Hybrid power plant

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America"s electric power system is undergoing radical change as it transitions from fossil fuels to renewable energy. While the first decade of the 2000s saw huge growth in natural gas generation, and the 2010s were the decade of wind and solar, early signs suggest the innovation of the 2020s may be a boom in "hybrid" power plants.

A typical hybrid power plant combines electricity generation with battery storage at the same location. That often means a solar or wind farm paired with large-scale batteries. Working together, solar panels and battery storage can generate renewable power when solar energy is at its peak during the day and then release it as needed after the sun goes down.

Our team at Lawrence Berkeley National Laboratory found that a staggering 1,400 gigawatts of proposed generation and storage projects have applied to connect to the grid - more than all existing U.S. power plants combined. The largest group is now solar projects, and over a third of those projects involve hybrid solar plus battery storage.

That"s where storage comes in. Lithium-ion battery prices have rapidly fallen as production has scaled up for the electric vehicle market in recent years. While there are concerns about future supply chain challenges, battery design is also likely to evolve.

The combination of solar and batteries allows hybrid plant operators to provide power through the most valuable hours when demand is strongest, such as summer afternoons and evenings when air conditioners are running on high. Batteries also help smooth out production from wind and solar power, store excess power that would otherwise be curtailed, and reduce congestion on the grid.

Today, solar and hybrids dominate the development pipeline. By the end of 2021, more than 675 gigawatts of proposed solar plants had applied for grid connection approval, with over a third of them paired with storage. Another 247 gigawatts of wind farms were in line, with 19 gigawatts, or about 8% of those, as hybrids.

Of course, applying for a connection is only one step in developing a power plant. A developer also needs land and community agreements, a sales contract, financing and permits. Only about one in four new plants proposed between 2010 and 2016 made it to commercial operation. But the depth of interest in hybrid plants portends strong growth.

In markets like California, batteries are essentially obligatory for new solar developers. Since solar often accounts for the majority of power in the daytime market, building more adds little value. Currently 95% of all proposed large-scale solar capacity in the California queue comes with batteries.

Aviation accounts for around 3% of global annual CO2 emissions, but it is often regarded as one of the most challenging industries to decarbonize. This is because the number of people travelling by air is increasing every year and the technologies needed for decarbonization are far from ready for mass deployment.

As a result, a single technology or change in aircraft operations will not be enough to achieve net-zero emissions. A combination of different strategies, encouraged by appropriate incentives and policies, will be required. This could include upgrading airport infrastructure, producing sustainable fuels or adopting new propulsion technologies.

Electrification has been used to decarbonize the automotive industry and now it's also being explored as a possible pathway for aviation. A battery-powered flight uses the energy stored in batteries to power electric fans for propulsion. Since it doesn't involve burning fossil fuels, electrification could eliminate in-flight emissions of carbon, as well as other environmentally unfriendly gases.

But greenhouse gases could still be emitted while producing the battery and generating the electricity needed to charge it. So, sustainable sources of electricity must be used for charging, alongside sustainable battery manufacturing practices, to significantly reduce overall emissions compared to using fossil jet fuel.