US

EIC Country Report

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SECTOR ANALYSIS • MAJOR PLAYERS • PEST ANALYSIS • HOW TO DO BUSINESS

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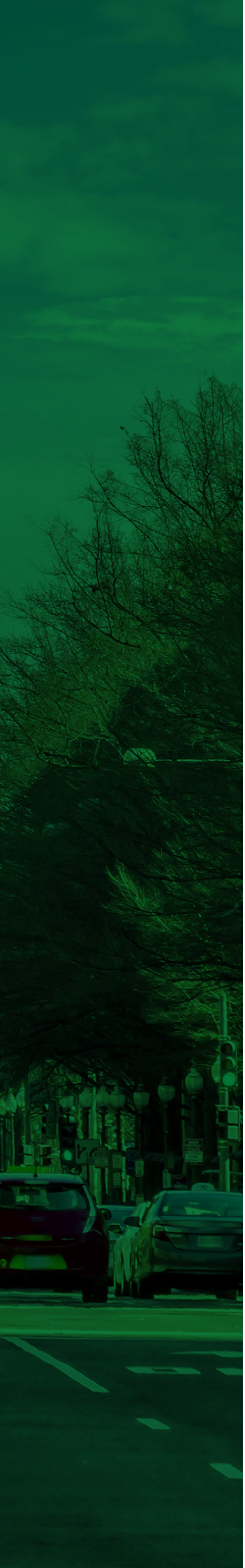

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Oil & Gas

Upstream

The US has consecutively been ranked as the top oil-producing country in the world since 2018 with 85% of production to come from onshore activity, according to the **Bureau of Ocean Management (BOEM)**. Within the offshore sector, 97% of oil production have been attributed to areas within the Gulf of Mexico (GOM) located off the coasts of Texas, Louisiana, Mississippi, Alabama, and Florida; the Pacific by Southern California; as well as the Beaufort Sea and Cook Inlet in Alaska. With the passing of the 2022 Inflation Reduction Act, questions have arisen whether the new bill would undermine this legacy, considering that the US$370B bill largely promotes the use of cleaner, alternative fuels such as hydrogen, rather than conventional fuels. In this first section of the USA country report, we will explore the current situation of the U.S. oil & gas industry post-Pandemic and assess how the IRA can potentially affect its growth its 10-year duration.

US OFFSHORE ASSETS

Offshore Planning Areas		Number of Blocks	Number of Leases		
Main Area	Regions		Active Leases[1]	Producing Leases[2]	Non-Producing Leases[3]
Gulf of Mexico	Central	12.409	1.778	497	1.281
	Eastern	11.537	13	31	13
	Western	5.240	304	0	273
Pacific	Southern California	16.164	30	30	0
	Others[4]	TBA	0	0	0
Alaska	Beaufort Sea	11.876	6	3	3
	Cook Inlet	1.093	14	0	14
	Others[5]	TBA	0	0	0

Table 1
The offshore Planning Areas found in the U.S. as well as the number of blocks available in each area | Source: The Bureau of Ocean Management (BOEM) as of 1st April 2023.

1 Active Lease is defined by the lease granted to an entity for the development of block(s) in a given region which has not yet expired or terminated.
2 Producing Lease is an Active Lease that has produced oil and/or gas.
3 Non-Producing Lease is an Active Lease which has not produced oil and/or gas.
4 Includes three planning areas with no lease announcements.
5 Includes 15 planning areas with no lease announcements.
TBA – To Be Announced

The latest **2019 OCS Report** by BOEM records a total of 58 production units in GOM including two floating production, storage, and offloading facilities (FPSOs) that was installed in 2011 and 2016. These were the 80,000bbl/d BW Pioneer FPSO at the Chinook-Cascade Field and the 60,000bbl/d Turritella FPSO at the Stones oilfield.

Number	Platform	Type of Production Platform	Capacity (BPD)	Operators
1	Cognac	Fixed Platform	28.000	Shell
2	Lena	Compliant Tower Platform	20.000	ExxonMobil
3	Bullwinkle	Fixed Platform	200.000	Superior Energy Services
4	Jolliet	Tension Leg Platform	20.000	Conoco Inc.
5	Amberjack	Fixed Platform	20.000	Stone Energy Corp.
6	Auger	Tension Leg Platform	105.000	Shell
7	Pompano	Fixed Platform	60.000	Stone Energy Corp.
8	Mars A	Tension Leg Platform	100.000	Shell
9	Neptune (VK)	Single Point Anchor Reservoir Platform	26.000	Kerr-McGee Corp.
10	Ram Powell	Tension Leg Platform	314.000	Talos Petroleum
11	Baldpate	Compliant Tower Platform	50.000	Hess Corporation
12	Genesis	Single Point Anchor Reservoir Platform	30.000	Chevron
13	Morpeth	Mini Tension Leg Platform	38.500	Eni US Operating Co.
14	Ursa	Tension Leg Platform	150.000	Shell
15	Marlin	Tension Leg Platform	40.000	Occidental Petroleum
16	Allegheny	Mini Tension Leg Platform	25.000	Eni
17	Virgo	Floating Platform	15.000	Total
18	Hoover	Single Point Anchor Reservoir Platform	65.000	ExxonMobil
19	Petronius	Compliant Tower Platform	60.000	Chevron
20	Brutus	Tension Leg Platform	120.000	EnVen Energy Ventures
21	Prince	Tension Leg Platform	50.000	EnVen Energy Ventures
22	Nansen	Single Point Anchor Reservoir Platform	40.000	Ker-McGee/ Ocean Energy
23	Boomvang	Single Point Anchor Reservoir Platform	40.000	Enterprise Oil/ Kerr-McGee/ Ocean Energy

Number	Platform	Type of Production Platform	Capacity (BPD)	Operators
24	Horn Mountain	Single Point Anchor Reservoir Platform	65.000	BP
25	Na Kita Hub	Semisubmersible Platform	110.000	BP
26	Matterhorn	Mini Tension Leg Platform	35.000	W&T Offshore
27	Medusa	Single Point Anchor Reservoir Platform	40.000	Murphy Oil Corp.
28	Gunnison	Single Point Anchor Reservoir Platform	40.000	Kerr-McGee Corp.
29	Marco Polo	Tension Leg Platform	100.000	Deepwater Gateway
30	Devil's Tower	Single Point Anchor Reservoir Platform	60.000	Eni/Williams
31	Holstein	Single Point Anchor Reservoir Platform	113.000	Anadarko Petroleum
32	Mad Dog	Single Point Anchor Reservoir Platform	80.000	BP
33	Front Runner	Single Point Anchor Reservoir Platform	60.000	Murphy Oil
34	Magnolia	Tension Leg Platform	50.000	ConocoPhillips
35	Thunder Horse	Semisubmersible Platform	250.000	BP
36	Constitution	Single Point Anchor Reservoir Platform	84.000	Kerr-McGee Corp.
37	Atlantis	Semisubmersible Platform	200.000	BP, BHP
38	Neptune (AT)	Mini Tension Leg Platform	50.000	BHP
39	Blind Faith	Semisubmersible Platform	60.000	Chevron
40	Tahiti	Single Point Anchor Reservoir Platform	155.000	Chevron
41	Shenzi	Tension Leg Platform	100.000	Woodside Energy
42	Phoenix	Floating Production Unit	45.000	Helix Energy Solutions Group
43	Thunder Hawk	Semisubmersible Platform	60.000	Murphy Oil
44	Perdido Hub	Single Point Anchor Reservoir Platform	100.000	Shell
45	Telemark/ Mirage/Morgus	Triple column Spar Structure	25.000	ATP Oil & Gas
46	Cascade/Chinook	FPSO	80.000	Petrobras
47	Who Dat	Semisubmersible Platform	60.000	LLOG Exploration
48	Mars B	Tension Leg Platform	100.000	Shell
49	Jack/ St. Malo	Semisubmersible Platform	170.000	Chevron
50	Tubular Bells	Single Point Anchor Reservoir Platform	60.000	Hess Corporation
51	Lucius	Single Point Anchor Reservoir Platform	80.000	Anadarko Petroleum
52	Delta House Hub	Semisubmersible Platform	80.000	LLOG Exploration

Number	Platform	Type of Production Platform	Capacity (BPD)	Operators
53	Coelacanth	Fixed Platform	30.000	Walter Oil & Gas Corporation
54	Stones	FPSO	60.000	Shell
55	Heidelberg	Single Point Anchor Reservoir Platform	80.000	Anadarko
56	Stampede	Tension Leg Platform	80.000	Hess Corporation
57	Big Foot	Tension Leg Platform	75.000	Chevron
58	Appomattox/ Vicksburg "A"	Semisubmersible Platform	200.000	Shell

Table 2
List of known production platforms in the GOM area.

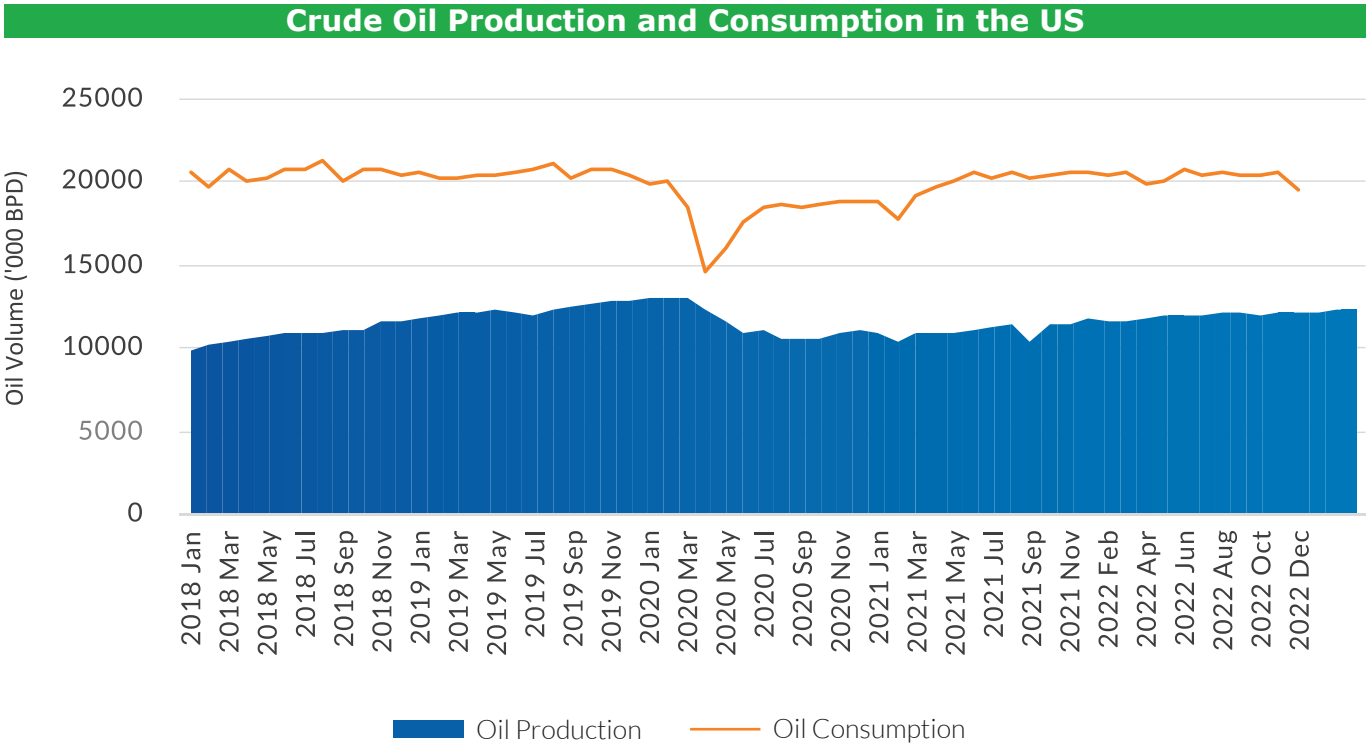
EICDataStream reports that two new production units were installed in the Gulf of Mexico (GOM) in 2022, bringing the total number of production facilities to 60. These new facilities are the 120,000-barrel-per-day Vito oil field semi-submersible platform and the 80,000-barrel-per-day King's Quay Floating Production System by Shell and Murphy Oil respectively.

Additionally, Talos Energy is developing the Lime Rock and Venice discoveries in the deep waters of Viosca Knoll, which are expected to produce about 15,000-20,000 barrels per day via tie-back to the nearby Ram Powell platform.

The Pacific Planning Area consists of four distinct areas which are categorised based on its jurisdictional borders which are Central, North, & South California as well as Washington-Oregon. The blocks in the Southern California are the only ones to have been awarded leases as seen in **Table 1**. The remaining three planning areas (Washington-Oregon, Northern and Central California) will be announced in future licensing rounds in the National Outer Continental Shelf (OCS) Oil and Gas Leasing Programs which is conducted every 5 years (See **"Recent & Future Licensing Rounds"** section below). The Central California area still holds a significant amount of undiscovered oil and gas resources over the other areas within the Pacific since it houses four basins which are the Point Arena, Bodega, Ano Nuevo, and Santa Maria-Partington basins. These basins have an estimated mean oil reserve of 5.22Bbbl of oil and 5.18Tcf of natural gas yet to be recovered. A total of 22 production units and one processing facility platform have been established in this area. The operators of these facilities include Beacon West Energy Group, Beta Operating Company, DCOR, ExxonMobil Corporation, and Freeport-Mcmoran Oil & Gas.

The Alaskan region holds the most potential for undiscovered, technically recoverable resources (UTRR) for oil and gas, which a **2021 BOEM Report** estimates that the number would be at an average of 46.76BBoe. In comparison, the average oil & gas UTRR for GOM in the same year would be 39.35BBoe. The 15 sub-sections of the Alaska Planning Area span over one billion acres surrounding the mainland coastlines of Alaska and only 11 are estimated to contain enough resources for exploration and development. However, these resources are difficult to extract to its full potential due to the sub-freezing temperatures in the region which occurs for most of the year.

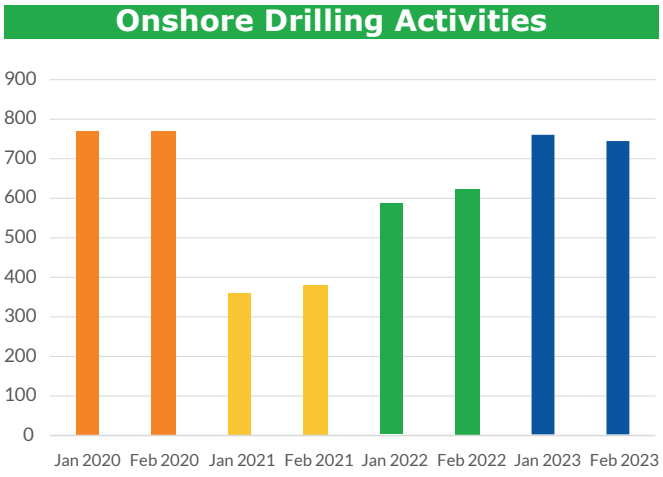
The Chukchi Sea holds the greatest number of discoveries which is 29, most of which contains oil. However, much like the Alaskan region, sub-zero temperatures as well as threats to the local biodiversity prove a challenge for developers to begin oil exploration and production. The Beaufort Sea, just East of the Chukchi Sea, is also rich with oil plays (14 identified exploration plays) and contains four gas-rich discoveries. All leases in the Beaufort Sea and Cook Inlet Planning Areas are held by Hilcorp Alaska, LLC or a joint venture led by the company.

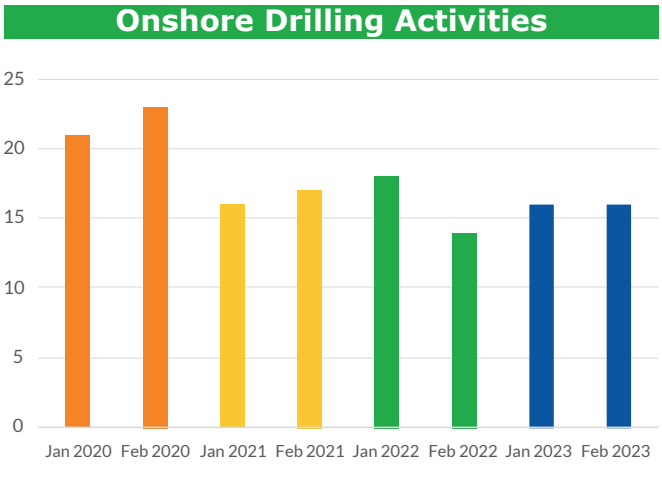


Graph 1

US Crude Oil Production and Consumption (in the form of petroleum) between January 2018 and February 2023. | Source: The U.S. Energy Information Administration.

Data from **Graph** 1 demonstrates how the US is striving to recover their upstream activities since production had peaked in March 2020 with approximately 13MMbbl/d. The latest data shows oil production to be at an average of 11.9MMbbl/d in the year 2022 and then 12.2MMbbl/d for the first three months of 2023. The consumption of crude oil has largely outpaced production with most of the oil to have been consumed through refined petroleum products such as gasoline, diesel, and jet fuel. Post-pandemic, those numbers are expected to steadily increase as the US economy resumes its activities.

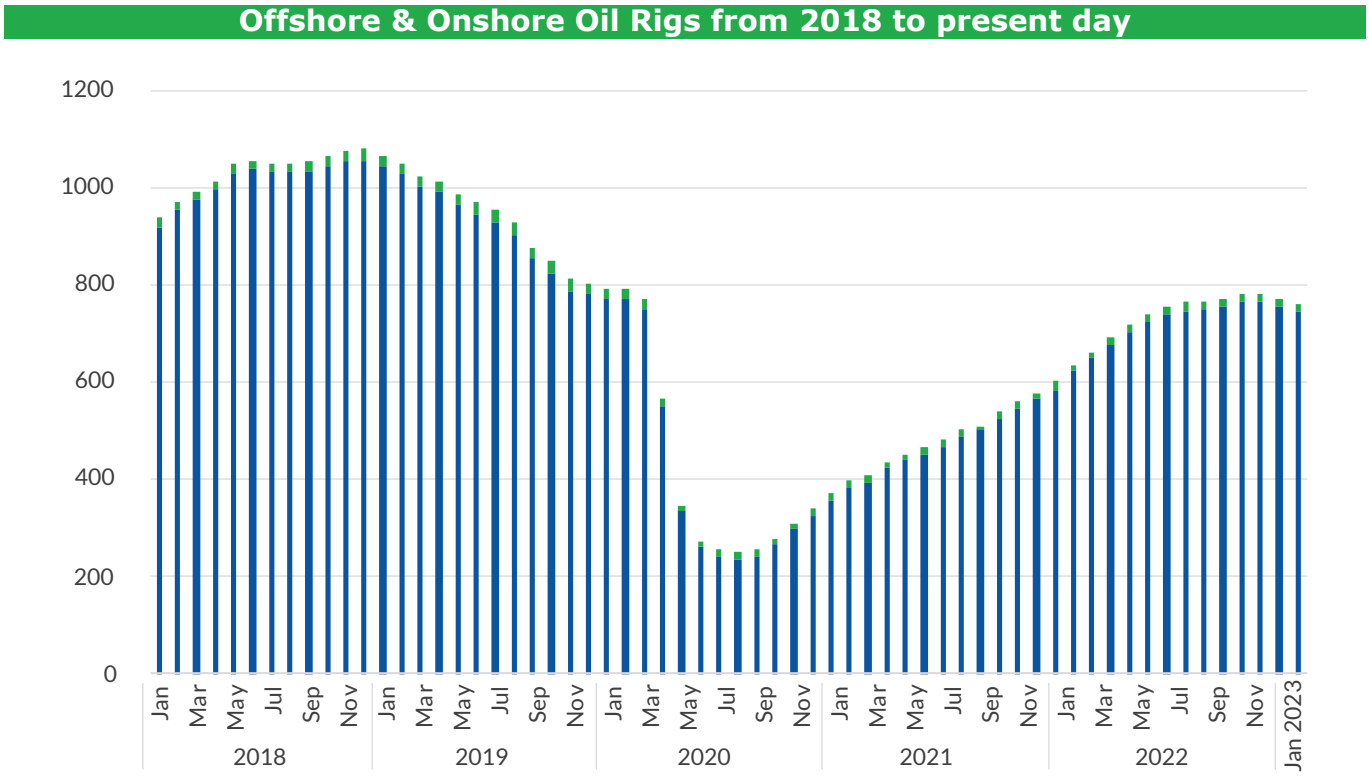




Graph 2

Comparison of onshore and offshore drilling activities in the recent years of 2020-2023

Activities in rig drillings have also been increasing albeit the at different rates d epending if they are done onshore or offshore. Based on **Graph 2**, it can be inferred that drilling activiti es on onshore terrain will increase more rapidly than its offshore counterpart.



Graph 3

Number of US Onshore and Offshore Rigs between January 2018 and February 2023 | Source: The U.S. Energy Information Administration

The main geological plays that are found inland include 15 such basins. These are the Anadarko Basin, Appalachian Basin, Ardmore Basin, Bakken Formation, Bone Spring, Delaware Formation, Eagle Ford Group, Haynesville shale play, Spraberry Formation, Texas-Louisiana Salt Basin, Niobara, Permian Basin, Western Gulf Basin, Williston Basin and Wolfcamp Formation. Among those, The Permian Basin is the country's most prolific onshore basin, accounting for 43% of crude oil production in June 2022.

Graph 3 further emphasises on how a large portion of this activity stems from the country's active onshore drilling through horizontal drilling and hydraulic fracking which has been deployed to access the shale oil reserves since the 1940s. Such methods have been deployed at the Permian Basin, located in west Texas and southeast New Mexico. The basin itself houses several other basins which are, in order of greatest magnitude to least, the Midland Basin, Delaware Basin, and Marfa Basin.

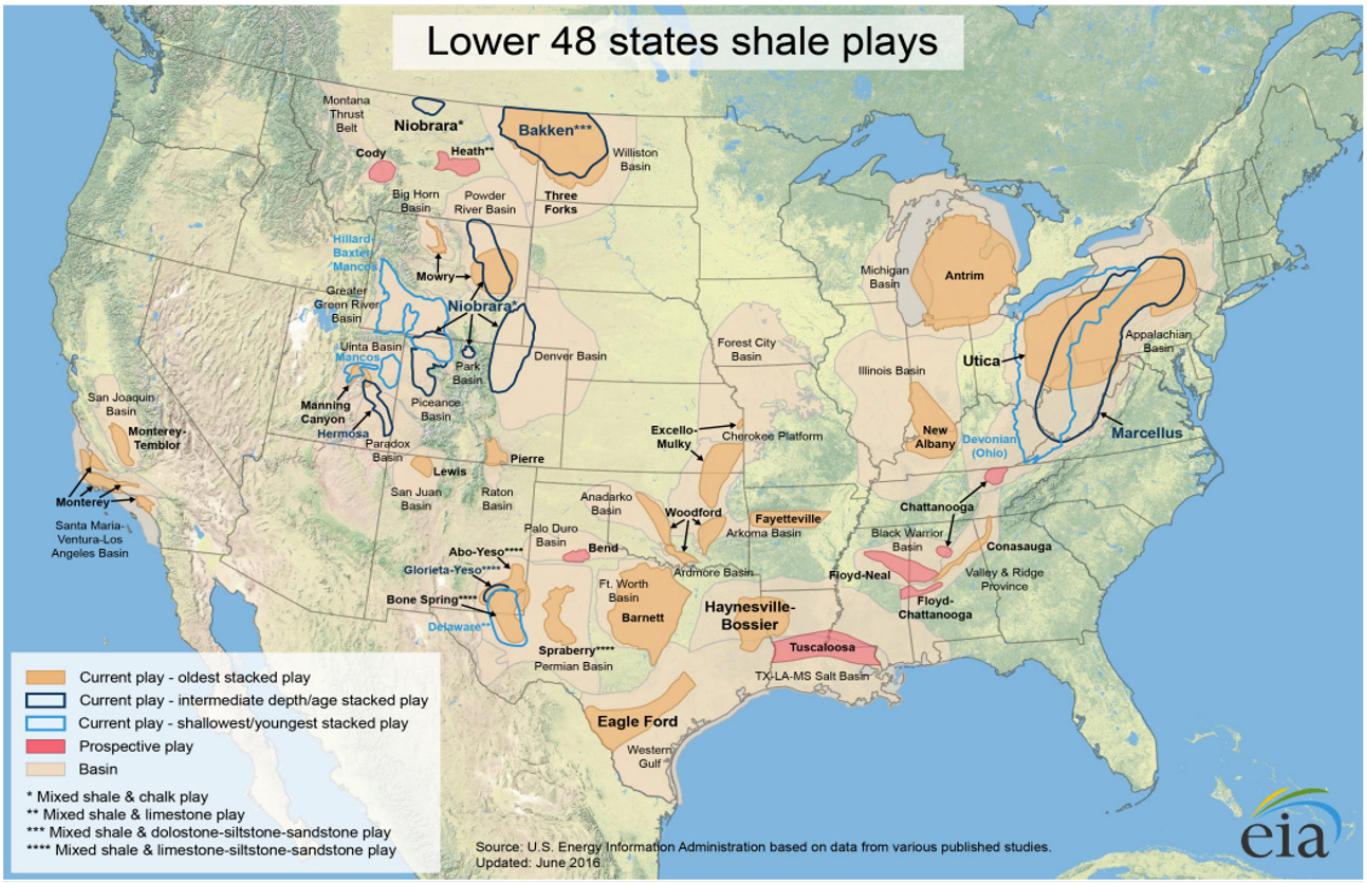


Figure 1
Onshore Shale Plays in the USA. | Source: U.S. Energy Information Administration.

Impact of IRA on O&G Industry

The IRA requires the BLM to offer the lesser of either 1) two million acres (roughly 8,100km2); or 2) 50% of the acreage requested by oil and gas developers in Expressions of Interest (EoIs); to onshore wind and solar developers for right-of-way. Furthermore, the developers of onshore solar and wind must be informed of the total acreage offered 120 days before the auction is held. This gives wind and solar developers an advantage in securing project sites over oil and gas developers.

On top of that, the IRA have introduced several cost changes on onshore and offshore oil and gas leases to ensure that renewable projects could compete economically:

1. Increased the cost of onshore oil and gas leases by US$5 per acre requested in a given EoI.
2. Increased in royalties from 12.5% to a minimum of 16.6% which is mandatory for gases released on federal lease areas. This will be applicable even if the gas was flared or vented.
3. Introduces a charge starting from US$900/MT of methane (or US$36/MT of CO2 equivalent) produced from specific oil and natural gas facilities. The figure will be raised to US$1,500MT after two years.

In conclusion, the IRA is likely to make onshore drilling more costly in the next 10 years, in order to prioritise the development of renewable energy projects. This is reinforced through priority given to onshore solar and wind projects by right-of-way, higher cost of lease auctions and higher royalty rates paid to the federal government on gas production. The offshore oil and gas industry is given a slight boost now that the issuance of offshore oil and gas leases will have to be made one year prior to any issuance of offshore wind leases. The IRA also gives support to the oil and gas industry, both onshore

and onshore, in its application process by way of imposing a two-year maximum environmental review of major projects and one-year maximum to minor project. A caveat to this change is that this mandate is reserved for projects considered "of national importance".

Recent & Future Licensing Rounds

The offshore license auction in the USA would usually arrive every five years under the National Outer Continental Shelf (OCS) Oil and Gas Leasing Programs which is managed by the Bureau of Ocean Energy Management (BOEM). The latest iteration of the five-year program had been for the years 2017-2022 which had officially expired at the end of June 2022. After which, the Biden administration had been preparing for the 2023-2028 edition which promised at most 11 lease sales consisting of 10 lease sales in the Gulf of Mexico region and one in the Alaska region as seen in **Table 3** below:

Lease Area	Intended Sale Year	Region
262	2023	GOM
263	2024	GOM
264	2024	GOM
265	2025	GOM
266	2025	GOM
267	2026	GOM
268	2026	Cook Inlet (Alaska)
269	2026	GOM
270	2027	GOM
271	2027	GOM
272	2028	GOM

Table 3
Maximum potential lease sale schedule for 2023-2028 National OCS Oil and Gas Leasing Program.| Source: Bureau of Ocean Energy Management (BOEM)
GOM - *Gulf of Mexico*

The lease sales were to be finalised by July 2022. However, this plan has since been disrupted with delays to September 2023 and then once more, to December 2023. The reason cited was that the Biden administration would need to respond to the 760,000 public comments submitted as part of the program's draft environmental impact assessment. Now, the US is faced with an unprecedented gap within their oil and gas production timeline, risking a decline in supply which will be felt in the medium-term or roughly in 7-10 years. However, this risk has only been mitigated through the **reinstatement of 4 lease areas** (Leases 257, 258, 259, and 261) from the previous 5-year OCS Programme (2017-2022) through a mandate stipulated in the IRA. Under the new bill, past and new participants of the OCS auctions will now be required to include stipulations to protect biologically sensitive resources, mitigate potential adverse effects on protected species, and avoid potential ocean user conflicts.

Lease Areas Held for 2017-2022 OCS Programme	No of Participating Companies	Reinstated Lease Areas for 2023 under the IRA	No of Participating Companies
249 (GOM 2017)	27	✗	-
250 (GOM 2018)	33	✗	-

Lease Areas Held for 2017-2022 OCS Programme	No of Participating Companies	Reinstated Lease Areas for 2023 under the IRA	No of Participating Companies
251 (GOM 2018)	29	✗	-
252 (GOM 2019)	30	✗	-
253 (GOM 2019)	27	✗	-
254 (GOM 2020)	22	✗	-
256 (GOM 2020)	23	✗	-
257 (GOM 2021)*	33	✓	33
258 (Cook Inlet 2021)	-	✓	1 (Hilcorp Alaska LLC)
259 (GOM 2021)	-	✓	32
261 (GOM 2023) **	-	✓	Pending
262 (Chukchi Sea 2023)	-	✗	-

Table 4
Number of participating companies in latest edition of the 5-year OCS Program (2017-2022) as well as reinstated lease areas from the 2017-2022 program to include in 2023 under the IRA.
** Lease sale 257 (2021) was then invalidated in February 2022. **
**Bids for Lease Sale 261 to be open on 20 December 2023.*

Table 4 reflects the result of the government bringing forward the selected reinstated lease areas from the previous programme to make up for the lack of them in 2023. The results of lease 257 was invalidated by a federal judge in February 2022 but the IRA in August 2022 has allowed the highest bidder to reinstate their winning bids which they were able to secure once again in December 2022 under the new conditions. Meanwhile, Lease Areas 258, 259 and 261 were unsuccessful in receiving interested bidders in the initial 2017-2022 program but Hilcorp Alaska has since won one bid for Leases 258 during its reinstatement. The latest license auction for Lease 259 was conducted in March 2023 and has received 32 bidding participants. Finally, Lease 261 will be open to receive bids come 8 November 2023.

The inflated costs of living as a direct result of inflation highlights the importance of affordable, reliable energy in the face of growing economic uncertainty amongst its denizens. Therefore, the oil and gas sector are unlikely to decline as a direct result of the IRA. At best, oil and gas developers are now incentivised to decarbonise their upstream operations, likely using carbon capture technologies or through the use of less carbon-intensive fuels such as renewable natural gas (RNG). The reinstatement of past Lease Areas also prove that conventional fuel is still essential in the federal government's efforts to provide affordable, reliable energy. However, we also do not expect the oil & gas to rise as it did in its golden age. **Graphs 2 & 3** already reinforces that the industry has been steadily recovering from the effects of the COVID-19 Pandemic and will likely continue that trajectory, given that current policies remain unchanged. Already, a highly contentious bill to look out for would be the recently announced **H. R. 1 Lower Energy Costs Act** which was passed by Congress in March 2023. The bill aims to reverse the decarbonisation efforts of the IRA and intently targets the increase of domestic oil production to lower energy and living costs that the country is experiencing. The bill will have to be reviewed by the Senate before it can be signed into law.

Midstream

The United States has an extensive network of pipelines with an approximate total length of 1.6 million kilometres, including both interstate and intrastate systems, which enable the movement of energy resources from production regions (such as those discussed in the Upstream section, i.e. the Appalachian basin and GOM assets) to major commercial areas and export terminals. Most of which operate under private ownership, unlike many countries that are predominantly state-owned or under national oil companies. This is in line with the country's characteristic free market system to encourage competition, innovation, and flexibility in responding to different market conditions. Regulations and standards are set through the Federal Energy Regulatory Commission (FERC) in conjunction with other federal agencies such as the Environmental Protection Agency to set certain acceptable guidelines. In 2021, the country had managed to deliver about 27.6Tcf of natural gas to 77.7 million consumers. About half of the existing natural gas distribution network responsible for delivering those volumes had already been constructed in the 1950s and 1960s, following increased demands post-World War II. Since then, the sector has continuously been growing to further its reach to new commercial and housing areas.

The United States has recently seen an increase in demand for LNG storage facilities and liquefaction/regasification infrastructure. This is due to a number of factors, but a key turning point was the 2008 Shale Gas Revolution, which enabled the country to begin exporting natural gas to the global market. Recent events that further encouraged the export of LNG was the Russia-Ukraine war. In 2022, the US exported around 10.6 billion cubic feet per day (Bcf/d) of LNG to the European Union to replace dwindling natural gas supplies from the Nord Stream pipeline. This was a 9% increase from 2021 volumes, or 0.8 Bcf/d, and accounted for nearly 64% of total US LNG exports.

As a result, the US market has begun to shift away from prioritizing import infrastructure and towards export infrastructure. This requires more natural gas liquefaction and storage capabilities, not only to ship LNG supplies to international markets, but also to safely store LNG during times of low demand, such as the summertime.

From the perspective of the global market, the demand for LNG is also on the rise because it offers a solution for countries to lower their carbon emissions from conventional coal-powered generation plants while addressing their increasing energy consumption.

Environmental and safety considerations have become significant factors in the midstream sector. Companies are looking to implement measures to minimize the environmental impact of their operations, such as pipeline integrity programs, leak detection technologies, and adherence to regulatory standards.

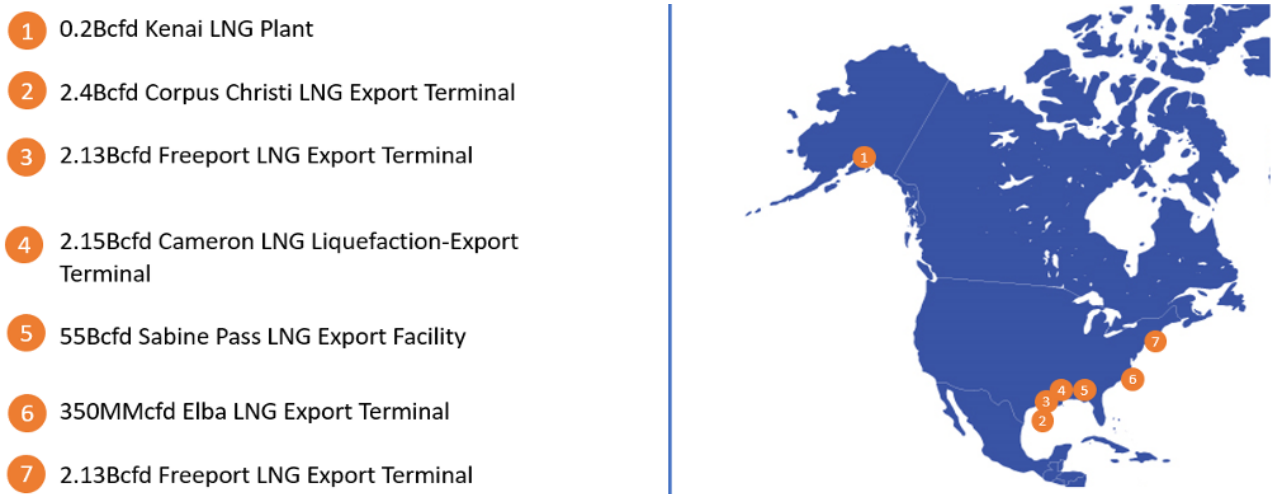
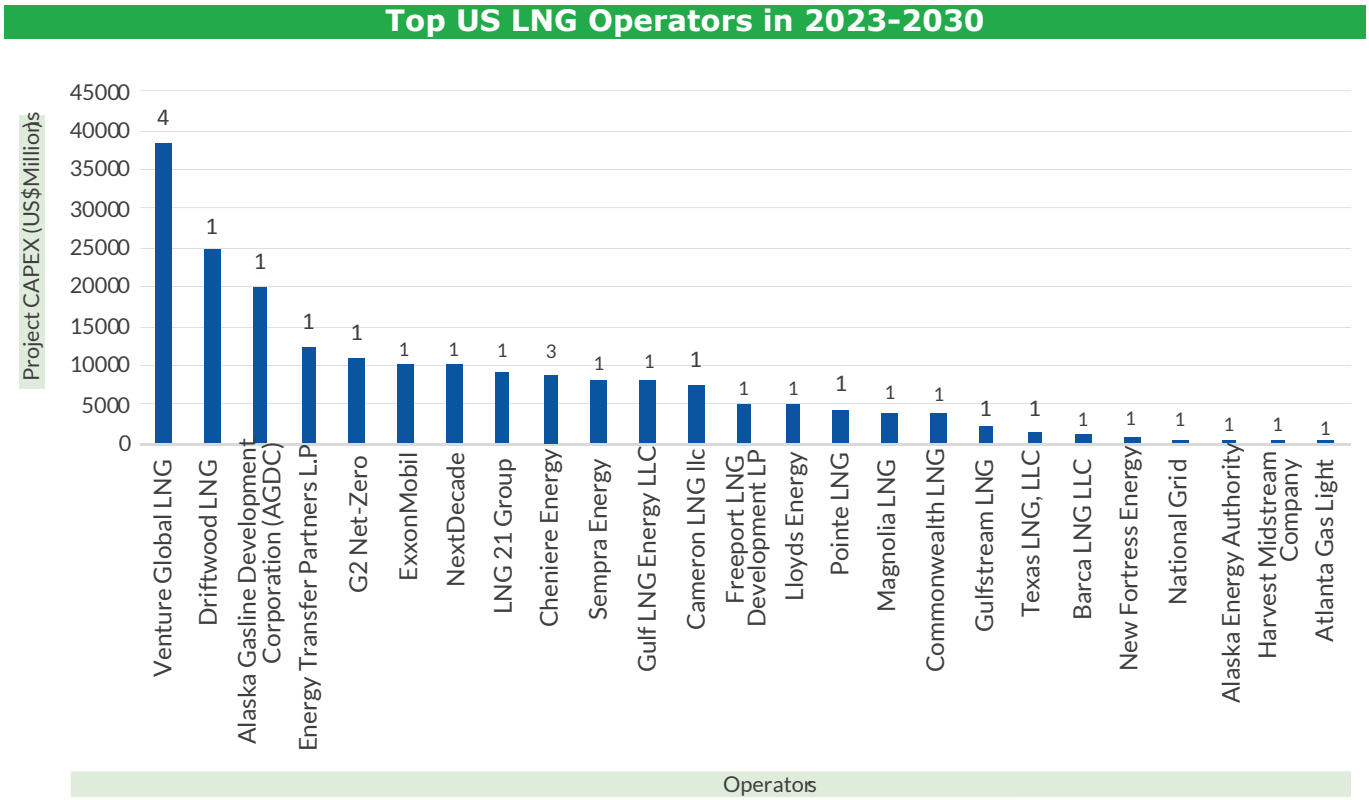


Figure 2
Location of Operating LNG Export Terminal in USA. | Source: EIC AssetMap

The U.S has seven liquefaction terminals primarily located in the Gulf Coast due to the strategic advantages of the region such as proximity to production basins, presence of a deepwater area, and ease of reach to the international market. These terminals, also illustrated in **Figure 2**, include:



Graph 4

Top 20 LNG Operators in the US as of 2023-2030. Data taken from the EICDS as of 23/3/2023

Future expansions and greenfield developments are also concentrated along the GOM coastlines due to the same reasons outlined above. Based on **Graph 4,** Venture Global is poised to take the lead when it comes to greenfield LNG liquefaction developments. This will be done through the development of four projects, which are the **Plaquemine LNG (Phases 1 & 2)**, **CP2 LNG**, and **Delta LNG Export Terminals**. In particular, Phases 1 & 2 of the Plaquemine projects are of a particular interest to contractors currently as they have already secured FIDs as of May 2022 and March 2023. The only other two projects which have secured an FID would be the greenfield **Port Arthur LNG** and the brownfield **Corpus Christi LNG** expansions by Sempra Energy and Cheniere Energy respectively. More FIDs are expected to be finalised within 2023 for projects to startup from 2026 and onwards, which is around the time that we can expect the LNG market to grow significantly, provided that the demand for it is as strong as it is has been recently.

Project Name	Operator	FID Expected	Startup
Rio Grande LNG Terminal (Phase 1)	NextDecade	June 2023	2026
Commonwealth LNG Liquefaction and Export Facility	Commonwealth LNG	2023	2026
Pointe LNG Liquefaction and Export Terminal	Pointe LNG	2023	2026
Delta LNG Export Terminal	Venture Global LNG	July 2023	2026
CP2 LNG Export Terminal	Venture Global LNG	October 2023	2026

Cameron LNG Liquefaction Plant Expansion (Train 4)	Cameron LNG LLC	June 2023	2027
Lake Charles LNG Export Terminal	Energy Transfer Partners L.P.	March 2023	2028
Freeport LNG Liquefaction Facility (Train 4)	Freeport LNG Development L.P.	March 2023	2028

Table 5
Projects with FIDs expected in 2023.

Downstream

The US has 130 refineries. Five of which have been idle as of 2022 and so the total refining capabilities for the remaining 125 accounts for 17.8MMbbl/d in total. In contrast, the largest refining capability in the South America would be Brazil with 17 refineries and a combined processing capacity of 2.41MMbbl/d, according to the EIC's Brazil Country Report. A significant focus has been given to produce transportation fuel such as gasoline, diesel, and jet fuel to meet the growing demands of the country which heavily relies on automobiles and trucks for transportation. The growth of the industry is closely tied to the growth of its upstream sector, tracing back to 1859 when the first commercial oil well was drilled in Titusville, Pennsylvania and then prominently during the Shale Revolution in the early 2000s when hydraulic fracturing methods were employed to uncover the oil and gas from shale formations. This, coupled with the various market deregulation policies in the 1980-1990s, has since allowed industry players to drive costs down and be globally competitive.

Despite that, emissions from refineries have been regulated by the federal government by implementing standards to reduce the sulphur content in fuels to reduce nitrogen oxide emissions. This is summarised in **Table 6** below.

Policies	Contents
Renewable Fuel Standard (RFS) (2005)	A standard to include a certain volume of renewable fuels, such as ethanol, to be blended with transportation fuels. Standards had also been set for biodiesel.
Ultra-Low Sulfur Diesel (ULSD) Rule (2006)	A standard to further reduce sulphur contents in diesel fuel to a maximum of 15ppm from the initial 500ppm.
Tier 3 Standards (2014)	The Tier 3 Vehicle Emission and Fuel Standards Program introduces a mandatory 70% reduction in sulphur content in gasoline from 30 parts per million (ppm) to 10ppm. Implementation began in 2017.
International Maritime Organization (IMO) Regulations (2020)	An international regulation to oversee the reduction of sulphur in marine fuels to 0.5% from 3.5%.

Table 6
Table of Sulphur-Reducing Regulations adopted in the US from 2005-2020

It is noteworthy that, in recent times, the industry has faced mounting pressure to embrace sustainable practices in order to contribute to the energy transition movement. This has led to the progressive development of alternative fuels such as waste-to-products, e-fuels, renewable natural gas (RNG), and sustainable aviation fuel (SAF) by established industry players such as Shell, Marathon Petroleum, and Valero Energy.

Project	Operator	Product	Startup
Friesian Biomethane Facility	Shell	RNG	2026
Green Bison Renewable Diesel Plant	Marathon Petroleum	Renewable diesel, naphtha	2023
Bayou Fuels Biomass To Fuels Project	Velocys Inc	SAF	2028
DGD Port Arthur Refinery - SAF Production Plant	Diamond Green Diesel LLC	SAF	2023
Convent Biofuel Facility	Shell	SAF, renewable diesel	2028
Galveston Bay Green Fuels Project (Texas Green Fuels)	Texas Green Fuels	E-fuels (ammonia, methanol)	2028
Cherry Point SAF Production Plant	BP	SAF	2030

Table 7
Table of downstream projects in the US. Extracted from the EICDS as of October 2023.

Plans to develop biofuel refineries such as the 300,000tpa Green Bison Renewable Diesel Plant by Marathon Petroleum and the 300,000tpa Bayou Fuels SAF Plant by Velocys Inc have been gaining traction partly due to the blending regulations set in the RFS in 2005 and are further reinforced by the incentives introduced in the IRA for biofuels, which includes:

1. Tax breaks for cleaner transportation fuel

- US$1.25 per gallon tax credit for SAF.
- US$1.75 per gallon tax credit for SAF depending on the greenhouse gas reduction achieved.
- Technology-neutral Clean Fuel Production Tax Credit for low-emissions transportation fuel produced in 2025, 2026, and 2027.
- Extension of US$1 per gallon blends tax credit for biodiesel and renewable diesel through 2024.
- Extension of 50-cent-per-gallon alternative fuels tax credit through 2025.
- Extension of second-generation biofuel income tax credit through 2024.
- Extension of alternative fuel vehicle refuelling property credit through 2032.

2. Grants target infrastructure investment

- Competitive grant program to support alternative aviation fuels and low-emissions aviation technologies.
- US$250mn in funding for SAF projects.
- US$500mn in funding for biofuel infrastructure development.
- Support for installing, retrofitting, or upgrading fuel dispensers to supply higher blends of biofuels.

The downstream sector has played a critical role in fulfilling the country's energy demands through the production of a diverse range of refined products. In recognition of the prevailing market trends, the sector is poised to embrace the ever-evolving market landscape, stringent environmental regulations, and maintain its position at the forefront of technological advancements.

Power Generation

Conventional Power Generation

US utility-scale electricity generation by source, amount, and share of total in 2021

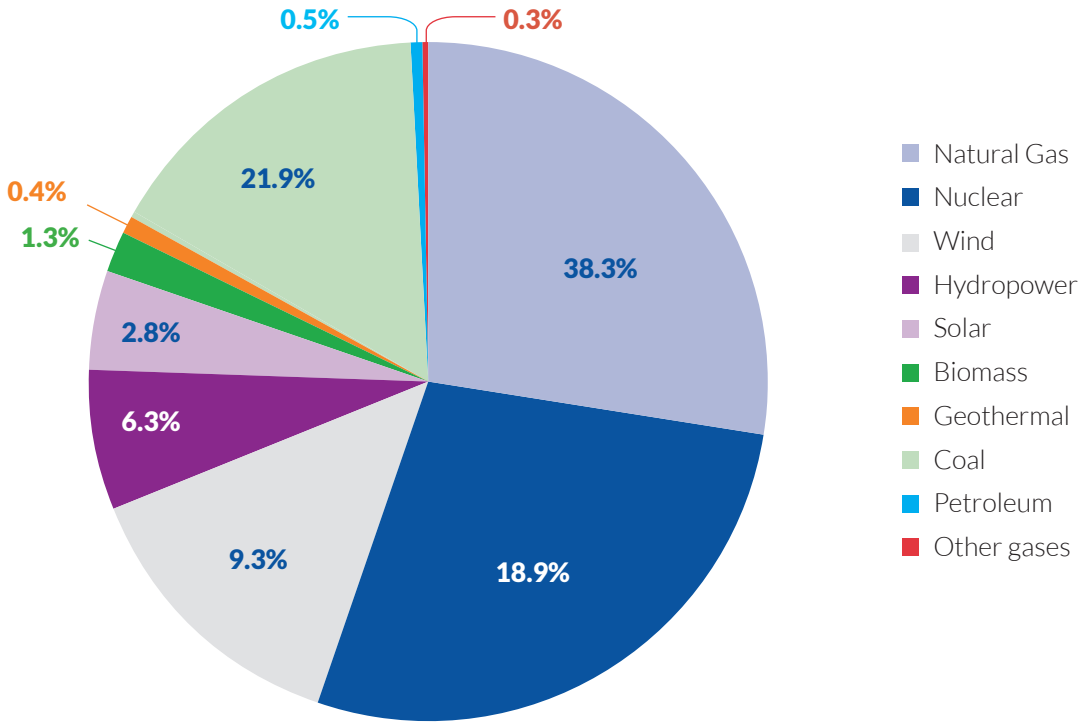


Figure 3
US utility-scale electricity generation by source, amount, and share of total in 2021 | Source: EIA

The US has recorded a total installed generation capacity of 4,090TWh, making it the largest electricity producer in the North and South American region. The US utilises a variety of energy sources ranging from fossil fuels, renewable energy, and nuclear in order to meet the country's growing population as well as its industrial and commercial needs. According to the **EIA**, conventional fuels such as natural gas and coal still accounts for most of the energy mix installed in 2022 at about 39% and 20% respectively. Regarding the renewable portion, the total solar and wind generation had accounted for 14% with hydropower to have remained the same from its 2021 figure of 6%.

Power auctions in the US typically operate through regional wholesale electricity markets which are operated by public entities such as PJM Interconnection, ISO New England, New York ISO, Midcontinent Independent System Operator (MISO) and the California Independent System Operator (CAISO). These entities would operate independently to ensure the efficient and reliable operation of their respective electricity grids. As such, the power auctions are held at different rules, market structures and auction mechanisms. That being said, there are mainly two types of wholesale electricity markets in the US which are day-ahead market and real-time market.

- In the day-ahead market, participants are expected to submit their bids to buy or sell electricity for the following day depending on their expected generation or consumption needs. The market operator will then collect and determine the bids with the least cost for the price of electricity for each hour of the following day.

- Conversely, in real-time market, the bids are expected to be submitted closer to the actual delivery of electricity which would allow participants to adjust their generation or consumption based on real-time conditions.

Policy Changes

The US has implemented several policy changes which have directly impacted the power sector to encourage the adoption of cleaner energy to address the climate change crisis. Such policies can be summarised as below:

- **Renewable Portfolio Standards (RPS) –** RPS policies have been established within many states which would require utilities to acquire a specific percentage of their energy to come from renewable sources.

- **Inflation Reduction Act (IRA) –** Expands upon the use of Investment Tax Credits (ITCs) and Production Tax Credits (PTCs) to support the deployment of carbon capture technologies within the power sector to further lower existing emissions produced from coal-fired and natural-gas fired power plants.

- **The US Bipartisan Infrastructure Law –** The announcement of several key fundings and programmes aimed to modernise the aging infrastructure of the country such as roads and hydroelectric dams as well as to support the deployment of renewable energy projects, electric vehicle charging infrastructure and grid modernisation.

The proportion of natural gas and renewable energy sources are growing in the power generation sector in the United States, while coal-fired electricity output is decreasing. Coal-fired power plants accounted for roughly 42% of total utility-scale electricity producing capacity in 1990, however by 2021, they only represented for 22% of total utility-scale energy generation. The EIA forecasts share of electricity generation from coal will decline to 21% in 2022 and to 20% in 2023 due to the retirement of coal-fired units. During the same period, natural gas-fired power generation capacity increased from 12% in 1990 to 38% in 2021.

Most nuclear and hydroelectric plants in the US were built before 1990. Since 1990, nuclear energy's percentage of overall electricity output in the US has remained steady at around 20%. Hydropower generation, which has traditionally been the main source of total annual utility-scale renewable electricity generation until 2019, varies year to year due to precipitation patterns.

The amount of electricity generated by non-hydro renewables in the US is rising. Renewable electricity generation from non-hydropower sources has gradually expanded in recent years, owing to increased wind and solar producing capacity. Since 2014, total yearly electricity generation from non-hydro renewable sources has exceeded hydropower generation.

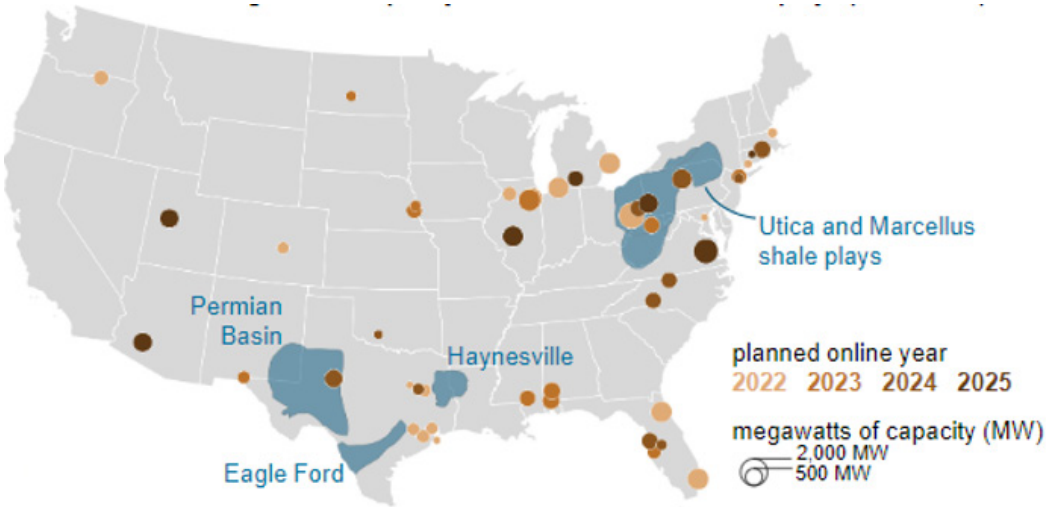


Figure 4
Planned US natural gas-fired capacity additions and select shale plays (2022-2025) | Source: EIA

The two main sources of power generation in the US have been coal and natural gas. These two fuels compete for electricity supply in various areas of the country based on their respective costs. Natural gas prices in the US have been more volatile than coal prices, so the cost of natural gas frequently influences the relative amount of power produced by natural gas and coal in the US. The EIC Datastream records 20.3GW of additional gas fired capacity to come online in the US between 2022 and 2025. This additional capacity would raise existing capacity by 6% (into 489.1 GW in August 2021). Many of the projected natural gas-fired capacity expansions are near significant shale formations in Appalachia and Texas.

Texas now has 70.7 GW of natural gas-fired capacity operational as of August, with further 2.7 GW of capacity increases scheduled between 2022 and 2025.

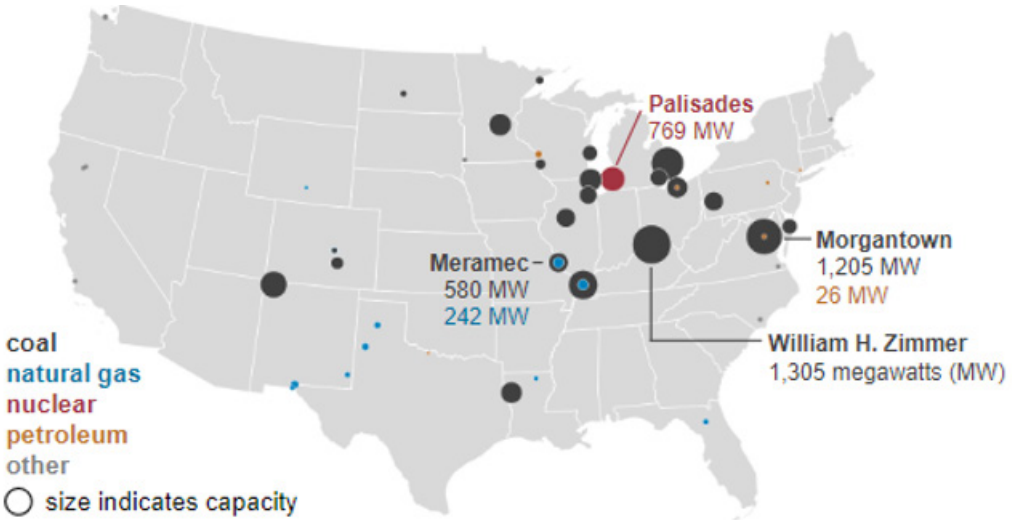


Figure 5
Planned US utility-scale electric generator retirements (2022) | Source: EIA

The majority of the coal plants in operation in the US were built in the 1970s and 1980s. Coal-fired power stations in the US are retiring as the fleet ages and natural gas and renewables become more competitive. The 1,305MW William H. Zimmer plant in Ohio is the largest coal power plant set to close in 2022. Morgantown Generating Station in Maryland will shut down two coal-fired units (1,205 MW combined) in June 2022, followed by two of the plant's six smaller petroleum-fired units in September 2022. Plant retirements are most common when the cost of operating a plant exceeds predicted revenue or when the facility's value to the power system, such as its value in providing grid reliability, exceeds the plant's operating costs. These scenarios can arise as a result of the introduction of lower-cost or more efficient technology, changes in fuel prices, or new laws that require further investment in the unit to assure compliance.

Planned US utility scale-scale elctric generating capacity retirements (2022)

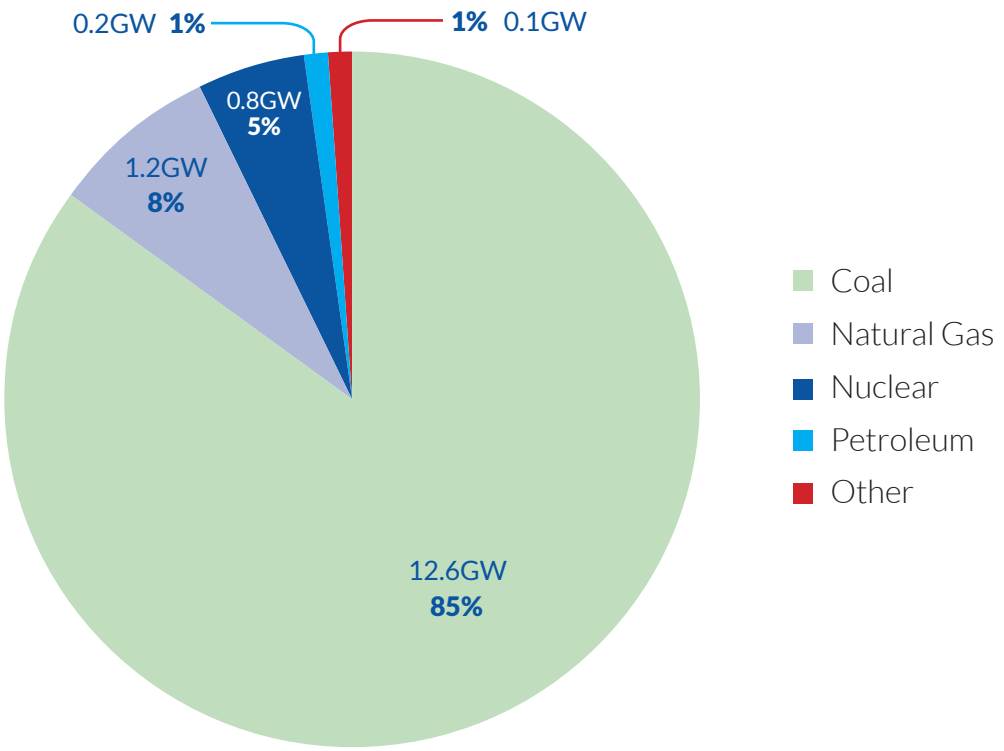


Figure 6
Planned US utility-scale electric generating capacity retirements, 2022 | Source: EIA

According to the **EIA**, operators have scheduled 14.9 GW of electric generating capacity to retire in the US in 2022. Coal-fired power facilities make up the bulk of planned retirements (85%), followed by natural gas (8%), and nuclear (5%).

Nuclear

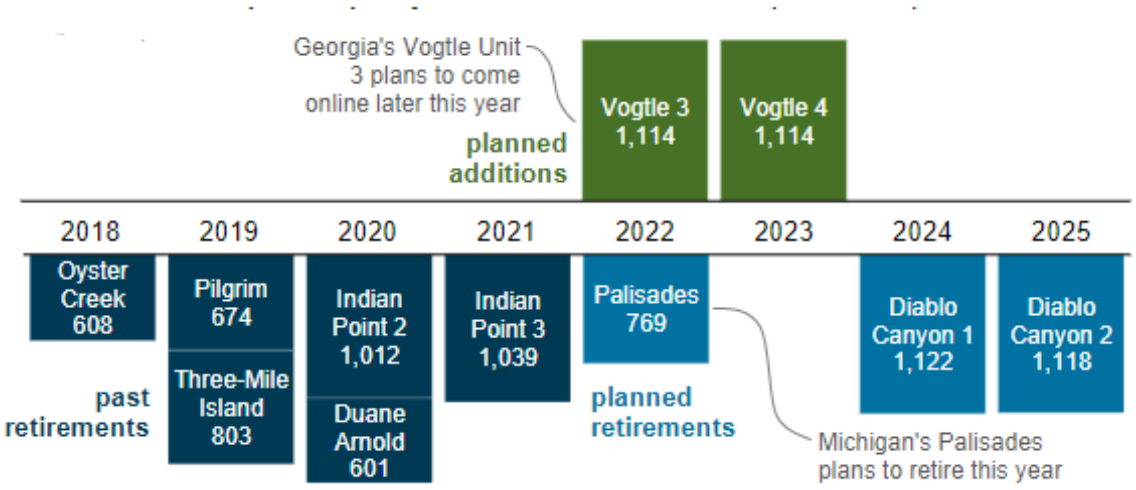


Figure 7
US nuclear power plant capacity additions and retirements (2018-2025) | Source: EIA

Nuclear-powered generation, which totalled 778 million MWh in 2021, has remained generally stable in the US during the past decade because uprates at existing facilities have offset the retirement of several reactors. Only one reactor, Indian Point Unit 3 in New York, was shut down in 2021. Despite a minor improvement in the nuclear fleet's capacity factor in 2021, nuclear power generation in the US fell to its lowest level since 2012. Three reactors with a total capacity of 3,009 MW are set to be taken offline through to 2025: Michigan's Palisades will shut down later in 2022, while California's Diablo Canyon will close one generating unit in 2024 and another in 2025. The Bipartisan Infrastructure Law, which was signed into law in November 2021, includes a US$6B investment to prevent existing nuclear power facilities from being shut down prematurely. The funds will be made available to nuclear power stations that would otherwise close but have been confirmed as safe to operate by the Nuclear Regulatory Commission.

Renewables

The **Annual Energy Outlook 2023** (AEO2023) by the Energy Information Administration (EIA) places the USA in a good position to meet its Paris Agreement target which outlines the country's goal to reduce greenhouse gas emissions by 50-52% below the 2005 level by 2030. In its latest iteration, the report goes on to state that energy-related CO2 emissions had fell 25-38% below the 2005 level owing to increased electrification, higher equipment efficiencies, and increased generation by renewable sources such as solar and wind. The report estimates that renewable generating capacity is expected to grow in the coming years, with additional support to come from battery energy storage systems (BESS). Data from the report's previous iteration (AEO2022) shows that new wind and solar accounts for the majority renewable energy additions. Meanwhile, hydropower had remained unchanged through 2050 and other renewable energy sources, such as geothermal and biomass, account for less than 3% of total generation. As a result of continuous additions in solar and wind generating capacity, the annual share of US power generation from renewable energy sources is expected to steadily rise from 21% (2021) to 22% (2022) and 24% (2023).

Solar

The Biden administration, in their **2021 blueprint for a Zero-Carbon Grid**, estimates that solar could supply over 40% of US electricity by 2035, with supportive policies such as tax credits for solar farms and manufacturers. The Infrastructure Bill 2021, Inflation Reduction Act (IRA) 2022, and Renewable Portfolio Standards (RPS) have all advanced solar-positive policies, with the IRA's extension of the Investment Tax Credit (ITC) and Production Tax Credit (PTC) being the most significant.
The ITC is a 26% tax credit on the capital costs of solar and onshore wind projects, while the PTC is a US$0.26 per kWh tax credit on electricity generated. Additional tax credits for PTC are available under the Advanced Energy Manufacturing Tax Credit (45X MPTC) for the manufacturing and sale of clean energy components domestically, on a per-unit basis. A full comprehensive list can be viewed in the **Appendix** section under Table A. Meanwhile, additional credits for ITC can be obtained under the Advanced Energy Project Investment Tax Credit (48C ITC) for the purchasing and commissioning of a property to build an industrial or manufacturing facility.

To meet the president's targets of net zero emissions by 2050 and a carbon-free domestic electricity industry by 2035, the US must add an average of 30 GW of solar power per year between now and 2025, more than doubling its current rate, and 60 GW per year between 2025 and 2030.

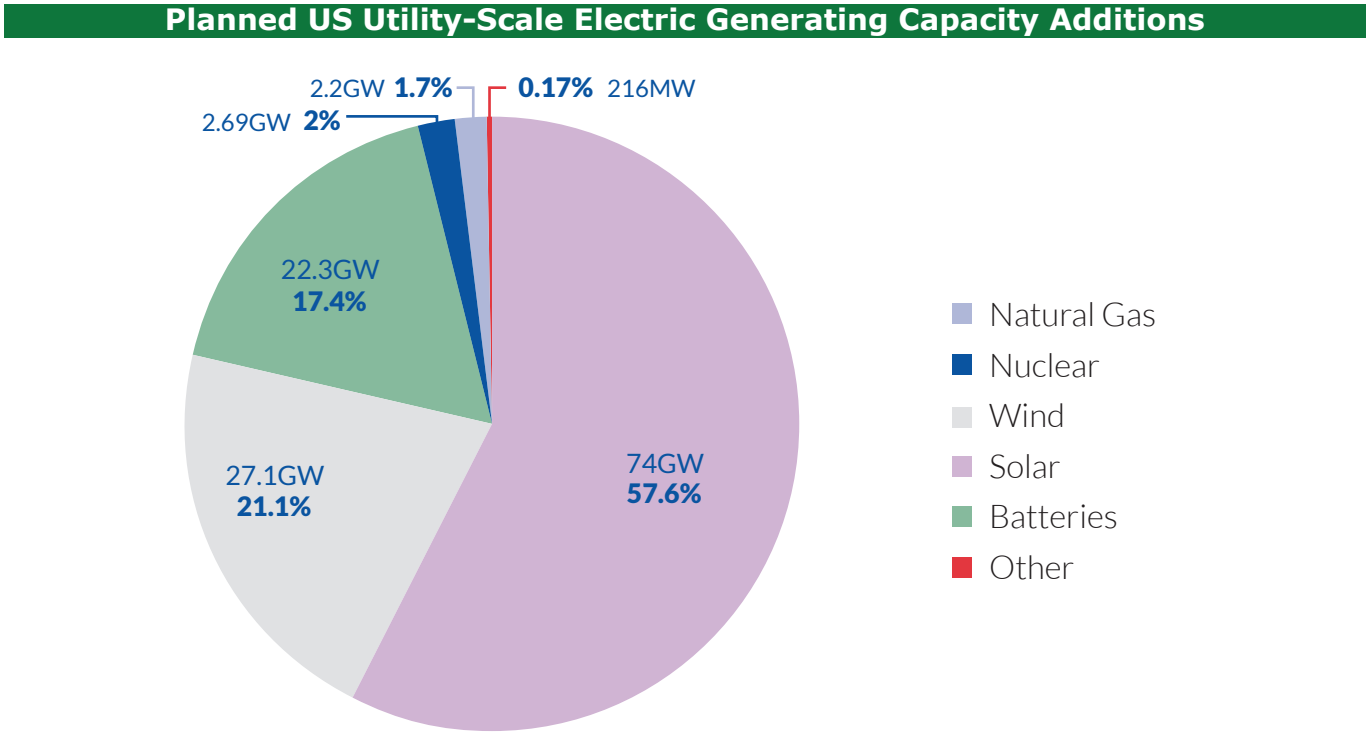


Figure 8
Pie Chart of Planned US Utility-Scale Generating Capacity Additions as of December 2022. | Source: **EIA** *Database*

Recent data pulled from the **EIA** shows that the US has added 16.8 GW of utility-scale electric generating capacity in the first half of 2023, with solar accounting for 35% of capacity added, marking the fourth year in a row that solar accounted for the largest new renewable electricity-generating capacity. This achievement is significant considering the challenges faced in the industry such as the COVID-19 Pandemic, on top of unfavourable renewable energy policies presented by the Trump administration in 2017-2021. The economic viability of building solar PV systems has generally been improved since 2019, as the average cost of construction has decreased by 8% (AEO2023). Generally, this would promote the development of solar PV systems further rather than wind or natural gas power plants,

which have not seen a similar decrease in construction costs. Conversely, the average construction costs of wind farms and natural gas-fired generators had risen by 8% and 4% respectively since the same year. The lower costs for PV are attributed by the reduction in costs of all solar panel types to US$1,655 per kW which in turn, was driven by a 17% reduction in construction cost for cadmium telluride track, which is at its lowest at US$1,631 per kW since 2014.

However, this feasibility can be easily overturned with polices such as **Section 201** which was implemented by the previous administration on 23rd January 2018. The Act imposes significant tariff duties on imported solar panels and modules, with exceptions made for "**GSP-Eligible**" developing nations. Though it intended to provide competitiveness for local manufacturers, it instead caused delays in solar projects from being commissioned as an increase in the price of such major equipment would mean that projects such as wind and natural gas projects would instead be looked upon more feasibly, as reported by the **Solar Energy Industries Association**.

Year	2018	2019	2020	2021	2022*	2023*	2024*	2025*	2026*
Imported Tariff	30%	25%	20%	15%	15%	15%	15%	15%	15%

Table 8
Section 201 Tariffs imposed on solar cells and modules imported into the U.S. on a year-by-year basis.
**Section 201 years extended by President Joe Biden until 4th February 2026.*

Supply chain issues persisted after the Biden administration had come into the picture even after they had decided to waive those tariffs on 6th June 2022 for Vietnam, Cambodia, Malaysia, and Thailand (countries that typically provided 80% of solar panels to the U.S) for a duration of two years. This is because solar power generating capacity additions had fell short of expectations by a large margin of 4.6GW. Supply chain issues continue to persist post-Pandemic, with delays reported in one third of all utility-scale solar capacity scheduled for completion in Q4 of 2021 by at least a quarter, and 13% of capacity scheduled for completion in 2022 has been postponed by at least a year or has been cancelled entirely. Similar delays continue to plague the solar industry throughout 2022. Despite those efforts, an investigation had to be carried out by the Department of Commerce (DOC) on suspicions that Chinese solar and module producers were circumventing antidumping and countervailing duties, such as those imposed by Section 201, by shipping their solar products through those four countries. The final verdict was released on August 2023 by the DOC and deemed that some companies (shown in **Table 9** below) were guilty of avoiding US duties through this method.

Country	Company	Findings
Cambodia	BYD Hong Kong	Circumventing
	New East Solar	Circumventing
Malaysia	Hanwha Q CELLS	Not Circumventing
	Jinko Solar	Not Circumventing
Thailand	Canadian Solar	Circumventing
	Trina Solar	Circumventing
Vietnam	Boviet Solar	Not Circumventing
	Vina Solar	Circumventing

Table 9
*U.S. DOC's solar investigation **findings** on companies circumventing anti-dumping duties.*

These findings will have significant impact on the solar supply chain going forward. In the short-term, the impact is much more forgiving as local developers have been given six months from the **Presidential Proclamation** of 6th June 2022 to search for new solar equipment manufacturers and readjust their supply chain. Duties will be imposed on June 2024, unless the solar modules and cells are consumed in the U.S. market. In the long-term, the growth of solar projects is likely to be stunted as it is possible that tariffs after June 2024 could jump by as much as 50 to 250%. A final decision on the matter is expected as we get closer to June 2024.

Other supply chain issues include four key factors which are high shipping costs, port congestion, container shortages in China and polysilicon shortages. The majority of solar panels used to be imported from China but even as travel restrictions have eased on both sides of the world, the **World Economic Forum** records an increase in shipping costs by six times the pre-pandemic baseline for deliveries from Shanghai to various international ports. Furthermore, ports in China are also struggling to meet the nation's demands as most of their containers were left stranded in US ports (mainly through Los Angeles and Long Beach) when lockdowns had occurred. This has led to longer wait times by consumers and manufacturers alike which is further exacerbated by the increase in pandemic spending, resulting in a situation where supply can not keep up with the demand.

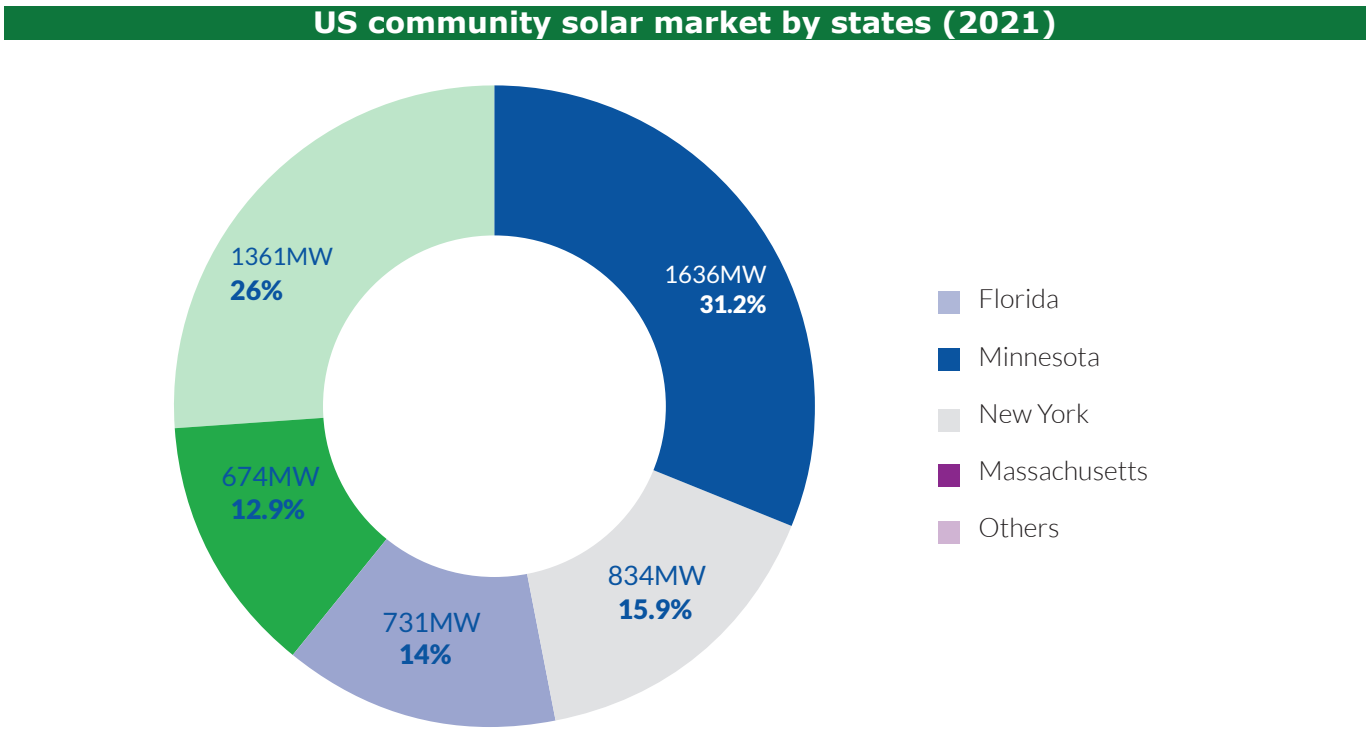


Figure 9
US community solar market by states in 2021. | Source: National Renewable Energy Laboratory (NREL)

Community solar, which provides renewable energy or even financial benefits to multiple community members, is also rapidly growing across the US. According to the National Renewable Energy Laboratory (**NREL**), as of December 2021, the US installed more than 3,200 MW of community solar capacity and 74% of the overall market is concentrated in the top four states: Minnesota, Florida, Massachusetts, and New York. New York also has the largest pipeline in the nation with enough community solar under construction to serve an additional 401,000 homes. In the next five years, New Jersey and Illinois are also expected to be major development drivers for the industry. The Biden administration has set their goal through the **National Community Solar Partnership (NCSP)** of powering 5 million American households with community solar projects by 2025, which would need a 700% increase in present capacity.

Onshore Wind

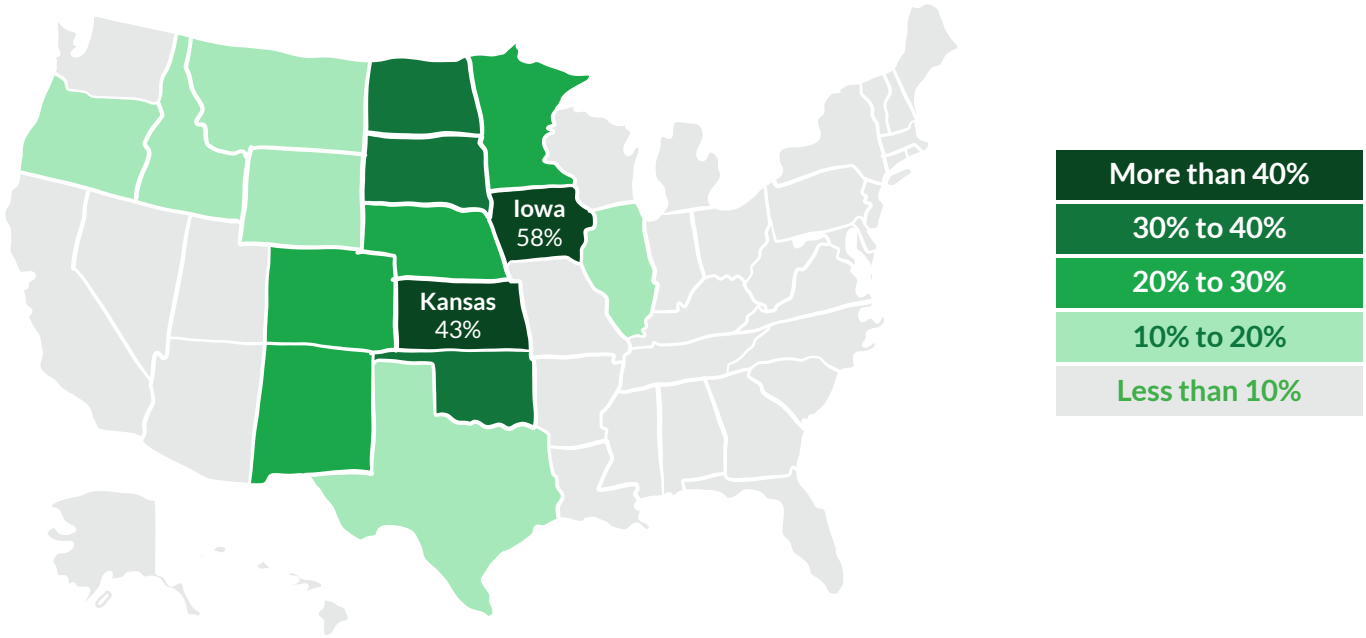
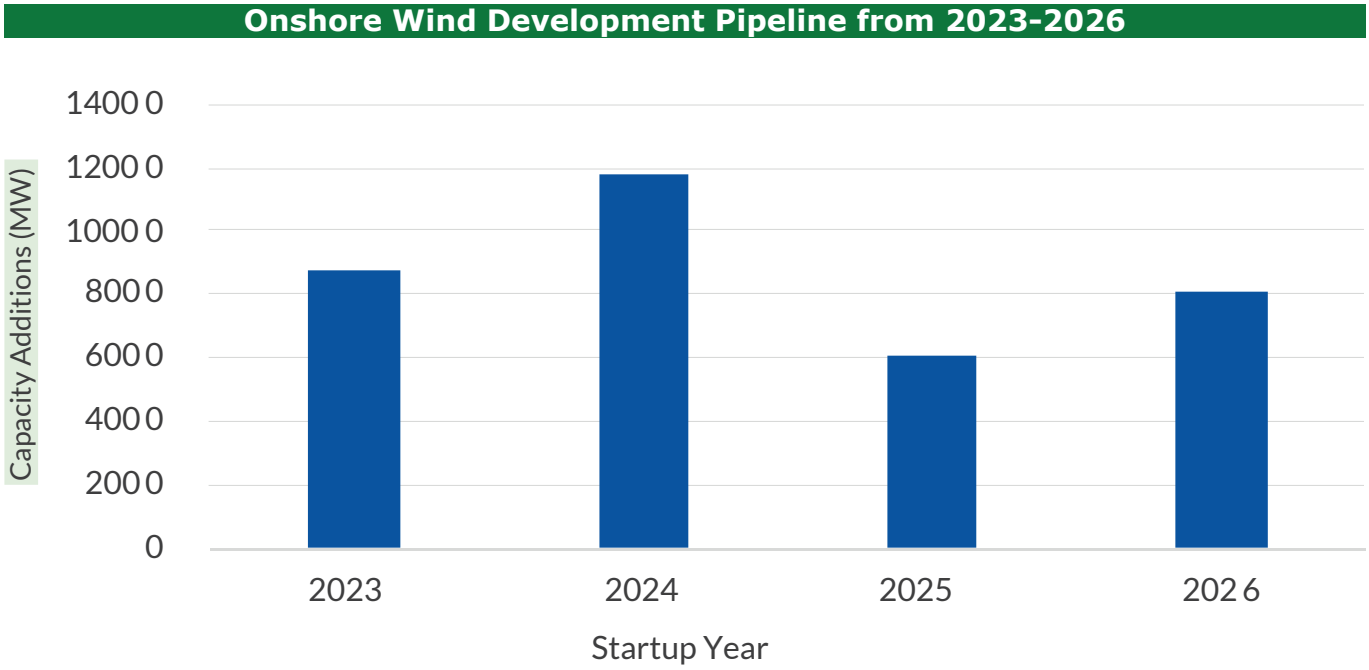


Figure 10
Wind's share of in-state utility-scale electricity generation (2020) | Source: EIA



Graph 5
Onshore Wind Development Pipeline from 2023-2026. Extracted from the EICDS as of 29th March 2023.

According to the EIA, wind turbines produced over 2,000GWh of power, and was able to compete with that of nuclear and coal-generated electricity but was still lagging behind natural gas in 2022. Previously, wind was the fourth-largest energy source in 2021 of around 9.2% of total US utility-scale electricity generation, behind natural gas, coal, and nuclear, generating almost 380TWh for the year. EIC records, as shown on **Graph 5** above, shows that another 8.7GW of utility-scale onshore wind developments will come online in the US by 2023. Onshore wind generates power in 16 states,

with Iowa, Kansas, Oklahoma, South Dakota, and North Dakota accounting for more than 30% of total in-state generation. Texas produced about 26% of all wind-powered electricity generation in the US in 2021, leading the nation for the 16th year in a row.

Offshore Wind

The offshore wind industry in the United States is still in its early stages of development when compared with China which had contributed over 50% (or over 47GW) of new capacity additions globally in 2021, according to the **2022 Global Wind Report** by the Global Wind Energy Council. In comparison, the United States had trailed behind in second place to add as much as 13.58% (or over 12GW) in newly installed capacity additions in the same year. The industry has significant room to grow in the coming years as an official statement by the **White House** in March 2021 unveils that the country has raised their offshore wind targets from 22GW to 30GW by 2030. **Table 10** below shows the different targets that is set to be achieved according to each state. Despite ambitious targets, the high cost of offshore wind development remains a major challenge. However, as the industry matures, costs are expected to decline due to the strong state and federal support, making it more competitive with other forms of power generation.

States	Offshore Wind Targets (Year)
North-East	
Connecticut	2GW (2030)
Delaware	N/A*
Maine	5GW (2030)
Maryland	1.2GW (2030)
Massachusetts	5.6GW (2035)
New Jersey	7.5GW (2035)
New York	9GW (2035)
Rhode Island	N/A**
Virginia	5.2GW (2035)
South-East	
Florida	N/A
Georgia	N/A
North Carolina	2.8GW (2030)
South Carolina	N/A
South	
Alabama	N/A
Louisiana	5GW (2035)
Mississippi	N/A
Texas	N/A
West	
California	2-5GW (2030)
Oregon	3GW (2030)

Pacific Ocean	
Hawaii	N/A***
Average Total	**44.8GW (2030-2035)**

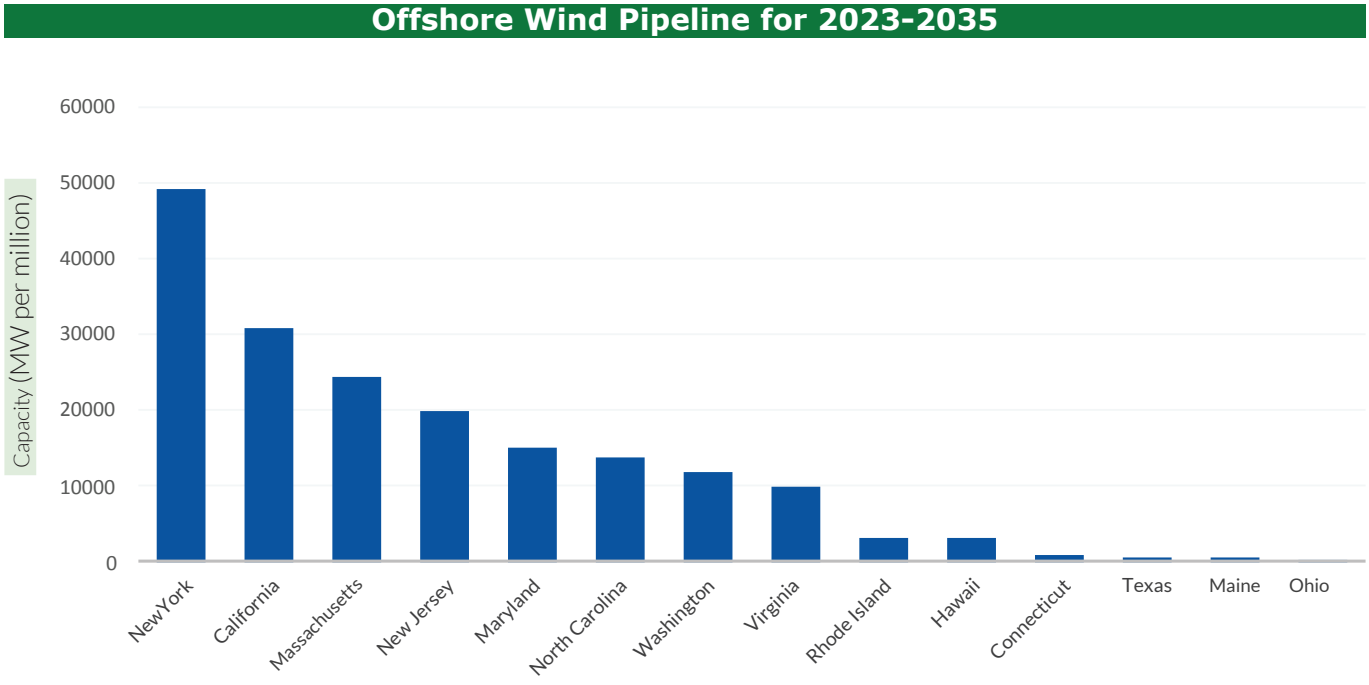
Table 10

Offshore Wind Targets for the Years 2030-2035 as of 5th October 2022

**Delaware aims to power 40% of the state's grid with power generated from offshore wind sources by 2035*

***Rhode Island aims to power 100% of the state's grid with power generated from offshore wind sources by 2035*

****Hawaii aims to power 100% of the state's grid with power generated from offshore wind sources by 2033.*



Graph 6

Planned and Ongoing Offshore Wind Projects by States for the Years 2022-2035; extracted from the EICDS as of 5th October 2022

The growth of the industry is also attributed to the arrival of the **Inflation Reduction Act (IRA)** in August 2022 which would allow developers to be eligible for either Investment Tax Credits (ITC) and Production Tax Credits (PTC), similar to solar and onshore wind generation. A special ITC rate of 30% is allowed for offshore wind facilities with construction beginning before 1 January 2026. Furthermore, **Section 13502** of the IRA stipulates that there would be a bonus credit of 10% should offshore wind components and related goods be manufactured domestically. Domestically manufactured construction products are those for which at least the adjusted percentage of the total cost of materials is attributable to components that were mined, produced, or manufactured in the United States. For example, if the adjusted percentage is 50%, then a construction product would be considered domestically manufactured if at least 50% of the cost of its materials was attributable to US-made components. The bonus credit is also adjusted based on the date of construction of the offshore wind development, which is summarised in **Table 11** below:

Start of Construction	Adjusted Percentage
Before January 1 2025	20%
After 31st December 2024 and before 1st January 2026	27.5%

Start of Construction	Adjusted Percentage
After 31st December 2025 and before 1st January 2027	35%
After 31st December 2026 and before 1st January 2028	45%
After 31st December 2027	55%

Table 11
Adjusted percentage for bonus credits for offshore wind development under the 2022 IRA.

However, to address rising concerns of project costs due to inflation and supply chain constraints, the requirements to be considered for the bonus credit may be exempted should the domestic production of steel, iron, or manufactured products would raise the overall construction costs by more than 25% and/or if those same products produced domestically were insufficient in reasonably available quantity or of a satisfactory quality.

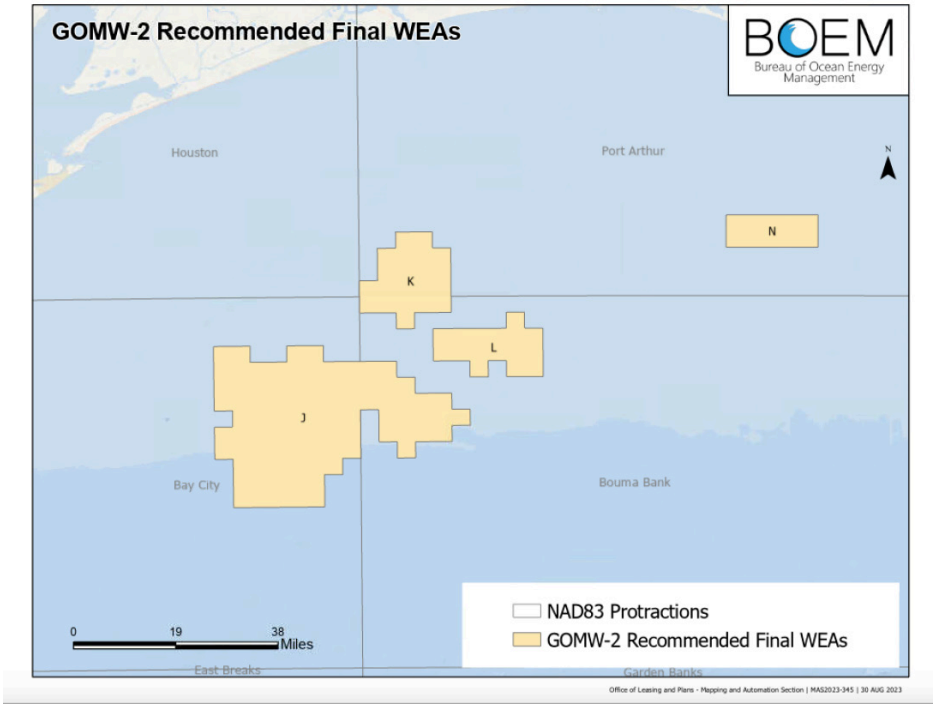


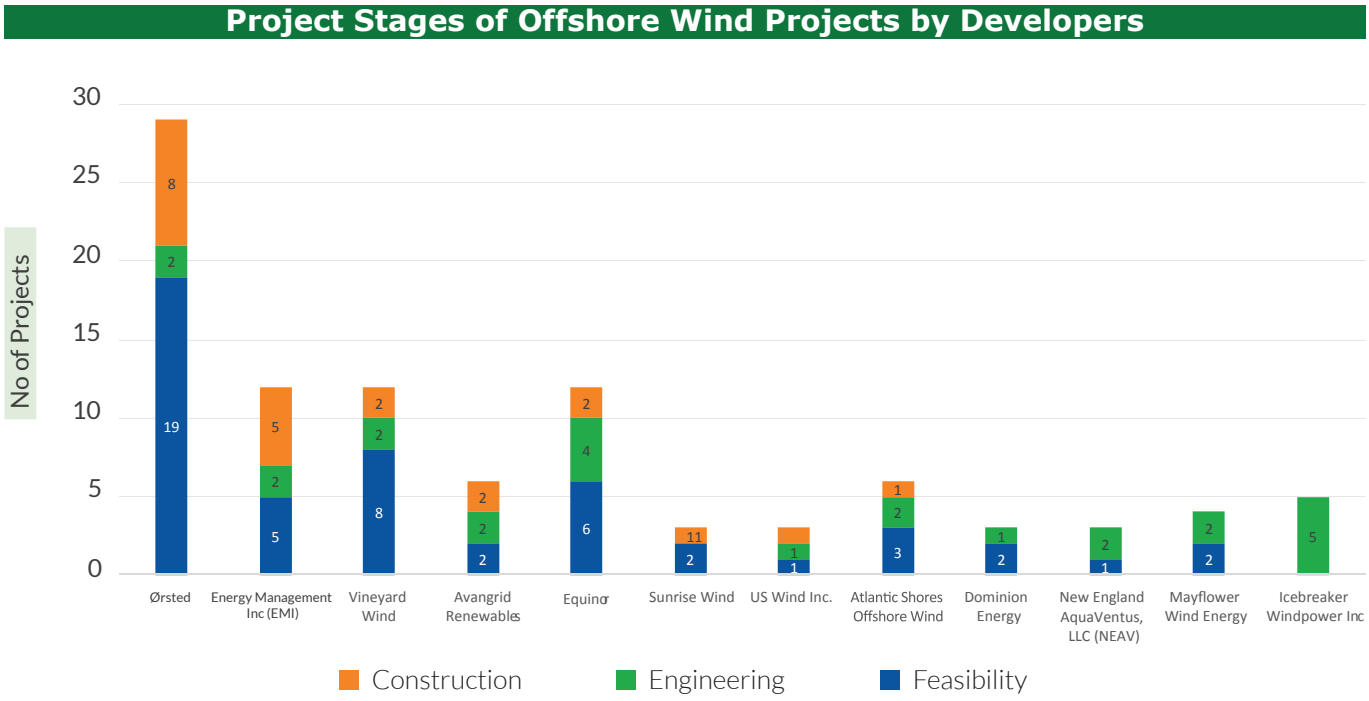
Figure 11
New Gulf of Mexico Lease Area off the coast of Texas & Louisiana.

Despite the absence of specific targets for offshore wind development in the Gulf of Mexico, the Southern region (particularly Texas and Louisiana) is expected to experience growth with the recent designation of four new Wind Energy Areas (WEAs) in the Gulf of Mexico as part of Lease Sale 261 (Figure 11). The BOEM has scheduled the bidding process to begin on December 20, 2023. Additional lease areas will be announced upon completion of evaluation studies. However, the region is characterised by either low-velocity winds or susceptibility to Category 4 hurricanes, such as Hurricane Harvey (September 2017), Hurricane Laura (August 2020), Hurricane Ida (August 2021), and Hurricane Rick (October 2021).

Texas boasts significant supply chain advantages due to the proximity to port infrastructures and presence of specialised skill force as a result of its rich history in Oil & Gas developments, being so close to the Gulf of Mexico. Such skills are most certainly needed because wind turbines would need to

be hurricane-resilient and have high-efficiency in low speeds to mitigate the areas shortcomings. The energy generated from these future offshore wind farms will also be used to decarbonise the various refineries found in these states to earn either ITC or PTC tax credits of the IRA.

The **North-East** region (Connecticut, Massachusetts, New York, etc), with 34 projects proposed for development, has a particularly positive outlook. More projects are likely to emerge once the **Central Atlantic WEAs** have been finalised. For now, the BOEM has confirmed that these will be placed in the waters of Delaware, Maryland, and Virginia for a total of three WEAs.



Graph 7
US Offshore Wind Developers by Planned Capacity and Number of Projects; extracted from the EICDS as of 28th March 2023

Graph 7 illustrates the number of projects held by each offshore wind developer as well as the project stage that they are in currently. We can see that of the offshore wind projects proposed most have yet to enter the construction phases with the majority projects at the feasibility phase. Orsted is at the forefront of constructing offshore wind farms in the US. The four projects under construction currently will add 2,860MW of capacity, and the company has a further seven projects in the early stages of development that if all proceed would see an additional 7.2GW of capacity added. Other projects by Ørsted to look out for would include their 150MW Skipjack Wind 1 Offshore Wind Farm and its expansion, the 846MW Skipjack Wind 2 Offshore Wind Farm, in Maryland. Both projects are to be in service in December 2026 with the first phase to feature 10-15 wind turbines ranging from 10-14.7MW each.

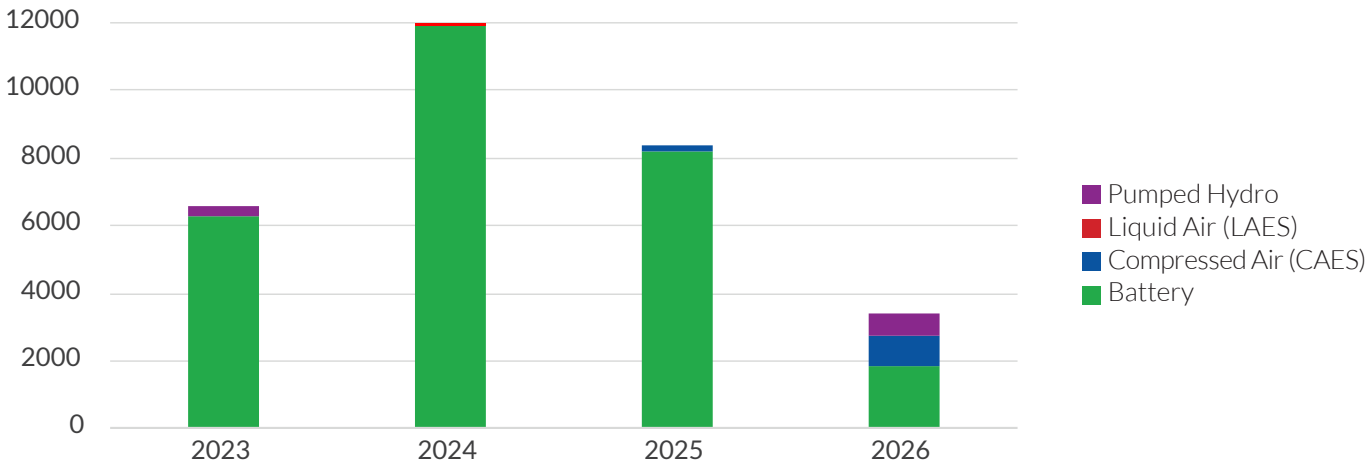
Energy Transition

Energy Storage

The energy storage industry is projected to grow favourably because while renewable energy (i.e. solar and wind power generation facilities) developments are crucial in reducing the carbon emissions in the power generation sector, they also introduce a problem that conventional gas- and oil-fired power plants are exceptionally good at – which is that they provide a consistent baseload power to the grid. This had allowed businesses and residents with a minimum of reliable power so that they may function in their day-to-day without power disruptions. Grid instability is one issue that is often addressed in the proliferation of renewable energy facilities and thus, the DOE had set up the Energy Storage Grand Challenge, a federal programme to help commercialise the deployment of next-generation energy storage technologies. Through this initiative, the DOE envisions that the country may be able to domestically manufacture and develop energy storage technologies that can meet domestic market demands by 2030. This vision is further exemplified by the 2021 Energy Earthshots initiative which aims to reduce energy storage costs by 90% to deliver long-duration BESS (systems that can discharge power at a minimum of 10 hours) in one decade.

Thus far, it can be noted that battery projects far outnumber the other types of projects such as pumped hydro, flywheel and compressed air storage (CAS) projects (as seen in **Graph 8** below). Notable developments can be seen in California with the development of the large-scale Pecho (400MW/3,200MWh) and Gem (500MW/4,000MWh) Energy Storage projects.

Graph of Future Energy Storage Additions fom 2023-2026



Graph 8

Graph of Future Energy Storage Projects by Technology for the Year 2023-2026. Data extracted from the EICDS as of 3rd March 2023.

The trajectory for long-duration battery projects is likely to persist in the short-term. However, we could potentially see the reemergence of older technologies scale up in numbers such as pumped storage hydropower. The technology already accounts for 93% of the commercial-scale energy storage that is operating in the US, according to the **2021 Hydropower Market Report**. That number equates to 43 operating pumped hydro storage facilities alone and initiatives such as the DOE's HydroWIRES (Water Innovation for a Resilient Electricity System) is targeted at its revival through extensive research in tech innovations and market studies. Through HydroWIRES, the federal government as well as various stakeholders recognise that the role of pumped hydro storage can significantly be expanded in tandem with the rapidly evolving electricity system, given that the systems are capable of storing larger and longer duration of energy storage when compared with BESS. The main issues that HydroWIRES has identified would be that:

1. More market research is needed to understand and quantify grid needs and the value of hydropower assets accurately.

2. Legacy pumped storage hydropower capabilities are limited by machine design, water availability, and institutional requirements, which may not align with modern grid needs.

3. Uncertainty about the best roles for hydropower in a changing grid with other resources creates gaps in operational knowledge and planning.

4. Current hydropower and pumped storage hydro technologies may not be designed for flexible operation, and deployment challenges remain.

Standalone energy storage systems have already been given a boost through the IRA, with a base ITC of 30% until 2034. This is a significant development, as the credit was previously only available for projects paired with renewable energy projects like solar farms. Additional credits are available for domestically manufactured battery projects, similar to incentives for solar and wind projects. Again, this can be viewed in the **Appendix** section under Table A for a comprehensive list of eligible components under the Advanced Energy Manufacturing Production Tax Credit (45X MPTC). The efficacy of these incentives in spurring the growth of standalone energy storage systems remains to be seen, as does the potential emergence of newer technologies in the coming years.

Hydrogen and Carbon Capture

The US is one of the world's leaders in hydrogen production currently producing 10MMtpa of hydrogen. Historically, that production would have come from natural gas or coal through steam methane reformation (SMR) –producing grey hydrogen – which is then further utilised in the production of ammonia for fertilisers, the reduction of sulphur content in fuels, as well as in metal treatments and food processes. Despite that, the cost of hydrogen remains as one of its biggest challenges for its adoption as fuel since it cannot compete with that of conventional fuels as shown in **Table 12**.

Year	Average Cost of Hydrogen ($/kg)	Average Cost of Gasoline ($/kg)	Average Cost of Diesel ($/kg)
2020	6	2.17	2.55
2021	8.5-10.8	2.01	3.29
2022	N/A	3.36	5.25
2025*	2	-	-
2031*	1	-	-

Table 12
Price comparison between hydrogen, gasoline, and diesel fuel.
**Average hydrogen fuel price projection for 2025 and 2031 are based on the 2021 Hydrogen Shot "1 1 1" targets.*

However, steps to address this issue have been outlined in the US National Clean Hydrogen Strategy and Roadmap report which essentially comes down to:

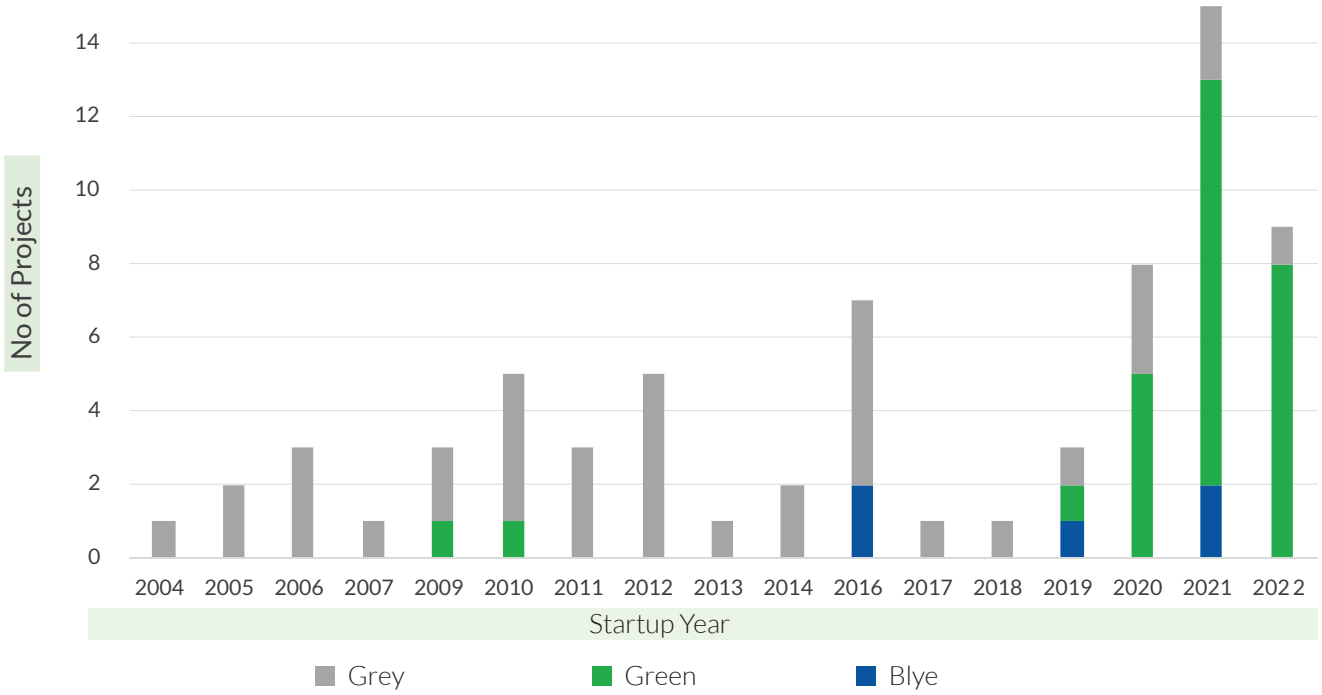
1. Targeting industries of high-impact when clean hydrogen is utilised which include the chemical, steel, and refining industries; heavy-duty transportation; as well as the long-duration energy storage sector specifically when used to create a cleaner grid. Other potential opportunities identified include the exportation of green hydrogen or hydrogen carriers (ammonia, methane, etc) to support the energy security for US allies.

2. Reducing the costs of clean hydrogen. Targets have been set out in the 2021 Hydrogen Energy Earthshots (Hydrogen Shot) targets to reduce the cost of 1kg of hydrogen fuel to US$1 in one decade or otherwise referred to as the "1 1 1" targets.

3. Scaling up investments in the development of the Regional Clean Hydrogen Hubs. This programme is aimed at creating a hydrogen production hub which contains a number of hydrogen production facilities in close proximity with each other to share key infrastructure capabilities. This is believed to not only expedite local manufacturing capabilities but would also create job opportunities to the residents in the surrounding area.

As seen in **Graph 9**, the EIC has recorded a shift in the hydrogen industry as new legislations are being introduced such as the H.R. 4909 Clean Hydrogen Energy Act (2021), the Bipartisan Infrastructure Law (2021), and the recent Inflation Reduction Act (2022) which will be discussed further in the "**Pathways, regulation and legislation, and funding availability"** section below. Unlike its predecessors, recent legislations are not only funding the research & development in hydrogen technologies, but they are also providing the financial incentives needed by the industry to adopt cleaner hydrogen production methods at cost-competitive levels.

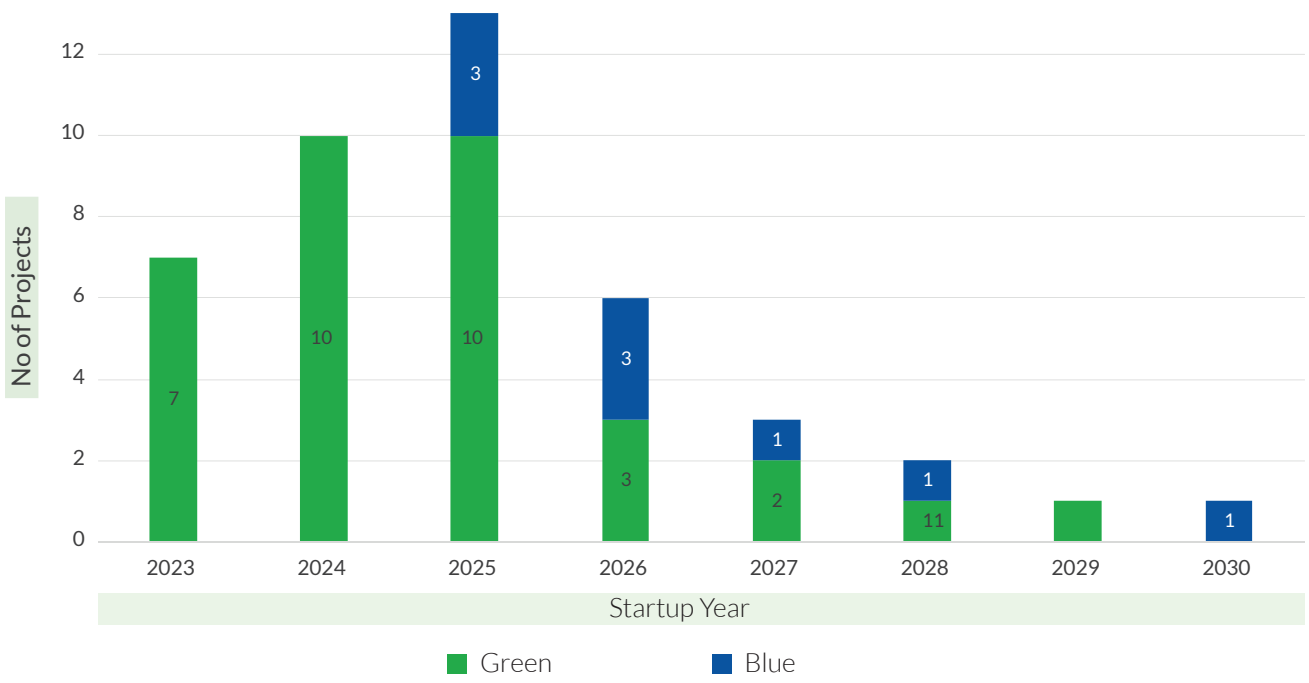
Operational Hydrogen Projects from 2004-2022



Graph 9

An archive of US hydrogen projects from the EICDS that have achieved commercial operations before 2023. Data extracted as of 3rd April 2023.

Hydrogen Projects Pipeline from 2023 to 2030



Graph 10

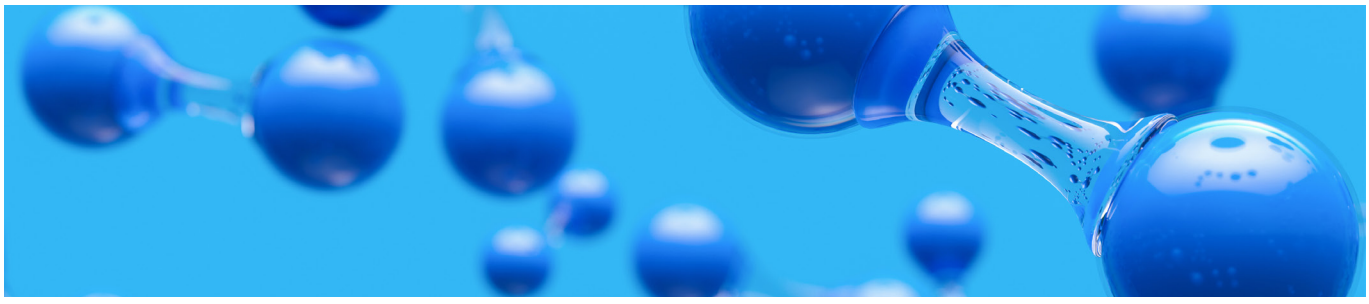
Projected hydrogen projects to begin commercial operations in 2023-2030. Data extracted from the EICDS as of 3rd April 2023.

The landscape of the hydrogen industry is expected to change in the 10 years in which the IRA is being enacted. Already, we are seeing more projects being approved to produce green hydrogen in the near future. Some of those projects that are in the advanced stage of development are included in **Table 13**.

Project Name	Developer	Hydrogen Production Capacity (tpa)	Startup Year
SGH2 Energy Lancaster Hydrogen Plant	SGH2 Energy Global Corporation	4,500	2023
Sauk Valley Green Hydrogen Plant	Invenergy LLC	52	2023
St. Gabriel Green Hydrogen Plant	Olin	5,475	2023
Douglas County Hydrogen Project	Douglas County PUD	730	2024
Lancaster Hydrogen Facility	Solena Group	3,800	2024
Richmond Waste-to-Green Hydrogen Project	Raven SR	2,400	2024
Clear Fork Green Hydrogen Plant	Clean Energy Holdings LLC (CEH)	Unknown	2024
H2OK Green Hydrogen Project	Woodside Petroleum	36,500	2025
ACES Delta Green Hydrogen Project	ACES Delta	32,850	2025
New York Green Hydrogen Plant	Plug Power	Unknown	2025

Table 13
Table of selected green hydrogen projects that have begun construction activities.

It should be noted that more blue hydrogen projects have started to surface after the announcement of the IRA in August 2022, as shown in **Graph 10**. Companies with established refinery and petrochemical operations such as ExxonMobil have started to include hydrogen and carbon capture projects within their portfolio such as their Baytown Blue Hydrogen and Carbon Capture projects in Texas which will produce about 862,000tpa of blue hydrogen in 2028. Around 7MMtpa of carbon dioxide will be captured in the process. Honeywell has already been contracted to supply the CO2 fractionation and hydrogen purification technology needed for the carbon capture project.



Pathways, Regulation and Legislation, and Funding Availability

- **Hydrogen Hubs Programme**

The 2021 Bipartisan Infrastructure Law introduces the Regional Clean Hydrogen Hubs programme (H2Hubs) which would distribute US$7B to 6-10 hydrogen hub proposals. The proposals must be centred around the creation of a network of hydrogen producers, consumers, and local connective infrastructure to expedite the proliferation of hydrogen as a clean energy alternative. Applications for the funding were received on 7 April 2023 with a resounding number of applicants. Successful applicant will receive up to US$1.25B to be used in four phases of their regional hub development. Some applicants had been identified by the DOE as "encouraged", meaning that their concept papers were likely to receive higher grants. The **Resources for the Future** notes that on average, encouraged applicants had filed for US$1B while "discouraged" applicants had requested for US$600mn.

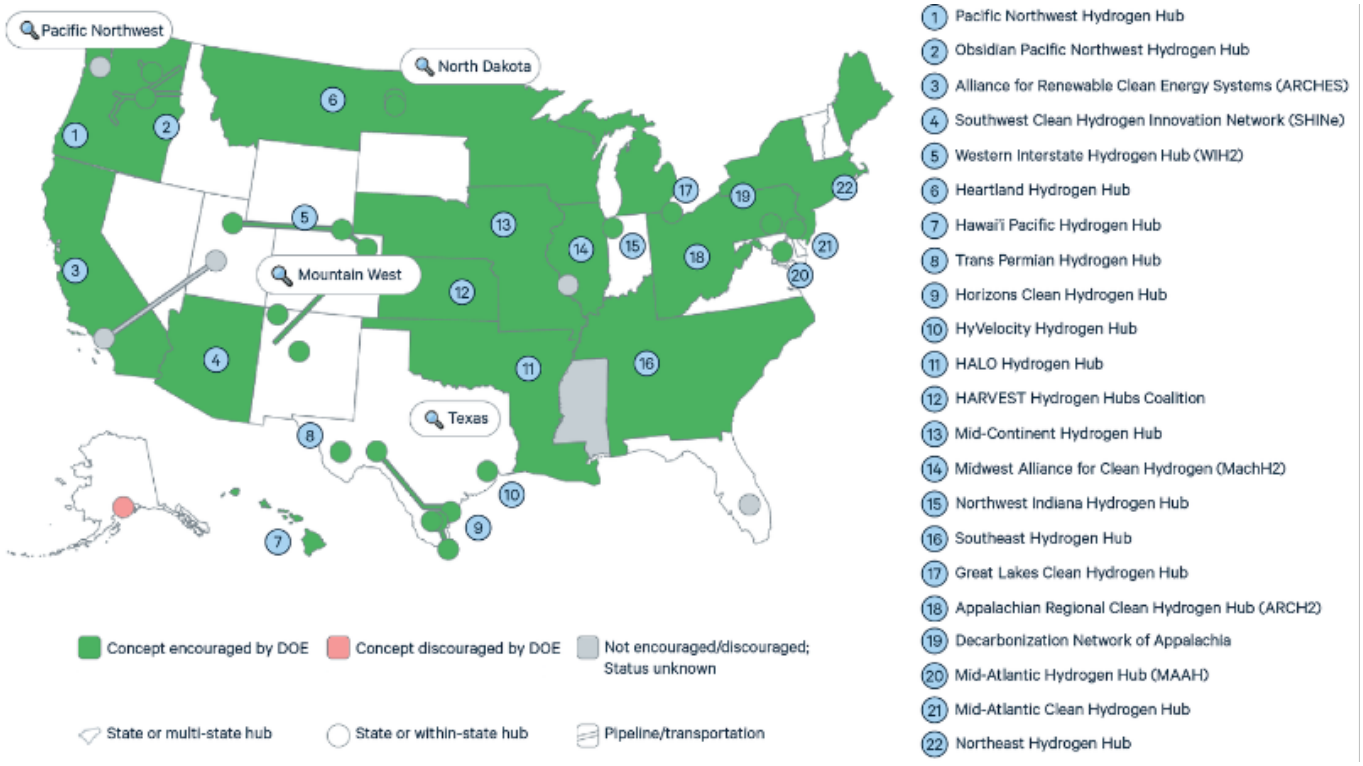


Figure 12

Map of known hydrogen hub proposals applying for the US$8B H2Hubs programme | Source: **RFF's Hydrogen Hub Explorer Data Tool** *as of 31 January 2023*

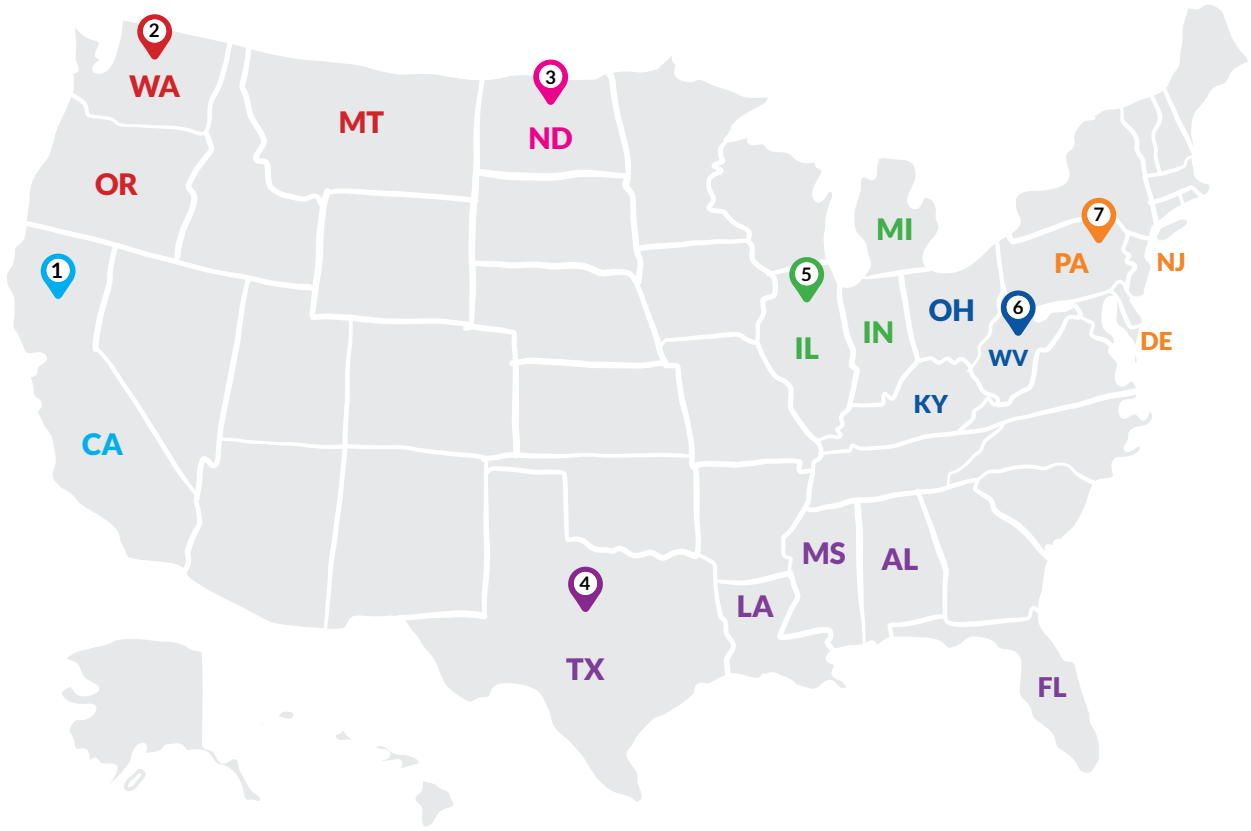
On October 25, 2023, the U.S. Department of Energy (DOE) announced the seven winners of the $7 billion H2Hubs program. **Figure 12** summarises the winners' identities, locations, and allocated winning bids.

All of the winners were from the "encouraged" pool of applicants. The lowest winning bid was $750 million, and the highest bid was $1.2 billion. Figure 13 also shows that a number of companies have already agreed to collaborate on the H2Hubs effort. With the funding now secured, more hydrogen developers are likely to emerge.

The DOE estimates that the program will create up to 10,000 permanent jobs and 35,000 construction jobs. The hubs are expected to produce enough clean hydrogen to power 2 million homes and displace 10MMtpa of carbon dioxide emissions.

The announcement of the winners is a major milestone in the Biden administration's efforts to accelerate the development and deployment of clean hydrogen. The program is expected to play a critical role in helping the United States achieve its climate goals and create a clean energy economy.

- **Inaugural Winners of the US$7B Bipartisan Infrastructure Law Hydrogen Hub Funding Programme**



1	**Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) Hydrogen Hub**	**Lead company:** California Governor's Office of business and Economic Development (GO-Biz) **Partnering companies:** 200-400 companies **Wiining Bid:** $1,200 million
2	**Pacific Northwest Hydrogen Hub (PNW H2)**	**Lead company:** Oregon Department of Energy **Partnering companies:** 19 companies **Wiining Bid:** $1,000 million
3	**Heartland Hydrogen Hub**	**Lead company:** The University of Dakota's Energy & Environmental Research center (EERC) **Partnering companies:** 4 companies **Wiining Bid:** $925 million
4	**HyVelocity Hydrogen Hub**	**Lead company:**GTI Energy **Partnering companies:** 174 companies **Wiining Bid:** $1,200 million
5	**Midwest Hydrogen Hub (MachH2)**	**Lead company:** - **Partnering companies:** 74 companies **Wiining Bid:** $1,200 million
6	**Appalachian Regional Clean Hydrogen Hub (ARCH2)**	**Lead company:** Alleghny Science and Technology **Partnering companies:** 51 companies **Wiining Bid:** $925 million
7	**Mid-Atlantic Clean Hydrogen Hub (MACH2)**	**Lead company:** - **Partnering companies:** 60+ companies **Wiining Bid:** $750 million

Figure 13
Identity and location (prime location and associated states) of the seven regional hydrogen hubs to receive US$7B from the Bipartisan Infrastructure Law funding.

- **Available Tax Credits for Hydrogen and Carbon Capture Projects**

Applicable hydrogen producers can offset their hydrogen production costs by applying for either one of three tax credit options available in the IRA for the next 10 years. These options are the **Production Tax Credit (PTC)** under Section 26 USC 45V (hereby referred to as "**45V**") or under Section 26 USC 45Q ("**45Q**"). A third and final option available would be under Section 48E ("**48E**") which is the **Energy Investment Tax Credit (ITC).** All three tax credits cannot be taken together, and it should be noted that the base amount presented in this section have been multiplied by **five** with the assumption that the developers have satisfied the prevailing wage and apprenticeship requirements. In the case of hydrogen and carbon capture projects, this would mean that a project must satisfy these conditions:

1. For energy projects, the project must have a maximum net output of less than 1MW of electrical or thermal energy.

2. One of two options, which are:
    - The construction of the clean hydrogen facility starts within **60 days** after the US Secretary of the Treasury has published the guidance for the wage and apprenticeship requirements, and that all requirements for the wage and apprenticeship requirements had been met within that time as well.
    - The prevailing wage and apprenticeship requirement have been met during the construction, alteration, or repair of the clean hydrogen facility through the end of the PTC 10-year period.

Production Tax Credit (PTC) – 45V

For any given taxable year, tax credits under 45V will depend on the life cycle emissions (consisting of carbon emissions and the hydrogen fuel produced) of a project over the course of its expected operational life.

Life Cycle Emissions (kg CO2/ kg H2)	PTC ($/ kg H2)
4-2.5	0.60
2.5-1.5	0.75
1.5-0.45	1.00
0.45-0	3.00

Table 14
Production Tax Credits under 45V | Source: **The Inflation Reduction Act Summary** *by the Bipartisan Policy Center*

Other requirements to qualify for the PTC include:

1. Construction of projects to have begun by 1 January 2033.

2. Projects may include retrofit facilities.

3. The carbon intensity is calculated with the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model.

Production Tax Credit (PTC) – 45Q

The other option available for blue hydrogen projects that do not meet the minimum lifecycle emissions of 4kg of CO2 in 45V would be the tax credit under 45Q. Other projects such as power plant and LNG terminal projects that are utilising carbon capture technology can also apply under this tax credit. The tax incentives will be based on the CO2 emissions captured using carbon capture technologies:

Carbon Capture Methods	Application	Base Tax Credits ($/ ton CO2)
CCUS	Low-carbon Fuels, Chemicals, Building Materials, Other Products	35-60
	Industrial Facilities	50-85
	EOR	35-60
DAC (with Saline Geologic Formations)	Any	50-180
DAC (without Saline Geologic Formations)	EOR	35-130
Saline Geologic Formations Only	Power Plants	50-85

Table 15
Production Tax Credits under 45Q | Source: **The Inflation Reduction Act Summary** *by the Bipartisan Policy*

The requirements to qualify for the tax incentives under 45Q includes:

1. Construction of projects to have begun by 1 January 2033

2. The projects to have a minimum carbon capture capacity of:
   - 1,000tpa for DAC plants
   - 18,750tpa for electric generating facilities
   - 12,500tpa for all other types of facilities

3. Direct Pay Compromise. Projects will receive direct pay for the first 5 years of carbon capture commercial operations but there will be no direct pay options for the last 7 years of the credit. An exception will be given for non-profit organisations and co-ops.

Investment Tax Credits (ITC)

The IRA also allows developers to categorise their hydrogen projects as energy properties under Section 48E. Therefore, developers would also be available to apply for the Investment Tax Credits (ITC) which is meant to incentivise the use of clean energy technologies in energy projects. The ITC will be built upon an existing tax credit scheme that is ending in 2024. The ITC under the IRA will replace that scheme once 2025 begins. Tax deduction through the ITC will be done in fixed percentages which will depend on the criteria that a project falls under. This has been summarised for hydrogen and carbon capture projects as below:

Criteria	Current ITC up to 2024 (%)	New ITC from 2025 to 2032 (%)
For fuel cell property, energy storage technology, biogas property, microgrid controllers, dynamic glass, and linear generators	30	0

Placed in service within ITC applicable years (regardless of type of clean electricity technology)	0	30
(+) Meets domestic manufacturing requirements for steel, iron, or manufactured components	10	10
(+) Located in brownfield sites or fossil fuel communities	10	10
(+) Located in low-income communities or Tribal land	0	10
(+) Located in low-income residential buildings or part of low-income economic benefit project	0	20

Table 16
Current and new Investment Tax Credits under 48E of the IRA. | Source: The Inflation Reduction Act Summary by the Bipartisan Policy Center
(+) – Additional credits applied for specific requirements.

The requirements to qualify for the tax incentives under 45Q includes:

1. Projects to apply for the **current ITC** will have to **begin constructions before 1 January 2025**.
2. The **new ITC** will be applied to projects that have **begun operations in 2025-2032**.

The new ITC may extend an additional three years after 2032 or earlier if emission targets have been met. Developers will be able to claim the ITC for 100% of its value in the first year, 75% in the second year and lastly 50% in the third year.

Major Players

The US has a vibrant and diverse energy sector, with a wide range of companies competing to provide affordable and reliable energy to Americans. This table provides a snapshot of some of the major players in the US energy sector, including direct links to the supplier registration forms, or to their main websites if unavailable.

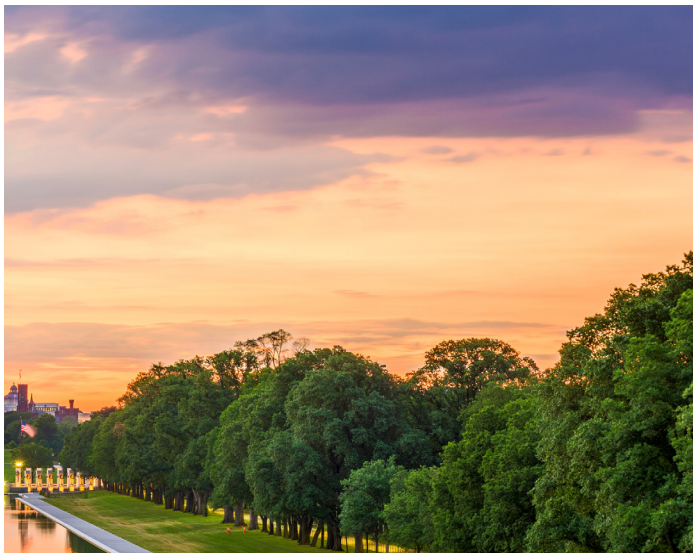
From oil and gas giants like ExxonMobil and Chevron to renewable energy leaders like NextEra Energy and AES Corporation, these companies are shaping the future of energy in the US. By understanding their strengths and weaknesses, we can better understand the trends that are driving the US energy sector.

Company name	Type	Origin	Sectors Involved	Registration link
Top Oil & Gas Players				
BP	Operator/ Developer	International	Oil & Gas	**Click Here**
Shell	Operator/ Developer	International	Oil & Gas	**Click Here**
Chevron	Operator/ Developer	International	Oil & Gas, Renewables	**Click Here**
Venture Global LNG	Operator/ Developer	Local	Oil & Gas	**Click Here**
ConocoPhillips	Operator/ Developer	Local	Oil & Gas, Renewables	**Click Here**
Alaska Gasline Development Corporation	Operator/ Developer	Local	Midstream, Downstream	**Click Here**
Sempra Energy	Operator/ Developer	Local	Midstream, Power, Renewables	**Click Here**
Cheniere Energy	Operator/ Developer	Local	Midstream	**Click Here**
NextDecade	Operator/ Developer	Local	Midstream	**Click Here**
ExxonMobil	Operator/ Developer	International	Oil & Gas	**Click Here**

Company name	Type	Origin	Sectors Involved	Registration link
Energy Transfer Partners	Operator/ Developer	Local	Midstream, Downstream	Click Here
Occidental Petroleum Corporation (Oxy)	Operator/ Developer	Local	Oil & Gas	Click Here
Nacero	Operator/ Developer	Local	Downstream	Click Here
Transocean	Contractor	Local	Upstream	Click Here
TechnipFMC	Contractor	International	Oil & Gas	Click Here
Aker Solutions	Contractor	International	Oil & Gas	Click Here
McDermott	Contractor	Local	Oil & Gas, Power	Click Here
Subsea 7	Contractor	International	Upstream	Click Here
Bechtel	Contractor	International	Oil & Gas, Power, Renewables	Click Here
CB&I	Contractor	Local	Oil & Gas, Power	Click Here
Willbros Group	Contractor	Local	Midstream, Downstream, Power	
Fluor Corporation	Contractor	Local	Oil & Gas, Power, Renewables	Click Here
KBR	Contractor	Local	Oil & Gas, Power, Renewables	Click Here
Top Power, Nuclear and Renewables Players				
Dominion Energy	Operator/ Developer	Local	Midstream, Downstream, Power, Renewables	Click Here
Tennessee Valley Authority (TVA)	Government Agency	Local	Power, Renewables	Click Here
Holtec International	Operator/ Developer	Local	Nuclear	Click Here
AES Corporation	Operator/ Developer	Local	Midstream, Power, Renewables	Click Here
Entergy	Operator/ Developer	Local	Power, Renewables	Click Here

Company name	Type	Origin	Sectors Involved	Registration link
Invenergy	Operator/ Developer	International	Power, Renewables	**Click Here**
Ørsted	Operator/ Developer	International	Downstream, Renewables	**Click Here**
Avangrid Renewables	Operator/ Developer	International	Renewables	**Click Here**
Equinor	Operator/ Developer	International	Upstream, Renewables	**Click Here**
Siemens	Contractor	International	Oil & Gas, Power, Renewables	**Click Here**
Burns & McDonnell Engineering	Contractor	Local	Downstream, Midstream, Power, Renewables	**Click Here**
General Electric	Contractor	Local	Oil & Gas, Power, Renewables	**Click Here**
Bechtel	Contractor	International	Oil & Gas, Power, Renewables	**Click Here**
Fluor Corporation	Contractor	Local	Oil & Gas, Power, Renewables	**Click Here**
Vestas	Contractor	International	Renewables	**Click Here**
First Solar	Contractor	Local	Renewables	**Click Here**
Mortenson Construction	Contractor	Local	Renewables	**Click Here**
Blattner Energy	Contractor	Local	Renewables	**Click Here**
Wanzek Construction	Contractor	Local	Renewables	**Click Here**

Table 17
Major players in USA, inclusive of operators, Operator/ Developers and Contractors.



PEST Analysis

Political

The United States is a federal republic, a system of government in which power is divided between the national government and the state governments. This system ensures that no one branch of government becomes too powerful. This separation of power is extended to the federal judiciary, which operates independently from the executive and legislative branches, and is guided by the country's constitution. The Supreme Court represents the highest court in the United States and unlike the state courts beneath them, many of their rulings become law or at the very least, form an interpretation of an existing law in certain circumstances.

Elections are held at the federal, state, and local levels and the next presidential election will take place on 5th November 2024. The maximum period that any one U.S. president can serve is eight years which is two elected four-year terms. President Joe Biden and former President Donald Trump have both announced their intention to run for a second term which could drastically alter the country's stance on the energy sectors. The two political parties, the Democrats (D) and the Republicans (R), are at odds over how to address the climate change crisis, with the Democrats favouring policies that would reduce greenhouse gas emissions and the Republicans favouring policies that would promote economic growth.

The United States is a country deeply divided along political lines. The World Bank's political stability index has recorded a declining score of +0.40 in 2016 to 0.00 in 2021. This division has been exacerbated in recent years beginning with the 2016 presidential election, the COVID-19 pandemic, and then the resulting cost-of-living crisis which have all contributed to increasing political tension on all sides. When President Donald Trump (R) won the presidential election in 2016, he had proceeded to take steps to weaken environmental regulations put in place by his predecessor, Barrack Obama (D), such as repealing of the Clean Power Plan, an initiative to reduce greenhouse gas emissions from power plants, and by lifting a moratorium on new coal leases on federal lands. Furthermore, he had also withdrawn the country from the 2016 Paris Agreement, the international agreement to combat climate change. Those policies as well as the nation's carbon emissions pledge in the Paris Agreement were then reinstated by President Joe Biden (D) after the Democrats had regained their seat the 2021 election.

Corruption levels in the United States remain stagnant with a ranking of 69 out of 180 countries in the 2022 Corruption Perceptions Index. However, the January 2021 attack on the US Capitol has brought forward small steps to introduce accountability at the corporate level. One such action taken would be the Corporate Transparency Act (2021) proposal that aims to help detect and prevent terrorism, money laundering and other misconduct at the corporate level. The act will take place on 1 January 2024 whereby companies will have the obligation to report their beneficial owners to the Financial Crimes Enforcement Network (FinCEN). This will directly affect individuals with corrupt and criminal offenses looking to launder money by establishing a company in America.

Economic

The US is the world's leading economy, boasting a GDP of roughly US$25tn in 2022 which is a 2.1% increase from the previous year. Data extracted from the Bureau of Economic Analysis, shown in **Table 18**, indicates that the top five industries in the private sector for 2022 are, in descending order, real estate rental and leasing; manufacturing; finance and insurance; professional, scientific, and technical services; and health care and social assistance.

Ranking	Industry	2022 GDP Contribution (%)	GDP Growth from 2021 (%)
1	Real estate rental and leasing	12.3	-2.4
2	Manufacturing	11	+2.8
3	Finance and Insurance	7.9	-6
4	Professional, scientific, and technical services	7.9	0
5	Health Care and social assistance	7.3	+1.4
6	Wholesale trade	6.3	+1.6
7	Retail trade	5.8	-3.4
8	Information	5.5	-1.8
9	Construction	4	+2.4
10	Administrative and waste management services	3.3	+3.1
11	Transportation and warehousing	3.2	+6.7
12	Accommodation and food services	3.1	+6.9
13	Other services, except government	2	0
14	Management of companies and enterprises	1.9	0
15	Utilities	1.7	+6.25
16	Oil & gas extraction	1.5	+50
17	Agriculture	1.1	+22.2
18	Educational services	1.1	+8.3
19	Arts, entertainment, and recreation	1.1	+22.2
20	Mineral mining	0.3	0

Table 18
Table of GDP growth of the US economy, categorised by private industries in descending order of GDP contributions. Data extracted from the **U.S. Bureau of Economic Analysis**.

Despite this growth of the US economy at the tail end of 2022, delays in energy projects are expected owing to the high inflation rates since 2021. This has also impeded the government's efforts to promote domestic manufacturing, particularly in the renewable energy sector, in the form of additional tax credits in the IRA or as international trade barriers to limit the influence of cheaper foreign manufacturers.

Delays has not slowed down even though inflation rates have steadily decreased from 7.04% in 2021 to 6.45% in 2022. In fact, reports across the solar and offshore wind sector in 2023 have cited continuing delays due to the high costs incurred to developers, which is further complicating supply chain issues.

Social

The United States is the third largest populous country in the world with a population of over 334 million people from many different backgrounds and nationality. The country was first inhabited by Native Americans before settlers from Europe came to the continent. Several mass migration events have since occurred including the Age of Mass Migration of the nineteenth century and have continued well into modern times. Today, the country is predominantly white (59.3% of population) with Hispanic, African American, and Asian groups accounting for 18.9%, 12.6% and 5.9% respectively. The percentage of people of ages 25 and above with at least a bachelor's degree has been steadily increasing since 2010 and has reached to an average of 35% of the population in 2021, as recorded by the **Census Bureau**. In comparison with the other states, Washington DC has the highest proportion of educated young people with 63% of residents obtaining, at minimum, a bachelor's degree while West Virginia records the lowest proportion of young, educated people at 24.1%.

Technology

The 2022 Global Innovation Index places the US as one of the top 100 science and technology clusters in the Northern American, European and Asian regions – which places it alongside China for their technological advancements. This is evident in the consistency of the nation's funding for the development and research of the latest cutting-edge technologies, in particular clean technologies such as hydrogen, CCS and nuclear, through various initiatives. Those newly announced in 2023 alone include the DOE's US$1.7B Carbon Capture Demonstration Projects Program, the US$47mn Clean Hydrogen Fund by the Hydrogen and Fuell Cell Technologies Office (HFTO), as well as the US$46mn Nuclear Fusion Pilots Projects Program by the DOE. We expect this trend to continue despite the political differences between the Democrats and Republicans as technological advancements to compete with other superpower nations such as China would remain a priority for the government.

However, the infrastructure in the country (public transport, water treatment, roads, bridges, etc) including energy infrastructure such as pipelines and transmission lines have deteriorated since its heyday in its 1960s and 1970s due to the lack of maintenance work on top of climate change effects which have brought upon more frequent extreme weathers such as tornadoes and wildfires in California. In the 2021 Bipartisan Infrastructure Investment and Jobs Act, as much as US$110B will be invested over a period of five years in an attempt to address this issue at a national scale. Funding was further extended in the IRA for this purpose as well which covers a wide array of industries including agriculture, energy and transportation. A comprehensive list of these funding programmes has been laid out by the National Governors Association through their website (**https://www.nga.org/ira-resources/**).

The US advocates strongly when it comes to intellectual property (IP) rights, being a member of the World Trade Organization (WTO) since 1995. Infringement to any IP rights (copyrights, patents, trademarks, etc) is enforced similarly as in other WTO members. This is further cemented through the four international signatories that the US has participated in which are the **1883 Paris Convention**, **1886 Berne Convention**, **1989 Madrid Protocol**, and the **1970 Patent Cooperation Treaty**. A patent and trademark database is provided through the United States Patent and Trademark Office's (**USPTO**) website. It is worth noting that trademarks are enforced through a 'First to File' basis, whereby ownership of trademark is given to whichever company utilises it first commercially. The trademark must also be registered in the country through the USPTO or it can be bypassed via the Madrid protocol and gain IP rights under the Community Trade Mark registration systems that is applicable in up to 130 countries.

Political

1. The USA adopts the constitutional federal republic system whereby the country is essentially governed by entities called the federal (sometimes referred to as national) and state governments. The federal government itself consists of three branches, namely the executive, judicial, and legislative branches. The state government consists of all 50 individual states which has the same authority as the federal government, but only within their defined county lines. This system provides a system of checks and balances among the branches of government to ensure that not one branch can assume full control of the central government which essentially enforces the democratic values instilled within the country's constitution.
2. The two major political parties in the US have become increasingly polarised since President Trump's election in 2016.
3. Next general election on 5th November 2024.
4. 2022 Corruption Perceptions Index: 69/180
5. 2023 Fragile States Index (FSI): 141/179
6. 2021 Political Stability Index: 95/193 (Score:0)
7. 2023 Press Freedom Index (PFI): 45/ 180
8. The United States is a committed partner in free trade, with **active agreements** in place with 20 countries.
9. 2023 Global Freedom Score: 83/100 (Rank: Free)
10. The US is a founding member of the United Nations (UN) with annual meetings held at the UN headquarters in New York.

Economic

1. 2022 Gross Domestic Product (GDP) of US$25.462tn
2. 2022 GDP per capita of US$76,398
3. 2022 GDP Growth: 2.1%
4. 2021 Gross National Savings: 18.1% of GDP
5. Foreign National Exchange Reserves: US$36.6B (July 2023)
6. Interest Rate: 5.5% (August 2023)
7. Inflation Rate: 3% (July 2023)
8. Federal Minimum Wage: US$7.25/hour
9. Unemployment Rate: 3.8% of labour force (August 2023)
10. 2023 World Competitiveness Ranking: 9th/64
11. 2020 Ease of Doing Business Ranking: 6th/190

Social

1. 2023 Population: 335 million
2. 2022 Population Growth Rate: 0.4%
3. 2019 Life expectancy: 78.5
4. 2021 Total Fertility Rate (TFR): 1.7 live births per woman
5. Official Language: English
6. 2003 Literacy Rate (age 15 and over, can read and write): 99%
7. 2022 Labour Force: 169 million
8. 2021 Human Development Index (HDI): 0.921, Ranked 21/191 countries

Technology

1. 2022 Global Innovation Index Ranking: 2/132 countries
2. 2021 Access to Internet: 100%
3. 2021 Access to Electricity: 100%
4. 2021 Mobile Phone Subscriptions: 361 million
5. Nationwide 5G Internet Service Providers: Verizon, UScellular, C Spire, Charter's Spectrum Mobile, Comcast/Xfinity, Cellcom
6. 2023 Logistics Performance Index (LPI): Scored 3.8/5, Ranked 17/139 countries

Doing Business in US

The US market is so large and complex that it cannot be treated as a single marketplace. Every state and region have its own unique purchasing behaviours, distribution systems, regulations, climates, hubs for specific sectors, and business cultures. Suppliers who assume that the US is a homogeneous export market may be overwhelmed, as the country can be divided into four distinct regions.

The Northeast region is known as the nation's global capital hub. It is home to New York City, a world city and global financial centre where about 50 Fortune 500 companies have their national headquarters. The region also focuses mainly on government services and is the centre of the nation's economy. Delaware is known for its corporate-friendly laws and is where most companies choose to incorporate.

The South is a major centre of commerce and foreign direct investment. It is known for its low costs, state tax incentives, and low cost of living, which make it a desirable location for manufacturing. The region is also a global leader in energy and chemicals and is home to the energy capital of the world, Houston.

The Midwest is a centre for advanced manufacturing, and is home to the Great Lakes, as well as Chicago's major port and transportation hub. The West is a global technology hub, with Silicon Valley at the heart of this industry.

Setting up a company

The **World Bank** places the US in 6th place in its global "Ease of Doing Business" rankings with comparisons made against 190 countries. Starting a business in the US on average takes about six days to complete. The World Bank's "Doing Business 2020" report outlines six steps in order to achieve this as well as associated costs. An example is taken out of the state of New York:

1. Reserve the company name and file the Articles of Organisation with the New York State Department of State. The cost estimate would be around US$275.
2. Apply for federal identification number (EIN) with the IRS for tax and employer purposes.

3. Register to collect state sales tax from the New York State Department of Taxation and Finance.
4. Register as an employer with the Unemployment Insurance division at the State Labor Department.
5. Arrange for workers' compensation and disability insurance with the Workers' Compensation Board.
6. Arrange for publication and submit certificate and affidavits of publication with the New York State Department of State. Costs would range between US$450-500.

Generally, steps 4-6 would differ from state-to-state which involves obtaining a business license with the relevant state governing agency.

There is no federal law on how to start a business in the US. Instead, businesses are created under state law. There are many different types of business entities, but most foreign companies choose to start a business corporation in the US because of certain tax advantages.

A company can incorporate in any state, even if it doesn't have a physical presence there. However, most companies incorporate in the state where they plan to do business, or in a state with favourable business laws. The requirements for incorporation vary from state to state, but they are generally simple, fast, and inexpensive.

When choosing a type of business entity and starting a business in the US, it is highly recommended that you consult with an attorney and accountant to help you with the legal and financial aspects of the process.

Here are the main types of business entities in the US:

- **Corporations**: A corporation is the most common type of business entity in the US. It is a separate legal entity from its owners, which means that the owners are not personally liable for the debts of the corporation. Corporations are taxed on their profits, and they can issue shares of stock to raise money.

- **Limited liability companies (LLCs)**: An LLC is a hybrid business entity that combines the characteristics of a corporation and a partnership. It is a separate legal entity from its owners, but it is not taxed as a separate entity. Instead, the profits and losses of the LLC are passed through to the owners, who are taxed on their individual tax returns.

- **Partnerships:** A partnership is a business owned by two or more people. There are two main types of partnerships: general partnerships and limited partnerships. In a general partnership, all of the partners are personally liable for the debts of the partnership. In a limited partnership, there are one or more general partners who are personally liable for the debts of the partnership, and one or more limited partners who are not personally liable.

- **Branches or foreign corporations**: A branch is a part of a foreign corporation that does business in the US. A foreign corporation can establish a branch in the US by registering with the state in which it plans to do business. A foreign corporation is also taxed on its US profits.

The best type of business entity for you will depend on your specific needs and circumstances. It is important to consult with an attorney and accountant to get help choosing the right type of business entity for you.

Local Content

Local content is applied to certain energy facilities in the form of **domestic content bonus credits**. These credits are applied to qualified energy projects that have "any steel, iron, or manufactured product" which is produced in the United States.

An example would be the offshore wind sector which includes the IRA, the Jones Act, federal wind lease sales, state-level power purchase auctions, federal and state grants and tax incentives to boost the growth of US domestic workforce and supply chain development. Based on the DAI's "**U.S. Federal and State Local Content Requirements for Offshore Wind Projects**" Report, there are six that one should be aware of:

1. **The Jones Act**
   - Mandates that goods and personnel transported between US ports be on ships that are built, owned, and operated by US citizens.

2. **The OCSLA:** Public Lands Act and Chapter III
   - The BOEM enforces a law that requires that leases in the Outer Continental Shelf Lands (OCSLA) jurisdiction to be conducted on a competition basis that (1) generates outcomes that assures protection of the national security interests of the US, and (2) secures a fair return to the US. The OCSLA covers natural resources in submerged lands from the coastline to up to three nautical miles (5.6km) into the Atlantic, Pacific, Arctic Oceans, or GOM. An exception is made for Texas and west coast of Florida where state jurisdiction extends three marine leagues (16.2km) from the coastline into the GOM.

3. **The Infrastructure Investment and Jobs Act (IIJA) 2021**
   - Supports local manufacturing of supply chain components which includes advanced energy manufacturing such as grants for fuel cells, microturbines, energy storage systems, equipment for electric grid modernisation, electrolysers, fuel-blending initiatives, and renewable/low-carbon products.
   - **Wage Rate Requirements**: Wages paid to workers on a particular project must be at least as high as the wages paid to workers on similar projects in the same area. This is to ensure that workers are paid fairly and that there is no wage competition between employers.
   - **Buy America Sourcing Requirements**: funds for infrastructure must only be used towards iron, steel, manufactured products, and construction materials to be produced in the US. A **waiver** is applied to this rule where (1) local content procurement preference would be inconsistent with the public interest, or (2) there is insufficient and reasonably enough quantities or of a satisfactory quality of the iron, steel, manufactured products, or construction materials.

4. **Inflation Reduction Act 2022** - A **Notice** has been put forth by the Department of the Treasury and the IRS to further elaborate on the IRA's impact on local content laws. This would apply to certain energy projects that are commercially operational after 31 December 2022. A bonus amount to those credits is applied for those placed in service after 31 December 2024.
   - A 10% credit bonus given if "any steel, iron, or manufactured product which is a component of such facility (upon completion of construction) was produced in the United States".
   - Construction products manufactured domestically are defined as products for which at least the adjusted percentage of the total cost of materials is attributable to components that are mined, produced, or manufactured in the United States. For example, if the adjusted percentage

is 50%, then a construction product would be considered domestically manufactured if at least 50% of the cost of its materials was attributable to components that were mined, produced, or manufactured in the United States.

- For a qualified offshore wind facility, the adjusted percentages are defined under Part 7 on incentives for renewable power (Subsection Special Rules g(11)(C)(ii)), as follows:
  - in the case of a facility the construction of which begins before January 1, 2025, 20 percent.
  - in the case of a facility the construction of which begins after December 31, 2024, and before January 1, 2026, 27.5 percent.
  - in the case of a facility the construction of which begins after December 31, 2025, and before January 1, 2027, 35 percent.
  - in the case of a facility the construction of which begins after December 31, 2026, and before January 1, 2028, 45 percent.
  - in the case of a facility the construction of which begins after December 31, 2027, 55 percent.
- Exemption from these requirements will be applied provided that the domestic production of steel, iron, or manufactured products had raised the overall construction costs by more than 25%, or
- Those same products were produced domestically but were insufficient in reasonably available quantity or of a satisfactory quality.

A summary is shown in the **Appendix** section under Table B to show an example of common equipment and parts manufactured for applicable projects. It is by no means an exhaustive list and must be consulted with a tax advisor for further details.

Special customs arrangement

Temporary Admissions

The U.S. – Mexico – Canada Agreement (USMCA) is a new agreement which replaced the 1994 North American Free Trade Agreement (NAFTA). NAFTA was a free trade zone which allowed duty-free temporary admission to certain classes of goods imported from another NAFTA country. The USMCA, signed into effect on 1st July 2020, continued this free trade zone with major changes to include the ease in customs and trade facilitation. Such changes include standardisation of port entry, express shipment for goods valued below US$2,500, and availability of up-to-date trade-related costs (import/export requirements, fees, and penalties) via the internet, which is that more goods had to be made in North America to qualify for preferential tariff treatment.

Bonded Warehouses

A Customs bonded warehouse is a secure facility where imported dutiable merchandise can be stored, manipulated, or undergo manufacturing operations without payment of duty for up to 5 years from the date of importation. This is because duty would be collected when the merchandise is withdrawn for use. The warehouse proprietor is responsible for the merchandise and must post a bond to ensure that the merchandise is properly accounted for and that any duties owed are paid.

The main advantages of using bonded warehouses would be that companies are able to avoid paying duty if the merchandise is unsold and they would also have the option to store many items even if they are subject to quota restrictions.

There are 11 different classes of bonded warehouses, each with its own specific purpose. Some of the most common classes of bonded warehouses include:

1. **Private bonded warehouses:** These warehouses are used by importers to store their own merchandise.
2. **Public bonded warehouses:** These warehouses are open to any importer and are used to store merchandise that is not owned by the warehouse proprietor.
3. **Bonded yards or sheds:** These warehouses are used to store heavy and bulky merchandise, such as vehicles and machinery.
4. **Bonded bins:** These warehouses are used to store grain.
5. **Bonded warehouses for manufacturing:** These warehouses are used to manufacture goods from imported materials.
6. **Duty-free stores:** These warehouses sell merchandise that is exempt from duty, such as perfume and alcohol.

According to the **U.S. Customs and Border Protection**, an applicant must submit an application to the local CBP port director to establish a bonded warehouse. The application must include a description of the premises, a blueprint of the building, and a certificate from a board of fire underwriters. The port director may also require additional information, such as a list of company officers and a set of fingerprints.

Tax

The US tax system is a complex system that is governed by a variety of laws and regulations. The Internal Revenue Service (IRS) is the main government body that is responsible for collecting taxes in the US. The basic structure of the US tax system is as follows:

Individuals: Individuals are taxed on their worldwide income, regardless of where they live. The US has a progressive tax system, which means that individuals with higher incomes pay a higher percentage of their income in taxes.

Corporations: Corporations are taxed on their worldwide income, but they can claim a credit for taxes paid to foreign governments. The US has a flat corporate tax rate of 21%.

Pass-through entities: Pass-through entities are businesses that do not pay taxes themselves. Instead, the income of a pass-through entity is passed through to the owners of the entity, who are taxed on their share of the income. Some common types of pass-through entities include partnerships, limited liability companies (LLCs), and S corporations.

International businesses that want to set up a company in the US will need to comply with a variety of US tax laws and regulations. Some of the key considerations for international businesses include:

1. **Tax residency:** The US has a worldwide tax system, which means that businesses that are tax residents of the US are taxed on their worldwide income. Businesses can be tax residents of the US if they are incorporated in the US, have a permanent establishment in the US, or have certain types of activities in the US.
2. **Withholding taxes:** The US taxes certain types of payments made to foreign persons, including payments for services, royalties, and interest. The amount of withholding tax that is imposed depends on the type of payment and the relationship between the payer and the recipient.

3. **Tax treaties:** The US has **tax treaties** with over 70 countries. Tax treaties can reduce or eliminate the amount of tax that is withheld on payments made to foreign persons.
4. **Transfer pricing:** Transfer pricing is the process of setting the prices for goods and services that are transferred between related companies. The US has transfer pricing rules that are designed to prevent companies from shifting profits to low-tax countries.

Technical compliance

Businesses that want to sell their products in the United States need to be aware of American standards. The American National Standards Institute (ANSI) has been overseeing the private sector's voluntary standardization system since 1918. Products sold in the US market are often required to comply with ANSI standards. This is not only to ensure the safe operation of equipment, but also to make sure that imported goods are fully compatible with existing US infrastructure.

Business etiquette

The United States is one of the most culturally diverse countries in the world, with no official language. English is the most commonly spoken language, and business is most often conducted in English. However, Spanish and Mandarin are also widely spoken, among others.

Despite sharing a common heritage and language, the business cultures of the United States and the United Kingdom are quite different. When doing business in the US, it is important to keep these cultural differences in mind. The US is an individualistic and competitive society. Americans value time and efficiency, and business often comes first. US businesspeople tend to be direct and to-the-point in their communications.

When meeting with someone for business, it is important to be prepared and to know your audience. You should also be familiar with the company's business, projects, and needs. It is important to be direct and to highlight your competitive advantage. Americans conduct business in a polite, yet direct and conservative manner. It is important to follow up with your contacts multiple times, even if you don't hear back right away. It is common to have multiple emails, phone calls, and meetings before a business deal is finalized.

American meetings are typically informal. When meeting someone for the first time, it is customary to shake hands and smile. Americans value eye contact and a firm handshake. Americans view business cards as a way to get to know someone in the future and expect to exchange business cards when meeting someone new. Americans do business with companies that offer the best deal. Service and long-term relationships are important, but they are typically developed after a successful sale or project is completed. Deadlines are taken very seriously in the US. Late delivery is seen as a failure.

Brand awareness and success stories are important in the US market. Companies should aggressively market their products or services with a local presence, through their website and social media, and by publicizing their success stories. Companies should also consider joining local associations and sponsoring trade shows and events.

Appendix

PTC tax credits available for the domestic manufacturing of certain clean components until 2032*

Component	Federal Definition	Credit Amount
	PV Module and Subcomponents	
Solar-grade polysilicon	Silicon that is suitable for photovoltaic manufacturing and is purified to a minimum purity of 99.999999 percent silicon by mass.	US$3 per kilogram (kg)
PV wafer	A thin slice, sheet, or layer of semiconductor material of at least 240 square centimeters that comprises the substrate or absorber layer of one or more photovoltaic cells. Produced by a single manufacturer either i) directly from molten or evaporated solar grade polysilicon or deposition of solar grade thin film semiconductor photon absorber layer, or ii) through formation of an ingot from molten polysilicon and subsequent slicing.	US$12 per square meter ($m^2$)
PV cell (crystalline or thin-film)	The smallest semiconductor element of a solar module that performs the immediate conversion of light into electricity.	4¢ per watt-direct current (W_{dc})
Polymeric backsheet	A sheet on the back of a solar module that acts as an electric insulator and protects the inner components of such module from the surrounding environment.	40¢ per m^2
PV Module	The connection and lamination of photovoltaic cells into an environmentally protected final assembly that is suitable to generate electricity when exposed to sunlight, and ready for installation without an additional manufacturing process.	7¢ per W_{dc}
	PV Inverter	
Central inverter	Suitable for large utility-scale systems. >1 megawatt-alternating current (MW_{ac})	0.25¢ per watt-alternating current (W_{ac})
Utility inverter	Suitable for commercial or utility-scale systems. ≥125 kW_{ac}, ≤1 MW_{ac}, with a rated output ≥600 volt three-phase power.	1.5¢ per W_{ac}
Commercial inverter	Suitable for commercial or utility-scale applications. ≥20kW_{ac}, ≤125 kW_{ac} with a rated output of 208, 480, 600, or 800 volt three-phase power >600 volt three-phase power.	2¢ per W_{ac}
Residential inverter	Suitable for a residence. ≤20 kW_{ac}, with a rated output of 120 or 240 volt single-phase power.	6.5¢ per W_{ac}

Microinverter	Suitable to connect with one solar module. ≤650 W_{ac} with a rated output of i) 120 or 240 volt single-phase power, or ii) 208 or 480 volt three-phase power.	11¢ per W_{ac}
PV Tracking Systems		
Torque tube	A structural steel support element (including longitudinal purlins) that is part of a solar tracker, is of any cross-sectional shape, may be assembled from individually manufactured segments, spans longitudinally between foundation posts, supports solar panels and is connected to a mounting attachment for solar panels (with or without separate module interface rails), and is rotated by means of a drive system.	87¢ per kg
Structural fasteners	A component that is used to connect the mechanical and drive system components of a solar tracker to the foundation of such solar tracker, to connect torque tubes to drive assemblies, or to connect segments of torque tubes to one another.	US$2.28 per kg
Batteries		
Electrode active materials	Cathode materials, anode materials, anode foils, and electrochemically active materials, including solvents, additives, and electrolyte salts that contribute to the electrochemical processes necessary for energy storage.	10% of the costs incurred by the taxpayer due to production of such materials
Battery cells	An electrochemical cell comprised of 1 or more positive electrodes and 1 or more negative electrodes, with an energy density of not less than 100 watt-hours per liter, and capable of storing at least 12 watt-hours of energy. The capacity of the cell to the maximum discharge amount of the cell or module (capacity-to-power ratio) cannot exceed 100:1.	US$35 per kilowatt-hour (kWh)
Battery module	A module, in the case of a module using battery cells, with 2 or more battery cells that are configured electrically, in series or parallel, to create voltage or current, as appropriate, to a specified end use, or with no battery cells, and with an aggregate capacity of not less than 7 kilowatt-hours (or, in the case of a module for a hydrogen fuel cell vehicle, not less than 1 kilowatt-hour). The capacity of the module to the maximum discharge amount of the cell or module (capacity-to-power ratio) cannot exceed 100:1.	US$10 (or, in the case of a battery module that does not use battery cells, US$45) per kWh
Critical Minerals		
Critical minerals**	In addition to products and components, the mining of certain critical minerals are included. Those most likely to pertain to the solar PV supply chain include: Aluminium that is purified to 99.9% or converted from bauxite to at least 99% purity; graphite that is purified to a minimum purity of 99.9%; tellurium that is purified to at least 99% purity or converted to cadmium telluride; indium that is purified to at least 99 percent, converted to indium tin oxide, or converted to indium oxide of at least 99.9% purity; gallium that is purified to 99% purity; arsenic that is purified to 99% purity; titanium that is purified to 99% purity.	10% of the costs incurred by the taxpayer due to production of such minerals

Table A

Summary of eligible components for Advanced Manufacturing Production Tax Credit (45X MPTC).

**Credits available in full until 2029. Subsequent phase out by 75%, 50%, 25%, and 0% of full credit amount by 2030, 2031, 2032, and post-2032 respectively.*

***Credits for critical minerals will be given in full indefinitely.*

Inexhaustive list of project components and their local content categorisation

Applicable Project	Category	Applicable Project Component
Utility-scale solar PV	Steel/Iron	Steel PV module racking
	Steel/Iron	Pile or ground screw
	Steel/Iron	PV tracker
	Manufactured Product	PV module including PV cells, mounting frame or backrail, glass, encapsulant, backsheet, junction box (including pigtails and connectors), edge seals, pottants, adhesives, bus ribbons, and bypass diodes) if applicable
	Manufactured Product	Inverter
Onshore wind facility	Steel/Iron	Tower
	Steel/Iron	Steel or iron rebar in foundation
	Manufactured Product	Wind turbine including nacelle, blades, rotor hub, and power converter if applicable)
	Manufactured Product	Wind tower flanges
Offshore wind facility	Steel/Iron	Tower
	Steel/Iron	Jacket foundation
	Manufactured Product	Wind turbine including nacelle, blades, rotor hub, and power converter if applicable)
	Manufactured Product	Wind tower flanges
	Manufactured Product	Transition piece
	Manufactured Product	Monopile
	Manufactured Product	Inter-array cable
	Manufactured Product	Offshore substation
	Manufactured Product	Export cable
Battery energy storage technology	Steel/Iron	Steel or iron rebar in foundation
	Manufactured Product	Battery pack
	Manufactured Product	Battery container/housing
	Manufactured Product	Inverter

Table B
Table of applicable project components and their local content classifications

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