



CONGRESSIONAL
PROGRAM
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ENERGIZING AMERICA'S FUTURE: Policies for Leadership in a Changing Global Landscape

April 21-26, 2025
Bellagio, Italy



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AGENDA¹

MONDAY, APRIL 21:

U.S. participants depart the U.S. throughout the day.

TUESDAY, APRIL 22:

U.S. participants arrive in Milan, Italy throughout the day and are transported by private bus for the 90 minute drive to Bellagio.

6:30 – 7 PM: Pre-Dinner Welcome

7:30 – 9 PM: Working Dinner

Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions will focus on America's energy policy and energy future.

WEDNESDAY, APRIL 23:

7 – 8:45 AM: Breakfast available to all participants

7:20 – 8:20 AM: Experts and Scholars meet for breakfast with Charlie Dent to review conference procedures

9 – 9:15 AM: Introduction and Framework of the Conference

This conference is organized into roundtable conversations, working lunches, and pre-dinner remarks. This segment will highlight how the conference will be conducted, how those with questions will be recognized, and how responses will be timed to allow for as much engagement as possible.

Speaker:

Charlie Dent, Vice President, Aspen Institute;
Executive Director, Congressional Program

¹ Congressional Program Executive Director Charlie Dent moderates the discussion sessions, recognizes members of Congress who have questions, and is assisted by a timekeeper to ensure the conversation is quick paced and every member of Congress has an opportunity to ask questions and discuss the issues.
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9:15 – 11 AM: Roundtable Discussion:
American Energy Competitiveness: Trade

The global energy transition is unfolding against a backdrop of increasing geopolitical tensions. Trade policy plays a central role in shaping U.S. strategies to drive innovation, secure critical supply chains, and maintain leadership in clean energy technologies. This session examines the trade-offs and opportunities in leveraging trade agreements and partnerships to advance both economic and environmental objectives.

Speakers will address the following questions:

- What role should trade agreements play in setting global standards for clean energy technologies, and how can the U.S. ensure these benefit its industries while encouraging global adoption?
- Should the U.S. use trade policies like carbon tariffs to address environmental goals, and how can it avoid triggering conflicts with key partners such as China and the EU?
- How can the U.S. reconcile its current reliance on imports of critical minerals for clean energy with its goals of energy security and independence?
- Should the U.S. prioritize reshoring clean energy manufacturing or accept reliance on global supply chains to keep costs low? What risks does each pose to national security?

Speakers:

Frank Fannon, *Managing Director, Fannon Global Advisors*

Robert “RJ” Johnston, *Senior Director of Research, Center on Global Energy Policy, Columbia University*

11 – 11:15 AM: Break

11:15 AM – 1 PM: Roundtable Discussion:
American Energy Competitiveness: Industrial, Financial, and Domestic Policy

As global competitors like China advance in critical industries tied to the energy transition, the United States faces the challenge of sustaining its competitive edge. This session explores the tools available to achieve this, from industrial strategies to financial mechanisms and domestic frameworks. Discussion will focus on how policy might be brought to bear to navigate shifting global dynamics and strengthen U.S. leadership.

Speakers will address the following questions:

- What U.S. industrial policies are needed to outpace China in clean energy manufacturing, and how should the U.S. counteract unfair trade practices?
- What immediate federal or state-level policy changes would most effectively close gaps in the U.S. clean energy supply chain?
- How can financial tools like tax credits or subsidies be targeted to maximize investment in U.S. energy industries without wasteful budget impacts?
- How can U.S. energy policies stay flexible enough to adapt to rapid technological innovation while ensuring adequate protection for consumers and industry?

Speakers:

Sonia Aggarwal, *Chief Executive Officer, Energy Innovation*

Drew Bond, *Chairman & CEO, C3 Solutions*

1 – 2 PM: Working Lunch

Discussion continues between members of Congress and experts on American energy competitiveness with Frank Fannon, RJ Johnston, Sonia Aggarwal, Drew Bond.

2 – 4 PM: Individual Discussions

Scholars will be available to meet individually with members of Congress for in-depth discussion of ideas raised in the morning sessions, including Frank Fannon, RJ Johnston, Sonia Aggarwal, Drew Bond.

4 – 5 PM: Pre-Dinner Remarks with Melissa Roberts, *Executive Director, American Flood Coalition*

7 – 9 PM: Working Dinner

Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions will focus on American energy competitiveness.

THURSDAY, APRIL 24:

7 – 8:45 AM: Breakfast

9 – 11 AM: Roundtable Discussion:

Data Center and AI-Driven Demand Growth

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The growth of data centers and AI-driven technologies is reshaping energy demand, requiring innovative approaches to supply and efficiency. This session focuses on how behind-the-meter and off-grid solutions, alongside clean energy integration and advanced manufacturing practices, can meet the sector's increasing energy needs while supporting broader decarbonization goals.

Speakers will address the following questions:

- What are the likely impacts on the power grid of a massive scale-up in energy demand from AI data centers?
- Are behind-the-meter and off-grid solutions scalable to meet these energy demands?
- What role should clean energy integration, such as solar and battery storage, play in powering the data center boom while ensuring cost-effectiveness?
- How can advanced manufacturing practices optimize the energy efficiency of data center infrastructure to align with decarbonization goals?
- Should policymakers enforce stricter energy efficiency standards on data centers, or would this stifle innovation and growth in AI-driven technologies?

Speakers:

Rob Gramlich, *President, Grid Strategies*

Colette Honorable, *EVP, Chief Legal Officer and Corporate Secretary, Exelon Corporation; former Member, Federal Energy Regulatory Commission*

11 – 11:15 AM: Break

11:15 AM – 1 PM: Roundtable Discussion:

Resilient Power Delivery and System Reliability

Reliability and resilience are under growing strain from extreme weather events and aging infrastructure. This session examines mechanisms to strengthen power delivery systems, improve disaster recovery, and address regional disparities in grid management. Topics include wildfire liability, regulatory innovations, and the evolving role of the federal government in enabling a cleaner, more robust electricity sector.

Speakers will address the following questions:

- What policies are most needed to protect the grid from extreme weather events and aging infrastructure failures? How should wildfire liability be addressed?

- How can the U.S. manage regional disparities to ensure reliable and resilient power is available across the country?
- What role should federal policy play in driving innovation and investment to improve grid reliability while enabling the transition to cleaner energy sources?
- What lessons can be drawn from recent disaster recovery efforts to develop faster, more effective responses to grid disruptions in the future?

Speakers:

Katie Dykes, *Commissioner, Connecticut Department of Energy and Environmental Protection*

Jason Grumet, *CEO, American Clean Power Association*

1 – 2 PM: Working Lunch

Discussion continues between members of Congress and scholars on the grid, system reliability and power delivery, AI-driven demand, and data center energy requirements with Rob Gramlich, Colette Honorable, Katie Dykes, and Jason Grumet.

2 – 5 PM: Individual Discussions

Scholars will be available to meet individually with members of Congress for in-depth discussion of ideas raised in the morning sessions, including Rob Gramlich, Colette Honorable, Katie Dykes, and Jason Grumet.

6 – 7 PM: Pre-Dinner Remarks with Andrew Herscowitz, CEO, M300 Accelerator

7 – 9 PM: Working Dinner

Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions today will focus on the grid, system reliability and power delivery, AI-driven demand, and data center energy requirements.

FRIDAY, APRIL 25:

7 – 8:45 AM: Breakfast

9 – 11 AM: Roundtable Discussion:

Energy Federalism: The Federal Government, the States, and Utilities

Energy governance in the United States requires careful coordination between federal oversight of bulk transmission and state-level management of distribution networks.

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This session considers how aging infrastructure, jurisdictional challenges, and the energy transition can be addressed within the framework of energy federalism. Strategies for aligning federal, state, and utility roles will be explored to modernize the nation's energy systems effectively.

Speakers will address the following questions:

- How can federal and state governments navigate jurisdictional boundaries while modernizing aging energy infrastructure?
- Is there a policy solution to resolve the tension between federal oversight of bulk transmission and state control of distribution networks? Should the federal government incentivize states to align their policies with federal energy transition goals?
- What role should utilities play in bridging gaps between federal and state priorities on clean energy technology deployment and increased capacity?

Speaker:

Rich Powell, *CEO, Clean Energy Buyers Association (CEBA)*

11 – 11:15 AM: Break

11:15 AM – 1 PM: Policy Reflections for Members of Congress

This time is set aside for members of Congress to reflect on what they have learned during the conference and discuss their views on implications for U.S. policy. Drawing on the full range of conversations throughout the week, members will seek to identify for each other the most promising takeaways for the United States policy process, with a special focus on opportunities for bipartisan cooperation. This is a members-only conversation.

1 – 2 PM: Working Lunch

Discussion continues between members of Congress and scholars on energy governance between the federal government, states, and utilities with Greg Gershuny and Rich Powell.

2 – 5 PM: Individual Discussions

Scholars will be available to meet individually with members of Congress for in-depth discussion of ideas raised throughout the week, including Frank Fannon, RJ Johnston, Sonia Aggarwal, Drew Bond, Rob Gramlich, Colette Honorable, Katie Dykes, Greg

Gershuny, Jason Grumet, Rich Powell, Jonathan Pershing, Maria Martinez, and Melissa Roberts.

7 – 9 PM: Working Dinner

Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions will focus on energy security policy reflections from the week.

SATURDAY, APRIL 26:

Participants depart throughout the day.

CONFERENCE PARTICIPANTS

MEMBERS OF CONGRESS AND THEIR SPOUSES:

Rep. Nikki Budzinski

Rep. Buddy Carter and Amy Carter

Rep. Kathy Castor and Bill Lewis

Rep. Steve Cohen

Rep. Jim Costa

Rep. Michael Guest and Haley Guest

Rep. Andy Harris and Nicole Harris

Rep. Bob Latta and Marcia Latta

Rep. Michael McCaul and Linda McCaul

Rep. Dan Meuser and Shelley Meuser

Rep. Scott Peters

Rep. August Pfluger and Camille Pfluger

Rep. Mike Quigley and Barbara Quigley

Rep. Deborah Ross and Steve Wrinn

Rep. Mike Thompson and Jan Thompson

Rep. Norma Torres and Louis Torres

Rep. Randy Weber and Brenda Weber

SCHOLARS AND EXPERTS:

Drew Bond	<i>Chairman & CEO, C3 Solutions</i>
Katie Dykes	<i>Commissioner, Connecticut Dept. of Energy & Environ. Protection</i>
Frank Fannon	<i>CEO, Fannon Global Advisors</i>
Rob Gramlich	<i>President, Grid Strategies</i>
Jason Grumet	<i>Chief Executive Officer, American Clean Power Association</i>
Colette Honorable	<i>EVP, Chief Legal Officer and Corporate Secretary, Exelon</i>
Robert “RJ” Johnston	<i>Senior Director of Research, Center on Global Energy Policy, Columbia University</i>
Maria Martinez	<i>Policy Director, Clean Economy Project, Clean Energy Buyers Association (CEBA)</i>
Rich Powell	<i>Chief Executive Officer, The Clean Energy Buyers Association (CEBA)</i>

CONFERENCE RAPPORTEUR:

Matthew Rojansky	<i>Rapporteur and Counselor to the Aspen Institute Congressional Program</i>
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FOUNDATION REPRESENTATIVES:

Sonia Aggarwal	<i>Chief Executive Officer, Energy Innovation</i>
John Dedrick	<i>Executive Vice President and Chief Operating Officer, Charles F. Kettering Foundation</i>
Lisa Epifani	<i>Head of Policy, ClearPath</i>
Dani Geanacopoulos	<i>Managing Director for Government Relations, The Rockefeller Foundation</i>
Andrew Herscowitz	<i>Chief Executive Officer, Mission 300 (M300) Accelerator, RF Catalytic Capital</i>
Jim Martin	<i>Treasurer and Chief Financial Officer, Charles F. Kettering Foundation</i>
Melissa Roberts	<i>Executive Director, American Flood Coalition</i>

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Daniel Schory *Vice President of Infrastructure, Energy and Permitting, Arnold Ventures*

Rajiv Shah *President, The Rockefeller Foundation*

ASPEN INSTITUTE ENERGY AND ENVIRONMENT PROGRAM:

Greg Gershuny *Vice President and Executive Director, Aspen Institute Energy and Environment Program*

Timothy Mason *Director, Energy & Climate, Aspen Institute Energy and Environment Program*

ASPEN INSTITUTE CONGRESSIONAL PROGRAM:

Charlie Dent *Executive Director, Congressional Program and Vice President, Aspen Institute*

and **Pamela Dent**

Tyler Denton *Deputy Director*

Jennifer Harthan *Senior Manager of Congressional Engagement*

Galen Voorhees *Senior Conference Manager*

RAPPORTEURS' SUMMARY

Matthew Rojansky

Rapporteur and Counselor to the Aspen Institute Congressional Program; President and CEO, The U.S.-Russia Foundation

From April 21 to 26, 2025, the Aspen Institute Congressional Program brought together Members of Congress and Scholars with wide-ranging expertise to explore key questions for U.S. energy policy in the face of surging global demand, intensifying geopolitical competition, and transformative technological change. Starting from discussions on domestic competitiveness, resilience, and national security, the program examined the U.S. energy system's readiness to meet the demands of the digital economy in a hyper-competitive global landscape. Sessions covered the roles of federal and state policy, private investment, permitting reform, grid modernization, and the intersection of energy with emerging technologies, such as artificial intelligence.

The conference yielded productive, bipartisan discussion of the challenges and opportunities facing our country's leadership on energy policy and competitiveness. Members heard from experts across the energy spectrum—from grid resilience and critical minerals to regulatory and cost experts—and debated practical strategies for streamlining regulation while protecting ratepayers, strengthening the grid, and ensuring a fair and maximally secure energy transition. There was broad agreement that energy policy today is not just about the environment or economics—it is a foundational component of national strength amid existential global competition and must be treated with the same urgency and strategic clarity as other top national security priorities.

Trade and Strategic Minerals

The conference opened with a session to assess U.S. industrial policy through the lens of energy and critical minerals. One Scholar opened by noting that the shift from market liberalism to a more interventionist approach marks a profound change in U.S. policy, but fits the current global reality. The Biden administration's green industrial policy prioritized sectors like batteries, wind, and solar. Now, the Trump administration is more focused on national security, with wide support for manufacturing resilience and development of advanced manufacturing technologies, signaling a broad bipartisan consensus on reindustrialization.

This transformation is driven in part by the recognition that critical minerals are foundational to U.S. manufacturing capacity, whether for clean energy, consumer technology, defense or other applications. As one Scholar explained, minerals and energy are not merely commodities—they are geopolitical assets. Competition with China has revived old debates about which sectors are too vital to be left solely to market forces. The Scholar pointed to Beijing's "Made in China 2025" strategy as a clear example of state-directed industrial planning that the U.S. should counter with smart and selective intervention.

The discussion also emphasized the need to balance the interests of American consumers, long accustomed to cheap goods, with the strategic necessity of rebuilding domestic capabilities. A quote from Treasury Secretary Scott Bessent captured this tension: “Access to cheap goods is no longer the essence of the American dream.” Instead, Members and Scholars emphasized values like self-reliance, resilience, and quality of life for ordinary Americans.

Scholars cited two recent Executive Orders to illustrate the federal government’s pivot. A January 2025 order underscored the need for reliable and affordable energy to support U.S. manufacturing—an insight that applies as much to aluminum production as to today’s energy-intensive data centers. A March 2025 order identified critical minerals as a sector unlikely to thrive without government support. As one Scholar noted, unlike factories, which can be relocated, mines are fixed assets, making physical access and control even more strategically important. NATO allies can play a supportive role, having collectively identified twelve rare earth critical minerals, most of which are currently dominated by China.

Another Scholar, focusing on geopolitical risk, explained why Western companies face serious limitations in mineral investment. Political instability and reputational risks discourage engagement in many resource-rich regions, allowing Chinese state-backed firms to dominate. The result, this Scholar warned, is that the U.S. is decades behind China. Consider this example: when Japan detained a Chinese fishing boat captain in 2019, China retaliated by banning exports of rare earth minerals, causing a 350% price spike. Although China lost the case at the WTO, it then flooded the global market to suppress competitors. As the Scholar concluded, this is not a free or transparent market—China not only owns many of the mines but also controls 100% of the output from numerous third-party sites.

Members of Congress asked, Who truly benefits from WTO rulings when China can outmaneuver them so easily? Others pointed out that while the U.S. has among the world’s cheapest electricity, its regional variability and infrastructure constraints limit potential advantages for manufacturers. Others noted that both the Biden and Trump administrations skewed energy policy too far toward one end of the spectrum—renewables or fossil fuels—without embracing a balanced “all of the above” approach.

Several Members raised concerns about the imposition of tariffs on allied countries, arguing that such measures undermine geopolitical partnerships and fail to advance a coherent strategy. One pointed to the withdrawal from the Trans-Pacific Partnership nearly a decade ago as a significant lost opportunity for U.S. economic and strategic leadership among allies. Members and Scholars alike called for a more nuanced understanding of “friendshoring,” bringing production to countries that are geopolitically aligned with the U.S., especially in sectors where other potential partners may be entangled with Chinese ownership or supply chains.

One Member highlighted how the current 15-year pipeline from discovery to production of critical minerals is misaligned with the rapid pace of change in technologies like AI. Meanwhile, a Scholar pointed out the stark implications for national defense, noting that a single Virginia-class submarine requires 9,000 pounds of rare earth minerals for propulsion and an F-35 fighter jet requires 500 pounds for its landing gear. Altogether, the U.S. government needs as much as 10,000 tons of rare earths annually.

Members and Scholars shared concerns about interagency coordination. One Member recommended establishing a single point of accountability to coordinate federal efforts on critical minerals, noting that without such clarity, the process becomes a bureaucratic cycle of missed deadlines and redundant reporting. Others suggested restructuring strategic reserves and shifting them from a purely defense-oriented framework to one focused on broader economic resilience. One Scholar cited the Uyghur Forced Labor Prevention Act of 2021 as a model useful in combating forced labor in mineral supply chains originating from Xinjiang.

Several Members and Scholars called for industrial policy to act as a scalpel, not a sledgehammer, targeted only where markets clearly fail. They emphasized the importance of predictability in regulation and taxation as the primary driver of private-sector investment, not government subsidies. One warned against repeating past failures, like the Solyndra loan guarantee debacle, and advocated for equity-based public-private partnerships. Another voiced skepticism about government-directed industrial policy altogether, noting that Intel has lost \$40B in market value despite a \$7B investment from the CHIPS Act.

Still other Members noted that good jobs must not come at the expense of increased pollution in vulnerable communities, and argued that mining and manufacturing reshoring must come with stricter environmental oversight. Members also discussed the potential for universities and national labs to play a larger role in maintaining American competitiveness, but acknowledged that these institutions must do more to communicate their strategic value in Washington. There was broad agreement that U.S. energy competitiveness will depend on industrial resilience coupled with sustainable environmental practices and partnerships with allies through global trade.

Industrial, Permitting, and Tax Policy

This session focused on how industrial policy, permitting reform, tax incentives, and financial tools can drive American energy competitiveness in a time of rising global demand, economic uncertainty, and geopolitical competition. Scholars posed the question of whether the U.S. would lead with an abundance mindset or fall behind more centralized and authoritarian economies, while linking energy dominance with U.S. global leadership. The U.S., they argued, should take advantage of its existing strengths—affordable electricity, technological innovation, and robust capital markets—to reduce costs at home while building a strong, resilient industrial base. Today’s policy question, they said, is not whether to invest, but where and how. Public support is strong: four out of five American voters back incentives for companies to

reshore manufacturing. Yet America's industrial base has declined due to outdated energy policies, and as a Scholar emphasized, strategic sectors like steel and aluminum cannot modernize without targeted public investment. Other countries have already made these moves: the EU's clean industrial deal and Australia's investments in aluminum and critical minerals were cited as models.

The discussion emphasized concrete policy tools already in play. These include the 45X Advanced Manufacturing Production tax credit under the Inflation Reduction Act of 2022, which rewards firms for creating components used in downstream industrial production, as well as Department of Energy lending programs and federal investment initiatives. These incentives, one Scholar argued, are essential to reduce investment risk, especially under current tariff regimes that many companies see as destabilizing. Lowering domestic energy bills also remains a key goal. Technology-neutral tax credits—rather than favoring specific energy types—have proven both effective and popular. The Scholar cited studies showing that these tax credits can reduce household energy bills by \$140 to \$220 annually. This has been particularly beneficial in rural areas, where electric cooperatives are passing along savings to consumers.

Another proposal was the creation of a “critical minerals club” with allied nations. Rather than continuing to import critical minerals embedded in finished goods nearing end-of-life, the U.S. should increase domestic recycling and reuse. However, one challenge is building a robust domestic market for non-defense applications of critical minerals to ensure steady demand for upstream producers and processors.

Another Scholar framed the issue in ideological terms: America stands at a crossroads, and can either unleash its economic potential through free-market values and fair trade, or risk adopting the centralized, top-down industrial models of authoritarian rivals. The Scholar advocated for more economic freedom—low regulation, secure property rights, and limited taxation—combined with unleashing all forms of energy, citing historical examples—West vs East Germany, North vs South Korea, and the U.S. vs China—as proof that economic freedom correlates with better outcomes across the board, including for the environment. Free economies, the Scholar asserted, are also clean economies.

Permitting reform emerged as a major theme. The current 7-10 year timeline for permitting major energy infrastructure projects was described as a critical obstacle. One Scholar proposed a new framework: presume projects are permissible and shift the burden to regulators to prove otherwise. Categorical exclusions under the National Environmental Policy Act of 1969 (NEPA) could apply to new solar arrays, Small Modular Reactors (SMRs), or upgrades to hydropower. Others suggested establishing

"energy acceleration zones"—pre-cleared federal sites near labs or military bases where energy and data infrastructure could co-locate.

Several Members agreed on the need for a streamlined permitting regime. One described how a single power line crossing federal land took seven years to permit, in part due to 11th-hour litigation. Others emphasized that even with technology and innovation in place, supply chains remain constrained, and regulatory delay is often the limiting factor.

The conversation highlighted the role of community partnerships in advancing energy goals. One Member pointed to the Nucor recycling facility in North Carolina as a permitting success story. The Member also described how Google built a data center in a distressed rural community, reusing legacy hydro power infrastructure from the now-defunct furniture industry. Others called for greater investment in community colleges and trade schools to develop the skilled workforce required for infrastructure deployment.

The group also debated energy subsidies and market design. One Member argued that subsidies simply shift costs to taxpayers, advocating instead for reducing the intrinsic cost of energy generation. Natural gas, solar, and onshore wind were identified as the lowest-cost energy sources, though noting that solar and wind require battery storage solutions, and other sources to compensate for non-peak production. Others pushed for a consistent, nationwide energy framework, instead of today's patchwork of open markets and regulated monopolies.

Discussion turned to nuclear power, with one Member pointing to the completion of two new reactors at the Vogtle plant in Georgia—the first in decades. Several Members supported advanced nuclear, especially Small Modular Reactors (SMRs), as part of a balanced energy portfolio. At the same time, Members stressed the need to protect agricultural land and natural habitats from energy sprawl, urging smarter land-use planning for solar deployment. Another Member argued for stronger physical security and grid resilience. Others asked how transmission lines and power systems could be hardened against both natural and manmade threats.

Finally, experts offered ideas to improve permitting without dismantling environmental safeguards. One proposed classifying and adjudicating similar projects together for faster approvals. Another called for a stronger federal role to prevent regulatory fragmentation across 50 states. A third emphasized reining in frivolous lawsuits that delay projects without providing meaningful protections. One scholar, a former FERC commissioner, affirmed that investments in nuclear and transmission have consistently paid off. A broad consensus emerged that Congress has the authority—and the obligation—to modernize America's permitting system, empower its industrial base, and align financial incentives with long-term energy security and economic prosperity.

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Energy and Resilience

This session addressed the urgent need for energy and infrastructure resilience in the face of increasingly frequent and intense natural disasters, emphasizing how smart federal policy, technological innovation, and nationwide resource coordination can reduce costs and protect vulnerable communities.

A Scholar representing the American Flood Coalition framed resilience not only as a climate and disaster preparedness issue, but also as a critical economic and national security concern. Damage from floods, fires, and other climate-driven disasters often renders recovery unaffordable for families and small businesses. The Scholar argued that too often, the federal government reacts to disasters with expensive, delayed recovery programs rather than investing in preventive resilience measures that could lower costs and burdens over time. The Scholar noted that Washington often sends personnel to manually verify disaster damage when tools like AI and satellite imagery could speed up the process and reduce human and economic costs—a reactive approach that has remained largely unchanged for over 50 years.

There are over 125 federal disaster programs spread across 30 agencies, the Scholar explained, a system that was built piece by piece over time rather than designed as a coherent whole. This patchwork produces inefficiencies, bureaucratic inertia, and a burdensome process for already-overwhelmed local communities. The Scholar described how every time something goes wrong or somebody cheats, a new bureaucratic step is added, penalizing everyone instead of targeting enforcement and improving overall outcomes.

The Scholar called for legislation to codify smarter resilience policy, including the Flooding Prevention and Restoration Act, and permanent authorization for Community Development Block Grant Disaster Resilience funding. The Scholar also recommended codifying a Trump administration Executive Order encouraging state and local action on resiliency, and flagged energy adaptation research at national labs as a promising direction for investment. The Scholar noted that this topic cuts across political and regional boundaries. In the Scholar's words: there is no "pro-disaster" lobby, only systemic inertia holding back reforms.

Members highlighted challenges and opportunities in applying resilience policy in their districts. One Member described successfully lobbying for a regional federal coordinator to help communities navigate programs. They emphasized the return on investment—every \$1 spent on resilience saves \$13 in post-disaster costs. However, they warned that national competitions for funding often favor larger, better-resourced jurisdictions and proposed a more equitable formula-based system.

Another Member described the flood insurance gap in North Carolina, which was hit by Hurricane Helene in 2024, and where few residents had flood coverage despite widespread flood risk. FEMA's outdated flood zone maps, the Member argued, left residents uninformed and taxpayers exposed to liability. Several Members raised the issue of insurance companies pulling out of disaster-prone markets altogether, making it impossible for citizens to buy or sell homes. They urged stronger federal engagement to ensure that investments in community resilience actually lead to insurance market participation.

Members called for more accurate and contestable flood mapping systems, recognizing that past events are no longer reliable predictors of future risks due to climate change. Others pushed for the inclusion of underinsured sectors like forestry (forestry assets represent 20-30 year investment cycles, but are usually not insured beyond the first few years). One Member called for disaster spending that reflects actual projected costs, not arbitrary round numbers, advocating for more precise and data-driven funding decisions.

Members also flagged the need for clarity on what actions should be taken by the executive branch versus Congress. There was strong bipartisan agreement on the need for a proactive resilience policy that leverages technology, reforms bureaucracy, and supports communities before disasters strike, not just after.

Data Center and AI-Driven Demand Growth

This session examined the rapid surge in electricity demand driven by the rise of AI technologies and data centers, and the implications for grid infrastructure, generation capacity, transmission planning, permitting, and regulatory modernization. Scholars and Members discussed how this evolving landscape presents both a major challenge and a strategic opportunity for U.S. energy leadership.

A Scholar opened the session by declaring that “the era of flat power demand is over.” Utilities accustomed to 20-30 year planning cycles are now facing sudden shocks from very large, fast-growing loads, especially from data centers and AI applications. These new demands differ not only in scale, often measured in gigawatts, but also in speed and flexibility. Data center operators and tech companies move quickly and expect utilities to do the same, and they decry the current utility permitting and interconnection system as bureaucratic and slow. The Scholar identified 15 “hot spot” states (e.g., Northern Virginia, the data center “hub”), where demand is already spiking. Solutions include colocation and reuse of retired generation facilities to get onto the grid more quickly, encouraging data center flexibility, and building out high-voltage transmission. But these are interim steps.

The Scholar emphasized the need for broad policy reform and federal leadership on grid upgrading. Federal policy, including funding, permitting reform, and transmission expansion, will be essential to incentivize and coordinate state-level and private actors. Other scholars reinforced this message. They projected that by 2030, U.S. data centers alone could consume as much as 9% of national electricity, equivalent to the current output of all nuclear power plants. The sheer growth in demand, from traditional industry as well as AI, is unprecedented. The Scholar shared how data center developers are now requesting power in multiples of gigawatts, with companies like Micron, Meta, and OpenAI exploring projects in the 2–5GW range. In some areas, like upstate New York, a single company may consume 8% of total grid capacity.

Utilities and states are scrambling to keep up. In some areas, new staff are being hired just to manage permitting and certification for these projects. Companies are being steered toward sites with existing infrastructure, such as retired power plants, that can be reactivated more easily, and some are aiming to collocate data centers with on-site generation, particularly natural gas cogeneration, to improve reliability and reduce pressure on the grid.

The conversation also addressed permitting, where there was broad agreement that both federal and state-level reform is needed. Scholars noted that a large number of staff in the Department of Energy's permitting office have been fired or resigned, creating bottlenecks, but also that DOE was not designed to manage the full permitting process. Members raised the Energy Permitting Reform Act, a bipartisan bill introduced in 2024, which has not yet passed the Senate, and would in any case need additional bipartisan support in the House. Under potential permitting reform, Members and Scholars proposed, the Federal Energy Regulatory Commission (FERC) would be given a central role, for example, in requiring interregional transmission planning and assigning cost responsibility across jurisdictions.

Members had a range of concerns related to permitting. One asked how to protect small businesses from bearing outsized electricity cost increases, while others highlighted opportunities for demand management and grid efficiency, e.g., incentivizing industrial and residential users to shift usage to off-peak hours. Another Member raised cybersecurity, warning that the U.S. grid remains vulnerable to both cyber and physical attacks, and stressing the need to build resilience, not just capacity.

Scholars explained that energy loads on the grid vary significantly. While some loads—like semiconductor manufacturing—cannot tolerate even momentary power losses, others, including many AI data centers, may have more tolerance than is broadly perceived or sought in initial bids. Scholars cited research suggesting that small,

strategically timed interruptions to data center power supplies could allow far more load to be integrated than previously assumed.

Regional coordination emerged as another major theme. Members emphasized the need for planning across state lines and urged vertically integrated utilities and regional transmission organizations (RTOs) like PJM in the mid-Atlantic region to take a more proactive role. Tariffs also surfaced repeatedly as a barrier—both to equipment procurement and cross-border energy flows, such as from Quebec, Ontario, and British Columbia. The group also discussed the trade-offs of overhead versus underground transmission lines, wildfire risks, and the need to modernize FERC and NERC. One Member warned that it takes 10 years to build an average power line in the U.S.—seven of which are tied up in permitting and litigation. Others pointed to China’s ability to complete similar lines in under two years—a sobering benchmark.

The discussion closed with broad agreement that a reliable energy grid is a national security imperative. Members aimed to explore legislation that would promote interoperable regional systems, strategic use of clean energy tax credits, support for workforce training, and both public and private investments in grid modernization. In any approach, policymakers must act quickly to ensure that America’s energy infrastructure can support our digital future, to be competitive in a world where power is already a national strategic asset.

Resilient Power Delivery and System Reliability

This session continued the discussion on strengthening the reliability of America’s power system amid growing demands from extreme weather, data center loads, and aging infrastructure, with a deeper dive on generation, transmission, and distribution. A Scholar opened the discussion by stressing that demand growth isn’t the only challenge—other cost drivers include aging infrastructure, extreme weather, and paralyzing uncertainty around federal permitting, funding, and tariffs. In some cases, this uncertainty is stalling or canceling major projects, such as an offshore wind installation that could have added 5% to New England’s electricity supply or a powerline with Canada that could boost imports by 8%.

Hazard mitigation, the Scholar argued, is also under threat. Prevention and resilience programs like FEMA’s Building Resilient Infrastructure and Communities (BRIC) are estimated to save \$13 for every \$1 invested, yet grants are being pulled back. Federal investment in resilience not only pays for itself—it leverages other sources of funding and protects vulnerable grid assets, many of which were built under outdated climate assumptions, such as low-lying substations that once served barge-fed coal plants and now face flooding. Similarly, wildfire risk, once thought of as a Western problem, now threatens nearly the whole country.

On the supply chain front, Scholars pointed to the benefits of federal purchasing power. If the government were to buy transformers and other critical equipment at scale, utilities could purchase from federal stockpiles and repay the investment at a profit to the government. This would reduce lead times and hedge against price spikes. They described the energy industry as aligned behind a national strategy and also as committed to a diversified energy future. They emphasized that diversity—across supply types, storage solutions, and fuel sources—is a strategic strength, echoing Churchill’s maxim that “security lies in variety.” Today’s clean energy portfolio includes major contributions from traditional oil and gas companies, which now generate nearly a third of America’s clean power.

The biggest threat to grid reliability, Scholars said, is not technical—it’s political. Builders of 30-year infrastructure projects need consistency. Instead, they face policy whiplash. A clean energy tax incentive passed by one administration might be undermined by the next, while federal LNG policy has swung rapidly in recent years, sending mixed signals to investors. In the next decade, Scholars argued, America must surge gas production, expand geothermal, build new nuclear capacity, and extend the life of aging hydro and nuclear plants. But to do this, Congress must stabilize policy and reform permitting.

Members echoed these priorities. One called for stronger support for “asset condition” projects—utility-led efforts to replace aging infrastructure—which can reduce the political backlash from rate hikes. Others stressed the need for a comprehensive strategy to treat energy like national security: define the threat, create a strategy, and fully resource it. Several participants proposed a quadrennial energy review, modeled on the Department of Defense’s process, to provide long-term accountability and policy guidance. Others highlighted the opportunity to modernize nuclear policy. While some expressed concerns over safety and public perception, many agreed that extending existing plant lifespans and advancing small modular reactor (SMR) technology could provide stable, zero-emission baseload power.

Debate also touched on battery storage—an area where the U.S. has fallen behind China. Members urged support for battery innovation, including alternative chemistries like iron-air, and suggested repurposing former steel sites and brownfields for grid-scale storage. Members stressed that hardening infrastructure should go hand-in-hand with boosting the grid’s flexibility and ability to recover quickly after disruptions.

On tax policy, some Members emphasized the risks of pulling back clean energy subsidies, warning this could slash hiring and investment. Others raised the potential of fusion energy, pointing to startups like Commonwealth Fusion and Helion, and recent moves by the Nuclear Regulatory Commission (NRC) to treat fusion reactor projects

differently from their traditional fission counterparts, allowing streamlined state-level oversight.

While many agreed that the U.S. has the best energy fundamentals in the world, some worried we have some of the worst energy policies, or at least are inconsistent in applying them over time. There was broad agreement among Members and Scholars that the government should lead with consistent, clear, and forward-looking policy that supports reliability, diversity, and resilience across the grid.

Energy Federalism – The Federal Government, the States, and Utilities

This session explored the complex and evolving relationship between federal authority, state decision-making, and utility responsibility in shaping the future of energy delivery. Scholars and Members considered how to accelerate advanced energy deployment—especially nuclear and high-demand applications like data centers—while preserving flexibility for regions and maintaining political and public support.

A Scholar opened by highlighting the growing influence of "hyperscalers"—large energy consumers such as Fortune 500 tech firms and data center operators. These companies are now some of the biggest energy buyers in the world, with demand rivaling that of entire states or regional grid systems like PJM. Despite their size, their goals are consistent: reliable, affordable, and increasingly clean energy. Notably, such firms purchased more nuclear energy than wind last year, signaling a shift toward high-density power sources.

Hyperscale users also often bring their own power solutions. Data centers, for instance, typically use grid electricity supplemented by on-site generation and backup systems, such as diesel or hydrogen fuel cells. For large loads that need near-perfect reliability, the primary source must be a dense and dependable technology like nuclear. Siting advanced nuclear reactors "behind the meter"—directly at or near energy-intensive facilities—offers advantages: bypassing lengthy grid interconnection queues, reducing transmission and distribution costs (which often make up two-thirds of delivered power costs), and mitigating public concern over grid strain. Still, some participants noted that many data centers are already operating on backup power more often than intended.

Permitting and siting remain key challenges, however. New SMRs must be certified by the NRC, a process that took over 40 months for the first design. Further environmental review and permitting can take another one to two years. Projects are likely to require federal incentives, loan guarantees, and possibly federal siting at national labs or military installations. While some university-scale research reactors may come online within two years, full-scale commercial SMRs are further off. The ADVANCE Act, which aims to streamline advanced nuclear permitting and increase NRC staffing, was noted as a step in the right direction, although staffing cuts in other agencies threaten progress.

At the regional and state levels, additional complexity accumulates. Each Regional Transmission Organization (RTO) sets its own rules, and many states either ban new nuclear power outright or are just beginning to lift long-standing moratoria. Federal leadership is needed to unify standards, but the path forward depends on balancing national needs with local autonomy.

Members raised concerns about workforce readiness and community opposition. Some areas—like former coal towns or federal lands—were highlighted as promising sites for collocating advanced nuclear facilities. Others pointed to the need for retraining energy workers and ensuring sufficient expertise to safely build and manage nuclear installations. Members and Scholars both emphasized the importance of community engagement, especially as public resistance has surfaced over even relatively small infrastructure projects.

Hydropower was also discussed as a reliable and underutilized resource. Members noted that one-third of the nation’s hydro capacity is up for relicensing, and thousands of existing dams could be retrofitted with more efficient turbines. Noting that there is currently a backlog of turbine production related to global supply chains, some Members suggested this could be an area for onshoring and friendshoring production. Likewise, hydropower transmission projects from Canada remain uncertain in the context of the current strained trade relationship.

Members debated the limits of federal authority in technology choice, emphasizing the need for market-driven, regionally appropriate solutions. The risks of politicizing energy policy were also discussed—particularly the danger of constant policy reversals that undercut long-term investment. There was also wide agreement that the U.S. should avoid picking energy “winners and losers.” Instead, government should create a level playing field, enabling all viable technologies to compete. Clean energy should be sold on performance and public benefit, not imposed through mandates. Successful transitions, many argued, would rely on strong public-private partnerships and bipartisan policy continuity.

With demand from AI and electrification growing rapidly, Members called for immediate and long-term strategies. In the near term, more than 2,000 GW of solar and gas projects are ready to power future data center growth—pending permitting and transmission upgrades. Longer term, SMRs and other dense energy sources will be essential to meeting exponential demand.

Security and competitiveness were never far from the discussion. Members noted that future warfare—and economic leadership—will be powered by data and AI, which in turn rely on massive, uninterrupted electricity. While the U.S. still leads on energy

hardware and talent, China is catching up fast. The session and the conference concluded with a broadly shared understanding that energy federalism must evolve quickly to meet the moment, and that Congress must act with speed, pragmatism, and clarity to ensure America's energy future is secure, reliable, and competitive.

POLICY ACTION MEMORANDUM FOR MEMBERS OF CONGRESS²

Energy and Economic Security

- Acknowledge that rising electricity demand poses a national security and global competitiveness challenge. Powering America's manufacturing base, data centers, and homes reliably and affordably must become a strategic priority.
- Recognize that the surge in electricity demand, driven by AI and digital infrastructure, presents risks to price stability and economic growth if supply cannot scale accordingly. This may be a strategic inflection point on par with the space race during the Cold War.
- Emphasize the need for bipartisan legislation to ensure long-term investment stability. Without durable federal action, whipsawing policies from administration to administration discourage the multi-decade capital investments needed to expand power infrastructure.
- Support reshoring initiatives by aligning regulatory and tax policies with energy availability, to ensure U.S. firms can compete globally.
- Consider mandating a quadrennial energy strategy review, modeled on the Department of Defense's approach, to align long-term goals and reduce strategic uncertainty.

Permitting and Infrastructure Modernization

- Prioritize permitting reform. Current timelines for transmission lines, power generation, and energy infrastructure—often exceeding five to ten years—are unacceptable. Reform should maintain environmental protections while streamlining approval processes.
- Emphasize the urgent need for interregional transmission development. The federal government has a unique role to play in enabling long-distance, multistate energy infrastructure that no single state can deliver alone.

²*Note: These are potential policy principles and proposals that emerged through conversations among Members of Congress and Scholars, and do not reflect any position endorsed by the Aspen Institute or the Aspen Congressional Program. This document is intended as a nonpartisan record of potential avenues for legislative action and as a companion to the Conference Rapporteur's report.*

- Accelerate deployment of grid-ready projects, particularly solar, natural gas, and battery storage, which can come online faster than advanced nuclear or hydro. Thousands of gigawatts are waiting in the pipeline.
- Consider using federal purchasing power to secure energy equipment at scale, creating a revolving supply that utilities can buy from—lowering costs and shortening lead times.
- Ensure full staffing and funding for federal and delegated state permitting offices. Staff shortages are a major bottleneck.

Technology-Neutral and Market-Based Policy Approaches

- Favor technology-neutral policies that allow all viable generation sources to compete on cost and performance—“all of the above” enabling “the best of the above.”
- Avoid restricting consumer choice in appliances, vehicles, or other technologies. Let market and regional conditions shape deployment.
- Invest in demand flexibility, smart grid tools, and efficiency to help lower costs for all customers.
- Recognize the role of states in determining resource mixes while preserving federal support for innovation, transmission, and interconnection.

Advanced Nuclear and Long-Term Innovation

- Accelerate development of new nuclear technologies—both small modular reactors (SMRs) and larger units—as promising sources of clean “dense” power.
- Streamline Nuclear Regulatory Commission (NRC) licensing and environmental review timelines, with the ADVANCE Act as a potential starting point.
- Support loan guarantees, tax incentives, and pre-approved siting processes (e.g., on federal lands or former coal plant sites) to catalyze early deployment.
- Maintain and extend the lifespan of existing nuclear plants to provide reliable baseload power during the transition.
- Invest in battery storage, including diverse chemistries and grid-scale brownfields storage solutions, to address intermittency and security of supply.

Strategic Competition and Bipartisan Opportunity

- Recognize that strategic competition with China requires robust and consistent U.S. energy policy. Plentiful, affordable and reliable power underpins America's technological and military edge.
- Develop a long-term, bipartisan blueprint for energy policy, including critical minerals, grid modernization, and permitting reform, with incentives for private-sector investment.
- Ensure continued Congressional engagement with subject matter experts, including in national labs, universities, and the private sector.

SCHOLARS' ESSAYS

WEDNESDAY, APRIL 23

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Robert Johnston	<i>Energy, trade, minerals, and defense: a new US industrial policy</i>
Sonia Aggarwal	<i>A New Era of Global Competition: Investing in America Today, for the Future</i>
Drew Bond	See "Free Economies are Clean Economies: A Correlation of Economic Freedom and Environmental Performance" (Page 126)

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FRIDAY, APRIL 25

Rich Powell	<i>Co-location and the Evolving Nexus of Federal and State Energy Governance</i>
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China's Quiet War Against America³

Frank Fannon

Managing Director, Fannon Global Advisors

China has been waging a quiet war on the United States for years. It is a war not fought with missiles and bullets but waged with minerals and refineries. It's past time for Washington to acknowledge this reality so America can adopt the war footing necessary for victory.

During his first term, [President Donald Trump](#) sounded the alarm that "America cannot be dependent on imports from foreign adversaries for critical minerals." In Congress, Senator Marco Rubio and Congressman Mike Waltz, the president-elect's nominees to serve as secretary of state and national security advisor, led the charge against Beijing's critical minerals dominance. They understood that China's state-directed control of the critical minerals supply chain was not just friendly competition but a strategic attack on America's industrial base.

The Chinese Communist Party (CCP) is hostile to democracy globally and seeks to displace the United States as the world's indispensable power. U.S. intelligence [reports](#) confirm that Communist China is an existential threat. Yet, Washington has failed to recognize this fact because it clings to an anachronistic definition of war.

Like Europe, Americans generally understand war as Carl von Clausewitz defined it: "an act of force to compel our enemy to do our will." Viewed through this eighteenth-century lens, the absence of kinetic action against U.S. forces would indicate China isn't engaged in war. However, the People's Republic of China (PRC) does not subscribe to the West's definition. Instead, it looks to Sun Tzu's *The Art of War*, which states that "supreme excellence consists in breaking the enemy's resistance without fighting" and recommends "first attacking his strategy."

The CCP seeks to win its war by depriving the United States of the means to wage a kinetic one. China leverages its domestic resources and state-owned enterprise investments for strategic advantage rather than commercial returns. In 1987, then-Chinese leader [Deng Xiaoping](#) presciently declared, "The Middle East has oil,

³ Originally published in [The National Interest](#) on December 17, 2024.

China has rare earths.” The state invested and built the world’s dominant industry player.

To reduce its vulnerability to imported oil, the CCP launched a sweeping electrification-focused industrial policy. Beginning with state-sponsored theft of American [intellectual property](#), Beijing directed clean tech manufacturing, increased electric vehicle [subsidies](#), and imposed coercive policies to accelerate electric vehicle (EV) adoption.

China has deployed more than [\\$1 trillion](#) in Belt and Road Initiative investments, including in critical minerals, and oftentimes in violation of basic human rights. According to a [U.S. Department of Labor](#) report, Chinese mining has increased child and forced labor, which “risks undermining the promise of a sustainable and equitable green future.” In 2023, Beijing increased mining and metals-focused spending by [158 percent](#) over 2022 levels, locking up key supplies over the long term.

The PRC has also increased economic warfare in the near term. In October 2023, Beijing restricted the export of graphite, which makes up most of an EV battery, and banned the export of rare earth processing technologies. In July 2024, the CCP announced that it would restrict exports of [germanium and gallium](#), which are used in solar energy, advanced optics, and microchips; a few months later, it announced it was prepared to restrict the export of [antimony](#), a mineral used in advanced defense weapons systems. This month, the [CCP made good](#) on its threat, an action that could cost the United States [\\$3.4 billion](#).

The United States has taken some actions over the years. The Trump administration issued America’s first critical minerals list, integrated critical minerals as a component of U.S. foreign policy, and sought to streamline domestic mining permits. The Biden administration mobilized billions of taxpayer dollars to accelerate domestic minerals processing and clean energy manufacturing, and it launched the Minerals Security Partnership. Yet, these policies lacked coordination and the mobilization of capital at a scale necessary to develop a secure critical minerals supply chain.

Rather than meet the China threat head-on, Washington and Europe have argued that they do not want to decouple but selectively de-risk where appropriate. This focus on semantics has constrained America’s thinking and limited its options to counter the CCP. The United States must recognize the challenge ahead, adopt the requisite policies, and harness the private sector for victory.

The new Trump administration should designate a senior official to coordinate a holistic interagency critical minerals strategy. This strategy must reform domestic mine permitting, modernize America’s inadequate [minerals stockpile](#), and impose stiff tariffs

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on producers that flout environment and human rights. Washington should coordinate efforts with allies yet prioritize those partners ready to mobilize capital and direct U.S. finance institutions to invest in near-term mining projects around the world.

Trump won the White House by talking directly to the American people. He has the platform to do so again and explain the costs, time, and likely shared sacrifice required to win this new war. The United States won World War II, the Space Race, and the Cold War by doing just that. It is time to do so again.

Energy, trade, minerals, and defense: a new US industrial policy⁴

Robert J. Johnston

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The prospect of successful implementation of a US reindustrialization and reshoring strategy anchored by long-term, durable tariffs is upending global trade flows and geopolitics around energy, materials, and manufactured goods. In parallel, there is a “big pivot” underway – a shift from decarbonization policy/electrification to national security and high tech – as the major drivers of industrial policy and key sectors like critical minerals.

The re-emergence of industrial policy is not just a Trump-driven phenomenon but has deeper roots in trends toward deglobalization, kinetic geopolitical conflicts, and growing state interventionism in the economy, particularly in strategic sectors. What are strategic sectors? One definition is that a strategic sector is one that governments decide is “too important to be left to market outcomes.”

Industrial policy has a long record in the US, good and bad, from World War Two, to the oil crisis of the 1970s, to the green industrial policy push of the Biden era. In assessing the Trump administration policy positions and actions so far, it is clear that the main focus of US industrial policy is targeting the manufacturing sector.

Reindustrialization also is politically powerful among Trump voters in red states, where the share of manufacturing jobs is high, both in the midwestern rust belt states and the non-union, low-cost states of the “new south.” In the 2024 election, Trump swept 13 of the top 15 states with the highest percentage of manufacturing workers in the overall workforce, according to BLS data.

The most common arguments against reindustrialization are that it won’t succeed because it will be too much of a costly, self-harming policy that disrupts existing North American and global supply chains and has inflationary effects for consumers. There are further arguments that the underlying deficits such as workforce, skills, and inputs such as raw materials and energy will make it hard to drive relocation of manufacturing from other jurisdictions. Lastly, there is a view that the ambition and complexity of a

⁴ This paper represents the individual views of Robert J. Johnston and does not necessarily reflect the views of Columbia University or the Center on Global Energy Policy.

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reshoring strategy might exceed the grasp of the Trump administration as it grapples with multiple challenges at home and abroad.

While these concerns are well-founded, the Trump administration is nonetheless pressing forward. Its key performance indicators include reductions in the trade deficit with major economic partners, but also a “scoreboard” of manufacturing related announcements, particularly that involving relocation from other markets. The administration also appears willing to tolerate some short-term consumer pain, with Treasury Secretary Scott Bessent stating that “access to cheap goods is not the essence of the American Dream.”

While tariffs are the most immediate and visible aspect of Trump’s reshoring strategy, there are several other policy tools that are critical. These include:

- **Energy** – On 20 January, the Trump administration issued an executive order declaring a “National Energy Emergency” – not unlike the “fentanyl crisis” used to justify the imposition of emergency (International Emergency Economic Powers Act of 1977 or IEEPA) tariffs. While the energy executive order had many components, manufacturing is central among them, with the call for “a reliable, diversified, and affordable supply of energy to drive our Nation’s manufacturing” and a reminder that the “ability to remain at the forefront of technological innovation depends on a reliable supply of energy and the integrity of our Nation’s electrical grid.” These policies are critical given that the oil shocks of the 1970s and electricity price shocks of the early 2000s were major drivers of the last round of deindustrialization in the US.
- **Currency** – The Trump administration is also focused on a weaker US dollar as a way to bolster US exports and make imports more expensive. This policy, sometimes linked to a potential “Mar-a-Lago Accord” would combine feature long-term debt restructuring with foreign holders of US Treasuries to induce a devaluation of the US dollar versus the currencies of major trading partners. These policies remain mostly theoretical but are seen by many market observers and Trump-linked advisors and outside economists as an important complement to tariffs.
- **Tax cuts** – The Trump administration is abandoning nascent efforts toward global minimum corporate tax begun by the Biden administration. It is also set to pursue an extension of existing 2017 tax cuts, including a proposed tweak that would lower the corporate tax rate from 21% to 15% for corporations that relocate their operations to the US from international markets.
- **Deregulation** – The Trump administration is also pursuing a permitting reform agenda that would fast-track approvals for energy and infrastructure projects and weaken provisions for outside interventions and court challenges. The

administration also seeks to weaken the overall burden of regulations through scaling back organizations such as the Environmental Protection Agency and shifting regulatory primacy back to the states.

- **Subsidies** – The potential pathways for expanding industrial subsidies are discussed in further detail below. These include both redirecting existing Biden-era critical minerals and manufacturing subsidies, as well as developing new policy tools such as the proposed US sovereign wealth fund.

It is possible that the above policies could fail to take root, effectively collapsing under their own weight. Or it could be, as many observers believe, an attempt to build leverage for tough negotiations through existing frameworks such as the United States-Mexico-Canada Agreement (USMCA). It is also possible that the reindustrialization strategy should be viewed through a sectoral rather than national framework – with Trump prioritizing sectors such as steel, aluminum, semiconductors, and autos, while taking a lighter approach in areas like solar panels or agricultural equipment.

Issues to watch:

a. Energy-intensive sectors

Steel and aluminum appear likely to be a main focus of Trump’s reindustrialization and reshoring tool kit, due to their political sensitivity in red states and the fact that there is significant holdover and momentum from Trump’s first administration. Whether countries like Canada and Mexico continue to be a target or whether sector-level pressure shifts back to China is uncertain. Trump’s April 2nd “Liberation Day” reciprocal tariffs suggest a more global approach.

For aluminum in particular, the energy dominance strategy will likely be critical. Reactivating idled aluminum smelters by waiving regulatory pressures for non-fossil-based energy and fast-tracking energy infrastructure development will be a focal point of policy. The Trump administration may also deploy subsidies and low interest loans to the aluminum industry through a critical minerals-related program (more on that below) and look to secure alumina and bauxite supply through state-backed agreements and investments in third party suppliers.

b. New North American economic and security frameworks

Canadian Prime Minister Mark Carney stated on 27 March that “Canada’s old relationship with the US is over.” The statement referred to both specific breakdowns on policy issues like trade as well as a broader sense that any kind of special relationship/closeness that the two countries had enjoyed were now replaced by a more transactional approach, similar to what the US has with most other nations.

While it is easy to observe that the old days/ways of doing business are gone, it is harder to pin down what comes next. Carney’s comments suggested that a broader realignment

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and renegotiation of the Canada-US relationship is likely to go beyond trade to include security. The security considerations will focus on border enforcement and the Arctic, as well as Canadian defense spending and contribution to NATO.

In the eyes of the Trump administration, a renegotiation is long overdue, not just with Canada but with other NATO members that have relied on a US security umbrella. A focus on border security is popular with Trump voters and the last serious US-Canada joint work on the border was after 9/11. The security dialogue would focus on new spending commitments and procurement from Canada. It is also possible the Trump administration could propose a new framework to succeed USMCA, such as a customs union or a Schengen-type common external border agreement. The differentiated 10% tariff on oil and potash under IEEPA suggests the Trump administration is mindful of the benefits of an integrated approach on energy and minerals, although it is still early days.

c. Critical minerals and industrial policy

The Trump critical minerals executive order, issued March 20th, elevates the importance of minerals processing, a long-standing source of bipartisan concern about US dependence on China in this domain. There is also a fear that China's dominance and ability to influence minerals processing markets make the sector too risky for private sector actors to develop on their own, particularly at scale. Trafigura CEO Richard Holtum suggested in the Financial Times on 25 March that smelting and processing "needs to have some form of government ownership or significant government support, because it is not competitive on an international basis comparing it to the Chinese smelters."

The proposed deployment of capital from the Development Finance Corporation and the Pentagon (via the Defense Production Act) through low-cost loans or even equity stakes is intended to establish a more level playing field for US smelting and processing projects, but it is not clear it will be enough. The Inflation Reduction Act and Bipartisan Infrastructure Law introduced an expanded range of investment programs, including through the DOE Loan Program Office, for critical minerals processing. Yet these programs generally targeted primary mining projects, recycling, or downstream battery component manufacturing. And the outlook for the IRA-funded programs is uncertain under the Trump administration.

The Trump administration may also, consistent with its larger reindustrialization strategy, seek to generate more domestic projects by imposing tariffs on refined metals from other markets. It will also provide fast tracking permitting both for smelting/processing projects directly and associated energy infrastructure. Even with

these measures, the hurdles to expand US critical minerals processing capacity remain high.

d. Defense minerals – the NATO strategy

With the G7 leaders meeting in Alberta, there is an opportunity to explore alignment and opportunities on energy security, industrial supply chains, and the defense industrial base. While the Trump administration wants to manufacture at home first, their second choice is Canada and G7 partners, especially in strategic sectors where the competition – or in some cases, threat – is China.

The defense element of critical minerals is crucial because the Trump administration has shown little interest in the contribution of critical minerals to electrification or the energy transition. This has marginalized, but not eliminated, the importance of lithium for example – perhaps contributing to the current massive collapse in lithium prices. The war in Ukraine, tensions in the Iran-Yemen-Gaza theater, and the risk of escalation in China-Taiwan are elevating the importance of military applications for minerals like tungsten and titanium. By contrast, the Trump administration is likely to pursue a new security framework across NATO, with a particular focus on defense spending and readiness. NATO has already elevated the importance of critical minerals in the defense strategy and readiness plans for the alliance, which provides a potential area for collaboration. In December 2024, it released its first ever list of 12 defense critical raw materials, prepared by the NATO Industrial Advisory Group.

Mineral	US Import Reliance	Canada % of US imports	Other NATO % of US imports	Chinese % of US imports
Aluminum	87	75	0	3
Beryllium	10	6	0	0
Cobalt	76	13	44 (Norway, Finland)	0
Gallium	100	17	19 (Germany)	19
Germanium	>50	23	49 (Belgium, Germany)	23
Graphite (Natural)	100	13	0	43
Lithium	80	0	0	0

Manganese	100	0	0	0
Platinum	85	0	31 (Belgium, Germany, Italy)	0
REE (metals and compounds)	80	0	5 (Estonia)	70
Titanium (mineral concentrates)	86	46	31 (Norway)	12
Tungsten	>50	0	14 (Germany)	27

Sources: US Geological Survey 2025 Commodity Mineral Commodity Summaries, Visual Capitalist

Summary:

Critical minerals and reindustrialization can pull in opposite directions. Critical minerals illustrate US vulnerabilities, as due to geological and market factors, it is a national interest unlikely to be resolved through a push for self-sufficiency alone. Manufacturing by contrast, while by no means exempt from cost and business risk related to reshoring, is easier to move than minerals in the ground. Whether through NATO, the USMCA, the Minerals Security Partnership, or bilateral relationships with important trading partners like Canada, the Trump administration will have opportunities to advance its industrial policy, defense, and critical minerals policy goals through international partnerships. The mix of carrots and sticks, and the appetite for multilateralism to be deployed in achieving these goals, remains to be determined.

A New Era of Global Competition: Investing in America Today, for the Future

Sonia Aggarwal

CEO, Energy Innovation

The Security Backdrop

Energy can be a potent weapon. Russia's fuel exports to some countries finance its physical aggression in Ukraine, and in other instances, Russia withholds fuel as a form of aggression. Europe has cut its fuel purchases from Russia to retaliate economically, leaving the bloc chasing other sources of fuel to reduce energy price spikes that make life harder for families across the continent. All of this stirs political unrest stretching far beyond the direct conflict.

President Trump has recently entered the scene, but this is nothing new. The United States has been enmeshed with the Middle East and its oil riches for more than fifty years, creating energy, economic, and security vulnerabilities with grave consequences for American families. Despite America's record production, global oil prices are in a substantial way controlled by a small number of nations that do not have our interests at heart, and when these volatile prices rise, we face serious economic and social consequences. Worse, American dependence on oil has funded terrorism, including the groups behind 9/11, bombing in Yemen, attacks in Syria and Israel, and so many more tragedies. Americans have footed the bill—and worse—for both sides of the War on Terror.

Coal, oil, and natural gas can extract this economic toll because fossil fuels have powered economic growth for the last century, dramatically expanding human capabilities and productivity. Picture one 500-horsepower car, then picture 500 horses. That's what's on call at the press of the gas pedal. If we powered the U.S. economy by burning matches, we'd need to strike 125 quadrillion every year (a quadrillion is a thousand trillion). That's every individual in America burning through 12 matches every second forever. The energy and industrial systems humans built around fossil fuels enabled incredible societal advances in the blink of an eye in human evolution.

Fossil fuels have been a force multiplier. They are stored in select regions of the world, ready for drilling or digging, at a steep cost for global security. Burning these fuels also costs us dearly in other ways – kids with asthma, crops drying up and dying, wildfires in Texas, megastorms that wipe away entire towns in North Carolina, families in Florida and Louisiana watching their nest egg vanish as the home they own becomes uninsurable, and on and on.

This is a heady record of benefits and drawbacks of fossil fuels, forcing painful trade-offs. Fortunately, new forms of energy have entered the scene, enabling us to avoid many of those painful economic and security drawbacks. Rapid technology cost declines and smart policy have made available proven options to power economic growth, and we're in the opening days of a domestic energy boom that's cutting energy bills, onshoring manufacturing, and supporting high-paying jobs across the U.S.

Last year, almost 95 percent of all power generation capacity added in the U.S. was solar, batteries, and wind. Looking forward, more than 85 percent of all new power projects in the queue for the next two years to meet growing demand are solar, wind, and batteries. To keep AI prowess at home, experts estimate we must build twice as many data centers in the next five years as we did in the last two decades.

John Ketchum, CEO of NextEra, one of America's largest power developers with fossil and clean energy alike in his fleet, has lamented that a new natural gas project can't get up and running until at least 2029, but "renewables are here today" – utilities can build wind in 12 months, battery facilities in 15 months, and solar in 18 months. And at CERAWeek 2025, he warned "if you take renewables and storage off the table, we're going to force electricity prices to the moon."

The Path Forward

Solar and wind are now the cheapest power sources on Earth, while battery costs have fallen 90 percent in the past decade, electric vehicles are confronting Americans' longstanding pain at the pump, and factory owners reduce pollution to secure their global competitiveness advantage. All this cuts our need for fossil fuels. The switch will not flip overnight, but the economic fundamentals have arrived.

The sun shines and the wind blows the world over, and it is possible to manufacture and deploy clean energy almost anywhere. Of course, raw materials—including common ones and some rare ones—are required to build clean energy, but the more time we spend looking for minerals, the more we find. In 2015, global lithium resources were 34 million tons.⁵ In the ten years since, those resources grew to 115 million tons⁶ – the difference? We really started to look. A similar phenomenon has happened with other minerals like nickel and copper.

The binding constraint on near-term availability of most of these materials is less about where they are located—many are common throughout Earth's crust—and more about who has the industrial capability to process them. Consider: China extracts just five percent of the world's nickel but refines and processes 35 percent of global demand,

⁵<https://d9-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/mineral-pubs/lithium/mcs-2016-lithi.pdf>

⁶ <https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-lithium.pdf>

extracts 13 percent of lithium but processes 58 percent, and extracts 1.5 percent of cobalt but processes 65 percent.⁷

The point is: China is investing in the capability to process the minerals needed for the future, even if they are importing much of the raw material. The U.S. and our allies could absolutely make more of these investments, which would pay dividends for our security and global positioning.

And one more thing—these minerals are relatively straightforward to recycle. They are not like fuels, which once burned, are spent. Investing in domestic mineral recycling capacity is a way to keep the (already-processed) minerals we import in the guts of high tech products inside our borders, ready to be used again to bolster our energy and national security.

We cannot trade dependence on Putin for dependence on Xi. Chinese policymakers are making strategic investments in critical minerals processing and manufacturing clean energy equipment. Nearly half of all vehicles sold in China last year were electric.⁸ China is the largest exporter of electric cars in the world, and recently became the largest vehicle exporter in general (combustion or electric)⁹ – overtaking Japan after beating out Germany.

Why? It is not just the price points they offer – it is also the availability of a range of high-end, modern, attractive electric cars. People are proving the world over that they want these cars. America cannot afford to fall behind.

The nations that win in this modern era of competition will be the ones that invest in innovation and manufacturing. They will be the ones that provide a high standard of living for their citizens with lower costs and lower pollution, shining a light on a better life. Doing this in our nation will help us shake the many security vulnerabilities generated by financing groups that hate America. This is not partisan, it is practical – it is where the world is going.

The Way to Win

According to JP Morgan, more than half of all private investment growth in America after the passage of the Inflation Reduction Act was from investments in our clean economy.¹⁰ Real investment in manufacturing construction has increased 130 percent in

⁷ Venditti, B. (2022, January 20). *Visualizing China's Dominance in Clean Energy Metals*. Visual Capitalist Elements.

<https://elements.visualcapitalist.com/visualizing-chinas-dominance-in-clean-energy-metals/>

⁸ <https://www.asiafinancial.com/one-in-nearly-every-two-cars-sold-in-china-was-electric-in-2024>

⁹ Hoskins, P. (2023, May 19). *China overtakes Japan as world's top car exporter*. BBC.

<https://www.bbc.com/news/business-65643064>

¹⁰ <https://am.jpmorgan.com/us/en/asset-management/adv/insights/market-insights/market-updates/on-the-minds-of-investors/how-might-the-us-election-affect-the-clean-energy-transition/#:~:text=Indeed%2C%20private%20clean%20investment%20has,barriers%20have%20been%20a%20constraint.>

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the past four years.¹¹ These trends are driving our domestic economy, cutting energy bills for people, and positioning America to compete and win in the modern global economy.

But, we risk falling behind. Take steel, for example, where the widely held impression that Chinese steel is low-quality, which masks impressive manufacturing progress. In 2019, Chinese steel company HBIS announced plans to build the world's first large-scale facility to make primary steel with hydrogen, using an Italian technology. That facility is running today, producing 600,000 tons of primary steel each year, with another 600,000 tons in the offing.¹² In 2023, Baosteel finished building its own 400 foot tall steelmaking furnace in Guangdong, with the capacity to produce another million tons of hydrogen-based primary steel.¹³ The volume of steel those two facilities alone can produce equals about 10 percent of the primary steel made in the U.S. annually today.¹⁴

Our allies are also making progress. Germany is leading. The German company Stahl-Holding-Saar (SHS) has made final investment decisions for a state-of-the-art clean steel facility in Western Germany.¹⁵ Salzgitter AG is building a zero-carbon primary steel facility with about \$1 billion in public support alongside the company's own \$1 billion investment.¹⁶ Beyond steel, Rio Tinto and Alcoa are investing \$1.1 billion in a zero-carbon aluminum facility in Canada, with about \$220 million in government support.¹⁷ But here's a red flag: The new aluminum factory in Canada uses a technology developed by an American company who was unable to find sufficient public support for demonstration in our country.

America should use its existing advantage over industrial materials manufactured in other places—our industries are already cleaner than Chinese industries, for example, steel made in America is the cleanest of the top seven global producers and Chinese steel

¹¹ <https://www.foreignaffairs.com/united-states/why-america-struggles-build>

¹² https://www.danieli.com/en/news-media/news/hbis-producing-dri-using-more-60-hydrogen_37_818.htm

¹³ <https://chinahydrogen.substack.com/p/chinas-first-1-million-ton-hydrogen>

¹⁴ Primary steel is a subset of total steelmaking, and refers to making new steel from iron rather than recycling steel. Much of the steel we make in the U.S. is recycled, but insufficient availability of scrap steel globally means primary steel will be required into the future. The U.S. currently makes approximately 23.5 million tons of primary steel each year.

¹⁵ <https://en.saarstahl.com/news/press-releases/next-step-in-the-transformation-central-plants-ordered-for-power4steel-europe-s-largest-decarbonization-project/?id=17507>

¹⁶ Salzgitter AG. (2023, May 24). *SALCOS® milestone reached - Salzgitter AG awards contract for direct reduction plant* [Press release].

<https://www.salzgitter-ag.com/en/newsroom/press-releases/details/salcos-milestone-reached-salzgitter-ag-awards-contract-for-direct-reduction-plant-20791.html>

¹⁷ Government of Canada. (2023, June 12). *Canada deepening its collaboration with global leader Rio Tinto to produce the world's greenest aluminum* [Press release].

<https://www.canada.ca/en/innovation-science-economic-development/news/2023/06/canada-deepening-its-collaboration-with-global-leader-rio-tinto-to-produce-the-worlds-greenest-aluminum.html>

is the dirtiest. The European Union adopted a Carbon Border Adjustment Mechanism to account for embedded pollution in industrial materials. America can confront this trade regime and similar actions other countries may take by leveraging our natural advantage – our industrial products are generally cleaner. Senator Cassidy has introduced an important bill that gets at this, as has Senator Whitehouse.

We can also consider trading clubs with environmental and labor standards for specific global commodities, including critical minerals. If designed and implemented well, this stimulates a race to the top, creating a more resilient supply of important commodities. Trade policy that accounts for pollution is an area of potential bipartisan cooperation that can position America to win globally, and support investment in our domestic industries to further modernize.

America will net geostrategic and economic returns from additional investment in mining and processing critical minerals, whose demand is on the rise. The U.S. has incredible lithium reserves, but lacks infrastructure to extract and process it at scale. Similar opportunities exist for other key minerals. Careful and proactive management of permitting and siting challenges related to new extraction projects here in the U.S. will be essential, and simultaneous investment in mineral refining and processing capabilities will pay off.

America can at the same time continue to invest in domestic innovation and manufacturing to set ourselves up to gain ground against China. We can work with our allies to build a resilient global supply chain for critical energy technologies—emphatically including renewables and battery storage, the most practical energy sources we have available, according to our nation’s power developers.

Policy that supports American manufacturing of strategically important products creates high-quality job opportunities, but it also accomplishes something else profound. A thriving manufacturing base provides the basis for world-leading innovation. Consider this: China manufactures lithium-based batteries at incredible scale. Now, Chinese researchers and companies are innovating in sodium-based chemistries that have long befuddled researchers elsewhere. Chinese researchers can walk across the street from their university to labs run by the world’s largest chemical manufacturers, and then stroll over to a nearby battery manufacturing line.¹⁸ These are the historically *American* benefits of maintaining a lively manufacturing base in critical areas.

We have the opportunity to regain technological leadership for critical energy equipment and minerals – the strategic industries of the future. Much more is needed to meet the moment and position America to win:

¹⁸ Bradsher, K. (2023, April 12). *Why China Could Dominate the Next Big Advance in Batteries*. The New York Times.

<https://www.nytimes.com/2023/04/12/business/china-sodium-batteries.html?smid=tw-share>
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1. Ensure that policies enacted in recent years that position America to invest in our domestic manufacturing base and the most practical sources of energy do not go by the wayside. This is important to ensure we have practical, abundant energy sources that maintain our AI edge and keep energy bills as low as possible for American families and businesses. It is also critical to provide the certainty needed for investors in multi-year projects just getting underway.
2. Enact new trade policies that accounts for America's natural advantage against Chinese competition – our industrial materials are less polluting. European tariffs are beginning to account for this pollution, and America could put in place its own tariffs accounting for pollution to counter China. Additionally, negotiating trading clubs for critical minerals and other critical energy technology is a near-term opportunity.
3. Dramatically increase domestic investment in modern, zero-pollution industrial facilities and mining and processing of critical minerals and materials.

The world's energy and industrial systems are changing. Fast. New bipartisan policy can position America to win globally in the new era.

Data Center and AI-Driven Demand Growth

Colette D. Honorable

EVP, Chief Legal Officer and Corporate Secretary, Exelon Corporation

Artificial intelligence (AI), once envisioned only in science fiction, is becoming commonplace in our offices and homes. Incredibly, the AI-enabled features of a modern world — from internet searches to chatbots to digital assistants — are all powered by an energy system that has been going strong for over 100 years.

Just as AI may be the most significant technological advancement of this century, the energy grid was the most important engineering achievement of the last. While the way the world produces power has evolved, how electricity flows — from power sources then over poles and wires to our homes and businesses — is largely unchanged from when the system was designed.

Electricity Demand

What has dramatically changed is the demand on that system. While no one has full visibility into the total amount of AI-driven electricity growth, all indications are that it will be substantial. The electricity needed to power a single traditional cloud computing chip is around 150W - the same as a powerful incandescent light bulb. The latest GB200 graphics processing unit (GPU) chips scheduled to ship from NVIDIA will require 2.7kW per chip, over 18 times the power draw. AI data centers also consume significantly more water and steel than their cloud computing data center cousins.

There are additional datapoints demonstrating how significant future AI electricity intensity will be. According to an Electric Power Research Institute (EPRI) study last year, data centers could consume 9% of total electricity in the U.S. by 2030.¹⁹ In the PJM Interconnection region — the grid operator with a footprint encompassing all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Washington D.C. — their most recent forecast expects the PJM summer electricity peak demand to climb about 70,000 megawatts (MW) to 220,000 MW, over the next 15 years.²⁰ To put this figure in perspective, the current summer peak record for the PJM footprint occurred in 2006 at 165,653 MW. PJM's existing installed generation capacity mix totals 181,533 MW. The scale of meeting this challenge should not be underestimated — one nuclear

¹⁹ *Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption*, EPRI, May 28, 2024.

²⁰ *Testimony of Asim Z. Haque, Sr. Vice President – Governmental and Member Services, PJM Interconnection*, U.S. House of Representatives Committee on Energy and Commerce, Subcommittee on Energy, March 5, 2025.

power plant produces just over 1,000 MW or the same amount of electricity needed to power around 1,000,000 homes. The load growth we observe today is unprecedented.

Policymakers, data center and AI developers, generation owners, electric utilities, and all stakeholders need to work together to meet this incredible moment in new electricity demand, which will require significant new investments in both generation and transmission and their associated supply chains.

Syncing Pace of Entry and Exit

To meet this moment of growth, the immediate need is to better sync the pace of energy generation additions to match the pace of new electricity load growth and generation retirements. PJM testified before the U.S. House of Representatives Committee on Energy and Commerce on March 5 about this challenge.²¹ According to PJM, they are seeing concerning trends with the pace of generation retirements far exceeding the addition of new generation being added to the system.

PJM's generation portfolio, which is largely owned by independent power companies and not fully regulated electricity utilities, is undergoing a significant transition. Dispatchable generators, which can respond to directions from grid operators regardless of weather, have recently been retiring at a rapid pace with few new dispatchable resources in the queue to connect to the grid. While there are consistent trends across the United States on the need to sync the pace of entry and exit, regions where states have turned over generation planning decisions to capacity market run by an organized market and grid operator, like PJM, are particularly challenged to replicate the attributes of retiring generators, including dispatchability, with similar attributes to replacement supply.

Affordability

Our country must win the race for AI dominance. Period. However, we also need to improve the standard of living for Americans by ensuring electricity is affordable. There are several considerations around affordability: sufficient available supply and thoughtful rate structures.

First, in their March testimony, PJM went on to say that as their reserve margin – the amount of excess supply available to navigate various operating conditions – continues to decline, prices are likely to increase further.

²¹ *Ibid.*

Second, thoughtful rate structures are needed in order to avoid cost shifts to existing customers. A key recommendation from last year’s Bipartisan House Task Force on Artificial Intelligence made this point:²²

“While meeting the significant energy demands of data centers is essential to economic growth and national security, it is also important to maintain affordability, reliability, and availability of electricity to customers. Protecting ratepayers from subsidizing these new large loads of technology companies should be a priority for utilities and grid operators.”

Recent proposals for co-location, a practice in which data centers are built next to a power plant, have gained attention. The Federal Energy Regulatory Commission convened a technical conference on the subject last November and rejected a precedent-setting interconnection agreement involving a data center and a nuclear generator. That agreement, which did not conform to standard terms, would have raised electricity bills for residential and other customers.

If data centers are connected to the grid — even if their first point of connection is a generator — they should contribute to the cost of the network infrastructure providing those services. Most data centers do just that. However, if co-located data centers are allowed to avoid the costs that all other customers pay, some estimates have shown that monthly electric bills for residential customers could increase by over \$50 co-location facility.²³

Equally important are elements of rate design that hold other residential, commercial, and industrial customers harmless in the event data centers close prematurely. Generation and transmission have expected lifespans in excess of forty years, and both are needed to support the addition of new data centers. The cost of these facilities are paid for by customers over an extended period. Safeguards to ensure existing customers are not forced to pick up the tab for generation and no-longer-needed transmission investments in the absence of the data center must be prioritized.

Winning the AI Race

The United States already has over 2,000 data centers online and connected to the electricity grid. Every state in the country has a data center located in it. Each of these 2,000 projects have taken careful planning and coordination. Yet we have also shown with each center that our country can successfully build while also preserving electricity reliability and prioritizing affordability.

²² *Bipartisan House Task Force Report on Artificial Intelligence*, U.S. House of Representatives, December 17, 2024.

²³ *Declaration of John J. Reed and Danielle S. Powers in FERC Docket No. ER24-2888*, Concentric Energy Advisors, November 6, 2024.

With their size and scale, however, AI data centers present new challenges. Policymakers can help the U.S. win the AI race by focusing on the following pinch points:

- **Promote Data Center Load Flexibility** – Data centers have very static, inflexible load profiles. Fostering flexibility in demand, particularly during times when the electric grid is under peak conditions, could result in quicker data center development and potentially eliminate the need for certain generation and transmission investments, ultimately reducing cost and leading to savings. According to a report by the U.S. Secretary of Energy Advisory Board last year, there are no examples of grid-aware flexible data center operations.²⁴
- **Encourage Reuse of Retired Generation Sites** - Support local communities and realize the benefits of brownfield development by streamlining the addition of new thermal and renewable generation and energy storage by eliminating regulatory impediments to re-using connections to the transmission system at retiring or retired generation sites. Generator replacement provisions have become a best practice in the parts of the country where they are implemented, especially where early community engagement is prioritized, communities realize economic benefits, and local environmental concerns are addressed.
- **Reduce Red Tape in Building Transmission** – New transmission development is a prerequisite to interconnecting new power generation and growing the economy. The current transmission planning processes do not support the rapid load growth needs of our customers today. In short, the federal rules designed to promote “competition” in the electricity industry are hampering our broader competitiveness in the global economy. This is one example where the regulatory framework in the U.S. is far too focused on meeting process requirements and not focused enough on achieving infrastructure development outcomes. PJM has recently proposed several reforms to support more timely development of transmission as well as generation, but more is needed – and soon.
- **Assess Why Needed Generation is not Materializing** – Electric utilities in the PJM footprint, which has seen tremendous data center growth

²⁴ *Recommendations on Powering Artificial Intelligence and Data Center Infrastructure*, U.S. Department of Energy Secretary of Energy Advisory Board, July 30, 2024.

in Virginia, Illinois, and Ohio particularly, generally serve customers through the transmission and distribution network they own and operate. Utilities in PJM, to a large degree, are currently dependent on competitive electricity suppliers to generate electricity that ultimately flows to customers. PJM's competitive framework, however, is not meeting the moment of growth. The competitive forces underpinning the value proposition of these markets are not producing market entry when it is needed most and when prices are signaling the need for new entry. Customers are feeling this imbalance.

- **Supply Chain** – Energy infrastructure needed to power data center development is currently produced across the world. Specialized equipment including large power transformers and electric generation equipment are also in high demand and require long delivery lead times. Ensuring our supply chains are robust and can ramp to meet our demand, especially in light of the worldwide need for this infrastructure, will be essential.
- **Permitting Reform** – Successful permitting is an ever-present prerequisite for building transmission, generation, and data centers. Depending on the project, federal agencies may have a permitting role alongside state and local entities. The need to address federal permitting broadly while also protecting the environment has been broadly recognized.
- **Training the Right Workforce** - Building a data center typically involves hundreds of construction jobs, including roles for engineers, electricians, HVAC technicians, and general laborers. In the U.S., a 100MW data center project can employ around 1,000 to 1,500 workers during peak construction periods. Once operational, a data center requires a workforce of 50-200 people for IT management, maintenance, security, and administration. Ensuring the U.S. can meet the demand for data center growth requires providing workforce development programs for skilled trades (electricians, steelworkers, HVAC technicians, plumbers) and IT professionals (structured cable installers, mechanical, civil, and environmental engineers, data center technicians, facilities management technicians).

The U.S. is well poised to meet this moment of incredible opportunity and economic growth. Doing so will require thoughtfulness about the needs of all customers and a recognition that the work we have done so well in the utility sector for over a century will continue to be a critical facilitator. Ensuring reliability, affordability, sustainability, and energy security must continue to be job number one today and in the future.



How can the US power AI?

Rob Gramlich
President, Grid Strategies
April 2025

Five-Year Load Growth Up Five-Fold to 116 Gigawatts

THE ERA OF FLAT POWER DEMAND IS BEHIND US ...

5-year load growth forecast increased by almost a factor of five, from 23 GW to 128 GW

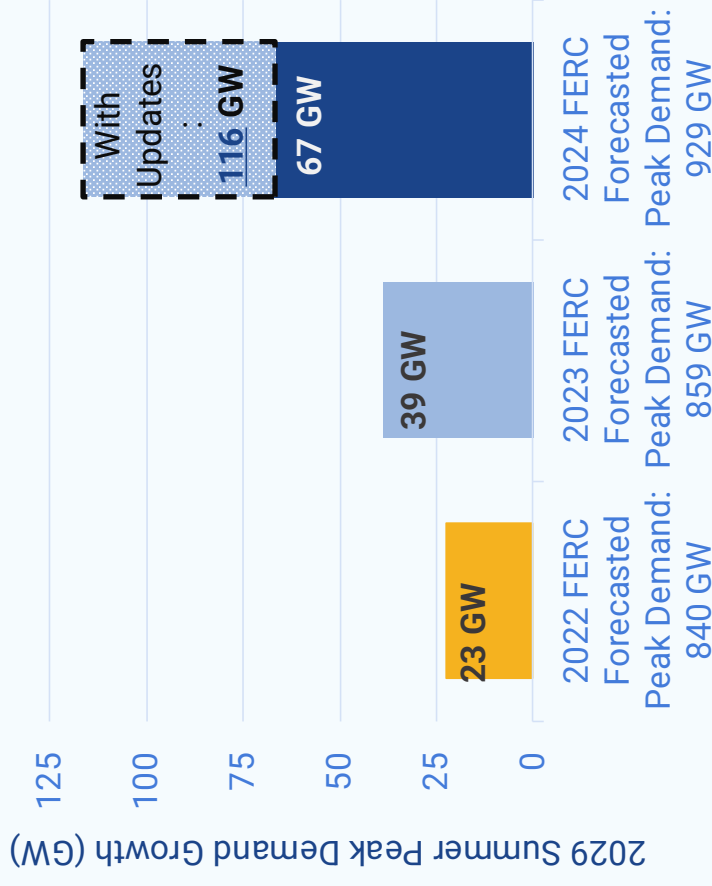
- Nationwide electric demand forecast to increase by 15.8% by 2029.

Key drivers are data centers and manufacturing.

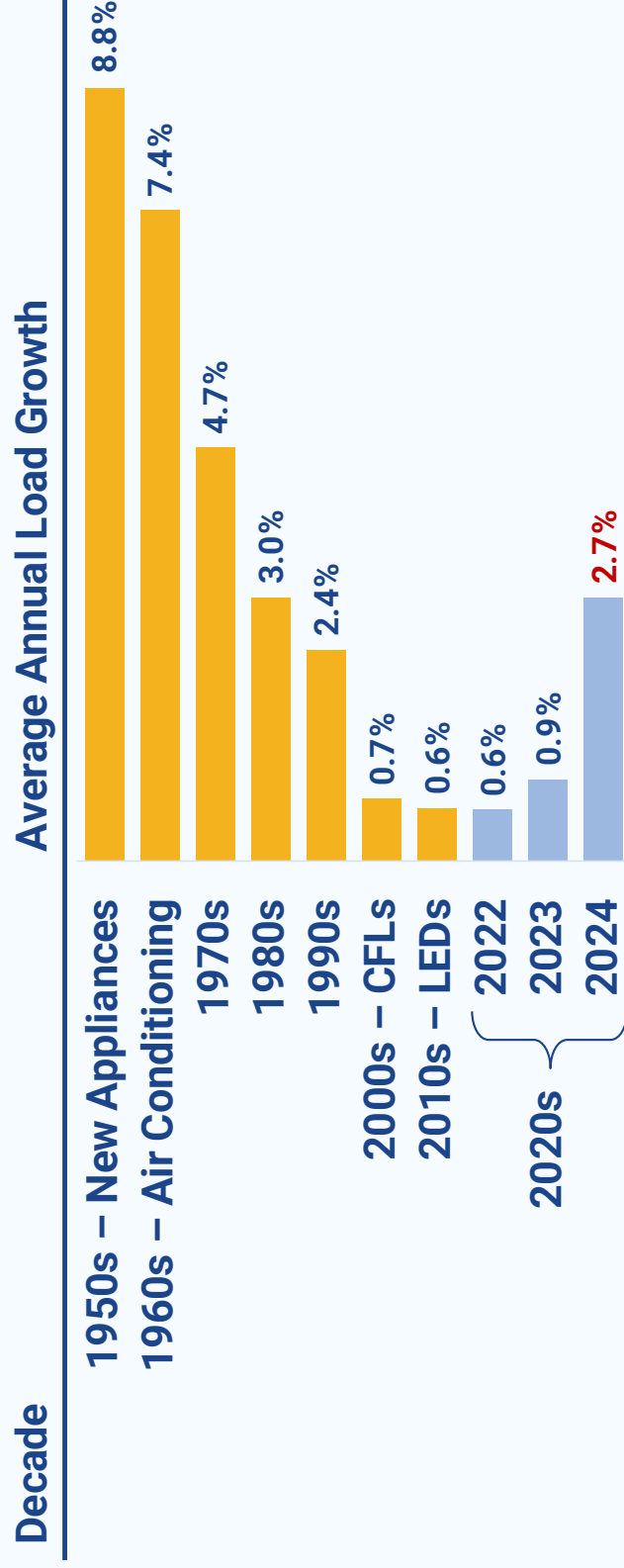
- Data center growth forecasts 65 GW (tech industry) to over 90 GW (sum of utility forecasts).
- Manufacturing demand forecasts ~20 GW growth, while electrification forecasts ~20 GW.

AND THE FORECASTS ARE MORE SHOCKING ...

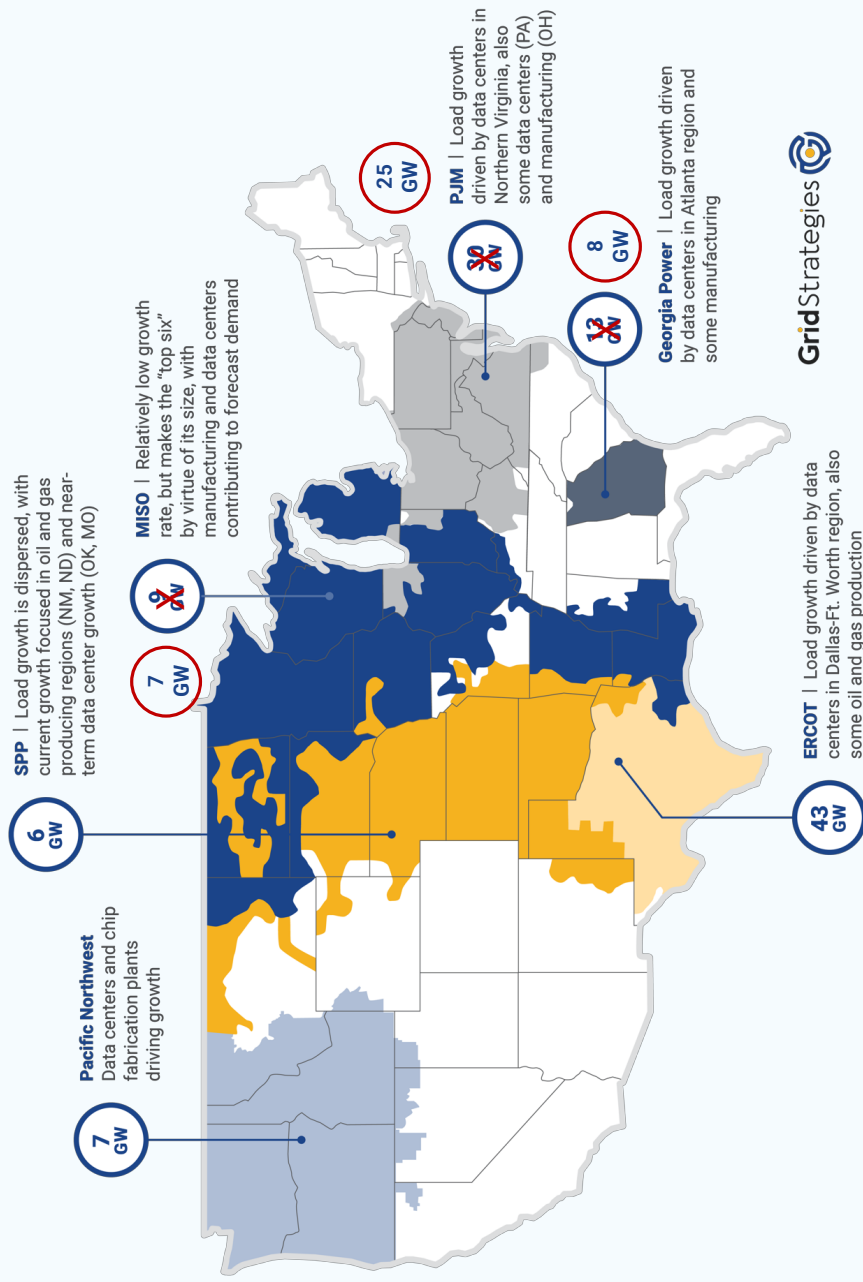
5-year Nationwide Growth Forecast



Load Growth Has Been Met Before, But Quantities are Bigger Now and Supply Options Are More Challenging



Six Regions Driving Load Growth Through 2029



Geographic Concentration of Data Center Development

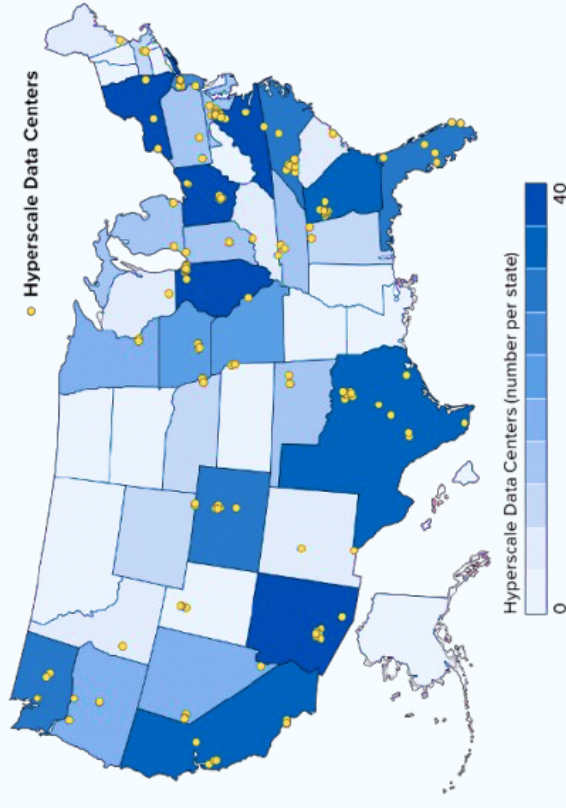
Estimates for additional data center demand vary from as little as 10 GW to as much as 65 GW.

15 states accounted for 80% of data center load in 2023 (source: EPRI)

Data center load growth is the single largest component of growth in utility load forecasts. These forecasts indicate that data center load growth will be concentrated in just a few areas:

- **Texas** – Dallas-Fort Worth area
- **PJM** – Northern Virginia and Pennsylvania
- **Georgia** – Atlanta area

Number of Hyperscale Data Centers by State (through 2023)



SOURCE | EPRI, [Powering Intelligence](#) (May 2024).

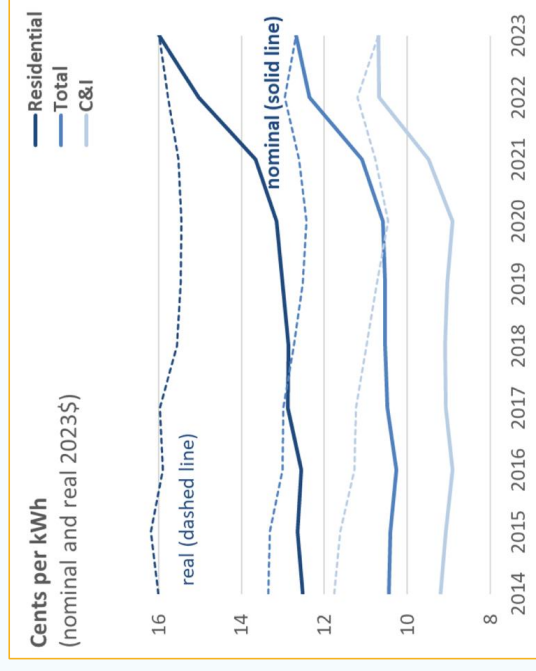
Retail rates likely to rise if we don't add transmission and generation supply to meet demand

Current rates mostly in line with inflation, but indications from utility rate filings suggest upcoming increases due to:

- **Asset replacement needs:** Higher costs for equipment and construction for Transmission and Distribution assets
- **Higher capacity prices as supply-demand balance tightens**
- **Storm and fire damage:** California, Southeast
- **Generation cost overruns:** Southeast

In nominal terms, U.S. avg. retail electricity prices rose by 0.2 cents/kWh (2.5%) annually. Most change took place from 2019-2023

U.S. Average Retail Electricity Prices over Time



SOURCE | LBNL, [Retail Electricity Price and Cost Trends](#), (December 2024).

State Policies on Large Loads to Reduce Ratepayer Impacts and Improve Forecasts

Common themes in new large load tariffs include minimum take requirements, exit fees, and direct contract with generation suppliers.

New large loads drive a need for large investments in generation and transmission infrastructure.

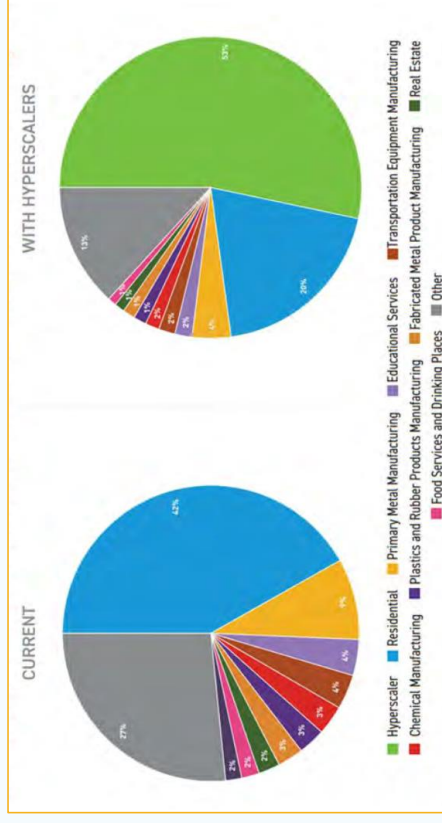
Utilities and regulators are turning to connection policies:

- Share infrastructure investment risk with large customers
- Ensure costs are not spread to existing customers
- Improve forecast quality

Examples:

- **AEP** has new policies on large loads in IN and OH.
- **NV Energy and Google** have jointly proposed a Clean Transition Tariff (CTT)
- **Duke Energy** partnered with large companies to develop the conceptual Accelerating Clean Energy (ACE) tariff

Hyperscale Data Centers Could Represent >50% of Indiana & Michigan Power Revenues



SOURCES | Indiana Utility Regulatory Commission, [Cause No. 46097](#).
Public Utilities Commission of Ohio, [Case No. 24-508-EL-ATA](#).
Public Utilities Commission of Nevada, [Docket No. 24-05022](#).
Utility Dive, [Rising Data Center Loads Pose Grid Reliability](#). Residential Cost Risks (November 2024).
Duke Energy, [Responding to Growing Demand](#). Duke Energy, Amazon, Google, Microsoft and Nucor
Execute Agreements to Accelerate Clean Energy Options (May 2024).

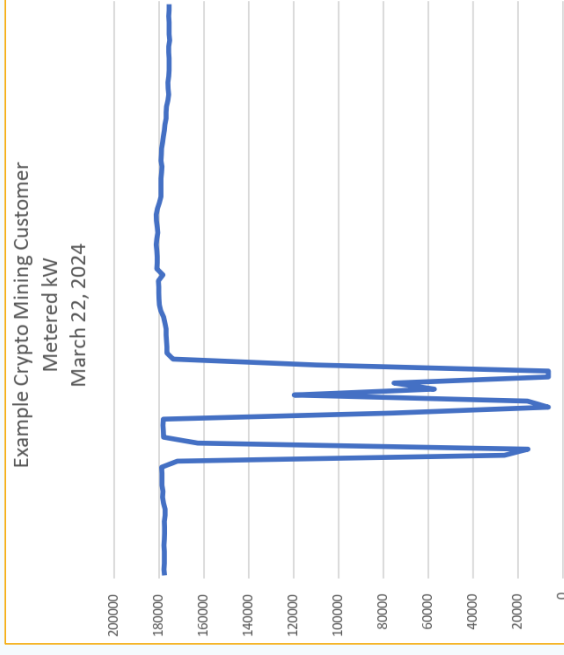
Reliability rule updates needed

NERC established a task force to address new, unique reliability risks associated with large data centers.

These risks include the impacts of large, rapid changes in system load caused by:

- **Price response** – Crypto mining operations can swing load by almost 100%.
- **“Ride-through”** – Data centers activate backup power systems on small changes in voltage (e.g., lightning)
- **Normal operations** – AI data center “training models” can create sharp load fluctuation in seconds

Planned data centers over 1 GW, totaling over 50 GW on individual systems, could cause reliability problems.



SOURCES | NERC, [Large Loads Task Force Work Plan Review](#) (October 8, 2024). David Ball (AEP), [Large Data Center Flexible Load Operational Impact Review](#) (October 8, 2024). Agee Springer (ERCOT), [Large Loads in ERCOT – Observations and Risks to Reliability](#) (October 8, 2024).

Adding Supply Quickly Requires FERC and Utility Generation Interconnection Reform

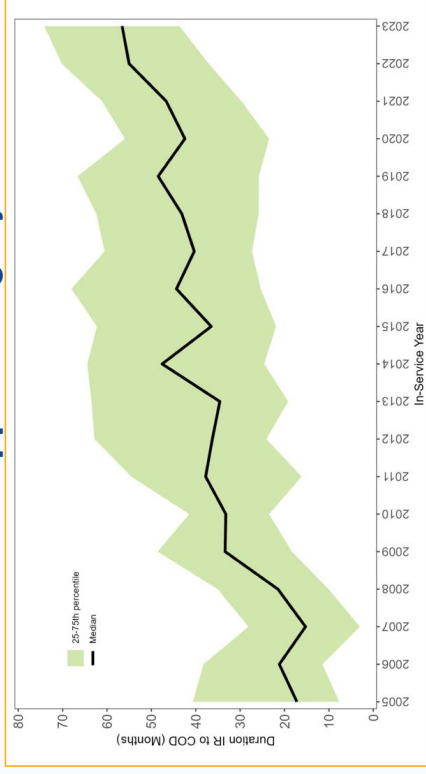
Speedy deployment of generation needs new entry fee and fast-track processes, plus optimizing the study and construction phases of interconnection.

New generation is not built fast enough to keep pace with new load, due to backlogged interconnection queues and pending construction of transmission upgrades.

Five reforms to address the interconnection backlog:

- **Certainty:** Implement a fixed interconnection entry fee for proactively planned capacity.
- **Utilization:** Adopt a fast-track process to use existing / already-planned interconnection capacity.
- **Efficiency:** Optimize the interconnection study process.
- **Construction:** Speed up the transmission construction backlog
- **Automation:** Expedite interconnection studies

3x increase in time to connect supply. The time between interconnection request and commercial operations continues to rise, with the median approaching 5 years.



SOURCE | Lawrence Berkeley National Lab, [Queued Up 2024 edition](#) (August 2024).

Four main supply options to serve data center load

FERC is actively evaluating this question, but industry consensus is already clear.

Option	Speed	Reliability
1 Onsite generation (behind the meter), disconnected from the grid e.g., Chevron-GE Vernova-Engine 1 building islanded gas	M	L
2 Behind the meter gas or hybrid generation, but grid connected e.g., GE Vernova gas retrofit in Pennsylvania	M	H
3 New load on the site of existing generation e.g., Microsoft + Crane Clean Energy Center	H	H
4 New load on the site of new generation e.g., Amazon funding four SMRs in Washington	L	H

Industry is pursuing grid-connected models

Generation options: What can power large loads?

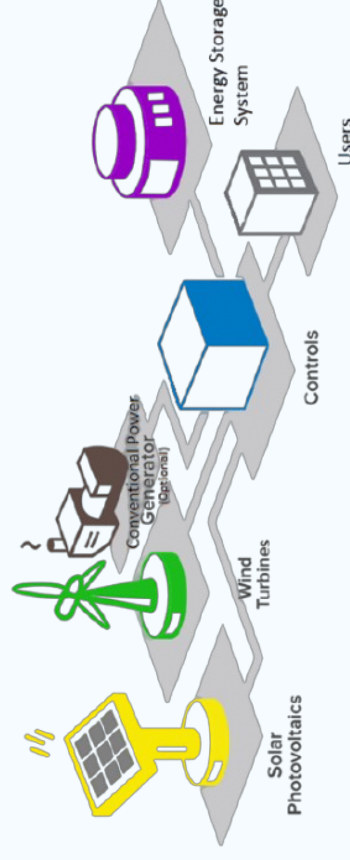
Various generation options exist...

- **Nuclear:** Firm and carbon free, but not ready for at least 8 years.
- **Natural gas:** Deployable now, but limited turbine availability.
- **Renewables:** Ready now, but limited on site supply and requires backup.
- **Coal:** Firm, but no US supply chain, workforce, or vendors, and no investors willing to take 40+ year emission/regulatory risks.



...hybrid, grid-connected solutions provide **reliable, scalable, diverse power.**

Blended models can use gas, renewables, and storage. No single solution will be enough; all require grid backup because all generators have outages.



SOURCE | Stelae Energy, [Hybrid Microgrids](#) (accessed April 2025).

Key organizations: Who does what?

Economic regulators		Market operators	Reliability regulator
FERC	Regulates all transmission and wholesale power markets in RTO areas, and the wholesale transmission and power sales for utilities in non-RTO areas	State PUCs Build and maintain safe, reliable, and high-quality electric infrastructure. Regulate most aspects of utilities outside of RTOs.	ISOs/RTOs Oversee electricity grid operations, wholesale market functions, and transmission planning across multi-state regions.
			NERC North American Electric Reliability Corporation ensures reliability of bulk power system

Other stakeholders

Includes those who develop and build transmission (i.e., utilities, independent developers), consumers (e.g., residential, commercial, industrial), independent power producers, environmental NGOs, and the clean energy industry.

Very little long-distance transmission has been built recently

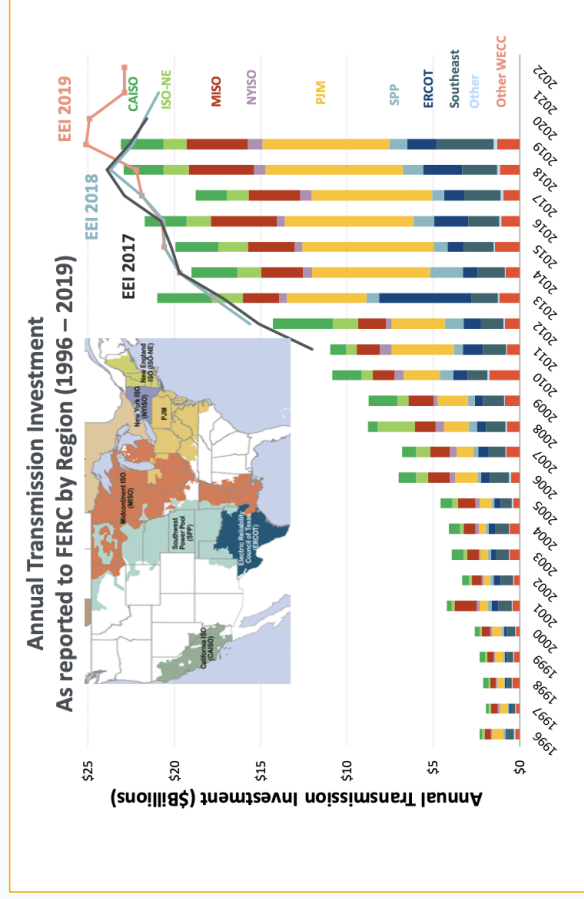
Many miles of new transmission in 2013, then dropped to a trickle...



SOURCE | Grid Strategies LLC, [Fewer New Miles](#) (July 2024)



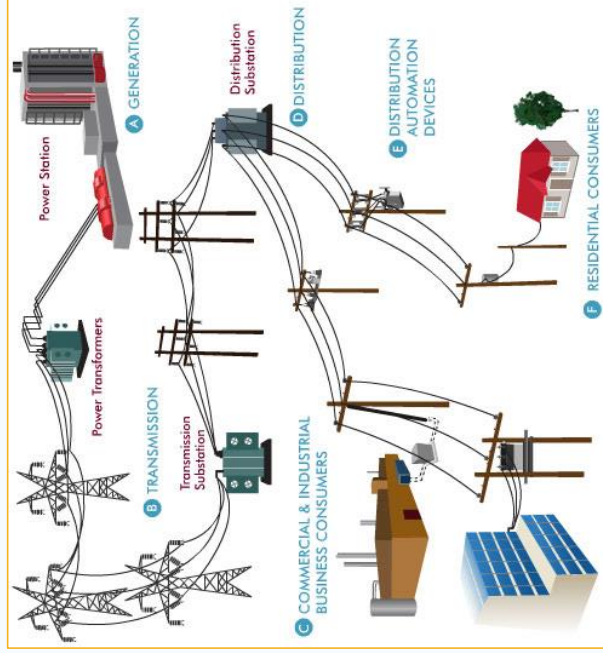
...with investment rising but capacity not increasing—mostly replacing aging assets



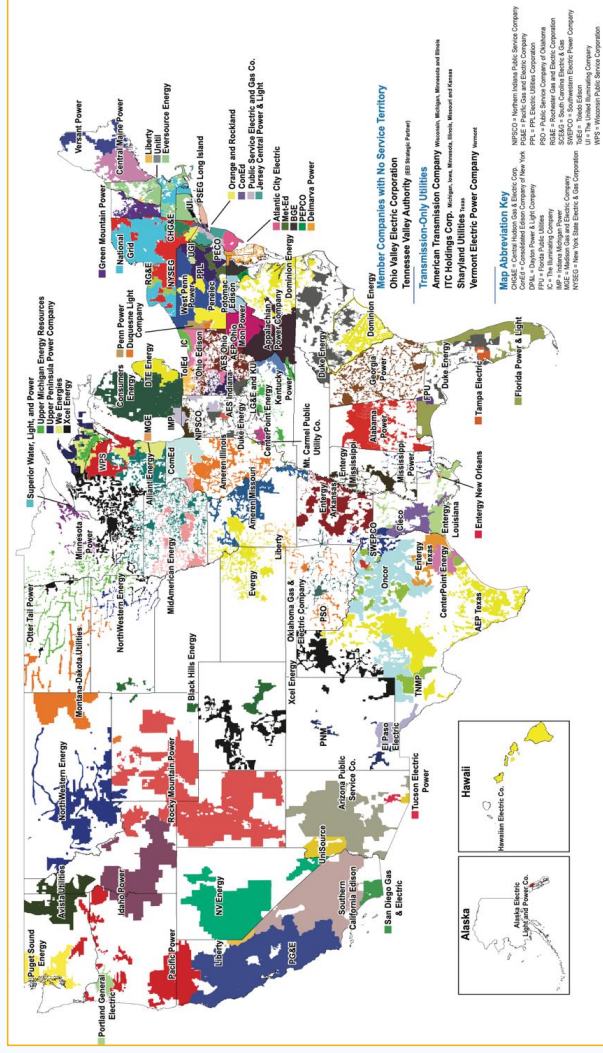
SOURCE | The Brattle Group, [Annual US Transmission Investments 1996-2023](#) (June 2024)

Fragmented US utility industry not designed to build large regional networks

Utilities operate individual systems...

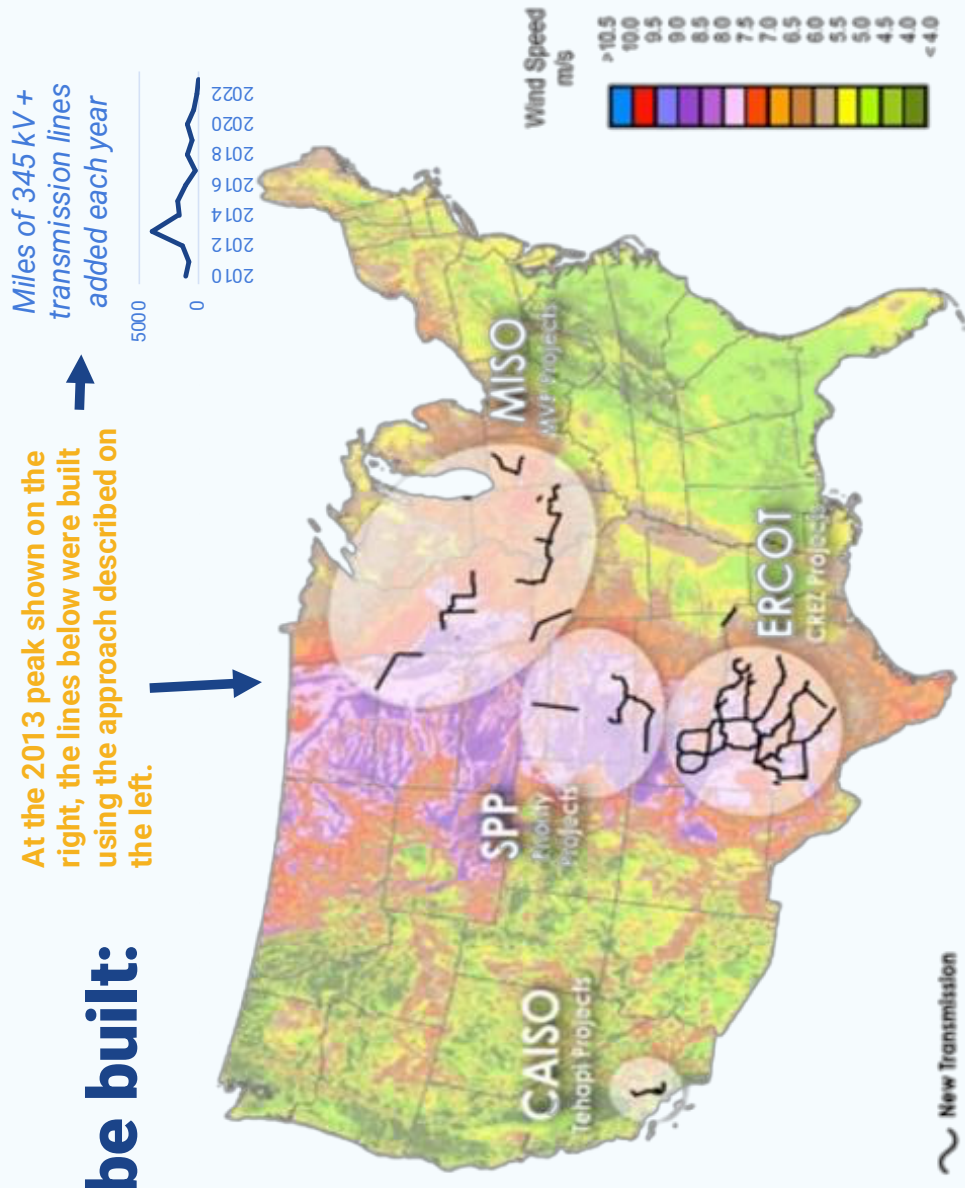


...with around 3000 separate utilities focused on their own small footprint



Big transmission CAN be built: Address the 3Ps

- **Planning:** Proactive, all electricity system benefits, probabilistic/scenario based, portfolio of network upgrades, all technology options, community engagement
- **Permitting:** Demonstration of benefits with credible regional authorities leads to high batting average
- **Paying:** Broad beneficiary pays cost allocation



Transmission option: more efficient High Performance Conductors (HPCs)

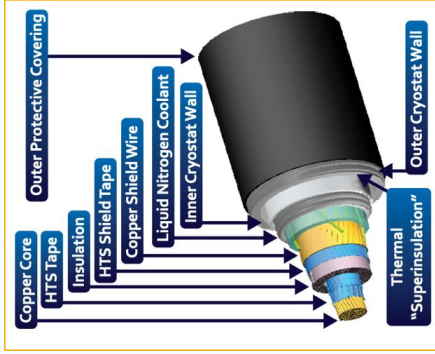
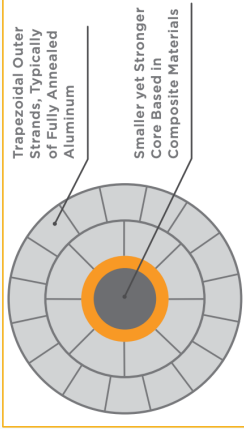
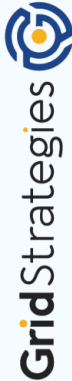
Carbon and composite core conductors

Overhead, bare conductors that use a trapezoid shaped wire of annealed aluminum to carry electrical current and use a carbon or

composite core for support, reducing sag and increasing power-flow capacity.

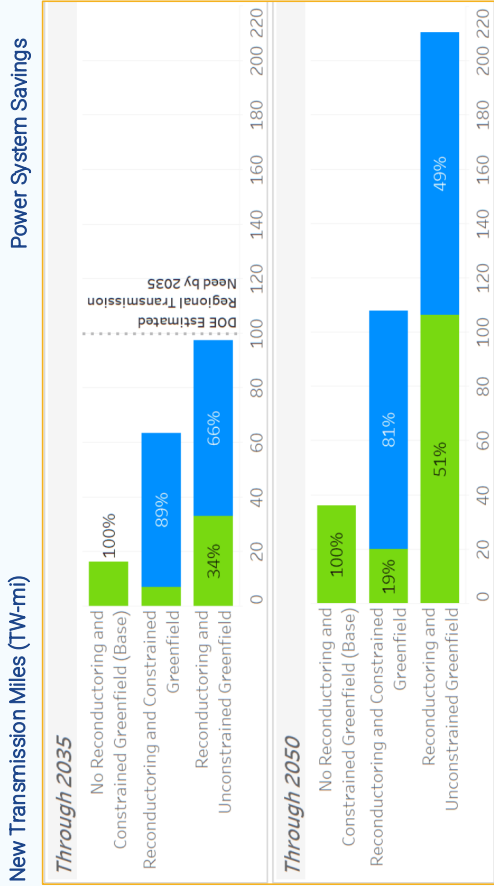
Superconductors

A class of metallic compounds that exhibit negligible resistive losses when cooled using liquid nitrogen, enabling very low losses and very high power-flow capacities.



Capacity Expansion with HPCs

Reconductoring generally takes 1–3 years and can 2x the capacity of a corridor at approximately half the cost of a new transmission line, while rebuild options can add significantly more capacity.



Source: GridLab, [Reconductoring Technical Report](#) (April 2024); ACORE, [High Performance Conductor Playbook](#) (October 2024).

Transmission: Delivering More for Less using Grid Enhancing Technologies

Grid Enhancing Technologies (GETs) are hardware, software, or both that dynamically increase the capacity, efficiency, reliability or safety of power lines, faster and at lower cost than traditional grid infrastructure.



Advanced Power Flow Control

redirects power to lines with extra capacity, preventing overloads and balancing the use of the grid.

- **2022 UK:** Unlocked 1.7 GW network capacity in UK, saving ratepayers \$500M
- **2023 New York:** Unlocked capacity for 185 MW of generation, with \$10M+ savings over legacy tech



Topology Optimization is software that finds the best use of grid infrastructure to redistribute power and unlock more capacity.

- **Alliant Energy 2025:** Reducing congestion costs by 50% in implementation since 2021
- **2022 SPP ex-post:** could resolve 98% of overloads in utility's territory



Dynamic Line Ratings (DLRs)

measure and calculate the true carrying capacity of transmission lines – often finding 20% or more capacity than assumed.

- **2022 Pennsylvania:** DLR increases line capacity by 25% on average.
- **2012 Belgium:** DLR increases capacity by 20%+ over 90% of the time

Incentivizing Resilience: Policy Strategies to Build Power System Resiliency and Reliability

Katie Dykes

Commissioner, Connecticut Department of Energy & Environmental Protection

Extreme weather events that result in major grid-scale power outages are becoming more frequent. These events are exacerbated by aging grid infrastructure that was not built to withstand these types of shocks, and when damaged, may take months or longer to fully restore due to lack of material availability. Nationally, weather-related debt issued for utilities has skyrocketed, totaling \$12.4 billion in 2022, compared with \$7 billion issued between 2002 and 2021.²⁵ These trends are impacting energy affordability, as portions of the recovery costs are passed down to consumers in the form of higher rates.

Some recent events that have caused extended power outages or involve utility infrastructure include:

- **January 2025:** Wildfires in Southern California caused catastrophic damage in the Pacific Palisades and Altadena areas of Los Angeles County. More than 18,000 structures were lost, and early estimates of total property damage range between \$95 billion and \$164 billion.²⁶ L.A. County has filed suit with Southern California Edison, alleging the utility's transmission towers sparked the Eaton Fire in Altadena.
- **September 2024:** Hurricane Helene in the Carolinas combined unusually strong winds with extreme rains that resulted in unprecedented flooding, leaving more than 5.9 million customers in 10 states without power. More than 300 substations were damaged or destroyed in North Carolina alone, which may take up to a year to fully restore. Duke Energy, the largest utility in NC, SC, and

²⁵ Thomas Keefe, et al. "Decoding the cost dilemma: How can electric companies navigate a shifting landscape?" Deloitte Insights. June 1, 2023, <https://www2.deloitte.com/us/en/insights/industry/power-and-utilities/rising-electricity-costs.html>

²⁶ Zhiyun Li and William Yu. "Economic Impact of the Los Angeles Wildfires." UCLA Anderson Forecast. March 3, 2025. <https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast/economic-impact-los-angeles-wildfires>

Florida, estimates the recovery cost for the 2024 hurricane season, including Helene, will be between \$2.4 and \$2.9 billion.²⁷

- **February 2021:** Extreme cold snap in Texas caused cascading impacts throughout the energy system – a spike in natural gas demand for heating, drawing supply away from gas-powered electric generating facilities, combined with icing and freezing of inadequately winterized components at power plants, wellheads, and fuel processing facilities – leading to a widespread energy emergency and the largest rolling blackout event in U.S. history.²⁸ Texas’s unique, isolated power grid lacks substantial connection and backup sources.
- **August 2020:** Extreme windstorm in the Midwest resulted in \$11 billion in downed communications systems, damaged residential gas connections, and damaged cooling towers at a nuclear power plant. Nearly 2 million customers lost electricity, some for several weeks, and internet service remained out for thousands of customers for more than a month.

Utilities, states, and the federal government must work together to invest in resilient power systems to reduce the frequency and duration of outages and infrastructure damage or failure. Taking a proactive approach will improve energy affordability for consumers and lower federal disaster recovery costs. This paper highlights six ways that the federal government can incent states and utilities to better plan for and proactively invest in a resilient grid:

1. Move away from constant disaster recovery by preserving and enhancing investments to protect critical infrastructure
2. Future-proof infrastructure with planning and design standards
3. Develop a robust national replacement supply chain system
4. Invest in grid infrastructure resilience to wildfires
5. Invest in advanced transmission technologies
6. Build back-up power for critical facilities including for national security assets

This essay discusses each of these policies with examples, where applicable, of how we have tried to advance these approaches in Connecticut.

²⁷ Mrinalika Roy. “Duke Energy Sees up to \$2.9 Billion in Hurricane Restoration Costs.” Reuters. November 7, 2024.

<https://money.usnews.com/investing/news/articles/2024-11-07/duke-energy-sees-up-to-2-9-billion-in-hurricane-restoration-costs>

²⁸ Federal Energy Regulatory Commission. “The February 2021 Cold Weather Outages in Texas and the South Central United States.” November 16, 2021.

<https://www.ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and>

1. Move away from constant disaster recovery by preserving and enhancing investments to protect critical infrastructure

Proactively preparing to avoid losses is economically more sustainable than continuing to rebuild after damage occurs. Mission critical utility infrastructure located in higher risk areas, such as in or near flood zones, may be prohibitively expensive to relocate, so protecting that infrastructure where it is already sited will be critical to maintaining services.

Building resilience has been a growing policy for the past decade and it is important for Congress and the Executive Branch to stay on this path. Federal funds spent on utility infrastructure resilience provide significant returns on investment. Looking across the federal Economic Development Agency grants for substation and power line resilience projects, the National Institute of Building Sciences²⁹ found that every dollar invested yielded a return of \$6 to \$9 in benefits. Two key federal funding programs have succeeded in incentivizing utilities and local governments to proactively invest in protecting power infrastructure from extreme events:

- **The Federal Emergency Management Agency’s (FEMA) Building Resilient Infrastructure and Communities (BRIC) grant program** has invested billions of dollars since launching in FY2020. This program funds resilient infrastructure protecting communities and community lifelines, which enable continuous operation of critical government and business functions essential to human health, safety, and/or economic security. Their projects include comprehensive protection of electrical substations and generation. FEMA BRIC was made possible by Congress’ passage of the Disaster Recovery Reform Act of 2018, which authorized the President, for each major disaster declaration, to dedicate to a pre-disaster mitigation fund an amount equal to 6% of the estimated total grants to be made for recovery.³⁰ Continuing to ensure the Executive Branch uses the 6% set aside requires adequate funding and program staffing to ensure prudent management and investment.
- **The Department of Energy (DOE) Grid Resilience and Innovation Partnerships (GRIP) Program** is a series of funding programs designed to strengthen and modernize America’s power grid against wildfires, extreme

²⁹ National Institute of Building Sciences. “Mitigation Saves.” 2019. https://www.nibs.org/files/pdfs/mitigationsaves2019_complete.pdf

³⁰ Congressional Research Service. “Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance.” August 6, 2024. <https://crsreports.congress.gov/product/pdf/IN/IN11187>

weather, and other natural disasters.³¹ This \$10.5 billion competitive grant program, authorized by the Infrastructure Investment and Jobs Act, funds utilities, grid operators, non-profits, and state and local governments. GRIP provides grants specifically for utilities, generators, and transmission owners to develop transformational solutions that reduce risks from extreme weather events, and higher educational institutions, state, and local governments to develop and deploy smart grid technologies. A separate, but related program, the *Grid Resilience State and Tribal Formula Grants* program, distributes funding to states, territories, and federally recognized Indian tribes based on a formula that includes factors such as population size, land area, probability and severity of disruptive events, and a locality's historical expenditures on mitigation efforts. These entities then award projects that provide affordable and reliable energy.³²

2. Future-proof infrastructure with planning and design standards

Building utility infrastructure takes time—and once constructed, we expect it to remain in service for many years (50+, for some assets). There is value in planning for changing conditions and the likelihood of damage not just today, but over the infrastructure's lifetime. To ensure that utilities are not always in recovery mode from extreme weather events, they can rebuild or replace with resilient measures in mind.

Unfortunately, there are no nationwide resilience standards to future-proof utility infrastructure for multi-hazard events. While some state requirements exist, the lack of uniform planning and building standards has left questions from utilities and states on what "prudent" guidelines are, such as how high to elevate a substation in or near a floodplain, methods to reduce wildfire risk from certain types of powerlines beyond temporarily cutting electricity, and who pays for resiliency measures. In the absence of guidelines, it is difficult for utilities and their regulators to agree on what level of investment is appropriate.

In Connecticut, following Hurricane Sandy in 2012, a major electric utility needed to reduce flood risk for a substation on a low-lying riverbank. The substation had to be powered down during the storm to avoid catastrophic damage, cutting off power supply to the state's most populous city. In the years following, it was determined the best strategy would be to relocate the substation further inland. At the time, there was no guidance from the federal government on how high to elevate a substation to account for sea level rise. The lack of planning standards caused permitting and approval delays and

³¹ U.S. Dept. of Energy. "Grid Resilience and Innovation Partnerships Program." <https://www.energy.gov/gdo/grid-resilience-and-innovation-partnerships-grip-program>

³² U.S. Dept. of Energy. "Grid Resilience State/Tribal Formula Grants Program." <https://www.energy.gov/gdo/grid-resilience-statetribal-formula-grants-program>

Aspen Institute Congressional Program

significant debate about appropriate project cost that could have been avoided had standards been in place.

Recently, the federal government has taken steps to provide uniform direction for planning and design standards. Flood risk standards, such as the Federal Flood Risk Management Standard formally adopted in July 2024 by FEMA,³³ help utilities better understand how to future-proof infrastructure by telling them what to expect. This includes hardening generation assets and right-sizing future infrastructure to withstand its designed lifespan.

In summer 2023, the Federal Energy Regulatory Commission (FERC) finalized two rules³⁴ establishing better guidance for transmission infrastructure. The rules will update national reliability standards to require planning for extreme heat and cold, among other weather risks, require detailed evaluation of the risks of extreme weather events, and mandate taking corrective action where risks are identified. Transmission providers must report on their policies and processes for conducting extreme weather vulnerability assessments and identifying mitigation strategies.

Utilities in some areas of the country are ramping up investment to replace aging infrastructure that is nearing the end of its useful life. Maintaining federal resilience standards for utility infrastructure increases the likelihood that asset replacement projects will be designed for a resilient future, instead of doubling down on existing vulnerabilities.

3. Develop a robust national replacement supply chain system

Whether we're rebuilding damaged infrastructure after a natural disaster or proactively building resilient infrastructure, robust supply chains will be critical to access necessary materials. This is particularly true for transmission and distribution system transformers and other grid infrastructure, which have suffered significant spikes in cost and delivery time. Order lead times for new transformers doubled from approximately one year in 2021 to over two years in 2024, with larger transmission transformers having lead times of up to four years.³⁵ The costs of new transformers have

³³ Federal Emergency Management Agency. "Federal Flood Risk Management Standard." <https://www.fema.gov/floodplain-management/intergovernmental/federal-flood-risk-management-standard>

³⁴ Federal Energy Regulatory Commission. "FERC Finalizes Plans to Boost Grid Reliability in Extreme Weather Conditions." June 15, 2023. <https://www.ferc.gov/news-events/news/ferc-finalizes-plans-boost-grid-reliability-extreme-weather-conditions>

³⁵ Kevin Jacobs et al., "Supply shortages and an inflexible market give rise to high power transformer lead times," Wood Mackenzie. April 2, 2024.

risen by 60% to 80% since the pandemic.³⁶ While utilities maintain replacement stocks, major disasters can strain inventory. For example, damage from Hurricane Helene required local utilities to replace thousands of transformers at once. In some instances, entire substations had to be rebuilt, a process that takes months to a year, even without recent supply chain shocks factored in.

States and the federal government play a role in addressing these supply chain issues. Through our participation in the Northeast States Collaborative on Interregional Transmission, Connecticut and nine other states plan to explore how states can collectively and proactively purchase critical grid infrastructure in bulk to ensure availability and potentially reduce costs on a per unit basis. The focus of that collaborative is on certain high-voltage technologies with lead times as long as ten years, but such a framework can be applied to other grid infrastructure. However, aligning different jurisdictions and associated utility regulatory structures will make a fully state-driven solution especially complicated.

The federal government could ensure that states have access to equipment necessary to quickly restore the grid following a natural disaster. This would not be a federal giveaway to states. Utilities would repay the federal government for these purchases, and ratepayers ultimately benefit because the federal government has stronger negotiating power to secure lower per unit costs and an appropriately-sized stockpile to ensure sufficient capacity to respond to natural disasters.

4. Invest in grid infrastructure resilience to wildfires

Wildfire risk has long impacted the West, but is rapidly becoming a national problem, with occurrences rising across the East, Midwest, and South. In 2024, parts of the Northeast experienced their worst fire season on record, with fires breaking out in late fall rather than the typical early spring. In October and November 2024, Connecticut more than tripled the state's previous record for number of wildfire starts and acres burned. While the state did not experience damage to its utility infrastructure during the fires, awareness of wildfire risk and future damage potential is increasing.

A pressing issue highlighted by the experience of Western states is how to manage the extensive costs associated with response, recovery, and utility liability. Since 2017, Southern California Edison has settled wildfire claims totaling more than \$6 billion. A January 2025 rate hike sought by the utilities seeks to reclaim \$1.6 billion from ratepayers.³⁷

<https://www.woodmac.com/news/opinion/supply-shortages-and-an-inflexible-market-give-rise-to-high-power-transformer-lead-times/>

³⁶ Jacobs, et al., 2024

³⁷ Caroline Petrow-Cohen. "What the Eaton fire could mean for Edison's bottom line." Los Angeles Times. February 11, 2025.

<https://www.latimes.com/business/story/2025-02-11/the-future-for-edisons-bottom-line-after-the-fires>
Aspen Institute Congressional Program

Without mechanisms to address costs and liability, utilities risk falling into a vicious cycle — where capital is diverted away from investments that could safeguard against future events (e.g., vegetation and tree trimming, infrastructure hardening, use of innovative monitoring technologies) — increasing the financial risks borne by the utility (and ultimately, ratepayers) and states.

One state has developed a model to address this issue. In 2019, after Pacific Gas & Electric underwent bankruptcy triggered by \$30 billion in liabilities, California lawmakers created a wildfire emergency fund, which is capitalized with a fee on power bills and reimburses eligible utility claims.³⁸ To participate, utilities must earn safety certifications and perform work to mitigate fire risk prior to wildfire season.

Expanding this model nationally using federal resources could incentivize participation and better manage costs, while still incenting utilities serving high risk areas to mitigate fire start risks from their infrastructure. This is especially important for states that don't have proactive wildfire planning and utility coordination due to a perceived low risk.

5. Invest in advanced transmission technologies

Transmission is another area where the federal government can complement efforts underway in the states. A robust and resilient transmission system is critical to the health, safety, and economic development of the nation. When developing this infrastructure, we must ensure that we're doing so as cost-effectively as possible. This means planning for knowable contingencies, including wildfire ignition and/or infrastructure damage.

Advanced transmission technologies show great promise in mitigating these issues. For example, advanced conductors sag less than traditional counterparts, which reduces the risk of contacting material that can ignite. Other advanced transmission technologies can more quickly notify transmission operators when infrastructure is at risk from ongoing wildfire.

These technologies have immense potential to reduce consumer costs in the long run by increasing the ability to transmit more electricity through existing lines (often with relatively inexpensive equipment). Aging transmission infrastructure can also be replaced with advanced conductors, a type of transmission line that utilizes a lighter core (typically carbon fiber) rather than the traditional steel, and as a result, can transmit up to twice the amount of power through the same corridor.

³⁸ Taryn Luna. "California utilities agree to pay \$10.5 billion into new wildfire fund." Los Angeles Times. July 25, 2019.
<https://www.latimes.com/california/story/2019-07-25/california-utilities-agree-to-pay-10-5-billion-into-new-wildfire-fund>

FERC recently required system operators to begin incorporating advanced transmission technologies into transmission planning processes. As different regions implement these reforms, best practices get established, and lessons learned are applied, there may be opportunities for Congress to provide direction around how opportunities for these innovative technologies should be identified, considered, and deployed to increase reliability and decrease costs for ratepayers.

6. Build backup power for critical facilities including for national security assets

While we work to make power systems as resilient as possible to prevent an outage, completely avoiding damage may not always be possible or cost-effective. A reliable source of backup power, particularly for critical facilities supporting life, safety, and economic viability, is an essential part of a resilient power system.

Microgrids, which can operate and provide power while being disconnected from the local grid, have become a popular option to provide backup power for critical facilities.

The most recent microgrid to be operational in Connecticut – supported in part by Connecticut’s first-in-the-nation microgrid grant program – is providing backup power to facilities supporting national security at the Naval Submarine Base in New London, CT. Previously the base was using unreliable polluting diesel generators for power in an outage. Utility costs account for 38% of the Navy’s shore budget. The savings from a microgrid’s energy efficiencies can unlock significant resources for other purposes.³⁹

While the installation in New London was powered by gas fuel cells, microgrids can also be powered by renewables through solar and battery storage technology. Battery storage paired with solar power can also back up homes and businesses, making this technology a highly versatile tool to improve energy resilience for communities. Congress can support programs funding microgrids and other reliable sources of backup power for critical facilities by making it an eligible approach to upgrades in federally-owned and operated infrastructure, like the Navy submarine base, as well as through federal grant programs.

In sum, affordable and reliable electricity is fundamental to U.S. competitiveness and quality of life. As the costs of disaster recovery mount, it’s important to maintain the federal infrastructure grant programs like FEMA BRIC and DOE GRIP that are catalyzing proactive state and utility investment in resilient infrastructure. Federal planning standards help streamline debate about project design, accelerating deployment and “future-proofing” the replacement of aging infrastructure (including

³⁹ Brian Scott-Smith. Submarine Base Powers Up Its Own Microgrid. CT News Junkie. October 24, 2024. <https://ctnewsjunkie.com/2024/10/24/submarine-base-powers-up-its-own-microgrid>

with the use of advanced transmission technologies). Leveraging federal solutions to supply chain bottlenecks for grid components can speed restoration and keep costs down. As wildfire risk becomes a concern for eastern and western states, demand for national solutions grows. In each case, proactive solutions to spur resilience investment are needed to reduce future disaster recovery costs and secure the reliable, affordable electric supply that residents and businesses depend on.

Resilience Requires Deploying “All-of-the-Above”

Jason Grumet

CEO, American Clean Power Association

It's time to join behind a true “all-of-the-above” energy strategy that lowers prices, creates jobs, and supports our national security.

Overview

Resiliency requires “all-of-the-above.”

The strategies for near-term and sustained success are simple to describe and hard to achieve.

We must support and accelerate all sources of shovel-ready renewable resources, energy storage, and natural gas generation while urgently building new electricity transmission and natural gas distribution infrastructure. We must bring equal urgency to accelerate the development and deployment of new nuclear generation capacity and fossil generation with carbon capture.

However, the necessity to embrace all American resources will only occur if both parties move beyond the idea that hydrocarbons and electrons have political affiliations. Absent greater policy consistency, no energy source will secure the hundreds of billions of dollars required to make the required long-term investments. It is time to join behind a true “all-of-the-above” energy strategy that lowers prices, creates jobs, and supports our national security.

To meet growing demand, we need to build more, and fast. This is more than a reliability issue, but a national security issue, with implications for US competitiveness in the global sphere.

- 1. Demand is Skyrocketing:** New generation and transmission are required now.
- 2. Renewable Power Can Scale Now:** New fossil and nuclear are not available until 2030-2040.
- 3. Resource Diversity Strengthens Reliability:** Intermittent resources strengthen the grid.
- 4. Must Reform the Permit Process:** Transmission and pipeline infrastructure buildout must be accelerated.

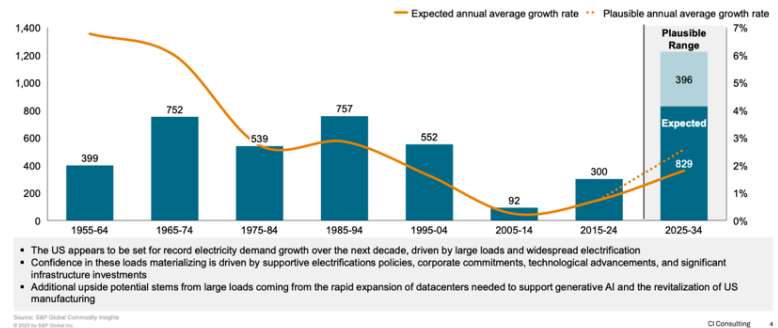
1. Demand is Skyrocketing:

- **Unprecedented Demand Growth.**

A new S&P Global Commodity Insights report⁴⁰ projects U.S. electricity demand will surge by 35-50% between 2024 and 2040—driven by a surge in data center construction, new manufacturing activity, and the electrification of transportation and heating. This projection accounts for energy efficiency measures and behind-the-meter solar deployment, which will help mitigate more drastic growth.

US power demand has gone through periods of slow and rapid growth, but the coming decade will see more absolute electricity demand growth than ever before in US history

Growth in US electricity consumption, 10-year periods
10-year growth (TWh)



- **To meet this growing need, we need to act, and fast, to unleash American energy abundance.**

2. Renewable Power Can Scale Now:

- Clean energy, like solar and wind, plus batteries will meet much of the new capacity in the short term as they are growing rapidly, are affordable, and can scale efficiently to meet increasing demand. In each of the reference cases in the recent Demand Growth Study, renewables and batteries were by far the main source of supply, given their availability, low-cost, preference from consumers, and policy support.”⁴¹
- **New Natural Gas and Nuclear Power are critical to meet mid to long term demand, but nuclear restarts won't appear until 2027-2030,**

⁴⁰The report was commissioned by the American Clean Power Association, American Petroleum Institute, Alliance to Save Energy, Clean Energy Buyers Association, Nuclear Energy Institute, the U.S. Chamber of Commerce, and the National Electrical Manufacturers Association (NEMA).

⁴¹ "U.S. National Power Demand Study Executive Summary", S&P Global, March 2025, https://cleanpower.org/wp-content/uploads/gateway/2025/03/US_National_Power_Demand_Study_2025_ExecSummary.pdf

natural gas until after 2030, and small modular nuclear power until 2035+.⁴²



Source: Brattle Group Report, “A Wide Array of Resources is Needed to Meet Growing U.S. Energy Demand”, February 2025

- Backlogs and supply chain constraints impact how quickly **new gas** can be deployed. All major gas turbine manufacturers have backlogs for new turbine deliveries that stretch to 2029 or later. There is also hesitancy to over-commit on building out capacity, only to have the environment become less receptive down the road. Most larger companies are responding conservatively to the increased demand, and companies remain hampered by supply chain constraints that limit how much can be built and built quickly.⁴³
- **New nuclear** development also faces longer growth timelines due to complex licensing, certification, and construction requirements.

3. Resource Diversity Strengthens Reliability:

- While intermittency of renewable power is a factor that must be addressed in the design of resilient systems, available data indicates that the addition of renewable energy to systems is enhancing reliability. While there are limits to the ability to integrate renewable energy absent technology and infrastructure improvements, renewable energy is currently only 23.9% of domestic generation capacity. The rapid progress in energy storage and transmission build out are enabling greater

⁴² Brattle Group Report, “A Wide Array of Resources is Needed to Meet Growing U.S. Energy Demand”, February 2025, <https://www.brattle.com/wp-content/uploads/2025/02/A-Wide-Array-of-Resources-is-Needed-to-Meet-Growing-US-Energy-Demand.pdf>

⁴³ Arun, Advait, “The Natural Gas Turbine Crisis”, Heatmap News, February 26, 2025, <https://heatmap.news/ideas/natural-gas-turbine-crisis>

renewable energy reliance. The addition of clean gas and new nuclear over the coming decade will further strengthen a multi-technology energy system.

- To paraphrase Winston Churchill, there is security in diversity and diversity alone.⁴⁴

4. Must Reform the Permit Process:⁴⁵

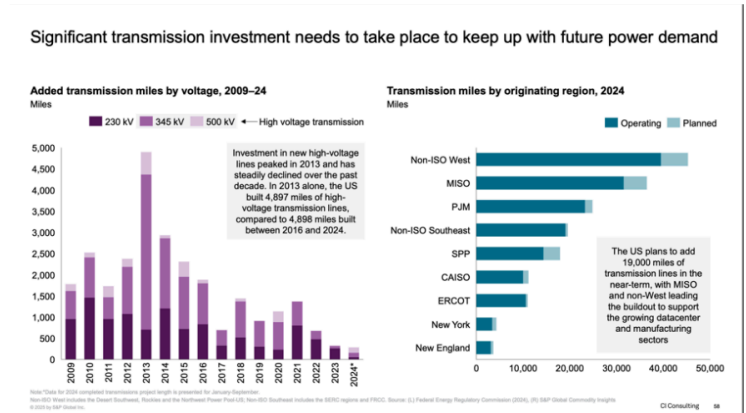
- To meet growing demand, we need to build more, and fast – and we need to be able to connect it to the grid. To fully unleash our nation’s energy abundance, we need to make the bureaucracy more efficient for American resources.

Currently, the ability to respond to new demand growth is constrained by siting and permitting barriers.

- Construction of new high-voltage transmission in the U.S. has slowed to a trickle over the past decade.⁴⁶

There are a lot of reasons we’re behind on this – the Energy Permitting and Reform Act was important, but didn’t pass. A slow, inefficient permitting process is preventing the U.S. from deploying more clean energy and building new power-transmission lines needed to deliver electricity nationwide.

- **Permitting:** It currently takes on average 4.5 years for an energy project and 7.5 years for a transmission project just to get the required permits needed to build. Clean energy investments, development, and deployment are being obstructed



Source: S&P Demand Growth Study, March 7, 2025

⁴⁴ Crooks, Ed, “Rethinking Energy Security”, Wood Mackenzie, April 4, 2022, <https://www.woodmac.com/blogs/energy-pulse/rethinking-energy-security>

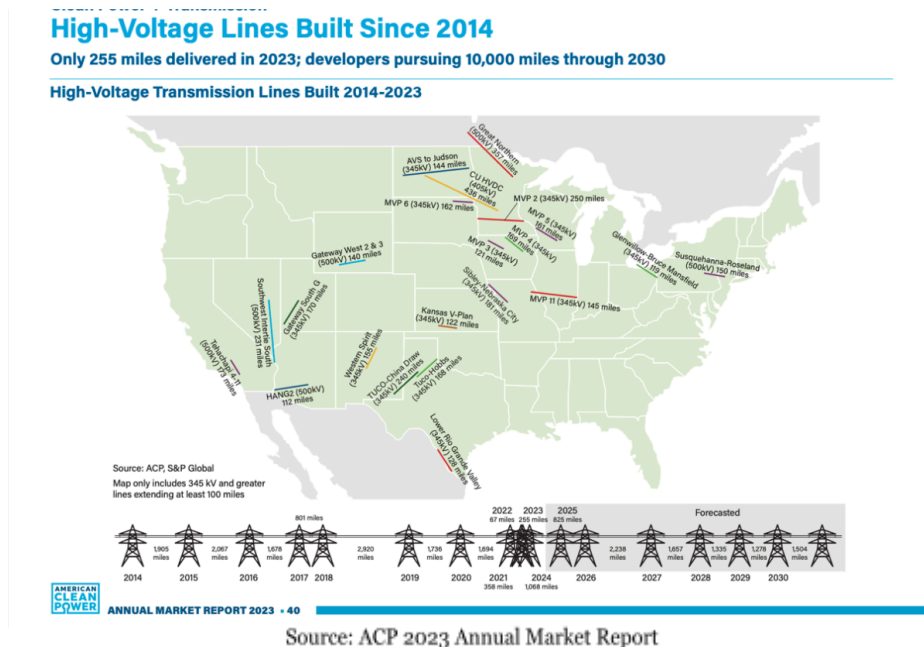
⁴⁵ “ACP Permitting Reform Fact Sheet”, ACP, August 2024, https://cleanpower.org/wp-content/uploads/gateway/2024/08/ACP_Pass-the-Energy-Permitting-Reform-Act_Fact-Sheet.pdf

⁴⁶ Shreve, Nathan; Zimmerman, Zachary; and Gramlich, Rob, “Report: Fewer New Miles: The U.S. Transmission Grid in the 2020s”, Americans for a Clean Energy Grid, July 2024, <https://cleanenergygrid.org/portfolio/report-fewer-new-miles-the-u-s-transmission-grid-in-the-2020s/>

due to this broken system. In 2023, over 60,000 megawatts (MW) of clean energy capacity experienced various permitting delays.⁴⁷

- **Transmission:** The U.S. needs more transmission lines. However, the current structure for permitting, planning, and paying for these lines that cross state and/or regional boundaries is unworkable and needs to be reformed. For example:
 - TransWest Express transmission line—took 15 years to get permitting approval.
 - SunZia transmission line—took 17 years to get permitting approval.
 - Pine Ridge Reservation transmission line—took 20 years to get permitting approval.

The pace of adding new transmission to the grid has slowed substantially. According to the American Clean Power Association (ACP)’s 2023 Annual Market Report, only 255 miles of high voltage transmission were delivered in 2023, and 67 miles were delivered the year prior. Those amounts are in stark contrast with the 10,000 miles developers are pursuing through 2030.⁴⁸



- **National Security Impacts:** This is not just a reliability and transmission issue; it’s a national security issue. Between 2014 and 2021, China had planned or completed over 80 times more high-voltage transmission interconnections than

⁴⁷ “ACP Permitting Reform Fact Sheet”, ACP, August 2024

⁴⁸ “ACP Annual Market Report 2023”, ACP, March 7, 2024,

<https://cleanpower.org/resources/clean-power-annual-market-report-2023/>

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the U.S., which developed a mere 3 gigawatts (GW) over that period. On interregional transmission development: the U.S. is the tortoise; China is the hare.⁴⁹

- Current permitting processes impact the build-out of essential energy infrastructure, compromising national defense, economic stability, and America's competitive edge. Reforming these processes could streamline approvals, enabling timely modernization of our grid to meet national security needs and secure U.S. military readiness.⁵⁰

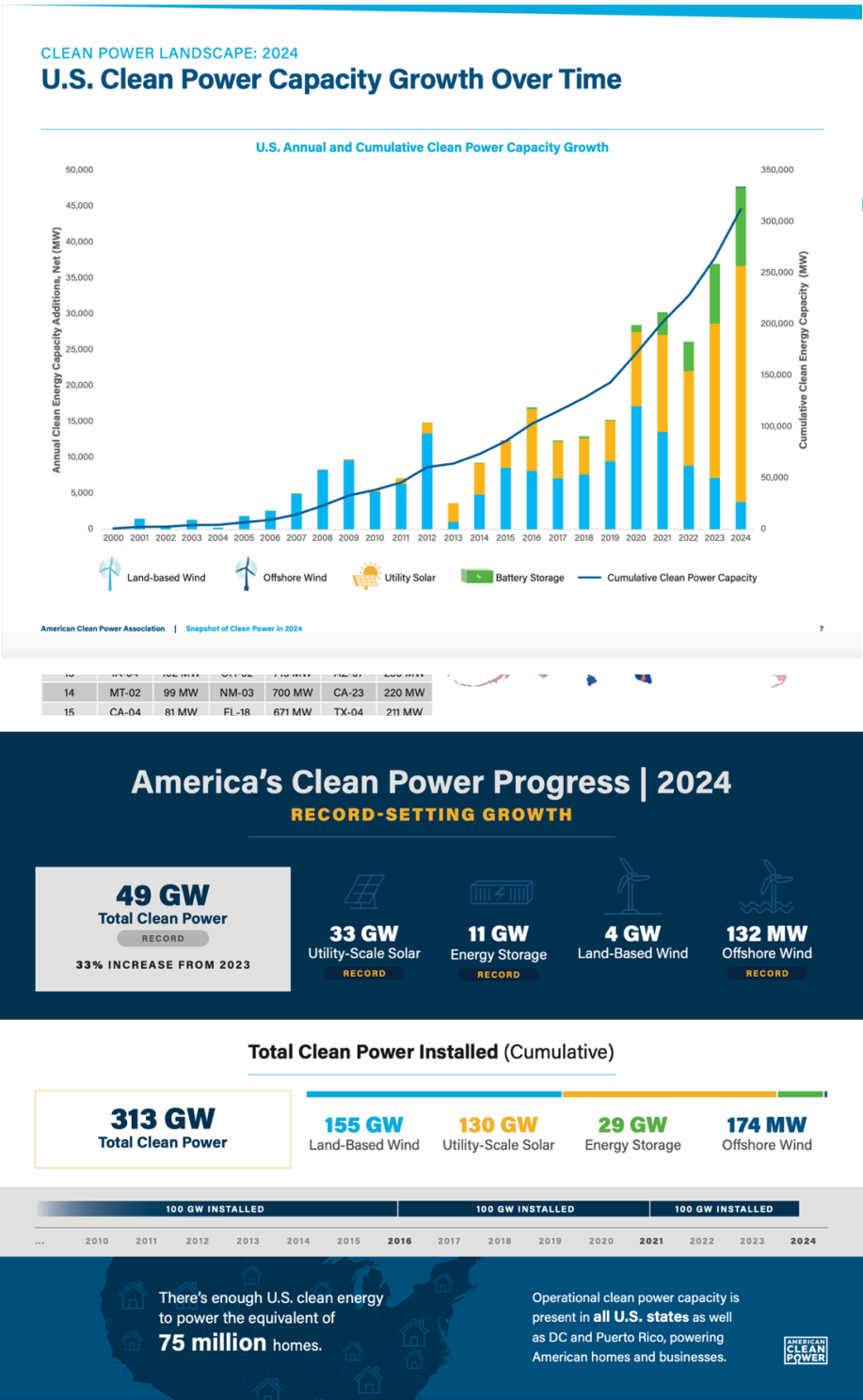
Conclusion

For too long, polarized energy politics have diminished American energy security. When demand was essentially flat, the policy of picking some technologies and obstructing others was unfortunate but manageable. In an era of tremendous growth, it is not viable to undermine any American energy resources. The nation needs a true “all-of-the-above” energy policy supported by significant acceleration of critical infrastructure deployment.

⁴⁹ McCalley, James, “Interregional transmission: The US is the tortoise; China is the hare,” Utility Dive, August 1, 2023, <https://www.utilitydive.com/news/interregional-transmission-reliability-renewable-energy-china-europe/689562/>

⁵⁰ “SAFE’s Center for Grid Security: Permitting Reform – A National Security Priority for the New Administration”, SAFE, November 13, 2023, <https://secureenergy.org/safes-center-for-grid-security-permitting-reform-a-national-security-priority-for-the-new-administration/>

Appendix: Highlights from Snapshot of Clean Power in 2024⁵¹

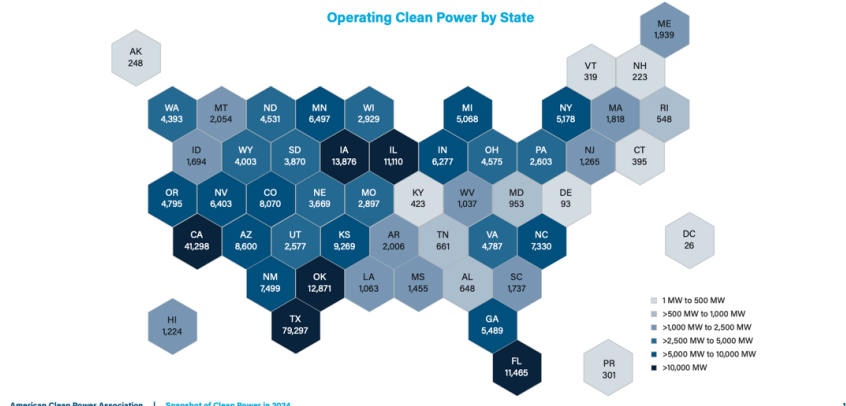


⁵¹ Snapshot of Clean Power in 2024, ACP, March 2025, https://cleanpower.org/wp-content/uploads/gateway/2025/03/ACP_SnapshotofCleanPowerin2024_Report_250304.pdf
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CLEAN POWER LANDSCAPE: 2024

Operational Clean Power Capacity

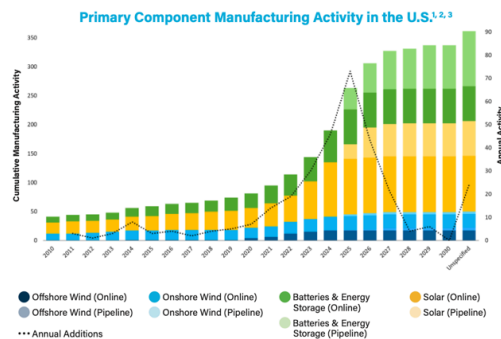
- All 50 U.S. states, as well as the District of Columbia and Puerto Rico, had at least one utility-scale solar, storage, or wind project in operation at the end of 2024.
- Six states can count more than 10 GW of clean power in operation. Florida and Illinois entered the 10+ GW list in 2024, joining Texas, California, Iowa, and Oklahoma.
- Seventeen states have more than 5 GW installed, up from 13 at the end of 2023, with Michigan, Nevada, New York, and Georgia crossing the 5 GW threshold.
- Forty states have more than 1 GW of clean power capacity installed, up from 37 states in 2023.
- Twelve states saw their clean power portfolios increase by 1 GW or more in 2024.
- Three states (Kentucky, Mississippi, and Louisiana) increased operational clean power capacity by more than 200% year-over-year, with Kentucky increasing its fleet by more than 400%.
- Arkansas, Ohio, and Arizona each increased operational clean power capacity by 50% or more in 2024 from 2023 levels.



CLEAN POWER LANDSCAPE: MANUFACTURING

U.S. Clean Power Manufacturing: Online in 2024

- In 2024, 46 U.S. primary component manufacturing projects across the utility-scale wind, solar, and storage supply chains came online largely because of the Bipartisan Infrastructure Law and Inflation Reduction Act.
- Two landmark laws aimed at reshoring manufacturing and securing the United States' energy future cascaded market signal waves, resulting in an exponential growth in domestic manufacturing.
- 2024 marked a year of growth that has exceeded prior years. The number of primary component manufacturing activity in this market segment has more than doubled since 2020.



- Activity includes all individual production line facilities and expansions. Multiple production lines can be at one location.
- Post-2028 includes those announcements that did not report an anticipated online date.
- Pipeline includes under construction, announced, pre-commercial startup, and reopening projects.

American Clean Power Association | Snapshot of Clean Power in 2024

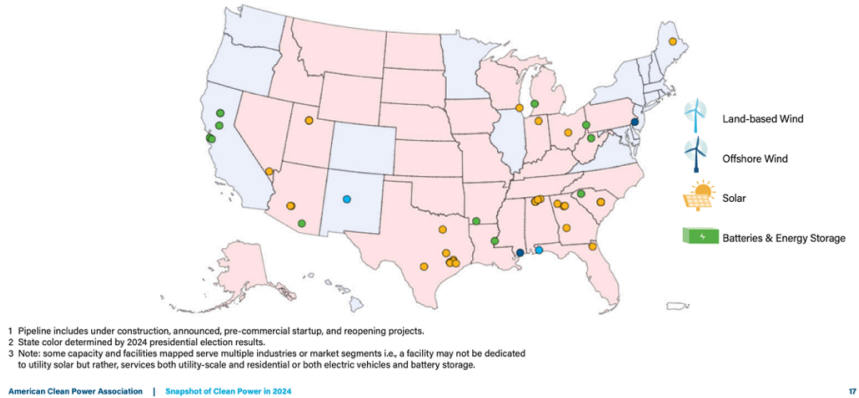
Technology	Primary Components Considered
Offshore Wind	Vessels
	Cables
	Towers
Onshore Wind	Nacelle
	Blades
	Cables
Batteries & Energy Storage	Module
	Cell
	Anode Active Material (AAM)
	Cathode Active Material (CAM)
	Electrolyte
Utility-Scale Solar	Lithium Extraction & Processing
	Module
	Trackers
	Inverters
	Cell
	Ingot/Wafer
	Polysilicon

CLEAN POWER LANDSCAPE: MANUFACTURING

U.S. Clean Power Manufacturing 2024

- 2024 saw 46 clean energy primary component manufacturing projects successfully commissioned across 20 states, providing \$22 billion in direct capital investments. These additions bring the total online to 190 commercial projects.
- Of the newly commissioned projects, 85% were in states that voted Republican in the recent presidential election. Texas saw the most activity with eight solar companies commissioning facilities, highlighting the growth of the industry in the state.
- In 2024, crystalline solar cells were manufactured at commercial scale in the U.S. for the first time in over a decade.
- Yet another wind manufacturing plant announced its plans to restart and expand its manufacturing operations, marking the third major wind component manufacturer with plans to begin production in 2025.
- There has been significant efforts made to utilize and retrain talent within communities where this manufacturing is occurring. This effort supports providing employment opportunities where adjacent industry may have been shuttered in prior years.

New Online Manufacturing Activity in 2024 for Clean Energy Primary Components^{1,2,3}

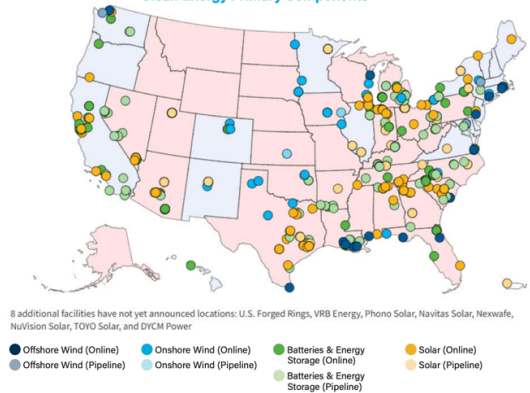


CLEAN POWER LANDSCAPE: MANUFACTURING

U.S. Clean Power Manufacturing Footprint: More to Come

- In 2024, 79 new projects were announced for plans to build or expand production of primary component manufacturing projects across solar, wind and battery storage in the United States.
- More than 59 primary component manufacturing projects are under construction and promise to make 2025 a banner year for American clean energy manufacturing.
- As more of the announced capacity begins to break ground, certainty of potential offtake improves. This then generates demand for the manufacturing of components further upstream in the supply chain to take shape.
- Because of this nuance, it is essential for downstream demand for energy projects to remain intact. Clean energy demand stimulus, coupled with manufacturing incentives has done well to revive domestic manufacturing across the country.
- Note there are hundreds of other manufacturing facilities that support the clean energy industry that are not captured here that include American steel, glass, concrete, raw materials, engineered materials, lubricants, safety equipment, as well as secondary and tertiary subcomponent manufacturing.

Existing and Expected Manufacturing Activity Clean Energy Primary Components^{1,2,3}



A new roadmap: Eight steps for better disaster recovery and stronger long-term resilience

Melissa Roberts

Founder & Executive Director, American Flood Coalition

From devastating events like Hurricanes Helene and Milton in the Southeast and raging wildfires in Southern California, to persistent, widespread challenges like drought currently affecting 44% of the country, communities across the United States face the daunting task of recovering from acute and chronic disasters, while taking proactive steps to strengthen their long-term resilience.

Each year, the US spends billions of taxpayer dollars on disaster recovery, and that number is only going up. However, we have the ability to drastically bring that amount down through proactive investment. We have to rethink how we approach resilience, while making sure disaster-hit communities get the help they need. It is time for a new roadmap that creates resilient, thriving communities that can recover quickly from increasingly threatening disasters.

As the founder and executive director of the largest adaptation nonprofit in the country, I have had countless conversations with leaders representing every kind of community, at every level, all facing this monumental challenge. The American Flood Coalition is a member-driven coalition that works directly in communities to identify and scale flood solutions, and develops policy to strengthen watershed-driven, strategic approaches at the state and federal levels. I have seen what works and what does not before and after a disaster. Right now, there are major opportunities for the 119th Congress and Trump Administration to not only fix our broken disaster recovery system, but to also reshape our national approach to resilience to be more proactive and forward-looking to usher in a safer, more prosperous America.

Transforming our approach to prepare for and recover from increasingly extreme and catastrophic natural hazards will take time, but Congress can move us closer to a more resilient future by taking the following eight steps – four immediate and four longer term.

Four immediate steps to help communities recover faster while building resilience strategies:

1. Streamline access to disaster aid while making sure it delivers maximum benefit

After Hurricane Helene, towns in Western North Carolina were without water for over a month. Last year, the Southern/Eastern/Northwestern drought and heatwave spanned much of the country and cost the U.S. \$5.4 billion. When homes in California went up in flames, residents were left with estimates of up to \$250 billion in property and economic damages.

At the worst moment in their lives, people shouldn't bounce between different agency websites and long wait times. Instead, they should be able to upload their information one time, in one place, and receive relief so they can quickly start rebuilding. To cut federal red tape and fix the process, Congress should pass common sense proposals, like the bipartisan Disaster Survivors Fairness and Disaster Assistance Simplification Acts.

We must also make the process dramatically easier for local leaders, who are similarly navigating the complex web of recovery programs for their communities. Mayors, council members, and county officials who want nothing more than to help their residents get back to normal are drowning in a sea of conflicting programs and red tape.

Our current system also undermines these leaders' efforts to rebuild smarter, with the next storm in mind. Instead of learning from our vulnerabilities, leaders are often forced to build infrastructure exactly as it was before the storm. For example, USDA's Emergency Watershed Protection (EWP) program cannot fund repairs to structures beyond pre-disaster levels. As a result, leaders cannot recover in a way that protects them from the next storm, leaving their residents vulnerable and undermining taxpayers' returns on investment.

Congressional action recommendations:

- Pass the Disaster Survivors Fairness Act and the Disaster Assistance Simplification Act to cut red tape for those seeking federal aid.
- Enact the bipartisan Flooding Prevention, Assessment, and Restoration Act, which would allow EWP to fund strategic investments that boost protection.
- Review all disaster programs to ensure red tape isn't blocking leaders from trying to rebuild smarter.

2. End pointless delays that stall recovery

After a disaster, states and communities eager to recover shouldn't have to wait for complex government processes to run their course. But that is the reality with HUD's

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Community Development Block Grant Disaster Recovery (CDBG-DR) program. After FEMA programs provide direct aid to households and help communities with short-term infrastructure repairs, CDBG-DR is intended to support states and communities as they tackle long-term recovery needs like affordable housing, infrastructure, and economic development.

While Congress has appropriated over \$100 billion for CDBG-DR over the last 30 years, the program is not statutorily authorized. This means that HUD must write new rules for every disaster, holding up resources for months or even years. Beyond wasting precious time, the status quo means that states and local governments must anticipate changed rules for every allotment of CDBG-DR funds, further slowing recoveries.

State and local governments need clear, consistent rules with flexibility to rebuild as they see fit. As bipartisan leaders in Congress consider ways to improve government and effectively steward taxpayer dollars, permanently authorizing CDBG-DR should be at the top of the list.

Congressional action recommendations:

- Permanently authorize CDBG-DR to ensure consistent, transparent, and faster delivery of long-term recovery dollars.

3. Empower state leadership

A leaner, more effective federal system can also create space for states to take on bigger roles in disaster response, recovery, and resilience. Compared to distant federal agencies, states are better positioned to understand their communities' vulnerabilities and priorities and direct federal funds accordingly. States are also well versed in working directly with local leaders, providing capacity and expertise that we shouldn't expect of small local governments, nor look to federal agencies to deliver at a national scale.

We are seeing both state progress and federal leadership along these lines: Florida, South Carolina, and Texas have all created proactive resilience strategies that reflect the needs of local governments. The bipartisan Championing Local Efforts to Advance Resilience Act, awaiting re-introduction in the 119th Congress, would give states flexibility, funding, and accountability to lead. The Trump Administration has taken executive actions to affirm state and local roles in proactive resilience through strategic planning, infrastructure investments, and disaster response and recovery.

To continue this momentum, Congress must invest in states' long-term, durable capacity while setting clear expectations across federal, state, and local government roles.

Congressional action recommendations:

- Reintroduce and pass the bipartisan Championing Local Efforts to Advance Resilience Act in the 119th Congress.
- Pass bipartisan legislation to codify President Trump's March 19 Executive Order on "Achieving Efficiency Through State and Local Preparedness."

4. Mandate resilience as a priority across federal programs

Natural hazards like floods, wildfires, and drought do not respect state or local jurisdictional boundaries. Farmers, communities, and nongovernmental stakeholders implementing resiliency strategies on the ground know this. Unfortunately, far too many federal programs fail to prioritize resilience as well as these issues' inherently regional scope.

Federal programs should explicitly mandate resilience as a priority to better help stakeholders embed it across projects and jurisdictional lines. For example, the Flood Resiliency and Land Stewardship Act, which Congress has already drafted, would formally add flood prevention, mitigation, and resiliency to the Regional Conservation Partnership Program (RCPP) administered by the USDA Natural Resource Conservation Service. This act would provide greater flexibility and support for partners to work together to address regional flooding issues. Passing this bill is a good first step, but Congress should ensure all programs can support and enhance regional collaboration that addresses natural hazards.

Congressional action recommendations:

- Reintroduce and pass the Flood Resiliency and Land Stewardship Act in the 119th Congress.
- Expand other programs' explicit mandates to embed resilience for all natural hazards across jurisdictional boundaries.

Congress should move right away on these immediate steps, while understanding they represent only the start of what is needed. Here are four additional, longer-term steps for Congress and the administration to strengthen resiliency at all levels, protect people and property, and transform our approach to natural hazards for future generations.

Four long-term opportunities to build proactive resilience across natural hazards:

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5. Invest in our understanding of what's at risk

After Hurricane Helene, fewer than 1% of the damaged properties in North Carolina were covered by flood insurance. Why? Because communities did not know their risks due to outdated, incomplete, and inaccurate FEMA flood maps. The consequences of outdated FEMA flood maps are staggering: financial ruin for thousands of property owners, plus an ever-higher bill for taxpayers to cover through individual assistance and other recovery programs for those without insurance.

Flood maps are just one federal data product that must be modernized so that leaders and individuals can understand what's at risk. Likewise, United States Geological Service (USGS) stream gauge and landslide datasets, National Oceanic and Atmospheric Administration (NOAA) rainfall estimates and river forecasts, among many others, can inform resilience planning, infrastructure design, and countless other decisions made by both public and private sector leaders.

Congress must continue to prioritize investment in robust, forward-looking data to drive smarter investments for not only today but tomorrow's natural hazards. Lawmakers should prioritize increased funding for FEMA flood map updates, especially in flood-impacted, undermapped regions, and continue robust investment across key FEMA, NOAA, USDA, USGS, and other federal datasets to drive risk-informed resilience planning.

6. Consolidate redundant federal programs

Congress also needs to comprehensively review the hairball of 125 different disaster recovery programs spread over 30-plus federal entities. Over decades, policymakers have incrementally added and tweaked individual programs, without considering how to create a more coordinated and efficient system.

The current complexity is staggering and only benefits highly paid consulting firms that help wealthy states and communities navigate the maze. It's time to dramatically reduce the number of federal cooks in the kitchen.

Congress should look to what it did with surface transportation packages in 2012: With reforms focused on efficiency, effectiveness, and accountability, Congress consolidated an unwieldy system of 90 transportation programs down to 30. Now, it should do the

same for disaster programs.

7. Harness American technology to respond smarter

The federal government verifies disaster damage the same way it did 50 years ago: sending civil servants from far away to complete slow, painstaking assessments. We have satellites orbiting hundreds of miles above Earth that can detect blades of grass, but after a hurricane, our government asks small, understaffed communities to document the geocoordinates of every downed tree.

Congress should direct FEMA to harness private sector technology to ensure faster, more accurate damage assessments that do right by survivors and taxpayers. And if we leverage American-owned technology like satellites and AI for damage assessments, we can also bolster national security interests by keeping critical data out of the hands of foreign companies or governments.

Federal IT platforms for document intake, grant applications, and other systems are similarly antiquated. We should leverage technology to simplify processes, speed up assessments, and create better and faster outcomes.

8. Bet big on American innovation by establishing a national lab that delivers proactive resilience strategies across natural hazards

American innovators should be leading the world in developing new technologies and strategies to prepare for and respond to disasters. Instead, we're ceding ground to Europe and China. By establishing a national lab focused on resilience solutions needed at home, we can help communities while reclaiming American leadership in this key arena. As our resilience challenges grow, we need to ramp up our focus on testing innovative technologies that can be scaled throughout the world.

A U.S. national lab would also advance a comprehensive approach to resilience across converging natural hazards. Current approaches are typically siloed by hazard, but natural disasters are inherently compound events: For example, intense riverine flooding, fueled by melting snowpack upstream, is exacerbated by extreme rainfall in regions where past wildfires might have killed plants and caused increased erosion. By centering resilience strategies on individual hazards, we fail to comprehensively address the amplified risks when multiple hazards collide.

To actually deliver a more resilient future, we need to double down on American research and development in this arena. In addition to giving the U.S. a competitive edge, a national lab centered on resilience and adaptation would better prepare

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communities for not only the next flood but also the next drought, wildfire, or heatwave, and the overlapping intersections of these and other challenges to come.

Conclusion

By following this roadmap, Congress can seize a once-in-a-generation window to overhaul our broken system of disaster recovery, while making major strides in how we approach long-term resilience.

Our slow, complex disaster recovery process fails to take obvious steps before disasters that would make communities more resilient and better prepared. As more Americans are impacted by these tragedies, we know it is possible to create a faster, more effective, and simplified system. We also know that each year we fail to address this problem, American taxpayer dollars are wasted, and communities nationwide continue to suffer.

By enacting these policies, the Trump Administration and Congress can save lives and livelihoods, stretch taxpayer dollars as far as possible, and build stronger, more resilient communities. The time to act is now.

Co-location and the Evolving Nexus of Federal and State Energy Governance

Rich Powell

CEO, Clean Energy Buyers Association (CEBA)

Introduction

The United States faces a strategic national challenge in meeting the growing energy demands of national important large loads, such as data centers and manufacturing facilities. To achieve speed to market, these large loads require timely and efficient integration into the grid and access to reliable power, which is increasingly difficult to secure given inadequate transmission, slow interconnection processes and aging infrastructure. Co-location offers a strategic solution by minimizing the need for transmission upgrades, reducing congestion, and accelerating project timelines.

Co-location, the practice of situating large energy consumers such as data centers or manufacturing, “behind the meter” of power generation facilities, is a prime example of the significant tension between state and federal energy governance. The jurisdictional tug of war between federal oversight of bulk transmission and state-level management of load and generator interconnection is directly playing out in the co-location discussions, and at a minimum, requires clear coordination between federal oversight of bulk transmission and state-level management.

Jurisdictional Challenges

The current status of co-location is marked by a lack of clarity and regulatory uncertainty. The Federal Energy Regulatory Commission (FERC) oversees interstate transmission and wholesale electricity markets, while states regulate local distribution and retail sales. However, the regulatory framework for co-location is still evolving, and there is a need for clear guidelines and standardized agreements to facilitate these projects.

Co-location has clear implications for FERC decision-making because co-location, particularly with existing generation, has implications for transmission system needs and reliability. States, or regional grid operators, on the other hand, want clear jurisdiction over approving generation and new loads. FERC recognizes they have a role but handed back to PJM (the largest Regional Transmission Organization (RTO) they oversee, a power full spanning 13 states from Virginia to Ohio) a precedential decision over tariff revisions to accommodate co-location.

A lack of clear rules in the PJM Tariff for interconnected generators seeking to serve co-located demand creates regulatory uncertainty and will lead to inconsistencies and delays in the approval process for such projects.

CEBA and others have advocated for better coordination between federal and state regulators to manage the complexities of co-location. Joint efforts are needed to develop standardized rules and tariff provisions that address the unique challenges of co-location while respecting jurisdictional boundaries.

Co-location serves as a prominent example of the energy governance issues that require a delicate balance between federal oversight and state-level management -- cooperative federalism in essence. Speedily resolving and standardizing the approach to co-location is of strategic national importance to enable a key short-term path for speed to power for the industries that will drive national economic growth and global competitive edge.

FERC's Role in Overseeing Co-Location

In November 2024, following a request by a large existing nuclear plant to take some of its generation “behind the meter” to supply a data center in PJM, FERC conducted a technical conference, highlighting both the challenges and benefits associated with integrating large-scale electricity loads with generation assets.

At that conference, CEBA urged FERC to adopt a regulatory framework that facilitates efficient co-location while protecting grid reliability and affordability and argued co-location is essential for national security, economic competitiveness, and the reliability of the U.S. energy system. There are two major configurations to consider for co-location:

1. With existing generation

Regulatory reforms should allow large loads to co-locate with existing generation facilities, particularly nuclear and renewable energy sites. Co-location maximizes existing infrastructure while ensuring access to stable power supplies. However, restrictive interconnection policies and inefficient pricing structures create barriers that delay projects and increase uncertainty.

To address these issues, CEBA recommends that FERC establish standardized interconnection agreements that fairly assess costs and prevent utilities from imposing unnecessary restrictions. Streamlined regulatory processes will help attract investment and accelerate grid integration.

2. Integrated energy parks to bring new generation to serve co-located loads

Beyond co-locating loads with existing generation, CEBA promotes integrated energy parks—facilities that combine load, generation, and energy storage at a single interconnection point. These parks enhance grid flexibility, reduce infrastructure costs, and improve system resilience. Key advantages include:

1. **Reduced Infrastructure Costs** – Shared equipment lowers capital expenditures.
2. **Accelerated Interconnection Timelines** – Fewer network upgrades shorten approval processes.
3. **Enhanced Grid Stability** – Co-located resources can provide backup power and grid services.
4. **Improved Clean Energy Utilization** – Proximity to renewable resources reduces transmission losses.
5. **Support for Emerging Industries** – Tailored energy solutions facilitate growth in sectors like hydrogen and battery storage.

CEBA encouraged FERC to establish regulatory frameworks that recognize energy parks as viable infrastructure models and create tariff provisions that support their development.

Policy Recommendations for FERC and Grid Operators

1. **Fair Tariff Structures** – Rates should reflect actual use of grid services.
2. **Streamlined Interconnection** – Standard agreements should accommodate co-location projects and respect existing or legacy co-location arrangements.
3. **Flexible Reliability Options** – Customers should be able to determine their own backup power needs.
4. **Improved Grid Planning** – Forecasting tools should account for rising electricity demand.
5. **Preventing Anti-Competitive Practices** – Policies should stop utilities from creating barriers to co-location projects.

Addressing Regulatory Uncertainty

Regulatory uncertainty discourages investment and slows project development. Without clear policies, the potential benefits of co-location and energy parks remain untapped. FERC must provide regulatory clarity to accelerate deployment and optimize grid operations.

RECOMMENDED READINGS

RECOMMENDED BY FRANK FANNON

Frank Fannon

*Critical Minerals and the Future of the U.S. Economy:
A Comprehensive U.S. Critical Minerals Plan*

RECOMMENDED BY DREW BOND

**Nick Loris and Jeff
Luse, C3 Solutions**

*Free Economies are Clean Economies: A Correlation of
Economic Freedom and Environmental Performance*

FEBRUARY 2025

Critical Minerals and the Future of the U.S. Economy

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CHAPTER 15

A Comprehensive U.S. Critical Minerals Plan

By Frank Fannon

WLDavies via Getty Images

Washington cannot assume that traditional alliances or free trade agreement status indicate alignment with U.S. security interests.

The United States' dependence on foreign rivals, especially the People's Republic of China (PRC), for critical and strategic minerals presents a material vulnerability to its industrial, energy, and defense sectors. This vulnerability quietly developed over decades, only coming to public attention in 2010 after Beijing banned the export of rare earth elements (REEs) to Japan.⁵³¹ Although Washington has elevated critical minerals as a top security issue, the United States remains dependent on an increasingly adversarial China. This chapter explores the importance and urgency of the United States developing resilient and secure critical minerals supply chains and recommends a comprehensive strategy to do so.

LESSONS (NOT) LEARNED

The United States' dependency was decades in the making. The United States and Europe were both happy to offshore low-margin and oftentimes heavy and polluting industries to other nations and import the refined goods on a just-in-time basis. This system worked well for years. However, the Chinese Communist Party (CCP) has forced Washington to confront its out-of-sight, out-of-mind reliance on China multiple times across the past three presidential administrations. Presidents Barack Obama, Donald Trump, and Joe Biden each responded to China's provocative actions differently—but incompletely, given its continued dominance.

The Obama Years

President Obama assumed office as China dramatically increased its military spending, replaced Japan as the United States' largest foreign creditor, and in 2010 became the world's second-largest economy.⁵³² During his term, Beijing publicly launched the Belt and Road Initiative, a strategy of coercive investments designed in part to lock up natural resources for China.

In 2010, Japan detained a Chinese trawler captain after repeated instances of illegal fishing and ramming Japanese coast guard vessels.⁵³³ In response, China temporarily banned the export of REEs to Japan and implied that it would impose new quotas. These actions skyrocketed REE prices by more than 400 percent, drawing condemnation from Washington and Brussels.⁵³⁴ In response, the Obama administration (joined by Japan and the European Union) initiated a World Trade Organization (WTO) case against China in 2012, stating:

Now, if China would simply let the market work on its own, we'd have no objections. But their policies currently are preventing that from happening. And they go against the very rules that China agreed to follow. Being able to manufacture advanced batteries and hybrid cars in America is too important for us to stand by and do nothing. We've got to take control of our energy future, and we can't let that energy industry take root in some other country because they were allowed to break the rules.⁵³⁵

Senator Chuck Schumer (D-NY) criticized the WTO case. He said, "There are faster ways to assert leverage on China than relying on the WTO, which could take years to resolve the case."⁵³⁶ He instead called to restrict Chinese mining in the United States and limit World Bank funding of PRC mining projects.

After two years of deliberations, the WTO finally concluded in 2014 that China violated trade rules. The U.S. trade representative Michael Froman stated, "By upholding rules on fair access to raw materials, this decision is a win not only for the United States, but also for every nation that respects the principles of openness and fairness. Those principles are the pillars of the rules-based global trading system, and we must protect them vigilantly."⁵³⁷

Rather than restrict exports, China flooded the market with supplies, sending prices crashing. In less than a year after the United States won in the WTO, its only REE mine filed for bankruptcy protection.⁵³⁸

The two terms of the Obama administration witnessed a rising and more brazen and provocative China. In response, Washington looked to well-intended, albeit conventional, remedies such as diplomatic convenings and Brenton Woods-era institutions to help settle disputes. However, the United States was unable to limit China's rising dominance of the critical mineral sector.

This experience showed that conventional mechanisms are only effective when countries agree to the conventions themselves. Since China rejects them, the United States needs to consider an alternative approach to the traditional rules-based order.

The Trump Years

By contrast, the Trump administration viewed critical minerals as a proxy for U.S. economic and national security. In December 2017, Trump issued an executive order directing the Department of the Interior to develop a critical minerals list.⁵³⁹ The resulting May 2018 report identified 35 minerals considered critical to the economic and national security interests of the United States, which informed the interagency's focus areas.⁵⁴⁰ The report helped increase awareness of the PRC's control of critical mineral supply chains, beginning in emerging markets targeted by the Belt and Road Initiative.

The Department of State created new bilateral and multilateral initiatives, such as the Energy Resources Governance Initiative (ERGI), to lay the foundation for alternative investment channels to the PRC. For example, when the PRC sought to make major investments to secure critical minerals in Greenland, ERGI enabled the Bureau of Energy Resources to pursue a series of diplomatic engagements that successfully culminated in memorandums of understanding to support Greenland's geologic endowment and preference U.S. and allied investors.⁵⁴¹

Overall, ERGI sought to elevate transparency, support mineral-producing countries, and eventually leverage the newly established U.S. International Development Finance Corporation (DFC) to provide seed capital to de-

risk projects and attract otherwise reputation-sensitive investors.⁵⁴² However, the administration was unable to implement its permitting reform ideas, and although historic, the DFC made only one critical minerals investment.⁵⁴³ Moreover, as the Trump administration utilized existing tools such as tariffs and diplomatic initiatives, it faced domestic permitting obstacles and lacked adequate financing tools to support many U.S.-based and U.S.-backed mining projects.

Even with new initiatives and approaches, the U.S. government must do more to support domestic and allied investment to develop a secure critical minerals supply chain. This may require establishing new government tools while rethinking and optimizing existing ones to fit the mission.

The Biden Years

President Biden sought to return the United States to a more conventional diplomatic position. He rescinded certain Trump-era energy sanctions (such as on the Nord Stream 2 pipeline), called for a review of China-directed tariffs, and immediately directed the administration to reenter the Paris climate accord. In further contrast to the Trump administration's focus on national security and defense, the Biden administration prioritized the climate crisis.⁵⁴⁴

Understanding that meeting its ambitious climate change and clean energy goals would require an exponential increase in critical minerals, President Biden issued Executive Order 14017 in February 2021, which mandated comprehensive reviews of supply chains across the U.S. government.⁵⁴⁵ The Department of the Interior issued a new critical minerals list, adding 15 new minerals, bringing the total to 50.⁵⁴⁶ Meanwhile, the Department of Energy (DOE) released its own new critical materials list for energy.⁵⁴⁷ The DOE material list rightly included copper as a "critical" mineral, but the USGS list excluded it, even though it is vital for every part of the modern U.S. economy—including infrastructure, clean energy technologies, electronics, and automobiles—and the International Energy Agency has forecasted a copper shortage.⁵⁴⁸

The passage of the Bipartisan Infrastructure Bill and the Inflation Reduction Act (IRA) established new federal programs, incentives, and, importantly, billions of dollars in funding to support clean energy supply

chains.⁵⁴⁹ The Biden administration channeled much of those direct grants and loans into domestic minerals processing and clean-tech manufacturing facilities, which should improve domestic capacities in both. The IRA has been so effective in attracting clean-tech investment that it has alarmed European partners, who sought to force “concessions” from President Biden to allow EU companies to benefit from certain IRA subsidies.⁵⁵⁰

The Department of State’s Minerals Security Partnership seeks to accelerate the development of a clean energy supply chain by convening governments and industry.⁵⁵¹ The department also leads the Partnership for Global Infrastructure and Investment, which aims to promote mining-related investment, such as the Lobito Corridor project.⁵⁵² In addition, the DFC increased its investment in Techmet, a technology metals company, from \$25 million to \$105 million but has not diversified equity-level investments in any other mining investors or operating companies.⁵⁵³

The Biden administration’s prioritization of climate action above other issues has contributed to pragmatic but conflicting messages. The IRA prohibits U.S. taxpayer funds from going to a “foreign entity of concern,” which covers firms controlled by China, Russia, North Korea, and Iran. However, China is by far the largest and least expensive critical minerals producer and clean-tech manufacturer in the world. To disqualify Chinese content from receiving taxpayer subsidies, as per the law, would increase prices—making electric vehicles unattractive to many American buyers. Therefore, the Department of the Treasury amended its rules in December 2023 to allow up to 25 percent of otherwise disqualified Chinese content to receive U.S. taxpayer subsidies under the IRA.⁵⁵⁴

The Biden administration’s actions appear to have had an impact. Beijing went back to the 2010 playbook, announcing curbs on the export of gallium, germanium, graphite, antimony, and REE technology.⁵⁵⁵ China furthermore flooded the market with cobalt, crashing prices and putting the United States’ only cobalt development project into care and maintenance.⁵⁵⁶

Based on these experiences across administrations, developing a responsible and secure clean energy supply chain will require two things to be effective. First, the government needs to have absolute clarity of mission

in recognizing the challenge the United States is trying to overcome. Second, there must be accountability to guard against mission creep and navigate the complexity and equities across the government. This will entail marshaling the United States’ limited resources around the mission to optimize impact.

A U.S. CRITICAL MINERALS STRATEGY

China remains the world’s dominant producer, processor, and buyer of critical minerals. The CCP continues to push domestic policies that artificially stimulate demand for its strategic sectors, mobilize state financing to influence market dynamics, and shirk environmental and human rights protections to produce commodities at the lowest cost. These are long-standing tactics.

The United States is still behind, but over the past three presidential administrations, it has learned a great deal, gained political support, and increased its tools and capabilities to develop a meaningful and comprehensive response. However, an effective strategy will require a blending of the Obama, Trump, and Biden administrations’ approaches and will test domestic and international relations.

Mission Clarity

The United States should be clear about its objective. National security and climate change are both important and interrelated, but the U.S. government ultimately needs to prioritize one over the other. It is hard to imagine how the world can address climate change by increasing reliance on China, the world’s super polluter, to produce inputs for clean energy technologies.⁵⁵⁷ The United States can and should develop a responsible and secure critical minerals supply chain necessary for economic growth, defense, and clean energy. However, realizing such a goal while reducing reliance on CCP-backed industry will be more expensive.

The United States has repeatedly tried to strike a middle road by partnering with China on climate change but holding firm on core principles such as human rights and environmental standards in critical minerals supply chains. The CCP has rejected such attempts. Rather the PRC rejects

the primacy of addressing climate change and instead views the matter as a core point of contention within the U.S.-China bilateral relationship.⁵⁵⁸

Although disappointing, the CCP's approach is rational from its perspective. The party-state is motivated first to advance its interests and second to increase its leverage or control over the United States and the rest of the world. By dominating the critical minerals supply chain, China forces the United States to increase its dependence on its adversary—and therefore forces Washington to question its security positioning.

The U.S. government should be clear in its mission to develop secure and responsible critical minerals supply chains. Successive administrations have repeatedly recognized that China dominates the production and refining of critical minerals—and thus also the defense industry and clean tech. To contest this threat, the White House should explicitly articulate its intention to develop secure supply chains and phase down reliance on China—not to provoke hostile powers but to galvanize interested stakeholders. Clear and unequivocal goal setting will signal to partner governments, resource-rich countries, and investors that the United States is on the field.

Accountability and Coordination

The U.S. government should have a single point of accountability to oversee and coordinate the administration's multiple lines of effort.

The IRA and Bipartisan Infrastructure Law provided historic levels of federal funding and new programs to develop clean energy and critical minerals supply chains. This explosion in funding coincided with the dramatic expansion of agencies working on critical minerals. Under the Biden administration, when counting, 15 federal agencies claim a meaningful role in U.S. critical minerals policy. While the increased interest is a positive development, the lack of clear oversight and management of such a complex set of issues can lead to inefficiencies or agencies working at cross-purposes, which may frustrate the mission.

To remedy this, the U.S. government should appoint or designate a special presidential coordinator at a minimum of an ambassadorial level to manage the critical minerals portfolio. This will be a difficult but necessary role: Although every federal agency or cabinet

member may have an interest, some interests are more consequential to achieving the mission than others.

Furthermore, this special coordinator should align U.S. policies to address the country's current pacing challenge. As mentioned, the IRA has accelerated domestic clean energy-related manufacturing. However, the United States has not taken sufficient action to increase supplies of the critical mineral inputs needed to feed these new gigafactories and industrial facilities. It may only take 5 years to build a plant but some 15 years to turn a discovered resource into a producing mine.

Update Finance Tools

The U.S. government should update and integrate its mission into international finance tools. The country has just two such financing entities: the DFC and the Export-Import Bank (EXIM). Both should have a clear critical minerals mandate and be empowered to act upon it, as well as the flexibility and resources to respond to the challenges of today.

The DFC was designed to advance U.S. foreign policy, which is why the secretary of state serves as the chairman of the agency's board. Yet, as the name suggests, the DFC must also consider a "development" impact. However, the statute does not provide a framework for weighing or prioritizing these factors. The U.S. government should be clear about its goals and financing, particularly as mining is such a long-term endeavor.

The DFC's equity and debt tools are intended to catalyze private sector investments into key industries in emerging market countries. However, the White House's Office of Management and Budget, like the DFC itself, chooses to treat equity investments as if they were grants, which for accounting purposes are treated as a loss. Furthermore, when the equity investment realizes its returns, those funds are returned to the Department of the Treasury, not the DFC.⁵⁵⁹ This accounting treatment significantly limits the agency's ability to make the requisite investments.

This scoring problem is a historical practice, not a statutory requirement. The White House could remedy the situation by issuing new scoring criteria but appears unwilling to take on that political fight without an express congressional mandate to do so. As such, Congress should provide that directive and

make the United States' primary international finance tool appropriate for the realities of the market and geopolitical statecraft.

The DFC's investments should be both strategic and commercial. With those goals in mind, and to improve political support for an expanded remit, the DFC should prioritize investments in domestic companies. Currently, there is no preference to support U.S. companies with U.S. taxpayer dollars over foreign parties.

The EXIM Bank is the United States' export credit agency (ECA). The 90-year-old institution must compete against the 115 foreign ECAs around the world, especially from the PRC. In its 2019 reauthorization, Congress recognized the threat and strength of China's investments and directed EXIM to establish the China Transformational Exports Program (CTEP).⁵⁶⁰ Through CTEP, EXIM gained greater flexibility to lend to projects focused on 10 strategic industries, including critical minerals. Congress should continue to build upon CTEP and further lower the domestic content requirements that constrain EXIM's lending authorities. The bank should also have the clear ability to provide debt financing at the company rather than project level. By providing company-level lines of credit, EXIM can empower U.S. companies to take advantage of strategic projects in real time.

The United States has two important international finance tools. The DFC and EXIM must be rightsized for the challenges of today.

Permitting Reform, at Long Last

The U.S. government has long been talking about, but doing little to improve, its permitting process. The federal permitting process has grown into a complex and uncertain process regardless of project type, whether related to a natural gas pipeline or solar power installation.⁵⁶¹

Bipartisan members of Congress have advocated for permitting reform but have made little substantive progress over the years.⁵⁶² The exhaustive federal permitting process is a main obstacle to meeting the IRA's clean energy goals.⁵⁶³ The IRA contains billions of dollars to develop clean energy networks, which will require the construction of electric transmission lines and

improvements to the grid. According to Representative Scott Peters (D-CA), "The problem is that the average line is taking 10 years to build, but seven years of that is process."⁵⁶⁴ The timeline is even worse for mining. According to an analysis by S&P Global, it takes an average of 29 years to turn a discovered resource into a mine in the United States, the second-longest mine development time after Zambia.⁵⁶⁵

The realization that today's exhaustive permitting process is undermining clean energy goals has helped to expand the parties calling for reform. In July 2024, Senators John Barrasso (R-WY) and Joe Manchin (I-WV) introduced the Energy Permitting Reform Act, which aims to start addressing some of these challenges. The bill proposes to improve certainty in decisionmaking by requiring a final agency decision within 150 days, reducing administrative steps, and providing clarity over the controversial Rosemont decision.⁵⁶⁶ The bill avoids some of the more controversial proposals, according to some industry advocates, such as tightening standing requirements to legally challenge projects or proposals to increase community engagement.

Although the bill has secured strong bipartisan support, environmental opposition groups have rejected the legislation, arguing that only clean energy, not oil, gas, and mining, should share in the benefits of permitting reform.⁵⁶⁷ The bill—which goes too far for some but not far enough for others—represents an incomplete but positive and needed step forward.

Permitting reform often includes difficult and long-standing issues, particularly concerning the history of mining in the western United States. Yet the federal government's failure to address permitting—in the meantime allowing the purchase of minerals known to be produced in a manner inconsistent with environmental protections, respect for human rights, or inclusion of local communities—is patently wrong. The United States should address this challenge head-on, especially if mining operations are to scale up to meet current and future clean energy targets.

Sticks

The IRA provided billions of U.S. taxpayer-funded dollars as "carrots" to incentivize investment in clean energy technologies. Many of these carrots take the form of tax credits that seek to reduce costs for consumers. While

subsidies are tried-and-true measures that can affect consumer behavior, such carrots alone are insufficient to remedy China's critical minerals dominance.

According to the Federal Bureau of Investigation, "The Chinese government is seeking to become the world's greatest superpower through predatory lending and business practices, systematic theft of intellectual property, and brazen cyber intrusions."⁵⁶⁸ Specifically, the Biden administration's supply chain report found that overreliance on China for critical minerals and materials posed national and economic security threats.⁵⁶⁹

It is hard to imagine a situation where China would allow the United States to out-subsidize and erode its dominant market share. After all, the CCP is the world's leader in economic statecraft, blending coercive domestic consumption, state investment in strategic industries, provincial support of local champions, and a willful blindness toward best-practice standards. And mining has been the bedrock of Chinese domestic industrial strategy and foreign policy for decades.

In response, the United States should take a more active and definitive role in countering the CCP's market-manipulating activities. Some businesses may argue that the U.S. government should go to great lengths to deal with the Chinese state and Chinese private sector separately. However, this is a fool's errand, as there is little distinction between the two. According to Stanford's Center on China's Economy and Institutions, a large share of China's economy operates in a gray zone of mixed or blended ownership: "The number of private owners with direct equity ties with the state almost tripled between 2000 and 2019, and those with indirect equity ties rose 50-fold. The analysis suggests that equity ties to the state may have aided, not constrained, the growth of China's private sector."⁵⁷⁰

The United States should take a much more realistic approach to address the threat it faces. To start, the United States should prohibit the use of taxpayer funds to subsidize Chinese technology or critical mineral interests. Furthermore, the U.S. government should require any company receiving taxpayer funds to certify that any imported or incorporated Chinese content or technology meets reporting standards.

The United States should also consider critical minerals and clean energy supply chains in light of today's new era of economic realpolitik. Washington cannot assume

that traditional alliances or free trade agreement status indicate alignment with U.S. security interests. For example, European Commission president Ursula von der Leyen would like the European Union to qualify for IRA subsidies even though several European EV factories are owned by Chinese companies.⁵⁷¹ And in November 2022, German chancellor Olaf Scholz, together with the heads of Volkswagen and other companies, met with Chinese leader Xi Jinping in Beijing to boost business ties.⁵⁷² Such moves to increase dependence on a strategic threat weaken free nations' shared security.

Even as it works to strengthen traditional alliances, the United States should take a more pragmatic approach. U.S. and European officials have discussed creating a critical minerals buyers' club, but to be credible, club membership should be dependent on more rigorous criteria than just geography.⁵⁷³

CONCLUSION

In 2010, China banned the export of REEs to Japan. In so doing, the CCP fired the first, transformative salvo in an ongoing fight to leverage its critical minerals dominance to coerce, intimidate, and extort. The United States has since learned some valuable lessons. Successive administrations have tried multiple, albeit incremental, remedies aimed at encouraging China to behave responsibly and incentivizing U.S. and allied companies to reorient their consumption.

Although meaningful, these incremental tactics have not altered the CCP's strategy, and the United States has failed to develop secure supply chains. Building on the experience of the past three administrations, the United States should follow the above guidance to achieve its objectives.

U.S. leaders should recognize that, given the scale of the challenge, the federal government has a meaningful role to play. Yet, the country's comparative advantage lies instead in its dynamic and world-leading private sector. To that end, U.S. diplomacy and financial tools should be rightsized to achieve the mission. This rightsizing must also apply to domestic policy. Leaders must finally take on long-standing special interests to advance meaningful permitting policy reform.

The United States has been forced to engage in a new era of economic realpolitik. This awareness requires the United States to reconsider traditional alliances and partner relationships at a company or project level. Chinese companies have expanded and, in certain instances, entrenched themselves within traditional allies' commercial interests. As such, the U.S. government needs to guard against unintentionally supporting adversarial interests.

In his famous speech launching the Space Race, President John F. Kennedy asked Americans "to accept a firm commitment to a new course of action, a course which will last for many years and carry very heavy costs."⁵⁷⁴ Kennedy's Apollo program was transformative for the United States' leadership in the world and led to innumerable technological innovations.

Transforming the United States' economic engine presents a challenge orders of magnitude greater than putting a man on the Moon. But while building secure clean energy and critical mineral supply chains will be neither easy nor inexpensive, it is increasingly vital.

- 127 Mines,” S&P Global, June 6, 2023, <https://www.spglobal.com/market-intelligence/en/news-insights/research/discovery-to-production-averages-15-7-years-for-127-mines>.
- 510 Mohsen Bonakdarpour et al., “Mine Development Times: The US in Perspective,” S&P Global, June 2024, https://cdn.ihsmarkit.com/www/pdf/0724/SPGlobal_NMA_Development-TimesUSinPerspective_June_2024.pdf.
- 511 Lawrence M. Cathles and Adam C. Simon, “Copper Mining and Vehicle Electrification,” International Energy Forum, May 15, 2024, <https://www.ief.org/focus/ief-reports/copper-mining-and-vehicle-electrification>.
- 512 European Commission, *Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020 (Text with EEA relevance)*, PE/78/2023/REV/1, May 3, 2024, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02024R1252:20240503>.
- 513 Ibid.; and “Nature Restoration Law,” European Commission, accessed October 30, 2024, https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-law_en.
- 514 Eleni Diamantopoulou, “Accelerating EU Mineral Permitting: The Critical Raw Materials Act,” Womble Bond Dickinson, May 3, 2024, <https://www.womblebonddickinson.com/uk/insights/articles-and-briefings/accelerating-eu-mineral-permitting-critical-raw-materials-act>.
- 515 Eva Liedholm Johnson, Magnus Ericsson, and Anton Löf, “The Mining Permitting Process in Selected Developed Economies,” *Land Use Policy* 131 (August 2023): 106762, <https://www.sciencedirect.com/science/article/pii/S0264837723002284>.
- 516 International Council on Mining and Metals, “Mining Principles,” International Council on Mining and Metals, August 8, 2024, <https://www.icmm.com/website/publications/pdfs/mining-principles/mining-principles.pdf?cb=83767>.
- 517 “About us,” ICMM, July 15, 2024, <https://www.icmm.com/en-gb/our-story/who-we-are>.
- 518 “TSM 101: A Primer,” Towards Sustainable Mining, July 11, 2024, https://mining.ca/wp-content/uploads/dlm_uploads/2024/07/TSM-PRIMER-2024-EN5.pdf; “The Copper Mark Theory of Change,” The Copper Mark, July 15, 2024, https://coppermark.org/wp-content/uploads/2024/07/CopperMark_Impact_TheoryofChange_2024-07-15.pdf; and World Gold Council, *Responsible Gold Mining Principles* (London: World Gold Council, 2019), <https://www.gold.org/download/file/14254/Responsible-Gold-Mining-Principles-en.pdf>.
- 519 “Who We Are,” ResponsibleSteel, accessed October 30, 2024, <https://www.responsiblesteel.org/who-we-are>; and “About ASI,” Aluminum Stewardship Initiative, accessed October 30, 2024, <https://aluminium-stewardship.org/about-asi/vision-mission-values>.
- 520 “About the Initiative,” Consolidated Mining Standard Initiative, accessed October 30, 2024, <https://miningstandardinitiative.org/about-the-initiative/>.
- 521 European Commission, “Critical Raw Materials: Ensuring Secure and Sustainable Supply Chains for EU’s Green and Digital Future,” press release, March 15, 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661.
- 522 “Responsible Sourcing,” London Metal Exchange, July 15, 2024, <https://www.lme.com/en/education/online-resources/lme-insight/lme-responsible-sourcing>.
- 523 London Metal Exchange, “Discovering the Low Carbon Premium for the Nickel Market,” press release, March 5, 2024, <https://www.lme.com/api/sitecore/MemberNoticesSearchApi/Download?id=1dcae570-87ee-422a-9596-aca2b041f11>.
- 524 “What Are Scope 1, 2 and 3 Carbon Emissions?,” National Grid, accessed October 30, 2024, <https://www.nationalgrid.com/stories/energy-explained/what-are-scope-1-2-3-carbon-emissions>.
- 525 BHP, “Western Australia Nickel to Temporarily Suspend Operations,” press release, July 11, 2024, <https://www.bhp.com/news/media-centre/releases/2024/07/western-australia-nickel-to-temporarily-suspend-operations>.
- 526 “About the Community of Interest (COI) Panel,” Mining Association of Canada, accessed October 30, 2024, <https://mining.ca/towards-sustainable-mining/community-of-interest-advisory-panel/>.
- 527 Steffany Bermúdez and Florencia Sarmiento, “Will the Inclusion of Voluntary Standards in Trade Agreements Lead to More Sustainable Trade?,” International Institute for Sustainable Development, April 23, 2024, <https://www.iisd.org/system/files/2024-04/ssi-voluntary-standards-agreements-sustainable-trade.pdf>.
- 528 Janne Bemelmans et al., “Trade Effects of Voluntary Sustainability Standards in Tropical Commodity Sectors,” *Food Policy* 118 (July 2023): 102440, <https://www.sciencedirect.com/science/article/abs/pii/S0306919223000386>.
- 529 Cristina Larrea et al., “Voluntary Sustainability Standards, Forest Conservation, and Environmental Provisions in International Trade Policy,” International Institute for Sustainable Development, October 28, 2021, <https://www.iisd.org/system/files/2021-10/voluntary-sustainability-standards-forest-conservation-trade-policy.pdf>.
- 530 RMI, “Major Corporations Come Together to Advance the First Commercial Batch of Sustainable Steel in the US,” press release, September 20, 2023, <https://rmi.org/press-release/major-corporations-come-together-to-advance-the-first-commercial-batch-of-sustainable-steel-in-the-us/>.
- 531 Keith Bradsher, “China Bans Rare Earth Exports to Japan amid Tension,” CNBC, September 23, 2010, <https://www.cnbc.com/2010/09/23/china-bans-rare-earth-exports-to-japan-amid-tension.html>.
- 532 “Timeline: U.S.-China Relations,” Council on Foreign Relations, accessed October 26, 2024, <https://www.cfr.org/time->

- line/us-china-relations.
- 533 Bradsher, “China Bans.”
- 534 Ben Blanchard and Tom Miles, “China 2010 Rare Earth Exports Slip, Value Rockets,” Reuters, January 19, 2011, <https://www.reuters.com/article/business/environment/china-2010-rare-earth-exports-slip-value-rockets-idUSTRE70I1IT/>.
- 535 The White House, “Remarks by the President on Fair Trade,” remarks, March 13, 2012, <https://obamawhitehouse.archives.gov/the-press-office/2012/03/13/remarks-president-fair-trade>.
- 536 CNN Wire Staff, “Obama Announces WTO Case against China over Rare Earths,” CNN, March 13, 2012, <https://www.cnn.com/2012/03/13/world/asia/china-rare-earths-case/index.html>.
- 537 Office of the U.S. Trade Representative, “U.S. Trade Representative Michael Froman Announces U.S. Victory in Challenge to China’s Rare Earth Export Restraints,” press release, August 7, 2014, <https://ustr.gov/about-us/policy-offices/press-office/press-releases/2014/August/USTR-Froman-US-Victory-in-Challenge-to-China-Rare-Earth-Export-Restraints>.
- 538 Molycorp, Inc., “Molycorp, Inc. Signs Restructuring Support Agreement with Key Creditors,” Mining.com, June 25, 2015, <https://www.mining.com/web/molycorp-inc-signs-restructuring-support-agreement-with-key-creditors/>.
- 539 Executive Office of the President, “Executive Order 13817 of December 20, 2017: A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,” *Federal Register* 82, no. 246 (December 20, 2017): 60835, <https://www.federalregister.gov/documents/2017/12/26/2017-27899/a-federal-strategy-to-ensure-secure-and-reliable-supplies-of-critical-minerals>.
- 540 U.S. Geological Survey, “Interior Releases 2018’s Final List of 35 Minerals Deemed Critical to U.S. National Security and the Economy,” press release, May 18, 2018, <https://www.usgs.gov/news/national-news-release/interior-releases-2018s-final-list-35-minerals-deemed-critical-us>.
- 541 U.S. Department of State, “Joint Statement on U.S.-Greenland MOU and Hyperspectral Survey,” press release, June 6, 2019, <https://2017-2021.state.gov/joint-statement-on-u-s-greenland-mou-and-hyperspectral-survey/index.html>.
- 542 “Energy Resource Governance Initiative (ERGI),” U.S. Department of State, December 15, 2020, https://www.state.gov/wp-content/uploads/2020/12/Marketing-Materials_ERGI-One-Pager_2.20.20.pdf.
- 543 TechMet, “TechMet Receives Investment from US International Development Finance Corporation,” press release, October 5, 2020, <https://www.techmet.com/press-release-05-october-2020/>; and U.S. Department of the Interior, “Trump Administration Announces Strategy to Strengthen America’s Economy, Defense,” press release, June 4, 2019, <https://www.doi.gov/pressreleases/trump-administration-announces-strategy-strengthen-americas-economy-defense>.
- 544 “Fact Sheet: Prioritizing Climate in Foreign Policy and National Security,” The White House, October 21, 2021, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/21/fact-sheet-prioritizing-climate-in-foreign-policy-and-national-security/>.
- 545 “Executive Order 14017 of February 24, 2021: America’s Supply Chains,” *Federal Register* 86, no. 38 (March 1, 2021): 11849, <https://www.federalregister.gov/documents/2021/03/01/2021-04280/americas-supply-chains>.
- 546 U.S. Geological Survey, “U.S. Geological Survey Releases 2022 List of Critical Minerals,” press release, February 22, 2022, <https://www.usgs.gov/news/national-news-release/us-geological-survey-releases-2022-list-critical-minerals>.
- 547 “What Are Critical Materials and Critical Minerals?” U.S. Department of Energy, accessed October 26, 2024, <https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals>.
- 548 International Energy Agency, *Global Critical Minerals Outlook 2024* (Paris: International Energy Agency, 2024), 108-123, <https://www.iea.org/reports/global-critical-minerals-outlook-2024>.
- 549 “Inflation Reduction Act and Bipartisan Infrastructure Law Resource Center,” BlueGreen Alliance, accessed October 26, 2024, <https://www.bluegreenalliance.org/site/inflation-reduction-act-and-bipartisan-infrastructure-law-resource-center/>.
- 550 Clea Caulcutt, “Trade War Averted? Macron Gets Biden to ‘Tweak’ His Industrial Subsidies,” *Politico* (EU edition), December 2, 2022, <https://www.politico.eu/article/emmanuel-macron-joe-biden-us-france-lands-unexpected-concession-on-inflation-reduction-act/>.
- 551 “Minerals Security Partnership,” U.S. Department of State, accessed October 26, 2024, <https://www.state.gov/minerals-security-partnership/>.
- 552 “Office of the U.S. Special Coordinator for the Partnership for Global Infrastructure and Investment,” U.S. Department of State, accessed October 26, 2024, <https://www.state.gov/bureaus-offices/secretary-of-state/office-of-the-u-s-special-coordinator-for-the-partnership-for-global-infrastructure-and-investment/>; Andres Schipani, “The US-Backed Railway Sparking a Battle for African Copper,” *Financial Times*, August 21, 2024, <https://www.ft.com/content/cb2823c7-f451-4bc9-959e-ec7e07384a31>; and U.S. Agency for International Development, “The U.S. Government Announces Grant to Promote Investment Opportunities in the Democratic Republic of the Congo’s Minerals Sector,” press release, June 11, 2024, <https://www.usaid.gov/democratic-republic-congo/press-release/jun-11-2024-us-government-announces-grant-promote-investment-opportunities-democratic-republic-congos-minerals-sector>.
- 553 “TechMet Receives Further \$50 Million Commitment from U.S. International Development Finance Corporation at COP28,” Business Wire, December 1, 2023, <https://www.businesswire.com/news/home/20231201346504/en/TechMet-Receives-further-50-Million-Commitment-From-U.S.-International-Development-Finance-Corporation-at-COP28>.

- 554 Frank Fannon, “The United States Should Fix the FEOC Guidance,” CSIS, *Commentary*, March 14, 2024, <https://www.csis.org/analysis/united-states-should-fix-feoc-guidance>.
- 555 “China’s Curbs on Exports of Strategic Minerals,” Reuters, August 15, 2024, <https://www.reuters.com/markets/commodities/chinas-curbs-exports-strategic-minerals-2024-08-15/>; and Reuters, “China to Limit Antimony Exports in Latest Critical Mineral Curbs,” CNN, August 16, 2024, <https://www.cnn.com/2024/08/15/tech/china-antimony-export-ban-intl-hnk/index.html>.
- 556 Bloomberg News, “China Cobalt Buyers Use Global Glut to Challenge Pricing,” *Mining.com*, January 16, 2024, <https://www.mining.com/web/china-cobalt-buyers-use-global-glut-to-challenge-pricing/>.
- 557 Arjun Murti, “Next 10 Years of Perpetual Transition: China,” Super-Spiked, September 7, 2024, <https://arjunmurti.substack.com/p/next-10-years-of-perpetual-transition>.
- 558 Shannon Tiezzi, “With Kerry in Beijing, China Signals It Will Go Its Own Way on Climate Change Policy,” *The Diplomat*, July 20, 2023, <https://thediplomat.com/2023/07/with-kerry-in-beijing-china-signals-it-will-go-its-own-way-on-climate-change-policy/>.
- 559 Daniel F. Runde, “Congress Should Support a ‘Fix’ to the Development Finance Corporation,” *The Hill*, March 24, 2022, <https://thehill.com/opinion/finance/599569-congress-should-support-a-fix-to-the-development-finance-corporation/>.
- 560 Daniel F. Runde, “The U.S. EXIM Bank in an Age of Great Power Competition,” Center for Strategic and International Studies, June 18, 2024, <https://www.csis.org/analysis/us-exim-bank-age-great-power-competition>.
- 561 “Permitting Process Flowchart for a Solar Project,” The Permitting Institute, accessed October 26, 2024, <https://www.permittinginstitute.org/solar-chart>.
- 562 Wayne Winegarden, “Energy Transition or Not, Permitting Reform Is Essential,” *Forbes*, June 19, 2024, <https://www.forbes.com/sites/waynewinegarden/2024/06/17/energy-transition-or-not-permitting-reform-is-essential/>; and U.S. Senate Committee on Energy and Natural Resources, “Manchin, Barrasso Release Bipartisan Energy Permitting Reform Legislation,” press release, July 22, 2024, <https://www.energy.senate.gov/2024/7/manchin-barrasso-release-bipartisan-energy-permitting-reform-legislation>.
- 563 Ted Mann and Timothy Puko, “Senate Tax-and-Climate Plan Hinges on Streamlining Energy Projects,” *Wall Street Journal*, July 31, 2022, <https://www.wsj.com/articles/senate-tax-and-climate-plan-hinges-on-streamlining-energy-projects-11659276002?mod=e2tw>; and “Let’s Reform America’s Clean Energy Permitting Process,” Citizens’ Climate Lobby, accessed October 26, 2024, <https://citizensclimatelobby.org/our-climate-solutions/clean-energy-permitting-reform/>.
- 564 U.S. Chamber of Commerce (@USChamber), “Why the U.S. Needs to Reform Its Permitting System,” YouTube video, August 9, 2023, 30:54, <https://www.uschamber.com/on-demand/infrastructure/common-grounds-us-needs-permitting-reform>.
- 565 PRNewswire, “United States Ranks Next to Last in Development Time for New Mines That Produce Critical Minerals for Energy Transition, S&P Global Finds,” S&P Global, July 18, 2024, <https://press.spglobal.com/2024-07-18-United-States-Ranks-Next-to-Last-in-Development-Time-for-New-Mines-that-Produce-Critical-Minerals-for-Energy-Transition,-S-P-Global-Finds>.
- 566 Philip Rossetti, “Manchin and Barrasso Revive Permitting Reform This Congress,” R Street, July 30, 2024, <https://www.rstreet.org/commentary/manchin-and-barrasso-revive-permitting-reform-this-congress/>; and Herman K. Trabish, “Congressional Action on Energy Permitting Remains Stuck, but States, Developers Are Finding Solutions,” *Utility Dive*, February 27, 2024, <https://www.utilitydive.com/news/federal-energy-permitting-reform-doe-ferc-congress/705818/>.
- 567 Earthjustice, “Ahead of Senate Markup, Earthjustice Blasts Manchin-Barrasso Permitting Bill,” press release, July 31, 2024, <https://earthjustice.org/press/2024/ahead-of-senate-markup-earthjustice-blasts-manchin-barrasso-permitting-bill>.
- 568 “The China Threat,” Federal Bureau of Investigation, accessed October 26, 2024, <https://www.fbi.gov/investigate/counterintelligence/the-china-threat>.
- 569 The White House, *Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth: 100-Day Reviews under Executive Order 14017* (Washington, D.C.: The White House, 2021). <https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf>.
- 570 Chong-En Bai, Chang-Tai Hsieh, Zheng Michael Song, and Xin Wang, “The Rise of the State-Connected Private Sector in China,” Stanford Center on China’s Economy and Institutions, updated November 1, 2023, <https://sccei.fsi.stanford.edu/china-briefs/rise-state-connected-private-sector-china>.
- 571 Patsy Widakuswara, “Biden, EU Chief Downplay Differences over US Climate Subsidies,” *Voice of America*, March 11, 2023, <https://www.voanews.com/a/biden-to-host-eu-chief-to-discuss-china-climate-subsidies/7000145.html>; and Peter Campbell and Harry Dempsey, “Chinese Battery Makers Set to Dominate Europe’s Car Industry,” *Financial Times*, December 6, 2022, <https://www.ft.com/content/d407772c-4a76-4e59-9bb0-998b3f22383b>.
- 572 Shannon Tiezzi, “China Celebrates German Chancellor’s Trip,” *The Diplomat*, November 5, 2022, <https://thediplomat.com/2022/11/china-celebrates-german-chancellors-trip/>.
- 573 Andrew Duehren, “U.S. and EU Advance Buyers’ Club for EV Battery Minerals,” *Wall Street Journal*, February 15, 2023, <https://www.wsj.com/articles/u-s-and-eu-advance-buyers-club-for-ev-battery-minerals-5288287e>.
- 574 John F. Kennedy, “Address to Joint Session of Congress May 25, 1961,” (speech, Washington, D.C., May 25, 1961), <https://www.jfklibrary.org/learn/about-jfk/historic-speeches/address-to-joint-session-of-congress-may-25-1961>.
- 575 Strategic and Critical Materials Stock Piling Act, Public Law

2023

Free Economies *are* Clean Economies

*A Correlation of Economic Freedom and
Environmental Performance*

by Nick Loris and Jeff Luse



CONSERVATIVE
COALITION *for* CLIMATE
SOLUTIONS

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ABUNDANT ENERGY FROM FREE MARKETS



*by Chris Wright,
Chief Executive Officer, Liberty Energy*

There are two broad approaches to problem solving: top down, or from the bottom up. Top-down approaches include presidential edicts, bureaucratic orders and government intervention. Bottom-up solutions include believing in people, individual empowerment and free market approaches.

With that in mind, I see three significant long-term, global challenges facing humankind:

1. Energy poverty.
2. Lack of a secure supply of reliable, affordable, and clean energy.
3. Climate change.

Notice that all of these revolve around energy: how to generate it, how to deliver it, how to consume it, and what the effects of consuming it will be. By keeping these challenges in mind, we can decide what goals to set, and we can see the danger of setting the wrong goals.

For example, in the year 2023, we are seeing major threats to energy security, reliability, and affordability. This is not due to any shortage of available resources. It is due to years of underinvestment in hydrocarbons and related infrastructure, which is happening because policymakers, operating from the top down, are setting the wrong goals. They are focused on naive political and regulatory pressures as well as a misguided attempt to get to zero carbon emissions without considering the implications of the adverse effects on human prosperity and upward mobility. They are ignoring inevitable tradeoffs. They are, in short, trying to pick winners and losers where there will be many more losers than winners if policies trap people in energy poverty.

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But energy markets are impossible to manage from Washington. Nobody knows when there will be a cold snap, a food shortage, or an outbreak of war in Europe or the Middle East. Any of these events can send energy markets soaring or plunging. Those markets mostly operate from the bottom up. They are the result of millions of people making billions of decisions. Those markets actually work and can respond more quickly to price signals when they are not constrained by government dictate. Market prices reflect current supply and demand dynamics and encourage investment in valuable products. That creates a virtuous cycle delivering more of what we need and less of what consumers no longer value. Market competition drives down prices.

Another problem is that those who want to guide markets are all too eager to underinvest in hydrocarbons, because they say they are concerned about climate change. Such heavy-handed, top-down intervention ignores the importance of reliable energy for everyday life and the fact that higher energy prices disproportionately hurt poor people. Even in wealthy nations, rising energy prices pose significant economic and health threats to lower-income people. Living in poverty is exhausting and we should strive to reduce this condition, not accept it as collateral damage from climate policies.

Things are even worse in poor nations. While media in the wealthy West warn of dramatic threats to human health today from climate change, the World Health Organization estimates that some 3 million people die each year from energy poverty. That is a conservative estimate, as it only considers impacts from a lack of clean cooking fuels which forces billions to suffer copious pollution from burning wood and dung indoors for cooking.

It doesn't need to be this way.

The goal at my company, Liberty Energy, is to bring modern energy to the one-third of humanity that still lacks access, and to help energize the world with a secure supply of affordable, reliable, clean energy. That will be "ESG" done right. When we do that, we can end global poverty, which should be our top 2050 goal.

Ending poverty will require using more hydrocarbons, not fewer. So it is important to note that hydrocarbons, like everything else, have downsides. They deliver air pollution and influence climate change. But their upsides are even larger. They deliver longer, more opportunity-rich lives, preserve forests, reduce the need for cropland, and can be used to provide clean water and basic medical care. Pollution control technologies

can reduce the environmental downsides while preserving the enormous upsides.

Simply put, there is no such thing as “clean” energy or “dirty” energy. All energy sources have positive and negative impacts on humans and the environment. Evaluating the tradeoffs in energy systems requires thoughtful analysis in the context of local conditions, values, and needs. It also requires the application of free markets: allow people to make decisions about their own energy future without subsidizing or constraining one form of energy over another.

The fact is that simply having access to energy is the greenest policy possible. People in Haiti depend on wood for fuel, for example, and this leads to significant deforestation and higher GHG emissions. Meanwhile, the Dominican Republic, its wealthier neighbor with modern energy sources, is covered in a healthy rainforest.

Liberty is working to deliver more clean-burning propane by launching the Bettering Human Lives Foundation, which will support entrepreneurs in expediting availability of clean cooking fuel (propane) to the over 2 billion people who lack it today. Those aspiring to cook with propane are currently burning wood, charcoal, dung, and agricultural waste. Replacing those fuel sources can save millions of lives and free countless women from the drudgery and danger of traditional biomass fuels.

Wealthy nations have pipeline infrastructure that delivers natural gas (methane) to your stove, home heater, clothes dryer, etc. Lower income countries lack this infrastructure, however propane can be a substitute as it can be widely distributed without pipelines. We need more propane, now and in the near future, to save lives and improve human outcomes. Fortunately, Liberty and our colleagues in the shale industry are delivering surging U.S. propane production available to better human lives.

It is not just propane, of course. We need more of every kind of energy to be delivered cleaner and cleaner with the help of innovation. We need more natural gas, nuclear, geothermal, solar, and yes, even coal. Everyone’s goal is to reduce energy poverty and reduce emissions in a way that better understands the tradeoffs people around the world face.

Utilizing more energy sources encourages bottom-up innovation. It can eventually deliver everything from propane stoves and small solar arrays for cell phones to next-generation hydropower projects. It allows different communities to employ the right tools for them, like using solar in sunny areas, geothermal where quality resources exist, nuclear in remote locations, and hydro along available streams. There is simply no one size fits all solution.

By preserving and improving millions of lives, new sources of energy and greater use of existing sources such as hydrocarbons can lift people out of poverty, allowing them to go to work or school and earn a better living. All of this unleashes human potential. This is how we can drive human progress to the next level and begin solving problems like climate change. Not by giving things up, but by leveling people up. This will come from markets, not mandates.

Our descendants can live in a richer world, a world free of dire human poverty. They can do so if we allow innovators and entrepreneurs to find cost-effective ways to clean up the environment while energizing the world. Human liberty, bottom-up social organization, and abundant, affordable energy enabled the modern world. The same forces can deliver a brighter future for all.



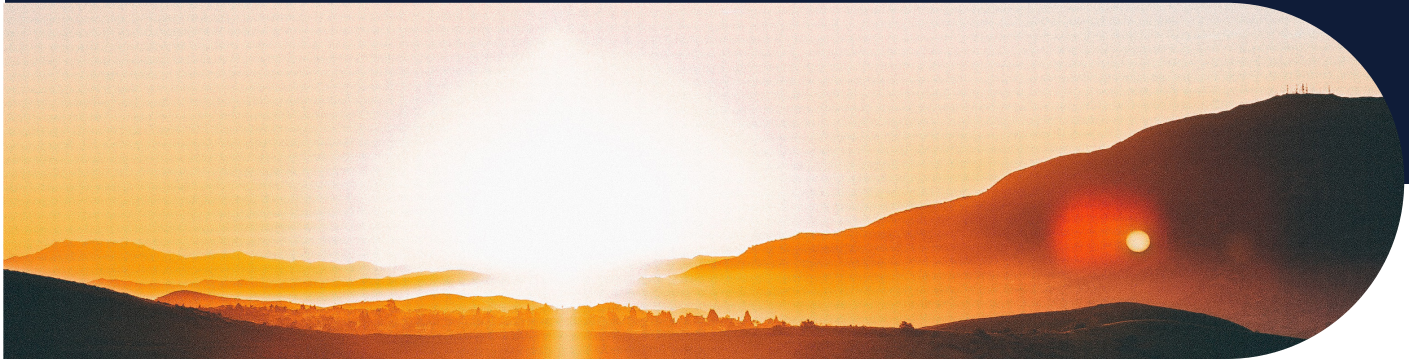
FREE ECONOMIES ARE CLEAN ECONOMIES

Freedom requires individuals to be free to use their own resources in their own way, modern society requires cooperation among a large number of people. The question is, how can you have cooperation without coercion? If you have a central direction you inevitably have coercion. The only way that has ever been discovered to have a lot of people cooperate together voluntarily is through the free market.

Milton Friedman, PBS, October 1, 2000¹

When shopping at your local grocery store, it is easy to take for granted the many steps it took for the bananas to make their way from Guatemala to your cart. Given the land, people, technology, and transportation involved, it is a marvel that a shopper can purchase a pound of bananas in the United States for less than 75 cents.² Through cooperation and voluntary exchange, a system of free enterprise with strong accountable governance empowers people and delivers innumerable benefits every day.

The belief in free, open societies is at its core a belief in people to solve the myriad of challenges that exist in the world today. Whether it is delivering more reliable electricity to homes, providing more access to food and health care, or addressing the world's most complex environmental challenges, harnessing the power of human ingenuity will result in higher levels of economic prosperity and environmental progress. Commitments to individual freedom and economic liberty are instrumental in making the world a cleaner, healthier place to live.



THE RELATIONSHIP BETWEEN ECONOMIC FREEDOM AND ENVIRONMENTAL PERFORMANCE

For nearly three decades, the Washington D.C.-based Heritage Foundation has published an Index of Economic Freedom. The Index measures economic freedom by scoring each country in the following categories.

1. **Rule of law:** property rights, judicial effectiveness, and government integrity;
2. **Government size:** fiscal health, government spending and tax burden;
3. **Regulatory efficiency:** business freedom, labor freedom, and monetary freedom; and
4. **Open markets:** trade freedom, investment freedom, and financial freedom.

Heritage compiles publicly available data from sources such as the African Development Bank, the Asian Development Bank, the European Commission, the Economist Intelligence Unit, the International Monetary Fund, the World Bank, various U.S. government agencies, Oxford University's World Economic Outlook, and the World Economic Forum.³

Countries earn aggregate scores and fall into one of five categories:

1. Free (scores of 80 to 100)
2. Mostly Free (70 to 80)
3. Moderately Free (60 to 70)
4. Mostly Unfree (50 to 60)
5. Repressed (50 and below).



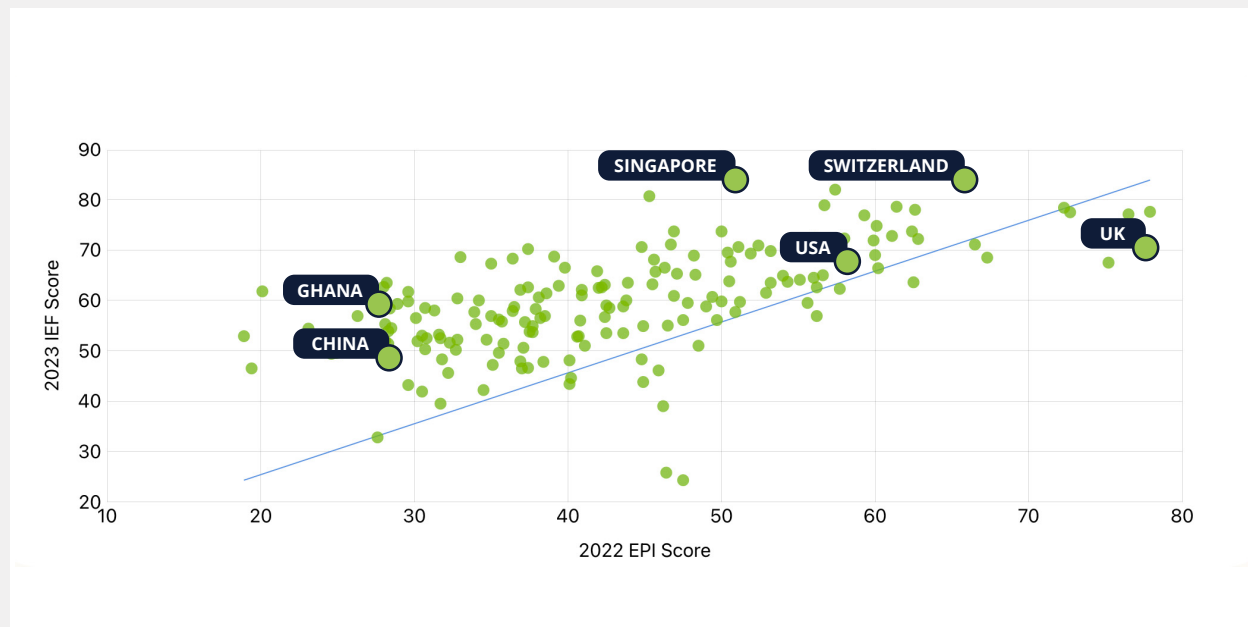
In the 2023 Index, only four countries (Singapore, Switzerland, Ireland and Taiwan) received the most elite designation of “Free” nations⁴ while 23 others fall into the “Mostly Free” category, including the United States. Another 56 countries are “Moderately Free.” The most fleeting connections to economic freedom are found in the 65 “Mostly Unfree” countries and the 28 “Repressed” countries.

The principles that make a country economically free are also critical to a cleaner environment. One of the most comprehensive measurements of a country’s environmental performance is Yale University’s Environmental Performance Index (EPI). Produced every other year, the EPI similarly scores a country on a 0-100 scale and includes 180 countries in its 2022 report.⁵

Figure 1.

ENVIRONMENTAL PERFORMANCE AND ECONOMIC FREEDOM

There is a strong correlation (0.61) between a country’s EPI and IEF index scores.



The EPI gives a country a score based on 40 environmental indicators broken down into eleven issue categories. These fall into three broader categories consisting of:

1. Climate change: climate change mitigation;
2. Environmental health: air quality, sanitation & drinking water, heavy metals, and waste management;
3. Ecosystem vitality: biodiversity & habitat, ecosystem services, fisheries, water resources, acid rain, and agriculture.

The report's technical appendix details how the authors weigh each of the eleven issue categories and how the authors weigh each of the 40 environmental indicators.⁶

Using these two indices, we can explore the importance of economic freedom on environmental performance. When correlating the Index of Economic Freedom and the Environmental Performance Index, one finds a strong, positive relationship between economically free economies and clean economies.⁷

Yale's report emphasizes:

Considering the strong association between EPI and Index of Economic Freedom (IEF) scores, the 2022 EPI drivers analysis suggests that democratically-elected governments and free markets are best positioned to respond to environmental challenges and adopt policy preferences that drive countries toward a more sustainable future.

Free economies are clean economies for many reasons. Well-defined and legally protected property rights incentivize environmental stewardship. Free, competitive markets empower producers to meet the needs of consumers, including consumer demand for environmentally friendly services and products. Open markets are conduits for investment, innovation, and technological advancement, which generates significant economic and environmental efficiencies. Indeed, freer economies are wealthier, providing more private and public resources for environmental protection.

When correlating the Index of Economic Freedom and the Environmental Performance Index, one finds a strong, positive relationship between economically free economies and clean economies.



MORE PROSPERITY, MORE ENVIRONMENTAL PROGRESS

A primary explanation of why economic freedom has a positive correlation with other important human and societal quality metrics is because economically free countries have higher levels of economic growth and more investment. People are wealthier and poverty rates are lower.⁸

Higher levels of income are imperative to better environmental outcomes. After higher priorities like food, water and shelter are met, greater wealth provides more resources to dedicate to environmental protection. Richer countries have more funds to invest in public services such as sanitation, garbage collection, and pollution abatement. Through policies, accumulation of knowledge and technological progress, public and private sectors reduce unwanted environmental byproducts.

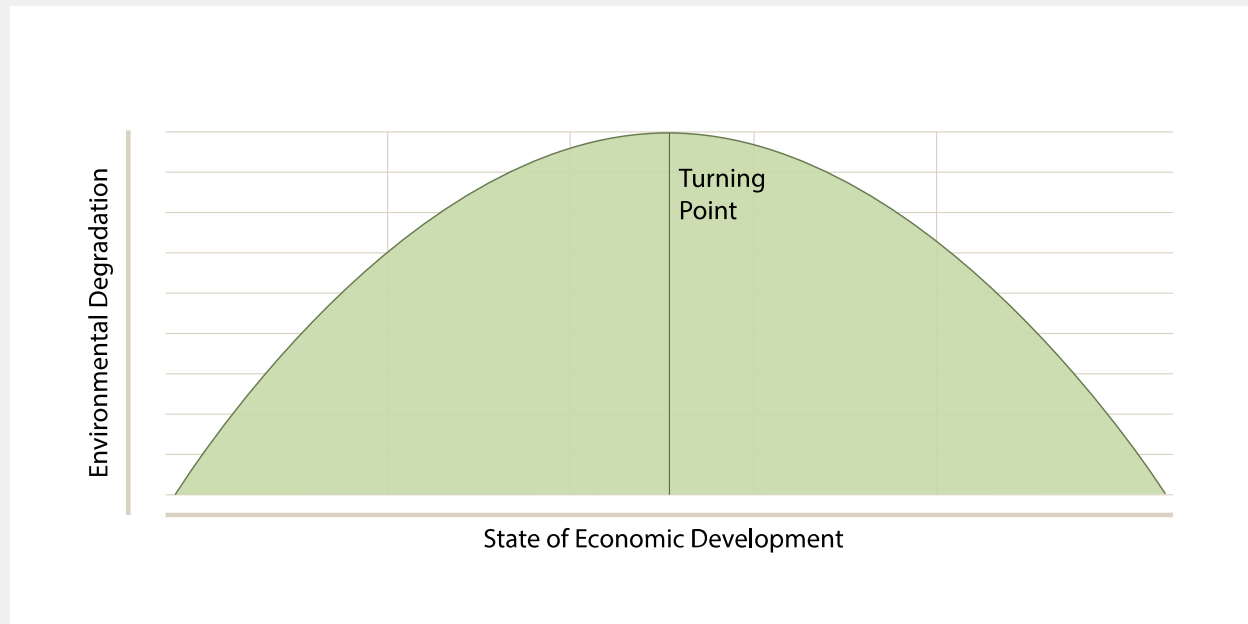
As Yale's report emphasizes, "wealth, which enables investments in environmental protection, leads to higher EPI scores by allowing countries to upgrade environment-related infrastructure and adopt better pollution-control technologies."⁹ The report goes on to say that "a consistent finding across Environmental Performance Index reports and other environmental analyses is that wealthy democracies rise to the top of rankings."¹⁰

The visual depiction of wealth's positive impact on the environment is the environmental Kuznets curve (EKC).¹¹ The EKC is an inverted-U relationship between both pollution and economic development where growth from industrialization initially results in higher levels of pollution. Over time, however, people spend their incomes on cleaning up the environment and can more easily afford the compliance costs of environmental policies.

Figure 2.

THE ENVIRONMENTAL KUZNETS CURVE

The environmental Kuznets curve (EKC) is a hypothesized relationship between various indicators of environmental degradation and per capita income.



Greater wealth also spurs investment in cleaner, more efficient processes as well as products. A cousin of the EKC, called the environmental transition curve, emphasizes the role of innovation and technology in bending pollution curves backward.¹² In effect, technological progress more quickly offsets the higher emissions from economic growth, resulting in cleaner, stronger economies. These investments will help turn green premiums into economic advantages and will help developing countries bend pollution curves back faster than it historically took more developed countries.

Peer reviewed literature has demonstrated the EKC exists for several ecological variables such as waste, waste emissions, sulfur dioxide and suspended particulate matter.¹³ Other literature has found insufficient evidence of an EKC for certain environmental indicators.¹⁴ The moment when the inverted U in the Kuznets curve starts bending downward depends on many factors and does not uniformly apply to all emissions or to all countries.



ECONOMIC FREEDOM BREEDS INNOVATION

Every day, people around the world innovate to make the world a better place. Whether it be breakthroughs in clean power generation, a new vaccine to combat illness, or artificial intelligence to improve business operations, technological advancements provide countless benefits to society and consumers. Whether those ideas start in someone's garage or in a multi-billion-dollar research facility, the policy conditions that protect and enable an idea to flourish in the market are essential to the process. Economically free countries set the stage for innovators to innovate. Business freedom, property rights, and government integrity drive innovation, research and development, and technological breakthroughs. Innovation leads to cleaner sources of energy, more efficient modes of transportation, and more cost-effective emissions reductions.¹⁵ These benefits in turn lead to higher levels of prosperity, fewer pollution related deaths, and more efficient and sustainable land use and management.

In comparing the Index of Economic Freedom with the World Intellectual Property Organization (WIPO)'s Global Innovation Index (GII),¹⁶ one finds a strong, positive correlation (0.757). Furthermore, a country's GII score has a strong, positive relationship with Yale's Environmental Performance Index (0.741).

The strong and positive relationship between these two indices makes sense. The policies that make a country economically free are also the ones that encourage entrepreneurial activity.

Economically free countries set the stage for innovators to innovate. Business freedom, property rights, and government integrity drive innovation, research and development, and technological breakthroughs.

Figure 3.

INNOVATION AND ECONOMIC FREEDOM

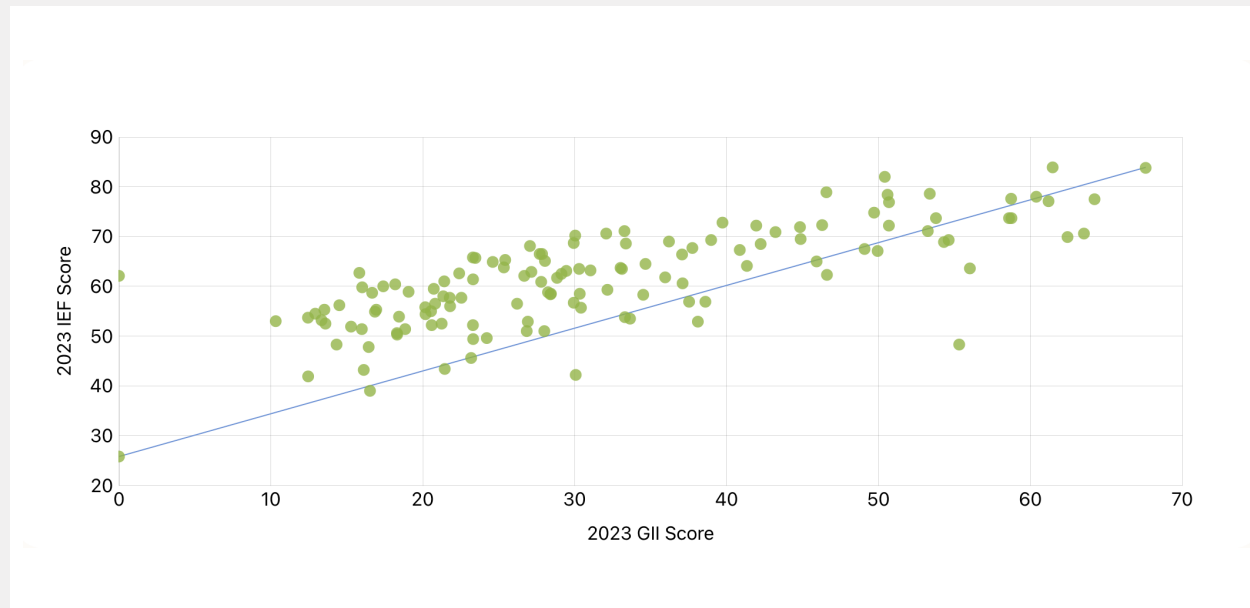


Figure 4.

INNOVATION BY ECONOMIC FREEDOM SCORE



Intellectual property rights,¹⁷ are critical for private sector innovation and breakthroughs in research and development. Intellectual property rights create opportunities for developers to protect their investment in emerging technologies, gain a competitive advantage, and generate revenue from charging for their use of intellectual property. This revenue can then be used to fund future research and investments, creating a positive feedback loop for innovation.¹⁸ *The Journal of Advanced Pharmaceutical Technology & Research* summarizes the importance of intellectual property rights (IPR):

The policies that make a country economically free are also the ones that encourage entrepreneurial activity.

There has been a quantum jump in research and development (R&D) costs with an associated jump in investments required for putting a new technology in the market place. The stakes of the developers of technology have become very high, and hence, the need to protect the knowledge from unlawful use has become expedient, at least for a period, that would ensure recovery of the R&D and other associated costs and adequate profits for continuous investments in R&D...Thus IPR, in this way aids the economic development of a country by promoting healthy competition and encouraging industrial development and economic growth.¹⁹

Digging deeper into the relationship between R&D and economic freedom, the IEF's Government Integrity (0.762) and Property Rights (0.732) subindices show a strong, positive relationship to the GII's R&D measurement. Further, a country's per capita GDP has a 0.727 correlation coefficient to its R&D score.

When countries are freer and wealthier, businesses have more resources to fund new technologies, cutting edge research, and to invest more in people through education and scientific institutions. Empirical measurements have estimated that a "one percent change in research and development expenditure will increase GDP per capita by 5 percent."²⁰ Encouragingly, in 2022, private sector research and development expenditures topped \$1 trillion for the first time ever.²¹

Conversely, weak protections for a person's or institution's intellectual property discourage research and development activities. Why invest money and resources if the product or process could be easily stolen or replicated? Weak private property protections cause underinvestment in R&D because "firms do not appropriate all of the returns to innovation, causing the social returns to R&D to be substantially higher than the private returns."²² In some instances, higher social returns may be welcome, but a system with weak property rights that disincentivizes R&D could ultimately lead to lower public and private returns.

Open markets and government integrity are important to a country's knowledge and technology outputs, with correlations of 0.743 and 0.753, respectively.²³ Business freedom is also a central driver for companies to produce and export technology, ideas, and research. They can expand their customer base and attract the best talent. Efficient and open business operations allow markets and industries to invest in cutting edge software, file patents for emerging technologies, and improve high-tech manufacturing.

Restricting free-flowing commerce, however, drives up the cost to enter the market, shrinking competition, and entrenching leading businesses in industry. Furthermore, while public investment in innovation incubators is beneficial and can generate significant positive economic spillovers, overzealous government spending can stymie innovation. Federal expenditures on research and development, for instance, can reach deprecating gains and crowd out private investment in the space.²⁴ It can also result in significant opportunity costs where

politicians allocate taxpayer dollars to their preferred interests rather than what may be a necessary, effective, or legitimate function of the federal government. Cronyism and preferential treatment between agencies and private contractors, or poor oversight on spending can lead to fraud, mismanagement, and abuse. This not only stalls economic progress but also erodes public confidence in institutions and misallocates precious resources that could be spent more productively elsewhere in the economy.

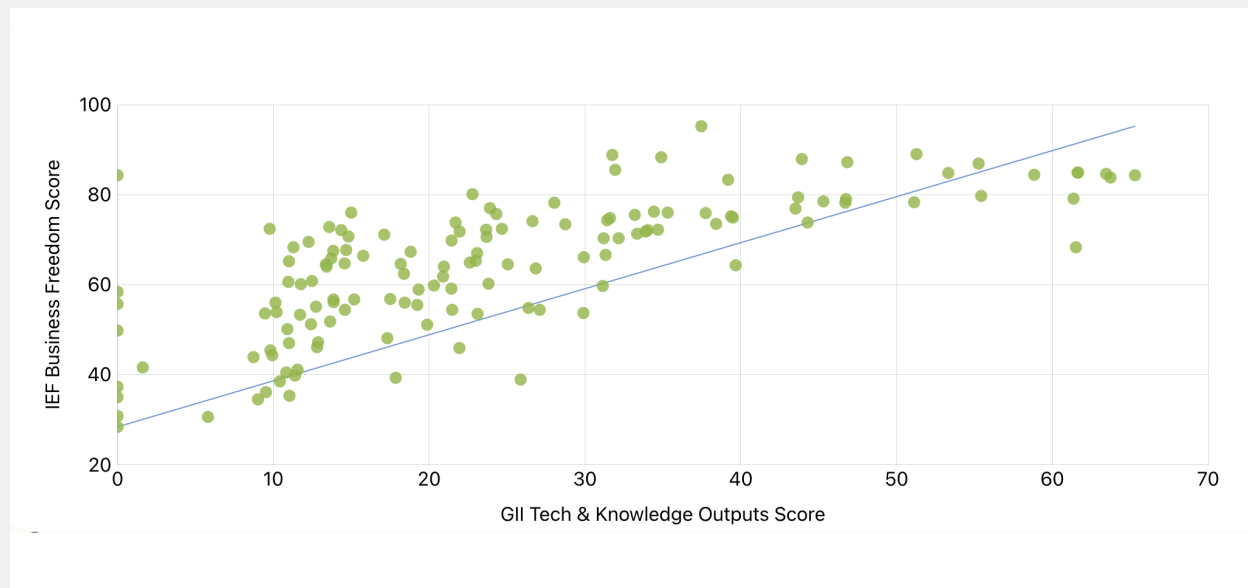
Additionally, poor fiscal policy (low monetary freedom according to the IEF) can lead to higher interest rates and more expensive borrowing costs which can discourage financial backing for startups, hamstringing venture capital funding, and make it more costly to deploy clean energy systems.²⁵ In November 2023, advanced nuclear company NuScale canceled its power plant in Idaho due to high costs and inflation.²⁶

The concern over high interest rates is highlighted in GII's report which states, "Global government R&D budgets are expected to grow in real terms in 2022, while R&D expenditure by top corporate spenders rose substantially. But it is unclear whether this can compensate for surging inflation." Recently, renewable energy companies have been particularly hit hard by high interest rates.²⁷

Yet another problem that can discourage innovation, and the export of innovation abroad, is government restrictions on business freedom by way of subsidies. Preferential treatment allows the government to pick winners and losers – with the winners often being large corporations that do not need support from taxpayers.²⁸ Entrenching special interests shields industries from disruption by making it more expensive and difficult for new companies and entrepreneurs to enter the market or reach a larger customer base.

Figure 5.

BUSINESS FREEDOM AND TECH & KNOWLEDGE OUTPUTS



Protectionist laws inhibit innovation and global clean energy progress. To allegedly remain competitive and appease constituencies, policymakers in industrialized nations are increasingly turning to protectionist policies and centralized planning to subsidize and reshore manufacturing and construction for green technologies such as solar cells and electric vehicles. Research from the European Central Bank (ECB) regarding the subsidies for domestic clean energy production in the Inflation Reduction Act found that:

Green sectors in America, unsurprisingly, benefit. But producers in other countries lose out so much that ‘the IRA could slow the green transition at global level’. That is an astonishing result. Add in the subsidies and domestic-content requirements implemented by other countries and the drag could be even bigger.²⁹

On the other hand, free trade allows results in more specialization of environmentally-friendly goods. For instance, iron smelters have the choice to purchase metallurgical coke from Argentina instead of Australia, where coke production is three times as dirty. Businesses also have the ability to buy Finnish lumber which emits about one-thirtieth the carbon, per dollar produced, of wood from Indonesia.³⁰

Policymakers should resist the temptations of central planning and protectionism and instead empower the private sector to meet peoples’ needs and address environmental priorities. Property rights, government integrity, and business freedom are integral to unleashing innovation and making breakthroughs that are necessary to reduce global emissions and accelerate human prosperity.



ECONOMIC FREEDOM PROVIDES A BREATH OF FRESH, CLEAN AIR FOR THE WORLD (LITERALLY)

Air pollution is one of the highest causes of premature death in the world. It accounts for more fatalities than alcohol use, unsafe water, and unsafe sanitation, combined.³¹ The World Health Organization estimates that ambient air pollution and household air pollution cause 6.7 million premature deaths annually.³² Importantly, these mortalities disproportionately occur in the developing world where access to energy is less readily available.³³ For instance, a lack of clean cooking infrastructure contributes to 3.7 million premature deaths annually, 60% of which occur in Africa.³⁴

Reducing ambient and indoor air pollution will require expanding electricity access in the developing world and transitioning away from the use of charcoal, dung, and coal to meet heating, cooking, and energy needs. Resolving this challenge has proven to be difficult. Economic freedom helps by generating more wealth, which results in more public and private investment in cleaner fuels, more efficient technologies, and pollution abatement. Strong institutions reduce cronyism and hold polluters accountable.

When comparing the air quality index of Yale's Environmental Performance Index, which "consists of seven indicators: PM2.5 exposure, household solid fuels, ozone exposure, nitrogen oxides exposure, sulfur dioxide exposure, carbon monoxide exposure, and volatile organic compound exposure,"³⁵ and The Heritage Foundation's Index of Economic Freedom, one finds a strong positive correlation (0.636).

Figure 6.

AIR QUALITY AND ECONOMIC FREEDOM

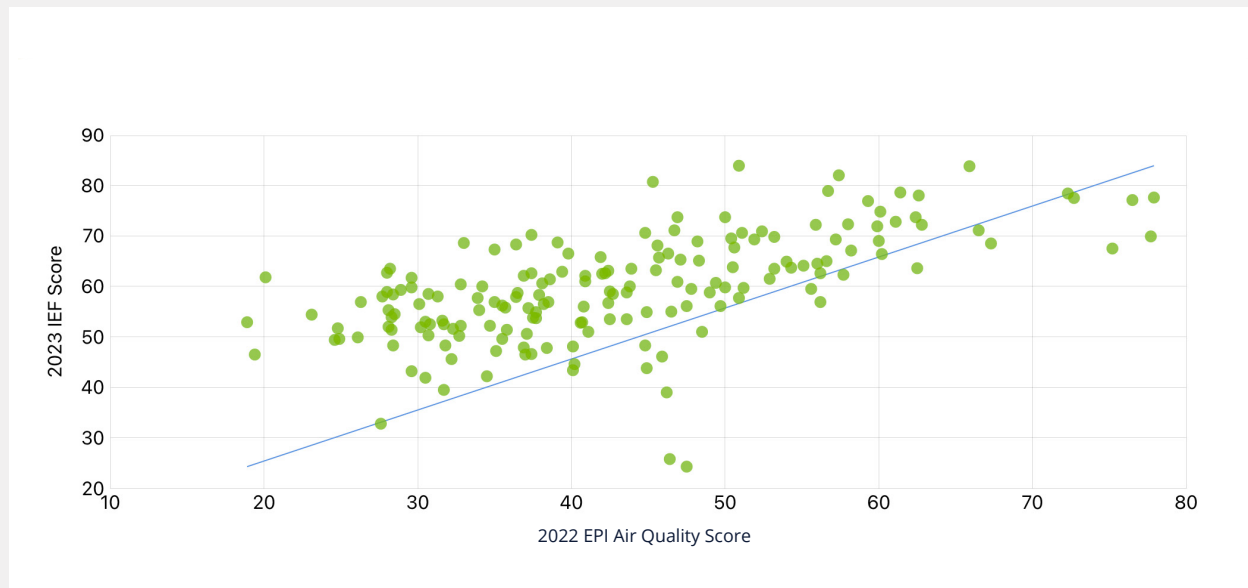
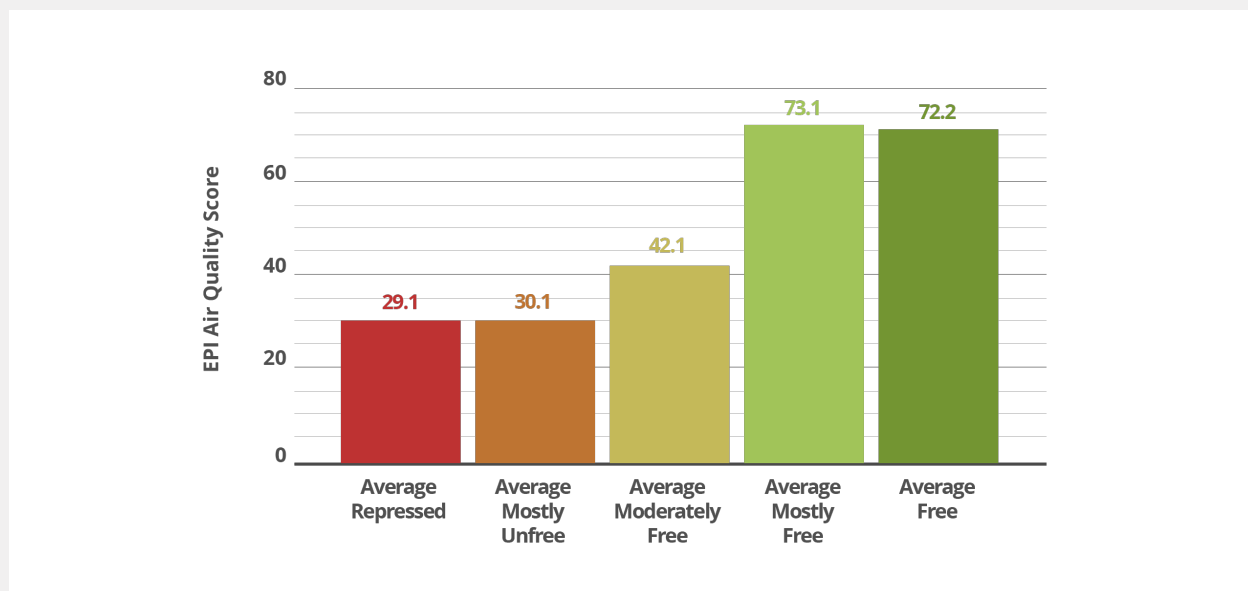


Figure 7.

AIR QUALITY AND ECONOMIC FREEDOM



The relationship between economic freedom and air pollution has been explored by previous literature. Writing for the Fraser Institute in 2014, Joel Wood and Ian Herzog find, “a permanent one-point increase in the Economic Freedom of the World index results in a 7.15% decrease in concentrations of fine particulate matter in the long-run, holding all else equal.”³⁶

Figure 8.

AIR QUALITY AND GOVERNMENT INTEGRITY



IEF’s Government Integrity subindex³⁷ plays a pivotal role in countries’ air pollution scores as evidenced by the two indices’ strong, positive correlation (0.786). One example where the role of high-quality institutions has had an impact on energy access and air pollution is the electricity sector. Privately-owned electricity utilities are unique to the U.S. and Western countries. In much of the developed world, electricity utilities are owned and operated by the central government, as the private market is not well-enough established to provide electricity to consumers.³⁸ Furthermore, a lack of adequate grid infrastructure and low activation rates, especially in rural areas, borne by high upfront investment costs disincentivizes private companies from entering emerging markets.³⁹ Because of these factors, the impetus of expanding access to electricity falls on the government.

This strategy can prove successful in countries whose governments are not corrupt. However, in countries where fraud is rampant, a publicly owned electricity system can lead to blackout and a lack of access to electricity (especially in rural areas). Without reliable power or a functional grid, families must heat and power their homes with high-polluting energy sources such as biomass, wood, and agricultural waste.

One notable instance is in South Africa, which ranks 144 out of 175 in Yale’s Air Quality rankings and low on

the IEF's rule of law scores. Corruption at state-owned Eskom has led to rolling blackouts and higher energy costs for consumers. As Paul Burkhardt of *Bloomberg* reported:

On a late Thursday afternoon last November, in the midst of rolling blackouts implemented by South Africa's state-owned electricity company, a contractor at a power station in the eastern Mpumalanga province pulled a plug connected to one of the site's main generation units.

The unit subsequently broke down, ensuring yet another day of nationwide outages.

The worker later confessed that he had intentionally sabotaged the machinery — resulting in \$1 million in damages and almost \$6 million in lost revenue — so his employer would be hired to make the repairs, according to a statement and report presented to lawmakers by Eskom Holdings SOC Ltd.

This wasn't an isolated event — rather, it was one of more than 760 criminal incidents targeting Eskom operations over a 90-day period ending in December. At every step of its supply chain, the utility, which is responsible for producing 90% of South Africa's energy, has had to defend itself against armed robbery, fuel theft, sabotage and corruption — all of which are increasing the risk of a complete power outage that could devastate a country teetering on the brink of recession.⁴⁰

As the most industrialized nation on the continent, South Africans enjoy near universal availability of electricity. However, government corruption may lead to recession and less adequate power. The impact of corruption in countries that are not as industrialized is far more realized, as they do not have the existing grid infrastructure and energy resources that South Africa uses.

PROSPERITY AND CLEAN AIR

Another relevant factor for a country's air quality is its economic well-being. Returning to the concept of the Environmental Kuznets Curve, higher levels of economic growth increases air pollution but equips countries with the resources necessary to do something about it. One way to measure this is to examine the relationship between prosperity and air quality. The Atlantic Council's Freedom and Prosperity Index provides an annual empirical snapshot of the current distribution of freedom and prosperity around the globe. The Atlantic Council's Freedom Index evenly weighs a country's Legal Freedom,⁴¹ Economic Freedom,⁴² and Political Freedom.⁴³

The Prosperity Index has six indicators, all of which receive equal weight.⁴⁴ A country's score on the Freedom Index and Prosperity Index are closely correlated, (0.80 correlation coefficient), meaning that as a nation becomes more prosperous, it tends to become freer and vice versa.

A similarly significant positive relationship exists between the Atlantic Council's Prosperity Index and Yale's Air Quality subindex (0.872).

The result of this relationship is not surprising. Countries will prioritize meeting the basic needs of citizens before addressing the environmental byproducts created by meeting those needs. Higher living standards will allow citizens and governments to invest in cleaner cooking systems, reliable infrastructure, and more innovative technologies. Countries with strong institution and property rights protections pass laws and

regulations to reduce environmental degradation.

Increasing a country's level of prosperity is integral to reducing indoor and outdoor air pollution-caused deaths. Research from Our World In Data shows that as per capita GDP increases, death rates from outdoor pollution increase before falling dramatically—which further lends credence to the EKC.⁴⁵ Wealthier people living in more prosperous countries have much lower death rates from indoor air pollution.⁴⁶ Climbing the economic ladder is one of the most effective ways to reduce air pollution-related deaths in the developing world.

The world's Least Developed Countries (LDCs), which the United Nations defines as “low-income countries confronting severe structural impediments to sustainable development [that] are highly vulnerable to economic and environmental shocks and have low levels of human assets,” are a testament to this. As seen in the chart below, 22 LDCs are heavily reliant on biomass and waste, such as dung and crop waste (which are large contributors of indoor air pollution) and oil to meet their energy needs.⁴⁷

The heavy use of biomass and waste is particularly troubling because it is primarily used to cook meals or heat and power small spaces.⁴⁸ Burning these sources produces particulate matter that either worsens underlying health conditions or create new problems.⁴⁹ The use of these materials also contributes to deforestation, which further reduces air quality in regions.

Industrialized countries must allow emerging economies to develop. Restricting energy access with top-down policies will trap people in poverty and poor living conditions, exposing them to higher levels of pollution. Policies rooted in economic freedom will allow people in developing countries achieve higher levels of prosperity, greater public health, and healthier environments.

Wealthier people living in more prosperous countries have much lower death rates from indoor air pollution. Climbing the economic ladder is one of the most effective ways to reduce air pollution-related deaths in the developing world.



Figure 9.

PROSPERITY AND AIR QUALITY

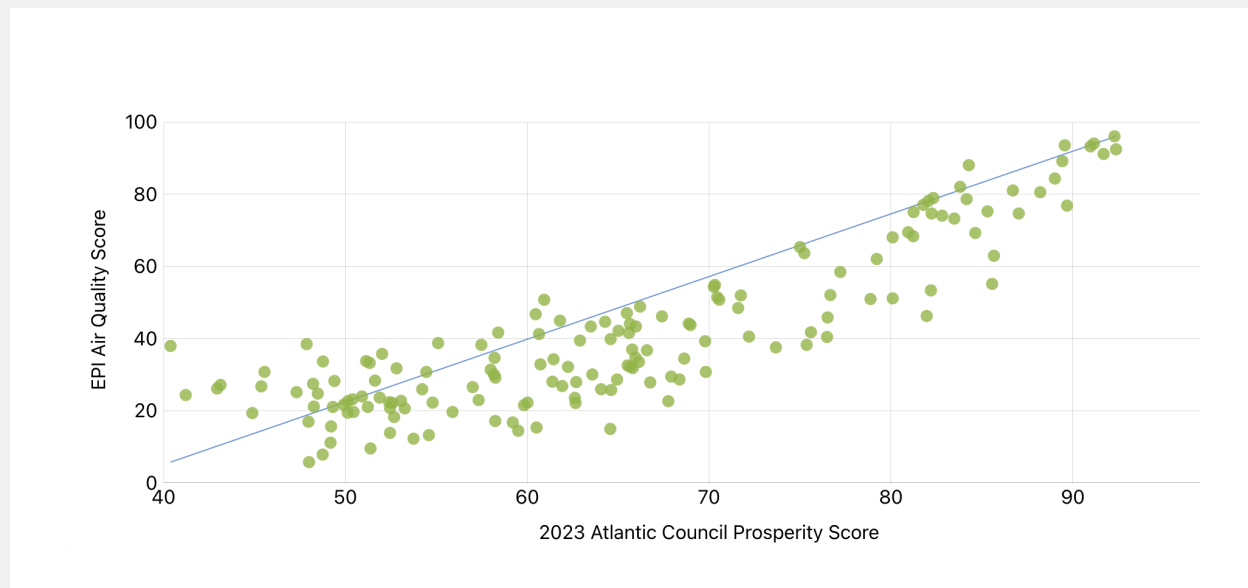


Figure 10.

PROSPERITY AND AIR QUALITY (LEAST TO MOST PROSPEROUS)

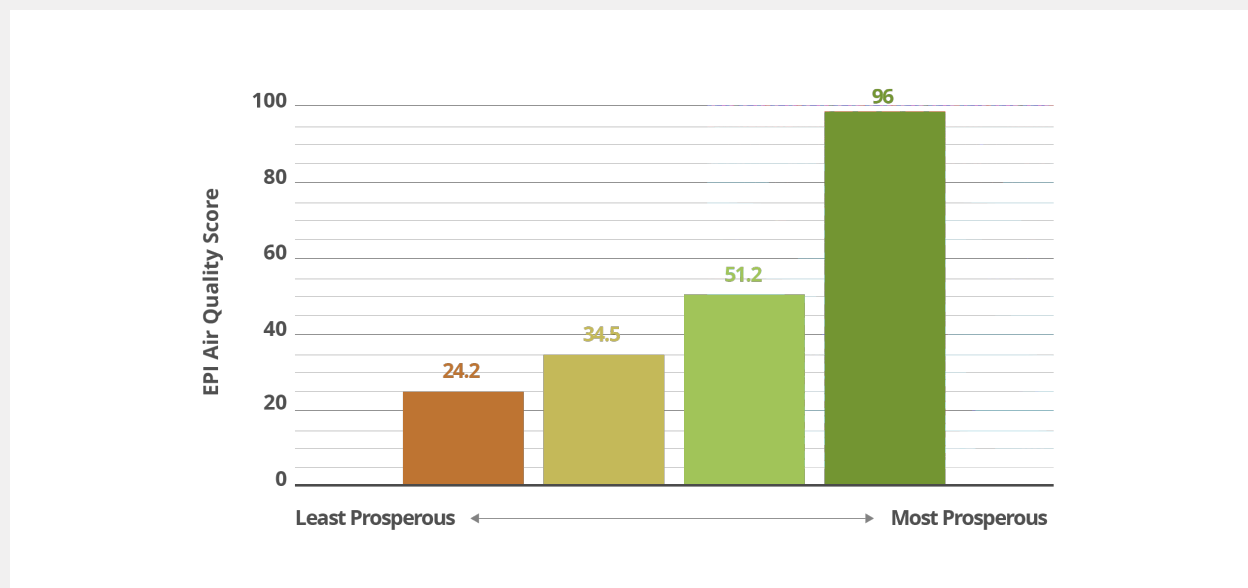


Figure 11.

DEATH RATE FROM INDOOR AIR POLLUTION VS. GDP PER CAPITA

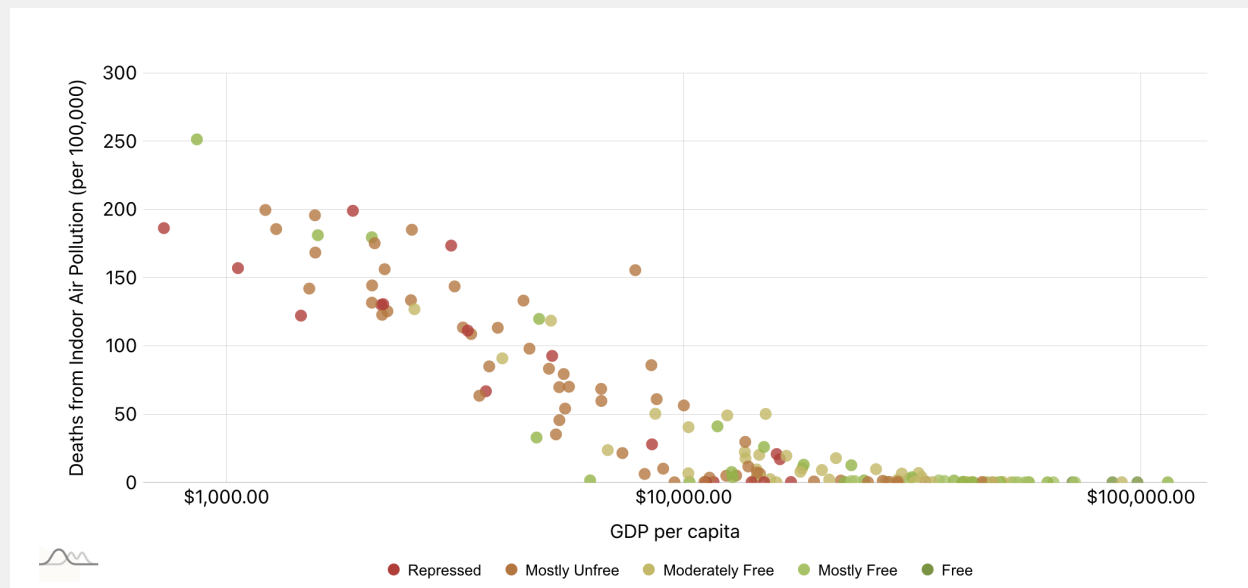


Figure 12.

DEATH RATE FROM OUTDOOR AIR POLLUTION VS. GDP PER CAP

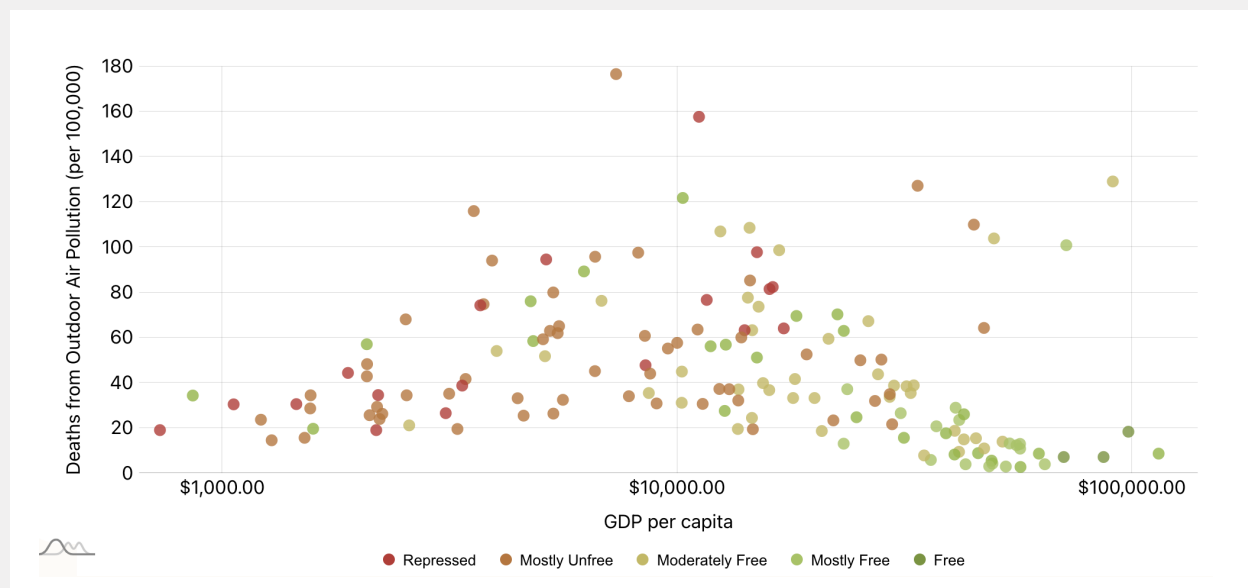


Figure 13.

TOTAL ENERGY USE BY SOURCE IN LEAST DEVELOPED COUNTRIES

Country	Fossil Fuels (% of total energy supply)	Biomass & Waste (% of total energy supply)	Clean energy sources (Hydropower, Renewables, etc)
Angola	41.93%	50.18%	7.89%
Bangladesh	81.94%	18.06%	0.00%
Benin	46.04%	53.95%	0.01%
Cambodia	53.34%	42.07%	4.59%
Dem. Rep. Congo	2.52%	94.19%	3.30%
Eritrea	21.15%	78.71%	0.14%
Ethiopia	10.02%	87.17%	2.80%
Haiti	20.02%	79.76%	0.22%
Madagascar	9.99%	88.85%	1.16%
Mozambique	18.99%	68.87%	12.14%
Myanmar	48.53%	47.49%	3.98%
Nepal	26.84%	69.54%	3.62%
Niger	21.20%	78.74%	0.06%
Rwanda	9.12%	90.84%	0.03%
Senegal	56.07%	42.80%	1.13%
South Sudan	74.56%	25.32%	0.12%
Sudan	32.52%	62.95%	4.53%
Tanzania	16.79%	82.06%	1.15%
Togo	15.07%	84.56%	0.37%
Uganda	9.82%	88.13%	2.05%
Yemen	93.95%	4.60%	1.46%
Zambia	18.97%	70.95%	10.08%



FREER ECONOMIES DELIVER CLEANER WATER TO CONSUMERS

Access to clean water and sanitation are two fundamental human rights,⁵⁰ yet billions of people around the world are living without them.⁵¹ In 2021, more than 2 billion people lived in water-stressed countries (defined as areas where demand for clean water outpaces supply either because supplies are insufficient or infrastructure is inadequate). In 2022 at least 1.7 billion people used a contaminated drinking water source.⁵² Relying on dirty, contaminated water leads to outbreaks of several waterborne diseases including cholera, dysentery, and hepatitis A. The World Health Organization estimates that each year some 1 million people die from diarrhea because of unsafe drinking water, sanitation, or hygiene.⁵³

The world has made impressive progress in making safe drinking water more readily available. From 2015 to 2022, some 687 million people gained access to safely managed drinking water.⁵⁴

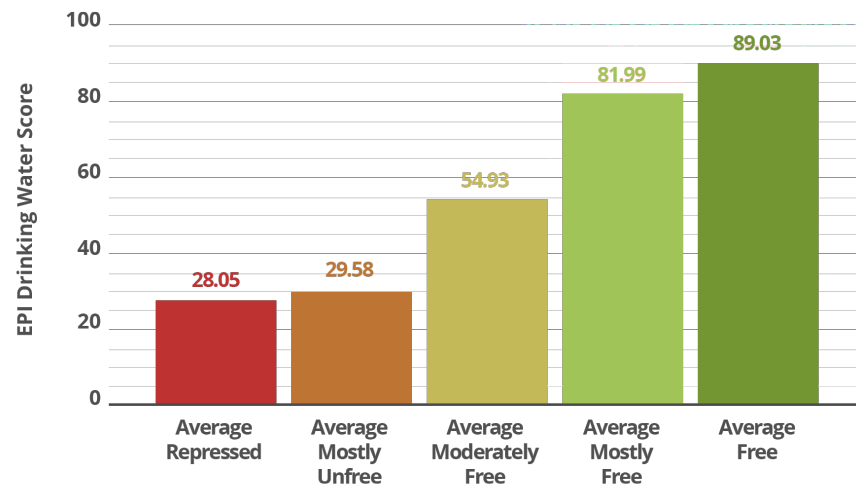
Expanding greater access to clean drinking water will require a suite of solutions. Economic freedom can help to deliver meaningful progress by increasing levels of wealth. Governments and private entities will have more resources to expand water infrastructure and households to spend additional resources to hook up water lines to their homes. Competitive and open markets will empower entrepreneurs to develop new methods of water filtration and strong institutions would provide oversight to ensure that water is being used sustainably and equitably.

There is a strong, positive correlation (0.669)⁵⁵ between Heritage's Index of Economic Freedom and the Environmental Performance Index's Unsafe Water Index.

Several other studies have identified the relationship between safe drinking water and economic prosperity. One recent and comprehensive analysis comes from Kokou Dangui and Shaofeng Jia in their study, "Water Infrastructure Performance in Sub-Saharan Africa: An Investigation of the Drivers and Impact on Economic Growth."⁵⁶ In this report, Dangui and Jia investigate how socioeconomic factors impact water access in Sub-Saharan Africa. The authors also explore the relationship between water infrastructure investment and economic growth.

Figure 14.

SAFE DRINKING WATER AND ECONOMIC FREEDOM



Dangui and Jai find a “positive statistically significant relationship between water infrastructure, GDP per capita, and population growth, and a negative statistically significant relationship between human capital and regulatory quality.”⁵⁷ Specifically, the study finds that for every 1% increase in per-capita income growth, water infrastructure increased by 0.2%. As the authors summarize their findings:

The consistent positive association between water infrastructure and per-capita GDP implies that the richer the country is getting, the more successful its water infrastructure performance. This is mainly because countries have more economic resources to invest in water infrastructure and management expertise as they become richer.

In much of the developing world, it is the responsibility of women and children to collect water. Because clean water access can be miles away, water collection takes women and children away from school, education, and other productive activities, all of which are critical to economic growth.⁵⁸ Improving the levels and accessibility of clean water is not only important for the physical health of citizens, but for the economic and environmental health of countries as well.

PROPERTY RIGHTS AND CLEAN DRINKING WATER

There is a very strong, positive correlation (0.770) between IEF's Property Rights subindex and the EPI's Unsafe Drinking Water measurement.

As seen in the chart above, countries with the greatest property rights protections have safe drinking water scores that are nearly quadruple that of countries with the weakest property rights protections. Expanding water infrastructure is essential to reducing water-borne illness and disease, but unclear roles and inconsistent enforcement of laws can lead to a lack of ownership among governments and communities, stymie investment, and reduce community-level upkeep and buy-in.

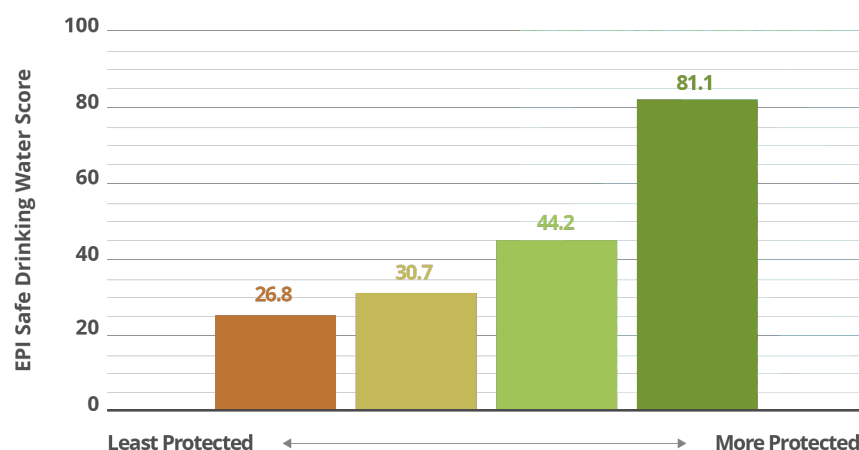
A real-world example of the importance of property rights for clean water is Uganda. In an article published in the *International Journal of Commons*, the authors point to weak property rights protections as one of many factors that prohibit adequate water access in the country.⁵⁹

Conversely, Switzerland, which has high scores in Yale's Unsafe Drinking Water subindex and Heritage's Property Rights subindex, attributes its robust water infrastructure to its strong property rights protections.

Countries with the greatest property rights protections have safe drinking water scores that are nearly quadruple that of countries with the weakest property rights protections.

Figure 15.

PROPERTY RIGHTS PROTECTIONS AND CLEAN DRINKING WATER



Only where the right to own (i.e. sell/buy) is guaranteed, are people willing to invest time and money for the improvement of a common water supply. Thus, the consistent and stable property laws provided a solid framework, not so much for private profit but for common enterprises such as water supply networks.⁶⁰

The importance of property rights and community ownership is understood not only by the Swiss government, but by the private sector as well. Water4 leverages the power of markets and price signals to expand clean water access in Africa. The company installs water pumps in rural villages and offers training the community to operate, maintain, and fix the pumping technology. Water4 also charges a small fee for the clean water that communities receive which is used to pay for infrastructure upgrades and training programs.⁶¹ This not only provides a revenue source, but it also ensures that the community has ownership of the water infrastructure, which incentivizes upkeep and repairs.

Weak property rights protections can also deplete natural resources and lead to water pollution. Because no one oversees and manages the land, no one is incentivized to take care of it, a phenomenon that is often referred to as the tragedy of the commons. Weak property rights encourage resource depletion and weak institutions allow polluters to go unregulated (and potentially violate the rights of other property owners). In Venezuela, which has the lowest possible ranking for property rights protections in the IEF,⁶² the state-owned oil company PDVSA has freely polluted and drained the land's natural resources. Despite plans for the federal government to clean up the country's degradation, at least 200,000 barrels of oil have leaked in recent years, heavily polluting lakes and water resources.⁶³

Similarly, more deforestation occurs with weak property rights and can be detrimental to clean water access. As more land is cleared for agricultural practices, more waste can seep into water supplies and reach consumers. Fewer trees also mean fewer naturally occurring systems to filter out pollutants before they reach water access points. Researchers studying deforestation in Malawi found that "a 1 percentage point increase in the forest ratio increases the probability of access to clean drinking water by 1.06 percentage points."⁶⁴

CLEAN WATER AND STRONG INSTITUTIONS

For much of the world, water is a public good, and as such its planning and distribution is handled by either the federal, state, or local government. For this reason, government integrity is integral to clean water access. A strong, positive correlation (0.752) exists between Government Integrity and Unsafe Drinking Water.

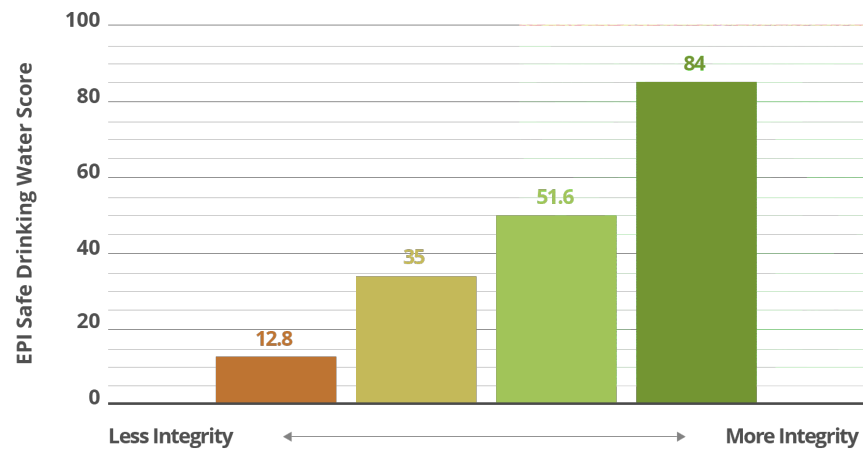
As countries look to build out key infrastructure to reduce water-related deaths and disease, governments must be able to act effectively and honestly to prevent corruption and the misallocation of resources. Government effectiveness is also essential to the planning of critical water infrastructure especially in population dense, developing countries. Dangui and Jia's findings support this conclusion:

Weak property rights encourage resource depletion and weak institutions allow polluters to go unregulated.

Further, the consistent negative and significant impact of population density across all income groups supports that the fast increase in the population density is the strongest determinant of water infrastructure underperformance in the

Figure 16.

GOVERNMENT INTEGRITY AND CLEAN DRINKING WATER



[Sub-Saharan Africa] SSA region. Indeed, the impact of population density is lowest in higher-income countries compared to lower-and middle-income groups. These results support the hypothesis that countries with stronger economies may be associated with greater governance effectiveness, allowing for sustainable planning of the increase in population density.⁶⁵

To decrease the rate of water-borne illness and disease, embracing policies rooted in economic freedom can be a matter of life and death. Specifically, implementing strong protections for property rights and eradicating government corruption will lead to safer and healthier societies.

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WHAT DOES ECONOMIC FREEDOM MEAN FOR CLIMATE?

When considering the effect of free economies on greenhouse gas emissions and climate resiliency, several factors come into play. In truth, the effectiveness of economic freedom on climate mitigation and adaptation will depend on which policy lever that increases or decreases economic freedom lawmakers use. More efficient tax policy or improving permitting processes could increase economic freedom, which could improve technological innovation⁶⁶ and therefore increase economic and environmental efficiencies. That would result in fewer emissions per dollar of GDP. On the other hand, imposing regulations on power plants to reduce CO₂ emissions would decrease economic freedom. One recent paper discusses the optimal and efficient level of economic freedom for prosperity and environmental protection.⁶⁷

Several studies have examined the causal effects of economic freedom on CO₂ emissions and environmental degradation using CO₂ as a proxy, and the results have been mixed. Like other byproducts of industrial activity, it stands to reason that if higher levels of economic freedom result in higher levels of economic growth, it will also lead to higher levels of greenhouse gas emissions.

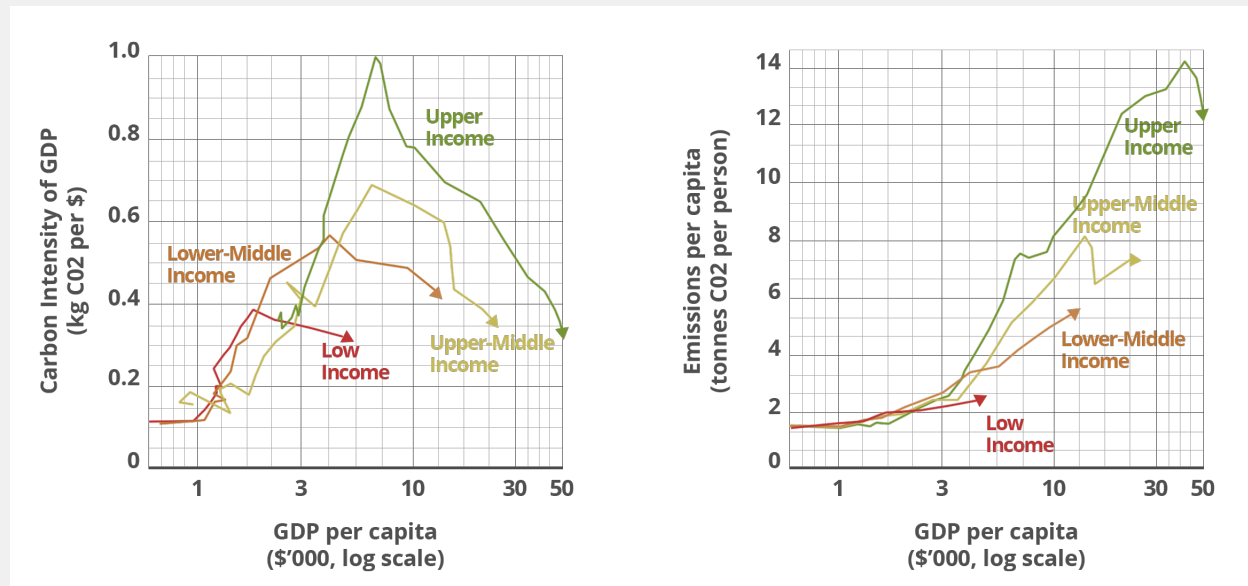
Research confirms this intuition. For instance, one analysis published in *Environmental Science and Pollution Research* in 2022 looked at the environmental outcomes of G-20 economies from 2000–2016. The authors found that the higher levels of investment and economic opportunity resulting from economic freedom put greater strains on countries' ecosystems.⁶⁸ The analysis from the Fraser Institute found no statistical significance between increases in economic freedom and CO₂ emissions reductions.⁶⁹

While it stands to reason that emissions increase as a country uses more energy and grows, it is also important to consider if the Environmental Kuznets Curve exists for CO₂ emissions. If so, free market policies can help decouple and drive down emissions. A 2020 *Research of Industrial Economies* paper found encouraging results. The paper combines emissions growth, GDP per capita and rankings on the Fraser Institute's Economic Freedom of the World Index to find that "available data from 155 countries observed in five-year periods between 1975 and 2015 indicate that economic freedom not only reduces overall CO₂ emissions but also shifts the top point of the EKC to the left. As such, the evidence suggests that the transition to lower emissions technology appears at an earlier stage in economically free societies."⁷⁰

Figure 17.

ENERGY TRANSITION CURVE

Energy transition path of countries in each wave of economic development, between 1800 and 2019.



Source: Financial Times

If cleaner technologies, processes, and products are more cost-effective, developing countries will have the incentive to pursue those technologies as opposed to their higher-emitting counterparts. To the extent mature, clean energy sources (as well as all energy technologies) are unsubsidized, they will likely have greater chance of long-term economic success because there will be more transparency regarding the price at which these technologies are competitive in the market.

A 2019 study in the *Journal of Developing Areas* measured how various subcomponents of economic freedom (trade freedom, business freedom, freedom from corruption and fiscal freedom) affected CO2 emissions using panel data in 24 African countries from 1995-2013.⁷¹ The paper found that economic freedom increased environmental quality as measured by reductions in CO2 emissions, with fiscal freedom having a negative effect on CO2 emissions for all country-income levels, freedom from corruption and business freedom having a negative impact on CO2 emissions on upper-middle income countries, and trade freedom having a negative impact on CO2 emissions for lower-income middle countries.⁷²

Other research has shown economic freedom's positive impact on clean energy generation. A July 2023 study in *Environmental Science and Pollution Research* looked at the relationship between economic freedom and CO2 emissions in 138 countries from 1995-2018 and found "economic freedom has a direct and indirect

negative effect on carbon emissions and that renewable energy consumption mediates the effect of economic freedom on carbon emissions.”⁷³

Many of the variables that measure a country’s economic freedom are also an indication of the size of government for a given country. That includes tax rates, spending levels, and the size of the regulatory state. As previously discussed, policy changes will sometimes create “win-win” scenarios, where reducing onerous, ineffective regulations and improving tax efficiencies will spur economic growth while improving the environment. Other regulations will restrict economic growth to reduce pollution, emphasizing the need for rigorous and transparent cost-benefit analyses.

There is not extensive literature measuring government size and CO2 emissions, but research published in the *International Journal for Social Economics* in May 2022 examined the relationship between economic freedom and CO2 emissions in several South Asian countries. The study found smaller government size and more market-oriented economies could reduce CO2 emissions by increasing green growth, arguing, “the role of the government needs to be redefined if not necessarily truncated.”⁷⁴ Similarly, *Environmental Science and Pollution Research* found larger government increased CO2 emissions in Brazil, India, and China but a negative impact in Russia.⁷⁵

Another article, published in the *International Journal of Environmental Research and Public Health* in July 2022, found mutual interplay between government size and CO2 emissions when looking at European Union countries between 2000-2018.⁷⁶ The authors performed a causality analysis of economic freedom, education and CO2 emissions and found that market-oriented economies and education can be significant contributors to improving the environment. By looking at the EU as a whole and specific member states, the authors concluded:

*Both panel and country-level causality analyses point out that economic freedom, government size, international trade freedom, and education are significant determinants of environmental degradation proxied by CO2 emissions, although country-level findings partially differ depending on country-specific characteristics in line with the theoretical expectations. Therefore, reforms toward market-oriented economic structures and education can be used effectively to combat environmental degradation by using market-based environmental instruments, raising environmental awareness, and developing green or energy-efficient technologies.*⁷⁷

Granted, determining what constitutes a “market-based” policy can sometimes be a matter of political debate. Furthermore, the unique attributes of a country’s economy, its policies, and its level of economic well-being may determine which policy reforms respective governments must prioritize.

Another consideration is how economic freedom can help countries better adapt to climate change. Free economies are wealthier, more innovative and have access to advanced technologies that enable people to better adapt to climate change. Having the economic means to construct stronger levees, sea walls, and more resilient infrastructure have helped save lives and protect communities. Advanced technologies such as early detection systems, visualization tools, up-to-date flood maps, computer modeling, satellite, and radar are several tools that scientists employ to track weather and storms. Affordable, reliable heat in the winter and air conditioning in the summer offer protection against extreme weather. Researchers are developing crops that better withstand heatwaves and droughts.⁷⁸ These investments are not costless but can be a cost-

effective solution to reduce the risks and costs of extreme weather.

One helpful tool that measures a country's resiliency is the Notre Dame Global Adaptation Initiative's Country Index. The index "uses 20 years of data across 45 indicators to rank over 180 countries annually based on their level of vulnerability, and their readiness to successfully implement adaptation solutions."⁷⁹ Given the connection between economic freedom and wealth, there is also a strong, positive correlation between those countries that are most economically free and those countries that are the most resilient.⁸⁰



FOR A BETTER LIFE AND A CLEANER ENVIRONMENT, THE WORLD NEEDS ENERGY ACCESS

While this report is largely an analysis of what policy principles improve the environment, an important undertone throughout the report is that economic freedom improves the human condition. Moreover, access to affordable, reliable energy is fundamental to bettering human lives. Dependable power heats homes for families and powers schools, hospitals, farms, and the industrial processes that make the products consumers rely on every day. Energy significantly enhances productivity by doing work for humans so they can be productive elsewhere. Moving from manual labor to mechanized equipment saves time, effort, and money.

Energy allows people to commute to work and thereby enables people to live in more affordable areas. Energy empowers people to travel the world and see things our ancestors could only read about. It keeps people safe in innumerable ways, from powering modern defense systems to lighting streets to reduce criminal activity.⁸¹ In short, energy is paramount to our way of life.

And yet, while many people take energy access for granted, it is a luxury or simply unavailable for far too many people. More energy is necessary to lift people out of poverty and improve living standards around the world. Encouragingly, the number of people without access to electricity has declined, from 1.3 billion people in 2012 to 774 million in 2022.⁸² However, energy poverty in emerging and developed countries remains unacceptably high. In fact, 2.3 billion people in 128 countries rely on open fires or cookstoves that use wood, charcoal, agricultural waste, and animal dung for fuel.⁸³ Alleviating economic and energy poverty (inadequate supplies at unaffordable costs) will be particularly challenging in parts of Africa, where poverty is highest, and populations are set to grow. More than 600 million people in Africa do not have access to electricity and the population on the continent may nearly double to 2.5 billion people by 2050.⁸⁴

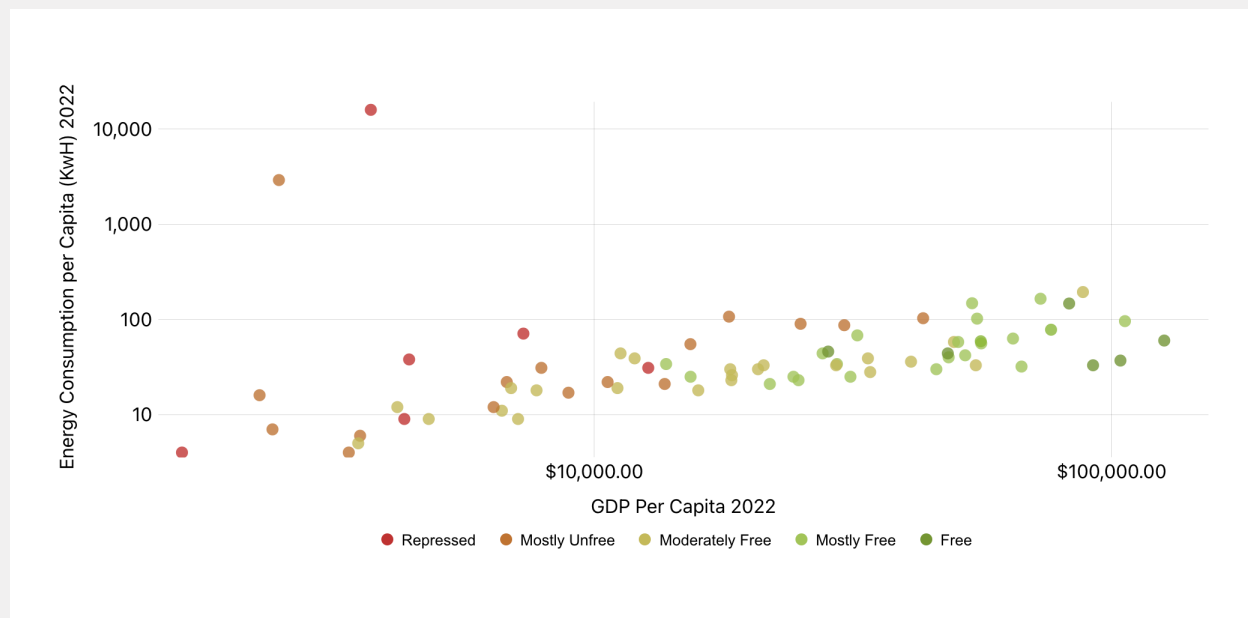
Policymakers set on improving environmental conditions and reducing climate risks cannot dismiss the priority of reducing poverty and improving economic well-being. The two goals do not need to be mutually exclusive,

but in some instances they may be. The tradeoff of rising emissions from the use of conventional sources is greater energy access and better living conditions. Providing families with electric or propane cookstoves may increase greenhouse gas emissions but significantly reduce indoor air pollution that prematurely kills millions.⁸⁵ Trapping people in poverty and constraining economic growth are not viable options.

As indicated in its latest International Energy Outlook, the U.S. Energy Information Administration projects that clean energy will grow faster than fossil fuel use.⁸⁶ Globally, energy transition investments totaled \$1.1 trillion in 2022, which is the first time these investments equaled the amount invested in fossil fuels. Whether it is renewables, batteries, geothermal or nuclear, making these energy sources cost-competitive will be essential to their wide scale global deployment. Nevertheless, fossil fuels will still be the predominant energy source.⁸⁷ The International Energy Agency projects relatively steady oil and natural gas consumption through 2050, with a rapid decline of coal use (which may or may not happen).⁸⁸ 100 percent renewable adoption, or even 100 percent clean energy adoption in emerging countries within the next few decades is unrealistic.⁸⁹ Even with improved energy efficiencies, it appears that the world is headed for an energy expansion that includes a variety of energy sources rather than an energy transition.

Figure 18.

GDP PER CAPITA VS. ENERGY USE



Free enterprise and strong institutions play a significant role in reducing energy poverty, improving peoples' lives, and ultimately improving the environment. One recent study in *Finance Research Letters* analyzed the effects of economic freedom on human wellbeing in Africa and, unsurprisingly, found that "free market economies with adequate supplies of electricity significantly improves the quality of life in the region."⁹⁰ In what is effectively a plea to inject more policies rooted in economic freedom, the authors stress that, "The effectiveness of economic freedom policy and access to electricity is more noticeable among countries with a lower quality of life, which suggests that if the qualities of institutions in poor African countries were strengthened and there were a constant supply of energy, the vast majority of Africans would prosper."⁹¹

This is true not just of African nations but countries around the world that suffer from poverty because of totalitarian regimes, corrupt institutions, weak and poorly protected property rights, and economies that are largely closed to the world. It is a moral imperative for policymakers to protect and expand the personal and economic liberties so that the people they serve can have a higher quality of life.



ECONOMIC FREEDOM: FOR PEOPLE, PROSPERITY, AND THE PLANET

Open markets, rule of law, protected property rights, lower tax burdens, and regulatory efficiency are the economic conditions that empower people to live freely and prosper. Whether it be global poverty, human rights, health care access, doubling down on the policies and principles that empower people is the most promising strategy.



WORKS CITED

- 1 Commanding Heights, "An interview with Milton Friedman," PBS, October 1, 2000, https://www-tc.pbs.org/wgbh/commandingheights/press_site/people/pdf/friedman_intv.pdf
- 2 U.S. Department of Agriculture, Economic Research Service, "Fresh and Processed Fruits," September 20, 2023, https://data.ers.usda.gov/reports.aspx?ID=17850#P8d99a273a17d423db-2456cad301a5f95_3_63iT0R0R0x1
- 3 The Heritage Foundation, 2022 Index of Economic Freedom, <https://www.heritage.org/index/explore>
- 4 Singapore, Switzerland, Ireland, New Zealand, Luxembourg, Taiwan, and Estonia.
- 5 Wolf, M. J., Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., et al. 2022 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy, <https://epi.yale.edu/epi-results/2022/component/epi>
- 6 See Yale EPI technical appendix at <https://epi.yale.edu/downloads/epi2022technicalappendix.pdf>
- 7 Yale's report finds a similar positive correlation. "Finally, we find that economic liberalism is positively associated with environmental performance. While our results do not give countries carte blanche to pursue laissez-faire economic strategies without regard for the environment, they do cast doubt on the implicit tension between economic development and environmental protection."
- 8 James Gwartney, Robert Lawson, Joshua Hall, and Ryan Murphy, 2022 Economic Freedom of the World: 2022 Annual Report. Fraser Institute. <https://www.fraserinstitute.org/sites/default/files/economic-freedom-of-the-world-2022.pdf>. The literature review Fraser's Index cites is: Joshua Hall and Robert Lawson (2014). Economic Freedom of the World: An Accounting of the Literature, Contemporary Economic Policy 32, 1: 1-19. ; and Robert Lawson, Economic Freedom in the Literature: What Is It Good (Bad) For?, pp. 187-200 in this edition.
- 9 Wolf, M. J., Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., et al. 2022 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy, <https://epi.yale.edu/epi-results/2022/component/epi>
- 10 Ibid.
- 11 Originally, Kuznets examined the relationship between GDP and income inequality. See, Bruce Yandle, Maya Vijayaraghavan, and Madhusudan Bhattarai, "The Environmental Kuznets Curve: A Primer," The Property and Environment Research Center, May 2002, <https://www.perc.org/wp-content/uploads/2018/05/environmental-kuznets-curve-primer.pdf>.
- 12 Indur M. Goklany, Affluence, Technology, and Well-Being, 53 Case W. Rsr. L. Rev. 369, 2002, <https://scholarlycommons.law.case.edu/caselrev/vol53/iss2/9>
- 13 Miah et al, <https://link.springer.com/article/10.1007/s10669-010-9303-8> and <https://www.sciencedi->

rect.com/science/article/abs/pii/S1364032115012228

- 14 For instance, see: Recep Ulucak and Faik Bilgili, "A reinvestigation of EKC model by ecological footprint measurement for high, middle and low income countries," *Journal of Cleaner Production*, Vol. 188, pp. 144-157, July 1, 2018, <https://www.sciencedirect.com/science/article/abs/pii/S095965261830862X>
- 15 Enrico Cagno, Andres Ramirez-Portilla, and Andrea Trianni, "Linking energy efficiency and innovation practices: Empirical evidence from the foundry sector," *Energy Policy*, August, 2015, <https://www.sciencedirect.com/science/article/abs/pii/S0301421515000968>
- 16 The Global Innovation Index (GII) measures a country's innovation score based on 80 indicators. 64 are hard data, 11 are composite indicators, and five are survey questions (three from the World Economic Forum's Executive Opinion, two from the Global Entrepreneurship Monitor's National Expert Survey (NES)). For more detailed information on the GI's indicators see: <https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023-appendix3-en-appendix-iii-global-innovation-index-2023.pdf>
- 17 For instance, Patents, trademarks, and copyrights.
- 18 Panagiota Dafniotis, "The green side of intellectual property and its role in energy transition innovation," *Dentons*, June 15, 2022, <https://www.dentons.com/en/insights/articles/2022/june/15/the-green-side-of-intellectual-property-and-its-role-in-energy-transition-innovation>
- 19 Chandra Nath Saha and Sanjib Bhattacharya, "Intellectual property rights: An overview and implications in pharmaceutical industry," *Journal of Advanced Pharmaceutical Technology & Research*, April-June, 2011, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/>
- 20 Sana Surani, Will Gendron, Swati Maredia, "The Economic Impact of Research and Development," *Georgia Tech*, April 6, 2017, <https://repository.gatech.edu/server/api/core/bitstreams/4b76a27a-9707-429f-9e4c-e28d672ce5a4/content>
- 21 World Intellectual Property Organization (WIPO), "Global Innovation Index 2023, 16th Edition," 2023, <https://www.wipo.int/publications/en/details.jsp?id=4679&plang=EN>
- 22 Brown et al, "What promotes R&D? Comparative evidence from around the world," *Research Policy*, March 2017, <https://www.sciencedirect.com/science/article/abs/pii/S0048733316302001>
- 23 The GI measures Knowledge and Technology Outputs based on a variety of quantitative variables including the "Number of resident patent applications filed at a given national or regional patent office, the"Number of scientific and technical journal articles,"High tech exports" as a percentage of trade, and more. For the full list see: <https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023-appendix3-en-appendix-iii-global-innovation-index-2023.pdf>
- 24 Nick Loris and Jeff Luse, "Research & Development," *C3 Solutions*, 2023, https://www.c3solutions.org/wp-content/uploads/2023/08/RD_CF_2023_Full_Chapter.pdf
- 25 Julie Steinberg and Joe Wallace, "Inflation Adds to Cost of Clean Energy Transition," *The Wall Street*

- Journal, December, 19, 2021, <https://www.wsj.com/articles/inflation-adds-to-cost-of-clean-energy-transition-11639918803>
- 26 Will Wade, "First US Small Nuke Project Canceled After Costs Surge 53%", Bloomberg, November 8, 2023, <https://www.bloomberg.com/news/articles/2023-11-08/first-us-small-nuclear-project-canceled-after-costs-climb-53>
- 27 George Steer, "Renewable energy stocks hit hard by higher interest rates," October 2, 2023, Financial Times, <https://www.ft.com/content/07443afb-b935-492d-8711-8c47e4353c59>
- 28 Chris Edwards, "Special Interests and Corporate Welfare," Cato Institute, 2022, <https://www.cato.org/cato-handbook-policymakers/cato-handbook-policymakers-9th-edition-2022/special-interests-corporate-welfare>
- 29 The Economist, "Green protectionism comes with big risks," October 2, 2023, <https://www.economist.com/special-report/2023/10/02/green-protectionism-comes-with-big-risks>
- 30 Eduardo Porter, "Global trade gets a bad rap. But we can't stop climate change without it.," The Washington Post, November 15, 2023, <https://www.washingtonpost.com/opinions/2023/11/15/global-trade-climate-change-benefits/>
- 31 Hannah Ritchie and Max Roser, "Air Pollution," Our World in Data, January 2021, <https://ourworldindata.org/air-pollution>
- 32 World Health Organization, "Household air pollution," November 28, 2022, <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>
- 33 Ibid.
- 34 International Energy Agency, "A Vision for Clean Cooking Access for All," July 2023, <https://www.iea.org/reports/a-vision-for-clean-cooking-access-for-all/>
- 35 Ibid.
- 36 Joel Wood and Ian Herzog, "Economic Freedom and Air Quality," Fraser Institute, April 2014, <https://www.fraserinstitute.org/sites/default/files/economic-freedom-and-air-quality.pdf>
- 37 The Heritage Foundation scores based on the perception of corruption, bribery risk, and control of corruption including "capture" of the state by elites and private interests.
- 38 Alkhuzam et al, "Private versus public electricity distribution utilities: Are outcomes different for end-users?", The World Bank, May 3, 2018, <https://blogs.worldbank.org/developmenttalk/private-versus-public-electricity-distribution-utilities-are-outcomes-different-end-users>
- 39 Bos et al, "Benefits and challenges of expanding grid electricity in Africa: A review of rigorous evidence on household impacts in developing countries," Energy for Sustainable Development, June 2018, <https://www.sciencedirect.com/science/article/abs/pii/S0973082617308074>

- 40 Paul Burkhardt, "Rampant Corruption at Energy Provider Drags Down South Africa," Bloomberg, May 8, 2023, <https://www.bloomberg.com/news/features/2023-05-08/crime-corruption-are-dragging-down-south-africa-s-energy-giant>
- 41 Measured by Bureaucracy & Corruption, Security, Clarity of the Law, Judicial Independence and Effectiveness, and Informality
- 42 Measured by Women's Economic Freedom, Investment Freedom, Property Rights, and Trade Freedom
- 43 Measured by Elections, Civil Liberties, Political Rights, and Legislative Constraints on the Executive. For more, see, <https://www.atlanticcouncil.org/in-depth-research-reports/report/prosperity-that-lasts-the-2023-freedom-and-prosperity-indexes/>
- 44 Measured by Education, Income, Health, Inequality, Environment, and Minority Rights. For more see <https://www.atlanticcouncil.org/in-depth-research-reports/report/prosperity-that-lasts-the-2023-freedom-and-prosperity-indexes/>
- 45 "Death rate from outdoor air pollution vs. GDP per capita, 2019," Our World in Data, <https://ourworldindata.org/grapher/outdoor-pollution-rate-vs-gdp>
- 46 "Death rate from indoor air pollution vs. GDP per capita, 2019," Our World in Data, <https://ourworldindata.org/grapher/death-rates-from-indoor-air-pollution-vs-gdp-per-capita>
- 47 LCD definition: <https://www.un.org/development/desa/dpad/least-developed-country-category.html> Energy data was sourced from IEA: <https://www.iea.org/countries> Full spreadsheet found here 2023 Free Economies Data
- 48 Ibid.
- 49 Ibid.
- 50 As recognized by the United Nations
- 51 <https://www.who.int/news-room/fact-sheets/detail/drinking-water>
- 52 Ibid.
- 53 Ibid.
- 54 UNICEF defines as "Drinking water from an improved source that is accessible on premises, available when needed and free from fecal and priority chemical contamination." <https://www.who.int/news-room/fact-sheets/detail/drinking-water>
- 55 Yale measures "Unsafe Drinking Water" by: "[T]he number of age-standardized disability-adjusted life-years lost per 100,000 persons (DALY rate) due to exposure to unsafe drinking water. A score of 100 indicates a country has among the lowest DALY rates in the world (M5th-percentile), while a score of 0 indicates a country is among the highest (U95th-percentile)
- 56 Kokou Dangui and Shaofeng Jia, "Water Infrastructure Performance in Sub-Saharan Africa: An Investigation of the Drivers and Impact on Economic Growth," Water, October 31, 2022,

<https://www.mdpi.com/2073-4441/14/21/3522>

- 57 Ibid.
- 58 OECD (2006), "The Returns to Education: Links between Education, Economic Growth and Social Outcomes", in Education at a Glance 2006: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/eag-2006-11-en>.
- 59 Naiga et al., "Challenging pathways to safe water access in rural Uganda: From supply to demand-driven water governance," International Journal of the Commons, March 2015, <https://www.jstor.org/stable/26522823>
- 60 Matthias Saladin, "Community Water Supply in Switzerland," Skat Foundation, 2003, https://www.ircwash.org/sites/default/files/community_water_supply_in_switzerland_0.pdf
- 61 Ericka Andersen, "A Clean Water Organization Brings Life, Hope and Opportunity to Africa," C3 News Magazine, September 7, 2021, <https://c3newsmag.com/a-clean-water-organization-brings-life-hope-and-opportunity-to-africa/>
- 62 "Venezuela," 2023, <https://www.heritage.org/index/country/venezuela>
- 63 Deisy Buitrago, "Focus: Venezuela fails to curb oil leaks, gas flaring despite pledges," Reuters, August 17, 2023, <https://www.reuters.com/business/environment/venezuela-fails-curb-oil-leaks-gas-flaring-despite-pledges-sources-document-2023-08-17/>
- 64 Annie Mwayi Mapulanga and Hisahiro Naito, "Effect of deforestation on access to clean drinking water," National Academy of Sciences, April 23, 2019, <https://www.jstor.org/stable/26703498>
- 65 Ibid
- 66 Jiafeng Gu, "Sharing economy, technological innovation and carbon emissions: Evidence from Chinese cities," Peking University, July-September 2022, <https://www.elsevier.es/en-revista-journal-innovation-knowledge-376-articulo-sharing-economy-technological-innovation-carbon-S2444569X22000634>
- 67 Jonas Rapsikevicius et al., "The Impact of Economic Freedom on Economic and Environmental Performance: Evidence from European Countries," Sustainability, 2021, <https://www.mdpi.com/2071-1050/13/4/2380>
- 68 Alola, A.A., Alola, U.V., Akdag, S. et al. The role of economic freedom and clean energy in environmental sustainability: implication for the G-20 economies. Environ Sci Pollut Res 29, 36608–36615 (2022). <https://doi.org/10.1007/s11356-022-18666-5>
- 69 Ibid.
- 70 Børnskov, Christian (2020) : Economic Freedom and the CO2 Kuznets Curve, IFN Working Paper, No. 1331, Research Institute of Industrial Economics (IFN), Stockholm, <https://www.econstor.eu/bitstream/10419/240474/1/wp1331.pdf>

- 71 Kolade Sunday Adesina and John W. Muteba Mwamba, 2019. "Does Economic Freedom Matter For CO2 Emissions? Lessons From Africa," *Journal of Developing Areas*, Tennessee State University, College of Business, vol. 53(3), pages 155-167, Summer.
- 72 Ibid.
- 73 Bétila, R.R. Economic freedom and carbon emissions across the globe: the mediating effect of renewable energy consumption. *Environ Sci Pollut Res* 30, 86300–86327 (2023). <https://doi.org/10.1007/s11356-023-28420-0>
- 74 Jain, M. and Kaur, S. (2022), "Carbon emissions, inequalities and economic freedom: an empirical investigation in selected South Asian economies", *International Journal of Social Economics*, Vol. 49 No. 6, pp. 882-913. <https://doi.org/10.1108/IJSE-02-2021-0108>
- 75 Lijuan Chen, "How CO2 emissions respond to changes in government size and level of digitalization? Evidence from the BRICS countries," *Environmental Science and Pollution Research*, July 31, 2021, <https://link.springer.com/article/10.1007/s11356-021-15693-6>
- 76 Gamze Sart et al., "Economic Freedom, Education and CO2 Emissions: A Causality Analysis for EU Member States," *International Journal of Environmental Research and Public Health*, July, 2022, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9265646/>
- 77 Sart G, Bayar Y, Danilina M, Sezgin FH. Economic Freedom, Education and CO2 Emissions: A Causality Analysis for EU Member States. *Int J Environ Res Public Health*. 2022 June 30;19(13):8061. doi: 10.3390/ijerph19138061. PMID: 35805730; PMCID: PMC9265646.
- 78 Press release, "Clemson researchers continue study to develop heat-tolerant soybeans," *Clemson News*, January 27, 2022, <https://news.clemson.edu/clemson-study-focuses-on-developing-heat-tolerant-soybeans/> and Heidelberg University, "Scientists Have Created Genetically Modified Drought-Resistant Plants," *SciTechDaily*, July 20, 2022, <https://scitechdaily.com/scientists-have-created-genetically-modified-drought-resistant-plants/>
- 79 University of Notre Dame, Notre Dame Global Adaptation Initiative (ND-GAIN), July 2022, <https://gain.nd.edu/our-work/country-index/>
- 80 Nick Loris et al., "Climate and Freedom Agenda," *Conservative Coalition for Climate Solutions*, June 2022, <https://www.c3solutions.org/wp-content/uploads/2022/06/C3-Solutions-Climate-and-Freedom-Agenda.pdf>
- 81 Aaron Chalfin et al., "Reducing Crime Through Environmental Design: Evidence from a Randomized Experiment of Street Lighting in New York City," *Journal of Quantitative Criminology*, 2022 <https://link.springer.com/article/10.1007/s10940-020-09490-6>
- 82 Laura Cozzi et al., "For the first time in decades, the number of people without access to electricity is set to increase in 2022," *International Energy Agency*, November 3, 2022, <https://www.iea.org/commentaries/for-the-first-time-in-decades-the-number-of-people-without-access-to-electricity-is-set-to-increase-in-2022>

- 83 "A Vision for Clean Cooking Access for All," International Energy Agency, July 2023, <https://iea.blob.core.windows.net/assets/75f59c60-c383-48ea-a3be-943a964232a0/AVisionforCleanCookingAccessforAll.pdf>
- 84 "Africa's population will double by 2050," The Economist, March 26, 2020, <https://www.economist.com/special-report/2020/03/26/africas-population-will-double-by-2050>
- 85 Ibid
- 86 "International Energy Outlook 2023," Energy Information Administration, October 11, 2023, <https://www.eia.gov/outlooks/ieo/>
- 87 Ibid.
- 88 "World Energy Outlook 2023," International Energy Agency, 2023, <https://iea.blob.core.windows.net/assets/ed1e4c42-5726-4269-b801-97b3d32e117c/WorldEnergyOutlook2023.pdf>
- 89 Seaver Wang and Vijaya Ramachandran, "Why False Energy Hopes Are Bad for Africa," Foreign Policy, October 5, 2023, <https://foreignpolicy.com/2023/10/05/africa-climate-energy-transition-renewable-wind-solar-fossil-fuels-net-zero/>
- 90 Sofia Johan et al., "Does energy poverty moderate the impact of economic freedom on the quality of life in Africa? A panel quantile via moment approach," Finance Research Letters, December 2023, <https://www.sciencedirect.com/science/article/abs/pii/S1544612323009029>
- 91 Ibid.