

Energy Trade Flows

U.S. LNG-based natural gas exports

Energy and the Economy: Charting the Course Ahead

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Outline

- Where have we come from?
- Where may we be going?
- What are the competitive challenges?
- Uncertainties



Natural gas imports and exports

[Source: BP Statistical Review of World Energy 2017-2018]

Year-on-year Growth
2015-2016
9.6%
2016-2017
10.3%

Gas Trade in 2015, 2016, and 2017															LNG import and export shares					
Billion cubic metres	2015				2016				2017				2015		2016		2017			
	Pipeline imports	LNG imports	Pipeline exports	LNG exports	Pipeline imports	LNG imports	Pipeline exports	LNG exports	Pipeline imports	LNG imports	Pipeline exports	LNG exports	exports	imports	exports	imports	exports	imports		
US	74.4	2.6	49.1	0.7	79.5	2.4	58.6	4.3	80.7	2.2	66.1	17.4	0.2%	0.8%	1.2%	0.7%	4.4%	0.5%		
Canada	19.2	0.6	74.3	†	21.1	0.3	79.5	†	24.0	0.4	80.7	†		0.2%		0.1%		0.1%		
Mexico	29.9	7.3	†	-	37.5	5.9	†	-	42.1	6.6	†	-		2.2%		1.7%		1.7%		
Trinidad and Tobago	-	-	-	16.9	-	-	-	14.3	-	-	-	13.4		5.2%		4.0%		3.4%		
Other S. & Cent. America	19.9	19.8	19.9	5.1	16.2	15.6	16.2	6.4	15.4	13.8	15.4	5.8	1.6%	6.1%	1.8%	4.4%	1.5%	3.5%		
France	31.8	6.8	-	0.6	32.2	9.1	-	1.5	33.5	10.8	-	1.0	0.2%	2.1%	0.4%	2.5%	0.3%	2.7%		
Germany	102.3	-	32.7	-	95.6	-	9.1	-	94.8	-	7.1	-								
Italy	55.7	5.4	0.2	-	60.5	5.9	-	-	53.8	8.4	-	-		1.7%		1.7%		2.1%		
Netherlands	33.6	2.1	47.1	1.3	36.8	1.3	46.8	0.9	40.9	1.6	43.3	0.8	0.4%	0.6%	0.2%	0.4%	0.2%	0.4%		
Norway	†	-	109.6	5.9	†	-	109.4	6.0	†	-	109.2	5.8	1.8%		1.7%		1.5%			
Spain	15.2	13.1	0.5	1.8	15.5	13.8	0.6	0.2	14.4	16.6	0.1	0.1	0.5%	4.0%		3.9%	0.0%	4.2%		
Turkey	38.4	7.7	0.6	-	36.9	7.8	0.6	-	42.8	10.9	0.6	-		2.4%		2.2%		2.8%		
United Kingdom	29.0	13.1	13.4	0.3	35.2	11.0	9.7	0.6	39.4	7.2	10.8	0.3	0.1%	4.0%	0.2%	3.1%	0.1%	1.8%		
Other Europe	94.7	6.9	13.8	1.5	94.8	7.9	13.9	1.3	103.7	10.2	21.6	0.2	0.5%	2.1%	0.4%	2.2%	0.1%	2.6%		
Russian Federation	21.8	-	179.1	14.0	18.1	-	200.1	14.6	18.9	-	215.4	15.5	4.3%		4.1%			3.9%		
Ukraine	17.3	-	-	-	10.5	-	-	-	13.3	-	-	-								
Other CIS	27.0	-	72.3	-	29.3	-	68.5	-	30.1	-	67.5	-								
Qatar	-	-	20.0	101.8	-	-	18.5	107.2	-	-	18.4	103.4	31.3%	0.0%	30.0%			26.3%		
Other Middle East	29.6	10.2	8.4	18.8	25.8	13.7	8.0	18.8	22.2	13.0	12.5	19.1	5.8%	3.1%	5.3%	3.8%	4.9%	3.3%		
Algeria	-	-	26.3	16.6	-	-	38.1	15.8	-	-	36.4	16.6	5.1%		4.4%			4.2%		
Other Africa	9.0	3.7	11.0	30.0	8.3	10.7	8.6	30.0	7.6	8.2	8.7	38.9	9.2%	1.1%	8.4%	3.0%	9.9%	2.1%		
Australia	6.4	-	-	38.1	6.4	0.1	-	59.2	5.8	-	-	75.9	11.7%		16.6%			19.3%		
China	33.6	25.8	-	-	36.0	35.9	-	-	39.4	52.6	-	-		7.9%		10.1%		13.4%		
India	-	-	-	-	-	23.6	-	0.1	-	25.7	-	-				6.6%		6.5%		
Japan	-	110.7	-	-	-	113.6	-	-	-	113.9	-	-			34.0%		31.8%	29.0%		
Indonesia	-	-	9.3	20.7	-	-	8.2	22.2	-	-	8.0	21.7	6.4%		6.2%			5.5%		
South Korea	-	43.8	-	0.2	-	45.7	-	0.1	-	51.3	-	0.1	0.1%	13.4%		12.8%	0.0%	13.0%		
Other Asia Pacific	20.3	46.0	21.4	51.4	18.1	32.5	20.0	53.4	17.7	40.0	18.8	57.2	15.8%	14.1%	15.0%	9.1%	14.6%	10.2%		
Total World	709.0	325.5	709.0	325.5	714.4	356.7	714.4	356.7	740.7	393.4	740.7	393.4								

Source: Includes data from FGE MENA gas service, IHS.

† Less than 0.05.

Note: As far as possible, the data above represents standard cubic metres (measured at 15°C and 1013 mbar) and has been standardized using a Gross Calorific Value (GCV) of 40 MJ/m3.



2016 US LNG-based natural gas exports

Country	Mcf	Share (%)
Chile	29,405,233	16.0%
Mexico	27,469,823	14.9%
China	17,220,633	9.4%
India	16,915,408	9.2%
Argentina	16,661,029	9.1%
Japan	11,137,261	6.1%
South Korea	10,166,100	5.5%
Jordan	9,870,110	5.4%
Brazil	9,196,380	5.0%
Turkey	8,762,481	4.8%
Kuwait	7,067,798	3.8%
Portugal	3,700,091	2.0%
Egypt	3,606,162	2.0%
U.A.E.	3,391,066	1.8%
Italy	3,328,199	1.8%
Dominican Rep	2,944,980	1.6%
Spain	2,930,435	1.6%
Total	183,773,189	
Bcf/d	0.585	

2017 US LNG-based natural gas exports

Country	Mcf	Share (%)
Mexico	140,321,287	19.9%
South Korea	130,185,448	18.4%
China	103,409,855	14.6%
Japan	53,298,599	7.5%
Jordan	36,321,482	5.1%
Spain	29,328,728	4.2%
Chile	25,745,690	3.6%
Turkey	24,854,835	3.5%
India	20,919,137	3.0%
Kuwait	20,213,124	2.9%
Portugal	19,522,724	2.8%
Brazil	17,647,879	2.5%
Argentina	16,276,094	2.3%
U.A.E.	13,408,114	1.9%
Taiwan	9,003,520	1.3%
Dominican Rep	8,690,714	1.2%
Lithuania	6,844,298	1.0%
Egypt	6,781,414	1.0%
Italy	6,492,590	0.9%
Poland	3,439,976	0.5%
United Kingdom	3,410,241	0.5%
Pakistan	3,165,927	0.4%
Thailand	3,112,643	0.4%
Netherlands	3,041,576	0.4%
Malta	867,346	0.1%
Total	706,303,241	
Bcf/d	1.935	

2018 US LNG-based natural gas exports - thru June

Country	Mcf	Share (%)
South Korea	110,412,158	22.5%
Mexico	105,262,400	21.4%
China	61,923,816	12.6%
Japan	44,283,389	9.0%
India	31,518,723	6.4%
Jordan	24,060,456	4.9%
Chile	24,032,902	4.9%
Argentina	13,941,443	2.8%
Pakistan	12,955,558	2.6%
Taiwan	10,073,582	2.1%
Brazil	7,680,001	1.6%
Turkey	6,992,293	1.4%
Egypt	6,553,756	1.3%
Kuwait	6,495,831	1.3%
United Kingdom	6,266,742	1.3%
Panama	3,518,379	0.7%
Israel	3,270,275	0.7%
Netherlands	3,252,599	0.7%
Portugal	3,247,452	0.7%
Dominican Rep	2,843,315	0.6%
Colombia	2,712,711	0.6%
Total	491,297,781	
Bcf/d	2.70	

Number of countries

2016 - 17
2017 - 25
2018 - 21

Sabine – 90.5% Cove Point 9.5%

US LNG export projects - FERC

Existing Capacity	Bcf/d	Sponsor	Proposed to FERC		
Cove Point, MD	0.82	Dominion	Pascagoula, MS	1.5	Gulf LNG
Sabine, LA	2.8	Cheniere	Cameron Parish, LA	1.41	Venture Global LNG
Kenai, AK	0.2	Conoco-Phillips	Brownsville, TX	0.55	Texas LNG
Subtotal	3.82		Brownsville, TX	3.6	Rio Grande LNG
			Brownsville, TX	0.9	Annova LNG
Approved - Under construction			Port Arthur, TX	1.86	Port Arthur LNG
Hackberry, LA	2.1	Sempr-Cameron LNG	Jacksonville, FL	0.132	Eagle LNG
Freeport, TX	2.14	Freeport LNG	Plaquemines, LA	3.4	Venture Global LNG
Corpus Christi, TX	2.14	Cheniere	Calcasieu, LA	4	Driftwood LNG
Sabine Pass, LA	1.4	Sabine Pass Liquefaction	Nikiski, AK	2.63	Alaska Gasline
Elba Island, GA	0.35	Southern LNG	Freeport, TX	0.72	Freeport LNG
Subtotal	8.13		Coos Bay, OR	1.08	Jordon Cove
			Corpus Christi, TX	1.86	Cheniere
Approved - Not under construction			Subtotal	23.642	
Lake Charles, LA	2.2	Lake Charles LNG			
Lake Charles, LA	1.08	Magnolia LNG	Total	42.382	
Hackberry, LA	1.41	Sempra-Cameron LNG			
Sabine Pass, LA	2.1	Golden Pass			
Subtotal	6.79				



BP Outlook 2035

2017 Outlook

Natural gas

Consumption,
production,
and balance

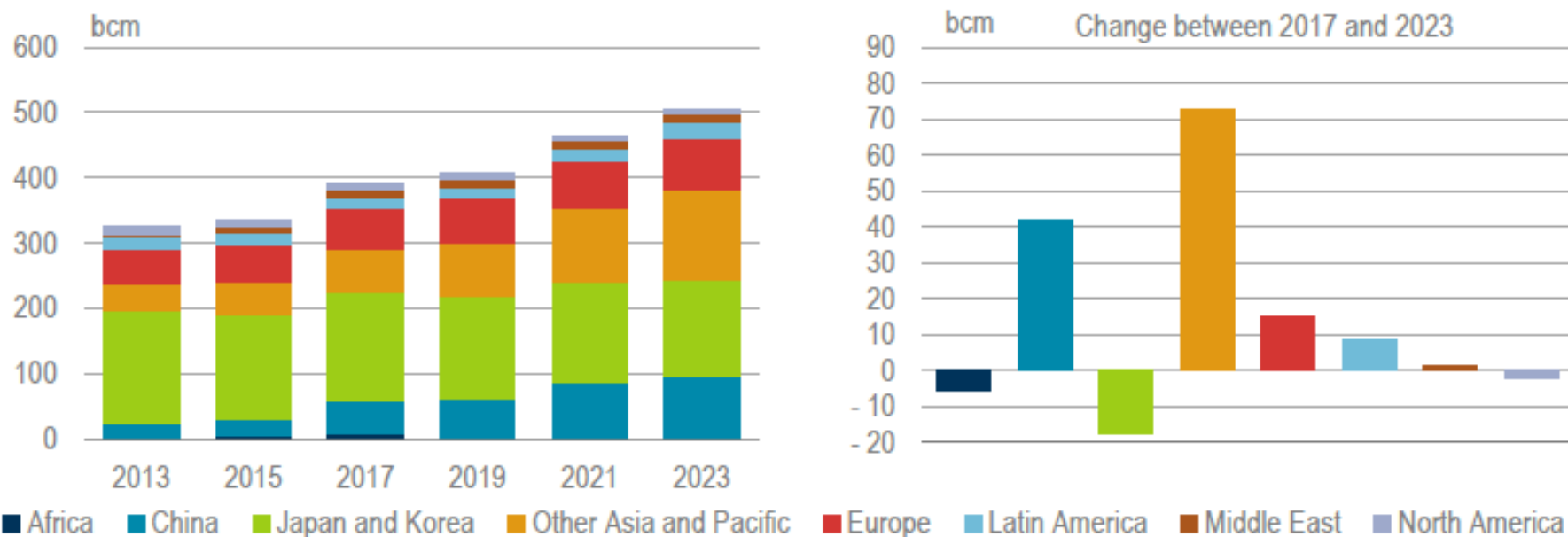
Consumption of natural gas										
Million tonnes oil equivalent	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
North America	579.0	673.8	720.5	711.5	770.0	880.7	992.4	1026.9	1096.4	1123.6
S & C America	52.0	67.7	85.2	111.1	135.8	157.3	164.7	172.3	183.6	186.5
Europe	309.4	350.6	420.0	481.7	494.6	412.2	459.4	458.5	475.9	492.0
CIS	566.0	472.2	467.7	502.5	509.8	490.9	491.5	496.0	499.6	494.6
Middle East	87.4	126.9	171.4	251.4	359.5	441.2	501.2	564.9	620.6	682.7
Africa	35.6	42.7	51.8	76.5	96.5	121.9	134.4	157.4	185.7	220.0
Asia Pacific	136.5	189.9	268.6	369.8	520.5	631.0	800.0	921.6	1032.7	1119.1
Total Natural Gas Consump	1765.9	1923.8	2185.3	2504.5	2886.7	3135.2	3543.7	3797.6	4094.5	4318.5
Production of natural gas										
Million tonnes oil equivalent	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
North America	584.0	651.7	693.9	683.0	745.2	900.4	1036.6	1128.9	1275.8	1330.7
S & C America	52.3	68.1	91.0	126.5	149.6	160.6	159.5	161.7	165.0	168.8
Europe	191.9	218.6	256.3	270.6	256.1	214.4	189.8	165.2	135.1	111.6
CIS	672.2	569.1	584.1	651.7	657.0	676.5	749.9	824.5	854.9	881.4
Middle East	94.6	134.1	189.6	288.9	446.0	556.1	604.7	673.5	733.1	792.8
Africa	62.0	76.8	119.4	159.3	192.0	190.6	190.7	211.1	237.2	280.3
Asia Pacific	134.6	187.4	251.3	339.3	448.0	501.0	642.5	678.4	708.8	756.0
Total Natural Gas Productio	1791.5	1905.7	2185.5	2519.4	2893.9	3199.5	3573.6	3843.4	4109.8	4322.5
Balance (production minus consumption)										
Million tonnes oil equivalent	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
North America	5.0	-22.2	-26.6	-28.5	-24.8	19.7	44.3	102.1	179.4	207.1
S & C America	0.3	0.4	5.8	15.3	13.8	3.3	-5.2	-10.6	-18.6	-17.7
Europe	-117.5	-132.1	-163.7	-211.1	-238.5	-197.9	-269.7	-293.3	-340.8	-380.4
CIS	106.2	96.9	116.3	149.3	147.2	185.6	258.4	328.5	355.3	386.8
Middle East	7.1	7.3	18.2	37.5	86.5	114.9	103.4	108.6	112.4	110.0
Africa	26.3	34.1	67.6	82.8	95.5	68.7	56.3	53.6	51.4	60.3
Asia Pacific	-1.9	-2.5	-17.4	-30.4	-72.5	-130.0	-157.5	-243.2	-323.8	-363.1
Total Natural Gas Balance	25.6	-18.1	0.2	14.9	7.2	64.3	30.0	45.7	15.3	3.0

For context,
the 45.7 Mtoe
surplus
represents
about 5 Bcf/d.

The 363.1 Mtoe
deficit implies
about
39 Bcf/d
403 Bcm/y
297 mtpa



Figure 3.4 World LNG imports by region, 2013-23



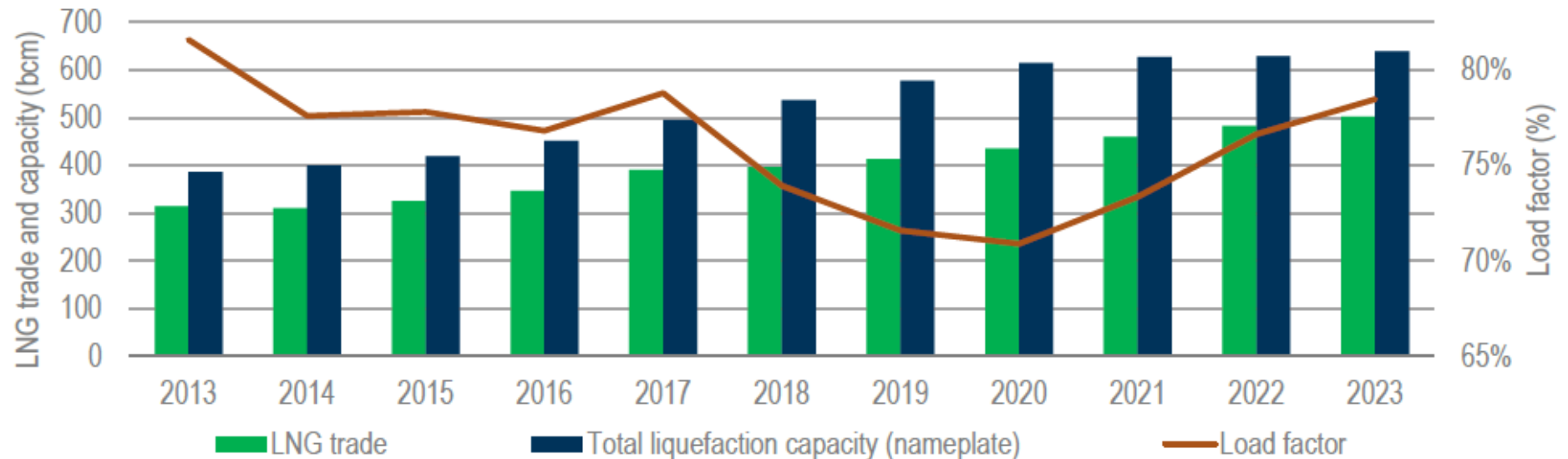
Liquefaction capacity - [GIIGNL]

- At the end of 2017 nameplate capacity was 365 mtpa (48.0 Bcf/d or 496.4 Bcm)
- At the end of 2017, about 89 mtpa (11.7 Bcf/d) of new capacity was under construction, with 49 mtpa (6.4 Bcf/d) in the US and 17 mtpa (2.2 Bcf/d) in Australia.
- During 2018, about 38 mtpa (5.0 Bcf/d) of new capacity will come on line, with 13 mtpa (1.7 Bcf/d) being in the US.
- Given exports of 393.4 Bcm (38.1 Bcf/d) in 2017, this implies a 79.3% capacity utilization rate.



IEA LNG liquefaction capacity outlook

Figure ES.3 LNG liquefaction capacity and utilisation, 2013-23



Roughly in line with US projects currently under construction

Figure 3.5 LNG nameplate liquefaction capacity, 2013-23

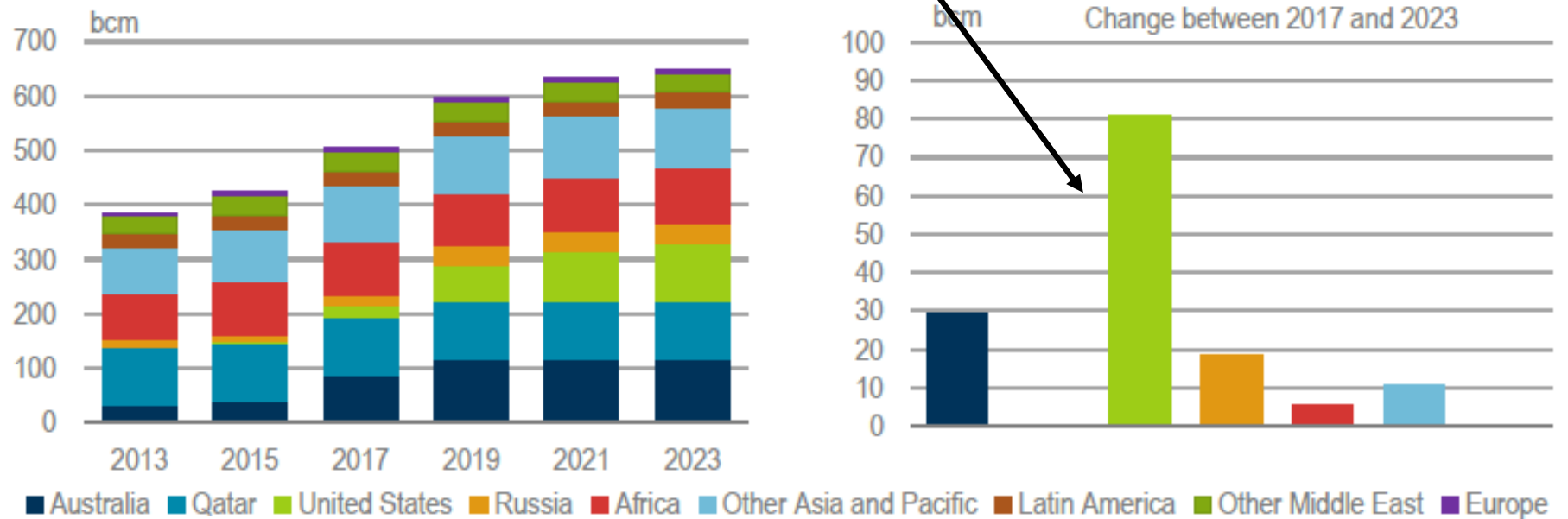
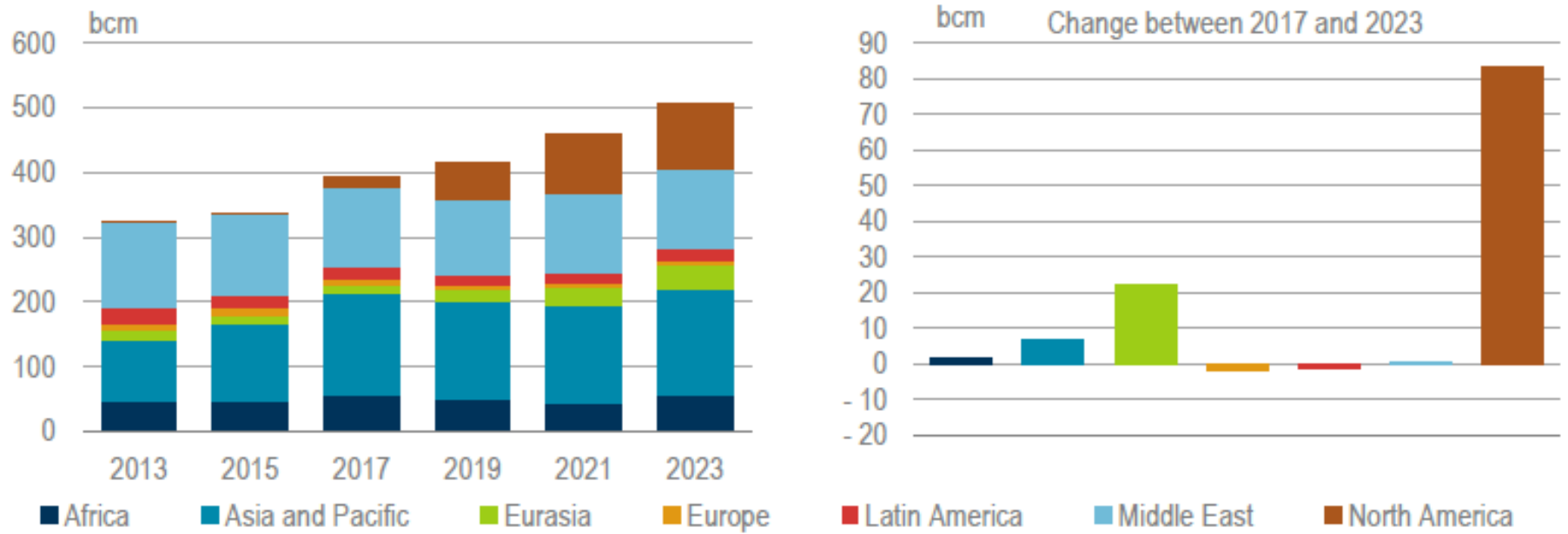
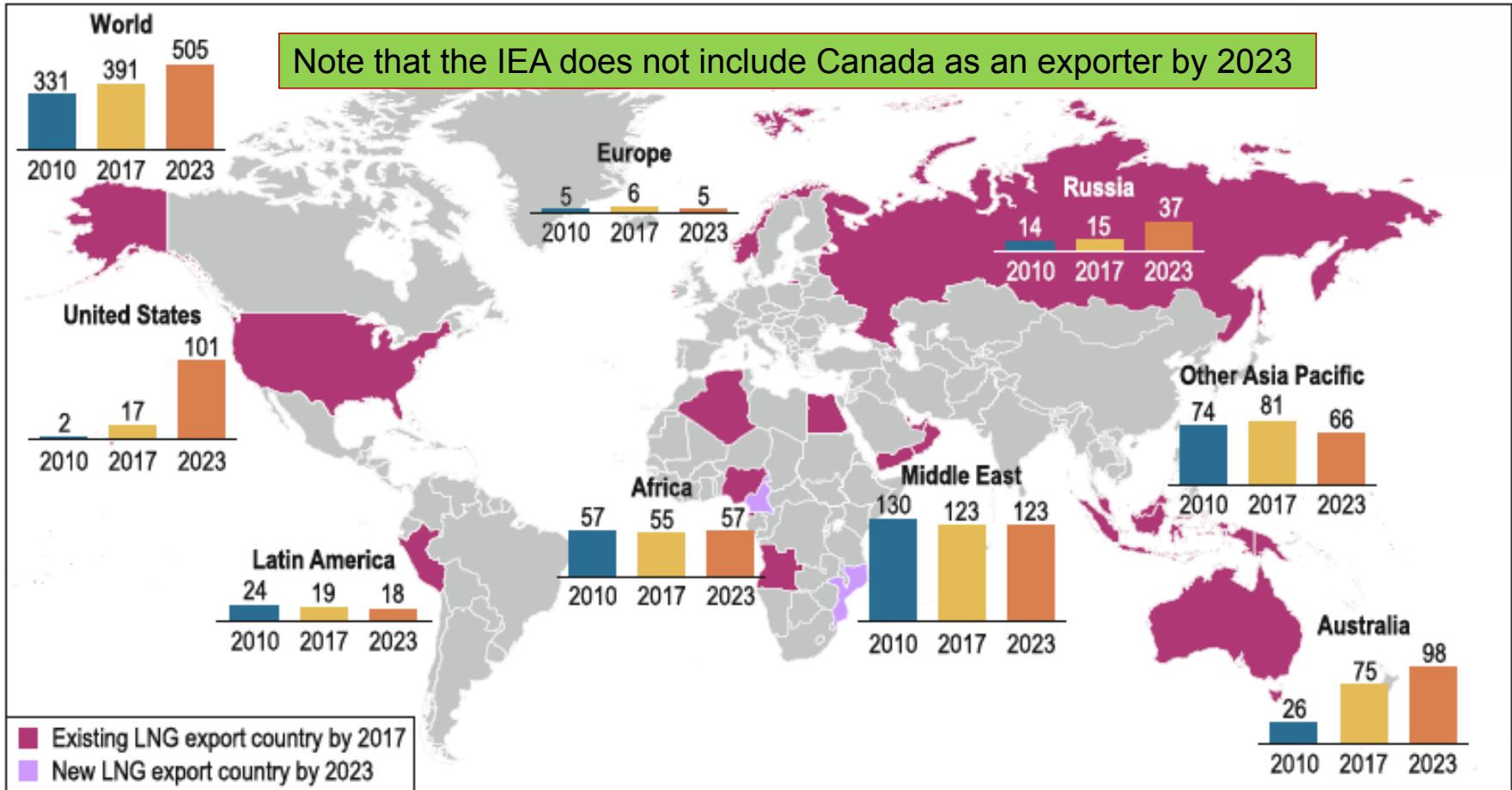


Figure 3.6 World LNG exports by region, 2013-23



Map 3.2 LNG export countries and LNG export volumes, 2010-23

Note that the IEA does not include Canada as an exporter by 2023



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.



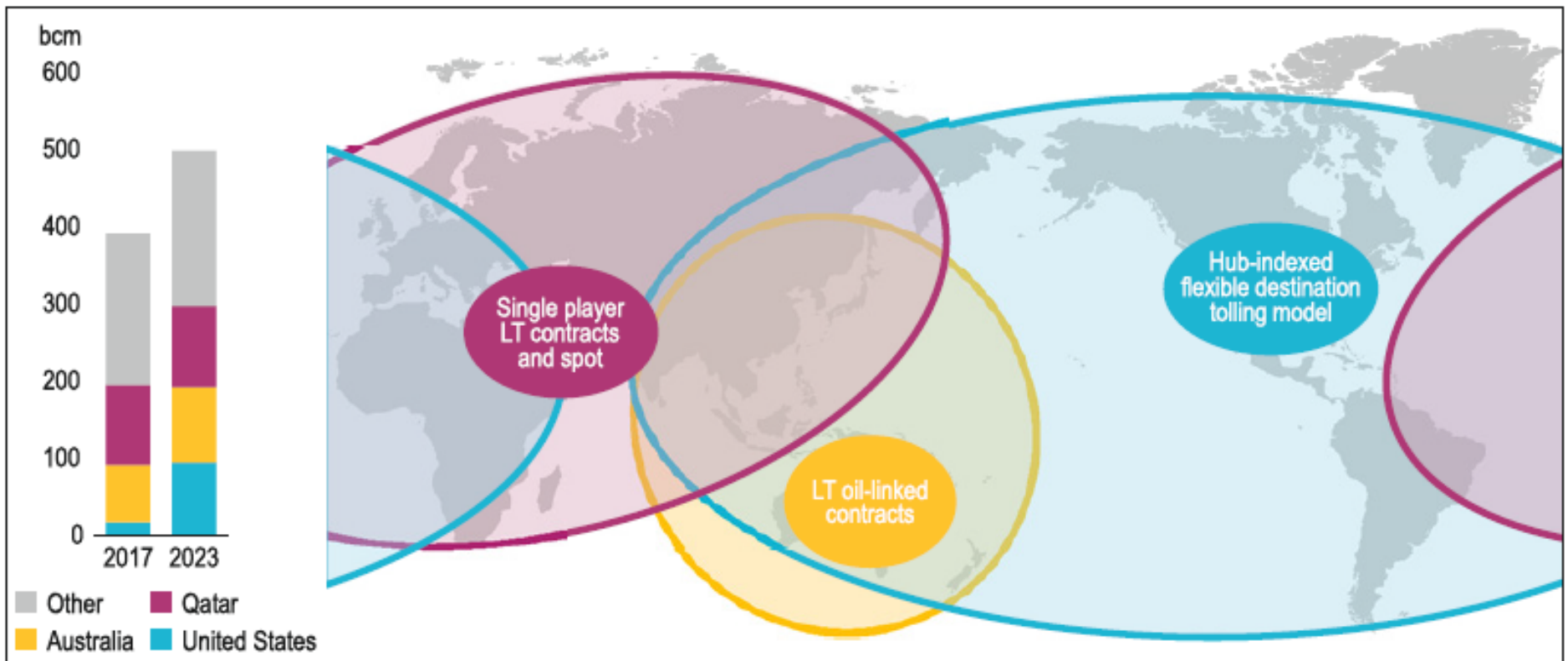
Regasification capacity - [GIIGNL]

- At the end of 2017 nameplate capacity 850 mtpa (111.8 Bcf/d or 1,156 Bcm)
- At the end of 2017, about 103.5 mtpa (13.6 Bcf/d) of new capacity was under construction, with 54.1 mtpa (7.1 Bcf/d) in the Asia. In addition, several FSRU projects were proposed, including in Australia.
- Given exports of 393.4 Bcm (38.1 Bcf/d) in 2017, this implies a 46.3% capacity utilization rate. Europe tends to be below 30% utilization.



Map 3.3

The three major LNG export players and their respective business models

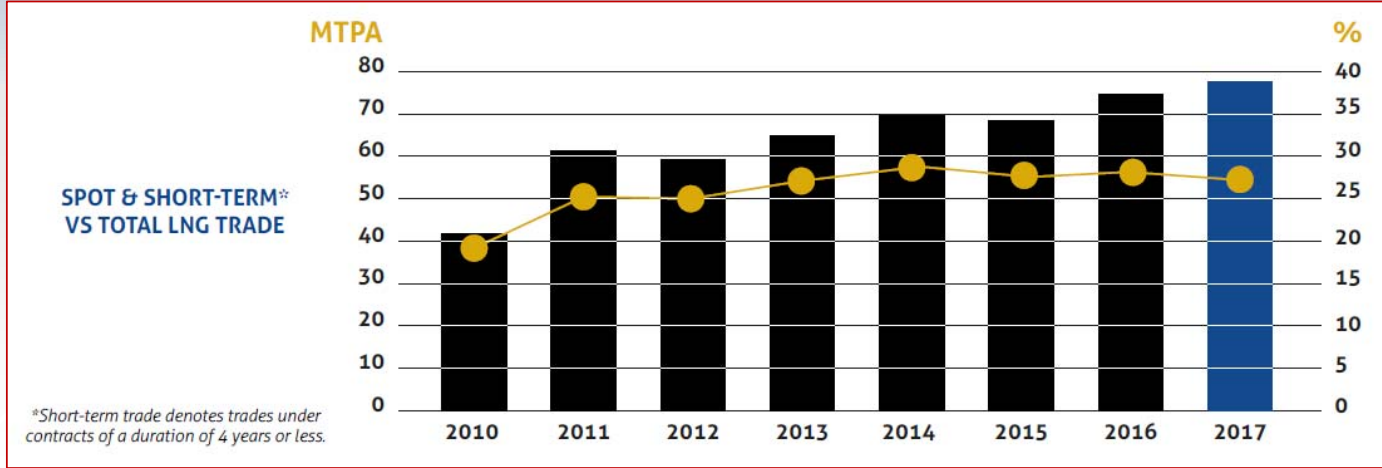
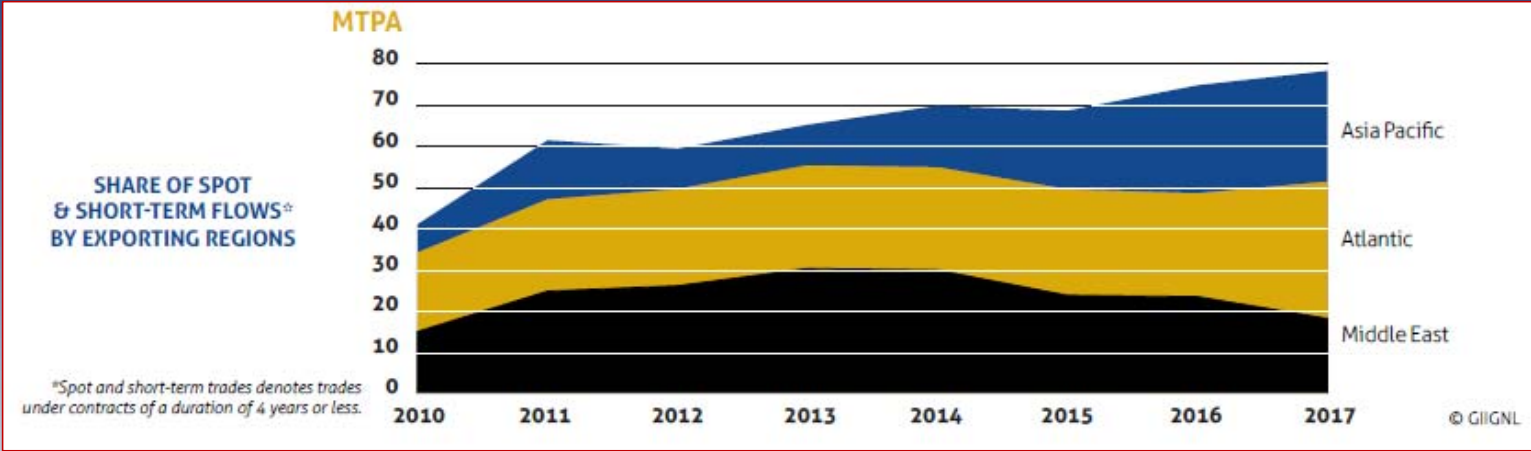


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Note: LT = long-term.

Note that Cheniere is NOT a tolling operation.

Pricing terms are evolving



LNG shipping cost estimates

LNG Carrier shipping cost comparison between XXX and YYY

160,000 m3 tanker => ~ 3,500,000 MMBtu

Accounts for round trip, includes 2 additional days for loading and unloading, \$35/nm fuel cost, \$0.21/MMBtu for Panama, \$150,000 each for port costs, \$30,000 insurance, and \$79,000 working capital charge

		Appr. Distance nautical miles	Fuel	18 knots		Day rate	Cost/MMBtu
Port-to-Port				Days	Hours	\$ 70,000	
Sabine	Zeebrugge	4861	\$ 340,248	13	6	\$ 2,135,000	\$ 0.96
	Shanghai (S.Afr.)	15098	\$ 1,056,860	34	23	\$ 5,174,167	\$ 2.20
	Shanghai (Panama)	10081	\$ 705,670	23	8	\$ 3,546,667	\$ 1.76
Dampier	Shanghai	3308	\$ 231,560	7	16	\$ 1,073,333	\$ 0.57

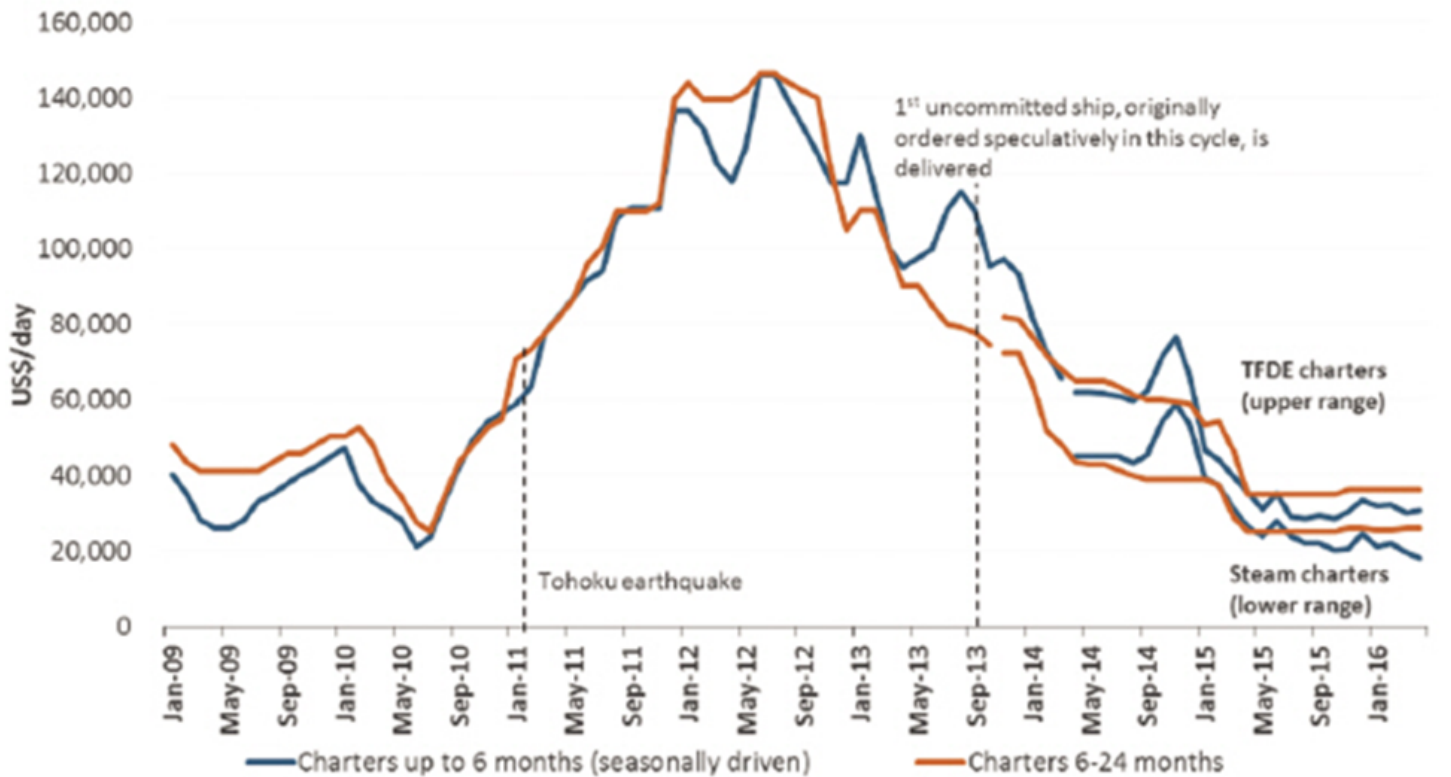
For tanker day rates of +/- \$20,000 around the \$70,000

Zeebrugge \$0.76 - \$1.16
Shanghai (Panama) \$1.42 - \$2.09



LNG tanker rates (2009-2016)

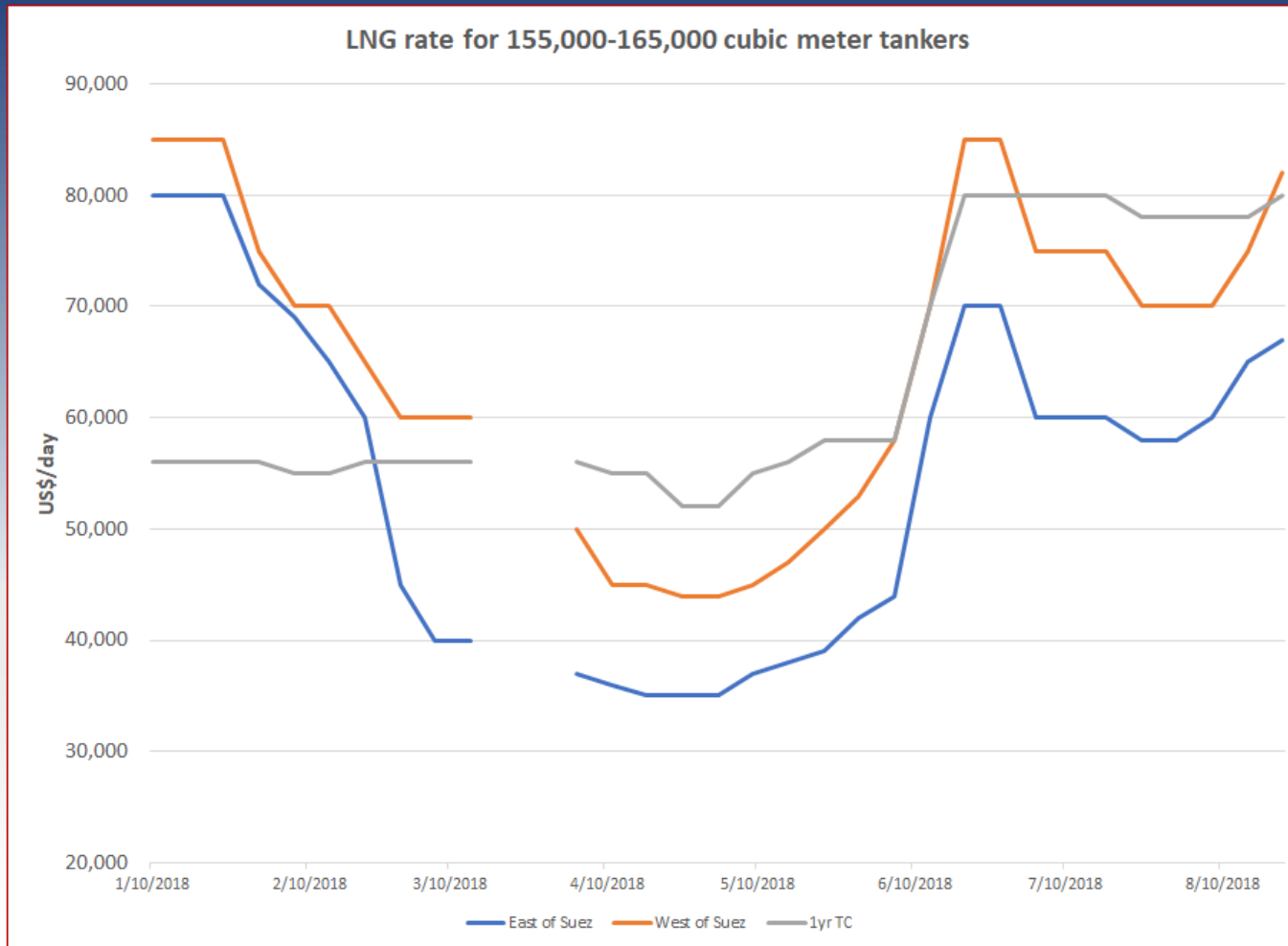
LNG Freight Rates for Ships of 145~165,000 m³



Source: Kenneth Wilson, in collaboration with FGE



LNG tanker rates (2018)



Netback values based a Cheniere-type business model

9/4/2018					www.xe.com quotes							
			Northern European values		0.77773	GBP/USD	CME/NYMEX quote					
					0.86374	EUR/USD	HH		HH+15%			
	ICE natural gas quotes						\$2.82		\$3.25			
									Net of liquefaction		Net of shipping	
							Net of HH+15%	BG \$2.25	\$3.00		\$0.96	
NBP	70.9	pence per therm	7.09	pounds sterling per MMBtu	\$ 9.12	US\$ per MMBtu	\$ 5.87	\$ 3.62	\$ 2.87		\$ 2.66	\$ 1.91
TTF	26.78	euros per MWh	7.84654	euros per MMBtu	\$ 9.08	US\$ per MMBtu	\$ 5.84	\$ 3.59	\$ 2.84		\$ 2.63	\$ 1.88
					Asia oil linked values							
							Brent crude oil price					
							Net of liquefaction	77.42				
							BG \$2.25	\$3.00			Net of HH+15%	
							\$ 7.41	\$ 6.66			\$ 9.66	
										\$ 12.90	heat rate parity based on 6 MMBtu per barrel	
											0.166667 implied slope	
							\$ 6.80	\$ 6.05		\$ 9.05	\$ 12.30	using Brent*0.1485 + 0.8
			Japan spot values									
			Japan spot									
			What if:	\$11.50	Net of liquefaction		Net of shipping					
					BG \$2.25	\$3.00	\$1.76					
			Japan spot - HH+15%	\$8.25	\$6.00	\$5.25	\$4.24	\$3.49				

Breakeven netbacks

Northern Europe – 56.04 pence per therm and 21.24 euros per MWh

Japan/Asia - \$8.01 per MMBtu



Uncertainties

- Japan's nuclear restart
- China's domestic production and pipeline imports
- FLNG success



Summary

- Global natural gas has been affected by the evolution of the energy price environment.
- Asia-Pacific is expected to be in production-consumption deficit for the foreseeable future, as is Europe.
- Substantial supplies of natural gas from LNG and pipeline sources will be available, keeping downward pressure on prices.
- Australia maintains an advantage over the US for Asia-Pacific natural gas markets due to geographic location, large capacity, and sunk costs.
- BUT, Asia-Pacific remains in consumption-production deficit even with Australia's contribution.
- Japan's nuclear re-start uncertainty clouds its the level of demand.
- China's role as an LNG-based natural gas importer is unclear, with potential competition from pipeline imports and domestic production.
- At current relative prices, and expected LNG shipping costs, margins from the US to Asia are likely to remain superior to those for Europe.



Thank you!

Questions - Comments

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