CJP CLIMATE JUDICIARY PROJECT™

ENERGY AND LAW FOR JUDGES

Introduction to the U.S. Energy System

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Acknowledgements

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The Climate Judiciary Project (CJP) began in 2018 in coordination with the Federal Judicial Center and the American Association for the Advancement of Science (AAAS) in response to demand from the judiciary for education about climate science, a topic that is both technical in nature and increasingly referenced in litigation. CJP helps meet this need by providing evidence-based judicial education about climate science, impacts, and solutions and how they are arising in the law.

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Introduction to the U.S. Energy System

by Climate Judiciary Project Team

This module introduces the basics of the energy system in the United States. Part One describes how the energy sources we rely on have changed over time and profiles the U.S. energy system. Part Two focuses on the unique role that electricity and grid governance play in the energy system. Part Three provides examples of the most common types of energy used in the energy system. It canvasses the legal and regulatory landscape that governs our energy sources, highlighting the relevant players, statutes, and processes involved.

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I. U.S. Energy Transitions and Trends

Early energy use in the United States included candlelight and oil lamps, heat from wood fires, and moving goods with sailing ships or animal power. By the latter half of the 19th century, fossil fuels became central to America's energy use, as coal was burned to power the steam engines that were at the heart of the nation's new ships, railroads, and factories (see Figure 1). This energy transition hailed a new era of American industry, known as the Gilded Age, where titans of the steel, railroad, and oil industries controlled the energy market.

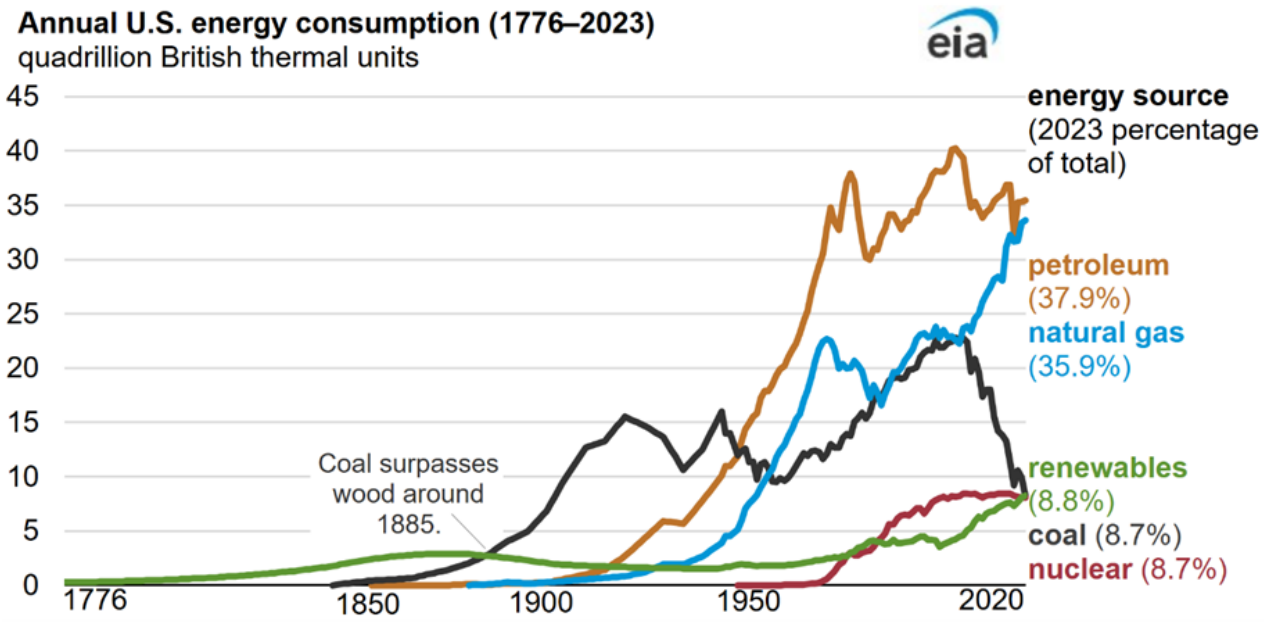

Figure 1. This chart shows the relative contributions of various energy sources over time, the transition from one source to another, and the dramatic growth in the total energy consumed in the past century. British Thermal Units (BTUs) measure heat energy. One quadrillion BTUs is known as a "quad." Source: U.S. EIA, *How Has Energy Use Changed Since 1776?* (July 2, 2025), https://www.eia.gov/todayinenergy/detail.php?id=65644.

American energy use underwent another transition as the 20th century began, with a shift to both petroleum and electricity. Petroleum became a central part of the nation's energy mix due to improvements in oil production and refinement and the invention of the internal combustion engine. Electricity became more widespread throughout the first half of the 20th century, in part because of large hydroelectric dams. Additionally, pipelines, utility poles, and other infrastructure allowed both natural gas and electricity to be readily moved (when it previously was more often used only locally). This era also saw an increase in regulatory action, with the federal and state governments taking a more proactive role.

There is yet another energy transition happening in the 21st century. Beginning around 2010, natural gas displaced coal as the leading source of electricity generation in the United States. This was the result of increased extraction and decreased prices brought about by improvements in drilling technologies, such as horizontal drilling and hydraulic fracturing (fracking).
The United States now produces the most natural gas of any country,[1] both for a large domestic market and as the world's largest exporter.[2] Though driven largely by market economics and technological advances in extraction methods, the shift from coal to natural gas led to a significant decrease in annual greenhouse gas (GHG) emissions, since burning natural gas releases only about half the carbon dioxide (CO_2, the main GHG responsible for climate change) as generating that same amount of energy from coal.[3] This has also meant that coal mines, coal-fired power plants, and coal-related jobs have been on the decline since the late 2000s.[4]

Renewables are also on the rise this century. In 2020, renewable sources (wind, solar, hydroelectric, and biofuels combined) produced more electricity in the United States than coal, and they have continued to do so since 2022.[5] In May 2026, solar alone surpassed coal for the first time.[6]
The decline in the production cost of wind and solar, which have now reached parity with fossil fuels, reflects a combination of factors: advances in solar photovoltaic and wind turbine technology, large-scale global manufacturing buildout that drove down per-unit production costs, falling battery prices, and policy support such as the 2022 Inflation Reduction Act's incentives for domestic clean energy manufacturing.[7]

Despite the growth of renewables, fossil fuels remain the largest energy sources in the United States, driven in part by the petroleum used in nearly all forms of transportation today.

Notably, the mix of generation sources varies significantly from one region of the country to another. For example, hydroelectric power (Pacific Northwest), wind (Great Plains), and solar (Southwest) are each concentrated in a few areas.

<u>How We Use Energy</u>
We use energy to light our homes, move our vehicles, charge our devices, and much more. Figure 2 provides a one-year (2024) snapshot of energy use for the United States. The colored boxes on the

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[1] U.S. Energy Info. Admin., *Three U.S. Regions Each Produce More Natural Gas Than Most Countries* (Nov. 7, 2025), https://www.eia.gov/todayinenergy/detail.php?id=66584.
[2] U.S. Energy Info. Admin., *The United States Remained the World's Largest Liquified Natural Gas Exporter in 2024* (Mar. 27, 2025), https://www.eia.gov/todayinenergy/detail.php?id=64844.
[3] U.S. Energy Info. Admin., *Carbon Dioxide Emissions Coefficients* (Sept. 18, 2024), https://www.eia.gov/environment/emissions/co2_vol_mass.php.
[4] Lexie Ryan, CONG. RSCH. SERV., R48587, U.S. COAL INDUSTRY TRENDS (Nov. 14, 2025), https://www.congress.gov/crs-product/R48587.
[5] U.S. Energy Info Admin., *Electricity Explained*, https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php (last visited Sept. 8, 2026). In 2021, coal generated 815 billion kilowatt hours (kWh) and renewables generated 815 billion kWh. *Id.*
[6] Ember, *Solar Overtakes Coal in U.S. Electricity for the First Month on Record* (June 10, 2026), https://ember-energy.org/latest-updates/solar-overtakes-coal-in-us-electricity-for-the-first-month-on-record/.
[7] U.S. Energy Info. Admin., *EIA Explores Effects of Inflation Reduction Act on the Annual Energy Outlook* (Apr. 6, 2023), https://www.eia.gov/todayinenergy/detail.php?id=56080.

left (from solar in yellow to petroleum in dark green) show the sources of energy with connections to where that energy went. Over one-third of total energy, from a variety of sources, went to generating electricity (orange).

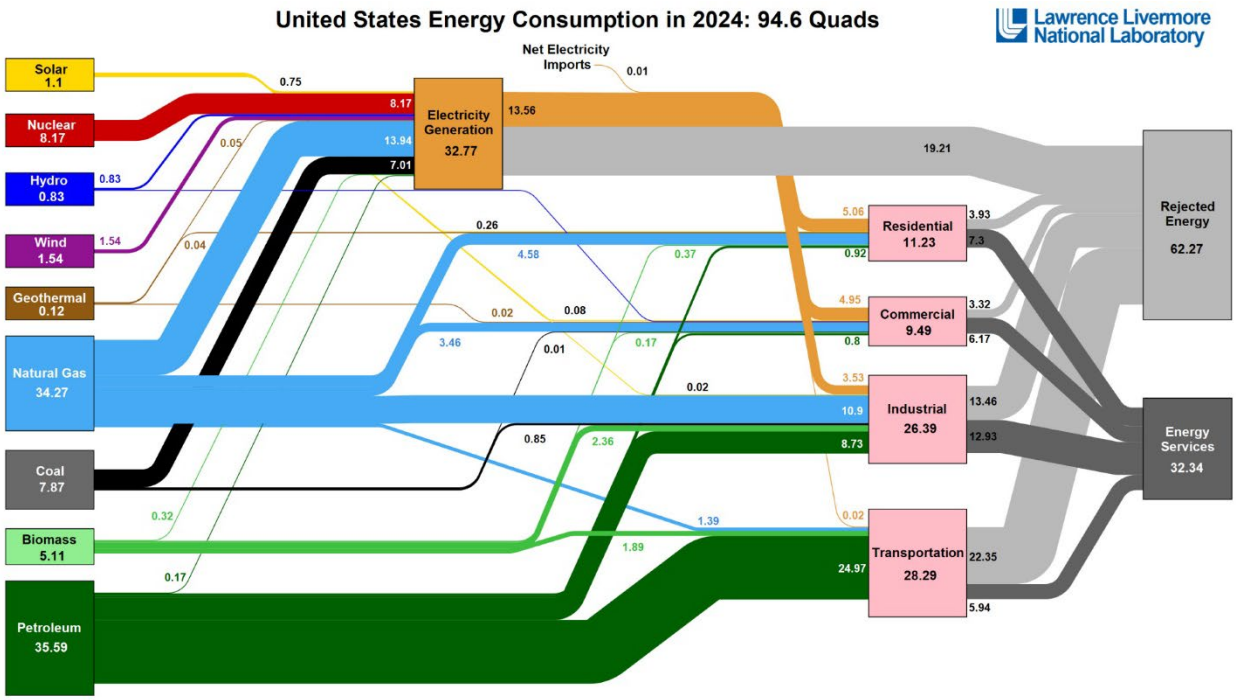

Figure 2. This chart shows the total energy generation and consumption of the United States in 2024. Source: Lawrence Livermore Nat'l Lab., Estimated U.S. Energy Consumption in 2024 (2026), https://flowcharts.llnl.gov/sites/flowcharts/files/2026-08/energy-2024-united-states.pdf.

The U.S. Department of Energy (DOE) breaks energy use into four categories, represented by the pink boxes. Residential uses include indoor lighting and heating in homes and apartments. Commercial uses include offices, stores, or other places of commerce, as well as government buildings. Industrial uses include any production or processing of raw materials, and therefore encompass vehicle manufacturing, mining operations, and all agricultural uses. Finally, transportation is any energy used to move people or products, including all gasoline and diesel (which are made from petroleum) as well as a small but growing portion of electricity for electric vehicles. Notably, electricity is cross-cutting and included in all of these categories.

Each color traces a source's energy consumption pathway. Coal (black), for example, is primarily burned in power plants to be turned into electricity or used directly in industrial processes like making steel. Natural gas (light blue) similarly is used by power plants to create electricity, but it is also used directly for industrial processes and in homes and businesses for heat and cooking. Most petroleum becomes transportation fuels.

Of this total energy consumption, only about one-third (32.34 quads) was actually used to provide energy (dark gray "energy services" box), while a bit less than two-thirds (62.27 quads) was "rejected energy" (light gray box), or lost to inefficiencies.

Figures 1 and 2 provide several key takeaways:

- The transportation sector is very dependent on petroleum. It is also relatively inefficient, with the largest proportion of its overall energy input going to waste.
- Natural gas is widely used, largely for electricity generation but still with significant amounts going directly to industry and residential and commercial uses.
- Natural gas has been increasing and coal decreasing since 2010, almost all of which has occurred in the electricity sector.
- Clean energy sources like solar, wind, and hydroelectric are all methods of creating electricity directly; of these renewable energy sources, only biomass has a significant role outside of the electricity sector.

II. Electricity and the Grid

While Part III of this module will review the primary sources of energy (e.g., fossil fuels, wind, and solar) and how they are regulated, Part II explains electricity, which is not itself an energy source but a common way we move energy from these sources (see Figure 3).

A. Electricity Explained

Commencing about 1900, electricity replaced oil and gas lamps in homes and offices, allowed new means of communication like the radio and telephone, and more recently, computing and the Internet. It has revolutionized how energy is distributed around the nation, since any of the sources in Figure 2, such as coal or a solar panel, can be (and are) used to generate electricity.

It's also a highly efficient system; very little energy (less than 5%) is lost in transmission even over thousands of miles. The caveat, however, is that electricity must be used immediately and cannot be easily stored, although improvements in battery storage mean that batteries are becoming an increasingly important part of electricity systems. Without such "buffers," the system is vulnerable to disruptions, as failure to simultaneously match electricity demand to supply can destroy expensive equipment and lead to widespread power outages.

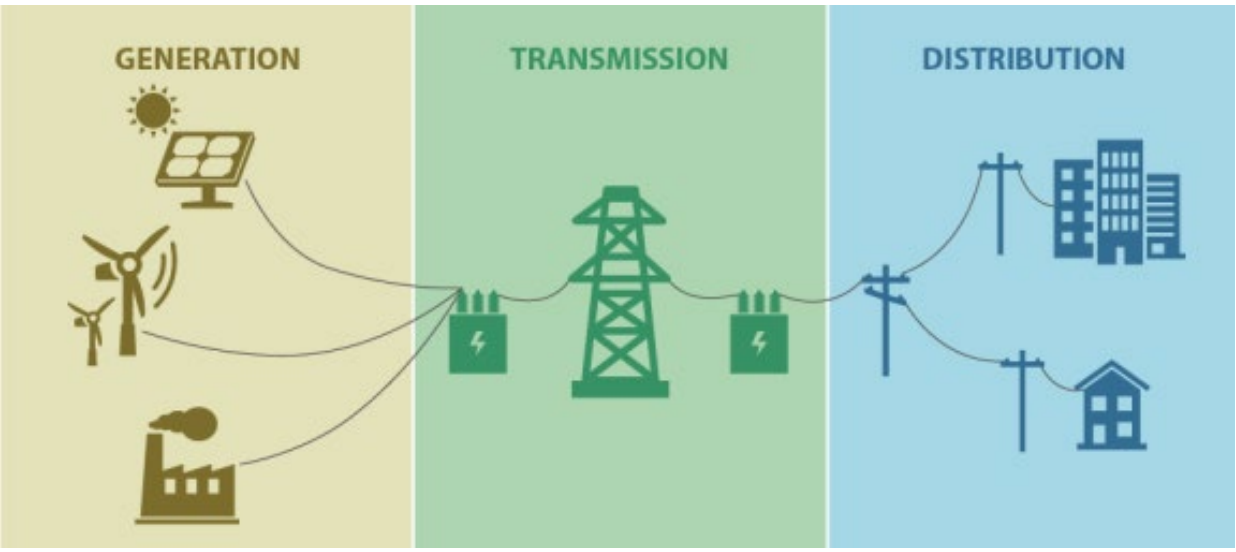

Figure 3. This diagram illustrates how power gets to your home. Electricity from multiple generation sources passes through transformers to transmission lines, where electricity is carried long distances to local substations and neighborhood transformers that help distribute it. Source: Ashley J. Lawson, CONG. RSCH. SERV., R45764, MAINTAINING ELECTRIC RELIABILITY WITH WIND AND SOLAR SOURCES: BACKGROUND AND ISSUES FOR CONGRESS (2022), https://www.congress.gov/crs-product/R45764.

The most commonly used unit of electrical energy is a kilowatt hour (kWh),[8] which most Americans will recognize from their power bills. This unit represents one thousand watts of power used over one hour, or 500 watts for 2 hours, or 2,000 watts for 30 minutes, and so on. In other words, the energy consumed (1,000 watts) in each of these kWh scenarios remains, but the power (or rate the electrical energy is delivered) varies.

Compare a night light that uses about 1 watt and a streetlamp that uses 1,000 watts (1 kilowatt, kW). If both run on a power source (like a battery) that provides 1 kW-hour of energy, the streetlamp will drain the battery in 1 hour, but the nightlight could stay on for 1,000 hours before discharging the battery.

It can be more helpful sometimes to describe the generation *capacity* of a facility rather than how much total energy it produces over a given time, especially because operating times vary. A nuclear plant, for example, might have a generation capacity of 1 gigawatt (GW, or a billion watts), meaning it is continuously generating 1 GW of energy when operating. By contrast, a large wind turbine might have a 1 megawatt (MW, a million watts) capacity (see Figure 4). That means that if both run continuously for one hour, the nuclear plant would produce 1 gigawatt-hour (GWh) of energy and the wind turbine 1 megawatt-hour (MWh). Since a refrigerator (for example) draws about 800 watts continuously while

[8] The watt receives its name from James Watt, a Scottish engineer and inventor whose work revolutionized steam engines in the late 18th century. One watt-hour of electrical energy is equal to 3.412 BTUs.

operating, the nuclear plant could power 1.25 million refrigerators and the wind turbine could power only 1,250.

Common electric energy systems and their size 1 kW = 1,000 Watts; 1 MW = 1,000,000 Watts; 1 GW = 1,000,000,000 Watts	
Production:	
3 x 5-foot solar panel	300 to 400 W
Diesel generator	5 to 25 kW
Large wind turbine	1 to 3 MW
Natural gas or coal power generator	50 to 700 MW
Large hydroelectric dam	1 to 2 GW
Nuclear power plant	1 to 2 GW
Consumption:	
Night light	1 W
Streetlamp	500 to 1,000 W
Refrigerator	800 W
Electric oven	2 to 5 kW
Average home electricity demand in the United States	1.33 kW (highly variable)
Aluminum smelter	200 to 500 MW

Figure 4. Sizes of various energy generators and energy consumers. These power ranges are for an average or typical system. Total household or statewide consumption can vary by a factor of two or more depending on the time of year, weather, and other factors.

Figure 5 shows the size and scale of the U.S. electricity sector across resources and technologies, comparing the number of large-scale power plants (facilities), how many total generators are at these plants, and how much capacity they produce collectively.

Type	Number of facilities	Number of generators	Total national capacity (GW)
Natural gas	2,078	6,693	571.23
Coal	219	462	188.95
Wind	1,563	75,417	153.49
Solar photovoltaic	7,141	N/A	122.91
Nuclear	56	96	103.58
Hydroelectric	1,433	3,978	79.98
Petroleum	1,065	3,884	33.32
Battery storage	777	N/A	27.26

Figure 5. Chart of U.S. Electric Power Plants. Sources: U.S. EIA, Electric Power Annual Report Tables 4.1 and 4.3 (Oct. 16, 2025), https://www.eia.gov/electricity/annual/; U.S. EIA, Form EIA-860 (Sept. 10, 2026), https://www.eia.gov/electricity/data/eia860/; U.S. Geological Survey, U.S. Wind Turbine Database, https://energy.usgs.gov/uswtdb/viewer/#3.15/37.25/-96.25 (June 2026).

B. Governing the Grid

Electricity from all sources moves along "the grid"—a series of generator plants, wires, converters, and transformers that make up the most widespread and ubiquitous energy distribution system in the country.

Grid governance involves federal, regional, state, and private actors, including the Federal Energy Regulatory Commission (FERC), regional transmission organizations (RTOs) or independent system operators (ISOs), state public utility commissions (PUCs), and utility companies. Each plays a distinct role in building and maintaining the infrastructure of the grid and pricing the commodity—electricity—that travels through it.

Jurisdiction	Entity	Role
Federal	FERC (Federal Energy Regulatory Commission)	Federal agency regulating interstate electricity transmission and wholesale power markets
Regional	RTOs (Regional Transmission Organizations) and ISOs (Independent System Operators)	Independent entities that operate high-voltage transmission lines and run competitive wholesale electricity markets across states or regions
State	PUCs (Public Utility Commissions)	State agencies that regulate retail electricity rates, local distribution infrastructure, and consumer service rules
Local	Investor-owned, public, or cooperative utilities	Power companies that own local distribution wires, maintain infrastructure, and sell electricity directly to end-use customers

The Federal Component: FERC

FERC, led by an independent five-member commission and located within DOE,[9] plays a central role in the nation's energy system by setting rates for wholesale electricity and interstate transmission (over power lines) and ensuring reliability across the system. (FERC also plays a role outside the electricity sector, in regulating the natural gas, oil, and hydropower industries.) FERC commissioners are appointed by the president, confirmed by the U.S. Senate, and serve five-year terms.[10]

For electricity, FERC must ensure rates and regulations are "just and reasonable" and not unduly discriminatory or preferential.[11] Prior to the 1990s, FERC used cost-of-service price-setting to calculate wholesale rates, determined through federal rate hearings. Now, rates depend on whether FERC is setting them pursuant to the Natural Gas Act (for natural gas transportation and storage), the Federal Power Act (for electricity), or the Interstate Commerce Act (for oil pipelines).

In practice, FERC regulates through orders, which can range from narrow (e.g., approving a specific tariff or rate change) to broad and sweeping (e.g., requiring all transmission owners to provide nondiscriminatory access to its wires). FERC does not regulate the retail sales of electricity to homes and businesses; that is done through state PUCs and publicly owned utility governing boards (see below).

The Regional Component: RTOs/ISOs and Utilities

For roughly two-thirds of the country's electric power supply, regional entities established and regulated by FERC are responsible for managing the wholesale electricity market (subject to FERC's

[9] FERC was preceded by the Federal Power Commission, whose role since 1920 was to grant hydroelectric dam licenses. *See* 42 U.S.C. §7172(a). FERC's governing statute requires that no more than three out of the five commissioners can come from the same political party. 42 U.S.C. §7171(b).

[10] 42 U.S.C. §7171(b).

[11] 16 U.S.C. §824d. *See also* Fed. Energy Regul. Comm'n, *An Introductory Guide to Electricity Markets Regulated by the Federal Energy Regulatory Commission* (Apr. 3, 2025), https://www.ferc.gov/introductory-guide-electricity-markets-regulated-federal-energy-regulatory-commission.

"just and reasonable" rates standard). These entities, known as RTOs or ISOs,[12] are responsible for coordinating transmission throughout their service areas, constantly balancing the grid by ensuring that the amount of electricity consumed is equal to the amount generated (see Figure 6). Functionally, RTOs and ISOs are the same; the major difference between the two is size, with RTOs managing bigger service areas and controlling a greater share of the grid than ISOs.

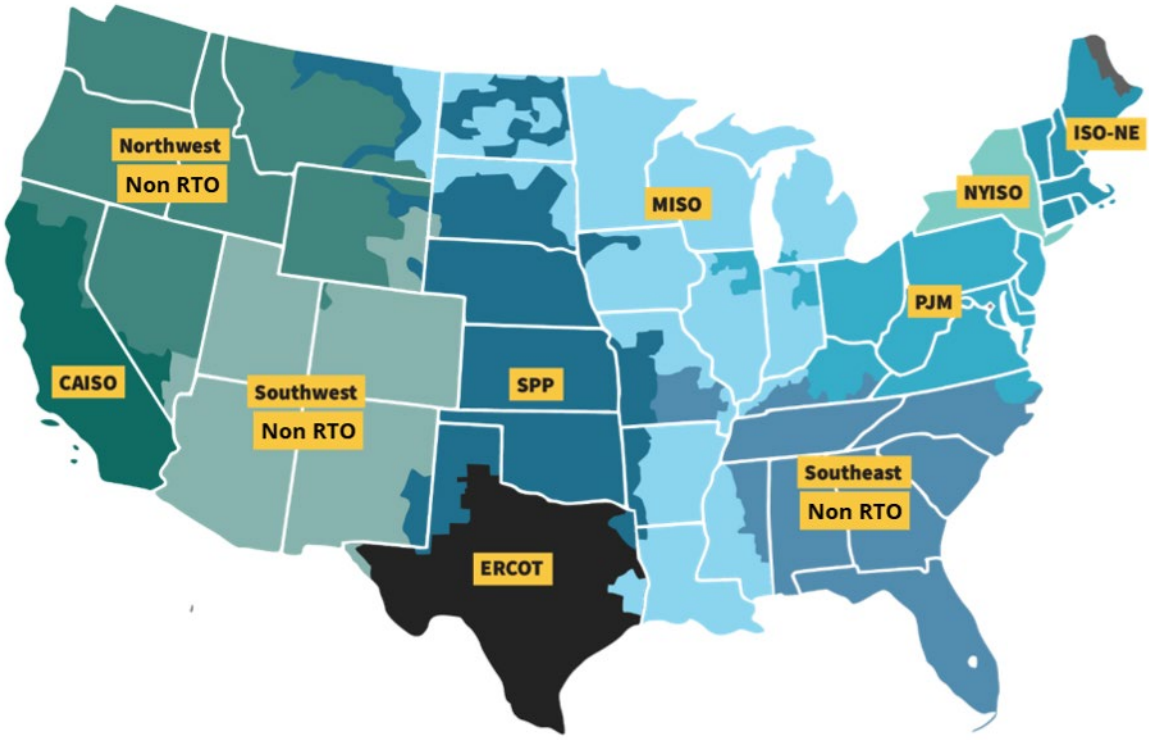

Figure 6. Map of U.S. Power Markets, including RTOs and ISOs. Non-RTO/ISO areas are also labeled. Adapted from FERC, *RTOs and ISOs* (last updated Jan. 17, 2024), https://www.ferc.gov/power-sales-and-markets/rtos-and-isos.

RTO/ISOs tend to be multi-state, though some, like CAISO in California or NYISO in New York, can operate in a single state. Texas is unique and maintains an isolated grid, with its ISO managed by the Electric Reliability Council of Texas, ERCOT, and regulated by the Texas PUC rather than by FERC. Each RTO/ISO has its own set of rules governing operations, which differ in how they approach renewable energy, decarbonization, and other climate issues.

For non-RTO/ISO areas, primarily in the Southeast, Southwest, and Northwest, most utility companies are vertically integrated, which means that they are responsible for all aspects of service,

[12] ISOs were established by FERC Order 888 in 1996 to ensure fair access to transmission lines and promote competition in energy markets. RTOs were established by FERC Order 2000 in 1999 to promote regional coordination and efficiency. *See* Jim Rossi & Hannah Wiseman, *Electricity Regulation, Markets, and Governance*, *in* GLOBAL CLIMATE CHANGE AND U.S. LAW 3D ED. (Michael B. Gerrard et al., eds. 2023).

from generation to transmission and distribution and serve as the "balancing authorities" to ensure electricity supply matches demand.

These entities (i.e., the RTO/ISO or utility, depending on location) must also approve all requests to connect to the grid. New sources, like a wind farm or natural gas plant, do not connect automatically—instead, they must wait in an interconnection queue before the operator can bring the new source online (see Box 1).[13] The interconnection queue is increasingly viewed as a significant bottleneck in energy infrastructure development, with queue wait times increasing from less than two years to more than four years over the last two decades.[14]

Box 1. The Interconnection Queue

Before joining the grid, proposed new power sources must first be put on a waiting list known as an "interconnection queue." Projects sit in the queue until system operators prepare a series of interconnection studies that detail the necessary system upgrades and costs required for the proposed project to connect to the grid. At the end of 2025, approximately 8,200 projects were seeking interconnection, with solar, and battery storage projects accounting for up 85% of the projects, with the remaining 15% mostly natural gas projects.[15] Timelines vary but interconnection studies can take more than five years, and delays can be exacerbated when projects leave the queue because operators must then re-calculate the effect of those pulled projects. Reforms to streamline the process have been adopted by some grid operators to lower the costs and shorten wait times.[16]

The State Component: PUCs

Local aspects of electricity—retail sales between utility companies and customers, and the distribution network of poles and wires that bring that electricity to your home or business—are governed at the state level by a PUC, sometimes called a Public Service Commission.[17] Because electric utilities are natural monopolies, state legislatures began establishing PUCs in the early 1900s as a way to control

[13] *See* Nat'l Conf. of State Legislatures, *Electric Transmission Interconnection Queues* (Jan. 7, 2025), https://www.ncsl.org/energy/electric-transmission-interconnection-queues.

[14] *See* LAWRENCE BERKELEY NAT'L LAB., QUEUED UP: 2026 EDITION 4 (2026) (noting that "[t]he median project built in 2025 took 61 months from the interconnection request to commercial operations, compared to 36 months in 2015 and 22 months in 2008"); *see also* Berkeley Lab, *Grid Connection Backlog Grows by 30% in 2023, Dominated by Requests for Solar, Wind, and Energy Storage* (Apr. 10, 2024), https://emp.lbl.gov/news/grid-connection-backlog-grows-30-2023-dominated-requests-solar-wind-and-energy-storage; *see also* Berkley Lab, *Generation, Storage, and Hybrid Capacity in Interconnection Queues*, https://emp.lbl.gov/generation-storage-and-hybrid-capacity (last visited Sept. 24, 2026).

[15] *Id.*

[16] *See* U.S. Dep't of Energy, *Tackling High Costs and Long Delays for Clean Energy Interconnection* (May 11, 2023), https://www.energy.gov/eere/i2x/articles/tackling-high-costs-and-long-delays-clean-energy-interconnection.

[17] For purposes of simplicity, this module uses PUC to refer to these entities.

the prices that utilities charge customers. PUC commissioners in most states are governor-appointed, while 11 states hold elections for their commissioners.[18]

When making decisions about electricity prices and the grid, PUCs have a role analogous to FERC's, ensuring that utilities provide reliable service at just and reasonable rates and consider energy demand and possible efficiency measures. This often means scrutinizing utility companies' rate adjustments and planned expenditures. As a result, PUC decisions can significantly affect whether, how, and at what pace utilities build and shift the energy mix and/or install infrastructure.

PUC authority differs depending on the state and the structure of the utilities, in at least two ways. First, PUCs deal primarily with, and exert greatest oversight over, investor-owned utilities (IOUs). Most U.S. electricity customers, around 110 million, are served by IOUs. In contrast, utilities with different ownership structures, including member-owned co-ops (20 million customers), and publicly owned utilities (24 million),[19] may be exempt or be subject to limited PUC regulation, on the theory that they are less susceptible to overreach because they are managed by a public body or the users themselves.

Second, where the utilities are vertically integrated, PUCs generally exercise the greatest influence over the grid because they regulate the utilities at every step. This means requiring utilities to provide service to all customers, setting retail rates (e.g., cost-of-service or time-of-day rates) for electricity consumption, approving rate adjustments, ensuring reliability of electric facilities, and approving the siting and construction of facilities and intrastate transmission lines (although sometimes other regulators have approval authority). In states that have restructured the vertically integrated model by breaking up utility monopolies, PUCs regulate only local distribution, while another entity (RTO or ISO) operates markets and oversees transmission planning.

All of these differences create jurisdictional complexity and make it important to determine which regulatory structure is in place for any given state.

III. Energy Sources: Legal Issues

With the exception of nuclear power and a few underground sources like geothermal, the sun is the source of all our energy.[20] Figure 2 above maps out these various sources and what they are used for, and Figure 7 breaks down the percentage contributed by each. The ability of various sources to provide and distribute energy services reliably, affordably, and equitably depends on a constellation of legal, social, technical, and economic considerations.

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[18] Nat'l Conf. of State Legislatures, *Engagement Between Public Utility Commissions and State Legislatures* (Oct. 28, 2019), https://www.ncsl.org/energy/engagement-between-public-utility-commissions-and-state-legislatures.

[19] U.S. Energy Info. Admin, *Investor-Owned Utilities Served 72% of U.S. Electricity Customers in 2017* (Aug. 15, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40913.

[20] Since the sun is driven by nuclear (fusion) reactions, all our energy ultimately traces back to nuclear power.

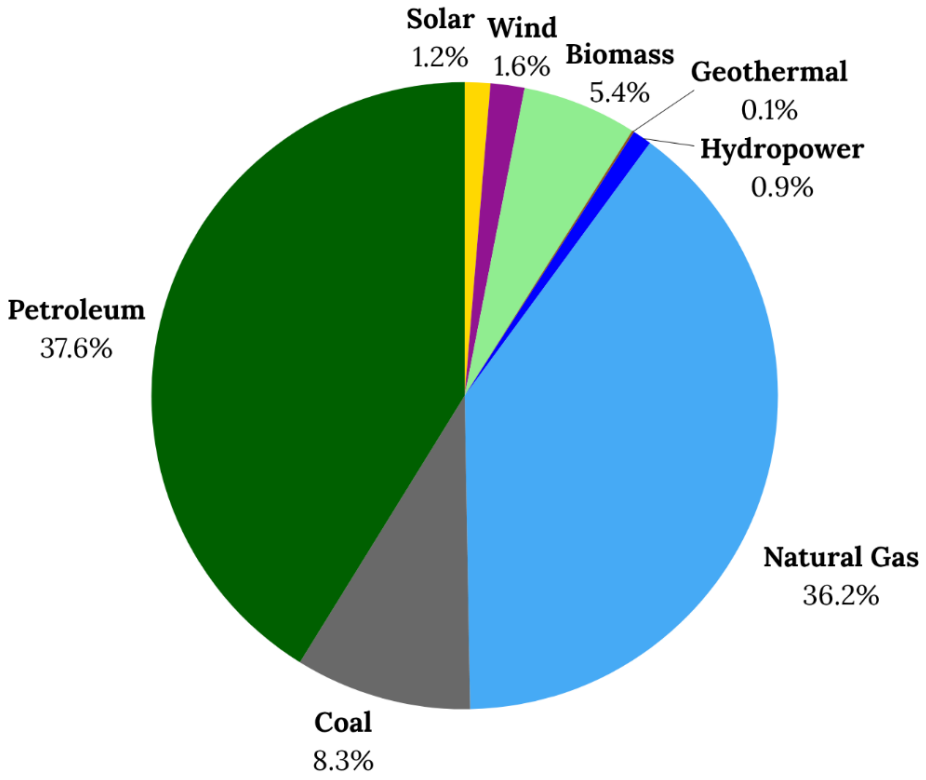

Figure 7. Chart showing relative contributions of various energy sources in the United States in 2024. Adapted from Lawrence Livermore Nat'l Lab., Estimated U.S. Energy Consumption in 2024 (2026), https://flowcharts.llnl.gov/sites/flowcharts/files/2026-08/energy-2024-united-states.pdf.

Both the variety of our energy sources and the historical changes to how we make, move, and use energy have resulted in a fragmented and overlapping patchwork of federal, state, and local laws. The governing regimes are often complex and can depend on a variety of factors, including the energy source involved, where and how it is produced, how it is transported, the end-use, and how it affects the environment.[21] Federal and state energy policies are also increasingly dynamic and hotly contested.[22]

In some instances, the same types of laws will apply to many different energy projects regardless of source. For example, public input, interagency consultation, and multiple studies and reports are common requirements for all projects. Some laws, however, are technology-specific or location- or impact-dependent. The suite of agencies that may be involved in a single decision or project can be

[21] *See generally* MICHAEL B. GERRARD ET AL. EDS., GLOBAL CLIMATE CHANGE AND US LAW (Am. Bar Assoc. 2023).
[22] *See* SHAWN ENTERLINE & ANDREW VALAINIS, REG. ASSISTANCE PROJ., LAWS IN ORDER: AN INVENTORY OF STATE RENEWABLE ENERGY SITING POLICIES (2024), https://eta-publications.lbl.gov/sites/default/files/rap-enterline-valainis-laws-order-inventory-state-renewable-energy-siting-policies-2024-june.pdf.

substantial, but not always consistent from project to project. Decisionmaking may rest with federal entities, state PUCs, one or more state executive agencies, and/or county commissions and municipal zoning authorities.

For more detail on the energy project lifecycle, from financing and siting to operations and decommissioning, across different technologies and resources, see Making Energy: Legal Processes and Frameworks for Energy Projects.

A. Fossil Energy

Fossil fuels get their name from their ancient lineage—they are derived from plant or animal matter buried millions of years ago. Over time, these materials were subjected to intense heat and pressure underground that transformed them into energy-dense fuels like coal, oil, and natural gas.[23] They are extracted in their raw form by mining or drilling, usually require subsequent refining, and mostly are burned to release their stored energy.

Fossil fuel combustion also releases GHGs such as CO_2, which trap heat in the atmosphere, raising global temperatures and causing climate change (see [What is Causing Climate Change?]).[24] Carbon capture and storage (CCS) technologies may eventually provide one method for capturing those emissions and sequestering them in long-term storage underground, although their effectiveness depends on capture rates and preventing leakage.[25]

As fossil fuels became central to America's energy use in the latter half of the 19th century, federal energy regulation began with antitrust laws to limit the monopoly power of oil and other industry interests.[26] While the federal government focused on punishing abuses of power by that age's "robber barons," it left regulation of production (e.g., of coal mines and oil wells) to the states.[27] When petroleum, natural gas, and electricity gained traction and increasingly crossed state lines, the U.S. Congress began to get involved and asserted greater federal authority over the energy system, including by enacting the Mineral Leasing Act (1920), Public Utility Act (1935), and Natural Gas Act (1938). Energy conservation laws enacted in the 1970s added another dimension of governance.

Today, the regulatory structures governing extraction, production, transportation, and sale of fossil fuels can vary greatly depending on the type of fuel, location and size of the project, and anticipated impacts, among other factors. For example, drilling for oil and gas or mining coal on federal land,

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[23] Natural gas is usually over 90% methane but also contains some other gases like propane and butane.
[24] *See* IPCC, CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS 244 (2021) (finding that "[t]he main human causes of climate change are the heat-absorbing greenhouse gases released by fossil fuel combustion, deforestation, and agriculture, which warm the planet, and aerosols such as sulphate from burning coal, which have a short-term cooling effect that partially counteracts human-caused warming.").
[25] *See* Andrew Moseman & Howard Herzog, *How Efficient Is Carbon Capture and Storage?*, ASK MIT CLIMATE (Feb. 23, 2021), https://climate.mit.edu/ask-mit/how-efficient-carbon-capture-and-storage.
[26] DAVID B. SPENCE, CLIMATE OF CONTEMPT: HOW TO RESCUE THE U.S. ENERGY TRANSITION FROM VOTER PARTISANSHIP 43 (2024).
[27] *Id.* at 47.

constructing an interstate natural gas pipeline, and operating a fossil-fuel power plant all implicate different laws and agencies.

This is a fast-moving area of law and numerous issues related to fossil fuels remain in flux, including major federal regulations as well as state and local policies that seek to restrict or enhance fossil fuel extraction or otherwise affect energy companies and the public. National Environmental Policy Act (NEPA) lawsuits are also common, and have included discussions about the scope of agency requirements to consider the climate impacts of a proposed action.[28]

Land Acquisition

Before a developer can extract coal, oil, or natural gas, it must acquire or lease the property, or at least the rights to the subsurface.[29]

Most extraction happens on private land, meaning extraction-related land disputes are likely to feature property and contract law issues. However, roughly 40% of coal, 25% of oil, and slightly more than 10% of natural gas production happens on federal land.[30] Decisions to withdraw or open certain federal lands from exploration have led to legal challenges.[31]

The federal land leases to extract coal, oil, and natural gas are administered by the U.S. Department of the Interior's (DOI's) Bureau of Land Management (BLM) and are awarded to the highest bidder at auction. Leaseholders then pay rent and royalties to the federal government at rates set by statute.[32] State agencies follow similar procedures when issuing leases to extract on state public land.[33]

Leases for oil and gas drilling in offshore federal waters are similar, but are administered by another agency within DOI, the Marine Minerals Administration (MMA).[34] These leases are for use of the seafloor, not the entire water column, meaning that any energy project within a leased area must not

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[28] *See, e.g.,* Seven Cnty. Infrastructure Coalition v. Eagle County, 605 U.S. 168 (2025); *cf.* WildEarth Guardians v. Zinke, 368 F. Supp. 3d 41 (D.D.C. 2019).

[29] Split estates—where the landowner owns the surface land while another party (such as the state or a private company) owns the subsurface oil and mineral rights—may complicate leasing. *See, e.g.,* Joe Schremmer, *Conflicts and Confluences Between Surface and Mineral Estates With CCUS*, 24 WYO. L. REV. 295 (2024) (examining the issue in the context of carbon capture and storage).

[30] Lexie Ryan, CONG. RSCH. SERV., IG10076, U.S. COAL PRODUCTION & FEDERAL LANDS (Mar. 4, 2024), https://www.congress.gov/crs-product/IG10076 (providing 2024 numbers for coal); *How Much Oil and Gas Comes From Federal Territory?*, USAFACTS (Apr. 6, 2023), https://usafacts.org/articles/how-much-oil-and-gas-comes-from-federal-territory/ (providing 2021 numbers for oil and natural gas). No coal, oil, or gas leases are allowed in national parks, designated wilderness areas, and national forest systems.

[31] *See, e.g.,* Louisiana v. Biden, No. 2:25-cv-0071 (W.D. La.). *See also Federal Offshore Oil and Gas Leasing Program*, HARV. ENV'T & ENERGY L. PROG. (last updated Apr. 3, 2026), https://eelp.law.harvard.edu/tracker/offshore-oil-and-gas-drilling-leasing-program/.

[32] *See* Adam Vann, CONG. RSCH. SERV., R48130, ENERGY PRODUCTION ON FEDERAL LANDS: LEASING AND AUTHORIZATION (July 19, 2024), https://www.congress.gov/crs-product/R48130; Lexie Ryan, CONG. RSCH. SERV., R46537, REVENUES AND DISBURSEMENTS FROM OIL AND NATURAL GAS LEASES ON ONSHORE FEDERAL LANDS (Feb. 12, 2026), https://www.congress.gov/crs-product/R46537.

[33] *See, e.g.,* N.Y. Dep't of Env't Conservation, *State Land Oil and Gas Leasing* (last visited Apr. 17, 2026), https://dec.ny.gov/environmental-protection/oil-gas/state-land-oil-gas-leasing.

[34] In July 2026, DOI consolidated the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement into the MMA. Before this, BOEM was responsible for leasing activities.

interfere with other uses, such as navigation, fishing, or military operations.[35] Leasing and drilling in state waters (within three miles of the shore) is administered by state agencies.[36]

Coal Extraction

Historically, coal was mined underground, where miners would descend into deep shafts to access mineral seams. While that method endures, today the majority (63%) of U.S. coal comes from surface mines (sometimes called strip mines), where land is scraped or blasted away to reveal coal deposits underneath. Three-quarters of all U.S. coal production occurs in five states—Wyoming, West Virginia, Pennsylvania, Illinois, and Montana.[37]

Broadly, surface mines are governed by the federal Surface Mining Control and Reclamation Act, which is implemented and enforced by the Office of Surface Mining Reclamation and Enforcement, establishes standards for environmental protection, and institutes a bond requirement for post-mining cleanup. Surface mines can also impact nearby waterways and require Clean Water Act (CWA) permits.

Oil and Gas Extraction

Oil comes mostly from land-based wells located in Texas (42% in 2025) and New Mexico (16.5%). Oil drilling also happens offshore, primarily off the Gulf Coast. Natural gas extraction in Texas, Pennsylvania, and Louisiana accounts for more than 60% of the nation's gas production, with a very small portion (~2%) coming from offshore sources.[38]

For oil and gas wells on federal lands, BLM must ensure that drilling activities are consistent with multiple-use and sustained-yield principles embedded in the Federal Land Policy and Management Act (FLPMA); and any drilling-related approvals must also comply with federal environmental review, wildlife, historical preservation, and water protection laws.

For drilling on state lands, state legal frameworks vary significantly, including with respect to both agency authority and substantive requirements related to setbacks, financial assurances, baseline water testing, and local government control.[39] Notably, fracking is exempt from most federal permitting requirements, though some states and municipalities regulate fracking through bans, moratoria, or other restrictions to reduce drilling.[40] Litigation about extraction has raised questions about the

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[35] *See* Bureau of Ocean Energy Mgmt., *Q&A: National OCS Oil and Gas Leasing Program for 2023-2028* (revised Aug. 2022), https://www.boem.gov/sites/default/files/documents/oil-gas-energy/national-program/National%20OCS%20FAQs.pdf.

[36] *See* Adam Vann, CONG. RSCH. SERV., RL33404, OFFSHORE OIL AND GAS DEVELOPMENT: LEGAL FRAMEWORK (Apr. 13, 2026), https://www.congress.gov/crs-product/RL33404.

[37] *Coal Explained,* U.S. ENERGY INFO. ADMIN. (last updated Dec. 22, 2023), https://www.eia.gov/energyexplained/coal/where-our-coal-comes-from.php. Wyoming alone produces 41 percent. *Id.*

[38] U.S. EIA, *FAQs: Which States Consume and Produce the Most Natural Gas?* (Oct. 30, 2024), https://www.eia.gov/tools/faqs/faq.php?id=46&t=8.

[39] *See* NRDC, HOW STATES STACK UP ON OIL AND GAS REGULATION (Feb. 2026), https://www.nrdc.org/sites/default/files/2026-02/Oil_and_Gas_Regulations_R_26-01-A_08_locked.pdf.

[40] For example, California, Maryland, New York, Vermont, and Washington have instituted fracking bans. In addition, South Portland, Maine, and Portland, Oregon, have enacted municipal fracking bans that have survived judicial review. *See* Sheila R. Foster & Chiara Pappalardo, *Local Initiatives*, *in* GLOBAL CLIMATE CHANGE AND U.S. LAW 3D ED. 368 (Michael B. Gerrard et al., eds. 2023).

impacts on affected communities,[41] whether extraction is consistent with federal land management statutes,[42] and the process and adequacy of disposal, cleanup, and remediation,[43] among other issues.

Moving Fuels From Extraction to Use

Fossil fuels typically must be moved to be useful—usually by rail for coal and by pipeline for oil and gas. Railroads transport nearly three-quarters of all coal[44] and a relatively small amount of petroleum products. Freight rail is overseen at the federal level by the U.S. Surface Transportation Board (STB),[45] while safety standards are administered by the Federal Railroad Administration (FRA).

Pipeline developers must secure rights-of-way from private landowners, and interstate pipelines must also obtain approval from FERC.[46] FERC also regulates offshore pipelines under the Outer Continental Shelf Lands Act (OCSLA), as well as liquefied natural gas (LNG) terminals that are used for export.[47] Intrastate pipelines fall under state jurisdiction, often a PUC. For pipelines wholly on tribal lands, tribal codes or ordinances and federal regulations (such as NEPA or the Indian Mineral Leasing Act) apply.[48]

End-Uses

After extraction and transport, most fossil fuels are burned to create electricity, heat homes, or power vehicles (see Box 2).

Electric power plants that burn coal, natural gas, or in some cases both, are subject to U.S. Environmental Protection Agency (EPA) air quality regulations under the Clean Air Act (CAA), which cover pollutants such as carbon monoxide, lead, nitrogen oxides, and particulate matter, as well as benzene and mercury, among others. Whether and to what extent EPA regulates GHGs from these facilities is the subject of ongoing litigation (see Overview of Climate Litigation). Fossil fuel plants that burn coal must also comply with regulations governing disposal of "coal ash," a byproduct of

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[41] *See, e.g.,* Compl., Cnty. of Los Angeles v. Sentinel Peak Res. California LLC, No. 25STCV36026 (Cal. Super. Ct. Dec. 10, 2025) (alleging impacts from unplugged oil and gas wells).

[42] *See, e.g.,* Theodore Roosevelt Conserv. P'ship v. Salazar, 616 F.3d 497 (D.C. Cir. 2010). *See also* Penn. Env't Defense Found. v. Commonwealth of Pennsylvania, 161 A.3d 911, 640 Pa. 55 (Pa. 2017) (discussing oil and gas leasing in the context of the Pennsylvania Constitution).

[43] *See, e.g.,* Black Warrior River-Keeper, Inc. v. Drumming Co., Inc., 387 F. Supp. 3d 1271 (N.D. Ala. 2019) (addressing claims related to acid mine drainage from an abandoned coal mine).

[44] U.S. EIA, *U.S. Coal Shipments Declined 8% in 2023 as Coal Consumption Fell Sharply* (July 16, 2024), https://www.eia.gov/todayinenergy/detail.php?id=62484.

[45] Congress, in 1995, replaced the Interstate Commerce Commission with the STB.

[46] *See* Fed. Energy Regul. Comm'n., *Cost-of-Service Rate Filings*, https://www.ferc.gov/natural-gas/general-information/cost-service-rate-filings (last visited Feb. 17, 2026).

[47] LNG is natural gas that has been cooled to a liquid state for long-distance transportation purposes, like on ships for global travel. LNG terminals are facilities that manage the import and export of LNG. LNG pipelines only differ from natural gas ones in that the natural gas is liquefied rather than gaseous, and the LNG is for intercontinental or international trade as opposed to regional or domestic gas supply. Fed. Energy Regul. Comm'n., *LNG*, https://www.ferc.gov/natural-gas/lng (last updated Sept. 11, 2024).

[48] Intermountain Oil and Gas BMP Project, Univ. of Colo. at Boulder, *Indian Law*, https://www.oilandgasbmps.org/laws/tribal (last visited Feb. 17, 2026).

coal combustion that contains toxic material. EPA regulations that make changes to the limits for these pollutants are frequently challenged in court.[49]

States and localities have also enacted laws related to using fossil fuels. For example, a number of municipalities have restricted natural gas use in new buildings to reduce GHG emissions and make progress toward climate targets.[50] At the same time, more than 20 states have enacted legislation to preempt their cities from limiting natural gas hookups in homes and buildings.[51] Federal courts have split on the question of whether federal law preempts these municipal restrictions: the U.S. Court of Appeals for the Ninth Circuit, reviewing Berkeley, California's ban, concluded that federal energy conservation laws preempted the bans,[52] while federal courts in the District of Columbia and Maryland reached the opposite conclusion.[53]

Box 2. Transportation

The transportation sector, which is a significant contributor to U.S. GHG emissions (about one-third of total U.S. emissions), is in many ways subject to a different regulatory regime than stationary infrastructure. EPA sets limits on conventional air pollutant emissions for vehicles (i.e., how much a car can pollute), and along with the National Highway Traffic Safety Administration (NHTSA), sets fuel economy standards (i.e., how efficiently a car should consume a given fuel).

Tax Credits and Incentives

Finally, state and federal governments also employ economic measures that influence how we make and use fossil energy. For example, the federal government has funded research and development of fossil fuel technologies, made some drilling-related costs deductible from taxable income, established favorable financing terms such as low-interest loans, and offered leases on public lands at below-

[49] *See, e.g.,* Chesapeake Climate Action Network v. EPA, 952 F.3d 310 (D.C. Cir. 2020) (vacating EPA denial of petition to reconsider emissions limits for hazardous air pollutants from certain power plant boilers).

[50] Foster & Pappalardo, *Local Initiatives*, *supra* note 40, at 367-69.

[51] These are often described as "energy choice" laws. *See* Adam Aton & Jeff Tomich, *Capital Control: States Strip Power From Cities, Counties*, POLITICO (Apr. 22, 2026), https://www.politico.com/news/2026/04/22/states-strip-power-cities-counties-00868763.

[52] *See* Cal. Restaurant Ass'n. v. City of Berkeley, 65 F.4th 1045 (9th Cir. 2023), *amended and superseded on denial of rehearing en banc*, 89 F.4th 1094 (9th Cir. 2024); *see also* Amy Turner, *Ninth Circuit Holds Berkeley's Gas Ban Preempted by U.S. Energy Policy & Conservation Act*, CLIMATE L. BLOG (Apr. 18, 2023), https://blogs.law.columbia.edu/climatechange/2023/04/18/ninth-circuit-holds-berkeleys-gas-ban-preempted-by-u-s-energy-policy-conservation-act/. Morgan Hill and Petaluma, CA, which passed their own bans in 2019 and 2021, respectively, have not enforced them following the Ninth Circuit's decision. The Donald Trump Administration nonetheless filed a lawsuit challenging both bans. *See* Compl., U.S. v. City of Morgan Hill, No. 26-00056 (N.D. Cal. Jan. 5, 2026).

[53] Vincent Nolette, *Two More Courts Uphold Building Decarbonization Laws, Rejecting EPCA Preemption*, CLIMATE L. BLOG (Apr. 3, 2026), https://blogs.law.columbia.edu/climatechange/2026/04/03/two-more-courts-uphold-building-decarbonization-laws-rejecting-epca-preemption/.

market rates.[54] In 2025, Congress lowered the royalty rates for coal, oil, and gas production on public lands to incentivize production.

B. Renewable Energy: Wind and Solar

In the 1970s, following the Arab Oil Embargo and ensuing energy crisis, Congress wanted to limit reliance on foreign energy sources and prepare for potential future disruptions in energy service. In 1978, it passed the Public Utility Regulatory Policies Act (PURPA), which required electric utilities to buy power from independent companies that could produce power at a lower cost than the utility itself. This hastened development of smaller-scale plants and facilitated the emergence of renewable energy sources.

Today, renewable energy is most commonly produced as wind energy from turbines or solar energy via photovoltaic panels (Box 3 explains the difference between renewable and clean energy). Unlike fossil fuels, which are limited to finite underground reserves, solar and wind "fuels" (i.e., sun and wind) are unlimited (although as discussed below, they can be intermittent).

Box 3. Renewable and Clean: What's the Difference?

Renewable energy is an energy source that is replenished as or more quickly than it is used.[55] Clean energy is an energy source that does not add GHGs to the atmosphere.[56] Some clean energy resources are also renewable, but not all. Wind power and solar power are both clean and renewable, as they convert sunlight and wind into electricity without emitting GHGs. Nuclear power, while clean because it does not directly add GHGs to the atmosphere, is not renewable because it depends on the finite resource of uranium or other radioactive substances. Other renewable energy sources include hydropower, which has a long history in the United States, and (though less common) geothermal and some sources of hydrogen. Biofuels are renewable because they are made from plants that can be regrown, but whether they are clean depends on land use changes and life-cycle emissions.

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[54] *See* Env't & Energy Study Inst., *Fossil Fuel Subsidies: A Closer Look at Tax Breaks and Societal Costs* (July 29, 2019), https://www.eesi.org/papers/view/fact-sheet-fossil-fuel-subsidies-a-closer-look-at-tax-breaks-and-societal-costs (noting that "[n]umerous energy subsidies exist in the U.S. tax code to promote or subsidize the production of cheap and abundant fossil energy").

[55] United Nations, *What Is Renewable Energy*, https://www.un.org/en/climatechange/what-is-renewable-energy? (last visited Feb. 24, 2026).

[56] MIT Climate Portal, *What Is "Clean Energy"? Is Any Kind of Energy Completely Clean?* (May 7, 2024), https://climate.mit.edu/ask-mit/what-clean-energy-any-kind-energy-completely-clean.

The regulatory structures governing renewable energy can vary greatly based on the type of technology, the location and size of the project, and its anticipated impacts, among other factors.[57]

State and local laws that restrict wind and solar facilities, even on private land, have proliferated in recent years. Examples of such restrictions include physical size or height requirements, location-based restrictions banning or limiting certain types of project within a geographic zone, or home ownership agreement restrictions. As of June 2025, 16 states had state-level restrictions; local restrictions were identified in 49 states.[58] Several states have enacted laws to preempt municipalities from restricting development of wind and solar.[59] In May 2026, in a clash between state objectives to decarbonize and local efforts to oppose renewables projects, the Michigan Court of Appeals affirmed that the state utility commission has authority to approve certain large-scale renewables projects over local objections.[60]

The federal renewables landscape remained unsettled in 2026, as the second Donald Trump Administration paused, cancelled, and/or took other executive action to prevent or delay certain renewables installations. Many of these actions have been challenged in court,[61] and though cases are ongoing, federal courts have allowed offshore wind projects to move forward in New York, Rhode Island, Virginia, and Massachusetts.[62]

Land Acquisition

Aside from rooftop solar (which makes up about one-third of all solar production in the United States), most wind and solar projects need relatively large swaths of contiguous land. That requirement has meant the vast majority of these resources—99.8% of wind and 74% of solar—are in rural areas.[63] Most are on private land, governed by contracts between developers and landowners. And although wind and solar do not require access to underground resources, in some states, a landowner can sever the right to harvest wind from the rights to the surface land.[64]

Some wind and solar projects, typically large-scale, are situated on federal land, mostly in the West. Unlike for fossil fuels, no federal law provides a framework for wind and solar leasing on federal land. Instead, renewables developers obtain rights-of-way that grant authorization for installing turbines or

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[57] *See* Berkeley Lab, *Siting Clean Energy: An Inventory of State Policies and Permitting Authorities* (June 13, 2024), https://emp.lbl.gov/news/siting-clean-energy-inventory-state-policies-and-permitting-authorities.

[58] *See* MATTHEW EISENSON ET AL., SABIN CTR. FOR CLIMATE CHANGE L., OPPOSITION TO RENEWABLE ENERGY FACILITIES IN THE UNITED STATES: JUNE 2025 EDITION (2025).

[59] *See* Andrew Light & Devashree Saha, World Res. Inst., *Clean Energy's Growing Problem: Restrictive Siting Laws* (Mar. 27, 2026), https://www.wri.org/insights/clean-energy-restrictive-siting-laws (discussing California, Illinois, Maryland, and New York).

[60] *See* In Re Implementing Provisions of Public Act 233 of 2023, No. 373259 (Mich. Ct. App. May 14, 2026).

[61] *See, e.g.,* Renew Northeast v. U.S. Dep't of Interior, No. 25-13961 (D. Mass. Apr. 21, 2026) (granting preliminary injunction in challenge to a series of federal actions by DOI, BLM, BOEM, FWS, and the U.S. Army Corps of Engineers affecting wind and solar).

[62] *See, e.g.,* Empire Leaseholder LLC v. Burgum, No. 26-00004 (D.D.C. Jan. 15, 2026); Revolution Wind, LLC v. Burgum, No. 25-02999 (D.D.C. Jan. 12, 2026).

[63] KAREN MAGUIRE ET AL., USDA ECON. RSCH. SERV., REPORT NO. ERR-330, UTILITY-SCALE SOLAR AND WIND DEVELOPMENT IN RURAL AREAS: LAND COVER CHANGE (2009-20) 6, 9 (2024).

[64] *See* Jeffrey A. Chester & Craig Duewall, *The Severability of Wind Rights From a Surface Estate*, GREENBERG TRAURIG (July 11, 2023), https://www.gtlaw.com/en/insights/2023/7/the-severability-of-wind-rights-from-a-surface-estate.

panels, and in return pay monthly rental payments to the federal government. Similar to fossil fuel leasing, federal agencies are likely to conduct an environmental review, issue water quality permits, consult about endangered or threatened species or historic sites, and/or consult with tribes.

Moving Electricity From Wind and Solar

Wind and solar energy is usually converted to electricity, and long-distance transmission lines are needed to move that electricity from rural areas to end-users, most of whom are in urban areas. In addition, because the wind does not always blow nor the sun always shine (known as intermittency, see Box 4), and because electricity generation must always be precisely balanced with demand, wind and solar systems are often coupled with batteries that can help to stabilize the grid and store energy for future use.

Box 4. What About Intermittency?

For renewable energy, what happens when the sun does not shine or the wind does not blow? Battery storage can help ensure reliability of supply and stability of the grid, and has become the focus of federal and state efforts as more renewable energy comes online. In 2018, FERC issued Order 841 that enabled battery storage projects to participate in and offer energy services to wholesale power markets (where power is sold to utilities, who then sell it to consumers). With a federal framework in place to ease grid access for batteries, state interest bloomed; between 2023 and 2025, there were 745 energy storage-related measures under consideration in statehouses around the country.[65] Illinois, for one, passed the Clean and Reliable Grid Affordability Act (SB 25), which requires the state to procure three GW of grid-scale battery storage by 2030.

Some states have sought to facilitate the siting of new transmission lines to increase renewable generation. For example, the PUC of Texas established five Competitive Renewable Energy Zones (CREZs) where transmission service providers constructed new lines between the zones and load centers even before new energy generation was built. This proactive planning led to more wind generation.[66] Texas' ability to conduct this within its borders is unique, however, and most long-distance transmission must cross state lines.

Interstate power lines require approval not only from the state where the energy is being generated and used, but also from "pass through" states that do not necessarily receive direct benefits. Any of these can be holdouts, delaying or blocking a line. For example, for one proposed transmission line

[65] NAT'L CONF. STATE LEGIS., *State Energy Legislation Database* (last updated Dec. 31, 2025), https://www.ncsl.org/energy/state-energy-legislation-archived-database.

[66] *See* Rossi & Wiseman, *Electricity Regulation*, *supra* note 12, at 426. California's Western Renewable Energy Zone had similar aims, but that effort never went beyond identifying promising areas. *Id.*

that would have crossed New Hampshire to bring hydropower from Canada to Massachusetts, New Hampshire's siting authority denied the application, a decision ultimately upheld by the New Hampshire Supreme Court.[67]

There is a federal mechanism—called National Interest Electric Transmission Corridors (NIETCs)—designed to relieve transmission constraints when states hold out.[68] The Federal Power Act authorizes FERC to designate NIETCs, and if a state fails to act on a siting application for a portion of an interstate transmission line within a designated corridor, then FERC can use federal backstop authority to proceed with siting. However, FERC's first two designated corridors were vacated by a Ninth Circuit decision in 2011,[69] and the agency has not finalized any NIETCs since.

Tax Credits and Incentives

As with other energy sources, federal policies incentivizing renewables have fluctuated over time. Most often for renewables, the federal government offers tax credits for projects either one time at construction (as Investment Tax Credits, ITCs) or as an ongoing credit when electricity/fuel is produced over the course of 10 years (as a Production Tax Credit, PTC).

Due to initial high costs, most solar or battery storage projects tend to opt for ITCs, whereas large-scale energy production projects (e.g., hydropower facilities, or onshore wind farms in wind-rich areas) benefit most from PTCs.[70] These tax credits were bolstered by the Inflation Reduction Act of 2022 but were repealed in 2025; wind and solar projects that began construction prior to July 2026 remained eligible for ITCs or PTCs, while geothermal, nuclear, and battery storage projects have extended eligibility through 2033.[71]

States have also offered grants and rebates for certain renewable technologies. Some states and local governments offer Property Assessed Clean Energy (PACE) financing, which are loans for individual residents and businesses to invest in renewable energy sources or for energy-efficiency projects on their properties.[72]

C. Nuclear Energy

As noted above, nuclear energy is not renewable, but it is clean with respect to GHGs and therefore has often been proposed as an alternative to fossil energy sources. Nuclear energy involves harnessing the energy emitted by radioactive substances, usually uranium. By refining natural uranium into a more

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[67] *See* Appeal of Northern Pass Transmission, LLC, 214 A.3d 590, 172 N.H. 385 (N.H. 2019).

[68] *See* U.S. Dep't of Energy, *National Interest Electric Transmission Corridor Designation Process* https://www.energy.gov/oe/national-interest-electric-transmission-corridor-designation-process (last visited May 5, 2026); Rossi & Wiseman, *Electricity Regulation*, *supra* note 12, at 425.

[69] *See* Calif. Wilderness Coal. v. U.S. Dep't of Energy, 631 F.3d 1072 (9th Cir. 2011).

[70] *See* Rossi & Wiseman, *Electricity Regulation*, *supra* note 12, at 415.

[71] Amy Turner, *The One Big Beautiful Bill Act: Considerations for Cities and Community Partners*, Climate L. Blog (July 7, 2025), https://blogs.law.columbia.edu/climatechange/2025/07/07/the-one-big-beautiful-bill-act-considerations-for-cities-and-community-partners/.

[72] Thirty-eight states offer commercial PACE programs. California, Florida, and Missouri also offer residential PACE programs. *See* PACENation, *What Is PACE?* (Aug. 31, 2023), https://www.pacenation.org/wp-content/uploads/2023/10/PACENation-What-is-PACE-Factsheet.pdf.

energy-dense fuel, the substance's natural decay can be accelerated in a reactor, and the energy released can be used to create steam and turn a turbine to generate electric power.

The history of nuclear energy in the United States originates from military applications, including the production of atomic bombs, in the 1940s. The Price-Anderson Act of 1957 provided the first federal incentive to develop nuclear energy, capping the liability of plant owners for nuclear accidents and assigning residual financial responsibility to the government.[73] In 1974, Congress created the Nuclear Regulatory Commission (NRC, eliminating its antecedent, the Atomic Energy Commission), which is an independent agency designed to ensure the safe use of radioactive materials and the primary regulatory body for nuclear energy.

To be built, nuclear projects require a construction permit and operating license from the NRC as well as an NRC safety review, environmental review, and antitrust review.[74] The environmental review process for nuclear power projects considers the cooling of nuclear reactors and related water usage under the CWA, long-term and safe disposal of radioactive waste, and monitoring of radiation doses, among other aspects.[75]

By the late 1980s, over 100 nuclear reactors were generating electricity in the United States. However, demand for such projects fell due to safety concerns following nuclear accidents both domestically (Three Mile Island, 1979) and abroad (Chernobyl, 1986). Nonetheless, nuclear energy continues to supply about 20% of the country's electricity, a share that has remained relatively flat since the late 1980s.

Today, while 10 states restrict the construction of new nuclear energy,[76] there is renewed interest in and support for this technology. The 2022 Inflation Reduction Act created a federal Zero-Emission Nuclear PTC that provides direct financial assistance for existing nuclear projects; and some states, such as Illinois and New York, likewise support existing nuclear plants through Zero Emissions Credit schemes that require electric utilities to purchase such credits from nuclear power facilities.[77]

Small nuclear reactors are also receiving more government support, as interest grows in their potential to power growing energy demands from data centers. The Bipartisan Infrastructure Bill in 2021 provided $2.4 billion for such projects. DOE provided partial funding for locally owned utilities to

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[73] Rossi & Wiseman, *Electricity Regulation*, *supra* note 12, at 424.

[74] U.S. Nuclear Regul. Comm'n, *Backgrounder on Nuclear Power Plant Licensing Process* (June 7, 2022), https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/licensing-process-fs. NRC findings are independently evaluated by the Advisory Committee on Reactor Safeguards. *Id.*

[75] U.S. NUCLEAR REGUL. COMM'N., PREPARATION OF ENVIRONMENTAL REPORTS FOR NUCLEAR POWER STATIONS 29-58, 89-132 (2018), https://www.nrc.gov/docs/ML1807/ML18071A400.pdf. *See also* U.S. Nuclear Regul. Comm'n, *Backgrounder on Environmental Monitoring at Nuclear Power Plants* (Aug. 26, 2021), https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/env-monitoring.

[76] *See* Nat'l Conf. of State Legis., *States Restrictions on New Nuclear Power Facility Construction* (updated Apr. 16, 2026), https://www.ncsl.org/environment-and-natural-resources/states-restrictions-on-new-nuclear-power-facility-construction.

[77] *See* Rossi & Wiseman, *Electricity Regulation*, *supra* note 12, at 424.

build small nuclear reactors in Utah (a project that was later terminated),[78] and the NRC has approved one next-generation nuclear test facility in Tennessee.[79]

D. Other Energy Sources: Hydropower, Biofuels, Geothermal, Hydrogen

Energy can also come from other renewable sources, including water (hydropower), plant matter (biofuels), and the earth's heat (geothermal). It can also come from one of the most common elements on earth, hydrogen, which can be produced through processes that use either renewable or non-renewable energy inputs.

Hydropower is electricity created using flowing or falling water to turn turbines, which then power generators. It is the oldest form of renewable energy in the United States. Beginning in 1920, the Federal Water Power Act gave the Federal Power Administration (now FERC) authority to regulate and grant licenses to hydroelectric projects. Hydroelectric facilities are eligible for PTCs, and their licensing and operation may implicate NEPA, the Endangered Species Act (ESA), CWA, National Historic Preservation Act (NHPA), and other laws related to environmental impacts on water, fish, and other wildlife.

Geothermal energy is heat or electricity harnessed from the heat in the earth's crust. Its regulation is very similar to fossil fuels because it involves subsurface materials and drilling deep wells. It is thus also governed by a mix of federal and state law, although two-thirds of current geothermal capacity is on public lands that are leased by BLM and subject to federal law.

Hydrogen can be used as an energy carrier; it can store energy or turn one form of energy (like electricity) into a more specific use (like jet fuel). There are no accessible sources of pure hydrogen, so before it can be used it must be extracted from fossil fuels (usually natural gas, through a process called Steam Methane Reforming) or from water via a process called electrolysis. While the end products are identical, experts frequently use a "hydrogen rainbow" to describe the process by which the hydrogen is made and its carbon footprint.

So-called gray hydrogen is made from natural gas through a process that emits CO_2; "blue hydrogen" is also made from natural gas, but the carbon emissions from the process are captured at the smokestack and stored; and "green hydrogen" is produced with renewable electricity, resulting in the fewest carbon emissions of the three. Today, almost all hydrogen that is produced is "gray," and almost all of it is used in industrial processes.[80]

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[78] *Id.* at 425; Timothy Gardner & Manas Mishra, *NuScale Ends Utah Project, in Blow to US Nuclear Power Ambitions*, REUTERS (Nov. 9, 2023), https://www.reuters.com/business/energy/nuscale-power-uamps-agree-terminate-nuclear-project-2023-11-08/.

[79] Off. of Nuclear Energy, U.S. Dep't of Energy, *NRC Approves Construction for Hermes Reactor* (Dec. 12, 2023), https://www.energy.gov/ne/articles/nrc-approves-construction-hermes-reactor.

[80] *See* U.S. Energy Info Admin., *Natural Gas Remains the Largest Source of Hydrogen in Our Long-Term Projects* (Aug. 4, 2025), https://www.eia.gov/todayinenergy/detail.php?id=65845.

Biofuels are combustible fuels derived from organic materials, like crops, plant waste, or algae. They are mostly regulated through the Renewable Fuel Standard (RFS) program authorized by the Energy Policy Act of 2005, which requires refiners or importers of gasoline or diesel fuel to use a certain volume of renewable fuel in transportation and heating fuels.[81]

E. Comparing Costs and Impacts Across Energy Sources

The availability, cost, efficiency, and environmental and climate impacts of each of these energy sources vary. These factors may be relevant to, and possibly impact the decisions, of both policymakers and courts.

To ensure an apples-to-apples comparison, policymakers and economists frequently use a life-cycle approach, both for economic costs and for climate impacts. The "levelized cost of energy" offers one common life-cycle approach to comparing sources, and is explained in more detail in Box 5.

This kind of analysis is also used in calculating the GHG emissions from any given project, often called a "life-cycle emissions" approach. Thus, it includes all associated emissions from mining, manufacturing, transportation, operation, and finally decommissioning of an energy project, and then averaging those emissions over the expected time that project will produce energy.

Wind turbines and solar panels do not directly create greenhouse gases while they are operating, but their raw materials must be mined, they must be refined and manufactured, and suitable land must be used to build these projects—all of which produce GHGs. However, a 2021 meta-analysis examining 3,000 life-cycle assessment studies of GHGs from electricity found that renewables like wind (13 g CO_2e/kWh) and solar (43 g CO_2e/kWh) had far fewer life cycle emissions than natural gas (486 g CO_2e/kWh) or coal (1,001 g CO_2e/kWh).[82]

For the electricity sector in particular, availability and reliability are other considerations that are not always reflected in the above analyses. Wind and solar are intermittent and can present challenges related to having available electricity supply to meet demand, which can be mitigated with batteries or other forms of energy storage. Fossil energy, nuclear power, and hydropower can also have issues with fuel or seasonal availability and be affected by shortages in global fuel markets, geopolitical shocks, severe weather, or drought, though those are typically over longer periods.

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[81] *See* U.S. Env't Prot. Agency, *Overview of the Renewable Fuel Standard Program* (May 7, 2025), https://www.epa.gov/renewable-fuel-standard/overview-renewable-fuel-standard-program.

[82] NAT'L RENEWABLE ENERGY LAB., LIFE CYCLE GREENHOUSE GAS EMISSIONS FROM ELECTRICITY GENERATION: UPDATE (2021), https://www.osti.gov/biblio/1820320.

Box 5. The Levelized Cost of Energy.

Cost is an important component of fully assessing the economics of our energy system, but comparing energy sources requires a degree of analysis and judgment. A leading method to compare overall costs of energy sources is the levelized cost of energy, or LCOE.

The LCOE for a given technology is calculated by dividing a facility's total lifetime costs by the total amount of energy made during its lifetime. For coal and natural gas, this includes the costs of building a plant and the coal and gas inputs burned in energy production. For wind and solar, most costs (70-75%) are related to initial construction[83]; operating costs are low because wind and sunlight are free.[84] LCOE analyses do not, however, account for the externalities (i.e., the hidden or indirect costs) of these energy sources. While the LCOE accounts for expenses related to capital investments, operations, and maintenance of projects, it does not quantify, for example, the health-related costs of air pollution.

Arriving at a single number for the LCOE of an energy source requires making assumptions; how many hours per year is the source of energy operating? How many years is a plant expected to operate? What will the cost of inputs like coal, gas, or labor look like years into the future? What discount rate or interest rate is used in calculating the cost of borrowing money for the project? Reasonable answers to these questions can produce a range of prices for a given technology.

For more information on this and related concepts, see Lazard's 2025 Levelized Cost of Energy report at https://www.lazard.com/media/eijnqja3/lazards-lcoeplus-june-2025.pdf.

IV. Conclusion

Energy is foundational to our lives and economy, and is produced, distributed, and used via a wide variety of technologies. The laws governing our energy system are just as varied. As the energy sector continues to change with new technologies, increasing demand, and a dynamic set of interlocking federal, state, and local policies, new legal issues will inevitably arise, and judges will be asked to adjudicate disputes about these changes.

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[83] *See Utility-Scale PV*, NAT'L LAB. OF THE ROCKIES, https://atb.nlr.gov/electricity/2024b/utility-scale_pv (last visited May 15, 2026); TYLER STEHLY ET AL., NAT'L RENEWABLE ENERGY LAB., COST OF WIND ENERGY REVIEW: 2024 EDITION (Nov. 2024), https://docs.nlr.gov/docs/fy25osti/91775.pdf.

[84] These cost estimates assume 30-year lifecycles for wind and solar projects, meaning about 1% per year of the total cost of the project is for operation and maintenance. *See Utility-Scale PV*, *supra* note 83.