

## New power systems

Compared to traditional methods, the new system envisages a move away from reliance on fossil fuels to one based on new energy sources to generate electricity. It involves gradually increasing the proportion of...

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Global economic growth and the electrification of transportation, heating, and industry are primary drivers of the anticipated surge in global electricity demand. Additionally, the development of data centers, notably for AI applications, is also expected to contribute to this increase. At the same time, AI holds considerable potential to introduce efficiencies in both the provision and use of power.

By mid-century, electricity will constitute 37% of global final energy use, a substantial rise from 20% in 2023. This upswing is accompanied by a dramatic shift towards renewable energy, with wind and solar anticipated to generate half of the world's electricity by 2040 and 70% by 2050. The decarbonization trajectory predicts that nearly 90% of electricity will be sourced from non-fossil sources by 2050.

The growing share of renewable power requires flexibility and a robust system of demand-response: as variable renewable energy sources (VRES) expand ninefold, the need for short-term flexibility will double. Fluctuating demand from sectors like heat and transport calls for new ancillary services such as synthetic inertia products and fast frequency response and adapting market and regulatory frameworks to support these technologies is critical for a sustainable energy future.

A key bottleneck in the energy transition is the expansion of the electrical grid. Global grid capacity needs to grow 2.5 times its current size, with annual expenditure on grids more than doubling to USD 970 billion by 2050. While Grid Enhancing Technologies (GETs) offer potentially significant temporary relief, the long-term solution lies in accelerating the construction of new grid infrastructure and advanced controlling systems, which are currently hampered by permitting timelines, the scarcity of human and material resources, and financial constraints.

Despite a rise in global grid expenditures from 15% to over 25% of annual energy expenditure by 2050, efficiencies in grid technology and increased electricity distribution will likely keep consumer grid charges stable or declining in most regions. Only four out of ten regions might see an increase.

He adds: "The pathway to a decarbonized power system is clear: renewables integration and grid expansion require significant investment, innovation, coordination, and commitment from all players, especially



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governments. As the world moves towards a greener future, addressing these challenges with a systemic and forward-thinking approach will be essential for a successful energy transition."

DNV's Energy Transition Outlook 2023 serves as the foundation for this report, with additional insights provided by experts in demand modeling, power grids, new market models, digitalization, and AI. The research delves into evolving market mechanisms, highlighting the importance of flexible and resilient grids. Insights include strategies for market design, addressing congestion, costs trajectories and expanding transmission and distribution networks.

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