Nutwood

Wind: the renewable workhorse keeps on giving

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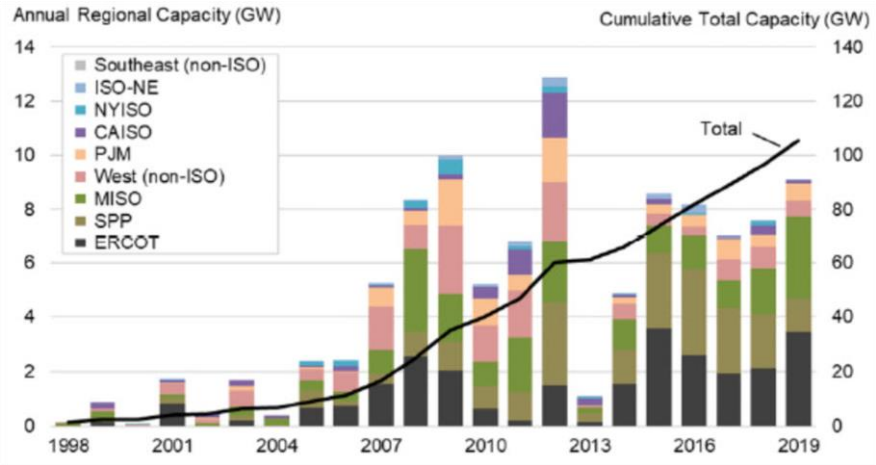
Every year, the Lawrence Berkeley National Laboratory (LBL) provides an update on the status of wind technology. While the report is US-centric, the trends observed in the US, such as the growing size of new turbines, improved performance and falling costs, are more-or-less applicable elsewhere. Moreover, it shows that despite solar power getting so much coverage, wind continues to deliver, especially in windy places.

According to the *2020 edition of the LBL report*, the US added more than 9GW of new wind capacity with an investment of $13bn in 2019 (see Figure 1). Wind energy output now represents more than 7% of the nation's electricity supply, more than 10% in 14 states, and more than 40% in Iowa and Kansas – not generally recognized as green but certainly windy. It said that at least 225GW of new wind is seeking transmission interconnection in the US with 5% paired with storage.

Despite the new installations, US lags behind China by a wide margin. However, as a source of energy, global installed wind capacity at 650GW is impressive indeed. It compares to 390GW for nuclear. While the average capacity factor for wind is much lower, at current rates of growth, it won't be long before wind generation will exceed that of nuclear. Nuclear capacity fell by 4.5GW in 2019 while the wind capacity grew by 60GW.

Figure 1: US wind installations, 1998-2019



Source: Wind Energy Technology Data Update: 2020 Edition, LNBL, Aug 2020, Ryan Wiser et al

US also lags over a dozen large and small countries when it comes to wind as a percentage of total generation (see Figure 2). A few US states, Iowa and Kansas, however, generate more than 40% of their generation from wind – putting them behind only Denmark and ahead of Ireland on this metrics.

Most US wind parks are concentrated in the Midwest and Texas, and generally not near major load centres (Figure 3). Building sufficient transmission capacity to move the generated wind power to where it can be used is a major challenge.

Texas, not generally regarded as a green state, dominates ahead of the second place Iowa by a wide margin. It beats California by a factor of nearly five – and California's wind has a poor correlation with peak demand, which means that it does not help much when the demand is high on hot summer afternoons or evenings.

The new generation of wind turbines now installed in the US, like those in Europe and elsewhere, are bigger, with taller towers, bigger rotor blades and are far more reliable. The capacity factor of turbines built from 2014 through 2018 was 41%, compared to 31% for those built between 2004 and 2012 and 25% for those built between 1998 to 2001.

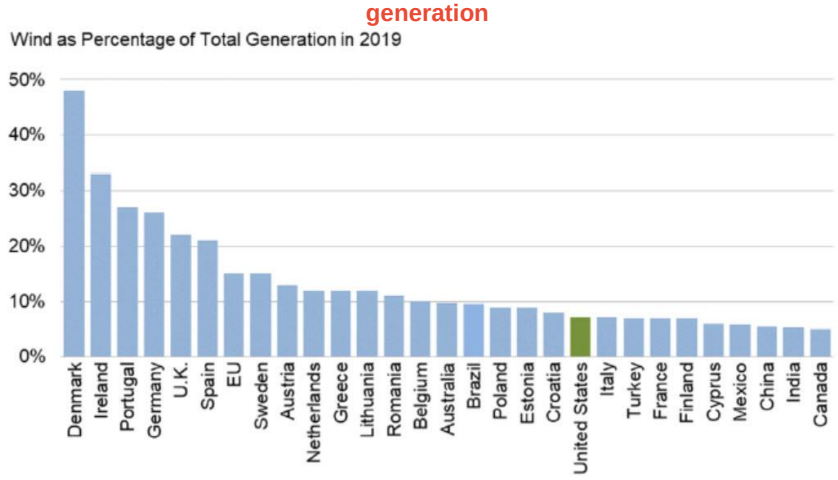
Turbines continue to get larger. The area swept by the average wind turbine rotor has more than doubled since 2010. The average nameplate capacity of new wind turbines installed in the US in 2019 was 2.5MW compared to 0.7MW in 98-99. GE's biggest offshore wind turbine, Haliade-X, will be 12MW.

At the same time, prices for the components continue to fall. Wind turbine prices have fallen to $700–850/kW

while the average installed cost in 2019 was $1,440/kW, down more than 40% from 2009-10 when they peaked in the US.

Wind energy prices are now below 2¢/kWh, on average after topping out at 7¢/kWh for power purchase agreements (PPAs) executed in 2009. These impressive low numbers, LBL report points out, are dominated by projects from the low-priced interior of the country, where the wind resource is strongest and are helped by the federal tax support. At these prices, wind power costs fall below the projected future fuel costs of gas-fired generation even with historically low natural gas prices in the US.

Figure 2: US small fish when it comes to wind as percentage of total generation



Source: Wind Energy Technology Data Update: 2020 Edition, LNBL, Aug 2020, Ryan Wiser et al

Many experts prefer to compare alternative technologies based on the levelized cost of electricity or LCOE, which has fallen 60% for wind in a decade. The LCOE for wind without the federal production tax credit (PTC) was in the mid-$30/MWh range in 2019, down from the $85-90/MWh range a decade ago.

Wind technology is considered more mature than solar and its projected cost declines are not expected to be spectacular.

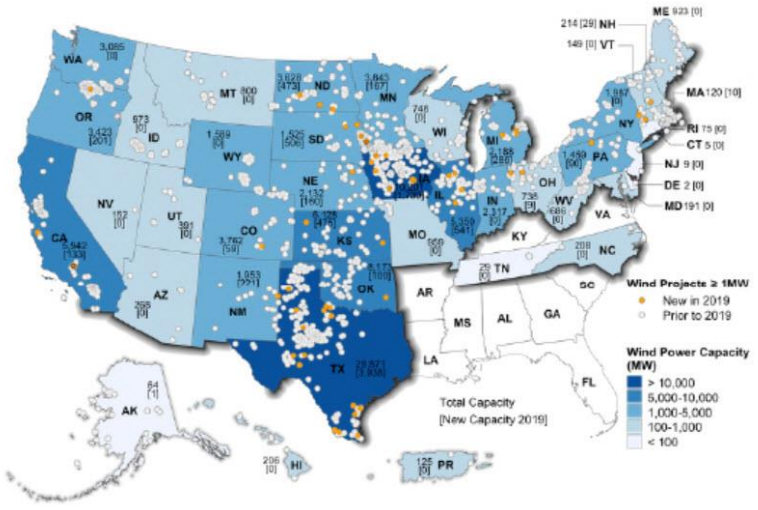
But they are pretty good as they are, beating or competing with solar PVs as illustrated on the accompanying visual based on the latest PPA prices.

The next growth opportunity for wind in the US and elsewhere is offshore, where wind speeds tend to be higher and steadier.

Moreover, wind is a good companion for solar, hydro, biomass and other renewables as grid operators increasingly favour a mixed portfolio of resources to complement each other across the hours of the day and seasons of the year. No system can totally rely on a single source of renewable energy as we move towards a carbon-free electricity mix over time.

Another important consideration is not the cost but the value of wind as an energy source. According to the LBL report, the value of wind in wholesale power markets is affected by the location of wind plants, their hourly output profiles, and how those characteristics correlate with real-time electricity prices and capacity markets as well as other generation resources on the network.

Figure 3: It's windy in the middle



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In California, for example, there is virtually no wind in mid-day hours during the summer when solar generation peaks. Wind and solar have different values at different times in different places.

According to the LBL report, wind's market value was lowest in the Southwest Power Pool and ERCOT, averaging $15/MWh and $16/MWh, respectively, and the highest in CAISO at $37/MWh. Wind energy PPA prices are generally competitive with these estimates.

The impact of the current pandemic aside, LBL projects 10GW of new wind capacity will be installed in 2020 in the US alone and continued growth especially if the federal tax incentives are extended. Some contraction in the years ahead can be expected if/as those tax incentives are phased out.