

The Clean Energy Gap: Quantifying the Feasibility of 100% U.S. Clean Energy Consumption by 2035 under Artificial Intelligence-Driven Demand Growth

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ABSTRACT

This paper investigates whether the U.S. can achieve 100% carbon pollution-free electricity consumption by the year 2035 in the context of rapidly accelerating electricity demand driven by artificial intelligence and data center expansion. Employing a compound annual growth rate methodology, this paper uses 2024 figures to model the growth of both the supply and demand sides of U.S. electricity through 2035.

On the demand side, data center demand is projected using historically derived compound annual growth rates (“CAGR”) of 15.77%, while non-data center demands use the Energy Information Administration’s (“EIA”) baseline of 1.7% growth rate, yielding a total electricity consumption range of 5471 terawatt hours (“TWh”) to 5821 TWh by 2035. On the supply side, clean energy capacity is projected to reach a total of 1066.1 gigawatts (“GW”) by 2035 using a CAGR of 7.30%, yielding an estimated generation of 4104 TWh. This falls short of demand estimates with a gap between 1366 TWh and 1716 TWh, with only 70.5% to 75.0% demand covered by clean electricity supply. Closing the gap requires total annual capacity additions of 72 to 91 gigawatts, less than double the current rates. Under current trajectories, clean energy generation is not projected to fully meet total demand until approximately 2042. Under the assumptions and growth trajectories modeled in this paper, the United States is not projected to achieve 100% clean electricity consumption by 2035, and closing the supply gap implies trillion-dollar capital requirements that current markets and situations are unlikely to support.

INTRODUCTION

In 2024, a single query submitted to an AI model consumed approximately 10 times the electricity of a traditional internet search, a seemingly trivial detail that, multiplied across the billions of daily interactions, turns into a fundamental restructuring of the American energy economy (Engler & West, 2026).

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As artificial intelligence transitions from a specialized research tool to a ubiquitous part of everyday life, the electricity demand behind such a scale is building up at an unforeseen rate. At the same time, the United States has committed to an ambitious clean energy target to reach 100% carbon pollution-free electricity consumption by 2035, driven by the recognition that decarbonizing the electrical grid is one of the most consequential steps towards reducing national carbon emissions (Donohoo-Vallett et al., 2023). Currently, data centers, which serve as the backbone for all A.I. workloads consume approximately 183 terawatt hours (“TWh”, a measure of total electricity generated or consumed) of electricity in 2024, roughly 4.5% of the total U.S. consumption, and are projected to grow to double-digit annual rates through the early 2030s (Leppert, 2025). This demand surge arrives directly when the U.S. clean energy sector faces challenges with manufacturing, grid interconnection, and federal investment, raising questions about whether supply can keep pace.

This paper investigates whether the United States can achieve its target of 100% carbon pollution-free electricity by 2035, given accelerating AI-driven electricity demand, using a compound annual growth rate (“CAGR”, measures the average yearly growth rate assuming smooth, compounding growth over a period) comparison model in order to assess whether supply growth can realistically meet projected total electricity consumption, converting policy ambitions into measurable terms.

Background on Clean Energy

The economic risks of fossil fuel dependence became starkly apparent during the 1970s oil embargo, when energy prices surged and electricity costs rose across the country, prompting the nation to begin investing seriously in clean energy alternatives (Macesar, 2025).

According to the United States Environmental Protection Agency, carbon pollution-free energy is characterized by all sources of clean energy¹, as well as Marine energy, Hydrokinetic energy, and fossil fuels, specifically with carbon capture and storage (“CCS”). However, this paper will omit marine energy, hydrokinetic energy, and fossil fuels with CCS because currently, the combined figure for all three is significantly less than 1% of total electricity generation, making these sources effectively negligible (U.S. Energy Information Administration, 2024a).

The transition toward clean energy has been driven primarily by long-term cost and reliability: greater use of clean energy reduces the risk of price volatility from geopolitical disruptions (Denis & Roche, 2025), nuclear generation provides a constant source of electricity that fills the gap left by intermittent renewable sources (Mueller, 2021), and clean energy systems benefit from lower fuel costs once constructed (Thoubboron, 2022). At the same time, expansion remains constrained because of public concern over nuclear safety, the daily fluctuation of wind and solar output, and the high upfront costs and land requirements of renewable technology (Consumer Energy Solutions, 2022).

¹ Clean Energy includes: Nuclear, Hydrokinetic, Geothermal, Solar PV, Wind, and Biomass

Clean energy investment in the United States reached \$272 billion in 2024, reflecting rapid acceleration of domestic deployment (Rhodium Group & MIT, 2025). Clean sources now supply around 45% of total U.S. electricity generation, with nuclear producing half of that figure, raising critical questions about whether clean generation can scale fast enough to meet future demand (Fulghum, 2025). Despite this growth, clean sources only intermittently generate more electricity than fossil fuels, and recent policy changes such as the One Big Beautiful Bill have cut solar funding and growth capacity by more than 40% (King et al., 2025). As electricity demand rises, particularly from artificial intelligence, the feasibility of the 2035 target remains uncertain (Bird et al., 2026).

PRIOR RESEARCH AND STUDIES

Previous research relating to this topic usually has fallen under 3 categories: Supply side feasibility estimates, long term electricity demand forecasting, and a broader study of historical energy transitions. The prior studies have usually approached the topic solely from a supply side or a demand side, but they rarely compare both angles at the same time.

On the demand side, an article from the Lawrence Berkeley National Laboratory calculated not only the growth of data center consumption from 76 TWh from 2018 to 183 TWh in 2024, but also projected that data centers could reach approximately 6.7% to 12% of the total U.S. electricity consumption by 2028. Their “bottom-up” methodology aggregated the power usage of actual data center equipment, cooling, and infrastructure, then projected future hardware needs. Globally, the International Energy Agency projects data center electricity consumption to roughly double from approximately 500 TWh in 2025 to 950 TWh by 2030, with AI-specific infrastructure, largely data centers, tripling over the same period (Spencer & Singh, 2026). The demand-side research also highlights how unpredictable electricity demand has become. Goggin and Gramlich (2025) found that many utility companies' own five-year demand forecasts more than tripled in a single year. For example, in 2023, utilities collectively expected 38 gigawatts (“GW”, a measure of energy capacity) of demand growth over the next five years, but by 2024, the forecast had jumped to 128 GW, with data centers driving most of the increase. Even professional forecasters revised their projections upward by more than three times within the span of a year, which is why this paper uses a range of CAGR values to calculate demand rather than a single point estimate.

On the supply side, the feasibility of achieving fully carbon-free electricity has been researched directly by the government and by academic institutions. The National Renewable Energy Laboratory (2022) used its Regional Energy Deployment System capacity expansion model to evaluate in what ways the supply can reach 100% clean electricity by 2035, finding that total generation capacity would need to roughly triple relative to 2020 levels, at an additional power system cost of \$330 to \$740 billion. Additionally, researchers at UC Berkeley's Goldman School of Public Policy found that a 90% clean grid by 2035 is physically and economically feasible, but would require approximately 1,100 GW of new wind and solar capacity, averaging 70 GW of additions per year (Phadke et al., 2020). Even though both studies are the most recent official publications for the feasibility of the project, they were conducted and published

before the spike of AI-driven data center demand, and therefore model supply requirements against the demand assumptions that are not reflective of the current circumstance and growth trajectories that are highlighted in this paper.

Finally, the broader category of energy transitions provides historical context for the general timeline required for the shift. Reviewing the global transitions from wood to coal and coal to oil, a study from the World Bank (Grubb et al., 2024) found that large-scale energy transitions have taken place over multiple decades rather than in strictly compressed policy targets. This pattern raises the question of whether the eleven year transition target to replace all fossil fuel electricity generation is realistic compared to how energy transitions have happened in the past.

Altogether, the literature review reveals three clear gaps. The demand-side forecasts quantify the speed of electricity consumption growth, but do not evaluate it in comparison to the supply of clean electricity. At the same time, supply-side studies evaluate feasible pathways to clean energy, but predate the AI demand acceleration. Finally, energy transitions reviews describe the historical pace of the shift without applying it to the current 2035 target. This paper addresses that gap by combining demand and supply projections into a single comparison, taking into account AI-driven data center demand growth, to assess whether the 100% clean electricity target remains achievable by 2035.

METHODOLOGY

To assess the feasibility of converting to 100% clean energy, this paper projects both total U.S. electricity demand and clean energy generation through 2035 using compound annual growth rates derived from historical data.

The core methodology compares the two growth rates: total U.S. electricity demand, emphasizing the data center demand, against U.S. clean energy capacity additions on the supply side. Total electricity demand is modeled in two components. The data center portion, representing approximately 4.5% of total U.S. electricity consumption in 2024, is projected using a historically derived CAGR of 15.77%. The remaining 95.5% of U.S. electricity consumption is projected using the EIA's 2025 baseline growth rate of 1.7%, applied exclusively to non-data center demand, which will be expanded on in later sections. The EIA's baseline growth rate of 1.7% was historically calculated by grouping data centers within the broader commercial sector, meaning a small portion of data center demand is already embedded in that figure. Since this paper models data center demand separately at 15.77%, there is double-counting of data center consumption: once in the 1.7% baseline and once in the data center projection. This marginal overlap slightly overshoots total projected demand, meaning the supply gap identified in this analysis is a modest overestimate. However, eliminating this overlap would only narrow the gap marginally and would not change the fundamental conclusion that 100% clean energy by 2035 is unlikely to be feasible.

CAGR also assumes constant growth and does not capture S-curve dynamics, meaning the identified gap may over or understate the true 2035 shortfall depending on where AI adoption and clean energy expansion sit on their respective adoption curves. The same applies to the supply side, where capacity growth may plateau as manufacturing and logistical constraints develop rather than sustaining 7.30% annually. Since CAGR assumes constant growth, these projections should be interpreted as moderately optimistic rather than worst-case scenarios.

An additional distinction must be noted between clean energy capacity (measured in GW, MW) and clean energy generation (measured in TWh, MWh, and kWh). Clean energy capacity represents the maximum potential output, while generation reflects actual electricity produced, which varies based on the capacity factors and the type of energy sources. Capacity factors measure how much realistic output a source generates compared to its maximum output (Mueller, 2025; U.S. Energy Information Administration, 2024b).

This paper applies the following decision rule: if the clean electricity supply generation meets or exceeds the total projected electricity demand, the 100% clean energy target is considered feasible within the 2035 timeframe. If a gap remains, the scale of that gap will be quantified in TWh and analyzed in terms of additional capacity required to close it, expressed in both gigawatts and relative addition rates based on current capacity growth trends. This method ensures transparency and reproducibility, along with acknowledging that long-term energy projections have inherent uncertainty, which is addressed through the use of ranges.

RESULTS

Projected Growth and Energy Consumption of Data Centers

AI is increasingly contributing to U.S. electricity consumption, especially through its dependence on data centers' storage and cloud network capabilities. In 2024, data centers consumed 183 terawatt hours ("TWh"), more than 4% of U.S. electricity consumption (Leppert, 2025). The integration of AI in everyday use significantly increases electricity demand, as AI workloads, especially training large models, consume more than 10 times the energy of a standard web search per query. GPU-accelerated servers draw considerably more energy than traditional servers, as training clusters run continuously rather than per query (Engler & West, 2026). According to BloombergNEF, the power demand for data centers alone could reach up to 106 GW by 2035. However, some analysts caution that speculative proposals and AI investment bubbles may be inflating load growth estimates, with more moderate projections closer to 65 GW by 2030 (Martucci, 2025). Even under conservative assumptions, this demand trajectory presents a significant challenge to clean energy capacity targets.

Energy Capacity Projection Conversion for Data Centers by 2035

The 106 GW of 2035 capacity converts to a total of **928.56 TWh** of electricity consumed over a year, assuming 8760 hours (full load year long). This is calculated through the following formula:

$$\text{Energy (TWh)} = (\text{GW} \times \text{hours per year}) \div 1000$$

$$\text{Energy (TWh)} = (106 \text{ GW} \times 8760 \text{ hours}) \div 1000$$

$$\text{Energy (TWh)} = 928.56 \text{ TWh}$$

CAGR of Data Center Energy Growth Using Historical Data

A compound annual growth rate approach was applied based on 2018 and 2024 U.S. energy usage data to account for uncertainties of future generation (“CAGR”). Using the starting energy in the year 2018 as 76 TWh, and the ending year of 2024 as 183 TWh, the CAGR value of data center energy consumption growth calculates to **15.77%** (Shehabi et al., 2024; Leppert, 2025). The CAGR value is calculated by the following formula:

$$\text{CAGR} = (\text{End Value} \div \text{Start Value})^{1 \div \text{years}} - 1$$

$$\text{CAGR} = (183 \text{ TWh} \div 76 \text{ TWh})^{1 \div 6} - 1$$

$$\text{CAGR} = 0.1577$$

Total Energy Consumption Range of Data Centers in 2035

This CAGR calculation yielding approximately 15.77% growth of data center energy usage corresponds with values from Goldman Sachs reports, and reflects the rapid expansion of data center infrastructure driven by AI (Davenport et al., 2024). However, projecting this growth rate at a constant rate over the next decade would be unrealistic due to physical, economic, and infrastructural constraints. To account for this uncertainty, a $\pm 2\%$ buffer was applied to the calculated CAGR value: a moderate and round-number adjustment intended to create a realistic CAGR range and to reflect the inherent uncertainty in projecting over an 11-year horizon. The sensitivity of this choice is tested against wider and narrower buffers in the Discussion section. This adjustment accounts for factors such as efficiency improvements, capital and financial constraints, and the non-linear and unpredictable nature of AI growth. Because electricity demands compound over time, even small deviations can lead to large differences in the 10-year horizon, which reinforces the need for a range rather than a single estimate. Applying the adjusted CAGRs of 13.77% and 17.77% to the 2024 base of 183 TWh yields projected 2035 data center demand of **756.4 to 1106.2 TWh**. These numbers correspond with BloombergNEF’s prediction, which this paper uses to cross-check its own calculations. The formulas used are shown below:

$$\text{Energy Consumption(TWh)} = \text{Start Value(TWh)} \times (1 + \text{CAGR})^{\text{years}}$$

$$\text{Energy Consumption(TWh)} = 183 \text{ TWh} \times (1 + 0.1377)^{11}$$

$$\text{Energy Consumption(TWh)} = 183 \text{ TWh} \times (1 + 0.1777)^{11}$$

$$\text{Energy Consumption(TWh)} = 756.4 \text{ TWh}; 1106.2 \text{ TWh}$$

Projected AI Specific Energy Usage in 2035

Focusing on AI-specific energy use, Gartner estimates that AI-related energy consumption accounts for approximately 21% of worldwide data center energy use in 2025, with this share projected to increase to 44% in 2030. This growth, however, is unlikely to be sustained indefinitely (Gartner, 2025). Data centers must continue to support a substantial share of essential non-AI workloads, such as increasing cloud storage, networking, enterprise software, and general computing, which places a structural upper limit on the fraction of energy that AI can consume. Extrapolating Gartner's projection trends while accounting for the structural baseline of non-AI workloads, this paper estimates that AI consumption will stabilize at 50-55% of data center electricity consumption by 2035, with 52.5% as the midpoint. This specific range is a bounded judgement rather than being derived from mathematical calculations. There is not enough reliable information on the growth of AI and the development of technology in the future, so this paper selects a reasonable range below the linear (67%) and compound (92%) growth from Gartner's values projected to reach in 2035 following the same growth trend. Because the AI-share of energy consumption is not being used to calculate the final projected 2035 demand specifically, the range presented does not affect the paper's conclusions, but rather serves an illustrative purpose. Using the median estimate of 52.5% could mean that approximately **397.1-580.8 TWh** of electricity would be devoted to AI. The AI Energy consumption is computed as follows:

$$\text{AI Energy Consumption (TWh)} = \text{Data Center Energy (TWh)} \times \text{AI Share}$$

$$\text{AI Energy Consumption (TWh)} = 756.4 \text{ TWh} \times 0.525$$

$$\text{AI Energy Consumption (TWh)} = 1106.2 \text{ TWh} \times 0.525$$

$$\text{AI Energy Consumption (TWh)} = 397.1 \text{ TWh}; 580.8 \text{ TWh}$$

The linear ceiling from Gartner's growth is projected to 2035 using the formulas below:

$$\text{Annual Increase} = (\text{2030 Share} - \text{2025 Share}) \div 5 \text{ years}$$

$$\text{Linear Ceiling} = \text{Current Share} + \text{Annual Increase} \times \text{Time}$$

$$\text{Linear Ceiling} = 21\% + (44\% - 21\%) \div 5 \times 10 = 67\%$$

The compounded ceiling based off of Gartner's growth is projected to 2035 using the formula below:

$$\text{Growth Rate} = (\text{2030 Share} \div \text{2025 Share})^{1 \div 5} - 1$$

$$\text{Compound Ceiling} = \text{Current Share} \times (1 + \text{Growth rate})^{\text{projection time}}$$

$$\text{Compound Ceiling} = 21\% \times (1 + (44\% \div 21\%)^{1 \div 5} - 1)^{10} = 92\%$$

The expansion of AI is expected to follow an S-curve trend, where rapid early growth decelerates as the technology matures and efficiency gains accumulate, supporting the assumption that AI's share of data center energy stabilizes rather than growing without end, as shown in appendix A (Rogers, 2003). This analysis uses a constant CAGR over the period for simplicity and transparency; however, real-world growth will likely follow the S-curve trend.

Estimated Cost of Data Center Electricity Supply in 2035

Using projected data center electricity demand of 756 to 1106 TWh, the total cost of power supply can be estimated. Current U.S. electricity prices average 12.75 cents per kilowatt hour ("kWh", the standard unit to measure and bill electricity usage), with projections indicating a 9%–18% increase by 2035 due to diminishing tax incentives, rising maintenance and transmission costs, and increased demand (U.S. Energy Information Administration, 2026b; Copley, 2025).

Assuming a conservative 9% price increase to \$0.14 per kWh in 2035, the cost of supplying total data center electricity using only grid energy will range from approximately **\$105.84B to \$154.84B**. The value is derived from the formula shown below:

C = Cost of Data Center electricity usage

$$C = Usage (TWh) \times (1 \times 10^9 kWh \div 1 TWh) \times (Cost per Kilowatt)$$

$$C = 1106 TWh \times (1 \times 10^9 kWh \div 1 TWh) \times (\$0.14/kWh)$$

$$C = 756 TWh \times (1 \times 10^9 kWh \div 1 TWh) \times (\$0.14/kWh)$$

$$C = \$154.84B; \$105.84B$$

To manage these costs, many AI companies are turning to Power Purchase Agreements ("PPA"), direct contracts to buy electricity from a clean energy source at a fixed price, and Virtual Power Purchase Agreements ("VPPA"), in which companies fund the generation of clean energy mixed into the grid in exchange for Renewable Energy Credits (Bocca, 2025; U.S. Environmental Protection Agency, n.d.-a, n.d.-b). Adoption remains limited, however, as individual states determine their own laws with these contracts, or sometimes completely restrict their usage (U.S. Environmental Protection Agency, 2026).

Company Overview: Next Era Energy

This analysis can determine current financial conditions and the feasibility of reaching the target goal using clean energy companies, specifically NextEra Energy ("NEE"), General Electric Vernova ("GEV"), and Constellation Energy Corp. ("CEG"). These companies are examined not only as generators and manufacturers but as capital allocators, since the pace at which the physical gap identified in the previous section can close is ultimately constrained by how much investment capital each company is willing and able to reinvest toward new generation capacity. In addition, all three companies were selected because

they encompass the generation of all forms of clean energy and have the largest market caps in the sector, which would represent the sector's overall growth.

NextEra Energy is one of the largest energy companies in the United States and a leading generator of renewable energy. It operates through two main segments: Florida Power & Light, the largest regulated electric utility in the country, and NextEra Energy Resources, which is the world's largest generator of wind and solar power, as well as a major developer of battery storage and clean energy infrastructure, having a combined total of 69 GW energy capacity with a growing development pipeline (NextEra Energy, Inc., 2025). The company saw a 4.6 GW increase in new US capacity additions in 2024, representing roughly 7-8% of total energy contributions during the year (U.S. Energy Information Administration, 2025b; Statista, 2026). Recent partnerships with major technology firms, such as Google Cloud and Meta, highlight NextEra's strategic role in meeting rising power needs from data centers and other power-hungry sectors (NextEra Energy, 2025). Additional investments in nuclear recommissioning, large-scale grid infrastructure, and renewable expansion support both sustainability goals and financial growth (NextEra Energy, 2026).

Company Overview: General Electric Vernova

Rather than generating electricity directly, General Electric Vernova serves as a unique position in the clean energy supply chain. GE Vernova designs and manufactures the physical infrastructure, such as turbines, grid equipment, and energy management systems, that are required to generate and transmit power at scale. Their equipment and services generate approximately a quarter of the global electricity generation, with over 59,000 wind turbines globally, and having the largest market cap out of all manufacturers, making it one of the largest indicators of whether clean energy can physically scale fast enough (GE Vernova, n.d.; CompaniesMarketCap, 2025). However, the company's order books highlight a critical constraint: the physical portion of the industry is bottlenecked by the long wait times, with wind turbine and grid equipment orders being booked multiple years in advance, and average grid interconnection typically takes five years or more (Rand et al., 2025). This wait time suggests that, even if capital and demand existed, clean energy capacity cannot be added at will, and that no amount of investment can immediately accelerate the construction.

Company Overview: Constellation Energy

Like NextEra Energy, Constellation Energy is one of the largest power producers in the United States and serves as a major supplier of low-carbon electricity, especially nuclear power. Its generation portfolio includes nuclear, hydroelectric, wind, solar, geothermal, and natural gas facilities, with a significant foothold in the nuclear sector (Constellation Energy, n.d.). The company supplies roughly 10% of the nation's clean electricity and 4% of total energy production, making it a major contributor to America's decarbonization efforts (Constellation Energy, 2024). Constellation owns the nation's largest nuclear fleet, operating at a capacity factor consistently above 94%, having stability that makes it increasingly important for continuous data center demand. As of 2026, Constellation Energy has a total capacity of 55

GW, but only an increase of 1 GW in capacity in 2023 (Constellation Energy, 2025). At such low capacity added in 2023, Constellation’s expansion rate falls drastically short of the annual additions required to close the projected supply gap, which is attributed towards their strategy of optimizing current plants rather than aggressively building new ones (Prabhu & Khattar, 2026).

Key Metrics Analysis

To evaluate and predict the growth within the renewable energy sector, this paper evaluates each company using capacity-based metrics (2022-2024), financial performance indicators (2022-2024), and capital expenditure data (“CapEx”, money spent on physical assets such as new power plants and equipment) to assess both growth trajectory and physical constraints on scaling. Backlog figures represent unfulfilled contracts rather than late orders, reflecting the inherently long wait times for clean energy infrastructure. This paper will not use the CAGR method due to differing strategies and an abnormal base year from 2022-2024: comparing CAGR rates would compare growth rates measuring fundamentally different strategies and events, making the comparison meaningless.

Table 1
Key Metrics from Selected Companies

Metric	NextEra (NEE)	Energy GE Vernova (GEV)	Constellation (CEG)	Energy
Added energy capacity 2022–2024 (MW)	12,643	10,965	(–679)	
Total capacity (Q4 2024)	69 GW	N/A	32 GW	
Annual added GW: 2022	4	5	0	
Annual added GW: 2023	4.2	3.7	0.739	
Annual added GW: 2024	4.6	2.3	(–1.418)	
Total operating revenue 2024 (billions)	\$24.75	\$35.00	\$23.57	
Total CapEx 2024 (billions)	\$24.70	\$0.88	\$2.57	
Backlog of orders (2024)	~30 GW	\$119B	~25 GW	
Turbines manufactured (2022–2024)	N/A	64,000	N/A	

Income growth after 2022	\$2,452	(−\$1,500)	(−\$3,875)
(millions)			

Note. Megawatt (“MW”) is a smaller unit of energy capacity; 1 GW converts to 1000 MW. Annual added capacity (NEE) = Q4 2024 capacity - Q4 2023 capacity = 68,807 MW - 64,220 MW = 4,587 MW $\approx$ 4.6 GW (Statista, 2026). Data sources: Constellation Energy - Constellation Energy (2025); Constellation Energy Corporation (2024); Constellation Energy Corporation (2025). GE Vernova - GE Vernova Inc. (2025); Statista (2025, August). NextEra Energy - NextEra Energy (2026); NextEra Energy, Inc. (2025); Statista (2026).

On first inspection, the reported metrics appear highly offset across companies. However, this is because of fundamental differences in business models rather than performance gaps, and are not intended for direct comparison but to evaluate each firm's ability to meet AI-driven energy demand growth.

NextEra Energy presents the most stable metrics due to a strategy focused on incremental capacity additions. NextEra's consistent expansion of around 4.6 GW annually has translated directly into stable financial returns, with approximately \$2.4 billion income generated since 2022, confirming that incremental clean energy growth is still financially viable. However, their annual additions of only 4.6 GW represent a fraction of the growth that will be needed by the U.S., a gap that the next section will quantify directly.

Reported added energy capacity of General Electric Vernova from 2022 to 2024 reflects turbine installations rather than net additions to the United States total grid capacity, which could include replacements and international deployments, limiting direct comparability with utility producers.² Operating revenue remains comparatively high due to strong equipment demand and rising turbine margins. With approximately \$119B in outstanding orders, GE Vernova's backlog reflects the multi-year wait-time between equipment demand and actual installation capacity, further being compounded by AI-driven electricity demand. A portion of these contracts were priced before significant material cost inflation, meaning fulfilling them at reduced margins could slow installation timelines further, adding a financial constraint on top of an already severe physical one.

Constellation Energy focused on maximizing output from its existing nuclear generation fleet rather than building new capacity from 2022 to 2024. While this strategy improved efficiency, total reported capacity still declined by approximately 0.7 GW over the period, reflecting the company's prioritizing performance over growth. Large-scale projects initiated in 2024 signified a shift toward expansion in upcoming years, including the Calpine acquisition, which would increase overall capacity by 27 GW upon completion, according to S&P Global (Prabhu & Khattar, 2026). Even this conservative strategy resulted in an approximately \$3.75 B loss over the period, illustrating that scaling clean energy aggressively enough to

² Total capacity metric does not apply because there is no accurate nor significant number amount in the U.S.

meet the 2035 target carries financial risks that even the largest and most established nuclear operator in the country struggled to absorb under a more modest growth strategy.

Electricity Supply for Clean Energy

In order to match the demand CAGR with the supply CAGR, this paper first quantifies the amount of new energy that will be added in this period. To stay consistent, this paper will only be using electricity capacity from 2018 to 2024 rather than 2025, as the U.S. Energy Information Administration (“EIA”) has not yet published official capacity data for 2025. This paper uses Net Summer Capacity, the EIA's standard reporting metric and the realistic maximum output during peak summer production; nameplate and net winter capacity are excluded.

Calculated CAGR of Clean Energy Electricity Capacity

From this information, the starting capacity is 321778.3 MW in 2018, and the ending capacity in 2024 is 491102.6 MW, leading to a clean energy capacity CAGR of around **7.30%** (U.S. Energy Information Administration, 2025a, Table 4.2A). This value was calculated through the formula shown below:

$$\begin{aligned} \text{CAGR} &= (\text{End Value} \div \text{Start Value})^{1 \div \text{years}} - 1 \\ \text{CAGR} &= (491102.6 \text{ MW} \div 321778.3 \text{ MW})^{1 \div 6} - 1 \\ \text{CAGR} &= 7.30\% \end{aligned}$$

DISCUSSION

Energy Consumption Estimated to 2035

To project the total U.S. electricity demand by 2035, the paper models demand in two distinct components. The table below calculates the electricity consumption of both the data centers, and the remaining portion using historical and current growth values.

Table 2

Total Weighted Electricity Consumption of Data Centers and Other Sectors by 2035

	Data Centers	Other
Percentage of total consumption	4.50%	95.50%

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Consumption Compound Annual Growth Rate	13.77% (lower bound)	(lower bound)	17.77% (upper bound)	1.70%
Total U.S. electricity consumption 2024 (TWh)	4,100			4,100
Ending electricity consumption 2035 (TWh)	756		1,106	4,715
Total U.S. electricity consumption 2035 (TWh)	5,471 (lower)		5,821 (upper)	
Data Center Consumption of total Consumption in 2035	13.8% (lower bound)	(lower bound)	19% (upper bound)	

Note. 2024 total U.S. electricity consumption of approximately 4,100 TWh derived from Leppert (2025), who reports data centers represented approximately 4.5% of total U.S. consumption in 2024. All projection data are the author's original calculation; the data center growth rate is calculated in the “CAGR of Data Center Energy Growth Using Historical Data” section using data from Shehabi et al. (2024); base consumption data in 2024 along with general consumption growth rate and percentage of Data center consumption values are from Schipper & Hodge (2025) and Leppert (2025).

The future value is calculated using the equation below:

$$\begin{aligned}
 \text{Future Value} &= (\text{Present Value} \times \text{Percentage of Total Consumption}) \times (1 + \text{CAGR})^{\text{years}} \\
 \text{Future Value} &= (4100 \text{ TWh} \times 4.5\%) \times (1 + 0.1377)^{11} \\
 \text{Future Value} &= (4100 \text{ TWh} \times 4.5\%) \times (1 + 0.1777)^{11} \\
 \text{Future Value} &= (4100 \text{ TWh} \times 95.5\%) \times (1 + 0.017)^{11} \\
 \text{Future Value} &= \sim 756 \text{ TWh}; \sim 1106 \text{ TWh}; \sim 4715 \text{ TWh}
 \end{aligned}$$

The Data Center Consumption percentage of total Consumption is calculated using formulas below:

$$\begin{aligned}
 \text{Percentage of Total} &= (\text{Data Center Consumption 2035} \div \text{Total Consumption 2035}) \\
 \text{Percentage of Total} &= (756 \div 5471) \\
 \text{Percentage of Total} &= (1106 \div 5821) \\
 \text{Percentage of Total} &= 13.8\%; 19\%
 \end{aligned}$$

The conservative lower bound is used to estimate throughout this analysis to maximize the probability that the 100% clean energy target appears feasible, ensuring that any shortfalls cannot be attributed to excess demand assumptions. The non-data center component, representing 95.5% of total U.S. electricity

consumption, is projected using EIA's Annual Energy Outlook 2025 baseline growth rate of 1.7% applied over 11 years, yielding an estimated 4715 TWh by 2035 (Schipper & Hodge, 2025). Combining both components, the total projected U.S. electricity demand is **5471 TWh** under conservative estimates, to **5821 TWh** under the upper bound scenario. These projections show that data centers would represent approximately 13.8% to 19% of total U.S. electricity demand by 2035, up from 4.5% in 2024, highlighting a structural change due to AI-driven demand over the economy. The blended total demand CAGR across both components is approximately **2.66% to 3.24%**.

The blended CAGR is calculated by the equations below:

$$\text{Blended CAGR} = (\text{End Value} \div \text{Start Value})^{(1 \div \text{Years})} - 1$$

$$\text{Blended CAGR} = (5471 \text{ TWh} \div 4100 \text{ TWh})^{(1 \div 11)} - 1$$

$$\text{Blended CAGR} = (5821 \text{ TWh} \div 4100 \text{ TWh})^{(1 \div 11)} - 1$$

$$\text{Blended CAGR} = 2.66\%; 3.24\%$$

Clean Energy Production Estimated to 2035

To estimate the clean energy capacity by 2035, this paper uses a CAGR of 7.30%, representing annual clean energy capacity expansion, derived from U.S. clean energy net summer capacity data spanning 2018 to 2024 as reported by the EIA's Electric Power Annual, to a base capacity of 491,102 MW. The tables below calculate both current capacities, along with the shortage of capacities needed by 2035 (if any).

Table 3

Current High-Carbon Source Capacity to Be Replaced by Clean Electricity Capacity

High-Carbon Source	2024 Capacity (GW)
Coal	174.18
Petroleum	28.649

Natural gas	506.371	
Other fossil gas	1.678	
Total	710.9	<i>Note.</i> Net summer capacity used for all high-carbon sources. 710.9 GW represents the sum of all High-Carbon sources. All source data from the U.S. Energy Information Administration (2025b) table 4.3.

Table 4
Projected Clean Energy Capacity in 2035 Compared to 2024 High-Carbon Electricity Capacity

Metric	Value
Clean energy capacity (2024)	491.1 GW
Projected clean energy capacity (2035)	1066.1 GW
Capacity added 2024–2035	575.0 GW
Shortfall vs. high-carbon replacement need	135.9 GW

Note. All projected clean energy capacities are the author’s original calculations using a CAGR of 7.30%. Clean Energy Capacity in 2024 and the CAGR derivation are from the U.S. Energy Information Administration (2025a) Table 4.2A.

Projected Clean Energy Capacity is calculated through the equation below:

$$\text{Projected Clean Energy Capacity} = 2024 \text{ Clean capacity} \times (1 + \text{CAGR})^{\text{years}}$$

$$\text{Projected Clean Energy Capacity} = 491.1 \text{ GW} \times (1 + 0.073)^{11}$$

$$\text{Projected Clean Energy Capacity} = 1066.1 \text{ GW}$$

Shortfall is calculated through the equation below:

$$\text{Shortfall} = 2024 \text{ High Carbon Capacity} - (\text{Projected 2035 Clean Capacity} - 2024 \text{ Clean Capacity})$$

$$\text{Shortfall} = 710.9 \text{ GW} - (1066.1 \text{ GW} - 491.1 \text{ GW})$$

$$\text{Shortfall} = 135.9 \text{ GW}$$

With 2024 figures, the sum of all high-carbon sources such as Coal, petroleum, and natural gas, represents an additional 710.9 GW capacity needed to replace all non-carbon-free generation sources, of which the calculated capacity faces a shortfall of around 135.9 GW on a nameplate capacity basis, before accounting for capacity factor differences between fossil and clean sources. Only 575.0 GW is added to total clean capacity by 2035. This is important, as the 710.9 GW capacity needed to replace before demand growth is even considered is not met, meaning no new electricity demand growth will be covered under clean energy additions.

To convert projected capacity to estimated generation, the 1066.1 GW total is allocated across energy sources using the current capacity mix derived from EIA data, and each source's capacity factor is applied individually.

This analysis assumes the 2024 source mix constant through 2035 for analytical simplicity. In practice, this may understate nuclear's role in the future. The One Big Beautiful Bill retains incentives for nuclear and geothermal while diminishing wind and solar tax credits and incentives (King et al., 2025; Beams & Subrahmanian, 2025), which could shift the realized mix toward nuclear's higher capacity factor at 90.8% relative to wind and solar's lower capacity factor at 34% and 23% (Table 5). If so, actual 2035 generation could be greater than this analysis's projection, since the fixed assumption does not capture a potential shift toward higher-capacity-factor sources. Tables 5 and 6 detail the capacity factors and current source mix, as well as calculating the total projected clean energy generation of around 4104 TWh by 2035.

Table 5

Conversion of 2024 Clean Energy Capacity to Projected 2035 Generation by Source

*The Clean Energy Gap: Quantifying the Feasibility of 100% U.S. Clean Energy Consumption by 2035
under Artificial Intelligence-Driven Demand Growth*

Source	2024 Capacity (MW)	Share of Total	2035 Capacity (GW)	Capacity Factor	2035 Generation (TWh)	Clean
Nuclear	98,391	21%	223.9	90.80%	1,781	
Hydro	79,897	17%	181.2	34.60%	549	
Wind	152,097	32.5%	346.5	34.30%	1,041	
Solar PV	122,062	26.00%	277.2	23.20%	563	
Geothermal	2,696	0.6%	6.4	64.60%	36	
Biomass/ Wood	11,412	2.40%	25.6	59.50%	133	
Total	466,555	100%	~1066.1 GW	—	~ 4104	

Note. Individual source shares are summed to approximately 99.5% due to rounding in EIA figures. Assumes no change in source mix or capacity factors in the projections to 2035. Pumped hydroelectric storage (~23 GW) is included in the CAGR base capacity but excluded here as it functions as storage rather than net electricity generation; inclusion would marginally narrow the projected gap without affecting the paper's conclusion. Capacity factors from the U.S. Energy Information Administration (2025c) table 4.8.B. Capacity values in 2024 is from the U.S. Energy Information Administration (2025a) table 4.3. Share of Total, 2035 Capacity projections, and 2035 Clean generations are all calculated by author.

The share of total is calculated through the equation below. The following three formulas were each applied identically to every source in Table 5.

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$$\text{Share of Total} = \text{Clean Source Capacity} \div \text{Total Clean Energy Capacity}$$

$$\text{Share of Total} = 98391 \text{ MW} \div 466555 \text{ MW}$$

$$\text{Share of Total} = 21\%$$

The 2035 Capacity by source is calculated through the equation below.

$$2035 \text{ Capacity by Source} = 2035 \text{ Total Capacity} \times \text{Share of total by Source}$$

$$2035 \text{ Capacity by Source} = 1066.1 \text{ GW} \times 0.21$$

$$2035 \text{ Capacity by Source} = 223.9 \text{ GW}$$

The 2035 Clean Generation by source is calculated through the equation below.

$$2035 \text{ Clean Generation by source} = 2035 \text{ Capacity by source} \times \text{Capacity factor} \times 8760 \text{ Hours}$$

$$2035 \text{ Clean Generation by source} = 223.9 \times 90.80\% \times 8760 \text{ Hours}$$

$$2035 \text{ Clean Generation by source} = 1781 \text{ TWh}$$

Table 6

Feasibility Assessment: Projected Clean Energy Supply vs. Total Electricity Demand by 2035

Metric	Lower Bound	Upper Bound
Total 2035 demand (TWh)	5,471	5,821
Projected clean energy generation (TWh)	4,104	4,104
Gap (TWh)	1,366	1,716
Clean energy coverage (%)	75.0%	70.5%

Note. Total 2035 demand values are derived from Table 2 (author's projections based on Leppert, 2025; Schipper & Hodge, 2025; and Shehabi et al., 2024). Projected clean energy generation values are derived from Table 5 (author's projections based on U.S. Energy Information Administration capacity and capacity factor data).

The gap between electricity demand and supply is calculated through the equations below:

$$\text{Gap} = \text{Total 2035 demand} - \text{Projected Clean Energy Generation}$$

$$\text{Gap} = 5471 \text{ TWh} - 4104 \text{ TWh}$$

$$\text{Gap} = 5821 \text{ TWh} - 4104 \text{ TWh}$$

$$\text{Gap} = 1366 \text{ TWh}; 1716 \text{ TWh}$$

The clean energy coverage is calculated using the formula below:

$$\text{Clean Energy Coverage} = \text{Clean Energy Generation} \div \text{Total 2035 Energy Demand}$$

$$\text{Clean Energy Coverage} = 4104 \text{ TWh} \div 5471 \text{ TWh}$$

$$\text{Clean Energy Coverage} = 4104 \text{ TWh} \div 5821 \text{ TWh}$$

$$\text{Clean Energy Coverage} = 75.0\%; 70.5\%$$

Comparison and Feasibility Assessment

The comparison between projected clean energy supply and total electricity demand reveals a substantial shortfall. Under conservative demand assumptions, projected clean energy generation of 4104 TWh by 2035 covers approximately 75.0% of the total projected demand of 5471 TWh, leaving a gap of 1,366 TWh. Under the upper-bound demand scenario, the gap widens to 1716 TWh, with clean energy covering only 70.5% of total consumption. The projected capacity additions in 2035 would not even replace the current fossil fuel capacity of 710.9 GW, falling short by 135.9 GW of capacity before a single GW of new demand growth is even considered, further increasing the disparity between current growth and the target.

Sensitivity Analysis for the Paper's assumptions

To test the sensitivity of this analysis to the $\pm 2\%$ buffer added to the base growth rate of 15.77%, alternative buffers of $\pm 1\%$, $\pm 3\%$ and $\pm 4\%$ were tested using the same formula shown in the section "Total Energy Consumption Range of Data Centers in 2035". Table 6.1 below demonstrates the clean energy coverage and gap under each buffer width.

Table 6.1

Sensitivity Analysis of 2035 Feasibility outcomes to CAGR buffer ranges

Buffer Width	Lower Coverage	Bound	Upper Coverage	Bound	Gap Range (TWh)
±1%	74.0%		71.7%		1,443-1,618
±2% (used in analysis)	75.0%		70.5%		1,367-1,717
±3%	76.0%		69.2%		1,297–1,825
±4%	76.9%		67.9%		1,233–1,942

Note. The formula used is the same as in the section “Total Energy Consumption Range of Data Centers in 2035”. All values are the author’s own calculations, holding supply side projection constant while only changing data center demand CAGR.

Even at the widest tested buffer of 4%, which is double the buffer used for the analysis of the paper, 2035 demand ranges only from 67.9% to 76.9%, and the projected gap remains substantial at 1,233 to 1,942 TWh. This demonstrates that the paper’s central conclusion that 100% clean electricity by 2035 is not achievable under current trajectories is not sensitive to the buffer range chosen for the data center demand projection.

This analysis also holds 2024 capacity factors constant through 2035 rather than projecting source-specific efficiency improvements, since there is not enough reliable information to estimate how efficient the machinery will become, along with how many replaced or added with those capacity factors; keeping the capacity factors constant does not mean that the factors will not change in the future, but rather serves as a conservative simplification. To test its effect, generation was recalculated under scenarios of improved wind and solar capacity factors specifically, since these two are the primary focus of ongoing efficiency-improving R&D, such as taller turbine towers and bifacial solar panel design (National Renewable Energy Laboratory, 2024a, 2024b), and have more room for capacity factor improvements, unlike nuclear, which already operates at or near full capacity year-round (U.S. Energy Information Administration, n.d.).

Table 6.2

Sensitivity of 2035 Feasibility Outcomes to Capacity Factor Improvement

Scenario	Wind/Solar Adjustment	CF	Total Generation (TWh)	Gap Range (TWh)	Coverage Range
Base (constant, used in analysis)	No change		4,104	1,367–1,717	70.5%–75.0%
Modest improvement	+2%		4,213	1,258–1,608	72.4%–77.0%
Larger improvement	+5%		4,377	1,094–1,444	75.2%–80.0%

Note. All values are the author's original calculations. Total Generation uses the same source-weighted formula shown in Table 5. Gap and Coverage use the same formulas shown in Table 6. Only wind and solar capacity factors were varied; all other inputs (demand, non-wind/solar capacity factors, source shares) are held at their base-case values.

Even under the larger improvement scenario of +5%, projected 2035 generation reaches only 4,377 TWh, leaving a gap of 1,094 to 1,444 TWh and coverage of 75.2% to 80.0%. The final generation value is still well short of the 100% target, which demonstrates that capacity factor changes do not meaningfully alter the paper's conclusion.

To calculate the amount of capacity needed to reach the projected value, Table 7 calculates the blended capacity factor average for all clean energy sources, while Table 8 calculates such additions. The blended capacity is needed to realistically convert generation into capacity.

Table 7

Conversion of Capacity to Generation Weighted by Source

*The Clean Energy Gap: Quantifying the Feasibility of 100% U.S. Clean Energy Consumption by 2035
under Artificial Intelligence-Driven Demand Growth*

Source	2035 (GW)	Capacity Share of 1066.1 GW	Capacity Factor	Weighted Contribution
Nuclear	223.9	21%	90.80%	19.07%
Hydro	181.2	17%	34.60%	5.88%
Wind	346.5	32.5%	34.30%	11.15%
Solar PV	277.2	26%	23.20%	6.03%
Geothermal	6.4	0.6%	64.60%	0.39%
Biomass	25.6	2.4%	59.50%	1.43%
Total	1066.1	100%	—	43.95%

Note. Capacity factors from the U.S. Energy Information Administration (2025c), Table 4.8.B. Projected 2035 capacity and share of total capacity are derived from Table 5. Weighted Contribution is the author's original calculation.

Required Capacity Additions and Capital Needs

The weighted contribution equation used is shown below. The formula is repeated identically for each source in Table 7.

Weighted Contribution = Share of Clean Capacity × Capacity Factor by source

Weighted Contribution = 21% × 90.80% =

Weighted Contribution = 19.07%

Table 8

Required Capacity Additions to Close the Clean Energy Supply Gap by 2035

Metric	Lower Bound	Upper Bound
--------	-------------	-------------

*The Clean Energy Gap: Quantifying the Feasibility of 100% U.S. Clean Energy Consumption by 2035
under Artificial Intelligence-Driven Demand Growth*

Total 2035 demand (TWh)	5,471	5,821
Projected clean generation (TWh)	4,104	4,104
Gap (TWh)	1,366	1,716
Blended capacity factor	43.95%	43.95%
Hours in a year	8,760	8,760
Additional GW needed (GW)	355	446
Current annual clean energy additions (GW/yr)	~40–50	~40–50
Additional annual additions needed (GW/yr)	~32–41	~32–41
Required total annual additions (GW/yr)	~72–91	~72–91

Note. Gap and Demand values are from Table 6; blended capacity factor is from Table 7; Projected Clean Energy Generation is from Table 5. Current annual clean additions (40-50 GW/Year) are based on American Clean Power Association (2025), reporting 49 GW installed in 2024 and 37 GW in 2023. All values other than the current annual clean additions are the author's own calculations. Capacity additions should gradually increase to surpass the calculated constant-pace figure.

Additional Capacity Required is calculated using the formula below:

$$\text{Additional Capacity} = \text{Gap} \div (\text{Blended Capacity Factor} \times 8760 \text{ Hours}) \times 1000$$

$$\text{Additional Capacity} = 1366 \text{ TWh} \div (43.95\% \times 8760 \text{ Hours}) \times 1000$$

$$\text{Additional Capacity} = 1716 \text{ TWh} \div (43.95\% \times 8760 \text{ Hours}) \times 1000$$

$$\text{Additional Capacity} = 355 \text{ GW}; 446 \text{ GW}$$

Required total annual additions is calculated using the formula below:

$$\text{Required Total Annual Additions} = \text{Current annual additions} + (\text{Additional Capacity} \div 11 \text{ Years})$$

$$\text{Required Total Annual Additions} = 40 \text{ GW} + (355 \text{ GW} \div 11 \text{ Years})$$

$$\text{Required Total Annual Additions} = 50 \text{ GW} + (446 \text{ GW} \div 11 \text{ Years})$$

$$\text{Required Total Annual Additions} = 72 \text{ GW}; 91 \text{ GW}$$

To close this gap, the U.S. would need to add approximately 355 to 446 GW of clean energy capacity beyond what current growth trends project by 2035, calculated through using a blended weighted capacity factor of 43.95%. This calculates to approximately 32 to 41 GW of additional annual capacity additions beyond the current trajectory, bringing total required annual additions to approximately 72 to 91 GW, less than double the current rate at 40-50 GW per year sustained over eleven consecutive years (U.S. Energy Information Administration, 2025a).

The physical and financial constraints identified through the analysis of NextEra Energy, GE Vernova, and Constellation Energy directly explain why closing this gap under current conditions is unlikely to be feasible under assumptions modeled in this analysis. GE Vernova's multi-year equipment backlogs reflect a manufacturing sector already operating near capacity, where turbines and other generators are booked years in advance, and installation extends across multiple years. NextEra Energy, the largest renewable energy generator in the United States, added only 4.6 GW of new capacity in 2024. Even doubling NextEra's additions to 9.6 GW annually would represent only around 13% of the 72-91 GW required nationally. Constellation Energy's focus on optimizing existing assets rather than aggressive expansion is inconsistent with the aggressive expansion the 100% target demands.

Beyond physical constraints, the financial burden of the required expansion places the target further out of reach. GE Vernova's recent losses, driven by old contract pricing and material cost inflation, along with Constellation Energy's capacity contraction during its fossil fuel and natural gas transition, illustrate that currently, scaling clean energy carries substantial financial risks even for the largest and most established companies in the sector. Doubling annual capacity additions would require proportional increases in capital expenditure, workforce, grid management infrastructure, and maintenance obligations: costs that cannot be absorbed without sustained federal subsidization at a scale that has no precedent in U.S. energy policy.

Bridging the projected gap of 1366 to 1716 TWh would require a coordinated and unprecedented policy change to address multiple constraints simultaneously. Accelerated federal investment in grid infrastructure, streamlined and more efficient permitting processes for new generation and transmission projects, and expanded adoption of PPAs and VPPAs could collectively increase the pace of clean energy deployment, but each policy carries its own implementation timeline and political feasibility constraints. Regulatory reforms that reduce grid interconnection wait times, which currently sit at five or more years, would unlock significant capacity from projects already approved but awaiting connection. Without a sustained and comprehensive policy intervention of this scale, the trajectory of U.S. clean electricity expansion remains fundamentally misaligned with the requirements of achieving 100% clean electricity consumption by 2035.

To contextualize the timeline implied by current growth trends, this paper constructs a graphical model in which projected clean electricity generation in Appendix B, growing at 7.30% annually from a 2024 base of 491,102 MW, is compared against total projected electricity demand growing at a blended rate of 2.66% annually. The two curves intersect approximately **18 years** from 2024, suggesting that under current trajectories, clean energy generation would not fully meet total U.S. electricity demand until approximately 2042. This represents an upper bound rather than a precise forecast, since the 15.77% CAGR is unlikely to hold for two decades; the realistic crossover is likely earlier than 2042 but remains beyond 2035 under any scenario.

It is important to note that recent capacity addition data in 2026 suggests that capacity additions may approach the annual threshold of 72-91 GW identified as necessary to close the supply gap (U.S. Energy Information Administration, 2026a). However, this short-term acceleration largely reflects projects initiated under IRA tax incentives that have since been reduced or eliminated by the One Big Beautiful Bill Act, making sustained additions at this level financially uncertain beyond the near term. Reports from the CFR indicate that a potential cut in subsidies to the renewable sector of around \$500B over the next decade will take place because of the act (Beams & Subrahmanian, 2025). Given that companies like NextEra and GE Vernova rely heavily on federal tax incentives to justify large capital expenditures, the reduction of these subsidies directly undermines the financial case for the accelerated expansion the 100% target requires.

Broader Implications

The projections carry significant impact beyond energy policy, touching on financial markets, AI development, geopolitics, and the climate in the near future.

In financial markets, the identified supply gap highlights underinvestment in clean energy infrastructure relative to what the demand requires. The table below uses official cost per MW values to try and project how much capital it would take to close the gap.

Table 9
Technology Benchmark Capital Requirement

Source	Share of Capacity Mix	Cost per MW	Weighted Contribution
Nuclear	21.0%	\$8,255,000	\$1,733,550
Wind	32.5%	\$1,502,000	\$488,150
Solar PV	26.0%	\$1,396,000	\$362,960
Hydro	17.0%	\$3,280,000	\$557,600
Geothermal	0.6%	\$3,282,000	\$19,692
Biomass	2.4%	\$4,843,000	\$116,232
Total (covered)	99.5%	—	\$3,278,184
Blended Cost per MW	—	—	\$3,294,657

Note. All cost figures from the U.S. Energy Information Administration (2026c) from the Total Overnight Cost column, Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2026. This benchmark covers 99.5% of the projected capacity mix (the remaining 0.5% reflects rounding in the original source shares, see Table 5). Weighted contribution calculations are the author's original work using independently sourced cost data.

The calculations for the weighted contribution use the formula below, and repeated for each source. An example for nuclear is shown as:

$$\text{Weighted Contribution} = \text{Share} \times \text{Cost per MW}$$

$$\text{Weighted Contribution} = 0.21 \times \$8,255,000$$

$$\text{Weighted Contribution} = \$1,733,550$$

The Blended cost per MW is calculated as shown in the equation below:

$$\text{Blended Cost per MW} = \text{Sum of Weighted Contributions} \div \text{Percent Sum of Shares Covered}$$

$$\text{Blended Cost per MW} = \$3,278,184 \div 0.995$$

$$\text{Blended Cost per MW} = \$3,294,657$$

The Capital requirement is calculated through the formula below:

$$\text{Capital Requirement} = \text{National Gap} \times \text{CapEx per MW} \times 1000$$

$$\text{Capital Requirement} = 355 \text{ GW} \times \$3.29\text{M} \times 1000$$

$$\text{Capital Requirement} = 446 \text{ GW} \times \$3.29\text{M} \times 1000$$

$$\text{Capital Requirement} = \$1.17\text{T}; \$1.47\text{T}$$

Table 9 estimates the national capital requirement using independent, technology-specific capital costs from a single current EIA source, weighted by this analysis's projected 2035 capacity mix. This approach avoids the limitations of using any individual company as a national proxy, since firm-level costs reflect company-specific factors such as regulated infrastructure spending or project-specific cost overruns rather than representative national costs. Closing the projected capacity gap is estimated to require \$1.17 to \$1.47 trillion in capital investment.

In AI development, the energy constraints identified in this paper represent a potential physical ceiling on the continued scaling of artificial intelligence rather than talent being the constraint. Geopolitically, the inability to scale clean energy rapidly weakens national competitiveness not only in energy security, but also the race to attract energy-intensive industries like AI data centers, creating an opening for competitors such as China to overtake the U.S. in these sectors.

Finally, the climate implications of the timeline gaps are significant. A projected crossover date of approximately 2042 rather than 2035 represents a maximum addition of 7 years of fossil fuel dependence

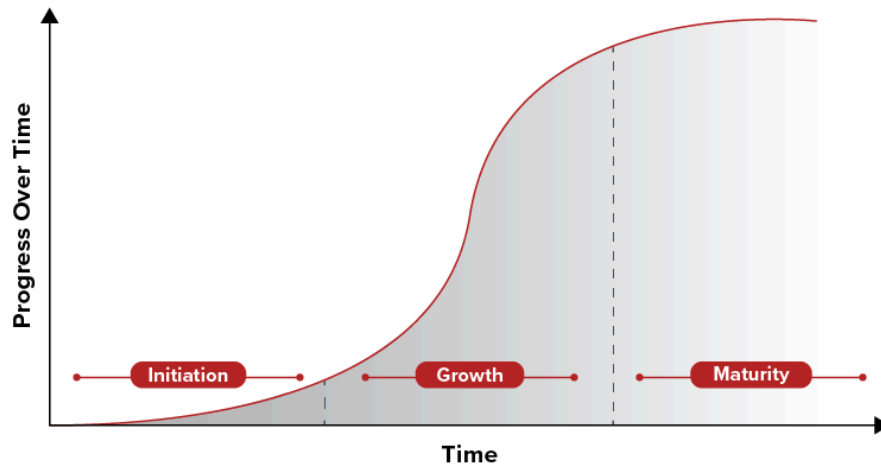
in the U.S. electricity sector beyond the target. Given that the electric sector is one of the largest sources of domestic carbon emissions, this delay has significant consequences to broader global efforts to limit climate change and carbon footprints deemed necessary by the U.N. This is compounded by the U.S. withdrawal from the Paris Agreement (Haskett, 2025), leaving U.S. carbon reduction efforts facing both a physical infrastructure constraint and a policy vacuum simultaneously.

CONCLUSION

This paper demonstrates that the United States is unlikely to achieve 100% carbon pollution-free electricity consumption under the assumptions and growth trajectory modeled by 2035. Employing a compound annual growth rate comparison framework, this paper projects total U.S. electricity demand of 5471 to 5821 TWh by 2035 against a projected clean energy generation of only 4104 TWh, which creates a shortfall of around 1366 to 1716 TWh, or about 25% to 29.5% of total consumption. Closing this gap would require additions of 72-91 GW annually, less than double the current rate, sustained over 11 consecutive years. This target appears increasingly difficult based on the model's assumptions, as manufacturing, infrastructure, backlog, and policy constraints under the One Big Beautiful Bill further hinder the progression of clean energy growth. Under current trajectories, clean energy generation is not projected to fully meet total U.S. electricity demand until a maximum of 7 years after the stated target. This paper concludes that, based on the modeled projections, 100% carbon pollution-free consumption in the U.S. is unlikely to be feasible under current conditions, and achieving it requires unprecedented levels of policy change, federal investment, and industrial growth scaled up to a pace the nation has not yet demonstrated the ability to sustain. These findings suggest the central barrier is not solely physical or political, but financial: absent a substantial expansion of external capital deployment beyond historical sector reinvestment levels, the underlying capacity gap is unlikely to close within the stated timeframe.

APPENDIX A

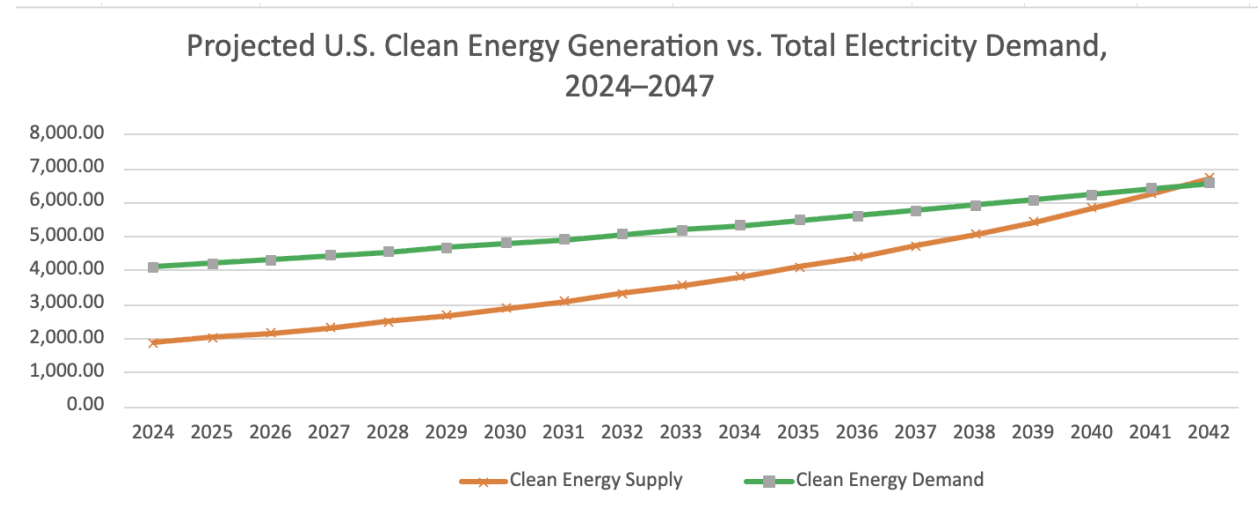
Common S-curve Growth Trend Visual



Note: Figure from Prometheus Group (n.d).

Appendix B

Graphical Analysis of Intersection of Clean Electricity Supply and Electricity Demand



Note. Supply curve represents projected annual clean electricity generation (TWh), growing at 7.30% (derived from “Calculated CAGR of Clean Energy Electricity Capacity” section) annually from a 2024 base of 491,102 MW (derived from Table 4), using a blended capacity factor of 43.95% (derived from Table 7). The demand curve represents projected total U.S. electricity consumption (TWh) growing at 2.66% annually (derived from “Energy Consumption Estimated to 2035” section) from a 2024 base of 4,100 TWh (derived from Table 2). Curves intersect at approximately 2042, since the supply exceeds demand in year 18, indicating the earliest year under current trajectories at which clean energy generation could fully meet total demand. The figure and underlying projections are derived from the author’s calculations, not from external charts or datasets. The supply crossover date is confirmed through the calculations below:

$CF = \text{Capacity Factor}$

$$\text{Supply}(t) = \text{Capacity}_{2024} \times (1 + \text{Supply CAGR})^{\text{time}} \times \text{Blended CF} \times 8760 \text{ Hours} \div 1000$$

$$\text{Supply}(18) = 491.1 \text{ GW} \times (1 + 0.073)^{18} \times 0.4395 \times 8760 \text{ Hours} \div 1000$$

$$\text{Supply}(18) = 6,721.9 \text{ TWh}$$

The demand crossover date is confirmed through the calculations below:

$$\text{Demand}(t) = \text{Demand}_{2024} \times (1 + \text{Demand CAGR})^{\text{time}}$$

$$\text{Demand}(18) = 4100 \text{ TWh} \times (1 + 0.0266)^{18}$$

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Demand (18) = 6,576.7 TWh

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