



Top Ten Energy Stories of 2023

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IdeaSmiths Turns 10!

Ten years ago we formed IdeaSmiths LLC to meet the needs of energy clients asking for prototype development, technical due diligence, and in-depth energy systems analysis. Our first client in 2013 was Paramount Pictures, who needed an energy prop for *Transformers 4*, which was in production in central Texas. If you watch the movie, look for a vertical axis wind turbine outside the barn of inventor Cade Yeager (played by Mark Wahlberg); that turbine was designed and built by Charlie Upshaw and Josh Rhodes over a weekend in the garage!

What started as a business for a project here and there has grown into an enterprise with a steady-stream of requests to provide high-profile analysis, expert witness support, training, and strategic advisory services.

Our work has supported some of the largest energy companies, banks and commercial entities in the world and has been cited or promoted by White House cabinet officials, executives, and journalists.

We are proud of our accomplishments from the first decade of our existence and we hope to keep supporting your needs for energy expertise in the coming decade. Thank you for being a client, friend or collaborator.

Without further ado, please find our list of top energy stories from 2023 (in no particular order).

Sincerely,

Charlie, Josh, Todd and Michael

IdeaSmiths LLC

1

What's the Hubbub? Hydrogen and Carbon Hubs Announced

The Department of Energy announced multiple “Hubs”, which are locations throughout the country focused on pilot projects for hydrogen and carbon management. Sixteen research and demonstration projects were announced across three programs in 2023, with a few more announcements expected soon. In May, the Department of Energy (DOE) announced up to \$189 million for seven projects selected for the Carbon Capture Demonstration Projects Program Front-End Engineering Design (FEED) Studies;¹ in August, DOE announced up to \$1.2 billion in funding for two selected Regional Direct Air Capture Hubs;² and in October, DOE announced \$7 billion in funding to support seven Regional Clean Hydrogen Hubs.³ The seven Hydrogen Hubs are aimed at accelerating large-scale production and use of clean hydrogen and are located in the Pacific Northwest, California, the Heartland, the Midwest, the Mid-Atlantic, Appalachia, and the Gulf Coast of Texas and Louisiana.⁴

In February 2023, the department released plans for up to \$820 million for projects selected for the Carbon Capture Large-Scale Pilot Program and up to \$1.7 billion for the

projects selected for the Carbon Capture Demonstration Projects Program.^{5,6} A significant number of selected projects are on the Texas-Louisiana Gulf Coast (one Hydrogen Hub, both Direct Air Capture Hubs, and two carbon capture demonstration projects). These projects are currently in a negotiation period with the DOE, a process that will determine how the projects will be deployed in their communities.

The Hubs and their associated pilot projects are meant to be small- and large-scale demonstrations of technology and market advancement for low-carbon solutions towards a net zero future. They are also intended to align with the Biden Administration’s Justice40 initiative that looks to ensure that at least 40% of project benefits are deployed in “disadvantaged communities that are marginalized, underserved, and overburdened by pollution.”^{7,8} DOE has developed Community Benefits Plans to help implement Justice40 along with other administration priorities, including diversity, equity, and inclusion initiatives.⁹

These multi-billion dollar initiatives are the first significant investment into carbon capture development at scale by the US government, and are meant to help jumpstart

- 1 <https://www.energy.gov/oced/carbon-capture-demonstration-projects-program-front-end-engineering-design-feed-studies>
- 2 <https://www.energy.gov/articles/biden-harris-administration-announces-12-billion-nations-first-direct-air-capture>
- 3 <https://www.energy.gov/articles/biden-harris-administration-announces-7-billion-americas-first-clean-hydrogen-hubs-driving>
- 4 <https://www.energy.gov/oced/regional-clean-hydrogen-hubs-0>
- 5 <https://www.energy.gov/oced/carbon-capture-large-scale-pilot-program-update>
- 6 <https://www.energy.gov/oced/carbon-capture-demonstration-projects-program-update>
- 7 <https://www.whitehouse.gov/environmentaljustice/justice40/>
- 8 <https://ejscorecard.geoplatform.gov/scorecard/>
- 9 <https://www.energy.gov/infrastructure/about-community-benefits-plans>

the commercialization of these technologies. These programs are noteworthy because they might accelerate the scale-up of these much-needed technologies, though it remains to be seen if the government and partnering

entities involved have the political wherewithal to support these hubs and programs long term and/or create additional market incentives beyond tax credits. ●



2

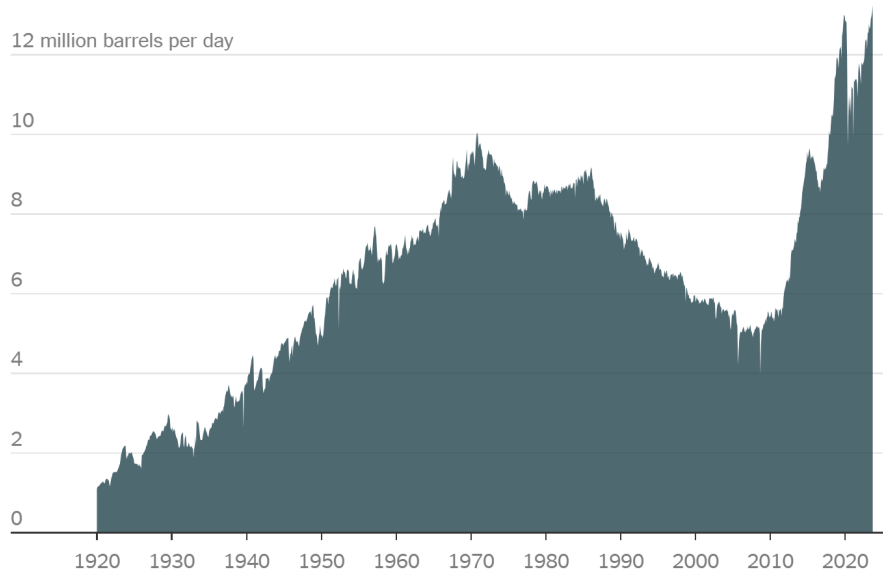
USA Produces and Exports Record Volumes of Oil

In 2023, US oil and gas production reached record levels^{1,2}. The heightened production is, in part, a result of new wells drilled in response to high prices caused by the Russian invasion of Ukraine, leading to a record 13.2 million barrels a day, an increase of roughly 800,000 barrels a day since early 2022. The previous record of 13 million barrels per day was set in November 2019 before the COVID-19 pandemic's damper on oil demand and production. Further, analysts expect an

additional 500,000 barrels a day in 2024. Most of the increase in production comes from the Permian Basin in Texas and New Mexico, with some expanded activity in Alaska and the Gulf of Mexico. The elevated production contributed to record oil exports, the highest since 2015 when the U.S. ban on oil exports was lifted.³ The main recipients of U.S. oil were Europe—led by the Netherlands and United Kingdom—and Asia—led by China and South Korea.⁴

The United States Is Producing Historic Levels of Crude Oil

Rate of U.S. crude oil production over time



Source: U.S. Energy Information Administration • By The New York Times

- <https://www.nytimes.com/2023/12/01/business/energy-environment/us-oil-production-record-climate.html>
- <https://www.reuters.com/markets/commodities/us-oil-output-hits-record-producers-boost-drilling-efficiency-kemp-2023-11-01/>
- <https://www.eia.gov/todayinenergy/detail.php?id=60622>
- <https://www.eia.gov/todayinenergy/detail.php?id=60622>

Despite record high oil production and exports, the U.S. has remained a net importer of oil because many refineries in the U.S. are configured for sour, heavy crude such as that from the Middle East rather than the light, sweet domestic crude.⁵ However, the largest source of imported crude comes primarily via pipeline from Canada and Mexico.⁶

Natural gas production also reached record highs, partially driven by high gas prices in 2022 and increasing demand for liquefied natural gas (LNG) exports.^{7,8} While the rate of increase in natural gas production has slowed in 2023 compared to recent years, production volumes are still expected to remain high for

the next couple decades, in part, due to the increased LNG export capacity which the Energy Information Administration expects to more than double by 2027.⁹

This story is notable because it shows that even with all of the high profile news about hydrogen and renewable energy, the US is producing more fossil fuels than ever. This growth is a boon to our domestic economy and many regional economies (especially Texas), and it has kept the US from experiencing significant energy price shocks. It is also a reminder that at a time of accelerating climate damage, the world economies are still heavily reliant on oil and gas. ●

5 <https://www.eia.gov/todayinenergy/detail.php?id=60622>

6 <https://www.eia.gov/todayinenergy/detail.php?id=60622>

7 <https://www.theguardian.com/us-news/2023/oct/23/louisiana-gas-export-hub-biden-climate-crisis>

8 <https://www.theguardian.com/environment/2023/nov/27/us-oil-gas-record-fossil-fuels-cop28-united-nations>

9 <https://www.eia.gov/todayinenergy/detail.php?id=60944&src=email>

3

Texas Peak Power Demand Increases 10.5 GW in 14 Months: Grid Holds Regardless

Texas recorded its second hottest summer on record in 2023, according to State Climatologist John Nielsen-Gammon,¹ resulting in record levels of energy demand for air-conditioning. The state's peak demand increased by 10.5 gigawatts in 14 months from June 2022 to August 2023. The grid powered through this high demand with help from wind and solar alongside its thermal fleet of mainly natural gas fired power plants, coal, and nuclear.² The phenomenal pace of new renewables (primarily solar) and batteries deployed during 2023 was enough to offset this unanticipated surge in demand.

This year, ERCOT began issuing "Weather Watch" alerts, notifications approximately 3-5 days ahead of potential high electricity demand days due to weather. The first Weather Watch was issued in June due to unseasonably high temperatures topping 100 degrees in much of the state.³ While Weather Watch alerts do not necessarily mean a conservation request will go out to the public, ERCOT did

issue eight conservation requests this summer.⁴ On three of those days, gas, coal, or nuclear plants went offline due to the heat.⁵ On multiple occasions, wind production forecasts were low.⁶ Should high demand coincide with fossil fuel outages and significant drops in wind production, the grid would be at risk.⁷ The state's independent grid operator employed its demand response program and called in reserve power sources to compensate for electricity shortfalls.

Though wide scale power outages were avoided this past summer, a report from the North American Electric Reliability Corporation (NERC) has called attention to reduced reserve capacity due to higher load and insufficient resources. This warning also highlights a loss of winter capacity due to partially mothballed thermal capacity.⁸ In November, Texas voters approved Proposition 7, which creates a \$7.2 billion low-interest loan program—the Texas Energy Fund—for dispatchable generation sources such as natural

1 <https://www.texastribune.org/2023/09/07/texas-hottest-summer-2023/>

2 <https://www.dallasnews.com/business/energy/2023/08/10/why-the-ercot-grid-has-held-up-despite-record-breaking-summer-temperatures/>

3 <https://www.dallasnews.com/business/energy/2023/06/13/texas-grid-braces-for-record-demand-amid-a-summer-weather-watch/>

4 https://www.ercot.com/services/comm/mkt_notices/opsmessages?m=08&y=2023

5 <https://www.texastribune.org/2023/09/01/ercot-conservation-notice-how-grid-works/>

6 <https://www.texastribune.org/2023/09/01/ercot-conservation-notice-how-grid-works/>

7 <https://www.dallasnews.com/business/energy/2023/08/10/why-the-ercot-grid-has-held-up-despite-record-breaking-summer-temperatures/>

8 https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_WRA_2023.pdf

gas, but the program excludes battery storage.⁹ An additional \$1.8 billion would go toward backup energy systems at critical facilities and a further \$1 billion will be spent on grants for transmission and distribution upgrades in the non-ERCOT parts of Texas.¹⁰

Voter approval of the Texas Energy Fund legislation indicates that Texans are still concerned about the state of the electricity grid and want to do something about it. Whether or not the TEF and other measures have their intended effect will be seen in the coming years.

In the shorter term, ERCOT attempted to recruit 3,000 MW of previously mothballed power plants to come back online as standby resources for this winter. However,

no generators signed up for the program.¹¹ A separate attempt to recruit new demand response participants garnered three volunteers.¹² The program was also scrapped due to low response. The lack of backup strategies to add to supply or rapidly reduce load in times of peak power demand poses a continued risk for the upcoming winter.

There remains an unanswered question as to whether the load growth experienced was a catch-up from a slow growth during COVID, or representative of a new trajectory. For 2024, we expect the story to be continued solar and battery deployment primarily carrying further load growth, as any new announced projects making use of the TEF funding will be years away from being operable. ●

9 <https://www.kut.org/energy-environment/2023-11-06/proposition-7-would-provide-billions-in-incentives-for-new-power-plants-in-texas>

10 <https://www.kut.org/energy-environment/2023-11-06/proposition-7-would-provide-billions-in-incentives-for-new-power-plants-in-texas>

11 <https://www.texastribune.org/2023/12/01/texas-power-grid-ERCOT-winter-2023/>

12 <https://www.texastribune.org/2023/12/01/texas-power-grid-ERCOT-winter-2023/>

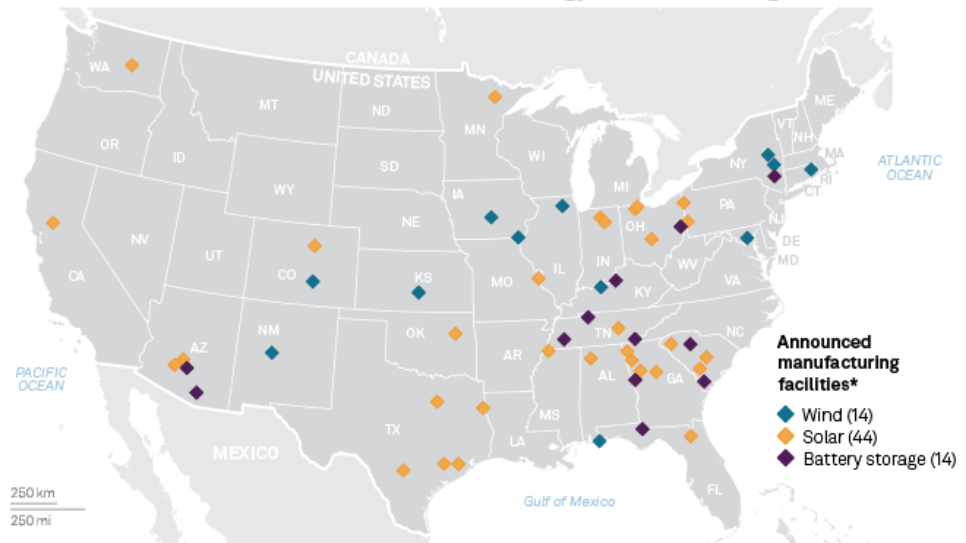
4

IRA: 1 Year Later Sees Massive Investment in Domestic Battery and Solar Manufacturing Capacity

August 2023 marked the one year anniversary of signing the Inflation Reduction Act into law. The climate and energy provisions of the bill included multiple clean energy tax credits and manufacturing incentives. One year hence, over

83 new or expanded clean manufacturing facilities have been announced, not including electric vehicle battery and component facilities.¹ These facilities are bolstered by incentives from the Infrastructure Investment and Jobs Act and IRA tax credits.²

IRA incentives drives wave of new clean energy manufacturing facilities



Data accessed July 6, 2023.
 IRA = Inflation Reduction Act.
 Map credit: Josephine Sajbel.
 Source: American Clean Power Association.
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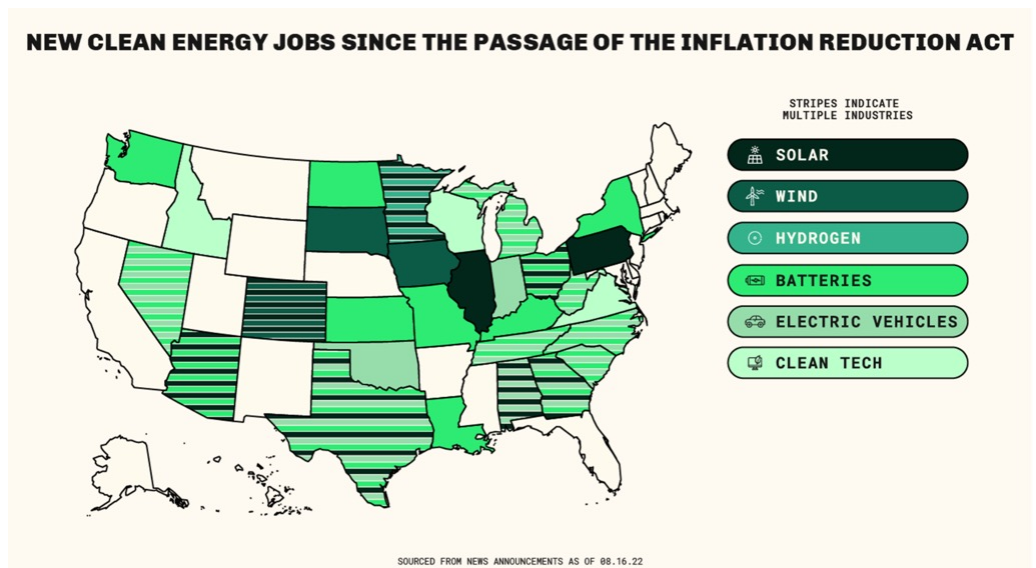
1 <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/ira-at-1-us-heralds-clean-energy-manufacturing-renaissance-76610817>
 2 <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/ira-at-1-us-heralds-clean-energy-manufacturing-renaissance-76610817>

Because the IRA tax credits for wind turbines, solar panels, and battery storage, will not expire for at least ten years, they provide more market certainty and lasting impact than the previous 2-3 year extensions. With the IRA passage, it is also the first time standalone battery storage systems will be eligible for the Investment Tax Credit.³ The Congressional Budget Office originally estimated they would cost the federal government \$270 billion over this ten year period. However, their popularity has exceeded expectations, so the total cost could be higher.⁴

The IRA funding programs are meant to be far reaching, with priorities including emissions reduction and job creation. On the anniversary, the White House announced that IRA funding had already helped create 170,000 new clean economy jobs in clean energy manufacturing, including solar, wind, hydrogen,

batteries, electric vehicles, and other clean tech, with many more expected.⁵ Additionally, by 2035, the law is expected to help reduce U.S. emissions by about 43-48% compared to 2005 emissions levels, according to Princeton researchers.⁶ While this reduction alone is not enough to achieve the U.S. commitment to slashing emissions by 50% by 2030, it is a significant contribution to this goal.

The IRA represented an unprecedented level of federal investment in clean technologies, renewable energy and carbon emission reduction, and this year has shown it to be popular and impactful legislation so far. The pace of project deployment and announcement is already reshaping local and regional economies, and it has proven that big climate legislation is not a political liability. ●



3 <https://www.utilitydive.com/spons/ira-sets-the-stage-for-us-energy-storage-to-thrive/635665/>

4 <https://www.nbcnews.com/science/environment/one-year-us-climate-law-already-turbocharging-clean-energy-technology-rcna95973>

5 <https://www.whitehouse.gov/briefing-room/statements-releases/2023/08/17/what-they-are-saying-one-year-anniversary-of-the-inflation-reduction-act/>

6 <https://www.science.org/doi/full/10.1126/science.adg3781>

5

Critical Minerals Take Center Stage

A low carbon future is dependent on the critical minerals and materials needed to manufacture clean energy technologies. Some of those minerals include rare earth elements that are used to create motors in electric vehicles and wind turbines.¹ Metals and non-metals such as lithium, nickel, cobalt, manganese, and graphite are needed for batteries.² Copper wires and cables are needed to move and distribute electricity and will be needed more to connect to distributed solar and wind resources.³ The energy sector is a primary driver for the demand for lithium tripling, a 70% increase in cobalt demand, and a 40% increase in nickel demand over the past five years.⁴

Critical materials investment is struggling to keep pace with the rapidly growing demand. However, China-based companies almost doubled their investment in 2022,⁵ and the country now controls about 44 million tons of deposits⁶ and 60% of the world's mining of critical materials.⁷ The United States is becoming increasingly dependent on foreign sources of these resources. The nation is 100% reliant on China for 12 critical minerals and more than 50% dependent on another 31

minerals.⁸ In addition to the dependence on foreign reserves for the raw materials, the global supply chains for clean energy are particularly dependent on upgrading and refining processes that take place in China. Thus, even if a domestic reserve is available, the raw resource might be sent overseas for processing before it can be integrated into a completed system.

The United States government has made critical minerals investment a priority, partnering with “like-minded” countries and making domestic investments to strengthen the supply chain for these resources.^{9,10} The U.S. and Japan signed such an agreement in March 2023,¹¹ and in June, the U.S. and United Kingdom announced their intention to negotiate a similar agreement.¹² Further, in September, the European Parliament passed a resolution regarding negotiations for an agreement with the U.S.¹³ The EU resolution called for inclusion of critical materials obtained through recycling, a transparency mechanism, and warning against supply chain issues. Allies such as Canada and Australia have both seen 40% growth in critical materials exploration spending. In addition to partnering with

1 <https://www.iea.org/topics/critical-minerals>

2 <https://www.iea.org/topics/critical-minerals>

3 <https://www.iea.org/topics/critical-minerals>

4 <https://www.iea.org/topics/critical-minerals>

5 <https://www.iea.org/topics/critical-minerals>

6 <https://www.mining.com/web/critical-minerals-take-central-stage-in-us-china-rivalry/>

7 <https://www.bakerinstitute.org/research/chinese-behemoths-what-chinas-rare-earths-dominance-means-us>

8 <https://payneinstitute.mines.edu/wp-content/uploads/sites/149/2023/09/Payne-Institute-The-State-of-Critical-Minerals-Report-2023.pdf>

9 <https://www.mining.com/web/critical-minerals-take-central-stage-in-us-china-rivalry/>

10 <https://www.wsj.com/articles/u-s-plans-to-spend-big-on-critical-minerals-choosing-where-isnt-easy-11624186800>

11 <https://ustr.gov/about-us/policy-offices/press-office/press-releases/2023/march/united-states-and-japan-sign-critical-minerals-agreement>

12 <https://www.whitecase.com/insight-alert/will-united-states-new-critical-minerals-agreements-shape-electric-vehicle>

13 [https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2023\)754617](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)754617)

allies, the administration is also aiming to limit China and Russia from benefiting from Inflation Reduction Act incentives.¹⁴

In August, the Department of Energy announced a \$30 million investment to lower costs for onshore production of rare earth minerals¹⁵ and in September announced another \$150 million to strengthen domestic critical material supply chains by producing and refining minerals in the United States.¹⁶ U.S. companies are also investing in domestic critical minerals mining to shore up their

supply chains. In January, GM announced a plan to invest \$650 million in Lithium Americas Corp to develop the Thacker Pass lithium mining project in Nevada.¹⁷ Tesla had announced a similar investment in Texas in late 2022.¹⁸ Mining and exploration companies have also made progress in developing new domestic resources, including Ramaco Resources discovery of the largest unconventional rare-earth deposit in the United States estimated to be worth around \$37 billion as of November, 2023.¹⁹ ●

14 <https://www.mining.com/web/critical-minerals-take-central-stage-in-us-china-rivalry/>

15 <https://www.energy.gov/articles/biden-harris-administration-announces-30-million-build-domestic-supply-chain-critical>

16 <https://www.energy.gov/articles/biden-harris-administration-announces-150-million-strengthen-domestic-critical-material>

17 <https://www.reuters.com/markets/commodities/gm-lithium-americas-develop-thacker-pass-mine-nevada-2023-01-31/>

18 <https://www.bloomberg.com/news/articles/2022-10-19/tesla-confirms-plans-to-build-lithium-refinery-in-texas>

19 <https://www.wsj.com/business/energy-oil/the-2-million-coal-mine-that-might-hold-a-37-billion-treasure-181dbdcf>

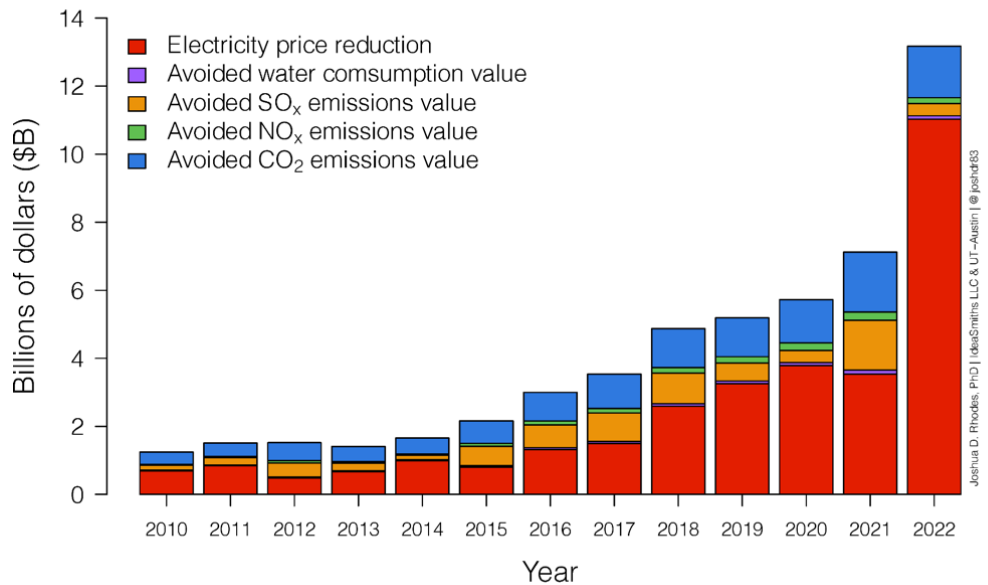
6

Renewables Save Texas Consumers Billions of Dollars

Of all sources, the Texas grid gets the most electricity from natural gas. However, the share of renewables has been growing rapidly.¹ Wind has generated double digit percentages of Texas electricity for over a decade, making Texas the nation's leading producer of wind energy for the past

17 years.^{2,3} Texas provided 26% of wind energy produced in the U.S. in 2022,⁴ and solar is quickly gaining market share [as shown below]. From June 15 to September 15 of this year, solar provided 10-16% of the peak power demand [as shown below], or an average 13.8% of that demand.⁵

Annual total benefits from renewables in ERCOT



The low marginal cost of renewable power sources—due to their lack of dependence on fuel—has saved Texans about \$200 per year

apiece on their electricity bills over the past five years.⁶ In total, renewables have reduced wholesale electricity prices by more than \$30

1 <https://www.houstonchronicle.com/business/energy/article/texas-solar-growth-2023-17769103.php>
 2 <https://x.com/joshdr83/status/1615406893836472340?s=20>
 3 <https://www.eia.gov/state/?sid=TX#tabs-4>
 4 <https://www.eia.gov/state/?sid=TX#tabs-4>
 5 <https://www.renewableenergyworld.com/solar/utility-scale/solar-delivers-for-the-texas-grid-reliable-output-at-peak-demand/#gref>
 6 https://static1.squarespace.com/static/652f1dc02732e6621adb2a3a/t/654c1889d23c9b5e380aa6bf/1699485834626/Impact-of-Renewables-in-ERCOT_FINAL.pdf

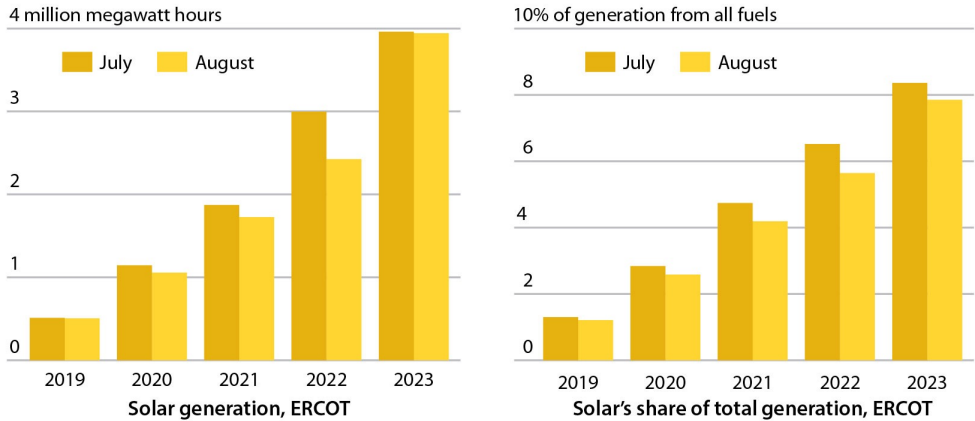
billion since 2010, as IdeaSmiths showed in a report published in May 2023.⁷ In addition to cost savings, using renewables in place of fossil fuels reduces water use and avoids carbon dioxide, nitrogen oxides, and sulfur oxide emissions.⁸

Renewable energy generation in Texas has grown quickly over the last two decades. The state has emerged as the leading producer

of wind energy in the country and in recent years has dramatically increased the amount of solar power. Texas now has more than 15,000 megawatts of nameplate utility-scale solar capacity -- enough to power 3 million homes during times of peak electricity demand, according to ERCOT, the state's grid operator. ●

Solar Generation in Texas, Growing Fast, Has Become a Key Source of Power

Solar generation in ERCOT, the main Texas grid area, has been growing very fast, outpacing overall demand growth. Shown here are figures for July and August, the two highest demand months of the year in Texas.



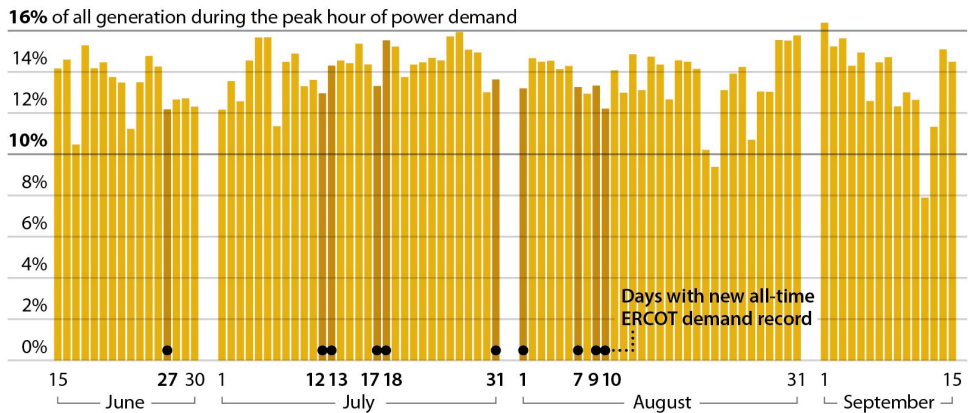
Source: Electric Reliability Council of Texas

IEEFA

9

Texas Solar Generation During Peak Electricity Demand Hour

Utility-scale solar consistently provided between 10% and 16% of the electricity needed in ERCOT during the critical peak hour on 91 out of 93 days between June 15 and September 15.



Source: Electric Reliability Council of Texas

IEEFA

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7 https://static1.squarespace.com/static/652f1dc02732e6621adb2a3a/t/654c1889d23c9b5e380aa6bf/1699485834626/Impact-of-Renewables-in-ERCOT_FINAL.pdf

8 <https://www.utilitydive.com/news/texas-solar-and-wind-resources-saved-consumers-nearly-28-billion-over-12-y/634893/>

9 <https://ieefa.org/resources/solar-delivers-texas-grid-reliable-output-peak-demand>

10 <https://ieefa.org/resources/solar-delivers-texas-grid-reliable-output-peak-demand>

7

The Crypto, DataCenter, & AI Surge is Upon Us

With OpenAI's launch of the artificial intelligence (AI) tool ChatGPT in 2022, the growing popularity of AI has spurred investment in data centers.¹ The popularity of crypto and cloud services had already caused rapid growth in demand for digital services in recent years, and, with it, demand for energy to serve the data centers and data transmission networks. However, the AI leadership race is expected to trigger \$1 trillion in investment in the industry, mainly in data centers that will be used to train the models.² The new spike in data center investment will have a significant impact on associated demand for energy, water, and land.

Data centers are among the most energy-intensive types of buildings, consuming about 10-50 times more energy than a commercial building of the same size.³ They currently make up about 1-1.5% of global energy demand⁴ and about 2% in the US.⁵ The increased investment in these buildings could double or triple energy demand for this sector,

reaching 35 gigawatts of power consumption annually by 2030.⁶ The spike might strain utilities, especially in rural areas⁷ where data centers might take advantage of the available land and possibly less competition for water resources, but where local utilities typically serve lower loads.

There are many efforts underway to reduce data center energy use, including at the US Department of Energy. Some data centers have the potential to be flexible loads and can participate in the demand response programs, taking advantage of payments to reduce energy demand. One cryptocurrency miner made \$31.7 million by reducing its energy use through this program in August 2023, earning more from not using energy than it did through cryptocurrency mining that month.⁸ The rapid growth of these new electricity loads is becoming more of a challenge as they scale faster than typical electricity sector load growth. ●

1 <https://www.businessinsider.com/ai-data-energy-centers-water-energy-land-2023-10>

2 <https://www.businessinsider.com/ai-data-energy-centers-water-energy-land-2023-10>

3 <https://www.energy.gov/eere/buildings/data-centers-and-servers>

4 <https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks>

5 <https://www.energy.gov/eere/buildings/data-centers-and-servers>

6 <https://www.businessinsider.com/ai-data-energy-centers-water-energy-land-2023-10>

7 <https://www.businessinsider.com/ai-data-energy-centers-water-energy-land-2023-10>

8 <https://www.texasmonthly.com/news-politics/texas-bitcoin-miner-riot-31-million-energy-credits/>

8

Geothermal Gains Headlines and Traction

In March, Energy Secretary Jennifer Granholm declared, “Geothermal is hot!” as part of a speaking engagement at S&P Global’s CERAWEEK in Houston.¹ The Department of Energy’s Geothermal Technology Office (GTO) has estimated that by 2050 geothermal energy could supply nearly 60 gigawatts of electricity (over 8% of demand), provide heating and cooling solutions to 28 million households, and enable 17,500 geothermal district heating systems in the United States.² The year 2023 was a big step toward that future with multiple major geothermal projects announced.

In March, the GTO announced two U.S. Department of Defense (DoD) installations—the U.S. Military Academy at West Point in New York and U.S. Army Garrison Detroit Arsenal in Michigan—would receive technical assistance in the Federal Geothermal Partnerships (FedGeo) initiative, an effort to help expand geothermal heating and cooling at federal sites.³ Oak Ridge National Laboratory and partners will provide the technical assistance, including data analysis, resource characterization, site surveys, and design to help DoD decide whether to build a system at each site.⁴ The Federal Energy Management Program will help identify financing mechanisms. These projects are a

long time in the making – the proposal for Detroit Arsenal began over 10 years ago.⁵

The DoD has also entered into agreements with Eavor, Teverra, and Zanskar Geothermal & Minerals for exploratory geothermal projects through initiatives at four military installations led by the U.S. Air Force, U.S. Army and the Defense Innovation Unit.⁶ The Air Force’s Joint Base San Antonio in Texas will partner with Eavor to evaluate the potential of their Eavor-Loop, a deep closed-loop process with a subsurface heat exchanger relying on conductive rather than convective heat transfer.⁷ The technology doesn’t require stimulation and uses minimal water.⁸ They are conducting a feasibility study to evaluate resources for the initiative.⁹ Eavor will collaborate with Chesapeake Energy on technical and operational aspects.¹⁰ Teverra will develop technology to improve geothermal energy exploration and production at the U.S. Army’s Fort Wainwright in Alaska.¹¹ Zanskar Geothermal & Minerals will deploy their AI-enabled discovery platform to quickly and accurately identify and de-risk geothermal resources at two installations: Mountain Home Air Force Base in Idaho and at the Army’s Fort Irwin in California.¹² These geothermal projects are intended to help DoD advance carbon-free and resilient energy goals.

1 <https://www.powermag.com/startups-are-shaking-up-geothermal-powers-prospects/>

2 <https://www.energy.gov/eere/geothermal/geovision>

3 <https://www.energy.gov/eere/geothermal/articles/leading-way-gto-announces-federal-sites-pursue-geothermal-projects>

4 https://www.army.mil/article/270864/detroit_arsenal_flips_switch_on_new_substation

5 https://www.army.mil/article/270864/detroit_arsenal_flips_switch_on_new_substation

6 <https://executivegov.com/2023/10/3-companies-chosen-for-dods-geothermal-energy-exploration-projects/>

7 <https://www.diu.mil/latest/u-s-air-force-u-s-army-the-defense-innovation-unit-and-industry-advance-dod>

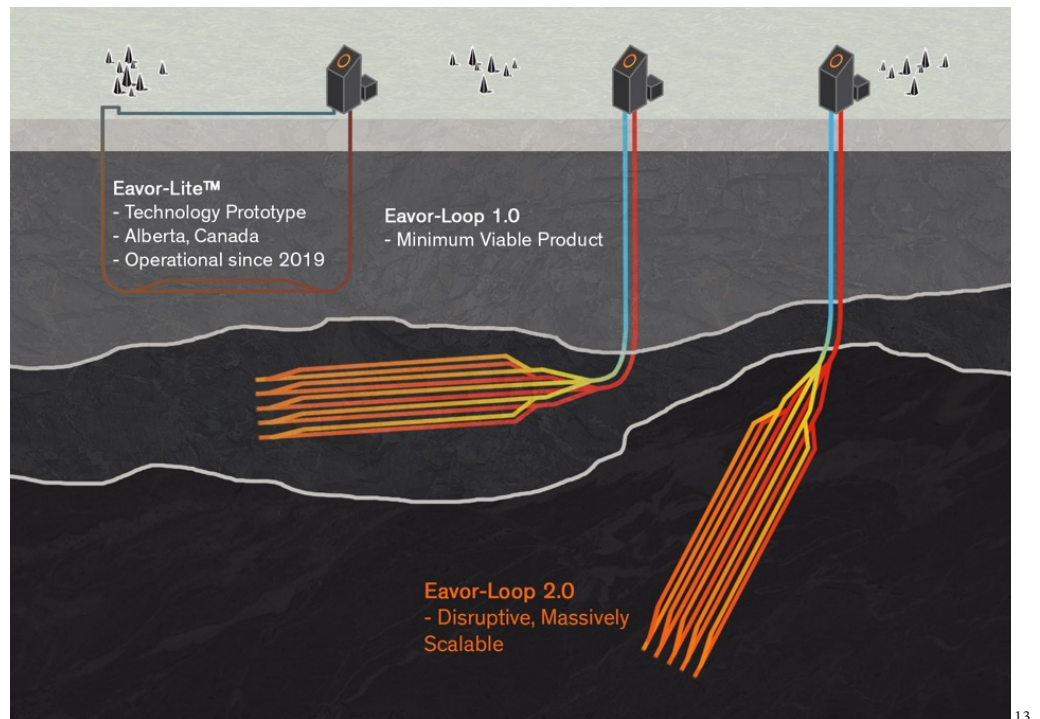
8 <https://www.diu.mil/latest/u-s-air-force-u-s-army-the-defense-innovation-unit-and-industry-advance-dod>

9 <https://www.thedefensepost.com/2023/10/04/us-geothermal-energy-san-antonio/>

10 <https://www.thedefensepost.com/2023/10/04/us-geothermal-energy-san-antonio/>

11 <https://executivegov.com/2023/10/3-companies-chosen-for-dods-geothermal-energy-exploration-projects/>

12 <https://www.diu.mil/latest/u-s-air-force-u-s-army-the-defense-innovation-unit-and-industry-advance-dod>



13

In July, Fervo announced that it successfully completed a well test for its pilot in northern Nevada.¹⁴ The company successfully drilled a horizontal well pair for commercial geothermal production able to support 3.5 MW of electricity production.¹⁵ Fervo plans to use its next horizontal well pair to more than double the power output achieved with the pilot.¹⁶ In November, Google announced that its project with Fervo began providing power to the local grid, helping meet the electricity demand for Google's Nevada data centers, among other customers.¹⁷

Deployment of geothermal solutions is beginning to accelerate as companies and customers recognize the unique opportunity to access firm low-carbon energy beneath our feet. Many of those companies have roots in the oil and gas (O&G) sector as drilling expertise will remain critical to the development of geothermal resources.¹⁸ Commercial developers are also seeing opportunities to reduce the carbon footprint of their buildings by installing geothermal systems that are designed to last over 100 years, including the largest residential geothermal heat pump system in Manhattan.¹⁹ ●

13 <https://www.eavor.com/faqs/>

14 <https://fervoenergy.com/fervo-energy-announces-technology-breakthrough-in-next-generation-geothermal/>

15 <https://www.thinkgeoenergy.com/fervo-and-google-geothermal-power-facility-starts-grid-supply/>

16 <https://fervoenergy.com/fervo-energy-announces-technology-breakthrough-in-next-generation-geothermal/>

17 <https://www.thinkgeoenergy.com/fervo-and-google-geothermal-power-facility-starts-grid-supply/>

18 <https://www.powermag.com/startups-are-shaking-up-geothermal-powers-prospects/>

19 <https://www.canarymedia.com/articles/geothermal/why-this-nyc-apartment-complex-will-use-a-giant-underground-heat-pump>

9

Natural Hydrogen Makes Headlines

As the race to economically develop hydrogen from electrolysis continues, some companies are now looking to natural sources (such as underground deposits) of hydrogen as a source of clean primary energy. Natural hydrogen might serve as a transitional product for the petroleum industry under a net zero future, with the potential to shift geologic skills from one underground energy source to another.¹ However, natural hydrogen is currently far less well understood, making it difficult at this time to build plans or portfolios around these discoveries.

Natural hydrogen has been in use since 2011 when it was discovered seeping from a plugged water well in a village in Mali after gases leaking from the well caused an explosion.² The concentration exiting the well was found to be 98% hydrogen.³ This instance was viewed as more of an anomaly than a path forward. However, since this discovery, natural hydrogen has been found in Australia, Canada, Germany, Japan, New Caledonia, New Zealand, Oman, and Russia.⁴ In France, natural hydrogen deposits could yield 3 million metric tons per year, about a third of the clean hydrogen the European Union plans to produce by 2030.⁵ One Australian company, Gold Hydrogen, confirmed reserves in South Australia with 73.3% hydrogen flow that it hopes could be commercially exploitable. Gold Hydrogen also found helium that could

increase profitability of the project. Another Australian company, Hyterra, believes it can produce natural hydrogen for about \$1 per kilogram. Hyterra also has two hydrogen projects in Nebraska (a joint venture with Natural Hydrogen Energy) and in Kansas (on owned and operated leases).

One prominent startup, Koloma, has raised substantial investment from Energy Impact Partners and Breakthrough Energy Ventures, among other notable investment firms.

Time will tell how much these prospects are able to produce, but there is growing interest at ARPA-E (Advanced Research Projects Agency - Energy), which has multiple R&D programs underway, and at the US Geological Survey, which will release a national assessment soon. Early estimates have high uncertainty: there might be enough hydrogen to provide a feedstock for fertilizer (at the low end) or sufficient volumes to provide clean energy supplies for hard-to-electrify industries or power plants. A 2020 study estimated that total global natural hydrogen generation amounts to 23 million tons per year or about 2.76 exajoules, similar in energy output to the amount of natural gas consumed weekly.⁶ However, the reserves in place might exceed 1 billion metric tonnes, sufficient to meet global demand for centuries. ●

- https://www.washingtonpost.com/business/energy/2023/07/31/clean-energy-mysterious-natural-hydrogen-could-be-a-game-changer/6efe08-2fe0-11ee-85dd-5c3c97d6acda_story.html
- https://www.washingtonpost.com/business/energy/2023/07/31/clean-energy-mysterious-natural-hydrogen-could-be-a-game-changer/6efe08-2fe0-11ee-85dd-5c3c97d6acda_story.html
- https://www.washingtonpost.com/business/energy/2023/07/31/clean-energy-mysterious-natural-hydrogen-could-be-a-game-changer/6efe08-2fe0-11ee-85dd-5c3c97d6acda_story.html
- https://www.washingtonpost.com/business/energy/2023/07/31/clean-energy-mysterious-natural-hydrogen-could-be-a-game-changer/6efe08-2fe0-11ee-85dd-5c3c97d6acda_story.html
- https://www.washingtonpost.com/business/energy/2023/07/31/clean-energy-mysterious-natural-hydrogen-could-be-a-game-changer/6efe08-2fe0-11ee-85dd-5c3c97d6acda_story.html
- https://www.washingtonpost.com/business/energy/2023/07/31/clean-energy-mysterious-natural-hydrogen-could-be-a-game-changer/6efe08-2fe0-11ee-85dd-5c3c97d6acda_story.html

10

COP28: Global Engagement on Climate Shows Consensus on Renewables, but Lack of Urgency on Fossil Fuels

One of IdeaSmiths' partners, Michael Webber, attended the global Student Energy Summit in Abu Dhabi and COP28 in Dubai. His reflections are available in [Mechanical Engineering magazine](#).

COP28 concluded in Dubai in December. Major agreements were penned related to fossil fuels, renewables, methane, recovery, and adaptation. However, many felt the agreements did not go far enough, either in their commitments or in the targets and financing needed for effective implementation.

The fossil fuel “phase-out” that over 80 countries¹ were hoping for was changed to “transitioning away” from fossil fuels to achieve net zero by 2050.² However, beyond this target no other timelines or metrics were added to the agreement.³ Some of the opponents to a fossil fuel phase-out included OPEC, who voiced a preference to focus on emissions rather than fuels. Sultan Al Jaber, minister of industry and advanced technology

of the United Arab Emirates, asserted there is no science indicating a fossil fuel phase-out is needed to limit global warming to 1.5 degrees C, a claim refuted by climate scientists.⁴ Additionally, some African Nations reported needing to be able to use fossil fuels like natural gas to provide electricity to their people who lack reliable access to power now.⁵ Disagreements over this fossil fuel decision caused delays for the summit's close. In addition to transitioning away from fossil fuels, COP28 attendees reaffirmed a goal to phase-down coal that was signed at COP26 in Glasgow but did not provide a baseline or measurement guidelines.⁶

Countries had an easier time coming to bold agreements for renewable energy, nuclear, methane emissions, adaptation, and a loss and damage fund for countries most impacted by climate disasters. COP28 member countries signed an agreement to contribute to doubling annual energy efficiency

1 <https://www.reuters.com/business/environment/big-divisions-loom-over-fossil-fuels-cop28-talks-head-into-final-phase-2023-12-10/>

2 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

3 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

4 <https://www.theguardian.com/environment/live/2023/dec/06/cop28-uae-latest-news-climate-crisis-live-updates>

5 <https://www.atlanticcouncil.org/content-series/fastthinking/the-final-report-card-for-cop28/>

6 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

improvements and tripling global installed capacity of renewable energy by 2030,⁷ and more than 20 countries launched a declaration to triple nuclear energy by 2050.⁸ COP28 member countries also agreed to globally accelerate and substantially reduce non-carbon-dioxide emissions like methane by 2030.⁹ On the conference's opening day, member countries operationalized a Loss and Damage Fund meant to provide financial assistance to countries recovering from climate-induced disasters, and several countries made funding commitments worth about US\$ 800 million

by the end of the conference.¹⁰ Additionally, adaptation goals were adopted including ones to address climate impacts on water scarcity and supply chains and climate resilience for health as well as food and agricultural production.¹¹ The adaptation agreement lacks financial provisions or indicators to establish progress on global goals, though.¹²

In addition to these agreements between countries, some companies have made their own announcements and partnerships, including Exxon Mobil, Blackrock, and Alterra, a firm from the UAE.¹³ ●

7 <https://www.cfr.org/article/renewable-energy-and-cop28>

8 <https://www.energy.gov/articles/cop28-countries-launch-declaration-triple-nuclear-energy-capacity-2050-recognizing-key#:~:text=Endorsing%20countries%20include%20the%20United,of%20the%20Declaration%20is%20below>

9 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

10 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

11 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

12 <https://indianexpress.com/article/explained/explained-climate/cop28-what-were-the-most-important-decisions-where-they-fell-short-9067358/>

13 <https://citywire.com/americas/news/cop28-blackrock-and-emirati-firm-launch-2bn-climate-partnership/a2431760>



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Nuclear Makes Headlines

Nuclear has had its ups and downs in 2023 with traditional big nuclear power seeing a long delayed win but small modular reactors seeing canceled contracts and other hurdles.

In July, the first new nuclear reactor in the USA in over 30 years—Vogtle Unit 3 in Waynesboro, Georgia—started commercially operating.¹ Vogtle Unit 4 has also been given a green light and could open in 2024. Vogtle faced multiple delays in getting to commercial operations, pushing its planned startup date back by seven years and coming in \$17 billion over budget.² The most recent delay was caused by a cooling system issue.³ Unit 3’s capacity is 1,100 MW, and it will provide power to customers in Alabama, Georgia, and Florida in the Southeast US.⁴

Microsoft is also investing in nuclear energy. The company signed an agreement to purchase electricity from Helion Energy, who is working to provide 50 megawatts of power from a nuclear fusion generator in Washington State by 2028.⁵

Small modular reactors have experienced rising opportunities and setbacks throughout the year. The zero-carbon goals outlined

by the international community has led to growing support to expand the use of nuclear power, including development of small modular reactors. However, some of the early wins have hit hurdles in recent months. In October, X-Energy and Ares Acquisition Corporation severed their deal to go public,⁶ exemplifying waning enthusiasm for special purpose acquisition companies (SPACs) under economic uncertainty.⁷ In November, X-Energy laid off 100 staff.⁸ However, X-Energy has seen growth in small developments with Dow and Energy Northwest. In March, Dow announced a deal with X-Energy to develop a four-unit combined heat and power facility on the Texas Gulf Coast.⁹ The second deal with Energy Northwest would have X-Energy supply up to 12 units in Washington State. X-Energy has also signed cooperative agreements with the U.S. Department of Defense and U.S. Department of Energy.¹⁰

In August, the Air Force and Defense Logistics Agency announced an “intent to award” contract for a small nuclear reactor at Eielson Air Force Base in Alaska to Oklo,¹¹ pending approval of the plan by the Nuclear Regulatory Commission.¹² However, by

- 1 <https://www.georgiapower.com/company/news-center/2023-articles/vogtle-unit-4-starts-nuclear-fuel-load.html#:~:text=August%2017%2C%202023&text=Vogtle%20Unit%203%20%E2%80%93%20the%20first,reliable%2C%20emissions%2Dfree%20energy>
- 2 <https://apnews.com/article/georgia-power-nuclear-reactor-vogtle-9555e3f9169f2d58161056feaa81a425>
- 3 <https://www.eenews.net/articles/what-vogtles-stumbling-finish-means-for-u-s-nuclear-energy/>
- 4 <https://apnews.com/article/georgia-power-nuclear-reactor-vogtle-9555e3f9169f2d58161056feaa81a425>
- 5 <https://www.theverge.com/2023/5/10/23717332/microsoft-nuclear-fusion-power-plant-helion-purchase-agreement>
- 6 <https://x-energy.com/media/news-releases/x-energy-ares-mutually-terminate-business-agreement>
- 7 <https://www.reuters.com/markets/deals/x-energy-mutually-terminates-2-billion-deal-go-public-with-ares-acquisition-2023-10-31/>
- 8 <https://thebreakthrough.org/blog/advanced-nuclear-energy-is-in-trouble#:~:text=The%20increase%20in%20finance%20and,%25%20from%20less%20than%204%25>
- 9 <https://corporate.dow.com/en-us/news/press-releases/dow-x-energy-collaborate-on-smr-nuclear.html>
- 10 <https://x-energy.com/media/news-releases/x-energy-ares-mutually-terminate-business-agreement>
- 11 <https://www.adn.com/alaska-news/military/2023/11/23/us-military-quietly-revokes-planned-contract-for-small-nuclear-plant-at-eielson-air-force-base/>
- 12 https://www.stripes.com/branches/air_force/2023-09-13/eielson-alaska-air-force-oklo-microreactor-11360797.html

September the Agency revoked this decision, citing a need for further consideration.¹³ The Air Force is on the lookout for a small reactor capable of producing up to 20 MW, part of a mandate in the 2019 National Defense Authorization Act that at least one licensed microreactor is operating on a Defense Department installation by 2027.¹⁴

In September, NuScale announced that due to increasing project costs it was canceling a deal for its first reactors to serve a consortium of small electricity collaboratives in Utah called UAMPs.¹⁵ NuScale is the only developer with a small modular reactor

(SMR) design approved by the Nuclear Regulatory Commission.¹⁶ New cost estimates from TerraPower and XEnergy as part of the Department of Energy's Advanced Reactor Deployment Program are also expected to be substantially higher than originally estimated.¹⁷

Despite these setbacks, hope in nuclear energy remains. In December, more than 20 countries launched a declaration at COP28 aimed at tripling nuclear energy capacity globally by 2050 and inviting shareholders to encourage the inclusion of nuclear energy in energy lending policies.¹⁸ ●

13 <https://www.adn.com/alaska-news/military/2023/11/23/us-military-quietly-revokes-planned-contract-for-small-nuclear-plant-at-eielson-air-force-base/>

14 https://www.stripes.com/branches/air_force/2023-09-13/eielson-alaska-air-force-oklo-microreactor-11360797.html

15 <https://thebreakthrough.org/blog/advanced-nuclear-energy-is-in-trouble#:~:text=The%20increase%20in%20finance%20and,%25%20from%20less%20than%204%25>

16 <https://www.eenews.net/articles/is-advanced-nuclear-in-trouble-whats-next-after-nuscale-cancellation/>

17 <https://thebreakthrough.org/blog/advanced-nuclear-energy-is-in-trouble#:~:text=The%20increase%20in%20finance%20and,%25%20from%20less%20than%204%25>

18 <https://www.iaea.org/newscenter/news/nuclear-energy-makes-history-as-final-cop28-agreement-calls-for-faster-deployment>



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Breakthrough in New England Energy and Transmission

The Champlain Hudson Power Express of CHPE “chippy” transmission line construction is underway. The transmission line will connect hydropower supplies in Canada owned by Hydro-Québec to demand in New York City and is expected to provide about 20% of the City’s needs with a relatively constant supply.¹ At 339 miles,² the line is expected to be the longest in the U.S. built entirely underwater and underground when it begins service in 2026.³

While other transmission projects have faced legal challenges and other issues getting approved and funded, burying the line may have helped with reducing public pushback.⁴ Putting the line underground and underwater also contributed to the high project cost. The total project came in at about \$6 billion, about twice the cost of New England Clean Energy Connect, a similar high-voltage line from Canadian hydropower to demand in the Northeast.⁵ CHPE is expected to bring \$3.5 billion in economic benefits and approximately 1,400 union jobs during project construction.⁶



In addition to this hydropower high-voltage transmission line, New York has also been making waves in the wind industry with the first large-scale offshore wind installation in the United States.⁷ The first of 12 planned offshore turbines was completed in December. Power from the turbine will be transmitted via undersea lines to customers on Long Island.⁸ When the wind farm is complete, it is expected to be able to produce 132 megawatts (MW) of electricity.⁹

1 <https://www.eenews.net/articles/how-a-6b-transmission-project-made-it-in-new-york/>

2 <https://www.governor.ny.gov/news/governor-hochul-announces-start-construction-339-mile-champlain-hudson-power-express>

3 <https://www.eenews.net/articles/how-a-6b-transmission-project-made-it-in-new-york/>

4 <https://www.eenews.net/articles/how-a-6b-transmission-project-made-it-in-new-york/>

5 <https://www.eenews.net/articles/how-a-6b-transmission-project-made-it-in-new-york/>

6 <https://www.governor.ny.gov/news/governor-hochul-announces-start-construction-339-mile-champlain-hudson-power-express>

7 <https://www.nytimes.com/2023/12/06/nyregion/ny-wind-farm-long-island.html>

8 <https://www.nytimes.com/2023/12/06/nyregion/ny-wind-farm-long-island.html>

9 <https://www.nytimes.com/2023/12/06/nyregion/ny-wind-farm-long-island.html>

Meanwhile, in Massachusetts, Vineyard Wind's attempt to construct an 800 MW wind farm off the coast of Martha's Vineyard is facing continued opposition.¹⁰ The project would come online in 2024, but opponents are aiming to impede its development. The main concern seems to be the plan to bring power onshore via local beaches.¹¹ The line would be

buried below the shoreline and under local residential neighborhoods.¹² While wind energy is considered to be a key clean energy driver for a net zero economy and offshore wind a potential avenue for large-scale projects that reduce onshore land constraint issues, this type of opposition despite efforts to conceal power lines, could limit its growth. ●

10 <https://harvardpolitics.com/turbines-in-trouble/>

11 <https://www.boston.com/news/the-boston-globe/2023/11/16/cape-cod-residents-say-no-to-offshore-wind-transmission-lines-under-beaches/>

12 <https://www.boston.com/news/the-boston-globe/2023/11/16/cape-cod-residents-say-no-to-offshore-wind-transmission-lines-under-beaches/>



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