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INSIGHT

Summer 2022—Weather Challenges and Risks to Electric Power

June 29, 2022

The 2022 summer season has arrived, and with warmer weather, the demand for electricity to cool residences and buildings generally increases across the country. According to the U.S. Climate Extremes Index (CEI), during summer months (June-August) there has been an increasing trend in the percentage of the contiguous United States with maximum temperatures much above normal over the last 30 years (Contiguous U.S., Summer—extremes in maximum temperature: step 1). Further, over the same timeframe, during summer months (June-August), the percentage of the contiguous United States with minimum temperatures much above normal has also increased (Contiguous U.S., Summer—extremes in minimum temperature: step 2). This summer has been held out by the North American Electric Reliability Corporation as one that may be especially challenging for electric power generation in several U.S. regions in its 2022 Summer Reliability assessment, due to the ongoing drought in the southwest and other factors. With a spate of recent older coal power plant retirements, electric utilities will place a greater reliance on natural gas and renewable electric sources for power generation. Coal, nuclear, natural gas and some renewable resources can be challenged to perform efficiently in the warmer summer months.

Generation Efficiency, Cooling, and Performance

Power generation in the summertime comes with some very specific challenges, as atmospheric conditions can impact overall efficiency. Most power plants (i.e., base load generation such as fossil fuel-fired power, some geothermal, and nuclear power plants) operate on a steam-electric cycle where water is heated turning it into steam to drive a turbine-generator. The steam exiting the turbine has to be condensed and cooled before it can be recycled to generate more electricity. While some power plants use rivers or other large bodies of water to cool the condensed steam (i.e., "direct once through" wet cooling), other power plants use cooling towers where air passing through the exiting steam cools the water by evaporation. Cooling the water is important for steam-electric cycle efficiency, as colder water provides more efficient power generation. The efficiency of evaporative cooling towers depends largely on the ambient wet bulb temperature, since evaporative cooling towers generally provide cooling between 5 degrees to 7 degrees Fahrenheit above the ambient wet bulb temperature. This means that cooling tower

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IN11964

efficiency is generally lower on warmer days than it would be on cooler days. Warmer summer temperatures can therefore result in lower power plant power generation efficiency and output, especially on humid days.

Elevated air temperatures can also decrease the capacity of transmission cables to carry electricity. The effects of ambient temperature on electric transmission capacity are well known, but electric utilities typically base transmission system ratings on historical temperature profiles. However, to increase existing electric transmission line capacity, the Federal Energy Regulatory Commission recently issued an order allowing transmission lines to operate closer to their thermal capacity ratings using ambient-adjusted ratings.

Warmer summer weather can also impact other renewable electric generation. While offshore wind power may see less seasonal variations, wind power performance for onshore turbines tends to be lowest during the warmer summer months due to lower average wind speeds, in most U.S. regions. Solar photovoltaic cells lose efficiency at high air temperatures, and the peak demand for power usually occurs in the late afternoon and early evening, a few hours after solar power has had its peak generation period in many regions.

Electricity Price Increases and Customer Demand

Even with increasing amounts of less expensive renewable electricity entering the market, electricity prices are expected to rise this year largely due to the increasing wholesale prices for natural gas. With the share of electric power generated from natural gas at about 37% in 2021, and expected to remain at the same level in 2022, wholesale electric power prices this summer will likely increase. The increase in natural gas prices has seen some utilities switching to coal, but this is not expected to reverse the decline in coal use over the longer term. The war in Ukraine is also impacting electric customers, as some analysts reportedly expect the price of natural gas to remain elevated for a longer period because of the conflict, and interest in exporting U.S. liquefied natural gas.

As wholesale electricity prices increase, retail rates generally follow. Increased electricity rates are likely to have a greater effect on lower-income customers who live in older, less energy efficient buildings, and who spend a higher percentage of their income on cooling. In particular, older lower-income customers are at increased risk of potential health impacts if they reduce their use of air conditioning to save money.

Potential Climate Change Risks to Power Generation

The U.S. electric power system exists largely in an exposed environment, and is subject to the physical extremes of climate and weather. The last seven years have been the hottest in recorded history (1880-2021). Adaptation to historical extremes of weather and climate have been considered in system hardening and other measures to increase electric system resilience. Some in the electric utility industry are beginning to realize that a proactive approach is needed to prepare for changing climate conditions.

Going forward, an increasing amount of electric capacity is expected to come from variable renewable sources that depend on wind and sun. Generation of electric power from these resources largely rely on weather and the time of day. Variable renewable energy sources now represent much of the uncertainty regarding power supply planning. A changing climate likely means that the past is not necessarily a predictor of potential future impacts of weather events on power systems, and electric power system planners should consider the changing risks as power generation changes from base load to more variable resources.

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