

Trends in the U.S. Power System: Demand Up, Emissions Down

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Surging electricity demand (or “load growth”) is making headlines as data centers, manufacturing, and the broader electrification of the economy require more from the grid. The attention raises important questions about whether demand growth will increase U.S. emissions from greater fossil fuel dispatch.

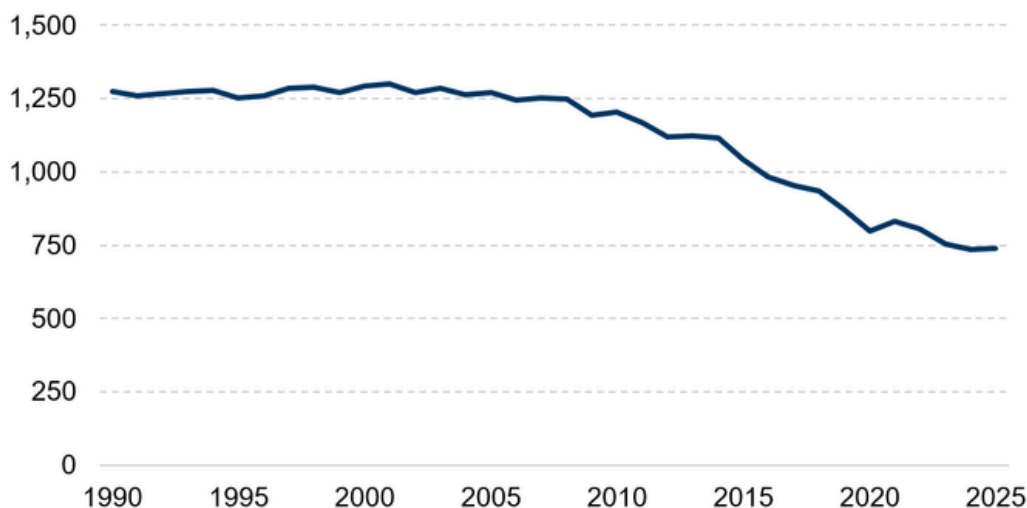
Since 2020, CLC has tracked the carbon intensity of the U.S. economy and its sectors, or how much carbon is emitted to produce each dollar of goods. We’ve found that most U.S. industries hold a “carbon advantage”: they produce goods with fewer emissions than the global average and most major trading partners. A relatively low-carbon grid is part of what drives that advantage, because cleaner electricity means cleaner manufacturing.

This analysis examines what happens next. **As electricity demand rises, we find that both the grid’s carbon intensity and absolute carbon emissions from the power sector will continue to fall**—even as new natural gas-fired capacity comes online. A cleaner overall mix enables the downward trend, which permitting reform would reinforce and accelerate.

What’s been happening with carbon intensity until now?

The U.S. power sector has experienced a long-term decrease in its “carbon intensity” (in this case, the pounds of CO₂ emitted per megawatt-hour or “lbs. CO₂ per MWh”). Between 1990 and 2008, electricity carbon intensity was stable around 1,250 lbs. CO₂ per MWh, reflecting a U.S. power sector dominated by coal and experiencing minimal change.

Figure 1 – U.S. electricity carbon intensity (lbs. CO₂ per MWh)



Then in 2008, U.S. carbon intensity started decreasing. Reasons for the steady decline include very little load growth between 2008 and 2020, energy efficiency, the replacement of coal- and petroleum-fired generation with gas-fired generation, more wind and solar capacity, and even some nuclear coming online. (A modest “blip” upward in 2025 is attributable to an uncharacteristically cold winter.)

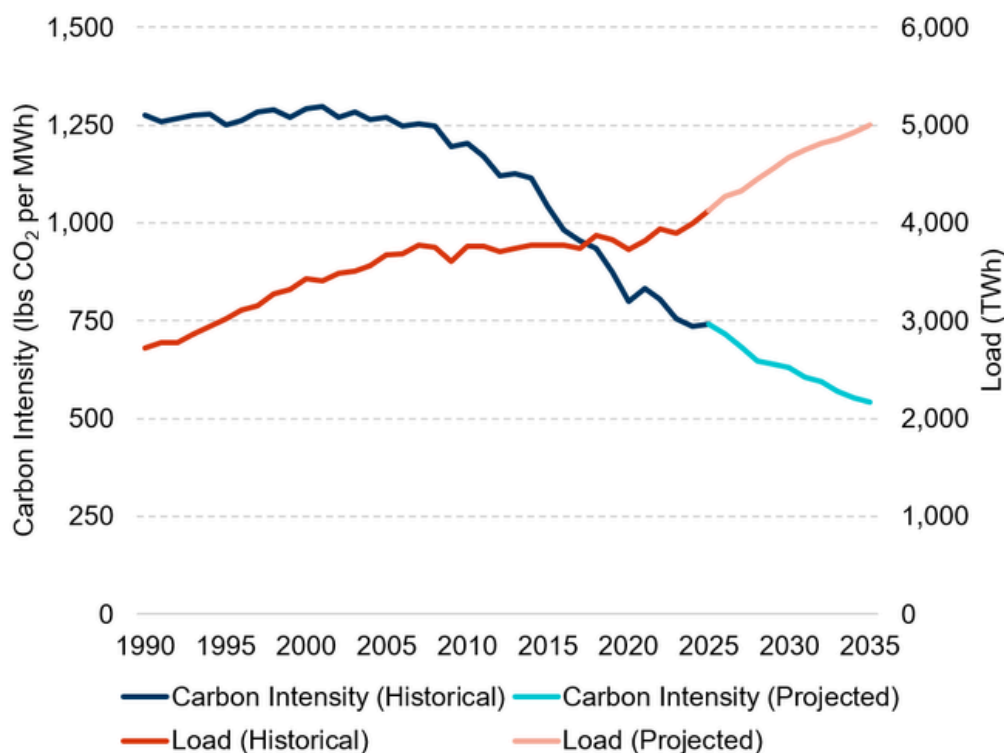
Absolute power sector emissions followed a similar path, peaking in 2007 at 2,367 MMT CO₂ and decreasing to 1,486 MMT CO₂ by 2025.

Carbon intensity and absolute emissions will continue to decrease.

CLC projections suggest these trends will continue, allowing higher anticipated load to coexist with lower absolute emissions from power generation and declining carbon intensity.

Using the Climate Leadership Council's Emissions, Revenues, and Technology model (CERT) and assuming current policy conditions, we find that U.S. load is projected to increase by 21% between 2025 and 2035 while carbon intensity decreases by 27%. CERT forecasts absolute power sector emissions will drop to 1,316 MMT CO₂ in 2035.

Figure 2 – U.S. electricity carbon intensity and load



Decreases are due to capacity and generation shifts.

Yes, electricity demand will increase sharply. But to serve that growth and keep electricity flowing to customers, the electricity system is drawing on a wider, cleaner mix of power sources than ever before. Over time, the power sector continues to lose more coal generation while adding more efficient natural gas-fired plants and capacity in wind, solar, battery storage, and nuclear.

We can monitor these shifts in the energy system in two ways. The first is “**capacity**,” or how much electricity power plants *could* produce at any one moment if they ran at full output. Think of it as the size and contents of the grid’s toolbox.

The second is “**generation**,” or how much electricity those power plants *actually* produce and deliver to the grid. Think of it as how much each of the tools in the toolbox gets used.

Capacity

The capacity mix has shifted toward gas and renewables, with modest increases in nuclear since 2008. That trend continues through 2035: the electricity system expands rapidly with little net change from fossil-fired units and sizeable additions from wind, solar, and storage capacity. Because new gas capacity largely replaces retiring coal, the fossil fleet gets cleaner even as its overall size holds steady.

Figure 3 – Projected change in U.S. power capacity between 2025 and 2035 (gigawatts)

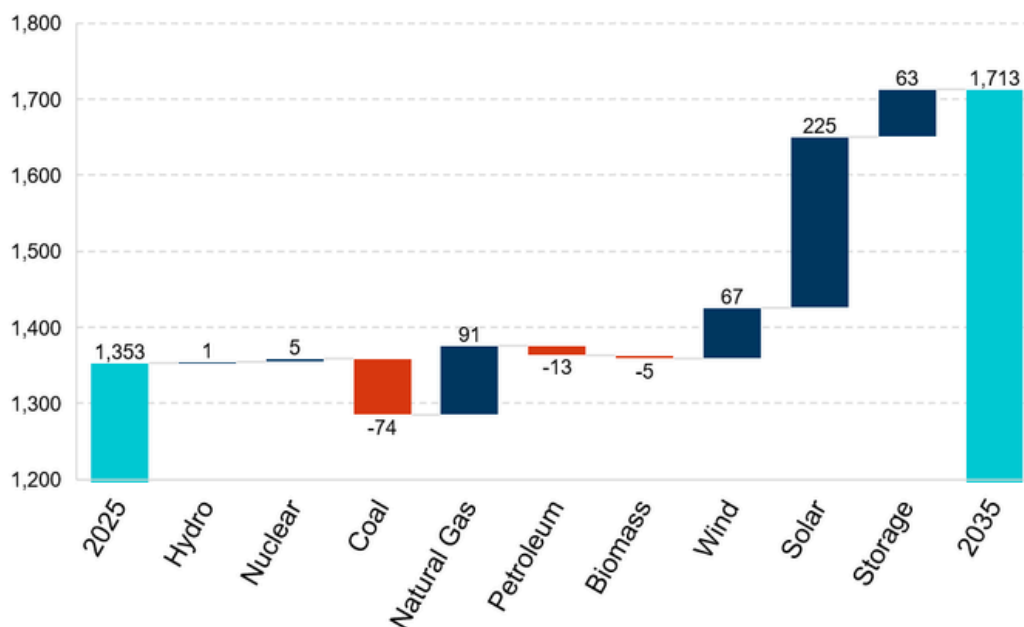


Figure 3 shows CERT’s projected change in power capacity between 2025 and 2035.

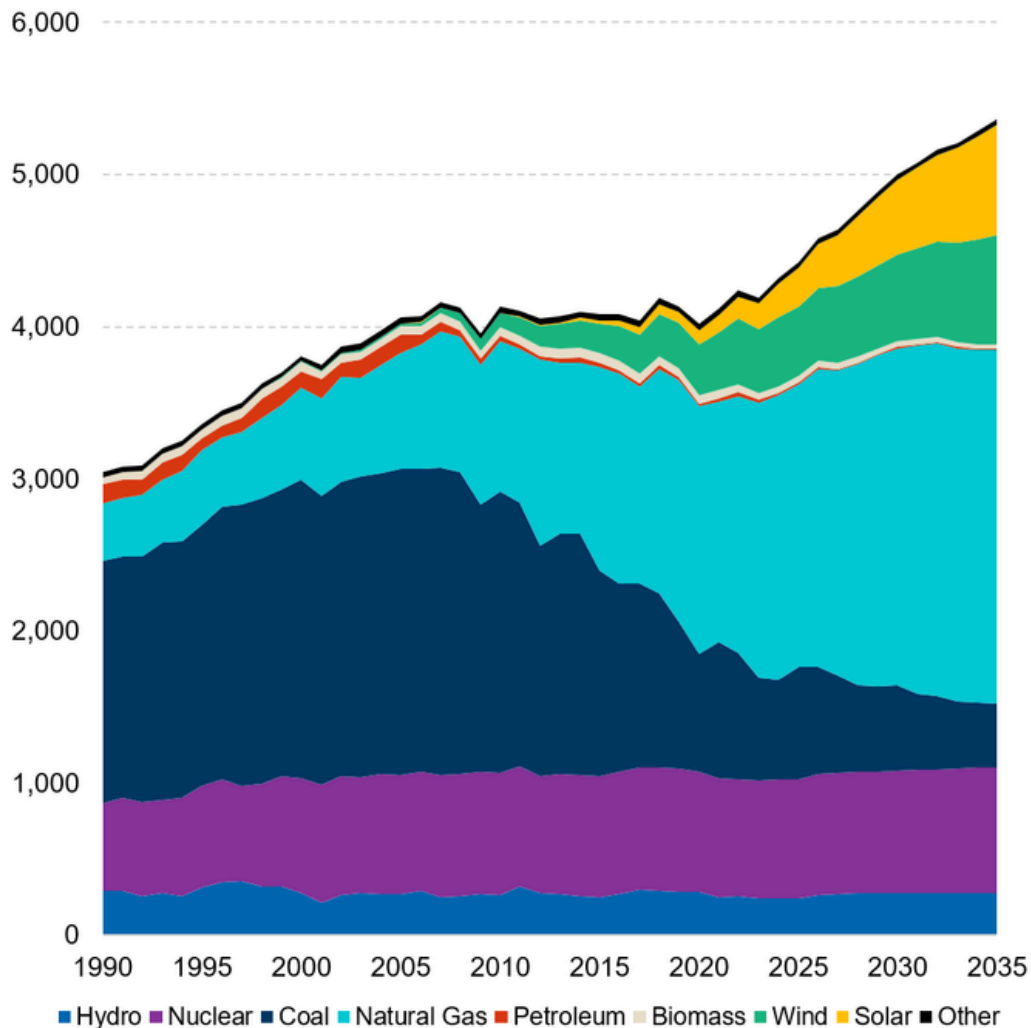
- Renewables continue to grow quickly, adding 292 gigawatts (“GW”) of wind and solar. Storage increasingly comes paired with these renewables for economic and capacity reasons, adding another 63 GW.
- Gas-fired capacity grows by 91 GW, roughly offsetting 74 GW of coal and 13 GW of petroleum capacity retirements. At the same time, older, less efficient gas units are giving way to newer, more efficient ones in the hourly operations of the markets. (The 91 GW of net gas additions include grid-connected, behind-the-meter, and off-grid units.)
- Hydro and nuclear are mostly unchanged, though nuclear capacity grows with planned reactor uprates and restarts.
- The small petroleum- and biomass-fired fleets continue to shrink.
- Both scheduled and economic retirements of coal units continue.

The shifting capacity mixture described in Figure 3 enables more lower-carbon resources to deliver power onto the grid.

Generation

The generation mix is mapped in Figure 4. The carbon intensity of the power system continues to decrease as zero-carbon resources (hydro, nuclear, wind, solar, and geothermal) make up more of total generation: 40% in 2025, 43% in 2030, and 48% in 2035.

Figure 4 – U.S. power generation, historical through 2025 and CERT projection to 2035 (terawatt-hours)



The trends in emission intensity from Figure 1 and Figure 2 can be read in Figure 4 based on how the generation mix has shifted between technologies. Coal generation peaked in 2007. Both gas-fired generation and renewables make up a larger share of the mixture in 2025.

Through 2035, coal generation is projected to decrease further, and gas generation is projected to stabilize. Going forward, wind, solar, and nuclear increasingly meet demand growth with zero-carbon terawatt-hours (“TWh”).

Policy change can accelerate emissions trends.

CERT and other forecasts expect many of the electricity sector trends we've experienced in the 2020s to be durable—especially long-term load growth and more emissions free generation. CERT projects that load will increase to about 5,000 TWh by 2035, while the carbon intensity of the grid falls to 541 lbs. CO₂ per MWh. **That is 27% less than the carbon intensity in 2025 and 57% less than in 2007.**

An important factor in how quickly the electricity system decarbonizes is the speed with which the U.S. can build new electricity infrastructure that connects zero-carbon resources with demand. This is why permitting reform is central to expanding and decarbonizing the grid. The Council's projections demonstrate that the electricity system can absorb substantial load growth and deliver power with lower carbon intensity and lower absolute emissions. Permitting reform would unlock additional energy infrastructure essential to keep pace with the demands of a modern economy, accelerate clean energy deployment and innovation, bring forward emissions reductions, and enable the grid to decarbonize even faster.

About

The Climate Leadership Council (the Council) is a 501(c)(3) organization whose mission is to develop and promote market-based policies that advance U.S. competitiveness, security, and economic opportunity as the central strategy for lowering global emissions.

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