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Engineering & Construction

Hydrogen and Ammonia Engineering & Construction:

Navigating your Pathway to Project Excellence

Plus Gulf Coast Low Emission H_2 & Derivatives Project Tracker

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Market Outlook

Momentum is picking up for clean hydrogen and its derivative products, but the industry is still at a nascent stage and scaling it up comes with various challenges. Not least among these is the fact that producing hydrogen with low or zero greenhouse gas (GHG) emissions costs more than traditional methods of hydrogen production.

The industry is focusing on two clean hydrogen options. Blue hydrogen is produced using steam-methane reforming – the same process as conventional grey hydrogen, but with an added carbon capture and storage (CCS) component to address carbon dioxide (CO2) emissions. Meanwhile, green hydrogen is produced via the separation of hydrogen and oxygen in water using electrolysis and renewable electricity so as to avoid CO2 emissions altogether. Green hydrogen can also provide an outlet for surplus renewable energy, with potential to act as an alternative to battery storage.

Storing and transporting hydrogen in gas form is challenging and costly, and an alternative is converting it to derivatives such as ammonia. As well as being easier and cheaper to store and transport in liquefied form, ammonia benefits from already being widely traded globally. Depending on the method of production, it can also be subdivided into blue and green ammonia along the same lines as the hydrogen it carries.

Green hydrogen can also be used to produce derivatives such as e-methanol and e-natural gas, which can be used in various applications while mitigating CO2 emissions.

The International Energy Agency (IEA) estimates that global hydrogen demand reached 95 million tonnes (Mt) in 2022[1], but this demand was met mainly by grey and black hydrogen – produced using natural gas and coal respectively, but without CCS. Low-emission hydrogen accounted for just 0.7% of total demand in 2022 according to the IEA, but this is set to grow. The pace of this growth depends on numerous factors including the speed of decarbonization, policy support and investment levels. The IEA estimates that the current pipeline of low-emission hydrogen projects could add 38 Mt of capacity by 2030. Meanwhile, government targets for 2030 represent 27-35 Mt of low-emission hydrogen production but only 14 Mt of demand.

However, under the IEA's Net Zero Emissions by 2050 scenario, demand for low-emission hydrogen would reach 70 Mt by 2030. The agency has said that there is therefore a need to stimulate demand, and other organizations agree. Indeed, in a recent article focusing on clean hydrogen on the US Gulf Coast alone, McKinsey & Co. says demand needs to be created in four key sectors – ammonia, petrochemicals and refining, ground transportation and power and utilities[2].

Ammonia accounts for the largest share, with the potential for 3 Mt per annum (mtpa) of demand for clean hydrogen from the Gulf Coast to be unlocked by 2030 according to McKinsey. Tapping the ammonia market also presents export opportunities – and with them the potential to grow demand even further depending on the pace of decarbonization globally.

1 Global Hydrogen Review 2023 https://www.iea.org/reports/global-hydrogen-review-2023
2 Unlocking clean hydrogen in the US Gulf Coast: The "here and now" https://www.mckinsey.com/industries/oil-and-gas/our-insights/unlocking-clean-hydrogen-in-the-us-gulf-coast-the-here-and-now

In a sign that demand is growing, offtake agreements for low-emission hydrogen are now being signed, though there has only been a limited number to date. According to the IEA, agreements for up to 2 Mt of low-emission hydrogen had been signed as of September 2023, though more than half were preliminary and non-biding at that point. The agency also estimates that some companies are developing a combined 3 Mt of low-emission hydrogen for their own use – without the need for offtake agreements.

On the supply side, a handful of regions is expected to take the lead globally on low-emission hydrogen.

"Hydrogen production will likely emerge in five or six main hubs around the world," says a McKinsey partner, Nikhil Ati. As well as the Gulf Coast, McKinsey expects emerging hubs to include the Middle East, Australia, Southeast Asia and the region that encompasses Southern Europe and Northern Africa, according to Ati.

Various factors play into what makes a region attractive for hydrogen production and exports, but at this early stage, government support is extremely important.

"What we're beginning to see is that some of the regions that are moving forward quickly are the ones that have got some policy support in place," says Wood Mackenzie's head of hydrogen research, Murray Douglas. He notes that some regions still need additional clarity on the support in place, while other factors such as cost pressures can act as a brake on development. Nonetheless, Wood Mackenzie still sees momentum building on the Gulf Coast, as well as in the Middle East – particularly in Saudi Arabia and the United Arab Emirates (UAE) on blue ammonia.

The policy support and government incentives offered vary by region. Prominent examples include the US' Inflation Reduction Act (IRA), passed in 2022, which is expected to significantly improve the economics of low-emission hydrogen, with tax credits on offer.

The administration of US President Joe Biden has also made funding available to the hydrogen industry under the 2021 Bipartisan Infrastructure Law. On October 13, 2023, the Biden administration announced that it had selected seven proposed clean hydrogen hubs across 16 states to share $7bn in funding under that law[3]. Combined with tax incentives offered under the IRA, the funding is expected to help drive private sector investment into low-emission hydrogen projects.

Other significant policy support globally includes the European Union's (EU) Carbon Border Adjustment Mechanism (CBAM). The mechanism is aimed at ensuring that the carbon price of imports is equivalent to the carbon price of domestic production, and that the EU's decarbonization objectives are not undermined. The CBAM entered into application in its transitional phase in October 2023, initially applying to imports of cement, iron and steel, aluminium, fertilizers, electricity and hydrogen.

The EU has a target of producing 10 Mt and importing 10 Mt of renewable hydrogen by 2030. The bloc has also defined the conditions under which hydrogen, hydrogen-based fuels or other energy carriers can be considered as renewable fuels of non-biological origin (RFNBOs) and has published a methodology for calculating life-cycle GHG emissions for RFNBOs.

3 Biden-Harris Administration Announces $7 Billion For America's First Clean Hydrogen Hubs, Driving Clean Manufacturing and Delivering New Economic Opportunities Nationwide https://www.energy.gov/articles/biden-harris-administration-announces-7-billion-americas-first-clean-hydrogen-hubs-driving

Elsewhere in the world, policy support could look different because the companies involved are state-owned, for example in the Middle East. The question, notes McKinsey's Ati, is whether a government is aiming to be an enabler of the low-emission hydrogen industry or a participant.

In Asia, the frontrunners in hydrogen policy include Japan and South Korea, with the latter working to establish a global import supply chain and exploring co-operation on hydrogen with Chile and Australia, among others.

Policy support needs to be combined with other regional advantages. For example, Ati sees the Gulf Coast as being advantaged in terms of scale, in terms of availability of feedstock and in terms of existing infrastructure.

"If you overlay the IRA on top of it, I think it definitely is the clear market leader," he says. The region's hydrogen push has encountered certain setbacks, including Nutrien's decision in August 2023 to suspend work on a planned low-carbon ammonia project in Louisiana. The company cited rising capital costs and continued uncertainty over demand for clean ammonia. However, numerous other projects are advancing, and recent progress includes OCI starting construction on a blue ammonia facility in Texas in December 2022.

As of June 2023, the US accounted for 11 out of 20 blue ammonia projects announced globally, and for 16.3 mtpa of planned capacity out of a total of nearly 26 mtpa. But Nutrien's subsequent suspension of its project illustrates that even with the benefits of the Gulf Coast location and US policy support, projects are not guaranteed to go ahead. In many cases, hydrogen projects will need to demonstrate their cost-effectiveness, quality and sustainability in order to attract and retain customers, who in turn will help make those projects bankable.

In the nearer terms, blue hydrogen and ammonia projects are expected to dominate, with green hydrogen and ammonia only making significant strides forward further down the line. "I think if you look at what needs to happen to establish a low-carbon hydrogen or low-carbon ammonia sector, you need to get bigger volumes into the market more quickly," says Douglas. "In the long term, everyone's talking about green electrolytic hydrogen … but in terms of scaling the power generation requirements and the electrolyzer capacity, these things are going to take a lot of time."

Douglas expects the majority of green projects to be comparatively small over the next few years, whereas blue projects have more potential to deliver scale in the shorter term, particularly for companies targeting Asian buyers.

"We're quite optimistic on the prospects for blue hydrogen, blue ammonia to play a role this decade in offering that early scale," Douglas says. "There will be fewer – but bigger – blue projects, versus green, where there will be more of them, but they will be pretty small."

Site Selection & Infrastructure Assessment

Hydrogen projects require access to infrastructure for production, storage, distribution and export of its derivatives. In some cases, certain infrastructure already exists, though it will require expanding or upgrading.

Indeed, this is one of the advantages enjoyed by the Gulf Coast. The region is home to the world's largest hydrogen pipeline network[4], operated by Air Products, and more than 90% of the US' total dedicated hydrogen pipelines as of September 2022, as well as six of the 10 largest US ports. A significant amount of CO2 infrastructure also exists in the region, while the local geology is favorable for CO2 storage.

While the Biden administration is trying to spur the nationwide development of low-emission hydrogen, the Gulf Coast accounts for the majority of existing hydrogen infrastructure. Supply chains for multiple consumers on the Gulf Coast are already developed to an extent that is unrivalled by any other region globally[5].

Nonetheless, developing and scaling up low-emission hydrogen will require upgrades and expansions of existing infrastructure including pipelines and port facilities.

Such infrastructure modifications could require updated permits from a variety of regulators. For new infrastructure that has yet to be built, regulatory review requirements will need to be factored into project timelines. However, two recent US cases of CO2 pipeline applications being rejected by regulators in North and South Dakota[6] show that even clean energy infrastructure is not guaranteed an easy path through regulatory reviews.

On top of this, hydrogen projects face additional regulatory uncertainty across the federal, state and local level. Indeed, the industry is still awaiting clarification on the definition of clean hydrogen, which will help determine access to subsidies.

“There's still some uncertainty around the rules in the US, which will define clean hydrogen as well,” says Wood Mackenzie's Douglas. “The Treasury was initially expected to announce those last month but they've been delayed,” he adds, saying that timing remains uncertain but that there are now expectations that an announcement could come in November.

4 Hydrogen isn't new—at least not in the Gulf Coast https://efifoundation.org/insights/hydrogen-isnt-new-at-least-not-in-the-gulf-coast/
5 Building the Gulf Coast Clean Hydrogen Market https://efifoundation.org/reports/building-the-gulf-coast-clean-hydrogen-market
6 CO2 pipelines rejected by regulators in the Dakotas, putting Minnesota status in limbo https://www.startribune.com/co2-pipelines-rejected-by-regulators-dakotas-putting-minnesota-in-limbo-carbon-dioxide-sequestration/600302778/

Partnership & Contracting Strategies

There is still much that needs to be figured out while the low-emission hydrogen industry remains at a nascent stage. Clarity will come as the industry matures and participants learn what approaches work and what ones do not. In the early days, though, participants will shoulder a large amount of risk, and within this, there are questions over how risk is to be shared among different stakeholders.

Design competitions for selecting front-end engineering design (FEED) contractors have worked well as a contracting strategy for other nascent industries and technologies[7]. Indeed, a number of early green hydrogen developers have taken this approach, with a view to converting the FEED contractor to a lump-sum turnkey (LSTK) engineering, procurement and construction (EPC) contractor at a later stage. This approach can also help developers with limited previous experience to make their projects more competitive.

While the industry remains at an early stage, contractors can expect to shoulder the majority of the risk. However, contractors that can demonstrate early expertise in the technology can set themselves up to benefit from more balanced risk-sharing as the industry matures.

It is not contractors alone that face uncertainties around risk-sharing, and this also filters through to offtakers and other players in the new hydrogen value chains. If a project brings together stakeholders from different sectors, which also have varying priorities and levels of risk tolerance, this can make it difficult to establish alignment.

"We are talking about breaking away from the traditional supplier-buyer relationship into more shared investments, shared risk," says McKinsey's Ati. "You have a supplier of renewable electricity partnering with a hydrogen manufacturer, partnering with an infrastructure player like an industrial gas company, and together driving shared investments, shared risk and shared profitability."

On top of navigating this and ensuring adequate transparency and the right balance between risks and rewards, Ati notes that stakeholders have additional uncertainty over what long-term partnership structures could look like compared to the short-term ones.

"Today we are talking about getting the industry started," he says. "And to start the industry, I think there is a lot more openness amongst companies and governments to trying something new and looking at – as an example – structuring hydrogen offtake in a slightly different way."

When it comes to negotiating offtake agreements, the low-emission hydrogen industry could learn from LNG exporters[8], for example by looking at tolling and sale-and-purchase (SPA) models. In the case of green hydrogen projects, power purchase agreements (PPAs) with renewable power suppliers would also need to be factored into an SPA arrangement.

7 What Is The Right Contracting Strategy For Green Hydrogen Projects? https://www.ipaglobal.com/news/article/what-is-the-right-contracting-strategy-for-green-hydrogen-projects/#:~:text=The%20most%20challenging%20aspects%20of%20these%20projects%20arise,tied%20to%20governmental%20targets%29%20and%20different%20risk%20tolerances

8 Negotiating hydrogen contracts https://www.projectfinance.law/publications/2021/february/negotiating-hydrogen-contracts/

A variety of factors can help determine which model is more suited to a specific project, but in any case, long-term offtake contracts could be vital in helping developers to make their projects bankable.

Project Design & Execution

Both blue and green hydrogen are seeing growing momentum, including a number of new project proposals being unveiled, but the developers behind these proposals have some way to go to make their facilities bankable.

On top of the challenges that come with building projects that use nascent technologies, the industry has also been beset by broader inflationary and supply chain pressures. These are particularly evident on the Gulf Coast, where resources such as labor and materials are stretched across the refining and petrochemical, oil and gas, renewable and LNG industries – among others.

Once again, this is an instance in which the low-emission hydrogen industry can learn from LNG, which has seen some developers embrace modularization in a bid to reduce costs, project timelines and pressures on the local construction market. Modularization enables certain project components to be constructed off-site. Debate is ongoing about the pros and cons of modularization, but as a growing number of projects across different sectors on the Gulf Coast uses up a larger share of local resources, the developers of new facilities entering construction may not have much choice.

There are certain steps developers can take to help offset rising costs. Wood Mackenzie's Douglas notes that locking down project costs early paid off for OCI for its Gulf Coast blue ammonia project. The company has also secured a long-term clean hydrogen supply from Linde, which is in turn partnering with ExxonMobil on CCS for its hydrogen production facility in the region.

"In terms of mitigating risk, it's probably about making sure you've got low-cost feed gas, making sure that you've got an established EPC contractor that can come in and build these plants, build this infrastructure, and that you've got supportive local politicians," Douglas says.

The rapid scaling and advancement of technology and processes including electrolyzers, autothermal reforming (ATR) and CCS will be key to enabling the construction of bankable zero-and low-emission facilities on the Gulf Coast.

Ati notes that on top of improvements to project design and configuration, there is also a learning curve when it comes to execution.

"I think companies learn over time how to execute these projects more efficiently and there will be some natural learning and efficiencies that will come from economies of scale," he says.

Workforce Development

While a variety of industries are competing for labor on the Gulf Coast, the low-carbon hydrogen industry will also require specialized skills in the complex and innovative technologies involved.

There is currently a lack of qualified workers with the relevant technical and soft skills in the region, and developers will need to invest in workforce development programs to help address this.

Filling the skills gaps presents opportunities, including in the area of diversity and inclusion, and it will be up to developers to foster a culture that is conducive to this.

As the industry matures, a shortage of specialized workers will hinder its progress, so players entering the low-emission hydrogen space need to be taking action now if they want to grow rapidly.

Project Tracker

This project tracker has been created using open source research (last updated:10/20/23).
If you are aware of an error or relevant update then please message jonny.witherspoon@hydrogenprojects.us

Developer(s)	Location	Production	Cost	Capacity	Expected FID / Development Stage	Expected Start up	Technology	Solution / Service Providers
ACME Greentech Ventures	Port of Victoria, Texas	Green H2 & NH3	Unknown	1.2 Mmtpa	Unknown	Unknown	Unknown	Unknown
Air Liquide Chevron LyondellBasell Uniper	Houston, Texas (TBC)	Blue & Green H2	Unknown	TBC	Awaiting results of Joint Study	TBC	Unknown	TBC
Air Liquide INPEX LSB Industries Vopak MODA	Houston Ship Channel	Blue NH3	Unknown	1.1 Mmtpa	pre-FEED	2027	Autotermal reforming (ATR) & CCS	CCS - Air Liquide ATR - Air Liquide Air Seperation Unit (ASU) - Air Liquide EPC & Operations - LSB Sotrage, handling, Very Large Gas Carriers (VLGC) - Vopak Moda
Air Products CF Industries NextEra Energy LSB Industries Baker Hughes Cherokee Nation GE Woodside	HALO Hydrogen Hub, Arkansas/Louisiana/ Oklahoma	Green, Blue & Pink H2	Unknown	Unknown	Failed to secure DoE funding	Unknown	Unknown	Unknown
Air Products AES	Wilbarger County, Texas	Green H2	$4 billion	200 Mtpd green hydrogen	TBC	2027	1.4 GW Wind & Solar	Unknown
Air Products AKA Clean Energy Complex AKA Darrow Blue Energy	Ascension Parish, Louisiana	Blue H2 & NH3	$4.5 billion	7.2 MMtpa	Project Underway	2026	Autotermal reforming (ATR) & CCS	Topsoe - SynCOR Technology EPC - Wood EPC Air Compressor Trains - MAN Energy Solutions
BP Linde	Linde facilities Houston & GC	Blue H2	Unknown	Unknown	Unknown	2026	Unknown	C02 capture & compress - Linde
CF Industires LOTTE Chemical	Blue Point Complex, Louisiana	Blue H2 & NH3	Unknown	Unknown	MOU	Unknown	Unknown	Unknown

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CF Industries	Donaldsonville Complex, Louisiana	Blue NH3	$200 million	1.7 Mmtpa		2025	Addition of carbon dioxide dehydration and compression facility at the Donaldsonville Complex	Storage - ExxonMobil Storage & Transport - ExxonMobil in partnership with EnLink Midstream
CF Industries	Donaldsonville Complex, Louisiana	Green NH3	$100 million	20,000 tpa	Underway	2023 - End	20 MW alkaline water electrolyzer (TSK)	EPC - thyssenkrupp Electrolyzer - thyssenkrupp
CF Industries ExxonMobil EnLink	Vermillion Parish, Louisiana	Blue H2 & NH3	Unknown	2 Mmtpa	Project Underway	2025	Unknown	CCS - ExxonMobil CO2 Transport - EnLink Midstream
CF Industries Mitsui & Co LOTTE Chemical	Blue Point Complex, Louisiana	Blue NH3	$2 billion	1 - 1.4 Mmtpa	FID 2023	2027 - 28	Steam methane reforming (SMR) & CCS	Technology provider - thyssenkrupp
CF Industries NextEra Part of the HALO Hydrogen Hub bid	Verdigris Complex, Oklahoma	Green H2 & NH3	Unknown	100,000 tpa	MOU	Unknown	100 MW electrolysis plant Powered by deadicated 450-MW Renewable Energy Facility (NextEra)	Unknown
CF Industries POSCO	Blue Point Complex, Louisiana	Blue H2 & NH3	$2 billion	Unknown	FEED to conclude H2 2024	2028 - 29	Autotermal reforming (ATR) & CCS	Unknown
Clean Hydrogen Works Denbury Hafnia MOL Clean Energy AKA Ascension Clean Energy (ACE)	RiverPlex, Megapark, South Louisiana	Blue H2 & NH3	$7.5 billion	7.1 MMtpa	FID 2024	2027	Unknown	CCS & Transport, via pipeline infrastructure - Denbury Shipping globally - Hafnia Shipping solutions - Mitsui O.S.K Lines (MOL) Low Carbon Technology Provider - Topsoe
ConocoPhillips JERA Americas	Gulf Coast TBC	Blue H2 & NH3	Unknown	2 MMtpa (potential to expand to 8 MMtpa)	MoU and HoA	2030	Unknown	CCS - ConocoPhilips
Energy Allied International - Sandpiper Chemicals	Bay Street (Land leased from Eastman Chemical)	Blue CH30H	Unknown	3,000 mtpd	Construction expected 2025	2027	Unknown	Unknown

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ExxonMobil	Baytown, Texas	Blue H2	Unknown	1 billion cubic feet per day	FEED underway	2027/8	Autotermal reforming (ATR) & CCS	FEED - Technip Energies CCUS Technology - Honeywell Topsoe SynCOR Technology
First Ammonia	Port of Victoria, Texas	Green H2 & NH3	$250 million (potential $1 billion build out)	Unknown	FID 2023	2025	Solid oxide electrolyzer cells (SOEC)	Unknown
G2 Net-Zero	Southwest Louisiana	Blue H2 & NH3	$11 billion - for the full 'Energy Complex'	TBC	Unknown	2027	Unknown	FEED - McDermott NET Power Siemens
Green Hydrogen International (GHI) INPEX	Hydrogen City, South Texas	Green H2 & NH3	Unknown	280,000 tpa H2 (phase 1) (1Mmtpa green NH3)	Joint Study Agreement (JSA) - Construction penciled for 2026	2029	3.75GW behind the meter renewable power 2.2GW electrolyzer production plant (phase 1) Salt caven storage	Unknown
GTI Energy Chevron AES Air Liquide Mitsubishi Power ExxonMobil Orsted Sempra Infrastructure	HyVelocity Hub, Houston	Green & Blue H2	$1.25 billion private finance Up to $1.25 billion public funding	Unknown	Selected for funding by the DoE	Unknown	Unknown	Unknown
HIF Global	Matagorda County, Texas	e-Gasoline	Unknown	200 mgpa	FEED Underway - Construction Q1 2024	2027	Silyzer 300 electrolyzers	FEED - Bechtel Energy, Siemens Energy, Topsoe Electrolyzers - Siemens
IGP Methanol	Plaquemines Parish, New Orleans	Blue CH30H	$3 billion	3.6 Mmtpa	Unknown	2026	Unknown	Haldor Topsoe Blue Methanol Technology Linde Veolia Entergy
Lake Charles Methanol (Morgan Stanley)	Port of Lake Charles, Louisiana	Blue CH30H	$4 billion	3.6 Mmtpa	Construction expected Q2 2024	2027	Autotermal reforming (ATR) & CCS	CCS Services - Denbury Topsoe SynCOR technology
Monarch Energy	Louisiana, Ascension Parish	Green H2	$500 million	120,000 kgpd	FID 2025	2027	300MW Electrolyzer plant	Renewable power & transmission infrastructure - Entergy

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New Fortress Energy Plug Power Aka: ZeroParks	Beaumont, Texas	Green H2	Unknown	50 tpd	Unknown	2025	100MW electrolyzer	Electrolyzers - Electric Hydrogen
Nutrien (Project Suspended Aug 23)	Geismar, Louisiana	Blue NH3	$2 billion	1.2 Mmtpa	FID 2023	2027	Unknown	CCS - Denbury
OCI Linde	Beaumont, Texas	Blue H2 & NH3	$1.8 billion	1.1 MMtpa (scope to double to 2.2 MMtpa)	Project Underway	early - 2025	Autotermal reforming (ATR) & CCS	Synthesis technology - KBR CCS - ExxonMobil EPC & Operation - Linde
Orsted	Gulf Coast TBC		Unknown	300,000 tpa e-methanol for shipping (Maersk)	FID End of 2023	2025	1.2GW new onshore wind & solar PV 675MW Power-to-X facility	Unknown
Proman Mitsubishi	Lake Charles, Louisiana	Blue NH3	Unknown	1.2 Mmtpa	Unknown	Unknown	Unknown	Unknown
RWE Lotte Chemical Mitsubishi	Corpus Christi, Texas	Green & Blue H2 & NH3	Unknown	10 Mmtpa	Joint Study Agreement (JSA)	2030	Unknown	Unknown
Sempra Infrastructure AVANGRID	Unknown	Green H2	Unknown	TBC	Heads of agreement (HOA) framework	Unknown	Unknown	Unknown
Sempra Infrastructure Tokyo Gas Company Mitsubishi	Gulf Coast (TBC)	Green CH4	Unknown	130,000 tpa	Unknown	Unknown	Unknown	Unknown
St Charles Clean Fuels (Co-owned by Copenhagen Infrastructure Partners (CIP) & Sustainable Fuels Group (SFG))	St Charles Parish, Louisiana	Blue H2 & NH3	$4.6 billion	3 Mmtpa	FEED underway - FID early 2024	2027	Unknown	Topsoe SynCOR Technology Storage & Handling - International-Matex Tank Terminals (IMTT)
TES (Tree Energy Solutions) TotalEnergies	Unknown	e-NG	Unknown	100,000 - 200,000 tpa	FID 2024	Unknown	1 GW electrolyzer Biogenic CO2	Unknown
Yara BASF	Gulf Coast TBC	Blue H2 & NH3	Unknown	1.2 - 1.4 MMtpa	Feasability study end of 23	2028/9	Unknown	Unknown
Yara Enbridge	Corpus Christi, Texas		$2.6 - 2.9 billion	1.2 - 1.4 MMtpa	FEED underway	2027/8	Autotermal reforming (ATR) & CCS	Unknown