OIL 101

INTRODUCTION

Oil is one of the most versatile products on the planet. It powers homes, cars, cargo ships, and is a critical ingredient in products ranging from toys to pharmaceuticals. The United States has been blessed with an abundance of oil and the Energy Information Agency predicts that fossil fuel usage will increase beyond 2050[1] despite trillions[2] of dollars in subsidies supporting alternative fuel sources.

In 2024, U.S. total production averaged about 13.2 million barrels per day[3] , which accounted for 17% of global crude oil production[4]. However, the Organization of Petroleum Exporting Countries (OPEC) nations control roughly 37% of the world's crude oil production. They also make up about 60% of the total petroleum traded internationally and control more than 80% of the world's proven oil reserves. OPEC acts as a “market manager” of oil by reducing production when oil is cheap and increasing production when the price then increases. While there are numerous factors that influence the global oil market, any decrease in domestic U.S. production would remove global competition for OPEC, meaning they would have close to sole control over international energy prices.

HOW DOES IT WORK?

Oil is typically found by using seismic surveys, where sound waves are used to create a three-dimensional image of underground rock layers. The oil is then extracted via traditional drilling or hydraulic fracturing, where water, sand, and other chemicals are injected into a well to form fissures in underground rock formations. Traditional or vertical drilling uses a pipe that is sent straight down into a well. This requires a new rig and borehole to be used for every well. Horizontal drilling is a technique that allows a drill to move horizontally, thus only requiring one bore hole to access more surface area of a deposit. Other methods, such as that employed in the Canadian tar sands, use open-pit mining to scrape oil that exists near the surface.

Crude oil is graded by its weight (light vs. heavy) and its sulfur content (high [sour] vs. low [sweet]). The United States primarily produces crude oils that range from medium to light weight, and lower sulfur crude oils.

Crude oils that are lighter and lower in sulfur can be processed with less complex refining equipment. Crude oils that are heavier and higher in sulfur require more complex refining equipment. A majority of the U.S. refining fleet is complex and highly sophisticated. Therefore, they are better suited to processing heavy higher-sulfur crude oils, than the domestic production of lighter lower-sulfur crude oils. To correct for this imbalance, the United States imports less expensive, heavy, higher-sulfur crude oils, and exports the more expensive, domestically produced, lighter lower-sulfur crude oils.

Refineries use a variety of processes; heat, pressure, and chemical reactions to produce finished petroleum products like motor gasoline, diesel fuel, and jet fuel. Additionally, some refineries also produce specialty products like asphalt and feedstocks for petrochemical processes that result in a variety of materials5 . Refined oil products are used to fuel machines which typically produce heat or drive pistons for locomotion through the rapid expansion of combusted gases. Fuel, such as gasoline and diesel, is injected into a combustion chamber where it is ignited. The combusted gases expand extremely rapidly, which forces pistons to reciprocate which in turn rotates a crankshaft. This system has been used to power virtually every vehicle on earth, including cars, semis, airplanes, tanks, and trains.

WHERE DOES IT COME FROM?

In 2022, 26% of domestic oil production came from federal land and waters[6] . Producing on federal lands often requires nearly a decade of steps that include obtaining a lease, exploring, obtaining permits for exploratory wells, drilling exploratory wells, assessing the results from those wells, and then finally permitting and drilling the production wells. It can take considerably longer to obtain the necessary permits on federal lands than on private lands. For a full explanation of permitting gridlock and the bills that seek remedy them, please see the Western Caucus document titled "Republican Actions on Permitting Reform in the 118th Congress."

Private landholdings therefore produce 74% of domestic production.

The most prominent areas for domestic onshore production are the Permian Basin, Eagle Ford Shale, Marcellus Shale, Utica shale, DJ Basin, Haynesville Shale, and Willison Basin. The Permian Basin alone provided 42% of all domestic oil in 2024 [7].

There are plenty of basins and shale plays that may contain massive reserves of oil and gas but are not yet cost-effective to explore, such as the Colombia basin in Idaho and Oregon. Modern drilling techniques are attempting to make these areas more accessible to extraction.

Domestic production of federal oil has been stymied by the near total prohibition of onshore and offshore leases by the Biden Administration. Through expansions of the Antiquities Act, Resource Management Plans, Areas of Critical Environmental Concern, and agency delays[8]. Worryingly, the Biden administration sought to make these changes permanent through several rulemakings, including the Landscape Conservation and Health Rule and the Fluid Mineral and Leasing Rule. This administration also tried to make it significantly more difficult to lease and operate in the National Petroleum Reserve in Alaska and even cancelled lease sales resulting from Congressionally mandated sales in the ANWR region of Alaska.

In the offshore space, the Biden administration's Department of the Interior's (DOI) 2024- 2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program was released nearly two years late, causing major disruptions for producers, and only included three proposed lease sales which is the fewest ever in the history of the OCS program and resulted in 2024 as the first year since 1966 without an offshore sale.

RELEVANT STATUTES

Federal Lands Policy and Management Act – This law, enacted in 1976, established the Bureau of Land Management and outlined its authority to determine Resource Management Plans (RMP, §1712). An RMP is a detailed document that outlines exactly how the BLM will manage its surface and mineral estate, including for the extraction of oil and gas. This bill also establishes the 'multiple use' doctrine, which provides that public lands must be maintained for the continued use of their natural resources.

Antiquities Act - The Antiquities Act, signed into law in 1906, gives the President the authority to designate as a monument any historic landmarks, historic and prehistoric structures, or other objects of historic or scientific interest that are present on federal land. The law compels the President to reserve "the smallest area compatible with the proper care and management of the objects to be protected." Federal land that has been designated as a monument is precluded from many, if not all, recreational or extractive activities. Use of monument proclamations since 1996 has been warped to lock up federal lands from new mineral leases, mining claims, prospecting or exploration activities, and oil, gas, and geothermal leases. There is no requirement that Congress approve a presidential monument designation, though Congress does have the ability to designate its own monuments. Monument designations also do not need to pass through any state, local, or tribal approval process, meaning the President may ignore formal opposition by affected entities in or near the monument designation without any legal recourse or veto power on their end.

Outer Continental Shelf Lands Act (OCSLA) - Enacted in 1953, the OSCLA defines outer continental shelf (OCS) as all submerged lands lying seaward of state submerged lands and waters. Under the OCSLA, the Secretary of the Interior is responsible for the administration of mineral exploration, energy production, and the development of the OCS. The Act empowers the Secretary to grant leases and to formulate regulations as necessary to carry out the provisions of the Act. Oil and gas is managed through a program renewed every five years. Authority over renewable energy was added in 2005.

Federal Oil and Gas Royalty Management Act – This bill establishes fees, royalties, and fines related to the extraction of oil and gas for federal, state, and tribal land. It also allows the federal government to conduct inspections to ensure compliance with federal law.

Gulf of Mexico Energy Security Act (GOMESA) – This bill establishes revenue sharing for oil drilled in the Gulf of America. It distributes portions of the royalty levied on this oil to Alabama, Mississippi, Texas, and Louisiana, as well as federal programs, such as the Land and Water Conservation Fund.

IMPORTANT NUMBERS

- Petroleum-fired power plants provide 2.7% of U.S. electricity capacity, but only 0.4% of total generation. Typically, petroleum-fired power plants are only used when electricity prices are extremely high or as emergency back-up generation. Petroleum-fired power plants are more common in areas that lack access to natural gas pipelines.
- In 2023, petroleum provided 38% of U.S. total primary energy consumption.
- Oil-fired power plants have a low capacity factor, or "up-time," of between 5%-10%.
  - This is because oil plants are typically used as must-run or emergency facilities, so they don't run 24/7. Oil plants are also significantly less energy efficient than other generation sources, meaning they lose a large amount of their stored energy to heat.
- Most gasoline powered engines have an efficiency factor between 20%-40%, meaning most of the energy contained in the gasoline is lost to heat.
- Many states' revenue relies entirely on oil and gas production. In 2023, Texan oil and gas companies paid $26.3 billion in state and local taxes and royalties. In New Mexico, that number was $15.2 billion and provided almost 40% of their entire state budget.
  - For offshore states, the GOMESA program is an invaluable source of revenue. Louisiana, for example, received $125 million in 2024[9]from offshore oil and gas royalties.
- According to a 2020 GAO report, Application for a Permit to Drill (APD) review times decreased from 196 days to 94 days between 2016 and 2019 under President Trump.
- In 2019, The United States became a net exporter of energy for the first time in 68 years[10] .

NATURAL GAS 101

WHY IS IT IMPORTANT?

Natural gas provides 43% of domestic electricity generation and 36% of domestic energy consumption[1]. This places it in a near tie with oil for being the largest energy-producing commodity not only in the United States, but in the world.

Prior to the early 2000's, significant oil and gas deposits had been located under shale rock but were considered to be economically unviable to extract due to the cost of conventional drilling techniques. The "Shale Revolution," a combination of horizontal drilling and hydraulic fracturing ("fracking"), fully unlocked the potential of these gas deposits. In 1975, the U.S. produced only 442,811,198 cubic feet (12,539,016 cubic meters) of natural gas. In 2020, the U.S. produced 1,446,065,646 cubic feet (40,948,019 cubic meters)[2].

Typically, extracted gas is transported via a pipeline network that has about 3 million miles of mainline piping across the country. In 2022, this natural gas transportation network delivered about 29.2 trillion cubic feet (Tcf) of natural gas to about 78.3 million consumers within the United States[3].

Natural gas has been the leading cause of domestic decarbonization. From 2005 to 2022, the shift from coal to natural gas for power generation resulted in an estimated reduction of 532 million metric tons in CO_2 emissions[4].

Unfortunately, gas leasing on federal lands has been stymied. Through abuses of the Antiquities Act, Resource Management Plans, Areas of Critical Environmental Concern, and more, the federal land estate for energy extraction has been severely shrunk. The Biden administration has sought to make these changes permanent through several concerning rulemakings, including the Landscape Conservation and Health Rule and the Fluid Mineral and Leasing Rule. This administration has also cancelled leases in the National Petroleum Reserve in Alaska, as well as leases in the ANWR region of Alaska. For a full breakdown of the Biden Administration's attack on the federal land estate, including the rules mentioned above, please see the section titled "Leasing, land access, and recreation."

Leasing has also been stalled for years on end through a regulatory permitting gridlock that will not allow any infrastructure projects to be completed anywhere in the federal domain. For a full explanation of permitting gridlock and the bills that seek remedy them, please see the Western Caucus document titled "Republican Actions on Permitting Reform in the 118th Congress."

HOW DOES IT WORK?

Natural gas is produced when organic matter is subjected to millions of years of heat and pressure, which decomposes the organic matter into smaller hydrocarbon molecules. Natural gas is a colorless and odorless gas primarily made of methane (CH_4), with trace amounts of ethane, propane, butane, and other molecules mixed in. The rotten-egg smell detected in gas is from an additive called Mercaptan that is put into the gas to facilitate detection of a leak.

Gas is typically found by using seismic surveys, where sound waves are used to create a three-dimensional image of underground rock layers. It is then extracted via hydraulic fracturing, where water, sand, and other chemicals are injected into a well to form fissures in underground rock formations. Horizontal drilling is a technique that allows a drill to move horizontally, thus only requiring one bore hole to access a vast amount of surface area of a deposit.

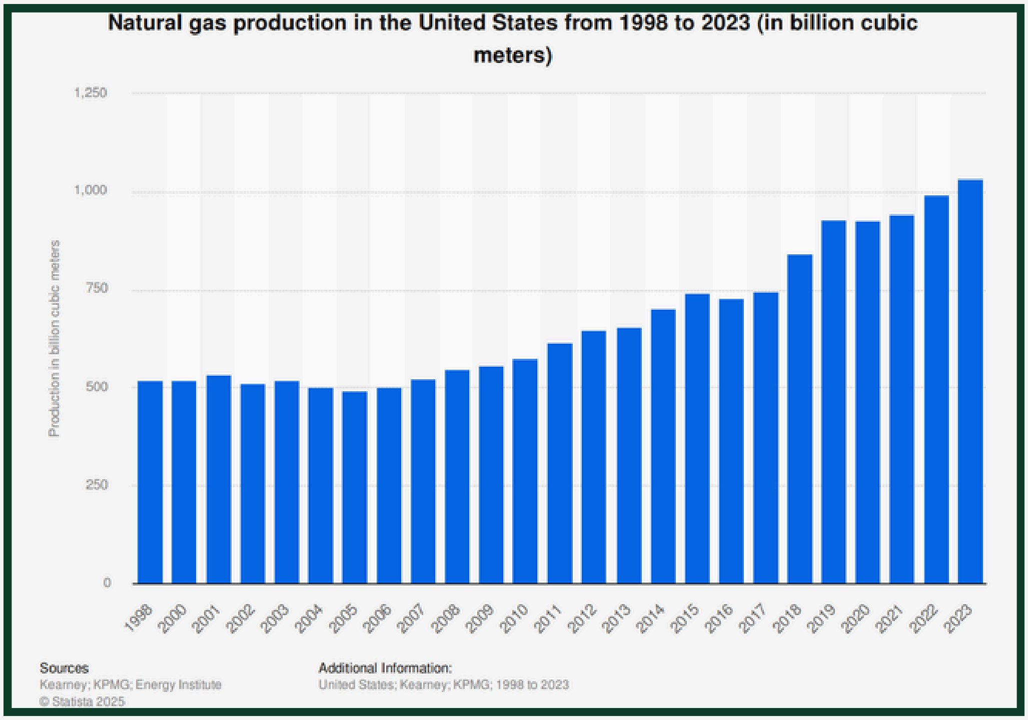
Delivery of natural gas from oil well to end users requires various infrastructure assets, processing and transfers of custody. The three main categories for gas infrastructure include processing, transportation and storage. Natural gas demands frequently fluctuate, while production and transportation remain constant. Storing natural gas helps to ensure gas is available during peak demand times. Storage of natural gas is both underground for large volumes and within tanks above or below ground in small volumes.[5]

Natural gas is delivered to end users of different types such as residential, commercial, industrial and electric power generation. When natural gas arrives to its delivery points or end user (usually through large pipelines), it flows into smaller diameter pipelines called mains and then into smaller service lines that go directly to homes or buildings[6].The large pipelines are comprised of a transmission system (interstate, intrastate and Hinshaw pipelines) that delivers gas from the oil fields to market.

The smaller pipelines comprise the local distribution system that deliver gas directly to consumers for use. Natural gas can also be transported in the form of compressed or liquefied via heavy duty trucks, ships and rail. These are known as compressed natural gas (CNG) and liquefied natural gas (LNG). CNG and LNG are also alternative fuels for transportation fleets, manufacturing machines, fuel storage and maritime.

For gas to be exported, it needs to be liquified, which is abbreviated as LNG (liquified natural gas). It is cooled to -260ºF and pumped into tankers before being turned back into a gas at its final destination. Gaseous methane occupies roughly 600 times more volume than its liquified state[7].

The United States is the world's largest exporter of natural gas, producing 1.035 quadrillion cubic meters in 2023[8], which is roughly a quarter of the world's total natural gas[9]. We are followed by Russia at only 618 trillion cubic feet. Natural gas exports are crucial for global stability: in 2023, total U.S. LNG exports averaged 11.9 billion cubic feet per day to 43 countries. The largest purchasers of U.S. LNG are the Netherlands, France, the United Kingdom, Japan, and South Korea[10].



Natural gas is primarily combusted in a turbine to produce electricity, or in homes to provide heating. In a simple cycle gas plant, the gas is pumped into a chamber and combusted, leading to a rapid expansion of carbon dioxide which spins a turbine and creates electricity. In a combined cycle system, excess heat from the first turbine is captured and used to flash water into steam, turning a second turbine. A combined cycle plant is significantly more efficient than a simple cycle plant. By rotating a turbine, gas plants are able to maintain rotational inertia which is crucial for maintaining grid reliability. U.S. transmission infrastructure is designed to run on a constant 60 Hertz frequency, and any discrepancy above or below this number can cause immediate and widespread blackouts, such as the blackout that occurred in Spain in April[11]. Rotational inertia maintains this frequency and reduces the risk of other generating facilities creating enormous frequency swings when they join or leave portions of the grid.

In homes, gas is piped into a house and lit by a pilot light to heat ovens and stoves. For home heating, gas is burned inside a furnace and passed through a heat exchanger before circulating through the air conditioning system.

IMPORTANT NUMBERS

- In 2023, natural gas supplied 36% percent of the United States energy consumption[12] and 43% of overall electricity production[13].
- A combined cycle gas turbine has an efficiency factor upwards of 60%[14], meaning 40% of the energy contained is lost to heat.
- The capacity factor (uptime) for a simple cycle plant is 9-14%. A combined-cycle gas turbine averages around 56%.
- It takes roughly 12.4 acres to produce one megawatt of electricity using natural gas[15].
- Numerous energy sources require backup generation that can be employed at will when the primary generation source is not functioning. This is typically provided by gas plants, known colloquially as peaker plants. Peaker plants often have lower capacity factors, higher overall emissions, and higher costs.
- A baseload gas plant will typically cost 6.5¢ per kilowatt hour, while peaker plants cost roughly 20¢ per kilowatt hour[16].
- Natural gas is the primary feedstock for nitrogen-based fertilizers, making gas production critical for domestic agriculture. The price of natural gas and the price of food are inextricably linked.
- The Levelized full-system cost of a combined cycle natural gas plant is $40/Mwh [16]

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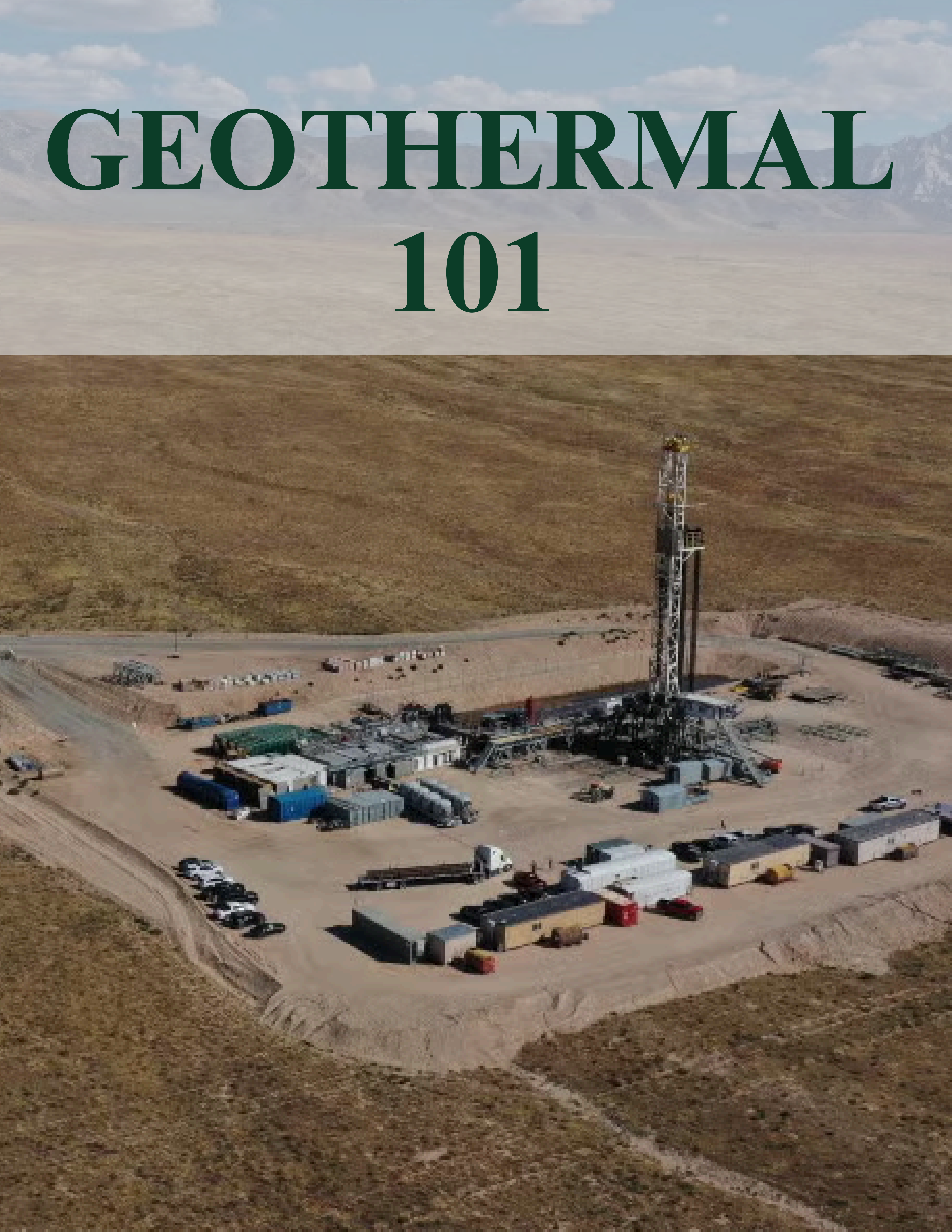
GEOTHERMAL 101



WHY IS IT IMPORTANT?

As the nation faces unprecedented energy growth, the demand for firm power sources grows. Renewables, like wind and solar, are intermittent, require substantial backup generation, and do not provide rotational inertia to the grid. Firm, dispatchable and 24/7 available sources of energy, like nuclear, geothermal, and fossil-derived resources provide a unique opportunity to help meet growing energy demand. These firm sources of power, such as geothermal, provide a significant opportunity for investment and to leverage American innovation. As such, the One Big Beautiful Bill Act preserved tax credits for nuclear and geothermal due to their potential to provide immense sources of affordable and reliable energy.

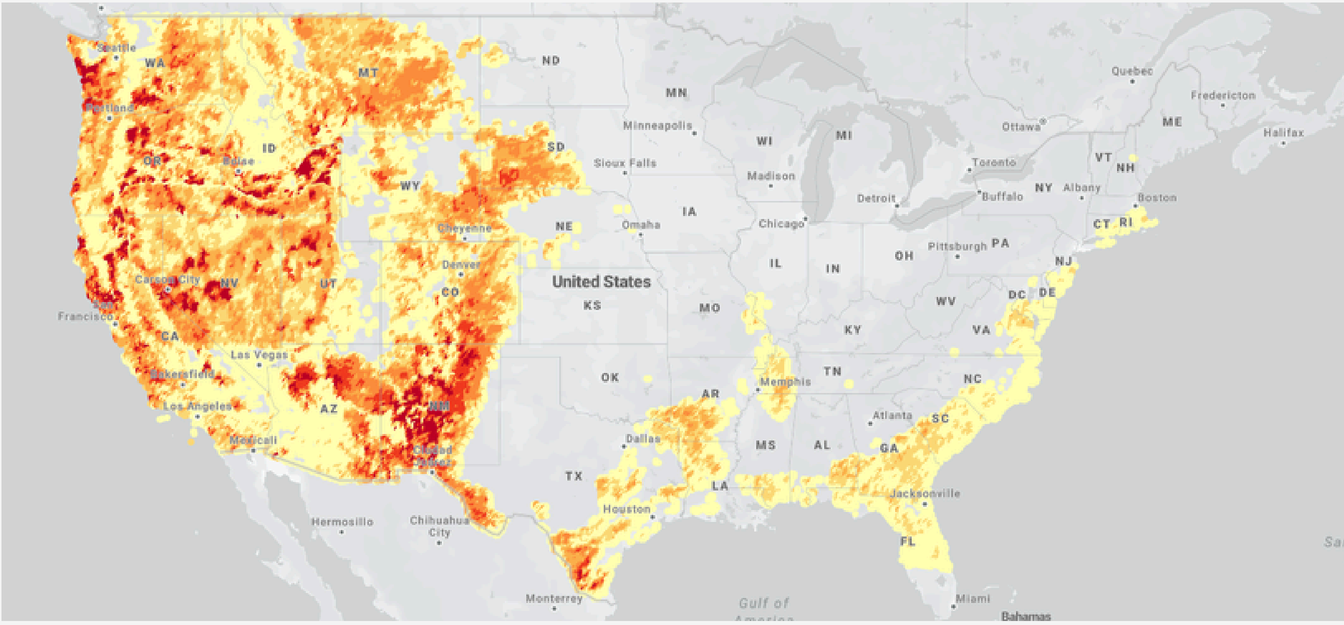
Momentum for geothermal is growing. Investment is increasing, with more than $2.2 billion directed toward next-generation technologies in 2025 alone, reflecting a remarkable 80% increase year-over-year (IEA/McKinsey). Geothermal technologies provide baseload, rotational electricity that does not require much in the way of new technology. While the greatest geothermal potential exists across the west, emerging technologies, like next-generation geothermal, are expanding the map and proving geothermal is a viable energy source across the country.

Geothermal has done more with less for the past decade. To date, geothermal projects have received just 10% of the federal demonstration funding allocated to support other clean firm technologies, such as nuclear and carbon capture. When Congress enacted the Energy Act of 2020, the largest update to federal energy R&D programs in a generation, next-generation geothermal systems were still largely a theoretical concept.

It has never received the level of federal demonstration program funding that has been allocated for nuclear, carbon capture, energy storage, and other innovative tech. While that hasn't stopped geothermal's momentum, it sure has made it harder for this reliable, clean, baseload energy source to achieve widespread adoption.

As companies seek to meet growing energy demands for AI, data centers and other energy intensive processes with clean, reliable power, geothermal has risen to the top of the list. Innovative geothermal companies have demonstrated technological successes that have dramatically reduced drilling timelines, improved the outlook of project finance through risk reduction, and verified long term production trends.

WHY IS IT IMPORTANT?

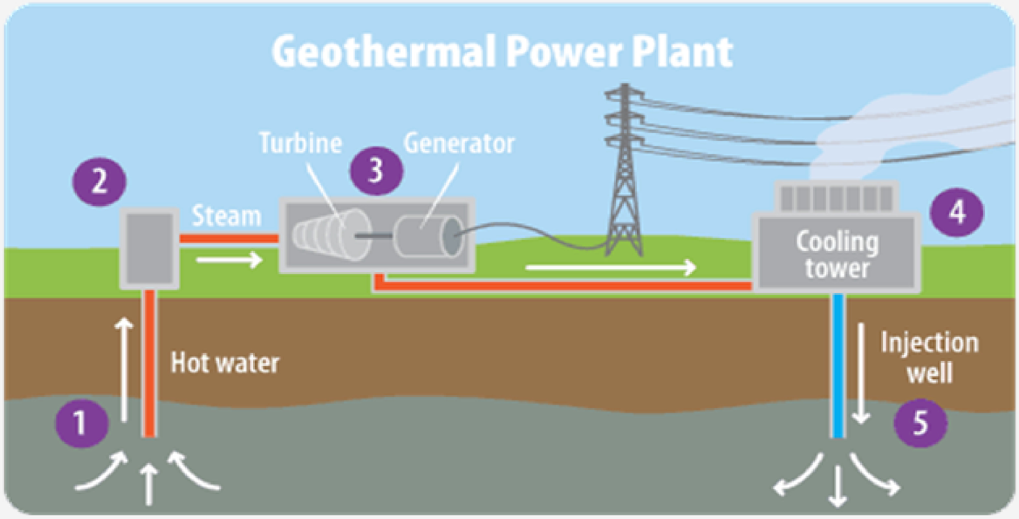


The United States boasts 3.7 GW of installed geothermal capacity(1), which represents 25% of the global total geothermal capacity1. Like wind and solar, geothermal energy does not require fuel, which dramatically reduces operating costs. The U.S. Department of Energy (DOE) is aiming for 60 gigawatts (GW) of enhanced geothermal systems (EGS) and hydrothermal resource deployment by 2050. Additionally, DOE's Enhanced Geothermal Shot initiative aims to increase geothermal power capacity by up to 100 GW by 2050.(2)

HOW DOES IT WORK?

Traditional – or conventional – geothermal is fairly simple. Naturally occurring heat from the earth's core can be accessed relatively close to the earth's crust in specific locations. After discovery, water is pumped down into a well drilled into the hot spot. The well requires a very specific drill bit which can withstand the immense temperatures and is lined with concrete to keep it from collapsing. The water is then naturally super-heated, causing it to turn to steam. The expanding steam then spins a three-phase turbine which produces electricity. The geophysical constraints of naturally occurring hotspots have proven to be a barrier to geothermal deployment at scale – they are too few and far between to be able to produce large quantities of energy. While it is possible to drill deeper wells to access heat further from the earth's crust, the increase in drilling distance adds significant cost which makes most projects unviable.

HOW DOES IT WORK?



However, thanks to American innovation and the advancements in drilling technology, the geothermal industry is on the cusp of at-scale deployments in geologies previously considered to be non-viable. While still early in its development journey, next generation, including enhanced and advanced geothermal systems, may prove to provide abundant supplies of clean, firm, American energy.

Enhanced geothermal (EGS) is a relatively new way to access the earth's naturally occurring heat. Like natural gas and shale oil extraction, a drill pad uses hydraulic fracturing – fracking – to create fissures in the earth's crust. These fissures dramatically increase the surface area in which water can become super-heated. The water is then piped in and heated to extreme temperatures. Instead of being cooled and reheated, however, the water is first passed through a heat exchanger. In the secondary loop is typically a chemical that expands much more violently than water, in many cases butane, which spins the turbine faster, creating more electricity. It is worth noting, however, that not all new geothermal companies are using EGS. Some new companies are using traditional geothermal methods, combined with new technology like AI to identify and access previously inaccessible hydrothermal rock formations.

There are numerous problems that have yet to be solved to truly expand EGS, including scaling, thermal degradation, and drilling cost. Scaling is the process by which numerous minerals dissolved in the water begin to calcify and choke off the aforementioned fractures. These dissolved minerals will, over time, reharden back into stone. When this happens, the surface area created by the initial fracturing process will disappear and with it most of the surface area needed to heat the water. However, the national labs and the newly-created Geothermal Technologies Office (GTO) at DOE are currently developing solutions to scaling.

HOW DOES IT WORK?

Likewise, thermal degradation presents numerous challenges. The second law of thermodynamics states that no transfer of energy is 100% efficient and that energy will always be lost in a system and its surroundings. Therefore, geothermal wells cannot last forever. This technology is different from oil and gas in that when oil or gas is drilled, the energy is stored in the hydrocarbon and is not burned until it reaches a power plant. Geothermal is different in that the power plant is built directly on top of the energy source and cannot be moved. Therefore, 100% of the investment and capital is placed onto a resource that will, over time, become depleted and no longer produce energy. This has proven to be a considerable hurdle for investors to overcome.

Lastly, drilling costs continue to be burdensome. A traditional natural gas fracking well averages 6,000 to 10,000 feet, and traditional, commercial geothermal wells in geologically "hot" areas can be as little as 500 feet deep. However, EGS wells can be as deep as five miles, significantly increasing drilling costs.(3)

It is important to note that geothermal technologies are not new. Famously, Iceland has been using geothermal since 1969 and currently receives a stunning 66% of their energy from this technology without worrying about blackouts or interruptions.(4) However, all 3.7 GW of the United States' current geothermal capacity comes from traditional wells that are concentrated in the western U.S. and require deep wells in particularly geologically active areas. The geographic isolation of these "hot spots" also makes transmitting the electricity to large population centers extremely costly when compared to abundant natural gas and, historically, coal.

IMPORTANT NUMBERS

- In 2023, geothermal energy supplied 0.4% percent of the United States electricity consumption.
- Geothermal plants maintain a capacity factor of 90-95%.
- It takes roughly 5 acres to produce one megawatt of electricity from geothermal.
- Geothermal systems maintain an efficiency factor of roughly 12%.
- Geothermal has a levelized cost of $61-$112 per megawatt.
- DOE's Enhanced Geothermal Shot initiative aims to increase geothermal power capacity by up to 100 GW by 2050.
- More than 780 MWs of letters of intent and power purchase agreements for geothermal energy have been signed since 2023.
- $900 million in private capital have been channeled toward next-generation geothermal technologies and projects in the past five years.

RELEVANT STATUTES

- **Geothermal Steam Act** – This law, enacted in 1970, is the foundational statute outlining federal land leasing for geothermal power generation. The law allows the Secretary of the Interior for geothermal resource development on various types of public lands, as well as establishing regular, reoccurring lease sales.
- **Energy Policy Act of 2005** – This landmark 2005 energy policy statute establishing categorical exclusions (CATEXs) for oil and gas drilling technology, which is the same technology as geothermal drilling. The Energy Policy Act of 2005 also removed the ability for BLM to issue noncompetitive leases and moved away from the determination of "Known Geothermal Resource Areas." Expansion of CATEXs to apply to geothermal leasing would use those established for oil and gas under this statute as a baseline.
- **One Big Beautiful Bill Act** – This law extended the 48E Clean Electricity Investment Tax Credit (ITC) and 45Y Clean Electricity Production Tax Credit (PTC) to expire in 2033. The tax credits, originally established by the Inflation Reduction Act of 2022, apply to investors in commercial geothermal projects and the companies generating geothermal power, respectively. The 48E credit provides a base 6% tax reduction on capital expenditures on qualified clean electricity facilities. The 45Y credit provides a base credit of 0.3 cents per kilowatt hour of electricity produced at a qualified facility.
- **Federal Lands Policy and Management Act** – This law, enacted in 1976, established the Bureau of Land Management and outlined its authority to determine Resource Management Plans (RMP, §1712). An RMP is a detailed document that outlines exactly how the BLM will manage its surface and mineral estate, including for the extraction of oil and gas. This bill also establishes the 'multiple use' doctrine, which provides that public lands must be maintained for the continued use of their natural resources.
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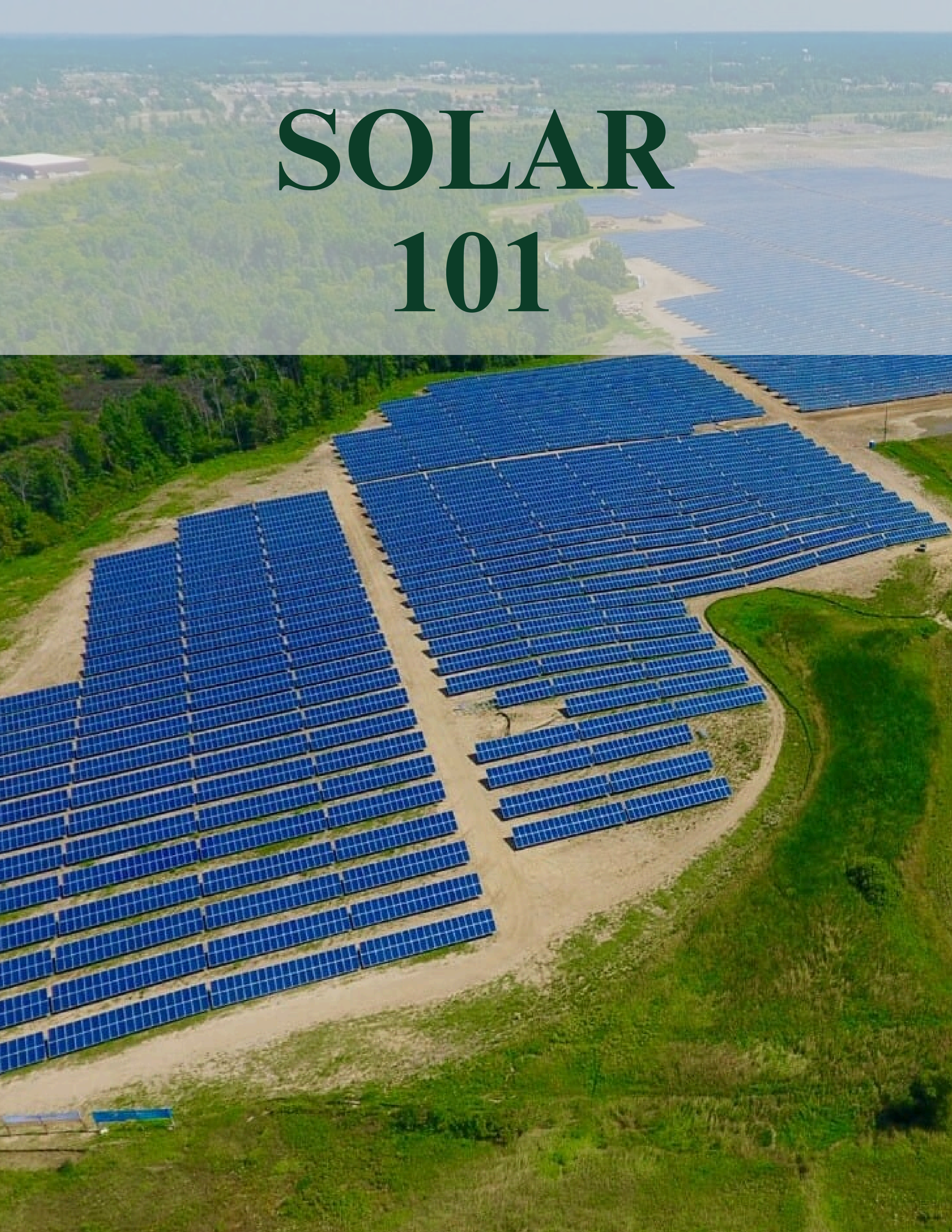
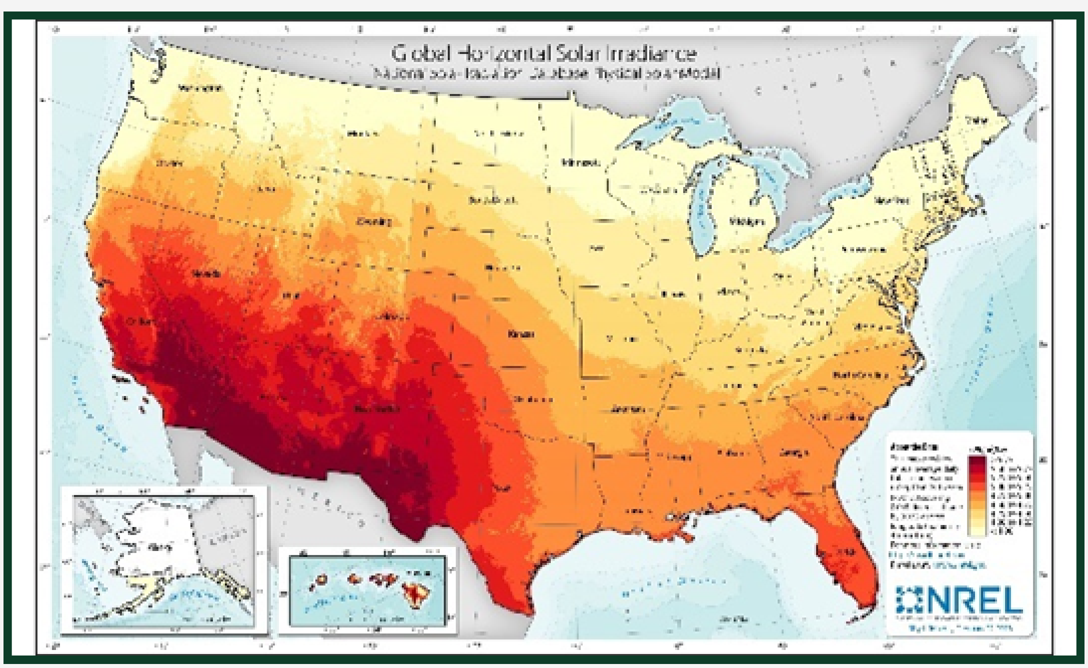
SOLAR 101



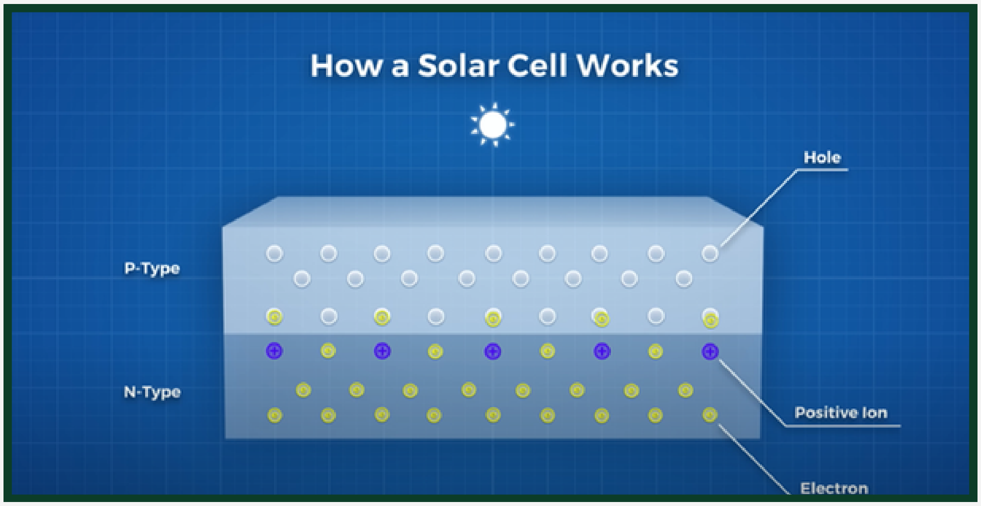
WHY IS IT IMPORTANT?

The Western United States boasts arguably one of the most productive solar fields in the world with at least 12 States able to produce 5 KWH per square meter or more each day[1]. Solar energy is unique in that it has no fuel cost, meaning it can avoid what is typically the costliest ledger item for most energy generation sources. If we focus purely on electrons and do not incorporate infrastructure or reliability costs, solar energy is one of the cheapest energy generations methods that exists today. As expected, its most obvious advantage is that it produces no particulates or emissions, which is an overall boon to public health. Lastly, an often-overlooked benefit of solar energy is that it requires very little water to operate. Typically, one megawatt-hour of solar electricity requires 20 gallons of water to operate, compared to 2,803 gallons for a gas plant and 19,185 gallons for a coal plant[2]

The United States now has 235 gigawatts of installed solar capacity and has increased its total energy generation from solar by roughly 28% each year[3]. Despite these increases, solar faces numerous challenges. Solar only represents 3.9% of domestic electricity generation[4] despite trillions of dollars in private and public investment. Likewise, solar energy struggles due to an onslaught of litigation. For example, the Center for Biological Diversity sued the Biden Administration in 2024 over its Western Solar Plan, which was a Resource Management Plan intended to dramatically expand solar installations in 11 Western States most suited for it. In fact, of all the Department of Energy's 2023 National Environmental Policy Act (NEPA) projects requiring either an environmental assessment or environmental impact statement (both laborious processes ripe for litigation), 42 percent were related to either clean energy, transmission or environmental conservation, while only 15 percent were related to fossil fuel[5].



HOW DOES IT WORK?

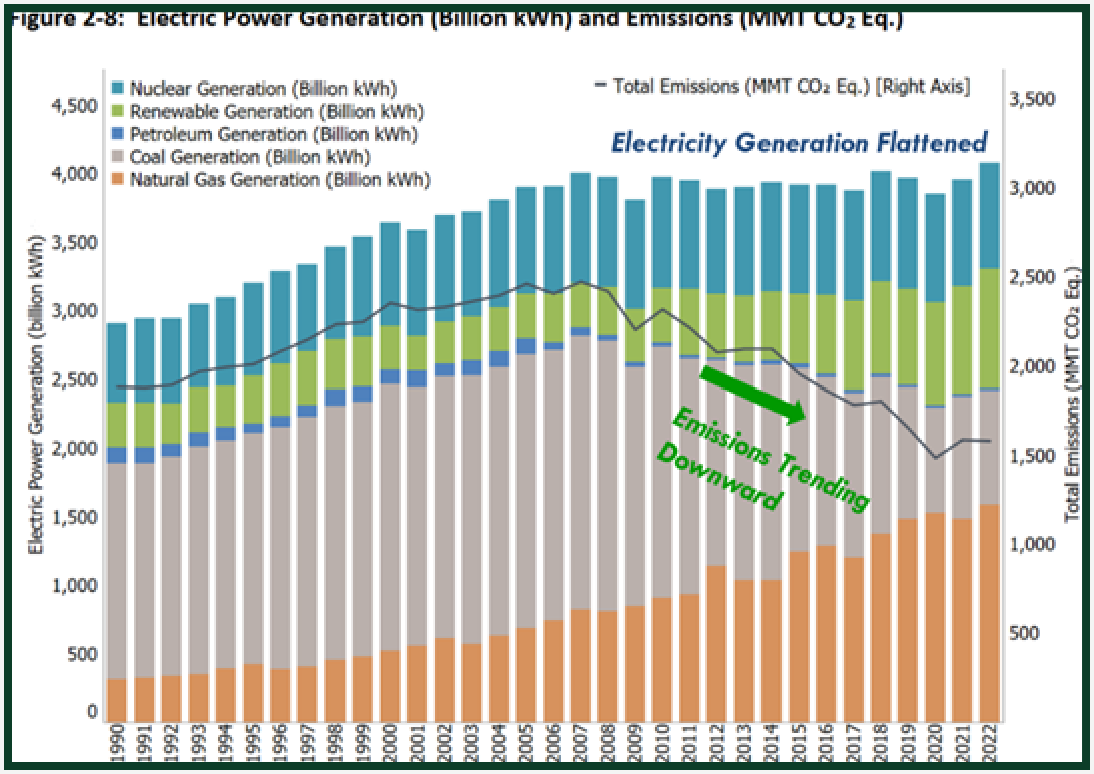


Solar cells begin by mining silicon, phosphorous and boron, all of which are critical minerals on the U.S. Geological Survey (USGS) list, from natural deposits in the earth. They are then interwoven into a silicon-based crystal lattice that is separated by a depletion layer. The technology is complex, but what is important to know is that the phosphorous layer (Positive, P-type) loses an electron when it is excited, or 'hit' by a photon from the sun. This loose electron then tries to fill an empty electron hole in the valence shell of the Boron layer (Negative, N-type) below it. The electron is allowed to pass from P-type to N-type by a wire, which is how we use the electrons to perform their electrical duties.

For optimal performance, a solar panel needs to be angled between 30 and 45 degrees and face the south. As many are familiar with, solar panels cannot produce electricity when they are covered with debris, when it is cloudy, or when the sun isn't out. Clouds, for example, can reduce a panel's output by up to 25%[6]. For these reasons, solar panels require duplicative infrastructure, typically in the form of natural gas, which is deployed when solar panels cannot move electrons. Consumers are required to pay for both of these systems, whether they are generating electricity or sitting idle.

Another feature of solar panels is that they cannot regulate when they produce electricity. The grid is designed to only be able to accept a certain amount of electricity at a given time – too much will damage or destroy infrastructure, and too little will cause a blackout. Solar panels across a geographic region will produce electricity all at once or not at all. The problem is that producing electricity at the same time can flood the grid which results in negative pricing. A negative price for solar electrons means that solar generators are producing more energy than is needed or can be maintained and thus must pay other utilities to take their excess generation[7]. Negative pricing is a poor sign for continued investment and dissuades potential investors from installing further solar generation.

While total generation from renewables has increased, the percentage of renewables within the total energy generation mix has stayed relatively flat and has even declined in recent years, as shown here by the EPA.



To increase reliability, solar generators have increasingly looked to batteries to absorb excess generation and place it back onto the grid when the panels themselves are not producing. While this memo won't get into the details of how a lithium-ion battery works, it is important to note that their cost and short service lifetime dramatically cut into solar's cost-competitiveness[8].

Contrary to public opinion, solar cells are not a new technology. The first solar cell was created in 1883 by Charles Fritts but was extremely inefficient and maintained an efficiency factor of just 1%. However, the concept has been well known since then. Vanguard 1, the first spacecraft to use solar cells, was launched in 1958. Efficiency factors have been increasing for a while – modern day panels can reach efficiency factors of roughly 20% in the real world, and above 40% in laboratory conditions[9].

Lastly, it should be noted that integrating renewables poses a unique challenge to the grid. The grid is designed to maintain a 60 Hertz alternating current frequency – it can tolerate no more and no less. Traditional energy, like gas, coal, and nuclear, spin massive turbines to create electricity. These turbines are designed with special gearboxes to match the 60hz requirement. The physical spinning of the turbine creates what is called rotational inertia, and it is this inertia that stabilizes the electrical flow in the grid so that it can tolerate the addition or subtraction of other generating units all across the footprint of the grid. Because renewables like wind and solar do not have large spinning turbines, they do not create an alternating current and therefore produce no frequency. Therefore, they must convert their direct current into alternating current via an expensive device called an inverter. While the inverter turns direct current into alternating current, it does not create rotational inertia, which makes the grid more susceptible to blackouts and general instability[10].

Roughly 78% of finished solar panels come from China[11], and a similar percentage of the raw materials in these panels also come from China (pg. 8)[12]. In 2024, the Biden Administration reinstated tariffs on solar panels from China and its Asian partners after a two-year exemption in an attempt to protect the American solar panel industry[13].

IMPORTANT NUMBERS

- In 2023, solar energy supplied 3.9% percent of the United States electricity consumption[14] and 1.4% of overall energy production.
- Solar panels have a capacity factor of 10-25%.
- It takes 43.50 acres to produce one megawatt of electricity from solar.
- Solar panels have an efficiency factor of roughly 20%.
- Solar maintains a full-system levelized cost of roughly $413 per megawatt[15].
- Wind and solar combined received $8.3 billion in tax subsidies in 2024, with solar receiving $5.9 billion. This amount was 10.3 times higher than fossil fuel subsidies for 2024 ($800 million)[16].
- Silicon, Boron, and Phosphorous are all included on the USGS critical minerals list. Silicon, the most prominent material, is produced widely in the United States. Unlike other materials, the United States is less than 50% reliant on other countries for silicon imports. Likewise, Boron and Phosphorous are also produced domestically, but are considerably more expensive than foreign counterparts.

RELEVANT STATUTES

Federal Lands Policy and Management Act – This law, enacted in 1976, established the Bureau of Land Management and outlined its authority to determine Resource Management Plans (RMP, §1712). An RMP is a detailed document that outlines exactly how the BLM will manage its surface and mineral estate, including for the extraction of oil and gas. This bill also establishes the 'multiple use' doctrine, which provides that public lands must be maintained for the continued use of their natural resources.

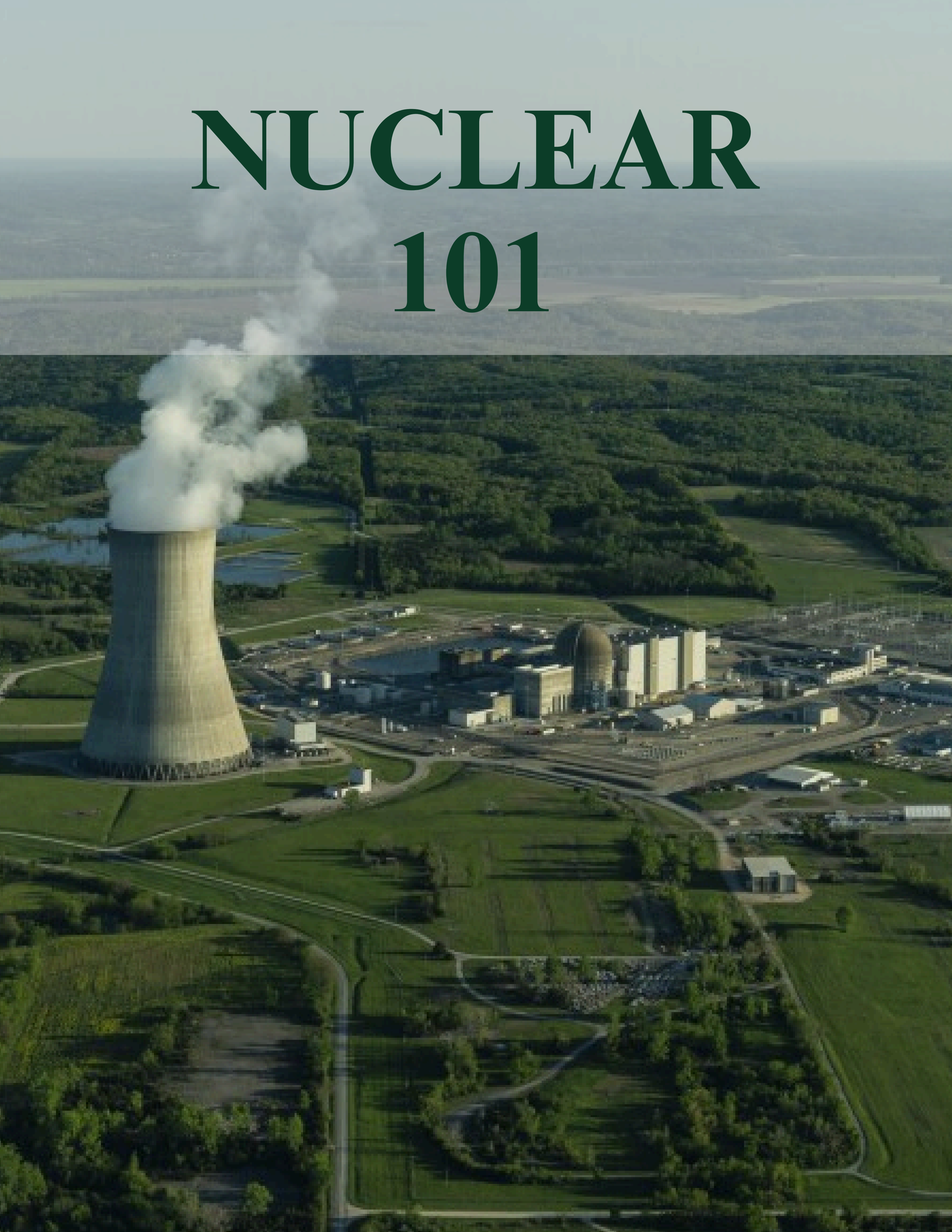
Antiquities Act - The Antiquities Act, signed into law in 1906, gives the President the authority to designate as a monument any historic landmarks, historic and prehistoric structures, or other objects of historic or scientific interest that are present on federal land. The law compels the President to reserve "the smallest area compatible with the proper care and management of the objects to be protected."

Federal land that has been designated as a monument is precluded from many, if not all, recreational or extractive activities. Use of monument proclamations since 1996 has been warped to lock up federal lands from new mineral leases, mining claims, prospecting or exploration activities, and oil, gas, and geothermal leases. There is no requirement that Congress approve a presidential monument designation, though Congress does have the ability to designate its own monuments. Monument designations also do not need to pass through any State, local, or tribal approval process, meaning the President may ignore formal opposition by affected entities in or near the monument designation without any legal recourse or veto power on their end.

Energy Act of 2005 - This bill contained provisions of the Public Lands Renewable Development Act which allowed the Secretary of the Interior to unilaterally adjust rental and megawatt capacity fees for renewables on public land. It also established the Investment Tax Credit (ITC) which has been the largest and most consequential tax incentive for this industry.

Inflation Reduction Act – This law, passed in 2022, significantly expanded both the investment tax credit and production tax credits to the cost of trillions of dollars. It also combined these credits into a tech-neutral credit which took effect in January of 2025. It also established direct pay and transfer of tax liabilities that let non-profits and other groups implement solar while taking advantage of the expanded tax credits.

NUCLEAR 101



WHY IS IT IMPORTANT?

The United States is the father of nuclear technology, having invented the first nuclear generation facility in history at the EBR-1 plant in Idaho in 1951. Today, the United States produces by far the largest amount of nuclear energy at 31% of all global production.[1] Nuclear is perhaps one of the most unique forms of electricity production—generating massive quantities of consistent baseload power without any carbon emissions.

The United States began producing nuclear power in 1958 and peaked in 1997 with 112 operating reactors that put out 99,624 megawatts (MW).[2] Today, there are 54 nuclear power plants with 94 nuclear power reactors across 28 states (one plant can have multiple reactors, such as the Vogtle Electric Generating Plant in Georgia).[3] However, construction and production have slowed down dramatically. The most recent plants to come online were the Vogtle Units 3 & 4 reactors in Georgia, the most recent of which began supplying power in 2024. Prior to this, the most recent reactor was the Watts Bar Unit 2 reactor in Tennessee which began construction in 1973, halted in 1985, resumed in 2007, and finally came online in 2016. The average age for a reactor in the U.S. is 42 years old.[4]

HOW DOES IT WORK?

Nuclear fuel, primarily uranium, is obtained through a multi-stage process: mining, milling to create uranium oxide concentrate ("yellowcake"), chemical conversion to uranium hexafluoride, and enrichment to increase the isotope concentration. Finally, the enriched uranium is fabricated into solid ceramic fuel pellets for reactors.

The process begins by mining uranium. The most common naturally occurring uranium isotope is uranium-238 (>99%), but roughly .7% of mined uranium is isotope uranium-235 – the most abundant fissile isotope, which a vast majority of nuclear power reactors use as fuel. So through a process called enrichment, U-235 concentration is increased from 0.7% to the level required.

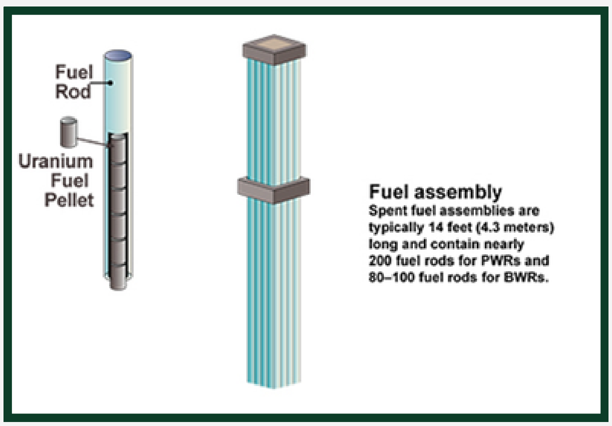
Most uranium produced globally is mined in Kazakhstan, followed by Canada and Australia.[5] Domestic uranium mining occurs primarily in Wyoming, New Mexico, and Colorado, though current production levels cannot supply the domestic nuclear reactor fleet. Therefore, with uranium at prices today, the U.S. nuclear industry is dependent on cheaper foreign sources.

After the uranium has been mined, it is crushed and heated to form a yellow powder known as yellowcake. Yellowcake is the solid form of mixed uranium oxide and is commonly referred to as (U_3O_8), because that chemical compound historically comprises the majority of the yellowcake produced. However, to enrich the uranium, it must first be converted to a gas form. So, large-scale conversion plants are used to convert the yellowcake into uranium hexafluoride (UF_6) for enrichment processes.

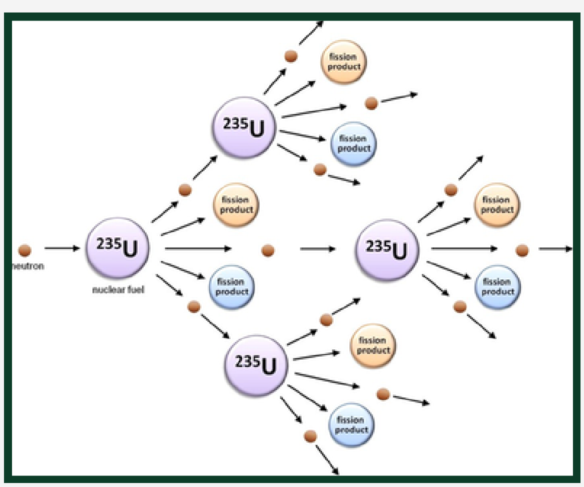
Next, the content of U-235 is increased to the content required for fuel at a separate enrichment facility. In all commercial plants currently, the UF_6 gas is spun incredibly fast in centrifuges. Because UF_6 molecules containing U-238 are about 1% heavier than those with U-235, the two isotopes separate slightly in the centrifuge as it spins. This process is repeated thousands of times until the concentration of U-235 reaches the level required for its designed activity.

Traditional light-water reactors (which encompass all functioning reactors today) use a U-235 concentration of roughly 3 to 5%. More advanced reactors use high-assay low-enriched uranium (HALEU) with a concentration of 5%-20%. Enriching uranium beyond 20% is under strict regulations.

The enriched UF_6 is then transported to a fuel fabrication facility, where it is converted into uranium dioxide (uO2) powder that is made into fuel pellets about the size of a gummy bear. The pellets are stacked into rods and joined together in a fuel bundle or assembly, which can be loaded into a reactor.

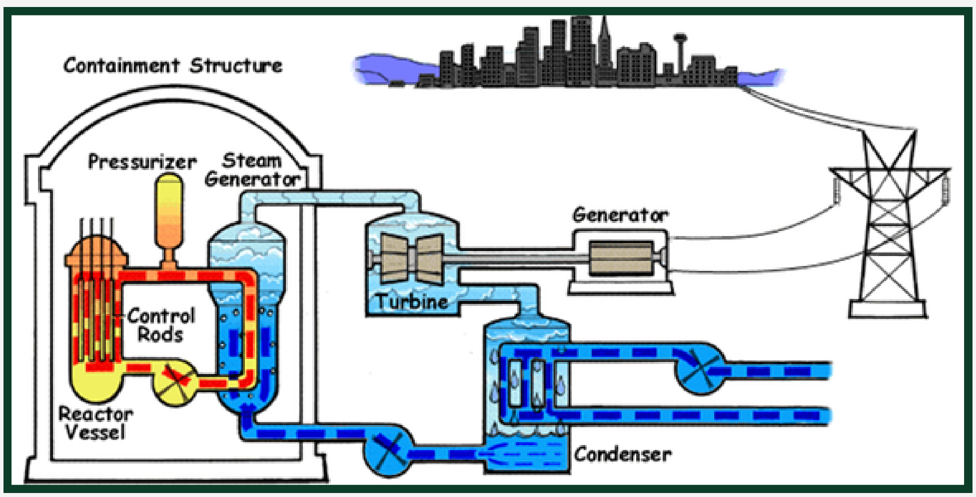


Reactors use the fission properties of U-235 to generate energy. When a neutron hits a U-235 nucleus, the uranium nucleus can split into two "daughter" products. The split will also release multiple neutrons that could go on to split other nearby nuclei, causing a chain reaction. This process is called fission. When the uranium splits, it also releases a large amount of energy in the form of heat. Reactors are designed to contain this energy and use it to generate electricity by producing steam to drive a turbine.

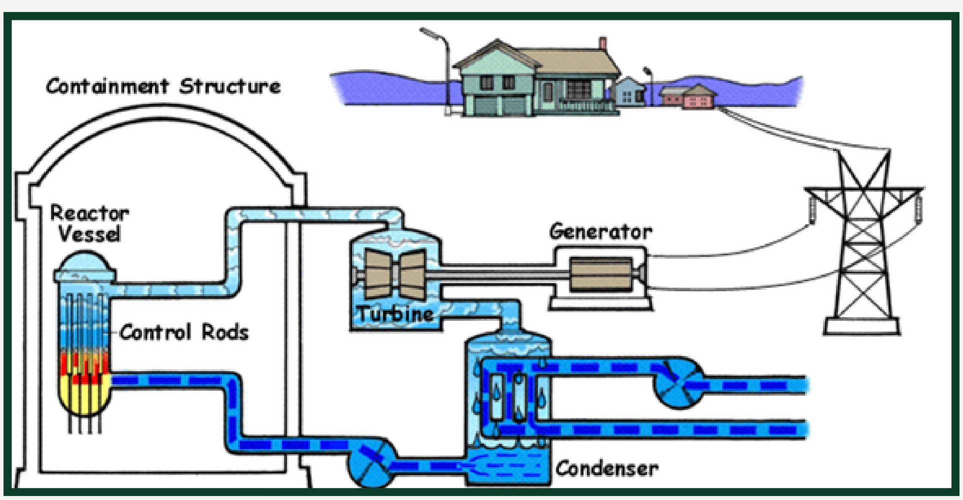


Fuel bundles are loaded into the reactor core, and inside the core, fission takes place: U-235 nuclei split, releasing neutrons and energy in a controlled chain reaction, moderated by water and controlled by control rods. Water helps slow down, or “moderate” neutrons, which makes them more likely to cause fission. To control the heat (produced by the energy released in fission), control rods are lowered into the active region of the reactor core, between the uranium fuel rods in order to absorb many, but not all, of the released neutrons. This helps regulate heat and power production, keeping the reactor within acceptable operating limits.

The high temperature water inside the reactor is used to create steam either directly or indirectly, depending on the reactor design. In the U.S. commercial nuclear fleet, 65% of reactors use high-pressure water to generate steam in a secondary loop (pressurized water reactors [PWRs]), while approximately one-third boil water directly in the core (boiling water reactors [BWRs]).[6] The steam expands into a steam turbine, which spins to generate electricity, and then is recycled back into water in a condenser. Note that the water molecules that pass through the reactor core are contained in a closed water loop and are never released to the environment. In all cases, water in a separate loop inside a condenser is used to cool the unused steam back into water to be used again in the heat process.



Pressurized Water Reactor (source: NRC)



Boiling Water Reactor (source: NRC)

NEXT GENERATION NUCLEAR

Reactors can be categorized into different generations based on their design. Generation I were the experimental and prototype reactors from the 1950's. Generation II reactors, typically called light-water reactors, were built primarily in the 60's through the 80's and represent the largest share of reactors operating today (described above). These reactors have provided millions of Americans with consistent, baseload power for 50+ years with a strong safety record and represent significant advancements in safety and cost-effectiveness.

Advanced reactors are generally classified as either Generation III+ or Generation IV.[7] What makes an advanced reactor unique is that in addition to supplying bulk power to a large part of the grid, they can also be built to provide smaller amounts of localized power or process heat that may be scaled up and down; a trait that has been less common in nuclear energy thus far. Many new reactor designs are also smaller (less materials) and simpler (easier to construct), which can make these reactors potentially lower in total project cost and easier to deploy than traditional reactors. Most advanced nuclear reactor designs incorporate passive safety systems that perform their safety function without operator action and by relying on natural physical principles (e.g., gravity). This is distinct from active safety systems of previous generations, which rely on powered pumps, valves, diesel generators, and control logic – though many reactors use a combination of active and passive features or systems.

However, these reactors can also be categorized based on size, either "Small Modular Reactor" or "Microreactor." Microreactors are designed to be fully factory fabricated and typically produce power up to 50MWe of electricity. SMR's utilize factory fabrication for large components and modules. They typically generate approximately 300 MWe, while advanced large power reactors, like those recently installed at the Vogtle plant, generate over 1100 MWe.

Advanced reactors encompass a large variety of reactor technologies. Some, like Vogtle 3 & 4, use traditional light-water technologies, while others are designed to use non-water coolants like molten salt, liquid metals, or high temperature gas or use advanced fuels like TRISO or liquid metals.[8] Despite authorization from Congress, no commercial SMRs or microreactors have been built in the U.S. yet, though several are currently being permitted. There have been two AP1000 plants deployed at site Vogtle in Georgia.

COST & ECONOMICS

Nuclear power costs are characterized by very high upfront capital construction expenses, but low, predictable operating costs after they're built that can last 60, 80 and maybe even 100 years. Advanced nuclear has an important role to play in our energy future, but barriers exist for new builds in both regulated and competitive electricity markets in the U.S. due to the increased cost and risks associated with early movers and first-of-a-kind deployment. For example, the Vogtle plant experienced cost overruns and construction delays.[9] The project had many well-documented challenges to overcome - the impact of Fukushima, bankruptcy of the prime contractor on the site and the global pandemic.[10] The nuclear industry has focused on lessons learned which Southern Company is committed to sharing with the industry as they embark on their own projects. The more you build the better you get, and countries like South Korea and China have demonstrated costs go down when you have a sustained program of new builds. In fact, Southern Company achieved approximately a 20% improvement in cost from Vogtle 3 to Vogtle 4.[11]

Nuclear-related financing is growing, and nuclear-related acquisitions and public offerings are on the rise. In 2024, the private sector transaction value in nuclear was more than the prior four years combined. Companies are making big moves to deploy nuclear energy and sending a clear signal to the marketplace. New nuclear partnerships with tech customers (like Amazon and Google) total more than 30 gigawatts of commitments across the U.S., and the numbers keep growing.

REGULATORY

The NRC licenses and regulates commercial nuclear energy. The NRC enforces its regulations with inspections, can levy fines—and can even order a plant to shut down. Every nuclear plant is assigned at least two full-time on-site NRC inspectors, who are free to observe anything at the plant at any time. Other countries look to the U.S. as the leader in nuclear operations because we have the safest nuclear power sector in the world. However, some regulations have become obsolete or are cumbersome, and new technology that could dramatically improve safety stays mired in antiquated processes.

Regulatory burdens have created some of the largest roadblocks to nuclear development. Nuclear power developers must pay for every step of the licensing process through the Nuclear Regulatory Commission (NRC), which is required to recoup 90% of its costs in licensing projects.[12] Uncontested mandatory hearings—hearings required for licensure even if the application is not contested by any entity—add time to projects, while NRC fees, labor salaries, and interest on loans compound development costs.[13]

That said, between the provisions of the Nuclear Energy Innovation and Modernization Act (NEIMA), the Nuclear Energy Innovation Capabilities Act of 2017, the ADVANCE Act of 2024, and the (4) Executive Order's signed in May 2025 intended to strengthen U.S. nuclear energy leadership and facilitate increased deployment of new nuclear reactor technologies, many of industry's concerns have been, or are being, addressed.[14]

In response, the NRC has made significant progress in reducing regulatory burden. NEIMA pushed for a technology-inclusive Risk-Informed Performance-Based (RIPB) changes to the regulations which was reemphasized in the ADVANCE Act. The ADVANCE Act further included a provision for a reduced hourly rate for advanced reactor applicants and pre-applicants under the NRC's FY2025 final fee rule which is >50% below the full-cost professional rate. The U.S. DOE also implemented a licensing cost share program that early movers can apply for to reduce cost burdens associated with licensing and permitting.

The NRC is also undertaking a review and wholesale revision of its regulations and guidance documents with over two dozen rulemakings planned for 2026, including a Technology-Inclusive Regulatory pathway promulgated under 10 CFR Part 53 and a "high-volume" licensing pathway promulgated under 10 CFR Part 57. If done right, these and the other rulemakings to revise the existing licensing pathways could result in greatly reduced regulatory costs and burden, without impacting the robust safety assessments to protect the public health and safety as required by law.

INSURANCE

Financial protection provided under the Price-Anderson is a crucial aspect of nuclear power generation. Established by the Price Anderson Act of 1957 ("Act"), this unique financial protection structure protects the public from losses related to bodily injury and property damage resulting from the hazardous properties of radioactive materials. The Act protects the public by ensuring a large source of funds are available to provide prompt compensation for injuries or damage resulting from a nuclear incident. At the same time, the Act encourages investment in the nuclear energy industry by providing limits on liability, as well as a predictable and efficient system for claims management and administration of funds.

For large commercial reactors, the financial protection requirements of the Act are met through private insurance which is provided in two layers. First, each licensed nuclear plant site must be covered by the maximum liability insurance commercially available, currently $500 million per site. The second layer is provided through a "retrospective premium" of pooled funds from every reactor in the country. This equates to $165.9 million per reactor that covers liability resulting from an incident that exceeds the $500 million provided by the primary layer of insurance. These two layers currently provide roughly $16 billion in coverage per incident. If liability resulting from a single incident exceeds this amount, the Act states that Congress will take whatever action is necessary to provide full and prompt compensation.[15]

SPENT NUCLEAR FUEL

Spent nuclear fuel, sometimes incorrectly referred to as "nuclear waste," consists of ceramic uranium fuel pellets that are retrieved from reactors once they reach their licensed performance limits. These pellets still contain more than 90% of their potential energy, even after typically four to six years of operation in a reactor, and can potentially be recycled for future power generation in reactor.[16]

Once the nuclear fuel is ready to be removed from the reactor, operators remove the bundles or assemblies into a deep cooling pool, where they will stay for several years.[17] After a few years, the fuel has cooled and its radioactivity decreased enough for it to be removed to free up space in the pool to store spent fuel newly removed from the reactor. The fuel assemblies are placed into sealed metal cylinders that are filled with an inert gas. The steel canister provides leak-tight confinement of the spent fuel in a configuration that prevents nuclear fission from occurring. Each canister is further encased in large casks of steel and concrete to provide radiation shielding to workers and members of the public and to allow passive heat removal.[18] These dry casks are tested to withstand extreme weather events and intentional human attacks. Since the first casks were loaded in 1986, dry storage safely stored spent fuel without any harmful radiological releases to the public or the environment. Right now, all of the commercial spent nuclear fuel that a power plant generates in its entire lifetime is stored in dry casks or in spent fuel pools.

There is currently no large-scale, permanent repository for spent nuclear fuel in the United States. However, all of the spent nuclear fuel that the U.S. nuclear industry has created since the 1950s takes up relatively little space, and it's all safely contained. The entire amount of spent nuclear fuel created in the United States would fill one football field, ~10 yards deep. By comparison, a single coal plant generates far more waste by volume in one year than the nuclear industry has during its entire history.[19]

IMPORTANT NUMBERS

- Nuclear provides 20% of U.S. electricity generation, 53% of non-fossil fuel electricity, and 9% of total energy production.
- Nuclear plants have a thermal efficiency of 33%.
- Nuclear plants have a capacity factor of over 90%.
- It takes roughly 12.71 acres to produce one megawatt of electricity from nuclear.
- The average total generating cost to produce nuclear electricity was $31.76/MWh in 2023.
- A uranium fuel pellet (~0.5" in height and diameter) contains energy equivalent to 1 ton of coal,149 gallons of oil or 17,000 cubic feet of natural gas. A typical 1 GW reactor holds 18M pellets.
- Spent nuclear fuel still contains more than 90% of its potential energy.

RELEVANT STATUTES

Atomic Energy Act of 1954 (AEA) – Described by the NRC as "the fundamental U.S. law on both the civilian and the military uses of nuclear materials," this law legalized the development of commercial nuclear energy technology. The law released restricted government data on nuclear technology to private companies for this use, as well as established the Atomic Energy Commission (AEC), ushering in the first generation of commercial nuclear reactors.

Price-Anderson Act of 1957 – This law established the three-tiered Price-Anderson insurance structure for civil nuclear operators in the event of a nuclear incident, managing liability and ensuring compensation.

Energy Reorganization Act of 1974 – This law split the functions of the Atomic Energy Commission between two new departments: the NRC and the Energy Research and Development Administration, which would eventually become the Department of Energy. The law established the NRC as an independent agency responsible for regulating civilian nuclear power plants and materials, whereas the Energy Research and Development Administration would focus on the development of nuclear technology, among other energy technologies.

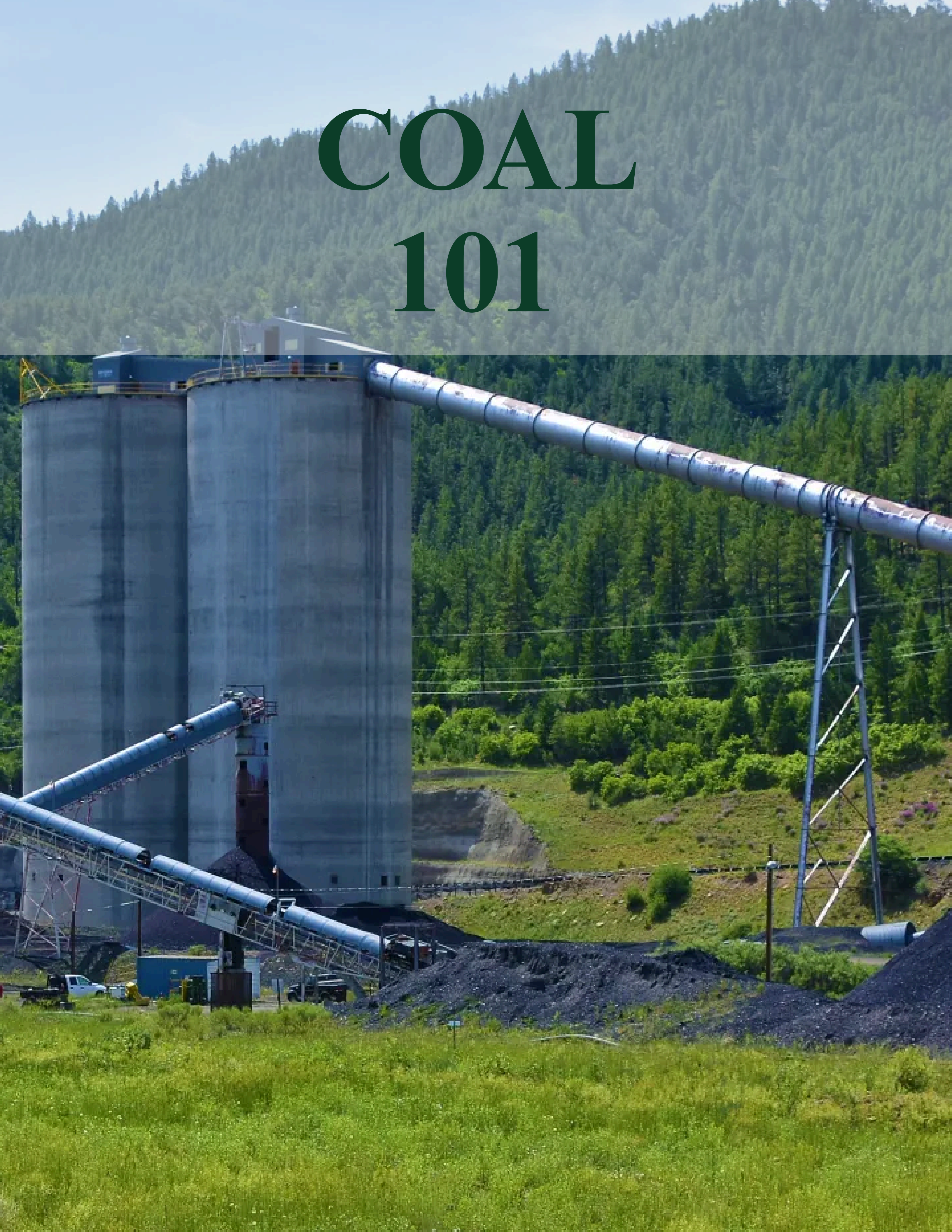
Energy Act of 1992 – This 1992 energy law laid the groundwork for modern-day advanced nuclear reactors, acting as a bridge between Cold War-era generations of nuclear power and modern reactor designs. This law established combined construction and operating licenses (COLs) and standardized design certifications at the NRC. It also enabled technology-neutral regulation of nuclear technology, paving the way for modern designs that use sodium, molten salt, or gas. Most notably, the law reformed the NRC's licensing outlook, viewing nuclear reactors as manufacturable products instead of one-off megaprojects, which is essential to today's advanced reactor renaissance.

Energy Act of 2005 – This landmark energy law sought to restart the stagnant civil nuclear industry. The law directed the establishment of a prototype nuclear power plant using modern technology. It also authorized federal loan guarantees for nuclear plants to lower the cost of capital for investors, which was critical to the eventual construction of Vogtle Units 3 & 4. The 2005 Energy Act also established a production tax credit (PTC) for the first 6,000 MW of new nuclear power generation brought online after its enactment.

Energy Act of 2020 – This 2020 energy law was foundational to shifting civil nuclear energy policy to focus on advanced reactors. Most notably, the law established the Advanced Reactor Demonstration Program, which is a cost-sharing demonstration project to bridge the gap between R&D of advanced reactors and commercial deployment. It also directed the DOE to establish a domestic HALEU supply, which is essential for fueling advanced reactors. Finally, the law expanded national lab, university, and industry partnerships for nuclear R&D and improved licensing timelines at the NRC.

ADVANCE Act of 2024 – This 2024 law made substantive changes to the NRC's licensing new reactors and fuels, while maintaining the NRC's core safety and security mission. The ADVANCE Act implemented initiatives for efficient, timely, and predictable license application reviews, and established an expedited procedure for reviewing qualifying new reactor license applications. It also developed regulatory pathways for microreactors and fusion energy technology.

COAL 101

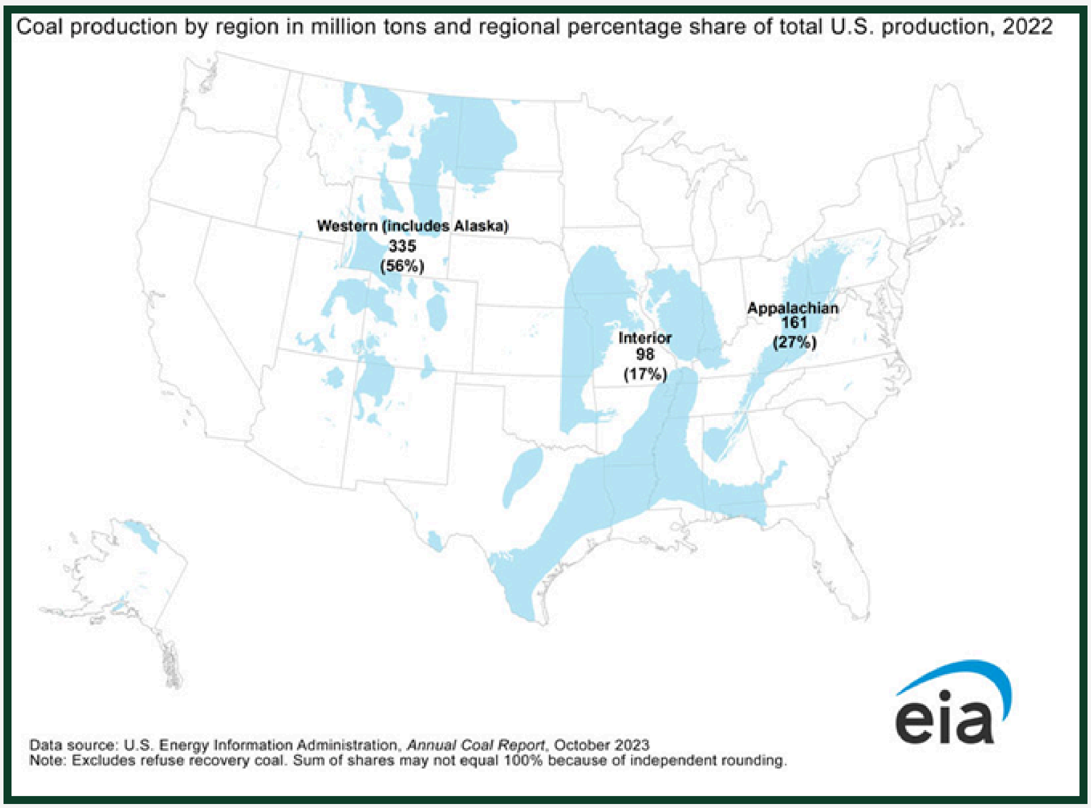


INTRODUCTION

Coal is one of the most important energy resources on the planet, and it is considered the most abundant, domestically produced energy resources in the United States. Coal generates nearly 40 percent of global electricity and 17 percent of all U.S. electricity. Coal accounts for nine percent of total U.S. energy consumption, nearly all of which comes from the power sector.[1] At current consumption rates, the U.S. has more than 250 years of remaining coal reserves. Its reliability as a fuel source makes it an essential piece of American energy security.

The United States tops the list of global proved coal reserves, holding 22 percent (1.16 trillion short tons) of the world's reserves.[2] The U.S. is also the fifth largest coal exporter, exporting nearly 600 million metric tons annually.[3] Like oil and gas, coal is a commodity that is traded in worldwide financial markets, which determine the benchmark price of a ton of coal based on global supply and demand.

Coal is mined in 26 states across the U.S. in three large regions: the Appalachian Coal Region, the Interior Coal Region, and Western Coal Region. Wyoming mines the most coal, followed by West Virginia, Kentucky, Pennsylvania, and Texas.[4]



TYPES OF COAL AND ITS USES

Coal is an organic energy source formed after millions of years of pressure and heat compacting decayed plant materials, known as coalification. The result is a tightly compressed compound of carbon packed with potential energy to be released through combustion. There are four basic types—or ranks—of coal, with the higher ranks like bituminous and anthracite being ideal for commercial use due to their chemical and physical composition and energy content.[5]

1. Lignite: The lowest rank of coal with the lowest energy content, containing 25-35 percent carbon. Lignite is crumbly, has high moisture content, and accounts for about 7 percent of U.S. coal production.
2. Subbituminous: Typically contains 35-45 percent carbon and accounts for about 44 percent of the coal produced in the U.S.
3. Bituminous: The most abundant coal found in the U.S. and was formed under high heat and pressure and therefore has two to three times the heating value of lignite. Bituminous coal contains 45-86 percent carbon and accounts for about half of U.S. coal production.
4. Anthracite: Very rare in the U.S., accounting for less than 0.5 percent of domestic coal production. Anthracite coal contains 86-97 percent carbon and has a heating value that is, on average, slightly higher than bituminous coal.

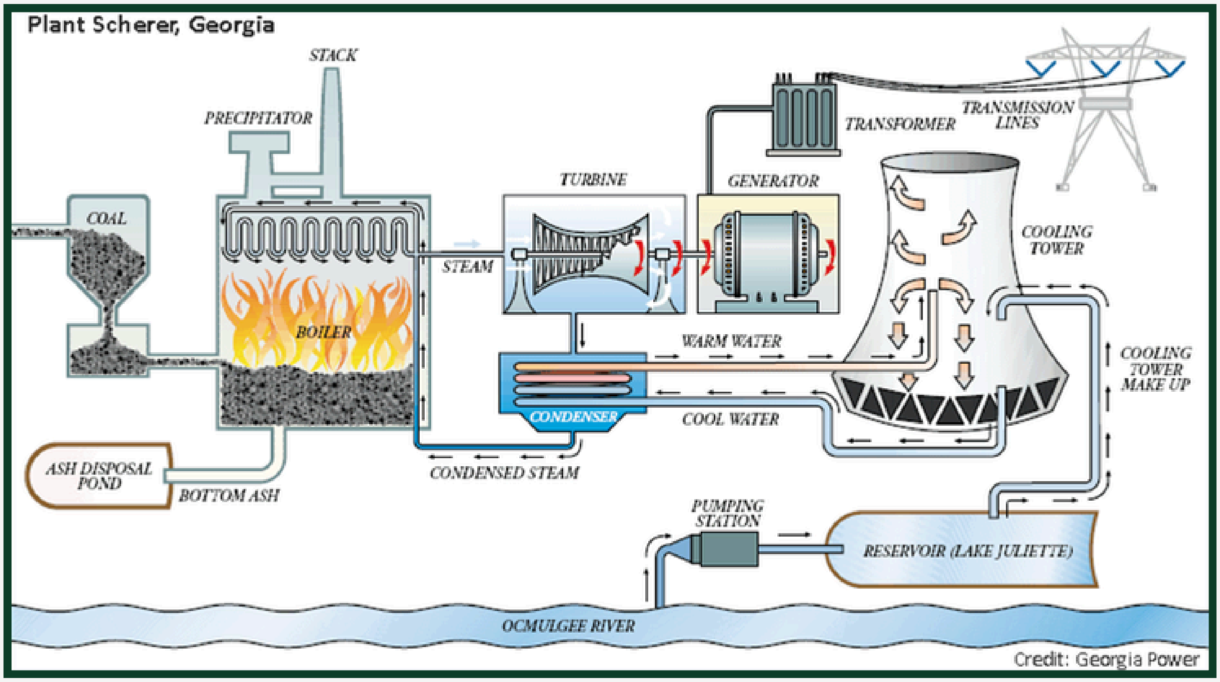
Metallurgical and thermal coal are two distinct grades of coal. Coal grades are distinguished by their sulfur content and the amount and type of ash, as well as their commercial use. Metallurgical coal, sometimes called met or coking coal, is used for steel production. Met coal is primarily used to produce coke, which results from heating coal with a specific set of properties in the absence of oxygen. Coke is then mixed with iron ore and limestone, and the resultant mixture is heated and processed to make steel.[6] It takes around 770 kilograms of coal to make one ton of steel, with approximately 70 percent of global steel produced in basic oxygen blast furnaces.[7]

Thermal coal is used in boilers to generate steam to produce electricity or for other purposes. The Energy Information Administration (EIA) broadly defines thermal coal, also referred to as steam coal, as encompassing all coal not classified as met coal.[8] According to the Congressional Research Service, “Met coal can be used for the same purposes as steam coal, but because met coal is less abundant than steam coal, it generally commands a higher price than steam coal. Therefore, steam coal is the type of coal most often used for electricity generation.”[9]

COAL SUPPLY CHAIN

Coal can be mined either underground or from open-pit surface mines, the latter accounting for the majority of U.S. coal production. Underground mining techniques utilize machinery to drive tunnels under the surface of the land. These tunnels are situated in coal seams; as the machinery advances further underground, coal is removed using a combined system of vehicle haulage and conveyor belts. Surface coal mining techniques involve the mechanical removal of overlying native earth and rock, or "overburden," to reach underlying coal seams.[10]

After extraction from the ground, coal requires very little chemical conversion prior to use. Coal is subject to pre-processing steps like crushing, screening, and washing to eliminate impurities to maximize its effectiveness during industrial or commercial use. It is then transported via rail, barge, or truck to the end user.[11]



Coal-fired power plants generate electricity by burning coal in a boiler to produce steam. The pulverized coal heats boilers to about 1,000 degrees to create high-pressure steam. This steam then flows into a turbine connected to a generator and spins them at around 3,600 revolutions per minute to make alternating current (AC) electricity. Water is pumped through tubes in a condenser to cool and condense the steam coming out of the turbines so it can either be passed through the system again or vented out of the system through a cooling tower.[12] It is important to note that the steam coming out of the cooling tower does not interact directly with the coal .[13]

ECONOMIC CONTRIBUTIONS OF DOMESTIC COAL

U.S. coal production has demonstrable benefits including the direct employment of more than 100,000 people and the creation of 3.2 jobs for every job in coal mining, for a total of more than 324,000 jobs. In addition, coal-based electric power plants directly employ another 70,000 employees. Coal industry jobs are high paying, with an annual average salary of a coal miner of $112,000 - nearly 51 percent above the U.S. average wage of $72,000 .

The economic activity attributable to coal mining also is subject to billions of dollars in taxation at the federal, state, and local levels.

OUTLOOK FOR US AND GLOBAL CONSUMPTION

Coal has been at the center of intense energy security and environmental debate over the last two decades. In the U.S., coal consumption peaked in 2007.[14] The use of coal experienced a sharp decline – over 50 percent over the last two decades – largely due to increased regulatory burdens, the emergence of the shale revolution and an abundant supply of domestic natural gas.

However, 2025 saw a sharp rise in U.S. coal demand. Electricity generation from coal power jumped 12 percent to meet rising power demand and in response to a 26 percent rise in the price of natural gas delivered to U.S. power plants. Economic analysis showed that the rise in coal generation shielded consumers from higher priced natural gas, providing $30-40 billion in savings.

Facing soaring electricity demand from the rapid addition of data centers, electrification and a growing economy, and warnings of rapidly deteriorating grid reliability from the North American Electric Reliability Corp., the Trump Administration has made preserving the coal-fired electricity generating fleet and boosting domestic coal production a policy priority.

The rising prominence of U.S. coal in the nation's energy policy reflects coal's ongoing global importance. Global coal consumption has also continued to grow, reaching a new high in 2025. Coal demand in Asia, notably in China, India, Indonesia and other emerging economies has been driving growth. China now consumers 30 percent more coal than the rest of the world combined.[15]

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