National Electrical Manufacturers Association

INTERMITTENT GENERATION

Solar and wind generation have grown from less than 1 percent of U.S. installed capacity to 14 percent in 20 years.[1] Wind and solar are considered **intermittent generation** as production varies with wind conditions or daylight. With U.S. targeting net-zero electricity by 2035[2], our dependence on these technologies will continue to grow, presenting the following challenge: **How can we deploy more intermittent generation and still ensure reliable power, 24 hours a day, 365 days a year?**

Key Technologies

Solar panels integrate multiple **photovoltaic (PV) cells** which absorb photons via semiconducting materials such as silicon, creating an electrical current. An **Inverter** converts the DC current produced to AC power used by the grid. **Racking systems** hold the Solar Panels while solar **control systems** monitor the solar facility and manage its integration into the grid.

Wind towers harness the wind's kinetic energy by using air flow over propeller blades to create rotation of a driveshaft, amplified by the gear box, to spin an electric generator. Electricity generated from a wind farm goes to a transmission substation and on to the grid.

Potential Market Size & Timing

The demand for clean energy will continue to increase over time. The U.S. is expected to see its highest record of power consumption this year, with projected power demand climbing to 4,029 billion kWh in 2022.[3] In the first half of the year, 24% of electricity in the United States was produced by renewable energy.[4] In addition, if the U.S. keeps to an "electrify everything" decarbonization strategy where all building, cars, trucks, and even most factories run on electricity, demand over the next 20 years could increase by as much as a 50%.

So, rapid acceleration of clean energy generation is needed to meet this increasing demand while simultaneously decarbonizing the grid. For example a NREL report determined that to move to 100% clean electricity by 2035; solar and wind would need to provide 60-80% of the power depending on the scenario analyzed. NREL also calculated that 100% decarbonization of the grid by 2035 would require a build out of 40–90 GW's of solar and 70–150 GW's of wind **per year**.[5]

Barriers

- **Grid reliability:** Additional intermittent generation cannot be managed by the traditional grid without concurrent investment into enabling technologies such as automated demand management, load shifting programs, clean peaking generation, and energy storage.
- **Transmission Permitting:** Currently transmission projects take years to permit and build yet expansion of wind and solar will require thousands of miles of new transmission lines.
- **Land availability and permitting** for utility scale projects.
- **Affordability** of distributed solar for residential customers and resolving **policy disputes** over who pays for grid upgrades (e.g., the resident adding the solar or the distribution system).

Accelerators

- Full implementation of the **Infrastructure Investment and Jobs Act** (IIJA) and the **Inflation Reduction Act** (IRA).
- **IIJA includes $65 billion of funding** for grid reliability, new transmission projects, grid flexibility, demand response and distributed energy resources.
- **The Inflation Reduction Act allocates $369 billion** to climate investments including enhanced tax incentives for wind, solar and energy storage projects and for domestic manufactures of clean energy components.
- Further investment in **grid reliability solutions** including clean backup power sources (hydroelectric facilities, hydrogen), smart meters, and two-way grid capabilities to further enable distributed generation, automated load shifting and demand reduction and management.
- **Siting/permitting improvements** to make sure sites are available for new renewable and transmission projects and to shorten time frames for construction.
- New programs to encourage **all new buildings to incorporate appropriate advance energy management technologies** such as smart appliances, automated demand reduction, smart EV charging, storage, and distributed generation.

1 https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php#:~:text=At%20the%20end%20of%202021,solar%20photovoltaic%20electricity%20generating%20capacity.
2 The Long-Term Strategy of the United States, Pathways to Net-Zero Greenhouse Gas Emissions by 2050 (whitehouse.gov)
3 U.S. power use to reach record high in 2022 as economy grows -EIA | Reuters
4 U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
5 Denholm, Paul, Patrick Brown, Wesley Cole, et al. 2022. Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035. Golden, CO: National Renewable Energy Laboratory. NREL/TP6A40-81644. https://www.nrel.gov/docs/fy22osti/81644.pdf