ALWAYSON ENERGY RESEARCH

Energy Source by Cost, Reliability

Electricity is an indispensable part of our lives. Our homes and businesses require “on-demand” power every second of every day. However, many people don't realize that electricity is consumed at the exact moment it is generated.

Consider what happens when you unplug a lamp; the light goes out instantly. The challenge of keeping the lights on is made more complex by the fact that the grid is not a storage device, like a bathtub filling with water, that can store power for later use. The poles and wires that connect to our homes act more like a highway rather than a parking lot.

This means that the cost of your electric bill is dictated by the expenses incurred to reliably generate enough electricity to meet demand on a second-by-second basis. Power plants that can be turned on or off to meet demand, known as “dispatchable” power plants, help keep system costs low. In contrast, non-dispatchable power plants like wind and solar require more infrastructure and batteries to meet demand, which increases prices and decreases reliability.

Our analysis of each energy source is below, based on their cost, and reliability on the grid.

COAL

- Cost: The existing coal fleet provides some of the lowest-cost electricity in the country. Federal data shows that, on average, American coal plants produced electricity for **$34.10 per megawatt-hour (MWh) in 2020** due to a large domestic supply of low-cost coal resources.

- Reliability: Coal plants **can reliably meet electricity demand** and increase or decrease their output by using more fuel. Because they generally have a large supply of fuel stored on site, **they can provide reliable electricity** even during extreme weather events.

NATURAL GAS

- Cost: Federal data show the existing natural gas fleet produced electricity for **$33.07 per MWh in 2020.** Costs were low because **the United States is, by far, the largest natural gas producer in the world**. New natural gas plants present an opportunity to provide low-cost electricity to meet the growing demand for electricity from data centers and reshoring manufacturing plants.

- Reliability: Natural gas plants are **dispatchable** and able to quickly ramp up and down their electricity generation to **reliably match fluctuations in electricity demand.** However, unlike coal or nuclear plants that store large amounts of fuel on site, natural gas is delivered to power plants via pipelines at the same time the fuel is consumed to produce electricity. This leaves the natural gas plants more vulnerable to supply disruptions if there are problems with the pipeline networks that transport the natural gas to the power plants.

NUCLEAR

- Cost: Existing nuclear power plants provide low-cost electricity, with federal data showing the average American nuclear plant generated electricity for **$32.54 per MWh in 2020.** These power plants provide low-cost power because the mortgages on them have been largely paid off. New nuclear power plants come with high upfront costs, and as a result, the power generated from them is more expensive than that generated by natural gas plants. However, nuclear power plants are **incredibly efficient and last for up to 80 years (and potentially longer)**, making them shrewd long-term investments.

- Reliability: Nuclear power plants are **the most reliable** on the American electric grid, producing more than 90 percent of their full potential electricity output. They are also **capable of producing power on demand**, making them valuable assets to the grid.

WIND

- Cost: Wind is not dispatchable and cannot be turned up or down to meet electricity demand. It requires additional expenditures like multi-billion dollar transmission lines and battery storage to provide the same reliability value to the grid as coal, natural gas, and nuclear plants. In areas that have 100 percent renewable energy mandates like Minnesota, team members at Always On Energy Research found the additional costs in the fine print cause the cost of serving demand with wind to reach **$272 per MWh**, which is much larger than the $50/MWh mid-point costs advertised by Lazard, which is slightly below the $51.52 per MWh cost of existing wind.

- Reliability: Wind resources are **not dispatchable**, which means grid operators need to plan on other resources like natural gas or battery storage to keep the lights on if the wind dies down. Unfortunately, **wind power is subject to "wind droughts,"** where the wind can operate below 10 percent of its potential output for multiple days at a time.

SOLAR

- Cost: Solar is also frequently touted as being some of the most affordable electricity available, but because it is also **non-dispatchable**, it also requires the fine print costs associated with wind power. Researchers from Always On Energy Research found that meeting electricity demand in a 100 percent carbon-free Minnesota would cost **$472 per MWh**, which is substantially higher than the mid-point cost estimates of $61 per MWh from Lazard and higher than the cost of existing U.S. solar facilities, which cost $72.50 per MWh.

- Reliability: While solar generation is **more predictable than wind** output because the sun shines every day, it is still non-dispatchable, which means it requires battery storage or natural gas plants on the grid to provide power when the sun isn't shining. Solar helps meet electricity demand on hot days, but as more people switch from heating their homes with natural gas to electricity, the times of **greatest electricity demand will occur during dark winter evenings, when solar will not be able to help** meet our electricity needs.