



Clarksons

Floating LNG

27 May 2014



David K. Jordan, Clarkson Research Services Limited
research.crs@clarksons.com



Clarksons

About Clarkson Group



Broking

Clarksons' shipbroking services are unrivalled: for the number and calibre of our brokers; breadth of market coverage; geographical spread and depth of market intelligence; analysis and support. We aspire to be best-in-class and market leaders in all key sectors.



Support

Clarkson Port Services provides the highest level of support to vessel owners, operators and charterers at strategically located ports in the UK and Egypt. Offering ship's agency services, we are also engaged in stevedoring and warehousing at UK ports and support to the Offshore industry.



Financial

From derivative products that have been pioneered at Clarksons to full investment banking services and tailored debt solutions, we help our clients manage risk and fund and conclude deals that would often be impossible via more traditional routes.



Research

Up-to-the-minute intelligence is the cornerstone of any shipping organisation and Clarksons Research Services is recognised worldwide as the market-leading provider of comprehensive and reliable maritime information.



Clarksons

Clarkson Research Services Limited



Shipping and trade

Market leaders in providing timely and authoritative information on all aspects of shipping. Data is available on over 100,000 vessels either in service or on order, 10,000 companies and 600 shipyards as well as extensive trade and commercial data, and over 100,000 time series.



Offshore and energy

The leading provider of data to the offshore industry for more than 30 years. Providing clients with the key information they need to operate their business more effectively. Market intelligence is available on more than 25,000 structures, vessels and companies and 6,000 oil and gas fields.



Valuations

The world's leading provider of valuations to the shipping industry and financial community. More than 20,000 valuations are handled annually, covering the full range of vessel types.



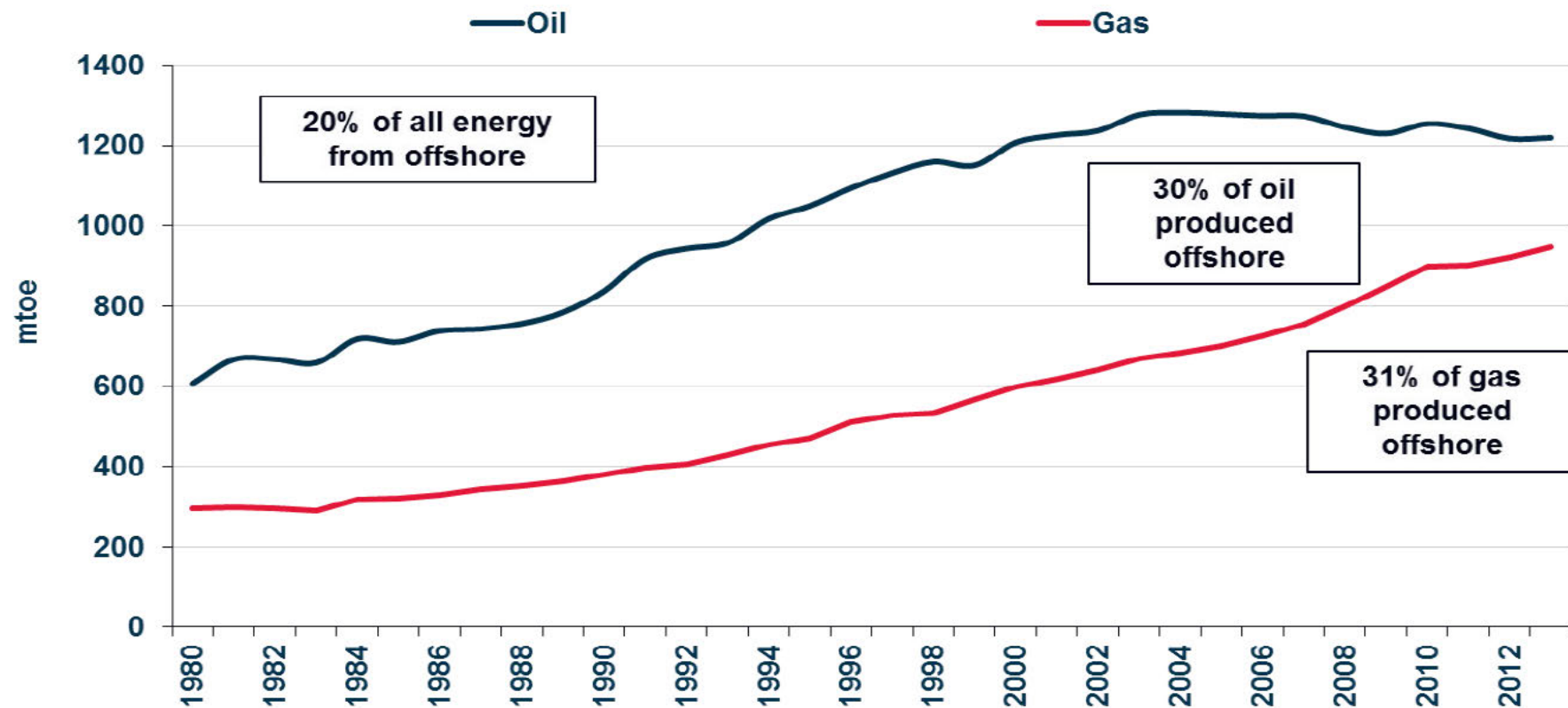
Clarksons

Offshore





Offshore Energy within the Global Context

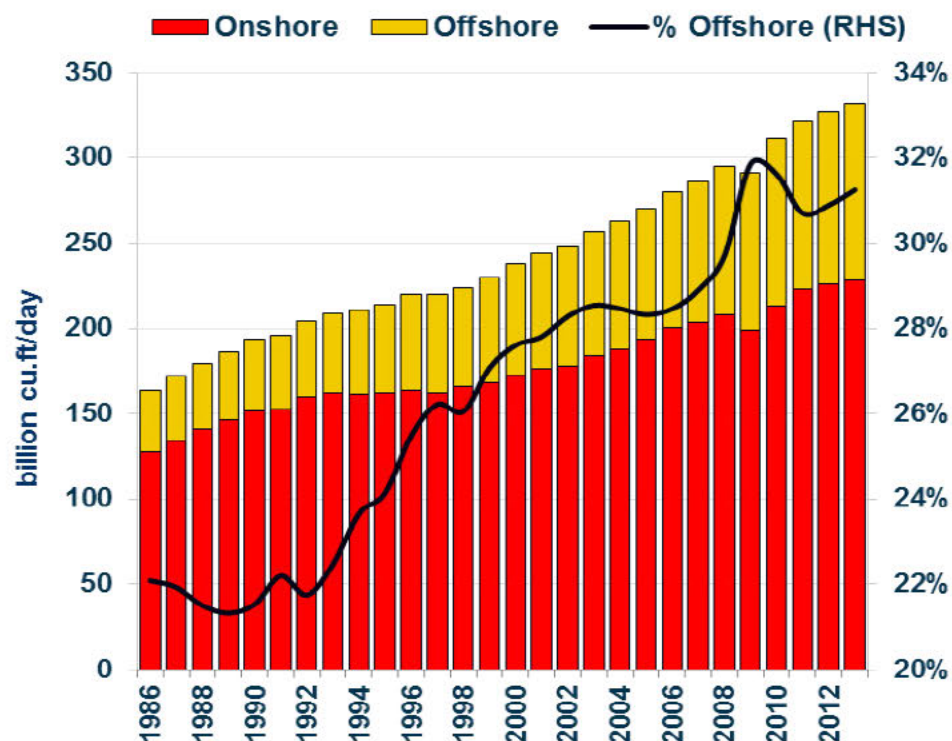




World Gas Production

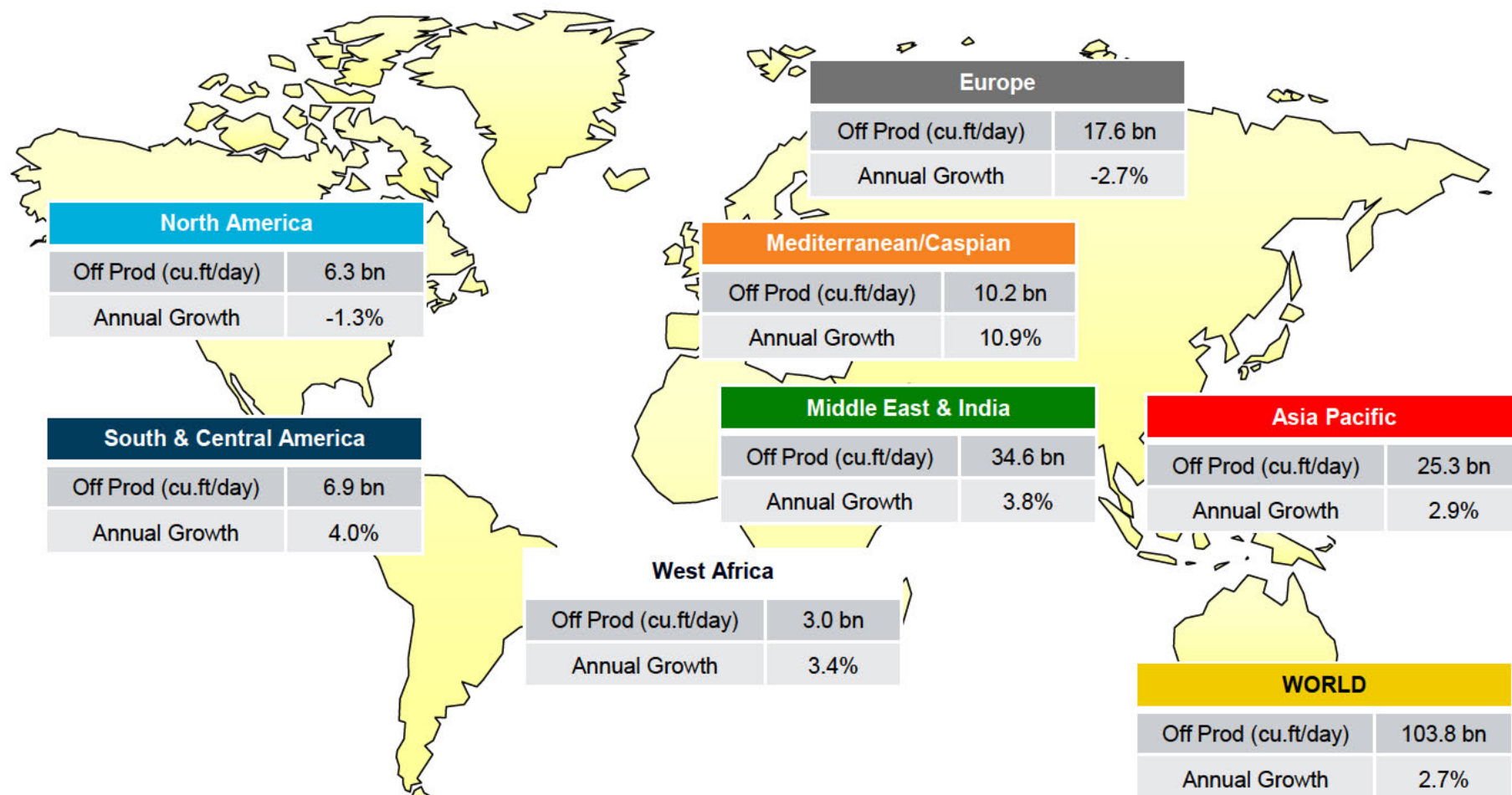
- In 2013, global gas production is estimated to have reached 332.2 billion cu.ft/day.
- In recent years, there have been large increases in total gas production in Africa, the Middle East and the Mediterranean.
- Gas produced offshore is accounting for an increasing percentage of the total. In 1980, 32.4 billion cu.ft/day was produced offshore – just over 20% of the total. By 2013, this figure had risen to 103.8 billion cu.ft/day – 31.3% of the total.

World Gas Production





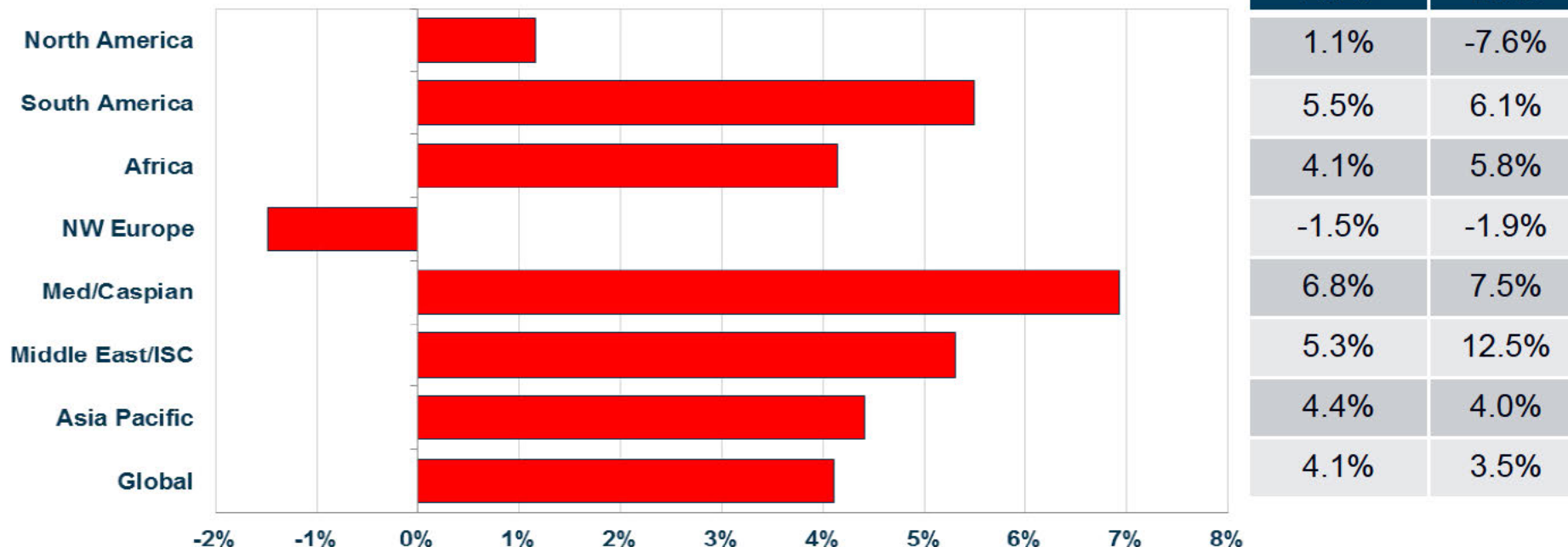
World Offshore Gas Producing Regions (2013)





World Offshore Gas Production by Region

CAGR in Offshore Gas Production, 2013-2023



Major Gas Growth Areas

Middle East: Further stages of project development in the South Pars/North Dome complex (**risk:** dependent on Iran)

Asia-Pacific: Driven by large remote NW Australian field start-ups (Browse, Canarvon, Bonaparte basins)

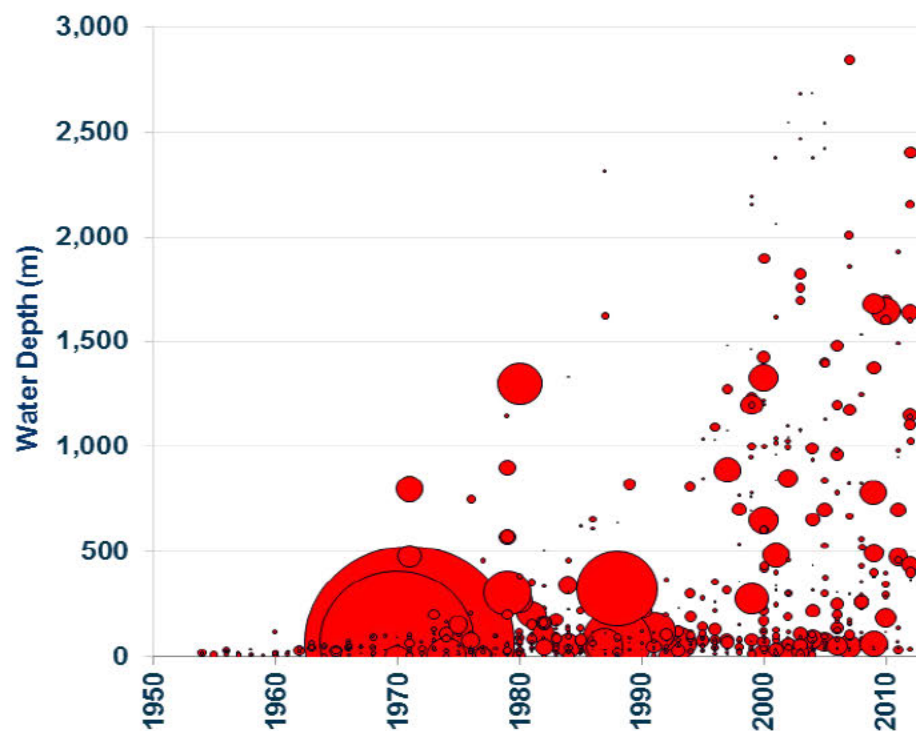
Eastern Mediterranean: Recent deep discoveries off Israel & Cyprus

Africa: Recent deep discoveries off Mozambique and Tanzania

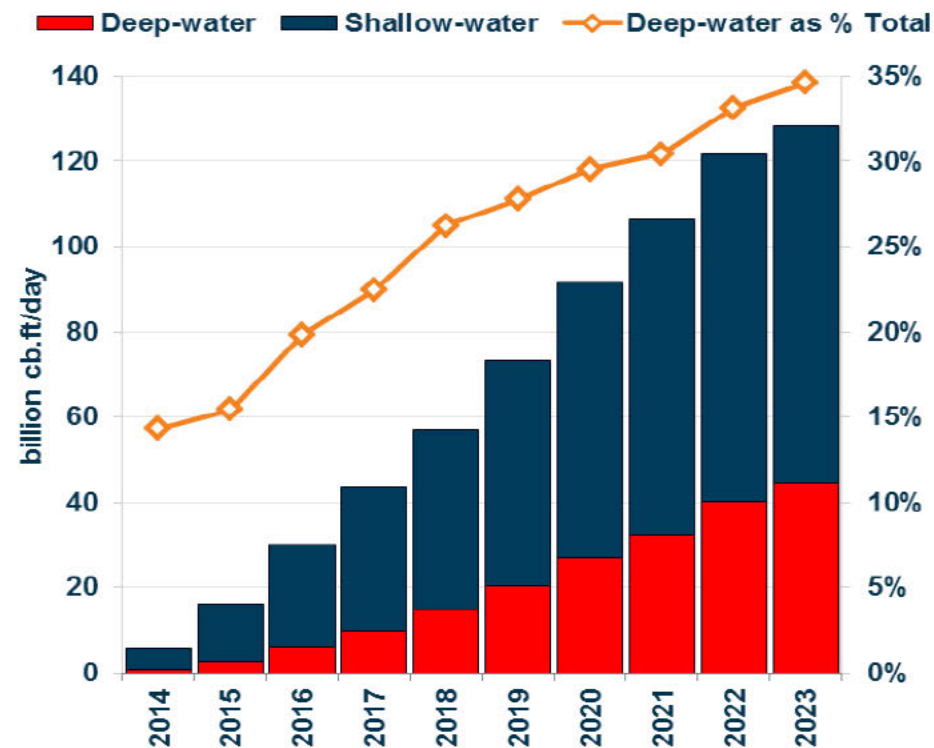


Major Trend (1): Deeper Offshore Gas Fields

Offshore Gas Discoveries by Depth



Additional Offshore Gas Prod from Start Ups

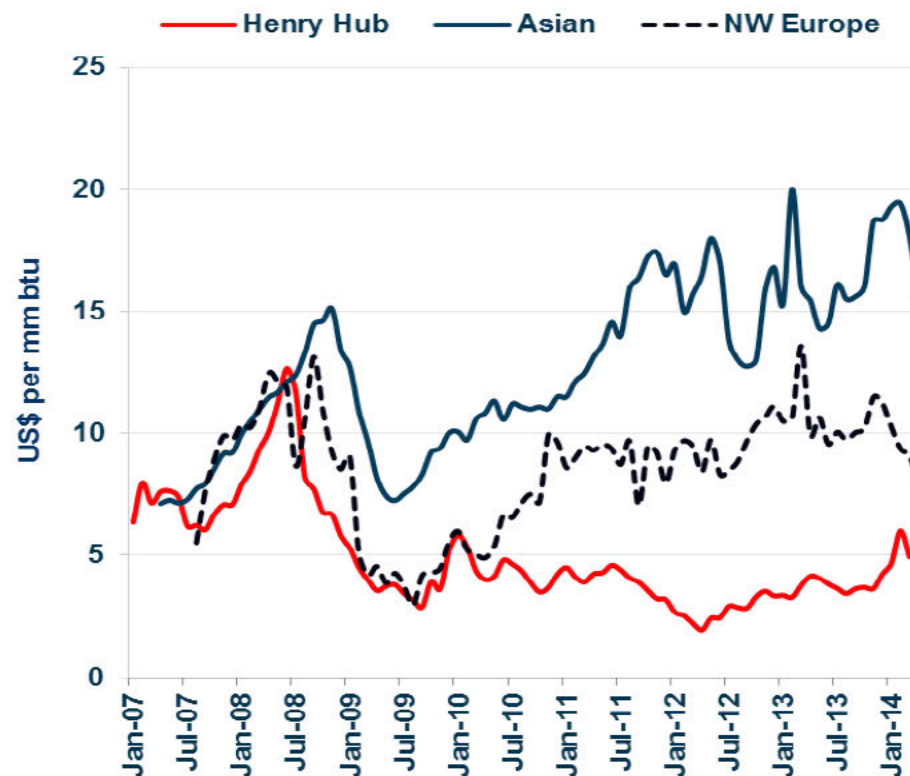




Major Trend (2): Gas Prices

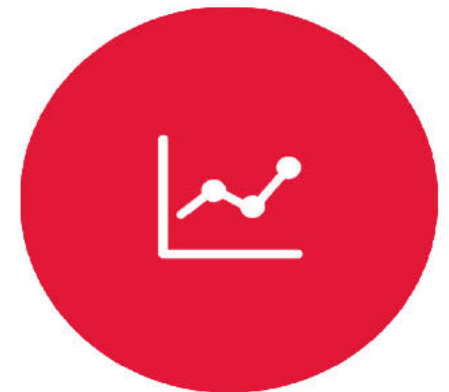
- Unlike oil, gas has yet to develop a global commodity market.
- Shale gas has made US gas much cheaper though. European supplies have also become cheaper as more LNG competes with Russian pipeline gas.
- Long-term LNG contract prices used to be benchmarked to oil (this is still common in Asia, dark blue line on chart)
- If the latter case, offshore developments including FLNG could become less attractive.

Natural Gas Prices





(Floating) LNG





Clarksons

The LNG Logistics Chain



Production

Pipeline

Liquefaction

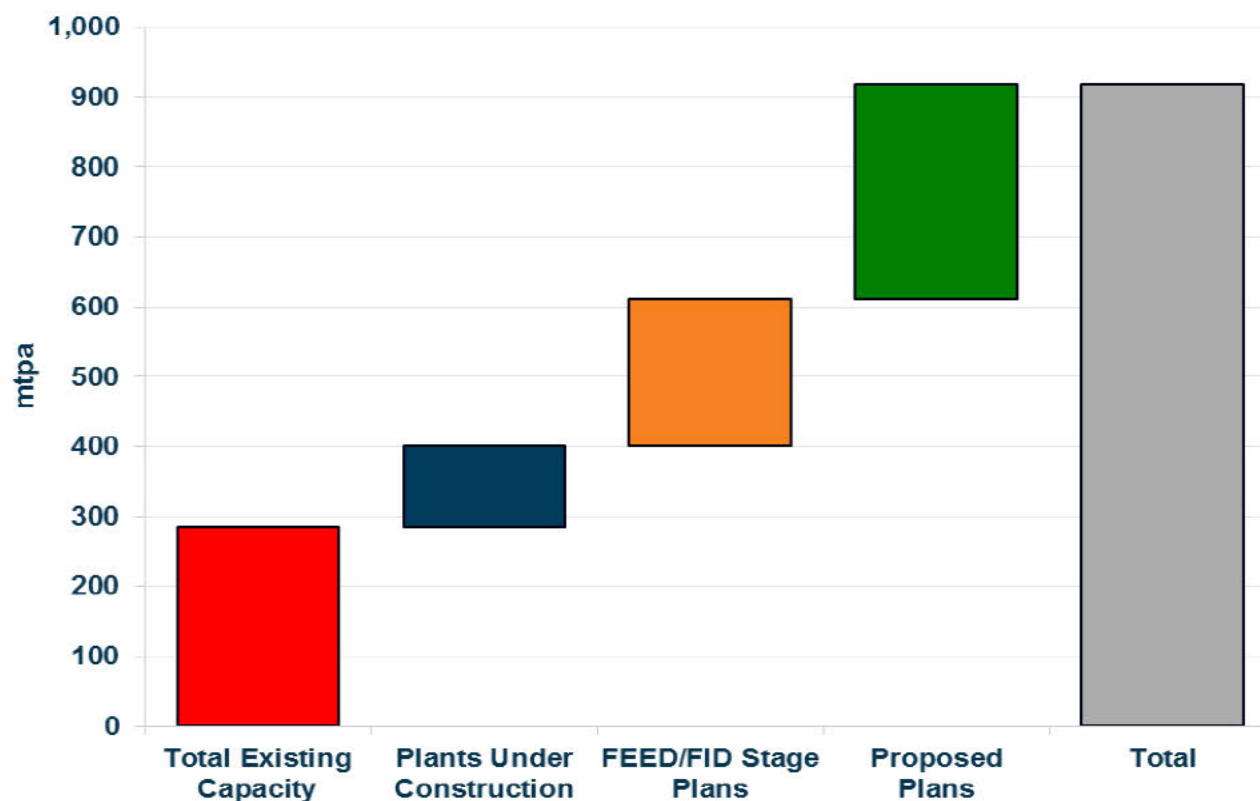
Shipping

Terminalling &
Regasification

Distribution



Development of Liquifaction Capacity, 2013-2021



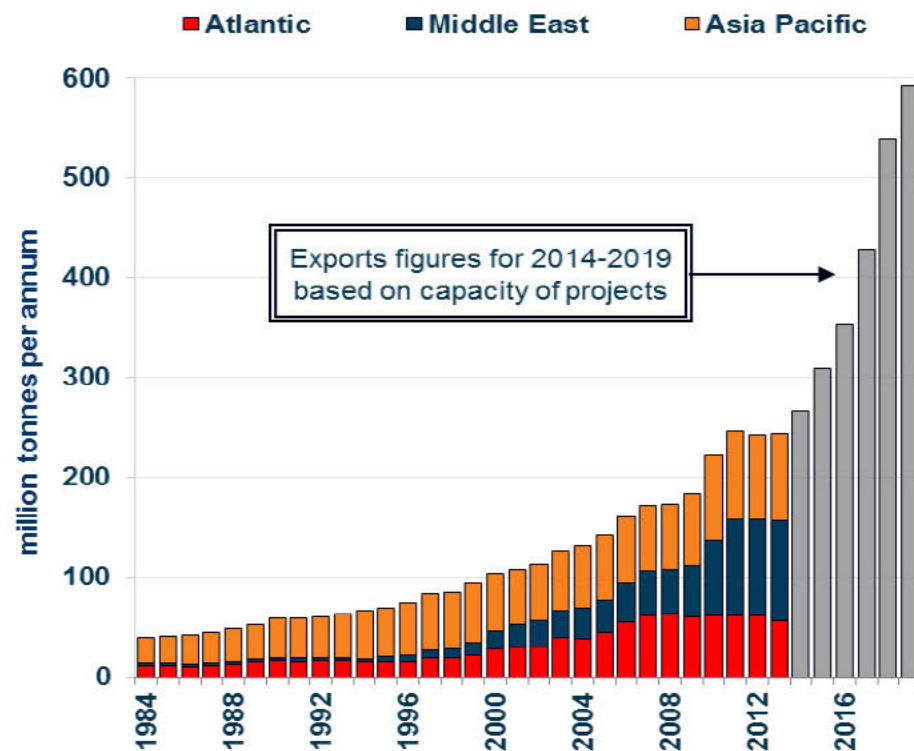
No. Projects	57	17	26	46	146
Capacity (mtpa)	286	115	211	307	c. 920



LNG Capacity

- 17 countries with LNG liquefaction infrastructure (89 liquefaction trains) at the start of 2014.
- Total production is currently estimated at 286 mtpa.
- Utilisation is estimated to average 80% in 2013.
- Just over 20 mtpa of capacity expected to come online in 2014.
- 30% of new capacity (97mtpa) to come on stream will be in the US – predominantly in 2017/2018

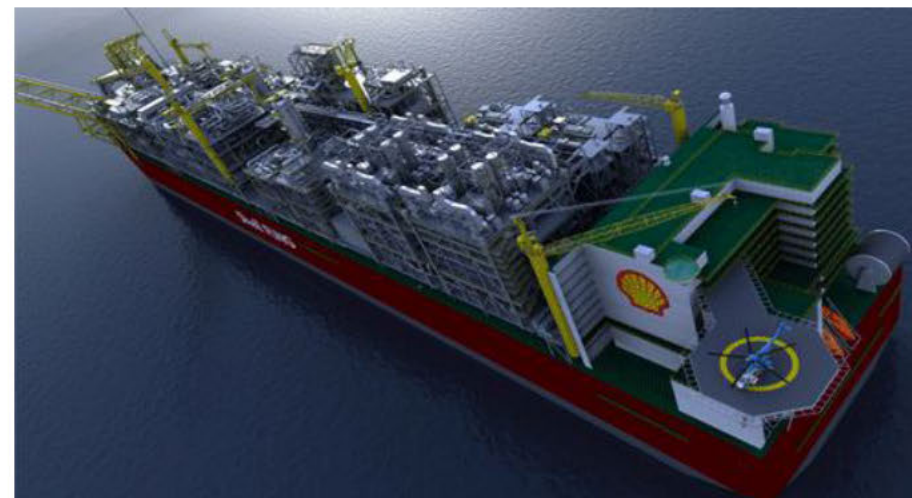
World LNG Exports





What is Floating LNG?

Floating LNG: Essentially a gas FPSO. A means to enable the production and export of gas from offshore fields which would otherwise be non-viable, e.g. “stranded” gas fields some distance from shore or established pipeline infrastructure. The majority of the units in the planning process so far. Capital investment is significant.



Floating Storage & Regasification Units: These are offloading units, analogous to the trans-shipment vessels which exist in bulk trades. Some units are designed to retain more ability to move location, thus serving countries like Kuwait where gas import demand is seasonal. Others are more permanently moored as a solution to reduce the cost or space issues of LNG Regas.



Clarksons

The **F** LNG Logistics Chain



Production

Pipeline

Liquefaction

Shipping

Terminalling &
Regasification

Distribution

FLNG



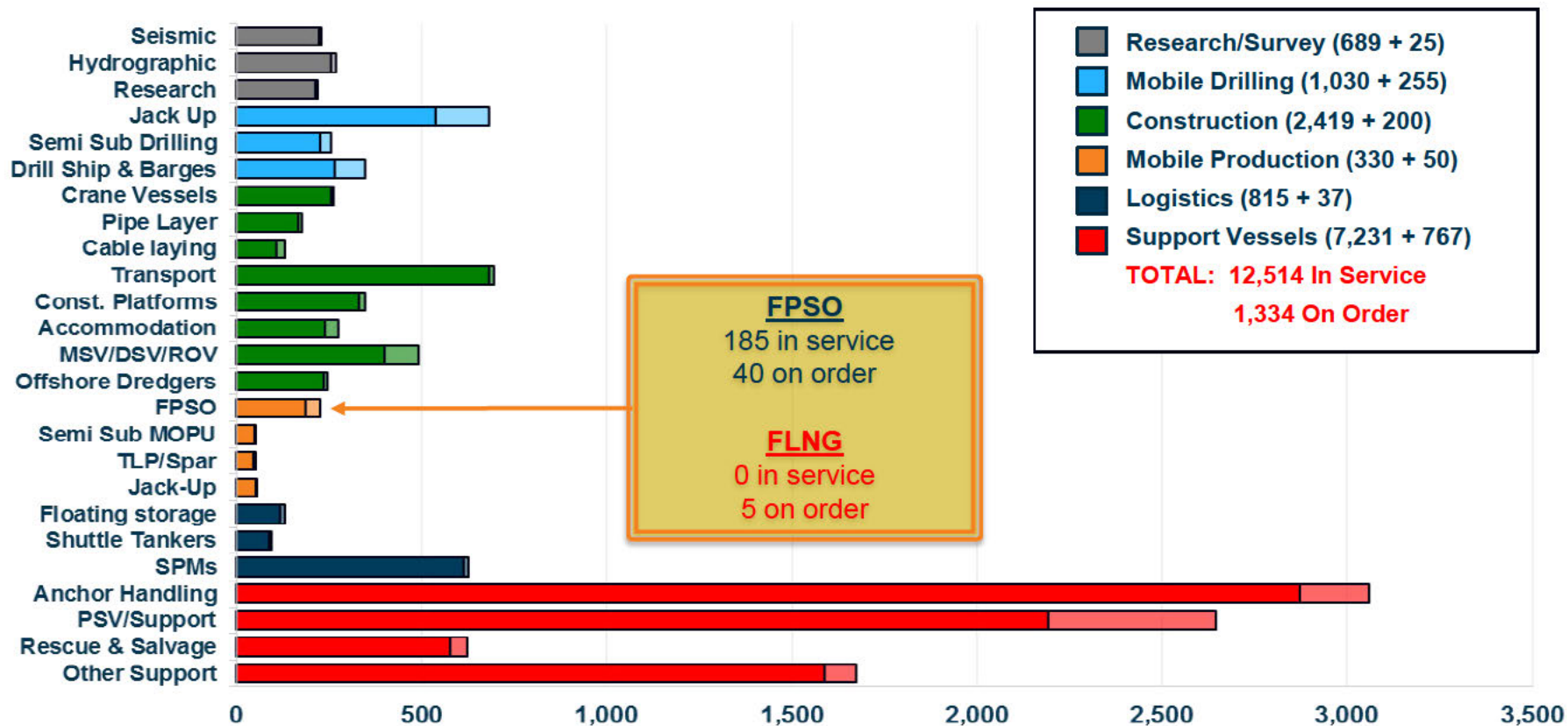


Small- vs. Large-Scale Floating LNG

Characteristic	Large-Scale FLNG	Small-Scale FLNG
Liquefaction Capacity:	3.0 – 7.0 mtpa	< 3.0 mtpa
Required Reserves:	> 3.0 Tcf	0.5 – 3.0 Tcf
Storage Capacity:	> 250,000 cbm	< 220,000 cbm
Liquefaction Processes:	Baseload-type processes (e.g. Dual MR, Mixed fluid cascade)	Simpler processes (e.g. Single mixed refrigerant processes, dual expander processes)
Employment:	Use avoids long distances submerged pipelines to shore	Stranded gas reserves that would be inadequate to support a traditional baseload LNG project
Participants	Remain domain of industry's established oil company participants	Requires less sponsor resources, broadening range of developers, concepts, vendors and construction resources
Examples:	Shell Prelude	Flex LNG



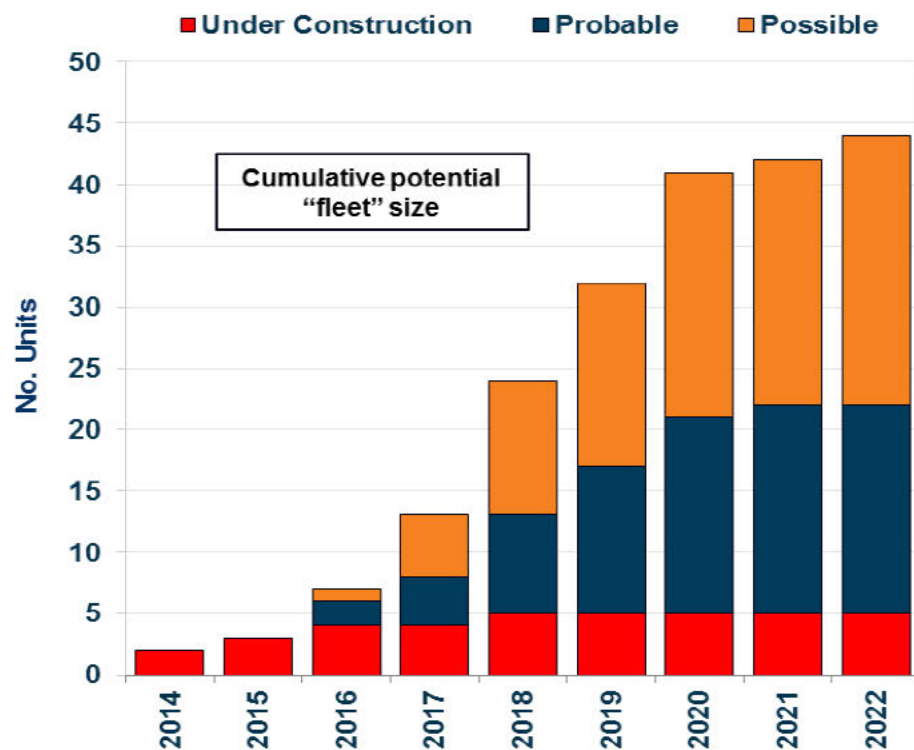
FLNG and the Offshore Fleet & Orderbook



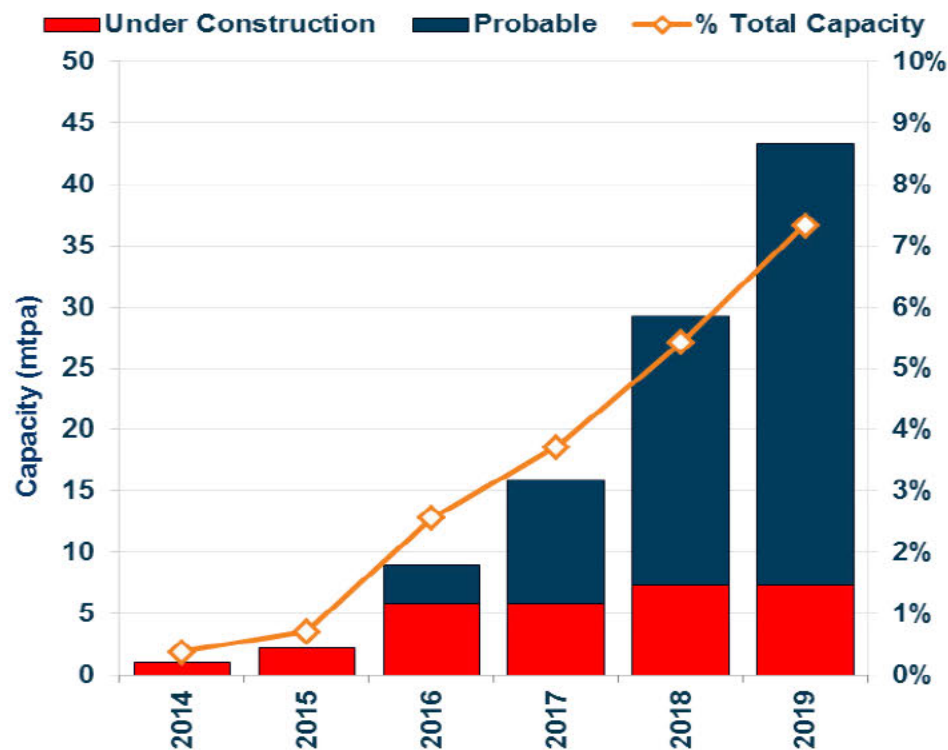


FLNG Projections

FLNG Project Projections



FLNG Project Capacity Projections





Why FLNG?

- Demand for natural gas is growing rapidly, particularly in Asia. Majority of prospective FLNG projects are in the Asia/Pacific region.
- Offshore gas fields are increasingly being discovered far from land, in deeper environments and harsher and more difficult conditions.
- In some situations FLNG can offer a cost effective solution to the question of extracting and delivering such gas to market, rather than using an onshore solution.
- LNG transport has an established track record in providing a logistical solution to moving volumes over long distances.



FLNG Risks

FLNG Technology

- FLNG is an unproven technology – any issues with the start-up of the first units in service could impact how widespread the technology becomes.
- Delays, postponement or cancellation of projects are a feature of the industry, given the resource constraints, technical challenges and high CAPEX involved.

Broader Risks

- Wider geopolitical and economic concerns.
- Development of onshore shale reserves and the effect this would have on commodity prices. If US regulators allow large-scale exports of shale gas, this could depress prices, which would make FLNG less attractive. However, the US government expects shale oil and gas growth to peak there by 2018 and outside of the United States, the extent to which shale technology will be adopted is uncertain.
- Switch to renewable resources.



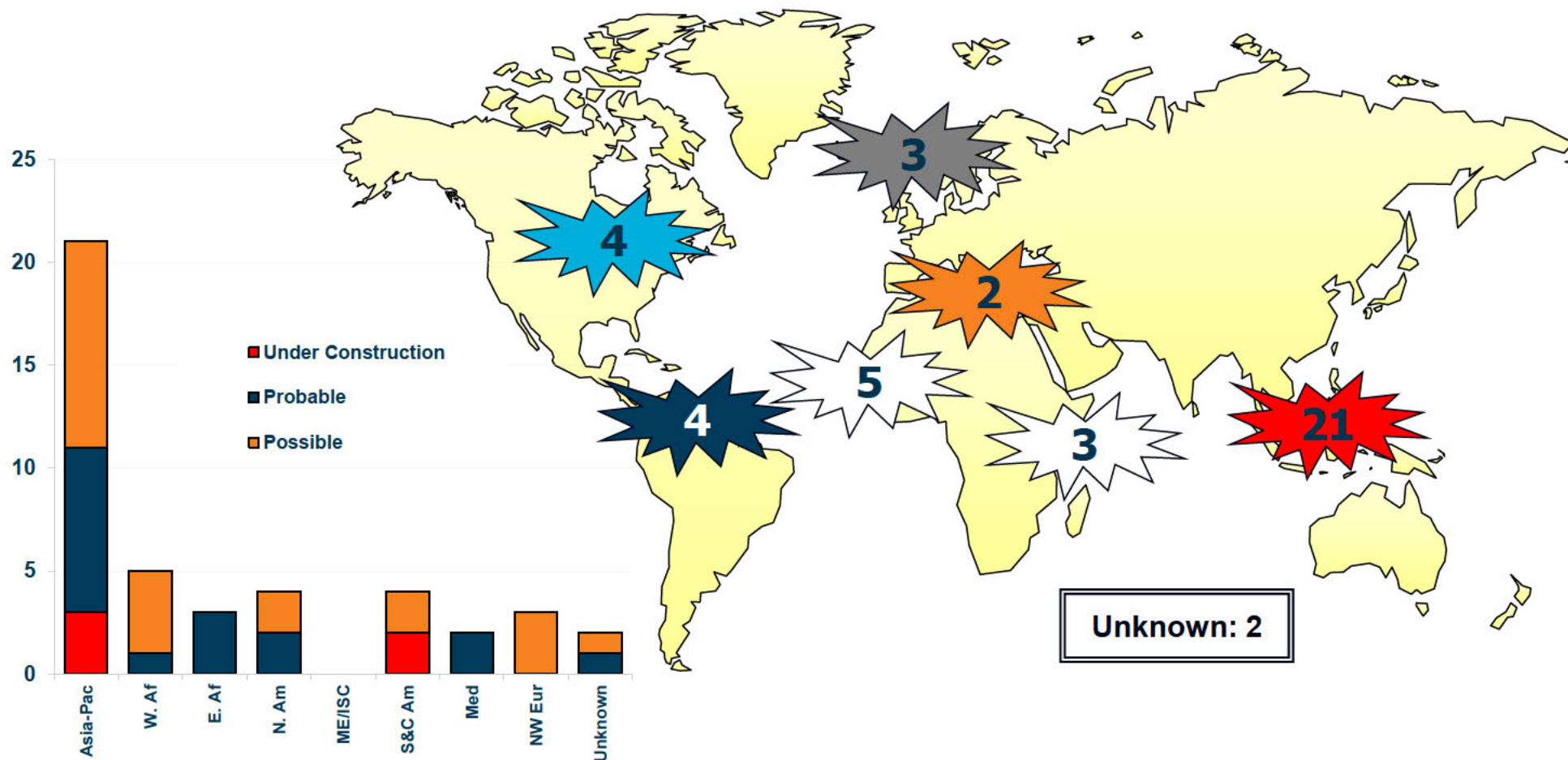
Clarksons

FLNG Projects





Future FLNG Deployment





FLNG Projects - Under Construction

FLNG Project	Field	Country	Build Date	Distance from Shore (km)	Operator
Shell Prelude FLNG	Prelude	Australia	2016	210	Shell
PFLNG-1	Kanowit	Malaysia	2015	162	Petronas Carigali
PFLNG-2	Rotan	Malaysia	2018	112	Murphy Sabah
Exmar FLNG Barge	La Crescente	Colombia	2014	Shoreside	Exmar Offshore
Exmar FLNG Barge 2	La Crescente	Colombia	2014	Shoreside	Exmar Offshore

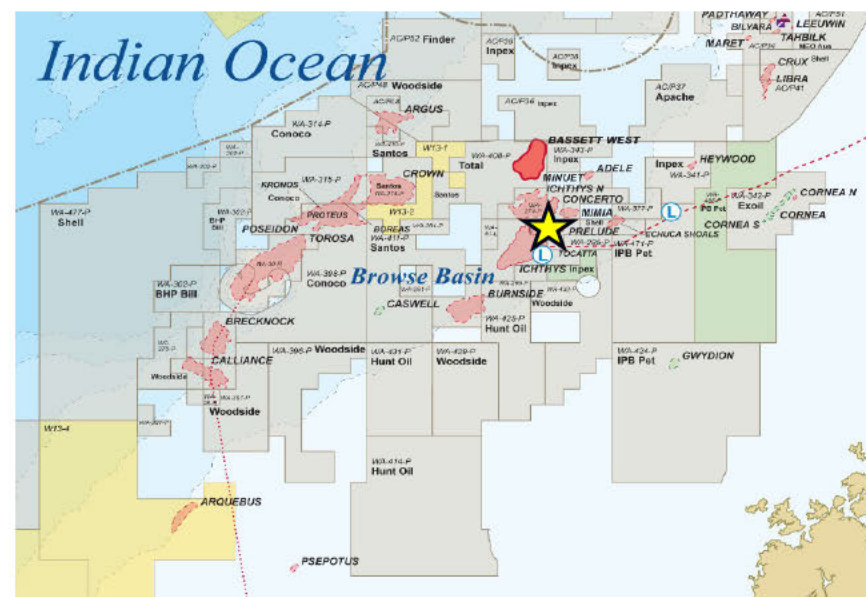
The majority of under construction and proposed FLNG projects are means of rendering exportable 'stranded' gas fields far from existing infrastructure - hence most are a large distance from shore.



Prelude FLNG – A World's First

Summary Table

Field	Prelude, Australia
Distance from Shore (km)	210
Water Depth (m)	217
Lead Company	Royal Dutch Shell
Total CAPEX (US\$ bn)	12.0 (est)
Current Status	EPC
FID	May 20, 2011
Start Up	Late 2016 - Early 2017
Capacity (mtpa)	5.3 (3.6 LNG; 1.3 Cond.; 0.4 LPG)



Key Developments

- A remote field, with reserves too small to justify conventional pipeline infrastructure and onshore processing.
- First steel was cut in October 2012; the keel was laid in May 2013 and floated in December 2013.
- FPSO-LNG production system awarded to Technip Samsung Consortium in July 2012.
- Noble began drilling 7 wells in September 2013 using semi-sub drilling unit. Est. completion early-2015.



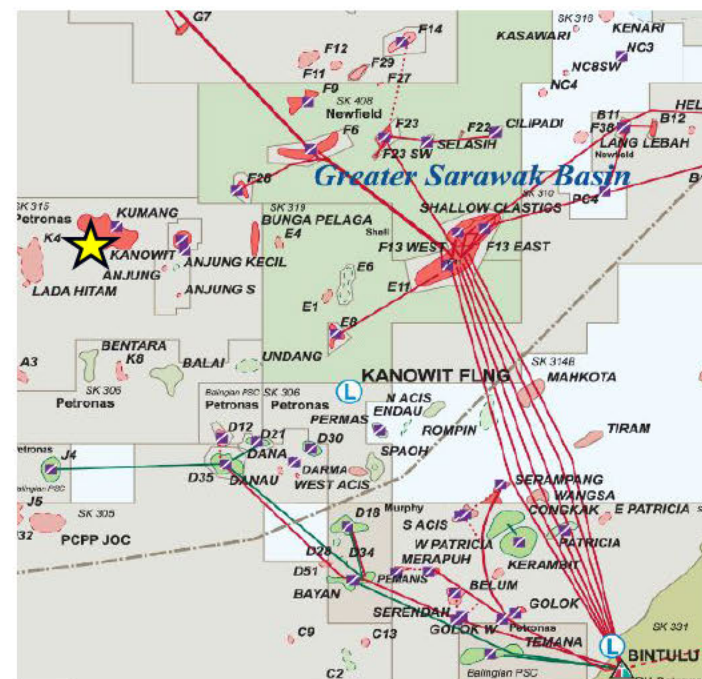
Petronas FLNG 1

Summary Table

Field	Kanowit, Sarawak
Distance from Shore (km)	162
Water Depth (m)	80
Lead Company	Petronas Carigali Sbn Bhd
Total CAPEX (US\$ bn)	4.0 (est)
Current Status	EPC
FID	April 2012
Start Up	4Q 2015
Capacity (mtpa)	1.2

Key Developments

- Attempt by Petronas to monetise its upstream stranded gas assets without the need for fixed infrastructure.
- Steel cutting began in June 2013, keel-laying began on 6th January 2014 and the hull was launched in April 2014. It has been named the “PFLNG SATU”.
- FPSO-LNG production system awarded to Technip-DSME Consortium in June 2012.

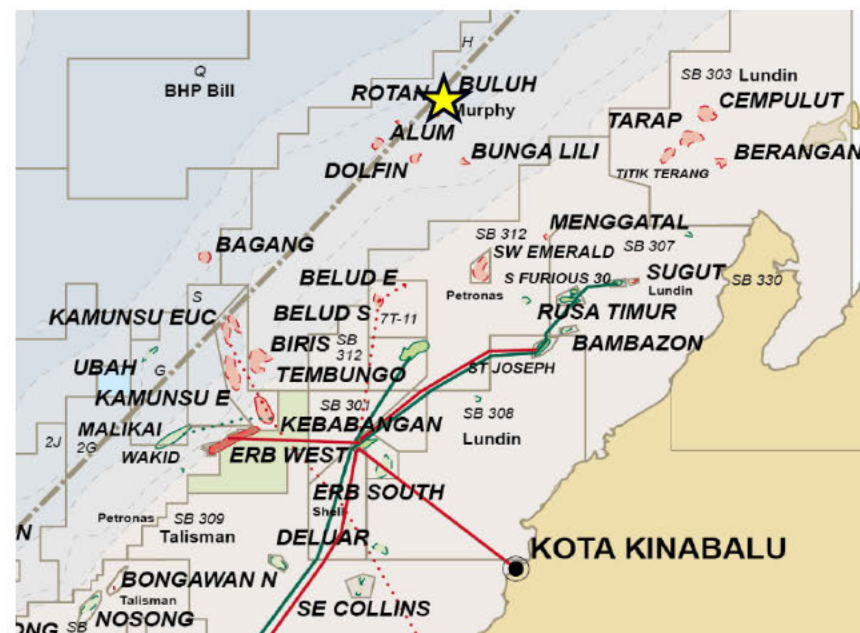




Petronas FLNG 2

Summary Table

Field	Rotan, Alum, Bemban, Buluh, Sabah
Distance from Shore (km)	112
Water Depth (m)	1,150
Lead Company	Murphy Sabah Oil Co. Ltd (60%); Petronas Carigali Sbn Bhd (40%)
Total CAPEX (US\$ bn)	4.5
Current Status	EPC
FID	January 23, 2014
Start Up	Early 2018
Capacity (mtpa)	1.5



Key Developments

- FLNG unit designed with a view to relocate in the future.
- Project experienced slight delays due to changes in design specifications for vessel during FEED.
- Project fully sanctioned towards the end of January 2014
- Petronas awarded the EPC contract to a partnership of Japan's JGC and South Korea's Samsung H.I. in mid-February 2014.



Exmar FLNG Barge

Summary Table

Field	La Creciente, Colombia
Distance from Shore (km)	Shoreside
Water Depth (m)	Shoreside
Lead Company	Pacific Rubiales Energy Corp.
Total CAPEX (US\$ bn)	0.6
Current Status	EPC
FID	January 2012
Start Up	2Q 2015
Capacity (mtpa)	0.5 per barge

Key Developments

- Small scale FLNG project deploying two FLNG barges. Unlike the other projects under construction, it is not intended to rescue remote offshore gas fields.
- Barges will be moored on the Caribbean coast, connected via pipeline to the Colombian onshore La Creciente gas field (88 km onshore; 3km subsea).
- 5 year purchase and sale agreement for LNG agreed with Gazprom in November 2013; topside integration started in December 2013.





FLNG Projects – Probable

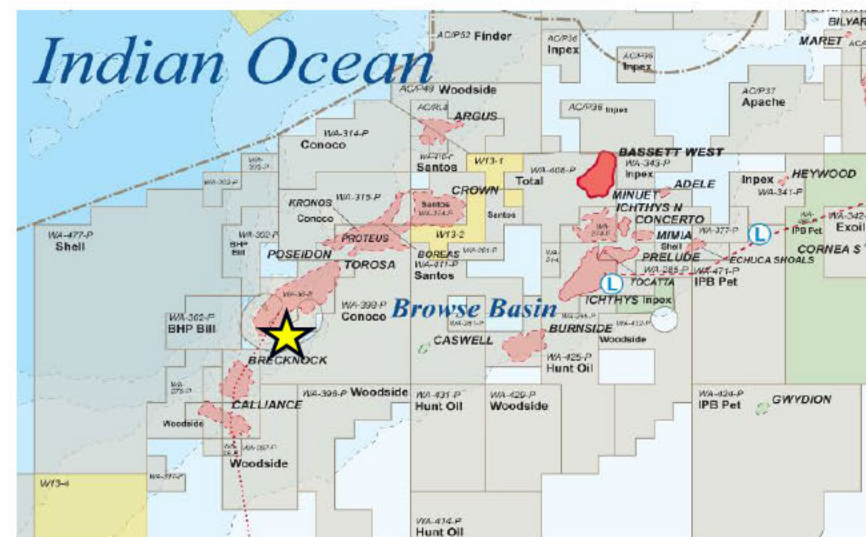
FLNG Project	Field	Country	Build Date	Distance from Shore (km)	Operator
Abadi FLNG	Abadi	Indonesia	2019	102	INPEX Masela
Area 4 Mamba FLNG 1	Mamba North	Mozambique	2020	49	ENI
Area 4 Mamba FLNG 2	Mamba South	Mozambique	2020	48	ENI
BC LNG Canada FLNG Barge	Douglas Channel	Canada	2016	Shoreside	Exmar
Bonaparte FLNG	Petrel	Australia	2020	158	GDF Suez
Browse FLNG 1	Brecknock	Australia	2017	259	Woodside Energy
Browse FLNG 2	Calliance	Australia	2018	247	Woodside Energy
Browse FLNG 3	Torosa	Australia	2019	285	Woodside Energy
Coral FLNG	Coral	Mozambique	2020	65	ENI
Fortuna Complex FLNG	Fortuna	Equatorial Guinea	2018	91	Ophir Energy
Golar FLNG	Unknown		2016		Golar LNG
Lavaca Bay FLSO	Unknown	United States	2019	Shoreside	Excelerate Energy
Leviathan FLNG	Leviathan	Israel	2020	126	Noble
Pandora FLNG	Pandora	Papua N. Guinea	2018	148	Cott Oil and Gas
PNG Petromin FLNG	Unknown	Papua N. Guinea	2019		Petromin PNG
Scarborough FLNG	Scarborough	Australia	2021	236	ExxonMobil
Tamar Israel FLNG	Tamar	Israel	2017	94	Noble Energy



Browse FLNG

Summary Table

Field	Brecknock, Calliance, Torosa
Distance from Shore (km)	285
Water Depth (m)	750
Lead Company	Woodside Energy Limited
Total CAPEX (US\$ bn)	30.0
Current Status	FEED
FID	1Q 2015
Start Up	2018
Capacity (mtpa)	3 x 3.5



Key Developments

- Original, conventional design concept for field was shelved in April 2013 following cost escalations. Replaced by phased FLNG project for a total of 3.5 mtpa vessels.
- Woodside signed an agreement with Shell in 2Q 2013 to use their technology, substantially reducing FEED requirements and time to FID.
- Agreement to proceed with design work given by JV partners in September 2013.

Scarborough/Thebe FLNG

Summary Table	
Field	Scarborough, Thebe
Distance from Shore (km)	280
Water Depth (m)	1,173
Lead Company	ExxonMobil Corp.
Total CAPEX (US\$ bn)	20.0
Current Status	Pre-FEED
FID	4Q 2014 – 1Q 2015
Start Up	2020-2021
Capacity (mtpa)	6-7

Key Developments

- Scarborough gas field has an expected producing life of 25-35 years – FLNG considered the best option for development.
- Project anticipated to utilise a 6-7 mtpa vessel.
- FID delayed to 2014-2015 due to engineering studies.

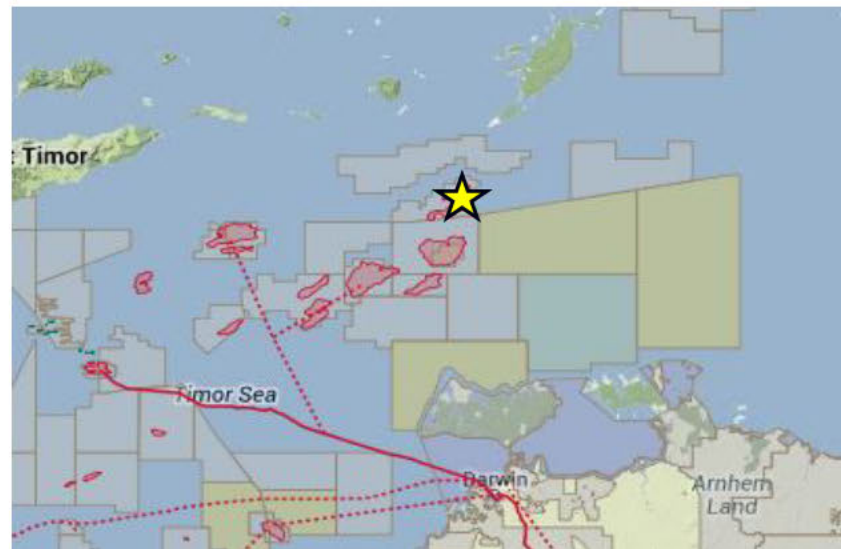




Abadi FLNG

Summary Table

Field	Masela PSC
Distance from Shore (km)	102
Water Depth (m)	650
Lead Company	Inpex Corporation (65%); Royal Dutch Shell (35%)
Total CAPEX (US\$ bn)	20.0
Current Status	FEED
FID	4Q 2014
Start Up	2019
Capacity (mtpa)	2.5



Key Developments

- The vessel is expected to use Shell's FLNG technology
- INPEX and Shell have awarded two contracts for the FEED of the FLNG unit in January 2013; one to JGC and one to Saipem Indonesia.
- FEED due for completion in late 2014; the winner will automatically be awarded the EPC contract.



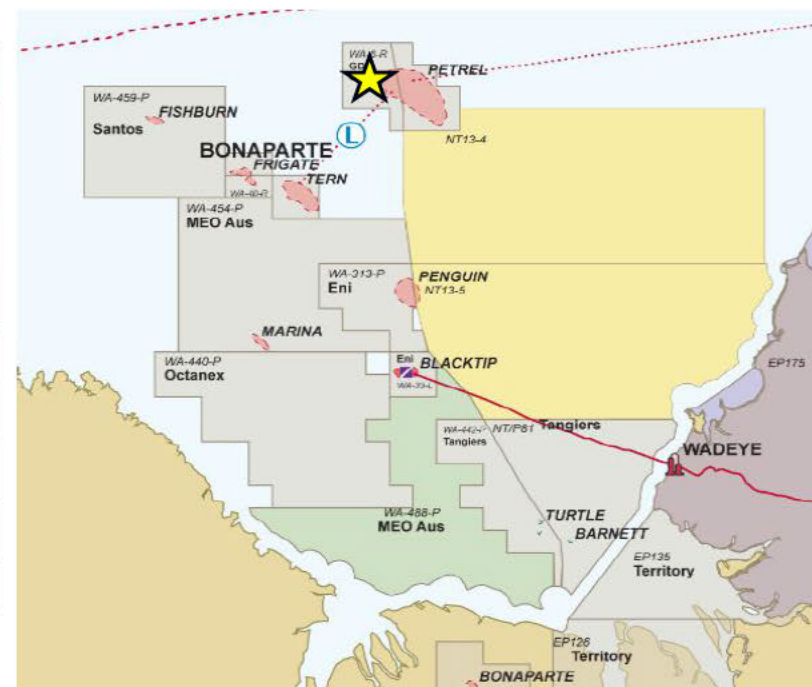
Bonaparte FLNG

Summary Table

Field	Petrel, Tern, Frigate
Distance from Shore (km)	158
Water Depth (m)	98
Lead Company	GDF Suez (60%); Santos Ltd (40%)
Total CAPEX (US\$ bn)	4.8
Current Status	Pre-FEED
FID	2015
Start Up	2018-2019
Capacity (mtpa)	2.4

Key Developments

- Development planned to exploit previously stranded gas fields.
- The FLNG proposal is for a vessel that is capable of producing 2.4 mtpa of LNG.
- Pre-FEED completed in 3Q 2013. Following reports that FEED would begin in 1Q 2014, this has now been revised to “sometime in 2014” following unspecified delays.
- CAPEX could be substantially higher based on proposed LNG production capacity.





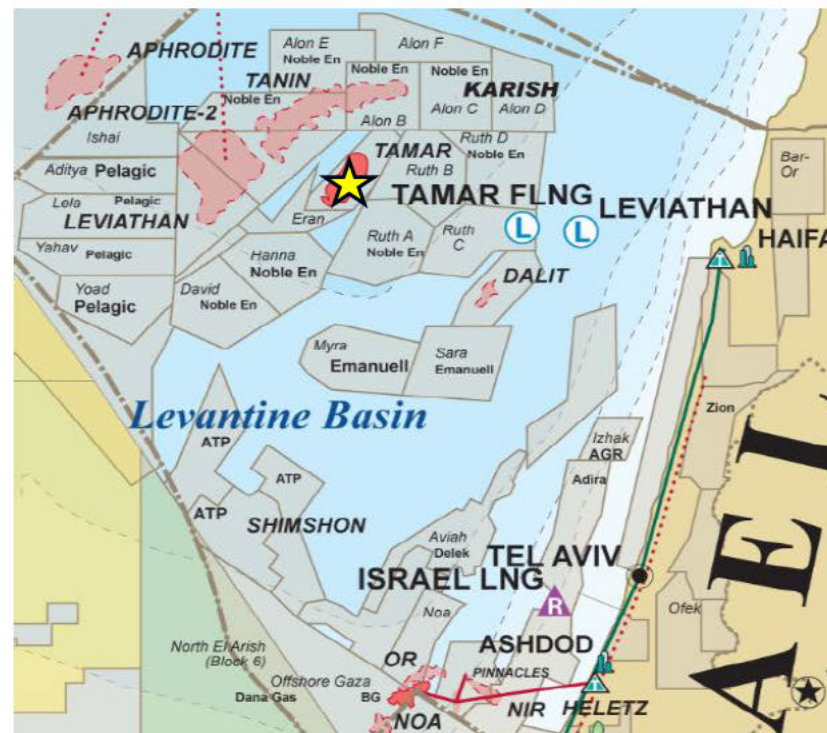
Tamar FLNG

Summary Table

Field	Tamar and Dalit (off Israel)
Distance from Shore (km)	280
Water Depth (m)	1,677
Lead Company	Noble Energy Mediterranean Ltd.
Total CAPEX (US\$ bn)	10.0
Current Status	FEED
FID	2014
Start Up	2018
Capacity (mtpa)	3.4

Key Developments

- Pre-FEED completed in February 2012 and Levant LNG Marketing and Pangea LNG BV have been awarded the FEED contract.
- Daewoo Shipbuilding likely to be awarded contract to build FPSO-LNG vessel
- Vessel to be owned and operated by Hoegh LNG
- Gazprom signed a 20 year sales agreement in February 2013 should the FLNG development go ahead. In May 2014, they went out to owners to tender for term charters.





FLNG Projects – Possible (1)

FLNG Project	Field	Country	Build Date	Distance from Shore (km)	Operator
Acme FLNG	Acme	Australia	2017	83	Chevron Australia
Arnhem/Pinhoe FLNG	Arnhem	Australia	2019	290	Chevron WA-364-P
Block 22/NCMA 4 FLNG	Unknown	Trinidad	2017		Centrica
Bumi FLNG	Unknown	Equatorial Guinea	2017		
Caldita/Barossa FLNG	Barossa	Australia	2018	157	Conoco Australia
Cambridge Energy FLNG 1	FSO	United States	2018	Mississippi River	Cambridge Energy
Cambridge Energy FLNG 2	FSO	United States	2018	Mississippi River	Cambridge Energy
Cash Maple/Oliver FLNG	Cash-Maple	Australia	2019	266	PTTEP Australia
Crux FLNG	Crux	Australia	2020	180	Nexus/Shell
Dongfang 13-2 FLNG	Dongfang 13-2	China	2020	91	CNOOC
Echuca Shoals FLNG	Echuca Shoals	Australia	2019	174	Nexus
Ghana FLNG		Ghana	2016		ENI
Greater Chuditch FLNG	Chuditch	Aust-East Timor JDZ	2019	246	Minza
Greater Sunrise FLNG 1	Greater Sunrise	Australia	2020	306	Woodside Energy
Greater Sunrise FLNG 2	Greater Sunrise	Australia	2022	306	Woodside Energy
NNPC Niger Delta FLNG		Niger	2017		NNPC
Pechora FLNG	Unknown	Russia	2018		Pechora LNG



FLNG Projects – Possible (2)

FLNG Project	Field	Country	Build Date	Distance from Shore (km)	Operator
Pelican/Faucon FLNG	Faucon	Mauritania	2020	210	Dana Petroleum
Petrobras FLNG	Lula	Brazil	2018	276	Petrobras
SBM FLNG	Unknown				Unknown
Sevan FLNG	Unknown	Norway	2018		Sevan Marine
Shtokman FLNG	Shtokman	Russia	2020	283	Shtokman Development



Clarksons

Conclusions





FLNG Summary

- Offshore production is expected to grow significantly during the next decade.
- Offshore gas production is likely to be the major element of this, growing at c. 4% p.a. over the next decade (offshore oil is expected to grow at c. 2% p.a).
- FLNG represents a highly complex engineering commitment in remote and sometimes hostile conditions.
- In an atmosphere of strong demand growth, FLNG provides a potentially cost-effective solution to deep-sea gas extraction.
- As at the start of May 2014, there are 5 FLNG under construction, 17 which we rate as probable and a further 22 possible projects.
- Risks (1): FLNG is an unproven technology – any issues with the start-up of the first units in service could impact how widespread the technology becomes.
- Risks (2): Delays, postponement or cancellation of projects are a feature of the industry, given the resource constraints, technical challenges and high CAPEX involved.
- Risks (3): Commodity prices. If US regulators allow large-scale exports of shale gas, then if this were to produce downward pressure on prices, FLNG could become less attractive.



Disclaimer

The information supplied herewith is believed to be correct but the accuracy thereof is not guaranteed and the Company and its employees cannot accept liability for loss suffered in consequence of reliance on the information provided. Provision of this data does not obviate the need to make further appropriate enquiries and inspections. The information is for the use of the recipient only and is not to be used in any document for the purposes of raising finance without the written permission of Clarkson Research Services Limited.

The statistical and graphical information contained herein is drawn from the Clarkson Research Services Limited ("CRSL") database and other sources. CRSL has advised that: (i) some information in CRSL's database is derived from estimates or subjective judgments; and (ii) the information in the databases of other maritime data collection agencies may differ from the information in CRSL's database; and (iii) whilst CRSL has taken reasonable care in the compilation of the statistical and graphical information and believes it to be accurate and correct, data compilation is subject to limited audit and validation procedures and may accordingly contain errors; and (iv) CRSL, its agents, officers and employees do not accept liability for any loss suffered in consequence of reliance on such information or in any other manner; and (v) the provision of such information does not obviate any need to make appropriate further enquiries; (vi) the provision of such information is not an endorsement of any commercial policies and/or any conclusions by CRSL; and (vii) shipping is a variable and cyclical business and any forecasting concerning it cannot be very accurate.