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Analysis of LNG/LPG Supply Chain and its Sustainability in Peace and War
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ANALYSIS OF LNG/LPG SUPPLY CHAIN AND ITS SUSTAINABILITY IN PEACE AND WAR

INTRODUCTION

1. Natural Gas is a clean, safe, efficient and environment friendly fuel. The Gas has been the backbone of the energy sector in Pakistan, however, its indigenous sources of supply have not grown proportionately with demand. The indigenous gas supplies contribute about 35 percent in total primary energy supply mix of the country.[1] This appears to be insufficient to meet the increasing demand of the energy sector including power generation, domestic use, and fertilizer and other industrial units in the country. The total natural gas supply in 2019 stood at approximately 4,397 MMCFD with local production contributing about 3,416 MMCFD (77.69%) natural gas and 981(22.31%) MMCFD coming through LNG imports.[2] The demand-supply gap during 2018-19 was approx. 2bcfd, which is expected to rise to 3.68bcfd by 2024-25 and 5.39bcfd by 2029-30[3]. In addition, as the indigenous natural gas supply is expected to reduce, Pakistan in future will have to rely increasingly on the imported LNG to meet the country's gas demands or enhance exploration and production activities and perhaps both.[4]

2. Another commodity used in the in the energy sector for utilization in the country is Liquefied Petroleum Gas (LPG), which is a by-product of natural gas extraction and crude oil refining. LPG is a mixture of hydrocarbon gases, the most common being butane and propane.[1] At room temperature, LPG is a colorless and odorless non-toxic gas which can be transformed into liquid under pressure or cooler conditions and its volume is reduced to 1/250 of the gaseous aggregate state. This allows storage and transportation of LPG easy in cylinders. Local Gas producing fields, refineries in Pakistan and imports are the three main sources of LPG supply in the country. Total market demand for LPG in 2019 was around 1057707 TOE (Tones Oil Equivalent). The 76% of the demand was supplied by domestic field plants (612466 TOE) and refineries (193488 TOE).[5] Whereas, around 251753 TOE (24%) of LPG was imported in 2019.[6] The LPG is primarily consumed in the domestic and industrial sectors (e.g., textile, ceramic, steel, glass, edible oil, beverage and chemical) particularly in natural gas starved areas/ sectors and in peak shaving periods in the urban territories, mostly in Punjab province. Currently, LPG contributes about 1.2 percent towards the national primary energy supply[7]. 76% of the

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[1] http://www.finance.gov.pk/survey/chapters_21/14-Energy.pdf

[2] http://www.mpnr.gov.pk/SiteImage/Downloads/1389(20)Development%20Plan%20New%20Mail%20on%2011-11-2020%20(2nd%20Draft).pdf

[3] https://www.dawn.com/news/1603381

[4] Ibid

[5] Pakistan Energy Year Book, HIDP, 2019.

[6] Ibid

[7] GoP, "Economic Survery of Pakistan," 2021.

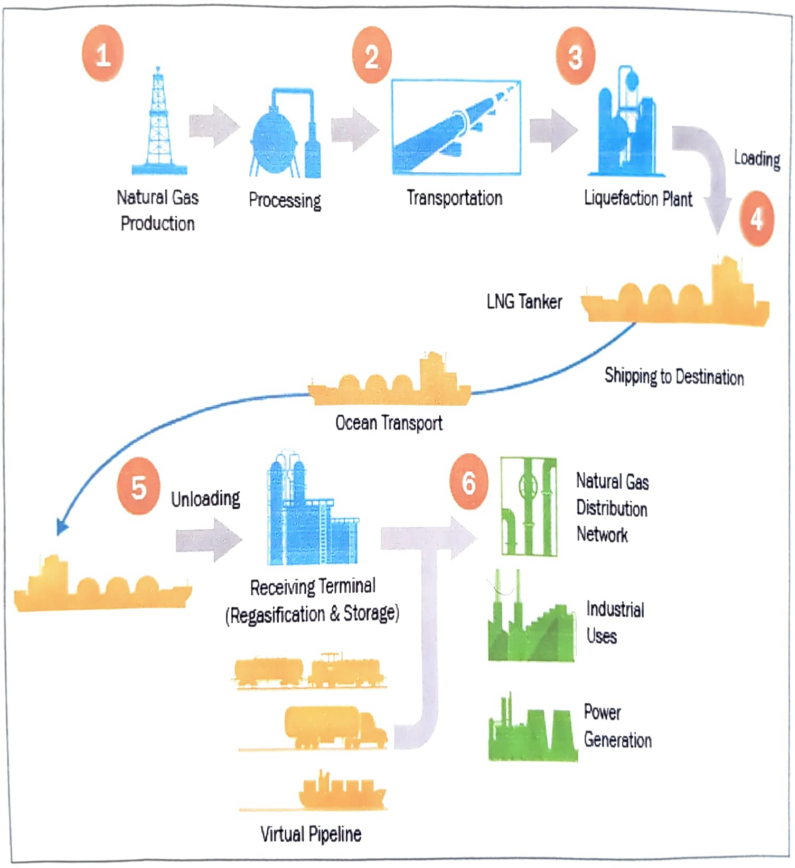
LPG consumed was through the domestic production, whereas the rest 24% was imported during FY 2019-20[8].

3. With the growing energy needs, Pakistan's dependence on imported LNG and LPG will further increase in future. Therefore, improvement/development in existing/new infrastructure for handling of imported LNG/LPG is required. This study will therefore discus the existing supply chain of LNG/LPG and its sustainability in future.

LNG/LPG SUPPLY CHAIN DEPICTION

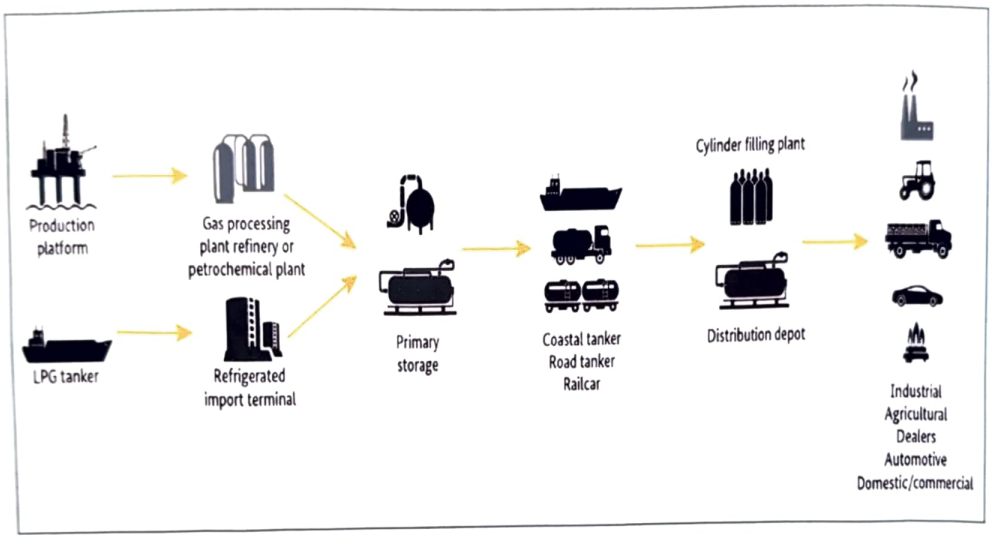
4. Following two diagrams explains the supply chain of LNG and LPG.

a. **LNG.** Natural gas after extraction is processed to liquefied form at Liquefaction Plant and transported through ships to destinations where it is re-gasified and transferred to transmission lines for distribution to consumers.



[8] GOP, "Economic Survery of Pakistan," 2020.

b. **LPG.** A typical supply chain for LPG is given in the figure below. The gas is produced during the cleaning process of crude oil and natural gas and is utilized by its liquefaction. LPG is delivered from supply points in a liquefied form to primary storage facilities, where it is stored under refrigeration or pressurization. It can then be sold to distributors in its refrigerated or pressurized form.



LNG IMPORT IN PAKISTAN

5. The Government of Pakistan (GOP) has contracted the supply of LNG at government levels through long term contracts and short term contracts. Two state-owned companies, that is, Pakistan State Oil (PSO) and Pakistan LNG Limited (PLL) are authorized by the GOP to import LNG.[9] PSO has signed a long term contract (span of 15 years) with Qatar. PLL has relatively short-term contracts with Guvnor (one of the world's largest independent commodities trading housed based in Switzerland) and Shell Energy. LNG imported by PSO is re-gasified at the Engro Elengy Terminal Pakistan Limited (EETPL) at Port Qasim, Karachi. EETPL has the peak capacity of up to 690 MMCFD for re-gasification. Similarly, PLL has hired the capacity of Pakistan Gas Port Consortium Limited (PGPCL) for re-gasification of LNG at Fauji Foundation's Fauji Oil Terminal & Distribution Company Limited (FOTCO) Port Qasim, Karachi. PGPCL has a peak re-gasification capacity of 750 MMCFD.

6. Each of the two LNG terminals at Port Qasim are contracted for handling and processing of 600 MMCFD Re-gasified LNG. After arrival of LNG cargo ship, the LNG is

[9] file:///C:/Users/BUKC/Desktop/LPG-LNG/Gas-and-Petroleum-Market-Structure-and-Pricing.pdf

transferred to Floating Regasification Storage Units (FRSU) for Re-gasification of LNG. Subsequently, Re-gasified LNG is supplied into the national pipeline networks.

LNG/LPG IMPORT TERMINALS

7. Following terminals for import of LNG/LPG (2xLNG & 2xLPG) are operating at Port Qasim in Pakistan.

LNG TERMINALS

a. **Pakistan Gasport Consortium Limited (PGPCL)**. It was established in December 2017 with handling capacity of 750 mmcsfd. It consists of a state-of-the-art Floating Storage and Regasification Unit (FSRU), and Fauji Foundation's Fauji Oil Terminal & Distribution Company Limited (FOTCO) is providing metering system and the 14 -kilometer subsea and onshore pipeline from the jetty to the national gas grid.

b. **Engro Elengy Terminal Pakistan Limited (EETPL)**. This terminal is operational since 2015 and has the capacity for regasification of LNG up to a peak of 690 mmscfd. The terminal is owned by Engro and Royal Vopak Netherland. The re-gasified LNG is transferred through 10km pipeline to SSGC main gas grid.

LPG TERMINALS

a. **Sui Southern Gas Company LPG (Pvt.) Limited (SLL).** This terminal is owned by Sui Southern Gas Company Limited, engaged in LPG marketing and distribution across the country. The Company owns and operates a dedicated open access LPG terminal with storage facilities at Port Qasim to handle LPG imports with 6,500 MT of storage Capacity. SLL is a fully integrated LPG Company capable of providing end to end solutions right from the terminal at Port Qasim to the supply of consumer retail packs of LPG.

b. **Engro Vepok Terminal Limited (EVTL)**. It is state of the art Terminal and Storage facility for bulk liquid chemicals and LPG at Port Qasim. The total storage capacity of EVTL is 7000 MT.

LNG/ LPG IMPORT DATA

8. The import data of last three years of LNG/LPG obtained from Port Qasim Authority is as under:

LNG (Figures in Tonnes)

Year	PGPCL (Pakistan Gas Port Consortium Limited)	EETPL (Engro Elengy Terminal Pakistan Limited)
2018-19	2, 802, 834	4427, 602
2019-20	2, 443, 606	4412, 802
2020-21	3, 770, 679	4550, 878

LNG (NO OF VESSELS)

Year	PGPCL	EETPL
2018-19	42	28
2019-20	37	45
2020-21	58	39
TOTAL	**137**	**112**

LPG (Figures in Tonnes)

Year	SSGC	EVTL (Engro Vopak Terminal Limited)
2018-19	85, 393	109, 593
2019-20	149, 562	180, 953
2020-21	182, 792	180, 239

LPG (NO OF VESSELS)

Year	SSGC	EVTL
2018-19	25	73
2019-20	37	74
2020-21	46	71
TOTAL	**108**	**218**

9. It is evident from the above that 249 LNG ship cargos and 326 LPG ship cargos arrived in Pakistan in last three years, with an average of 83 vessels of LNG and 108 vessels of LPG berthed at Port Qasim per year. The continuity of LNG/LPG shipments with safety is crucial for sustained provision of gas to meet the energy needs of the country. The gas cargo supplies are expected to increase in future to meet the growing demands of energy in the country. Therefore, there is a need for setting up of new

LNG/LPG terminals in the country to have more flexibility. In addition, the safe and secure arrival of cargos at the terminals is also of utmost importance for uninterrupted supply of gas, particularly during tension periods. In addition, there is a need to enhance indigenous productions of oil and gas as well to reduce the dependence on imported LNG/LPG.

SUSTAINABILITY OF LNG/LPG IN PAKISTAN

10. While Pakistan's dependence on overseas shipments of the gas has increased ever since imports began in 2015. Owing to the increasing demand, it is inevitable to develop long term plans and execution of existing planned projects for sustainable supply chain. In this regard following significant points are have been analysed for consideration.

a. **Incentivize indigenous discoveries.** The exploration of oil and gas in the country needs to be incentivized for new discoveries to meet the shortages of growing energy needs. Pakistan offers huge potential for the exploration & production of oil and gas. Vast areas in the province of Balouchistan, Punjab and Khyber Pakhtunkhwa remain unexplored.[10] Similarly, there is a need to focus more on off shore drilling/discoveries in Exclusive Economic Zone of Pakistan. United Energy Pakistan (UEP) and Exploration & Production (E&P) carried out extensive 3D seismic data interpretation and other detailed studies on offshore potential of Pakistan in collaboration with China Petroleum National Corporation and China National Offshore Oil Company which have supported the possibility of existence of hydrocarbon system.[11] Presence of numerous gas seepages along the coastal area of Makran basin supports the argument.[12]

b. **Setting up of new terminals for imported shipments.** There is a need to set up new terminals and receiving facilities to handle the increasing supply of gas in future. It may be mentioned that following two terminals have already been approved by the Government of Pakistan. Operationalization of these terminals will help in handling of increased gas cargos.

(1) **Energas Gas terminal at PQA by Lucky Group.** It is a joint venture between Lucky Group, Sapphire Group and Hallmore Power. The group is planning to set up a LNG terminal at Port Qasim along with a floating ship re-gasification unit (FRSU) of 600msft^3 per day capacity.[13]

(2) **Tabeer Energy Terminal by Mitsubishi Group.** The terminal is being setup by Mitsubishi Japan for handling LNG shipments at Port Qasim. The terminal will have capacity of handling 750-1000 mmcfd.

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[10] Development Plan for Pakistan Oil & Gas Industry 2020.
[11] Ibid.
[12] Ibid.
[13] https://www.cemnet.com/News/story/162405/lucky-group-forms-joint-venture-for-lng-terminal.html

c. **Establishment of on land storage facilities for LNG.** At present there is no on-land storage facility for LNG exists in Pakistan. The storage facility is essentially required to manage strategic reserves and sustainable distribution of gas in case of supply shortages. Such interruptions can be caused during emergencies, crisis situations or tension periods and when the imported LNG is not available. Transportation of natural gas through high pressure pipelines can be interrupted for various reasons; causing huge losses of production in the downstream industry. The storage facility may also be utilized for additional LNG storage when it is available at cheaper price in the international market. These storage facilities, can be in form of Under Ground Storage (UGS) to ensure flexibility in the gas supply chain. UGS projects have been implemented as a viable alternative for the continuity of gas supply across the globe; especially USA, UK, Germany, Russia and Turkey have developed huge UGS facilities by deploying depleted gas fields, salt caverns and aquifers. UGS of gas provides the standby reserves to mitigate risks of interruption in supplies until the main stream supplies are restored or to meet fluctuations in demand.

d. **Establishment of LNG terminal at Gwadar.** The Ministry of Planning, Development and Special Initiatives has plans to build a large-scale LNG terminal with a network of pipelines at the Gwadar port along with a truckload facility as per media reports. The project if implemented would provide much needed flexibility to the supply chain of gas imports in peace and tension periods.

e. **Bahria Foundation LNG Terminal.** Bahria Foundation planned to set up an offshore LNG Terminal in Sonmiani Bay in recent past. It was planned to be a tolling type terminal with an FSRU along with a jetty and for transferring RLNG through a 10 KM long subsea pipeline to the shore. The terminal was designed to handle maximum of 1 bcfd LNG. Originally, the project was to be completed by end of third quarter of the year 2021, however the project could not be undertaken to date and further working on the project has been stopped mainly due to financial constraints. Bahria Foundation however should consider venturing into this business in view of the growing demands of LNG in future.

f. **Expeditious work on North South Gas Pipeline Project.** Pakistan and Russia are planning a domestic pipeline that connects Pakistan's southern LNG terminals to the north, but the project has been delayed for several years.[14] The Pakistan Russia Inter Governmental Agreement (IGA) on North South Gas pipeline was earlier signed between both countries in 2015 but has not been implemented. It is a flagship Pakistan-Russian energy project which will enhance bilateral

[14] https://www.bloomberg.com/news/articles/2021-03-01/pakistan-to-begin-shipping-lng-by-truck-rail-on-pipeline-delays

cooperation in the hydrocarbon sector between both countries and provide huge technological uplift and employment opportunities to local companies in Pakistan. "Under the revised IGA, Pakistan will be having the major shareholding with 74 percent stakes in the Pakistan Stream Gas Pipeline (PSGP) and Russia will have 26 per cent equity."[15] As per the IGA signed in 2015, Russia had to build the gas pipeline project on its own, with 100 percent financing based on the build, own, operate and transfer (BOOT) model, and had to transfer the ownership of the pipeline to Pakistan after 25 years.

g. **Materialization of Virtual Gas Pipeline Concept.** Virtual Pipeline is a system that allows for natural gas transportation in the form of compressed/liquefied gas using modules coupled to mobile platforms, which are transported by trucks, ferry boats, boats and/or rail platforms. The Gwadar Gas Port Limited (GGPL) plans to invest $94.04 million in a 'virtual pipeline' to deliver imported LNG at the doorsteps of the industrial and other private sector consumers at competitive prices via cryogenic bowsers.[16] The facility is being planned to be established at Gwadar, which will also provide much needed redundancy to Pakistan's energy supply line. The Virtual Pipeline concept entails establishment of regasification facility at the user end.

h. **Turkmenistan – Afghanistan – Pakistan – India Gas Pipeline (TAPI).** The Turkmenistan – Afghanistan – Pakistan – India (TAPI) gas pipeline project aims to bring natural gas from Turkmenistan to Afghanistan, Pakistan and India. The ADB is acting as the facilitator and coordinator for the project. The feasibility study, proposed to lay a 56-inch diameter 1,680 KM pipeline with design capacity of 3.2 bcfd of natural gas from Turkmenistan through Afghanistan and Pakistan up to Pak-India border. The project is long term and depends on political and security situation in the region.

j. **Iran-Pakistan Pipeline.** The project will deliver natural gas from Iran to Baluchistan and Sindh provinces in Pakistan. The Iran-Pakistan pipeline, also known as Peace Pipeline, emerged from a plan dating back to 1994 and had originally included India. The $7.5 billion, 1,700-mile project was to bring gas from the South Pars Gas Fields through Baluchistan into India. The project however stalled multiple times. In 2008, a deal was nearly struck between the three countries until India decided to move towards an alternative pipeline project (TAPI). Sanctions on Iran coupled with pressure from the United States most likely influenced India's decision to leave the deal and move towards an alternative that excluded Iran. After India pulled out of the plan for the original pipeline project, Iran

[15] https://www.thenews.com.pk/print/854268-disturbing-move-petroleum-division-to-pitch-pakistan-stream-gas-pipeline-in-ccoe
[16] https://www.dawn.com/news/1612812

and Pakistan remained in partnership and signed a deal in 2009. The pipeline's construction was planned to begin in 2012 and was supposed to be completed by 2014. However, the project faced significant delays due to geopolitical conditions in the region. Iran has since completed construction of its part of the pipeline however, construction of Pakistan's portion of the pipeline is pending and is expected to be completed by 2024 under a new agreement signed in 2019 between the Inter State Gas Systems (ISGS) of Pakistan and the National Iranian Gas Company (NIGC).

SAFETY AND SECURITY OF LNG VESSELS

11. LNG is a hazardous fuel shipped in large tankers from overseas to Port Qasim. LNG infrastructure consists primarily of tankers, import terminals, and inland transmission system. The LNG vessels and onshore infrastructure is prominently visible and easily identifiable. Therefore, it can be vulnerable to sabotage by terrorist attacks or subversive acts by the enemy. The safety and security of LNG vessels while transiting through approx. 45 km long Port Qasim channel is therefore paramount and challenging. Presently, there are two operational LNG terminals at Port Qasim and two more terminals have been approved to be established there. Keeping in view the strategic value of the LNG fuel for the economy of Pakistan, the safe and secure arrival of vessels in Port Qasim is being looked after by Pakistan Navy and Pakistan Maritime Security Agency in collaboration with port authorities and terminal management. Accordingly Pakistan Navy has made elaborate arrangements and deploys its surface and air assets with the LNG vessels while entering and leaving (traversing) Port Qasim. With the two upcoming terminals at Port Qasim, Pakistan Navy will be required to deploy more assets for the safety and security of LNG vessels. Therefore, in order to ensure comprehensive security mechanism for LNG import infrastructure, capacity building of PN/PMSA in terms of latest assets/ equipment is considered essential.

CONCLUSION AND RECOMMENDATIONS

12. **Conclusion.** Pakistan is a highly gas deficit country. The local gas production has drastically decreased and current demand-supply gap has reached about 2 bcfd and the deficit is envisaged to increase further in future. Pakistan is importing LNG/LPG through long term and short term contracts through ships. Therefore reliance on imported gas supply is going to further increase in future. In order to bridge the demand-supply gap, Pakistan should undertake new initiatives and boost the execution of already planned and approved projects. Currently, the imported LNG/LPG is processed at two LNG terminals and two LPG terminals located at Port Qasim. The past three years data shows that at an average 83 LNG vessels 108 LPG vessels yearly were berthed at respective terminals at Port Qasim. The two new upcoming LNG terminals at Port Qasim

would help in improvement of supply gas supply. At the same, there will be increased movement of LNG ships towards Port Qasim. Therefore, safety and security plans needs to reviewed in the light of increasing gas cargo shipments in future.

13. **Recommendations.** Based on above discussion and to maintain a robust supply chain of LNG/LPG, following are key recommendations:

a. Incentivized explorations for indigenous discoveries of oil and gas be expedited on war footings.

b. Two new gas import terminals approved by Govt of Pakistan at PQA be established on priority.

c. Pakistan must establish alternative storage mechanisms such as UGS to ensure much-needed flexibility to the Pakistani gas supply chain especially in emergency/crisis situations and to capitalize on availability of low rates.

d. Establishment of LNG terminal at Gwadar planned by Ministry of Planning, Development and Special Initiatives be materialized on priority.

e. In order to increase capacity of exiting gas transmission network, expeditious work on North South Gas Pipeline Project be initiated.

f. The concept of Virtual Gas Pipeline be established at Gwadar for redundancy and flexibility in supply chain.

g. As a long-term solution, to ensure supply chain, focus must be kept to materialized TAPI and Iran-Pakistan Pipeline.

h. In order to ensure comprehensive security mechanism for growing LNG import infrastructure in the country, capacity building of PN/PMSA in terms of latest assets/ equipment be ensured accordingly.