BUILDING A RELIABLE AND RESILIENT 21ST CENTURY ELECTRIC GRID

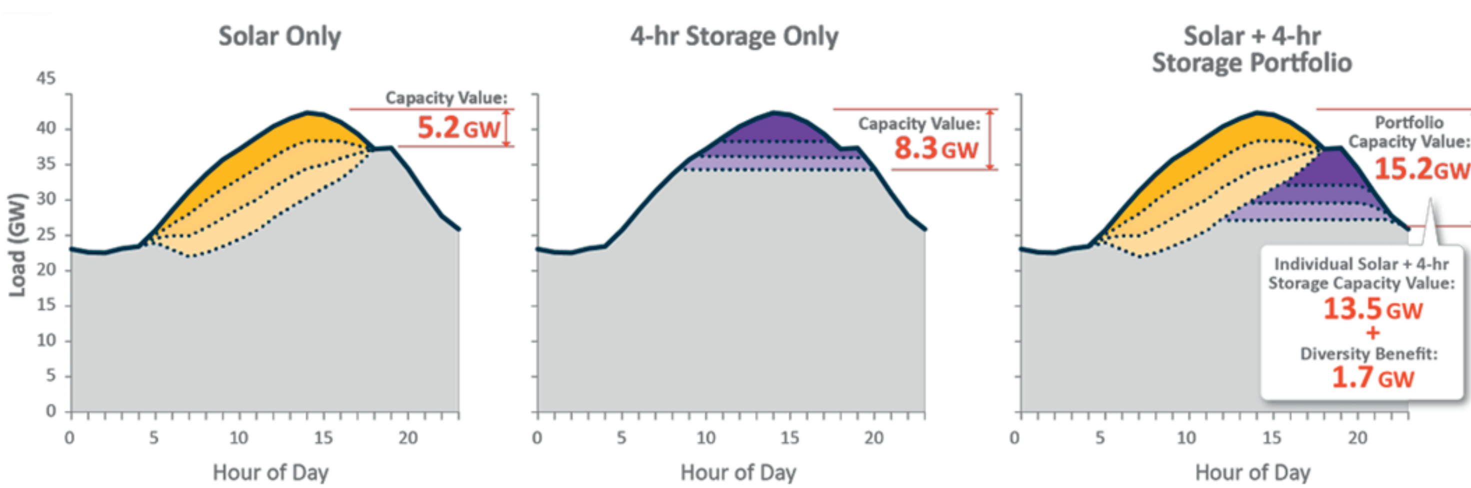
Iowa has long been a national clean energy leader, which has served as an economic development engine for our state, attracting businesses and growing local jobs. While Iowa has historically invested in wind energy, the state also has strong solar resources, capable of being supported with battery storage technologies. With the passage of the Inflation Reduction Act and continued technology advances, wind, solar and storage are increasingly the lowest cost sources of electricity.

Many wonder how we can build a reliable and resilient power system using those resources to fully decarbonize the electric sector. Grid operators across the U.S. and world have already shown that utilities can maintain or even improve electricity reliability by responsibly building out a mix of renewable and battery resources, and their studies show that reliability can further improve with much larger additions [1].

RENEWABLES & STORAGE WORK TOGETHER TO KEEP THE LIGHTS ON

The key to grid reliability is tapping into the synergies among wind, solar, and battery resources:

- Wind and solar tend to produce the most energy at opposite times of the day and year, with wind producing more at night and during the winter.
- It's always windy or not cloudy somewhere, so a strong transmission system provides access to diverse wind and solar resources with more constant aggregate output.
- With solar meeting summer afternoon air conditioning demand, batteries are better able to meet the shorter period of need in the evening after the sun goes down, as shown below. [2]



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DIVISION OF LABOR ON THE POWER SYSTEM

	Energy	Capacity	Flexibility
Wind	X+	X-	Costly
Solar	X+	X	Costly
Storage	None	X+	X+
Nuclear	X+	X	None
Coal	X	X	X-
Gas CT	X-	X+	X+
Gas combined cycle	X	X	X-
Hydroelectric	X	X	X

Some media sources and stakeholders suggest that the grid needs coal generators to support a reliable grid, mistakenly believing that coal generation provides every reliability service needed to support the grid. The power grid has always depended on a "division of labor" among diverse generation resources to cost-effectively meet reliability and resiliency needs, because no single energy source is perfectly reliable. Until recently, coal and nuclear were the lowest cost sources of energy, but those types of power plants are not flexible enough to accommodate the large fluctuations in electricity demand over the course of the day and year.

As a result, grid operators used more flexible power plants like hydroelectric dams, pumped storage power plants, and oil- and gas-fired power plants to follow changes in electricity demand. The 21st Century grid is similar, with wind and solar providing even lower cost energy, and batteries and existing flexible resources complementing them with the additional capacity and flexibility to meet demand, as shown below.

EXTREME WEATHER AFFECTS ALL ENERGY SOURCES

Another common misconception is that coal and other fossil generators are impervious to disruption, and are therefore needed to keep the lights and heat on during severe weather. All power plants are affected by the weather, so moving to renewable and storage resources and building a stronger grid increases resilience to disruptions due to severe weather. For example:

- During extreme cold, gas-fired power plants have lost their fuel supply. [3]
- Fossil and nuclear plants require large amounts of cooling water, so heat or drought can force them offline. [4]
- Coal deliveries via rail and barge have been disrupted, and coal piles at the plant can be unusable if they freeze during winter weather. [5]
- All power plants experience higher rates of equipment failure in extreme cold or heat.

This is not hypothetical. Fossil and nuclear accounted for 75% of the power plant capacity that failed during Winter Storm Uri in February 2021, [6] causing extended power outages in Texas and other states, with gas accounting for the majority of total generator outages.

Because extreme weather events that take both conventional and renewable resources offline and cause electricity demand to spike tend to only affect limited geographic areas, transmission ties are a key resilience tool. [7]

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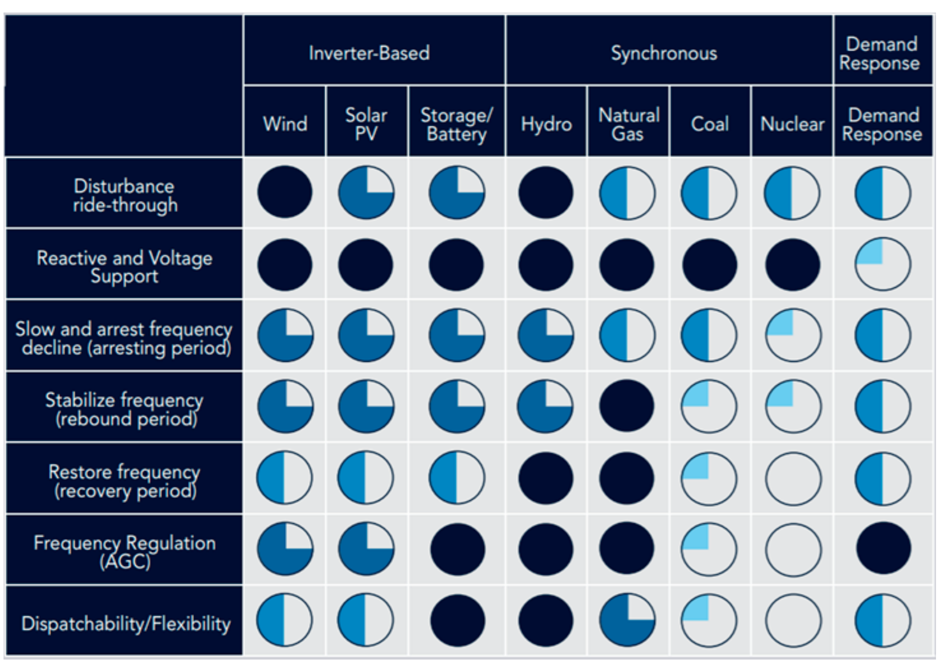
Savings per additional GW of transmission, February 12-20, 2021

Receiving region – delivering region	Savings per GW of additional transmission capacity (millions of $)
ERCOT – TVA	$993
SPP South – PJM	$129
SPP South – MISO IL	$122
SPP South – TVA	$120
SPP S – MISO S (Entergy Texas)	$110
MISO S-N (Entergy Texas - IL)	$85
MISO S (Entergy Texas) – TVA	$82

During Winter Storm Uri, the regional grid operators for Iowa (the "Midcontinent Independent System Operator" or MISO and the Southwest Power Pool or "SPP") were generally able to keep the lights on because they could import 15 times as much power as Texas. However, improving our transmission system would have allowed even more imports of low-cost power to SPP and MISO from regions to the east that were not experiencing extreme cold, saving consumers hundreds of millions of dollars, as shown in the graph. [7]

IT'S NOT JUST ABOUT ENERGY - RENEWABLES AND STORAGE PROVIDE OTHER RELIABILITY SERVICES

The power grid requires other reliability services to stably and efficiently deliver power. The digital power electronics included in all wind, solar, and battery resources allow them to respond more quickly and accurately to changes in voltage or frequency than conventional generators, as shown below. [8] As wind and solar reach higher penetrations, many grid operators are using their fast response to follow fluctuations in demand.



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CITATIONS

[1]https://www.nrel.gov/docs/fy15osti/63979.pdf, https://www.nrel.gov/docs/fy22osti/81644.pdf

[2] https://www.ethree.com/wp-content/uploads/2021/05/E3-Scalable-Clean-Energy-Market-Design-2021.05.25.pdf, at 69

[3]https://www.nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final.pdf

[4]https://www.climatecentral.org/blogs/heat-and-drought-pose-risks-for-nuclear-power-plants

[5] https://www.powermag.com/blog/ferc-to-look-at-winter-coal-deliveries-to-power-plants/

[6]https://www.ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and, at 16

[7]https://acore.org/wp-content/uploads/2021/07/GS_Resilient-Transmission_proof.pdf

[8]https://www.sciencedirect.com/science/article/pii/S104061901830215X

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