

CPD Virtual Dialogue on

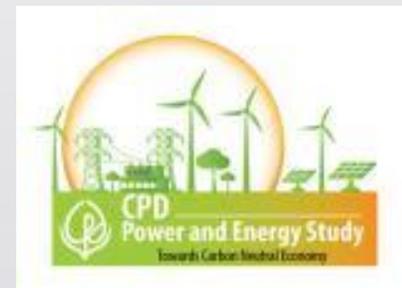
Gas-LNG Debate in Energy Supply

Costs and Consequences of LNG Import for the Power Sector



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1. Introduction – Background

- In recent years, major economic activities of household, industry, transport and power sectors have been **facing challenges due to shortage of gas supply**
 - Challenges are getting acute in recent months
 - Several business associations have raised concerns about this situation
- The government has attempted **to adjust the shortage of gas by augmenting LNG imports**
 - The sharp increase in the spot LNG price led Bangladesh to buy LNG at **35.89 USD/MMBTU and 36.95 USD/MMBTU for October 2021** delivery
 - This has **significant fiscal-budgetary consequences**
- In the **short to medium terms, finding alternate sources to meet country's energy demand seems difficult**
 - Continuing import of LNG would be required
- **There are options for the power sector to look for alternate options** at least in the medium term
 - To reduce the burden of imported LNG
- This is **an opportune moment to find an alternate solution for the power sector to resort to clean energy**



1. Introduction – Background

- It is important **to discuss various aspects of LNG import for the power sector**
 - **Risks of further concentration of energy-mix based on imported LNG**
 - **Possible economic and environmental costs** of increased LNG import for power generation
 - **Possible alternatives for sustainable clean energy-based solutions** for the power sector, which the government targets to achieve by 2040
- The **objectives of the study** are
 - To **review the demand and supply of gas** at present and future, and possible role of imported LNG in overall gas supply
 - To **examine country's existing strategy of LNG import**
 - To **estimate the economic costs of LNG import and associated environmental emissions related to use of LNG in the power sector**
 - To put forward **a set of suggestions on alternate to LNG use in the power sector**

2. Introduction – Methodology

- The study **analyses the demand and supply of gas in the economy** based on the available secondary information
- A detailed analysis has been carried out on **LNG supply chain of Bangladesh based on secondary and primary information (KIIs)**
- The study **estimated per unit economic cost of imported LNG** following standard method
- *Per Unit Economic Cost =*

$$\frac{\{(LNG\ Import\ Costs + LNG\ Regasification\ Costs + RPGCL\ Operational\ Costs) * (1 + Tax\ Deducted\ at\ Source\ Rate)\}}{Regasified\ LNG\ Volume} + Petrobangla\ Operational\ Cost\ Per\ Unit + Transmission\ Cost\ Per\ Unit + Distribution\ Cost\ Per\ unit$$



1. Introduction – Methodology

- The environmental emissions of LNG import have been estimated based on McConnell et al. (2020) which considered 4 impact categories in a comparative Life Cycle Assessment (LCA) of LNG
 1. climate change
 2. photochemical smog
 3. particulate matter
 4. acidification
- In LNG operations primary Green House Gas (GHG) emissions include - Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O) (American Petroleum Institute)
- For this study, **only the climate change impact of the LNG supply chain is considered**



2. Gas Scenario in Bangladesh – Gas supply

- Bangladesh's energy supply has been **historically dominated by natural gas**
 - The current **energy supply infrastructure hugely depends on natural gas**
- Gas was the **major (46%) primary energy supply source** in **FY2020-21**
- The share of **gas-based power plants was 52%** in the same fiscal year
- In the end of the last decade, the **country's local gas production started declining**
 - **remaining proven/recoverable gas reserve (10 Tcf) will gradually diminish over the years (one third per day by 2030 and zero by 2041)**
- **Bangladesh shifted to imported Liquefied Natural Gas (LNG)** to meet the gap in existing demand
 - Bangladesh's long term target of clean energy-based power sector would be difficult to attain

2. Gas Scenario in Bangladesh – Gas supply

Gas Supply including LNG

Fiscal Year	Local Production	Import (LNG)	Total	Share of LNG (%)
2011-12	774		774	0%
2012-13	801		801	0%
2013-14	820		820	0%
2014-15	890		890	0%
2015-16	971		971	0%
2016-17	972		972	0%
2017-18	961		961	0%
2018-19	965	116	1081	11%
2019-20	887	203	1090	19%
2020-21	892	216	1108	19%

Source: Hydrocarbon Unit, Energy and Mineral Resources Division

2. Gas Scenario in Bangladesh – Gas consumption

Gas consumption (Bcf)

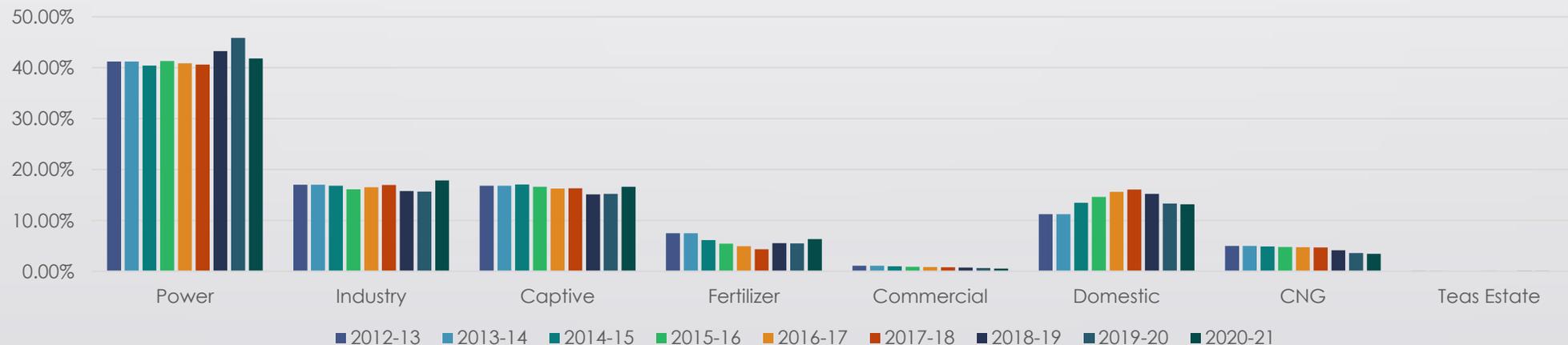
Fiscal Year	Power	Industry	Captive	Fertilizer	Commercial	Domestic	CNG	Tea Estate	Total
2012-13	328.80	135.72	134.12	59.94	8.80	89.73	40.15	0.79	798.05
2013-14	333.37	137.61	135.98	60.78	8.93	90.98	40.70	0.80	809.15
2014-15	354.71	147.70	150.02	53.81	9.09	118.17	42.92	0.80	877.22
2015-16	399.59	155.98	160.83	52.62	8.98	141.44	46.46	0.91	966.81
2016-17	403.51	163.10	160.48	49.10	8.65	154.4	46.95	0.97	987.16
2017-18	398.59	166.53	160.51	42.97	8.17	157.93	46.19	0.94	981.83
2018-19	450.82	164.49	157.50	57.67	7.94	158.86	43.37	1.01	1041.66
2019-20	455.89	155.73	151.55	54.55	6.67	132.69	36.10	1.14	994.32
2020-21	425.70	181.75	169.05	64.65	6.02	134.17	35.07	0.98	1017.39

Source: Hydrocarbon Unit, Energy and Mineral Resources Division

2. Gas Scenario in Bangladesh – Gas consumption

- No major change is observed in gas consumption over the last one decade (av. yearly growth 3.4%)
- Power sector is the main consumer of gas (42% of total) and its share has further increased in recent years
- Some other sectors have experienced marginal rise in their shares in recent years – fertilizer, captive power, and industry
- Some of the sectors have experienced a decline in their share – CNG and domestic

Share of Gas Consumptions in Different Consumer Groups



Source: Hydrocarbon Unit, Energy and Mineral Resources Division

2. Gas Scenario in Bangladesh – Demand/Supply projection

- According to the projection of Gas Sector Master Plan (2017), local supply would be largely unable to meet the local demand and the gap persists till 2030
- Demand is increasing at a higher rate compared to that of local production, thus increasing the gap, which will be the **highest in 2023-24**
- The gap is currently being addressed through **LNG import**
- Typical gas supply through LNG import is **650 MMSCFD**
- There are still shortage of supply even with existing LNG supply

Projected Demand-Supply Gap in MMSCFD

FY	Demand	Local Supply	Gap	% of total demand
2021-22	4224	2639	1585	37.5
2022-23	4274	2616	1658	38.8
2023-24	4331	2492	1839	42.5
2024-25	4396	2758	1638	37.3
2025-26	4467	3134	1333	29.8
2026-27	4543	3586	957	21.1
2027-28	4704	3814	890	18.9
2028-29	4853	4262	591	12.2
2029-30	5005	4703	302	6.0

Source: Gas Sector Master Plan 2017

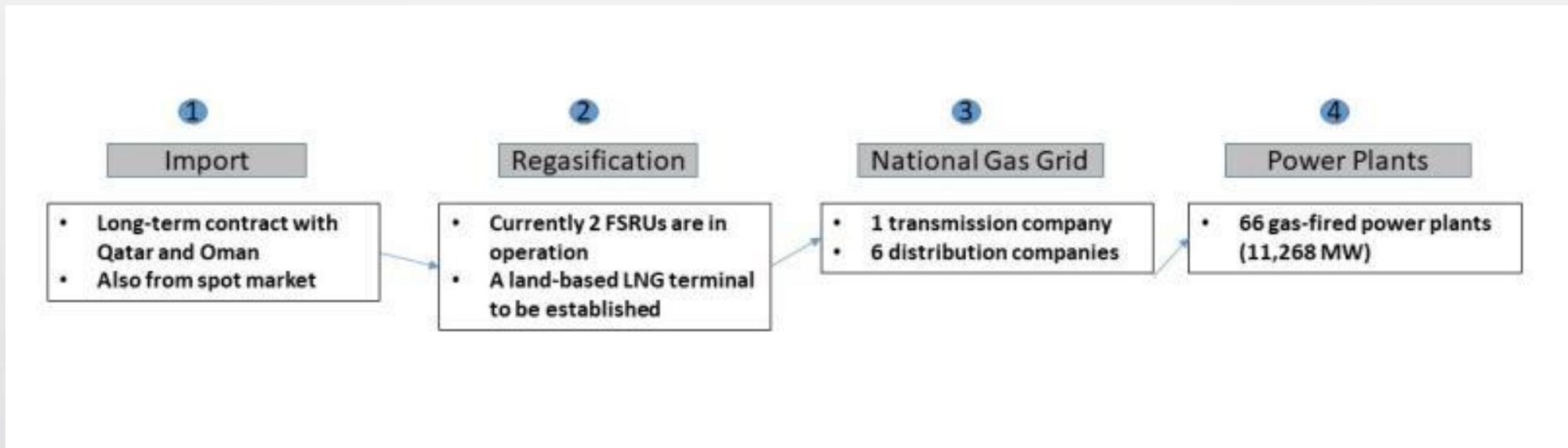


2. Gas Scenario in Bangladesh – LNG Supply Chain

- Four distinctive stages can be identified in the LNG supply chain for Bangladesh starting from import and ending at consumers e.g. power plants
 - 1. Import:** Bangladesh imports LNG under long-term contracts, and procures from the spot market as well
 - 2. Regasification:** There are two operational LNG terminals, both are Floating Storage Regasification Units (FSRU)
 - 3. Transmission:** The Gas Transmission Company Limited (GTCL) is the sole company responsible for gas transmission in Bangladesh and there are six gas distribution companies
 - 4. Distribution:** Power plants are the major clients of these gas distribution companies in Bangladesh
- Rupantarita Prakritik Gas Company Limited (RPGCL) has been assigned to task of conducting LNG-related operations in the country

2. Gas Scenario in Bangladesh – LNG Supply Chain

Defining LNG Supply Chain in Bangladesh



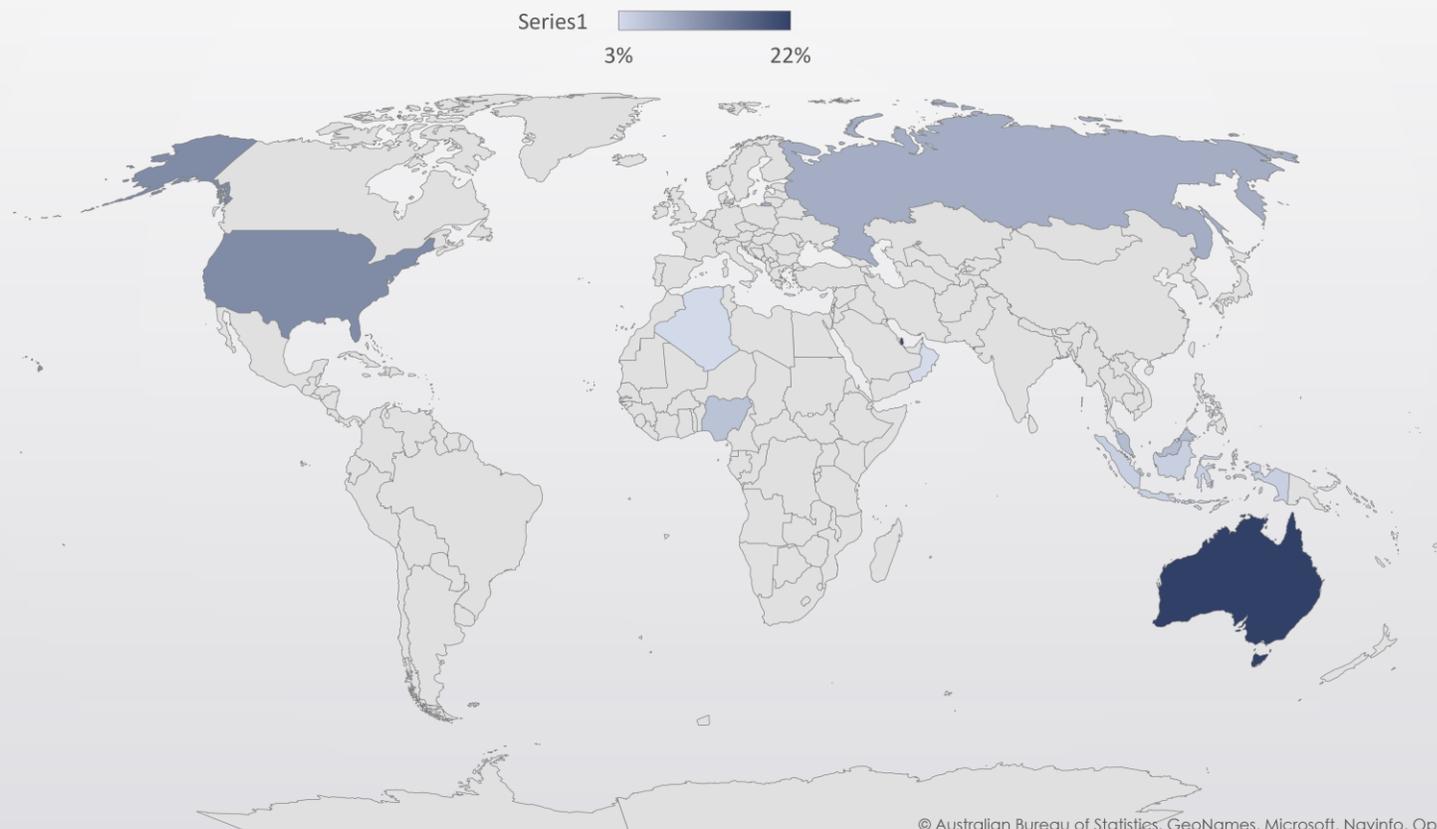


3. Global LNG Trade – Export & Import

- In 2020, **801,240 cubic meters (356.1 million tonnes)** of LNG were globally imported, with a 0.4% growth from 2019
 - About **40% of the total trade was spot or short-term basis**
- The LNG trading market consists of **20 exporting countries** and **43 importing economies** in 2020
- **71% of the total global import was from Asia**
 - 41% of the LNG volumes were supplied from the Pacific basin in 2020
- Australia was the largest exporter in 2020 followed by Qatar and USA
 - Japan was the largest importer followed by China
- **Bangladesh came in fourteenth in the import ranking in 2020**

3. Global LNG Trade – Export & Import

Global LNG Export Share in 2020

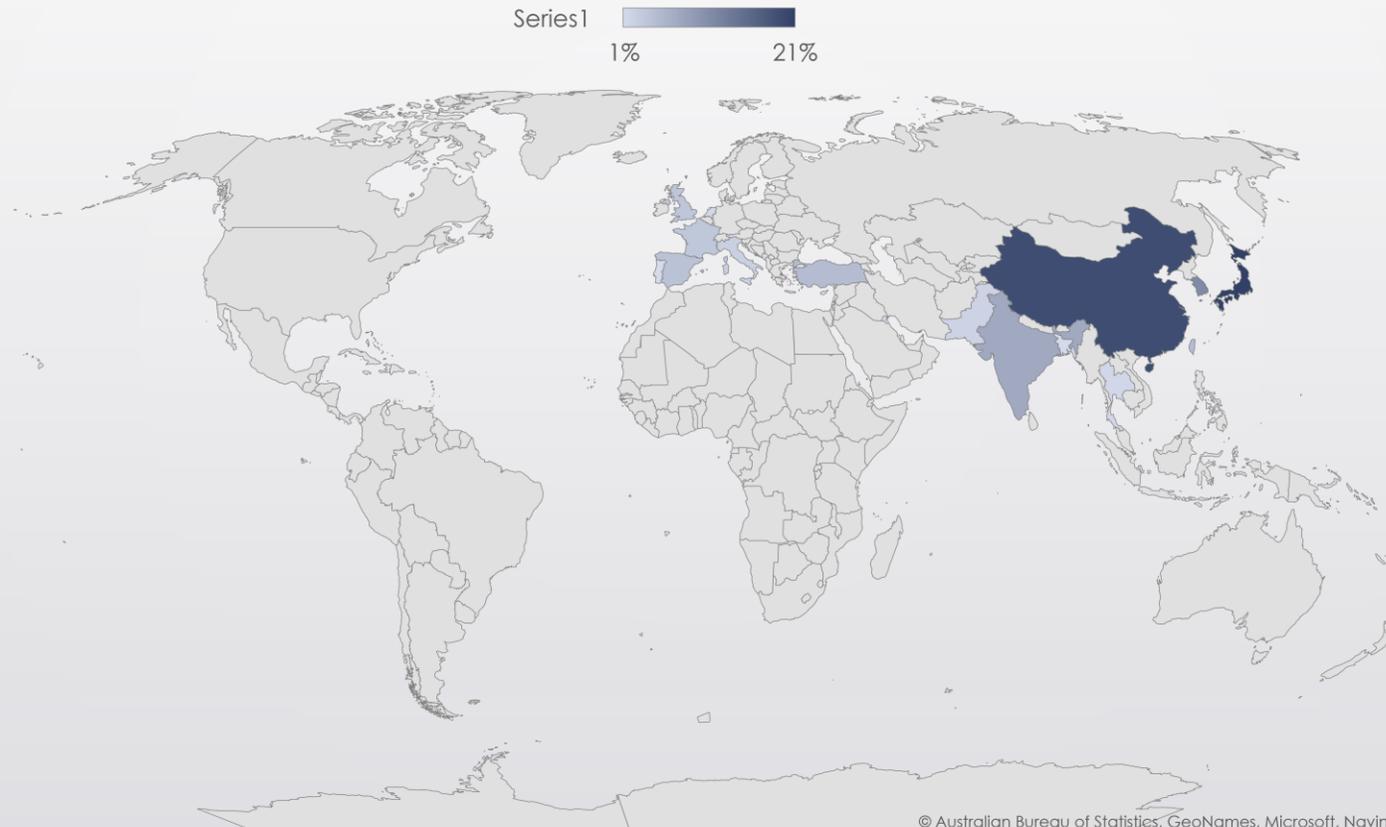


Data Source: GIIGNL Annual Report 2021

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3. Global LNG Trade – Export & Import

Global LNG Import Share in 2020



Data Source: GIIGNL Annual Report 2021

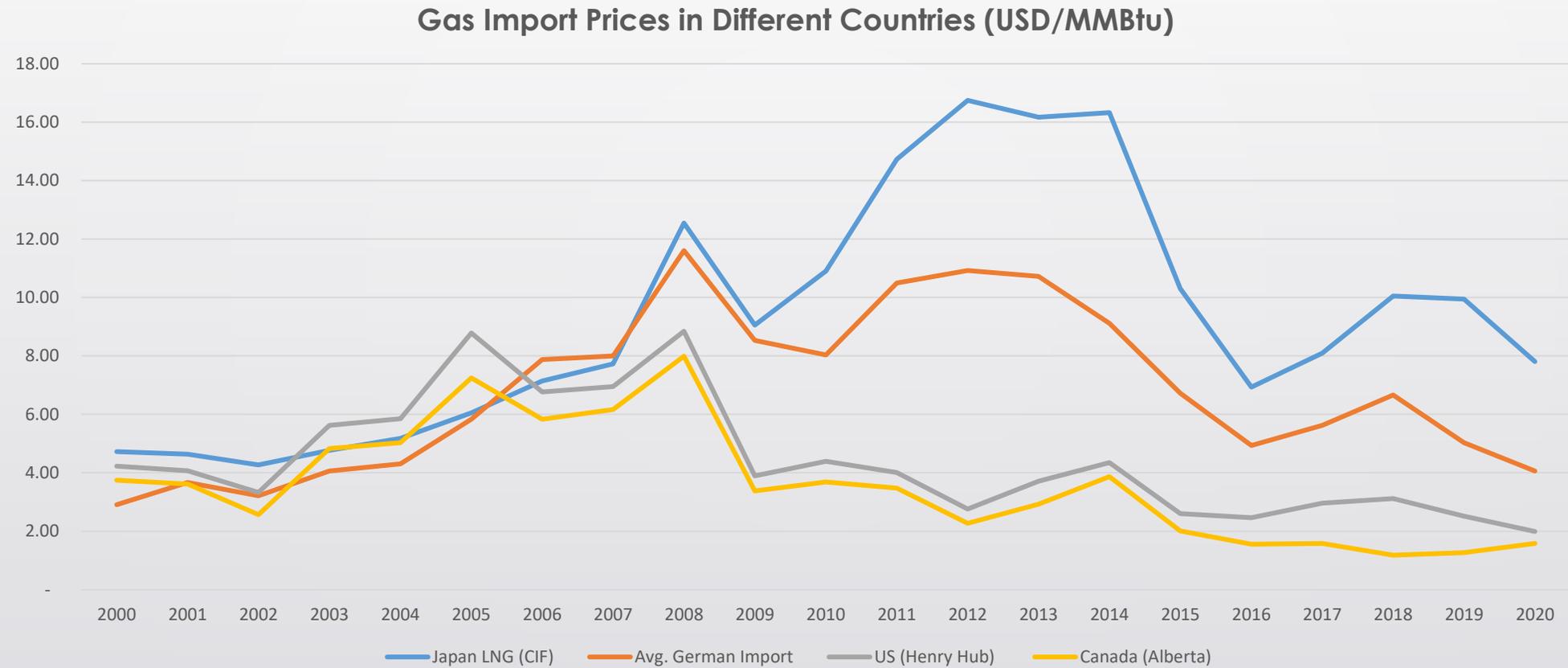
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3. Global LNG Trade – Price

- According to Furlonge (2008), **the annual growth rate for LNG (7%) was way higher than the world energy demand (1.6%)**
 - Average US Henry Hub gas prices jumped to USD 5.00 in 2006 from USD 2.00 in 1999 per MMBtu
- **Since 2010, the regional gas prices started to diverge**
 - US prices below 4.5 USD/MMBtu, European hub price 8-11 USD/MMBtu and Asian LNG 15 USD/MMBtu
- **These price gaps created business opportunities in Europe and Asia for gas exporters in North America**

3. Global LNG Trade – Price



Data Source: BP



4. LNG Scenario in Bangladesh – Infrastructure

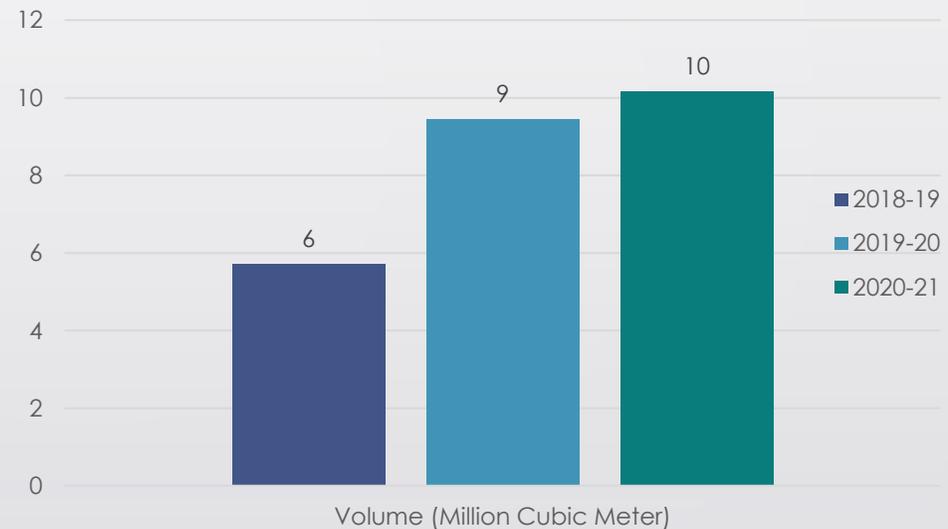
- **Two FSRUs** with daily regasification capacity of **500 MMSCF** each
- **Terminal capacity of 138,000 Cubic Meter** each FSRU
- One **land-based terminal with daily regasification capacity of 1000 MMSCF** in pipeline
- A **30-inch 91-km pipeline from Maheshkhali to Anowara** to transfer re-gasified LNG to the National Grid
- A **42-inch 79-km parallel gas transmission pipeline from Maheshkhali to Anowara**
- Petrobangla signed a **MoU with H-Energy in June 2021 for importing LNG through the cross-border pipeline**

4. LNG Scenario in Bangladesh – LNG Import

Import of LNG (mil. Cub. Meter)

Fiscal Year	Volume (million Cubic Meter)
2018-19	5,727,618
2019-20	9,456,779
2020-21	10,150,626
Total	25,335,023

Bangladesh's LNG Imports



Data Source: RPGCL

4. LNG Scenario in Bangladesh – LNG Import

- The sharp increase in the spot LNG price led Bangladesh to buy LNG at 35.89 USD/MMBTU and 36.95 USD/MMBTU for October 2021 delivery
 - **This has significant fiscal-budgetary consequences**

Import Prices for LNG Long-term Contracts and Spot Market

Import Prices (USD/MMBTU)	
Fiscal Year	2020-21
Qatargas	6.23
OQ Trading Limited	6.29
Spot Market	7.98



4. LNG Scenario in Bangladesh – Power Generation

- There are currently **66 gas-based power plants with installation capacity of 11,268 MW**
- New **11 LNG-based power plants with 6,468 MW installation capacity between 2022 and 2025** in PDB's plan

5. Economic Costs of LNG – Import Costs

Item	2018-2019	2019-2020	2020-2021
Total Purchase Price (Taka)	99,093,815,721	137,624,794,912	130,272,894,862
Per unit Purchase Price of LNG (Taka/CM)	30.20	23.96	21.29
Total Import Costs (including VAT, AIT, Financing costs, bank charge & commission) (Taka)	121,489,018,074	168,727,998,562	159,714,569,100
Per unit Import Cost (Taka/CM)	37.02	29.37	26.10

Calculated based on data from Petrobangla and RPGCL



5. Economic Costs of LNG – Regasification Costs

Item	2018-2019	2019-2020	2020-2021
Per Unit Regasification Cost (Taka/Cubic Meter)	2.41	2.64	2.50

Calculated based on data from RPGCL



5. Economic Costs of LNG – Import + Regasification

Item	2018-2019	2019-2020	2020-2021
Re-gasified LNG Cost (Taka/Cubic Meter)	42.6160	34.4731	30.8051
Petrobangla Operational Cost (Taka/Cubic Meter)	0.0550	0.0550	0.0550

Calculated based on data from Petrobangla and RPGCL



5. Economic Costs of LNG – Transmission & Distribution Costs

Item	2018-2019	2019-2020	2020-2021
Transmission Cost (Taka/Cubic Meter)	0.4235	0.4235	0.4235
Distribution Cost (Taka/Cubic Meter)	0.2500	0.2500	0.2500

Data Source: BERC



5. Economic Costs of LNG – Per Unit Cost

2018-19	2019-20	2020-21
BDT 43.3445	BDT 35.2016	BDT 31.5336

Calculated based on data from Petrobangla, RPGCL, and BERC

5. Economic Costs of LNG – Summary

Item (Taka/Cubic Meter)	2018-2019	2019-2020	2020-2021
Per Unit Purchase Price	30.1975	23.9561	21.2891
Per Unit Import Cost	37.0221	29.3702	26.1004
Per Unit Regasification Cost	2.4108	2.6398	2.4984
Per Unit Re-gasified LNG Cost (including TDS and RPGCL Operational Costs)	42.6160	34.4731	30.8051
Petrobangla Operational Cost	0.0550	0.0550	0.0550
Transmission Cost	0.4235	0.4235	0.4235
Distribution Cost	0.2500	0.2500	0.2500
Per Unit Economic Cost	43.3445	35.2016	31.5336

Calculated based on data from Petrobangla and RPGCL



5. Economic Costs of LNG – Petrobangla Estimation

- Petrobangla recently estimated **the cost for LNG import for the year 2021-2022**
 - Per unit **import price** was estimate as **BDT 36.69 cubic meter**
 - Per unit **import cost** was estimated as **BDT 44.95 per cubic meter**
 - Per unit **regasification cost** was estimates as **BDT 1.85 per cubic meter**
 - Per unit **re-gasified LNG cost** was estimate as **BDT 50.39 per cubic meter**

5. Economic Costs of LNG – Price Increase in Percentage

Item	from 2019-20 to 2020-21*	from 2020-21 to 2021-22**
Per Unit Purchase Price	-11.13%	72.34%
Per Unit Import Costs	-11.13%	72.22%
Per Unit Regasification Costs	-5.36%	-25.95%
Per Unit Re-gasified LNG Costs	-10.64%	63.58%

*CPD calculation based on RPGCL data

**Calculated based on Petrobangla Cost Estimates for 2021-22

5. Economic Costs of LNG – Total Costs

Item	2018-2019 (Crore Taka)	2019-2020 (Crore Taka)	2020-2021 (Crore Taka)
Total Purchase Price	9,909	13,762	13,027
Total Import Costs	12,149	16,873	15,971
Total Regasification Costs	791	1,517	1,529
Total Re-gasified LNG Costs	13,985	19,804	18,850

Calculated based on data from Petrobangla and RPGCL

5. Economic Costs of LNG – Total Costs [power sector only]

Item	2018-2019 (Crore Taka)	2019-2020 (Crore Taka)	2020-2021 (Crore Taka)
Total Re-gasified LNG Costs	43.28% of 13,985=6052.7	45.85% of 19,804=9080.1	41.84% of 18,850=7886.8

Calculated based on data from Petrobangla and RPGCL

5. Economic Costs of LNG – Cost Burden

- Consumer's tariff for **power plants is BDT 4.45 per cubic meter**
 - Rest of the costs for imported LNG (**BDT 27.08 per cubic meter in 2020-21**) is an **additional cost burden**
- Total amount of **cost burden in FY 2020-21 is amounted to be BDT 6773.8 Crore** for LNG use in power plants

Additional Cost Burden of LNG use in Power Plants

Fiscal Year	in Crore Taka
2018-2019	5431.3
2019-2020	7932.2
2020-2021	6773.8

5. Economic Costs of LNG – Cost Burden

- Per unit LNG import cost is about **24 times** than our national company production and **11 times** IOC production

Per Unit Cost Distribution in Different Gas Supply

National Production*		Import in 2020-21**
National Company	IOC	LNG
1.27	2.91	30.81

*Current cost estimation by Petrobangla

**Calculated based on data from Petrobangla and RPGCL

5. Economic Costs of LNG – Cost Burden

Current Gas Tariff (effective from July 2019)

Consumer Group	Price (Taka/CM)	Weighted Average Price (Taka/CM)	Difference
Power	4.45	9.8	-5.35
Captive Power	13.85	9.8	4.05
Fertilizer	4.45	9.8	-5.35
Industry	10.70	9.8	0.90
Tea Estate	10.70	9.8	0.90
Hotel & Restaurants	23.00	9.8	13.20
Small and Cottage Industry	17.04	9.8	7.24
CNG Feed Gas	35.00	9.8	25.20
Domestic	12.60	9.8	2.80

Data Source: BERC



5. Economic Costs of LNG – Cost Burden

- Gas supply in different sector has been cross subsidized
 - Gas has been provided at a subsidized price for power generation and fertilizer production
 - It has been cross-subsidized by industry, SMEs, CNG, hotel & restaurants
- The current development probably taking the LNG import venture to the unsupportable subsidy burden, **otherwise the costs will have to be borne by the consumer groups**
- Users of natural gas in transportation vehicles, hotel & restaurant, and small & cottage industries are already paying premium prices



6. Environmental Emissions

- Silva and Raadal (2019) found that **GHG emissions in coal-fired and natural gas-fired power plants are in the range of 692.0 to 1250.0 g CO₂e/kWh and 359.6 to 539.5 g CO₂e/kWh** respectively
- It was also found by UNECE that **coal-fired power plant emit 751 - 1095 g CO₂e/kWh emissions**, whereas **natural gas power combined cycle power plant can emit 403-513 g CO₂e/kWh**
- While natural gas has comparatively lower GHG emissions than coal, **Liquefied Natural Gas (LNG) has GHG emissions close to coal**
- This is because of the **extra processes LNG goes through e.g. liquefaction, shipping**
- Roman-White et al. (2019) found that **LNG life cycle emissions can be high as 822 g CO₂e/kWh, which is higher than some coal-fired power plants**



6. Environmental Emissions

- Natural gas has been considered cleaner fossil fuel than coal or oil, **however LNG to replace other fossil fuels is not an effective strategy** to reduce GHG emissions
- An **appropriate strategy is required in terms of LNG use in different sectors** considering the shortages of gas
 - Short, medium and long term strategy based on availability of possible suitable options, implications of costs, scope of engagement of the private sector and transitioning towards clean energy options



7. Key Observations

- **Greater dependency on imported LNG** is acknowledged to meet the demand-supply gap of the natural gas requirements in the country
- In terms of price surge, **LNG is found to be one of the unpredictable energy commodities**, and suppliers of the long-term contracts are not showing interest in stable contractual obligations, as media reports claimed
- The increasing price trend of LNG in global markets is not likely to change and **regional gas prices have already started to converge, thus making LNG export less profitable**
- In the fiscal year **2020-21**, the **economic cost of LNG was BDT 31.56 per cubic meter** where the **power plants only paid BDT 4.45 per meter cube**
There are additional cost burden of BDT 27.08 per unit of LNG import
- Current price estimates for the fiscal year **2021-22** make **LNG 24 times expensive than our national production by national companies**



7. Way Forward

- It is time to **revisit the country's existing approach** on the growing reliance on the LNG imports for the power generation and the associated infrastructure development plans
 - For example, **establishing new LNG-based power plants** (*11 plants with 6,468 MW capacity in the pipeline*) **does not seem logical**
- In the short term, LNG imports may need to continue to meet the existing demand-supply gap particularly for activities/sectors where no immediate alternative
 - These may include household, industry, hotel restaurant, transports etc.
- In the medium to long term, Bangladesh needs to consider alternates of LNG import in the above-mentioned sector targeting more cleaner source of energy use
 - These may include industry and transport



7. Way Forward

- **In short, medium to long term, Bangladesh needs to put emphasis on gas supply from domestic gas reserves**
 - According to Professor Badrul Imam (2022), four possible ways are there to consider for increased gas supply – (a) discovery of gas fields to increase the reserve base; (b) field development with increasing number of development wells per field; (c) bringing stranded gas reserves into production; (d) Optimization of producing wells; (e) Work over the dried up producing wells; (d) Unconventional reserve recovery – tight gas sand; thin bed plays



7. Way Forward

- **Bangladesh should not consider LNG import as a long-term solution, especially for the power sector**
 - Government should put emphasis on clean energy based power generation, gradually increase the share of renewable energy in the fuel-mix, improve energy efficiency
 - BPDB should revisit its existing power generation plan which are in the pipeline and should not encourage future power plants based on LNG or petroleum
 - BPDB should redesign its future power generation plan putting emphasis on renewable energy-based power plants
 - BPDB should not allow using the land available from abandoned coal fired power plants for establishing LNG-based power plants
- **The BERC should not consider increasing the gas price**
 - Increase in gas price might be unaffordable to the low income population/households in this critical circumstance of Covid-19
 - Hence, for the short-term government should take the burden



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Thank You