Data Center Power Play

How Clean Energy Can Meet Rising Electricity Demand While Delivering Climate and Health Benefits

HIGHLIGHTS

Data centers are poised to reshape the energy landscape in the United States in the coming years. Enacting policies to decarbonize the US power sector will ensure the country can meet the projected growth in electricity demand with clean energy while saving $1.6 trillion from harmful climate and health costs over the next decade.

Unmitigated data center growth puts the public at risk of large cost increases, from higher utility bills to public health costs to climate impacts. Increased transparency, greater accountability, and better planning are essential to guarantee responsible growth of electricity demand from AI and avoid overbuilding the electricity system.

Policymakers and regulators at every level of governance must use their authority—and standing—to ensure data centers are powered by clean energy and protect ratepayers by requiring data center operators to pay their fair share of new electricity costs.

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Key Findings

The United States can meet electricity demand from data centers primarily with clean energy and, at the same time, phase down fossil fuel use. US electricity demand could increase by 60 to 80 percent between 2025 and 2050, with data centers accounting for more than half of the increase by 2030. The nation can scale up renewable resources feasibly and cost-effectively, but meeting growing electricity demand and displacing coal and gas to achieve climate goals will require policy intervention.

The growth of data centers puts ratepayers at risk of large cost increases. Estimates of the cumulative electricity costs attributable to data centers from 2026 to 2050 range from $886 billion to $978 billion, representing 18 percent of total US wholesale electricity costs. These costs could get passed onto other consumers without policies requiring tech companies to pay their fair shares.

Clean energy policies reduce air pollution and heat-trapping emissions from fossil fuels. Without stronger clean energy policies, the additional fossil fuel generation used to power data centers results in an increase in annual US power plant emissions of carbon dioxide (CO_2) of 19 to 29 percent (229 to 342 million metric tons—MMT) by 2035. Restoring federal clean energy tax credits would reduce total US power plant emissions of CO_2 by 33 percent between 2026 and 2035, even if data center demand more than doubles. Additional policies to nearly decarbonize the power sector by 2050 would help limit future damages from extreme heat, drought, wildfires, flooding, and other climate impacts. These policies would also deeply cut harmful air pollutants that contribute to respiratory ailments, heart attacks, other illnesses, and mortalities.

The climate and health benefits of reducing fossil fuels outweigh the costs of transitioning to clean energy. The cumulative global climate benefits from reducing US heat-trapping emissions total $1.3 trillion to $1.6 trillion between 2026 and 2035, growing to $8 trillion to $13 trillion by 2050. Cumulative health benefits from reducing local air pollution range from $120 billion to $220 billion by 2050. These broader societal benefits far exceed the $412 billion (7 percent) increase in total US wholesale electricity costs from decarbonizing the power sector. Restoring federal clean energy tax credits lowers electricity costs by $248 billion (4 percent) compared with current policies.

With forward-looking policies, the United States can avoid the health and environmental harms associated with the unmitigated growth of data centers. Ensuring that data centers are efficient, flexible, and powered with clean energy requires stronger state and federal policies. Policymakers and regulators should require utilities and data center developers to be more transparent and accountable, improve long-term planning for meeting data center demand, and protect other customers from cost increases and negative health impacts.

Introduction

The US electricity sector is at an inflection point. After nearly two decades of flat demand, US electricity use is projected to surge over the next decade and beyond due primarily to the growth of data centers for artificial intelligence (AI). The emergence of large language models and other forms of generative AI has led to proposals for larger and larger "hyperscale" data centers, with some consuming more electricity than mid-sized cities (Marshall 2025). Over the longer term, greater electrification of transportation, buildings, and industry will drive up demand for electricity even further.

Until recently, data centers accounted for a small share of US electricity demand. Improved efficiency in energy use and computing power offset most of the past growth in demand. But the rise of AI has caused data center electricity use to more than double, from 1.9 percent of US electricity use in 2018 to 4.4 percent in 2023. By 2028, the proportion could increase to the range of 6.7 to 12 percent, according to a Lawrence Berkeley National Laboratory projection (Shehabi et al. 2024). Some projections are even higher (Pilz, Yusuf, and Lennart 2025; IEA 2025).

The number of data centers anticipated to be built in the United States and how much electricity they will need are both highly uncertain quantities. Recent actions by electric utilities indicate that many proposals to build data centers are redundant (Martucci 2025; Skidmore 2025). In addition, utilities, which earn a guaranteed return on investment, have an incentive to overestimate future demand. This could lead to overbuilding the electricity system, higher costs, and stranded assets (Carvallo et al. 2018; Sward et al. 2025). Also uncertain are efficiency improvements in AI training practices, data center hardware, software, and cooling technology, yet these all could significantly reduce demand or enable companies to increase data-processing capacity (Liebreich 2024; Lovins 2025).

A lack of transparency compounds the uncertainties, even for the utilities themselves. Proposals to build data centers, as with power plants to serve them, are typically confidential. Communities often lack information on energy use, water consumption, emissions, and other environmental impacts of proposed data centers (Wittenberg 2025; Hedgepeth and Isom 2025). Many communities already experience high levels of pollution from existing sources (NAACP 2025; Dulani and Zaidi 2025). And many local and state decisionmakers, seeking to attract multibillion-dollar investments, overlook these risks and sign confidentiality agreements with developers.

The stakes are high. How the nation and the states choose to power data centers and electrify the economy has important implications for energy affordability, grid reliability, climate change, and public health. A path that accelerates the clean energy transition can mitigate the harmful environmental and health impacts of data center development and operations while keeping overall costs affordable and limiting the worst impacts of climate change. But a path that increases reliance on fossil fuels to power AI will expose customers to greater volatility in fuel prices, lead to higher emissions, and result in adverse environmental, climate, and public health impacts.

OPTIONS FOR POWERING DATA CENTERS

The surge in demand from data centers comes at a time when the power sector, as well as the broader economic and policy environment, is undergoing a significant transition, leading to complicated questions about how to meet new electricity demand. While many utilities are turning to traditional resources like methane gas, the cost of new gas power plants has increased significantly over the past five years, and gas turbine shortages are causing delays of up to seven years in building new plants (DiGangi 2025; Webb and Plautz 2025; Cohen, Fitch, and Shwisberg 2025; GridLab, Energy Futures Group, and Halcyon 2025). Increases in exports of liquified natural gas are projected to lead to higher, more volatile prices for gas and electricity (EIA 2025a; Penrod 2025).

Fears of electricity supply shortfalls have led to proposals for other regressive solutions—for example, delaying the retirements of coal plants—that could not only mean even higher costs and adverse public health impacts but also jeopardize state and corporate climate goals (see box) (Goggin 2025; Tosado, Massey, and Daniel 2025; Behr, Northy, and Reilly 2025). Building new nuclear plants utilizing small modular reactors or advanced reactor designs would rely on unproven technologies that have long lead times, high projected costs, and important safety and security risks (Liebreich 2024; Lyman 2024; Lyman 2021).

Alternatively, combining wind and solar with battery storage and greater data center flexibility offers a promising solution for powering data centers and meeting overall electricity demand.[1] Deployment of wind, solar, and storage has accelerated, with more than 45 gigawatts (GW) of capacity added in 2024 and another 60 GW projected though the end of 2025. This represents 93 percent of total additions to US electricity capacity in 2025 (EIA 2025b).

Costs for wind and solar have fallen 70 to 90 percent over the last 15 years, making them cheaper in many cases than new gas and existing coal plants even without subsidies and before factoring in environmental and health benefits (Wiser et al. 2024; Seel et al. 2024; Lazard 2025). The lead time to plan and build wind and solar projects is also much shorter than it is for new gas or nuclear plants. Co-locating these projects near existing generators that have excess capacity and approved interconnection to the grid could allow for faster approval, while also reducing emissions, maintaining reliability, and lowering costs (Engel, Varadarajan, and Posner 2025).

In striking contrast to this forward momentum is the Trump administration's stated preference for using dirty, outdated fossil fuel generation to power emerging technology. Clean energy resources face significant headwinds due to rollbacks of federal incentives, restrictive administration actions, and the slow expansion of transmission capacity (Walton 2025). Even as the Trump administration boasts of leading the global AI race, it is sidelining the clean, plentiful, affordable, and efficient energy technologies that are best poised to power such a future, rendering the United States more vulnerable to international fuel price volatility.

The Union of Concerned Scientist (UCS) has analyzed the economic, health, and climate impacts of different approaches to meeting near- and longer-term demand growth under varying policies and assumptions. The results of our modeling inform recommendations calling on policymakers and regulators to require that utilities and data center developers increase transparency and accountability and do better long-term planning for meeting data center demand—and, at time same time, protect other customers from cost increases and negative health impacts. Ensuring that clean energy powers data centers also requires stronger state and federal policies, while utilities and big tech companies must follow through on their sustainability commitments. With climate and clean energy policies under federal attack, states, utilities, and corporations must continue pressing ahead with the clean energy transition.

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[1] Data center flexibility refers to the ability of data centers to reduce demand during periods of high demand or high stress on the grid (e.g., during extreme weather). While data center flexibility is not currently being deployed, big tech companies have initiated several pilot projects with utilities (Terrell 2025). It has the potential to significantly reduce peak demand and the need for new generation while lowering overall costs (Norris et al. 2025; Knittel, Senga, and Wang 2025; Cox, Schwartz, and Stenclik 2025).

Box 1. Powering Data Centers with Clean Energy Aligns with State Laws and Corporate Goals
Renewable Portfolio Standards (RPS) and Clean Electricity Standards (CES), which together set requirements for utilities to procure clean electricity, have been successful, cost-effective state-level policies for driving the deployment of renewable resources (Barbose 2024). As of August 2024, 29 states and the District of Columbia had adopted RPSs and CESs. Sixteen states have both an RPS target of at least 50 percent of retail electricity sales and a broader 100 percent CES that reaches these targets between 2040 and 2050. Paralleling moves toward clean energy in state policies, big tech companies like Google, Microsoft, Meta, and Amazon have committed to achieving 100 percent carbon-free electricity and net zero heat-trapping emissions across their operations and supply chains (Meta 2025; Amazon 2025; Brandt 2025; Smith and Nakagawa 2025). With those goals set for either 2030 or 2040, each of these companies has made major purchases of renewable energy and significantly reduced emissions from data centers. For example, Google entered into 170 agreements between 2010 and 2024 to purchase more than 22 GW of clean electricity, including procuring more than 8 GW in 2024 (Brandt 2025). Unfortunately, progress has been mixed. Google's overall emissions have risen 51 percent compared with a 2019 baseline. Microsoft's overall carbon footprint has increased more than 23 percent since 2020. And Amazon's emissions rose 6 percent in 2024 after two years of declines (Johnson 2025; Stiffler 2025a; Stiffler 2025b). Many utilities also have ambitious climate and clean energy goals. However, most utilities are failing to meet their commitments, according to a study of 75 of their long-term plans. Many are using load growth from data centers as a reason to delay retiring coal plants or to build new gas plants (Anderson 2025).

Methodology

UCS analyzed the impact of meeting projected growth in electricity demand from AI data centers. We modeled several policy and sensitivity scenarios using the National Renewable Energy Laboratory's (NREL) [2] Regional Energy Deployment System (ReEDS) electricity planning and dispatch model (Cole et al. 2024). The results of our modeling focus on changes over time in US electricity generation and capacity, carbon dioxide (CO_2) emissions, and electricity system costs. In addition, we calculated the public health benefits of reducing air pollution from fossil fuel generation.

MODELING ASSUMPTIONS

UCS based the assumptions used in its analysis primarily on the NREL's 2024 Standard Scenarios version of the ReEDS model and Annual Technology Baseline 2024 mid-case cost

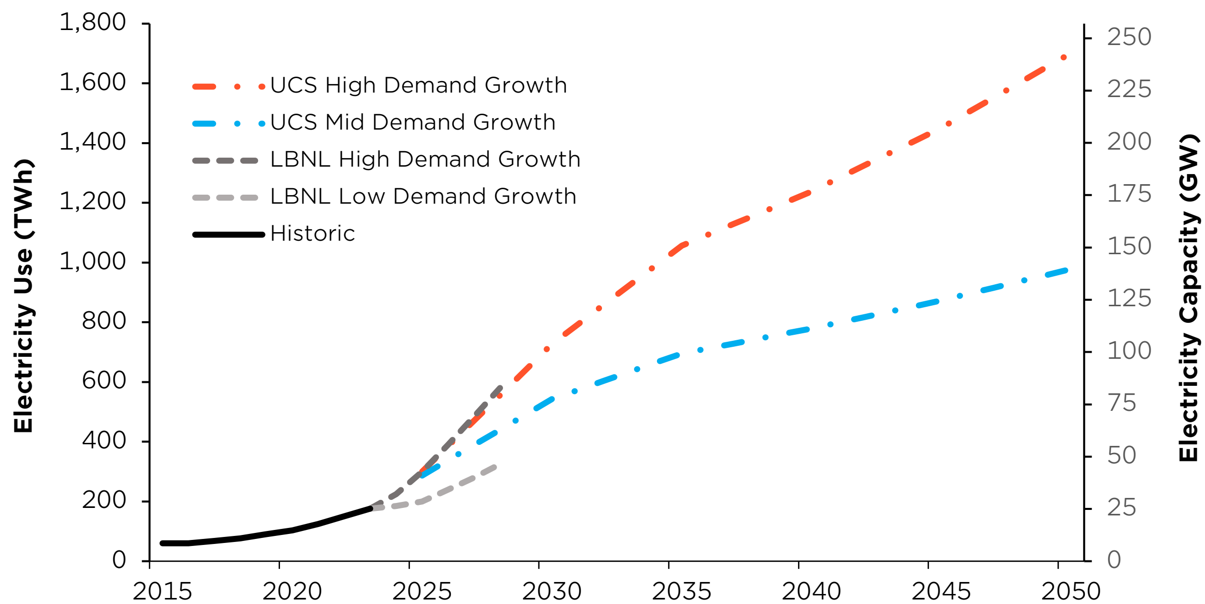
[2] *On December 1, 2025, the US Department of Energy announced that the National Renewable Energy Laboratory (NREL) would be renamed the National Laboratory of the Rockies. In our report and supporting materials, we have chosen to use the original name for clarity.*

and performance assumptions (NREL 2024; Gagnon et al. 2024), with these exceptions regarding electricity demand:

- We used electricity demand projections developed by Evolved Energy Research (EER) for its Annual Decarbonization Perspective 2024 report (Jones et al. 2024).
- Most of our scenarios used EER's reference load growth trajectory for data centers because this projection is in the middle of the range of most recent studies.
- We made adjustments to include more recent projections from S&P Global and announced data center projects in select states.
- To address the uncertainty in data center proposals, we assumed that half of the capacity from announced projects would actually be built and that it would take up to five years for projects to reach full capacity (MISO 2024a; S&P Global 2025).

The UCS projections for data center demand are consistent with those in a 2024 Lawrence Berkeley National Laboratory report informed by recent academic and industry studies (Figure 1) (Shehabi et al. 2024).

Figure 1. US Data Center Electricity Use and Capacity



UCS projections for data center demand growth are in the range of other studies. Total US data center capacity increases from 31 GW in 2023 to 78 GW under the UCS mid demand growth scenario in 2030 and to 104 GW in the high demand growth scenario. It increases to 140 GW in 2050 under the UCS mid demand growth scenario and to 243 GW in the high demand growth scenario.

We project overall demand to increase 62 percent between 2025 and 2050 under the UCS Mid Demand Growth scenario and 79 percent under the UCS High Demand Growth scenario. Data centers account for 46 to 59 percent of total demand growth by 2030 under these scenarios. However, this share falls as electrification increases in other sectors (especially transportation).[3] We made other assumption changes based on literature reviews and our analysis. For details, see the technical appendix.

MODELING SCENARIOS

UCS modeled three scenarios. One scenario represents current policies. Two scenarios represent stronger national climate and clean energy policies. Within each policy scenario, we modeled different levels of electricity demand attributable to data centers.

Current Policies scenario: This is a reference case scenario. It reflects recent changes in federal tax credits, as enacted by the One Big Beautiful Bill Act (OBBBA) on July 4, 2025. It excludes Environmental Protection Agency (EPA) power plant carbon standards; the EPA was in the process of repealing these when UCS conducted the modeling. It includes NREL's representation of state-level electricity sector policies adopted as of August 2024.

Restored Tax Credits scenario: This scenario includes the electricity sector tax credit provisions in the 2022 Inflation Reduction Act (IRA). As a point of comparison with the Current Policies scenario, it isolates the impacts of recent rollbacks in federal tax credits.

Low-Carbon Policy scenario: This scenario analyzes the impact of national policies to nearly decarbonize the power sector by 2050. It assumes the United States would reduce power-sector CO_2 emissions to 70 percent below 2026 levels by 2035, 80 percent by 2041, and 95 percent by 2050. This scenario includes policies that would:

- Restore federal tax credits for wind, solar, energy storage, and other low-carbon technologies after they expire under the OBBBA, using the IRA provisions as a proxy;
- Adopt federal power plant carbon standards in 2030, using as a stand-in EPA's rules finalized under the Biden Administration but delayed by five years; and
- Facilitate development of new transmission capacity needed to integrate higher levels of wind and solar, using NREL's assumptions for mid-case transmission availability.

We modeled each policy scenario under different levels of data center electricity demand, while assuming the same level of electricity demand in other sectors under all scenarios (Table 1):

- **Mid Demand Growth:** This scenario uses our core, mid-level assumption for data center demand growth.
- **No Demand Growth:** This counterfactual scenario enabled UCS to isolate the impacts of data centers.

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[3] *As electrification of other sectors grows, the share of electricity demand growth from data centers falls to 27 percent by 2050 under our Mid Demand Growth scenario and 55 percent under our High Demand Growth scenario. However, UCS based our electricity demand projections for other sectors on data from Evolved Energy Research that only included modest increases in electrification. Using EER projections for a high-electrification scenario that would be necessary for the United States to reach economy-wide net zero emissions by 2050, the data center share of total demand growth would fall to 17 to 29 percent by 2050 under the Mid and High Demand Growth cases (Jones et al. 2024).*

- **High Demand Growth:** This is a sensitivity scenario. It assumes data center electricity demand to be near the higher end of the range of recent projections.

Table 1. Key Assumptions for Modeling Scenarios

Scenario	Data Center Demand Growth	Federal Tax Credits	EPA Power Plant CO_2 Standards	NREL Transmission Availability	CO_2 Reduction Policy
Current Policies	**None**	OBBA	No	Low	No
	Mid	OBBA	No	Low	No
	High	OBBA	No	Low	No
Restored Tax Credits	**None**	IRA	No	Low	No
	Mid	IRA	No	Low	No
	High	IRA	No	Low	No
Low-Carbon Policy	**None**	IRA	Yes	Mid	95% by 2050
	Mid	IRA	Yes	Mid	95% by 2050

UCS modeled three national policy scenarios assuming three different levels of data center demand growth, transmission investment, and combinations of clean energy and emission reduction policies.

MODEL AND POLICY LIMITATIONS AND OPPORTUNITIES FOR FUTURE RESEARCH

The UCS analysis did not include the impacts of several recent but highly uncertain changes in energy policy and technology. While we assumed that the Trump administration would delay offshore wind deployment and repeal EPA power plant carbon standards, we did not include the potential impact of other recent actions that could limit deployment of wind, solar, and storage.

We did not explicitly include the impacts of recent Trump administration actions to increase deployment of fossil fuels and nuclear power. We also did not include the increased costs and limited availability of gas turbines and potential increases in gas prices triggered by administration policies to increase liquified natural gas exports; these could result in a lower contribution from gas than shown in our analysis. In addition, we did not include the impact of new tariffs on technology costs and energy prices, which vary by technology. Also, ongoing changes in tariff policies make it highly difficult to estimate the impacts.

We did not consider the potential for increased operational flexibility at data centers, which recent studies show could reduce peak loads, reduce the need for new generation, and lower overall costs (Norris et al. 2025; Knittel, Senga, and Wang 2025; Cox, Schwartz, and Stenclik 2025). Although data center flexibility solutions are not fully proven, pilot projects are underway. For example, Google is working with utilities in three states to increase demand flexibility during periods of high demand by shifting model training workloads and reducing data center power usage (Terrell 2025).

ReEDS can provide a solid understanding of the evolution of US electricity generation, storage, transmission, and production technologies, but more localized and temporally granular reliability analysis would be needed to identify the preferred mix for any specific location. ReEDS represents a broad range of technology types but not individual units, transmission lines, or detailed operating characteristics. Also, it only includes a sample of representative time periods within a year. It neither directly links storage nor assumes it to be co-located with renewable energy technologies. Nor does ReEDS consider long-duration energy storage.

While our electricity demand forecast includes modest increases in electrification in the transportation, buildings, and industrial sectors, further electrification would be needed to achieve economy-wide net zero emissions by 2050 (Clemmer et al. 2023; Jones et al. 2024). Because ReEDS is an electric power system model, we did not capture reductions in energy costs and emissions that would result from replacing fossil fuel use with clean electricity in other sectors.

Modeling yields an approximation of the least-cost generation mix needed to meet data center demand under a given policy scenario. Our results may not reflect actual decisions made by data center developers and utilities that the model does not consider cost-effective. Because ReEDS is a least-cost planning model, it does not capture proposals by large tech companies to pay above-market costs to restart existing nuclear plants, build new nuclear plants, or install other behind-the-meter generation to power data centers.

Modeling Results

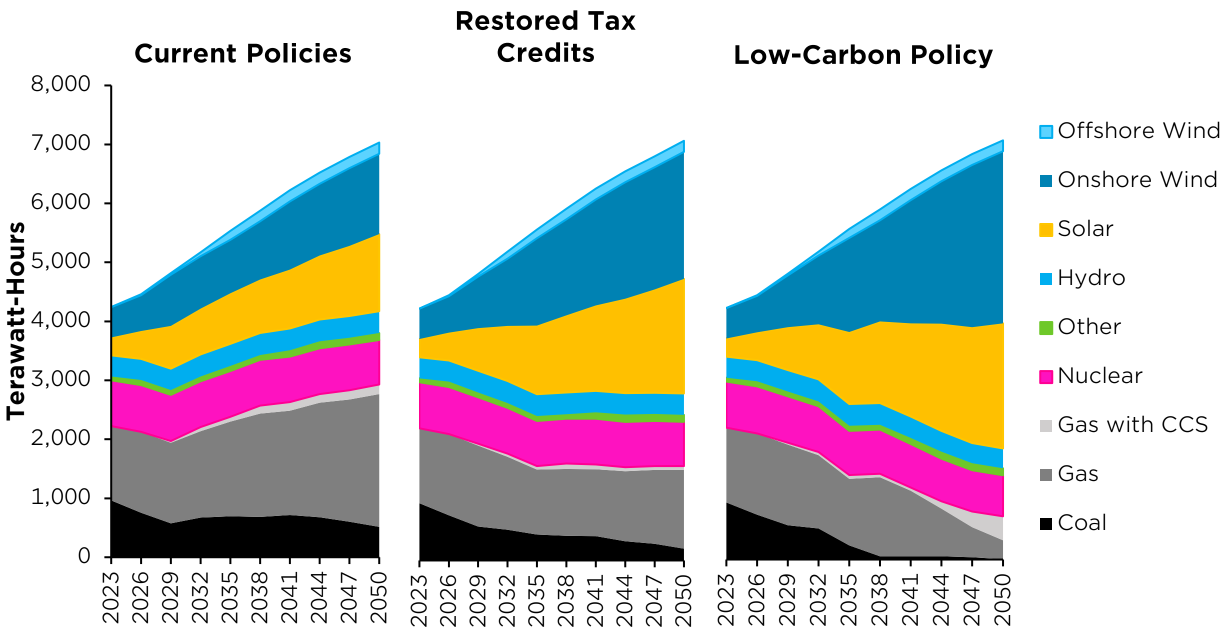
The United States can meet the growth of electricity demand from data centers and modest electrification of other sectors primarily with clean energy, while phasing down the use of fossil fuels and providing important economic, climate, and public health benefits.

Taken together, our results show that powering data centers with clean energy is more affordable, safer, and healthier than using fossil fuels. However, these beneficial outcomes require stronger federal, state, and local policies.

CURRENT POLICIES INCREASE RELIANCE ON FOSSIL FUELS

Under the Current Policies scenario, the United States risks increasing its reliance on fossil fuels to meet the growth in electricity demand from data centers and other sectors (Figure 2; Table 2). To supply this power, the nation adds more than 90 GW of new gas capacity between 2026 and 2035 and 335 GW by 2050 (Figure 3). Coal generation declines between 2026 and 2029 in response to planned retirements; it then remains relatively flat despite continued retirements; remaining coal plants are dispatched more to help meet the growth in demand.

Figure 2. Electricity Generation



Under the Restored Tax Credits and Low-Carbon Policy, Mid Demand Growth scenarios, wind and solar meet most of the growth in electricity demand from data centers and the electrification of other sectors; reliance on gas and coal generation greatly diminishes. "Other" includes biopower, geothermal, hydrogen combustion turbines, and oil and gas steam plants.

Wind and solar generation increase under Current Policies to help meet demand growth and the requirements under states' climate and clean energy policies. Significant growth in wind and solar occurs through 2029 when tax credits are potentially available for projects that meet the beginning of construction and safe-harbor requirements. Growth is much slower after the tax credits expire. [4]

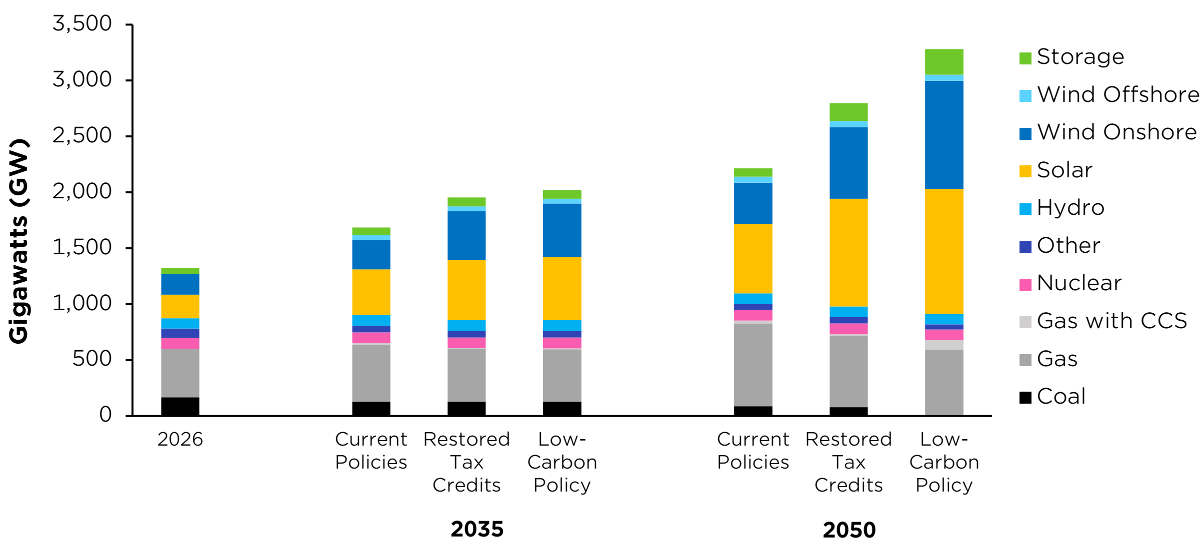
[4] *In updated guidance issued on August 15, 2025, the Internal Revenue Service (IRS) revised beginning-of-construction and safe-harbor tax credit eligibility requirements for wind and solar projects. Construction is considered to have started if projects can demonstrate that physical work of a significant nature has begun onsite or offsite of the energy facility property. Previous IRS "safe harbor" guidance also allowed projects that incurred 5 percent or more of total costs to be eligible. The updated IRS guidance only allows smaller solar projects with a nameplate capacity of less than 1.5 MW (AC) to qualify. Wind and solar projects meeting these requirements before July 4, 2026, have up to four years to be placed in service to qualify for the tax credits. If they do not meet these requirements, projects must be placed in service by December 31, 2027 (Sweeney, Hanlon, and Kaercher 2025). For our modeling, we assumed that larger wind and solar projects could meet these requirements and receive tax credits until July 4, 2030. See the technical appendix for more details.*

Table 2. Changes in Electricity Generation (Change Relative to 2026 Levels, Mid Demand Growth)

Technology	Current Policies		Restored Tax Credits		Low-Carbon Policy	
	2035	2050	2035	2050	2035	2050
Wind and Solar	75%	161%	152%	286%	169%	374%
Gas	23%	77%	-16%	2%	-13%	-47%
Coal	-8%	-32%	-42%	-74%	-69%	-99%

The Current Policies scenario increases US reliance on fossil fuels to meet electricity demand growth from data centers and electrification of other sectors. While wind generation and solar generation increase under all scenarios, it is more than twice as high in 2035 and 2050 under the Low-Carbon Policy scenario compared with Current Policies.

Figure 3. Electric Generating Capacity

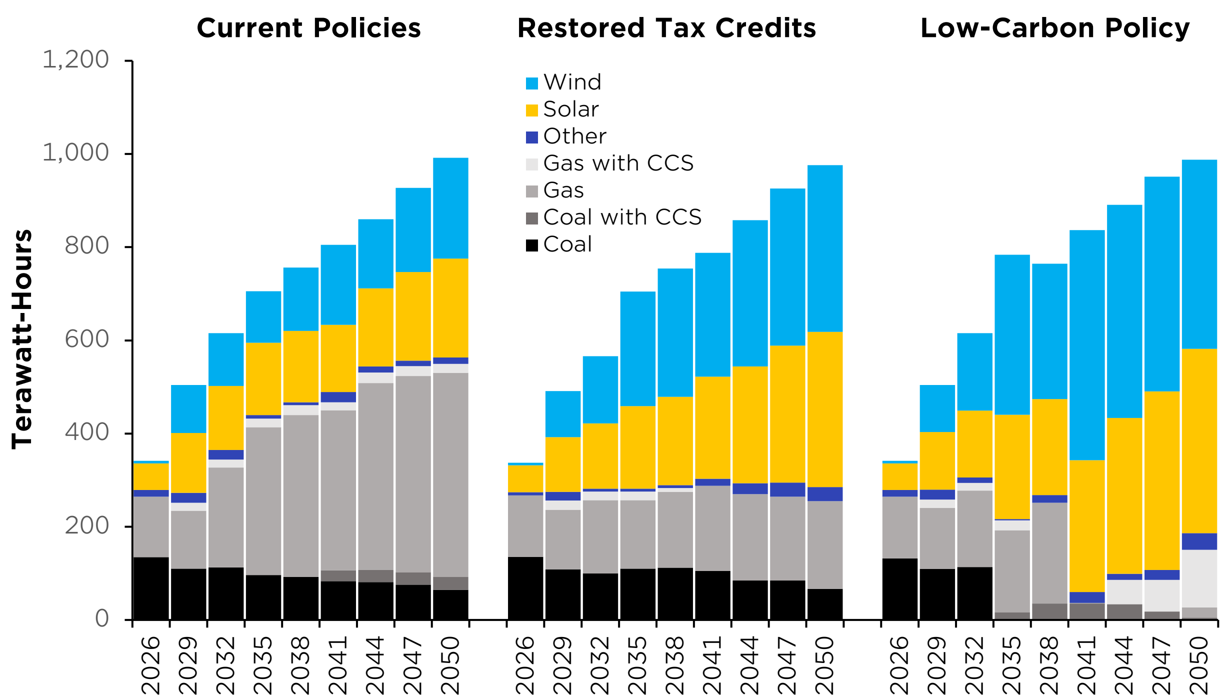


US solar and wind capacity is 616 GW to 1,096 GW higher by 2050 under the Restored Tax Credits and Low-Carbon Policy, Mid Demand Growth scenarios than under the Current Policies scenario; gas capacity is 97 GW to 115 GW lower by 2050. To integrate higher levels of wind and solar, total battery storage capacity increases four to six times the 2026 levels, reaching 125 GW to 188 GW by 2050. "Other" includes biopower, electrolyzers, geothermal, hydrogen combustion turbines, and oil and gas steam plants. "Storage" includes batteries and pumped hydro.

While most existing nuclear plants continue to operate through 2050, no new nuclear capacity is added, as it is more expensive than other options even with tax credits available through 2035. Because ReEDS is a least-cost planning model, it does not capture proposals by big tech companies to pay above-market costs to restart existing nuclear plants or build new ones to power data centers.

Isolating the impacts of data center demand, under the Current Policies scenario more than 60 percent of the generation needed to power data centers comes from gas and coal by 2035. Wind and solar provide nearly 40 percent (Figure 4).

Figure 4. Isolating the Impacts of Data Centers on Electricity Generation



To isolate the impact of data centers on electricity generation, the charts show the difference between the Mid and No Demand Growth scenarios for each policy scenario. Under the Current Policies scenario, more than 60 percent of the generation for data centers comes from gas and coal by 2035, with nearly 40 percent from wind and solar. Wind and solar generation are much higher under the two clean-energy policy scenarios, representing 60 to 70 percent of data center generation between 2035 and 2050 under the Restored Tax Credits scenario, and 70 to 90 percent under the Low-Carbon Policy scenario. "Other" includes biopower, geothermal, hydrogen combustion turbines, and oil and gas steam plants.

STRONGER POLICIES ENSURE THAT CLEAN ENERGY POWERS DATA CENTERS

Restoring tax credits accelerates the deployment of wind and solar to power data centers. It also reduces reliance on gas and coal generation to meet the growth in electricity demand.

Adopting policies to reduce US power sector emissions of CO_2 to 95 percent below 2026 levels by 2050 would go even further, facilitating the clean energy transition to help meet economy-wide emission reduction targets. Wind and solar generation nearly triple between 2026 and 2035 and increase five-fold by 2050 to replace coal and gas. Combined, all renewable energy sources provide more than 60 percent of total US electricity generation by 2035 and 81 percent by 2050. Total low-carbon generation from renewables, nuclear, and carbon capture and storage (CCS) supply 75 percent of US electricity generation in 2035 and 97 percent by 2050.

To meet the emission reduction targets and comply with power plant carbon standards, coal generation is nearly phased out by 2038. Gas generation stays relatively flat through 2038 and then declines to 10 percent of US electricity generation by 2050. Gas with CCS increases near the end of the forecast, providing more than half of remaining gas generation in 2050. Most existing nuclear plants continue to operate through 2050. A small amount of new nuclear capacity (2.3 GW) is added near the very end of the forecast.

Under the Restored Tax Credits scenario, nearly half of the generation for data centers comes from gas and coal through 2032, but after that wind and solar meet nearly all of the growth in data center demand. Under the Low-Carbon Policy scenario, wind and solar meet most of the growth in demand from data centers; these sources replace generation from conventional coal and gas plants in the later years of the forecast. Gas with CCS and a small amount of coal with CCS also increase in the later years under the Low-Carbon Policy scenario.

THE ROLE OF GAS PLANTS CHANGES IN A DECARBONIZED ELECTRICITY SYSTEM

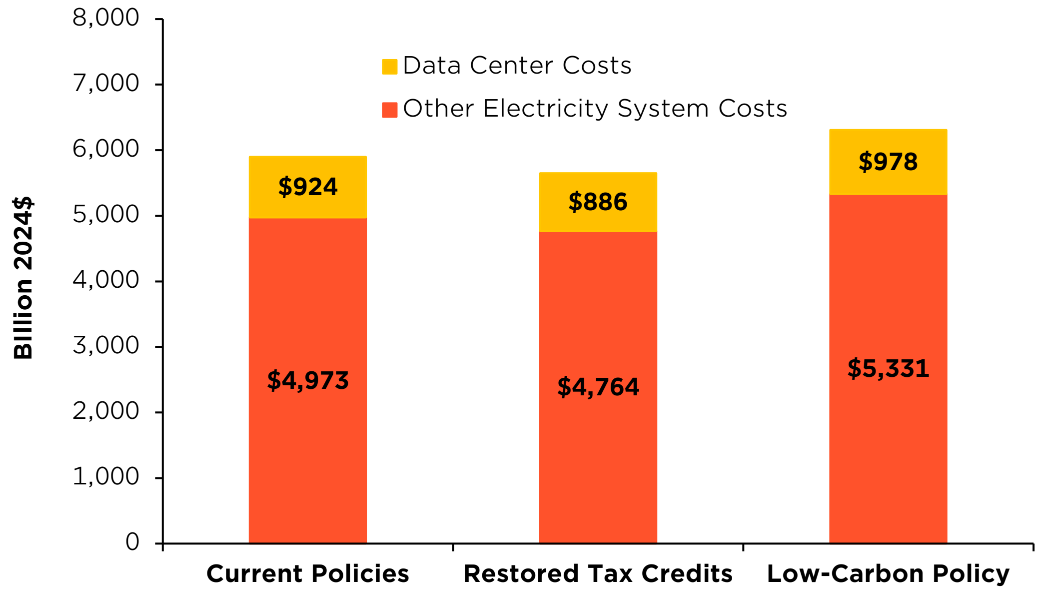
Gas capacity increases by a modest amount to meet the increase in demand during the transition to clean energy resources, but use of that capacity dramatically declines over time. By 2050, conventional gas plants (without CCS) operate at 6 percent of their rated capacity on average across the United States, down from 36 percent in 2026, as they help maintain reliability and integrate high levels of wind and solar over longer, seasonal timeframes.

MEETING THE GROWTH OF DATA CENTER DEMAND INCREASES ELECTRICITY COSTS

Data center growth puts electricity ratepayers at risk of large cost increases. Wholesale electricity costs attributable to data center-driven demand growth range from $411 billion to $524 billion, cumulatively from 2026 to 2035 and $886 billion to $978 billion from 2026 to 2050. This represents 18 to 24 percent of total costs across the three scenarios (Figure 5).

Restoring federal clean energy tax credits results in higher cumulative electricity costs of $202 billion (8 percent) from 2026 to 2035, but cumulative savings of $248 billion (4 percent) through 2050 compared with the Current Policies scenario. Adopting more ambitious climate and clean energy policies under the Low-Carbon Policy scenario results in slightly higher costs of $291 billion (12 percent) from 2026 to 2035 and $412 billion (7 percent) through 2050 compared with Current Policies.

Figure 5. Data Center Share of US Electricity System Costs, 2026-2050



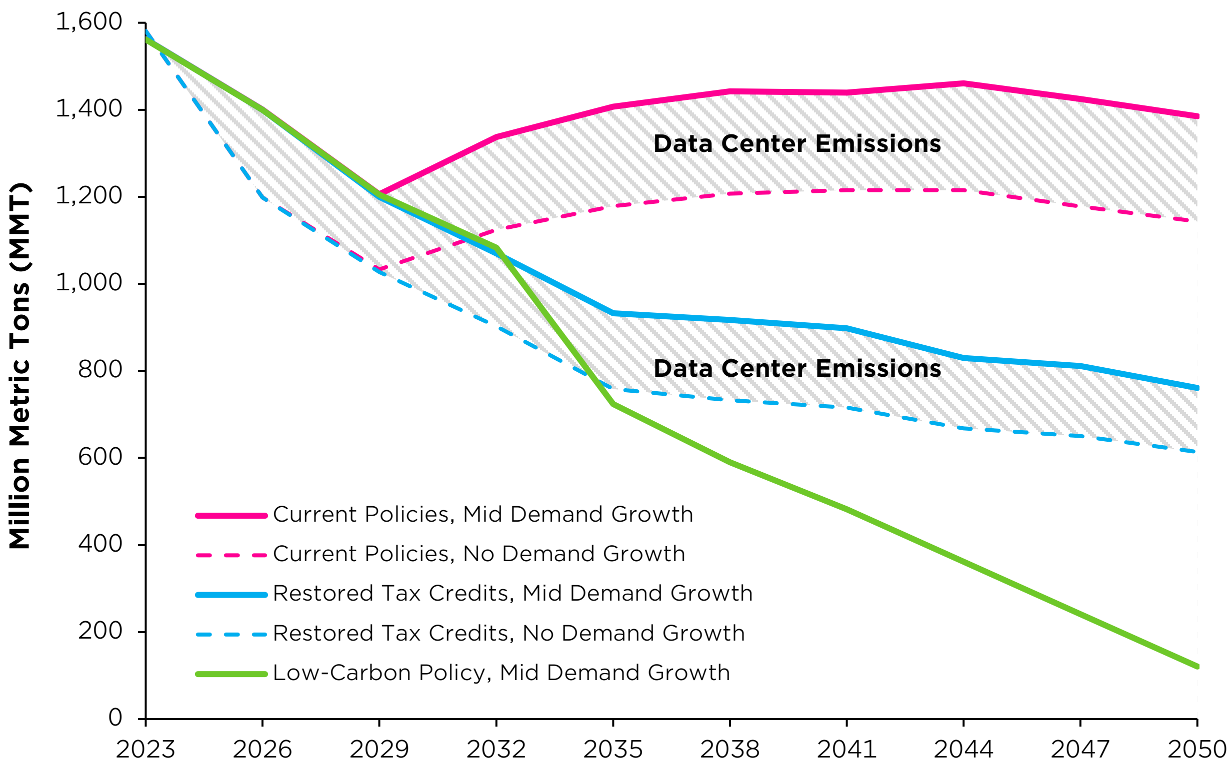
Across all three scenarios with Mid Demand Growth, the costs that can be attributed to data center demand represent more than 18 percent of total electricity system costs.

INVESTING IN CLEAN ENERGY REDUCES HEAT-TRAPPING EMISSIONS AND AIR POLLUTION

Under the Current Policies scenario, reliance on fossil fuels to power data centers and meet overall US electricity demand results in higher power plant CO_2 emissions, jeopardizing science-informed climate goals and resulting in greater climate-related damages (Figure 6) (Biden Administration 2024). CO_2 emissions decline between 2023 and 2029 as growth in wind and solar generation, accelerated by tax credits, replaces retiring coal generation and limits increases in gas generation. However, after tax credits for wind and solar expire, CO_2 emissions steadily increase as gas generation grows and more coal generation sticks around to meet demand growth.

The additional fossil fuel generation used to power data centers increases the annual CO_2 emissions from US power plants by 19 percent (229 MMT) by 2035 under Current Policies when comparing the No Demand Growth scenario with the Mid Demand Growth scenario. In contrast, CO_2 emissions continue declining after 2029 in the Restored Tax Credits and Low-Carbon Policy scenarios as much higher levels of wind and solar generation replace coal and gas.

Figure 6. Power Plant CO_2 Emissions



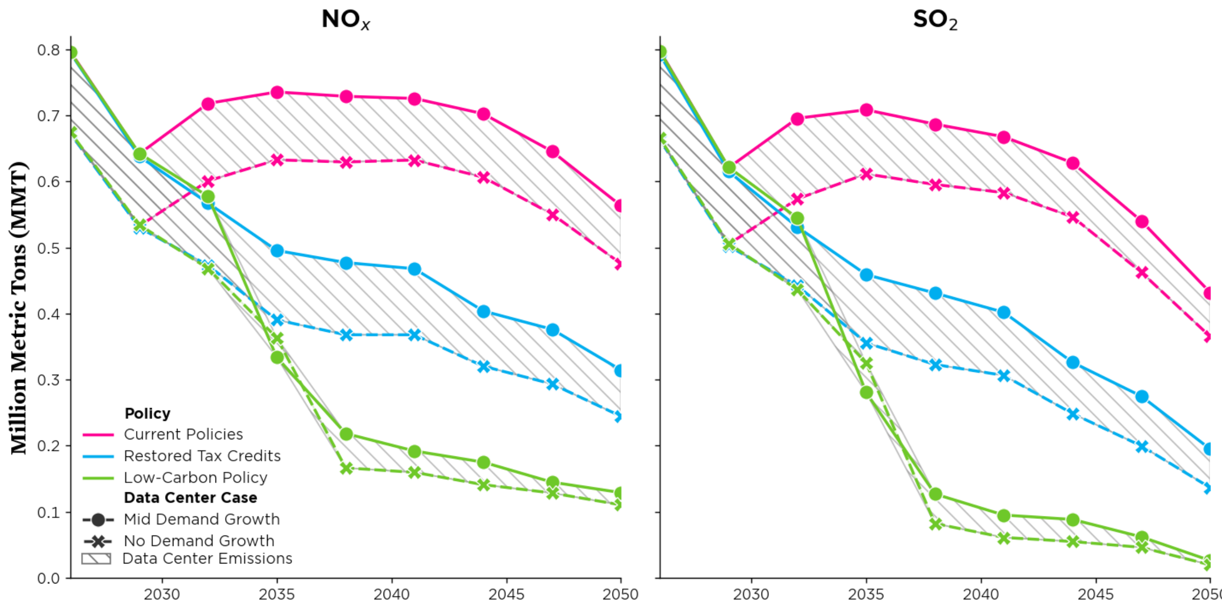
Under the Current Policies scenario, CO_2 emissions steadily increase after tax credits for wind and solar expire. Under the two clean energy policies, emissions continue to decline. The difference between Mid and No Demand Growth for each of the policy scenarios shows the emissions attributable to data centers.

THE CLIMATE AND HEALTH BENEFITS OF REDUCING FOSSIL FUEL USE OUTWEIGH THE COSTS OF THE CLEAN ENERGY TRANSITION

Replacing electricity generation from fossil fuel combustion with clean electricity resources yields important public health benefits. It decreases emissions of the harmful air pollutants, such as nitrogen oxides (NOx) and sulfur dioxide (SO_2), that contribute to respiratory ailments, heart attacks, other illnesses, and even mortalities (Lelieveld et al. 2023) (Figure 7).

The transition also results in a significant reduction in the heat-trapping emissions that drive climate change, which yields towering economic benefits by reducing future damages from climate impacts (EPA 2022). Between 2020 and 2024, the United States experienced 115 extreme weather and climate disaster events, each with losses exceeding $1 billion and causing more than $746 billion in total damages (NOAA 2025). Without action to curb emissions, these costs will continue to grow as the severity and frequency of extreme weather and climate disasters increase.

Figure 7. Power Plant Emissions of Nitrogen Oxides and Sulfur Dioxide



Replacing electricity generation from fossil fuel combustion with clean energy under the Low-Carbon Policy and Restored Tax Credits scenarios results in significant reductions in harmful NOx and SO_2 emissions. The difference between the Mid and No Demand Growth cases for each of the policy scenarios shows the emissions attributable to data centers.

Table 3. Reductions in Power Plant Emissions (Change Relative to 2026 Levels, Mid Demand Growth)

	Current Policies		Restored Tax Credits		Low-Carbon Policy	
	2035	2050	2035	2050	2035	2050
CO_2	1%	-1%	-33%	-46%	-48%	-91%
NO_x	-8%	-29%	-38%	-60%	-58%	-84%
SO_2	-11%	-46%	-42%	-75%	-65%	-97%

Investing in clean energy results in significant reductions in heat-trapping emissions and air pollution from coal- and gas-fired power plants.

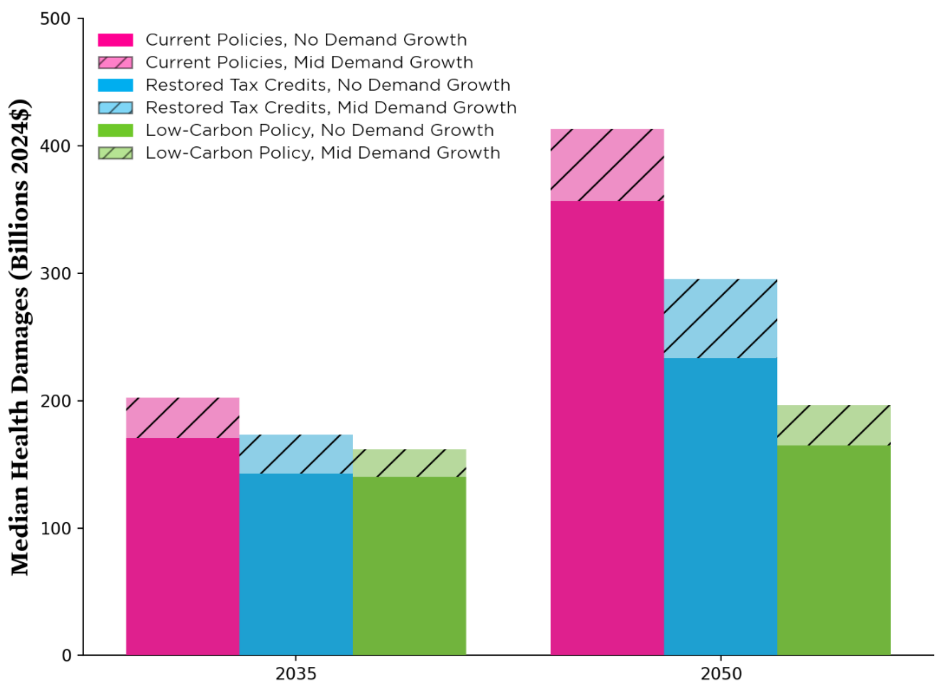
The increases in air pollution and heat-trapping emissions that result from using fossil fuels to power data centers also results in tens of billions of dollars of health costs and trillions of dollars in climate damages under Current Policies (Table 4 and Figure 8). Adopting clean energy policies as reflected in the Low-Carbon Policy scenario would result in much lower costs compared with Current Policies.

Table 4. Climate and Health Damages from Additional Data Center Demand

	Current Policies		Low-Carbon Policy	
	2035	2050	2035	2050
Climate Damages (billions 2024$)	$1,547	$4,423	$1,165	$1,754
Median Health Damages (billions 2024$)	$32	$57	$24	$31
Median Additional Mortalities	998	1,777	672	977

Adopting clean energy policies would help lower climate and health damages from powering data centers. These costs represent the cumulative net present value climate and health damage costs from 2026 to 2035 and 2026 to 2050.

Figure 8. Data Center Share of Health Damages



The health damages from fossil fuel power plants that can be attributed to data center demand is $32 billion in 2035, representing 16 percent of total health damages under the Current Policies scenario. The data center share of health damages is slightly lower under the Restored Tax Credit scenario by 2035, but much lower under the Low-Carbon Policy scenario. And the overall health costs of the two clean energy policy cases are much lower by 2050 than Current Policies. These costs represent the cumulative net present value health damages from 2026 to 2035 and 2026 to 2050.

CLEAN ENERGY POLICIES SAVE LIVES AND LOWER HEALTH COSTS

Reducing emissions of NOx and SO_2 avoids thousands of premature deaths and saves billions of dollars due to avoided mortalities. This underscores the importance of a rapid clean energy transition to reduce the public health harms resulting from fossil fuel-fired electricity generation.

AVOIDING CLIMATE IMPACTS SIGNIFICANTLY BOOSTS OVERALL BENEFITS

Unlike public health damages, for which the impacts are more local, the damages from climate change are global, affecting the United States and other countries. These impacts include, but are not limited to, property damage, changes in agricultural productivity, and disrupted energy systems resulting from extreme heat, drought, wildfires, flooding, extreme weather, and other impacts. Using the social cost of carbon (EPA 2022), the Restored Tax Credits and Low-Carbon Policy cases deliver $8.3 trillion to $13.1 trillion in avoided climate damages when compared with Current Policies (Table 5).

Table 5. Total Climate and Health Benefits of Clean Energy Policies

	Restored Tax Credits		Low-Carbon Policy	
	2035	2050	2035	2050
Climate Benefits (billions 2024$)	$1,350	$8,350	$1,610	$13,120
Median Health Benefits (billions 2024$)	$30	$120	$40	$220
Median Avoided Mortalities	940	3,750	1,250	6,875

Stronger clean energy policies yield important public health and climate benefits as clean energy replaces fossil fuels and reduces emissions. The benefits represent the cumulative net present value climate and health benefits from 2026 to 2035 and 2026 to 2050 compared with the Current Policies, Mid Demand Growth scenario.

WITHOUT STRONGER POLICIES, HIGH DATA CENTER DEMAND RESULTS IN ADDITIONAL EMISSIONS AND COSTS

Without stronger policies, high growth of data center demand results in greater reliance on fossil fuels, higher emissions, and additional costs. Under the Current Policies, High Demand Growth scenario:

- **Generation from gas and coal** is 11 percent higher by 2035 and 15 percent higher by 2050 than the Mid Demand Growth scenario.
- **Power plant CO_2 emissions** from data centers are 342 MMT in 2035 and 416 MMT in 2050, which is 50 to 72 percent higher than the Mid Demand Growth scenario.
- **Electricity system costs** that can be attributed to this higher data center demand exceed $1.6 trillion, cumulatively, from 2026 to 2050. This is 73 percent higher than the Mid Demand Growth scenario costs of $924 billion.

ADOPTING CLEAN ENERGY POLICIES LIMITS EMISSIONS AND COST INCREASES FROM HIGH DATA CENTER DEMAND GROWTH

Under the Restored Tax Credits, High Demand Growth scenario, wind and solar generation meet most of the increased demand while the share of gas and coal generation gradually declines. Power plant CO_2 emissions are 44 percent (690 MMT) lower in 2050 than in the Current Policies, High Demand Growth scenario; electricity system costs are $292 billion (4 percent) lower.

Recommendations for Policymakers, Regulators, Utilities, and Big Tech Companies

The UCS modeling illustrates that clean energy can meet the challenge of increased demand caused by data centers even as the electricity sector simultaneously transitions away from fossil fuels. Our recommendations provide a starting point for ensuring that primarily clean, affordable, and healthy energy sources power new load growth from data centers and electrification, rather than meet new demand by increasing the nation's reliance on dirty and outdated fossil fuels. This outcome will require action at both the state and federal levels. State Public Utility Commissions (PUCs) have jurisdiction over retail electricity sales and rates; the Federal Energy Regulatory Commission (FERC) has jurisdiction over interstate transmission, wholesale electricity markets and rates, and the setting of reliability standards.

The UCS recommendations are broad in scope, drawing not only on insights from our modeling but also from on-the-ground advocacy, best practices emerging at the state and regional levels, and other policy and regulatory changes needed to accelerate the clean energy transition.

REQUIRE DATA CENTERS TO PAY FOR ADDITIONAL ELECTRICITY COSTS

State PUCs should require data centers and other large electricity customers (such as manufacturing facilities) to pay a fair share of any incremental costs for generation, transmission, grid upgrades, and operations, ensuring that these costs do not fall on other ratepayers. In our analysis, the cumulative costs of meeting data center electricity demand could be more than $900 billion by 2050, representing more than 18 percent of total US electricity system costs. Minimum revenue obligations, as well as prepayments or letters of credit for those costs, should be conditions for utilities to serve data center customers.

Regulators must hold utilities accountable for developing new electricity supplies required by data centers, basing accountability on firm commitments with financial backing from data center customers. The Federal Energy Regulatory Commission should also require utilities to utilize rate-setting processes to track transmission costs caused by specific customers. States must then require data center customers and other large loads to pay the costs of direct transmission connection. State PUCs should require utilities to recognize these costs in retail-cost-of-service studies so that costs can be allocated appropriately (Jacobs 2025).

State PUCs should require utilities to develop tariffs and other rate structures that lead data centers to acquire 24/7 carbon-free electricity (CFE) and protect other customers from rate increases; such requirements should build off current examples from leading states (Linvill et al. 2024; Fisher et al. 2024). The requirements should include mandates to procure additional, deliverable, and time-matched clean energy.

"Bring your own capacity and energy" is another 24/7 CFE model that enables data centers to identify resources that meet their own needs while the utility serves as purchaser, schedules the delivery of power, and passes costs and benefits to the buyer. Data centers and other large customers can also directly procure 24/7 CFE from suppliers through power purchase agreements.

REQUIRE UTILITIES TO CONDUCT LONG-TERM PLANNING FOR DATA CENTER LOAD GROWTH

State PUCs and legislatures should require utilities to develop long-range integrated resource plans that include transparent reporting of projected increases in electricity demand from data centers, other large loads, and electrification. The UCS analysis highlights the importance of detailed scenario modeling that projects the sources of electricity generation needed to meet this demand and fulfill state climate and clean energy requirements. Requiring utilities to publicly disclose their assumptions and bases for load and generation forecasts will improve planning and help avoid overbuilding the electricity system.

Due to the uncertainty in forecasting load growth due to data centers, utilities should model multiple scenarios that identify a range of generation, storage, transmission, and demand-side solutions. This would help minimize the risks of over- or underinvesting. Scenarios and iterative planning cycles also enable utilities to adjust as better information becomes available.

ADOPT FAIR INTERCONNECTION AND TRANSMISSION RULES THAT REDUCE BARRIERS TO DEPLOYING CLEAN ENERGY

As the UCS analysis shows, adopting policies to decarbonize the power sector by 2050 could nearly triple wind and solar generation by 2035; by 2050, wind and solar generation would increase five-fold and replace coal and gas. This would require a significant increase in energy storage and transmission capacity. FERC should require regional grid operators to reform generator interconnection processes to ensure that they treat all resources fairly. That can be accomplished largely through the timely implementation of FERC Order 2023; initially issued in 2023, its implementation has been slow.

Utilities and regional grid operators should increase transmission capacity to enable the delivery of power from new resources to consumers. This progress starts with smart, forward-looking investments identified through robust planning processes envisioned in FERC Order 1920, issued in 2024. In recent years, the Mid-Continent System Operator's Long Range Transmission Planning process—a good example of such planning—has produced two project portfolios that represent more than 40 individual investments designed to enable new resource additions and address forecasts of load growth, including from data centers (MISO 2024b).

Utilities and regional grid operators should consider other cost-effective solutions and strategies as well. Examples include grid-enhancing technologies, non-wires alternatives, virtual power plants, the reconductoring of existing lines, and demand flexibility.

REQUIRE GENERATION FOR DATA CENTERS TO BE ADDITIONAL AND CARBON-FREE

State PUCs and legislatures should require utilities to meet the growth in electricity demand from data centers with new low-carbon or zero-carbon generation. States with renewable or clean electricity standards should require data centers and other large loads to contribute financially to ensuring the standards can be met cost effectively and to avoid imposing additional costs on other customers.

In addition, state PUCs should not allow co-location of data centers with existing power plants being used to meet electricity demand from existing customers. Replacing this existing generation with other sources of generation could increase emissions and costs for other customers.

On the other hand, co-locating data centers with new wind, solar, and storage projects that are sized to meet the load and located near existing generators with excess capacity and approved interconnection could allow for faster approval processes. At the same time, this type of co-location would reduce emissions, help maintain reliability, and lower costs (Engel, Varadarajan, and Posner 2025).

To reduce emissions and public health impacts on local communities, data centers and other large loads should use energy storage instead of diesel or gas generation for back-up power.

INCREASE TRANSPARENCY AND ACCOUNTABILITY

The UCS analysis highlights the importance of tracking and publicly reporting air pollution and heat-trapping emissions to protect public health and meet climate goals. State and federal policymakers should require data center companies and utilities to negotiate power purchase agreements and grid interconnection terms in public proceedings rather than behind closed doors and non-disclosure agreements.

Policymakers should also require data center companies and utilities to publicly report power needs, onsite and induced emissions, water use, and other data—and to do so with enough advance notice for communities to make informed decisions. State legislatures should direct environmental and utility regulators to hold data center companies accountable for avoiding, minimizing, or mitigating any negative reliability, environmental, or public health impacts.

ADOPT STRONGER CLIMATE AND CLEAN ENERGY POLICIES

The UCS analysis shows the need for stronger policies to accelerate the clean energy transition and provide important economic, climate, and public health benefits. State and federal policymakers should adopt policies that require utilities to meet a growing share of overall electricity demand with renewable energy and other carbon-free electricity sources, combined with investments in storage, new transmission capacity, energy efficiency, and demand-flexibility.

Policy changes include, but are not limited to, restoring federal clean energy tax credits, establishing binding emission reduction targets and carbon-free electricity standards, adopting strong power plant carbon standards, and providing incentives to increase transmission capacity. Policies supporting the development of data centers should include standards and guardrails that protect public health while reducing emissions, energy and water use, and other environmental impacts (NAACP 2025; Dulani and Zaidi 2025)

Setting a Proper Course

The path that states and the nation choose on how to power data centers has wide-ranging implications for energy affordability, reliability, public health, the climate, and the economy as a whole.

Alarmingly, the federal government is moving in the wrong direction. Recent congressional rollbacks of federal clean energy tax credits and incentives, combined with regulatory and executive actions favoring fossil fuels, repealing power plant carbon standards, undermining climate science, and attacking renewable energy and environmental, social, and governance (ESG) policies are dramatically heightening the risks to people and the environment. Limiting cost-effective clean energy solutions like solar, wind, and energy storage that can be deployed quickly and at scale to meet data center load growth could lead to electricity shortages, higher prices, and greater climate and public health impacts. It also undermines the nation's ability to compete as a global leader on clean energy innovation.

Despite the compelling economic and societal benefits of investing in clean energy, they will not be fully realized without stronger policies at the state and national levels. Already, states and local communities across the country are facing proposals to build power-hungry data centers with uncertain trajectories for development and concerns about costs and benefits.

Strong leadership from Congress, future administrations, and the states can get the United States back on track. Such efforts can build on the foresight of leading states that have adopted carbon-free electricity standards and targets to achieve deep reductions in heat-trapping emissions. Utilities and big tech companies must follow through on their commitments to power data centers with carbon-free electricity and achieve net zero emissions across their operations and supply chains. And achieving science-based climate goals will require stronger policies to clean up other sectors of the economy, including by replacing fossil fuels with carbon-free electricity.

Throughout, it is critical to monitor and prioritize energy affordability. This includes requiring data centers to pay a fair share of any additional costs they impose on the system. Increased investments in energy efficiency and demand flexibility will also help limit future increases in demand and lower consumer energy bills.

Better planning, regulatory reforms, and increased transparency and accountability will be needed to make informed decisions that enable the responsible growth of electricity demand from AI and avoid overbuilding the electricity system. Only bold action will ensure that the nation meets electricity demand growth with clean energy, achieves its climate goals, and protects consumers from added costs brought on by the growth of data centers. The path for the United States to achieve these benefits is clear.

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