shut-down not only cause considerable wear but are also expensive, they are considered as a focal point of power plant optimisation. Optimised new firing systems and innovative combustion technologies like dry-lignite combustion or electric ignition processes are central elements in developments towards more flexibility. To avoid the strains of start-up and shut-down, a reduction of minimum load is of particular importance. Downtimes can be avoided by extremely low minimum load operation without high costs and wear.
Besides these technical aspects associated with the future role of conventional power plants, further important aspects must also be considered such as the affordability of electricity. Conventional power plants with low capacity utilisation produce electricity at higher costs which are ultimately reflected by higher electricity prices and needs to be considered in the design of the electricity market. RWE is ready to work further on these challenges arising from the transition of the energy systems and develops corresponding suitable solutions.