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What would it take to decarbonize the electric grid by 2035?A new reportby the National Renewable Energy Laboratory (NREL) examines the types of clean energy technologies and the scale and pace of deployment needed to achieve 100% clean electricity, or a net-zero power grid, in the United States by 2035. This would be a major stepping stone to economy-wide decarbonization by 2050.

The study, done in partnership with the U.S. Department of Energy and with funding support from the Office of Energy Efficiency and Renewable Energy, is an initial exploration of the transition to a 100% clean electricity power system by 2035--and helps to advance understanding of both the opportunities and challenges of achieving the ambitious goal.

Overall, NREL finds multiple pathways to 100% clean electricity by 2035 that would produce significant benefits, but the exact technology mix and costs will be determined by research and development (R& D), manufacturing, and infrastructure investment decisions over the next decade.

"There is no one single solution to transitioning the power sector to renewable and clean energy technologies," said Paul Denholm, principal investigator and lead author of the study. "There are several key challenges that we still need to understand and will need to be addressed over the next decade to enable the speed and scale of deployment necessary to achieve the 2035 goal."

None of the scenarios presented in the report include the IRA and BIL energy provisions, but their inclusion is not expected to significantly alter the 100% systems explored--and the study"s insights on the implications of achieving net-zero power sector decarbonization by 2035 are expected to still apply.

To examine what it would take to fully decarbonize the U.S. power sector by 2035, NREL leveraged decades of research on high-renewable power systems, from theRenewable Electricity Futures Study, to theStorage Futures Study, to theLos Angeles 100% Renewable Energy Study, to theElectrification Futures Study, and more.

Using its publicly available flagshipRegional Energy Deployment System (ReEDS)capacity expansion model, NREL evaluated supply-side scenarios representing a range of possible pathways to a net-zero power grid by 2035--from the most to the least optimistic availability and costs of technologies.

Unlike other NREL studies, the 2035 study scenarios consider many new factors: a 2035 full decarbonization timeframe, higher levels of electrification and an associated increase in electricity demand, increased electricity demand from carbon dioxide removal technologies and clean fuels production, higher reliance on existing commercial renewable energy generation technologies, and greater diversity of seasonal storage solutions.

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"For the study, ReEDS helped us explore how different factors--like siting constraints or evolving technology cost reductions--might influence the ability to accelerate renewable and clean energy technology deployment," said Brian Sergi, NREL analyst and co-author of the study.

In all modeled scenarios, new clean energy technologies are deployed at an unprecedented scale and rate to achieve 100% clean electricity by 2035. As modeled, wind and solar energy provide 60%-80% of generation in the least-cost electricity mix in 2035, and the overall generation capacity grows to roughly three times the 2020 level by 2035--including a combined 2 terawatts of wind and solar.

To achieve those levels would require an additional 40-90 gigawatts of solar on the grid per year and 70-150 gigawatts of wind per year by the end of this decade under this modeled scenario. That"s more than four times the current annual deployment levels for each technology. If there are challenges with siting and land use to be able to deploy this new generation capacity and associated transmission, nuclear capacity helps make up the difference and more than doubles today"s installed capacity by 2035.

Across the four scenarios, 5-8 gigawatts of new hydropower and 3-5 gigawatts of new geothermal capacity are also deployed by 2035. Diurnal storage (2-12 hours of capacity) also increases across all scenarios, with 120-350 gigawatts deployed by 2035 to ensure that demand for electricity is met during all hours of the year.