

FLNG - Unlocking Offshore Gas Opportunity and Global Supply



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What is FLNG?

A floating LNG facility is essentially a floating natural gas processing plant. The massive, specialized marine facility is used to extract, process, store, and offload natural gas directly at an offshore field. FLNG is transformative because it enables the efficient commercialisation of gas reserves previously considered too challenging or uneconomical to access using conventional methods, and the nature of the infrastructure means that it can be utilised in more than one area, allowing the investment cost to be spread over multiple resources.

Floating LNG technology involves a self-contained, offshore facility that integrates the entire natural gas supply chain onto a single marine vessel. This vessel is permanently moored over an offshore gas reservoir, serving as a floating production, storage, and offloading unit specifically adapted for gas liquefaction.

The primary function of the FLNG facility is to handle the complete processing of natural gas at sea, eliminating the need for long subsea pipelines to transport raw gas to an onshore plant. It receives gas from subsea wells via risers, processes it onboard, and then stores the finished liquid product in cryogenic tanks within its hull. The integrated nature of the facility (which includes living quarters, control rooms, and the full processing plant) and its ability to withstand severe weather conditions allows it to remain on location for decades. To dispatch the production, the LNG is loaded into conventional LNG carriers which are moored alongside the FLNG unit during transfers.

FLNG technology is an accepted monetisation option, it is no longer not confined to “gas reserves previously considered too challenging or uneconomic to access using conventional methods”. Its features which now means it competes across the board with land based conventional methods are:

- Competitive economics (Capex, efficiency) which work at low volumes (~3 mtpa)
- Redeployability enables lower volume and/or shorter tenor contracts to be struck at economic rates
- Market digestible offtake volumes
- Phased development of resource providing earlier cash flow to all stakeholders.

Early Days

Widespread deployment of FLNG technology is a fairly recent phenomenon, despite LNG being used as a medium to transport gas internationally since the 1960s. Studies into offshore LNG production began soon after in the early 1970s, but it was only in the mid-1990s that significant research backed by experimental development began. In 1997, Mobil developed an FLNG production concept based on a large, square structure with an opening in the hull or floor of a vessel (a 'moonpool') in the centre, sized to produce 6 mtpa of LNG, which was followed up shortly by major studies undertaken by Chevron and several other oil and gas companies. There was still some time before Shell made the first final investment decision on an FLNG project when the Prelude FLNG project was instigated in May 2011.

The Prelude FLNG facility is a giant – it remains the largest floating structure ever built. It was designed to process 3.6 mtpa of LNG, 0.4 mtpa of LPG, and 1.3 mtpa of condensate with an initial total project cost estimate at around USD 12 billion – in the execution however construction proved to be challenging and took far longer than expected, with final costs are understood to have ballooned to about \$18 bn.

Whilst Shell was struggling, Petronas built a far smaller, simpler 1.2 mtpa unit FLNG Satu which in 2016 became the first FLNG unit to go into service. It is less complex than Prelude as it does not also handle LPG and condensate.

Following the aforementioned delays, Prelude eventually went into service in 2018 at the same time as the third FLNG concept, Cameroon FLNG started up. Cameroon FLNG is significantly different from the earlier concepts as, rather than utilise a fully newly-built vessel it is an LNG carrier conversion. Golar installed the liquefaction train onto an existing LNG carrier, the Hilli. The Cameroon Hilli FLNG demonstrated the commercial flexibility of FLNG. A 2.4 mtpa rated vessel was contracted to monetise a restricted resource (1.2 mtpa, 8 years) underpinned by the ability to redeploy.

In 2019 BP granted a de facto supermajor seal of approval for FLNG conversion technology by contracting the Gimi (2.5 mtpa) for 20 years to be deployed in Phase 1 of the GTA project. Following the success of their initial unit Petronas introduced their second FLNG vessel, the 1.5 mtpa FLNG Dua in 2020.

Enthusiasm for FLNG waned in the mid-2010s when the industry saw Shell's travails with the implementation of Prelude, and seventeen projects which had been proposed fell by the wayside. It picked up again when in 2017 ENI took FID on the 3.4 mtpa Coral Sul FLNG unit to be utilised off Mozambique and they effectively relaunched FLNG.



FLNG Units Operating & Under Construction

Existing FLNG Projects

Country	Project	MTPA	FID	Start Up	Sponsor
Malaysia	FLNG Satu, Sarawak	1.2	2012	2016	Petronas
Australia	Prelude	3.6	2011	2018	Shell, Inpex, CPC, Cogas
Cameron	Cameron FLNG	1.2	2014	2018	SNH, Perenco
Malaysia	FLNG Dua	1.5	2014	2020	Petronas
Mozambique	Coral Sul FLNG	3.4	2017	2022	Eni, CNPC, ENH, KOGAS, Galp Energia
Congo	Tango FLNG	0.6	2020	2024	Eni
Mexico	Altamira	1.4		2024	New Fortress Energy, CFE
Senegal / Mauritania	Tortue	2.5	2018	2026	BP Kosmos
Congo	Nguya FLNG	2.4	2023	2026	Eni
		17.8			

Source - etasca LNG Database

FLNG Projects Under Construction

Country	Project	MTPA	FID	Start Up	Sponsor
Malaysia	PFLNG Tiga	2.1	2023	2027	Petronas
Gabon	Cap Lopez	0.7	2024	2027	Perenco
Canada	Cedar FLNG	3.3	2204	2028	Haisla Nation, Pembina Pipeline
Indonesia	Kasuri FLNG	1.2	2024	2026	Genting Oil & Gas
Argentina	Hilli FLNG	2.45	2025	2027	Southern Energy Partners (YPF, Pan American Energy, Pampa Energia, Harbour Energy, Golar)
Argentina	Golar MkII	3.5	2025	2028	Southern Energy Partners (YPF, Pan American Energy, Pampa Energia, Harbour Energy, Golar)
Mozambique	Coral North	3.6	2026	2028	Eni, CNP, KOGAS, ENH, XRG
		16.85			

Source - etasca LNG Database

African LNG Focus

Following the success of the Cameroun FLNG project, Africa has become somewhat the epicentre for FLNG deployment, with several projects operational and under construction, with many more in the development pipeline as FLNG became a very attractive option for early monetisation of Africa's extensive offshore gas reserves. Following the Coral Sul in Mozambique, the small 0.6 mtpa Tango FLNG in Congo, the 2.5 mtpa Tortue FLNG off Senegal/Mauritania and a second larger unit, Nguya FLNG, in Congo have all come into operation. The 0.7 mtpa Cap Lopez FLNG is currently under construction and is scheduled to go into service off Gabon in 2027. ENI also recently took FID on its second FLNG unit for Mozambique, the 3.6 mtpa Coral North project. Four FLNG projects have also been proposed in Nigeria to monetise some of its offshore gas reserves.

FLNG has become a popular option for development of African reserves, not only because many of the continent's gas fields are located offshore. In many instances the fields have been located adjacent to remote or underdeveloped areas of land which makes construction of an offshore LNG liquefaction facility challenging. Alongside this is a perception that implementing major infrastructure projects in Africa is challenging and prone to cost overrun or delays. As the FLNG vessels are fully fabricated in shipyards (almost exclusively in East Asia) with vast experience of building comparable infrastructure (such as LNG carriers or floating production, storage and offloading vessels for oil and gas), this has the perception of derisking some of the implementation aspects of a project.

Variations on a Theme

One of the biggest challenges for FLNG was integrating so many process units and storage capacity into a footprint the quarter of the size of a conventional onshore liquefaction projects whilst maintaining safety distances – these challenges partly led to Prelude's costs ballooning through design and execution. As the technology has evolved, there have therefore been variations on the fully integrated model to maintain project economics. At the Tortue project for example, the initial gas processing is undertaken on an FPSO before being sent to the FLNG unit, and the Tango FLNG unit in Congo is supported by a separate floating storage unit (FSU). In Gabon the Cap Lopez FLNG unit will be supported by the FSU Cap Lopez. Removing the gas processing system and putting it on another vessel (typically an FPSO) means the developer can also consider utilising cheaper LNG carrier conversions as their FLNG unit.



FLNG Displaces Onshore Liquefaction

The Coral Sul FLNG project in Mozambique is a good example of proving the case for FLNG. The facility was built within schedule and within budget, and has successfully operated in the ultra-deep waters of the Rovuma Basin. It also reports a liquefaction cost of \$1,062 per tonne. This is comparable or better than the liquefaction cost for many onshore liquefaction projects and has led to a number of LNG project developers electing to utilise FLNG to monetise onshore reserves rather than building a conventional onshore facility.

For example, Genting Oil and Gas's 1.2 mtpa FLNG unit in Indonesia will be fed by gas from the onshore Kasuri field. In Canada the 1.2 mtpa Woodfibre FLNG unit (plus FSU) will be moored inshore drawing on onshore gas fields as will the 3.3 mtpa Cedar FLNG at Kitimat. The much larger Ksi Lisims project will utilise two 6 mtpa FLNG barges to monetise its onshore reserves. In Argentina, YPF has sanctioned the first two of four FLNG units that will be fed from the onshore Vaca Muerta fields.

LNG Carrier Conversions

LNG carrier conversion has also proved to be a cost-efficient alternative to newbuild facilities. Projects such as Tortue/Ahmeyim FLNG, Cameroon FLNG and Southern Energy's FLNG MK II have achieved notably lower capex levels of \$640, \$500 and \$630 per tonne/year, respectively. Golar has specialised in LNG carrier conversions repurposing Moss-type LNG carriers as the vessels' modular spherical tank design, allows for simpler integration of prefabricated liquefaction modules. This further boosted interest in FLNG as these economics are far superior to those for similar sized onshore facilities.

Re-Deployable - Flexible Friend

Unlike onshore liquefaction projects FLNG units are re-deployable when their gas reserves are depleted. The Tango FLNG unit has already been re-deployed from Argentina to the Congo and the Hilli is currently being re-deployed from the Cameroon to Argentina. Petronas's PFLNG 1 started production from the Kanowit gas field in 2016 before being relocated to the Keabangan field, offshore Sabah, in March 2019.



Nguya FLNG Cong transferring its first cargo, February 2026



Tango FLNG Unit

The FLNG Champions

Development in the FLNG industry has been driven by a few companies in each area of construction, operation and technology development.



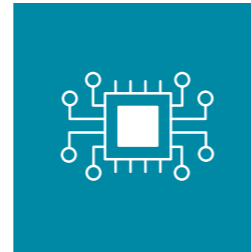
Construction

Samsung Heavy Industry (SHI) of Korea dominates new build construction and has built eight FLNG units for Shell, Petronas and ENI. Wison of China is now developing a strong position with its design, construct, commission packages.



Operators

The leading operators of FLNG are ENI with six projects and Petronas with four projects.



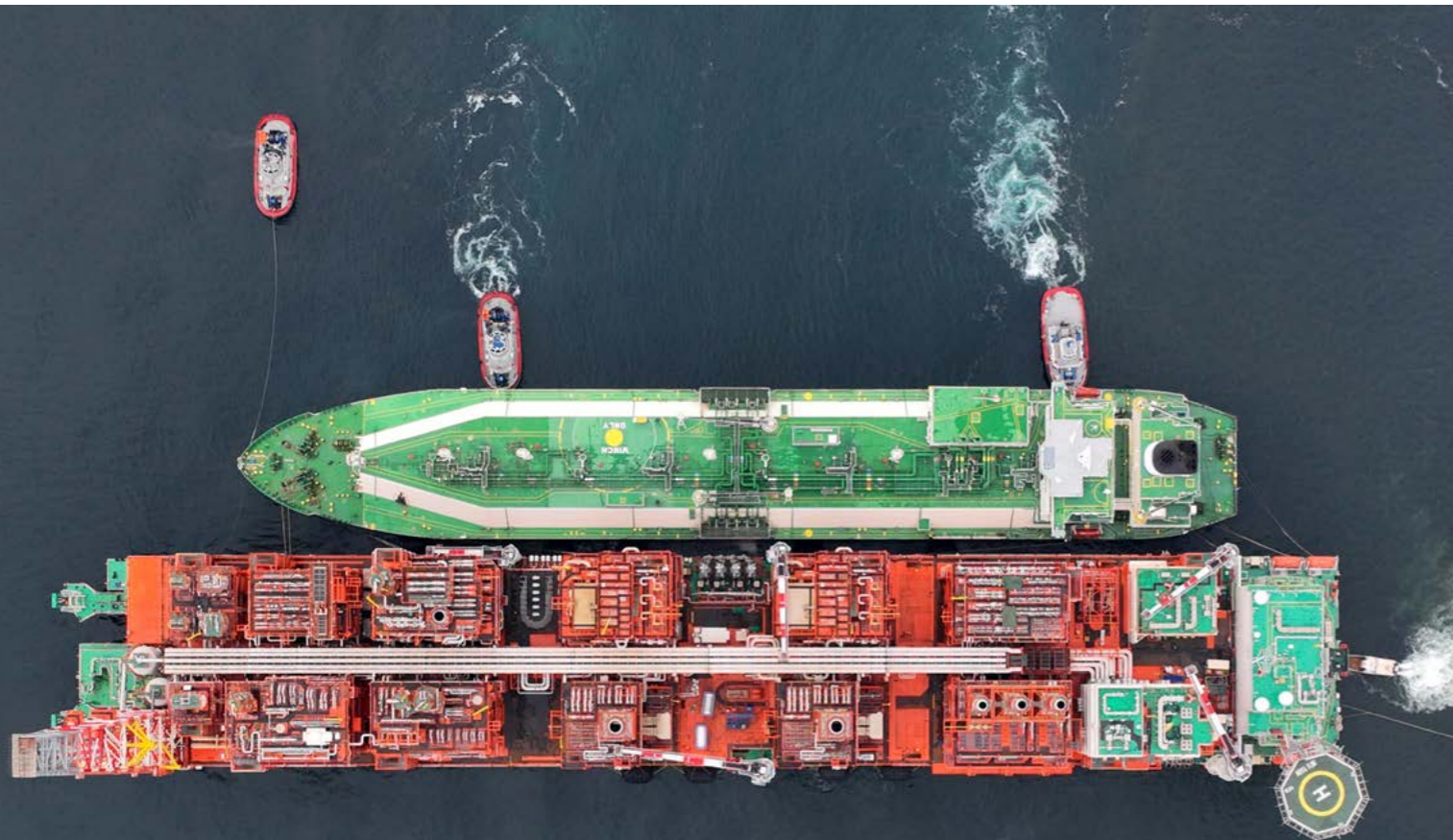
Technology

A wide range of liquefaction technology has been utilised, but Black & Veatch's Prico system dominates, having been used (or will be used) on eight projects.

Proposed FLNG Units

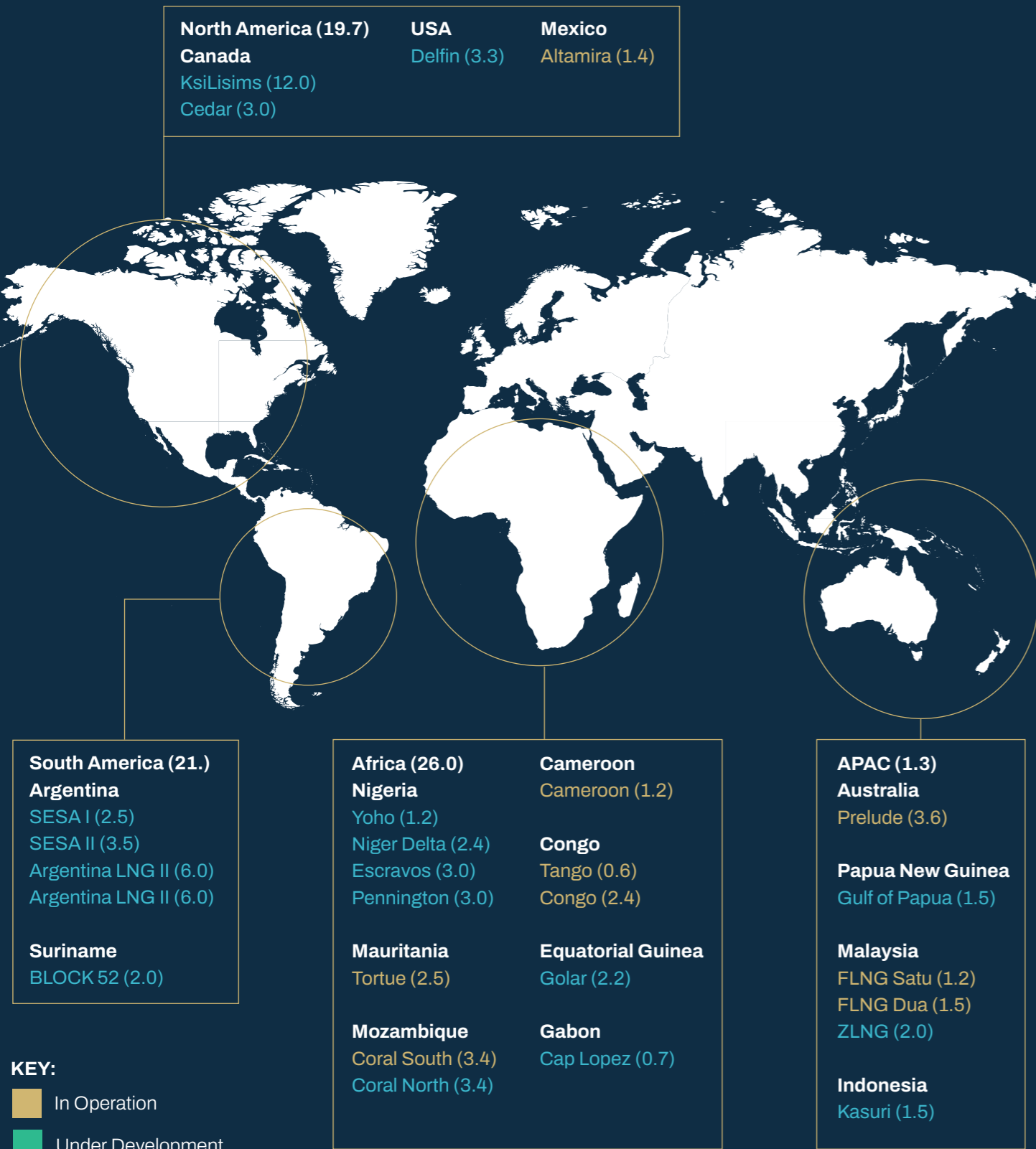
Country	Project	MTPA	FID e	Start Up e	Partners
Argentina	YPF Vaca Muerta	6	2026	2030	Argentina LNG (YPF, Eni, XRG)
Argentina	YPF Vaca Muerta II	6	2026	2030	Argentina LNG (YPF, Eni, XRG)
Canada	Ksi Lisims	12	2026	2029	Naisga Nation, Rockies LNG, Western LNG, TotalEnergies
Equatorial Guinea	EQ FLNG	2.2			Golar
Nigeria	Yoho	2.1	2026	2029	UTM, NNPC, Delta State
Nigeria	Niger Delta	2.4		2029	NNPC, Golar
Nigeria	Escravos	3			Ace Gas
Nigeria	Pennington	3			Transoceanic
Papua New Guinea	Gulf of Papua	1.5	2026		Kumul
Suriname	Block 52	2	2026		Petronas
	Louisiana	3.3	2026		Delfin
		43.5			

Source - etasca LNG Database



Renaissance and Burst of Activity

Major developments occurring in Africa and South America



Summary

After a hesitant start, FLNG has come of age and is now going through a renaissance, strongly competitive with onshore facilities for new gas liquefaction capacity, and becoming the preferred mode of liquefaction for many projects. A summary comparison of offshore vs onshore consideration is shown in the below table:

Pros & Cons - Floating Versus Onshore

	Floating LNG	Onshore LNG Plant
Project Development Stage	Shorter (1-2 years) less resistance, fewer approvals need. Fast track sometimes possible.	Lengthy – can take 5 or even ten years depending on location.
Regulatory Considerations	Faces offshore environmental regulations, but fewer land-use issues.	Must comply with land-use regulations, zoning, and environmental assessments.
Permitting	More straightforward. Well established process in place for offshore upstream development	Often challenging due to community, environmental and sustainability objections. May require government to pass new legislation.
CAPEX	Medium and coming down where existing designs can be replicated or LNG carrier conversion utilised. Risk of CAPEX overrun – contained. Can be spread over multiple fields if vessel redeployed.	High, particularly as it may also have to cover berths, pipelines, storage tanks and dredging. Modular construction can bring CAPEX down closer to FLNG. Potentially very high risk of CAPEX overrun due to project locales and interfaces.
O&M	Can be higher than onshore where the FLNG unit wishes to remain classed as a seagoing vessel (has to maintain a marine crew in addition to the plant operatives).	Relatively modest (fewer resources) and ability to schedule maintenance.
Reserves	Can utilise small, medium, large onshore and offshore reserves.	Needs large reserves (unless a small scale LNG project) proven for at least 25 years.
Construction	Done by major shipyards, almost exclusively in East Asia.	Potential challenges finding suitable EPC contractors in country. May depend on small pool of suitably experienced international EPC contractors. Timely resource mobilisation can be challenging.
Construction Risk	Medium. Built within the very controlled environment of a major shipyard.	High, particular stick-built approach in a remote area.
Technology	Sophisticated engineering and technical challenges. Smaller (but adequate) pool of proven, mature technology available) New designs, optimised for FLNG, being introduced.	Large pool of mature liquefaction technology.
Scaleability	Done by adding an additional FLNG unit or by rotating a small vessel with a larger one. Can be done fairly quickly.	Can add additional trains and storage tanks but these would be new projects with about 3 year timelines.
Flexibility	High. Mobile unit that can be quickly redeployed when reserves depleted.	Low. Fixed and cannot be moved (unless a small scale LNG unit)

Summary

Nine projects are in operation with a total liquefaction capacity of 18 mtpa and another seven projects are under construction adding another 33 mtpa of capacity. The project pipeline is fully stocked with eleven proposed projects, which if they all went ahead could add another 44 mtpa of liquefaction capacity. FLNG capacity of 7.5 mtpa in 2020 could reach almost 80 mtpa by 2030 – almost 12% of global liquefaction capacity. Africa in particular looks to remain a key location for FLNG deployment, with several projects under development in West Africa.



Operating

Nine projects
18 mtpa



Under Construction

Nine projects
36 mtpa



Proposed Projects

Eleven projects
44 mtpa



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