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ABOUT

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While the commercial real estate sector has been a longtime energy consumer (and subsequent source of innovation for energy management), new technologies and innovative partnerships with the energy sector could lead to a new industry convergence.

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As electricity demand accelerates across global markets, real estate is emerging as both a constraint and a solution. From microgrids to distributed generation, buildings are evolving into critical energy infrastructure—and capital strategy must evolve with them.

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America's severe shortage of housing and energy poses an existential threat to the viability of long-term infrastructure investment. Yet with coordinated action from energy and real estate investors, we can meet America's housing, energy, and economic goals.

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The rapid expansion of digital demand is transforming middle America into a strategic hub where commercial real estate and energy sectors collaborate to leverage renewable power, existing rail infrastructure, and rural land for the future of digital infrastructure.

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THE REAL ESTATE POWER INITIATIVE: A NOTE FROM THE PUBLISHER



Gunnar Branson
Publisher
Summit Journal

The world is asking for more power than ever before. It's time for real estate to join the discussion.

When the world gathers to solve the greatest challenges facing humanity, why is real estate usually relegated to the “kids table?” Whether it is at a Davos-type conference, in the halls of governments, or at scientific gatherings where experts debate the problems of climate change, energy infrastructure, geopolitical friction, affordable housing, or social unrest, real estate leadership is rarely represented, and this industry’s insights and practical knowledge are usually ignored until someone decides they need more square footage for their next project, or more housing for their employees.

That seems to be a bit backwards, doesn't it?

After all, people spend 90% of their lives indoors,¹ which is one reason that residential and commercial buildings used almost 37% of the total US energy consumption in 2023.² Buildings account for 39% of global carbon emissions.³ Over half of the world’s population lives in cities.⁴ What is built and how it is maintained can influence or even determine the quality of life for everyone who lives, works, and plays within the walls real estate designs, funds, builds, and maintains.

It can be argued that real estate, as an industry, has done more to improve efficiency and the environment than most other industries. Commercial real estate construction practices reduced energy use intensity by 42% between 2009 and 2019.⁵ Sustainability and resiliency practices now considered standard were inconceivable twenty years ago. A small but growing number of buildings today are even creating more energy than they use. The technology, funding mechanisms, and best practices of real estate are quietly transforming the built environment.

The world is asking for more power than ever. If the world understood what real estate has done—and could do—perhaps we might find better answers to the challenges that face us.

After decades of slow growth in electricity consumption, data centers demand more and more electricity for AI, crypto currencies, streaming media, and machine learning, while electric vehicles and heat pumps are fast switching demand to the grid. Growth projections for the next five years predict more than a doubling of demand.⁶ Meanwhile, most of the coal-fired power plants in the US and Europe are coming to the end of their useful life, and utilities are having a hard time providing new sources of power fast enough while their distribution grids need to be re-built and re-thought even as demand inexorably rises.

Perhaps it is time that real estate and energy talk to each other. Maybe then leaders in both sectors could find new solutions. What would happen if real estate and energy leaders worked together to overcome NIMBYism and out-of-date zoning and permitting rules? Can grid operators benefit by working with back-up energy systems in commercial buildings?

Real estate uses a lot of energy, but can also help create, distribute, and store it. Is there a smarter way for us to work together long before we start talking about rentable square feet?

AFIRE is starting a new “Real Estate Power Initiative” with this issue of **AFIRE Summit**. Every article focuses on the intersection of real estate and energy. This is the beginning of a series of discussions between real estate and energy leaders, academics, and experts to create a new collaboration that can better solve the energy challenges of the next ten years.

Energy is one of the most pressing issues of our day and real estate can contribute practical and meaningful solutions. I look forward to hearing your thoughts in the months ahead and for all of us to learn how we can power the future of our built environment.

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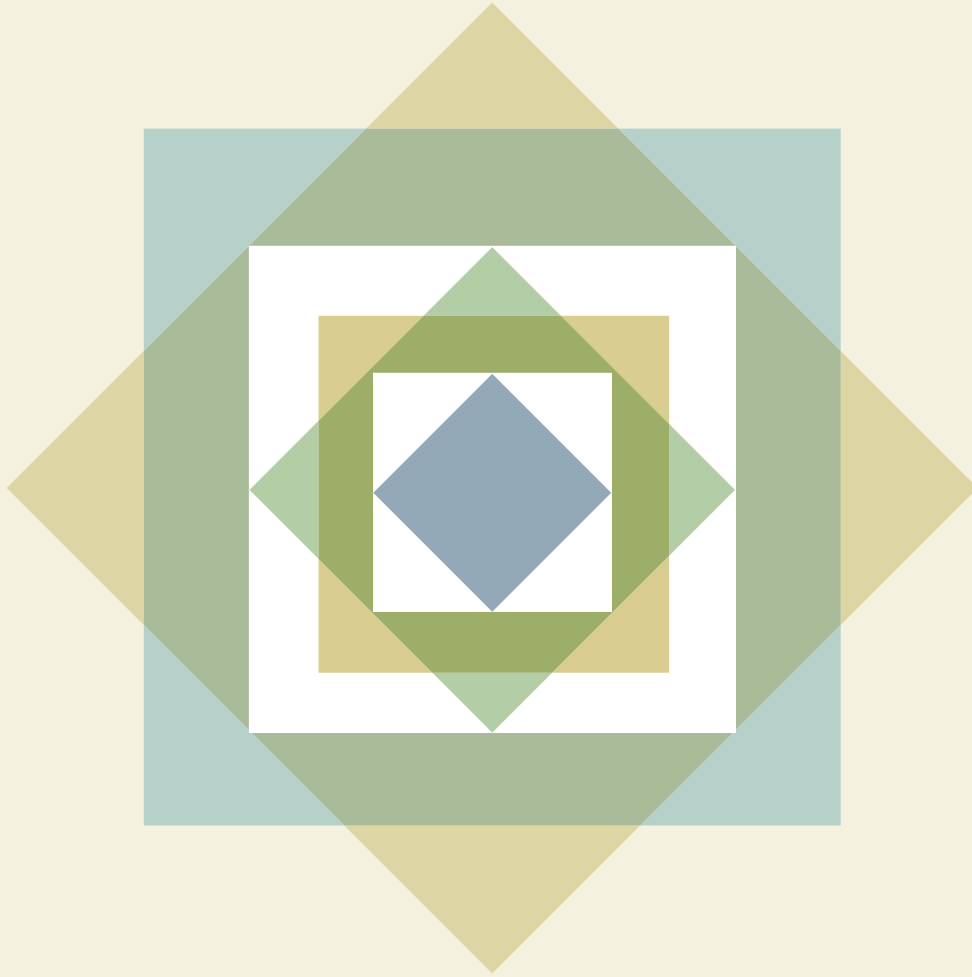
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SECTOR INTERSECTION



Benjamin van Loon
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While the commercial real estate sector has been a longtime energy consumer (and subsequent source of innovation for energy management), new technologies and innovative partnerships with the energy sector could lead to a new industry convergence.

One of the basic laws of nature is that energy can neither be created nor destroyed; only transformed.

While this fundamental law of conservation describes the physical universe, it's also a useful analogy for industry: business can neither be created nor destroyed; only *transformed*.

And with the ongoing evolution of the commercial real estate sector—and its broader social, economic, and technological symbiosis—we are witnessing transformation in real time at the increasingly critical intersection of energy and the built environment.

Importantly, this transformation goes beyond the core ethos of “sustainability” that has dominated the conversation around innovation and management of real estate over the past two decades. The utility and fiscal importance of LEED, BREEAM, DGNB, and other building standards have concretized the priority of sustainability in commercial development, and their compliance continues to generate measurable, positive impacts for our cities and communities. But aside from some of the more futuristic sustainability targets (e.g., Living Building Challenge, PassivHaus, etc.), these standards are largely intended to reposition or minimize the consumptive footprint of real estate.

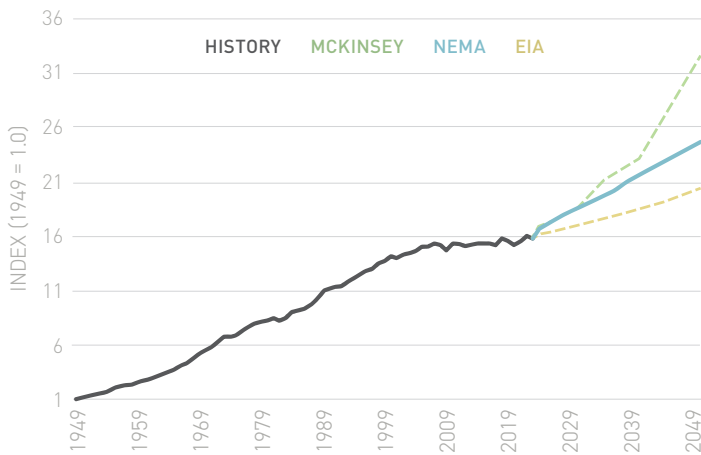
Meanwhile, the energy sector sets in own pace, using the real estate sector as one of many points of input for guidance in the ongoing global “energy transition.” But the input from commercial real estate for transition planning, and energy sector-specific investment in particular, often frames real estate as merely consumptive—rather than as a potential (and asset-rich) partner for expediting and streamlining the transition.

Despite the occasional complaints from a diminishing pro-fossil fuel cohort, this transition will come one way or another. And commercial real estate, with its established sustainability practicum and well-documented list of benefits (that go far beyond ideology), is well-positioned to partner with the energy sector and the next era of the built environment.

TIDAL RISE OF ENERGY DEMAND

With the current data center boom underway, and the accelerating US transition to electric vehicles, the National Electrical Manufacturers Association (NEMA) recently forecasted a 2% annual increase in electrical demand in the US, with a total 50% increase by 2050 (*Exhibit 1*).¹

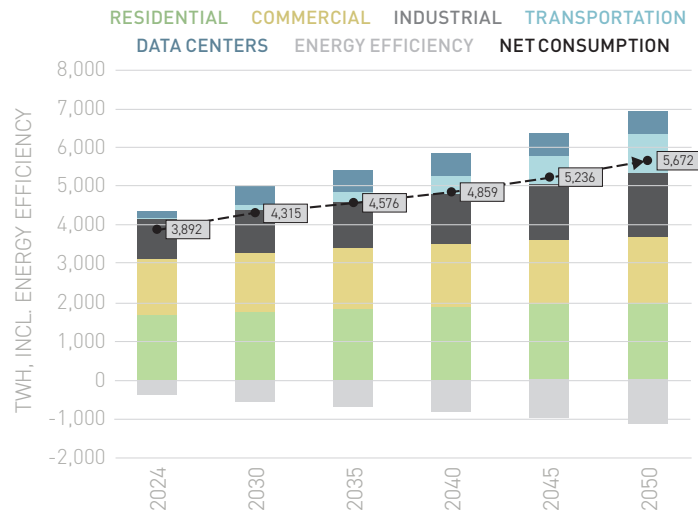
EXHIBIT 1: ELECTRICITY DEMAND FORECAST, 1949-2050



Source: National Electrical Manufacturers Association

This forecast—which splits the difference between a more liberal outlook from McKinsey² and more conservative outlook from US Energy Information Administration³—assumes a 300% growth in data center energy consumption over the next decade, and 9000% growth in “e-mobility power consumption” through 2050 (*Exhibit 2*).

EXHIBIT 2: DATA CENTERS AND TRANSPORTATION LEAD DEMAND GROWTH THROUGH 2050

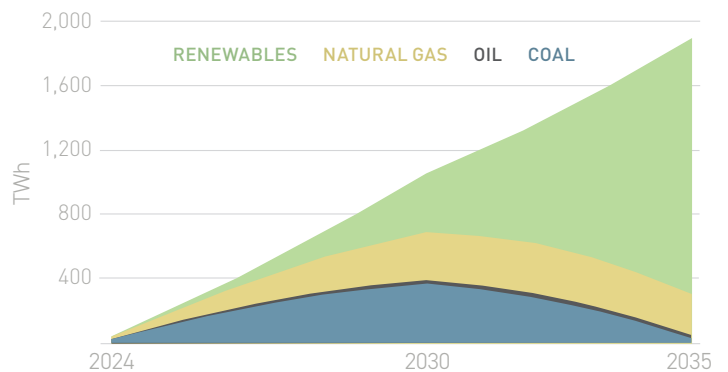


Source: National Electrical Manufacturers Association

Electricity demand growth in the US is largely consistent with similar global forecasts, which expect a 34% increase in global energy consumption by 2050, driven by increased regional manufacturing and evolving living standards.⁴ This same forecast posits that the growth in demand will outpace advances in energy efficiency, putting increased stress on existing energy infrastructure and outmoded electricity supply methods (e.g., oil and coal), especially in the US.

While this increased stress exposes systemic flaws, especially in the disjointed US power grid, it has already opened opportunities for innovations in renewable energy investment and development. According to the 2024 World Energy Outlook from the International Energy Agency, capacity from new renewables could be substantially increased over the next decade to meet nearly 85% higher electricity demand.⁵ And with solar and wind energy increasingly affordable, these sources are poised to boom (*Exhibit 3*).

EXHIBIT 3: INCREASE IN GLOBAL ELECTRICITY SUPPLY BY ENERGY SOURCE, 2024-35



Source: International Energy Agency

The commercial real estate industry, as a whole, recognizes the challenges posed by the confluence of increased energy demands, the inadequacy of current energy sources to meet these demands, and the potentialities of renewable energy (realized as more affordable energy, or even self-generated energy, as discussed elsewhere in this issue of *Summit*). Data from the recent AFIRE Spring 2025 Investor Survey underscore this priority, as approximately 95% of respondents agreed that energy infrastructure, reliability, and cost will be increasingly important factors for market selection over the next five years. And 15% of those same respondents are already prioritizing increased investment in markets powered by renewable energy.⁶

The energy industry is poised to develop increased generation and distribution—but it faces some of the same roadblocks to development as any other commercial real estate development (i.e., permitting timelines, litigation procedures, planning and siting complications, NIMBYism, etc.). At the end of 2023, for example, the Federal Energy Regulatory Commission reported a backlog of nearly 12,000 power generation projects in the US.⁷ With exponentially increasing electricity demand, this backlog is expected to grow.

And yet, despite their shared challenges, the two sectors have fought similar battles from separate fronts. (History is partly to blame here, with the energy sector as relatively “new” and real estate having several centuries’ head start.) But with identical external trends now defining and intertwining the futures of both sectors, a new convergence might be in order.

The Federal Energy Regulatory Commission reported a backlog of nearly 12,000 power generation projects in the US.



The US could serve as a unique testing ground for this approach, with its 16 billion square feet of commercial properties that account for nearly 19% of all energy usage.

TWO SIDES OF THE SAME COIN

When the frustrations of the energy sector are placed alongside the frustrations of, the multifamily sector with its well-documented backlog of millions of homes in the US, or the data center sector, with its well-documented (and deeply regulated) appetite to meet exponentially growing demand—the overlap is clear.

The performance of commercial real estate is driven by the same external trends bounding energy sector performance and so there is good reason to see both sectors as two sides of the same coin.

A recent policy position from the Commercial Real Estate Development Association (NAIOP) addresses this convergence, arguing that “lack of future availability of electricity is hindering the commercial real estate development needed to support industries in a rapidly transforming economy.”⁸ NAIOP advocates for federal policies that can incentivize regional coordination and cooperation by utilities and local jurisdictions for larger transmission projects, with the assumption that a less inhibited energy sector will thus accelerate stalled commercial real estate development. Or in other words, if energy can move, commercial real estate can be activated in kind.

But as innovations in renewable energy evolve, will this order of events still be necessary? Could the energy and real estate sectors form a united front for the next era of development?

The US could serve as a unique testing ground for energy innovation, with its 16 billion square feet of commercial properties that account for nearly 19% of all energy usage. Through various energy strategies, derived from the assets themselves—such as demand-side energy management, distributed energy resources, energy efficiency, and so forth—a recent white paper from CPower Energy argues that “CRE organizations with distributed [energy] resources at their facilities [. . .] are therefore in a position to reap significant financial benefits.”⁹

These benefits differ based on the market and the supply/utility landscape in a given region—which is also part of the challenge.

RETHINKING INFRASTRUCTURE AND ENERGY AS A SERVICE

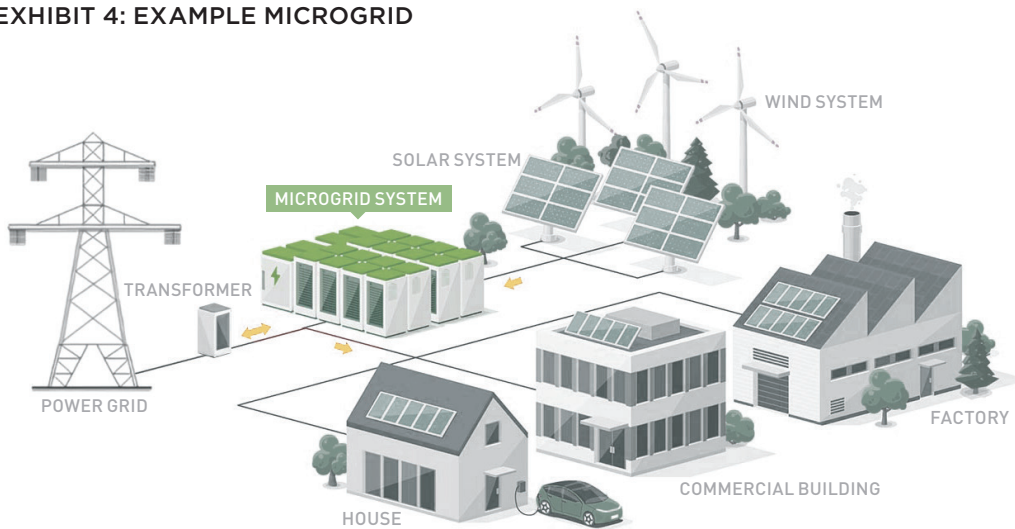
The other part of the challenge is the infrastructure itself. The majority of the US grid over the past century was built around coal plants, which are on track to mostly retire within the next five years. Next-generation nuclear and enhanced geothermal energy are nascent but facing regular and substantial physical and legislative roadblocks to replace coal at scale.

Jake Elder, Senior Vice President of Research and Innovation at Energy Impact Partners (an investment platform focused on the energy transition), recently wrote in *Urban Land* that this particular moment of transition, especially

in the US, “is shaping up to be a generational opportunity for the whole electric power sector. If navigated correctly, utilities can deepen partnerships with their customers, help them decarbonize, and grow their business.”¹⁰

Elder points to “microgrid” technologies as one such generational opportunity for collaboration, or “distributed hubs that could take themselves off of the centralized power grid during outages” (*Exhibit 4*). Rooftop solar is a simple example of this, as are lithium-ion batteries, fuel cells, linear generators (which use chemical energy from both clean and standard fuels), and other technologies.

EXHIBIT 4: EXAMPLE MICROGRID



Source: Flyfine Battery

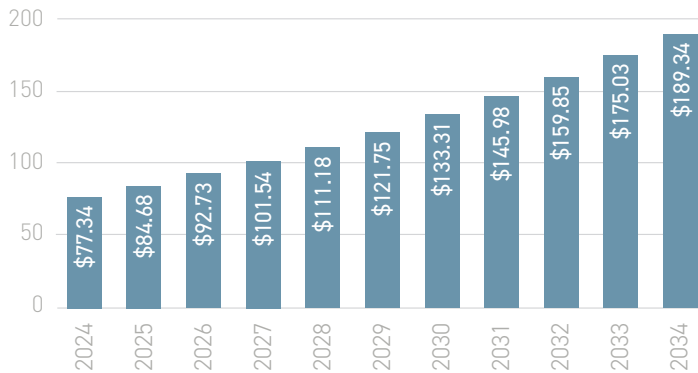
Other technologies are posed to be more revolutionary and may not need to be reliant on extant grids in any form. For example, Simon Treacy, former CEO of Private Equity Real Estate for CapitaLand Investment, a Singapore-based firm, recently launched a new energy venture: PolarBlue is developing technologies to “engineer energy into a self-scaling cloud-based service—a replicable array of smart infrastructure—deployable anywhere, continuously optimized.”

PolarBlue owns “the entire energy technology stack—including invented breakthroughs in materials, conversion, and distribution—allowing its platform to scale direct-to-user across homes, industries, and communities worldwide.”¹¹

Treacy and PolarBlue’s approach is part of a broader turn to “Energy as a Service” (EaaS), which allows building owners and users to subscribe to energy through a service contract—like Apple Cloud Storage or Netflix. This model allows subscribers to get energy and predictable rates based on their consumption, with less exposure to fossil fuel markets, weather events, or geopolitical tensions.

Additionally, the energy itself comes from carbon-free sources (e.g., solar, wind, battery-backed systems, microgrids, etc.), which can be deployed quickly without the need for extensive permitting, mining, or primary grid connections. As such, the infrastructure is “software-defined and hardware-light,” like cloud computing, and could use real-time data, algorithms, and AI to manage supply and demand.

EXHIBIT 5: ENERGY AS A SERVICE (EAAS) MARKET SIZE AND GROWTH, 2024-34

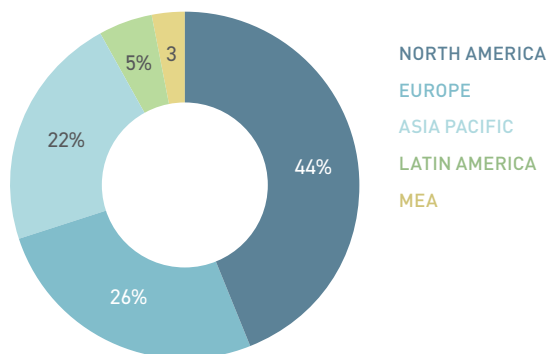


Source: Precedence Research

According to Precedence Research, the global EaaS market is calculated at approximately \$85 billion in 2025, with a forecast to reach nearly \$190 billion by 2034 (*Exhibit 5*).¹² The US is currently driving most EaaS demand, especially in the commercial sector, where adoption is being fueled by initiatives aimed at improving energy storage efficiency and reducing operational costs (*Exhibit 6*).

Performance-based approaches facilitated by EaaS—such as pay-for-performance models (which are based on the measured energy savings achieved, rather than a fixed rate)—can further incentivize energy savings at scale, particularly for industrial applications, which account for more than a third of the EaaS market share.

EXHIBIT 6: ENERGY AS A SERVICE (EAAS) MARKET SHARE BY REGION, 2024



Source: International Energy Agency

The revolutionary dream of emergent EaaS providers and adjacent technologies may eschew visions of collaboration between the energy and real estate sectors but are still based on partnership. All cloud-based solutions demand a physical footprint, but rather than coopting utilities and regulations to fit modern energy demands (and waiting for legislation to meet the moment), real estate owners have a growing set of tools to take command of the energy transition themselves—from something as familiar as solar arrays and on-site energy storage to more revolutionary approaches that reframe energy from “utility” to “service.”

Or as Simon Treacy has said, “When energy becomes abundant and predictable, everything changes. Industry grows without destruction. Families thrive without sacrifice.”

FINDING OURSELVES AT THE FOREFRONT

Over the past few decades, the real estate industry has gone from skepticism about sustainability, to fetishism, to balance, and eventually, to responsible fiscal practice. The engineering, architecture, and planning sectors have followed apace—even as legislation has been mesmerized by the bumbling dance between economic responsibility and populist apathy on the same path.

Meanwhile, the energy and utility sectors are trying to respond to twenty-first-century pressures with twentieth- (and nineteenth-) century tools, with or without the collaboration from the owners and investors of the broader built environment. Some patchwork policy solutions and public-private partnerships have emerged from this disconnect, but as the forces affecting energy and real estate converge, these sectors will be well-served to do the same.

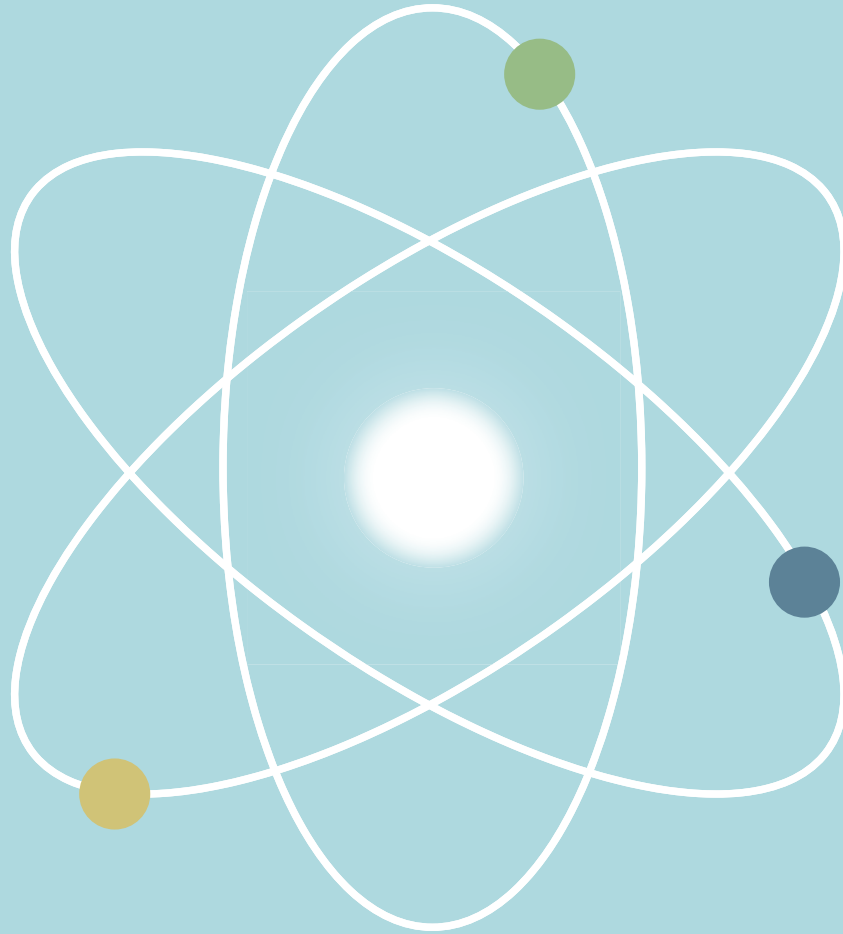
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- ¹ “US Electricity Demand Will Grow 50% by 2050: Electrical Manufacturer Study.” *Utility Dive*. Accessed May 23, 2025. <https://www.utilitydive.com/news/us-electricity-demand-will-grow-50-by-2050-electrical-manufacturer-study/744575/>; “Grid Reliability Study.” *Make It Electric*. April 2025. <https://www.makeitelectric.org/wp-content/uploads/2025/04/grid-reliability-study-nema-deck.pdf>.
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POWERING FUTURE DEVELOPMENT



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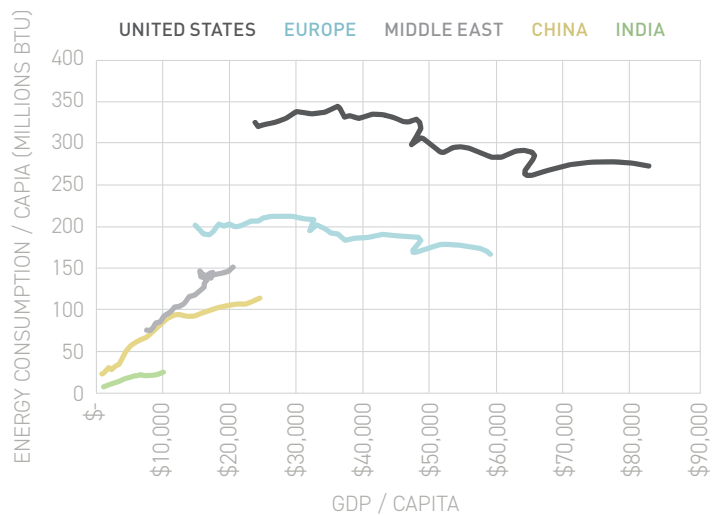
THE ROLE OF ENERGY IN ECONOMIC DEVELOPMENT

Energy is fundamental to modern economies. Historically, there has always been a link between energy use and economic development: richer countries consume more electricity, and fast-growing economies ramp up their energy consumption quickly (*Exhibit 1*).

But something interesting has happened over the last few decades: while US, and European GDP continued to grow, electricity use plateaued. That shift wasn't due to energy becoming less important, but rather, to gains in energy efficiency—particularly in areas such as lighting—and, crucially, the offshoring of many energy-intensive manufacturing operations. Meanwhile, countries such as China saw both GDP and energy use surge in tandem.

Energy isn't just a service.
It's the foundation of our
economy, cities, and future.
Understanding its evolving
and growing role cannot
be optional for real estate
investors.

EXHIBIT 1: EVOLUTION OF PER CAPITA ELECTRICITY CONSUMPTION AND GDP IN SELECTED REGIONS, 1990–2023



Source: International Energy Agency

That dynamic is changing, and the US is entering a new era of energy consumption. Real estate developers, investors, and planners should be prepared to engage deeply with energy and electricity markets. Understanding how energy demand will shape where and how people live, work, and manufacture will be key to capturing opportunities in the evolving economy.

Generating and delivering electrical energy is an expensive, complex, and inherently risky endeavor with significant environmental implications. As a result, most utilities operate as monopolies or quasi-monopolies, a structure that has led to the development of a vast and layered regulatory framework overseeing every aspect of power generation, distribution, and pricing.

These dynamics, in turn, have fostered a deeply risk-averse and conservative approach to building and maintaining the infrastructure that powers our economy.

TYPES OF ELECTRICITY SUPPLIERS AND STRUCTURES

Large-scale electricity consumers, such as data centers and manufacturers, must navigate a highly fragmented network with more than two thousand electric utilities across the US. These include:

- Investor-Owned Utilities (IOUs) (e.g., Con Edison)
- Municipally Owned Utilities (e.g., Los Angeles Department of Water and Power)
- Electric Cooperatives (e.g., Pedernales Electric Cooperative, Jackson EMC, etc.)
- Federal Power Agencies (e.g., Tennessee Valley Authority)
- Independent Power Producers (IPPs) (e.g., Calpine)

Further complicating this landscape is the wide range of utility structures. Providers may be vertically integrated—managing generation, transmission, and distribution under one entity (e.g., Georgia Power)—or operate in more limited capacities. Some specialize solely in generation, others in high-voltage transmission (e.g., Transbay Cable), and still others in local distribution, delivering power to end users.

EXHIBIT 2: US ELECTRIC UTILITIES BY OWNERSHIP TYE

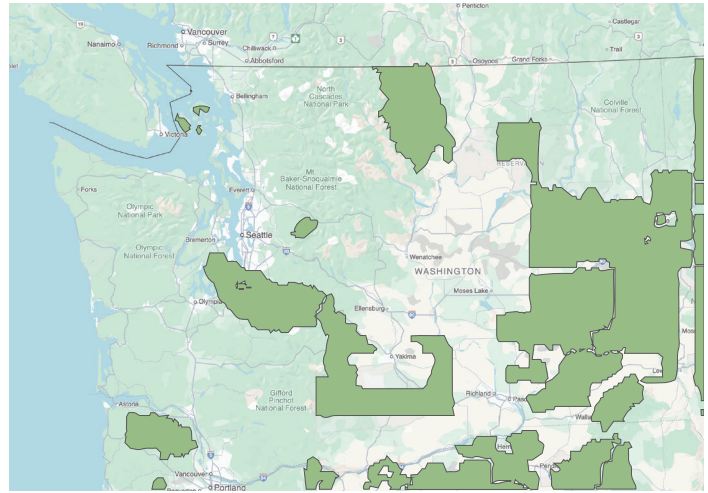
	INVESTOR OWNED	COOPERATIVES	PUBLICLY OWNED
NUMBER OF ENTITIES	168	812	1958
CUSTOMERS	110,000,000	20,000,000	24,000,000
% OF TOTAL	71%	13%	16%

Source: Authors

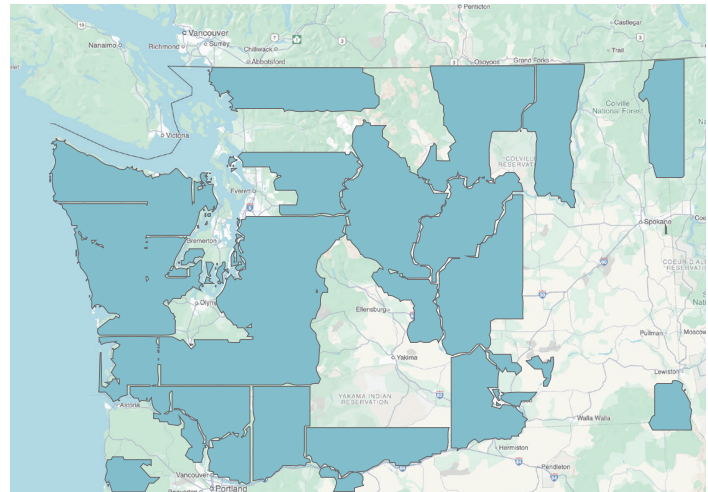
A single state can host multiple utility types with overlapping service areas. Washington State, for example, includes electric co-ops, municipal providers, and IOUs—each with distinct priorities and regulatory frameworks.

EXHIBIT 3: UTILITY TYPES IN WASHINGTON STATE

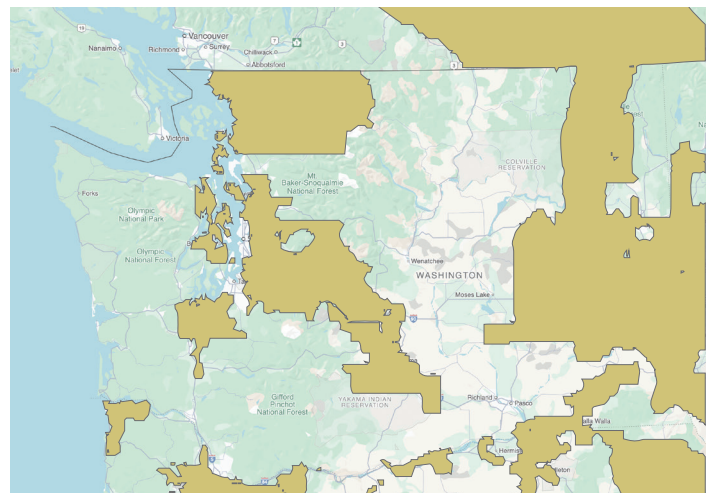
COOPERATIVE UTILITIES



MUNICIPAL UTILITIES & PUDS



INVESTOR-OWNED UTILITIES



Source: U.S. Energy Atlas

When undertaking a new project that requires a significant commitment of electrical power, developers must navigate the typical hurdles associated with real estate development—such as zoning approvals, site plans, architectural reviews, traffic impact studies, community benefit agreements, and building code compliance.

Beyond these standard requirements, developers must also engage with the local utility provider to secure the necessary energy infrastructure. In cases where additional distribution facilities—such as transmission lines—are needed, coordination may extend to regional transmission organizations (RTOs), which are nonprofit entities responsible for managing the flow of electricity over large geographic areas (e.g., NYISO in New York and New England), as well as the owners of local “last-mile” distribution networks (e.g., Baltimore Gas and Electric).

These various entities often operate independently, and their priorities and processes may not align. All of them are subject to a complex web of regulations enforced by federal, state, county, and municipal authorities.

THE SHIFT IN ENERGY DEMAND

This intricate utility landscape is about to face even greater pressure. US electrical utilities are confronting a challenge they haven’t encountered in two decades: adding significant new power supply to meet demand.

Over the past twenty years, demand for electricity in the US has grown only modestly, driven in part by the widespread adoption of energy-efficient appliances, industrial equipment, and building systems, as well as the offshoring of mass industrial processes. But that trend is set to change. Goldman Sachs now predicts a 35% increase in US electricity demand over the next decade—a sharp contrast to the 8% growth seen over the previous twenty-year-period.¹

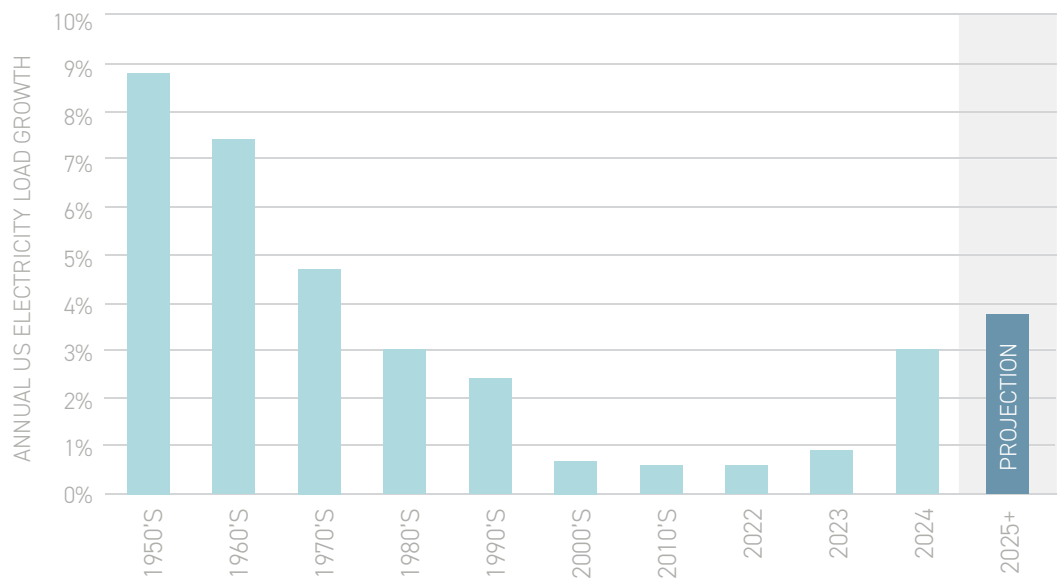
This renewed growth in the US mirrors a broader global trend. Worldwide, electricity demand grew by 4.3% in 2024 and is projected to continue increasing at nearly 4% annually through 2027.² Over the next three years, electricity consumption worldwide is expected to rise by an unprecedented 3,500 terawatt-hours—equivalent to adding more than the annual electricity use of the country of Japan each year.

This anticipated surge is driven by the accelerating electrification of industries increase use of heat pumps, electric vehicle adoption—and particularly—the growing electricity requirements of data centers, including the power used to generate Artificial Intelligence (AI) in data centers.

Forecasts suggest that the data centers and the demand from AI uses will be one of the main drivers of new investment. In fact, the Goldman Sachs analysis predicts that data centers may grow from less than 2% of US electrical usage today to perhaps 4% by the end of this decade, making up over 20% of the increased demand.

The forecast suggests a transformative period for the US power sector, requiring significant infrastructure investments and grid modernization to meet projected electricity consumption. Additionally, factories, electric vehicles, and data centers will increasingly compete for limited power resources, driving up prices and benefiting utilities and users with long-term power contracts already in place.

EXHIBIT 4: ANNUAL US ELECTRICITY LOAD GROWTH AND US DATA CENTER ELECTRICAL DEMAND



Note: Goldman Sachs projects 15% annual growth in data center demand over the next six years, half of which is projected to come from AI usage.³

Sources: Goldman Sachs; Wall Street Journal

CASE STUDIES: REAL-WORLD ENERGY DEVELOPMENT SCENARIOS

The following case studies illustrate a range of real-world scenarios in which developers seek to secure substantial power commitments—highlighting how various utility structures and regulatory entities interact in the process.

1. Microsoft and Three Mile Island

Microsoft, like many major tech companies, is pursuing aggressive carbon neutrality—and even carbon negativity—goals while simultaneously increasing its energy consumption to support growing AI operations.

To help balance these priorities, Microsoft signed a twenty-year power purchase agreement (PPA) with Constellation Energy to buy 835 MW of nuclear power. The energy will be generated by restarting the long-shuttered Three Mile Island nuclear power plant, which is slated to reconnect to the PJM grid in 2028. The electricity will power Microsoft's data centers across the Mid-Atlantic and Midwest regions served by PJM. Constellation has stated that, under the agreement, Pennsylvania taxpayers and ratepayers will not bear the cost of the plant's restart. However, the company plans to pursue federal funding through the Inflation Reduction Act to support the refurbishment.⁴

This type of power deal is the simplest from a regulatory and political standpoint, as it leverages existing infrastructure, expands grid capacity, maintains stakeholder relationships, and enables Microsoft to claim 100% carbon-free energy use.



Three-Mile Island, Harrisburg, PA

2. Constellation Energy vs. Baltimore Gas and Electric Company (BGE)

Further south in Maryland, Constellation Energy has proposed reconfiguring and potentially expanding one of its existing nuclear facilities to accommodate on-site data center development. The plan envisions building data centers “behind the meter” at the company's 1,756 MW Calvert Cliffs nuclear plant—meaning that the facilities would draw power directly from the plant rather than from the public grid.

Constellation argues that this setup would provide tech companies with access to carbon-free energy without burdening the existing grid, while requiring private developers to cover the costs of any necessary distribution infrastructure upgrades. The proposal, however, has sparked controversy.

Baltimore Gas and Electric, which operates the local electric grid and would forgo revenue from distributing electricity to the proposed data centers, has filed complaints with regulators to block the project. BGE contends that bypassing the grid would be unfair to current ratepayers and that widespread adoption of behind-the-meter developments could undermine grid stability. The Maryland Public Service Commission is currently reviewing the proposal and will ultimately decide whether the project can proceed.⁵

This type of behind-the-meter configuration could represent the future of data center and other energy-intensive industrial development. However, the Calvert Cliffs case highlights the regulatory, economic, and infrastructure challenges of directly integrating major energy consumers with existing power generation facilities.



Calvert Cliffs Nuclear Facility, Lusby, MD

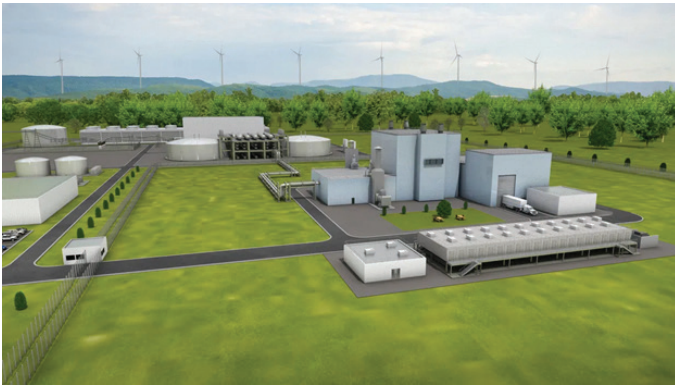
3. TerraPower and Data Center Energy Innovation

TerraPower, a nuclear innovation company, is partnering with several major data center operators to explore the use of advanced small modular reactors (SMRs) to power data center campuses.

Through a series of strategic agreements and memoranda of understanding (MOUs), TerraPower is evaluating the deployment of its Sodium reactor technology—an advanced nuclear design that combines a sodium fast reactor with molten salt-based energy storage. The goal is to enable behind-the-meter, carbon-free power generation directly on or adjacent to large-scale data center campuses.

Initial efforts are focused on regions where energy demand is rapidly increasing and regulatory environments are becoming more supportive of next-generation nuclear technologies.

This case study highlights the growing trend of integrating innovative power generation solutions into energy-intensive infrastructure, with advanced nuclear emerging as a viable path to achieving carbon-free reliability at scale.



Terrapower Sodium Nuclear Plant (Rendering), Kemmerer, WY

Factories, electric vehicles, and data centers will increasingly compete for limited power resources, driving up prices and benefiting utilities and users with long-term power contracts already in place.

BUILDING THE FUTURE AT THE INTERSECTION OF ENERGY AND INNOVATION

Whether a developer is navigating traditional grid relationships, pioneering behind-the-meter solutions, or exploring next-generation nuclear technology, success hinges not just on engineering or policy—but on people. Like any other industry, cultivating strong relationships with stakeholders is essential.

Ultimately, energy isn't just a service, it's the foundation of our digital economy, our cities, and our future. Understanding its evolving and growing role, how it's sourced and supplied, is not an option for those shaping the built environment. Those who can bridge the gap between innovation and collaboration will power not just their own projects—but a new era of sustainable development.

ABOUT THE AUTHORS

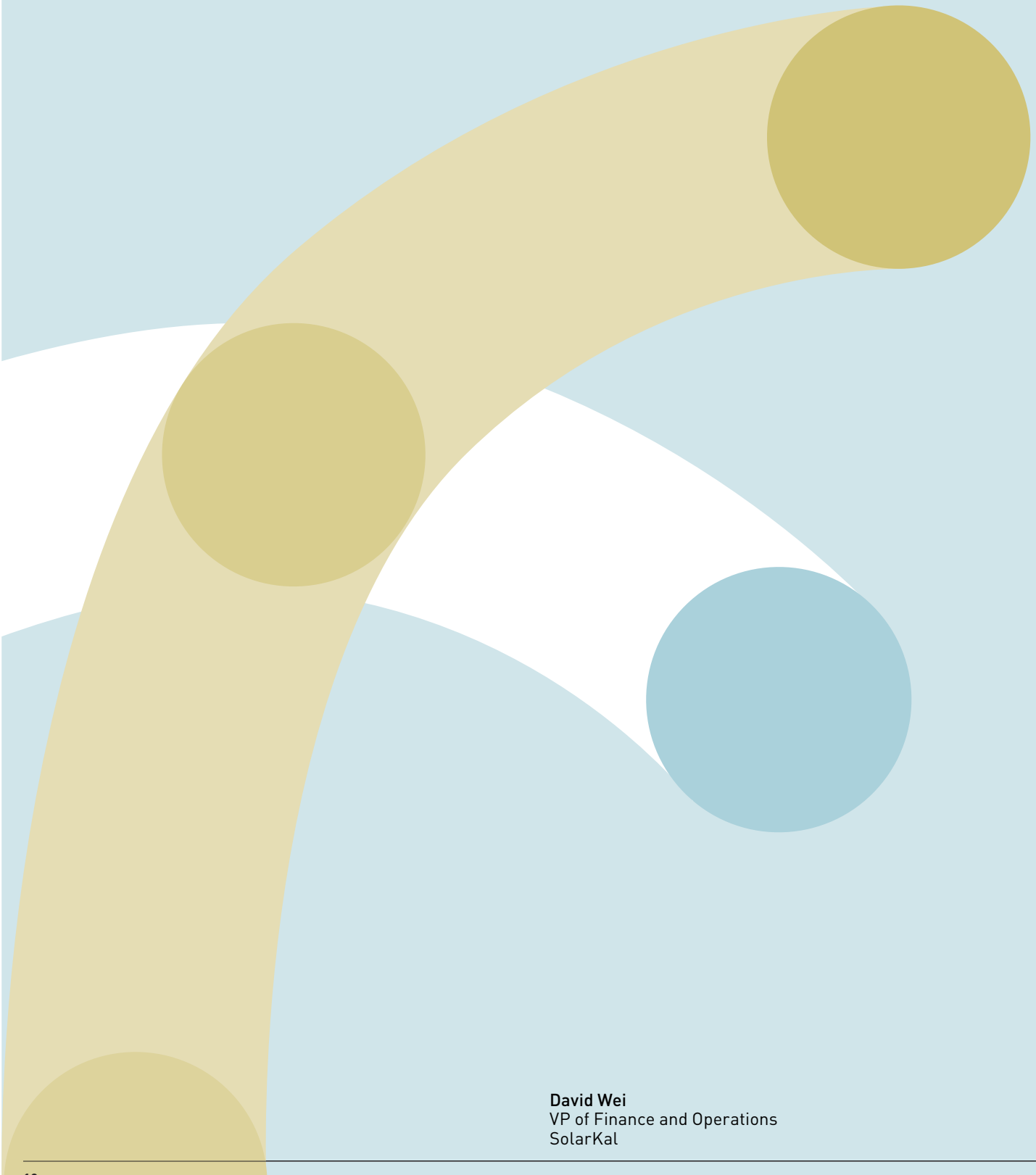
Jeff Kanne is the President and CEO of National Real Estate Advisors, where he leads the firm's strategic direction and investment activities in transformative commercial real estate projects.

Darob Malek-Madani is the Head of Research at National Real Estate Advisors, focusing on the intersection of macroeconomic trends, real estate, and emerging technologies.

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US SOLAR IN 2025



David Wei
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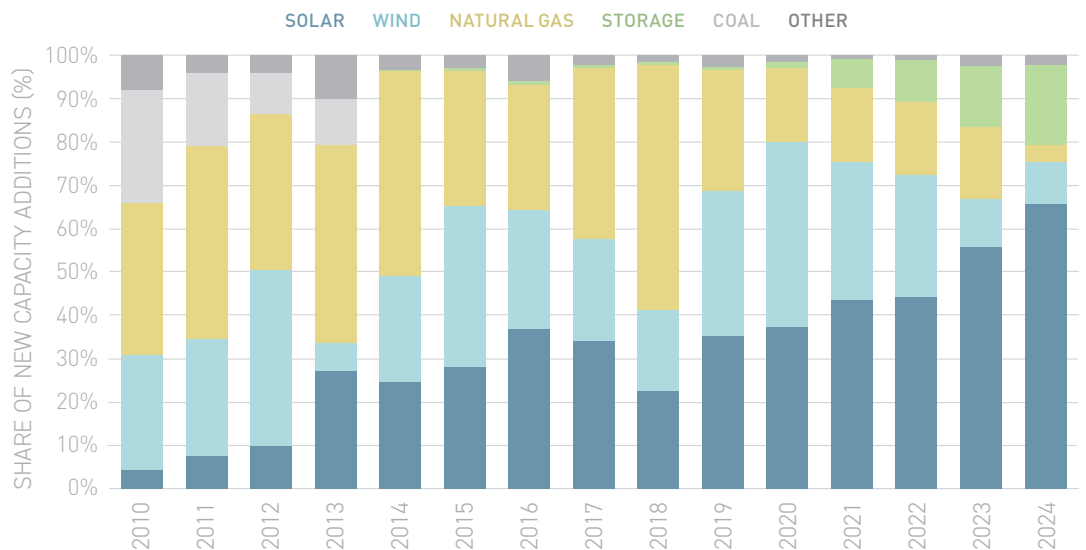
The commercial solar landscape in the US is shifting—driven by new policies, evolving incentives, and rising investor interest. So what’s new, what’s next, and what matters most for the future of solar?

SOLAR’S STRONG FUNDAMENTALS IN THE US

For international real estate investors with assets in the US, solar in 2025 represents both a hedge and a high-return opportunity. Despite political noise, the core fundamentals remain unchanged: Solar is cheap, the market share winner, fast to deploy, and increasingly supported across the political spectrum with high durability.

Solar is the fastest-growing energy source in the country, capturing a staggering 81.5% of all new electricity capacity added to the grid in 2024. Despite this momentum, solar still accounts for only about 5% of total generation — leaving significant room for growth as both industry and government projections target solar reaching about 40% of the US energy mix by 2050.¹

EXHIBIT 1: NEW US ELECTRICITY-GENERATING CAPACITY ADDITIONS, 2010-24



Source: Solar Energy Industries Association

This strong outlook is driven by two fundamental forces: (1) **the accelerating demand for energy** and (2) **compelling economics**. Solar is now the most cost-effective source of unsubsidized energy, with panel prices having steadily declined over decades thanks to global economies of scale.

Yet with the new administration, under President Donald Trump, the strong underlying fundamentals for solar are currently experiencing elevated levels of headline risk. Fortunately, that risk has yet to bleed into significant quantifiable changes to solar economics.

SOLAR IS PRESIDENT TRUMP'S BEST OPTION

President Donald Trump wants to “unleash” American energy, but his plan relies on a twentieth-century playbook.

By creating the National Energy Dominance Council, imposing a moratorium on federal support for many renewable energy projects, supporting expanded oil and gas leasing and drilling, and lifting liquid natural gas (LNG) export moratoriums—all under the banner of a “national energy emergency”—Trump is doubling down on fossil fuels. The message is clear: To meet rapidly rising electricity demand and lower costs, this administration is looking to oil and gas and putting renewables in limbo.

This approach is bypassing the most obvious and ready solution: solar.

If Trump's true goal is US energy dominance, his administration needs to support solar first by affirming the investment tax credits and benefits, reforming the interconnection process to speed up grid connections, and maintaining key elements of the Inflation Reduction Act, especially as it relates to credits and their transferability.

The great news is that this support largely doesn't require anything “new”—just the wherewithal to maintain the status quo. Chevron CEO Mike Wirth noted recently, “Swinging from one extreme to another is not the right policy approach. We have allocated capital that's out there for decades, and so we really need consistent and durable policy.”²

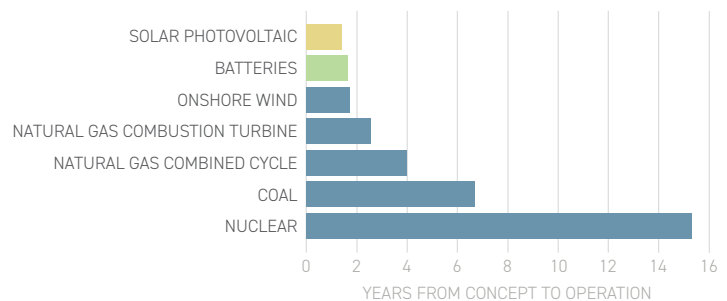
Policy stability is critical for all capital projects, and US energy infrastructure is no different. If solar can maintain the status quo, it can and should be the right solution for the country's grid.

Solar is now the most cost-effective source of unsubsidized energy, with panel prices having steadily declined over decades thanks to global economies of scale.

Here's the pitch for solar under President Trump:

- 1. Solar is American.** Solar energy is generated right here at home, using a source that's free, unlimited, and immune to global supply shocks. Domestic production has skyrocketed to meet demand, and the Inflation Reduction Act has supported an acceleration with tax credit bonuses for US manufacturing.³
- 2. Solar supports US jobs.** The industry employs more than 250,000 Americans, including 34,000 manufacturing jobs—a figure expected to triple by 2033.⁴
- 3. Solar is the cheapest.** Solar is now the most cost-effective source of unsubsidized energy, with panel prices having steadily declined over decades, which is why solar has been the incremental market share winner of all electricity sources, making upward of 80%⁵ of all generation added last year.
- 4. Solar is the fastest source to add.** Solar (41%) and battery storage (40%) are the supermajority of the active interconnection queues across the country, with natural gas at just 3%.⁶ If you want more production to the grid sooner, solar is ready. Ramping up natural gas plants will take much longer. (Exhibit 2⁷)

EXHIBIT 2: AVERAGE US POWER PLANT DEVELOPMENT TIMELINE



Source: Solar Energy Industries Association

SOLAR HAS THE MOMENTUM—AND THE VOTES

NextEra CEO John Ketchum discussed the contrast between solar and gas in a recent article from CERAWeek⁸:

“To get your hands on a gas turbine and to actually get it built across the market, you’re really looking at 2030, or later”—with the next nuclear plant potentially in 2031 or 2032.

This leaves solar as the primary near-term solution. Ketchum, who is uniquely qualified to comment on the subject, given how NextEra has built the most gas-fired generation over the last two decades, said, “renewables are ready to go right now because they’ve been up and running.”

Moreover, members of Trump’s own party recognize the solar path forward. In March 2025, twenty-one House Republicans signed a letter defending the IRA’s clean energy tax incentives, outlining their opposition to any potential efforts to repeal the legislation. As Rep. Andrew Garbarino⁹ (R-NY), who spearheaded

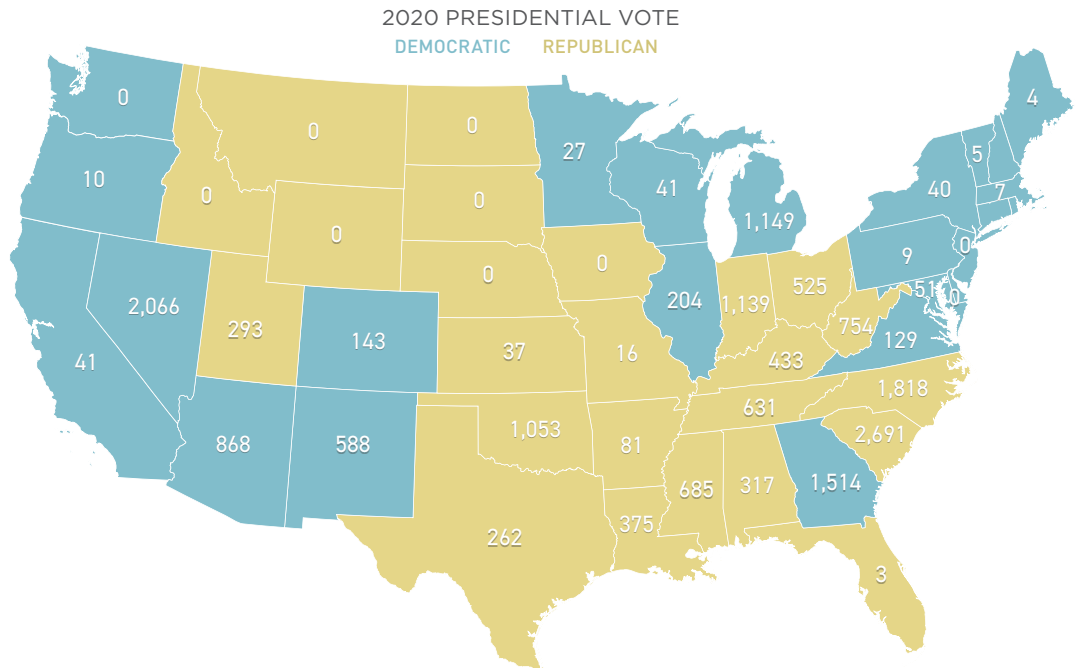
the letter, put it: “We have twenty-plus (sic) members saying, ‘Don’t just think you can repeal these things and have our support.’”

The data underscores why: Eight of the top ten congressional districts seeing the largest solar investments since the IRA’s passage are Republican-held. As shown in *Exhibit 3*, these districts have attracted between \$721 million and \$1.1 billion in actual investments each.¹⁰ IRA-driven disbursements also follow this trend, with Republican districts benefiting disproportionately from new funding and job creation — making any attempt to unwind the legislation politically risky for GOP lawmakers.

The solar industry—even with this GOP support—is still sensitive to headline risks. In fact, 84% of investors and 73% of developers would decrease their investments if there is lingering uncertainty around the tax credits and the IRA.¹¹

EXHIBIT 3: RED STATES BENEFITING THE MOST FROM THE IRA

Dollar value of Inflation Reuction Act projects per capita, 2022-24



Source: Green Energy Times

LATEST ON SOLAR ECONOMICS

There are three additional major factors that could potentially alter solar economics in 2025: higher electricity rates, tariffs, and domestic content manufacturing.

Electricity Rates

Driven by an explosion in demand and stable supply, the US EIA is forecasting that wholesale power prices will rise across most regions of the country at an average of about 7% year over year (the long-term historical average is 2% to 3%)

The higher the electricity rates, the larger the benefit is for solar owners, as avoided costs are the primary source of returns.

Tariffs

In 2024, approximately 80% of the 54GW of solar panels installed in the US were imported from Cambodia, Malaysia, Thailand, and Vietnam—countries now directly impacted by the US Department of Commerce’s final ruling on antidumping (AD) and countervailing duties (CVD) announced on April 21. While enforcement awaits a June determination by the US International Trade Commission, the immediate effect is moderated by a reported 40GW stockpile held by US installers—nearly a full year’s supply.¹³

Still, commercial real estate investors should prepare for a potential uptick in project pricing due to compounded tariff effects, including additional steel and aluminum duties that could disproportionately affect carport structures. Fortunately, with solar panel hardware representing just ~20% of total system costs, the overall impact on system economics may remain modest in the near term—especially as US domestic manufacturing ramps up to fill the gap.

Domestic Content

The US is now the third-largest module producer in the world, and it happened fast — domestic production skyrocketed from 7GW in 2020 to 56GW of capacity today. According to SEIA, at full capacity, “these factories can produce enough to meet all demand for solar in the United States”—an amazing feat.

An increased supply of domestic content panels means solar consumers can take advantage, as these systems may qualify for an additional 10% tax credit-adder (40% total in tax credits).

To earn the additional credit, a project must use certain percentages of steel, iron, or manufactured products that were mined, produced, or manufactured in the US this includes solar panels, racking, and inverters. Some domestic components come at a premium, which must be weighed against the additional tax credit and potential return on investment.

The US is now the third-largest module producer in the world, and it happened fast — domestic production skyrocketed from 7 GW in 2020 to 56 GW of capacity today.

WHAT THE MARKETPLACE SHOWS

SolarKal's marketplace, which includes approximately 200 vendors, offers a snapshot of current conditions in the solar industry. Drawing from a broad dataset, it reflects observable trends and patterns across the vendor landscape.

Josh Newell, SolarKal's Senior Vice President of Project Delivery, shared: "Our RFPs are coming back unchanged. Bids for Q1 2025 are showing lease rates and EPC prices in line with Q4 2024, and we're continuing to see strong bid participation. Developers are still actively bidding, and there's been no sign of softening across our active project pipeline, despite the broader macroeconomic backdrop."

That said, Newell noted that a handful of vendors are taking a more conservative approach when underwriting ITC adders for third-party lease rates, anchoring closer to the base 30% credit considering ongoing political uncertainty.

STILL COMPELLING

If the Trump administration is serious about achieving true American energy dominance, it must stop treating solar as an afterthought and start embracing it as the cornerstone of our energy future. Solar is not a partisan technology—it's a pragmatic solution. It's fast, cheap, homegrown, and already delivering economic and job growth across the country.

With rising electricity rates, robust domestic manufacturing, and the potential for enhanced tax credits, solar installations can meaningfully improve net operating income while boosting asset value. And with leasing structures and third-party financing widely available, property owners can unlock these benefits with minimal upfront cost.

Uncertainty is not the same as risk. The US solar market continues to be one of the most attractive global investment environments if you move early, understand the policy landscape, and partner with experienced advisors. Now is the time to act before the window of optimal incentives begins to narrow.

With rising electricity rates, robust domestic manufacturing, and the potential for enhanced tax credits, solar installations can meaningfully improve net operating income while boosting asset value.

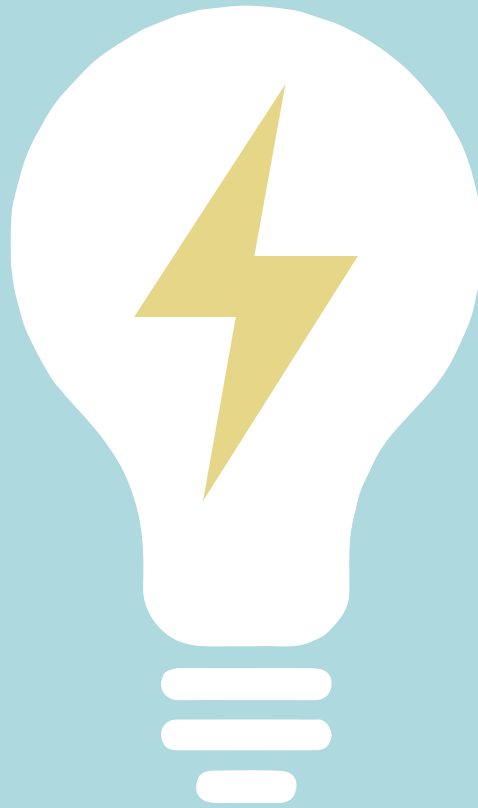
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- ¹¹ *Tax Stability for Energy Dominance*. American Council on Renewable Energy, March 19, 2025. <https://acore.org/resources/tax-stability-for-energy-dominance/>.
- ¹² US Department of Commerce. *Final Affirmative Determinations in the Antidumping and Countervailing Duty Investigations of Crystalline Photovoltaic Cells*. April 21, 2025. <https://www.trade.gov/final-affirmative-determinations-antidumping-and-countervailing-duty-investigations-crystalline>.
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DECENTRALIZED ENERGY



Dr. Michael Ferrari
Chief Scientific and Investment Officer
AlphaGeo

When we expand the definition of what constitutes an “energy real estate investment,” the aperture needs to be broadened so that related opportunities become part of the capital discussion.

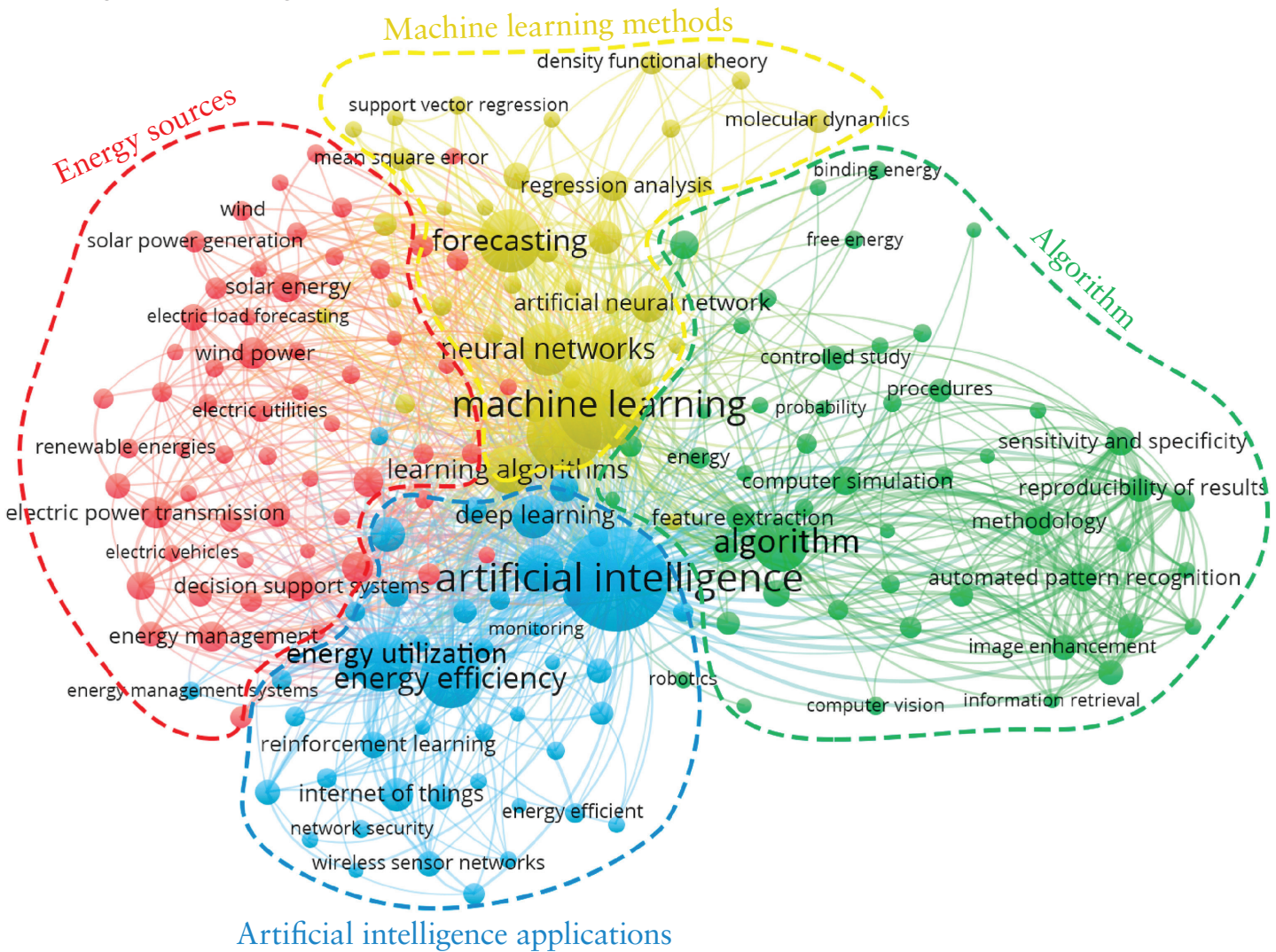
While energy production, storage, and distribution usually guide the energy discussion, the real estate sector—which spans commercial, industrial, and residential—is ultimately the conduit through which molecules move from origin to endpoint.

The global energy network operates as a system of systems, and relationships across this tangled web have become increasingly complicated, interconnected, and in many cases prone to failure. One system’s waste can be another’s feedstock, so all pieces of the puzzle need to have an energy emission externality value.

Just like our food products are required to label the caloric benefit of what we consume, so should our buildings and infrastructure with respect to energy-emission costs and benefits. The importance of understanding human, commercial, environmental, and technological relationships as a series of networks is the foundation of any meaningful analysis if we are to attempt to apply our learnings towards making more informed decisions that lead to more favorable outcomes for the largest number of people.

In addition, examining energy externalities through the lens of geographic complexity and network sciences can help to better understand the web of relationships which underlie the socioeconomic and technological foundation which is the driver of today’s interconnected global economy (*Exhibit 1*).¹

EXHIBIT 1: A COMPREHENSIVE NETWORK OF ENERGY, ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING



Source: Energy Strategy Reviews

The figure above depicts the clustered relationships as defined by the connections between artificial intelligence and machine learning in the energy field.

The transition to an energy system capable of supporting a 'Net Zero economy' will require participation from every sector of the global industrial and economic value chain. However, focusing solely on current emissions indicators is an insufficient foundation for effective investment and capital deployment strategies. Now is the time to articulate an attempt at a new spatially and intensity-referenced framework which incorporates decarbonization, emissions, and other sustainability metrics, and translates to signals that serve as precursors to long term environmental and capital appreciation. In the decades ahead, climate and energy considerations will move from being side factors which help capital allocators to a central standard group of data points influencing all investment decisions.

The transition to an energy system capable of supporting a 'Net Zero economy' will require participation from every sector of the global industrial and economic value chain.

DECENTRALIZED ENERGY SYSTEMS

Amazon CTO, Dr. Werner Vogels, recently—and indirectly—highlighted the importance of decentralization as a fundamental component of the energy ecosystem of the future. Referencing the ability of Amazon’s data centers to remain online during a massive power outage that disrupted much of Portugal and Spain in Spring 2025, Vogels aptly noted that “everything fails, all the time, so plan for failure and nothing fails.”

Decentralization is a common methodological foundation associated with data architecture and operating systems. The fundamental building blocks associated with data decentralization are equally important to incorporate when we think about how to provide sustainable energy to the world in the decades ahead.

While the world seems to be at an inflection point with respect to the sustainability of climate and decarbonization themes driving investment and capital expenditure activities, it is clear that AI-driven energy efficiency and scalability will continue to serve as a key catalyst of the thematic discussion for the foreseeable future.

Further, nothing works without a sustainable and reliable energy backbone, and this translates across where people live, work and play. It follows that, whether the emphasis is on residential, commercial, or industrial real estate, no capital should be deployed without first understanding the energy challenges and opportunities that are associated with (re) development.

A responsive and smart decentralized energy ecosystem will display characteristics that emphasize localized generation, a portfolio of sources (both renewable and fossil based), and operational flexibility and responsiveness largely driven by advances in artificial intelligence. This end-to-end energy value chain will evolve under the framework of sensible operating parameters. Whether or not climate concerns are at the foundation of capital deployment is secondary; what I believe to be more important is the incorporation of an engineering and distribution architecture that allows for and embraces decentralization.

The degree to which the energy-infrastructure system operates as a decentralized and flexible network will determine its ultimate success as both an investment and as a service. Such a framework yields benefits to both producers and consumers through cost savings, reliability and resilience to disruption, environmental and financial incentives for leveraging cleaner sources where appropriate, and ultimately value appreciation for property owners.

Therefore, the 2025 energy system challenges should be viewed as more evolution than revolution. As this new blueprint includes what, how, and where we build infrastructure, the real estate sector, including both land and the built environment, sits at the epicenter of this important discussion.

The transition to decentralization will also reduce the energy externality footprint, which undoubtedly extends to all sectors of the real estate economy.

MATERIAL FLOWS TO CAPITAL FLOWS

The transition to decentralization will also reduce the energy externality footprint, which undoubtedly extends to all sectors of the real estate economy. How this unfolds remains to be seen, but given that oil and gas will undoubtedly remain the cornerstone in the new energy systems’ infrastructure of the future (pretending otherwise is irresponsible), it will likely be more of an evolution than a revolution of the energy system. As such, the ways in which externalities are viewed and accounted for will also need to evolve.

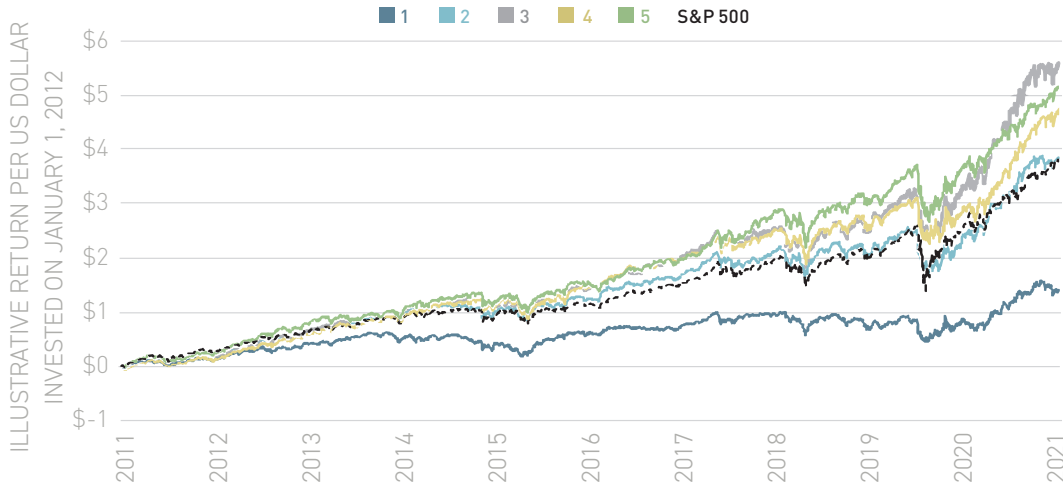
Conventional valuation orthodoxy suggests that assets associated with more favorable sustainability profiles (i.e., lower emissions) should be better performers over a longer duration return profile, as measured by absolute or relative returns through asset price, capital appreciation, or other valuation metric. As shown in *Exhibit 2*, the ‘Total Value Framework’ investment approach developed by asset management firm Engine No.1 demonstrates this concept as it relates to public market investable assets.² This logic can be extended to property and real estate asset valuations with respect to softer characteristics such as location, socioeconomics, and habitability.

The identification and quantification of energy and decentralization pathways and related exposures at the asset level using a more comprehensive library of data is one way that allows for early signal detection towards long term asset appreciation and alpha generation. Companies that operate in the energy and manufacturing sectors have physical and financial exposures to a unique set of risks and opportunities; early identification of mispriced assets and deeper attribution and understanding of the emissions drivers can allow us to take advantage of the catalysts that impact future performance, many of which are not captured by traditional research and engineering accounting methodologies.

Material environmental risk and raw material/commodity costs are both the starting and ending points of the attribution exercise. Think “Life Cycle Analysis” rather than upstream/downstream accounting estimates.

We then move from material flows to capital flows, which have already served as a catalyst for this transition. There is no need to look any further than the earmarked and deployed capital following the passage of the Inflation Reduction Act for support. In addition to the environmental and security benefits, real money is already being made as a precursor to the decades-long transition in front of us.

EXHIBIT 2: ILLUSTRATIVE RETURN BASED ON TOTAL VALUE PROFILE (FROM 1 TO 5) VS. S&P 500



Note: Engine No. 1's Total Value Framework analyzed the performance of 700 S&P 500 firms between December 2, 2011 and August 9, 2021, separating the firms into quintiles; '1' represents firms with the lowest Total Value Profile (or largest negative impacts) which substantially underperformed the benchmark, and '5' represents the highest Total Value Profile (or smallest negative impacts) which outperformed the benchmark.

Source: Engine No. 1

REFRAMING THE ENERGY DISCUSSION

So how can investors and operators with physical and financial property exposures begin to evaluate the benefits of energy management and emissions abatement potential through a thematic story that is still being written? There are surely as many approaches as there are analysts one way is to start with externalities.

Every atom of material which contributes to the products, goods, and services that we consume, transform and interact with—including property and—carries an energy and emissions burden.

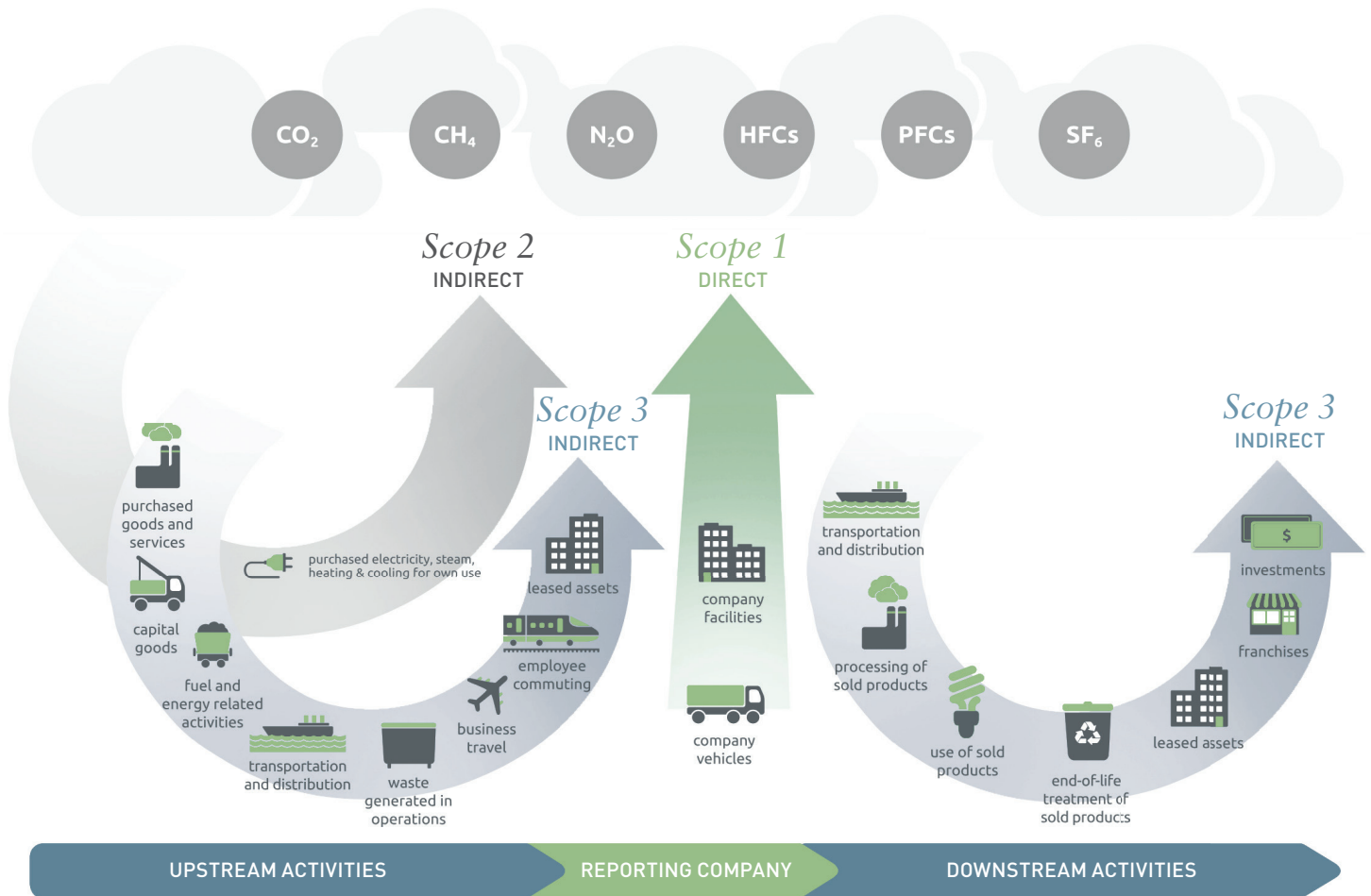
As shown in Exhibit 3, the current Scope 1 through 3 (and Scope 4 for avoided emissions) accounting methodologies and standards are a start, but there is a long way to go before we can accurately and defensibly estimate the material flows, consumption, transfer, and attribution quantities in a defensible manner—all associated with greenhouse gas emissions.

Scope 1 and 2 emissions calculations are both relatively straightforward: Mass balance approaches allow operators to measure and manage emissions associated with their own products and the energy used to create them. Scope 3, the largest emissions exposure for most companies which focuses on downstream emissions, is where it gets messy. Due to the intent of why Scope 3 emissions need to be tracked, and the uncertainty of the estimate's attribution methods for downstream users, Scope 3 in many cases does not have any true meaning. Until there is literally a recording instrument on every single discharge point (i.e., never), we will need to rely on estimates to determine attribution. And until there is a standard that can accurately and defensibly account for downstream emissions (also, never), quantification techniques leveraging artificial intelligence are the next best alternative. *Exhibit 3* illustrates some of the measurement and management complexities with respect to emissions tracking, accountability, and attribution.

As downstream attribution methods evolve with the help of AI, the framework through which we view and assess economic and environmental opportunities which should start to proactively dictate investment over the coming decades—the remit of what an 'energy investment' is, will also need to expand. Essentially, economic growth and environmental stewardship start with energy, and every company therefore should then be viewed through the lens of spatially referenced energy systems science and engineering. But rather than focusing explicitly on emission reduction for the sake of permitting or public relations, the driving force behind quantifying, controlling, and reducing emissions—moving from Scope 3 to Scope 4 territory—should be to view energy derived emissions as externalities.

By definition, an externality is a cost or a side effect. A balance sheet item that carries a cost. However, if we place a value on emissions, and in the process flip the conversation from side effect to opportunity, real estate operators can start to see ways that reducing emissions can create value, as opposed to simply minimizing line-item costs that impact margins. Reducing emissions has been demonstrated to improve worker productivity, raise property values and reduce the disease burden which in turn decreases health care expenditures while raising GDP per capita. As we shift the energy emissions discussion from being a climate issue to one focused on economic and societal well-being, return on investment with respect to place takes on a different meaning.

EXHIBIT 3: OVERVIEW OF GHG PROTOCOL SCOPES AND EMISSIONS ACROSS THE VALUE CHAIN



Source: The World Resources Institute and World Business Council for Sustainable Development, Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard, 2011

THE PATH FORWARD

When we expand the definition of what constitutes an energy real estate investment, the aperture needs to be broadened so that upstream and downstream opportunities rise to the surface and become part of the capital discussion. Decentralization provides the lens through which such investments start to make sense. Sustainable energy is the lifeblood of the planet.

Where people live, work, and socialize all have one common denominator—the energy required to do so. Let’s use this inflection point to steer the discussion in the direction that is responsible to all partners, accretive in value, and beneficial for the participants. It is time to embrace decentralization.

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NOTES

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IT'S ABOUT NOI



Kevin Berkemeyer
Co-Founder and CEO
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Solar is no longer just about ESG—it’s a strategic investment that boosts NOI, increases property valuations, and hedges against rising energy costs.

Nearly two decades of experience in clean energy—originating solar projects of all sizes—has led to one clear conclusion: clean energy adoption is most successful when evaluated through a financial lens. A background shaped by family-run businesses instilled an early focus on profitability and return on investment—principles that continue to guide how clean energy is approached in commercial real estate.

Early solar development efforts involved selling solar farms to traditional farmers by comparing energy yield directly to crop yield. As adoption expanded into commercial real estate (CRE), one metric emerged as central: Net Operating Income (NOI). In the early days of CRE solar, the NOI impact was limited. But today, the dynamics have fundamentally shifted. Solar is increasingly a no-brainer—not just for enhancing NOI, but for boosting valuation multiples and mitigating growing risks tied to grid instability and rising energy costs.

Many real estate owners still view solar primarily as an ESG initiative—not an NOI opportunity. And while that narrative may resonate with some, it often misses the true business value of deploying solar—typically on underutilized rooftops, parking lots, or open land. Leading property owners like Prologis, Walmart, and Lineage Logistics have built significant solar and energy platforms not for the optics, but for the economics.

This paper makes the financial case for clean energy—and solar in particular—as a strategic lever for financial resilience and value creation. And yes, the ESG benefits come along for the ride, whether you prioritize them or not.

TAX INCENTIVES THAT SUPERCHARGE RETURNS

Let’s start by walking through the economics of a solar project. The financials are compelling on their own—but today’s tax incentives make them even stronger.

The 30% Investment Tax Credit (ITC) allows investors to deduct 30% of the cost of a solar system directly from their federal tax liability. On a \$1 million system that could power approximately 90 to 125 homes or a 30,000-125,000 square foot commercial building, that’s a \$300,000 tax credit.

In addition, 100% bonus depreciation allows the remaining cost of the system to be fully depreciated in the first year—creating a substantial write-off that can offset other taxable income. Depending on the investor’s tax position, this can reduce the effective net cost of the system by another 20–30%.

Together, these incentives can reduce the true out-of-pocket cost of a system by 50% or more, dramatically improving payback periods and return on investment—even before a single kilowatt-hour is generated.

The ability to monetize these incentives depends on the investor’s structure. Private equity owners can typically use both the ITC and bonus depreciation directly to reduce taxable income. REITs, on the other hand, often need to partner with tax equity investors or use a taxable REIT subsidiary to unlock the value of those benefits. Either way, the bottom line is the same: with the right structure, the incentives are real—and material.

EXHIBIT 1: SOLAR TAX INCENTIVES, PERE VS. REITS

CATEGORY	PRIVATE EQUITY REAL ESTATE (PERE)	REITs
ITC ELIGIBILITY	✓ Can directly claim and use ITC	✗ Generally cannot claim ITC directly
DEPRECIATION (MACRS)	Fully usable to offset taxable income	! Limited benefit due to REIT tax structure
MONETIZATION STRATEGY	✓ Direct ownership or partnership flip	✗ Sale-leasebacks or tax equity partnership
TAX BENEFITS TO INVESTORS	✓ Flow through to LPs or sponsors	Indirect or diluted via third parties
COMPLEXITY	Moderate – some structuring needed	High – due to REIT compliance and income rules

Source: Author

BRIDGING THE GAP BETWEEN EVALUATION AND EXECUTION

For many commercial property owners, the interest in solar is there, but the path from idea to implementation is unclear. Evaluating a building’s solar potential, identifying the right system size and design, soliciting provider proposals, comparing those proposals, and aligning on financial terms can be daunting. This is all compounded by the complexity of local incentives and electricity bills, a fragmented network of providers who execute projects, and a traditionally manual process. This friction often delays or derails promising projects, and in some cases, prevents them from happening.

In many respects, the path from evaluation to execution has not really changed. It’s still largely manual, iterative, slow, and expensive. This is the gap that Station A was created to solve with software and process innovation. By combining building-level energy analysis with a curated marketplace of qualified solar providers, Station A enables commercial real estate owners to quickly assess financial viability of transactions and efficiently source competitive proposals for execution. Whether managing a single asset or nationwide portfolio, owners can use these insights to treat solar like any other capital improvement project – one backed by data, efficiency, and NOI.

“Solar Return on investment: 3 to 4x”

CASE STUDY: TURNING SOLAR INTO PROPERTY VALUE

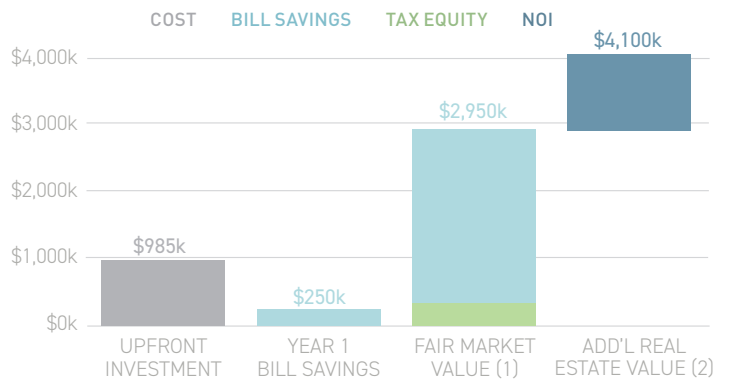
Now let’s apply this to a specific project, anonymized here for the sake of discussion. A commercial real estate owner we’ll call “Sunny Haven,” located in California, purchased a rooftop solar system for approximately \$1 million through the Station A marketplace in 2022.

The system was initially estimated to generate \$110,000 in annual electricity savings, delivering an 11% return on cost before applying the ITC or bonus depreciation. But as utility rates rose, actual savings in the first year reached nearly \$250,000—a 25% return on cost. With rates continuing to climb, those savings will only grow and compound over time.

The real inflection point came when the property was refinanced in 2023. At a 6.2% cap rate, the solar-driven increase in NOI translated into \$4.1 million in additional property value. The owner was able to refinance and pull out more than the full cost of the system, while still increasing net cash flow.

The takeaway is clear: solar increased operating income, which increased the value of the property. It wasn’t treated as a sunk cost or an ESG initiative—it was treated like any other income-generating investment. Clean energy became a strategic asset.

EXHIBIT 2: SUNNY HAVEN SOLAR PROJECT FINANCIALS



Source: Station A, Inc. analysis of actual project level transaction and financial performance data.

The other key component of this case is the impact of rising electricity rates. Since Sunny Haven’s system was commissioned, the property’s cost of electricity has nearly doubled. As a result, the project’s simple payback period was cut in half—from over four years to just over two.

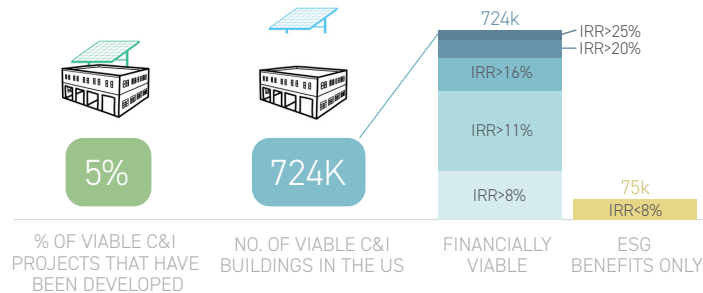
This isn’t unique. We’re seeing utility rate hikes across the country, and that trend shows no sign of slowing. Which means the economics of solar—already strong—are only getting better.

SO WHY AREN'T MORE COMPANIES DOING THIS?

The economics of solar development have historically been more elusive to pencil out, because there was an information gap between the solar markets and data for US commercial and industrial building stock. Our own organization began by solving how to build this bridge, starting with an analysis of more than one million buildings, conducted in 2023. The top markets, from a pure all-cash financial basis, were Texas, California, Illinois, Pennsylvania, Massachusetts, and New York

The initial analysis indicated that at least 724,000 of these one million buildings, accounting for nearly 30 billion square feet at an average of 41,000 square feet per building, could support financially viable rooftop solar today, factoring in applicable incentives, local energy costs, and current project economics. Yet only 5% of the market is tapped. Why the gap?

EXHIBIT 3: SOLAR FINANCIAL VISIBILITY, COMMERCIAL, AND INDUSTRIAL



Source: Station A, Inc. analysis of actual project level transaction and financial performance data.

So, what's stopping broader adoption? It boils down to three things:

1. Analysis paralysis: Evaluating buildings for solar at speed and scale is hard.
2. Provider complexity: With thousands of providers in every market, it's difficult to compare and choose.
3. Perceived operational hassle: The process feels too complicated to even start.

In many respects, people just don't know where to get started.

The barrier is rarely economics—it's inertia and confusion. The good news is that software is helping lower the barrier to entry, making building evaluations simpler and more efficient for asset management, energy, facilities, and finance teams, and helping more easily connect with providers who can execute projects best.

THE REALITY IS THAT THERE IS A COST TO INACTION

The cost of inaction in mid-2025 is increasingly difficult to justify. Across the US, rising utility rates — driven by surging data center demand, and electrification accelerating across the grid — are eroding NOI and exposing commercial portfolios to escalating operational risk.

In high-cost markets like California, New York, Massachusetts, and Illinois, commercial electricity rates are increasing anywhere from 15-35%. For many buildings, this translates to hundreds of thousands of dollars in avoidable annual utility costs, simply by not deploying onsite solar. In addition, in some markets such as Illinois, Pennsylvania, and Maryland, among others, there are active community solar markets where real estate owners can lease out their rooftop to a solar provider to build, operate, and maintain a community solar project. Lease rates can range from \$20,000/MW/year to \$80,000/MW/year, providing \$100,000 to \$400,000 in annual lease revenue for a 5MW project.

The market conditions are strong, the incentives are in place, and the savings or revenue are material. What's missing, in many cases, is the infrastructure to act with speed, confidence, and scale.

The right time to act was yesterday. The second-best time is today. As one of Station A's core values puts it: Just don't wait.

CLEAN ENERGY IS A FINANCIAL STRATEGY

The commercial real estate industry doesn't need another idealistic sustainability pitch—it needs investments that perform. Solar delivers exactly that. It's an NOI enhancer, a valuation lever, and a hedge against volatility. With the right incentives, the right technology, and the right partners, solar is no longer a climate story. It's a capital allocation story.

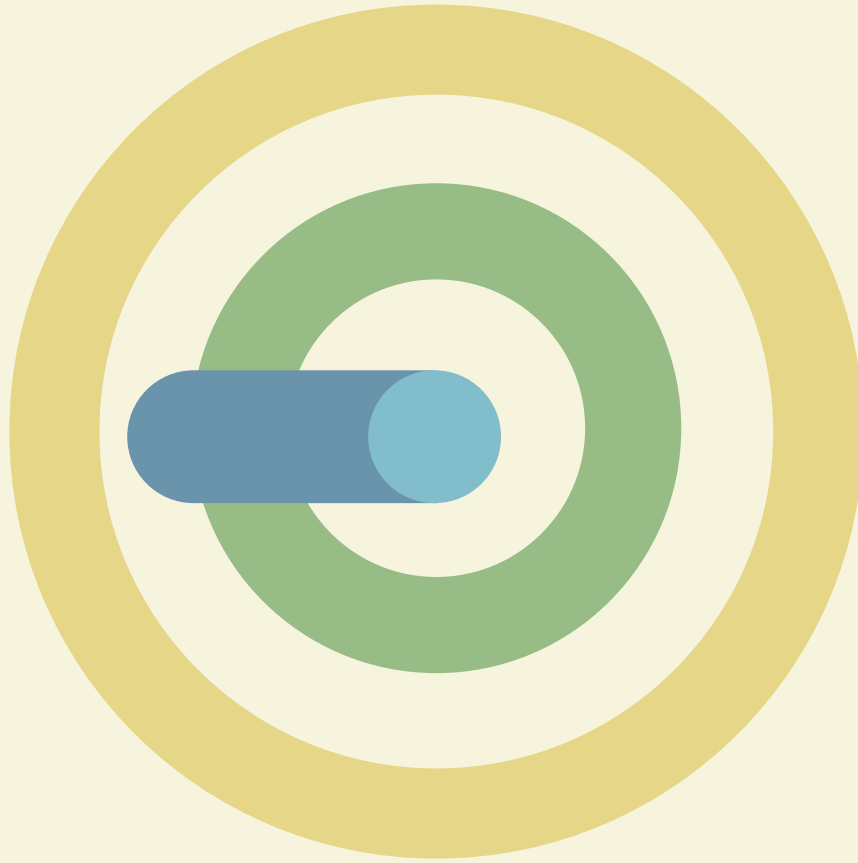
For commercial property portfolios, the question is no longer whether to adopt solar—but how much longer delay remains feasible. The economics are solid. The infrastructure is in place. The market is ready.

Just don't wait.

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Kevin Berkemeyer has spent his career in the clean energy sector and is the Co-Founder and CEO of Station A, Inc.

TARGETED INVESTMENT



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Sustainable investing now emphasizes precise energy and carbon performance metrics. This shift requires aligning sustainability goals with investment strategies, and integrating factors related to building efficiency and grid sources into the investment process to effectively promote sustainability and boost returns.

Sustainable investing is becoming more precise. Investors are moving beyond simple net-zero goals or GRESB scores, recognizing that these may not always reflect actual energy and carbon performance. The industry now understands that net-zero carbon encompasses both operational and embodied carbon, with operational carbon further divided into site energy use and energy production/transmission factors.

This shift has led to more specific sustainability goals and metrics. Investors now consider whether they want to invest in already green assets or transform brown ones, and whether they prioritize greenhouse gas (GHG) emissions or building-level efficiency. The choice of primary sustainability metric significantly impacts tactics and effectiveness. Importantly, metrics and targets must align with overall investment strategies to be both achievable and profitable.

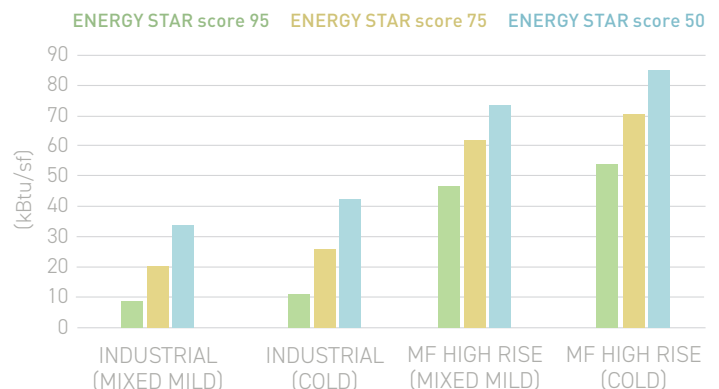
KEY LEVERS: BUILDING ENERGY USE AND GRID ENERGY SOURCES

The GHG emissions impact of operational real estate can be broken down into (1) energy use and (2) energy sources.

Building Energy Use

Ranked in descending order of impact on energy use in real estate - property type comes first, followed by building efficiency and then climate zone.

EXHIBIT 1: ENERGY USE INTENSITY (EUI) BY PROPERTY TYPE, EFFICIENCY PERFORMANCE, AND CLIMATE ZONE



Source: Urban Land Institute, Technical Site EUI Reference for ESPM Score Derivations (2024)

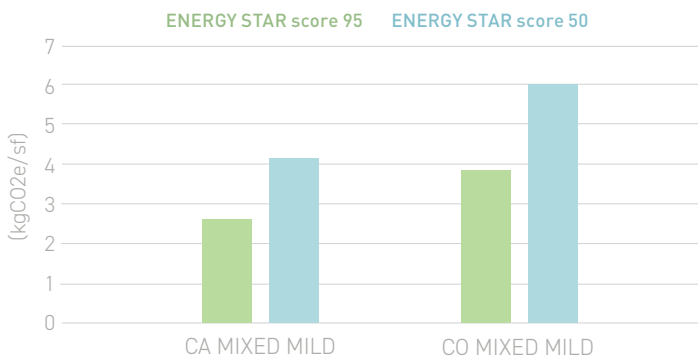
- **Property type** is the most important single determinant of a property’s total energy use. For example, low energy intensity property types such as non-refrigerated warehouses may use around 50% of the energy of high intensity property types such as high-rise multifamily. Property type also impacts investors’ ability to obtain data and implement improvements. A forward-looking sustainability strategy could prioritize the property types with greater control and ability to electrify—such as low-rise office and multifamily—over more challenging property types, such as high-rise office and multifamily, hotels, shopping centers, and life science.
- **Building energy efficiency** is the second most impactful factor on energy use. The best multifamily buildings use 15-35% less than the median building, and the best warehouse building uses 40-75% less than the median building. Therefore, selecting efficient assets or increasing the efficiency of assets can significantly reduce overall energy use and GHG emissions.
- **Climate zone** is also a driver of overall energy use. For example, the median industrial building in mixed mild versus cold climates differs by about 25%, and the median multifamily building differs by 15%. Climate zone also has an impact on the ability for properties to electrify, as gas heating is used more in colder climates, where the technical and economic feasibility for heat pumps is also more challenging.

Grid Energy Sources

Differences in building-level energy efficiency are multiplied by transmission losses and grid energy mix in determining variation in GHG emissions. Utility regulation and supply have always been under state—rather than federal—control. There are twenty-two main grid regions in the US with different power generation sources, with variations down to the local utility even within regions.¹

Energy sources and building energy efficiency are almost equally powerful levers influencing GHG emissions. The same building on a relatively clean grid such as California, versus a dirty grid such as Colorado, has a difference in GHG performance of about 45%.

EXHIBIT 2: HIGH RISE MF GHGI IN MIXED MILD CLIMATE ZONES ACROSS CALIFORNIA AND COLORADO



Source: Urban Land Institute, Technical Site EUI Reference for ESPM Score Derivations (2024).

There are 22 main grid regions in the US with different power generation sources, with variations down to the local utility even within regions.

WHAT SHOULD INVESTORS PRIORITIZE: BUILDINGS OR THE GRID?

It is not possible for a building to get all the way to net zero without addressing energy supply — buildings will always require energy to operate. But it is possible for a building to get to net-zero only through electrification and supply, without addressing efficiency.

The best sustainability strategy should depend on an investor’s goals. At a high level, they should seek to articulate their objectives in two main areas:

- **Key Metric:** either directly contribute climate change mitigation by targeting GHG emissions, or prioritize ensuring that the property uses resources efficiently by targeting site EUI, defined as the amount of energy used per square foot per year (which is one factor in reducing GHG emissions)
- **Type of Strategy:** Either purchase and hold buildings that are already high performers or drive reduction over time through “brown to green” efficiency improvements.

EXHIBIT 3: PRIORITIZING EMISSIONS VS. USAGE

ENERGY PRIORITY	OUTPUT	BENEFITS
GHG EMISSIONS	<ul style="list-style-type: none"> • Minimize GHG exposure and ultimately reach net-zero carbon • Achieve potential premium associated with all-electric buildings • Manage grid-related risk 	<ul style="list-style-type: none"> • Achieve significant reductions in GHG emissions • Drive returns through potential increased marketability from electrification • Generate revenue through on-site solar
ENERGY USE	<ul style="list-style-type: none"> • Own highly efficient buildings • Minimize exposure to energy cost changes, energy codes, and building performance standards • Achieve potential premium associated with the most efficient buildings (i.e. rent and OPEX) 	<ul style="list-style-type: none"> • Achieve significant reductions in energy use • Reduce exposure to energy cost changes, energy codes and building performance standards • Drive returns through decreasing OPEX and increasing marketability

Selecting GHG emissions as the primary metric enables a pure focus on carbon-science based Net Zero Carbon (NZC) goals and the macro change towards a low carbon economy. A focus on GHG and electricity grids also helps create market signals for green power generation and electrification of buildings. This means that areas where utilities are not acting strategically to clean up their generation and distribution may see less institutional investment over time.

Energy efficiency remains the primary focus for many US real estate owners and investors. EUI has the greatest alignment with fiduciary and financial goals. Investing in efficient equipment and operations can decrease costs, future proof the building, and make it more marketable to tenants and investors. In addition, whether a building is a relatively high or low energy user can indicate its relative risk exposure to energy price changes and local regulations (e.g., Building Performance Standards).

Energy supply is outside the scope of levers that can generate returns or protect against risk at the property. In fact, paying a premium for green power can be dilutive to returns. Moreover, building owners cannot directly control the efficiency of the electric grid, and recent presidential administrations have taken drastically different stances on energy policy, leading to diverging projections regarding the future energy supply and its carbon intensity.

Looking at total GHG emissions ties to NZC but is agnostic to how that performance is achieved. In other words, an efficient building on a dirty grid and an inefficient building on a clean grid could have the same GHG performance. Looking at EUI helps ensure that buildings are “doing their part” independent of the grid, in addition to identifying building-specific risks and benefits.

An efficient building on a dirty grid and an inefficient building on a clean grid could have the same GHG performance.

WHAT ARE THE BEST INVESTMENT TACTICS TO REACH DIFFERENT SUSTAINABILITY GOALS?

Achieving each of these objectives entails different investment tactics:

The choice of properties to acquire depends on the specific goals and approach of the investor. For those prioritizing strong GHG performance, the focus may be on ENERGY STAR–certified, all-electric buildings in cleaner grid areas like California—supplemented by green power purchases to achieve zero emissions. Investors aiming for relative GHG improvement could target median-performing buildings in dirtier grid markets like Colorado, then implement electrification measures, install on-site solar where feasible, and potentially purchase green power. In this scenario, improving property efficiency might be optional if green power proves more cost-effective than capital investments in efficiency upgrades.

For those focused on high EUI performance, ENERGY STAR certified buildings in any market would be the primary targets. A strategy centered on relative EUI improvement would involve acquiring median-performing buildings across various markets and enhancing their energy efficiency and ENERGY STAR score, without necessarily pursuing full electrification.

EXHIBIT 4: TACTICAL CONSIDERATIONS FOR EMISSIONS VS. USAGE

ENERGY PRIORITY	OUTPUT	BENEFITS
GHG EMISSIONS	<ul style="list-style-type: none"> • Strict focus on Market selection – clean vs green grids (location-based GHG) • Purchase all-electric buildings • Pay premium for green power (market-based GHG) 	<ul style="list-style-type: none"> • Invest in dirty grids and create demand for green power; invest in grids with plans for decarbonization (and look at future energy sources as well) • Implement capital plans to electrify buildings (and select property types that are easier to electrify) • Pursue on-site solar where technically feasible and state policies are in place for power to be sold to tenants or grid
ENERGY USE	<ul style="list-style-type: none"> • Buy, hold, and maintain efficient buildings 	<ul style="list-style-type: none"> • Buy lower performing buildings and integrate efficiency into capital plans • Consider property type dynamics related to data and landlord control

WHAT ARE THE BEST METRICS TO MEASURE PROGRESS TOWARDS GOALS?

There are several options to measure progress towards each type of goal:

GHG Emission Metrics

For GHG emissions, totals and reduction over time are the most straightforward metrics. Reductions over time can be evaluated annually, over hold period, since vehicle inception, and/or since base year.

Investors can also track on-site solar installations as a GHG metric. On-site solar is one of the main ways that owners can directly impact GHG in a financially accretive manner.

Many investors are also using the CRREM Pathways, which provide descending annual targets for GHG intensity, broken out by property type, climate zone and grid. The targets are based on the remaining carbon budget allocated to that market segment under a 1.5-degree scenario.² These investors are often evaluating “stranding year” or the year when the property’s GHG exceeds the remaining carbon budget. While this can be a useful high-level metric, it is important to note that most properties exceed the CRREM carbon budget by the early 2030s. Market-based green power procurement is therefore essential to meeting the CRREM GHG pathways.

EXHIBIT 5: METRICS FOR EMISSIONS VS. USAGE

ENERGY PRIORITY	OUTPUT	BENEFIT
GHG EMISSIONS	<ul style="list-style-type: none"> Total GHG Total on-site solar generation (kW) CRREM GHG Pathway – average “stranding year” (year above curve) 	<ul style="list-style-type: none"> Change in GHG intensity over time On-site solar installations (kW) Change in CRREM average “stranding year”
ENERGY USE	<ul style="list-style-type: none"> EUI by property type Average ENERGY STAR score % of SF or AUM with ENERGY STAR certification 	<ul style="list-style-type: none"> Change in energy use intensity by property type, over time Change in average ENERGY STAR score Change in % of properties with ENERGY STAR Certification

Energy Use Intensity (EUI) is a widely accepted metric globally.

EXHIBIT 6: CRREM GHG “STRANDING YEAR” BY PROPERTY TYPE ON A CLEAN GRID

CRREM GHG “STRANDING YEAR” BY PROPERTY TYPE ON A CLEAN GRID		
ENERGY STAR SCORE	WAREHOUSE - CALIFORNIA	HIGH RISE MF - CALIFORNIA
95	2039	2031
75	2034	2023
50	2024	2020

Energy Use Metrics

For evaluating energy use, Energy Use Intensity (EUI) is a widely accepted metric globally, and should be examined on a property type basis to control for the variations discussed previously.

Moreover, ENERGY STAR Portfolio Manager is an exceptional resource for sustainable investing in the US, because it is the industry standard tool for tracking, evaluating, and reporting energy performance. The tool tracks utility usage, normalizes for weather and occupancy, and generates key metrics as well as a 1-100 score representing the property’s performance relative to the building stock. Investors can examine the ENERGY STAR score of individual buildings, the average score for the portfolio and/or the portion of properties achieving ENERGY STAR certification for performance above the seventy-fifth percentile.

As a public tool that provides benchmarks based on measured performance, ENERGY STAR is perhaps only comparable to NABERS in Australia, since European EPCs are based on physical conditions and modeled data.³ In general, actual energy performance is usually worse than modeled energy performance, meaning ENERGY STAR is more accurate and stringent than modeled approaches.

WHAT TYPE OF SUSTAINABILITY TARGET IS BEST FOR DIFFERENT TYPES OF VEHICLES?

Investors in real estate must carefully consider their goals when developing sustainability targets, as different objectives can lead to varying approaches.

While some may focus strictly on GHG emissions, this approach often requires investors to allocate capital based on power grids or invest in items that may not have a strong financial business case, such as electrification and green power. For those pursuing carbon budget-based GHG targets in the US, it's crucial to be transparent about their willingness to pay for these items and to consider handling them separately from typical investment return calculations. Alternatively, many investors may find it more appropriate to view NZC as a long-term goal and emphasize GHG emissions reduction progress.

Energy efficiency measures often rival or surpass grid location choices and green energy initiatives in their impact on reducing greenhouse gas emissions. Site energy use is a robust metric for performance

evaluation. Real estate owners have greater influence over a property's energy use than its energy sources, and energy use aligns more closely with value generation. Prioritizing energy-efficient buildings can lead to lower operational expenses, enhanced market appeal, and reduced vulnerability to energy price volatility and emerging regulations such as building performance standards.

Investors have options when it comes to building a sustainable portfolio using either metric. They can either acquire properties that are already low-carbon or energy efficient or improve properties through a "brown to green" strategy. The former approach can benefit from tenant and investor premiums associated with best-in-class properties, and the latter approach can drive returns by decreasing OPEX and increasing marketability to tenants and buyers. Either strategy can potentially achieve sustainability goals while also addressing risks and opportunities that can impact financial performance.

Investors can either acquire properties that are already low-carbon or energy efficient or improve properties through a "brown to green" strategy.

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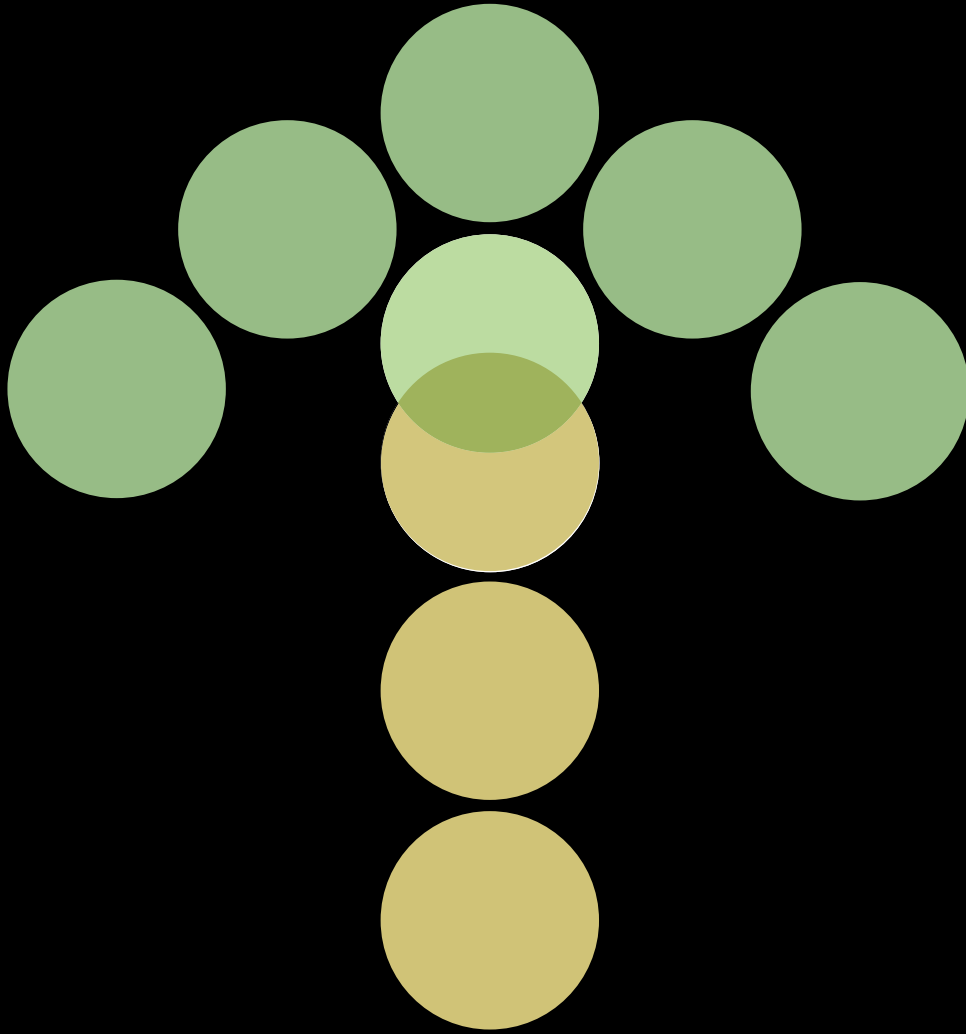
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¹ eGRID source "Emissions & Generation Resource Integrated Database (eGRID) | US EPA," US EPA, March 20, 2025, <https://www.epa.gov/egrid>.

² CRREM. "Objectives & Benefits." Last modified 2025. <https://www.crrem.eu/objectives-and-benefits/>.

³ Yefei Bai, Cong Yu, and Wei Pan, "Systematic Examination of Energy Performance Gap in Low-energy Buildings," *Renewable and Sustainable Energy Reviews* 202 (July 5, 2024): 114701, <https://doi.org/10.1016/j.rser.2024.114701>.

FARING ON ADOPTION



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In the US commercial real estate sector, the path to green energy transition is strong—but higher energy efficiency and lower demand for competing brown sources makes them relatively more cost-effective over time, which acts as a counteracting force to the path of transition to green sources.

Investing in energy-efficient technologies and infrastructure is increasingly portrayed as a major driver of market value for commercial real estate properties. Despite a long-standing debate, assessing the value that US commercial real estate operators attach to energy efficiency is still elusive.

On top of the baseline value of energy efficiency, an overlooked aspect is that when the demand for green energy sources spikes, the demand for brown sources drops, which makes brown sources relatively cheaper and more attractive economically over time.

How can we quantify these second-order effects on the relative value of green vs. brown energy sources?

THE RESEARCH

A recent academic paper* proposes the first steps to tackle this question, benchmarking the paths of adoption of energy efficiency in commercial real estate to those in the manufacturing sector—a natural benchmark given that both sectors faced a push to convert to green energy sources over the last two decades.

To assess the potential second-order effects of changes in the demand for green sources on the economic viability of brown sources, the paper employs newly available data collected from a set of US sources on the split of usage of renewable sources and carbon fossil energy sources by sector and over time.

The paper develops a statistical model called a “UCTT multivariate diffusion model” to examine and compare the diffusion of coal, gas, and biomass as sources of the energy used in the US commercial real estate and manufacturing sectors over time. This model assesses the dynamics of adoption of each energy source and the direct and indirect effects across energy sources and sectors.

Exhibit 1 reports the raw data and modeled paths of energy-source adoption across sectors over the last two decades.

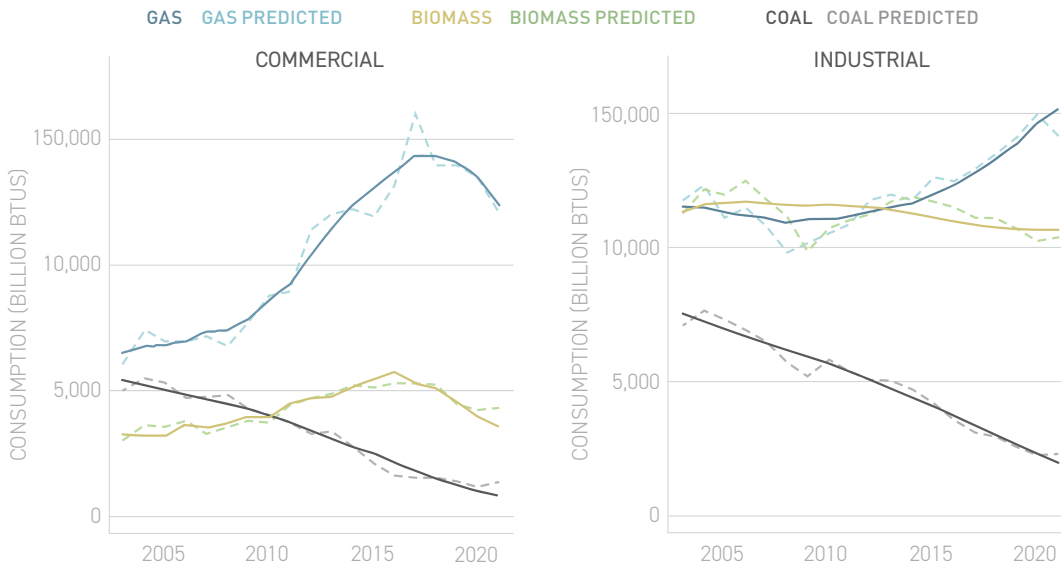
In the US commercial real estate sector, the path to green energy transition is strong—biomass adoption, in particular, grows at sustained rates. At the same time, the higher efficiency and lower demand for competing brown sources (gas and coal) makes them relatively more cost-effective over time, which acts as a counteracting force to the path of transition to green sources.

(Note: This article was originally published in January 2025 on the blog of the Georgetown University McDonough School of Business: “Clark Quick Take: How Does U.S. Commercial Real Estate Fare on Green Energy Adoption?” Summit has made minor modifications to comply with AFIRE style. View the original at: globalrealestate.georgetown.edu/insight/clark-quick-take-how-does-u-s-commercial-real-estate-fare-on-green-energy-adoption/)

For manufacturing, the higher viability of natural gas has crowded out the adoption of green sources over the last decade, leading to a flat or even declining path of adoption for green sources that has no parallel in commercial real estate.

Ultimately, the existing data and predictive model suggest a sustained adoption of green sources in US commercial real estate largely because of the lack of a crowding out effect, which instead is strong in manufacturing.

EXHIBIT 1: OBSERVED AND MODEL-PREDICTED TIME SERIES OF ENERGY CONSUMPTION FOR ELECTRICITY GENERATION AND USEFUL THERMAL OUTPUT OF COAL, GAS, AND BIOMASS IN THE US COMMERCIAL REAL ESTATE AND MANUFACTURING SECTORS (2003-21)



WHAT DO WE CONCLUDE FROM THIS RESEARCH?

Subsidizing green energy sources makes brown sources relatively cheaper, which pulls the break rather than accelerating the race toward sustainability and energy efficiency. Policies and programs that support the adoption of renewable energy sources cannot be effective unless they consider this quantitatively important and unintended counter-effect.

EXCERPT: MODELING ENERGY TRANSITION IN US COMMERCIAL REAL ESTATE: A DIFFUSION COMPARISON WITH THE INDUSTRIAL SECTOR

Savio, Andrea. 2023. "Modeling Energy Transition in US Commercial Real Estate: A Diffusion Comparison with the Industrial Sector" Engineering Proceedings 39, no. 1: 15. <https://doi.org/10.3390/engproc2023039015>

An extensive structural transformation in energy systems is denoted by the term energy transition. This transition is often referred to as the decarbonization of the energy sector and aims to shift the system to renewable energy technologies (RETs), implying a change from centralized to decentralized energy production.¹ According to the International Renewable Energy Agency,² the use of appropriate technology and regulations in all sectors, including real estate, may potentially reduce carbon emissions from the energy sector by 90%. In recent years, many studies have been conducted on the causal relationships between green energy consumption and economic growth in the US,³ emphasizing how institutional and political policies have impacted on the diffusion of US renewable energy and the decrease in fossil fuels.⁴ In this context, the US commercial real estate industry has

made significant strides in energy efficiency⁵ and sustainability⁶ using green energy sources. Many policies and initiatives have been put in place to encourage and facilitate the adoption of more environmentally friendly practices in this sector.⁷ In this context, the Energy Performance of Buildings Directive requires all new real estate construction beginning after 2021 to adhere to the “virtually zero-energy buildings” standard in order to combat the property industry’s GHG emissions’ slow decline.⁸ Incentives, technological advancements, and cost reductions all contribute to reducing barriers that hinder renewable energy development,⁹ paving the way to continue expanding the use of green energy in the future.¹⁰ Energy efficiency and sustainability are becoming increasingly valued in the commercial sector not only for the environmental benefit aspects but also for investing in energy-efficient technologies, and infrastructure is becoming a sliding door for constructors and property managers to increase the market value of their properties.¹¹

Based on these premises, this project aims to analyze in depth how the energy transition path is developing in the commercial real estate sector. This study compares this green energy diffusion scenario with the one of another exemplary and significant US sector, the industrial one, focusing on examining the relationships between renewable and carbon fossil energy diffusion. Energy policies for the commercial and industrial sectors in the US are similar in many ways, as both sectors are subject to the same national- and state-level policies regarding energy efficiency and sustainability.¹² However, the specifics of these policies and regulations may differ based on several factors, such as the scale, energy intensity, and operational differences between the two sectors.¹³

In the literature, diffusion models have been extremely valuable for defining and forecasting the development of an energy source, considering it as a technology that must be accepted in a market.¹⁴ This well-established area of study¹⁵ allows for analysis of the temporal dynamics of energy sources in order to comprehend the intricate dynamics of energy systems. Understanding how products or technologies compete or collaborate is essential for describing the trend of diffusion processes. Depending on the situation, the presence of competition can act both as a barrier to the growth of the innovation under consideration and as a stimulus for its development.¹⁶ From this perspective, this project studies and compares commercial and industrial sectors’ energy transitions in order to comprehend the intricate dynamics of energy systems through a refinement of the UCTT multivariate diffusion model presented in *Forecasting*.¹⁷ This paper examines the temporal diffusion of coal, gas, and biomass in the two sectors to identify peculiarities, similarities, and differences that characterize each energy system since the development and diffusion among different sectors can play a role in establishing technological innovation systems.¹⁸

View the full presentation: <https://www.mdpi.com/2673-4591/39/1/15#B6-engproc-39-00015>

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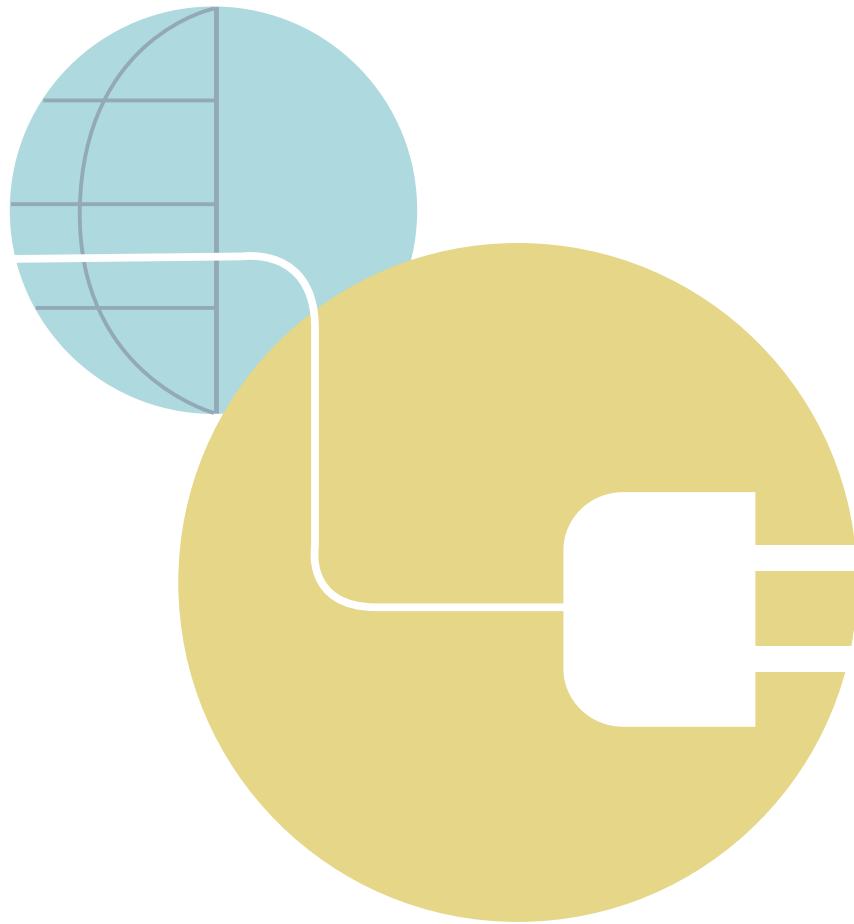
Andrea Savio is a 2022-2023 Steers Research Fellow at Georgetown University.

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POWERING THE FUTURE



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Geopolitical instability, rare earth supply constraints, and decarbonization mandates are redefining the long-term value of real estate, prompting greater alignment between energy, policy, and investment strategy across global markets.

The world's energy landscape is rapidly changing, and real estate investors can no longer afford to treat energy security, trade risk, and climate threat as separate concerns. These converging forces demand a reassessment of how and where capital is deployed.

The global real estate market is undergoing a fundamental transformation to asset performance and investment strategy, driven by three major forces: trade instability, energy price volatility, and climate-driven energy risk.

US trade instability and supply chain disruption are adding volatility. Meanwhile, energy security and pricing are prompting investors to reassess their established assumptions. Across the US and beyond, grid instability—driven by aging infrastructure and slow permitting—is slowing modernization.¹ As a result, energy-resilient and self-sufficient properties are becoming increasingly attractive. The rollback of US clean energy incentives, including provisions of the Inflation Reduction Act, has added further uncertainty to renewable infrastructure investment—directly impacting asset performance. Rising geopolitical tension across North America, Asia, and the Middle East has only compounded the pressure.

Climate-driven energy risks are intensifying the urgency for adaptation. Extreme weather events—heat waves, wildfires, hurricanes—are straining energy grids and physical infrastructure alike.² High-risk properties face blackouts, rising insurance premiums, and physical damage, while tightening carbon regulations in the EU, Canada, and California are making fossil-fuel-reliant buildings obsolete. Capital is now pivoting toward net-zero and climate-resilient developments that offer stable, lower-risk returns.

WHY THIS MATTERS FOR REAL ESTATE INVESTORS

The connection between trade, energy, and real estate has never been more consequential. Yet many institutional investors remain underprepared for the complexity and scale of long-term risks emerging from this convergence. Geopolitical instability and climate disruptions are reshaping costs, underwriting, and capital flows.

Nowhere is this more evident than in the unraveling of the US–Canada energy partnership. Once a symbol of cross-border stability, it is now a source of policy friction and volatility, with flows of energy and building materials disrupted. Canada is emerging as a pivotal player in the rare earth minerals sector, but China's dominance in processing poses risks for developers reliant on solar, batteries, and smart building systems.³ Additionally, the Middle East's pricing power through OPEC+ continues to pressure energy-dependent markets amid rapid decarbonization, affecting real estate operating costs across regions.

Portfolio strategies must now account for more than location and asset type. They must integrate supply chain resilience, geopolitics, and long-term energy access.

This article examines how these forces are shaping commercial real estate. Drawing on global case studies, it explores the impact of energy security and climate risk on valuation and underwriting and outlines how real estate and energy sector leaders can collaborate to build more resilient, investable markets.

Real estate is at an inflection point. Those prepared to adapt will lead. Those who delay will fall behind.

A RELATIONSHIP UNDER STRAIN: US-CANADA TRADE IN TRANSITION

For decades, the US–Canada trade partnership has underpinned North American economic stability—especially in energy and critical materials. Canada supplies about 60% of US crude oil imports, 99% of its natural gas imports, and around 90% of its electricity imports, much of it vital to the Northeast and Midwest.⁴ Canada is also a key source of critical minerals—including nickel, cobalt, graphite, and magnesium—essential to battery storage, electric vehicles, and energy-efficient building technologies.⁵

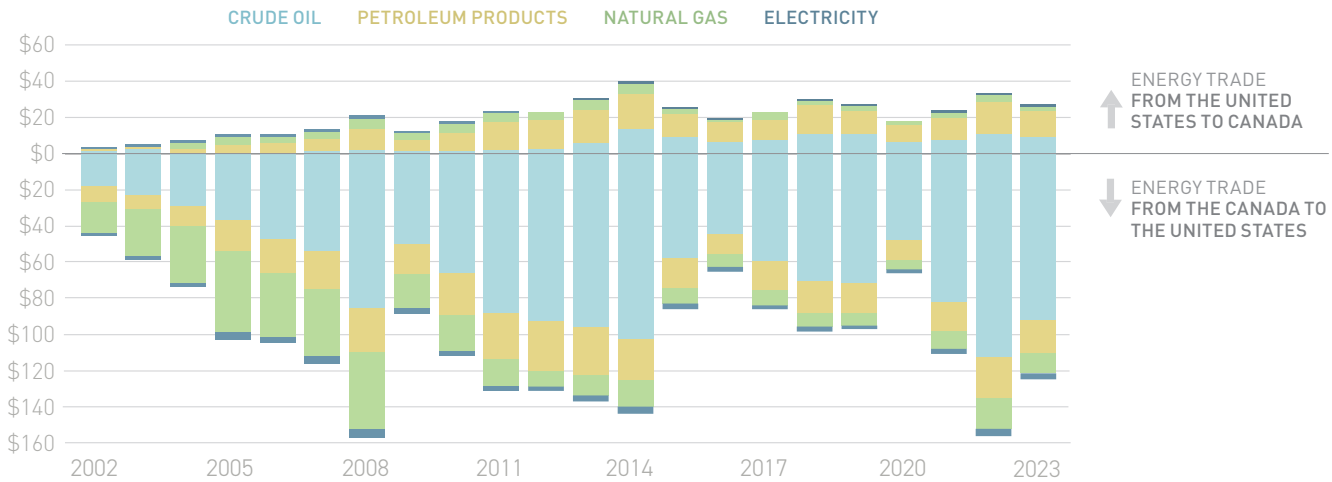
But this stability is now under strain. Since President Trump’s re-election in 2024, escalating trade disputes have disrupted long-standing bilateral norms. New tariffs, tighter regulations, and the politicization of cross-border infrastructure are undermining a cornerstone of global trade. For real estate, these disruptions are reshaping development, operations, and long-term performance.

THE 2025 US-CANADA TRADE WAR: STRUCTURAL SHIFTS IN ENERGY AND REAL ESTATE

Since early 2025, a series of tariffs and countermeasures—including new US universal import duties and vehicle tariffs— have upended the US–Canada energy and materials trade (*Exhibit 1*).⁶ In February, the US imposed sweeping tariffs on Canadian imports. While oil

and natural gas were exempt, key construction and energy-transition materials—including steel, aluminum, lumber, and rare earth minerals—were not. These measures have sharply raised project costs and delayed clean energy infrastructure.

EXHIBIT 1: ANNUAL VALUE OF ENERGY TRADE BETWEEN THE US AND CANADA 2023



Source: US Energy Information Administration.

Canada retaliated with tariffs on US materials and a 25% surcharge on electricity exports to states like New York and Vermont, adding stress to already fragile regional grids (*Exhibit 2*).⁷ As of April 9, Canada also imposed a 25% tariff on US-made vehicles and initiated a formal World Trade Organization dispute over US duties.⁸ For real estate operators, this has meant cost instability and energy uncertainty.

In response, the US has reopened federal lands for oil and gas exploration, reauthorized pipeline projects such as Keystone XL, and accelerated investments in nuclear and gas capacity. These efforts aim to boost domestic independence, particularly in energy-producing states—but also introduce risk for markets still reliant on Canadian inputs.

On the mineral front, the US invoked the Defense Production Act to accelerate domestic mining. Projects in Nevada, Arizona, and Montana are now federally supported, while the Pentagon is backing a “mine-to-magnet” initiative to rebuild a domestic supply chain. Scaling these operations is a gradual process, and the interim risks must be carefully managed. Material supply issues continue, causing delays and pricing fluctuations on batteries, EV infrastructure, and sustainable materials.

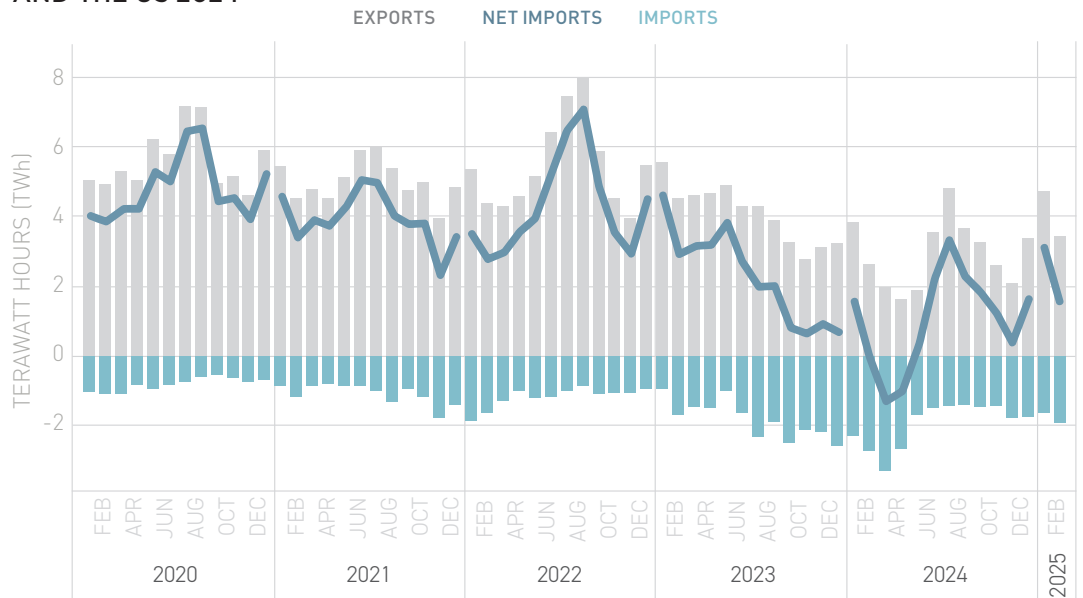
Canada is pursuing diversification as well. With US demand becoming less reliable, Canadian officials are fast-tracking energy partnerships with Asia and Europe. LNG Canada is expected to begin exports to Asia by year-end, and the Trans

Mountain pipeline expansion will serve Pacific markets. Québec and Ontario are exploring electricity exports to European utilities.

Central to this shift is the rare earth mineral supply chain. These inputs are essential to clean energy, yet fractured US–Canada coordination threatens North America’s ability to compete. Clean infrastructure project costs have risen 12–17% due to disrupted access to materials.⁹ Meanwhile, growing exposure to China—responsible for over 70% of processing—compounds supply risk.

For real estate investors, the implications are immediate: higher development costs, slower progress on net-zero goals, and more volatile energy pricing. Slower cross-border investment is raising risk of regional dislocation.

EXHIBIT 2: ELECTRICITY EXPORTS AND IMPORTS BETWEEN CANADA AND THE US 2024



Source: Canada Energy Regulator.

Above all, real estate and energy leaders must advocate for renewed US–Canada cooperation on infrastructure and permitting. Without it, unpredictability will persist—even as domestic capacity expands.

The way forward demands adaptation. Markets responded sharply, with major indices dipping in April on fears of prolonged supply chain instability and rising costs.¹⁰ Developers and investors must diversify sourcing, monitor emerging mineral processing hubs, and build flexibility into timelines and procurement. These strategies require active collaboration between energy providers, material producers, and real estate developers—shared solutions to shared vulnerabilities. Above all, real estate and energy leaders must advocate for renewed US–Canada cooperation on infrastructure and permitting. Without it, unpredictability will persist—even as domestic capacity expands.

THE BIGGER PICTURE: GLOBAL TRADE DISRUPTIONS AND THE ENERGY-REAL ESTATE NEXUS

While US–Canada tensions dominate headlines, they reflect a broader shift: the fragmentation of global energy trade and the rising impact of geopolitical risk on real estate.

China remains the world’s dominant supplier and processor of rare earth minerals. It also leads in solar panels, batteries, and EV components—technologies core to energy-efficient real estate. In early 2025, China’s restrictions on the export of gallium, germanium, and antimony triggered immediate cost increases and supply delays across sectors, including sustainable real estate. These export controls underscore a deeper structural risk: reliance on a single supplier for inputs critical to the energy transition.

In response, North America is accelerating efforts to build domestic capacity—but permitting and regulatory timelines remain long. Australia, Latin America, and Southeast Asia may offer alternatives, but the road to redundancy is complex.

Meanwhile, the Middle East remains a dual-force actor—both as a source of price-setting fossil fuels and as an emerging hub for green infrastructure investment. In April 2025, OPEC+ shocked markets by announcing a production hike that sent Brent crude prices tumbling.¹¹ The move reminded investors that oil pricing is still highly political—and real estate portfolios must hedge accordingly.

At the same time, sovereign-backed mega-projects like Saudi Arabia’s NEOM and the UAE’s Masdar City are pioneering new urban design models rooted in clean energy. These cities exemplify genuine progress in scalable net-zero infrastructure, rather than merely serving as public relations showcases. Qatar is also expanding its portfolio of LEED-certified and mixed-use sustainable developments.

Crucially, Gulf sovereign wealth funds are deploying increasing capital into global energy-efficient real estate.¹² Their investments point to a shift in priorities, offering a model for energy-real estate collaboration around resilient development.



Investors who anticipate geopolitical risk, align capital with the shifting trade and energy landscape, and deploy into resilient assets will be best positioned to lead.

NAVIGATING THE NEW ENERGY-TRADE ORDER: STRATEGIES FOR RESILIENT REAL ESTATE

In today's global environment, institutional real estate investors face a new strategic reality. Energy instability, fractured trade relationships, and climate-driven shocks are no longer temporary—they are structural. The once-clear lines between energy markets, infrastructure, and asset performance have disappeared. Success now depends as much on geopolitics and supply chain strategy as on local market fundamentals.

Mitigating supply chain vulnerability—particularly in clean energy technologies—has become a top priority. China still dominates mineral extraction, battery components, and solar manufacturing, creating material delivery risk for real estate reliant on energy-efficiency technologies. Leading investors are shifting upstream exposure to North America and Australia, while building trade partnerships across Southeast Asia and Latin America to diversify away from concentrated sourcing.

At the asset level, energy-resilient properties are emerging as foundational to future portfolio strategies. Buildings equipped with microgrids, on-site renewables, and battery storage stabilize costs and ensure continuity amid price swings and grid stress. As carbon regulations tighten, investors increasingly favor developments with low emissions, local energy generation, and embedded flexibility.

Globally, capital flows are tracking this shift. The Middle East, long a symbol of fossil fuel dominance, is now positioning itself as a global hub for energy-smart urbanism, demonstrating scalable net-zero design backed by sovereign capital and long-term vision. This signals a lasting shift toward low-carbon development and resilience.

Across markets, the most resilient real estate strategies are grounded in geopolitical awareness, materials flexibility, and infrastructure adaptability. Permitting, regulatory friction, and price volatility are now baseline conditions. High-performing firms are updating underwriting models to reflect this reality, extending timelines, and stress-testing procurement assumptions. The opportunity is to reduce shared risks and pursue common goals. Real estate and energy sectors must now co-design the systems, materials, and regulatory pathways that shape urban sustainability.

The future is not about restoring stability—it's about building for controlled volatility. Investors who anticipate geopolitical risk, align capital with the shifting trade and energy landscape, and deploy into resilient assets will be best positioned to lead. Energy-smart real estate is now the global standard. Those who move first will hedge risk—and own the next era of value creation.

ABOUT THE AUTHOR

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NOTES

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DISCLAIMER: The information contained in this article is based on events and data available as of April 2025. Given the rapidly evolving nature of U.S. trade policy and global energy markets, developments may have changed by the time of publication. Readers are encouraged to consult the latest sources for the most current information.

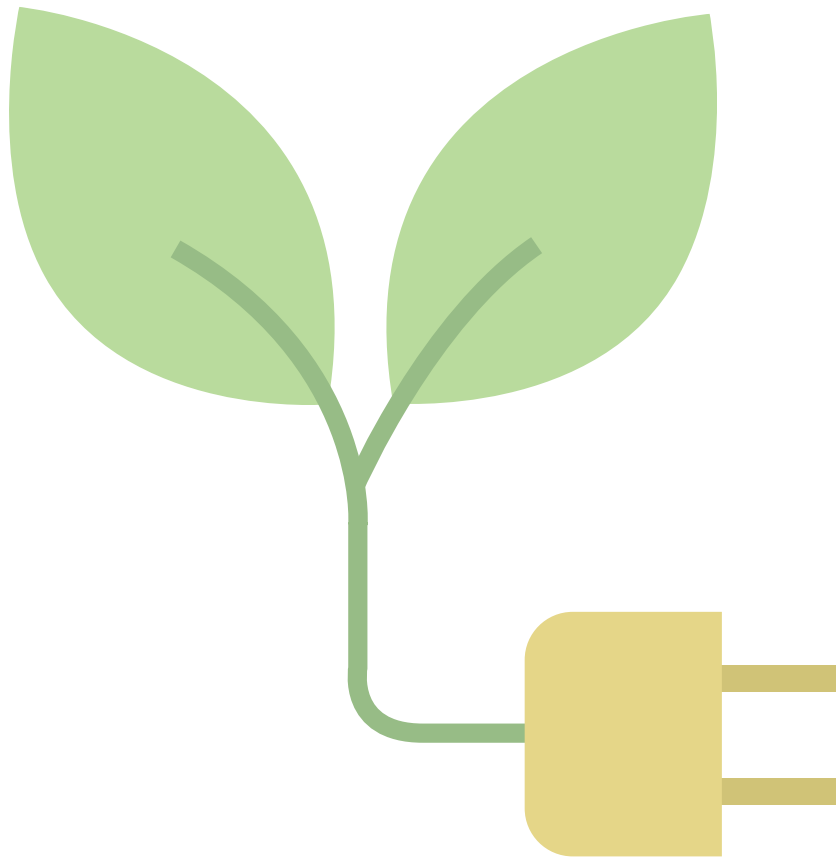
The world's energy landscape is rapidly changing, and real estate investors can no longer afford to treat energy security, trade risk, and climate threat as separate concerns. These converging forces demand a reassessment of how and where capital is deployed.

The global real estate market is undergoing a fundamental transformation to asset performance and investment strategy, driven by three major forces: trade instability, energy price volatility, and climate-driven energy risk.

US trade instability and supply chain disruption are adding volatility. Meanwhile, energy security and pricing are prompting investors to reassess their established assumptions. Across the US and beyond, grid instability—driven by aging infrastructure and slow permitting—is slowing modernization¹. As a result, energy-resilient and self-sufficient properties are becoming increasingly attractive. The rollback of US clean energy incentives, including provisions of the Inflation Reduction Act, has added further uncertainty to renewable infrastructure investment—directly impacting asset performance. Rising geopolitical tension across North America, Asia, and the Middle East has only compounded the pressure.

Climate-driven energy risks are intensifying the urgency for adaptation. Extreme weather events—heat waves, wildfires, hurricanes—are straining energy grids and physical infrastructure alike². High-risk properties face blackouts, rising insurance premiums, and physical damage, while tightening carbon regulations in the EU, Canada, and California are making fossil-fuel-reliant buildings obsolete. Capital is now pivoting toward net-zero and climate-resilient developments that offer stable, lower-risk returns.

ROOT CAUSE



Asaf Rosenheim
Director
Profimex

The current climate crisis is the result of centuries of industrialization—and the economic and social factors that have driven this evolution. The fix will require investors to reconsider the problem from the ground up.

With greenhouse gas emissions at the highest levels in documented history, the UN projects that unless serious action is taken, the world could see a temperature increase of 3.1 degrees Celsius by 2100, resulting in catastrophic changes in the global climate (and how humans live, work, and invest in the same).¹

To understand the full picture of how we arrived at this point, we need a broad perspective that accounts for environmental, economic and social points of view. It is a combination of these factors, over decades, if not centuries, that has resulted in the climate and energy crisis we're facing now.

How we understand these factors, and the evolution of the challenge, will frame how private and institutional investors have the power to slow down—and find solutions to—something that will impact the human economy (and ecosystem) for generations well beyond the life-cycle of our standard investments.

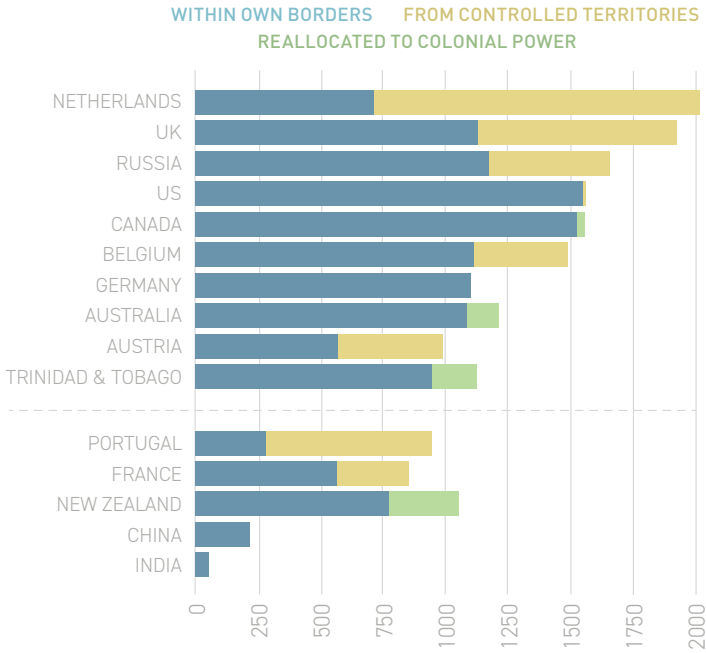
HISTORICAL CONTEXT AND ROOT CAUSES

While natural factors play a role, developed nations have driven climate change since the 1800s through fossil fuel use, deforestation, vehicle emissions, and air travel—releasing greenhouse gases that have warmed the planet and fueled the current crisis.

If we look back further in time, colonialism has had a direct impact on the environment through exploitation of resource-rich nations in the less developed world. Countries such as India, Kenya, and islands in the West Indies, originally colonized by the British Empire, are prime examples of how such regions have been robbed of their natural resources, including the exploitation of their labor forces. Many of these regions continue their economic struggle even now, even as Britain went on to accelerate its own growth and, for a time, to be one of the most powerful countries in the world.

Similar examples abound, with the related effects of colonialism also well-documented in regions such as South Africa and the United States. In these countries, the detrimental symptoms of economic and racial segregation persist (realized through environmental impacts), with a simple metric of cumulative carbon emissions from once-active colonizing polities (e.g., UK, Russia, Netherlands, etc.) displaying a stark difference with less colonially-oriented powers.

EXHIBIT 1: CUMULATIVE CO₂ EMISSIONS FROM COLONIAL POLITIES POWERS, 1850-2023



Source: Carbon Brief analysis of figures from Jones et al (2023); Lamboll et al (2023); the Global Carbon Project; CDIAC; Our World in Data; the International Energy Agency and Carbon Monitor.²

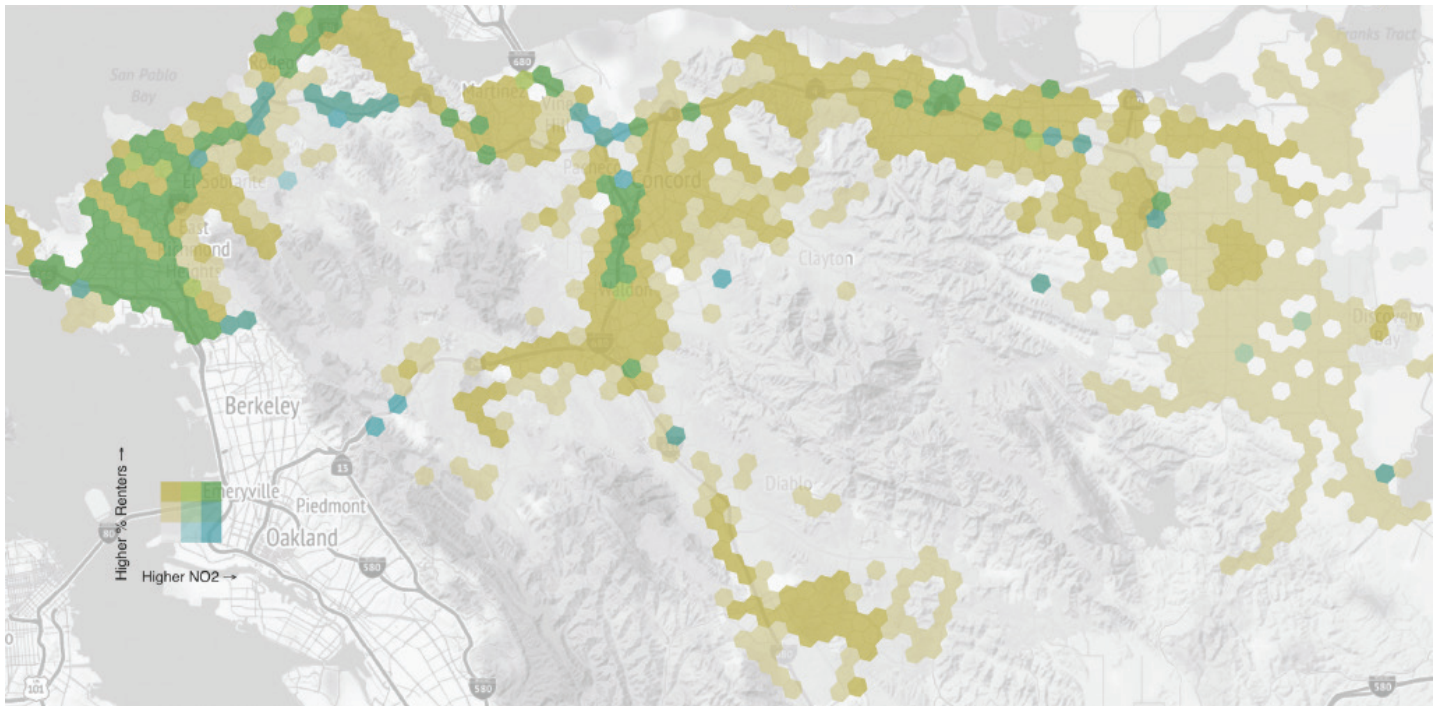
THE DISPROPORTIONATE IMPACT

As a result of historical power and investment imbalances between developed and “underdeveloped” nations, many critical geographies within these affected regions face notable negative impacts, including higher pollution and limited access to clean air and water. Decades of underinvestment and economic imbalance have left their population and talent with limited economic resources and educational opportunities, which are key to economic growth and increased knowledge share, ultimately hindering efforts to combat larger-scale global challenges, including the climate crisis.

These imbalances aren’t limited to underdeveloped countries, but also play out in “developed” nations, such as the UK, Canada, and the United States. Despite being among the wealthiest countries in the world, many areas across these countries still lag economically and in living standards (with these issues often exacerbated by race-based policies).

For example, *Exhibit 2* shows a map of Contra Costa County in California, which is adjacent to the more established San Francisco County. The darker hexagonal regions in the exhibit represent areas with high percentages of rental housing as well as high levels of nitrogen dioxide (NO₂), a harmful air pollutant. Conversely, the lighter hexagonal regions show similarly high levels of NO₂, but fewer renters and more homeowners (i.e., more home ownership). Ultimately, the data show how people in rental housing in Contra Costa County have up to 10% greater exposure to NO₂ than homeowners.

EXHIBIT 2: RENTAL HOUSING VOLUME AND POLLUTION EXPOSURE IN CONTRA COSTA COUNTY



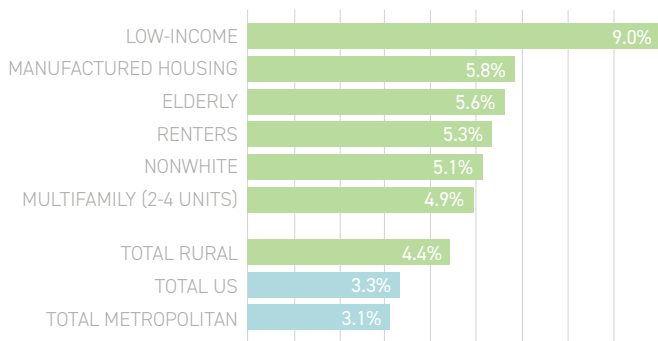
THE COMMUNITY CHALLENGE: BRIDGING THE GAP IN CLIMATE ACCESS AND INVESTMENT

Despite a growing global and scientifically based urgency for businesses and buildings to transition to clean energy, the benefits of this transformation are not reaching all communities equally. Low- to moderate-income (LMI) households (which often overlap with communities of color), despite their relatively diminutive contribution to climate change, are often also the communities most impacted by negative climate change effects—and the least likely to benefit from emerging solutions.

Continuing our look at the Bay Area, for instance, communities with a larger share of LMI households are exposed to 55% more NO₂ than the average resident, contributing to heightened risks of respiratory illness and premature death.³ Yet, these same communities are largely excluded from investments in clean energy transition. Only 5% of community solar projects have meaningful participation from LMI households, even though these households spend, on average, 8.6% of their income on energy—three times more than non-LMI households.⁴ The disparity is similarly pronounced in the electric vehicle (EV) market, where 87% of EV buyers are white, and the typical owner is a high-income, middle-aged man.⁵

Only 5% of community solar projects have meaningful participation from LMI households.

EXHIBIT 3: ENERGY BURDEN DISPARITIES



Note: Energy burden is calculated by dividing annual household energy spending by annual household income.

Source: ACEE, “The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency”

Systemic financial barriers limit access to clean energy for emerging, often minority-led, developers. Lacking large balance sheets or long track records of more established institutional investors, “small” developers are seen as risky by traditional lenders. Credit systems still rely on FICO scores, ignoring factors like projected savings or environmental impact. Even available financing is often geographically limited or restricted to individual projects, making scaling difficult.

The result is a climate finance ecosystem that reinforces existing inequities instead of addressing them.

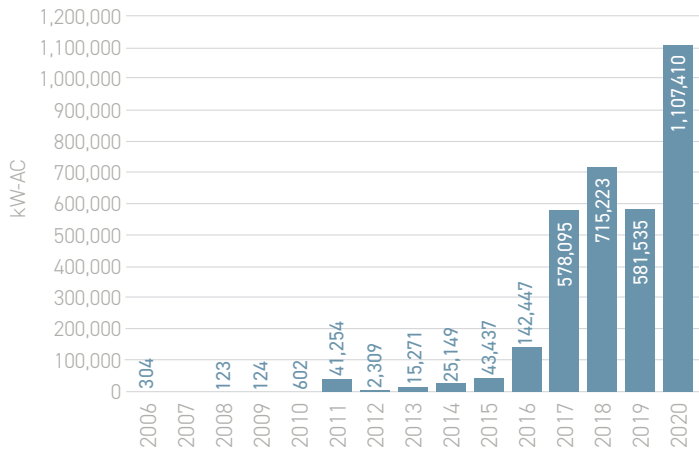
INVESTOR PERSPECTIVE AND SOLUTIONS

Investors today must prioritize climate change and adopt environmentally and community-conscious approaches to real estate. Sustainability is no longer optional, as rising insurance costs and evolving legislative, investor, and tenant standards increasingly impact asset value.

Green bonds—loans dedicated to environmentally beneficial infrastructure and real estate—have long connected investors with climate-conscious initiatives. These instruments offer capital growth, long-term returns, and socio-economic benefits, such as advancing equity and lowering operational costs, while simultaneously contributing to the larger global transition to clean energy.

Community solar, for example, is gaining investment momentum within community-based energy programs. These types of programs ultimately help low-income communities shift from fossil fuels, reduce energy costs, and generate local jobs and income through solar panel ownership.

As shown in *Exhibit 4*, community solar is growing rapidly, with more than 5,200 MW of solar energy installed across more than forty states within the past several years—enough to power 344,470 homes. This fast-expanding sector offers institutional investors strong, stable returns while meeting ESG goals and reaching underserved markets.

EXHIBIT 4: COMMUNITY SOLAR GROWTH OVER TIME

Source: NREL's Sharing the Sun Community Solar Project Data⁷

Community solar is growing rapidly, with more than 5,200 MW of solar energy installed across more than forty states within the past several years—enough to power 344,470 homes.

THE SOLUTION: UNLOCKING CLIMATE FINANCE FOR COMMUNITY BENEFIT

To close gaps between developed and underdeveloped communities—as well as gaps in energy burdens and clean energy transitions—new forms of climate capital are needed to de-risk community-based solutions and support developers at various stages of the project lifecycle. One prominent example is the Afterglow Climate Justice Fund (CJF), which illustrates a model for how this can be done effectively.

CJF identifies three core areas where catalytic finance can meet urgent market needs: (1) pre-development, (2) construction, and (3) permanent project financing.

In the **pre-development phase**—the riskiest and most capital-starved stage—flexible loans can fund early milestones such as site control, permitting, and utility interconnection studies.

Once a project is ready to break ground, revolving **construction** loans enable developers to draw capital incrementally and recycle it as each project is completed and refinanced.

Lastly, **permanent project** debt, repaid through long-term energy savings and tax credits, allows projects to scale while generating reliable returns.

For institutional investors, these mechanisms provide a pathway to align investment portfolios with climate justice outcomes—ensuring that clean energy reaches those who need it most.

Real estate investors are therefore uniquely positioned to drive change. By integrating these forms of capital into their ESG strategies and forming public-private or developer joint ventures, investors can help scale climate infrastructure in overlooked markets—contributing to community resilience and long-term asset stability in the process.

Full-stack financing supports solar projects from early development through operation, providing crucial capital to local developers. When paired with flexible investment models, it helps overcome barriers to renewable energy in low- to moderate-income areas. Collaborating with local installers, businesses, and community groups ensures projects meet local needs, driving sustainable outcomes, job creation, and economic growth.

INSTITUTIONAL INVESTMENT IN COMMUNITY ENERGY IN THE US

Sunwealth: Financing Impactful Distributed Solar

In December 2024, Sunwealth, a clean energy impact investment firm, secured a \$30 million construction loan from Goldman Sachs' Urban Investment Group (UIG). This funding aims to develop solar and solar-plus-storage projects across the US, focusing on historically underserved communities. With more than 58% of Sunwealth's portfolio already benefiting disadvantaged areas, this partnership is set to expand access to clean energy, reduce energy costs, and create green jobs. The Kresge Foundation supported the initiative with a \$3 million non-funded guarantee, underscoring the collaborative effort to promote equitable clean energy solutions.⁸

Solar Holler: Scaling Solar in Appalachia

Solar Holler is transforming energy access in coal-dependent West Virginia, historically underserved in the renewable transition. With a \$5 million construction-to-term loan from the Afterglow Climate Justice Fund, the developer is building 10,000 solar panels for Wayne County Schools—representing the largest solar power purchase agreement (PPA) in the state. The initiative is reducing school district energy bills by 20%, training union electricians for green jobs, and sourcing panels domestically, thereby reinforcing regional economic development.⁹

Investing in climate justice isn't just the right thing to do—it's increasingly a source of resilient, risk-adjusted returns.

INEQUALITY BUILT THIS CRISIS—EQUITY MUST SOLVE IT

It's well-known and well-documented that the current climate crisis has been caused by a complex mix of economic and environmental practices, and problematic social ideologies. When it comes to the climate crisis, what we are witnessing (and trying to solve for) today is a culmination of centuries of harmful, overlapping, and deeply interconnected forces.

Now, the challenge we face is attempting to slow down the effects of climate change, while ensuring that nations who have been “left behind” not only receive the support they rightfully deserve, but also look to move towards cleaner energy. This represents a massive institutional opportunity for leadership, but because the climate crisis has been caused by a myriad of factors, it is vital that investors cultivate an intersectional understanding of the challenge. It is not merely financial, but social and environmental, as well.

Investing in climate justice isn't just the right thing to do—it's increasingly a source of resilient, risk-adjusted returns. Institutional real estate investors are uniquely positioned to catalyze local solutions through blended finance models, joint ventures, and catalytic capital.

ABOUT THE AUTHOR

Asaf Rosenheim is a Director for Profimex with a background in impact investing.

NOTES

¹ UN Emissions Gap Report 2024

² Revealed: How colonial rule radically shifts historical responsibility for climate change

³ Aclima, Air disparities in the Bay Area, 2022

⁴ Examining community solar programs to understand accessibility and investment: Evidence from the US

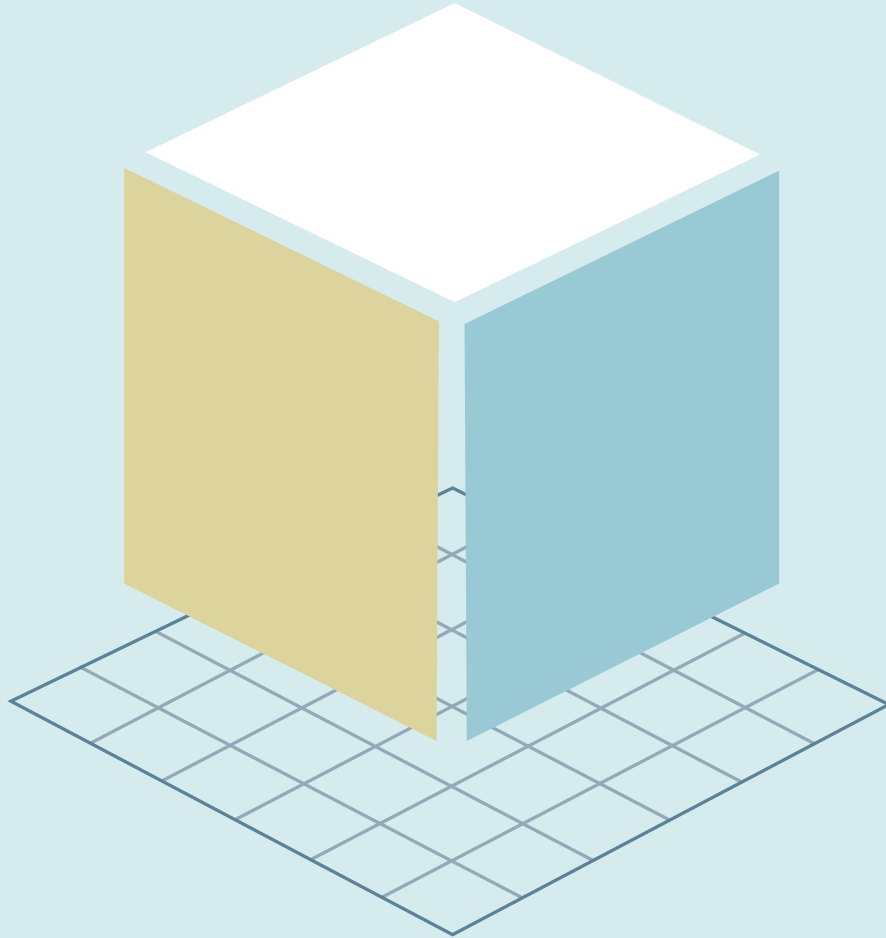
⁵ Consumer Report, Across Racial Demographics, Interest in Purchasing Electric Vehicles is Considerable, but Systemic Barriers Persist. September 2022

⁷ Source: NREL's Sharing the Sun Community Solar Project Data, December 2020

⁸ <https://www.sunwealth.com/blog/goldman-sachs-uig-loan>

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GRID-INTERACTIVE MULTIFAMILY



Thomas Stanchak
Managing Director of Sustainability
Stoneweg

Multifamily buildings are evolving from captive energy consumers to grid-connected assets. This transformation unlocks financial returns, mitigates risk, and delivers on rising regulatory and capital market expectations.

Anyone invested in US real estate is, with rare exceptions, connected to—and benefiting from—the largest machine on the face of the earth: the US electrical grid.¹

The benefits are real, too: reliable energy that powers every device, light, appliance, elevator, and HVAC unit (often simultaneously) across the built environment.

Despite these benefits, how real estate investors think about energy needs to change. The grid isn't just a utility, it's an asset. The systems that connect buildings to the grid aren't just infrastructure; they're opportunities. In an era of tightening margins and rising expectations for performance, energy systems are emerging as a powerful driver of improved cash flow, operational efficiency, and resilience.

However, for those outside infrastructure, development, or construction, the relationship between buildings and the grid often goes unnoticed.

From an asset management perspective, utility accounts may change hands when a property does, but the embedded infrastructure and energy relationship itself is inherited, rarely questioned, and almost never treated as a performance lever. Unlike rents—other income, operating expenses, or capital improvements—utilities are often just passed through without consideration, under the assumption that someone else will pay. This dynamic, known as the split incentive, discourages owners from considering a building energy performance. Compounding the issue is the assumption that these systems are fixed and unchangeable, reinforcing outdated notions that buildings are simply energy

consumers and an endpoint in the grid machine.

Disturbances in the steady stream of cash flow away from buildings as just energy consumers are appearing everywhere, and they are signaling a new dynamic relationship between buildings and energy. These signals are the result of the ever-growing demand for energy, technological advancements, changing policies, and some innovative investors who've made some novel success because of their focus solutions in delivering on climate-aligned returns.

When it comes to energy, the best of today's established real estate investment efforts focuses heavily on improving building efficiency and reducing emissions. They're motivated by demands from capital markets and threats from regulators. While tinkering with improved efficiency and decarbonization are rational acts, the financial benefits are rarely clear in the underwriting. When presented, energy-related performance is often abstracted by benchmark terminology or buried within sustainability reports. What's missing is a direct and transparent connection between energy performance and financial results.

As these pressures and technology continue to evolve, US multifamily real estate is presented with unique opportunity to redefine its relationship with energy and transform buildings from captive consumers into active, value-generating participants in the grid.

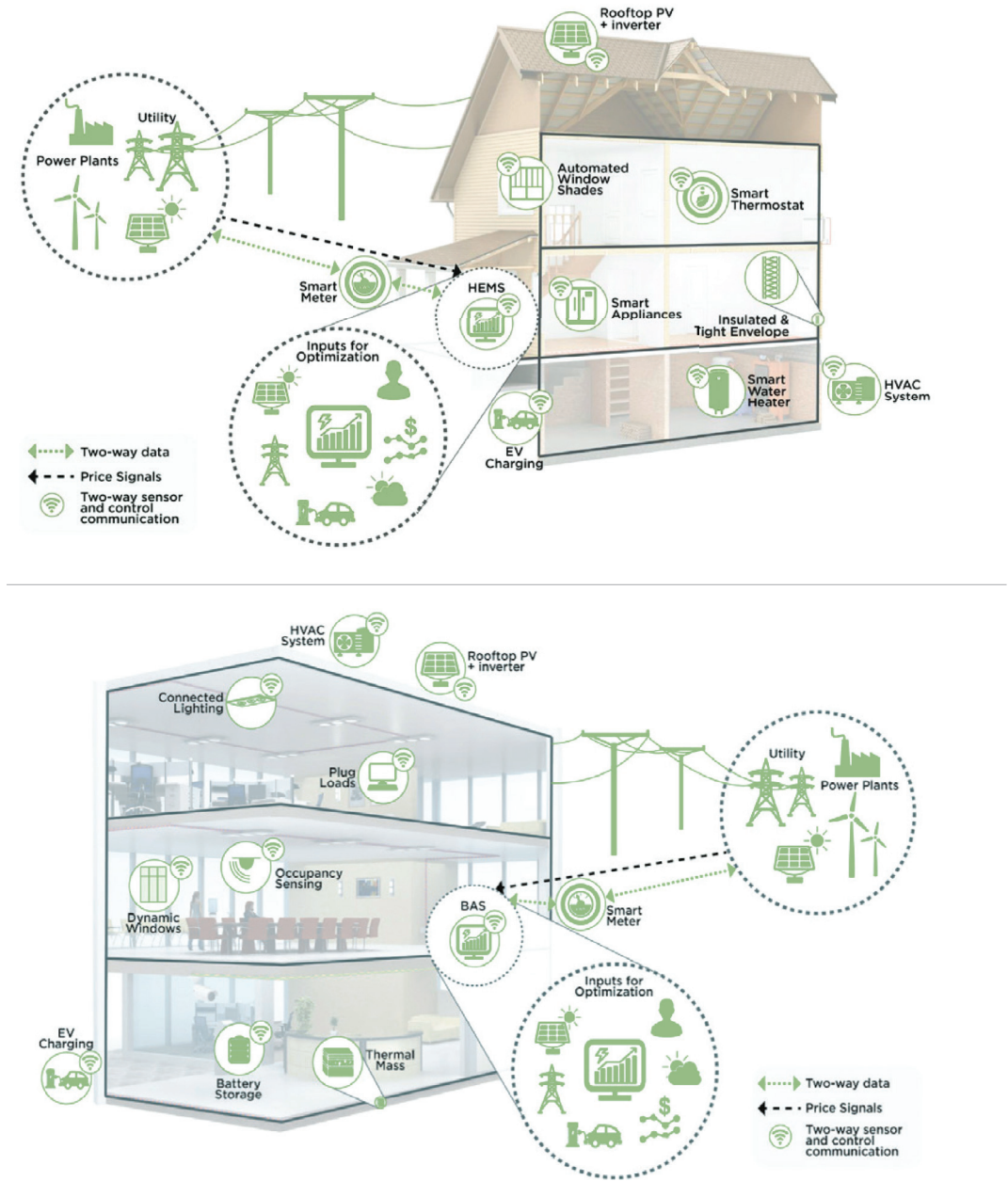
THE CASE FOR GRID-INTERACTIVE MULTIFAMILY

Multifamily buildings are perfectly positioned to participate in the next evolution of energy: becoming grid-interactive efficient buildings (GEBs). These properties house millions of American individuals and families who share roofs, walls, systems, and (critically) energy load profiles. With smart technologies like networked thermostats, heat pumps, on-site renewable power and energy storage, building owners can partner with the grid to aggregate demand and enroll in responsive utility or wholesale market programs like virtual power plants (VPPs).

Unlike a single-family home, a 300-unit apartment complex with networked systems can shift energy use in meaningful ways. When aggregated and enrolled in a demand response program, this technology becomes a valuable grid resource. It's not hypothetical: the US Department of Energy (DOE) projects that emerging GEBs could reduce system-wide power costs by \$18 billion annually by 2030 and cut 80 million tons of CO₂ per year.²

The shift isn't just about trying one's best to appease in response to pressure on emissions; it's about unlocking new dynamic value from systems that are incorrectly perceived as one-way and fixed.

EXHIBIT 1: GRID-INTERACTIVE EFFICIENT BUILDINGS

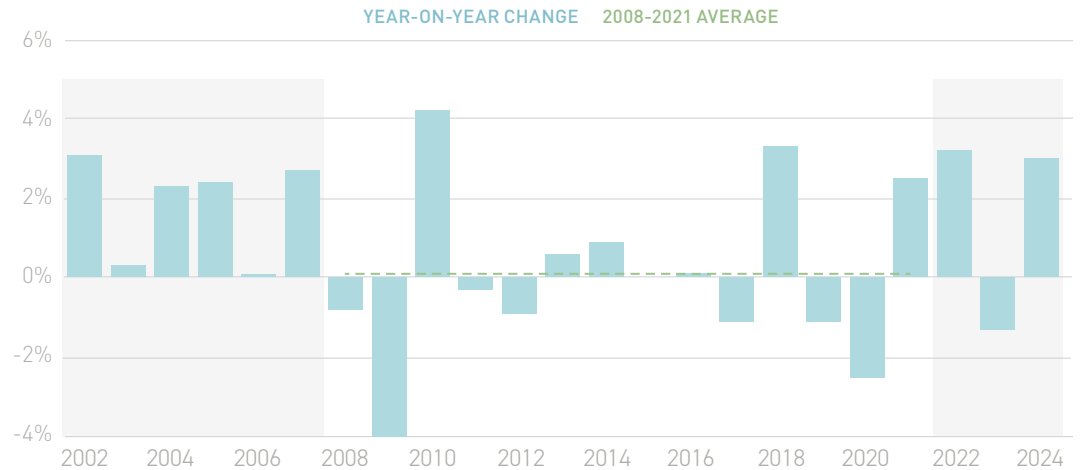


FINANCIAL OPPORTUNITY FOR INVESTORS

Underwriting has long ignored and treated energy operating expenses as an uncontrollable cost that either just unilaterally erodes away at income or is passed on to renters regardless of their individual behavior. Those that still underwrite utilities as pass-through costs or simply burdens to bear, ignore the opportunity for real value creation. GEBs and the potential of VPP participation offer a real incentive to multifamily investors to change this zero-sum-game.

Smart meters, thermostats, IoT enabled mechanicals and energy management systems enable buildings to respond to grid signals, reducing usage during peak hours. That flexibility becomes a revenue stream through demand response. Grid-responsive technology is designed to be nearly invisible, with small, temporary shifts during short-duration events. When thoughtfully implemented, it improves occupant comfort, lowers bills, and enhances resilience of the grid.

EXHIBIT 2: RISE OF ELECTRICITY DEMAND IN THE US



Source: Ember, "US Electricity 2025 Special Report"

Electricity demand in the US is rising fast, driven by electrification and data center growth, with buildings making up a major share. Meanwhile, solar and battery storage costs have plummeted where battery prices are now less than one-fifth of what they were a decade ago. These shifts position multifamily owners to cut costs, boost resilience, and actively participate in energy markets. In March 2023, Logical Buildings announced a \$110 million VPP project aimed at decarbonizing multifamily buildings in New York City and New Jersey.³ This initiative focuses on installing smart thermostats and integrating them with platforms like GridRewards™ and SmartKit AI™ to enhance energy efficiency and generate grid services revenue. As of March 2025, the project has achieved notable success in two key areas:⁴

Increased Enrollment: Logical Buildings reported a record number of enrollments in its GridRewards™ platform for 2024, indicating strong adoption among residents and building owners.

Regulatory Compliance: The platform has been instrumental in helping building owners comply with local regulations, such as New York City's Local Law 97, by effectively reducing carbon emissions.

Energy upgrades don't just improve operations, they de-risk the asset. Lower operating expenses, new revenue streams from GEB and VPP participation, and regulatory alignment contribute to cap rate compression and stronger exit multiples. In a tightening policy environment, assets with measurable performance gain preferential lender terms and can avoid insurance premium hikes tied to climate exposure and energy inefficiency.

Here's a high-level example to demonstrate some investment potential: In New York, multifamily properties participating in Con Edison's GridRewards™ program can earn \$75–\$150 per unit annually simply by reducing energy use during peak demand events.⁵ With smart meters already installed in most buildings and optional thermostat upgrades, participation often requires little to no upfront capital. It's a low-barrier, revenue-generating entry point into the grid services economy. With a 5.5% cap rate, boosting asset value by \$300,000–\$600,000 with minimal effort is within reach.

REGULATORY AND MARKET DRIVERS

Feel that? It's the financial pinch. Building investors in the US are increasingly exposed to energy and emissions regulations at the state and local level. While some hope to avoid these costs or pass them through, the reality is unavoidable: more than 50 US jurisdictions have enacted Building Performance Standards (BPS) requiring energy or carbon reductions in commercial and multifamily buildings.⁶ In New York City, Local Law 97 imposes significant fines on owners who fail to decarbonize.

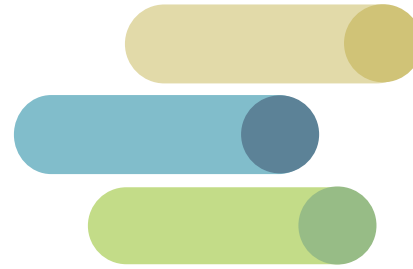
The real opportunity lies in anticipating these regulations and investing early with a flexible, forward-looking strategy. Think of clean energy technologies: solar, storage, smart controls, not as one-time capital projects, but as modular components in a broader system. These upgrades are modular and can be staged over time creating a pathway for compliance while also opening the door to new revenue opportunities.

RESIDENT DEMAND AND COMPETITIVE ADVANTAGE

Energy investments improve a building's financial performance and have the potential to generate non-financial qualitative returns, such as improved resident comfort, compliance with regulations, enhanced reputation, and the benefits of demonstrating environmental impact.

They drive leasing performance and minimize total vacancy loss. Resident surveys increasingly show demand for energy-efficient housing. Well-managed energy programs can turn tenants into active participants, rewarding them for behaviors they can control. That means comfort, control, and cash back. The definition of a positive feedback loop.

While grid-interactive technologies may sound highly technical, and they are, but they often simplify daily operations. Systems that rely on onsite combustion for example, like natural gas ranges or furnaces, involve mechanical parts, fire risk, carbon monoxide hazards, and regular servicing by licensed professionals. By contrast, solar arrays and battery systems operate quietly, automatically, and with minimal maintenance.



That simplicity can cause confusion.

At one property we acquired, everyone from the seller to the site staff assumed the rooftop solar array was broken. It had operated silently and reliably for a decade, but because it required no maintenance, its performance went unnoticed. In another deal we evaluated, a broker listed a solar array with accurate capacity but badly understated its output by nearly half of what it should have been given the location. That error translated into a \$500,000 undervaluation in their underwriting model. In both cases, the issue wasn't the technology; it was a lack of familiarity with how these systems work and generate value.

In both these cases, the issue isn't energy technology. It's clearly an improvement to these multifamily investments. The problem is the lack of experience and understanding in how it functions, and how it generates value. These systems don't require routine wrench-turning, oil changes, or gas top-offs. They do require teams to trust them, to monitor them, and to understand their role as an asset.

As technology simplifies and transforms the old energy infrastructure operations teams will have more time to focus on the things people truly care about. Therefore, devoting more focus to service, comfort, and care of what can't be automated, which is the sense of community inherent in multifamily assets.

Transparency and continuous practical communication on these subjects such as energy and environmental performance: signage, certifications, pre- and post-project surveys can result in measurable improvement in Overall Satisfaction, Net Promoter Scores and retention. This effort doesn't have to be expensive because it doesn't require a lot of technology either. For example, the manufacturer of our solar inverters offers a link to real-time solar production reporting. Instead of investing in displays and networks to support this, our marketing people produced a nice sign that includes a QR code that links to the "kiosk" URL. Residents and prospects that are curious to learn more about the solar can view the data on their own device.

The bottom line is that individuals and families who rent will choose to stay longer in buildings that work better and work for them. And with GEB tech, buildings don't just consume less, they adapt, respond, and generate value. That's a competitive advantage in terms of both maximizing revenues and rightsizing costs.

COLLABORATION IS THE CATALYST

Scaling requires partnership. GEBs and VPPs depend on coordination across tech providers, utilities, regulators, and building owners. Projects like Marcus Garvey Apartments in NYC show how early engagement with utilities and creative design can solve interconnection and permitting hurdles.⁷ National programs like DOE's Connected Communities and tools like SolarAPP+ are making deployment faster and smoother.

EXHIBIT 3: MARCUS GARVEY MICROGRID FINANCE AND REVENUE STREAMS

MICROGRID SYSTEM COMPONENTS	FUNDING & REVENUE SOURCE(S)
PROPERTY REHABILITATION	• NYS HCR tax-exempt bonds
ENERGY EFFICIENCY UPGRADES	• A grant from the NYSERDA Multifamily Performance Program • Low income tax credits
SOLAR PV	• Federal investment tax credit allocations supported by Wells Fargo • Incentives from the NY-SUN program
LITHIUM ION BATTERY	• Energy Services Agreement (ESA) loan from New York Energy Efficiency Corporation (NYCEEC) • Third party ownership under a shared savings agreement • Performance payments from Con Edison for the BQDM and DLRP programs, and NYISO SCR for demand response
FUEL CELL	• A grant from the NYSERDA Multifamily Performance Program • Low income tax credits

Source: Solarmarket Pathways

But we must go further. Shared challenges like permitting delays, outdated tariffs, and data silos require shared solutions. Collaboration is no longer optional. It's the only way to unlock the full power of grid-interactive multifamily.

For investors and asset managers, success depends on embracing change and aligning with diverse stakeholder perspectives. Success in this space will require learning new concepts and rethinking old assumptions.

The most important litmus test is, if the investment doesn't result in a better experience for everyone in the building, residents and staff alike, it's not a good investment. To be successfully adopted, these upgrades can't just replace the status quo; they must be obviously better.

Help is readily available. The DOE's Better Buildings program connects participants to expert peer groups and national lab engineers—at no cost. Programs like Connected Communities and energy equity initiatives are guiding this change in real time. The energy transition isn't just about carbon or compliance. It's about shared systems and shared outcomes. Real estate investors and energy innovators face many of the same headwinds: local permitting, stakeholder opposition, entrenched processes. Working together isn't just possible; it's the only way forward.

BUILDINGS AS ENERGY ASSETS

The real estate sector is under growing pressure to modernize, not just for compliance, but to retool the means of value creation. GEBs and VPPs move beyond outdated models of passive energy use, turning consumption into active, revenue-generating performance. This shift isn't just about emissions. It's about delivering smarter, simpler systems that enhance reliability, comfort, and resilience. Multifamily buildings can stabilize the grid and better serve everyone who lives and works in them. Value in real estate isn't static—it's time to rewire the definition.

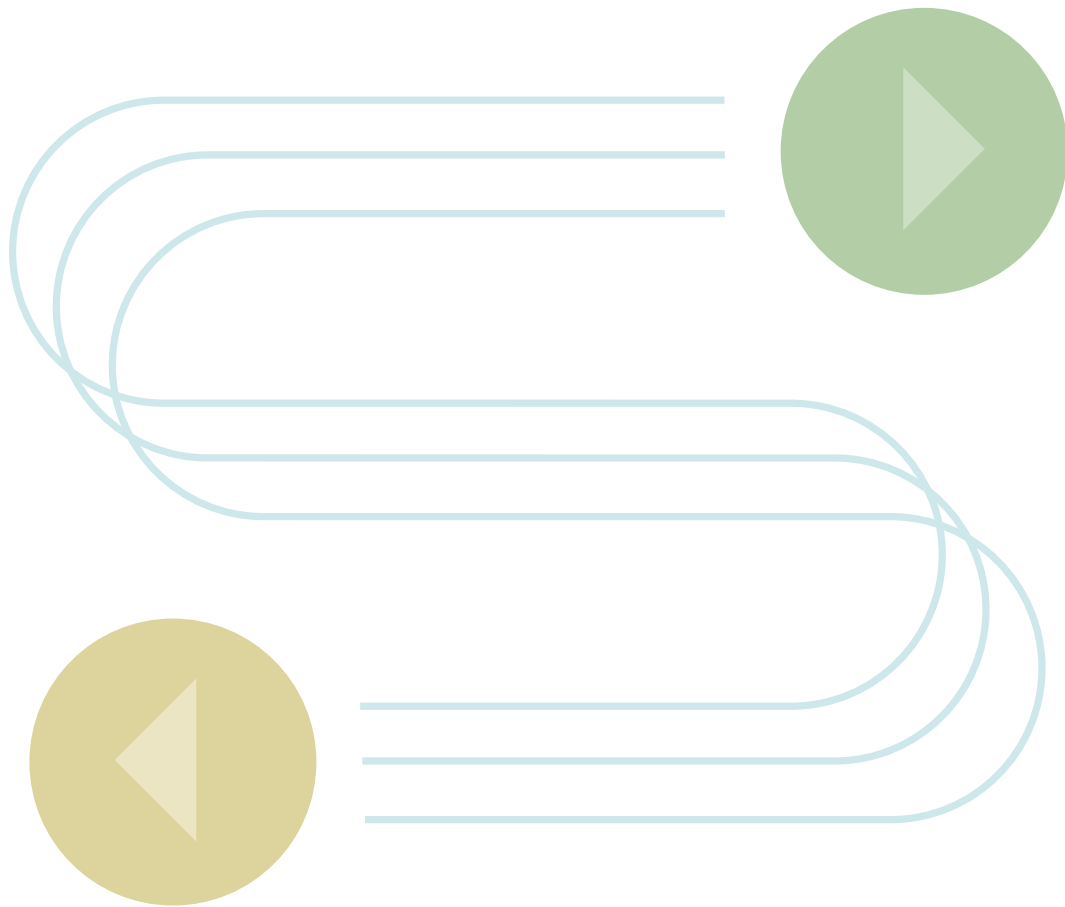
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Thomas Stanchak is the Managing Director of Sustainability at Stoneweg US, where he creates and leads innovative strategies to improve investment performance and value across a national portfolio of multifamily commercial real estate assets.

NOTES

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POWER AS A PLATFORM



Susan Uthayakumar
Chief Energy and Sustainability Officer
Prologis

As electricity demand accelerates across global markets, real estate is emerging as both a constraint and a solution. From microgrids to distributed generation, buildings are evolving into critical energy infrastructure—and capital strategy must evolve with them.

In today's evolving world, energy demand is soaring—driven by data centers, electric vehicle infrastructure, and the electrification of buildings and logistics operations. Yet across global markets, power availability is lagging. New grid connections can take years, and in some cases, utility infrastructure simply isn't ready to support high demand uses.

According to the International Energy Agency, global electricity demand is expected to double by 2050. This growth is not limited to North America. In parts of Europe and Asia, grid access delays are prompting national governments to review permitting timelines and capacity planning.

This disconnect is not rooted in a lack of foresight by utilities. Instead, it reflects the sheer complexity of modernizing century-old infrastructure in the face of skyrocketing demand and regulatory hurdles. The grid, in its current form, was not built for this level—or distribution—of demand.

The question is not whether we need more power. It's how we deliver it in time.

REAL ESTATE AS ENERGY INFRASTRUCTURE

Historically, buildings have been treated as passive consumers of power—drawing electricity from the grid to meet operational needs. That model no longer holds. As demand intensifies, real estate is increasingly expected to act as a platform for energy generation, storage, and smart load management.

Industrial and logistics real estate is a particularly clear example of this shift. These facilities must now support autonomous material handling systems, highly efficient heating and cooling systems and other uses required for a modern distribution or manufacturing facility. All require significantly more electricity than traditional uses—and often in areas where grid capacity is already constrained.

Data centers further highlight the challenge. With artificial intelligence driving an explosion in compute workloads, electricity consumption in the sector is projected to more than double in the next five years alone. In certain global regions, power availability is already the top constraint on new development, sometimes surpassing even land or water availability.

Across asset classes, real estate owners, investors, and occupiers must now think differently. Power availability is no longer a utilities problem—it's a real estate imperative. Sites that can solve for power early and flexibly will be better positioned to meet tenant needs and unlock economic activity.

BRIDGING THE GAP WITH INTERIM SOLUTIONS

While long-term grid upgrades are underway in many regions, they will take years—if not decades—to complete. In the interim, the private sector is deploying distributed and modular energy systems to bridge the gap.

Microgrids, modular energy systems and behind-the-meter storage solutions are being used to energize sites ahead of traditional interconnection. These systems offer localized generation and resilience, using a combination of solar, batteries and clean backup technologies such as linear generators. Because they operate independently of the broader grid, they allow operations to begin without waiting for utility upgrades.

One such example is a heavy-duty truck charging hub in Torrance, California, developed by Prologis, which operates entirely on a behind-the-meter microgrid. Designed to power up to 96 trucks simultaneously, the system includes battery storage and linear generators—all working in tandem to deliver clean, reliable power. This approach enabled the facility to become operational despite facing multi-year delays in utility interconnection, offering a model for how interim power solutions can meet immediate needs at scale while aligning with long-term sustainability goals.

EXHIBIT 1: THE DENKER HUB MICROGRID CHARGING SITE, TORRANCE, CALIFORNIA



Completed in April 2024, the Denker Hub is the largest heavy-duty truck charging hub in North America, powered by a self-sufficient microgrid with 18 MWH energy storage, 9 MW charging capacity, and 96 charging stalls.

Importantly, these systems are not simply workarounds. They are building blocks of a more distributed and adaptable energy future. Many are built to be portable and reconfigurable, allowing operations to launch in areas where grid connections are delayed or uncertain. Once service is established, the same systems can provide backup power or support grid stability by participating in energy markets.

Intelligent software platforms play a key role in maximizing asset performance, using real-time data to manage loads, prioritize essential functions and respond to grid conditions. This allows even power-constrained sites to run reliably and efficiently.

Distributed energy systems—
if deployed in a coordinated way—
can help utilities manage growth
without overextending capital budgets.

THE STRATEGIC VALUE OF DISTRIBUTED GENERATION

At the heart of this transition is a broader shift toward distributed generation—the production of power close to the point of use. In the real estate context, distributed generation most often takes the form of rooftop solar arrays and onsite battery storage. Together, these technologies offer speed, resilience, and grid relief—providing electricity directly to buildings, reducing peak demand and creating backup capacity during outages or delays in utility service.

The strategic value of distributed generation lies in its ability to reduce peak demand and ease pressure on transmission and distribution systems. It's a pressure valve for a grid that is increasingly stretched thin. During extreme weather events or unplanned outages, distributed generation assets can maintain uptime and continuity. Over time, they also offer decarbonization benefits, allowing buildings to operate with lower emissions by avoiding fossil-based grid peaks.

A recent example is a grid-scale battery storage project in Texas, where batteries were installed next to a logistics center, where land was available and is helping to stabilize the ERCOT grid by providing power during peak power times, helping to ensure

that Prologis customers and the local community where we operate have access to reliable power. Integrating large-scale battery projects demonstrate how real estate can broaden grid reliability goals.

Individually, these assets are relatively small. But aggregated across a portfolio—particularly in dense urban areas or logistics hubs—they can represent significant load reduction. Coordinated portfolios of distributed generation assets can participate in demand response programs or form the foundation for virtual power plants, providing services back to the grid and improving system-wide efficiency.

As the scale of distributed generation platforms grows, their role in energy strategy will shift from supplemental to central. What once was seen as optional infrastructure is becoming core to real estate value and energy resilience.

REAL ESTATE-UTILITY COLLABORATION: A SHARED OPPORTUNITY

The emergence of real estate as critical energy infrastructure offers an opportunity to reimagine the relationship between the private sector and utilities. Rather than being at odds, both parties can benefit from greater alignment.

Utilities face significant constraints: aging infrastructure, labor shortages and increasing pressure to decarbonize while maintaining reliability and affordability. Distributed energy systems—if deployed in a coordinated way—can help utilities manage growth without overextending capital budgets. For example, distributed generation assets located near substations or in constrained service areas can help defer or eliminate the need for major upgrades.

Utilities increasingly see value in working with real estate platforms as “living laboratories” for grid innovation. Distributed assets—when aggregated and digitally managed—offer utilities a way to test demand-side flexibility programs, enhance outage response and pilot grid services without massive capital outlays. In many cases, large real estate portfolios span multiple utility jurisdictions, offering a unique vantage point on cross-regional energy needs and resilience opportunities. Deepening this collaboration could enable faster deployment of new technologies, more accurate load forecasting, and a more customer-centric model of energy planning.

To unlock this potential, collaboration must begin early. Developers and utilities need shared visibility into project timelines, load requirements and interconnection priorities. At the same time, regulatory support for streamlined permitting, standardized interconnection processes and grid-interactive technologies will be essential.

RETHINKING ENERGY RISK IN REAL ESTATE STRATEGY

As grid limitations become more acute, energy availability is shifting from an operational detail to a strategic investment factor. Traditionally, electricity was considered an abundant and commoditized input. Today, it is an increasingly scarce, localized and time-bound constraint. For real estate investors, this represents a redefinition of risk—and a new lens through which to assess long-term value.

Energy risk manifests in several ways, including delayed site activation due to interconnection bottlenecks and rising utility rates driven by infrastructure strain. For developers and asset owners, addressing these exposures proactively—through modular energy platforms, or energy-as-a-service partnerships—can unlock new competitive advantages.

Critically, energy resilience is also becoming a tenant expectation. As occupiers—from logistics operators to e-commerce companies to data users—set decarbonization targets and scale electrification, they are seeking partners who can deliver both space and power. Buildings that are energy-ready, or companies that are capable of rapidly deploying interim solutions, are more likely to attract and retain future-facing users.

IMPLICATIONS FOR GLOBAL CAPITAL

For institutional investors, the shift toward energy-aware real estate is both a challenge and an opportunity. As electricity becomes a gating factor in everything from data center expansion to modernization of distribution centers, energy strategy must become part of portfolio strategy.

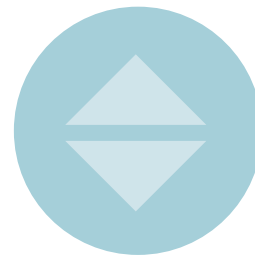
Assets that can adapt to grid volatility will be better positioned to deliver stable performance amid an evolving energy landscape. In high-demand asset classes like logistics and data infrastructure, the ability to solve for power will soon rival traditional value drivers like location and yield.

At the same time, distributed generation platforms offer new avenues for value creation. In addition to reducing reliance on utility infrastructure, distributed generation systems can support sustainability targets, offer revenue from grid services participation and enhance the long-term relevance of a property. As energy becomes both more valuable and more constrained, capital will increasingly flow to assets that can both consume and create it.

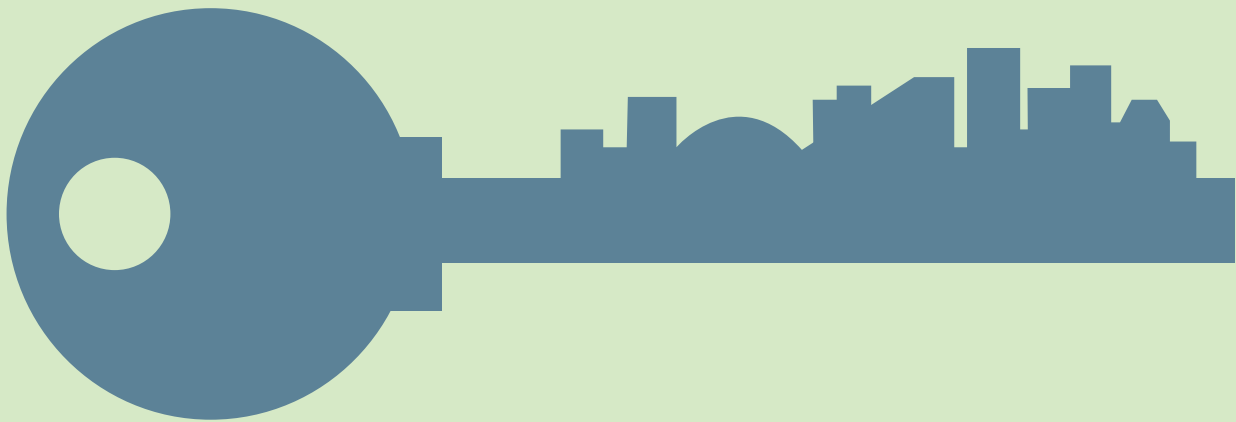
Those who act early—integrating power strategy into real estate—won’t just mitigate risk. They’ll help define the infrastructure model of the future.

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UNLOCKING ABUNDANCE TOGETHER



Derek Kaufman
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America's severe shortage of housing and energy poses an existential threat to the viability of long-term infrastructure investment. Yet with coordinated action from energy and real estate investors, we can meet America's housing, energy, and economic goals.

America stands alone in the way it builds.

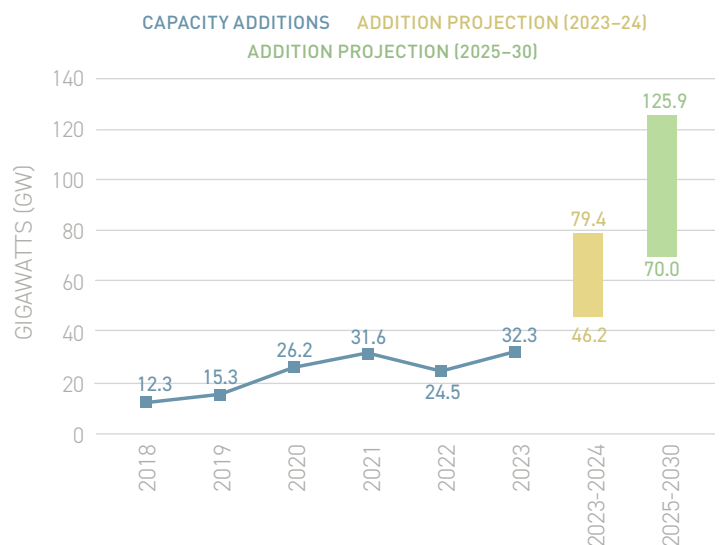
In the 1970s, the United States passed a slew of new policies that governed development, causing the approval process for new construction—new housing projects, new energy projects, new factories—to become increasingly decentralized. Today, it's hardly an exaggeration to say that anyone with any stake in a physical project needs to agree on its parameters before it can be built. The result: While America is leading the future in bytes (in software and digital services), its development has ground to a halt in bolts.

America now faces a severe shortage of housing and energy that poses an existential threat to economic dynamism, climate progress, and the viability of long-term infrastructure investment.

The US is at least 3.9 million units short on housing, and most acutely short in its productive, superstar cities like New York, Los Angeles, and San Francisco. A large body of research shows that this shortage constrains productivity and fuels inequality, among other costs.¹

Energy markets, which depend on continuous change to the built environment, are similarly failing Americans. A weak energy sector raises utility bills, dampens innovation, leads to more polluted air, and hurts climate progress. Clean energy deployment remains at just one-third of what's needed to reach climate targets, with the US adding only 32.3 GW of clean power in 2023, when 60-127 GW annually are required to meet climate goals.²

EXHIBIT 1: CLEAN ENERGY CAPACITY ADDITIONS VS. PROJECTIONS



Source: Rhodium Group; MIT; CEEPR; REPEAT; Energy Innovation

These shortages are the result of self-imposed scarcity—an artificial throttling of our productive capacity not driven by natural constraints, but by policy choices. A framework of *abundance* presents an opportunity for real estate and energy investors to identify and dismantle these bottlenecks to unlock a prosperous, investable future.

As this reality has become more widely recognized, a quiet nonpartisan consensus has emerged on one idea: we must make it easier to build in America.

Across the political spectrum, leaders are converging around efforts to accelerate housing and energy development as a means to strengthen national prosperity and global leadership. Influential thinkers like the *New York Times*' Ezra Klein and *The Atlantic*'s Derek Thompson, now co-authors of the book *Abundance*, along with a growing chorus of conservatives and libertarians, have catalyzed a growing movement across traditional ideological lines. This abundance movement frames regulatory reform, targeted public investment, and improved government effectiveness not as competing tools, but as a winning combination that unlocks capital and enables long-term growth. With particular case studies housing and energy.

Abundance and the community of thinkers around it have identified the difficult politics of “abundance.” It’s a technocratic platform that doesn’t lend itself to any easy campaign slogans or flatter voter preconceptions. And where bottlenecks to material abundance exist, they’re generally propped up by entrenched interests. *Abundance* is a desperately needed solution to America’s most pressing problems, but scarcity is a huge windfall to a few.

REGULATORY CONSTRAINTS

The housing and energy crises share a common culprit: a system designed to say no.

In America, it’s easy to delay or derail a project. That’s not an accident. It’s the result of a policy regime built to avoid potential harms, not the equally real—and often deeper—harm of inaction: rising rents, stalled clean energy, declining productivity. Our regulatory model is therefore incapable of solving any problem that requires building quickly.

Three chokepoints define our housing dysfunction. First, zoning laws prohibit density and innovation, locking vast swaths of urban land into low-yield uses. Second, bureaucratic reviews are slow, costly, duplicative, and easily litigated, imposing multi-year delays that often kill viable projects.³ And third, discretionary approvals and adversarial public comment processes empower the loudest objectors—often would-be neighbors protecting their convenience—to veto change at everyone else’s expense. Utility-scale energy faces the same challenges, while typically requiring additional permits because state or federal lands are involved.⁴

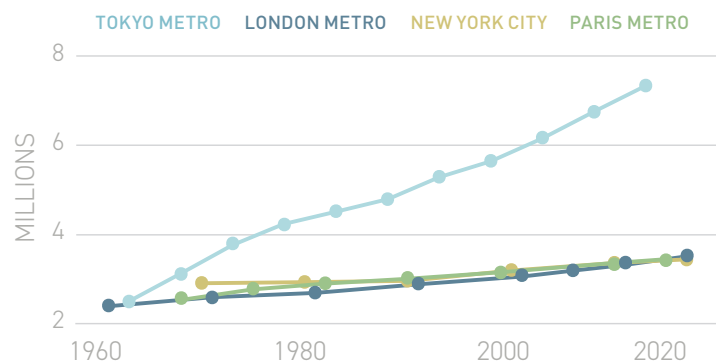
Infrastructure requirements only compound the problem. Housing needs transit. Electricity needs power lines. Each new layer of complexity makes it harder to build anything at all.

Other countries show it doesn’t have to be this way. In nations such as Japan, Germany, and South Korea, clear and consistent approval processes make it far easier and cheaper to get homes and infrastructure built.

While New York’s housing stock grew just 19% over five decades, Tokyo nearly tripled its supply through a simple and flexible national zoning code, rapid approvals (2-6 weeks versus New York’s 3-12 months), and performance-based standards rather than extensive procedure.⁵

In nations like Japan, Germany, and South Korea, clear and consistent approval processes make it far easier and cheaper to get homes and infrastructure built.

EXHIBIT 2: NUMBER OF HOMES BUILT IN GLOBAL MEGACITIES, 1960–PRESENT



Source: Urban Design Forum

Tokyo points the way: We need to legally allow abundant housing and energy through zoning reform. Then we need faster processes to approve permits and get projects built. The best solutions will be guided by set standards about how much environmental risk is acceptable, or how much a neighborhood must benefit, to build a certain amount of energy on natural lands or housing in that neighborhood. Then projects that meet those guidelines should be automatically approved. And any role for the courts must be productive, not destructive.⁶

The capital is there. The market demand is clear. What we need now is a regulatory model that promotes abundance—not one that protects the privilege to say no.

FINANCING BARRIERS

High-return public investment, like smart deregulation, is essential to abundance.

In today's high-interest rate environment, even permitted projects often fail to pencil. Ørsted's cancellation of two major US offshore wind farms—intended to provide power equal to the needs of almost a million homes—was largely due to rising capital costs.⁷ Similarly, housing developers increasingly emphasize the capital barriers to new multifamily buildings, like a scrapped 352-unit apartment building in Philadelphia.⁸

Public investment can bridge the gap. Unlike private lenders, public capital can absorb longer time horizons and incorporate social returns, a fact observed as far back as John Maynard Keynes' *General Theory*.⁹ Consider office high-rise-to-housing conversions—an elegant way to revive downtowns and add transit-connected homes. These projects are generally financially infeasible, even where bureaucratic barriers have been eased. But research shows a small public investment could deliver affordable units at a fraction of the typical cost.¹⁰

The same principle applies to middle-income housing, long absent from hot markets; market-rate financing simply won't cut it. Massachusetts Housing Development Incentive Program (HDIP) shows the power of public financing in action. The program, which offers tax

incentives to developers, has to date created 2,700 market-rate housing units for a cost of only \$23,664 per unit to the public, and was significantly expanded by the legislature in 2023.¹¹

Likewise, utility-scale clean energy requires particularly large upfront investments that are being hampered by rates.¹² Finally, next-generation energy needs support through its middle period between seed and commercial maturity.

The solution isn't just more money; it's more options. Expanding tax credits and full expensing would ease cash flow for builders of housing and energy. Proposals to offer construction financing through America's government-sponsored enterprises, Fannie Mae and Freddie Mac, could unlock a new wave of multifamily investment.¹³ And some housekeeping is needed on our next-generation energy investments, including geothermal and nuclear energy.

The regulatory and financing challenges are linked. Projects that take years to permit require higher rates of return over long time horizons. A fragmented, unfamiliar development model is riskier for lenders.¹⁴ If we want capital to flow into the infrastructure of the future, we need a system that makes building fast, legible, and investable.

The real bottleneck is a culture of legalistic caution, born of outdated statutes and reinforced by institutional fear.

GOVERNMENT EFFECTIVENESS

Abundance isn't just about policy—it's about execution.

Even the best-intentioned efforts to fix problems can be paralyzed by a public sector that's slow, risk-averse, and overwhelmed. Any abundance agenda includes a key pillar—government effectiveness—not necessarily focused on a bigger or smaller government, but rather a more effective one, addressing the failures that have steadily destroyed trust in government.¹⁵

The problem isn't primarily about increasing staffing or staff resources. More hands or better software won't fix a system that treats delay as a virtue. Nor is it solved by cutting public servants. The real bottleneck is a culture of legalistic caution, born of outdated statutes and reinforced by institutional fear. Around the same time that red tape slowed development, agencies became subject to new laws such as the Paperwork Reduction Act that slowed government action significantly.¹⁶

Today, agencies are rewarded by Congress and their own legal teams for increasingly cautious interpretations of those laws, not for solving problems, and this has bred a culture of inaction. Jennifer Pahlka, founder of the US Digital Service, puts it plainly: "*Culture eats policy.*"¹⁷

This cultural rigidity is deepened by anti-corruption reforms that, while well-intentioned, have stripped governments at all levels of discretion and outsourced work into contracts that both reflect and reinforce the culture. In his new book *Why Nothing Works*, Mark J. Dunkelman spells out the consequences: even mundane projects—like fixing a park—have become prohibitively expensive and slow.¹⁸ Public sector leaders learn that action receives more scrutiny than inaction. They learn not to bother. "It should not be this hard to serve the public," write the authors of *Abundance*. (In the Dunkelman example, it's a private developer named Donald Trump who ends up fixing the park.)

Fixing these problems demands two changes: reform and leadership. We can and should rewrite laws to reduce the complexity of direct government action as well as the private sector’s interaction with government.

But we will still desperately need new types of public sector leadership. For one, management will need to embrace accountability, creativity, and innovation. Outsourcing and action

restriction are poor substitutes for those virtues, with accordingly poor results to show. A stronger government is also a more expert one, meaning more technical experts to properly manage complicated contracts (or help bring that work in-house).

While revitalizing the private sector, abundance thus promises a stronger American public sector to match.

FROM GRIDLOCK TO GROWTH: CLEARING THE PATH TO PROGRESS

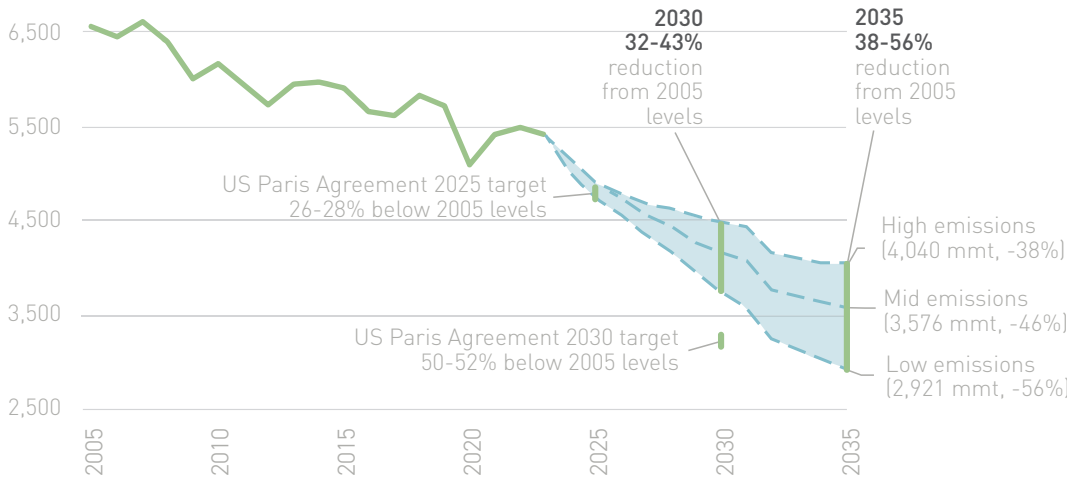
America is blessed with an abundance of capital, ambition, and innovation. And yet we throttle it. Few people understand this better than real estate and energy stakeholders. Both sectors are grounded in the physical world. They build things people depend on. They navigate complex permitting, financing, and delivery challenges. And increasingly, their work is understood as core to solving our greatest modern challenges.

Each of our American dysfunctions has its defenders. They tend to be incumbents, some actively benefiting from the status quo, like homeowners who want to preserve the wealthiest parts of San Francisco in amber. Others, like a renter who thinks new development causes

gentrification rather than ameliorates it, are incredulous of the benefit they would receive. Legacy environmental groups, who have oriented much of their work around suing to stop projects they don’t like (*including clean energy projects*), sit somewhere in between.¹⁹

But the costs of inaction are clear: Los Angeles is short at least 340,000 homes, and New York 350,000, as rents continue their upward march and young families can no longer afford to live in our most prosperous places.^{20,21} The US is badly lagging on climate goals.²² Until the government can act with clarity and speed, faith in it will continue to erode and capital will remain sidelined.

EXHIBIT 3: US GREENHOUSE GAS EMISSIONS UNDER CURRENT POLICY



Source: Rhodium Group

To unlock our potential, we don't need to reinvent the system—we need to unjam it. That means regulatory frameworks that reward progress, not process. Financing tools that reflect today's rate environment. And public institutions that are capable of and accountable for results. Imagine a world where we close the national housing gap and rents begin to fall everywhere, and where energy bills do too as we speed towards decarbonization—a world of fast and fair growth. As Klein and Thompson write: “Abundance is the state in which there is enough of what we need to create lives better than we have had.”²³ We know how to achieve that. Other nations have shown the way.

The growing momentum of the abundance movement provides a key opportunity to change the status quo. A coalition of thought leaders, policy experts, and advocacy organizations are working to craft and implement solutions that make it easier for America to build again.

The market has spoken: unsustainably high costs for both housing and energy reflect pent up demand that self-inflicted barriers have created. The abundance agenda represents a market opportunity, not just a philosophy.

The success of these efforts will depend on increased involvement from the investor community joining together to remove the bottlenecks that perpetuate scarcity. And few can speak to the barriers to building better than the builders. The time has come to unlock abundance, together.

ABOUT THE AUTHORS

Derek Kaufman is Founder and CEO of Inclusive Abundance and a former Wall Street executive specializing in investment strategy and public policy innovation.

Mike Kingsella is Founder and CEO of Up for Growth, a national policy association advancing solutions to America's housing shortage, with over twenty years of industry and policy experience.

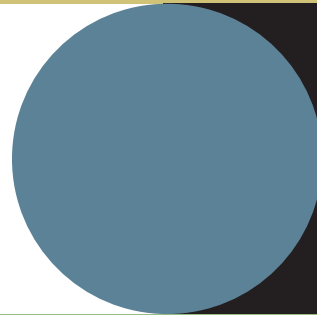
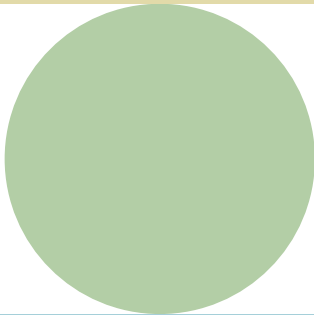
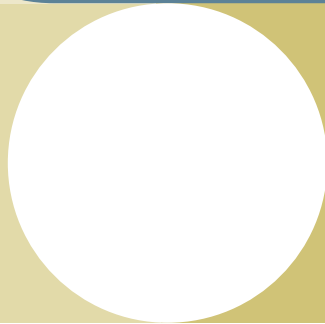
Joshua Seawell is Head of Policy at Inclusive Abundance and an impact strategist with experience working across sectors to zero out American GHG emissions and poverty.

Unsustainably high costs for both housing and energy reflect pent up demand that self-inflicted barriers have created.

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INVESTING IN TECH ADJACENCIES



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Technology is transforming the face of real estate. Government stimulus is incentivizing the buildout of critical infrastructure in innovations hubs, which is driving demand for advanced manufacturing, residential and retail assets in these areas.

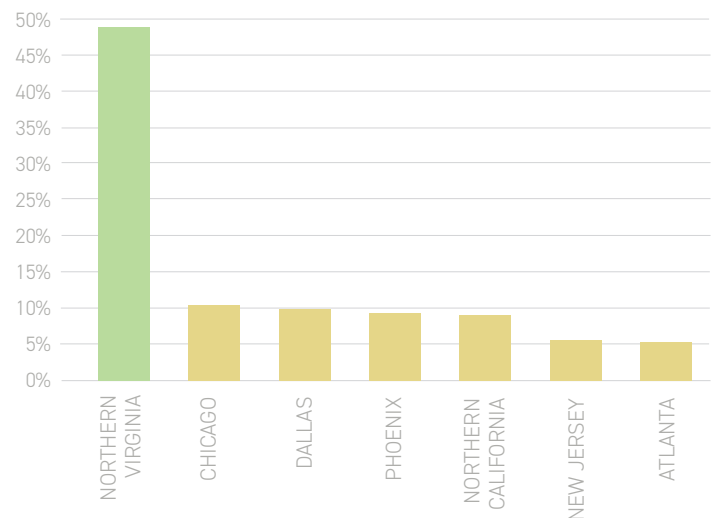
One in twelve American businesses are actively using artificial intelligence (AI) to add productivity to their processes.¹ While overall AI penetration is still low, it is growing quickly. Just five years ago, AI adoption was confined to AI innovators since there were little to no AI-enabled products offered to businesses. However, that is changing quickly, as more solutions come to market.

This rapid AI adoption is spawning the development of digital infrastructure to support AI applications. Data centers are at the heart of this infrastructure buildout, as is cheaper and cleaner energy. This transition is having a global impact. While the US is the largest market for data centers, accounting for roughly 40% of the global share, the market is growing around the world. In Europe, Latin America, and Asia Pacific regions, data center inventory grew between 15% and 22% year-over-year in Q1 2024.²

Fundamentally, we are AI believers. J.P. Morgan (JPM) was an early adopter, and it's already adding productivity benefits to our overall business, from chatbots to enhanced modeling. However, in our real estate portfolio, we don't own data centers and prefer to own real estate that is adjacent to this digital infrastructure. Here's why:

1) Data centers are not "real estate" in a classic sense, but more closely resemble infrastructure investments. While traditional real estate is leased on a per square foot (PSF) basis, data centers are generally leased based on energy capacity (more akin to a utility). This pricing methodology intrinsically ties a data center's value to the availability and need for power. More than 40% of US data centers are in Northern Virginia, where nuclear power is prevalent, and regulations have traditionally allowed data centers to connect to the power grid relatively quickly.³

EXHIBIT 1: MORE THAN 40% OF US DATA CENTERS ARE IN NORTHERN VIRGINIA



Source: JLL, Goldman Sachs Investment Research, J.P. Morgan Asset Management; as of 8/27/24

Further, most of the value of a data center is the hardware inside, rather than in its physical location. According to Green Street, in the two years ending March 2025, the average industrial asset traded for \$180 PSF, while the average data center traded at \$514 PSF. That puts traditional industrial assets at roughly a third of the cost of a data center, implying that approximately two-thirds of the value is in the hardware (e.g., power, cooling systems, etc.) as opposed to the real estate. This makes data centers more of a tech/infrastructure investment as opposed to pure-play real estate.

2) Technical obsolescence risk is high. With most of a data center’s value tied up in the power and hardware, owning one is more of a tech play than a real estate play.

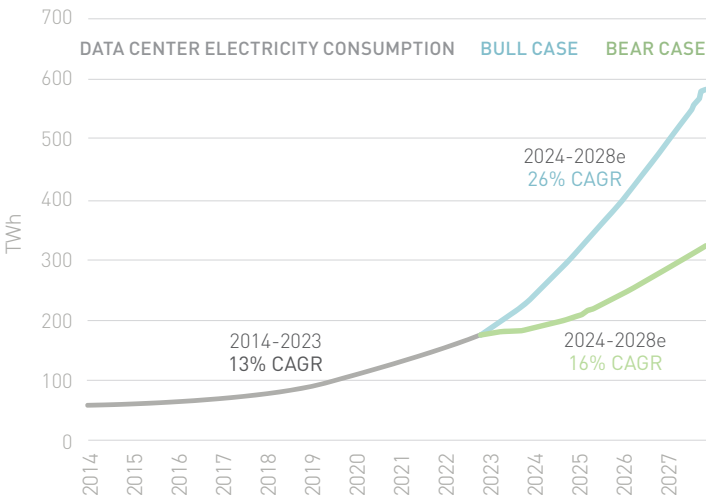
In January 2025, DeepSeek, a two-year-old AI startup based in China, unveiled a new AI model that reportedly performed on par with leading US models. What was most interesting is that DeepSeek is ten times more power efficient than one of the more popular US models, Meta’s Llama 3.1. This breakthrough creates both opportunities as well as obstacles. On the one hand, DeepSeek might help ease one of the obstacles to broad AI adoption: constraints on power generation. More power-

efficient AI will be less costly to use, and we expect this will help speed up AI adoption and its productivity gains throughout the global economy.

On the other hand, this also exposes the risk of owning data centers, as it calls into question the energy demands of AI in the future. In December 2024, the Department of Energy projected that US data center electricity demand could increase by 16% to 26% annually by 2028. The efficiency of DeepSeek makes it unlikely that demand will reach the bull case and calls into question if even the bear case will be reached.

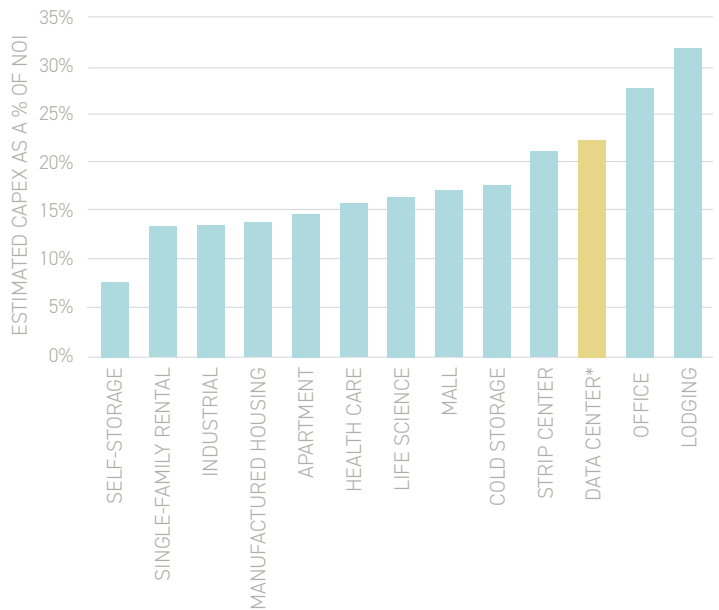
Further, data centers require more capital investment than most other CRE sectors, especially for hyperscale and colocation facilities, which are the most common implementation. The elevated CapEx is indicative of technological obsolescence risk, as it is often the case that the additional capital is necessary to keep up with technological change. In only seven years, Google has reportedly revamped its cooling systems multiple times—shifting from air to liquid—to keep pace with the demands of next-gen chips. It’s a clear signal: data center infrastructure is evolving fast.

EXHIBIT 2: WIDE RANGE OF DATA CENTER POWER ESTIMATES



Source: Lawrence Berkley National Laboratory, U.S. Department of Energy, ‘United States Data Center Energy Usage Report’, J.P. Morgan Asset Management as of 12/31/24.

EXHIBIT 3: DATA CENTERS ARE MORE CAPITAL INTENSIVE THAN MOST OTHER SECTORS



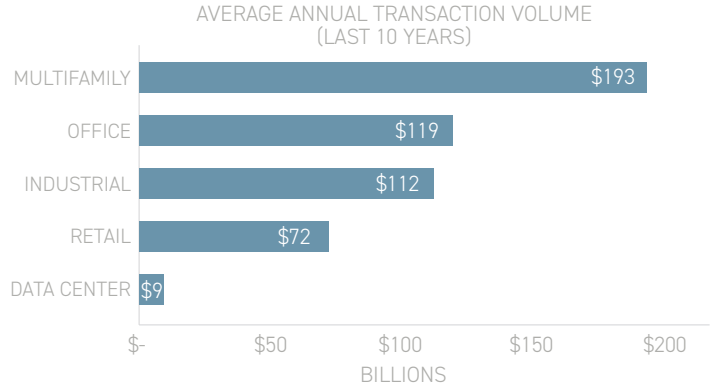
Source: Green Street Advisors, J.P. Morgan Asset Management; as of 3/31/25. *Data centers are a 50/50 blend of hyperscale and colocation.

3) Data centers are illiquid. Conceptually, real estate liquidity is based on (1) how often the asset trades, (2) the size of the investor base, and (3) the ease of valuation. With this framework, data centers are less liquid than all traditional CRE sectors. Despite data centers being the most illiquid, they no longer offer a valuation discount to the broader CRE market.

By following this money and focusing on the demand created by the changing trends in real estate, knowledgeable investors can capitalize on this growth.

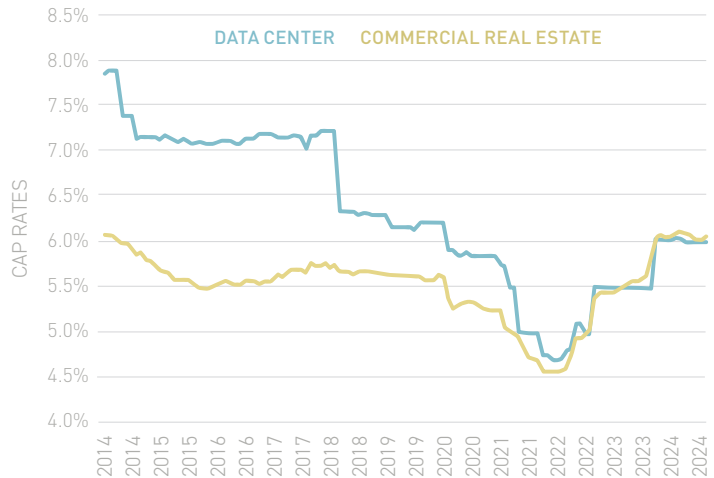
The next generation of industrial demand will increasingly be shaped by technological innovation, and the assets that can keep up will be the ones that outperform.

EXHIBIT 4: DATA CENTER LIQUIDITY IS A FRACTION OF THE OTHER SECTORS



Source: MSCI Real Capital Analytics, J.P. Morgan Asset Management; as of 12/31/24.

EXHIBIT 5: DATA CENTERS NO LONGER ENJOY A CAP RATE PREMIUM



Source: Green Street Advisors, J.P. Morgan Asset Management; as of 3/31/25.

INVESTING ALONGSIDE THE DIGITAL INFRASTRUCTURE BUILDOUT

Despite informed skepticism on data centers, we are AI believers and expect the CRE landscape to change as AI adoption increases. However, we prefer to invest in CRE that stands to benefit beyond data centers.

The CHIPS Act and the Inflation Reduction Act are fiscal stimulus measures aimed at further incentivizing the buildout of critical tech infrastructure. As of year-end 2024, these fiscal measures were the catalyst for more than \$1 trillion in private sector capital investment across semiconductor, renewables, and biomanufacturing.⁴ Interestingly, through year-end 2024, nearly half of those private investments have been made in just three states: Texas, New York, and Arizona.

We believe the Trump administration is unlikely to roll back these incentives. These programs are helping red and blue states alike, and they support the reshoring and growth of US manufacturing. Additionally, the recently floated Stargate fiscal stimulus initiative (while lacking details) seems to have a similar objective as the CHIPS and Inflation Reduction Acts, indicating broad support of this type of program from the current administration.

Fiscal stimulus via CapEx is the most effective form of stimulus, with academic literature suggesting fiscal multipliers can be as high as approximately six times.⁵ Stimulus creates jobs, knock-on business formation, and retail spending in areas where the CapEx is spent. By following this money and focusing on the demand created by the changing trends in real estate, knowledgeable investors can capitalize on this growth.

As an example, in Phoenix we developed a 200,000-square-foot industrial asset in the Price Road Corridor, a location proximate to Intel's \$50 billion Ocotillo campus. Because Intel is one of the largest beneficiaries of funding from the CHIPS Act, the investment thesis was to draft off the additional demand created by the capital infusion into the area.

While still under construction, the building was entirely pre-leased to one of Intel's vendors at a rent above underwriting. Despite being a new building, designed and constructed to the latest spec, the tenant came out-of-pocket to upgrade the power to 10,000 amps. This is roughly three to five times what was previously considered the standard for a building of this size and was due to the elevated power requirements of the tenant's advanced manufacturing techniques. It's a clear indication that the definition of "modern industrial" is shifting—driven not just by square footage or clear heights, but also by power capacity, manufacturing capabilities, and proximity to innovation hubs.

For investors, the takeaway is simple: The next generation of industrial demand will increasingly be shaped by technological innovation, and the assets that can keep up will be the ones that outperform.

ABOUT THE AUTHORS

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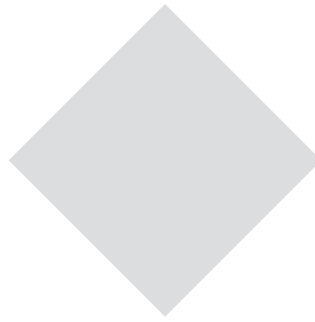
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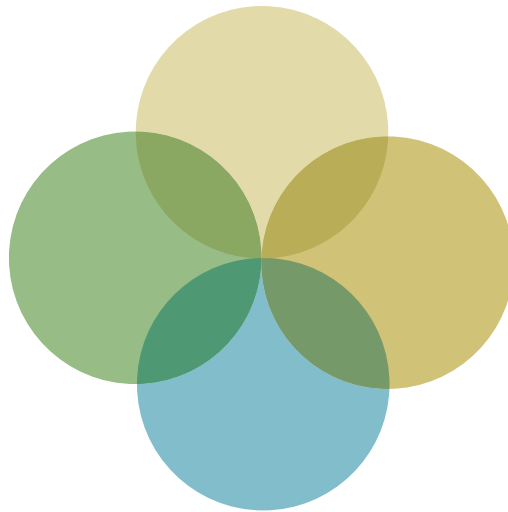
³ Data latency is also relatively low in the area, thanks to high-powered fiber optic cable required by the U.S. government in nearby Washington, DC.

⁴ <https://bidenwhitehouse.archives.gov/invest/>

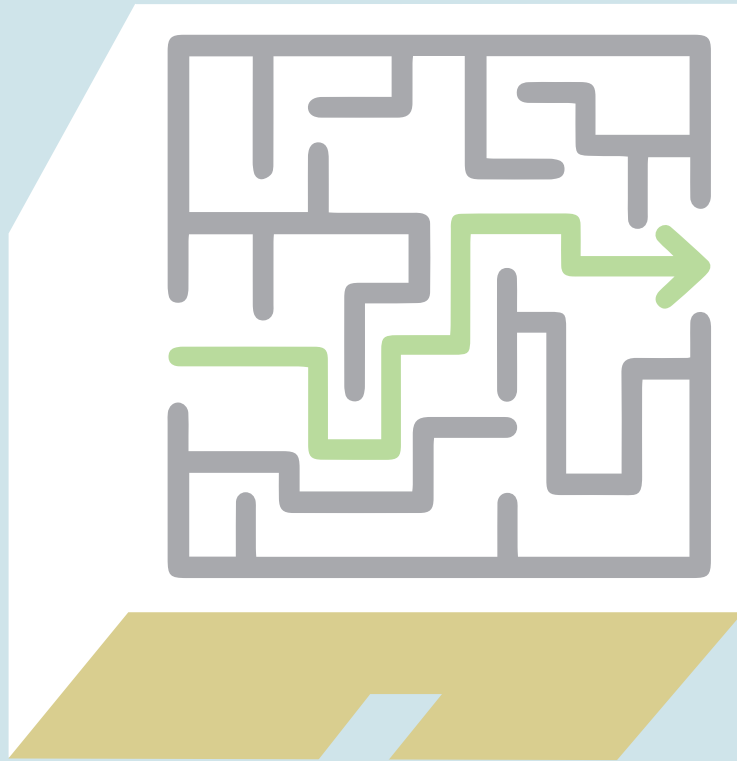
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The definition of “modern industrial” is shifting—driven not just by square footage or clear heights, but also by power capacity, manufacturing capabilities and proximity to innovation hubs.



NAVIGATING THE LABYRINTH



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The growth in data centers is so significant and their energy use so large, this sector is shifting the US energy landscape.

For years, data center development was largely a real estate discussion. But now, it is pivoting into an energy discussion—leaving data center developers and Big Tech “oftakers”¹ to figure out how to ensure they have sufficient and affordable power at their site—with states carefully watching to make sure local energy users aren’t hurt in the process.

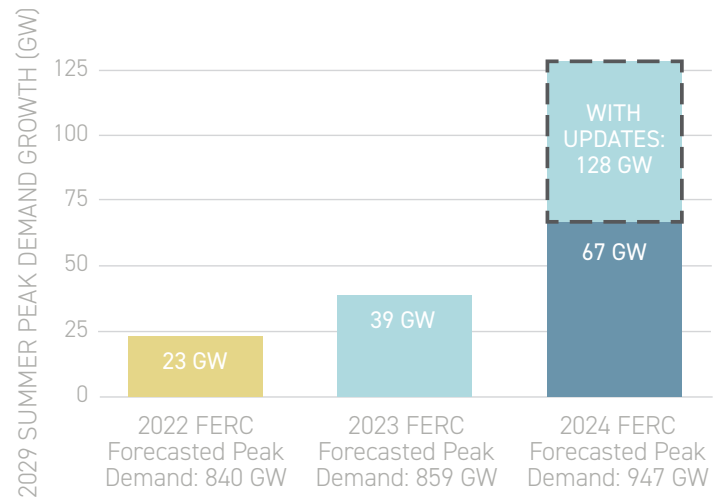
The growth in data centers is so significant and their energy use so large, this sector is shifting the US energy landscape. US electricity demand, fueled by the need to power data centers, including to support artificial intelligence (AI), is growing at a rate unseen in decades, demanding both intermediate and long-term solutions. Pairing nuclear energy with data centers could solve many issues, but it raises novel questions.

This article explores how data centers’ energy consumption is changing the US energy landscape by looking at one type of energy form, nuclear energy, and Big Tech’s big bet on nuclear. This article also examines the practical considerations behind the recent wave of nuclear energy and data center announcements, including the regulatory issues that will need to be navigated.

DATA CENTERS DEMAND MASSIVE ELECTRICITY GROWTH

Energy demand in the US is projected to rise massively over the next decade, in large part due to an explosion in data centers to support AI technology. In the next five years alone, US electricity demand is forecasted to increase by as much as 16%—an incredible jump considering power consumption has increased less than 1% annually for the past twenty years.² That 16% demand increase represents about 128 GW of electricity, or enough to power 128 million homes.

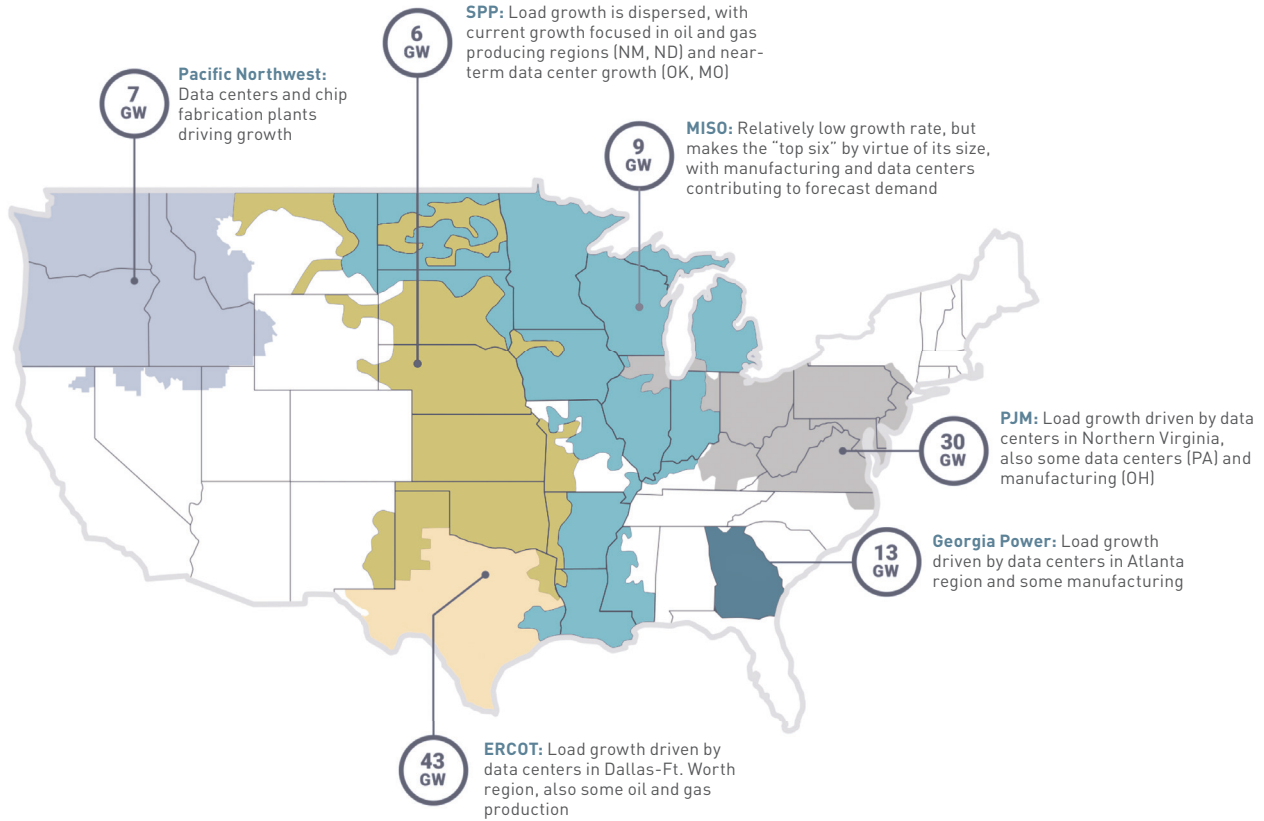
EXHIBIT 1: NATIONWIDE GROWTH FORECAST FOR ENERGY THROUGH 2029



Source: GridStrategies

This demand is not spread out evenly, either. Just two markets—Texas and the PJM Interconnection (PJM) market, which covers the Mid-Atlantic and parts of the Midwest region, are projected to see a whopping 73 GW of that 128 GW demand growth.³ Current electricity demand projections are already double what they were last year, and the numbers continue to rise.

EXHIBIT 2: US REGIONS DRIVING ENERGY LOAD GROWTH THROUGH 2029



Source: GridStrategies

Driving this massive demand are data centers, industrial onshoring and electrification, with the anticipated needs from data centers causing the lion's share of the increase. Generative AI requires major data processing capabilities and, as a result, consumes huge amounts of electricity.⁴ Large data centers can consume about the same amount of electricity as a medium-sized city.⁵ According to the US Department of Energy, data centers used about 4% of US electricity in 2023, but that consumption could rise to 9% of total electricity demand by 2028.⁶ Adding in projected increases from new domestic manufacturing, the rise in electric vehicles, increased system burdens from extreme weather, and broader electrification, the US grid could be under incredible strain in the next few years.

This skyrocketing demand is putting pressure on utility companies to meet the nation's electricity needs, which will become increasingly more difficult as more data centers come online.⁷ Fears of increased household and commercial electricity

rates and reduced grid reliability are causing some to grow concerned that the average American electricity customer may end up shouldering the burden for Big Tech's growth.⁸ A recent paper from the Harvard Electricity Law Initiative suggests that electricity customers, or ratepayers, are already paying for data center infrastructure.⁹ With multiple states turning their attention to this issue, several are looking at proposed legislation to ensure costs for data center's energy use are not borne by taxpayers.¹⁰

Given these market factors, tech companies and data center developers are increasingly looking for their own dedicated sources of reliable energy, whether using existing infrastructure or new energy projects—with nuclear energy seeing a surge in interest from data centers.¹¹

NUCLEAR ENERGY AND TECH: A MATCH MADE IN HEAVEN?

One example of a possible solution is the emerging relationship between Big Tech and nuclear energy. Data centers need an immense amount of reliable power, with many companies also wanting their power to be carbon-free. Nuclear power has the highest reliability rating among all power sources, can operate 24/7, and produces zero carbon emissions.¹²

As an added bonus, data center developers are willing to pay for the positive externalities of nuclear—such as their reliability and clean power—whereas the complex rules of the wholesale electric markets in the US do not generally recognize these benefits. The US Department of Energy recently re-issued a \$900 million funding opportunity to de-risk the deployment of small modular reactors (SMRs)—which can be sited more flexibly than large reactors—for energy-intensive operations like data centers.¹³

The private sector is arguably ahead of the curve on this issue, though. In the past year alone, tech companies have announced the following collaborations with the nuclear industry:

- **Microsoft** signed a twenty-year power purchase agreement (PPA) with utility company Constellation Energy to purchase energy from a restarted Three Mile Island Unit 1, which operated from 1974 to 2019. Under the PPA, Microsoft will purchase energy from the restarted Unit 1 to supply power for nearby data centers.¹⁴ The power level from the restart would be enough to power approximately 800,000 homes.
- **Amazon** and nuclear reactor designer X-Energy announced a collaboration to bring online more than 5 GW of new nuclear power projects—or 64 of X-Energy’s Xe-100 small modular reactors (SMR)—in the US by 2039. This announcement represents the largest commercial deployment target of SMRs to date. The deployment will begin with an initial four-unit, 320 MW project with utility Energy Northwest in central Washington, with the option to increase up to 960 MW.¹⁵ Amazon and Virginia-based utility company Dominion Energy entered into a Memorandum of Understanding to explore deploying SMRs in the state for Amazon’s data centers, likely at the existing North Anna Power Station.¹⁶ Virginia is projected to feel the electricity crunch acutely—the state is a global hub for data centers, with at least 70% of the world’s internet traffic running through Northern Virginia.¹⁷
- **Google** and reactor company Kairos Power signed a Master Plan Development Agreement to deploy 500 MW of advanced nuclear power by 2035, with the first deployment by 2030. Under the agreement, Kairos Power will develop, construct, and operate a series of SMRs and sell energy, ancillary services, and environmental attributes to Google under PPAs. Kairos’ plants will be sited to supply 24/7 clean electricity to Google data centers.¹⁸
- **Meta** is actively seeking nuclear power developers to help it achieve its AI innovation and sustainability objectives by adding one to four gigawatts of new nuclear generation capacity in the US, starting in the early 2030s.¹⁹ A Request for Proposal (RFP) was announced in December 2024, and the RFP process remains ongoing.

In addition to Big Tech deals, data center investors have also struck deals to integrate nuclear power into their data center developments. In January 2025, Sabey Data Centers entered into a Memorandum of Understanding with Bill Gates’ TerraPower to power its data center developments with advanced nuclear Sodium plants.²⁰ Switch, a developer of cloud, AI, and enterprise data centers, has contracted with Sam Altman’s Oklo Inc. for a nuclear-powered data center collaboration extending through 2044.²¹

Pairing nuclear energy with data centers raises several novel practical and regulatory challenges. While “behind-the-meter” generators serving large industrial facilities (i.e., configurations where an industrial user like a data center is directly connected to the generator, bypassing the grid) are not a new concept, the scale and speed of the anticipated expansion are unprecedented. Also unprecedented is the idea of nuclear generation serving as a dedicated resource for a limited number of customers.

These issues give rise to legal and policy considerations that will require careful navigation by stakeholders, including federal and state government authorities. For example, existing, traditional nuclear facilities power the local grid. Removing that power from the grid to dedicate to a data center raises various legal and policy issues including how such power can be dedicated for the benefit of a single customer, and, if so, who should be responsible for the cost of replacing it. It is not simply a matter of substituting another source of megawatts—nuclear facilities are highly reliable, and their surrounding interconnection facilities often serve as hubs for the larger grid.

As another example, new nuclear facilities also raise novel issues. For example, even though a data center may be located at the same site as a generator and even interconnected exclusively to that generator, that data center will still benefit from such “grid services” as backup power when the generator is offline. These grid services are usually paid for primarily through “wires” charges on system users, charges that would not normally be assessed on a customer located “behind the meter” of a co-located generator.

THE FERC MAZE: REGULATORY HURDLES AND OPPORTUNITIES

Controversy regarding the use of nuclear facilities to power data centers exploded in March 2024 in the PJM region, which includes the global data center hub of Northern Virginia. Talen Energy had sold a data center campus near the Susquehanna Nuclear Power Plant in Pennsylvania to Amazon Web Services²² and intended to sell power to Amazon from its ownership share of the Susquehanna plant. This agreement would have effectively redirected power from the regional grid to Amazon.

In response, many vociferous protests were filed with the Federal Energy Regulatory Commission (FERC), which oversees the transmission system and wholesale electric markets. Arguments against the proposed configuration focused on the impact that dedicating a large existing generator to a single customer could have on other customers and the extent to which other customers might directly or indirectly end up burdened with the resulting costs.

Upon review, FERC rejected the agreement between Talen and PJM that would have accommodated the behind-the-meter configuration.²³ Although FERC's rejection focused on technical reasons, the agency was clear that its concerns were significantly broader. Soon thereafter, FERC opened a new docket to investigate and resolve²⁴ the problem of providing power to large loads in the PJM region, an overarching concern that is

not confined to nuclear facilities or to data centers. Although this proceeding concerns the PJM region in particular, the outcome is likely to provide a template for how similar issues are treated elsewhere in the US, FERC's concerns are focused on resource adequacy, reliability, and rates.

For example, allowing data centers to enter agreements with existing generators runs the risk of making that power unavailable to existing customers, which raises the question of how to ensure "resource adequacy," or the presence of sufficient resources to meet demand even under extreme conditions. Insufficient resource adequacy threatens the reliability of service, which can lead to an increase in blackouts for end users, including residential customers.

Blackouts have an economic cost, and tragically, all too often a human cost as well. Mitigating resource adequacy and reliability challenges, by, for example, building transmission to bring in power from elsewhere, is expensive and time consuming, which, if the costs are not carefully assigned to beneficiaries, could result in an overall increase in electricity rates. Even the construction of new generation together with data centers raises potential issues of cost allocation, responsibility for upgrading the grid, and whether co-located generation and load should be allowed to "skip the line" and interconnect to the grid ahead of generation intended to serve the entire grid.

FERC has emphasized that data centers are customers too, and that FERC's mandate to ensure reliable power at "just and reasonable" rates on a non-discriminatory basis also applies to those customers. FERC must determine how to serve both rapidly increasing demand and existing customers while fairly allocating the cost, and it must do so quickly. Failure to accommodate increased demand risks stymying economic progress, while doing so carelessly risks blackouts and/or untenable price increases.

Complicating FERC's role is that FERC has limited jurisdiction. FERC only regulates the sale of electricity at wholesale (i.e., sales for resale, not sales to "end-users," such as data centers). Sales to end-users are "retail sales" subject to state jurisdiction. Likewise, FERC has very little authority over the siting of generation and transmission, which are also the responsibility of the states. Therefore, FERC cannot devise a comprehensive solution alone. For their part, numerous state regulatory commissions have already expressed their own concerns about the rapid increase in demand and how it can be met without harming electric ratepayers.

LOOKING AHEAD

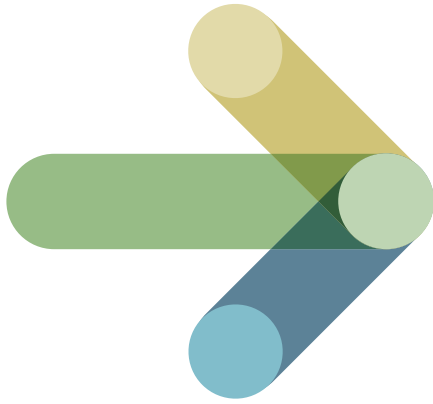
On May 23, 2025, U.S. President Donald Trump signed four significant Executive Orders to revitalize the U.S. nuclear energy sector, including to accelerate the civilian deployment of nuclear power plants, and to leverage the resources of the Department of Energy and the Department of Defense to deploy nuclear reactors. Under the orders, AI data centers, particularly those linked to Department of Energy facilities, are designated as critical defense infrastructure, and the nuclear reactors powering them as defense-critical electric infrastructure.

The Administration characterized these actions as the most consequential reforms to nuclear regulation in decades, marking the beginning of a new era in American nuclear energy innovation and development.

Pairing data centers with nuclear energy could solve a plethora of concerns about the nation's increasing energy needs—but it creates novel issues that will need to be navigated.

As the Talen-Amazon agreement demonstrates, existing nuclear plants are tightly integrated into the grid, which raises many economic and engineering concerns if they are reconfigured to provide service to an onsite data center. But if FERC creates expanded opportunities for constructing data centers together with new generation, this could create a wealth of opportunities for small modular reactors, which are not only zero-emissions but also provide highly reliable power.

US electricity demand is growing—and fast—meaning that Big Tech, data center investors, utilities, and FERC will need to address it sooner rather than later. Data center investors need to take an active role and be flexible in helping to formulate solutions as state and federal policy makers attempt to meet the competing demands of energy users.



Data center investors need to take an active role and be flexible in helping to formulate solutions as state and federal policy makers attempt to meet the competing demands of energy users.

ABOUT THE AUTHORS

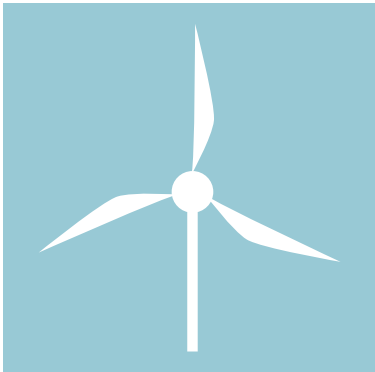
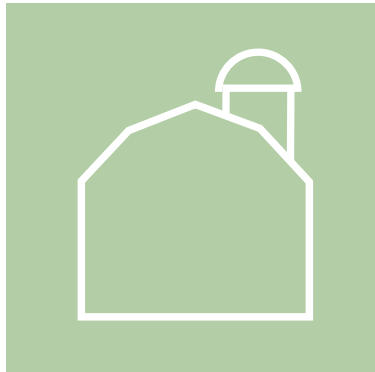
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TRANSMISSION ALLEY



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The rapid expansion of digital demand is transforming middle America into a strategic hub where commercial real estate and energy sectors collaborate to leverage renewable power, existing rail infrastructure, and rural land for the future of digital infrastructure.

The rapid rise in data center demand, driven by tech giants like Google, and Microsoft, along with major real estate developers such as Equinix Inc. and PGIM Real Estate has already led to billions in investments.¹ With data centers requiring massive amounts of power and large parts of the country benefiting from existing railroad rights-of-way, middle America is emerging as a prime location for hyperscale developments.

This shift presents an opportunity to repurpose land traditionally used for agriculture into energy and data infrastructure. If investments in power generation, distribution, and transmission continue, and if utility companies and data center operators collaborate effectively, these secondary and tertiary—often rural—markets will remain attractive to developers due to lower land costs and access to renewable energy.

DATA CENTERS ARE HOT

Fueled by artificial intelligence, cloud computing, data storage, and cryptocurrency mining, the data center sector is expected to experience unprecedented growth.

The industry, projected to reach \$150 billion annually and to triple by 2030, is expected to drive over \$1 trillion in investments.² Major commitments are already underway. Related Companies has launched Related Digital, committing at least \$500 million towards the buildout of its development pipeline.³ And PGIM, intending to “deploy capital in the hot data center space” recently raised \$2 billion for its Global Data Center Fund, with \$450 million already allocated.⁴

POWER UP!

Requiring vast amounts of electricity to maintain continuous operations and optimal operating conditions, data centers are among the most energy-intensive facilities, with power demands expected to grow by 160% by 2030.⁵ While AI advancements drive demand, the challenge remains securing “abundant, low-cost, and reliable power.”⁶ Despite the current Administration’s commitment to “drill, baby, drill,” traditional power sources are insufficient to meet this demand, necessitating consideration of alternative sources. But sourcing power from traditional versus renewable methods need not be mutually exclusive; a balanced approach incorporating multiple energy sources is essential.

The demand for faster, more efficient data processing, coupled with sustainability goals, has accelerated investments in solar farms, wind turbines, and other renewable energy projects, making the integration of renewables a “critical strategy” for data center developers.⁷ As of February 2025, renewable energy investments neared \$1.966 trillion, outpacing traditional sources like coal and natural gas.

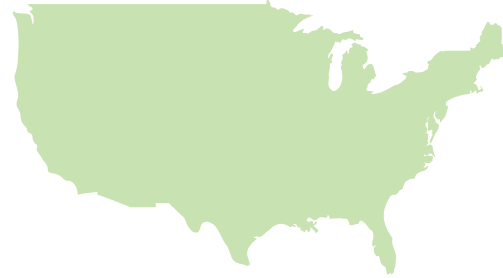
SURGING REAL ESTATE MARKETS

Data center and renewable energy developments are transformational, representing a “seismic shift” in what defines valuable real estate today. The US is shifting from what once dominated traditional real estate investments—residential, commercial, and industrial—toward energy, data centers, and infrastructure. This transition is particularly significant for middle America, often dismissed as “flyover” country.

As energy production shifts toward renewable sources, farmers and landowners along existing rail corridors in high-potential areas—such as Texas, Central Washington, Des Moines, and Umatilla, Oregon—are well positioned to benefit.⁸ The real estate market for energy and data infrastructure, currently valued at \$13.095 trillion, is projected to grow to \$19 trillion by 2030 and \$27 trillion by 2035, providing a unique opportunity to reconsider the best and most productive use of the land blanketing middle America.⁹

The real estate market for energy and data infrastructure, currently valued at \$13.095 trillion, is projected to grow to \$19 trillion by 2030 and \$27 trillion by 2035.

Tech giants, including Meta and Google, are already investing heavily in carbon neutrality and renewable energy solutions. Meta, for instance, sources power from more than 10 solar farms in Utah, generating 1.6 GW.¹⁰ And Google, one of the largest corporate buyers of clean energy, aims for 24/7 carbon-free operations by 2030 and already secured over 7 GW of renewable energy.¹¹ Google also expanded its focus on renewable energy with a \$5.5 billion investment in its Council Bluffs data center campus. Another leading American cloud services provider, the largest corporate buyer of renewable energy globally, has more than one hundred solar and wind projects for its data centers.¹² Dominion Energy, planning to double its generation capacity in 15 years, expects solar to account for 45% of this growth.¹³



LOCATION, LOCATION, LOCATION: MIDDLE AMERICA AS THE HOLY GRAIL

With few signs that the expansion of AI, cloud computing, data storage, and crypto is slowing down, data center development is set to accelerate, requiring developers to consider the perennial real estate question—where to build. Traditionally located near urban hubs or major fiber optic network intersections, site selection now hinges on power, fiber, and climate conditions. Given high land costs in primary markets such as Northern Virginia, currently one of the top co-location destinations, developers are turning to secondary and tertiary markets with robust connectivity and access to renewable power.

Co-location, which requires a lot of land, another benefit of rural America, is another key factor for data center locations by reducing energy loss and improving sustainability. The United States Department of Agriculture estimates that 90% of renewable energy siting will occur in rural areas by 2050, potentially generating 1.5 million solar jobs by 2035 and 600,000 wind jobs by 2050.¹⁴ And converting land to renewable generation not only makes sense, but it also makes dollars. With the most likely outcome for a farmer transitioning farmland to solar generation resulting in “a ~350% increase in gross revenue per acre,” a recent study looking at the implications of large-scale solar developments in Maryland found that producers who convert to utility-scale solar are being “rational economic agents.”¹⁵

Additionally, data centers require stable environments safe from natural disasters, extreme weather events, and climate change — conditions often more prevalent in rural parts of middle America than in coastal regions. The Midwest and Plains states—such as Iowa, Kansas, Oklahoma, and Texas—with some of the highest wind speeds are “prime locations” for wind-powered facilities, while Arizona, California, and New Mexico—receiving some of the highest solar irradiance in the country—are optimal for solar-powered developments.

CHOO-CHOO-CHOOSING SITES

Middle America is well situated to become the next hotbed for data center development considering its ability to leverage the potential for leveraging existing railroad rights-of-way to simplify infrastructure development. America's extensive, privately owned 140,000-mile "steel interstate" is a valuable asset for modern data infrastructure. Six privately owned Class I railroads (a designation in terms of revenue per year)—BNSF, Union Pacific, Norfolk Southern, CSX, Canadian National, and CPKC—own the majority of this track, which already claims own rights-of-way through middle America, obviating reducing the need to negotiate with multiple private land owners for access rights.

This model has proven successful along the Transcontinental Railroad, which runs railroad rights-of-way that run from Iowa to California along the 41st parallel; a key corridor for data center expansion and a "natural landing spot" for hyperscalers. Google has invested \$5 billion in its Council Bluffs, Iowa data center facility, with another \$500 million center planned in Cedar Rapids; and Meta has committed \$6 billion along this route to facilities in Iowa, Nebraska, Wyoming, and Utah.

Chicago has also experienced success with telecommunications companies building fiber infrastructure along the Transcontinental Railroad. Centrally located between the coasts, Chicago ranks as one of the top five cities in the country for connectivity, with more than 120 data centers.¹⁶ In 2021 Direct Connect recently announced a proposed \$2.5 billion project called the "SOO Green HVDC Link." The proposal is for a proposed 349-mile, 2.1 gigawatt, 525-kilovolt transmission line running along existing railroad from Iowa to Chicago; and. In addition, Related Digital's \$45 billion development pipeline includes a state-of-the-art campus in Chicago containing more than 500 acres and more than 1,000 MW capacity (as well as 600+ acres/1,200 MW capacity in Missouri and 115 acres/250 MW capacity in Wyoming).¹⁷

America's total investment in data centers and AI infrastructure has surpassed \$2.5 trillion and is expected to exceed \$6 trillion by 2030, with the market projected to reach \$27 trillion by 2035.

IF YOU BUILD IT, THEY WILL COME

Maintaining America's leadership in AI and meeting surging data center demand requires substantial investment in infrastructure. Unlike oil and gas, where costs primarily involve fuel, electricity costs stem from generation, transmission, storage, and distribution infrastructure, requiring a "mammoth" investment in equipment. America's total investment in data centers and AI infrastructure has surpassed \$2.5 trillion and is expected to exceed \$6 trillion by 2030, with the market projected to reach \$27 trillion by 2035.¹⁸ While infrastructure investment is expensive, necessitating high upfront costs for infrastructure and grid interconnection, long term savings and government subsidies (e.g., favorable tax treatment and sales tax exemptions) can offset these expenses over time.

Leveraging America's massive railroad infrastructure can promote clean energy, revitalize rural economies, and reshape real estate values. In addition to creating jobs and attracting new businesses, the surrounding areas often see a rise in property demand and prices, improving living standards for those currently left behind. And it's not just the localities that benefit; developers are signaling confidence by deploying capital (i.e., putting their money where their mouth is), highlighting strong profit potential for both developers and investors.

As Jeff T. Blau, CEO of Related Companies, states, digital infrastructure is "one of the most remarkable growth categories and asset classes."¹⁹ Related Companies is not alone in this bullish outlook. Investment firms such as KKR and Energy Capital Partners are backing this trend, recently announcing a \$50 billion partnership to accelerate data center and energy infrastructure development.^{20,21}

Co-locating data centers along railroad corridors would also create additional revenue streams for rail owners. And we already have an ideal location to begin co-locating. The Northern Transcon, traversing the most northerly route of any railroad in the Western United States, and the Southern Transcon, running from Los Angeles/Long Beach through Kansas City to Chicago and passing over the top of Texas, present ideal starting points for data center expansion.

THE DIGITAL FRONTIER: HOW THE HEARTLAND BECOMES AI'S NEW POWERHOUSE

Middle America, with its vast rural land, low disaster risk, renewable energy potential, and railroad infrastructure, is ideal for data center development, offering economic benefits to farmers and landowners. With AI transforming infrastructure needs and data centers forming the “backbone” of the digital economy, future real estate strategies must prioritize connectivity, infrastructure reliability, and sustainability. As history has shown—whether with transcontinental railroad rights-of-way or the modernization of energy infrastructure—bold, transformative investments in infrastructure are a matter of national greatness and drive progress. Regardless of whether artificial general intelligence arrives in the next year or next decade, to continue our competitive edge in AI, we need to be prepared, requiring a “visionary” modernization of our energy infrastructure.

As history has shown—whether with transcontinental railroad rights-of-way or the modernization of energy infrastructure—bold, transformative investments in infrastructure are a matter of national greatness and drive progress.

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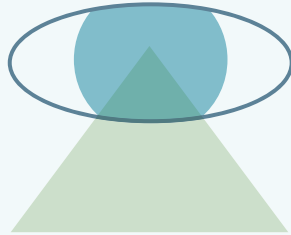
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