Liquefied Natural Gas (LNG)

Sector Overview
June 2018

LNG INDUSTRY

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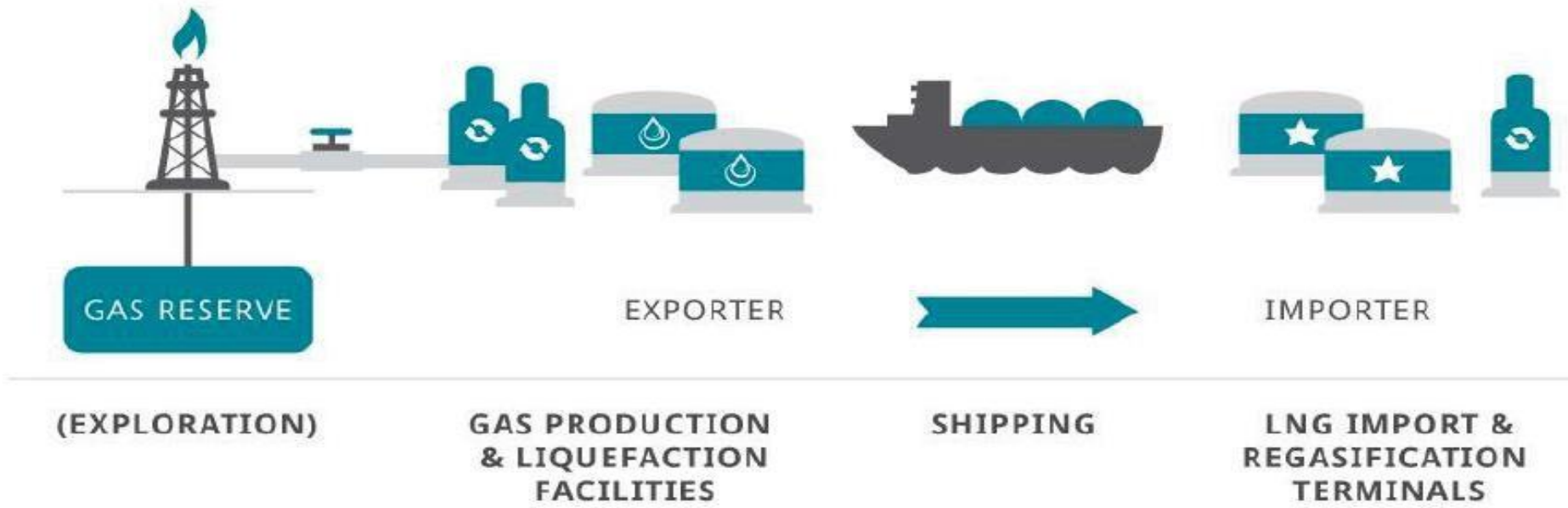
LNG – Lifecycle

- ***Liquefied Natural Gas (LNG)*** **is a form of natural gas converted to liquid form ease of storage or transport. It is odourless, colourless, non-toxic, and non-corrosive.**

LNG achieves a higher reduction in volume than (CNG) so that the (volumetric) energy density of LNG is 2.4 times greater than that of CNG or 60 percent that of diesel fuel. This makes LNG cost efficient to transport over long distances where pipelines do not exist.



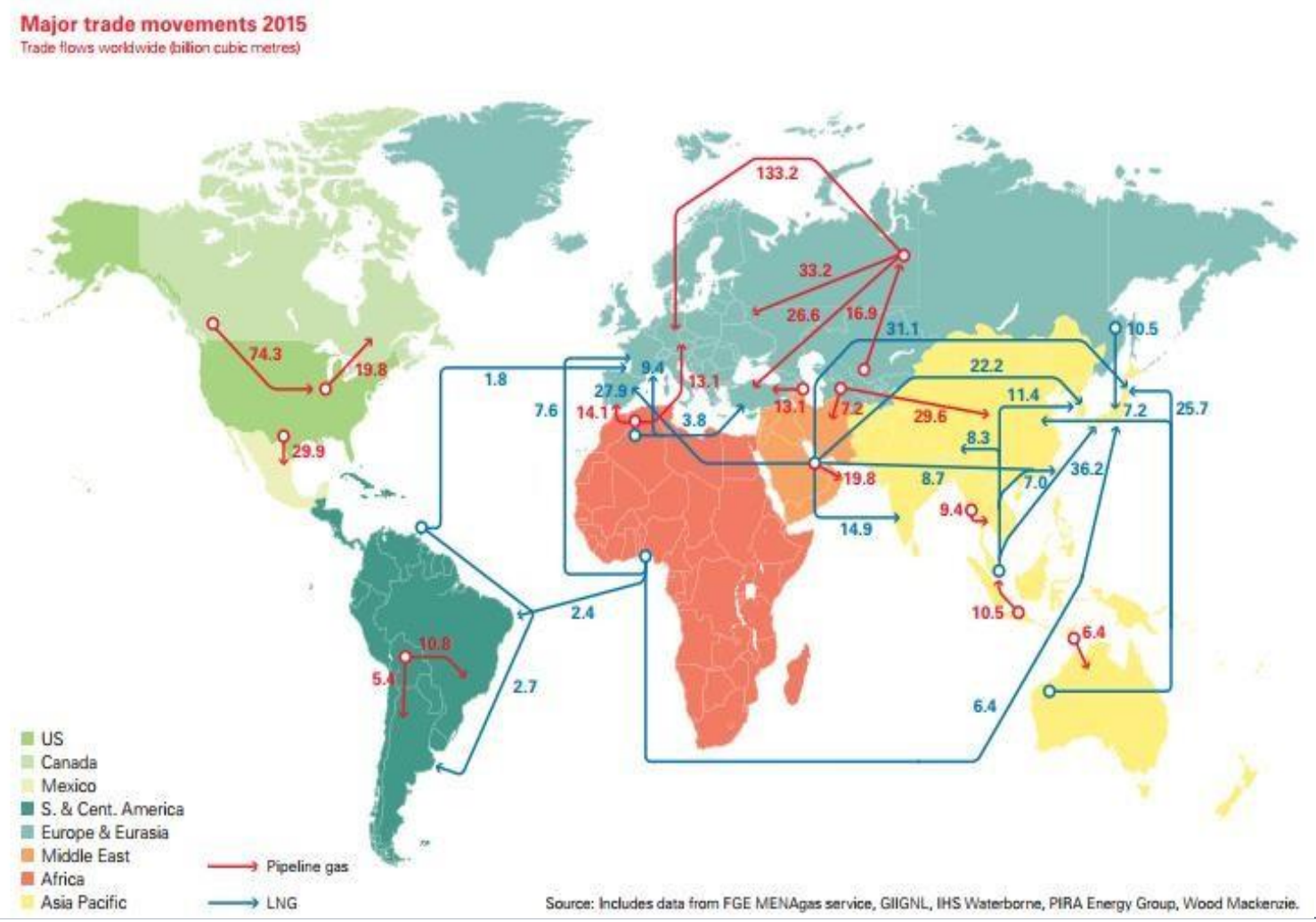
Changes in Global Gas Markets:

- LNG Growth Rate is expected to be seven times faster than pipeline gas trade in the coming years.
- Expected to account for 50% of all globally traded gas by 2035.

SIGNIFICANCE

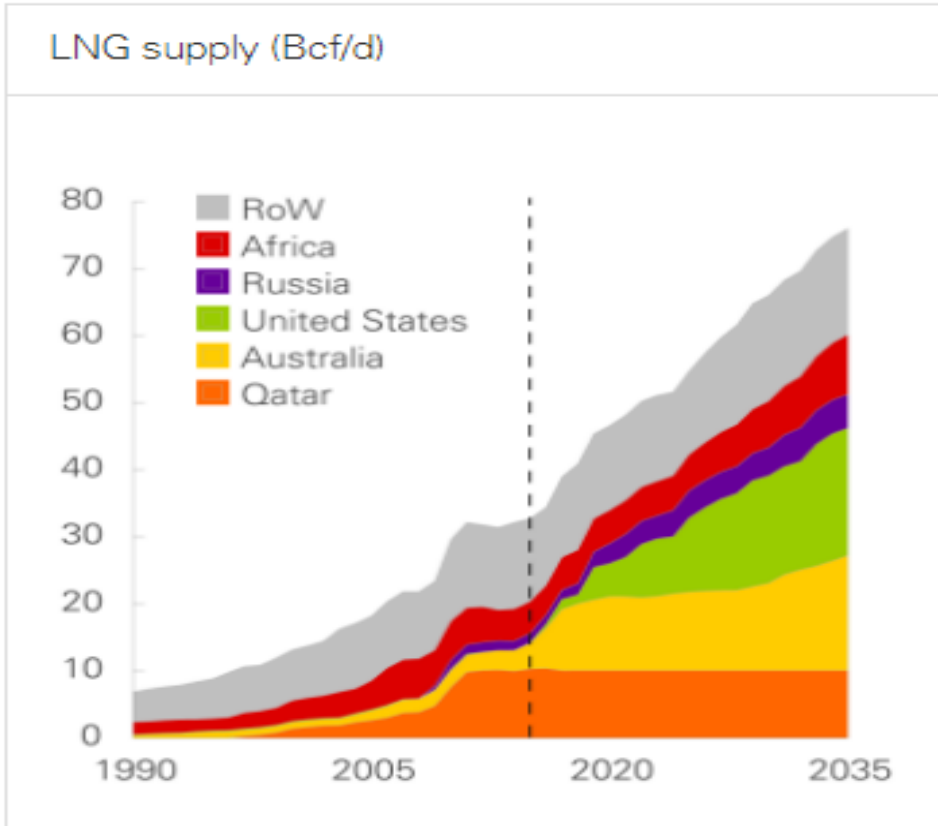
- Unlike Pipeline gas, LNG Cargoes can be redirected to different parts of the world in response to regional fluctuations in demand & supply.
- Due to increase in LNG supply, Global gas market is moving towards integration.

Global Gas Industry



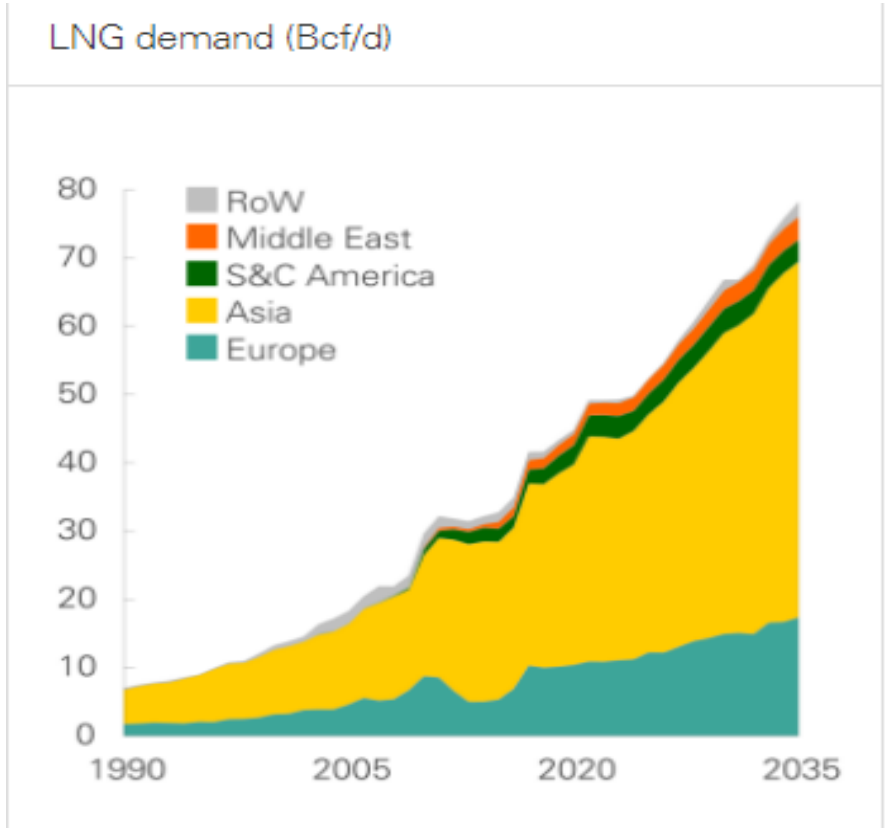
Global Demand and Supply Dynamics

Growth in Global LNG Supply:



** Growth in global LNG supply is led by the US, Australia and Africa*

Growth in Global LNG Demand:



** Rise in LNG Demand: making gas is the fastest growing fossil fuel among Asian countries*

Global Trade – Regional Mix for CY16

billion cubic metres	From									
To	**USA**	**Brazil**	**Russia**	**Oman**	**Qatar**	**UAE**	**Australia**	**Malaysia**	**Others**	**Total Imports**
USA	2.20	0.50	-	-	1.80	-	0.50	0.30	18.90	24.20
Europe	0.50	-	1.00	-	23.70	0.10	-	-	31.10	56.40
Middle East	0.50	-	-	1.30	4.50	-	0.90	0.10	6.90	14.20
Africa	0.10	-	-	-	6.40	-	0.40	-	3.30	10.20
China	0.30	-	0.30	0.10	6.50	-	15.70	3.40	8.00	34.30
India	0.50	0.10	-	0.30	14.00	0.70	1.20	0.10	5.60	22.50
Pakistan	-	-	-	-	2.90	-	0.20	-	0.90	4.00
Malaysia	-	-	-	0.10	0.10	-	0.70	-	0.70	1.60
Japan	-	-	9.50	3.30	15.80	6.50	29.20	20.20	24.00	108.50
Others	0.30	-	3.20	5.50	28.70	0.10	8.00	8.00	16.90	70.70
Total Exports	**4.40**	**0.60**	**14.00**	**10.60**	**104.40**	**7.40**	**56.80**	**32.10**	**116.30**	**346.60**

- *Qatar takes the highest share of global exports of LNG in CY16 followed by Australia and Malaysia.*
- *Japan holds the largest share in imports followed by Europe and China. India emerges as a strong developing economy with Imports of 22.50bcm in the CY16.*
- *Asia Pacific stands as the highest consumer of global LNG having around 70% of the total share in Global Imports.*

Global – State of the Industry

258 MT Global trade in 2016[1]

83 MTPA FSRU capacity, January 2017

879 MTPA Proposed liquefaction capacity, Jan 2017

439 Vessels LNG Fleet, Jan 2017

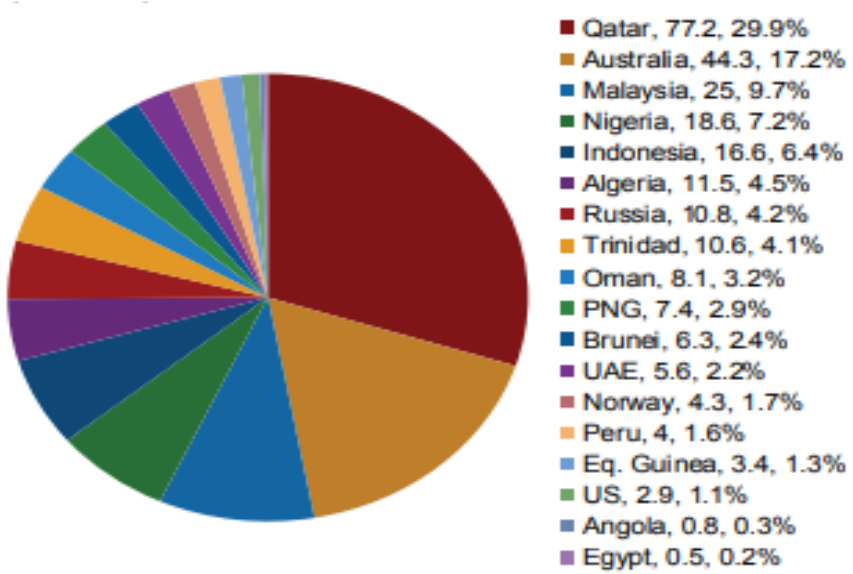
795 MTPA Global nominal regasification capacity, Jan 2017

10% of Supply share of LNG in global gas supply in 2015[2]

1 & 2 . Data for 2017 not available.

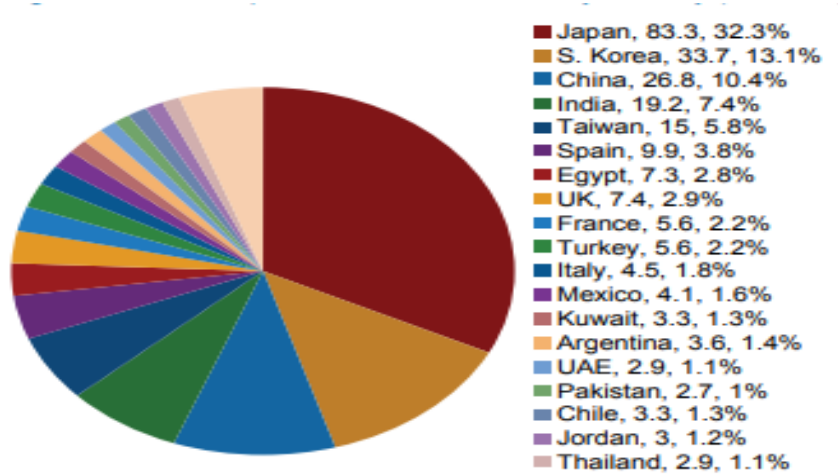
Global Trade | Countries

LNG Exports by Countries



Note: Numbers in the legend represent total 2016 exports in MT, followed by market share. Source: IHS Markit, IGU

LNG Imports by Countries



Note: Number legend represents total imports in MT, followed by market share %. "Other" includes countries with imports less than 2.5 MT (by order of size): Singapore, US, Portugal, Puerto Rico Belgium, Malaysia, Brazil, Lithuania, Poland, Dominican Republic, Greece, Netherlands, Israel, Canada, Jamaica, and Colombia. Sources: IHS Markit, IGU

- Total number of exporting countries increased from 17 in CY15 to 18 in CY16 as:
  i)Angola and Egypt both returned to producing LNG following a halt in CY15 due to repair work,
  ii)and Yemen, which exported LNG during 1HCY15, did not export a single cargo in CY16 due to ongoing instability in the country.
- Total number of importing countries increased from 33 in 2015 to 35 in CY16, with Jamaica and Columbia entering the industry.

Global Pricing Mechanism:

- Pricing in world gas markets is driven more by local and regional factors. Following are the details pertaining to pricing contracts and mechanism more widely available in the International Market:

- **Pricing Contracts:**
  - **Long-term contracts**
  - **Medium-term**
  - **Spot & Short-term contracts**

- **Pricing Mechanism:**

1. ***Hub-Based:*** Prices are largely set at liquid trading hubs, the largest and most important of which is **Henry Hub** in Louisiana.
2. ***Oil-Linked:*** Without established and liquid gas trading markets, the price of LNG for majority of Asia and emerging markets is set via oil-linkages.

Global Pricing Dynamics

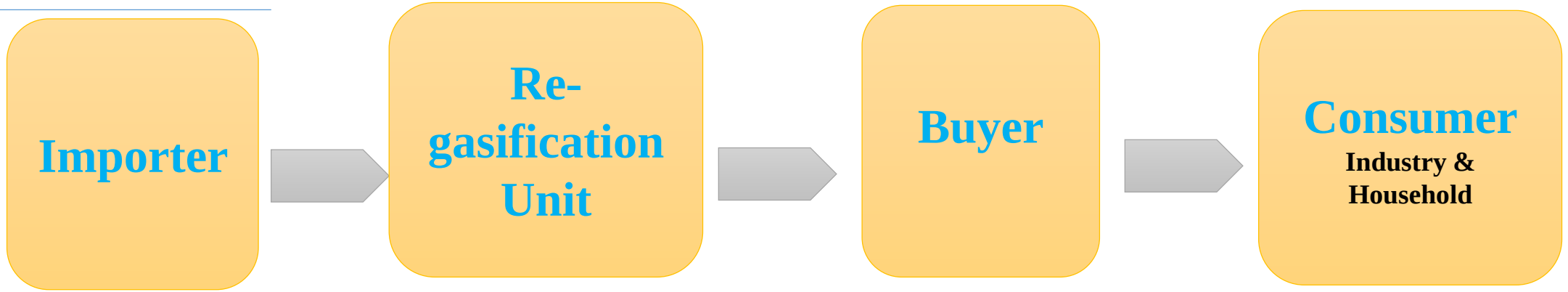
US Entry as an Exporter

- The technological advancements during the last decade in US Shale gas boom led to a 79% increase in reserves and a 50% increase in production of natural gas.
- Increased shale production reduced natural gas prices in the US in comparison to Europe and Asia, creating a commercial logic to import from US. This led to increase in the projected export facilities from US.
- Lower prices in US as compared to Europe and Asia since 2009 have increased the appetite for short-term supply contracts and spot trade of LNG. These contracts offer buyers the flexibility to arbitrage prices between alternate LNG markets.

Declining Oil Prices

- The decline in oil prices in the last 3 years impacted the economics of LNG import from the US. Due to a large share of long-term contracts and oil-linked pricing, US LNG exports were not able to compete with Russian Pipeline supplies and Qatar's LNG exports. With a sharp decline in prices in 2014-15 resulting in lower spread between the two contracts, US LNG exports slowed down.
- However, with crude prices increasing from $29 in Jan16 to $54 in Dec16, last year saw a return to preference for US LNG contracts.
- European market: Europe would not have a direct advantage of US LNG exports but would reap indirect benefits due to increased total supply.
- ***Asian market:*** The higher shipping cost due to longer distances would make the export commercially unviable in most regions at current oil prices.

Pakistan LNG Model



- Total Natural Gas Supply of the Country reached to 4,131 MMCFD in the FY2016-17.

- Major Gas fields in the country include Sui, Uch, Qadirpur, Sawan, Zamzama, Badin, Bhit, Kandhkot, Mari & Manzalai.

- Pakistan began to import LNG in 2015 with Engro Elengy Terminal establishing its first LNG Regasification terminal in Port Qasim, Karachi with a storage and re-gasification capacity of 600mmcfd. The License for operation of LNG Terminal was granted on 18th March,2016. Till Dec-15, the terminal was handling 200mmcfd of LNG. Post Jan-17, it has been operating at its peak capacity of 600mmcfd.

Domestic Industry | Gas Production & Consumption

Demand- ~6000mmcfd

Supply- ~4000mmcfd

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Shortfall- ~2000mmcfd

Top 3 Companies Producing Natural Gas in FY17

Company	Production (mmcf/year)	% Production
Oil & Gas Development Co. Ltd	383,615	25%
Pakistan Petroleum Ltd	329,367	22%
Mari Petroleum Co. Ltd	243,820	16%
Total	**956,802**	63%
Others	551,013	37%
TOTAL	**1,507,815**	100%

LNG Imports License

Status of LNG Import Licenses

(MMcfd)

Sr. No.	Name of LNG Developer	License Issuance Date	Type of License Issued	Envisaged RLNG
i.	PGP Consortium Ltd.	Dec 21, 2016	Modification of License for Construction of LNG Receiving Terminal at Port Qasim, Karachi.	600-750
ii.	Global Energy Infrastructure Pakistan Limited	Sept 23, 2016	Extension in license for construction for LNG Integrated Project at Port Qasim, Karachi	500
iii.	Engro Elengy Terminal Limited	Mar 18, 2016	Operation License of LNG Receiving Terminal at Port Qasim, Karachi	600-690
iv.	Bahria Foundation	Mar 17, 2015	Provisional License. The company has applied for construction license.	-

- At present, two of the above LNG Terminals are operative – Engro Elengy and PGP consortium Limited. Both are operative at a capacity of ~600mmcfd each.

- The terminal for PGP Consortium Limited was completed in Nov-17 with a maximum capacity of 750mmcfd and a project cost of $300mln. This project is providing ~3,600MW of electricity generation for new RLNG-based power plants set up by the Government.

Domestic Consumption | Natural Gas & LNG

Sector Wise Natural gas & LNG Consumption (July 1,2016 to Feb 28, 2017)

Sector	Natural Gas Consumption (mmcf/day)	% Share in Consumption (Natural Gas)	RLNG Consumption (mmcf/day)	% Share in Consumption (RLNG)
Power	980	30%	116	28%
Domestic	801	25%	0	0%
Commercial	89	3%	0%	0%
Transport	150	5%	43	10%
Fertilizer	611	18%	64	16%
General Industry	613	19%	187	46%
TOTAL	**3,244**	**100%**	**410**	**100%**

Industry Developments | Terminals

- **3rd LNG Terminal (Expected CoD: FY19)**
- Installation of a first merchant LNG Terminal without any government intervention – whereby import, regasification and supply – whole cycle would be managed by Engro Elengy Terminal (Private) Limited.
- Project being initiated by Engro Elengy Terminal (Pvt) Limited in partnership with Gunvor, Shell and Fatima group with a total project cost of $500mln.

4th LNG Terminal to be set-up by PGPC:

- After installation of its 1st floating FSRU with a re-gasification capacity of ~750mmcfd, Pakistan GasPort Consortium in collaboration with Trafigura – a Singaporean commodity trading company plans on establishing a new re-gasification unit which will operate entirely for the private sector without recourse to the Government. Details are yet to be disclosed.

5th LNG Terminal

- Exxon Mobil and Energas are also planning on installation of an FSRU near port Qasim. Related facts and timeline are not yet disclosed.

Potential benefits of LNG Revolution

- LNG is at least 30% more economical in use than CNG. Since Pakistan is one of the top CNG-user countries, LNG availability to automobiles will result in considerable savings for consumers as well as the Government.

- If the Railway Sector starts planning to switch from diesel-run locomotives to LNG, this would save around 40-60% of the fuel cost.

- If the furnace-oil based power plants are replaced by more energy-efficient LNG based plants, this is expected to save $1.5-2bln in foreign exchange annually.

- The availability of cheaper fuel will increase the country's competitiveness, resulting in revival of exports and the overall economy.

Challenges for LNG in Pakistan

- Pricing mechanism for commercial and households use of LNG is yet not clear.
- Devaluation of currency – RLNG based power generation costs higher than conventional power plants.
- Inequitable tariff distribution amongst provinces.
- The emergence of circular debt may hamper the continuity of smooth operations.

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4. **US Energy Information Agency (EIA)**
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6. **Engro Elengy Terminal (Private) Limited**

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