Invesco

Thinking Thematically

Virtual power plants and the grid of the future

Rene Reyna, CFP®
Head of Thematic & Specialty Product Strategy,
ETF & Indexed Strategies

Brett Boor, CFA
Director, Thematic Research
ETF & Indexed Strategies

Overview

- The global energy grid is rapidly aging just when we need to expand energy rapidly for new technologies
- However, by combining the technology we already have, we could potentially solve our energy needs without relying on simply building new powerplants
- Through the use of virtual powerplants, new transmission lines, and better customer involvement, we may just see the grid of tomorrow sooner than we think

Let's face it, unless you're an electrical engineer, electricity is a bit magical. You flip a switch and *boom*, there it is. Even trying to quantify this ability is no less astounding. Electricity moves at a speed of 300,000 kilometers per second (671 *million* miles per hour), and it has a wavelength of 5,000 kilometers (3,100 miles), which is a large part of what allows so much of our modern world to be nearly instantaneous.

Unfortunately, just when we need to begin electrifying our world en masse to respond to climate change, the infrastructure surrounding this technology is groaning from old age. In Europe, the average age of the power grid is 45-50 years old, while in North America, it averages around 35-40.[1] Meanwhile, new technologies like artificial intelligence (AI) are set to expand electricity demand even more than previously expected, reversing recent declines in projected demand. According to experts, AI could represent 8% of total US power demand by 2030, representing 323 terawatt hours of new demand.[2]

So, what's a grid to do? Some in the industry want to simply build more natural gas power plants, responding to current incentives that only reward utilities for building new capacity – even if it's only necessary for a few dozen hours of peak demand each year.[3] However, that is clearly out of step with our current climate goals – and a grid that's currently only approving 13% of new connection requests for distributed renewables.[4] Thankfully, that's not the only way. Today, we'll be looking at new ways of thinking about – and incentivizing – the grid and how we can chart a path forward that hopefully meets all our goals.

How the many replace the one

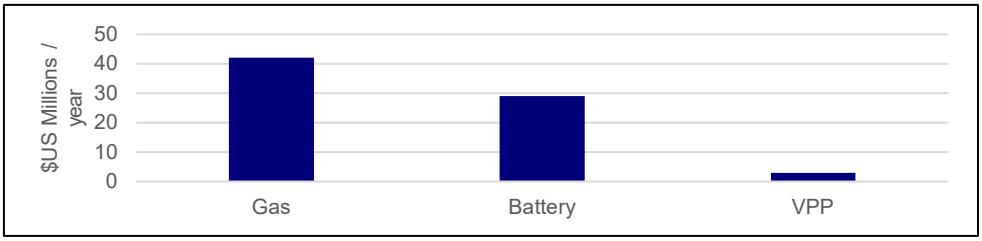
The beauty – and complexity – of a better grid means there isn't a single solution. In a recent report from the US Department of Energy, they named this multi-faceted path "Innovative Grid Deployment." And in many ways, it's just that: deploying the grid we have in new ways. From virtual powerplants to bi-directional distribution and more active customer involvement, the grid of the future is often about working smarter not harder. Let's start with what a virtual powerplant even is.

Virtual powerplants (VPPs) are aggregations of distributed demand and supply that can offer the same services as a traditional powerplant: namely, ensuring electric capacity for all the grid's users. It involves using the power of the internet of things to connect all our energy producing and consuming devices: electric vehicles (EVs), solar panels, thermostats, batteries, and more. Most importantly, it involves – and rewards – consumers at factories, homes, and businesses by paying them for using energy at the right time to keep the grid working at its current capacity.

The best part? They're incredibly cheap compared to new physical powerplants, combining the baseload power we already have with the data we're currently wasting. According to one analysis, implementing VPPs could lower utility costs by up to $35B over the next decade, and can be built at only 40%-60% of the cost of an alternative option – with cheaper operation after.[5] In fact, over the last decade, we've added 110 gigawatts to the grid primarily for resource adequacy – simply to ensure there's enough peak power – at a cost of $120B. VPPs could help avoid some of those costs – and with fewer emissions.[5]

1. Climateweek, September 2022. Most Recent Data
2. CNN, May 2024
3. New York Times, May 2024
4. Bloomberg New Energy Finance, May 2024
5. Brattle, May 2023

Estimated net operating cost of providing 400 megawatts of resource capacity[5]



Keeping the lights on – and solving the traffic jam

Another problem our grid has, of course, is how hard it is to build new things. Permitting is complicated and in desperate need of reform, and getting land rights for new transmission lines can be a challenge. We also have the potential to build more than ample clean energy, but – as noted earlier – it's currently very hard to get those renewables on the grid given limitations of our current transmission infrastructure.

However, we don't have to be stuck with our current transmission reality. In many places, we're using old technology in our wires: steel wrapped in aluminum, a 100-year-old design basically unchanged from the early days of the grid. One solution is "reconductoring," which essentially involves hanging new wires from your existing poles. New designs frequently feature a carbon fiber center and increased aluminum, which can increase grid capacity by as much as 50%. More importantly, reconductoring could – if implemented more fully – improve our planned grid expansions by 4x through 2035.[6] In Europe, this is already in flight, with Belgium and the Netherlands reconductoring nearly their entire high voltage transmission network.[7]

Transmission also clearly needs new incentives. Currently, most transmission networks are run by a hodge podge of utility providers, and there is often little desire to expand the network beyond preventing outages on the fly. However, in May, FERC (the US Federal Energy Regulatory Commission, which oversees the grid) passed new rules requiring grid operators to take a 20-year planning horizon into consideration when managing their networks. This would mean doing the work now to start the long process of building new high voltage transmission lines that we'll clearly desperately need as we add powerful new capacity from renewables.[8]

To that end, regardless of which route we take, more grid investment is needed. Globally, $3.1T of investment is needed by 2030 to get the grid ready for the energy transition – before considering AI energy needs.[9] Meanwhile, we're likely to see more renewables "behind the gate," providing on-site electricity for data centers – and hopefully shoring up the grid before they even draw power from it. Technologies like hydrogen, which are still in their infancy, could be in a unique position to provide carbon-free back-up energy.[10] Industry experts are also seeing interest in nuclear. Even in Chicago, where we're writing from, data center energy use is expected to rise 9x as providers chase the high proportion of nuclear energy in Illinois.[11]

Where do we go from here?

The grid is a technological wonder. It's also getting a little long in the tooth. Just as we're starting to learn about the limitations our current grid setup is placing on the energy revolution, we're also realizing just how much capacity we need for new technologies like AI. However, as we've shown today, innovation isn't only happening in the realm of robots. With a mix of data, updated transmission, and good policy, we can realize the grid we need. It's simply time to start.

6. Berkely GridLab, April 2024
7. Volts, January 2024
8. FERC, May 2024
9. Rystad, February 2024
10. Reuters, March 2024
11. Bloomberg, April 2024

Investment Risks

The value of investments and any income will fluctuate (this may partly be the result of exchange rate fluctuations) and investors may not get back the full amount invested.

Investments focused in a particular industry or sector are subject to greater risk, and are more greatly impacted by market volatility, than more diversified investments.

Important information

This document is intended only for professional investors in Hong Kong, for Institutional Investors and/or Accredited Investors in Singapore, for certain specific sovereign wealth funds and/or Qualified Domestic Institutional Investors approved by local regulators only in the People's Republic of China, for certain specific Qualified Institutions and/or Sophisticated Investors only in Taiwan, for Qualified Professional Investors in Korea, for certain specific institutional investors in Brunei, for Qualified Institutional Investors and/or certain specific institutional investors in Thailand, for certain specific institutional investors in Malaysia upon request, for certain specific institutional investors in Indonesia and for qualified buyers in Philippines for informational purposes only. This document is not an offering of a financial product and should not be distributed to retail clients who are resident in jurisdiction where its distribution is not authorized or is unlawful. Circulation, disclosure, or dissemination of all or any part of this document to any unauthorized person is prohibited.

This document may contain statements that are not purely historical in nature but are "forwardlooking statements," which are based on certain assumptions of future events. Forward· looking statements are based on information available on the date hereof, and Invesco does not assume any duty to update any forward-looking statement. Actual events may differ from those assumed. There can be no assurance that forward-looking statements, including any projected returns, will materialize or that actual market conditions and/or performance results will not be materially different or worse than those presented.

All material presented is compiled from sources believed to be reliable and current, but accuracy cannot be guaranteed. Investment involves risk. Please review all financial material carefully before investing. The opinions expressed are based on current market conditions and are subject to change without notice. These opinions may differ from those of other Invesco investment professionals.

The distribution and offering of this document in certain jurisdictions may be restricted by law. Persons into whose possession this marketing material may come are required to inform themselves about and to comply with any relevant restrictions. This does not constitute an offer or solicitation by anyone in any jurisdiction in which such an offer is not authorised or to any person to whom it is unlawful to make such an offer or solicitation.

This document is issued in the following countries:

- in Hong Kong by Invesco Hong Kong Limited景順投資管理有限公司, 45/F, Jardine House, 1 Connaught Place, Central, Hong Kong.
- in Singapore by Invesco Asset Management Singapore Ltd, 9 Raffles Place, #18-01 Republic Plaza, Singapore 048619.
- in Taiwan by Invesco Taiwan Limited, 22F, No.1, Songzhi Road, Taipei 11047, Taiwan (0800-045-066). **Invesco Taiwan Limited is operated and managed independently.**