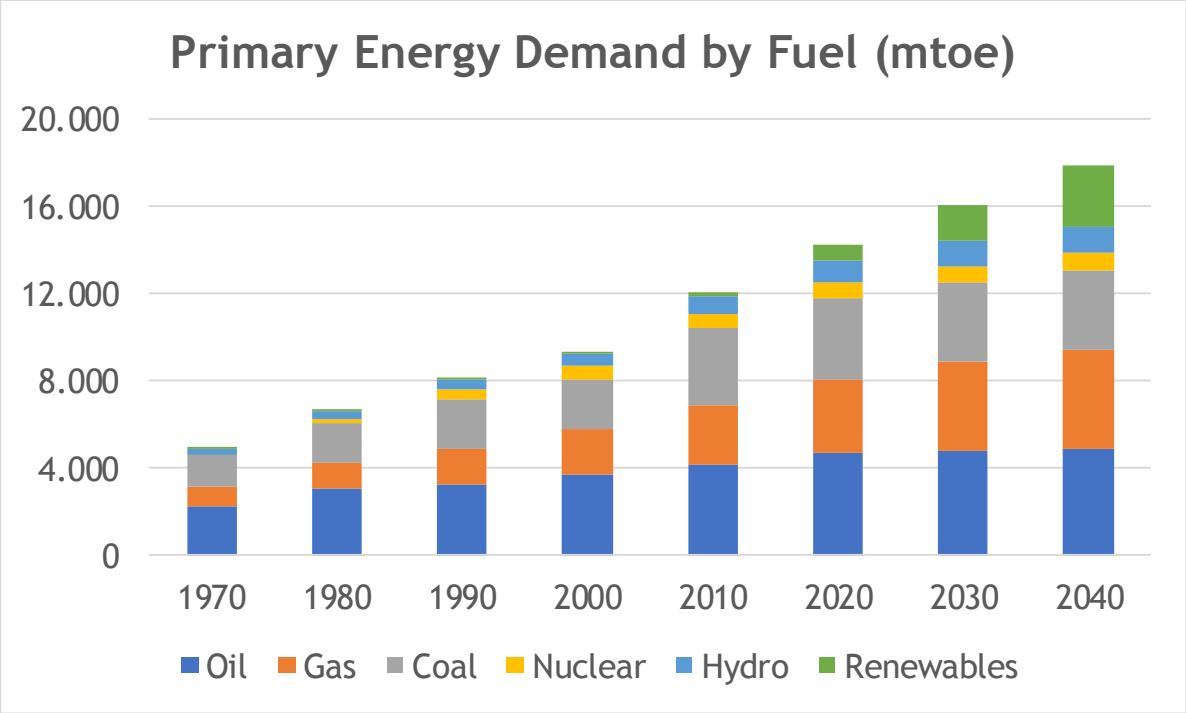
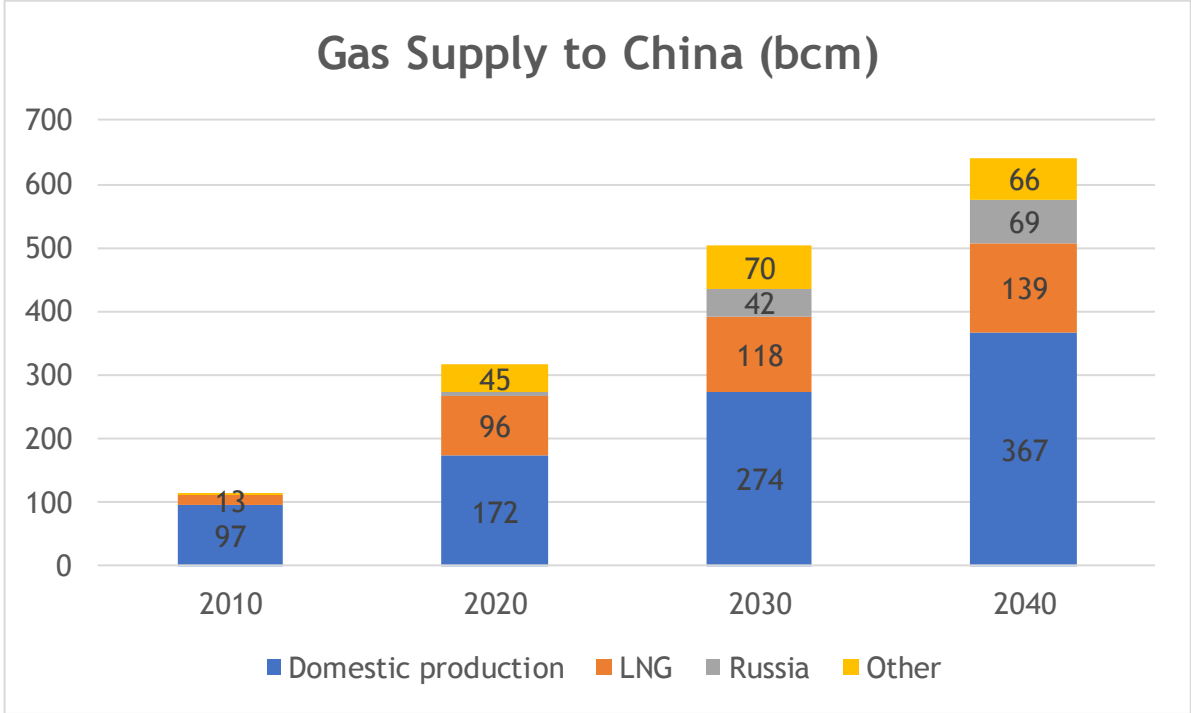
Potential Regional LNG Developments

Cantekin Dinçerler Feb/2019

Primary Energy Demand and Share of Gas

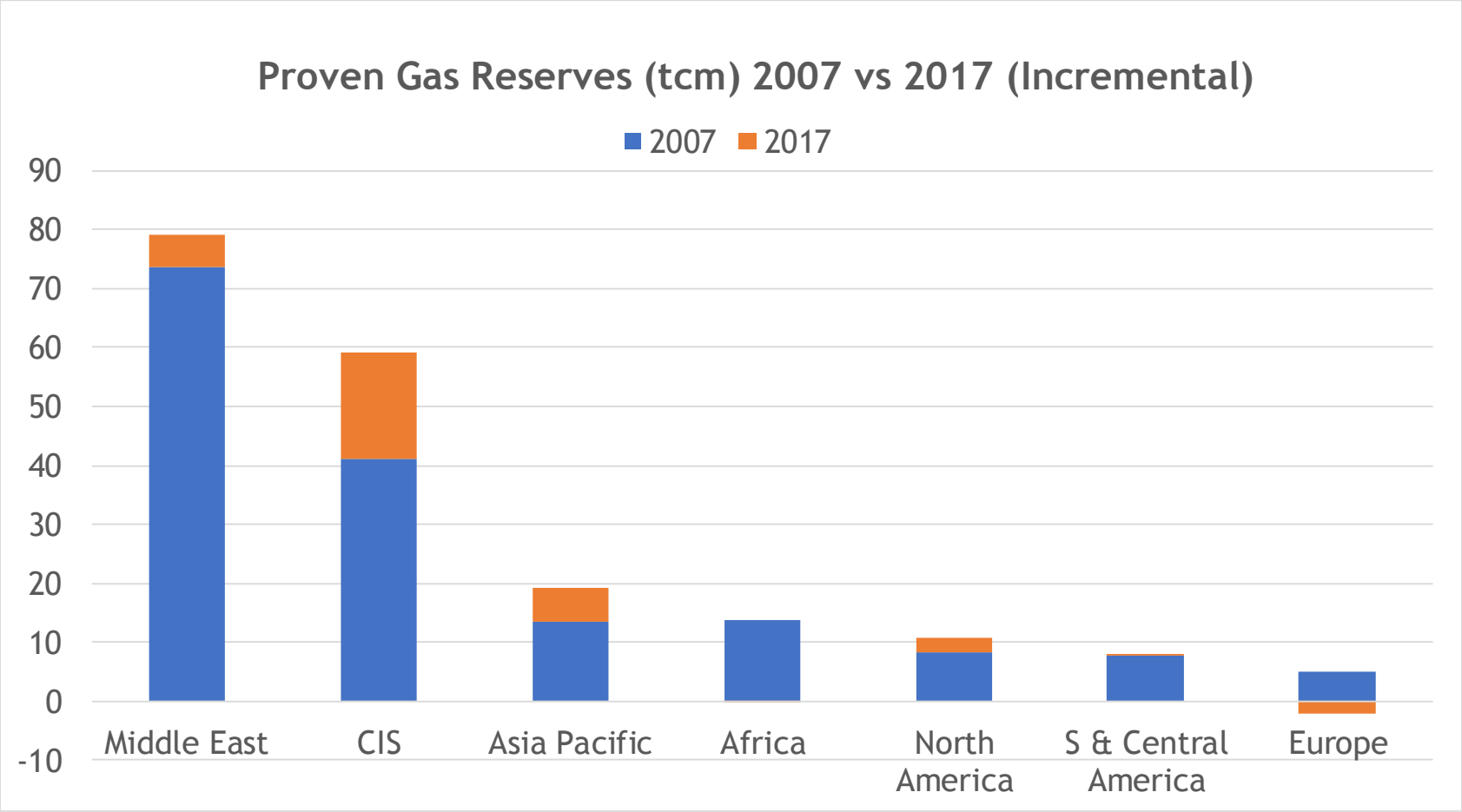




- Most of the increase in energy demand is going to be met by **natural gas** and **renewables**.
- Gas Supplies to China via LNG increases by around 40 bcm/a until 2040, whereas Russian gas supplied to China dominates the imports by this country with ~70 bcm from its 0 (zero) level in 2010.

Source: *BP Energy Outlook 2019*

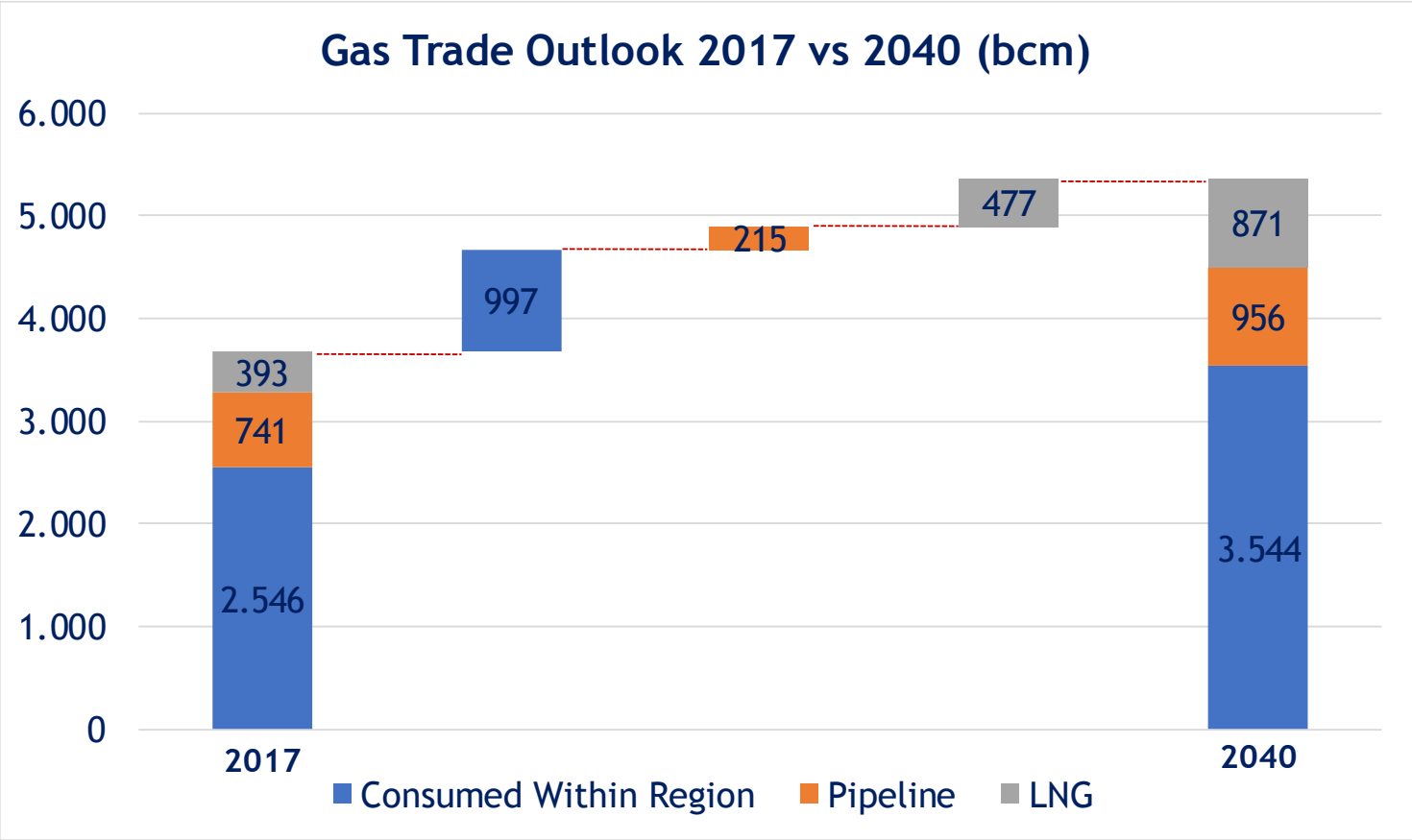
Change in Proven Gas Reserves: 2007 and 2017



- Quantity of proven gas reserves continue to increase with technological advancement and shale revolution in recent years.
- In almost all regions there are positive changes compared to a decade ago, whereas reserves of Europe decrease.

Source: *BP Statistical Review of World Energy 2018*

Gas Trade Volumes: Pipeline vs LNG

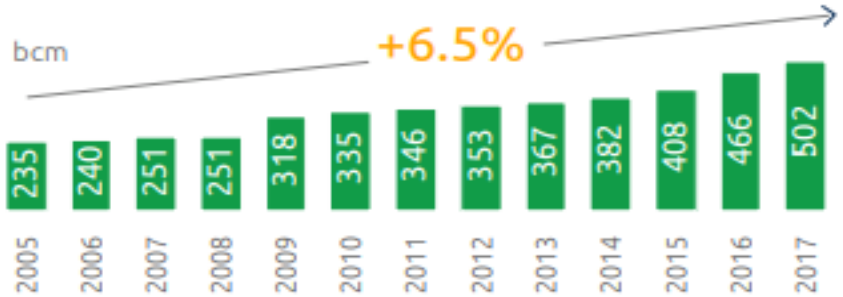


- In 2017, global gas trade approached 1.2 Tcm with LNG accounting for 32.9% of global trade.
- **LNG trades will increase to more than double of its current levels towards 2040.**

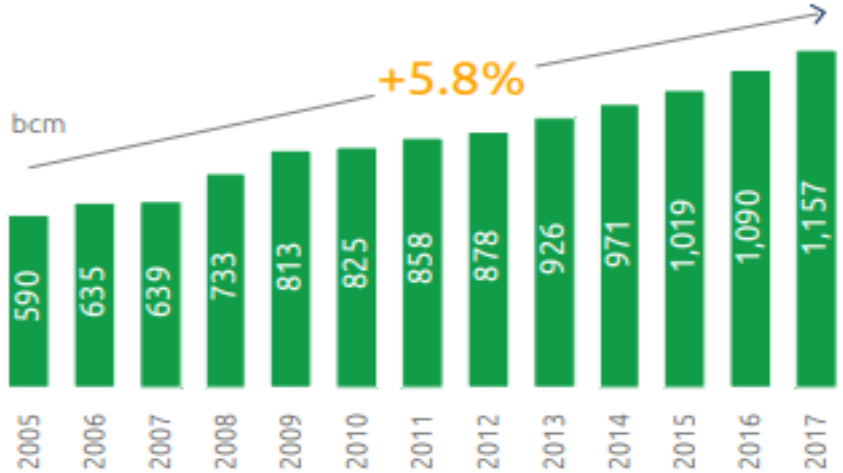
Sources: *IEA, BP*

Liquefaction and Regasification Capacities

Global Liquefaction Capacity



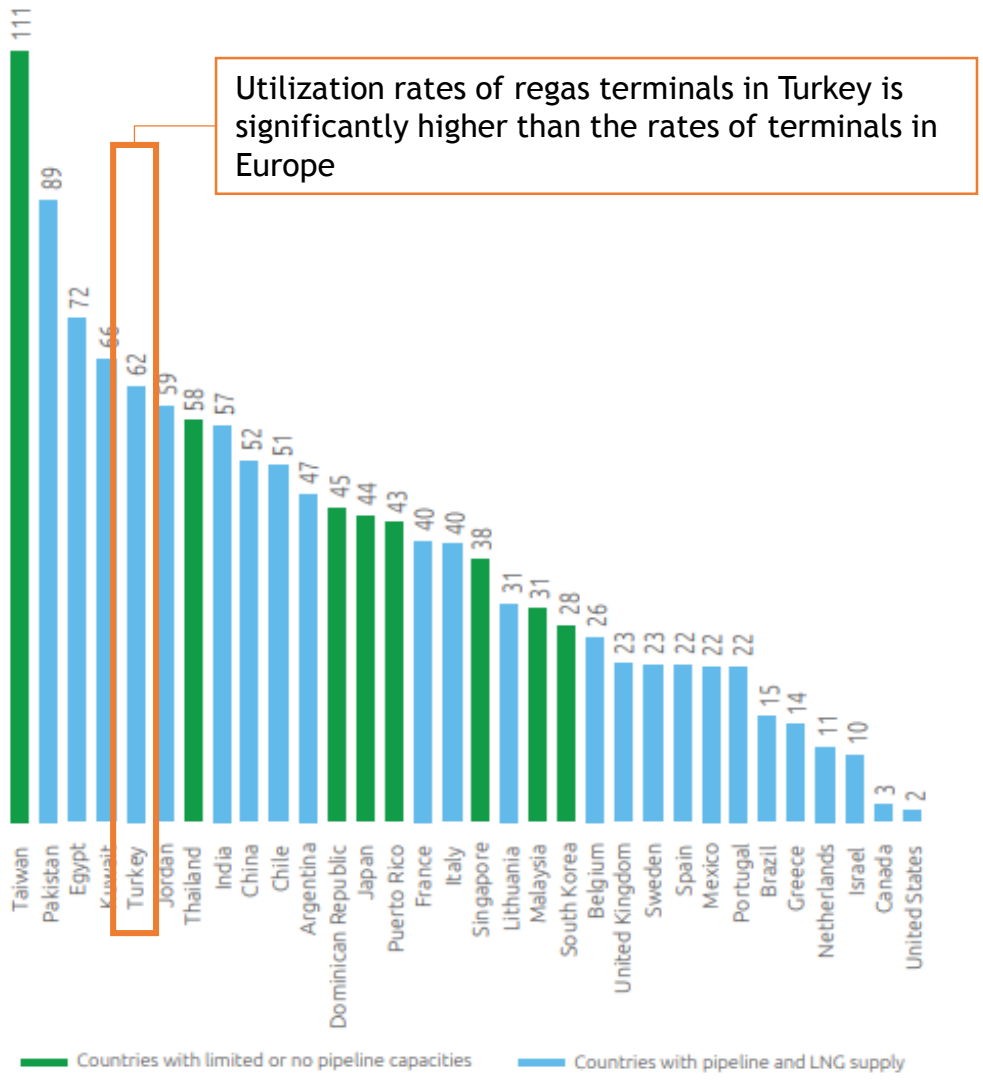
Global Regasification Capacity



Sources: *GIIGNL, SNAM*

- In 2017, liquefaction capacity increased by 38 bcma (~28 mtpa) across Australia (13 bcm), US (12 bcm) and Yamal in Russia (7 bcm) and other locations including Malaysia and Indonesia (4 bcm).
- With these additions, global liquefaction capacity reached ~500 bcma (~365 mtpa). At the end of 2017, 120 bcma (~89 mtpa) of new liquefaction capacity was under construction. However, this increase will certainly slow down in upcoming years, as liquefaction terminal investments decreases. There has been only one FID taken during 2017, for Coral FLNG project in Mozambique (3.4 mtpa).
- On the other hand, 5 new regasification terminals were commissioned during 2017, adding a combined 15.6 bcma regas capacity, and resulting in global regas capacity reach 1160 bcm (~850 mtpa)
- Utilization rates of the regas terminals were around 34% in 2016 and this has not changed significantly during 2017.

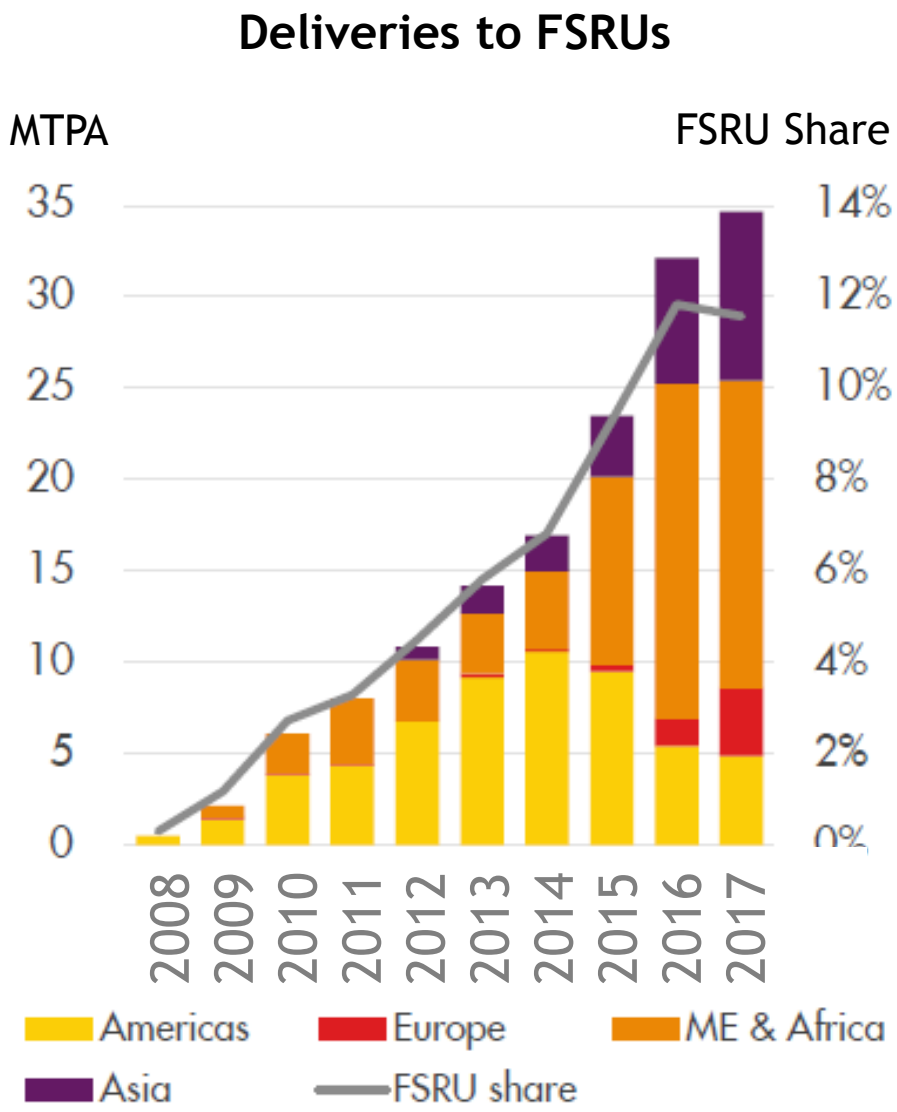
Regasification Terminal Utilizations



	2005	2010	2016
Africa	0	0	72
Asia / Oceania	31	39	43
Europe	42	50	28
Latin America	14	49	35
Middle East	0	0	43
North America	34	11	4
Total	**33**	**36**	**34**

- Utilization rates of European terminals on average is around 30%, which is close to global average of 34%.
- The same rate for Turkish regas terminals were around 60% in 2016.

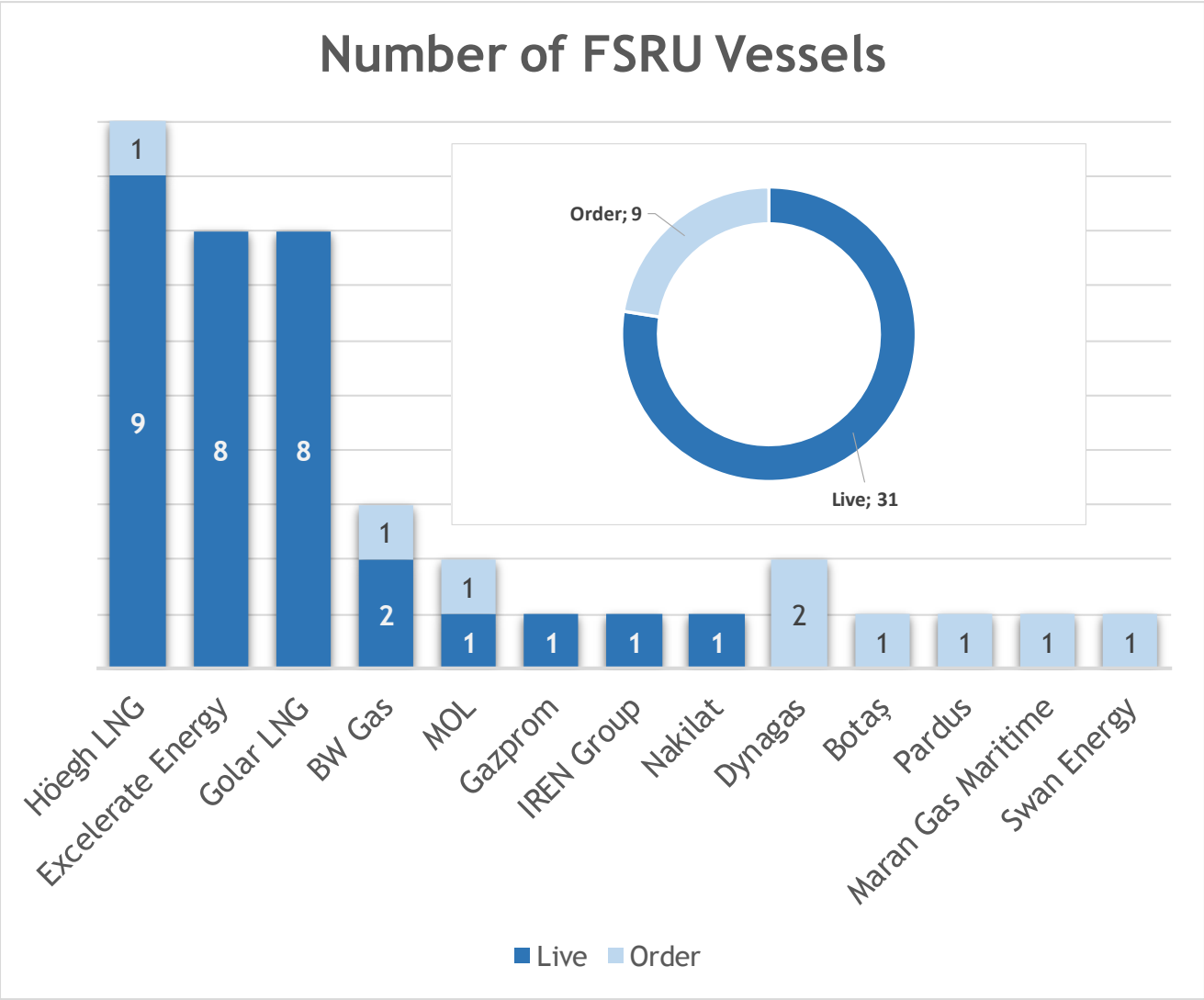
Floating Regas Terminals



Sources: *Shell, GIIGNL*

- One fact on regas terminals is increasing use of floating storage and regasification units.
- The number of FSRUs continue to increase worldwide, as they provide a quick, safe and cost-effective solution to access global LNG market supplies.
- According to Shell data, the volume of LNG delivered to FSRUs increased to 35 MTPA during 2017, resulting in the share of LNG deliveries to FSRUs reach around 12% in global LNG deliveries.
- It is worth to note that 2 FSRU units are on duty in Turkey.

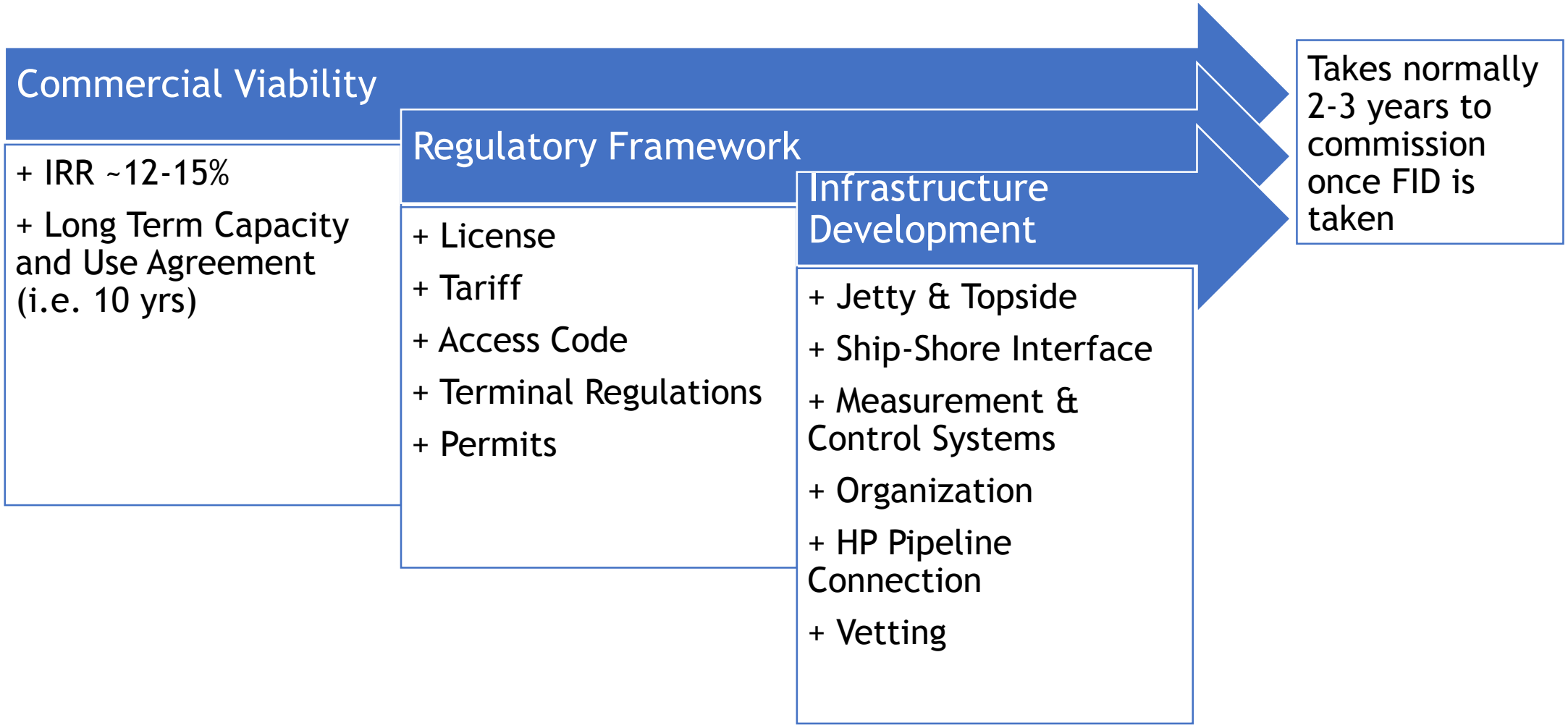
Floating Regas Terminals



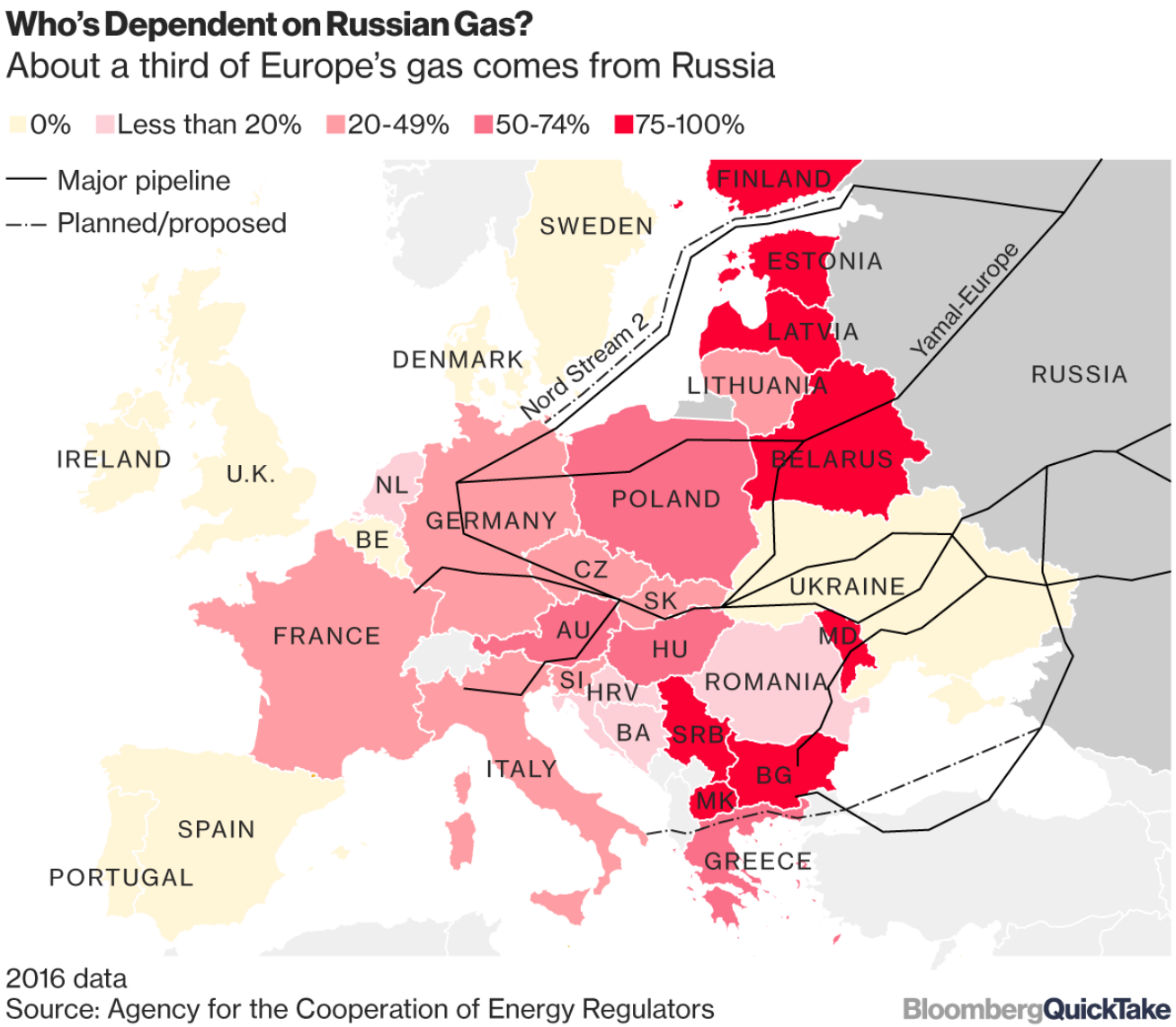
- Existing number of FSRUs in the market reached to 31 with recent deliveries to Norwegian Höegh LNG, which carries them to the leading position in the market.
- As slots of the shipyards for deliveries in 2021 are almost full, the construction time now extends to ~32 months for new orders.
- Qatargas is expected to order 40-60 LNGcs, which will have impact on all Korean shipyards' delivery periods.

Sources: *Fearnleys, Höegh, Excelerate, Golar*

Regas Project Development Requirements

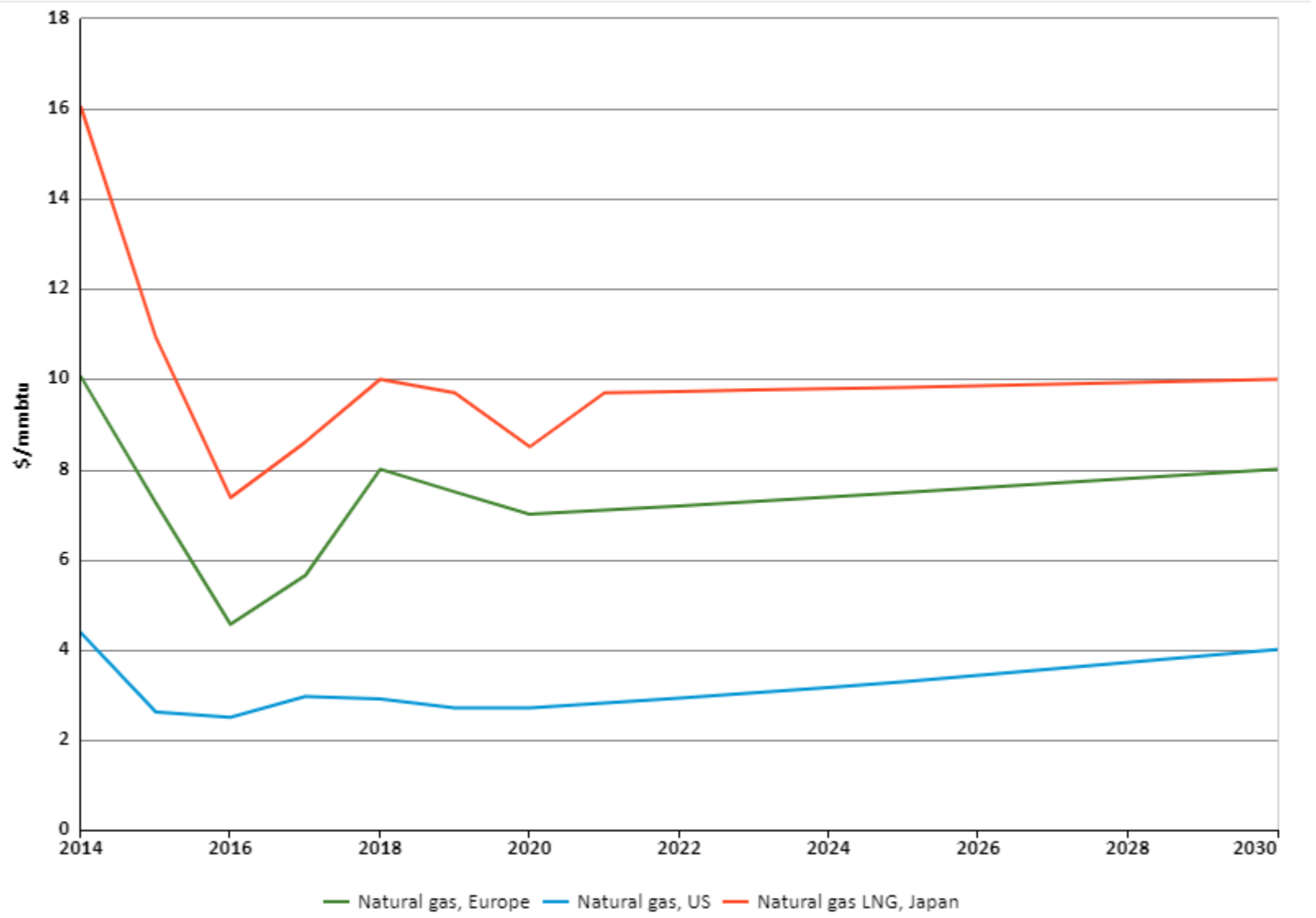


Europe’s Dependence on Russian gas



- About 1/3 of Europe’s gas demand is supplied by Russia.
- With decreasing gas reserves, it is not an easy task to downsize the level of this dependence.

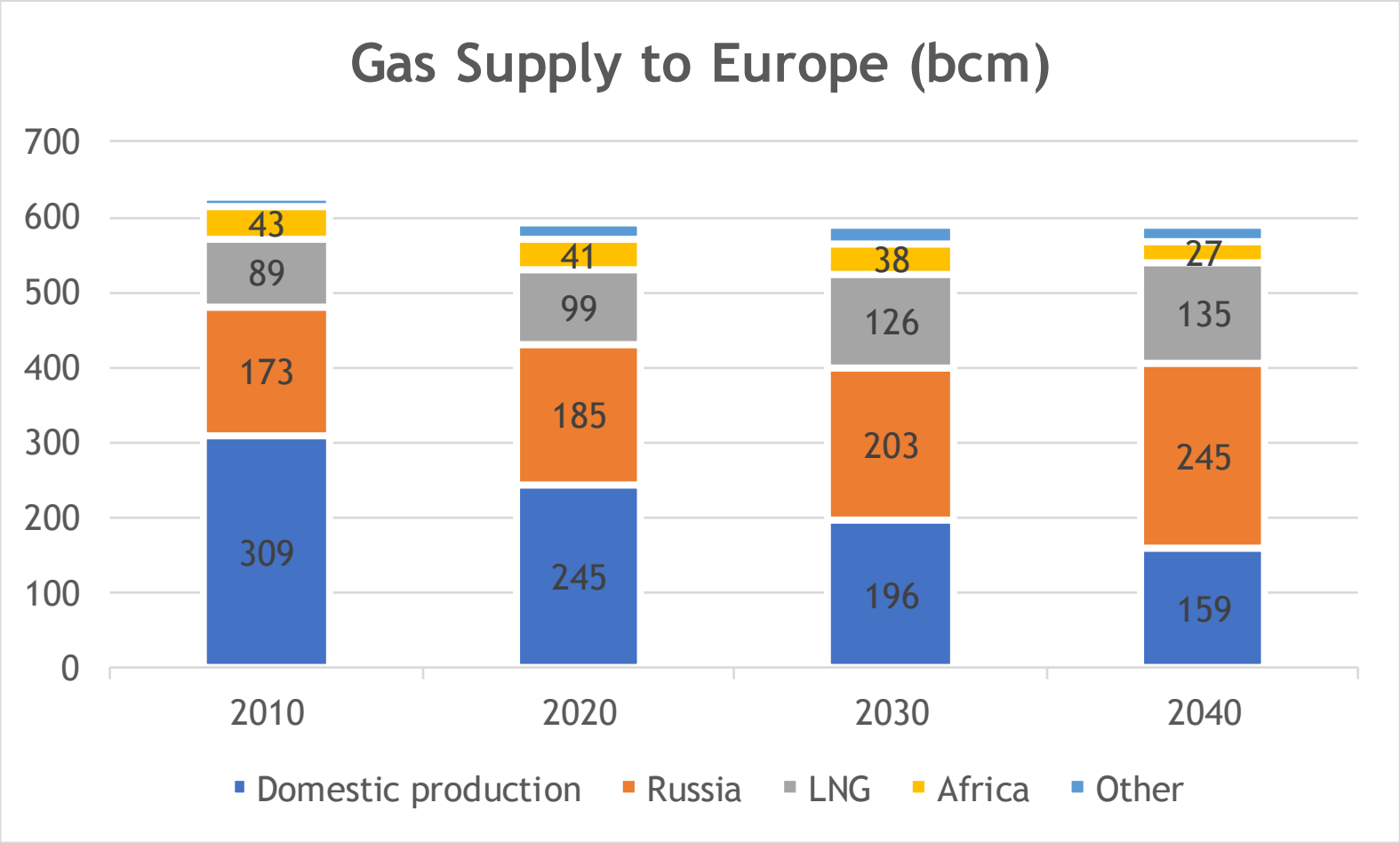
Long-Term Natural Gas Price Forecast



- Typical Japan LNG net back to Henry Hub requires deduction of
  - Henry Hub gas margin (around 15%)
  - Liquefaction cost (around 2.25 $/MMBtu)
  - Shipping cost (1-1.5$/MMBtu)
- East Asian LNG pricing will yield better margin for US LNG than Europe

Source: World Bank Estimates October 2018

Declining Production in Europe



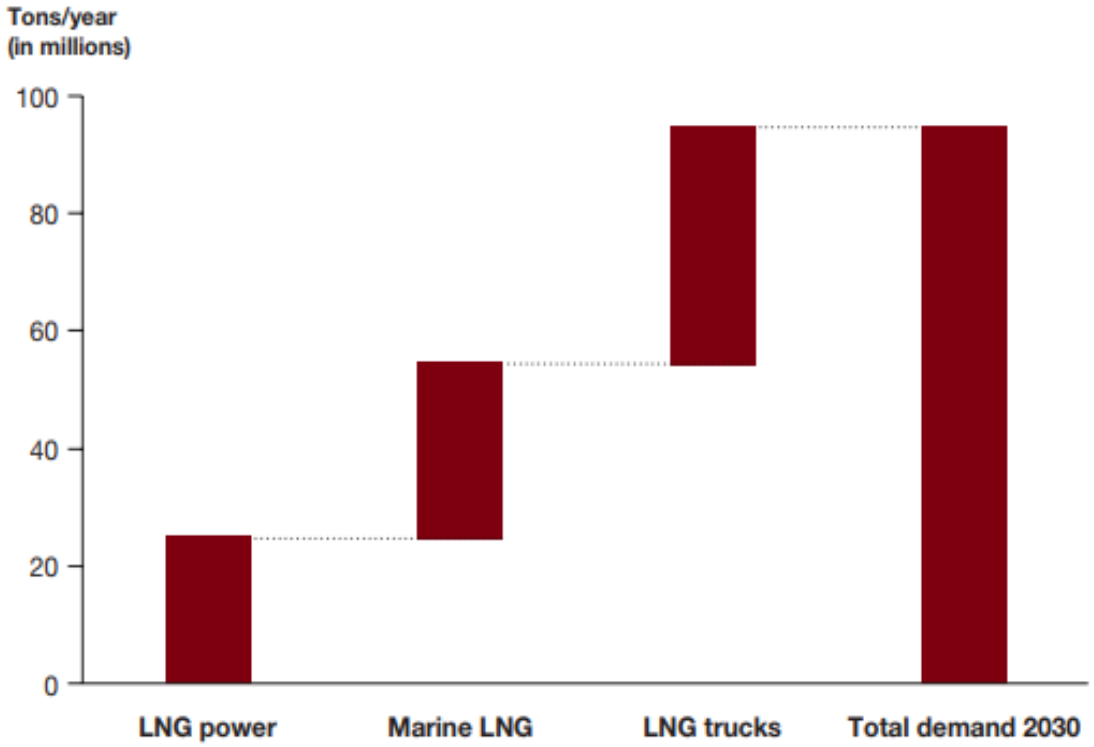
- The full-cost based breakeven price of U.S. LNG supplies to Europe stands around $6 to $7.50 per million British thermal units. That compares with $3.50 to $4 for Russia's pipeline gas based on Gazprom's current taxation[1].
- As such, the share of Europe's total gas consumption met by Russian exports is projected to increase from around a third currently to almost half by 2040[2].
- **Still, LNG supplies to Europe increase by around 40 bcm/a until 2040.**

Sources:
1 - Alexander Kornilov, Aton LLC / Moscow
2 - BP

An Emerging LNG business - Smal Scale LNG (SSLNG)

SSLNG typically refers to liquefaction scale less than 0.5 mta, LNG storage tank size less than 30K m3 and re-gas capacity lesss than 10 MMCFD

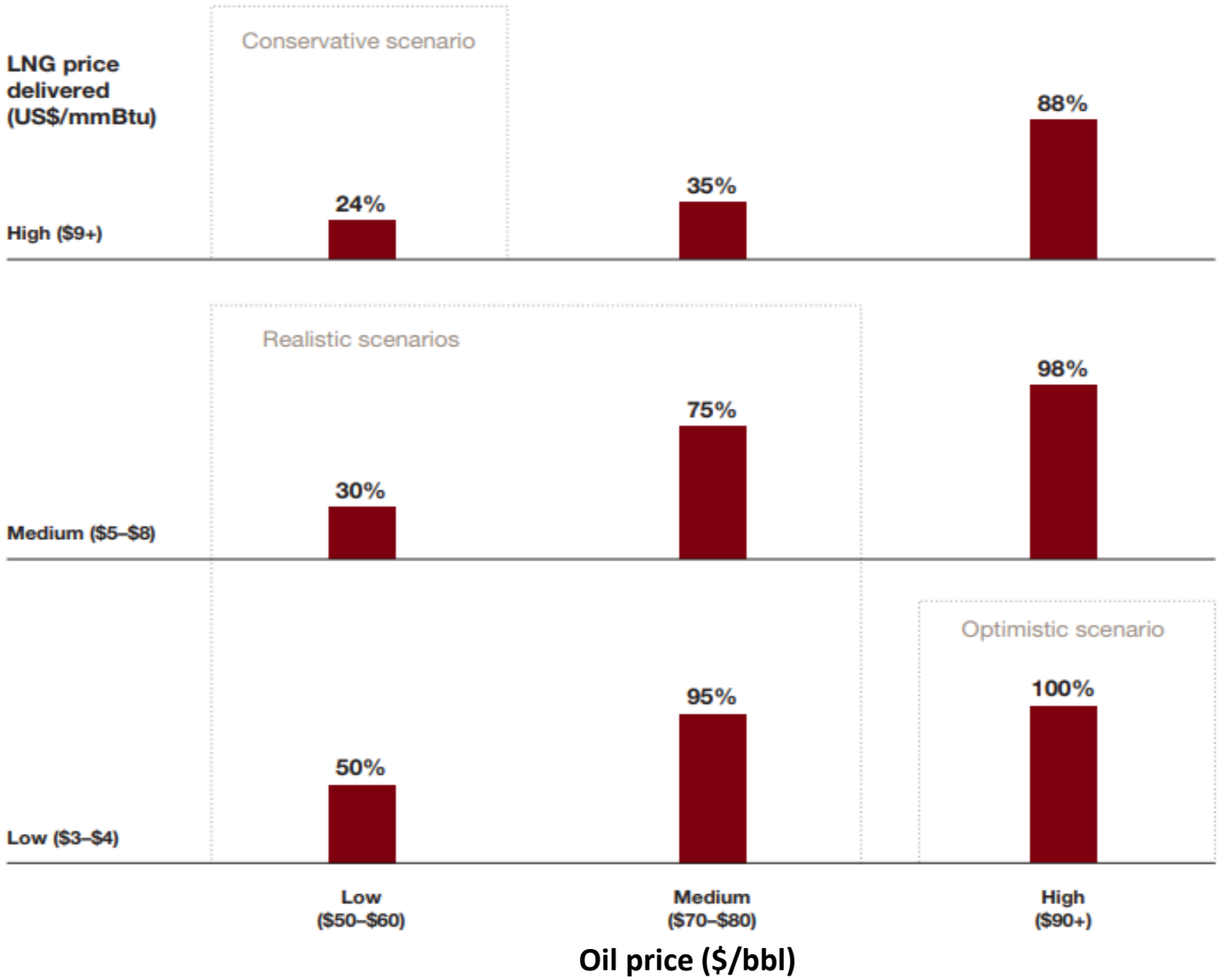
Demand forecast for SSLNG by segment, 2030



- Various sources estimate current market size around 30 MTA
- Market growth rate CAGR 10%

Source: Engie; Strategy& analysis

SSLNG Demand Scenarios



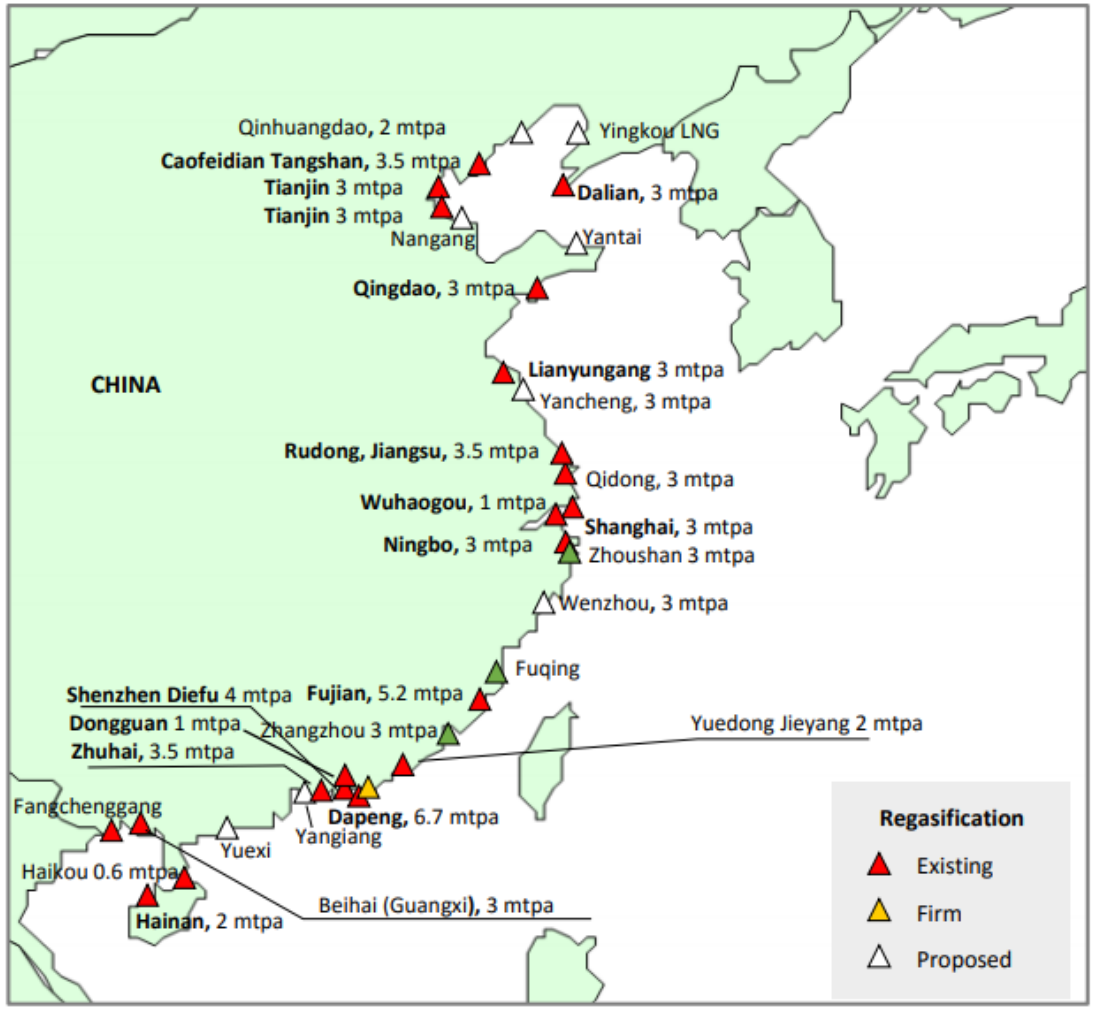
- A signifcant driver of SSLNG will be price of LNG versus oil
- By 2030, if the price of LNG stays between $3 and $4 / mmBtu while oil is above $90 a barrel, ssLNG demand will be more than four times what it would be if LNG cost more than $9 per mmBtu while oil was between $50 and $60 a barrel.

Source: Strategy& analysis

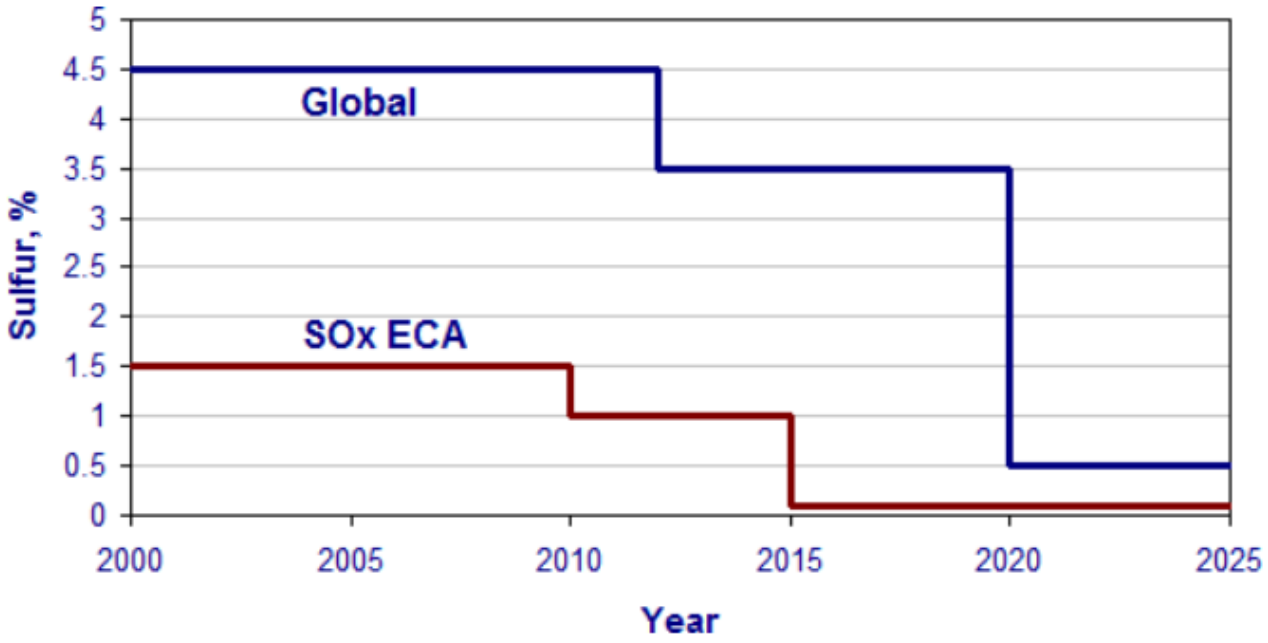
SSLNG landscape in China

China

- 20 LNG receiving terminals
- 4 small scale LNG terminals
- 100+ small scale liquefaction plants
- 5 million NGV's
- 250,000 LNG fuelled trucks
- 3,300 LNG service stations
- 10,000 LNG trucks
- 106 inland river LNG fuelled vessels



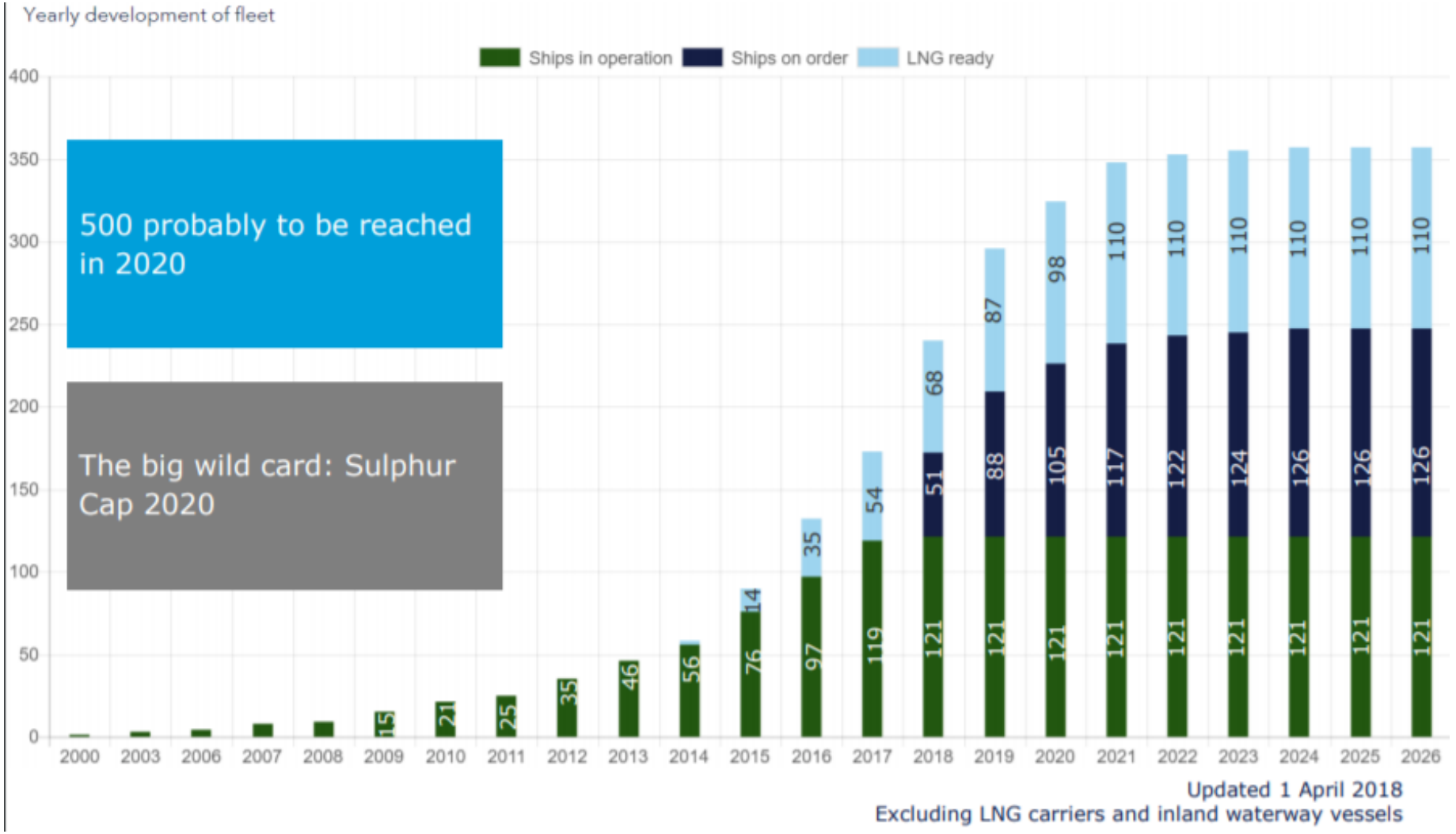
LNG Bunkering



MARPOL Annex IV – Sulfur content limitation

- International Maritime Organization (IMO) is the agency of the United Nations promoting maritime safety, and it is the owner of the «International Convention on the Prevention of Pollution from Ships» known as «MARPOL Convention».
- 1997 and 2008 amendments in MARPOL included Tier I and Tier II/III emission standards in Emission Control Areas (ECA) and globally.
- MARPOL Annex IV limits the sulfur content of the marine fuel globally at 0.5%, starting from 2020, which means no use of FO 3.5% as marine fuel any longer.
- This regulation will lead to increased use of LNG as marine fuel in the upcoming years.

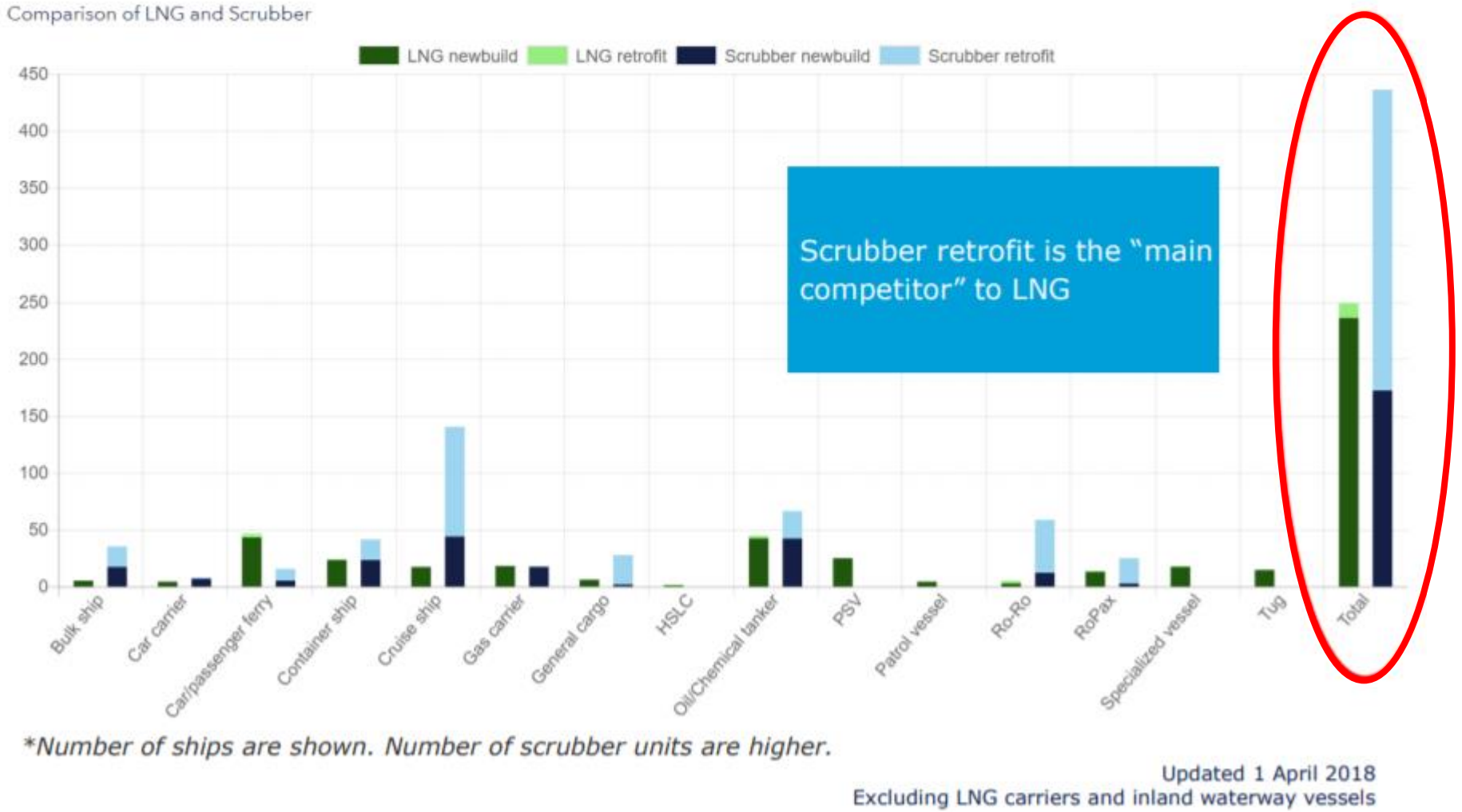
LNG Bunkering



- There are currently 247 confirmed LNG fuelled ships, and 110 additional LNG ready ships

Sources: *DNV GL*

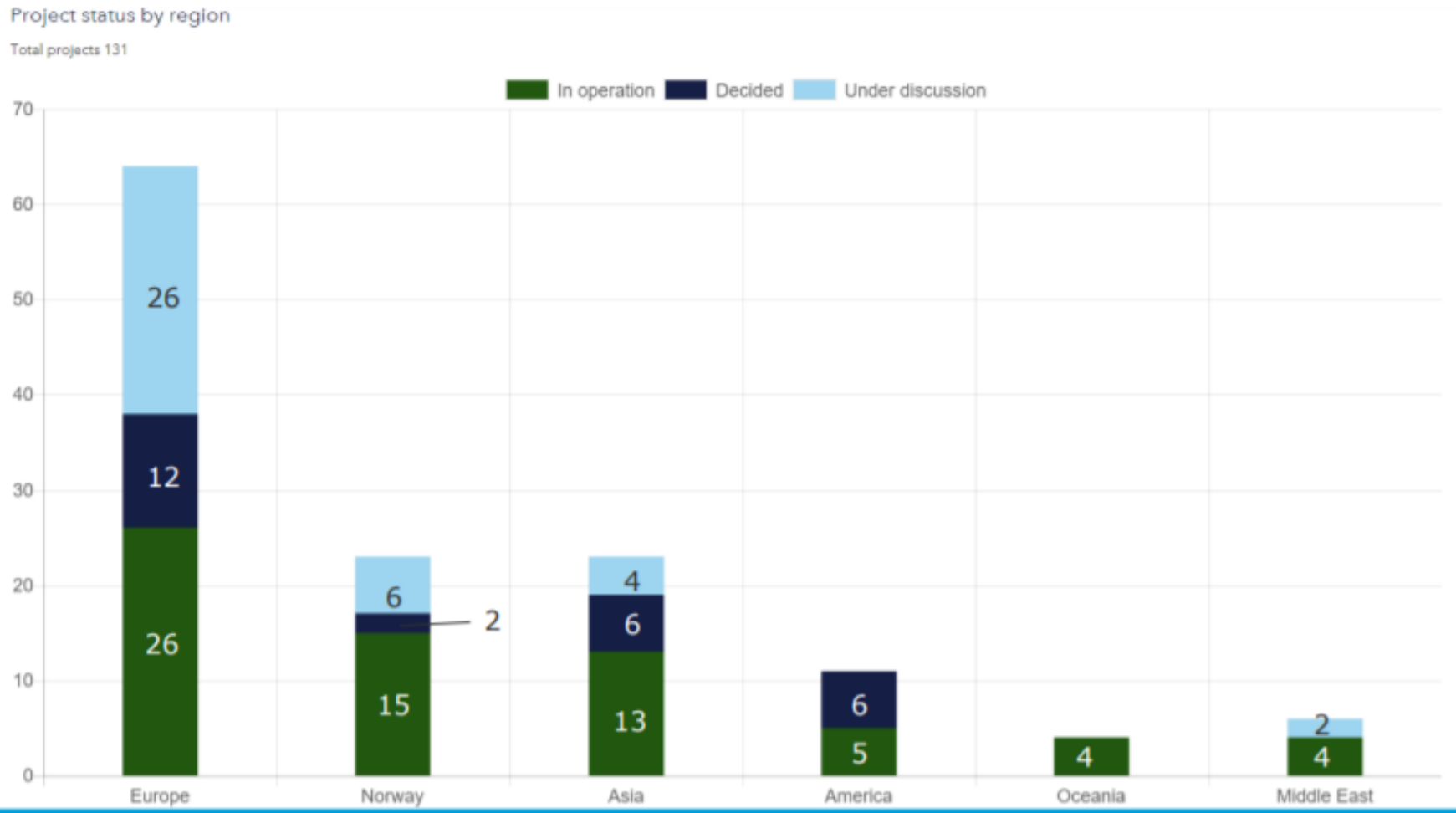
Scrubbing and LNG Retrofit as Alternatives



- Investments in scrubbers are higher, but LNG fuel is the most frequent choice for newbuilds

Sources: *DNV GL*

SSLNG Bunkering Project Development by Region

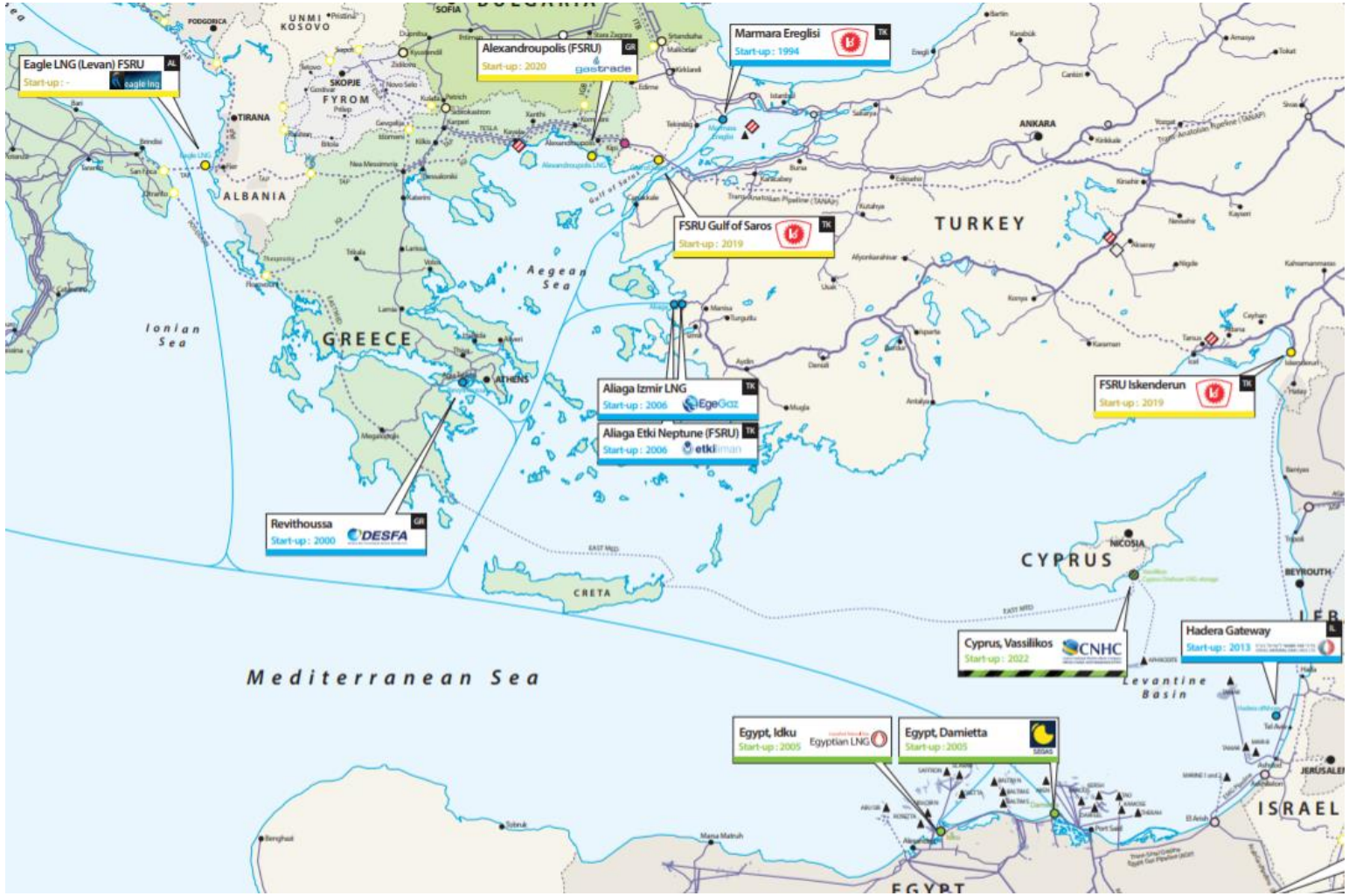


*There may be several bunkering facilities/modes for one location. The count includes local storages, bunker ship loading facilities and truck loading facilities. Locations where LNG fuelled ships can be bunkered by truck or by ship is not counted.

Sources: *DNV GL*

- The majority of SSLNG supply locations for ships are in Europe

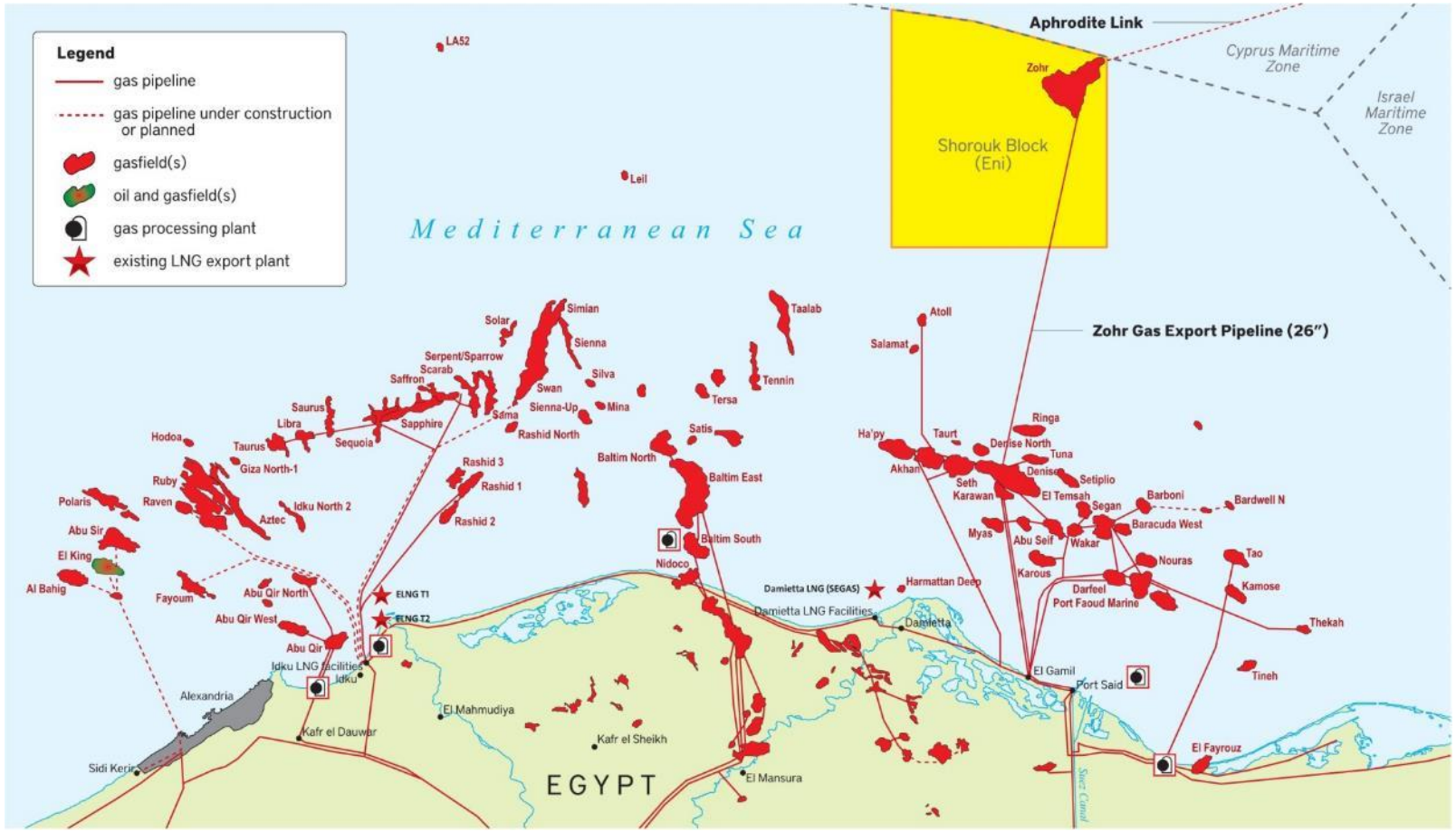
Mediterranean Gas Play



- The majority of the LNG projects in the Mediterranean region are import facilities, and FSRUs have proved to be the most popular scheme.
- Turkey, Egypt, Israel and Jordan make use of FSRUs to import LNG while Greece, Cyprus and Lebanon are evaluating FSRU projects.
- Greece's only active LNG terminal Revithoussa has an ongoing expansion project, and the country considers 2 FSRU projects (Alexandroupolis and Aegean LNG (Kavala)) under development.
- There are LNG liquefaction facilities in Egypt remaining idle for a while, but expected to be active with new gas discoveries in the region. Egypt has two FSRUs active at coast of the Red Sea.

Sources: *Map from Gas Infrastructure Europe*

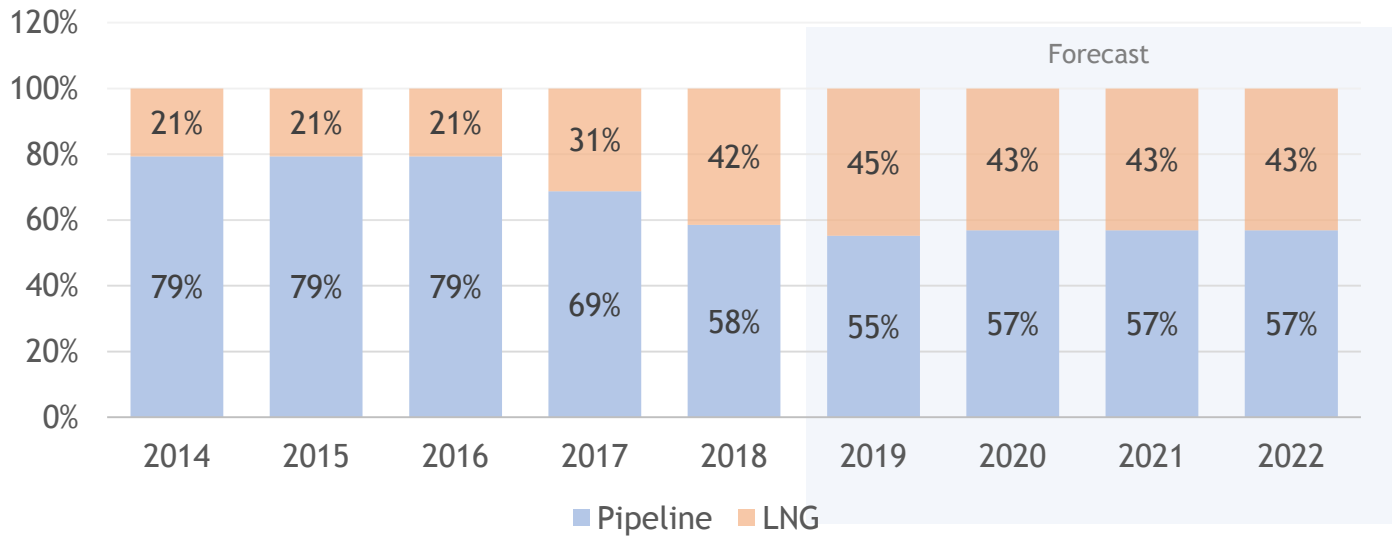
Mediterranean Gas Play



- There are 2 LNG liquefaction facilities in Egypt, Idku and Damietta which have remained idle.
- Indeed, Egypt has been importing LNG through two FSRUs active at coast of the Red Sea.
- However, with major new gas discoveries in the region, these plants are expected to be utilized further and Egypt to cease LNG import
  - West Delta and Zohr in Egypt (30+ tcf)
  - Aphrodite in Cyprus (4.5 tcf) and Leviathan/Tamar (30+ tcf) in Israel

Sources: *Map from Petroleum Economics*

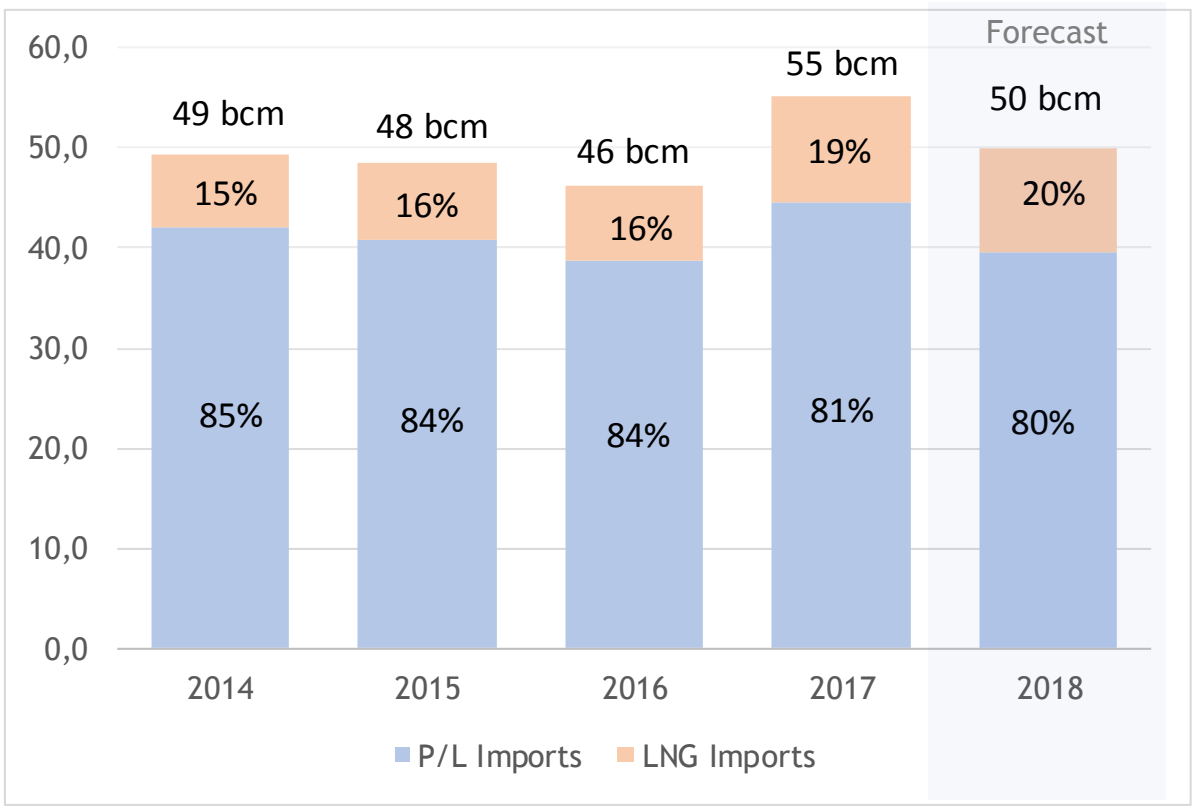
Turkish Gas Network Import Capacities



		Import Capacities					Forecast			
Entry Point	**Type**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Malkoçlar (West Coast Black Sea)	Pipeline	51	51	51	51	51	51	15	15	15
Durusu (Blue Stream)	Pipeline	47	47	47	47	47	47	47	47	47
Turkish Stream	Pipeline	-	-	-	-	-	-	45	45	45
Gürbulak (Iran)	Pipeline	29	29	29	29	29	29	29	29	29
Türkgözü (Azerbaijan)	Pipeline	19	19	19	19	19	19	19	19	19
Marmara Ereğlisi (LNG)	LNG	22	22	22	22	37	37	37	37	37
Egegaz (LNG)	LNG	16	16	16	25	31	31	31	39	39
Etki (LNG)	LNG	-	-	-	20	20	20	20	20	20
Dörtyol (LNG)	LNG	-	-	-	-	20	20	20	20	20
Saros (LNG)	LNG	-	-	-	-	-	20	20	20	20
Eskişehir Tanap	Pipeline	-	-	-	-	6	11	14	16	16
Trakya Tanap	Pipeline	-	-	-	-	-	-	-	8	8
Total		**185**	**185**	**185**	**213**	**260**	**286**	**297**	**315**	**315**

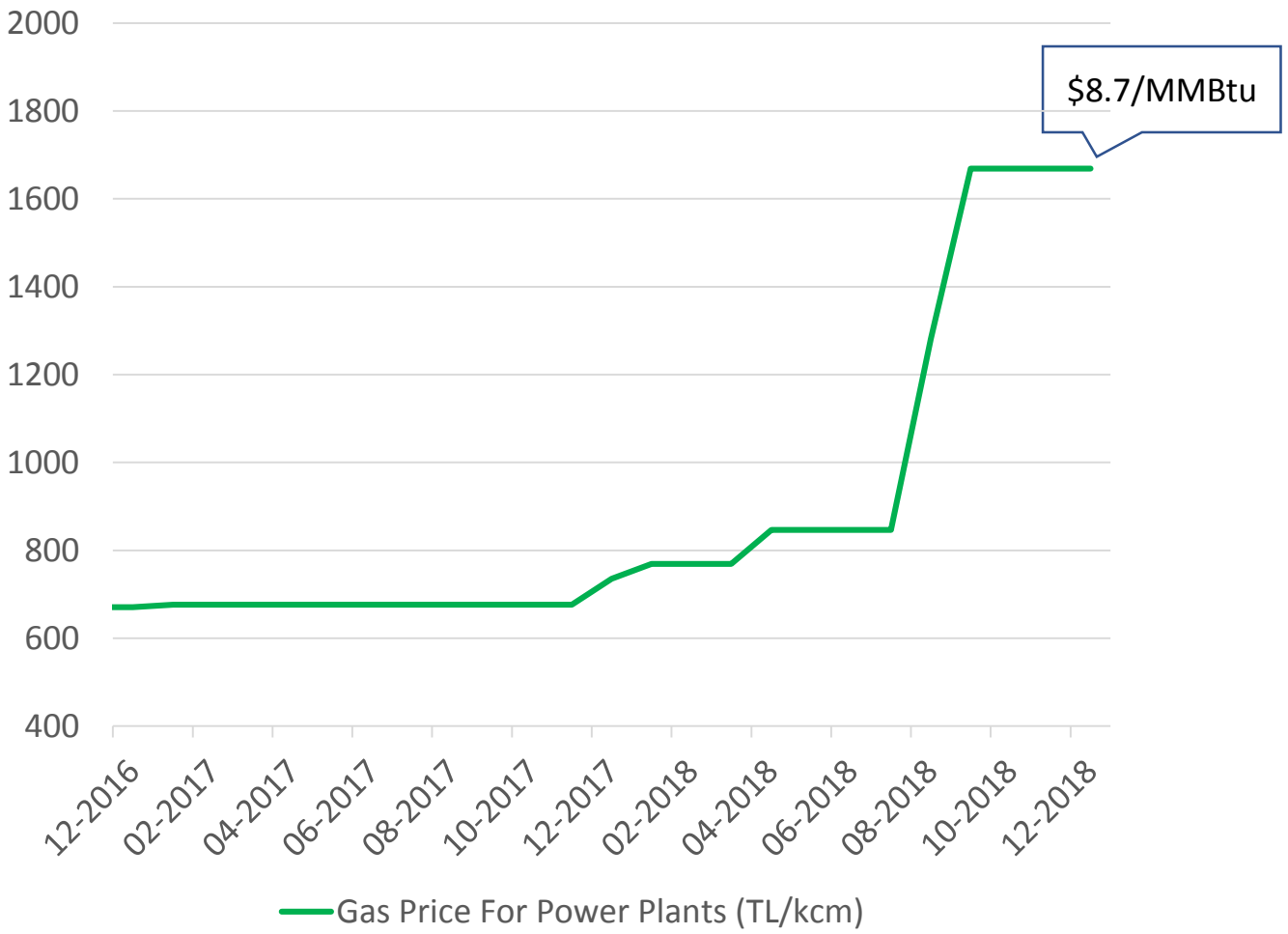
- Share of LNG in import capacities continues to increase in Turkey. After inauguration of Etki FSRU Terminal in Aliaga, and capacity increases in Egegaz and Marmara Ereğlisi terminals, the aggregate daily gas sendout capacity reached to 88 mcm/day at the end of 2017.
- Thanks to increased LNG investments, it is estimated that even when plateau volumes of Tanap and Turkish Stream are taken into account, the share of LNG import points in total import capacities will remain higher than 40% in coming years.
- LNG import ability of the country will lead to access to global LNG market and chance of having a diverse and optimized gas supply mixture in the coming years.

Actual Gas Imports into Turkey



- With its increasing LNG import capacity and high regas terminal utilization rate, Turkey has already started to supply LNG loaded from various sources. It has recently exceeded its historical %15-16 LNG share in gas supply mix, and reached 19% in 2017 and 23% in 2018, July year-to-date volumes considered.
- It has been reported by Energy Market Regulatory Authority that Turkey imported LNG originated from 12 different countries during 2017 and during the first 7 months of 2018.
- In the near future, Turkey shall be ready for re-exporting LNG, in case the country is aiming to be a gas hub in its region, and have a closer look at the bunkering opportunities in the area.

Turkish Gas Market Developments



- During the period between December 2016 to October 2018, gas sales price for power generation facilities **increased by 149%.**

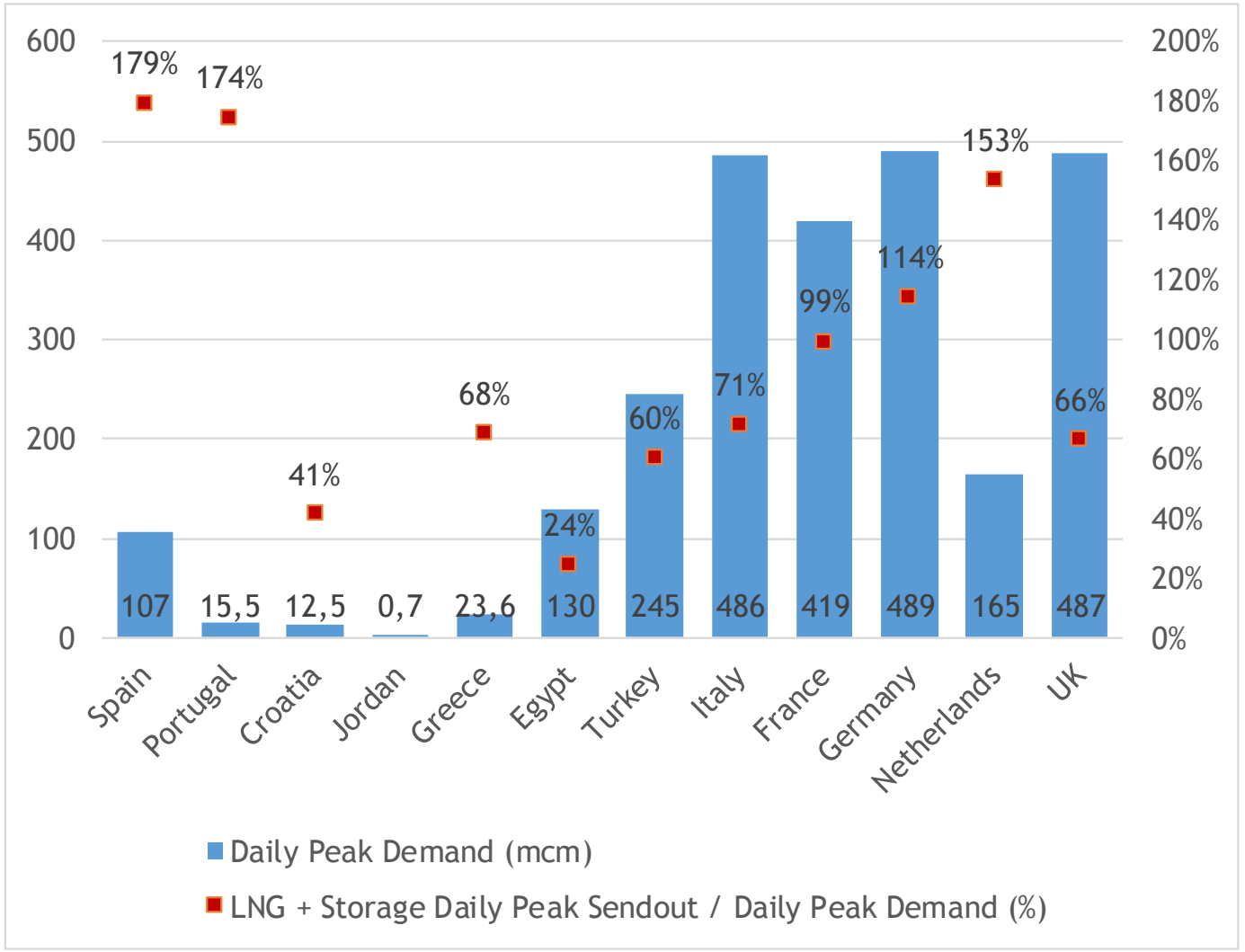
- By these increases, government provided a positive message to the market players for **cost based pricing** on at least one customer segment, which is an encouragement for the gas market.

- Another development for the market was activation of the continuous gas trading platform at the beginning of September in 2018, through exchange entity EPIAS. This is expected to increase gas trading volumes and number of transactions in the market, supporting the aim of having a **regional hub**.

THANK YOU

FSRU Terminals Around the World

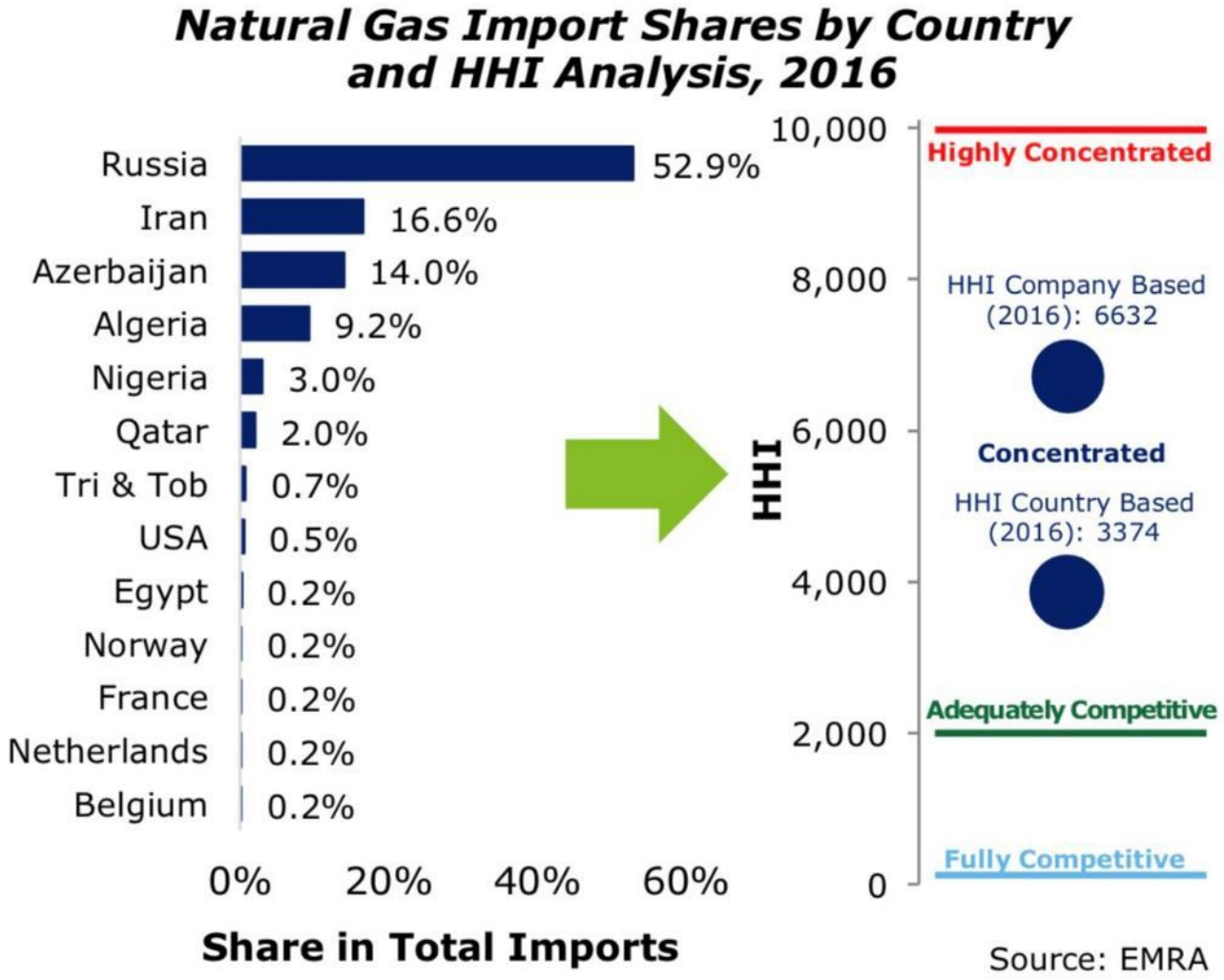
Storage Capacity & Sendout Adequacy



Sources: *Medreg Gas Infrastructure Map of the Mediterranean Region (April 2018), Turkey figures updated*

- For the case of Turkey, the rate of undergrond storage withdrawals per day to Daily avearge consumption was very low at the beginning of 2017.
- Combined with LNG sendout capacities, updated matching rate of Daily Peak Sendout to Daily Peak Demand increased significantly with upgrades in LNG terminals and new FSRU facilities.
- There are ongoing works for Silivri, which will increase the daily withdrawal capacity significantly (i.e. from 25 mcm/d to 75 mcm/d) as a result.
- Expansion Project for Tuz Gölü underground storage facility will lead to greater working gas capacity and withdrawal/injection rates.

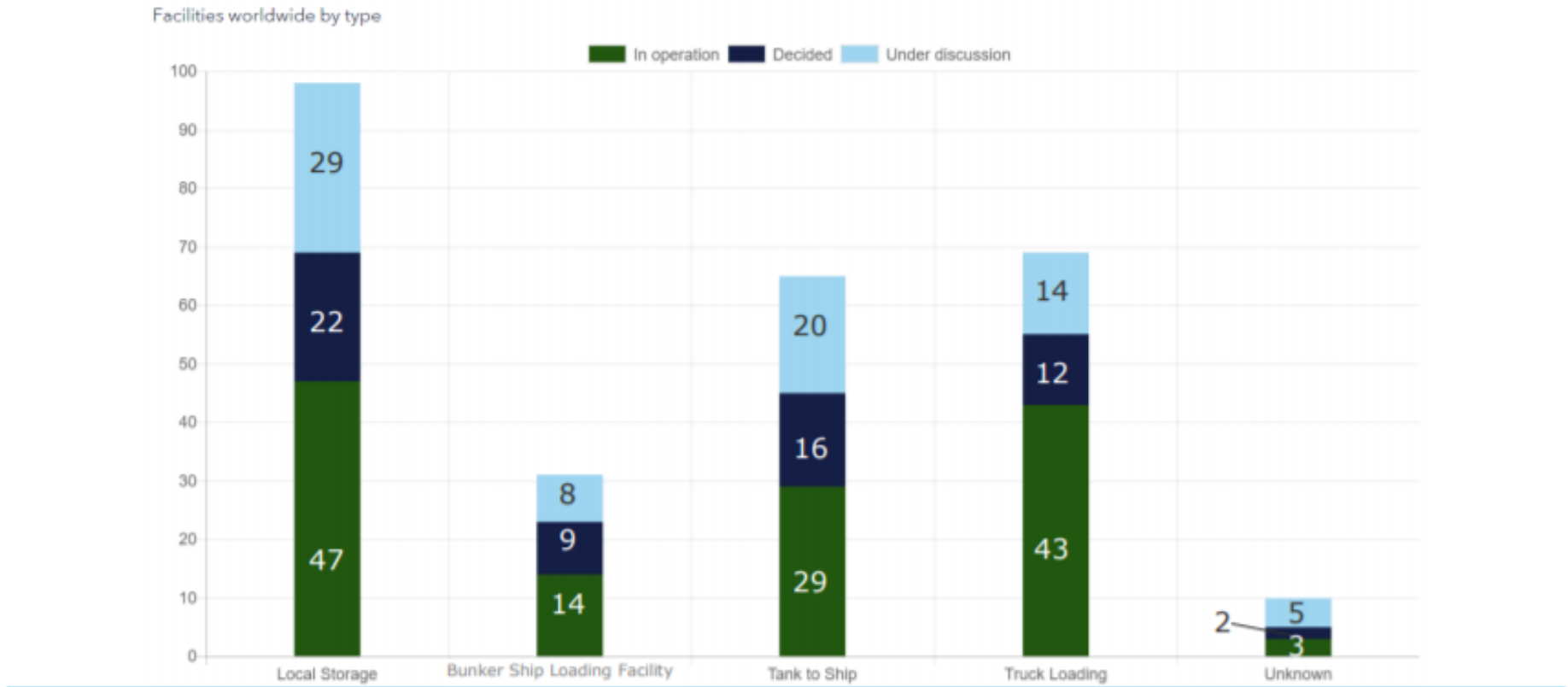
Turkey’s gas supply diversity



Turkey’s gas supply concentration is high in both «Company Based» and «Country Based» analysis

Sources: EMRA, Deloitte

SSLNG Project Development by Application



*Some locations have several types of facilities, which is why the number of facilities is higher than the number of locations.

- Local storage – An intermediary LNG storage
- Tank to ship bunkering – A local storage where an LNG fuelled ship can bunker directly from shore
- Truck loading facility – A terminal where LNG trucks can load LNG (probably under-estimated)
- Bunker Ship loading facility – LNG terminal accessible by small LNG carriers

Sources: *DNV GL*