A PLAIN-ENGLISH FACT CHECK

KEEPING THE LIGHTS ON

The Power Grid, Your Electric Bill and the Fight Over Energy



THE GRID · YOUR BILL · BLACKOUTS · CLAIMS

How Electricity Gets to You, Why Bills Are Rising, and What the Records Show

ANDREW DOMINGUEZ

TRINFINITY Enterprises

Keeping the Lights On

The Power Grid, Your Electric Bill and the Fight Over Energy

Andrew Dominguez

Trinfinity Enterprises

Keeping the Lights On: The Power Grid, Your Electric Bill and the Fight Over Energy

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Every factual statement is footnoted to its source, with the date the source was accessed. Web addresses were working on that date and may change.

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Introduction: Why I Wrote This Book

Information in this book is current as of November 12, 2026. Electricity prices, grid forecasts and federal rules change often, so check the newest numbers before you rely on any figure here.

A few years ago, most people never thought about the power grid. You flipped a switch and the lights came on. Now the grid is in the news almost every week. Bills are going up. Data centers are going up. People argue about wind turbines, coal plants, nuclear reactors and whether the next big storm will leave them in the dark.

Most of what I read about these subjects falls into one of two piles. One pile is written by people selling something: a power source, a policy or a political party. The other pile is so technical that an ordinary person gives up on page two. I wanted a book in between, one that explains how the grid works, why bills are rising and who is right about the big arguments, in plain English, with every fact tied to a source you can check yourself.

Who this book is for

This book is for anyone who pays an electric bill and wants to understand it. You do not need any background in engineering or economics. I define every technical term the first time I use it, and Appendix B is a glossary you can flip to any time.

How this book is organized

Part One tells the history of how America got its grid, from Edison's first station to the creation of the reliability watchdog we have today. Part Two explains how the grid works now. Part Three covers who sets your rates and why bills are rising. Part Four looks at the big blackouts and what investigators found. Part Five compares power sources on the same four tests. Part Six covers threats from attackers and from the sun. Part Seven checks 14 common claims and gives each a verdict. Part Eight looks ahead and ends with what you can do.

How I handled sources

Every factual statement in this book has a footnote that tells you where it came from, with a web address and the date I looked at it. The full list of sources is in Appendix D, grouped by how much weight I gave them. I used five tiers:

Tier	What it includes	How I used it
1	Primary records: laws, court decisions, government data, official investigation reports, and grid operator and NERC reports	Main evidence
2	Nonpartisan government analysis, such as the Congressional Research Service (CRS) and the Government Accountability Office (GAO)	Main evidence and explanation
3	Peer-reviewed research, national laboratory studies and established reference works	Supporting evidence
4	Established news reporting	Recent events and quotes, checked against other sources

Tier	What it includes	How I used it
		where possible
5	Industry groups, advocacy groups, labor unions and companies with a stake in the outcome	Only to show what a side argues, always labeled

I did not use social media posts as evidence for anything.

How to read the labels

When I could not confirm something, I say so with the tag **[Not verified]** and tell you what I searched. I keep three kinds of statements apart: confirmed facts, which have a footnote; my interpretation, which I mark with words like "I think" or "in my view"; and unknowns, which I name as unknown.

Dollar amounts are nominal, meaning not adjusted for inflation, unless I say otherwise. When a source adjusted for inflation, I tell you.

In Part Seven, every claim gets one of four verdicts: True, Partly true, False (debunked) or Inconclusive. Chapter 15 explains what each one means.

Where I stand

I am not an engineer at a utility, and I have no stake in any power source. I live in Nevada and pay an electric bill like you do. My goal is not to tell you which side to take. It is to make sure that when you take a side, you know what the evidence says, including the parts that do not help your side. If I did my job, readers on every side will find something in here that makes them uncomfortable.

Part One: How the Grid Was Built

Chapter 1: Edison, Westinghouse and the Fight Over Current

Flip a light switch and the room lights up. Most of us never think about what happens between the switch and the power plant, and honestly, that is a compliment to the people who built the system. It works so well that we forget it is there.

It was not always that way. A little over 140 years ago, there was no grid at all. There were a few small power plants, each one feeding a handful of nearby buildings. This chapter covers how that changed, and why a fight between two kinds of electric current in the 1880s and 1890s still shapes what comes out of your wall outlet today.

The first central power station

On September 4, 1882, Thomas Edison's company began delivering electricity from a station at 257 Pearl Street in lower Manhattan.[1] It was run by the Edison Electric Illuminating Company of New York, and it served an area of about one-quarter of a square mile.[2]

The start was small. The IEEE History Center, the history arm of the world's largest electrical engineering society, records that there were only about 85 customers with a total of about 400 lamps on the first day.[3] The station's six generators, called dynamos, could supply up to 7,200 lamps.[4]

It grew quickly. Within a year, the station was lighting about 10,000 lamps for 513 customers.[5] It was also steady. The IEEE History Center says it ran from September 4, 1882, to January 2, 1890, "with only one interruption, that lasting for three hours."[6] A major fire on January 2, 1890, did heavy damage, and service was restored in 11 days. The station was retired and taken apart in 1895.[7] I find that record worth pausing on. The very first central power station in the country set a standard for keeping the lights on that the grid still argues about today.

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[1] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[2] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[3] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[4] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[5] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[6] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[7] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

Pearl Street used direct current, or DC.[8] Direct current flows one way, like water running downhill in a pipe. The original system ran at 110 volts DC, and it was later changed to a 220-volt, three-wire design.[9]

That same fall, a different kind of first happened in Appleton, Wisconsin. A plaque at the Vulcan Street Plant says that on September 30, 1882, "the world's first hydroelectric central station began operation."[10] Here is a small example of why I check sources and tell you when they disagree: the same IEEE page that reproduces the plaque also says, in its main text, that the plant began operating in November 1882 and lit homes on November 25, 1882.[11] Both dates come from the same respected source. The safe statement is that the Appleton plant began operating in the fall of 1882, and the exact day depends on which part of the record you read.

Why direct current had a problem

You might ask, "If Edison's system worked, why did it lose?" The short answer is distance.

Electricity loses energy as it travels through wires. The U.S. Energy Information Administration (EIA), the federal government's energy statistics agency, explains it this way today: "Higher-voltage electricity makes long-distance electricity transmission more efficient and less expensive."[12] The catch is that you cannot safely run high voltage into a home. You need a way to raise the voltage for the trip and lower it again at the end.

In the 1880s there was no practical way to do that with direct current. That meant DC power plants had to sit close to their customers. A city would have needed a power station every mile or so.

Alternating current and the transformer

Alternating current, or AC, flows back and forth many times a second instead of one way. Its big advantage is that a device called a transformer can step AC voltage up or down easily.

On March 20, 1886, an engineer named William Stanley lit offices and stores on Main Street in Great Barrington, Massachusetts, with alternating current.[13] Stanley designed and built his own transformers. His system stepped the 500-volt output of a generator up to 3,000

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[8] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[9] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[10] IEEE History Center, "Milestones: Vulcan Street Plant, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Vulcan_Street_Plant,_1882, accessed November 12, 2026.

[11] IEEE History Center, "Milestones: Vulcan Street Plant, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Vulcan_Street_Plant,_1882, accessed November 12, 2026.

[12] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[13] IEEE History Center, "Milestones: Alternating Current Electrification, 1886," Engineering and Technology History Wiki, https://ethw.org/Milestones:Alternating_Current_Electrification,_1886, accessed November 12, 2026.

volts for the trip through the wires, then stepped it back down for use. Twenty businesses were lit.[14]

Stanley's work connects to George Westinghouse, an inventor and industrialist. According to the IEEE History Center, Westinghouse imported AC equipment from Europe in 1885, and the following year the Westinghouse Electric Company developed constant-voltage AC generators.[15]

Nikola Tesla

Nikola Tesla was an immigrant inventor who had worked for Edison before striking out on his own. The IEEE History Center records that by about 1888, Tesla "had applied for more than thirty patents on his system" of alternating current.[16] Westinghouse purchased Tesla's patents for an AC motor.[17] The IEEE page on Tesla says that after "agreeing to a contract that turned over AC development and patents to the Westinghouse Corporation, Tesla became a wealthy man."[18] The exact terms of that deal are discussed in many popular books, but I did not find them in a source I could check, so I am leaving them out. [Not verified: exact royalty terms of the Tesla-Westinghouse agreement. I searched the IEEE History Center pages on Tesla and Westinghouse.]

The 1893 World's Fair and Niagara Falls

Two events showed the country that alternating current could do big jobs.

The first was the 1893 World's Columbian Exposition in Chicago. The IEEE History Center says Westinghouse "supplied all the lighting for the Chicago World's Fair in 1893 using the Tesla system."[19] Its page on Westinghouse calls that lighting the symbol of AC's victory.[20]

The second was at Niagara Falls. The Adams Hydroelectric Generating Plant, built by the Niagara Falls Power Company, went into operation on August 26, 1895.[21] The IEEE History

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[14] IEEE History Center, "Milestones: Alternating Current Electrification, 1886," Engineering and Technology History Wiki, https://ethw.org/Milestones:Alternating_Current_Electrification,_1886, accessed November 12, 2026.

[15] IEEE History Center, "George Westinghouse," Engineering and Technology History Wiki, https://ethw.org/George_Westinghouse, accessed November 12, 2026.

[16] IEEE History Center, "Nikola Tesla," Engineering and Technology History Wiki, https://ethw.org/Nikola_Tesla, accessed November 12, 2026.

[17] IEEE History Center, "George Westinghouse," Engineering and Technology History Wiki, https://ethw.org/George_Westinghouse, accessed November 12, 2026.

[18] IEEE History Center, "Nikola Tesla," Engineering and Technology History Wiki, https://ethw.org/Nikola_Tesla, accessed November 12, 2026.

[19] IEEE History Center, "Nikola Tesla," Engineering and Technology History Wiki, https://ethw.org/Nikola_Tesla, accessed November 12, 2026.

[20] IEEE History Center, "George Westinghouse," Engineering and Technology History Wiki, https://ethw.org/George_Westinghouse, accessed November 12, 2026.

[21] IEEE History Center, "Milestones: Adams Hydroelectric Generating Plant, 1895," Engineering and Technology History Wiki, https://ethw.org/Milestones:Adams_Hydroelectric_Generating_Plant,_1895, accessed November 12, 2026.

Center calls it "a key victory for alternating-current systems over direct-current."[22] Water falling through turbines spun generators, and alternating current made it possible to send that power to customers who were not standing next to the falls.

From one plant to a region

Niagara did not stay a local story. The IEEE History Center says the Adams plant first served "local industries in Niagara Falls, New York," and reached its full size of ten 5,000-horsepower generators in May 1900.[23] On May 18, 1910, the Niagara Transformer Station in Ontario began distributing power. The IEEE page describes that as the first time power "was distributed to an entire region over a long-distance network of high voltage transmission lines."[24]

That is the pattern for the rest of this book. Power plants got bigger, they moved farther from customers, and the lines between them got longer and carried higher voltages. Each step lowered costs. Each step also tied more people's lights to equipment they would never see.

What this means for you

Every outlet in your house today delivers alternating current. The long-distance power lines you see along the highway carry very high voltage, and transformers on poles or in green boxes in your neighborhood step it down before it reaches you. That basic design goes straight back to Great Barrington, Chicago and Niagara Falls. I explain how it works today in Chapter 5.

There is a second lesson here, and it will come up again and again in this book. The best technology does not win on its own. It wins when someone can build it at a cost people will pay and when the business and legal rules allow it. The next chapter is about the man who figured out the business side, and how that went badly wrong.

Sources and notes for this chapter

The facts in this chapter come from the IEEE History Center's milestone records, which are reviewed historical summaries written for the Institute of Electrical and Electronics Engineers (IEEE). Where the IEEE record disagreed with itself (the Appleton start date), I said so. Popular stories about a personal feud between Edison and Westinghouse, public animal electrocutions and similar events are widely told, but I did not find them in the sources I checked for this chapter, so I left them out.

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[22] IEEE History Center, "Milestones: Adams Hydroelectric Generating Plant, 1895," Engineering and Technology History Wiki, https://ethw.org/Milestones:Adams_Hydroelectric_Generating_Plant,_1895, accessed November 12, 2026.

[23] IEEE History Center, "Milestones: Adams Hydroelectric Generating Plant, 1895," Engineering and Technology History Wiki, https://ethw.org/Milestones:Adams_Hydroelectric_Generating_Plant,_1895, accessed November 12, 2026.

[24] IEEE History Center, "Milestones: Adams Hydroelectric Generating Plant, 1895," Engineering and Technology History Wiki, https://ethw.org/Milestones:Adams_Hydroelectric_Generating_Plant,_1895, accessed November 12, 2026.

Chapter 2: Samuel Insull, Holding Companies and the 1935 Crackdown

If Edison and Westinghouse figured out how to make and move electricity, Samuel Insull figured out how to sell it to a whole region at once. His story explains why most Americans still buy power from one regulated company, and why Congress once broke up the biggest utility empires in the country.

From Edison's secretary to Chicago's power company

Samuel Insull was born in London on November 11, 1859, and died in Paris on July 19, 1938.[25] He came to the United States in 1881 to become Thomas Edison's private secretary.[26] When Edison General Electric was formed in 1889, Insull became a vice president, and in 1892 he became president of the Chicago Edison Company.[27]

Insull's company grew fast. Encyclopaedia Britannica reports that "by 1907 all of Chicago's electricity was provided by Insull's firm, now the Commonwealth Edison Company."[28]

Thousands of little power companies

It is easy to forget how scattered the industry was at first. EIA notes that at the start of the 20th century, "more than 4,000 isolated electric utilities operated in the United States."[29] Most served one town or one part of a city, with their own small plant and their own wires. Insull's insight was that bigger systems could spread the cost of large, efficient plants over many more customers. The question that followed, and that Congress answered in 1935, was who would keep those big systems honest.

What a holding company is

A holding company is a company whose main business is owning stock in other companies. Insull built several of them. The first, Middle West Utilities, was formed in 1912, and by 1917 the electrical systems under his control reached most of Illinois and parts of neighboring states.[30]

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[25] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[26] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[27] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[28] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[29] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[30] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

You might ask, "What is wrong with that?" On its own, nothing. Buying up small local utilities and tying them together can lower costs. The trouble came from stacking holding companies on top of holding companies, borrowing heavily at each level, and selling the stock to ordinary investors. When one level wobbled, the whole stack could fall.

The collapse

Insull's empire went into receivership in 1932, in the depths of the Great Depression.[31] Receivership means a court takes control of a company that cannot pay its debts. Insull left for Europe and fought being sent back.[32] He was returned to Chicago in 1934 and tried three times on charges including fraud, violating federal bankruptcy laws and embezzlement. He was acquitted each time.[33]

I want to be fair to Insull here. He was found not guilty three times. What the record supports is that his empire collapsed and that its collapse helped push Congress to act. It does not support calling him a convicted criminal.

Congress responds: the Public Utility Act of 1935

In 1935 Congress passed the Public Utility Act. It had two main parts. Title I was the Public Utility Holding Company Act of 1935, usually shortened to PUHCA, and Title II was the Federal Power Act.[34]

The Congressional Research Service (CRS), the nonpartisan research office that works for members of Congress, explains that PUHCA "was enacted to guard against exercise of undue market power."[35] CRS says it responded to "a small number of 'power trusts' in the early part of the 20th century that controlled the utility industry through holding companies."[36]

Here is what PUHCA did, according to CRS:[37]

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[31] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[32] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[33] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[34] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[35] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

[36] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

[37] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

- It required utility holding companies to register with the U.S. Securities and Exchange Commission (SEC).
- It put strict limits on how those holding companies could operate.
- It applied to any company that owned 10 percent or more of the voting stock of a utility.

CRS notes that these rules "effectively limited ownership of public utilities to a small subset of companies."[38]

The second half of the law, the Federal Power Act, gave the federal government power over interstate electricity. Today, CRS explains, "Under the FPA and NGA, FERC is charged with regulating the interstate transmission of natural gas and electricity."[39] FERC is the Federal Energy Regulatory Commission. (NGA is the Natural Gas Act.) In plain terms, the Federal Power Act split the job: the federal government oversees power sold between utilities and moved across state lines, and the states oversee the rates you pay at home. The text of the law gives federal regulators jurisdiction over "the transmission of electric energy in interstate commerce and to the sale of electric energy at wholesale in interstate commerce."[40] I come back to that split in Chapter 7, because it is the reason your state, not Washington, sets your electric rate.

PUHCA's long life and repeal

PUHCA stayed on the books for 70 years. Congress repealed it in the Energy Policy Act of 2005, which President George W. Bush signed on August 8, 2005.[41] The repeal took effect on February 8, 2006, and after that the SEC no longer oversaw electric and gas holding companies.[42]

People argued about the repeal, and both sides had real points. Supporters said the 1935 rules were out of date and kept money from flowing into the industry. Critics worried the old dangers of concentrated ownership could come back. CRS noted at the time that remaining oversight would fall to FERC, the states and the antitrust agencies.[43] I am not

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[38] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

[39] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

[40] 16 U.S. Code 824, Federal Power Act section 201 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/uscode/text/16/824, accessed November 12, 2026.

[41] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[42] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

[43] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

taking a side on that. What matters for you is that the rules about who can own your utility have changed over time, and they can change again.

Why this still matters

You might ask, "Why should I care about a businessman who died in 1938?" Here is why. Insull's big idea, that one company should serve a whole area and spread its costs over lots of customers, is still how most of the country gets power. The government's answer to the risks of that idea was regulation: if a company gets a monopoly, a public body sets its prices. That deal is the heart of Chapter 7.

Sources and notes for this chapter

Facts about Insull's life come from Encyclopaedia Britannica. The description of PUHCA, its purpose and its repeal comes from two CRS reports, published in 2006, and the Federal Power Act text from the Cornell Legal Information Institute. I looked for the 1930s Federal Trade Commission findings on how much of the industry the largest holding companies controlled, but the sources I could open did not give a figure, so I did not use one. [Not verified: share of the 1930s utility industry controlled by the largest holding companies. I searched the CRS PUHCA report and Britannica.]

Chapter 3: The New Deal Brings Power to the Countryside

By the early 1930s, city people had electric lights, refrigerators and radios. Most farm families did not. This chapter covers how the federal government stepped in, and why that decision still shapes who owns the power company in much of rural America.

How dark the countryside was

In 1935, according to a U.S. Department of Agriculture history quoted by The Living New Deal project at the University of California, Berkeley, "fewer than 11 of every 100 U.S. farms were receiving central station electric service."[44] Central station service means power from a utility's power plant, as opposed to a small generator or battery set on the farm itself.

You might ask, "Why didn't the power companies just run lines out to the farms?" The basic answer is cost. A mile of line in a city can serve hundreds of customers. A mile of line in farm country might serve two or three. Private companies, answering to their investors, mostly chose not to make that investment.

The Tennessee Valley Authority

On May 18, 1933, President Franklin D. Roosevelt signed the bill creating the Tennessee Valley Authority, or TVA.[45] The bill was named for its sponsor, Senator George Norris of Nebraska, who had pushed for public power for years.[46] TVA was a federal corporation charged with building dams on the Tennessee River system. Its first dam, Norris Dam on the Clinch River in Tennessee, was started in October 1933 and finished in July 1936.[47]

I want to be upfront about my source here. The details above come from a history article published by the International Brotherhood of Electrical Workers, a labor union. I would rather cite TVA's own history page, but the archived copies I tried did not load. The dates match what is widely reported, but you should know who published them. [Partly verified: TVA dates are from a union publication, not a government source. I tried an archived copy of TVA's history page.]

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[44] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[45] International Brotherhood of Electrical Workers, "Grounded in History," The Electrical Worker, December 2021 (labor union publication), https://www.ibew.org/articles/21ElectricalWorker/EW2112/GroundedinHistory.1221.html, accessed November 12, 2026.

[46] International Brotherhood of Electrical Workers, "Grounded in History," The Electrical Worker, December 2021 (labor union publication), https://www.ibew.org/articles/21ElectricalWorker/EW2112/GroundedinHistory.1221.html, accessed November 12, 2026.

[47] International Brotherhood of Electrical Workers, "Grounded in History," The Electrical Worker, December 2021 (labor union publication), https://www.ibew.org/articles/21ElectricalWorker/EW2112/GroundedinHistory.1221.html, accessed November 12, 2026.

Encyclopaedia Britannica gives a fuller picture of what TVA became. It says TVA's area is "generally limited to the drainage basin of the Tennessee River, which covers parts of seven states," and that its power system "includes more than 50 dams."[48] It also reports that "no major flood damage has occurred on the Tennessee River since the system of dams was completed."[49]

TVA was controversial from the start. Private power companies argued that the federal government had no business selling electricity in competition with them. The case reached the Supreme Court, which upheld TVA in Ashwander v. Tennessee Valley Authority in 1936.[50]

TVA is still a federal corporation today and still sells wholesale power in the Tennessee Valley. It comes up again in Chapter 10, in the story of the 2022 Christmas storm.

The Rural Electrification Administration

Two years after TVA, Roosevelt created the Rural Electrification Administration, or REA, by Executive Order 7037, signed May 11, 1935.[51] He used money and authority from the Emergency Relief Appropriation Act of 1935, a Depression jobs law.[52] The order told the new agency "to initiate, formulate, administer, and supervise a program of approved projects with respect to the generation, transmission, and distribution of electric energy in rural areas."[53] The original order is held by the National Archives.[54]

At first REA was a relief program. The next year Congress made it permanent. The Rural Electrification Act was signed by President Roosevelt on May 20, 1936.[55] The law let REA

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[48] Encyclopaedia Britannica, "Tennessee Valley Authority," The Editors of Encyclopaedia Britannica, https://www.britannica.com/topic/Tennessee-Valley-Authority, accessed November 12, 2026.

[49] Encyclopaedia Britannica, "Tennessee Valley Authority," The Editors of Encyclopaedia Britannica, https://www.britannica.com/topic/Tennessee-Valley-Authority, accessed November 12, 2026.

[50] Encyclopaedia Britannica, "Tennessee Valley Authority," The Editors of Encyclopaedia Britannica, https://www.britannica.com/topic/Tennessee-Valley-Authority, accessed November 12, 2026.

[51] Franklin D. Roosevelt, "Executive Order 7037 - Establishing the Rural Electrification Administration," May 11, 1935 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-7037-establishing-the-rural-electrification-administration, accessed November 12, 2026.

[52] Franklin D. Roosevelt, "Executive Order 7037 - Establishing the Rural Electrification Administration," May 11, 1935 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-7037-establishing-the-rural-electrification-administration, accessed November 12, 2026.

[53] Franklin D. Roosevelt, "Executive Order 7037 - Establishing the Rural Electrification Administration," May 11, 1935 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-7037-establishing-the-rural-electrification-administration, accessed November 12, 2026.

[54] National Archives, "Executive Order 7037, dated May 11, 1935," National Archives Identifier 300002 (DocsTeach), https://www.docsteach.org/documents/document/executive-order-7037-dated-may-11-1935-in-which-president-franklin-d-roosevelt-establishes-the-rural-electrification-agency, accessed November 12, 2026.

[55] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

make long-term, low-interest loans, with repayment that could run up to 25 years.[56] The first administrator was Morris Cooke, who served from 1935 to 1937.[57]

Co-ops: farmers building their own power companies

Here is the part I find most interesting. Many private utilities did not want REA loans for rural lines. So farmers formed cooperatives, called co-ops, which are businesses owned by the people they serve. The co-ops borrowed from REA, built the lines and ran the systems themselves.

The results were dramatic. The Living New Deal reports that REA helped raise the share of U.S. farms with electricity from about 11 percent to almost 97 percent by 1960.[58] By 1943 more than a million consumers were getting power through the program.[59]

Britannica uses slightly different numbers that point the same way: "nine out of 10 farms were electrified by 1950, compared to one out of 10 in 1935."[60] Britannica describes REA as providing "low-interest loans to farm cooperatives."[61] It adds a caution I think is fair: electrification "did not halt the movement of farm workers to cities."[62] Electricity made farm life easier. It did not, by itself, keep people on the farm.

The co-ops also organized nationally. Their trade group, the National Rural Electric Cooperative Association (NRECA), says co-ops formed it in 1942, and that "By 1953, more than 90 percent of U.S. farms had electricity."[63] NRECA is an industry group, so I use it here only for its own history and its members' description of themselves.

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[56] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[57] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[58] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[59] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[60] Encyclopaedia Britannica, "Rural Electrification Administration," last updated July 23, 2026, https://www.britannica.com/topic/Rural-Electrification-Administration, accessed November 12, 2026.

[61] Encyclopaedia Britannica, "Rural Electrification Administration," last updated July 23, 2026, https://www.britannica.com/topic/Rural-Electrification-Administration, accessed November 12, 2026.

[62] Encyclopaedia Britannica, "Rural Electrification Administration," last updated July 23, 2026, https://www.britannica.com/topic/Rural-Electrification-Administration, accessed November 12, 2026.

[63] National Rural Electric Cooperative Association (NRECA), "History," America's Electric Cooperatives, https://www.electric.coop/our-organization/history, accessed November 12, 2026.

REA itself was ended on October 13, 1994, and its work moved to a newer agency, the Rural Utilities Service, in the U.S. Department of Agriculture.[64]

Three kinds of power companies

The New Deal left the country with three main kinds of electric utilities, and you are served by one of them right now:

- **Investor-owned utilities.** Private companies owned by shareholders, regulated by state commissions. Most Americans are served by one.
- **Cooperatives.** Owned by their members, common in rural areas, many of them born with REA loans.
- **Public power.** Owned by a city, a public district or a federal agency like TVA.

Each kind is regulated differently, which is one reason your neighbor in the next county might pay a different rate than you. I cover that in Chapter 7.

How many of each

The best official count I could open is from EIA, using 2017 data. EIA found "almost 3,000 electric distribution companies" operating in the United States that year, and that investor-owned utilities served 72 percent of all electricity customers.[65] The other two kinds are far more numerous but much smaller:[66]

Table 3-1. U.S. electric utilities by type, 2017 (EIA)

Type	Number of utilities	Average customers per utility
Publicly owned (federal, state and municipal)	1,958	12,100
Cooperatives	812	24,500

Source: EIA, Today in Energy, August 15, 2019.[67] EIA adds that co-ops "are located in 47 states but are most prevalent in the Midwest and Southeast."[68] These counts are now nine years old. They will not match newer figures exactly, partly because utilities merge and partly because groups count differently.

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[64] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[65] EIA, "Investor-owned utilities served 72% of U.S. electricity customers in 2017," Today in Energy, August 15, 2019, https://www.eia.gov/todayinenergy/detail.php?id=40913, accessed November 12, 2026.

[66] EIA, "Investor-owned utilities served 72% of U.S. electricity customers in 2017," Today in Energy, August 15, 2019, https://www.eia.gov/todayinenergy/detail.php?id=40913, accessed November 12, 2026.

[67] EIA, "Investor-owned utilities served 72% of U.S. electricity customers in 2017," Today in Energy, August 15, 2019, https://www.eia.gov/todayinenergy/detail.php?id=40913, accessed November 12, 2026.

[68] EIA, "Investor-owned utilities served 72% of U.S. electricity customers in 2017," Today in Energy, August 15, 2019, https://www.eia.gov/todayinenergy/detail.php?id=40913, accessed November 12, 2026.

Measured by how much power each kind sells, the split looks like this. EIA reports that in 2024, investor-owned utilities made 56 percent of U.S. retail electricity sales, public and federal entities 15 percent, cooperatives 13 percent, and other providers 16 percent.[69]

The two trade groups for co-ops and public power publish their own, newer numbers. These are Tier 5 sources, so I treat them as each side's own description:

- NRECA's April 2026 fact sheet counts "830 distribution and 60 G&T cooperatives," says co-ops "Serve an estimated 42 million people in 48 states," and says co-ops serve 13.6 percent of the nation's electric customers.[70] A G&T, or generation and transmission cooperative, is a co-op owned by other co-ops that builds power plants and high-voltage lines for its members. NRECA notes its count includes "a small number of rural public power, tribal and mutual utilities."[71]
- The American Public Power Association (APPA), the trade group for city-owned and other public utilities, says public power utilities "serve more than 54 million people," and that "The median public power utility serves about 4,400 people."[72] APPA also claims its members' customers pay $100 to $320 less a year on average and have about 90 fewer minutes without power.[73] [Not verified: I did not test APPA's bill and outage comparisons against EIA data. Treat them as the group's claims.]

Why co-ops cost more to run per customer

Here is the number that explains a lot about rural electric bills. NRECA reports that co-ops own about 2.7 million miles of power line, "about 42%" of the nation's distribution lines, but average only 8.7 customers per mile of line, compared with 38.9 for the rest of the industry.[74] That is the same problem that kept private companies out of farm country in the 1930s. A mile of line costs about the same to build and maintain whether it serves 9 customers or 39. Spread over fewer people, each one carries more of the cost. (The comparison is my reading of NRECA's figures.)

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[69] EIA, "Electricity generation, capacity, and sales in the United States," Energy Explained (2025 preliminary data), https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php, accessed November 12, 2026.

[70] NRECA, "America's Cooperative Electric Utilities: The Nation's Consumer Owned Electric Utility Network," fact sheet, April 2026, p. 1, https://www.cooperative.com/programs-services/bts/Documents/Data/Electric-Co-op-Fact-Sheet.pdf, accessed November 12, 2026.

[71] NRECA, "America's Cooperative Electric Utilities: The Nation's Consumer Owned Electric Utility Network," fact sheet, April 2026, p. 3, https://www.cooperative.com/programs-services/bts/Documents/Data/Electric-Co-op-Fact-Sheet.pdf, accessed November 12, 2026.

[72] American Public Power Association (APPA), "How Public Power Compares to Other Electric Utilities," November 18, 2024, https://www.publicpower.org/periodical/article/how-public-power-compares-other-electric-utilities, accessed November 12, 2026.

[73] American Public Power Association (APPA), "How Public Power Compares to Other Electric Utilities," November 18, 2024, https://www.publicpower.org/periodical/article/how-public-power-compares-other-electric-utilities, accessed November 12, 2026.

[74] NRECA, "America's Cooperative Electric Utilities: The Nation's Consumer Owned Electric Utility Network," fact sheet, April 2026, p. 2, https://www.cooperative.com/programs-services/bts/Documents/Data/Electric-Co-op-Fact-Sheet.pdf, accessed November 12, 2026.

Different views of the New Deal power programs

Supporters of TVA and REA point to the result: nearly every farm got power within a generation. Critics at the time, and some since, argued that federal power projects competed unfairly with private companies and used taxpayer backing that private firms did not have. Both arguments were made loudly in the 1930s, and versions of them come back every time someone proposes a new federal power project. You will see that debate again in Chapter 18.

Sources and notes for this chapter

The REA executive order text comes from the American Presidency Project at the University of California, Santa Barbara, and the National Archives. Farm electrification figures come from The Living New Deal, which quotes a 1960 U.S. Department of Agriculture publication; I could not open the USDA original. TVA dates come from a labor union publication, and I have said so above.

Chapter 4: Tying the Country Together, and the Night the Northeast Went Dark

After World War II, America used more electricity every year. Utilities found it made sense to connect their systems to their neighbors'. If one company's plant broke down, it could borrow power from next door. If one region had cheap power to spare, it could sell it.

Those connections made the grid cheaper and, most of the time, more reliable. On the night of November 9, 1965, they also showed the downside: a problem in one place could spread across a huge area in minutes.

The 1965 Northeast blackout

President Lyndon B. Johnson described it this way a month later: "IN A brief instant on November 9, 1965, 30 million Americans were suddenly plunged into darkness."[75]

NERC's own history puts the number the same way: the blackout "caused 30 million people to lose power in the northeastern U.S. and southeastern Ontario, Canada."[76] [Not verified: the exact failed device and the minute-by-minute timing. I searched for the Federal Power Commission report text and the NPCC and NERC histories, and none of the copies I could open stated the triggering device in a form I could quote.]

The Federal Power Commission, the federal agency that then oversaw interstate electricity, investigated and sent a report to the President dated December 6, 1965, titled "Northeast Power Failure, November 9 and 10, 1965."[77] In his statement that day, Johnson said the Commission "has now completed the first phase of the investigation" and that "Many of the Commission's initial recommendations are already being implemented by the power companies."[78]

The birth of NERC

The industry's answer came in 1968. According to NERC's own record of milestones, on "June 1, 1968 National Electric Reliability Council (NERC) was established by the electric utility industry, in response to the 1965 blackout."[79] Note the name: it was a council, set up

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[75] Lyndon B. Johnson, "Statement by the President in Response to Federal Power Commission Report on the Northeastern Electric Power Blackout," December 6, 1965 (The American Presidency Project), https://presidency.ucsb.edu/documents/statement-the-president-response-federal-power-commission-report-the-northeastern-electric, accessed November 12, 2026.

[76] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, p. 1, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

[77] Federal Power Commission, "Northeast Power Failure, November 9 and 10, 1965: A Report to the President," December 6, 1965 (HathiTrust catalog record), https://catalog.hathitrust.org/Record/001617348, accessed November 12, 2026.

[78] Lyndon B. Johnson, "Statement by the President in Response to Federal Power Commission Report on the Northeastern Electric Power Blackout," December 6, 1965 (The American Presidency Project), https://presidency.ucsb.edu/documents/statement-the-president-response-federal-power-commission-report-the-northeastern-electric, accessed November 12, 2026.

[79] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, p. 1, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

by the utilities themselves, not a government body. Regional councils came first in some places. The Northeast Power Coordinating Council, for example, says it formed in 1966 based on the Federal Power Commission's recommendations.[80]

The council wrote operating policies and planning guides, but, as NERC's history puts it, "NERC still had no authority to enforce compliance with the policies, criteria and guides."[81]

Voluntary rules for almost 40 years

For decades, the grid's reliability rules were voluntary. Utilities agreed to follow them, and most did, but there was no legal penalty for breaking them. That changed only after another massive blackout, in 2003, which I cover in Chapter 10.

The official U.S.-Canada task force that investigated the 2003 blackout found "seven violations of the voluntary reliability standards administered by NERC."[82] Its very first recommendation was to "Make reliability standards mandatory and enforceable, with penalties for noncompliance."[83]

Congress did that in the Energy Policy Act of 2005. CRS explains that before the law, "the Federal Power Act gave FERC jurisdiction over unbundled transmission and authority to regulate wholesale rates; however, no authority was provided to regulate reliability."[84] Section 1211 of the 2005 law required FERC to certify an Electric Reliability Organization, or ERO, which "will develop and enforce reliability standards for the bulk power system."[85] The bulk power system means the big power plants and high-voltage lines, not the local wires on your street.

FERC acted quickly. NERC's history records that on "July 20, 2006 FERC certified NERC as the 'electric reliability organization' for the United States."[86] In March 2007, FERC approved 83 NERC standards, "the first set of legally enforceable standards for the U.S. bulk

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[80] Northeast Power Coordinating Council (NPCC), "About NPCC," undated web page, https://www.npcc.org/about, accessed November 12, 2026.

[81] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, p. 2, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

[82] DOE, "Blackout 2003: U.S.-Canada Task Force Presents Final Report on Blackout of August 2003," press release, April 5, 2004, https://www.energy.gov/oe/articles/blackout-2003-us-canada-task-force-presents-final-report-onblackout-august-2003, accessed November 12, 2026.

[83] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, p. 3, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[84] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[85] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[86] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, p. 3, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

power system."[87] Compliance became "mandatory and enforceable in the United States" on June 18, 2007.[88] After almost 40 years of voluntary rules, breaking a reliability standard could now bring a penalty.

Who NERC is today

The North American Electric Reliability Corporation, NERC, is a nonprofit, not a government agency, but its standards carry the force of law in the United States once FERC approves them. It also publishes the reliability forecasts that are quoted in nearly every news story about blackout risk. I lean on those forecasts in Chapters 11 and 17.

You might ask, "If NERC is not the government, why does it get to make binding rules?" Because Congress set it up that way in 2005. FERC oversees NERC and can approve, send back or order changes to its standards. Supporters say this puts the people who know the equipment best in charge of the details. Critics have argued that an industry-funded body may be slow to impose costly rules on its own members. Both views show up in later chapters, especially in the cold-weather story in Chapter 10.

Where this leaves us

By the end of the 1960s, the country had big interconnected grids, a voluntary reliability council, and a hard lesson about how failures spread. The next part of the book explains how all of that works today, and who is in charge of what.

Sources and notes for this chapter

The 1965 blackout description comes from President Johnson's statement, the Federal Power Commission report record and NERC's own milestone history, which also supplied the dates for NERC's founding and its legal powers. The story of NERC's legal powers comes from a CRS report on the Energy Policy Act of 2005 and from the 2003 blackout task force report.

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[87] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, p. 3, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

[88] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, p. 4, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

Part Two: How the Grid Works Today

Chapter 5: From Power Plant to Plug

This chapter is the plain-English tour. If you already know how the grid works, skim it. If you don't, this is the chapter that will make the rest of the book make sense. I have kept the engineering to what you need to follow the arguments in later chapters.

Information about the present in this chapter is current as of November 12, 2026.

Four jobs

Every electric system does four jobs:

1. **Generation:** making the electricity at a power plant.
2. **Transmission:** moving it long distances at high voltage.
3. **Distribution:** stepping it down and delivering it along local lines to homes and businesses.
4. **Balancing:** matching supply and demand every second of every day.

The first three are hardware. The fourth is the hard part, and it is where most blackouts start.

Generation: making electricity

EIA, the federal energy statistics agency, defines a generator simply: "An electric generator is a device that converts a form of energy into electricity."[89] In most power plants, a turbine does the work. EIA explains that in a turbine generator, "a moving fluid - water, steam, combustion gases, or air - pushes a series of blades mounted on a rotor shaft."[90] The spinning shaft turns the generator.

That one idea covers most of the grid:

- A coal plant or nuclear plant boils water into steam, and the steam spins a turbine.
- A natural gas plant burns gas, and the hot gases spin a turbine. A combined-cycle gas plant then uses the leftover heat to make steam and spin a second turbine.
- A hydroelectric dam lets falling water spin a turbine.
- A wind turbine uses moving air.

Solar panels are the big exception. A solar photovoltaic panel turns sunlight directly into electricity with no moving parts.[91] Batteries are another exception: they store electricity made somewhere else and release it later.[92]

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[89] EIA, "Electricity explained: How electricity is generated," Energy Explained, last updated October 31, 2023, https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php, accessed November 12, 2026.

[90] EIA, "Electricity explained: How electricity is generated," Energy Explained, last updated October 31, 2023, https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php, accessed November 12, 2026.

[91] EIA, "Electricity explained: How electricity is generated," Energy Explained, last updated October 31, 2023, https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php, accessed November 12, 2026.

[92] EIA, "Electricity explained: How electricity is generated," Energy Explained, last updated October 31, 2023, https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php, accessed November 12, 2026.

Where your electricity came from in 2025

In 2025, total U.S. utility-scale electricity generation was about 4.43 trillion kilowatthours.[93] A kilowatthour, or kWh, is the unit on your bill. Using 1,000 watts for one hour is one kWh.

Table 5-1 shows where it came from. (These are EIA's rounded shares for utility-scale plants. Rooftop solar is counted separately.)

Table 5-1. U.S. utility-scale electricity generation by source, 2025 (information as of November 12, 2026)

Source	Share of generation, 2025
Natural gas	about 41%
Nuclear	about 18%
Coal	about 17%
Wind	about 11%
Solar (utility-scale)	about 7%
Hydropower	about 6%
Biomass	about 1%
Geothermal	less than 1%
Petroleum	about 0.7%

Source: EIA, Electricity in the United States.[94]

Taken together, fossil fuels made about 58 percent of the country's electricity in 2025 and renewable sources made about 24 percent.[95] For comparison, EIA says renewables were about 12 percent of utility-scale generation in 1990.[96] Small-scale solar, mostly rooftop panels, added about 0.09 trillion kWh on top of the utility-scale total.[97]

You might ask, "Is that the mix in my state?" Almost certainly not. The national mix is an average. Some states run mostly on coal, some mostly on hydropower, some mostly on gas. I come back to that in Chapter 12.

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[93] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[94] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[95] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[96] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[97] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

Transmission: the highway system

Power plants are often far from the people who use their power. Transmission lines are the highways that connect them. As we saw in Chapter 1, EIA explains that "Higher-voltage electricity makes long-distance electricity transmission more efficient and less expensive."[98] So the voltage is stepped up at the power plant for the long trip.

How big is the system? EIA describes it as "thousands of miles of high-voltage power lines and millions of miles of low-voltage power lines" connecting "thousands of power plants to hundreds of millions of electricity customers."[99] An older EIA count from 2016 put it at more than 7,300 power plants and nearly 160,000 miles of high-voltage power lines.[100] That count is now ten years old, and I could not find a newer national figure from EIA while writing, so treat it as a rough size, not a current number.

Some power is lost along the way, mostly as heat in the lines and transformers. EIA estimates that annual transmission and distribution losses "averaged about 5%" of the electricity sent through the grid in 2018 through 2022.[101] That is one reason power plants generate more electricity than customers buy. EIA reports about 4,429 billion kWh of utility-scale generation in 2025 and about 4,058 billion kWh of retail sales.[102]

How many plants are there? EIA says that as of March 2026 there were "219 coal power plants in the United States with 462 generators at about 188,952 MW."[103] The total U.S. utility-scale capacity at the end of 2025 was 1,280,799 MW, or about 1,281 GW.[104] The mix of that capacity has shifted a lot. EIA reports that coal plants were about 42 percent of capacity in 1990, while natural gas grew "from 17% in 1990 to 40% in 2025."[105]

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[98] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[99] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[100] EIA, "U.S. electric system is made up of interconnections and balancing authorities," Today in Energy, July 20, 2016, https://www.eia.gov/todayinenergy/detail.php?id=27152, accessed November 12, 2026.

[101] EIA, "How much electricity is lost in electricity transmission and distribution in the United States?" Frequently Asked Questions, last updated November 7, 2023, https://www.eia.gov/tools/faqs/faq.php?id=105&t=3, accessed November 12, 2026.

[102] EIA, "Electricity generation, capacity, and sales in the United States," Energy Explained (2025 preliminary data), https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php, accessed November 12, 2026.

[103] EIA, "How many power plants are in the United States?" Frequently Asked Questions (data as of March 2026), https://www.eia.gov/tools/faqs/faq.php?id=65&t=2, accessed November 12, 2026.

[104] EIA, "Electricity generation, capacity, and sales in the United States," Energy Explained (2025 preliminary data), https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php, accessed November 12, 2026.

[105] EIA, "Electricity generation, capacity, and sales in the United States," Energy Explained (2025 preliminary data), https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php, accessed November 12, 2026.

Distribution: the local streets

When power reaches your area, a substation steps the voltage down and sends it out on distribution lines, the poles and wires on your street or the cables buried under it. A smaller transformer near your house steps it down again to the voltage your outlets use.[106]

Here is a point that matters for your bill. EIA says retail electricity prices are "usually highest for residential and commercial consumers" because "it costs more to distribute electricity to them."[107] A factory might take power straight from a high-voltage line. Your house needs all those poles, wires and transformers on the last mile.

Balancing: the hardest job

Electricity is hard to store in large amounts, so for most of the grid's history, power had to be made at the same instant it was used. Every time you turn on your air conditioner, some generator somewhere has to produce a little more.

The organizations that keep supply and demand in balance are called balancing authorities. The U.S. Department of Energy (DOE) describes a balancing authority as an organization that "manages the operation of the electric system within a specific geographic area."[108] DOE says there are "more than 60 balancing authorities in the U.S."[109] EIA notes that "Most balancing authorities are electric utilities."[110]

What happens if balancing fails? If demand gets ahead of supply, the frequency of the alternating current drops. If it drops far enough, equipment protects itself by shutting down, and that can start a chain reaction. You will see exactly that in the Texas story in Chapter 10, where the grid came within minutes of a collapse that could have taken weeks to recover from.

Batteries are now changing the balancing job. NERC, the grid reliability organization I introduce in the next chapter, reported that battery additions added 14.7 gigawatts of on-

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[106] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[107] EIA, "Electricity explained: Factors affecting electricity prices," Energy Explained (2025 data from Electric Power Monthly, February 2026), undated web page, https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php, accessed November 12, 2026.

[108] U.S. Department of Energy (DOE), "Balancing Authority Backgrounder," 2023 (2022 data), https://www.energy.gov/sites/default/files/2023-08/Balancing%20Authority%20Backgrounder_2022-Formatted_041723_508.pdf, accessed November 12, 2026.

[109] U.S. Department of Energy (DOE), "Balancing Authority Backgrounder," 2023 (2022 data), https://www.energy.gov/sites/default/files/2023-08/Balancing%20Authority%20Backgrounder_2022-Formatted_041723_508.pdf, accessed November 12, 2026.

[110] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

peak capacity heading into summer 2026.[111] A gigawatt (GW) is a million kilowatts, roughly enough to run a mid-size city. More on that in Chapter 12.

How much does a home use?

In 2022, the average U.S. home that bought power from a utility used 10,791 kWh for the year, about 899 kWh a month.[112] That average hides a lot of difference: Louisiana homes averaged 14,774 kWh, and Hawaii homes averaged 6,178 kWh.[113] Hot summers, electric heat and home size all play a part. EIA also notes that these numbers count only power bought from the utility, so homes with their own solar panels may use more than the figures show.[114]

Who buys all this power? EIA reports that in 2025, homes bought 1,515 billion kWh (37 percent of retail sales), businesses such as stores and offices bought 1,493 billion kWh (37 percent), and industry bought 1,042 billion kWh (26 percent).[115]

And what does a home use it for? EIA's survey of homes, using 2020 data, found that the three biggest uses of electricity in homes were air conditioning at 19 percent, space heating at 12 percent and water heating at 12 percent.[116] Lighting and refrigerators came next.[117] Air conditioning has spread a long way: EIA says "In 2020, about 89% of homes used air conditioning compared with 57% of homes in 1980."[118] That one change helps explain why summer heat waves now drive peak demand in so much of the country. (EIA's household average in that survey, about 10,500 kWh a year, is a little lower than the 2022 sales figure above because it comes from a different survey and year.[119])

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[111] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[112] EIA, "How much electricity does an American home use?" Frequently Asked Questions (2022 data), last updated January 8, 2024, https://www.eia.gov/tools/faqs/faq.php?id=97&t=3, accessed November 12, 2026.

[113] EIA, "How much electricity does an American home use?" Frequently Asked Questions (2022 data), last updated January 8, 2024, https://www.eia.gov/tools/faqs/faq.php?id=97&t=3, accessed November 12, 2026.

[114] EIA, "How much electricity does an American home use?" Frequently Asked Questions (2022 data), last updated January 8, 2024, https://www.eia.gov/tools/faqs/faq.php?id=97&t=3, accessed November 12, 2026.

[115] EIA, "Electricity generation, capacity, and sales in the United States," Energy Explained (2025 preliminary data), https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php, accessed November 12, 2026.

[116] EIA, "Electricity use in homes," Energy Explained, last updated December 18, 2023, https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php, accessed November 12, 2026.

[117] EIA, "Electricity use in homes," Energy Explained, last updated December 18, 2023, https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php, accessed November 12, 2026.

[118] EIA, "Electricity use in homes," Energy Explained, last updated December 18, 2023, https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php, accessed November 12, 2026.

[119] EIA, "Electricity use in homes," Energy Explained, last updated December 18, 2023, https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php, accessed November 12, 2026.

Where this leaves us

One more point that surprises people: your meter records how much power you used and, on newer meters, when you used it. It cannot tell which power plant made the electricity you used at any moment. Once power enters the grid, it mixes with power from every other plant connected at the time. (This is my plain-English explanation of how a connected grid works, not a quote from a source.)

Generation, transmission, distribution and balancing. Keep those four jobs in mind. When your bill goes up, it is because one or more of them got more expensive. When the lights go out, it is because one of them failed. The next chapter covers who is in charge of each job, which turns out to be a much more complicated answer than most people expect.

Chapter 6: Three Grids and Who Runs Them

People talk about "the grid" as if it were one machine with one boss. It isn't. The lower 48 states run on three big grids, and inside them, dozens of organizations each own or run a piece. This chapter is a map of who is in charge of what.

Information about the present in this chapter is current as of November 12, 2026.

The three interconnections

An interconnection is a set of power systems tied together so tightly that they run in step with each other, all at the same frequency. EIA lists three main interconnections in the lower 48 states: the Eastern Interconnection, the Western Interconnection, and the Electric Reliability Council of Texas, or ERCOT.[120] EIA adds that "The Eastern and Western Interconnections are also linked to Canada's power grid."[121]

An EIA review in 2016 described how they are organized:[122]

Table 6-1. The three U.S. interconnections (EIA, 2016)

Interconnection	Balancing authorities (2016)
Eastern	36 (31 in the United States, 5 in Canada)
Western	37 (34 in the United States, 2 in Canada, 1 in Mexico)
ERCOT (Texas)	1

Source: EIA, Today in Energy, July 20, 2016.[123] These counts are from 2016 and have changed since. DOE's more recent count is "more than 60 balancing authorities in the U.S."[124]

The three grids are connected to each other only by a few special links, so power cannot flow freely between them. That fact becomes very important in the Texas story in Chapter 10, and in the claim about Texas's grid that I test in Chapter 15.

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[120] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[121] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[122] EIA, "U.S. electric system is made up of interconnections and balancing authorities," Today in Energy, July 20, 2016, https://www.eia.gov/todayinenergy/detail.php?id=27152, accessed November 12, 2026.

[123] EIA, "U.S. electric system is made up of interconnections and balancing authorities," Today in Energy, July 20, 2016, https://www.eia.gov/todayinenergy/detail.php?id=27152, accessed November 12, 2026.

[124] U.S. Department of Energy (DOE), "Balancing Authority Backgrounder," 2023 (2022 data), https://www.energy.gov/sites/default/files/2023-08/Balancing%20Authority%20Backgrounder_2022-Formatted_041723_508.pdf, accessed November 12, 2026.

The players

Here is the cast, from the national level down to your street.

FERC, the Federal Energy Regulatory Commission. FERC is an independent federal agency. Under the Federal Power Act, it oversees "the transmission of electric energy in interstate commerce" and "the sale of electric energy at wholesale in interstate commerce."[125] Wholesale means power sold to a utility or another business for resale, not power sold to you. FERC also approves NERC's reliability standards, as covered in Chapter 4.[126]

NERC, the North American Electric Reliability Corporation. NERC writes and enforces the reliability standards for the bulk power system and publishes the reliability forecasts I use in Chapter 11.[127]

Grid operators: ISOs and RTOs. In much of the country, the power lines are owned by many different utilities, but a single independent organization runs the system and the wholesale market. These are called Independent System Operators (ISOs) or Regional Transmission Organizations (RTOs). FERC encouraged them starting in the 1990s, which I cover in Chapter 8.[128]

FERC lists seven of them: the California ISO (CAISO); the Midcontinent ISO (MISO), covering portions of 15 states in the Midwest and South; ISO New England, covering six states; the New York ISO; PJM, covering all or part of 13 states and the District of Columbia; the Southwest Power Pool (SPP), covering portions of 14 states; and ERCOT in Texas.[129] According to FERC, "two-thirds of the nation's electricity load is served in RTO regions."[130] FERC also notes that it has "the final say on changes to RTO and ISO's protocols and operations," except for ERCOT, which "does not fall under FERC's regulatory jurisdiction."[131]

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[125] 16 U.S. Code 824, Federal Power Act section 201 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/uscode/text/16/824, accessed November 12, 2026.

[126] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[127] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[128] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

[129] FERC, "Electric Power Markets," national overview web page, undated, https://ferc.gov/electric-power-markets, accessed November 12, 2026.

[130] FERC, "Electric Power Markets," national overview web page, undated, https://ferc.gov/electric-power-markets, accessed November 12, 2026.

[131] FERC, "What are Wholesale Electricity Markets?" web page, last updated November 5, 2024, https://ferc.gov/energy-markets-0, accessed November 12, 2026.

Utilities. The company that sends you a bill. As covered in Chapter 3, it may be investor-owned, a cooperative or public power. Most utilities also act as balancing authorities.[132]

State utility commissions. Every state has a commission, often called a public utility commission or public service commission, that sets the retail rates for the investor-owned utilities in that state. The Federal Power Act leaves retail sales to the states.[133] I cover how they set your rate in Chapter 7.

Texas: the grid on its own

ERCOT is the odd one out. EIA notes that ERCOT "consists of a single balancing authority."[134] Because the ERCOT grid is not synchronized with the Eastern or Western grids, its power generally does not move in interstate commerce, and FERC's wholesale rules mostly do not reach it.

FERC says ERCOT serves about 24 million customers, "approximately 90 percent of Texas' electrical load."[135] The rest of Texas, mostly at the edges of the state, is tied into the Eastern or Western grids. The state's own regulator, the Public Utility Commission of Texas (PUCT), "oversees the wholesale and retail markets within the ERCOT region."[136] ERCOT is not completely cut off: a 2022 history from Rice University's Baker Institute describes "four direct current (DC) ties - two links with the Eastern Interconnection and two links to Mexico."[137] Those ties can move only a limited amount of power.

You might ask, "Is that good or bad?" People disagree. Supporters say it lets Texas build faster and run a simpler market. Critics say it limits how much help Texas can import in an emergency. In Chapter 16, I test the popular claim that Texas set up its own grid on purpose to avoid federal rules.

Two kinds of regions: market and traditional

Across the country, you will find two broad setups.

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[132] U.S. Energy Information Administration (EIA), "Electricity explained: Delivery to consumers," Energy Explained, undated web page, https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php, accessed November 12, 2026.

[133] 16 U.S. Code 824, Federal Power Act section 201 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/uscode/text/16/824, accessed November 12, 2026.

[134] EIA, "U.S. electric system is made up of interconnections and balancing authorities," Today in Energy, July 20, 2016, https://www.eia.gov/todayinenergy/detail.php?id=27152, accessed November 12, 2026.

[135] FERC, "Electric Power Markets," national overview web page, undated, https://ferc.gov/electric-power-markets, accessed November 12, 2026.

[136] Juli A. Cohn, "Connecting Past and Future: A History of Texas' Isolated Power Grid," Rice University's Baker Institute for Public Policy, December 1, 2022, https://bakerinstitute.org/research/connecting-past-and-future-history-texas-isolated-power-grid, accessed November 12, 2026.

[137] Juli A. Cohn, "Connecting Past and Future: A History of Texas' Isolated Power Grid," Rice University's Baker Institute for Public Policy, December 1, 2022, https://bakerinstitute.org/research/connecting-past-and-future-history-texas-isolated-power-grid, accessed November 12, 2026.

In **market regions**, an ISO or RTO runs a wholesale market where power plants compete to sell electricity every few minutes. Many of the power plants are owned by independent companies, not the local utility.

In **traditional regions**, much of the Southeast and West outside California among them, the local utility still owns its power plants, its transmission lines and its distribution lines, and the state commission approves its costs.

FERC puts it this way: "Traditional wholesale electricity markets exist primarily in the Southeast, Southwest and Northwest."[138]

Neither setup is automatically cheaper or more reliable. Chapter 8 tells the story of how markets came about, and Chapter 9 looks at what the data says about prices in each.

Where this leaves us

When something goes wrong on the grid, the first question is usually, "Whose job was it?" Now you have the map. The next part of the book follows the money: who sets your rate and why it keeps going up.

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[138] FERC, "Electric Power Markets," national overview web page, undated, https://ferc.gov/electric-power-markets, accessed November 12, 2026.

Part Three: Your Electric Bill

Chapter 7: Who Sets Your Rate, and How

Most people never meet the folks who decide what they pay for electricity. They are usually three to five commissioners at a state agency you may never have heard of, plus a staff of accountants, engineers and lawyers. This chapter explains what they do.

Information about the present in this chapter is current as of November 12, 2026.

Why a monopoly gets a referee

As Chapters 2 and 3 showed, most Americans buy power from one company that has the area to itself. It would make no sense to string three competing sets of poles down your street. But a company with no competitors could, in theory, charge whatever it wants. The answer the country settled on is regulation: the company gets its service territory, and in exchange, a public body approves its prices.

The Federal Power Act gives the federal government the wholesale and interstate side and leaves retail sales, the ones to you, to the states.[139] So for most customers of investor-owned utilities, a state commission sets the rate. Cooperatives are usually overseen by their own elected boards, and city-owned utilities by city councils or utility boards, though some states also regulate them. [Not verified: I looked for an official national summary of which states regulate cooperative and city-owned utility rates and did not find one I could cite. Check your own state commission's website.]

Who the commissioners are

The people on these commissions have a national association, the National Association of Regulatory Utility Commissioners (NARUC), founded in 1889.[140] NARUC says "Most state commissioners are appointed to their positions by their governor or legislature," and that in 11 states the public elects them, while in two states the legislature does.[141] [Not verified: the list of which states elect their commissioners. NARUC's page gives the counts, not the names. Your state commission's website will say how its members are chosen.]

That difference matters to you. If your commissioners are elected, you can vote them out. If they are appointed, you can tell your governor or legislator what you think of the appointment.

NARUC describes the commissions as "quasi-judicial, meaning they function much like court proceedings."[142] It says "many states have strict policies regarding outside 'ex parte'

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[139] 16 U.S. Code 824, Federal Power Act section 201 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/uscode/text/16/824, accessed November 12, 2026.

[140] National Association of Regulatory Utility Commissioners (NARUC), "History and Background", https://naruc.org/about-naruc/our-mission/history-background, accessed November 12, 2026.

[141] National Association of Regulatory Utility Commissioners (NARUC), "History and Background", https://naruc.org/about-naruc/our-mission/history-background, accessed November 12, 2026.

[142] NARUC, "Frequently Asked Questions," How Commissions Work, https://www.naruc.org/serving-the-public-interest/how-commissions-work/frequently-asked-questions/, accessed November 12, 2026.

communications."[143] Ex parte means one side talking privately to the judge. In a rate case, it means you generally cannot lobby a commissioner privately about a pending case, the same way you could not call up the judge in a lawsuit. NARUC also notes that "Commissions often hold special hearings after storms and major outages."[144] NARUC is the commissioners' own association, so I use it to describe how commissions say they work, not to judge how well they do it.

The Supreme Court's rule: a fair return

How much should a utility be allowed to earn? Two U.S. Supreme Court cases set the basic rule.

In 1923, in Bluefield Water Works v. Public Service Commission, the Court said: "A public utility is entitled to such rates as will permit it to earn a return on the value of the property which it employs for the convenience of the public."[145] The Court said that return should be equal to what is being earned at the same time and in the same general part of the country on other investments with "corresponding, risks and uncertainties."[146] In that case, the Court found a 6 percent return "substantially too low."[147]

In 1944, in Federal Power Commission v. Hope Natural Gas Co., the Court added: "the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks."[148] It also said that under the "just and reasonable" standard, "it is the result reached not the method employed which is controlling."[149]

In plain English: a regulated utility is not guaranteed a profit, but it is entitled to a fair chance to earn a return like other businesses with similar risk. Regulators have a lot of freedom in how they get there, as long as the result is fair.

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[143] NARUC, "Frequently Asked Questions," How Commissions Work, https://www.naruc.org/serving-the-public-interest/how-commissions-work/frequently-asked-questions/, accessed November 12, 2026.

[144] NARUC, "Frequently Asked Questions," How Commissions Work, https://www.naruc.org/serving-the-public-interest/how-commissions-work/frequently-asked-questions/, accessed November 12, 2026.

[145] Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), decided June 11, 1923 (FindLaw), https://caselaw.findlaw.com/us-supreme-court/262/679.html, accessed November 12, 2026.

[146] Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), decided June 11, 1923 (FindLaw), https://caselaw.findlaw.com/us-supreme-court/262/679.html, accessed November 12, 2026.

[147] Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), decided June 11, 1923 (FindLaw), https://caselaw.findlaw.com/us-supreme-court/262/679.html, accessed November 12, 2026.

[148] Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944), decided January 3, 1944 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/supremecourt/text/320/591, accessed November 12, 2026.

[149] Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944), decided January 3, 1944 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/supremecourt/text/320/591, accessed November 12, 2026.

What a rate case is

A rate case is the formal process where a utility asks the commission to change its prices. It works a lot like a trial. The utility files evidence about its costs. The commission's staff, consumer advocates, big business customers and environmental groups can all file their own evidence and question the utility's witnesses. Then the commission decides.

The basic math the commission works through is called the revenue requirement: the total amount the utility needs to collect in a year. It has two main parts. This is my plain-English summary of the standard approach; the details and names vary from state to state, so I have not footnoted it to a single source:

- **Operating costs:** fuel, salaries, maintenance, taxes and the like, passed through at cost, with no profit added on top.
- **Return on capital:** the utility's investment in plants, poles, wires and substations (called the rate base), times an allowed rate of return.

That second part is where the profit comes from. Notice something: a utility earns its return on what it builds, not on what it spends on fuel. That is the root of the claim I test in Chapter 16, "Utilities make more money when they spend more."

Why rates differ so much by state

In 2025, the average U.S. retail price across all customers was about 13.63 cents per kWh. The average residential price was 17.30 cents.[150] But the spread between states is huge. In 2025, Hawaii's average retail price was 35.72 cents per kWh and North Dakota's was 8.20 cents.[151]

Table 7-1. Average U.S. retail electricity prices by customer type, 2025 (nominal cents per kWh; information as of November 12, 2026)

Customer type	Average price, 2025
Residential	17.30
Commercial	13.41
Industrial	8.62
Transportation	13.83
All sectors	13.63

[150] EIA, "Electricity explained: Factors affecting electricity prices," Energy Explained (2025 data from Electric Power Monthly, February 2026), undated web page, https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php, accessed November 12, 2026.

[151] EIA, "Electricity explained: Factors affecting electricity prices," Energy Explained (2025 data from Electric Power Monthly, February 2026), undated web page, https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php, accessed November 12, 2026.

Source: EIA, citing Electric Power Monthly, February 2026 (preliminary data).[152] Nominal means not adjusted for inflation.

EIA lists the main factors that push prices up or down: fuels, power plant costs, the transmission and distribution system, weather conditions and regulations.[153] Hawaii burns a lot of imported oil to make electricity. North Dakota sits on top of coal and has strong wind. Geography matters a lot.

Different views on regulation

People across the spectrum have long argued about whether this system works.

Consumer advocates often argue the allowed returns are too generous and that utilities have a built-in reason to build more than they need. Utility representatives argue that they must compete for investors' money, and that a return set too low makes it harder and more expensive to raise money for needed upgrades. Some economists favor "performance-based regulation," which ties part of a utility's earnings to results like reliability and customer service instead of only to how much it has invested. (This paragraph sums up the arguments each side makes; it is my summary, not a finding from one source.)

Where this leaves us

Your rate is set by a state body balancing what the utility says it needs against what customers and their advocates say is fair, under a standard the Supreme Court set a century ago. The next chapter covers the big change of the last 50 years: wholesale markets, and the crisis that made people afraid of them.

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[152] EIA, "Electricity explained: Factors affecting electricity prices," Energy Explained (2025 data from Electric Power Monthly, February 2026), undated web page, https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php, accessed November 12, 2026.

[153] EIA, "Electricity explained: Factors affecting electricity prices," Energy Explained (2025 data from Electric Power Monthly, February 2026), undated web page, https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php, accessed November 12, 2026.

Chapter 8: Markets Enter, and California Learns a Hard Lesson

For most of the 20th century, your local utility did everything: built the power plants, ran the lines and sent you the bill. Starting in the late 1970s, Washington began opening the door to competition. This chapter traces that change, and the crisis in California and the West in 2000 and 2001 that still makes people nervous about electricity markets.

PURPA: the first crack in the door

The first crack came in 1978 with the Public Utility Regulatory Policies Act, known as PURPA. A Congressional Research Service fact sheet explains that under PURPA, "utilities are required to buy all power produced by a class of nonutility electric generators."[154] Those generators were called qualifying facilities, and "Two types of generators can be certified as a qualifying facility: a small power producer and a cogenerator."[155] (A cogenerator makes electricity and useful heat at the same time, often at a factory.) The price was set by rule: "the local utility must purchase all power produced by QFs in their service area at 'avoided cost,'"[156] meaning roughly what it would have cost the utility to make that power itself.

PURPA mattered because it proved that companies other than the local utility could build power plants and sell power reliably. Decades later, Congress loosened PURPA's purchase rule. The Energy Policy Act of 2005 let FERC end the mandatory purchase requirement for new contracts where FERC found a competitive market existed.[157]

Opening the highways: FERC Order 888

The next big step came on April 24, 1996, when FERC issued Order No. 888.[158] It required all public utilities that own, control or operate interstate transmission lines to file open

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[154] Amy Abel, CRS, "Public Utility Regulatory Policies Act of 1978: A Fact Sheet," CRS Report 92-603 ENR, July 30, 1992 (copy hosted by Yale University), p. 1, https://bpb-us-w2.wpmucdn.com/campuspress.yale.edu/dist/0/4222/files/2023/06/Purpa-Fact-Sheet.pdf, accessed November 12, 2026.

[155] Amy Abel, CRS, "Public Utility Regulatory Policies Act of 1978: A Fact Sheet," CRS Report 92-603 ENR, July 30, 1992 (copy hosted by Yale University), p. 1, https://bpb-us-w2.wpmucdn.com/campuspress.yale.edu/dist/0/4222/files/2023/06/Purpa-Fact-Sheet.pdf, accessed November 12, 2026.

[156] Amy Abel, CRS, "Public Utility Regulatory Policies Act of 1978: A Fact Sheet," CRS Report 92-603 ENR, July 30, 1992 (copy hosted by Yale University), p. 2, https://bpb-us-w2.wpmucdn.com/campuspress.yale.edu/dist/0/4222/files/2023/06/Purpa-Fact-Sheet.pdf, accessed November 12, 2026.

[157] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[158] Federal Energy Regulatory Commission (FERC), "Order No. 888," web page, https://ferc.gov/industries-data/electric/industry-activities/open-access-transmission-tariff-oatt-reform/history-oatt-reform/order-no-888, accessed November 12, 2026.

access, non-discriminatory transmission tariffs.[159] FERC said that service had to be offered "on a comparable basis to the transmission service they provide themselves."[160]

In plain English: if you own the highway, you have to let other people's trucks use it on the same terms as your own. Before that, a utility could favor its own power plants. FERC issued a companion rule, Order No. 889, the same day, setting up an online system for posting available transmission capacity and rules of conduct.[161] Order 888 also let utilities seek to recover "stranded costs," meaning investments that might not pay off once competition arrived.[162] FERC updated these rules in Order No. 890, issued February 16, 2007.[163]

FERC later encouraged utilities to hand control of their transmission lines to independent regional operators, the ISOs and RTOs described in Chapter 6.[164] Today, FERC says, two-thirds of the nation's electricity load is served in those regions.[165] [Not verified: the specific dates and terms of FERC Order No. 2000 and the Energy Policy Act of 1992. FERC's order pages and the congress.gov law pages would not load for me.]

FERC kept adjusting those rules. Its own history page says the goal of Order No. 888 was "to remove impediments to competition in the wholesale bulk power marketplace," and that Order No. 889, issued at the same time, set up an online system, called OASIS, where transmission owners must post what space they have on their lines.[166] On February 16, 2007, FERC issued Order No. 890, which reformed the 1996 rules after about two years of comments.[167]

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[159] Federal Energy Regulatory Commission (FERC), "Order No. 888," web page, https://ferc.gov/industries-data/electric/industry-activities/open-access-transmission-tariff-oatt-reform/history-oatt-reform/order-no-888, accessed November 12, 2026.

[160] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

[161] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

[162] Federal Energy Regulatory Commission (FERC), "Order No. 888," web page, https://ferc.gov/industries-data/electric/industry-activities/open-access-transmission-tariff-oatt-reform/history-oatt-reform/order-no-888, accessed November 12, 2026.

[163] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

[164] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

[165] FERC, "Electric Power Markets," national overview web page, undated, https://ferc.gov/electric-power-markets, accessed November 12, 2026.

[166] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

[167] FERC, "History of OATT Reform," web page, https://www.ferc.gov/history-oatt-reform, accessed November 12, 2026.

CRS reports that the Energy Policy Act of 2005 also told FERC to "implement incentive rate-making for utilities that join a Regional Transmission Organization."[168]

Some states go further: retail choice

In the late 1990s, several states went beyond wholesale markets and let customers choose who supplied their electricity, while the local utility still delivered it. California was one of the boldest.

[Not verified: the details of California's 1996 restructuring law (Assembly Bill 1890). I searched for the official legislative text and a California commission summary and could not open either.]

How far did retail choice spread? Less far than its supporters hoped. EIA reported in 2018 that "13 states and the District of Columbia have active, statewide residential retail choice programs."[169] Four more states, including Nevada, have "a form of limited retail choice."[170] Participation peaked at "17.2 million customers (13% of total residential customers) in 2014" and had slipped to 16.7 million in 2017.[171] Texas is the big exception: EIA says retail choice is mandatory under state law in most of the area ERCOT runs.[172] Illinois shows how quickly customers can change their minds. EIA reported that alternative suppliers served 35 percent of residential customers there in 2017, "down from the peak of 57% in 2014."[173] [Not verified: current national participation. The EIA article I could open uses 2017 data, and I did not find a newer EIA summary.]

The Western energy crisis of 2000 and 2001

What happened next is still argued about. Wholesale prices in California and the West shot up in 2000 and stayed high into 2001. California's grid operator ordered rotating blackouts.

[Not verified: the exact dates of the rotating blackouts in early 2001 and the date of Pacific Gas and Electric's 2001 bankruptcy filing. FERC's web page on the crisis that I could open covers the settlements and the staff findings, not the timeline.]

FERC's staff investigated and issued a final report in March 2003. FERC summarizes the conclusion this way: "market conditions involving diminished power supplies due to

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[168] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[169] EIA, "Electricity residential retail choice participation has declined since 2014 peak," Today in Energy, November 8, 2018, https://www.eia.gov/todayinenergy/detail.php?id=37452, accessed November 12, 2026.

[170] EIA, "Electricity residential retail choice participation has declined since 2014 peak," Today in Energy, November 8, 2018, https://www.eia.gov/todayinenergy/detail.php?id=37452, accessed November 12, 2026.

[171] EIA, "Electricity residential retail choice participation has declined since 2014 peak," Today in Energy, November 8, 2018, https://www.eia.gov/todayinenergy/detail.php?id=37452, accessed November 12, 2026.

[172] EIA, "Electricity residential retail choice participation has declined since 2014 peak," Today in Energy, November 8, 2018, https://www.eia.gov/todayinenergy/detail.php?id=37452, accessed November 12, 2026.

[173] EIA, "Electricity residential retail choice participation has declined since 2014 peak," Today in Energy, November 8, 2018, https://www.eia.gov/todayinenergy/detail.php?id=37452, accessed November 12, 2026.

drought conditions, inadequate infrastructure and a flawed power market design contributed to the market manipulation."[174]

That one sentence holds both sides of the argument. On one side: there really was a supply problem. Drought cut hydropower, and not enough power plants and lines had been built. On the other side: companies took advantage of it. In its presentation of the final report on March 26, 2003, FERC staff said: "Staff found evidence of manipulation of both electricity and natural gas markets."[175] It found that "The Enron trading strategies, economic withholding, and inflated bidding all violate the Cal ISO and Cal PX tariffs' anti-gaming provisions."[176] (Cal ISO was the state's grid operator; Cal PX was the power exchange where much of the trading happened.) Staff recommended "show cause" orders, a demand to explain or face penalties, for more than 30 companies, and recommended taking away Enron's authority to sell power at market prices.[177]

The staff also found problems in the natural gas market feeding the power market, citing "gas transaction misreporting and wash trading."[178] A wash trade is a fake trade where a company buys and sells the same thing to itself, or a partner, to create a false picture of prices or volume.

Enron

Enron was a Houston energy company that grew into one of the biggest energy traders in the country. It is remembered mostly for its accounting fraud and collapse, which went beyond California. On May 25, 2006, a federal jury in Houston convicted Enron's former chief executives Kenneth Lay and Jeffrey Skilling.[179] The Department of Justice reported that the jury convicted Lay on all six counts against him, including conspiracy, wire fraud and securities fraud, and convicted Skilling on 19 of 28 counts, acquitting him on nine

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[174] FERC, "Addressing the 2000-2001 Western Energy Crisis," web page, https://ferc.gov/industries-data/electric/general-information/addressing-2000-2001-western-energy-crisis, accessed November 12, 2026.

[175] Donald J. Gelinas, FERC, "Final Report on Price Manipulation in Western Markets," staff presentation, Docket No. PA02-2-000, March 26, 2003 (copy hosted by the California Independent System Operator), https://www.caiso.com/Documents/FERCPresentationonFinalReportonPriceManipulationinWesternMarkets.pdf, accessed November 12, 2026.

[176] Donald J. Gelinas, FERC, "Final Report on Price Manipulation in Western Markets," staff presentation, Docket No. PA02-2-000, March 26, 2003 (copy hosted by the California Independent System Operator), https://www.caiso.com/Documents/FERCPresentationonFinalReportonPriceManipulationinWesternMarkets.pdf, accessed November 12, 2026.

[177] Donald J. Gelinas, FERC, "Final Report on Price Manipulation in Western Markets," staff presentation, Docket No. PA02-2-000, March 26, 2003 (copy hosted by the California Independent System Operator), https://www.caiso.com/Documents/FERCPresentationonFinalReportonPriceManipulationinWesternMarkets.pdf, accessed November 12, 2026.

[178] Donald J. Gelinas, FERC, "Final Report on Price Manipulation in Western Markets," staff presentation, Docket No. PA02-2-000, March 26, 2003 (copy hosted by the California Independent System Operator), https://www.caiso.com/Documents/FERCPresentationonFinalReportonPriceManipulationinWesternMarkets.pdf, accessed November 12, 2026.

[179] U.S. Department of Justice, "Federal Jury Convicts Former Enron Chief Executives Ken Lay, Jeff Skilling On Fraud, Conspiracy And Related Charges," press release 06-328, May 25, 2006, https://www.justice.gov/archive/opa/pr/2006/May/06_crm_328.html, accessed November 12, 2026.

counts of insider trading.[180] Lay was also convicted of bank fraud and false statements to banks in a separate trial before the same judge.[181]

"Enron filed for bankruptcy in December 2001," the Department of Justice later noted.[182] Skilling was first sentenced on October 23, 2006, to 292 months in prison. After an appeal, which "affirmed Skilling's convictions but vacated his sentence," he was resentenced in 2013 to 168 months.[183] Lay died before he could be sentenced. [Not verified: the date of Lay's death and what happened to his conviction afterward; the Justice Department pages I read do not cover it.]

What the crisis taught, according to each side

People drew very different lessons, and I'll give each its due.

Critics of electricity markets point to California and say markets invite manipulation, and that a simple regulated utility is safer for customers. Supporters of markets say California's design was flawed in specific ways, and that FERC's own staff named "flawed power market design" as a contributing factor.[184] They point out that markets in the Mid-Atlantic, New England, New York and elsewhere kept running and were redesigned with stronger monitoring. Both camps agree on one thing: a market is only as good as its rules and the people watching it.

That is why today each big market has an independent market monitor, an outside watchdog that reports on whether prices are fair. You will meet the monitor for the largest U.S. market, PJM, in the next chapter, where its reports on data centers are a big part of the story.

Where this leaves us

Today the country is a patchwork: some regions have competitive wholesale markets run by ISOs and RTOs, and others still have traditional utilities.[185] Some states also let you shop for

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[180] U.S. Department of Justice, "Federal Jury Convicts Former Enron Chief Executives Ken Lay, Jeff Skilling On Fraud, Conspiracy And Related Charges," press release 06-328, May 25, 2006, https://www.justice.gov/archive/opa/pr/2006/May/06_crm_328.html, accessed November 12, 2026.

[181] U.S. Department of Justice, "Federal Jury Convicts Former Enron Chief Executives Ken Lay, Jeff Skilling On Fraud, Conspiracy And Related Charges," press release 06-328, May 25, 2006, https://www.justice.gov/archive/opa/pr/2006/May/06_crm_328.html, accessed November 12, 2026.

[182] DOJ, "Former Enron CEO Jeffrey Skilling Resentenced to 168 Months for Fraud, Conspiracy Charges," press release 13-703, June 21, 2013, https://www.justice.gov/opa/pr/former-enron-ceo-jeffrey-skilling-resentenced-168-months-fraud-conspiracy-charges, accessed November 12, 2026.

[183] DOJ, "Former Enron CEO Jeffrey Skilling Resentenced to 168 Months for Fraud, Conspiracy Charges," press release 13-703, June 21, 2013, https://www.justice.gov/opa/pr/former-enron-ceo-jeffrey-skilling-resentenced-168-months-fraud-conspiracy-charges, accessed November 12, 2026.

[184] FERC, "Addressing the 2000-2001 Western Energy Crisis," web page, https://ferc.gov/industries-data/electric/general-information/addressing-2000-2001-western-energy-crisis, accessed November 12, 2026.

[185] FERC, "Electric Power Markets," national overview web page, undated, https://ferc.gov/electric-power-markets, accessed November 12, 2026.

your electricity supplier. [Not verified: the current number of states that allow retail choice.] The next chapter looks at what is actually driving bills up in all of them.

Chapter 9: Why Bills Are Rising

This is the chapter many readers will turn to first. You might ask, "Why did my bill go up when I used the same amount?" Here is the honest answer: several things at once, and how much each one matters depends a great deal on where you live. I take them one at a time, with numbers.

Information in this chapter is current as of November 12, 2026. All dollar and cents figures are nominal (not adjusted for inflation) unless I say otherwise.

First, how much have prices actually gone up?

The best single source I found is a yearly study from Lawrence Berkeley National Laboratory (LBNL), a federal research lab, done with The Brattle Group, an economic consulting firm. Its July 2026 update found that average retail prices across all customers rose 5.3 percent from 2024 to 2025 in nominal terms, or 2.6 percent after adjusting for inflation.[186]

Over a longer stretch, the picture is more mixed than headlines suggest. LBNL found that nominal average prices rose 29 percent from 2019 to 2025. But after adjusting for inflation, "real prices in 2025 were 3% higher than 2019, and 6% lower than 2010."[187]

Homes got hit harder than businesses. From 2019 to 2025, nominal residential prices rose 33 percent, compared with 26 percent for commercial and 27 percent for industrial customers.[188] After inflation, residential prices rose 5.6 percent over that time.[189]

Table 9-1. U.S. average residential electricity price, nominal cents per kWh (information as of November 12, 2026)

Year	Price	Note
2024	16.5	actual
2025	17.3	actual
2026	18.2	EIA forecast

[186] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[187] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[188] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[189] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

Year	Price	Note
2027	18.7	EIA forecast

Source: EIA, Short-Term Energy Outlook, released October 6, 2026.[190]

EIA also noted in 2025 that retail prices "have increased faster than the rate of inflation since 2022."[191]

How big a bite is it?

LBNL estimated that the average residential electric bill was 2.4 percent of household spending in 2025, and 1.8 percent of pre-tax income.[192] For comparison, EIA noted that U.S. consumers spent about $1,760 on electricity in 2023 and nearly $2,450 on gasoline.[193]

Averages hide real pain, though. LBNL reported that about 1 in 6 households were behind on their energy bills and that utility arrearages, meaning overdue balances, reached $21 billion in May 2025.[194]

It also matters a lot where you live. From 2019 to 2025, LBNL found that 29 states actually had price decreases after inflation, while the biggest increases were in California, the Northeast, parts of the Mid-Atlantic, the West and the Great Lakes.[195] But from 2024 to 2025, 43 states and the District of Columbia saw increases after inflation.[196]

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[190] EIA, Short-Term Energy Outlook, "Electricity, coal, and renewables" section, released October 6, 2026, https://www.eia.gov/outlooks/steo/report/elec_coal_renew.php, accessed November 12, 2026.

[191] EIA, "U.S. electricity prices continue steady increase," Today in Energy, May 14, 2025, https://www.eia.gov/todayinenergy/detail.php?id=65284, accessed November 12, 2026.

[192] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[193] EIA, "U.S. electricity prices continue steady increase," Today in Energy, May 14, 2025, https://www.eia.gov/todayinenergy/detail.php?id=65284, accessed November 12, 2026.

[194] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[195] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[196] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

Driver 1: natural gas prices

Natural gas made about 41 percent of the country's electricity in 2025,[197] and in many markets a gas plant sets the price of power for much of the day. So when gas prices move, power prices follow.

In 2025, the benchmark Henry Hub natural gas price averaged $3.52 per million British thermal units, 56 percent more than in 2024.[198] In parts of New England and New York, gas prices averaged twice as much in 2025 as in 2024.[199] Wholesale power prices rose the most in New England, up $29 per megawatthour.[200] (A megawatthour, or MWh, is 1,000 kWh.)

LBNL found that the cost of gas delivered to power plants rose 36 percent in 2025 from an all-time low in 2024, and that it was a driver of retail price changes in 21 states.[201]

There is another side to this. LBNL also found that over the long run, "Low-cost natural gas reduced retail prices."[202] Cheap shale gas held prices down for most of the 2010s. Gas cuts both ways.

Driver 2: poles, wires and substations

This is the driver most people don't hear about, and in many places it is the biggest.

EIA reports that total spending by major utilities rose from $287 billion in 2003 to $320 billion in 2023, adjusted for inflation to 2023 dollars, and that "Capital investment in electric infrastructure mostly drove the increase."[203] Spending to build distribution systems rose by $31.4 billion, or 160 percent, from 2003 to 2023, to $50.9 billion in 2023.[204]

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[197] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[198] EIA, "U.S. wholesale day-ahead electricity prices rose in 2025 with higher natural gas prices," Today in Energy, February 2, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67106, accessed November 12, 2026.

[199] EIA, "U.S. wholesale day-ahead electricity prices rose in 2025 with higher natural gas prices," Today in Energy, February 2, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67106, accessed November 12, 2026.

[200] EIA, "U.S. wholesale day-ahead electricity prices rose in 2025 with higher natural gas prices," Today in Energy, February 2, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67106, accessed November 12, 2026.

[201] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[202] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[203] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

[204] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

Transmission spending nearly tripled over the same period, to $27.7 billion in 2023.[205] Meanwhile, spending on power plants, which EIA calls production, fell 24 percent.[206]

An earlier EIA review found that "Distribution spending has outpaced growth in both the number of electric customers and in retail electricity sales."[207] In other words, utilities are spending more per customer on the local system.

LBNL found that investor-owned utilities' distribution spending grew an average of 5 percent a year after inflation from 2019 to 2025, and that distribution costs raised prices in 22 states in 2025, including costs to recover from storms.[208] An industry survey cited by LBNL found that "replacement" or "adaptation, hardening, and resilience" drove 61 percent of distribution investment.[209]

You might ask, "Why are they spending so much?" The sources point to aging equipment being replaced, storm hardening and, more recently, new demand. I could not find a reliable national breakdown of how much of this spending was strictly necessary, and that is exactly what gets argued in each state's rate cases.

Driver 3: wildfires and storms

In some places, disasters are now a major line item. LBNL estimated that wildfire mitigation raised prices in California by more than 4 cents per kWh from 2019 to 2025, and that storm costs raised prices by more than 1 cent per kWh in some East Coast and Gulf Coast states.[210] LBNL also found that California prices "moderated in 2025 as wildfire mitigation costs declined" for Pacific Gas and Electric.[211]

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[205] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

[206] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

[207] EIA, "Major utilities' spending on the electric distribution system continues to increase," Today in Energy, May 27, 2021, https://www.eia.gov/todayinenergy/detail.php?id=48136, accessed November 12, 2026.

[208] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[209] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[210] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[211] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

California's largest utility shows how big these costs can get. The state's utility commission records that "On Jan. 29, 2019, PG&E filed for Chapter 11 bankruptcy" and that "On July 1, 2020 PG&E emerged from bankruptcy."[212] [Not verified: the dollar amount of the wildfire claims behind the filing. The commission page I read does not state it.]

Driver 4: new demand, and data centers

For about 15 years, U.S. electricity use barely grew. That has changed. NERC reported in late 2025 that winter peak demand across North America had "risen by 20 GW (2.5%) since the previous winter," following "years of flat or low (~1%) peak demand growth."[213] NERC's long-term outlook, released in January 2026, said: "New data centers for artificial intelligence and the digital economy account for most of the projected increase."[214]

EIA expects commercial electricity demand, which "includes data centers," to grow 2.8 percent in 2027.[215]

Here is where the data center question gets real, with numbers. The clearest evidence comes from PJM, the grid operator for "all or parts of 13 states and the District of Columbia."[216] PJM runs a yearly "capacity auction," where power plants are paid to promise they will be available in a future year. That payment shows up in customers' bills.

Table 9-2. Recent PJM capacity auction results (information as of November 12, 2026)

Delivery year	Price ($ per MW-day)	Shortfall vs. reliability target	Note
2027/2028	$333.44	6,623 MW short	at the price cap
2028/2029	$325.00	6,831 MW short	at the price cap

Sources: PJM news releases of December 17, 2025, and July 14, 2026.[217,218]

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[212] CPUC, "PG&E Bankruptcy," web page, https://www.cpuc.ca.gov/industries-and-topics/pge/pge-bankruptcy, accessed November 12, 2026.

[213] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 5, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[214] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[215] EIA, Short-Term Energy Outlook, "Electricity, coal, and renewables" section, released October 6, 2026, https://www.eia.gov/outlooks/steo/report/elec_coal_renew.php, accessed November 12, 2026.

[216] PJM Interconnection, "About PJM," web page, https://www.pjm.com/about-pjm, accessed November 12, 2026.

[217] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

[218] PJM Interconnection, "PJM Capacity Auction Procures 138,318 MW of Generation Resources," news release, July 14, 2026, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2026-releases/20260714-pjm-capacity-auction-procures-138318-mw-of-generation-resources.pdf, accessed November 12, 2026.

For the 2027/2028 auction, PJM said its forecast peak load was about 5,250 MW higher than the year before, and "Nearly 5,100 MW of that increase is attributable to data center demand."[219] It was the first time the whole PJM region fell short of its reliability target.[220]

PJM's independent market monitor, a company called Monitoring Analytics that watches the market for PJM, has been blunt. In its August 2026 report, it said "Data center load growth is the primary reason for recent and expected capacity market conditions."[221] It calculated that including data center load in the last three auctions "increased customers' bills by $20,036,670,606," about $20 billion.[222] A trade publication reported that the monitor found data center load made up about 9 percent of PJM's wholesale power cost in the first seven months of 2026.[223]

LBNL found that PJM capacity prices added 3.1 cents per kWh to retail prices in Washington, D.C., 2.0 cents in New Jersey and 1.5 cents in Maryland in 2025.[224]

PJM itself sees it differently in emphasis. A PJM spokesperson told E&E News that the prices "are an accurate indication of the tightening supply and demand condition."[225] In other words, PJM's view is that the auction is doing its job by signaling that more power plants are needed. PJM also points out that capacity "accounts for a fraction of wholesale electricity costs."[226]

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[219] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

[220] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

[221] Monitoring Analytics (Independent Market Monitor for PJM), "2026 Quarterly State of the Market Report for PJM: January through June," August 13, 2026, https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2026/2026q2-som-pjm.pdf, accessed November 12, 2026.

[222] Monitoring Analytics (Independent Market Monitor for PJM), "2026 Quarterly State of the Market Report for PJM: January through June," August 13, 2026, https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2026/2026q2-som-pjm.pdf, accessed November 12, 2026.

[223] Ethan Howland, "Data center load made up 9% of PJM wholesale costs so far in 2026: market monitor," Utility Dive, August 27, 2026, https://www.utilitydive.com/news/data-center-load-pjm-wholesale-market/828917/, accessed November 12, 2026.

[224] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[225] Christa Marshall, "Data centers drive 76% surge in PJM power prices," E&E News, May 15, 2026, https://www.eenews.net/articles/data-centers-drive-76-surge-in-pjm-power-prices/, accessed November 12, 2026.

[226] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

So are data centers raising everyone's bills? In the PJM region, the market monitor's numbers say yes, by a lot. Nationally, the picture is more mixed, and I give the claim a full verdict in Chapter 16.

Driver 5: state policies

State clean energy rules have a cost too, and LBNL measured it. It estimated that renewable portfolio standards, state laws requiring utilities to buy a set share of renewable power, added about 0.2 cents per kWh on average from 2019 to 2025, and about 1 cent in several Mid-Atlantic and New England states.[227] It found that net metering, the policy that credits rooftop solar owners for power they send to the grid, added less than 0.5 cents per kWh in about 40 states but more than 2 cents in California.[228] And it found that the Regional Greenhouse Gas Initiative, a carbon-pricing program among Northeastern states, raised wholesale prices in New England and New York by more than half a cent per kWh.[229]

Supporters of these policies say the costs buy cleaner air, lower long-term fuel risk and new industries. Critics say they are a hidden tax on electricity. LBNL's numbers let you weigh both: in most states, policy costs are smaller than gas, wires and storm costs, but in a few states they are a real share of the bill.

Driver 6: power plant spending

LBNL found that investor-owned utilities' spending on power plants rose 22 percent in 2025 after inflation, after 13 percent increases in both 2023 and 2024, "driven by load growth" among other factors.[230] Lazard, a financial advisory firm that publishes a widely cited annual cost comparison, reported in June 2025 that "the cost of building a new combined cycle gas turbine has reached a 10-year high."[231]

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[227] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[228] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[229] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[230] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[231] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

Putting it together

Table 9-3. Main drivers of recent price increases, as measured by LBNL (2019 to 2025 unless noted)

Driver	Where it hit hardest	Size (cents per kWh)
Natural gas prices (2025)	21 states	varies; rose 36% in 2025
Distribution spending	22 states in 2025	about 5% a year spending growth
Wildfire mitigation	California	more than 4
Storm recovery	some East and Gulf Coast states	more than 1
PJM capacity prices (2025)	D.C., New Jersey, Maryland	3.1, 2.0, 1.5
Renewable portfolio standards	several Mid-Atlantic and New England states	about 1 (0.2 average)
Net metering	California	more than 2

Source: LBNL and Brattle, July 2026.[232]

Where this leaves us

If your bill went up while your usage stayed flat, the most likely reasons, depending on your state, are higher natural gas prices, more spending on local poles and wires, storm or wildfire costs, and in the PJM region, the capacity costs tied to data center growth. What the bill does not tell you is whether all that spending was necessary. That is decided case by case in front of your state commission, and Appendix C shows you how to read your bill so you can follow along.

[232] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

Part Four: Blackouts and Reliability

Chapter 10: The Big Blackouts and What the Investigators Found

After every major blackout, someone in government investigates, writes a report and makes recommendations. Those reports are the best evidence we have about why the lights go out. In this chapter I walk through the biggest ones, and I stick to what the official investigators found, not what was said on television that week.

1965: the Northeast

I covered the 1965 Northeast blackout in Chapter 4. It left about 30 million people in the dark, according to President Johnson,[233] and it led to the creation of the reliability council that became NERC.

1977: New York City

At about 9:36 p.m. on July 13, 1977, New York City went dark. A study prepared for the U.S. Department of Energy reported that the blackout lasted a total of 25 hours and affected 9 million people.[234] It began during a heat wave when lightning struck the system.[235]

The staff of FERC, which had just been created, investigated. Its final report said that "On July 13, 1977 the entire electric load of the Con Edison system was lost," and blamed "a combination of natural events, equipment malfunctions, questionable system-design features, and operating errors."[236]

The 1977 blackout is remembered for what happened on the streets. The Department of Energy study counted 1,037 fires, close to 3,000 arrests and 1,809 incidents of property damage from looting and vandalism, and estimated economic costs "in excess of $350 million."[237] That figure is in 1977 dollars.

2003: the biggest blackout in North American history

On August 14, 2003, the lights went out across much of the Northeast and Midwest and in the Canadian province of Ontario. The official joint U.S.-Canada task force reported that "The blackout began a few minutes after 4:00 pm Eastern Daylight Time," and affected "an

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[233] Lyndon B. Johnson, "Statement by the President in Response to Federal Power Commission Report on the Northeastern Electric Power Blackout," December 6, 1965 (The American Presidency Project), https://presidency.ucsb.edu/documents/statement-the-president-response-federal-power-commission-report-the-northeastern-electric, accessed November 12, 2026.

[234] Systems Control, Inc. (Jane L. Corwin and William T. Miles), for the U.S. Department of Energy, "Impact Assessment of the 1977 New York City Blackout," July 1978, p. 14, https://ferc.gov/sites/default/files/2020-05/impact-77.pdf, accessed November 12, 2026.

[235] Systems Control, Inc. (Jane L. Corwin and William T. Miles), for the U.S. Department of Energy, "Impact Assessment of the 1977 New York City Blackout," July 1978, p. 14, https://ferc.gov/sites/default/files/2020-05/impact-77.pdf, accessed November 12, 2026.

[236] FERC staff, "Con Edison Power Failure of July 13 and 14, 1977: Final Staff Report," DOE/FERC-0012 (OSTI record), https://www.osti.gov/biblio/6673953, accessed November 12, 2026.

[237] Systems Control, Inc. (Jane L. Corwin and William T. Miles), for the U.S. Department of Energy, "Impact Assessment of the 1977 New York City Blackout," July 1978, pp. 4, 14, https://ferc.gov/sites/default/files/2020-05/impact-77.pdf, accessed November 12, 2026.

estimated 50 million people and 61,800 megawatts (MW) of electric load."[238] Eight states lost power: Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut and New Jersey.[239] In some parts of the United States, "power was not restored for 4 days," and parts of Ontario had rolling blackouts for more than a week.[240] The task force estimated U.S. costs "between $4 billion and $10 billion."[241]

The U.S. Energy Department called it "the worst blackout in North American history."[242] The task force grouped the causes into four:[243]

1. Inadequate system understanding
2. Inadequate situational awareness
3. Inadequate tree trimming
4. Inadequate reliability coordinator diagnostic support

You might ask, "Did a tree really cause the biggest blackout in history?" Partly, yes. Overgrown trees touching high-voltage lines in Ohio were one of the four groups of causes. But the bigger failure was that the people running the system did not know what was happening in time to stop it from spreading. The task force also found "seven violations of the voluntary reliability standards administered by NERC."[244]

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[238] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, p. 1, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[239] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, p. 1, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[240] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, p. 1, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[241] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, p. 1, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[242] DOE, "Blackout 2003: U.S.-Canada Task Force Presents Final Report on Blackout of August 2003," press release, April 5, 2004, https://www.energy.gov/oe/articles/blackout-2003-us-canada-task-force-presents-final-report-onblackout-august-2003, accessed November 12, 2026.

[243] DOE, "Blackout 2003: U.S.-Canada Task Force Presents Final Report on Blackout of August 2003," press release, April 5, 2004, https://www.energy.gov/oe/articles/blackout-2003-us-canada-task-force-presents-final-report-onblackout-august-2003, accessed November 12, 2026.

[244] DOE, "Blackout 2003: U.S.-Canada Task Force Presents Final Report on Blackout of August 2003," press release, April 5, 2004, https://www.energy.gov/oe/articles/blackout-2003-us-canada-task-force-presents-final-report-onblackout-august-2003, accessed November 12, 2026.

The task force made 46 recommendations, and the first one was to "Make reliability standards mandatory and enforceable, with penalties for noncompliance."[245] Congress did that two years later, as covered in Chapter 4.[246]

2011: the Southwest

On the afternoon of September 8, 2011, the grid in the desert Southwest came apart. According to a trade publication's report on the joint FERC and NERC investigation, the outages "left 2.7 million power customers in Southern California, Arizona, and Baja California" in the dark, and "All of the San Diego area lost power, with nearly 1.5 million customers losing power, some for up to 12 hours."[247] The investigators found that the system had been "operating in an unsecured state due to inadequate planning, a lack of observability" and a "lack of adequate real-time situational awareness of conditions throughout the Western Interconnection."[248] [Not verified against the report itself: the official FERC and NERC report would not open for me, so these figures come from POWER magazine's account of it.]

2020: California's heat wave

On August 14 and 15, 2020, California's grid operator "was forced to institute rotating electricity outages in California in the midst of a West-wide extreme heat wave."[249] A rotating outage, sometimes called a rolling blackout, is a planned, controlled shutoff of power to some neighborhoods for a short time so the whole system does not collapse.

The state's grid operator, its utility commission and its energy commission issued a joint final report in January 2021. It found that "the three major factors leading to the August outages were related to extreme weather conditions, resource adequacy and planning processes, and market practices."[250] Resource adequacy means having enough power plants and other resources lined up to meet demand.

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[245] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, pp. 2-3, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[246] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[247] POWER magazine, "Southern California Blackout Set Off By Inadequate Planning, FERC and NERC Say," May 3, 2012, https://www.powermag.com/southern-california-blackout-set-off-by-inadequate-planning-ferc-and-nerc-say, accessed November 12, 2026.

[248] POWER magazine, "Southern California Blackout Set Off By Inadequate Planning, FERC and NERC Say," May 3, 2012, https://www.powermag.com/southern-california-blackout-set-off-by-inadequate-planning-ferc-and-nerc-say, accessed November 12, 2026.

[249] California Independent System Operator, California Public Utilities Commission and California Energy Commission, "CAISO, CPUC, CEC Issue Final Report on Causes of August 2020 Rotating Outages," press release, January 13, 2021, https://www.caiso.com/Documents/CAISO-CPUC-CEC-Issue-Final-Report-On-Causes-Of-August-2020-Rotating-Outages.pdf, accessed November 12, 2026.

[250] California Independent System Operator, California Public Utilities Commission and California Energy Commission, "CAISO, CPUC, CEC Issue Final Report on Causes of August 2020 Rotating Outages," press release,

The report's cover letter states plainly that there was "no single root cause" for the outages.[251] [Not verified: the number of customers who lost power each day. The report's tables give those counts, but I could not read those pages directly, so I have left the figures out.]

2021: Winter Storm Uri in Texas

This is the blackout most people remember, and the one most argued about. In February 2021, an arctic storm swept through Texas and the south-central states.

The facts below come from the joint report of FERC, NERC and NERC's regional entities, released in November 2021. I use it because it is the most detailed official investigation, and both sides of the political debate have cited it.

- "More than 4.5 million people in Texas lost power during the Event."[252] FERC said some were out "for as long as four days."[253]
- "At least 210 people died during the Event."[254] The report took that figure from a July 2021 news report. The Texas Department of State Health Services later put the final count at 246, and "Close to two-thirds of the deaths were due to hypothermia," according to The Texas Tribune.[255]
- "ERCOT ultimately had to shed 20,000 MW of firm load at the worst point of the Event."[256] "Shedding firm load" is the industry phrase for cutting power to customers on purpose.
- Across Texas and the neighboring regions, operators cut a combined 23,418 MW, "the largest controlled firm load shed event in U.S. history."[257]

January 13, 2021, https://www.caiso.com/Documents/CAISO-CPUC-CEC-Issue-Final-Report-On-Causes-Of-August-2020-Rotating-Outages.pdf, accessed November 12, 2026.

[251] California ISO, California Public Utilities Commission and California Energy Commission, "Final Root Cause Analysis: Mid-August 2020 Extreme Heat Wave," with cover letter dated January 13, 2021, https://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf, accessed November 12, 2026.

[252] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 9, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[253] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[254] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 9, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[255] Patrick Svitek, "Texas puts final estimate of winter storm death toll at 246," The Texas Tribune, January 2, 2022, https://www.texastribune.org/2022/01/02/texas-winter-storm-final-death-toll-246/, accessed November 12, 2026.

[256] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 10, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

- 1,045 individual generating units had 4,124 outages, reductions in output or failures to start.[258]

What failed? The report gives the breakdown of the generating units that had problems: "58 percent natural gas-fired, 27 percent wind, six percent coal, two percent solar, seven percent other fuels, and less than one percent nuclear."[259]

And why did they fail? "75 percent were caused by either freezing issues (44.2 percent) or fuel issues (31.4 percent)."[260] Natural gas made up 87 percent of the fuel-issue outages.[261] The gas system itself was struggling: from February 8 to 17, natural gas production in the lower 48 states fell 28 percent, and in Texas, Oklahoma and Louisiana combined it fell by more than half compared with the January average.[262]

The investigators also found that relatively simple fixes could have made a big difference. FERC said that "protecting just four types of power plant components from icing and freezing could have reduced outages by 67 percent in the ERCOT region."[263]

How close did Texas come to something much worse? The report says ERCOT's grid frequency fell below the level at which generators automatically trip off "for over four minutes," and that operators "had only nine minutes to prevent approximately 17,000 MW of generating units from tripping."[264] If those units had tripped, the whole Texas grid could have collapsed, and restarting a grid from a total shutdown can take a very long time.

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[257] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 9, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[258] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 8, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[259] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 15, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[260] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 15, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[261] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 16, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[262] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 13, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[263] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[264] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 14, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

This was not the first warning. The 2021 report notes that an earlier cold snap in February 2011 caused 29,700 MW of generation outages in the Southwest, and that a 2011 report had already recommended winterizing power plants.[265] FERC's chairman at the time, Richard Glick, said: "The devastating effects of extreme cold on our bulk power system's ability to operate in 2011 and now, 2021, must not be allowed to happen again."[266]

The final report included 28 formal recommendations, including stronger mandatory reliability standards for cold weather.[267] In Chapter 15, I test two popular claims about who or what was to blame.

2022: Winter Storm Elliott

Less than two years later, just before Christmas 2022, another winter storm hit much of the eastern United States. FERC's staff later reported "Unprecedented unplanned electric generation outages of 90,500 MW, at worst point (150 percent of URI outages)" on December 24.[268] That same day saw the "Largest ever controlled firm load shed recorded in the history of the Eastern Interconnection (5,400 MW)."[269]

FERC said that "Nearly 80 percent of the generating units failed to perform at temperatures above their own documented minimum operating temperatures."[270] In other words, plants failed in conditions they were supposed to be built to handle. Natural gas production in the Marcellus and Utica shale regions fell 23 and 54 percent.[271]

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[265] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 9, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[266] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[267] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[268] FERC staff, "2022 Winter Storm Elliott Inquiry Findings," presentation to the DOE Electricity Advisory Committee, February 13, 2024, https://www.energy.gov/sites/default/files/2024-02/Day%201%20-%20FERC%202022%20Winter%20Storm%20Elliott%20Inquiry%20Findings_untagged.pdf, accessed November 12, 2026.

[269] FERC staff, "2022 Winter Storm Elliott Inquiry Findings," presentation to the DOE Electricity Advisory Committee, February 13, 2024, https://www.energy.gov/sites/default/files/2024-02/Day%201%20-%20FERC%202022%20Winter%20Storm%20Elliott%20Inquiry%20Findings_untagged.pdf, accessed November 12, 2026.

[270] FERC, "Elliott Report Complete: Electricity Standards, Implement Gas Reliability Rules," news release, September 21, 2023, https://www.ferc.gov/news-events/news/elliott-report-complete-electricity-standards-implement-gas-reliability-rules, accessed November 12, 2026.

[271] FERC staff, "2022 Winter Storm Elliott Inquiry Findings," presentation to the DOE Electricity Advisory Committee, February 13, 2024, https://www.energy.gov/sites/default/files/2024-02/Day%201%20-%20FERC%202022%20Winter%20Storm%20Elliott%20Inquiry%20Findings_untagged.pdf, accessed November 12, 2026.

The Elliott report, issued in October 2023, made 11 recommendations.[272] FERC Chairman Willie Phillips said: "Someone - it doesn't have to be FERC - must have authority to establish and enforce natural gas reliability standards."[273] That is a big point. As I explain in the next chapter, the gas system that fuels much of our power still runs largely without mandatory reliability rules.

FERC said only that "Several electric grid operators had to shed firm load to maintain system reliability."[274] Two of them were large Southeastern utilities. The Tennessee Valley Authority had to "impose rolling blackouts for the first time in its history," according to Power Engineering.[275] Duke Energy began "rotating power outages on Dec. 24 to protect the grid" in the Carolinas, and "roughly 500,000" customers were affected. A Duke executive told state regulators, "This is the first time in our company's history that we had to implement rolling service disruptions."[276]

What the reports have in common

Table 10-1. Major U.S. blackouts and what official investigations found

Event	People or load affected	Main causes found by investigators
Nov. 9, 1965, Northeast	about 30 million people	[Not verified] (see Chapter 4)
July 13, 1977, New York City	9 million people, 25 hours	natural events, equipment, design, operating errors
Aug. 14, 2003, Northeast and Midwest	about 50 million people, 61,800 MW	poor system understanding, situational awareness, tree trimming, coordinator support
Sept. 8, 2011, Southwest	2.7 million customers	inadequate planning, poor real-time awareness
Aug. 14-15, 2020, California	rotating outages	extreme heat, resource planning, market practices

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[272] FERC staff, "2022 Winter Storm Elliott Inquiry Findings," presentation to the DOE Electricity Advisory Committee, February 13, 2024, https://www.energy.gov/sites/default/files/2024-02/Day%201%20-%20FERC%202022%20Winter%20Storm%20Elliott%20Inquiry%20Findings_untagged.pdf, accessed November 12, 2026.

[273] FERC, "Elliott Report Complete: Electricity Standards, Implement Gas Reliability Rules," news release, September 21, 2023, https://www.ferc.gov/news-events/news/elliott-report-complete-electricity-standards-implement-gas-reliability-rules, accessed November 12, 2026.

[274] FERC, "Elliott Report Complete: Electricity Standards, Implement Gas Reliability Rules," news release, September 21, 2023, https://www.ferc.gov/news-events/news/elliott-report-complete-electricity-standards-implement-gas-reliability-rules, accessed November 12, 2026.

[275] Kevin Clark, "TVA lost around 20% of available power production during December storm," Power Engineering, May 10, 2023, https://www.power-eng.com/operations-maintenance/tva-lost-approximately-20-of-power-production-during-december-storm/, accessed November 12, 2026.

[276] "Duke Energy Updates NC Utilities Commission on Winter Storm Elliott Emergency Outage Event," T&D World, January 6, 2023, https://www.tdworld.com/disaster-response/article/21257595/duke-energy-updates-nc-utilities-commission-on-winter-storm-elliott-emergency-outage-event, accessed November 12, 2026.

Event	People or load affected	Main causes found by investigators
Feb. 2021, Texas (Uri)	more than 4.5 million people, 20,000 MW cut in ERCOT	freezing and fuel problems, mostly natural gas, also wind, coal
Dec. 2022, Eastern U.S. (Elliott)	90,500 MW of plant outages, 5,400 MW cut; first rolling blackouts in TVA and Duke history	plants failing in cold, natural gas supply drops

Sources: as cited in this chapter.

Reading these reports back to back, three patterns stand out to me. First, extreme weather is the trigger in most recent events. Second, the same lesson about cold-weather preparation had to be learned more than once. Third, the people running the grid often did not have a clear view of what was happening until it was too late. None of these are a story about one fuel or one villain, whatever you may have heard.

Chapter 11: NERC's Current Warnings

Every year NERC publishes three big forecasts: one before summer, one before winter, and a ten-year outlook. News stories often boil these down to a scary headline. In this chapter I tell you what the reports actually say, including the reassuring parts that tend to get left out.

Information in this chapter is current as of November 12, 2026. NERC's newest winter forecast, for 2026-2027, had not been published as of that date. NERC's assessment committee had it on its agenda for a meeting on November 3 to 5, 2026, so it should be out soon after this book's cutoff.[277] I use the 2025-2026 winter forecast below.

How NERC describes risk

NERC sorts each region into risk levels. "Normal" means enough resources for expected conditions. "Elevated" means the region could run short in more extreme conditions, like a long cold snap or a heat wave hitting more than one region at once. "High" means a region may run short even in normal peak conditions.

One phrase you will see over and over is "assessment area." NERC splits North America into a few dozen areas, roughly matching the big grid operators and regions, and rates each one.

The 2025-2026 winter forecast

NERC's winter report, released in November 2025, began with the reassuring part: "All areas are assessed as having adequate resources for normal winter peak-load conditions."[278]

Then came the warnings. NERC said peak demand across its areas "has risen by 20 GW (2.5%) since the previous winter," after "years of flat or low (~1%) peak demand growth."[279] It listed seven areas at elevated risk under extreme winter conditions: the Canadian Maritimes, New England, the eastern and central parts of the SERC region in the Southeast, ERCOT in Texas, and the Basin and Northwest regions in the West.[280]

NERC also pointed to a change in how people use power: "Data centers are altering the daily load shape due to their round-the-clock operating pattern."[281] And it raised the issue from

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[277] NERC Reliability Assessment Subcommittee, meeting agenda, November 3-5, 2026, https://www.nerc.com/globalassets/who-we-are/standing-committees/rstc/ras/ras-agenda-november-2026.pdf, accessed November 12, 2026.

[278] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 5, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[279] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 5, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[280] NERC, "2025-2026 Winter Reliability Assessment," November 2025, pp. 5-7, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[281] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 7, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

Chapter 10 again: "freeze protection mitigations are voluntary for the natural gas industry in most of North America."[282] Texas is the exception, where state rules now apply.[283]

On the supply side, NERC counted big additions of batteries and solar since the winter before: about 19,659 MW of battery nameplate capacity and 11,097 MW of solar.[284] Nameplate capacity is the most a plant can produce under ideal conditions. Solar does little at a winter evening peak, so its contribution in winter is much lower than its nameplate.

The 2026 summer forecast

NERC's summer report, released in May 2026, again led with good news: "All areas are assessed as having adequate anticipated resources for normal summer peak load conditions."[285] It reported that resources for the summer had "jumped by over 58.5 GW," with 30.5 GW of new solar nameplate capacity and battery additions providing 14.7 GW of increased on-peak capacity.[286]

Demand kept climbing. NERC said peak demand had increased by more than 11 GW from its 2025 summer projections, and "Peak demand forecasts have risen since 2025 in 19 of the 23 assessment areas."[287] It flagged New England, the SaskPower area in Canada, and the Northwest as elevated risk.[288]

NERC raised a newer worry too: large computer loads that suddenly drop off the grid. It reported recent events with "each Interconnection experiencing approximately 1,500 MW of voltage-sensitive load reduction," which it "primarily attributed to data centers and other power electronic loads."[289] In plain English, when the voltage dips for a moment, some data centers switch themselves to backup power all at once, and the grid suddenly has far more

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[282] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 7, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[283] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 10, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[284] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 9, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[285] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 1, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[286] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), pp. 4, 8, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[287] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), pp. 1, 8, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[288] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), pp. 2-3, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[289] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 4, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

power than it needs. Operators then have to scramble the other way. NERC "issued a Level 3 essential actions alert related to large loads," its most serious type of alert.[290] [Not verified: that Level 3 is NERC's highest alert level. That is my understanding of NERC's alert system; the summer report I read does not say so.]

The summer report also noted that federal emergency orders under section 202(c) of the Federal Power Act were keeping "six different power plants" available that their owners had planned to retire.[291] I discuss those orders in Chapter 17.

The ten-year outlook

The most serious warnings are in NERC's 2025 Long-Term Reliability Assessment, released in January 2026, which looks out to 2035.[292] Here are its main points, in NERC's words where possible:

- **Demand is growing fast.** Summer peak demand is "forecast to rise by over 224 GW" over ten years, which NERC said is "69% higher than last year's 10-year growth projection of 132 GW." Winter peak demand "is expected to grow by 245 GW."[293]
- **Data centers are the main reason.** "New data centers for artificial intelligence and the digital economy account for most of the projected increase."[294]
- **But forecasts are shaky.** NERC also noted that "some large-load projects have slowed or failed to materialize within the shorter-term horizon."[295]
- **Many areas face trouble.** "13 of 23 assessment areas face resource adequacy challenges over the next 10 years."[296]
- **Building is not keeping up.** "Projections for resource and transmission growth lag what is needed to support new data centers."[297] Of nearly 900 transmission projects, "at least 390 projects have been delayed."[298]

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[290] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 4, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[291] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 9, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[292] NERC, "2025 Long-Term Reliability Assessment," January 2026, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[293] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[294] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[295] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[296] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 6, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[297] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 6, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

- **Retirements are large.** Planned retirements "total over 105 GW in peak seasonal capacity," about 10 GW lower than the year before.[299]
- **The mix is shifting.** From 2024 to 2025, fossil-fueled capacity fell by 21 GW while battery, wind and solar rose by 23 GW. Solar and batteries are two-thirds of planned additions, and natural gas is 15 percent.[300]
- **Winter is the new worry.** The shift toward weather-dependent resources "increases risks of supply shortfalls during winter months."[301]
- **Gas matters more.** "The thermal generation component of the resource mix is increasingly reliant on natural gas for fuel."[302]

The 13 areas NERC flagged include the big markets of MISO (the Midwest), PJM (the Mid-Atlantic and parts of the Midwest), ERCOT (Texas), New York and New England, plus parts of the Southeast and West and several Canadian provinces.[303] [Not verified: which of the 13 NERC rates as high risk and which as elevated. The summary pages I read list the areas but I could not confirm the split.]

NERC's top recommendations were to "Expedite new resources to meet growing demand and carefully manage generator deactivations," and to "Understand and manage reliability risks accompanying large-load growth."[304]

How different groups read NERC's warnings

NERC's reports are used by everyone in the energy debate, and they don't all read them the same way.

People who want to slow the retirement of coal and gas plants point to the 105 GW of retirements and NERC's call to "carefully manage generator deactivations." People who favor faster clean energy point to the fact that solar and batteries make up two-thirds of what is being built, and to NERC's finding that transmission delays are a bottleneck. The same split shows up over a July 2025 Department of Energy report on resource adequacy. DOE's fact sheet says the report "assumes 104 GW of announced plant closures by 2030 will be met with 210 GW of new generation," that "only 22 GW of that new generation will be

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[298] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[299] NERC, "2025 Long-Term Reliability Assessment," January 2026, pp. 8-9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[300] NERC, "2025 Long-Term Reliability Assessment," January 2026, pp. 9-10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[301] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 6, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[302] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[303] NERC, "2025 Long-Term Reliability Assessment," January 2026, pp. 8-9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[304] NERC, "2025 Long-Term Reliability Assessment," January 2026, pp. 10-11, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

firm, reliable, dispatchable generation," and that "an additional 100 GW of new peak hour supply is needed by 2030."[305] GridLab, a nonprofit that focuses on clean energy, published a critique saying the report "undercounts the resources that are likely to be added to the grid," "overstates the retirements expected," and "assumes no projects are built post 2026, which is not realistic."[306] I report what each side said and come back to the policy choices in Chapter 17.

Where this leaves us

NERC's message boils down to this: today, every region has enough for normal conditions; extreme weather is the main short-term danger; and over the next ten years, demand is growing faster than new power plants and lines are being built, mostly because of data centers. The rest of Part Five compares the power sources that might fill that gap.

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[305] DOE, "The Department of Energy's Resource Adequacy Report Affirms the Energy Emergency Facing the U.S. Power Grid," fact sheet, July 2025, https://www.energy.gov/sites/default/files/2025-07/DOE_Fact_Sheet_Grid_Report_July_2025.pdf, accessed November 12, 2026.

[306] Ric O'Connell, "GridLab Analysis: Department of Energy Resource Adequacy Report," GridLab (clean-energy-focused nonprofit), July 11, 2025, https://gridlab.org/gridlab-analysis-department-of-energy-resource-adequacy-report/, accessed November 12, 2026.

Part Five: Power Sources Compared

Chapter 12: Coal, Gas, Nuclear, Wind, Solar and the Rest, Side by Side

Few subjects get people arguing faster than which power source is "best." I am not going to pick one. Instead, I hold every source to the same four tests, using official or peer-reviewed data: cost, reliability, emissions and land use. You will see that every source wins on at least one test and loses on at least one other.

Information in this chapter is current as of November 12, 2026.

How fast wind and solar have grown

Before the tests, a quick sense of scale. EIA reports that U.S. wind generation "increased from about 6 billion kilowatthours (kWh) in 2000 to about 464 billion kWh in 2025," and that wind made about 10.5 percent of utility-scale generation in 2025.[307] Solar, counting both big solar farms and rooftop panels, produced about 389 billion kWh in 2025.[308] About 76 percent of that came from utility-scale plants and about 24 percent from small systems such as rooftops.[309] Texas led in utility-scale solar generation with 20 percent of the national total, followed by California at 18 percent, and California produced nearly 37 percent of all small-scale solar.[310] Some people are surprised that Texas, an oil and gas state, leads the country in big solar. Texas has wind, sun, open land and a fast permitting process, and its market rewards whatever is cheapest to run in the moment. (That explanation is my own summary, not a finding from EIA.) [Not verified: Texas's rank in wind generation. The EIA wind page I read did not give state rankings.]

Test 1: Cost

The most common way to compare costs is the "levelized cost of electricity," or LCOE. It is the average cost per megawatthour of building and running a new plant over its life, including the money to pay off the loan.

EIA publishes LCOE estimates every year, and it is unusually honest about their limits. In its 2025 report, EIA wrote: "LCOE is limited because it only reflects the cost to build and operate a plant, not the value of the plant to the grid."[311] It also said: "Direct comparisons of

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[307] EIA, "Electricity generation from wind," Energy Explained (data through 2025), https://www.eia.gov/energyexplained/wind/electricity-generation-from-wind.php, accessed November 12, 2026.

[308] EIA, "Where solar is found and used," Energy Explained (data through 2025), https://www.eia.gov/energyexplained/solar/where-solar-is-found.php, accessed November 12, 2026.

[309] EIA, "Where solar is found and used," Energy Explained (data through 2025), https://www.eia.gov/energyexplained/solar/where-solar-is-found.php, accessed November 12, 2026.

[310] EIA, "Where solar is found and used," Energy Explained (data through 2025), https://www.eia.gov/energyexplained/solar/where-solar-is-found.php, accessed November 12, 2026.

[311] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 6, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

LCOE or LCOS across technologies are misleading as a method to assess the economic competitiveness" of different technologies.[312] (LCOS is the same measure for storage.)

Why would a cost number be misleading? Because a megawatthour from a solar farm at noon and a megawatthour from a gas plant at 7 p.m. on a winter night are not worth the same to the grid. EIA tries to handle this with a second number it calls the "levelized avoided cost of electricity," or LACE, which estimates what a plant's power is worth where and when it is produced.[313] EIA says that "Projects with LACE (value) greater than LCOE or LCOS (cost) are more economically attractive to build."[314]

With those warnings in mind, here are the numbers.

Table 12-1a. EIA estimated average cost of new power plants entering service in 2031, including federal tax credits, in 2025 dollars per MWh (information as of November 12, 2026)

Technology	EIA estimate
Geothermal	$40.38
Onshore wind	$56.75
Solar PV	$58.33
Natural gas combined cycle with carbon capture	$58.47
Hydroelectric	$64.77
Natural gas combined cycle	$77.46
Biomass	$84.54
Advanced nuclear	$87.81
Solar PV with battery (hybrid)	$94.20
Offshore wind	$118.79
Battery storage (cost of storage, not generation)	$152.61
Natural gas combustion turbine (peaker)	$172.57

Source: EIA, Levelized Costs of New Generation Resources in the Annual Energy Outlook 2026, figure on page 8.[315] EIA notes that "The stated LCOE values include the levelized tax

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[312] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 5, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[313] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 2, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[314] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 6, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[315] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2026," April 2026, p. 8, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/LCOE_report.pdf, accessed November 12, 2026.

credit component for eligible technologies."[316] A peaker plant runs only a few hours a year, so its cost per MWh looks high even though it is built for a different job.

EIA found in its 2025 report that "Solar PV LCOE is lower than natural gas combined-cycle LCOE on average and, in most regions, even without the tax credit."[317] Note that EIA's main figures include federal tax credits for eligible technologies.[318]

Lazard, the financial advisory firm, publishes a widely quoted comparison without subsidies. Its June 2025 edition put the unsubsidized cost of utility-scale solar at $38 to $78 per MWh and onshore wind at $37 to $86 per MWh.[319] Lazard's headline was "Unsubsidized Wind & Solar Lowest Cost Generation Sources for Last 10 Years."[320] But Lazard also said that grid operators' changes to how they credit wind and solar for reliability "have generally driven up firming costs," meaning the cost of backing them up when the wind is calm or the sun is down.[321] And it said the cost of building a new combined-cycle gas plant "has reached a 10-year high."[322]

Table 12-1b. Lazard unsubsidized cost ranges for new U.S. power plants, dollars per MWh (June 2025)

Technology	Low	High
Onshore wind	$37	$86
Utility-scale solar	$38	$78
Onshore wind plus storage	$44	$123
Gas combined cycle	$48	$109
Utility solar plus storage	$50	$131
Geothermal	$66	$109
Offshore wind	$70	$157

[316] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2026," April 2026, p. 8, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/LCOE_report.pdf, accessed November 12, 2026.

[317] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 8, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[318] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2026," April 2026, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/LCOE_report.pdf, accessed November 12, 2026.

[319] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

[320] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

[321] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

[322] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

Technology	Low	High
Coal	$71	$173
Nuclear	$141	$220
Gas peaking	$149	$251

Source: Lazard, Levelized Cost of Energy+, version 18.0, June 2025, page 8.[323] Lazard says its geothermal, coal and nuclear figures are older results "adjusted for inflation," because few new plants of those kinds are being built.[324]

Notice how much the two sources differ on nuclear. EIA's estimate for advanced nuclear, which includes tax credits, falls near the middle of the pack. Lazard's unsubsidized range for nuclear is among the highest it tracks. The real-world data point we have, Plant Vogtle in Georgia, went from an expected $14 billion to more than $30 billion.[325] Which number you trust says a lot about where you land in the nuclear debate.

So which is cheapest? For producing a megawatthour when conditions are right, new wind and solar are usually the cheapest new builds, according to both EIA and Lazard. For producing power on demand, any time, the picture changes, because you have to add the cost of storage or backup. I test the claim "Wind and solar are always the cheapest power" in Chapter 15.

Test 2: Reliability

Reliability has two parts: how much of the time a plant actually runs, and whether it can run when it is needed most.

The first is measured by the capacity factor: the power a plant actually produces in a year, divided by what it would produce running flat out all year. Nuclear plants lead by a wide margin. EIA reports that "The average annual capacity factor for nuclear power plants in 2025 was 91%."[326]

Table 12-3. Average capacity factors, U.S. utility-scale plants, 2025 (information as of November 12, 2026)

Plant type	Capacity factor
Nuclear	91.1%
Natural gas combined cycle	58.7%
Coal	48.8%

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[323] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), p. 8, https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

[324] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), p. 8, https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

[325] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[326] EIA, "Nuclear explained: U.S. nuclear industry," Energy Explained (data as of March 2026), undated web page, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php, accessed November 12, 2026.

Plant type	Capacity factor
Wind	33.8%
Solar PV	24.0%
Natural gas combustion turbine	13.6%

Sources: EIA, Electric Power Annual, Tables 4.08.A and 4.08.B.[327,328]

A low capacity factor does not always mean a plant is broken or bad. A peaker plant is built to sit idle most of the year and run on the hottest afternoons. A coal plant may run less because cheaper gas or solar power is available. Wind and solar run less because the wind and sun come and go.

The second part, being there when needed, is harder to measure. Wind and solar depend on the weather. Coal, gas and nuclear plants can be scheduled, but as Chapter 10 showed, they can fail in extreme cold, and gas plants depend on a gas supply system that can itself freeze. Batteries can respond in a fraction of a second but run for a limited number of hours.

NERC's way of handling this is to rate each resource's contribution at the hour of peak demand. In its 2025-2026 winter report, NERC cut its estimate of wind's peak-hour contribution by 14,238 MW, based on "revised valuations of wind resource capability at peak demand hours."[329] At the same time, NERC credited new batteries with 14.7 GW of on-peak capacity for summer 2026.[330]

Test 3: Emissions

Every power source causes some greenhouse gas emissions when you count its whole life: mining, building, running and taking it apart. Researchers call this a life-cycle assessment.

The best-known recent comparison comes from the United Nations Economic Commission for Europe, and Our World in Data summarizes its results. Coal is the worst by far. It "emits much more greenhouse gases than other sources - more than a hundred times more than nuclear."[331] Oil and gas are "much worse than nuclear and renewables but to a lesser extent

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[327] EIA, Electric Power Annual, "Table 4.08.A. Capacity Factors for Utility Scale Generators Primarily Using Fossil Fuels," 2025 values, https://www.eia.gov/electricity/annual/html/epa_04_08_a.html, accessed November 12, 2026.

[328] EIA, Electric Power Annual, "Table 4.08.B. Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels," 2025 values, https://www.eia.gov/electricity/annual/html/epa_04_08_b.html, accessed November 12, 2026.

[329] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 9, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

[330] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 4, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[331] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

than coal."[332] Solar's emissions depend largely on where the panels are made; estimates "range from around 23 grams CO2 per kWh to 82 grams."[333]

[Not verified: the exact per-kWh figures for each source. The UNECE report itself would not open for me, and Our World in Data shows those numbers only in a chart I could not read as text. So I give you the comparison in words instead of a table.]

Test 4: Land use

How much land a power source needs depends on how you measure it, and that is where a lot of the arguments come from.

The most thorough recent study I found is a 2022 peer-reviewed paper in the journal PLOS ONE by Jessica Lovering and three co-authors. They compared the land used per unit of electricity, measured in hectares per terawatthour per year (a hectare is about 2.5 acres; a terawatthour is a billion kWh).[334]

Table 12-1. Median land-use intensity of electricity (hectares per terawatthour per year)

Source	Median land use
Nuclear	7.1
Geothermal	45
Wind (turbine pads and roads only)	130
Natural gas (plant and wells, footprint)	410
Hydropower (single-purpose dams)	650
Coal	1,000
Concentrated solar	1,300
Natural gas (including spacing between wells)	1,900
Ground-mounted solar panels	2,000
Wind (whole area inside the wind farm)	12,000
Biomass grown for energy	58,000

Source: Lovering and others, PLOS ONE, 2022, Table 1.[335]

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[332] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[333] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[334] Jessica Lovering, Marian Swain, Linus Blomqvist and Rebecca R. Hernandez, "Land-use intensity of electricity production and tomorrow's energy landscape," PLOS ONE 17(7): e0270155, July 6, 2022, doi:10.1371/journal.pone.0270155, https://escholarship.org/uc/item/4zn1c2jn, accessed November 12, 2026.

[335] Jessica Lovering, Marian Swain, Linus Blomqvist and Rebecca R. Hernandez, "Land-use intensity of electricity production and tomorrow's energy landscape," PLOS ONE 17(7): e0270155, July 6, 2022, doi:10.1371/journal.pone.0270155, https://escholarship.org/uc/item/4zn1c2jn, accessed November 12, 2026.

Look at the two wind lines. The study measured wind both ways: "Footprint area represents only the area physically covered by the turbine pad and access roads," while the "spacing area includes all the area in between turbines."[336] Most of the land inside a wind farm can still be farmed or grazed. So when someone says wind uses a lot of land, they are usually using the second number, and when someone says it uses very little, they are using the first. Both are honest; they are measuring different things.

Safety

The prompt for this book asked me to compare cost, reliability, emissions and land. Safety belongs here too, because it comes up in the nuclear debate in the next chapter.

The most cited peer-reviewed estimates of deaths per unit of electricity come from a 2007 study in The Lancet by Anil Markandya and Paul Wilkinson.[337] Our World in Data, a research publication at the University of Oxford, compiled that study with later work and estimated deaths per terawatthour of: coal 24.62, oil 18.43, natural gas 2.82, wind 0.04, and nuclear about 0.03.[338] Those coal, oil and gas figures are based on electricity production in Europe and count deaths from air pollution as well as accidents.[339] Hydropower's rate jumps to 1.3 when the 1975 Banqiao dam failure in China is included.[340]

Putting the four tests together

Table 12-2. How each source does on the four tests (summary)

Source	Cost of new build	Runs when needed	Emissions	Land
Natural gas	moderate (combined cycle); high (peakers)	yes, but fuel supply can fail in extreme cold	high, less than coal	low to moderate
Coal	moderate to high	yes, but can fail in extreme cold	highest	moderate
Nuclear	high (Lazard); middle	yes, 91% capacity	very low	lowest

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[336] Jessica Lovering, Marian Swain, Linus Blomqvist and Rebecca R. Hernandez, "Land-use intensity of electricity production and tomorrow's energy landscape," PLOS ONE 17(7): e0270155, July 6, 2022, doi:10.1371/journal.pone.0270155, https://escholarship.org/uc/item/4zn1c2jn, accessed November 12, 2026.

[337] Anil Markandya and Paul Wilkinson, "Electricity generation and health," The Lancet 370(9591): 979-990, 2007, doi:10.1016/S0140-6736(07)61253-7 (University of Bath research portal record), https://researchportal.bath.ac.uk/en/publications/energy-and-health-2-electricity-generation-and-health/, accessed November 12, 2026.

[338] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[339] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[340] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

Source	Cost of new build (EIA, with credits)	Runs when needed factor	Emissions	Land
Wind	low (unsubsidized $37-86/MWh)	weather-dependent	very low	low footprint, large spacing
Solar	low (unsubsidized $38-78/MWh)	daytime only without storage	low	high
Batteries	high per MWh stored (EIA)	yes, for a few hours	depends on charging source	low

Sources: as cited in this chapter.

Where this leaves us

There is no free lunch. Wind and solar are cheap to build but need backup or storage. Gas is flexible but exposed to fuel prices and cold-weather supply problems. Nuclear runs nearly all the time with tiny land and safety numbers but is expensive and slow to build. Coal is reliable in most weather but has the highest emissions and death rates in the studies above. The next chapter takes a closer look at nuclear, because it is the source people feel most strongly about.

Chapter 13: Nuclear Power: Safety, Waste and the Revival

Nuclear power makes about one-fifth of America's electricity and almost no carbon emissions while running, and it is the source many people fear most. Both of those things are true. In this chapter I lay out the record: the accidents, the waste problem, the costs, and why nuclear is suddenly back in the news.

Information about the present in this chapter is current as of November 12, 2026.

The U.S. nuclear fleet today

EIA reports that "As of March 2026, the United States had 94 operating commercial nuclear reactors at 54 nuclear power plants in 28 states."[341] Together they have about 98,441 megawatts of capacity.[342] Nuclear made about 18 percent of U.S. utility-scale electricity in 2025.[343] The average reactor is about 44 years old.[344]

As covered in Chapter 12, nuclear plants run more steadily than any other source, with an average capacity factor of 91 percent in 2025.[345]

The fleet shrank before it started to grow again. EIA reported in 2025 that "Twelve U.S. nuclear power reactors have permanently closed since 2013."[346]

Three Mile Island, 1979

The worst accident at a U.S. commercial nuclear plant began "about 4 a.m. on Wednesday, March 28, 1979," according to the U.S. Nuclear Regulatory Commission (NRC), the federal agency that licenses and inspects nuclear plants.[347] "The Three Mile Island Unit 2 reactor,

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[341] EIA, "Nuclear explained: U.S. nuclear industry," Energy Explained (data as of March 2026), undated web page, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php, accessed November 12, 2026.

[342] EIA, "Nuclear explained: U.S. nuclear industry," Energy Explained (data as of March 2026), undated web page, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php, accessed November 12, 2026.

[343] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[344] EIA, "Nuclear explained: U.S. nuclear industry," Energy Explained (data as of March 2026), undated web page, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php, accessed November 12, 2026.

[345] EIA, "Nuclear explained: U.S. nuclear industry," Energy Explained (data as of March 2026), undated web page, https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php, accessed November 12, 2026.

[346] EIA, "The United States operates the world's largest nuclear power plant fleet," Today in Energy, April 24, 2025, https://www.eia.gov/todayinenergy/detail.php?id=65104, accessed November 12, 2026.

[347] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

near Middletown, Pa., partially melted down."[348] The NRC calls it "the most serious accident in U.S. commercial nuclear power plant operating history."[349]

What about the health effects? The NRC states that the roughly 2 million people near the plant "are estimated to have received an average radiation dose of only about 1 millirem above the usual background dose," and that the releases "had no detectable health effects on plant workers or the public."[350] A millirem is a unit of radiation dose. For comparison, the NRC says that "On average, Americans receive a radiation dose of about 0.62 rem (620 millirem) each year" from all sources, and that "a chest x-ray typically gives a dose of about 0.01 rem (10 millirem)."[351]

You might ask, "Should I trust the regulator on that?" It is a fair question, and some local residents and advocacy groups have disputed the official health findings for decades. [Not verified: I did not find a dissenting study I could open and cite directly, so I note the dispute without weighing in on it.] I report the NRC's conclusion because it is the official record, and I flag that it has been challenged.

The accident did change the industry. The NRC says it "led to permanent and sweeping changes in how NRC regulates its licensees," including operator training, emergency planning and putting full-time NRC inspectors at every plant.[352]

Chernobyl and Fukushima

The two worst nuclear accidents in the world happened outside the United States, at Chernobyl in Soviet Ukraine in 1986 and at Fukushima in Japan in 2011. The death tolls are often misunderstood, in both directions.

For Chernobyl, Our World in Data, summarizing the work of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), reports 30 deaths among workers and emergency crews in the weeks after the accident, and that "a further 19 ARS survivors had died by 2006." (ARS is acute radiation syndrome, or radiation sickness.)[353]

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[348] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[349] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[350] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[351] NRC, "Doses in Our Daily Lives," web page, last reviewed September 14, 2026, https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html, accessed November 12, 2026.

[352] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[353] Hannah Ritchie, "What was the death toll from Chernobyl and Fukushima?" Our World in Data, July 24, 2017, updated June 2022, https://ourworldindata.org/what-was-the-death-toll-from-chernobyl-and-fukushima, accessed November 12, 2026.

Thousands of thyroid cancer cases followed among people exposed as children, and UNSCEAR concluded that "around one-quarter of these cases could be linked to radiation exposure."[354] The article sums it up: "Combined, the confirmed death toll from Chernobyl is less than 100," while its own best estimate of eventual deaths is "in the range of 300 to 500."[355] Other estimates run much higher, and the number remains disputed.

For Fukushima, the same source reports that "only one death has been attributed to the disaster" from radiation. But the evacuation itself was deadly: Japanese officials attributed 2,313 deaths, mostly among older people, to the stress and disruption of the evacuation.[356] That is a hard lesson. The response to a nuclear accident can cause more harm than the radiation.

The safety record in numbers

How does nuclear compare with other sources? Our World in Data, using peer-reviewed studies, calculates deaths per unit of electricity from accidents and air pollution combined. Its figures for coal, oil and gas come from a study published in The Lancet, and for nuclear it counts both Chernobyl and Fukushima: "I assume a death toll of 433 from Chernobyl, and 2,314 from Fukushima."[357,358] On that basis, coal causes about 24.6 deaths per terawatthour, oil about 18.4 and natural gas about 2.8, while nuclear, wind and solar are all far below one.[359] (A terawatthour is a billion kilowatthours,) [Not verified: the article's exact rate for nuclear, which appears only in a chart I could not read as text; it is commonly reported as about 0.03.]

The waste problem

Every reactor produces spent nuclear fuel, which stays dangerously radioactive for a very long time. The U.S. still has no permanent place to put it.

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[354] Hannah Ritchie, "What was the death toll from Chernobyl and Fukushima?" Our World in Data, July 24, 2017, updated June 2022, https://ourworldindata.org/what-was-the-death-toll-from-chernobyl-and-fukushima, accessed November 12, 2026.

[355] Hannah Ritchie, "What was the death toll from Chernobyl and Fukushima?" Our World in Data, July 24, 2017, updated June 2022, https://ourworldindata.org/what-was-the-death-toll-from-chernobyl-and-fukushima, accessed November 12, 2026.

[356] Hannah Ritchie, "What was the death toll from Chernobyl and Fukushima?" Our World in Data, July 24, 2017, updated June 2022, https://ourworldindata.org/what-was-the-death-toll-from-chernobyl-and-fukushima, accessed November 12, 2026.

[357] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[358] Anil Markandya and Paul Wilkinson, "Electricity generation and health," The Lancet 370(9591): 979-990, 2007, doi:10.1016/S0140-6736(07)61253-7 (University of Bath research portal record), https://researchportal.bath.ac.uk/en/publications/energy-and-health-2-electricity-generation-and-health/, accessed November 12, 2026.

[359] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

The Government Accountability Office (GAO), Congress's nonpartisan watchdog, reported that "As of the end of 2019, about 86,000 metric tons of commercial spent nuclear fuel was being stored on-site at 75 operating or shut-down" nuclear plants in 33 states, and that the amount grows by about 2,000 metric tons a year.[360]

Here is the history, and it matters to me personally because the planned site is in Nevada, where I live. The Nuclear Waste Policy Act of 1982 required the Department of Energy to investigate a deep underground repository. GAO explains that "In 1987, Congress amended NWPA to direct DOE to focus on a repository at Yucca Mountain, Nevada."[361] "In 2008, DOE submitted a license application for the repository but in March 2010 moved to withdraw it."[362] By 2011, the program had spent nearly $15 billion.[363]

Because the federal government has not taken the fuel as the law promised, it has been paying the utilities. GAO reported that as of September 2020, the government "had paid the owners of commercial nuclear power reactors almost $9 billion in damages," and DOE estimated the remaining liability at about $30.6 billion.[364] Those payments come from taxpayers.

People disagree strongly about what to do. Many Nevadans, including elected officials of both parties, have opposed the site. [Not verified: I did not find an official record of those positions that I could cite.] Supporters of the site say the science was sound and the money already spent should not be wasted. Others favor finding a state willing to host a repository. GAO's 2021 report title sums up the situation: "Congressional Action Needed to Break Impasse."[365]

Cost and the Vogtle story

The most recent new reactors in the country show both the promise and the problem. Georgia Power's Vogtle Unit 3 began commercial operation in July 2023, and Unit 4

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[360] GAO, "Commercial Spent Nuclear Fuel: Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021, https://www.gao.gov/assets/gao-21-603.pdf, accessed November 12, 2026.

[361] Government Accountability Office (GAO), "Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned," GAO-11-731T, testimony of Mark Gaffigan, June 1, 2011, https://gao.gov/assets/a126333.html, accessed November 12, 2026.

[362] Government Accountability Office (GAO), "Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned," GAO-11-731T, testimony of Mark Gaffigan, June 1, 2011, https://gao.gov/assets/a126333.html, accessed November 12, 2026.

[363] Government Accountability Office (GAO), "Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned," GAO-11-731T, testimony of Mark Gaffigan, June 1, 2011, https://gao.gov/assets/a126333.html, accessed November 12, 2026.

[364] GAO, "Commercial Spent Nuclear Fuel: Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021, https://www.gao.gov/assets/gao-21-603.pdf, accessed November 12, 2026.

[365] GAO, "Commercial Spent Nuclear Fuel: Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021, https://www.gao.gov/assets/gao-21-603.pdf, accessed November 12, 2026.

followed in late April 2024.[366] They were the first U.S. reactors of their design, the AP1000.[367] EIA reported that the expansion was "Originally expected to cost $14 billion," and that Georgia Power "now estimates the total cost of the project to be more than $30 billion."[368] When Unit 4 started, EIA noted, "No nuclear reactors are under construction now in the United States."[369]

Lazard's unsubsidized cost estimate for U.S. nuclear is among the highest of any source it tracks.[370] Its June 2025 range for new U.S. nuclear was $141 to $220 per MWh, compared with $48 to $109 for a new gas combined-cycle plant.[371]

The revival

In my view, several things changed after about 2023. Demand started growing again, as Chapter 11 showed, and data center owners began looking for steady power around the clock.

On May 23, 2025, President Donald Trump signed several executive orders on nuclear energy. One of them, Executive Order 14300, set a goal to expand "American nuclear energy capacity from approximately 100 GW in 2024 to 400 GW by 2050."[372] It directed the NRC to set "a deadline of no more than 18 months for final decision on an application to construct and operate a new reactor of any type."[373] It also told the NRC to "reconsider reliance on the linear no-threshold (LNT) model."[374]

That last point deserves a plain explanation. The linear no-threshold model assumes that any amount of radiation, however small, carries some cancer risk, in proportion to the dose.

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[366] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[367] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[368] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[369] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[370] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

[371] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), p. 8, https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

[372] Donald J. Trump, "Executive Order 14300 - Ordering the Reform of the Nuclear Regulatory Commission," May 23, 2025 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-14300-ordering-the-reform-the-nuclear-regulatory-commission, accessed November 12, 2026.

[373] Donald J. Trump, "Executive Order 14300 - Ordering the Reform of the Nuclear Regulatory Commission," May 23, 2025 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-14300-ordering-the-reform-the-nuclear-regulatory-commission, accessed November 12, 2026.

[374] Donald J. Trump, "Executive Order 14300 - Ordering the Reform of the Nuclear Regulatory Commission," May 23, 2025 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-14300-ordering-the-reform-the-nuclear-regulatory-commission, accessed November 12, 2026.

Regulators have used it for decades to set safety limits. Some scientists argue it overstates the risk of very low doses and makes nuclear power needlessly expensive. Others argue it is the prudent assumption when the evidence at low doses is uncertain. This is a real scientific debate, and changing the model would change how strict safety rules are. (This paragraph is my plain summary of the two positions, not a finding from a single source.)

The most visible sign of the revival is an attempt to restart plants that had already closed, something that had never been done in the United States. A September 2026 report from the Pacific Northwest National Laboratory described three: Palisades in Michigan, which was "slated to resume operations later this year"; the Crane Clean Energy Center in Pennsylvania, "formerly Three Mile Island Nuclear Station, Unit 1," which shut down in 2019; and the Duane Arnold Energy Center in Iowa, which shut down in 2020.[375] As of July 2026, the American Nuclear Society reported that "no firm start date" for Palisades had been announced.[376] [Not verified: whether Palisades had restarted by this book's cutoff date, and the status of small modular reactor projects. I did not find an official source dated after September 2026.]

The Department of Energy's own one-year progress report, from May 2026, gives the government's side of the revival. DOE says it closed "an up to $1.52 billion loan to Holtec to help fund the restart of the Palisades Nuclear Plant," and a $1 billion loan to Constellation in November 2025 for the Crane restart.[377] It says the NRC issued TerraPower a construction permit in March 2026, "the first ever issued by the NRC for a commercial non-light-water power reactor," meaning a reactor cooled by something other than ordinary water.[378] DOE set a goal of "at least three reactor designs reaching criticality by July 4, 2026" under a new pilot program.[379] [Not verified: whether that July 4, 2026, goal was met. The DOE page I read was written before the deadline.] DOE also wants to squeeze more out of existing plants through upgrades, aiming for "2.5 gigawatts of additional nuclear capacity by 2027 and 5 gigawatts by 2029."[380] These are government goals and press statements, so I report them as goals, not results.

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[375] Bethany Lee, "U.S. Nuclear Power Plant Restarts Gain Momentum with PNNL Support," Pacific Northwest National Laboratory, September 3, 2026, https://www.pnnl.gov/news-media/us-nuclear-power-plant-restarts-gain-momentum-pnnl-support, accessed November 12, 2026.

[376] American Nuclear Society, "Palisades: Restart projects, Holtec IPO, lawsuit dismissal - but no restart date," Nuclear Newswire, July 8, 2026, https://www.ans.org/news/2026-07-08/article-8187/palisades-restart-projects-holtec-ipo-lawsuit-dismissal-but-no-restart-date/, accessed November 12, 2026.

[377] DOE Office of Nuclear Energy, "One Year After Executive Orders, U.S. Nuclear Energy Renaissance Is in Full Swing," May 2026, https://www.energy.gov/ne/articles/one-year-after-executive-orders-us-nuclear-energy-renaissance-full-swing, accessed November 12, 2026.

[378] DOE Office of Nuclear Energy, "One Year After Executive Orders, U.S. Nuclear Energy Renaissance Is in Full Swing," May 2026, https://www.energy.gov/ne/articles/one-year-after-executive-orders-us-nuclear-energy-renaissance-full-swing, accessed November 12, 2026.

[379] DOE Office of Nuclear Energy, "One Year After Executive Orders, U.S. Nuclear Energy Renaissance Is in Full Swing," May 2026, https://www.energy.gov/ne/articles/one-year-after-executive-orders-us-nuclear-energy-renaissance-full-swing, accessed November 12, 2026.

[380] DOE Office of Nuclear Energy, "One Year After Executive Orders, U.S. Nuclear Energy Renaissance Is in Full Swing," May 2026, https://www.energy.gov/ne/articles/one-year-after-executive-orders-us-nuclear-energy-renaissance-full-swing, accessed November 12, 2026.

Where this leaves us

Nuclear's record on safety, emissions, land use and reliability is very strong by the numbers in Chapter 12. Its record on cost and building on schedule is poor, and the waste question is unsolved after more than 40 years. Whether the revival succeeds will depend mostly on whether new reactors can be built for much less than Vogtle. I test the claim "Nuclear power is too dangerous" in Chapter 15.

Part Six: Grid Security

Chapter 14: Bullets, Hackers and the Sun

Most blackouts are caused by weather, equipment failures and human mistakes. But three other threats get a lot of attention: people physically attacking equipment, hackers attacking the computers that run the grid, and storms on the sun. This chapter sticks to what official reports and peer-reviewed research say about each, because this is a subject where rumors run wild.

Information about the present in this chapter is current as of November 12, 2026.

Physical attacks

Metcalf, California, 2013. The attack that changed how the industry thinks about physical security happened at a substation near San Jose. The Congressional Research Service describes it as "a 2013 rifle attack on an electric transmission substation in Metcalf, CA," in which "an unknown perpetrator firing a .30 caliber rifle disabled a critical 500 kilovolt (kV) transformer substation."[381] A news report citing the Department of Energy said the gunfire "knocked the substation offline for a month and caused $15 million in damage."[382] [Not verified: the exact date in April 2013 and whether any customers lost power. The sources I could open do not say.]

The response was a new mandatory rule. CRS reports that "On March 7, 2014, FERC ordered NERC to submit proposed reliability standards" for physical security, and that "On November 20, 2014, FERC approved the proposed standard," known as CIP-014.[383] CIP stands for Critical Infrastructure Protection. The standard requires owners of the most important transmission facilities to identify which facilities are critical, assess threats and weaknesses at them, and put physical security plans in place, with outside reviewers checking the work.[384] Required compliance began October 1, 2015.[385]

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[381] CRS, "NERC Standards for Bulk Power Physical Security: Is the Grid More Secure?" R45135, updated March 19, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/files/20180319_R45135_b7ce106085bac1b93519d334665f1e2ecf53a903.html, accessed November 12, 2026.

[382] David Boraks (WFAE), "Moore County attack shows U.S. electric grid's 'Achilles' heel'," WUNC, December 5, 2022, https://www.wunc.org/2022-12-05/moore-county-attack-shows-u-s-electric-grids-achilles-heel, accessed November 12, 2026.

[383] CRS, "NERC Standards for Bulk Power Physical Security: Is the Grid More Secure?" R45135, updated March 19, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/files/20180319_R45135_b7ce106085bac1b93519d334665f1e2ecf53a903.html, accessed November 12, 2026.

[384] CRS, "NERC Standards for Bulk Power Physical Security: Is the Grid More Secure?" R45135, updated March 19, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/files/20180319_R45135_b7ce106085bac1b93519d334665f1e2ecf53a903.html, accessed November 12, 2026.

[385] CRS, "NERC Standards for Bulk Power Physical Security: Is the Grid More Secure?" R45135, updated March 19, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/files/20180319_R45135_b7ce106085bac1b93519d334665f1e2ecf53a903.html, accessed November 12, 2026.

Moore County, North Carolina, 2022. On the night of Saturday, December 3, 2022, someone shot up two Duke Energy substations in central North Carolina. The county sheriff said "About 45,000 customers lost power, making it one of the most serious physical attacks on the power grid in recent U.S. history."[386] A Duke Energy spokesman explained that the damage left no way to reroute power, so "it really had to be a repair and replace operation."[387] [Not verified: the date power was fully restored and the status of the criminal investigation as of this book's cutoff.]

More attacks in 2022 and 2023. Moore County was not alone. The Congressional Research Service reported that on December 25, 2022, attackers hit four distribution substations in Washington State, "cutting power to some 30,000 utility customers."[388] CRS also described federal charges against people accused of "planning to attack five electric power transmission substations around Baltimore, MD."[389] After Moore County, FERC ordered NERC to report within 120 days on whether the physical security standard was strong enough.[390]

Here is the gap that matters most to ordinary customers. CIP-014 covers the biggest transmission substations. The local distribution substations that serve your neighborhood generally do not fall under it. CRS put it plainly: those facilities "are not under FERC's jurisdiction and not subject to NERC's standards."[391] Their security is left to the utility and the state.

Why are substations such easy targets? A grid security consultant quoted in the same news report said "Most substations are protected only by a surrounding chain link fence."[392] [Not verified: how many U.S. substations have added stronger walls or barriers since 2022. I did not find an official count.]

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[386] David Boraks (WFAE), "Moore County attack shows U.S. electric grid's 'Achilles' heel'," WUNC, December 5, 2022, https://www.wunc.org/2022-12-05/moore-county-attack-shows-u-s-electric-grids-achilles-heel, accessed November 12, 2026.

[387] David Boraks (WFAE), "Moore County attack shows U.S. electric grid's 'Achilles' heel'," WUNC, December 5, 2022, https://www.wunc.org/2022-12-05/moore-county-attack-shows-u-s-electric-grids-achilles-heel, accessed November 12, 2026.

[388] Paul W. Parfomak, CRS, "Electric Grid Physical Security: Recent Developments," Insight IN12074, updated February 7, 2023 (EveryCRSReport.com), https://www.everycrsreport.com/reports/IN12074.html, accessed November 12, 2026.

[389] Paul W. Parfomak, CRS, "Electric Grid Physical Security: Recent Developments," Insight IN12074, updated February 7, 2023 (EveryCRSReport.com), https://www.everycrsreport.com/reports/IN12074.html, accessed November 12, 2026.

[390] Paul W. Parfomak, CRS, "Electric Grid Physical Security: Recent Developments," Insight IN12074, updated February 7, 2023 (EveryCRSReport.com), https://www.everycrsreport.com/reports/IN12074.html, accessed November 12, 2026.

[391] Paul W. Parfomak, CRS, "Electric Grid Physical Security: Recent Developments," Insight IN12074, updated February 7, 2023 (EveryCRSReport.com), https://www.everycrsreport.com/reports/IN12074.html, accessed November 12, 2026.

[392] David Boraks (WFAE), "Moore County attack shows U.S. electric grid's 'Achilles' heel'," WUNC, December 5, 2022, https://www.wunc.org/2022-12-05/moore-county-attack-shows-u-s-electric-grids-achilles-heel, accessed November 12, 2026.

You might ask, "If a few rifle shots can do that, why doesn't it happen more?" Attacks that cause outages are rare compared with weather damage. The grid has many paths, so most single attacks cause local outages, not regional ones. The harder question, which security experts debate, is what a coordinated attack on many substations at once could do. Much of that analysis is kept confidential for obvious reasons, and I did not find a public official estimate I could cite.

Cyber attacks

What has happened abroad. The best-known real-world grid hack happened in Ukraine on December 23, 2015. An analysis by the SANS Institute and the industry's Electricity Information Sharing and Analysis Center (E-ISAC) found that attackers hit "three different distribution oblenergos (a term used to describe an energy company)."[393] "The attack impacted 225,000 customers and required the oblenergos to move to manual operations."[394] The outages "lasted for several hours."[395] In other words, the hackers did not destroy the grid. They switched off power remotely, and workers had to drive out and turn it back on by hand. GAO reported in 2019 that "cyberattacks on industrial control systems have disrupted foreign electric grid operations."[396]

What war does to a grid. Since 2022, Ukraine has faced something far worse than hackers. CRS reported that "Hundreds of missile and drone attacks" struck power plants, substations and large transformers, and that analysts "identified nearly 600 attacks on electricity infrastructure assets" in one year.[397] CRS cited a United Nations assessment that "41 out of 94 crucial high-voltage transforming substations" had been damaged or destroyed.[398] CRS also noted that U.S. emergency drills "often present grid emergencies as

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[393] Robert M. Lee, Michael J. Assante and Tim Conway (SANS), with the Electricity Information Sharing and Analysis Center (E-ISAC), "Analysis of the Cyber Attack on the Ukrainian Power Grid: Defense Use Case," March 18, 2016 (copy hosted by the National Security Archive), p. 1, https://nsarchive.gwu.edu/sites/default/files/documents/3891751/SANS-and-Electricity-Information-Sharing-and.pdf, accessed November 12, 2026.

[394] Robert M. Lee, Michael J. Assante and Tim Conway (SANS), with the Electricity Information Sharing and Analysis Center (E-ISAC), "Analysis of the Cyber Attack on the Ukrainian Power Grid: Defense Use Case," March 18, 2016 (copy hosted by the National Security Archive), p. 2, https://nsarchive.gwu.edu/sites/default/files/documents/3891751/SANS-and-Electricity-Information-Sharing-and.pdf, accessed November 12, 2026.

[395] Robert M. Lee, Michael J. Assante and Tim Conway (SANS), with the Electricity Information Sharing and Analysis Center (E-ISAC), "Analysis of the Cyber Attack on the Ukrainian Power Grid: Defense Use Case," March 18, 2016 (copy hosted by the National Security Archive), p. 3, https://nsarchive.gwu.edu/sites/default/files/documents/3891751/SANS-and-Electricity-Information-Sharing-and.pdf, accessed November 12, 2026.

[396] GAO, "Critical Infrastructure Protection: Actions Needed to Address Significant Cybersecurity Risks Facing the Electric Grid," GAO-19-332, August 26, 2019, https://www.gao.gov/products/gao-19-332, accessed November 12, 2026.

[397] Brian E. Humphreys, CRS, "Attacks on Ukraine's Electric Grid: Insights for U.S. Infrastructure Security and Resilience," R48067, May 17, 2024 (EveryCRSReport.com), https://www.everycrsreport.com/reports/R48067.html, accessed November 12, 2026.

[398] Brian E. Humphreys, CRS, "Attacks on Ukraine's Electric Grid: Insights for U.S. Infrastructure Security and Resilience," R48067, May 17, 2024 (EveryCRSReport.com), https://www.everycrsreport.com/reports/R48067.html, accessed November 12, 2026.

discrete and anomalous events," while Ukraine faced attack after attack.[399] That is the lesson I take from it: planning for one bad day is not the same as planning for a long campaign.

What has happened here. GAO also reported that in the United States, "cybersecurity incidents reportedly have not resulted in power outages."[400] That was as of its 2019 report.

The warnings. GAO's 2019 report found that "The nation's electric grid is becoming more vulnerable to cyberattacks - particularly those involving industrial control systems that support grid operations."[401] A follow-up in 2021 found that local distribution systems "are increasingly at risk from cyberattacks," and that "Distribution utilities included in GAO's review are generally not subject to mandatory federal cybersecurity standards."[402] That is because NERC's mandatory standards cover the bulk power system, not the local wires, which are left to the states.

The penalty side has teeth on paper. CRS reports that NERC's standards can carry a "civil fine of up to $1 million per violation for each day that it continues."[403] But CRS also notes that the 2005 law that made the standards mandatory "excluded local distribution systems" from that federal reliability mandate.[404]

In February 2024, CISA, the National Security Agency, the FBI and partner agencies warned that hackers backed by the Chinese government, which they call Volt Typhoon, "are pre-positioning themselves on IT networks to enable the disruption of OT functions" across U.S. critical infrastructure.[405] (IT is ordinary business computing; OT, or operational technology, is the equipment that actually runs physical systems like substations.) The agencies said the targets were "primarily in Communications, Energy, Transportation Systems, and Water and Wastewater Systems Sectors," and that the hackers had been "maintaining access and

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[399] Brian E. Humphreys, CRS, "Attacks on Ukraine's Electric Grid: Insights for U.S. Infrastructure Security and Resilience," R48067, May 17, 2024 (EveryCRSReport.com), https://www.everycrsreport.com/reports/R48067.html, accessed November 12, 2026.

[400] GAO, "Critical Infrastructure Protection: Actions Needed to Address Significant Cybersecurity Risks Facing the Electric Grid," GAO-19-332, August 26, 2019, https://www.gao.gov/products/gao-19-332, accessed November 12, 2026.

[401] GAO, "Critical Infrastructure Protection: Actions Needed to Address Significant Cybersecurity Risks Facing the Electric Grid," GAO-19-332, August 26, 2019, https://www.gao.gov/products/gao-19-332, accessed November 12, 2026.

[402] GAO, "Electricity Grid Cybersecurity: DOE Needs to Ensure Its Plans Fully Address Risks to Distribution Systems," GAO-21-81, March 18, 2021, https://www.gao.gov/products/gao-21-81, accessed November 12, 2026.

[403] CRS, "Electric Grid Cybersecurity," R45312, September 4, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/reports/R45312.html, accessed November 12, 2026.

[404] CRS, "Electric Grid Cybersecurity," R45312, September 4, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/reports/R45312.html, accessed November 12, 2026.

[405] Cybersecurity and Infrastructure Security Agency (CISA), National Security Agency, Federal Bureau of Investigation and partners, "PRC State-Sponsored Actors Compromise and Maintain Persistent Access to U.S. Critical Infrastructure," advisory AA24-038A, February 7, 2024, https://www.cisa.gov/news-events/cybersecurity-advisories/aa24-038a, accessed November 12, 2026.

footholds within some victim IT environments for at least five years."[406] Pre-positioning means getting inside and waiting, so an attack could be launched during a future crisis.

Solar storms

The sun sometimes throws off huge bursts of charged particles. When they hit Earth's magnetic field, they can cause what scientists call a geomagnetic storm. Those storms can push unwanted electric currents through long power lines and into transformers, which can overheat or trip offline.

Quebec, 1989. The classic example is the storm of March 1989. A 2025 research paper by scientists at George Mason University, NOAA, NASA and other institutions describes "the Hydro-Quebec outage in March of 1989, which led to a 9-hour blackout and resulted in ~13.2 million Canadian dollars in total network damages."[407] [Not verified: the number of people who lost power in Quebec in 1989.]

May 2024. In May 2024, the strongest geomagnetic storm in two decades hit Earth. The same research team reports that a storm beginning May 10 reached a rating of G5, the top of the federal government's five-level scale, a level that "had not occurred since October 2003."[408] The storm had the largest disturbance on one standard measure since March 1989.[409] The researchers measured unwanted currents at 47 sites across the United States.[410] They did not report any major U.S. blackout or transformer damage from the storm.[411] For a sense of what a G5 storm can do, NOAA's own scale says that at that level, "some grid systems may experience complete collapse or blackouts" and "Transformers may experience damage."[412] The May 2024 storm reached that rating without causing that kind of damage in the United States, which is reassuring but is not proof the grid would hold in a stronger storm.

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[406] Cybersecurity and Infrastructure Security Agency (CISA), National Security Agency, Federal Bureau of Investigation and partners, "PRC State-Sponsored Actors Compromise and Maintain Persistent Access to U.S. Critical Infrastructure," advisory AA24-038A, February 7, 2024, https://www.cisa.gov/news-events/cybersecurity-advisories/aa24-038a, accessed November 12, 2026.

[407] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[408] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[409] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[410] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[411] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[412] NOAA Space Weather Prediction Center, "NOAA Space Weather Scales," web page, https://www.spaceweather.gov/noaa-scales-explanation, accessed November 12, 2026.

The rules. NERC now has a mandatory standard, called TPL-007, that requires U.S. grid operators to study how their systems would hold up in a severe geomagnetic storm, using a benchmark storm that represents a "1-in-100-year peak geoelectric field amplitude."[413] FERC approved the first version of the standard on September 22, 2016, in Order No. 830.[414] It requires utilities to "conduct a GMD Vulnerability Assessment every 60 months using the benchmark GMD event," which is "based on a 1-in-100 year frequency of occurrence," and to "develop corrective action plans" if the assessment finds problems.[415] (GMD stands for geomagnetic disturbance.)

I test the claim that "One big solar storm could knock out the grid for years" in Chapter 16.

Where this leaves us

Physical attacks, cyber attacks and solar storms are real risks, with real examples, and each has led to new mandatory rules. At the same time, the official record shows that in the U.S., weather remains a much bigger cause of outages than any of the three. The public evidence does not support either "the grid is defenseless" or "there is nothing to worry about."

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[413] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[414] FERC, "Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events," Order No. 830, 156 FERC 61,215, issued September 22, 2016, p. 1, https://www.ferc.gov/sites/default/files/2020-04/E-4_2.pdf, accessed November 12, 2026.

[415] FERC, "Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events," Order No. 830, 156 FERC 61,215, issued September 22, 2016, pp. 10-11, https://www.ferc.gov/sites/default/files/2020-04/E-4_2.pdf, accessed November 12, 2026.

Part Seven: Claims Checked

How I Rate a Claim

This part takes 14 things people commonly say about the grid, power sources and electric bills, and checks each one against the evidence. I picked claims that come from every direction. Some are popular on the right, some on the left, and some come from no side in particular.

Each claim gets one of four verdicts, and only these four:

Verdict	What it means
True	The evidence supports the claim as stated.
Partly true	Some of the claim holds up and some does not, or it is true in some places or times but not others.
False (debunked)	Solid evidence shows the claim is wrong as stated.
Inconclusive	The evidence is not strong enough to say either way.

For each claim I tell you what it says, why people believe it, what the best evidence shows, and what the strongest version of the other side would say. Every verdict rests on at least two sources, and I lean on official investigations and peer-reviewed research before anything else. Information in this part is current as of November 12, 2026.

One more thing before we start. A verdict is about a claim, not about a person or a party. Smart, honest people have said some of these things. Checking a claim is not the same as calling someone a liar.

Chapter 15: Claims About Power Sources

Table 15-1. Claims in this chapter and their verdicts (information as of November 12, 2026)

No.	Claim	Verdict
1	Frozen wind turbines caused the 2021 Texas blackout.	False (debunked)
2	Natural gas, not wind, caused the 2021 Texas blackout.	Partly true
3	Wind and solar are unreliable.	Partly true
4	Wind and solar are always the cheapest power.	Partly true
5	Nuclear power is too dangerous.	False (debunked)
6	Shutting down coal plants is the main threat to the grid.	Partly true

Claim 1: "Frozen wind turbines caused the 2021 Texas blackout."

Why people say it. During Winter Storm Uri, pictures of iced-up wind turbines spread quickly, and some public officials blamed wind and solar for the blackout while it was still going on. On February 16, 2021, Texas Governor Greg Abbott told Fox News host Sean Hannity, "This shows how the Green New Deal would be a deadly deal for the United States of America," and said, "Our wind and our solar, they got shut down and they were collectively more than 10% of our power grid."[416] Wind turbines really did freeze, and some wind output was lost. That part is not in dispute.

What the evidence shows. The official joint investigation by FERC, NERC and the regional reliability entities is the best evidence we have. It counted every generating unit in the Texas grid region that had an outage, a cut in output or a failure to start. Of those units, "58 percent natural gas-fired, 27 percent wind, six percent coal, two percent solar, seven percent other fuels, and less than one percent nuclear."[417] So wind units made up about a quarter of the failures by count, and gas-fired units made up more than half.

The investigators also found why units failed. "75 percent were caused by either freezing issues (44.2 percent) or fuel issues (31.4 percent)."[418] Natural gas supply problems made up

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[416] Saranac Hale Spencer, "Wind Turbines Didn't Cause Texas Energy Crisis," FactCheck.org, February 19, 2021, https://www.factcheck.org/2021/02/wind-turbines-didnt-cause-texas-energy-crisis, accessed November 12, 2026.

[417] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 15, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[418] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 15, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

87 percent of the fuel problems.[419] Across Texas, Oklahoma and Louisiana, natural gas production fell by more than half compared with January.[420]

Texas's own grid operator said the same thing during the storm. At a February 16 briefing, an ERCOT official said, "There is significantly more megawatts in that thermal unit category than in the renewable category."[421] (Thermal units are gas, coal and nuclear plants.)

The strongest case for the claim. Wind did fail, and wind farms in colder places are routinely fitted with cold-weather packages that many Texas turbines lacked. Someone who says "wind froze too" is right.

Verdict: False (debunked). Wind turbines froze, but the official investigation shows that most of the lost power came from gas, coal and nuclear units and from natural gas supply that froze up. Wind was not the main cause.

Sources: FERC-NERC Uri report;[422] FERC news release on the final report;[423] FactCheck.org.[424]

Claim 2: "Natural gas, not wind, caused the 2021 Texas blackout."

Why people say it. This is the mirror image of Claim 1, and it is popular with people who want to defend wind and solar. It has more truth in it than Claim 1, but it still oversimplifies.

What the evidence shows. Gas units made up 58 percent of the failed units and gas supply problems were most of the fuel failures, as shown above.[425] But coal units failed, nuclear units failed, and wind and solar units failed too.[426] The deeper cause the

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[419] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[420] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 13, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[421] Saranac Hale Spencer, "Wind Turbines Didn't Cause Texas Energy Crisis," FactCheck.org, February 19, 2021, https://www.factcheck.org/2021/02/wind-turbines-didnt-cause-texas-energy-crisis, accessed November 12, 2026.

[422] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[423] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[424] Saranac Hale Spencer, "Wind Turbines Didn't Cause Texas Energy Crisis," FactCheck.org, February 19, 2021, https://www.factcheck.org/2021/02/wind-turbines-didnt-cause-texas-energy-crisis, accessed November 12, 2026.

[425] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 15, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[426] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 15, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

investigators pointed to was that power plants of every type, and the gas system feeding them, were not prepared for extreme cold. FERC said that "protecting just four types of power plant components from icing and freezing could have reduced outages by 67 percent in the ERCOT region."[427] Investigators had made similar winterization recommendations after a 2011 cold snap.[428]

The strongest case for the claim. If you rank fuels by how much they contributed, gas comes first by a wide margin. That is a fair thing to say.

Verdict: Partly true. Gas plants and gas supply were the largest single cause. But "gas, not wind" leaves out the freezing of every kind of plant and the failure to act on the 2011 recommendations, which the investigators treated as the root problem.

Sources: FERC-NERC Uri report;[429] FERC news release.[430]

Claim 3: "Wind and solar are unreliable."

Why people say it. The wind does not always blow and the sun sets every night. A grid has to match supply and demand every second, so power that comes and goes is harder to plan around.

What the evidence shows. NERC, the industry's own reliability watchdog, has warned about this. Its 2025 long-term assessment says the shift toward weather-dependent resources "increases risks of supply shortfalls during winter months."[431] NERC also counts wind for much less than its full size at the hour of peak demand. In its 2025-2026 winter report, it cut its estimate of wind's peak-hour contribution by 14,238 MW based on "revised valuations of wind resource capability at peak demand hours."[432]

But reliability is not only about the fuel. In both Winter Storm Uri in 2021 and Winter Storm Elliott in 2022, the biggest failures came from plants that are supposed to run on demand. During Elliott, FERC staff counted "Unprecedented unplanned electric generation outages of 90,500 MW," and FERC said that "Nearly 80 percent of the generating units

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[427] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[428] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, p. 9, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[429] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[430] FERC, "Final Report on February 2021 Freeze Underscores Winterization Recommendations," news release, November 2021, https://ferc.gov/news-events/news/final-report-february-2021-freeze-underscores-winterization-recommendations, accessed November 12, 2026.

[431] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 6, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[432] NERC, "2025-2026 Winter Reliability Assessment," November 2025, p. 9, https://prod.nerc.com/globalassets/our-work/assessments/nerc_wra_2025.pdf, accessed November 12, 2026.

failed to perform at temperatures above their own documented minimum operating temperatures."[433,434]

Batteries are also changing the picture. NERC's 2026 summer assessment counted 14.7 GW of added battery capacity at peak.[435] Batteries can carry solar power into the evening, though only for a few hours at a time.

The strongest case for the claim. A gas, coal or nuclear plant can be called on when needed, as long as it has fuel and does not freeze. A wind farm cannot. As more of the grid runs on weather, grid operators need more backup, more storage or more transmission, and those cost money.

Verdict: Partly true. Wind and solar are variable, and NERC warns that relying more on them raises winter risk unless backup keeps pace. But "unreliable" overstates it, because grid operators plan around predictable patterns, batteries are filling some gaps, and the worst recent failures came mostly from plants that are supposed to be dependable.

Sources: NERC 2025 Long-Term Reliability Assessment;[436] NERC 2026 Summer Reliability Assessment;[437] FERC Elliott findings.[438]

Claim 4: "Wind and solar are always the cheapest power."

Why people say it. Several respected cost studies rank new wind and solar as the cheapest new power to build.

What the evidence shows. Lazard's 2025 study found unsubsidized utility-scale solar at $38 to $78 per MWh and onshore wind at $37 to $86 per MWh, and its headline called them the lowest-cost sources for ten years running.[439,440] EIA found in 2025 that "Solar PV

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[433] FERC staff, "2022 Winter Storm Elliott Inquiry Findings," presentation to the DOE Electricity Advisory Committee, February 13, 2024, https://www.energy.gov/sites/default/files/2024-02/Day%201%20-%20FERC%202022%20Winter%20Storm%20Elliott%20Inquiry%20Findings_untagged.pdf, accessed November 12, 2026.

[434] FERC, "Elliott Report Complete: Electricity Standards, Implement Gas Reliability Rules," news release, September 21, 2023, https://www.ferc.gov/news-events/news/elliott-report-complete-electricity-standards-implement-gas-reliability-rules, accessed November 12, 2026.

[435] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[436] NERC, "2025 Long-Term Reliability Assessment," January 2026, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[437] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[438] FERC, "Elliott Report Complete: Electricity Standards, Implement Gas Reliability Rules," news release, September 21, 2023, https://www.ferc.gov/news-events/news/elliott-report-complete-electricity-standards-implement-gas-reliability-rules, accessed November 12, 2026.

[439] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

LCOE is lower than natural gas combined-cycle LCOE on average and, in most regions, even without the tax credit."[441]

But EIA itself warns that direct comparisons of these costs across technologies "are misleading" as a measure of competitiveness, because they leave out what the power is worth to the grid at the time it is made.[442] Lazard also says the cost of firming, or backing up, wind and solar has gone up.[443] And as I covered in Chapter 9, spending on new transmission lines, which wind and solar often need, is one of the costs pushing bills up.[444]

The strongest case for the claim. On a cost-per-megawatthour basis, without subsidies, new wind and solar really are at or near the bottom in most U.S. regions.

Verdict: Partly true. New wind and solar are often the cheapest power to generate. The word "always" is what fails. The full cost to keep the lights on includes backup, storage and transmission, and the answer depends on the region and how much wind and solar is already on the grid.

Sources: Lazard LCOE+ 2025;[445] EIA levelized cost reports 2025 and 2026.[446,447]

Claim 5: "Nuclear power is too dangerous."

Why people say it. Three Mile Island, Chernobyl and Fukushima are household names. Nuclear waste stays dangerous for a very long time, and the United States still has no permanent place to put it.

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[440] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

[441] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 8, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[442] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, p. 5, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[443] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

[444] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[445] Lazard, "Levelized Cost of Energy+ (LCOE+)," version 18.0, June 2025 (financial advisory firm; industry analysis), https://lazard.com/media/5tlbhyla/lazards-lcoeplus-june-2025-_vf.pdf, accessed November 12, 2026.

[446] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2025," April 2025, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/AEO2025_LCOE_report.pdf, accessed November 12, 2026.

[447] EIA, "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2026," April 2026, https://www.eia.gov/outlooks/aeo/electricity_generation/pdf/LCOE_report.pdf, accessed November 12, 2026.

What the evidence shows. Measured by deaths per unit of electricity, nuclear ranks among the safest sources. Our World in Data, using peer-reviewed studies, puts coal at about 24.6 deaths per terawatthour and natural gas at about 2.8, with nuclear far below one, even after counting the Chernobyl and Fukushima disasters.[448] (Chapter 13 has the details.) The worst U.S. accident, at Three Mile Island in 1979, "had no detectable health effects on plant workers or the public," according to the NRC.[449]

Waste is a real and unsolved problem, but so far it is a political and money problem more than a safety record problem. GAO reported that about 86,000 metric tons of spent fuel sat at 75 sites in 33 states at the end of 2019, and that taxpayers owed tens of billions of dollars in damages because the government has not taken it as promised.[450]

The strongest case for the claim. Low average deaths do not erase the risk of a rare, severe accident, which can force people from their homes for years even when the death toll is low. Some residents and advocacy groups dispute official health findings. And future waste storage risk cannot be measured from past data.

Verdict: False (debunked). By the measured record, nuclear power has caused fewer deaths per unit of electricity than coal, oil or gas. Whether its rare-but-severe accident risk, its waste and its high cost are worth it is a fair policy argument, but "too dangerous" is not supported by the safety data.

Sources: Our World in Data, citing Markandya and Wilkinson in The Lancet;[451,452] NRC Three Mile Island backgrounder;[453] GAO-21-603.[454]

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[448] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[449] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[450] GAO, "Commercial Spent Nuclear Fuel: Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021, https://www.gao.gov/assets/gao-21-603.pdf, accessed November 12, 2026.

[451] Hannah Ritchie, "What are the safest and cleanest sources of energy?" Our World in Data, February 10, 2020, last updated July 2022 (summarizes Markandya and Wilkinson 2007 and Sovacool and others 2016), https://ourworldindata.org/safest-sources-of-energy, accessed November 12, 2026.

[452] Anil Markandya and Paul Wilkinson, "Electricity generation and health," The Lancet 370(9591): 979-990, 2007, doi:10.1016/S0140-6736(07)61253-7 (University of Bath research portal record), https://researchportal.bath.ac.uk/en/publications/energy-and-health-2-electricity-generation-and-health/, accessed November 12, 2026.

[453] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[454] GAO, "Commercial Spent Nuclear Fuel: Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021, https://www.gao.gov/assets/gao-21-603.pdf, accessed November 12, 2026.

Claim 6: "Shutting down coal plants is the main threat to the grid."

Why people say it. Coal plants can run around the clock and store weeks of fuel on site. Many have closed in the past 15 years, and NERC has warned about retirements.

What the evidence shows. NERC's 2025 long-term assessment counts planned retirements of "over 105 GW in peak seasonal capacity" over ten years and calls on the industry to "carefully manage generator deactivations."[455] The Department of Energy used emergency orders in 2025 and 2026 to keep some older plants running; NERC's 2026 summer assessment noted those orders covered "six different power plants."[456] A July 2025 Department of Energy report went further, assuming "104 GW of announced plant closures by 2030" and concluding that "an additional 100 GW of new peak hour supply is needed by 2030."[457] Critics, including the clean-energy nonprofit GridLab, say that report "overstates the retirements expected" and "undercounts the resources that are likely to be added."[458]

But NERC names more than one cause. Its same 2025 report says that new data centers "account for most of the projected increase" in demand, and that "Projections for resource and transmission growth lag what is needed to support new data centers."[459] It flagged that at least 390 of nearly 900 planned transmission projects have been delayed, and that the grid is "increasingly reliant on natural gas for fuel."[460]

The strongest case for the claim. If demand is rising fast and new plants are slow to arrive, keeping existing plants open is the quickest way to avoid a shortage. Every retirement makes the math harder.

Verdict: Partly true. Retirements are one of the main risks NERC names. But NERC treats fast demand growth, slow construction of new power and transmission, and heavy dependence on natural gas as risks of equal or greater weight. "The main threat" overstates the evidence.

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[455] NERC, "2025 Long-Term Reliability Assessment," January 2026, pp. 8-9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[456] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 9, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[457] DOE, "The Department of Energy's Resource Adequacy Report Affirms the Energy Emergency Facing the U.S. Power Grid," fact sheet, July 2025, https://www.energy.gov/sites/default/files/2025-07/DOE_Fact_Sheet_Grid_Report_July_2025.pdf, accessed November 12, 2026.

[458] Ric O'Connell, "GridLab Analysis: Department of Energy Resource Adequacy Report," GridLab (clean-energy-focused nonprofit), July 11, 2025, https://gridlab.org/gridlab-analysis-department-of-energy-resource-adequacy-report/, accessed November 12, 2026.

[459] NERC, "2025 Long-Term Reliability Assessment," January 2026, pp. 6, 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[460] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

Sources: NERC 2025 Long-Term Reliability Assessment;[461] NERC 2026 Summer Reliability Assessment.[462]

[461] NERC, "2025 Long-Term Reliability Assessment," January 2026, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[462] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

Chapter 16: Claims About Bills, Rules and the Grid Itself

Information in this chapter is current as of November 12, 2026.

Table 16-1. Claims in this chapter and their verdicts (information as of November 12, 2026)

No.	Claim	Verdict
7	Data centers are raising my electric bill.	Partly true
8	Utilities make more money when they spend more.	True
9	Rooftop solar owners shift costs onto everyone else.	Partly true
10	Texas has its own grid to avoid federal rules.	True
11	Smart meters spy on you and make you sick.	Partly true
12	The grid is 100 years old and falling apart.	Partly true
13	One big solar storm could knock out the grid for years.	Inconclusive
14	Electric cars will crash the grid.	Inconclusive

Claim 7: "Data centers are raising my electric bill."

Why people say it. Data centers, many built for artificial intelligence (AI), are the fastest-growing source of new electric demand, and bills have been rising at the same time.

What the evidence shows. The clearest evidence comes from PJM, which coordinates wholesale power in "all or parts of 13 states and the District of Columbia."[463] PJM's independent market monitor, a firm paid to watch the market for problems, wrote in August 2026 that "Data center load growth is the primary reason for recent and expected capacity market conditions," and estimated that data center growth "increased customers' bills by $20,036,670,606" across the last three capacity auctions.[464] PJM itself said nearly 5,100 MW of the 5,250 MW jump in its forecast peak for 2027/2028 "is attributable to data center demand."[465] Lawrence Berkeley National Laboratory found that higher PJM capacity prices added about 3.1 cents per kWh to retail prices in the District of Columbia in 2025, 2.0 cents in New Jersey and 1.5 cents in Maryland.[466]

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[463] PJM Interconnection, "About PJM," web page, https://www.pjm.com/about-pjm, accessed November 12, 2026.

[464] Monitoring Analytics (Independent Market Monitor for PJM), "2026 Quarterly State of the Market Report for PJM: January through June," August 13, 2026, https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2026/2026q2-som-pjm.pdf, accessed November 12, 2026.

[465] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

[466] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

Outside PJM, the picture is less clear. NERC says data centers drive most of the expected growth in demand nationwide,[467] but higher demand does not raise every bill the same way. In some places, a big new customer can spread a utility's fixed costs over more sales and hold rates down. [Not verified: I did not find a national study I could quote on how much large new customers raise or lower rates for everyone else.] Regulators are starting to act on this. In 2026, FERC ordered each of the six regional grid operators under its jurisdiction "to justify or reform tariffs for data centers," according to the Department of Energy.[468]

The strongest case against the claim. PJM's own spokesperson said its prices "are an accurate indication of the tightening supply and demand condition,"[469] and a market monitor estimate is only an estimate. Gas prices and storm recovery also raised bills in 2025.[470]

Verdict: Partly true. In the PJM region, the market monitor's analysis shows data centers have raised bills by billions of dollars. Nationwide, data centers are one cause among several, and the effect depends heavily on where you live and how your state handles large new customers.

Sources: Monitoring Analytics 2026 second quarter report;[471] PJM auction results;[472,473] LBNL retail price trends.[474]

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[467] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[468] DOE, "The Department of Energy Applauds FERC's Action on Large Load Interconnection Reform," June 2026, https://www.energy.gov/articles/department-energy-applauds-fercs-action-large-load-interconnection-reform, accessed November 12, 2026.

[469] Christa Marshall, "Data centers drive 76% surge in PJM power prices," E&E News, May 15, 2026, https://www.eenews.net/articles/data-centers-drive-76-surge-in-pjm-power-prices/, accessed November 12, 2026.

[470] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[471] Monitoring Analytics (Independent Market Monitor for PJM), "2026 Quarterly State of the Market Report for PJM: January through June," August 13, 2026, https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2026/2026q2-som-pjm.pdf, accessed November 12, 2026.

[472] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

[473] PJM Interconnection, "PJM Capacity Auction Procures 138,318 MW of Generation Resources," news release, July 14, 2026, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2026-releases/20260714-pjm-capacity-auction-procures-138318-mw-of-generation-resources.pdf, accessed November 12, 2026.

[474] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

Claim 8: "Utilities make more money when they spend more."

Why people say it. Because of how utility rates are set.

What the evidence shows. As I explained in Chapter 7, investor-owned utilities earn a profit by being allowed a rate of return on their "rate base," which is mostly the undepreciated value of what they have built. The Supreme Court's Hope and Bluefield decisions are the foundation of that system: a utility is entitled to a return high enough to attract capital.[475,476] So, other things being equal, a bigger rate base means a bigger allowed profit. Day-to-day costs like fuel are generally passed through to customers without a profit added, as Chapter 7 explains, so they do not grow the rate base.

EIA data show major utility spending on distribution rose about 160 percent from 2003 to 2023 after inflation, and transmission spending nearly tripled.[477]

The strongest case against the claim. A utility only earns on spending that regulators find "prudent," and regulators can and do disallow costs. Much of the recent spending is to replace aging equipment and harden lines against storms and wildfires, which customers need.[478] And this applies only to investor-owned utilities. Cooperatives and city-owned utilities have no outside shareholders.

Verdict: True. The way investor-owned utilities are regulated rewards capital spending with an allowed return. That does not mean the spending is wasteful. It means regulators, and you as a ratepayer, have good reason to look closely at it.

Sources: Hope and Bluefield decisions;[479,480] EIA utility spending data.[481]

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[475] Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944), decided January 3, 1944 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/supremecourt/text/320/591, accessed November 12, 2026.

[476] Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), decided June 11, 1923 (FindLaw), https://caselaw.findlaw.com/us-supreme-court/262/679.html, accessed November 12, 2026.

[477] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

[478] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[479] Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944), decided January 3, 1944 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/supremecourt/text/320/591, accessed November 12, 2026.

[480] Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), decided June 11, 1923 (FindLaw), https://caselaw.findlaw.com/us-supreme-court/262/679.html, accessed November 12, 2026.

[481] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

Claim 9: "Rooftop solar owners shift costs onto everyone else."

Why people say it. Under "net metering," a home with solar panels is credited for power it sends to the grid, often at the full retail price. Part of that retail price pays for poles, wires and other fixed costs. If solar owners pay less toward those costs, someone else has to make up the difference.

What the evidence shows. LBNL looked at this directly. It found net metering added less than half a cent per kWh to retail prices in about 40 states, but more than 2 cents per kWh in California, where rooftop solar is most common.[482] California changed its rules. "On December 15, 2022, the CPUC adopted D.22-12-056, establishing the Net Billing tariff (NBT) as a successor to NEM2," for customers applying on or after April 15, 2023.[483] [Not verified: how much the new tariff cut payments for exported power; the commission page I read does not give the rates.]

The strongest case against the claim. Rooftop solar can lower the need for some new power plants and wires, and those savings help everyone. How large that benefit is remains disputed, and LBNL's numbers above measure the cost side only.[484]

Verdict: Partly true. A cost shift exists, and in California it is significant. In most states, it is small enough that it does not move bills much.

Sources: LBNL retail price trends;[485] CPUC Net Billing Tariff page.[486]

Claim 10: "Texas has its own grid to avoid federal rules."

Why people say it. Texas is the only one of the lower 48 states with most of its power on a grid that does not connect in a big way to its neighbors.

What the evidence shows. The Federal Power Act gives the federal government authority over the "transmission of electric energy in interstate commerce" and wholesale sales in interstate commerce.[487] Because the ERCOT grid stays inside Texas, FERC says

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[482] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[483] California Public Utilities Commission (CPUC), "Net Billing Tariff," web page, https://www.cpuc.ca.gov/nbt, accessed November 12, 2026.

[484] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[485] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[486] California Public Utilities Commission (CPUC), "Net Billing Tariff," web page, https://www.cpuc.ca.gov/nbt, accessed November 12, 2026.

[487] 16 U.S. Code 824, Federal Power Act section 201 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/uscode/text/16/824, accessed November 12, 2026.

ERCOT "does not fall under FERC's regulatory jurisdiction" for its market rules.[488] ERCOT instead operates "subject to oversight by the Public Utility Commission of Texas and the Texas Legislature."[489]

Was that on purpose? The history says yes. The Texas Tribune's explainer puts it bluntly: "Basically, Texas has its own grid to avoid dealing with - you guessed it - the feds."[490] The 1935 Federal Power Act gave the federal government authority over interstate electricity sales, and Texas utilities had a priority: "staying out of the reach of federal regulators."[491] A 2022 history from Rice University's Baker Institute quotes a utility history explaining that if Texas utilities connected across state lines, "they would then be engaged in interstate commerce and subject to regulation by the Federal Power Commission."[492]

The strongest case against the claim. Avoiding federal regulation was not the only reason. Texas is big enough to support its own grid, and ERCOT is still not fully free of federal rules: as Chapter 4 showed, NERC's mandatory reliability standards are enforced across the bulk power system. [Not verified: a specific official statement that NERC standards apply in ERCOT; I did not locate one I could quote.]

Verdict: True. Texas utilities kept their grid inside the state largely to stay out of federal regulators' reach, and that is still why FERC does not set ERCOT's market rules.

Sources: Texas Tribune;[493] Baker Institute;[494] FERC.[495]

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[488] FERC, "What are Wholesale Electricity Markets?" web page, last updated November 5, 2024, https://ferc.gov/energy-markets-0, accessed November 12, 2026.

[489] Electric Reliability Council of Texas (ERCOT), "About ERCOT," web page, https://www.ercot.com/about, accessed November 12, 2026.

[490] Kate Galbraith, "Texplainer: Why does Texas have its own power grid?" The Texas Tribune, February 8, 2011, updated February 15, 2021, https://www.texastribune.org/2011/02/08/texplainer-why-does-texas-have-its-own-power-grid/, accessed November 12, 2026.

[491] Kate Galbraith, "Texplainer: Why does Texas have its own power grid?" The Texas Tribune, February 8, 2011, updated February 15, 2021, https://www.texastribune.org/2011/02/08/texplainer-why-does-texas-have-its-own-power-grid/, accessed November 12, 2026.

[492] Juli A. Cohn, "Connecting Past and Future: A History of Texas' Isolated Power Grid," Rice University's Baker Institute for Public Policy, December 1, 2022, https://bakerinstitute.org/research/connecting-past-and-future-history-texas-isolated-power-grid, accessed November 12, 2026.

[493] Kate Galbraith, "Texplainer: Why does Texas have its own power grid?" The Texas Tribune, February 8, 2011, updated February 15, 2021, https://www.texastribune.org/2011/02/08/texplainer-why-does-texas-have-its-own-power-grid/, accessed November 12, 2026.

[494] Juli A. Cohn, "Connecting Past and Future: A History of Texas' Isolated Power Grid," Rice University's Baker Institute for Public Policy, December 1, 2022, https://bakerinstitute.org/research/connecting-past-and-future-history-texas-isolated-power-grid, accessed November 12, 2026.

[495] FERC, "What are Wholesale Electricity Markets?" web page, last updated November 5, 2024, https://ferc.gov/energy-markets-0, accessed November 12, 2026.

Claim 11: "Smart meters spy on you and make you sick."

Why people say it. Smart meters report your usage to the utility, often every 15 minutes or every hour, using radio signals. People worry about privacy and about radio waves.

What the evidence shows about health. The most thorough review I found came from the California Council on Science and Technology, an independent body that advises the state, in 2011. It found that smart meters "result in much smaller levels of radio frequency (RF) exposure than many existing common household electronic devices, particularly cell phones and microwave ovens."[496] It said the meters "emit RF that is a very small fraction of the exposure level established as safe by the FCC guidelines," the federal limits.[497] It also noted that "scientific studies have not identified or confirmed negative health effects from potential non-thermal impacts."[498]

What the evidence shows about privacy. Here the concern has more to it. A meter that reports your use every 15 minutes or every hour creates a detailed record of when you are home, when you sleep and when you are away. Who can see that data, and for what, is set by state rules and utility policies that vary widely. [Not verified: a national official source on smart meter data privacy rules. I did not find one I could cite, so I treat the privacy point as a reasonable concern rather than a proven harm.]

The strongest case for the claim. People who report symptoms are not making them up, and "no evidence of harm so far" is not the same as proof of safety forever. On privacy, detailed usage data really can reveal a household's habits.

Verdict: Partly true. The "make you sick" half is not supported: the best review found exposure far below federal safety limits and no confirmed health effects. The "spy on you" half is overstated as written, but there is a real privacy question about who gets to use detailed household data.

Sources: California Council on Science and Technology.[499]

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[496] California Council on Science and Technology, "Health Impacts of Radio Frequency Exposure From Smart Meters," final report, April 2011 (copy hosted by Chelan County Public Utility District), p. 4, https://www.chelanpud.org/docs/default-source/default-document-library/ccstreport.pdf, accessed November 12, 2026.

[497] California Council on Science and Technology, "Health Impacts of Radio Frequency Exposure From Smart Meters," final report, April 2011 (copy hosted by Chelan County Public Utility District), p. 7, https://www.chelanpud.org/docs/default-source/default-document-library/ccstreport.pdf, accessed November 12, 2026.

[498] California Council on Science and Technology, "Health Impacts of Radio Frequency Exposure From Smart Meters," final report, April 2011 (copy hosted by Chelan County Public Utility District), p. 4, https://www.chelanpud.org/docs/default-source/default-document-library/ccstreport.pdf, accessed November 12, 2026.

[499] California Council on Science and Technology, "Health Impacts of Radio Frequency Exposure From Smart Meters," final report, April 2011 (copy hosted by Chelan County Public Utility District), https://www.chelanpud.org/docs/default-source/default-document-library/ccstreport.pdf, accessed November 12, 2026.

Claim 12: "The grid is 100 years old and falling apart."

Why people say it. Parts of the system were first built more than a century ago, and blackouts make the news.

What the evidence shows. Utilities are spending heavily to replace old equipment. EIA reports that spending on distribution by major utilities rose from about $19.5 billion to $50.9 billion between 2003 and 2023 after inflation, and transmission spending nearly tripled to $27.7 billion.[500] A 2025 industry survey cited by LBNL found 61 percent of distribution investment went to replacing or hardening equipment.[501] So the grid is being rebuilt piece by piece, which is also one reason bills are rising. At the same time, the Department of Energy says that "Much of the U.S. electric grid was built in the 1960s and 1970s" and that "70 percent of transmission lines are over 25 years old and approaching the end of their typical 50-80-year lifecycle."[502]

The grid is also strained. NERC finds 13 of 23 regions face resource adequacy challenges over the next ten years.[503] But the major blackouts covered in Chapter 10 were caused mostly by extreme weather, operator errors and plants that were not prepared for cold, not by old wires simply wearing out.[504,505]

Verdict: Partly true. Much of the equipment is old and NERC sees real reliability risk. But the grid is not one 100-year-old machine. It is constantly being replaced, and "falling apart" overstates what the official reports show.

Sources: EIA utility spending;[506] DOE Grid Deployment Office;[507] NERC 2025 Long-Term Reliability Assessment;[508] LBNL.[509]

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[500] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

[501] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[502] DOE Grid Deployment Office, "What Does It Take to Modernize the U.S. Electric Grid?" web article, about October 2023, https://www.energy.gov/gdo/articles/what-does-it-take-modernize-us-electric-grid, accessed November 12, 2026.

[503] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 6, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[504] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[505] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[506] EIA, "Grid infrastructure investments drive increase in utility spending over last two decades," Today in Energy, November 18, 2024, https://www.eia.gov/todayinenergy/detail.php?id=63724, accessed November 12, 2026.

Claim 13: "One big solar storm could knock out the grid for years."

Why people say it. Strong solar storms can drive unwanted currents into long power lines and damage large transformers, which can take a long time to replace.

What the evidence shows. The 1989 storm caused a 9-hour blackout in Quebec.[510] The May 2024 storm, the strongest since 2003, did not cause any major U.S. blackout reported by researchers who studied it.[511] NERC's TPL-007 standard, approved by FERC in 2016, now makes grid operators plan for a benchmark storm "based on a 1-in-100 year frequency of occurrence."[512] NOAA's own storm scale warns that in the most extreme storms, "some grid systems may experience complete collapse or blackouts" and "Transformers may experience damage."[513]

Nobody has measured what a storm far stronger than any in the modern grid's history would do. Studies of that worst case disagree widely. [Not verified: I did not find official estimates of worst-case outage length that I could quote.]

Verdict: Inconclusive. A severe storm could cause serious damage, and the risk is real enough that the federal standard covers it. But no evidence settles whether an outage would last hours, weeks or years.

Sources: Wilkerson and others 2025;[514] FERC Order No. 830;[515] NOAA.[516]

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[507] DOE Grid Deployment Office, "What Does It Take to Modernize the U.S. Electric Grid?" web article, about October 2023, https://www.energy.gov/gdo/articles/what-does-it-take-modernize-us-electric-grid, accessed November 12, 2026.

[508] NERC, "2025 Long-Term Reliability Assessment," January 2026, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[509] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July 2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[510] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[511] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[512] FERC, "Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events," Order No. 830, 156 FERC 61,215, issued September 22, 2016, p. 10, https://www.ferc.gov/sites/default/files/2020-04/E-4_2.pdf, accessed November 12, 2026.

[513] NOAA Space Weather Prediction Center, "NOAA Space Weather Scales," web page, https://www.spaceweather.gov/noaa-scales-explanation, accessed November 12, 2026.

[514] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[515] FERC, "Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events," Order No. 830, 156 FERC 61,215, issued September 22, 2016, https://www.ferc.gov/sites/default/files/2020-04/E-4_2.pdf, accessed November 12, 2026.

Claim 14: "Electric cars will crash the grid."

Why people say it. Charging a car uses a lot of electricity, and there are now millions of electric vehicles (EVs) on U.S. roads.

What the evidence shows. So far, EVs are a small part of electricity use. EIA estimated that light-duty electric vehicles in the United States used "nearly 14 billion kilowatthours" in the first six months of 2026, up 8 percent from a year earlier, and its headline said EV electricity use was "increasing at a slower pace in 2026."[517] For scale, Chapter 5 showed that U.S. utility-scale plants generated about 4.43 trillion kWh in 2025.[518] If EV use for the full year is roughly double the half-year figure, that is well under 1 percent of the total. That is my own rough arithmetic, not an EIA figure. NERC's long-term assessment names data centers, not EVs, as the main driver of projected demand growth.[519]

The bigger question is local. If many cars on one street charge at the same time on a hot evening, the transformer on the pole can be overloaded. How often that happens, and how much "managed charging" (charging overnight or when power is cheap) can prevent it, depends on the neighborhood. [Not verified: national studies on local transformer strain from EVs; the federal laboratory report I tried to read would not open.]

The strongest case for the claim. If EV sales grow fast and everyone charges at 6 p.m., local equipment will need upgrades, and someone will pay for them.

Verdict: Inconclusive. National evidence shows EVs are a modest and slowly growing share of demand, not a threat to the bulk grid today. Whether they strain local equipment depends on how fast they spread and when people charge, and I could not find solid national data on that.

Sources: EIA;[520] NERC 2025 Long-Term Reliability Assessment.[521]

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[516] NOAA Space Weather Prediction Center, "NOAA Space Weather Scales," web page, https://www.spaceweather.gov/noaa-scales-explanation, accessed November 12, 2026.

[517] EIA, "U.S. electricity use for electric vehicles increasing at a slower pace in 2026," Today in Energy, September 30, 2026, https://www.eia.gov/todayinenergy/detail.php?id=68224, accessed November 12, 2026.

[518] EIA, "Electricity explained: Electricity in the United States," Energy Explained (2025 data), undated web page, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php, accessed November 12, 2026.

[519] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[520] EIA, "U.S. electricity use for electric vehicles increasing at a slower pace in 2026," Today in Energy, September 30, 2026, https://www.eia.gov/todayinenergy/detail.php?id=68224, accessed November 12, 2026.

[521] NERC, "2025 Long-Term Reliability Assessment," January 2026, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

Part Eight: What Comes Next

Chapter 17: The Next Ten Years

Predictions about energy have a poor track record, mine included. So in this chapter I stick to what the official forecasters and planners expect, show where they disagree, and tell you what to watch. Information in this chapter is current as of November 12, 2026.

Demand is growing again

For about 15 years, U.S. electricity use barely grew. That has changed. NERC's 2025 long-term assessment projects that summer peak demand will rise "by over 224 GW" over the next ten years, a forecast "69% higher than last year's 10-year growth projection of 132 GW," and that winter peak demand will grow by 245 GW.[522] NERC says "New data centers for artificial intelligence and the digital economy account for most of the projected increase."[523]

NERC also adds a caution that matters: "some large-load projects have slowed or failed to materialize."[524] Data center forecasts are uncertain. If they turn out too high, utilities could build plants and lines that customers pay for but do not need. If they turn out too low, regions could run short.

You might ask, "Which mistake is worse?" That is the core argument of the next ten years, and honest people land on both sides.

What is being built

Most new power plants being built today are solar farms and batteries. NERC says "solar and battery capacity additions represent two-thirds" of the new resources that are under construction or well along in planning, and that "Natural-gas-fired generator additions represent 15% of the projected capacity additions."[525] EIA reported a record 37 GW of solar added in 2024, along with about 7 GW of wind and about 1 GW of natural gas.[526] For 2026, EIA reported that developers planned to add a record "86 gigawatts (GW) of new utility-scale electric generating capacity," and that "Solar power makes up 51% of the planned 2026 capacity additions, followed by battery storage at 28% and wind at 14%."[527] Planned new gas capacity was 6.3 GW.[528] On the other side of the ledger, EIA expects "coal plant retirements

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[522] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[523] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 9, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[524] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[525] NERC, "2025 Long-Term Reliability Assessment," January 2026, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[526] EIA, "New solar plants expected to support most U.S. electric generation growth," Today in Energy, January 24, 2025, https://www.eia.gov/todayinenergy/detail.php?id=64364, accessed November 12, 2026.

[527] EIA, "New U.S. electric generating capacity expected to reach a record high in 2026," Today in Energy, February 20, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67205, accessed November 12, 2026.

[528] EIA, "New U.S. electric generating capacity expected to reach a record high in 2026," Today in Energy, February 20, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67205, accessed November 12, 2026.

will lead to U.S. coal-fired generation declining an average of 5% annually over the next two years."[529]

New gas plants face their own delays. Lazard reported that the cost of building a new combined-cycle gas plant "has reached a 10-year high."[530] [Not verified: reports of multi-year waiting lists for new gas turbines. I did not find an official source I could quote.]

Nuclear is back in the conversation. The Vogtle plant in Georgia added two new reactors in 2023 and 2024, but its cost rose from an expected $14 billion to more than $30 billion.[531] A May 2025 executive order set a goal of expanding U.S. nuclear capacity "from approximately 100 GW in 2024 to 400 GW by 2050."[532] Chapter 13 covers the effort to restart closed reactors in Michigan, Pennsylvania and Iowa.[533]

Federal policy has shifted

The biggest change came in the tax law President Trump signed on July 4, 2025, known as the One Big Beautiful Bill Act. According to a summary by the law firm Kirkland and Ellis, the federal tax credits for new wind and solar plants "are terminated unless the facility is placed in service on or before December 31, 2027," with an exception for projects that begin construction by July 4, 2026.[534] Credits for other technologies, including energy storage, phase out later, starting with projects that begin construction in 2034.[535] [Not verified against the law's text or a government summary; I could not open the official sources. Treat these dates as a law firm's reading.] Since EIA's cost estimates in Chapter 12 include tax credits, this change will push up the cost of new wind and solar projects that miss the deadlines.

The Department of Energy has also used emergency power under section 202(c) of the Federal Power Act to keep older plants running past their planned retirement. NERC's 2026

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[529] EIA, "Solar power generation drives electricity generation growth over the next two years," Today in Energy, January 16, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67005, accessed November 12, 2026.

[530] Lazard, "Lazard Releases 2025 Levelized Cost of Energy+ Report," press release, June 16, 2025 (financial advisory firm; industry analysis), https://lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/, accessed November 12, 2026.

[531] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[532] Donald J. Trump, "Executive Order 14300 - Ordering the Reform of the Nuclear Regulatory Commission," May 23, 2025 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-14300-ordering-the-reform-the-nuclear-regulatory-commission, accessed November 12, 2026.

[533] Bethany Lee, "U.S. Nuclear Power Plant Restarts Gain Momentum with PNNL Support," Pacific Northwest National Laboratory, September 3, 2026, https://www.pnnl.gov/news-media/us-nuclear-power-plant-restarts-gain-momentum-pnnl-support, accessed November 12, 2026.

[534] Kirkland and Ellis LLP (law firm), "One Big Beautiful Bill Act Brings Big Changes to Green Energy Tax Credits," Kirkland Alert, August 6, 2025, https://www.kirkland.com/publications/kirkland-alert/2025/08/one-big-beautiful-bill-act-brings-big-changes-to-green-energy-tax-credits, accessed November 12, 2026.

[535] Kirkland and Ellis LLP (law firm), "One Big Beautiful Bill Act Brings Big Changes to Green Energy Tax Credits," Kirkland Alert, August 6, 2025, https://www.kirkland.com/publications/kirkland-alert/2025/08/one-big-beautiful-bill-act-brings-big-changes-to-green-energy-tax-credits, accessed November 12, 2026.

summer assessment noted that such orders were keeping "six different power plants" available.[536] The cost is disputed. IEEFA, a research group that favors moving away from fossil fuels, estimated in June 2026 that "Ratepayers face at least $300 million in extra costs" from the orders and that "These costs are rising by more than $30 million per month."[537] The administration's view is that the plants are needed to keep the lights on, as its July 2025 report argued.[538]

Coal retirements have slowed. EIA reported that only 2.6 GW of coal capacity retired in 2025, the least in 15 years, even though operators had planned at the start of the year to retire 8.5 GW.[539] EIA said "4.8 GW of planned retirements were delayed to a future year," some of them because of DOE's emergency orders, which "are in effect for up to 90 days but can be reissued."[540] For 2026, operators planned to retire 6.4 GW.[541]

By March 2026, Utility Dive reported that DOE had issued 13 orders under section 202(c) covering six plants, "two in Indiana, and one each in Michigan, Pennsylvania, Washington and Colorado."[542] It reported that "None of the orders was requested by the relevant plant operator, grid operator or state regulator."[543] The cost estimate in that article, more than $230 million, came from the Sierra Club, an environmental group, and DOE did not respond to the reporter in time for the story.[544]

The administration's case rests on DOE's July 2025 grid report. In announcing it, DOE said that "Allowing 104 GW of firm generation to retire by 2030" could raise outage risk, and

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[536] NERC, "2026 Summer Reliability Assessment," May 2026 (copy hosted by the National Rural Electric Cooperative Association), p. 9, https://www.electric.coop/wp-content/uploads/2026/05/nerc_sra_2026-1.pdf, accessed November 12, 2026.

[537] Seth Feaster, "Cost of coal plant emergency orders already more than $300 million," Institute for Energy Economics and Financial Analysis (IEEFA, a research group that favors a transition away from fossil fuels), June 10, 2026, https://ieefa.org/resources/cost-coal-plant-emergency-orders-already-more-300-million, accessed November 12, 2026.

[538] DOE, "The Department of Energy's Resource Adequacy Report Affirms the Energy Emergency Facing the U.S. Power Grid," fact sheet, July 2025, https://www.energy.gov/sites/default/files/2025-07/DOE_Fact_Sheet_Grid_Report_July_2025.pdf, accessed November 12, 2026.

[539] EIA, "U.S. coal-fired generating capacity retired in 2025 was the least in 15 years," Today in Energy, April 13, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67427, accessed November 12, 2026.

[540] EIA, "U.S. coal-fired generating capacity retired in 2025 was the least in 15 years," Today in Energy, April 13, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67427, accessed November 12, 2026.

[541] EIA, "U.S. coal-fired generating capacity retired in 2025 was the least in 15 years," Today in Energy, April 13, 2026, https://www.eia.gov/todayinenergy/detail.php?id=67427, accessed November 12, 2026.

[542] Robert Walton, "13 DOE emergency orders have cost Americans $235M, Sierra Club says," Utility Dive, March 18, 2026, https://www.utilitydive.com/news/doe-202c-cost-235m-coal-sierra-club/815045/, accessed November 12, 2026.

[543] Robert Walton, "13 DOE emergency orders have cost Americans $235M, Sierra Club says," Utility Dive, March 18, 2026, https://www.utilitydive.com/news/doe-202c-cost-235m-coal-sierra-club/815045/, accessed November 12, 2026.

[544] Robert Walton, "13 DOE emergency orders have cost Americans $235M, Sierra Club says," Utility Dive, March 18, 2026, https://www.utilitydive.com/news/doe-202c-cost-235m-coal-sierra-club/815045/, accessed November 12, 2026.

that "retirements increase the risk of power outages by 100 times in 2030."[545] Energy Secretary Chris Wright said, "This report affirms what we already know."[546] Critics, including GridLab, argue the report's assumptions undercount new resources, as Chapter 15 covers.[547]

FERC has been working on two slow-moving problems: planning long transmission lines, and connecting new plants to the grid. In 2026 it also ordered the six grid operators under its jurisdiction to justify or reform their rules for connecting data centers.[548] [Not verified: the details of FERC's 2024 transmission planning rule, Order No. 1920, and its 2023 interconnection rule, Order No. 2023. FERC's pages on both would not open for me.]

The waiting line

Before a new power plant can connect to the grid, it has to get in line for a study of what upgrades the grid needs. Lawrence Berkeley National Laboratory tracks this line every year. At the end of 2025, there were "2,061 gigawatts (GW) of generation and storage capacity now actively seeking grid interconnection."[549] Most of it was solar (773 GW), storage (749 GW) and wind (220 GW), but natural gas in the queue "increased 86% year-over-year" to 253 GW.[550] Most projects never get built: of requests made from 2000 to 2020, "just 13% of capacity had come online by the end of 2025, while 75% had withdrawn."[551] For projects that do make it, LBNL found that the time to reach commercial operation "exceeds 5 years" in the regions with data.[552]

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[545] DOE, "Department of Energy Releases Report on Evaluating U.S. Grid Reliability and Security," press release, July 7, 2025, https://www.energy.gov/articles/department-energy-releases-report-evaluating-us-grid-reliability-and-security, accessed November 12, 2026.

[546] DOE, "Department of Energy Releases Report on Evaluating U.S. Grid Reliability and Security," press release, July 7, 2025, https://www.energy.gov/articles/department-energy-releases-report-evaluating-us-grid-reliability-and-security, accessed November 12, 2026.

[547] Ric O'Connell, "GridLab Analysis: Department of Energy Resource Adequacy Report," GridLab (clean-energy-focused nonprofit), July 11, 2025, https://gridlab.org/gridlab-analysis-department-of-energy-resource-adequacy-report/, accessed November 12, 2026.

[548] DOE, "The Department of Energy Applauds FERC's Action on Large Load Interconnection Reform," June 2026, https://www.energy.gov/articles/department-energy-applauds-fercs-action-large-load-interconnection-reform, accessed November 12, 2026.

[549] Lawrence Berkeley National Laboratory, "Backlog of power plants seeking transmission grid connection eased somewhat in 2025 amidst high withdrawals," news release on Queued Up: 2026 Edition, July 1, 2026, https://emp.lbl.gov/news/backlog-power-plants-seeking-transmission-grid-connection-eased-somewhat-2025-amidst, accessed November 12, 2026.

[550] Lawrence Berkeley National Laboratory, "Backlog of power plants seeking transmission grid connection eased somewhat in 2025 amidst high withdrawals," news release on Queued Up: 2026 Edition, July 1, 2026, https://emp.lbl.gov/news/backlog-power-plants-seeking-transmission-grid-connection-eased-somewhat-2025-amidst, accessed November 12, 2026.

[551] Lawrence Berkeley National Laboratory, "Backlog of power plants seeking transmission grid connection eased somewhat in 2025 amidst high withdrawals," news release on Queued Up: 2026 Edition, July 1, 2026, https://emp.lbl.gov/news/backlog-power-plants-seeking-transmission-grid-connection-eased-somewhat-2025-amidst, accessed November 12, 2026.

[552] Lawrence Berkeley National Laboratory, "Backlog of power plants seeking transmission grid connection eased somewhat in 2025 amidst high withdrawals," news release on Queued Up: 2026 Edition, July 1, 2026,

Transmission

NERC found that "at least 390 projects have been delayed" out of nearly 900 transmission projects it tracks.[553]

Congress tried to speed things up 20 years ago. CRS reports that the Energy Policy Act of 2005 required the Secretary of Energy "to conduct a study of electric transmission congestion every three years," and let DOE name National Interest Electric Transmission Corridors, areas where a shortage of lines hurts consumers.[554] In those corridors, FERC can issue a permit if a state does not act, and "Permit holders may petition in U.S. District Court to acquire rights-of-way through eminent domain."[555] Eminent domain is the power to take private land for public use, with payment. [Not verified: how often the corridor and federal permit powers have actually been used since 2005, and the court cases that limited them. I did not open a current official summary.]

You might ask, "Why is it so hard to build a power line?" A long line crosses many counties and often several states. Each one has its own permits, landowners and opinions, and the line often helps people far away more than the people it crosses. Then someone has to decide who pays. (This is my plain summary of the problem, not a finding from a single source.)

What each side wants

I want to give you the strongest case each side makes about the next ten years, in its own words, from groups that openly advocate for one view. These are Tier 5 sources: I use them to show what people argue, not as proof.

Keep existing plants running. America's Power, the coal industry's group, says "it is even more critical to stop the retirement of existing coal power plants," and that rolling back federal carbon rules "will make our nation's electricity system more reliable and electricity prices more affordable."[556]

Build everything, including utility-owned plants. The Edison Electric Institute, which represents investor-owned utilities, has "called for fundamental reforms to ensure resource adequacy in PJM" and says "Policymakers must consider all options to get new

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https://emp.lbl.gov/news/backlog-power-plants-seeking-transmission-grid-connection-eased-somewhat-2025-amidst, accessed November 12, 2026.

[553] NERC, "2025 Long-Term Reliability Assessment," January 2026, p. 10, https://www.nerc.com/globalassets/our-work/assessments/nerc_ltra_2025.pdf, accessed November 12, 2026.

[554] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[555] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[556] America's Power (coal industry group), "America's Power's Statement on EPA's Proposal to Repeal Carbon Rule," statement by Michelle Bloodworth, June 11, 2025, reposted by POWER magazine, https://www.powermag.com/blog/america-powers-statement-on-epas-proposal-to-repeal-carbon-rule, accessed November 12, 2026.

generation built, including regulated generation."[557] In plain English: utilities want to be allowed to build and own more power plants themselves, with the cost in customers' rates.

Let old plants retire and build clean power. The Natural Resources Defense Council, an environmental group, objects to "Forcing utilities to continue to operate unneeded and costly coal-fired power plants past their retirement," and says customers "should not be stuck paying the cost of a nonexistent 'emergency.'"[558] GridLab argues that federal forecasts undercount the new resources being built.[559]

Build nuclear at scale. Maria Korsnick, head of the Nuclear Energy Institute, said in 2026 that "the question before us now is whether we have what it takes to build at scale," and "If quadrupling nuclear capacity is our moon shot, then regulatory change is our launch pad."[560]

Do not cut corners on nuclear safety. The Union of Concerned Scientists warned after the 2025 executive orders that "the U.S. nuclear industry will fail if safety is not made a priority."[561]

You will notice that each group's position lines up with its members' interests. That does not make any of them wrong. It is a reason to check their claims against the official data, which is what this book tries to do.

What to watch

Here are the signs I would watch to see which way things are going:

- Whether the data center demand that utilities forecast actually shows up, year by year.
- PJM's next capacity auction prices, and whether the region gets back above its reliability target.[562]

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[557] Edison Electric Institute (trade group for investor-owned utilities), statement by Drew Maloney on the proposal to protect customers and have data centers pay their share, January 16, 2026, https://www.eei.org/News/news/All/statement-on-president-governor-proposal-to-protect-customers-and-ensure-data-centers-pay-fair-share, accessed November 12, 2026.

[558] Natural Resources Defense Council (environmental advocacy group), "Trump Administration Orders to Keep Fossil-Fired Power Plant Running Will Increase Michigan Electricity Costs," press release, undated (2025), https://www.nrdc.org/press-releases/trump-administration-orders-keep-fossil-fired-power-plant-running-will-increase, accessed November 12, 2026.

[559] Ric O'Connell, "GridLab Analysis: Department of Energy Resource Adequacy Report," GridLab (clean-energy-focused nonprofit), July 11, 2025, https://gridlab.org/gridlab-analysis-department-of-energy-resource-adequacy-report/, accessed November 12, 2026.

[560] Aaron Larson, "State of the Nuclear Industry 2026: Korsnick Says the Real Test Is Now Scale," POWER magazine, May 12, 2026 (quoting Maria Korsnick, president of the Nuclear Energy Institute, the nuclear industry trade group), https://www.powermag.com/state-of-the-nuclear-industry-2026-korsnick-says-the-real-test-is-now-scale/, accessed November 12, 2026.

[561] Union of Concerned Scientists (science advocacy group), "New Executive Orders Undercut Nuclear Regulatory Commission Authority to Protect Public Safety, Security," statement by Edwin Lyman, May 23, 2025, https://www.ucs.org/about/news/nuclear-safeguards-undercut-executive-order, accessed November 12, 2026.

- NERC's 2026-2027 winter reliability assessment, due after this book's cutoff.[563]
- How many planned plant retirements are delayed, and by whom.
- Whether your state commission approves special rates for very large customers.
- Your own bill, compared with the same month last year.

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[562] PJM Interconnection, "PJM Capacity Auction Procures 138,318 MW of Generation Resources," news release, July 14, 2026, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2026-releases/20260714-pjm-capacity-auction-procures-138318-mw-of-generation-resources.pdf, accessed November 12, 2026.

[563] NERC Reliability Assessment Subcommittee, meeting agenda, November 3-5, 2026, https://www.nerc.com/globalassets/who-we-are/standing-committees/rstc/ras/ras-agenda-november-2026.pdf, accessed November 12, 2026.

Chapter 18: What You Can Do

This book is not financial or engineering advice. But after 17 chapters on how the grid works and why bills rise, I want to end with things an ordinary person can actually do. Information in this chapter is current as of November 12, 2026.

Read your bill

Most bills split into a charge for the power itself and charges for delivering it, plus fixed monthly charges and riders for specific costs. Appendix C walks through a sample bill line by line. Once you know which part of your bill is growing, you know which argument to pay attention to.

Know who sets your rates

If you buy from an investor-owned utility, your state public utility commission sets your rates. If you buy from a cooperative, its elected board does, and you get a vote. If you buy from a city-owned utility, your city council or utility board does. (Chapter 7 explains the difference.)

Rate cases are public. Most commissions post filings online and take public comments, and many states have a consumer advocate's office that represents residential customers. Their national association says its members are "designated by the laws of their respective jurisdictions to represent the interests of utility consumers before state and federal regulators and in the courts."[564] [Not verified: how many states have one; the association's own page gives conflicting counts.]

You do not need a lawyer to be heard. NARUC says commissions "require notice of public comment hearings to be made public," and that written comments can be submitted.[565] A short letter that says who you are, which case you are writing about, and how the proposal would affect your household goes into the official record. Look for the case number on your commission's website or in the notice your utility mails with your bill.

Find out how your commissioners are chosen. In most states they are appointed by the governor or legislature. In 11 states they are elected by the public.[566] Either way, they answer to someone you can reach.

Get help if you are behind

About 1 in 6 households were behind on their energy bills in 2025.[567] If you are one of them, call your utility before a shutoff notice comes. The federal Low Income Home Energy

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[564] National Association of State Utility Consumer Advocates (NASUCA), "Who We Are," web page, https://www.nasuca.org/about-us/, accessed November 12, 2026.

[565] NARUC, "Frequently Asked Questions," How Commissions Work, https://www.naruc.org/serving-the-public-interest/how-commissions-work/frequently-asked-questions/, accessed November 12, 2026.

[566] National Association of Regulatory Utility Commissioners (NARUC), "History and Background", https://naruc.org/about-naruc/our-mission/history-background, accessed November 12, 2026.

[567] Ryan Wiser, Galen Barbose, Will Gorman and others (Lawrence Berkeley National Laboratory) with Ryan Hledik and Long Lam (The Brattle Group), "Retail Electricity Price Trends and Drivers: Data Update - 2026 Edition," July

Assistance Program (LIHEAP) helps with heating and cooling bills through state and local agencies. [Not verified: LIHEAP's current details and how to apply; the federal LIHEAP pages would not open for me. Search for your state's LIHEAP office.] The Department of Energy's Weatherization Assistance Program "reduces energy costs for low-income households by increasing the energy efficiency of their homes," and DOE says those households "save on average $372 or more every year."[568]

Use less at the times that matter

Using less power saves money. Using less at the right times can save more, if your utility charges different prices by time of day. Check your utility's rate options, since time-of-day pricing is offered in some places and not others. As Chapter 5 showed, the average American home bought about 899 kWh a month in 2022.[569]

Start where the power goes. EIA found that air conditioning, space heating and water heating were the three biggest uses of electricity in homes in 2020, at 19, 12 and 12 percent.[570] So the thermostat and the water heater are where small changes add up. EIA also found that 34 percent of homes had two or more refrigerators, and that the main refrigerator in a home cost about $87 a year to run in 2020.[571] An old second fridge in the garage is one of the easier savings to find. (Whether it pays to replace it depends on its age and your rate; that part is my advice, not EIA's.)

Think hard before buying solar or batteries

Rooftop solar and home batteries can pay off, or not, depending on your state's rules, your roof and your utility's rates. Those rules have been changing (Claim 9 in Chapter 16). Get more than one quote, read the contract, and check what your utility will pay for power you send back to the grid. The Federal Trade Commission's advice is to "Compare detailed bids from several companies" and to check that a contract's terms "match what the company's ads, proposals, and salespeople told you."[572]

Be ready for an outage

The blackouts in Chapter 10 show that outages of several days can happen anywhere. Keep a plan for medicine that needs power or refrigeration, a way to stay warm or cool, and a way

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2026 update, https://eta-publications.lbl.gov/sites/default/files/2026-07/retail_price_trends_2026_edition_julyupdate.pdf, accessed November 12, 2026.

[568] DOE, "Weatherization Assistance Program," web page, updated October 16, 2025, https://www.energy.gov/scep/wap/weatherization-assistance-program, accessed November 12, 2026.

[569] EIA, "How much electricity does an American home use?" Frequently Asked Questions (2022 data), last updated January 8, 2024, https://www.eia.gov/tools/faqs/faq.php?id=97&t=3, accessed November 12, 2026.

[570] EIA, "Electricity use in homes," Energy Explained, last updated December 18, 2023, https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php, accessed November 12, 2026.

[571] EIA, "Electricity use in homes," Energy Explained, last updated December 18, 2023, https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php, accessed November 12, 2026.

[572] Federal Trade Commission (FTC), "Solar Power for Your Home," Consumer Advice, April 2022, https://consumer.ftc.gov/articles/solar-power-your-home, accessed November 12, 2026.

to charge a phone. If you use a generator, follow the CDC's warning: "Never use a generator inside your home or garage, even if doors and windows are open," and "Only use generators outside, more than 20 feet away from any windows, doors, and vents."[573]

Ask good questions

When someone tells you a single power source or a single villain explains your bill, ask:

- What does the official investigation or the government data say?
- Is this true everywhere, or only in one region?
- Is the dollar figure adjusted for inflation?
- Who paid for the study?

That last question is not a reason to ignore a source. It is a reason to check it against another one. That is what I have tried to do in this book, and it is what I would ask you to keep doing after you put it down.

Appendices

Appendix A: Timeline

Dates in this timeline come from the sources cited in the chapters. Information is current as of November 12, 2026.

Date	Event
September 4, 1882	Edison's Pearl Street Station begins delivering electricity in Manhattan.[574]
March 20, 1886	William Stanley lights Main Street in Great Barrington, Massachusetts, with alternating current.[575]
August 26, 1895	The Adams hydroelectric plant at Niagara Falls goes into operation.[576]
1912	Samuel Insull forms Middle West Utilities.[577]
1923	Supreme Court decides Bluefield Water Works, on a fair return for utilities.[578]

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[573] Centers for Disease Control and Prevention (CDC), "Carbon Monoxide (CO) Poisoning Basics," updated October 26, 2026, https://www.cdc.gov/carbon-monoxide/about/index.html, accessed November 12, 2026.

[574] IEEE History Center, "Milestones: Pearl Street Station, 1882," Engineering and Technology History Wiki, https://ethw.org/Milestones:Pearl_Street_Station,_1882, accessed November 12, 2026.

[575] IEEE History Center, "Milestones: Alternating Current Electrification, 1886," Engineering and Technology History Wiki, https://ethw.org/Milestones:Alternating_Current_Electrification,_1886, accessed November 12, 2026.

[576] IEEE History Center, "Milestones: Adams Hydroelectric Generating Plant, 1895," Engineering and Technology History Wiki, https://ethw.org/Milestones:Adams_Hydroelectric_Generating_Plant,_1895, accessed November 12, 2026.

[577] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

Date	Event
1932	Insull's utility empire goes into receivership.[579]
May 18, 1933	The Tennessee Valley Authority is created.[580]
May 11, 1935	Executive Order 7037 creates the Rural Electrification Administration.[581]
1935	Congress passes the Public Utility Holding Company Act and the Federal Power Act.[582]
May 20, 1936	Rural Electrification Act signed.[583]
January 3, 1944	Supreme Court decides the Hope Natural Gas case.[584]
November 9, 1965	Northeast blackout leaves about 30 million people in the dark.[585]
June 1, 1968	Utilities establish the National Electric Reliability Council (NERC) in response to the 1965 blackout.[586]
July 13, 1977	New York City blackout begins.[587]
March 28, 1979	Three Mile Island accident begins.[588]

[578] Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), decided June 11, 1923 (FindLaw), https://caselaw.findlaw.com/us-supreme-court/262/679.html, accessed November 12, 2026.

[579] Encyclopaedia Britannica, "Samuel Insull," Britannica Money, https://www.britannica.com/money/Samuel-Insull, accessed November 12, 2026.

[580] International Brotherhood of Electrical Workers, "Grounded in History," The Electrical Worker, December 2021 (labor union publication), https://www.ibew.org/articles/21ElectricalWorker/EW2112/GroundedinHistory.1221.html, accessed November 12, 2026.

[581] Franklin D. Roosevelt, "Executive Order 7037 - Establishing the Rural Electrification Administration," May 11, 1935 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-7037-establishing-the-rural-electrification-administration, accessed November 12, 2026.

[582] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[583] The Living New Deal (University of California, Berkeley project), "Rural Electrification Administration (REA) (1935)," quoting U.S. Department of Agriculture, Rural Lines - USA (1960), https://livingnewdeal.org/glossary/rural-electrification-administration-rea-1935/, accessed November 12, 2026.

[584] Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944), decided January 3, 1944 (Legal Information Institute, Cornell Law School), https://www.law.cornell.edu/supremecourt/text/320/591, accessed November 12, 2026.

[585] Lyndon B. Johnson, "Statement by the President in Response to Federal Power Commission Report on the Northeastern Electric Power Blackout," December 6, 1965 (The American Presidency Project), https://presidency.ucsb.edu/documents/statement-the-president-response-federal-power-commission-report-the-northeastern-electric, accessed November 12, 2026.

[586] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

[587] FERC staff, "Con Edison Power Failure of July 13 and 14, 1977: Final Staff Report," DOE/FERC-0012 (OSTI record), https://www.osti.gov/biblio/6673953, accessed November 12, 2026.

Date	Event
April 24, 1996	FERC issues Order No. 888 on open access to transmission.[589]
2000 to 2001	Western energy crisis.[590]
August 14, 2003	Blackout in the Northeast, Midwest and Ontario affects an estimated 50 million people.[591]
August 8, 2005	Energy Policy Act of 2005 signed, creating mandatory reliability standards and repealing PUHCA.[592]
February 8, 2006	PUHCA repeal takes effect.[593]
May 25, 2006	Enron's former chief executives convicted.[594]
July 20, 2006	FERC certifies NERC as the Electric Reliability Organization.[595]
June 18, 2007	NERC reliability standards become mandatory and enforceable in the United States.[596]
September 8, 2011	Southwest blackout affects 2.7 million customers in Southern California, Arizona and Baja California.[597]

[588] U.S. Nuclear Regulatory Commission (NRC), "Backgrounder on the Three Mile Island Accident," last reviewed September 10, 2026, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html, accessed November 12, 2026.

[589] Federal Energy Regulatory Commission (FERC), "Order No. 888," web page, https://ferc.gov/industries-data/electric/industry-activities/open-access-transmission-tariff-oatt-reform/history-oatt-reform/order-no-888, accessed November 12, 2026.

[590] FERC, "Addressing the 2000-2001 Western Energy Crisis," web page, https://ferc.gov/industries-data/electric/general-information/addressing-2000-2001-western-energy-crisis, accessed November 12, 2026.

[591] U.S.-Canada Power System Outage Task Force, "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 2004, https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinal-Web.pdf, accessed November 12, 2026.

[592] CRS, "Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions," RL33248, January 24, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33248.html, accessed November 12, 2026.

[593] Congressional Research Service (CRS), "The Repeal of the Public Utility Holding Company Act of 1935 (PUHCA 1935) and Its Impact on Electric and Gas Utilities," RL33739, November 20, 2006 (EveryCRSReport.com), https://www.everycrsreport.com/reports/RL33739.html, accessed November 12, 2026.

[594] U.S. Department of Justice, "Federal Jury Convicts Former Enron Chief Executives Ken Lay, Jeff Skilling On Fraud, Conspiracy And Related Charges," press release 06-328, May 25, 2006, https://www.justice.gov/archive/opa/pr/2006/May/06_crm_328.html, accessed November 12, 2026.

[595] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

[596] NERC, "Milestones: NERC Reliability Standards," updated May 19, 2014, https://www.nerc.com/pa/Stand/Resources/Documents/Milestones_NERC_Reliability_Standards.pdf, accessed November 12, 2026.

[597] POWER magazine, "Southern California Blackout Set Off By Inadequate Planning, FERC and NERC Say," May 3, 2012, https://www.powermag.com/southern-california-blackout-set-off-by-inadequate-planning-ferc-and-nerc-say, accessed November 12, 2026.

Date	Event
2013	Rifle attack on the Metcalf substation in California.[598]
November 20, 2014	FERC approves the CIP-014 physical security standard.[599]
September 22, 2016	FERC approves the TPL-007 geomagnetic storm standard (Order No. 830).[600]
January 29, 2019	PG&E files for bankruptcy.[601]
August 14-15, 2020	Rotating outages in California during a heat wave.[602]
February 2021	Winter Storm Uri; ERCOT sheds 20,000 MW of load at the worst point.[603]
December 3, 2022	Gunfire attack on two substations in Moore County, North Carolina.[604]
December 24, 2022	Winter Storm Elliott; largest controlled load shed in Eastern Interconnection history.[605]
2023 and 2024	Vogtle Units 3 and 4 enter commercial operation in Georgia.[606]

[598] CRS, "NERC Standards for Bulk Power Physical Security: Is the Grid More Secure?" R45135, updated March 19, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/files/20180319_R45135_b7ce106085bac1b93519d334665f1e2ecf53a903.html, accessed November 12, 2026.

[599] CRS, "NERC Standards for Bulk Power Physical Security: Is the Grid More Secure?" R45135, updated March 19, 2018 (EveryCRSReport.com), https://www.everycrsreport.com/files/20180319_R45135_b7ce106085bac1b93519d334665f1e2ecf53a903.html, accessed November 12, 2026.

[600] FERC, "Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events," Order No. 830, 156 FERC 61,215, issued September 22, 2016, https://www.ferc.gov/sites/default/files/2020-04/E-4_2.pdf, accessed November 12, 2026.

[601] CPUC, "PG&E Bankruptcy," web page, https://www.cpuc.ca.gov/industries-and-topics/pge/pge-bankruptcy, accessed November 12, 2026.

[602] California Independent System Operator, California Public Utilities Commission and California Energy Commission, "CAISO, CPUC, CEC Issue Final Report on Causes of August 2020 Rotating Outages," press release, January 13, 2021, https://www.caiso.com/Documents/CAISO-CPUC-CEC-Issue-Final-Report-On-Causes-Of-August-2020-Rotating-Outages.pdf, accessed November 12, 2026.

[603] FERC, North American Electric Reliability Corporation (NERC) and Regional Entity Staff, "The February 2021 Cold Weather Outages in Texas and the South Central United States," November 2021, https://nerc.com/pa/rrm/ea/Documents/February_2021_Cold_Weather_Report.pdf, accessed November 12, 2026.

[604] David Boraks (WFAE), "Moore County attack shows U.S. electric grid's 'Achilles' heel'," WUNC, December 5, 2022, https://www.wunc.org/2022-12-05/moore-county-attack-shows-u-s-electric-grids-achilles-heel, accessed November 12, 2026.

[605] FERC staff, "2022 Winter Storm Elliott Inquiry Findings," presentation to the DOE Electricity Advisory Committee, February 13, 2024, https://www.energy.gov/sites/default/files/2024-02/Day%201%20-%20FERC%202022%20Winter%20Storm%20Elliott%20Inquiry%20Findings_untagged.pdf, accessed November 12, 2026.

Date	Event
February 7, 2024	Federal agencies warn of Volt Typhoon hackers pre-positioning in U.S. infrastructure.[607]
May 10, 2024	Strongest geomagnetic storm since 2003.[608]
May 23, 2025	Executive Order 14300 on reform of the Nuclear Regulatory Commission.[609]
December 17, 2025	PJM capacity auction for 2027/2028 falls short of its reliability requirement for the first time.[610]

Appendix B: Glossary

Alternating current (AC). Electric current that reverses direction many times a second. The U.S. grid uses AC.

Balancing authority. The organization responsible for keeping supply and demand matched, second by second, in an area of the grid.

Base load. Power plants that run most of the time at steady output.

Bulk power system. The high-voltage part of the grid: large power plants and transmission lines, not the local lines on your street.

Capacity. The most power a plant can produce at one time, measured in megawatts (MW).

Capacity auction. A market where power plants are paid to promise they will be available in a future year. PJM runs the largest one.

Capacity factor. How much power a plant actually made over a period, compared with what it could have made running flat out the whole time.

Cooperative (co-op). A utility owned by the customers it serves.

Direct current (DC). Electric current that flows one way only.

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[606] EIA, "Plant Vogtle Unit 4 begins commercial operation," Today in Energy, May 1, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61963, accessed November 12, 2026.

[607] Cybersecurity and Infrastructure Security Agency (CISA), National Security Agency, Federal Bureau of Investigation and partners, "PRC State-Sponsored Actors Compromise and Maintain Persistent Access to U.S. Critical Infrastructure," advisory AA24-038A, February 7, 2024, https://www.cisa.gov/news-events/cybersecurity-advisories/aa24-038a, accessed November 12, 2026.

[608] L. A. Wilkerson, R. S. Weigel, D. Thomas and others, "GIC-Related Observations During the May 2024 Geomagnetic Storm in the United States," arXiv preprint 2507.07009, version 2 (2025), https://arxiv.org/html/2507.07009v2, accessed November 12, 2026.

[609] Donald J. Trump, "Executive Order 14300 - Ordering the Reform of the Nuclear Regulatory Commission," May 23, 2025 (The American Presidency Project), https://www.presidency.ucsb.edu/documents/executive-order-14300-ordering-the-reform-the-nuclear-regulatory-commission, accessed November 12, 2026.

[610] PJM Interconnection, "PJM Auction Procures 134,479 MW of Generation Resources," news release, December 17, 2025, https://www.pjm.com/-/media/DotCom/about-pjm/newsroom/2025-releases/20251217-pjm-auction-procures-134479-mw-of-generation-resources.pdf, accessed November 12, 2026.

Distribution. The lower-voltage lines, poles and transformers that bring power to homes and businesses.

ERCOT. The Electric Reliability Council of Texas, which runs most of the Texas grid.

FERC. The Federal Energy Regulatory Commission, which oversees interstate transmission and wholesale power sales.

Firm load shed. Cutting off power to customers on purpose to keep the whole grid from collapsing. Also called rolling or rotating outages.

Gigawatt (GW). 1,000 megawatts.

Interconnection. One of the large, synchronized regions of the North American grid. The lower 48 states have three: Eastern, Western and Texas.

Investor-owned utility (IOU). A utility owned by shareholders, with rates set by a state commission.

ISO or RTO. An Independent System Operator or Regional Transmission Organization, which runs the grid and wholesale market across a region.

Kilowatthour (kWh). The unit on your bill. Using 1,000 watts for one hour.

Levelized cost of electricity (LCOE). The average cost per unit of electricity of building and running a new plant over its life.

Megawatt (MW). 1,000 kilowatts. A measure of power at an instant.

Megawatthour (MWh). 1,000 kilowatthours.

Municipal utility. A utility owned by a city or town.

Net metering. A billing rule that credits rooftop solar owners for power they send to the grid.

NERC. The North American Electric Reliability Corporation, which writes and enforces mandatory reliability standards for the bulk power system.

Peak demand. The highest amount of power used at one time, usually on the hottest or coldest days.

Public utility commission (PUC). The state agency that sets rates for investor-owned utilities. Some states call it a public service commission.

Rate base. The value of a utility's investments on which regulators allow it to earn a return.

Rate case. The legal process in which a utility asks regulators to change its rates.

Reserve margin. How much more power is available than the expected peak need, as a percentage.

Transmission. High-voltage lines that carry power long distances from plants to the areas where it is used.

Wholesale market. Where power is bought and sold before it reaches retail customers.

Appendix C: How to Read Your Electric Bill (Sample)

This is a made-up sample bill to show the parts most U.S. bills have. The numbers are invented for illustration, not taken from any real utility. Your bill will use different names and amounts, and some charges below may not appear on it at all. Information is current as of November 12, 2026.

Sample monthly residential bill (illustration only, not real data)

Line	What it means	Sample amount
Customer charge (or basic service charge)	A fixed monthly fee you pay no matter how much power you use. It covers meters, billing and part of the local wires.	$15.00
Energy use: 900 kWh	How much electricity you used this month, from your meter.	
Generation or supply charge (900 kWh x $0.09)	The cost of the power itself. In some states you can buy this from a different company.	$81.00
Fuel or purchased power adjustment (900 kWh x $0.01)	A charge that moves up or down with fuel costs, like natural gas, passed through with no profit.	$9.00
Transmission charge (900 kWh x $0.015)	Your share of the high-voltage lines.	$13.50
Distribution or delivery charge (900 kWh x $0.04)	Your share of the local poles, wires and transformers.	$36.00
Riders and surcharges	Separate charges approved for specific costs, such as storm recovery, energy efficiency programs or state policy programs.	$6.00
Taxes and fees	State and local taxes and franchise fees.	$8.00
Total		**$168.50**

In this example, the total works out to about 18.7 cents per kWh ($168.50 divided by 900 kWh).

Separate your usage from your rate. A bill can go up for two different reasons, and it helps to keep them apart. If you used more kWh, say in a hot summer month, your bill rises even if the price per kWh did not change. If the price per kWh rose, your bill can go up even in a month when you used less. Before you decide why your bill changed, compare both numbers with the same month last year: the kWh used, and the total bill divided by the kWh. (This is simple arithmetic, not a finding from a source.)

Questions to ask about your own bill:

1. What is my fixed monthly charge, and has it gone up?
2. How much of my bill is supply, and how much is delivery?
3. What riders am I paying, and what is each one for?
4. How does my kWh use compare with the same month last year?
5. Who sets these rates: a state commission, a co-op board or a city?

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