

DAY ONE PROJECT

Building Back with a Cleaner Power Grid for America

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Summary

Achieving energy decarbonization in America will require a power grid supplied by renewable energy and backed by ample energy storage. The challenge is that many types of renewable energy provide power intermittently depending on factors such as the time of day or weather conditions. To maintain grid reliability while working towards a nation powered by 100% renewable energy, the Biden-Harris Administration should accelerate adoption of distributed energy resources and expand transmission capacity to create a more unified national power grid. These efforts will increase equitable access to clean energy, accelerate investment in renewables, and create thousands of long-term, high-skilled jobs in a robust American energy sector.

Challenge and Opportunity

The U.S. power grid was built in—and designed for—a previous energy era: one in which on-demand, regionally located energy supplies (such as coal-fired power plants) are delivered to thousands of customers along one-direction transmission lines and managed by public utilities that operate as local monopolies.

But as our nation pushes to replace fossil fuels with cleaner sources of power, the energy landscape will look quite different. Many types of renewable energy provide power intermittently depending on factors such as the time of day or weather conditions. Supplies of such energy sources cannot be ramped up easily (or at all) during periods of peak demand. Meanwhile, smart- and distributed-energy technologies—such as smart thermostats, rooftop solar, and electric vehicles¹—have led to an increasingly dynamic and complex power grid.

The policy response to these rapid changes in the way we generate power has mostly constituted a patchwork of efforts at the state and regional level. Federal attention to renewables has focused largely on tax incentives and on regulation via orders from the Federal Energy Regulatory Commission (FERC)². For instance, FERC's recent order³ opening wholesale energy markets to distributed energy resources is an important step towards increasing the share of renewables in the U.S. energy sector. Incentives to increase adoption of renewables and investment in research and development (R&D) to improve performance and utility of renewables are essential as well. But to realize a quick and smooth transition to a clean-energy future, concerted action is needed to tackle the intermittency challenge that renewables pose.

¹ See the Frequently Asked Questions section FAQ #1 for more on the role that electric vehicles can play in balancing a power grid.

² Jetta L. Wong and David M. Hart, "Mind the Gap: A Design for a New Energy Technology Commercialization Foundation," *Information Technology and Innovation Foundation* (May 2020), <https://itif.org/sites/default/files/2020-mind-gap-energy-technology.pdf>.

³ Department of Energy Federal Energy Regulatory Commission, *Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 18 CFR Part 35, Docket No. RM18-9-000, Order No. 2222, September 17 2020, https://www.ferc.gov/sites/default/files/2020-09/E-1_0.pdf.

Such action can proceed via two complementary pathways simultaneously. The first pathway is using technology advances like vehicle-to-grid (V2G) integration, demand response, smart thermostats, and energy storage to flexibly shift load demand. These technologies help guide certain discretionary types of energy consumption (e.g., running a load of laundry) to occur during times when renewable-energy supply is high but demand is low, and can even enable consumers to return energy to the grid (e.g., by plugging in a parked electric vehicle so that the vehicle's battery can be used as a power source) to during periods of peak demand.

Unfortunately, innovative energy-management technologies are markedly underutilized in the U.S. power sector. Distorted market-incentive structures, inadequate control protocols governing relationships between operators and consumers, and reliability concerns have all made utilities reluctant to embrace a more dynamic grid. Moreover, grid users (i.e., residential and commercial customers) cannot currently participate in an open energy market on an equal footing with utilities. This means that our nation is not realizing the full value of services that customers can provide to a power grid.

A smarter grid-operating system would (1) make it easier for operators to integrate distributed energy resources (DER) with more conventional types of power supplies, (2) economically incentivize changes in user behavior to smooth out energy-demand curves, and (3) enable everyday Americans to invest in distributed clean-energy technologies and earn returns for providing various services to the power grid. These steps in turn would greatly facilitate large-scale integration of renewables into the U.S. power mix.

The second pathway for addressing the intermittency problem is to finally create a connected and integrated American power grid. This would enable areas with steady supplies of renewable energy—such as solar in the Southwest, wind in Texas and the Midwest, and off-shore wind in New England—to deliver power to different parts of the country as needed. Preliminary studies done by the National Renewable Energy Laboratory (NREL) have demonstrated the economic and environmental benefits of unifying currently disconnected sections of the American power grid.⁴ Examples from California and Texas illustrate the need to and benefits of expanding national transmission capacity.

California's power grid highlights the problems of building aggressive renewable energy portfolios without sufficient transmission. As renewable-energy capacity in California has increased, so too has curtailment—i.e., deliberate reduction in output—of that capacity (Figure 1). Roughly half of this curtailment has been due to transmission constraints.⁵ Transmission

⁴ National Renewable Energy Laboratory, "Interconnections Seam Study," 2020, <https://www.nrel.gov/analysis/seams.html>

⁵ Mark Specht, "Renewable Energy Curtailment 101: The Problem That's Actually Not a Problem At All," Union of Concerned Scientists, June 24, 2020, <https://blog.ucsusa.org/mark-specht/renewable-energy-curtailment-101>.

constraints have also prevented creation of approximately 72,000 potential American jobs from renewable-energy projects in the Midwest.⁶

Wind and solar curtailment totals by month

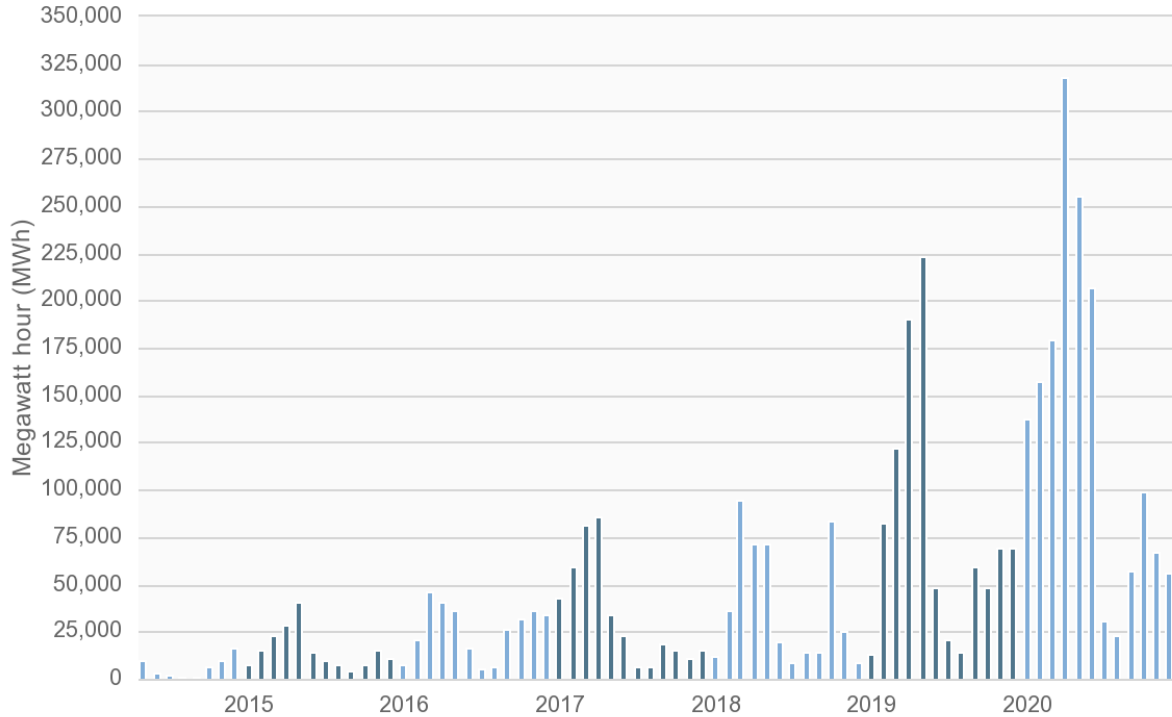


Figure 1. Insufficient transmission capacity coupled with increasing renewable-energy production in California is resulting in significant curtailment, or waste, of renewable energy in the state. (Source: California ISO. (2021).

In **Texas**, the 2021 winter storm Uri recently demonstrated an even more dire consequence of limited interconnection across our nation’s power infrastructure: the disastrous failure modes that can manifest in isolated power grids. When Uri hit, grid operators simultaneously encountered high load demand as residents turned up their heaters and inadequate energy supply as natural-gas power plants began failing in the cold weather. The rolling power failures experienced in Texas during the storm could have been mitigated if Texas had been able to import energy from other grids. Connecting the regional power grids that exist in the United States will improve grid resiliency across the nation by allowing regions to draw from each other as circumstances and local conditions demand.

Strengthening the U.S. power grid through improved use of energy-management technologies and better regional interconnections will have benefits that extend beyond grid flexibility and resilience. Grid modernization will create jobs across America in the construction, manufacturing,

⁶ John Moore, “New Analysis: Midwest and Southern Leaders Are Letting Crucial Clean Energy Projects Slip Away,” Sustainable FERC Project, November 23, 2020, <https://sustainableferc.org/new-analysis-midwest-and-southern-leaders-are-letting-crucial-clean-energy-projects-slip-away/>.

DAY ONE PROJECT

and energy sectors. By empowering rate-payers to produce their own energy, sell back surplus energy to the grid, and be rewarded for shifting energy-consumption patterns in response to grid conditions, grid modernization will generate economic value for consumers. By encouraging development of distributed energy resources, grid modernization will allow rural communities to replace expensive and burdensome propane shipments with continuously flowing electricity from local solar and storage installations. By transforming the U.S. power grid from a collection of regional entities into an interconnected, national resource, grid modernization will allow energy developers to tap into a national energy market instead of being limited by regional boundaries. And by creating a more unified energy sector, one in which states and communities rely on each other for power, grid modernization might even result in a more united country.

Plan of Action

The federal government plays a critical role in regulating and maintaining the nation's grid infrastructure. As such, there is much that the Biden-Harris Administration can do—by using existing executive authority and by working with Congress on legislative actions—to strengthen the resilience of the U.S. power grid and foster integration of distributed energy resources and renewables into the U.S. power sector. Progress on these fronts will help transition the United States towards a 100% clean-energy future while creating industries and jobs centered around clean-energy resources, building up America's advanced manufacturing base, and generating new economic opportunities for all Americans.

Actions using existing executive authority

- (1) **Improve coordination between federal and state entities to reduce regulatory barriers to energy development.** The federal government can support interstate grid projects (such as regional interconnections) by helping coordinate state legislatures and by reducing regulatory burdens related to such projects. In particular, FERC plays an important role in coordinating regional grid investments and planning across states (such as the Eastern seaboard's off-shore wind grid). The Biden-Harris Administration should prioritize this function of FERC in order to reduce the bureaucratic hurdles faced by energy developers. The new White House Office of Domestic Climate Policy (Climate Policy Office) can play an additional coordinating role, helping to align technical research conducted at the Department of Energy (DOE)'s national labs with policy and regulatory work conducted through the White House Office of Science and Technology Policy (OSTP), the Department of Interior, the Department of Defense, and other relevant federal entities. Finally, the Climate Policy Office can work with state legislatures to provide state-specific recommendations (i.e., recommendations tailored to the unique natural resources and electricity market structures of each state) on how to best incentivize investment and job growth in the energy industry.

Actions involving collaboration with Congress

(1) Scale R&D innovations in clean-energy technologies by increasing relevant DOE funding.

The federal government can use its federal budget to help scale R&D innovations in clean energy and help advance those innovations towards manufacturing and production. By accelerating commercialization and mass production of clean-energy innovations, federal investment will help make clean energy more affordable for American consumers, while simultaneously fostering job growth in the American energy sector. To that end, the next White House budget proposal should include significant funding increases for DOE, in particular for DOE's Office of Energy Efficiency & Renewable Energy (EERE),⁷ Loan Program Office (LPO), and Advanced Research Project Agency for Energy (ARPA-E). Increasing funding for these offices, which use different financing schemes to invest in technologies at different stages of commercialization, is a direct way for the federal government to scale up American-made energy technologies. These three offices have a proven ability to identify promising candidates for energy innovation.⁸ Increasing appropriations for these high-impact offices by \$500M will represent a more than 10% increase in each offices' budget: enough to make a difference, but not a dramatic departure from the budget increases already appropriated by Congress from FY 2019–FY 2020.

(2) Broaden the definition of “qualifying facilities” to allow everyday Americans to participate in energy markets. Broadening the definition of “qualifying facility (QF)” in the Power Utility Regulatory Policy Act (PURPA) of 1978 to include energy storage, power quality factors, and demand response would require utilities to compensate energy providers for a wider range of services: i.e., services that go beyond simple energy production. The power grids of today and of the future are more than a collection of relatively fixed energy demands and supplies. Broadening the definition of QF would acknowledge the increasingly dynamic nature of the power grid, where excess supply often needs to be stored for later and where some portion of demand load can be shifted to different times of day. In particular, broadening the definition of QF would require utilities to (1) treat their own customers as first-class suppliers for a diverse set of potential use-cases in the energy marketplace and (2) properly compensate rate-payers for any services they provide to the power grid. Ensuring the market properly rewards customers for adopting novel clean-energy technologies will spur clean-energy market growth, drive

⁷ In particular, the State Energy Program within the EERE Office is one program that allows the federal government to partner with and channel funds to state offices for energy efficiency. increasing funding for this office is one way that the Biden Administration can build capacity for energy-efficiency policies at the state level, foster cooperation between local entities, and direct federal funding to support construction of local energy-efficiency pilot projects.

⁸ Tesla is one of the more well-known companies to receive early support from the DOE Loan Program Office, see “Tesla,” Loans Program Office, last updated June 2017, <https://www.energy.gov/lpo/tesla>.



innovation, and generate economic value for individual Americans newly able to participate in electricity markets.⁹

- (3) **Encourage construction of additional transmission capacity via tax incentives and loan programs.** Tax credits have historically been a popular way for Congress to incentivize development of renewable energy such as wind and solar¹⁰. By making the construction of additional transmission capacity similarly eligible for tax credits, Congress can support a critical piece of our nation’s grid infrastructure while creating construction jobs across the country.¹¹

⁹ See FAQ#4 for more details on how amending PURPA can improve access to the electricity market

¹⁰ For instance, the recent American Energy Innovation Act passed in late 2020 by Congress includes extensions to pre-existing tax credits for solar and wind developers, see Catherine Morehouse, “Federal stimulus includes wind, solar, tax credit extensions, adds first US offshore wind tax credit,” *Utility Dive*, December 22, 2020, <https://www.utilitydive.com/news/federal-stimulus-includes-wind-solar-tax-credit-extensions-adds-first-us/592572/>.

¹¹ Indeed, a bill providing tax credits for transmission line construction has already been introduced in Congress (see U.S. Congress, Senate, *Electric Power Infrastructure Improvement Act*, S.3107, 116th Congress, introduced in Senate December 29, 2019, <https://www.congress.gov/bill/116th-congress/senate-bill/3107>). Strong executive support for such programs can help raise visibility for promoting this important piece of the power grid decarbonization puzzle.

Frequently Asked Questions

What role can electric vehicles play in a smarter grid?

From the standpoint of the power grid, electric vehicles (EV) are essentially mobile batteries. EVs plugged in and their batteries used to store surplus renewable energy when production is high or return energy to the grid when renewable-energy production drops.¹² However, this vehicle-to-grid exchange requires careful coordination between EV owners and utility operators. The current power grid is not designed to handle individual consumers returning power to the grid, and there is no way for utilities to compensate EV owners for the value they provide to utilities by doing so. A “smart grid” would create an electricity marketplace that EV owners could participate in. Such a marketplace would significantly improve the value proposition of EVs, encouraging EV uptake as well as domestic investment in advanced automobile manufacturing. Given that Tesla became America’s most valuable automobile company in 2020,¹³ the market has already seen the value that EVs have to offer. A smarter power grid will allow full capitalization of that value by consumers, industry, and our power grid.

In an increasingly divisive political environment, how can bipartisan support be generated for investment in energy infrastructure?

Investing in the U.S. power grid will benefit many constituent groups, allowing for a multifaceted approach to messaging. For instance:

- Solar energy coupled with storage can lower electricity costs and reduce reliance on imported natural gas or propane for rural and isolated communities.
- Certain U.S. geographic regions, such as the Southwest, contain some of the greatest natural renewable energy sources in the world. Directing federal incentives towards such areas will create jobs at the state and local level while reducing foreign energy dependence.
- President Eisenhower passed the Interstate Highway Act by appealing to bipartisan support in a Cold War environment and helped create our modern road infrastructure. The transmission power grid, as the “interstate highway” for the electricity that powers America, is a similarly important piece of infrastructure that will help America maintain its national security and international competitiveness.

¹² Jonathan Donadee, Robbie Shaw, Oliver Garnett, Eric Cutter, Liang Min, “Potential Benefits of Vehicle-to-Grid Technology in California: High Value for Capabilities Beyond One-Way Managed Charging,” *IEEE Electrification Magazine* 7, no. 2 (June 2019): 40–45, <https://doi.org/10.1109/MELE.2019.2908793>.

¹³ Karen Langley, “Tesla Is Now the Most Valuable U.S. Car Maker of All Time,” *The Wall Street Journal*, January 7, 2020, <https://www.wsj.com/articles/tesla-is-now-the-most-valuable-u-s-car-maker-of-all-time-11578427858>.



How do established or maturing clean-energy technologies relate to America's economic and strategic interests?

Distributed clean-energy technologies, like energy storage, residential solar, on-shore and off-shore wind, and electric vehicles are quickly reaching economies of scale. Artificial intelligence is increasingly being used to ensure grid stability, optimize grid operations, and inform resource planning. High-voltage transmission lines and power inverters are critical parts of the infrastructure that makes up the backbone of the power grid. Each of these technologies presents an economic opportunity for the federal government to invest in building new infrastructure and spur private development, creating new jobs and industries in the process. In addition, many of these technologies are currently manufactured abroad or rely on minerals imported from foreign countries. The federal government should direct research funding towards technologies that do not rely on foreign imports and that leverage America's existing manufacturing infrastructure and natural resources. Finally, maintaining a robust workforce of professionals who know how to manage and debug production processes will be important for ensuring that our nation is capable of translating American R&D into products that can be manufactured domestically. Following through on the Plan of Action outlined in this proposal will help open the power grid to broader participation and ensure cleaner, more equitable power distribution while simultaneously advancing American technical competitiveness and manufacturing capabilities.

Why is changing the definition of qualifying facilities under PURPA important to helping Americans achieve access to the power grid market?

The federal government's recent involvement in the power market has focused on tax credits and R&D funding. Indeed, the Energy Act of 2020 injects significant federal funding to R&D funding programs and extends certain tax credits. While continued support for R&D funding is important and tax credits are an important market mechanism, amending PURPA is a different type of action altogether. By changing the definition of qualifying facilities, the federal government categorically changes the basis by which utilities buy power. Firmly establishing an expanded definition of QF via legislation will prevent non-elected bodies from arbitrating the definition of QFs either now or in the future. FERC performed such arbitration in 2020,¹⁴ to the detriment of energy storage projects and the chagrin of clean-energy trade associations.¹⁵

Amending the definition will force the market to properly compensate consumer-provided services that provide value to the grid. For instance, smart thermostats can reduce electricity used for heating and cooling when energy supply drops or electric vehicles can be optimized to only charge when supply is ample. Incentivizing behavioral changes like these is critical for

¹⁴ Federal Energy Regulatory Commission, *Final Rule: Qualifying Facility Rates and Requirements. FERC Actions Regarding RM19-15-000, AD16-16-000*, July 16, 2020, <https://www.ferc.gov/sites/default/files/2020-07/07-2020-E-1-PURPA-fact-sheet.pdf>.

¹⁵ J. Haggerty, J., "FERC adopts big utilities' narrative in PURPA ruling," *PV Magazine*, September 17, 2020, <https://energystorage.org/ferc-adopts-big-utilities-narrative-in-purpa-ruling/>.

DAY ONE PROJECT

achieving a 100% clean power grid.¹⁶ Amending PURPA to allow Americans to invest in and earn returns on a broad range of energy technologies today will prepare the United States for the power grid of tomorrow.

¹⁶ The economics of renewable energy will require demand response and changing loads. Amending PURPA is one way to begin requiring utilities to begin incentivizing the development of the necessary infrastructure now, rather than later, to avoid so-called “cannibalization effects. For more, see: Javier López Prol, Karl W. Steininger, David Zilberman, “The cannibalization effect of wind and solar in the California wholesale electricity market,” *Energy Economics* 85 (January 2020), <https://doi.org/10.1016/j.eneco.2019.104552>.



About the Author

Charles Yang is a master's student at UC Berkeley studying Electrical Engineering and Computer Science. He is also affiliated with the Lawrence Berkeley National Laboratory. His research focuses on applying artificial intelligence to solve scientific and engineering problems, including discovering new optical materials and optimizing power-grid dynamics.



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