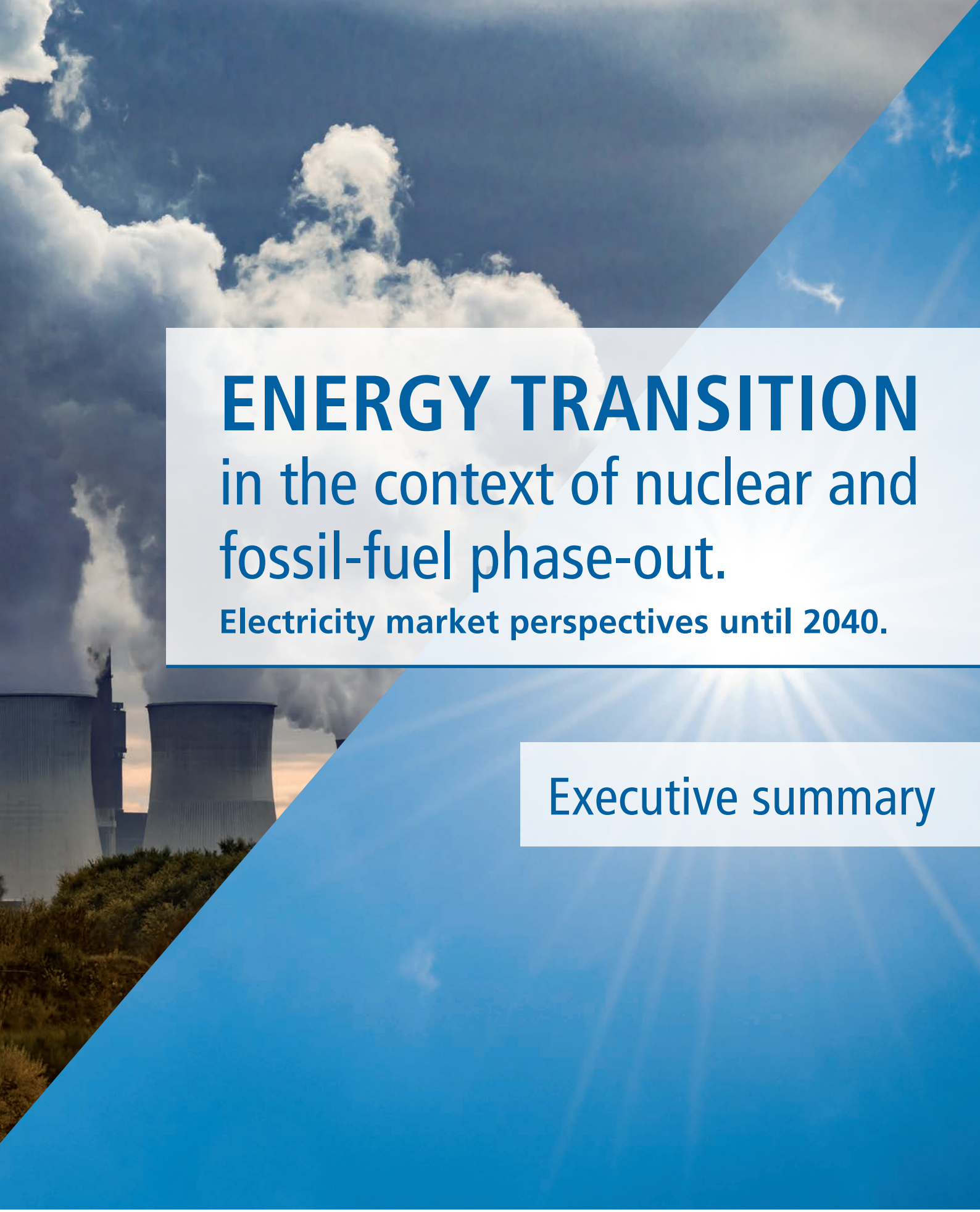

# ENERGY TRANSITION

## in the context of nuclear and fossil-fuel phase-out.

### Electricity market perspectives until 2040.

## Executive summary

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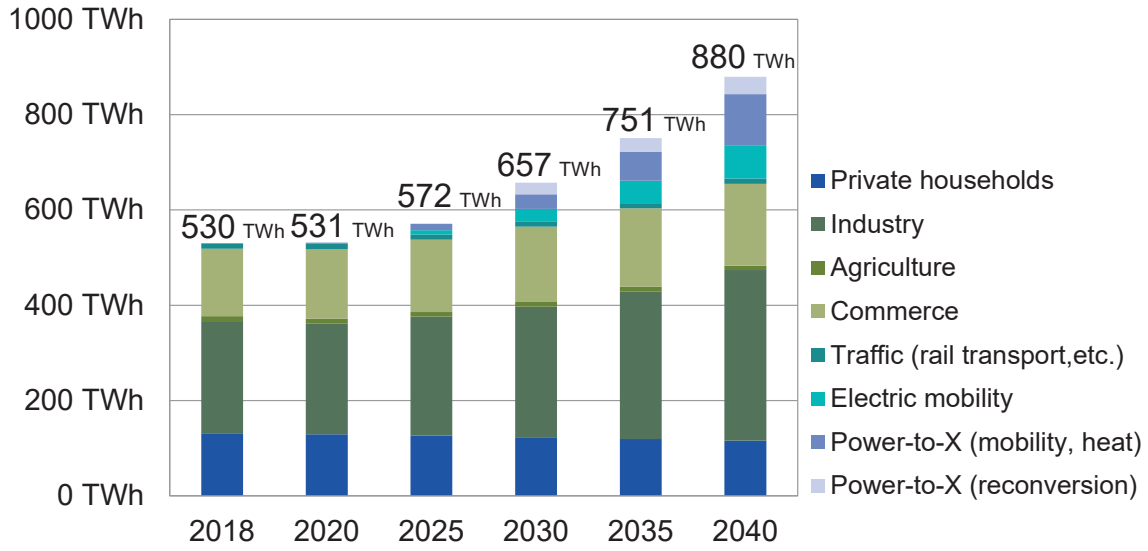
# Energy Transition in the context of nuclear and fossil-fuel phase-out. Electricity market perspectives until 2040.

The Energy Transition in Germany describes a comprehensive and long-term process of transforming the energy system – from generation to transportation and final consumption. Energy policy decisions such as the nuclear and fossil-fuel phase-out act as catalysts for that development. Against the background of technological developments, those political goals are to be balanced with the energy policy goal triangle consisting of ecology, economy and security of supply. Thus, the present study analyzes the developments of the electricity market until 2040 and creates a realistic vision of future electricity generation and expected consumption.

A core result of the analysis is the significant increase of net electricity consumption in Germany from 530 TWh today to approx. 880 TWh in 2040. Major drivers for a rapidly growing electricity demand are electric mobility as well as a fast increase of power-to-X applications.Power-to-X technologies refer to the direct use of electricity in areas like mobility and heat but it also includes power transformation or use of synthetic fuels. Moreover, larger amounts of electricity are being stored as hydrogen and converted back when needed. Displayed developments of net electricity consumption are consistent with current energy system studies.

## Net electricity consumption until 2040

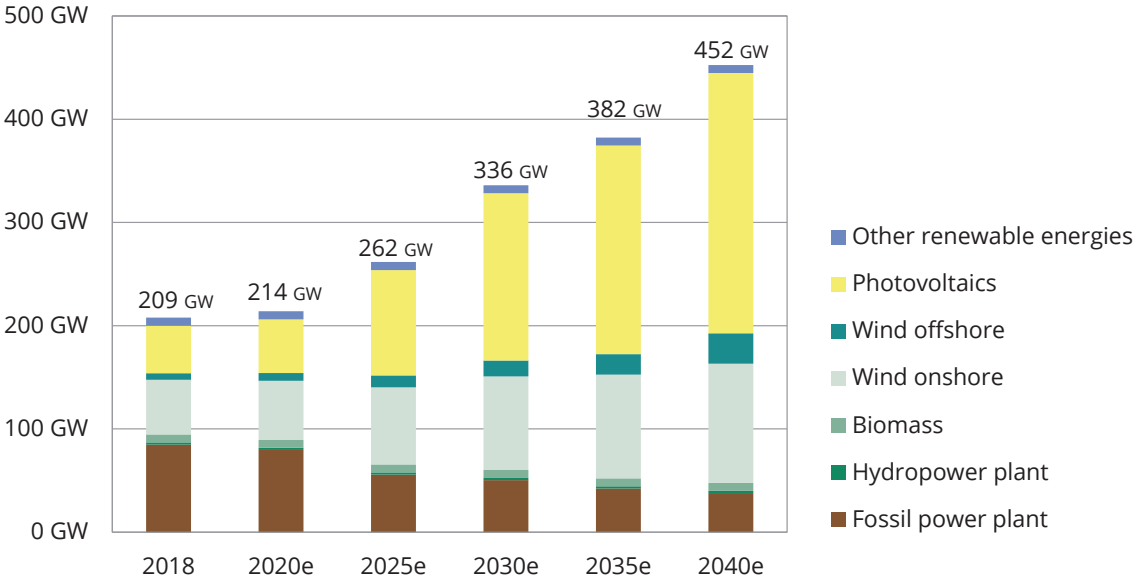
Source: EuPD Research 2019




The study shows that the current installed power plant output has to increase from approx. 210 GW today to 452 GW in 2040 to meet expected electricity consumption. Photovoltaics is a key element in this context. Installations have to triple to 162 GW from 2019 until 2030; and must be increased to 252 GW until 2040. Besides, a significant increase of wind energy capacity is to be expected – onshore as well as offshore.

## Forecast of installed net capacity in Germany

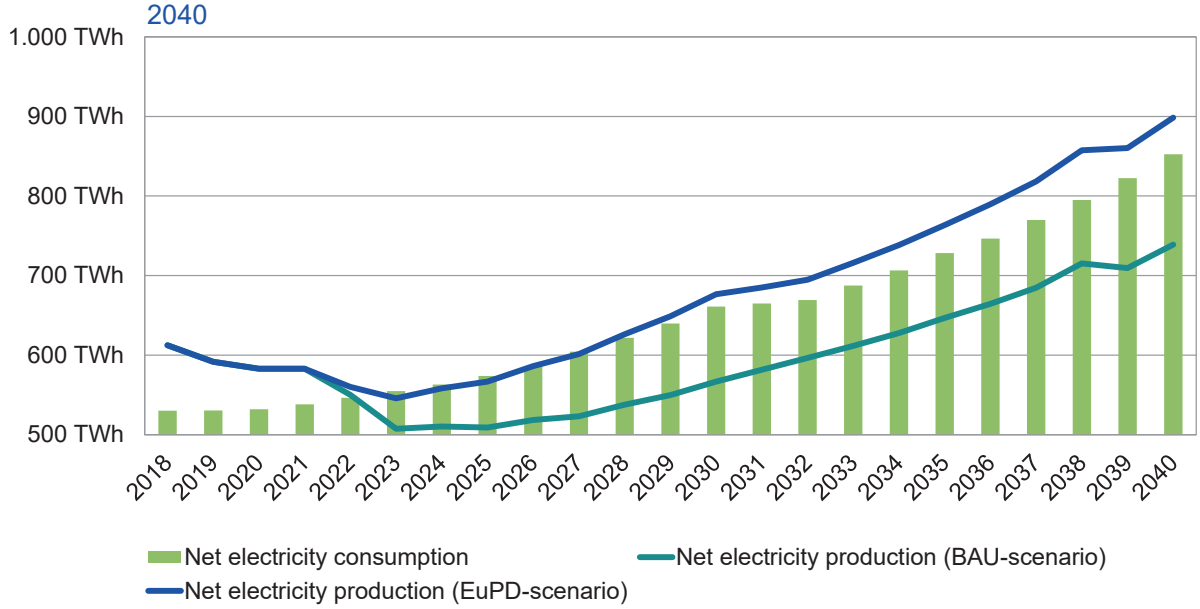
Source: EuPD Research 09/2019




Because of significantly higher full load hours and accompanying electricity generation per MW installed, wind energy remains to be the largest energy producer in the forecast period until 2040 – despite the strong growth trajectory for photovoltaics. Throughout Germany, the prognosis reveals a net electricity generation share of 45% for wind energy and 30% for photovoltaics in 2040.

A major finding of the study is the electricity shortfall starting 2022 and increasing to 70 TWh until 2030. Reasons for that are the limited photovoltaics capacity expansion of 2.5 GWh annually on average (BAU scenario), the reduction of conventional production capacity as well as an increasing electricity demand. In order to avoid this scenario, it is necessary to add a PV production capacity of more than 10 GWh per year in the coming years.

Comparison of net electricity production and consumption until 2040 Source: EuPD Research 09/ 2019




The significantly increasing share of fluctuating electricity generation capacities also result in a strong growth of storage capacities for short-term and seasonal energy storage to ensure a balance of electricity supply and demand. It affects short-term storage solutions to provide for system stability on the grid level as well as residential and commercial storage within the framework of prosumer models. Power-to-gas solutions for water electrolysis, or the production of "green" hydrogen and its conversion back to electricity, will play an important role for long-term and seasonal storage of solar and wind power.

These comprehensive structural changes may have an impact on electricity prices. In the medium term, rising grid charges and higher electricity generation costs of conventional energy sources result in slightly increasing electricity prices. In the long run, electricity prices are expected to decrease to less than 29 ct/kWh in 2040 – because of a systematic expansion of renewable energies, and especially an increase of photovoltaic capacity as the technology with the most favorable electricity generation costs.

Moreover, the developmental pathway of the photovoltaic and storage industry as presented in the study is associated with positive economic effects such as an increase of the direct employment by 50,000 employees until 2040. In this context, industry sales are expected to grow to more than 12 billion Euros until 2040 with a domestic gross value added of 8.4 billion Euros.

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