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LNG Market Under The Turbulence

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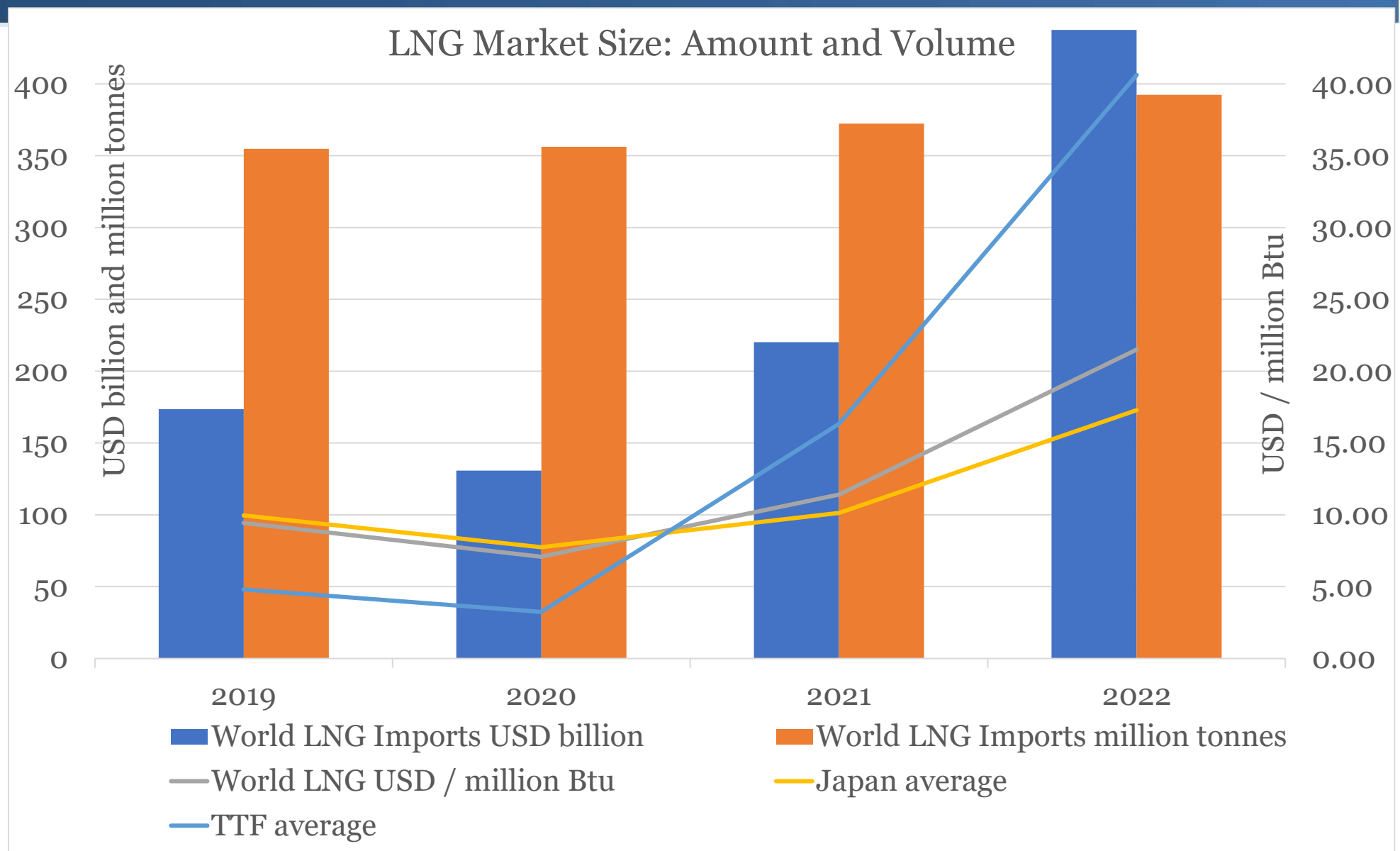
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Recent Notable Developments in the LNG Market

1. A few FIDs (final investment decisions) have been announced on LNG production projects in 2023 including three major ones in the Gulf of Mexico region in the United States.
2. LNG sales deals under term contracts continue being observed.
3. The short-term supply and demand balance was relatively relaxed in the LNG market in the first half of 2023.
4. The world traded a little over 200 million tonnes of LNG during the first half of 2023, a 2% increase from 2022 but still the highest for half a year.
5. The Philippines, Hong Kong and Vietnam have imported their respective first LNG cargoes.
6. The IEA published a report on the outlook of the gas market, preceding the G7 Ministers' Meeting on Climate, Energy and Environment in April.
 - i. Even with flat or declining natural gas demand in the STEPS (Stated Policies Scenario) and APS (Announced Pledges Scenario), new investments in upstream gas supply remain necessary to offset declines from existing fields;
 - ii. and projected demand growth in emerging economies requires investment in new LNG infrastructure in these scenarios.
7. New risks have been observed in Australia - labour issues and rule changes after start

Global LNG Grows in Volume but More in Amount

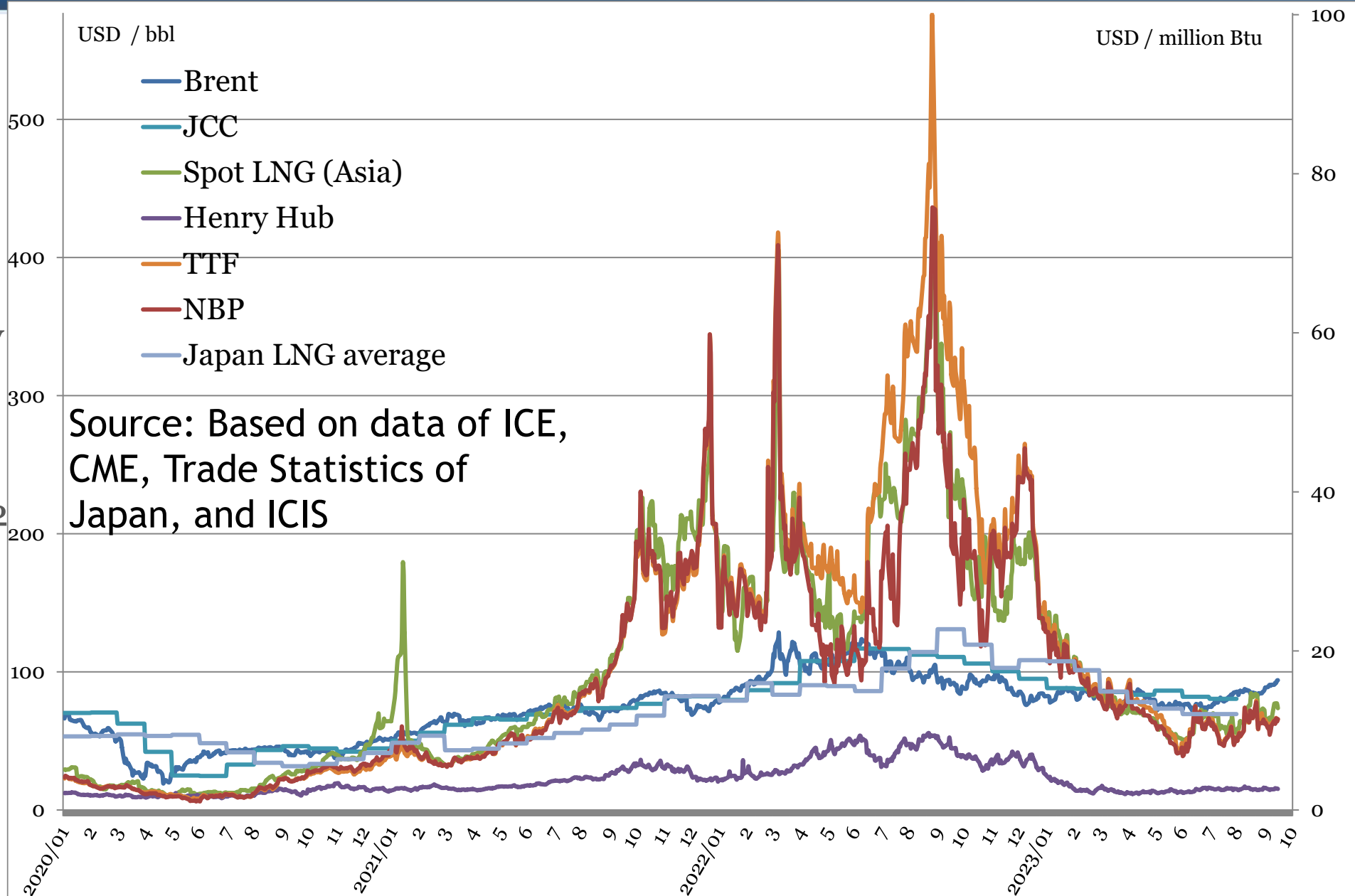
- Global LNG trade has grown steadily in volume during the last several years, but grown significantly in monetary amount in 2021 and 2022, after shrinking in 2020
- Japan paid lower than the global average due to higher prices paid by European importers



Source: based on data of GIIGNL, Global Trade Atlas, Trade Statistics, and ICE

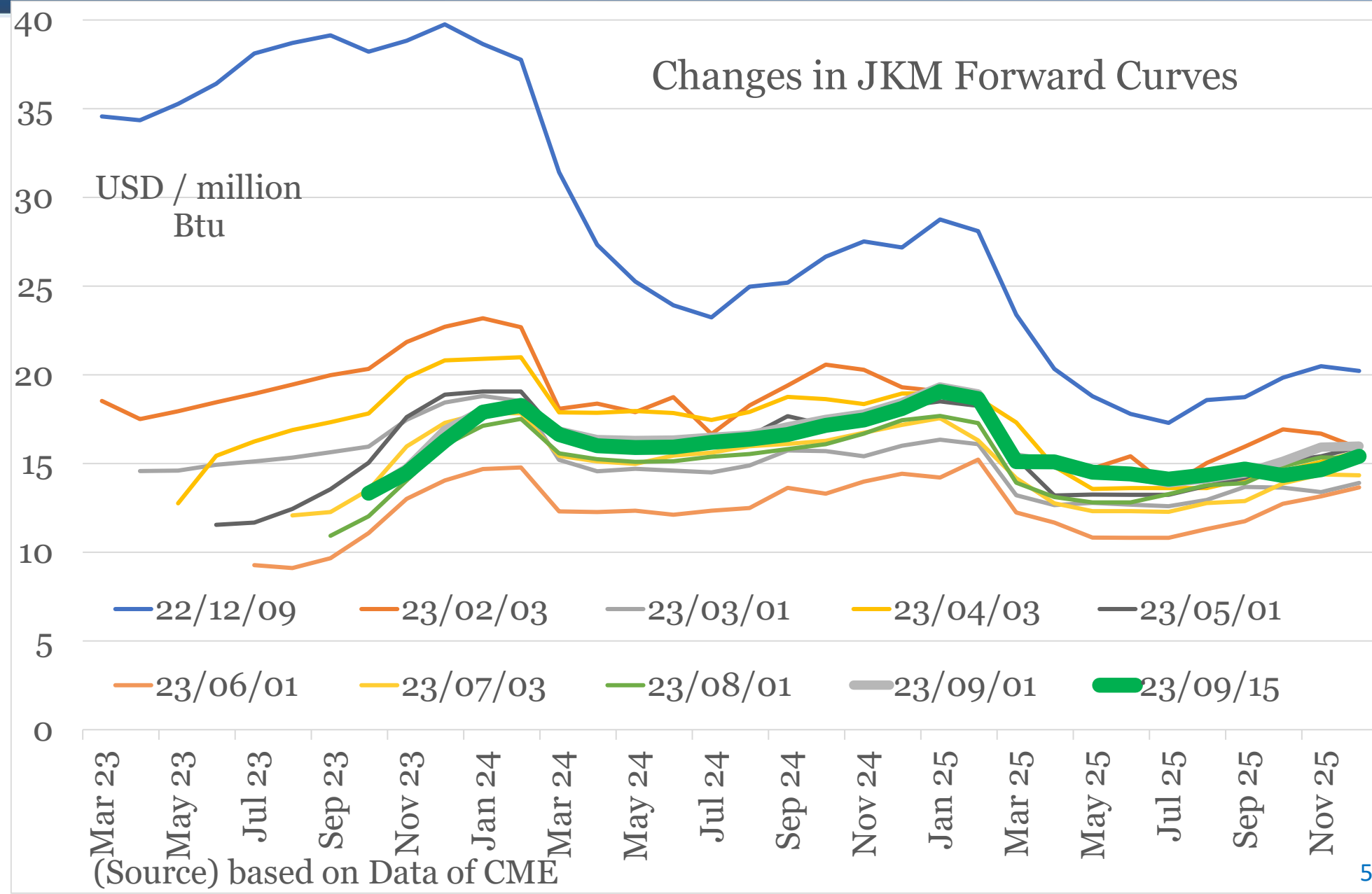
Global Gas Prices Move Faster and Wider than Past

- Spot LNG and gas prices have trended down since December 2022
- Term contract prices have reduced advantages in 2023, except relative stability
- European TTF prices were exceptionally higher than others in the second half of 2022
- Asian spot LNG prices have tended to follow higher TTF to rise
- Spot LNG and gas prices were more expensive than crude oil prices from August 2021 until April 2023



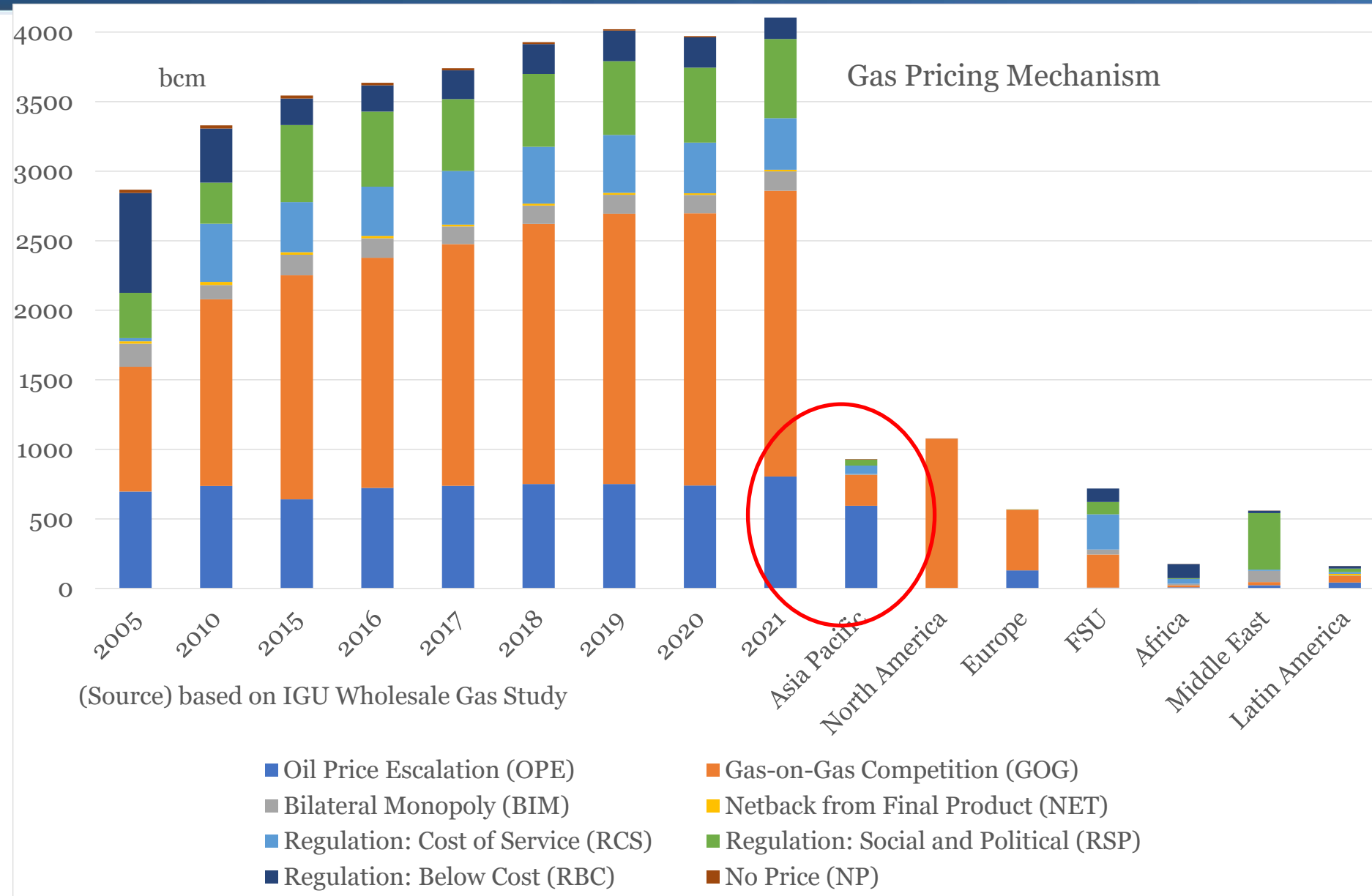
Price Expectation Declined Significantly But Can Change Fast

- Spot price expectations for 2023 were in the USD 30s at the end of 2022, although they were now in teens
- Market sentiments can shift very quickly



Wholesale (and Import) Gas Prices Are Set Differently

- On the global basis, more gas has been priced out of gas-on-gas competition
- In the Asia Pacific region, more gas is priced out of oil prices
- Increasing inflow of LNG from the United States has pushed diversification of gas prices in different regions of the world
- Interactions with other global regions cause greater fluctuations in gas prices within a region



Risks in LNG Supply Sources More Apparent These Days

- In recent years, the LNG market has seen unexpected events and developments that have significantly swing the balance of the market
- Some LNG suppliers, which used to be considered very stable, could suddenly reduce supply availability due to unforeseen developments

Russia



- [Nord Stream 1 and 2](#) have been out of operation.
- [Sakhalin 2](#) has been operating stably. According to Gazprom, it has now been back in full operation after the planned maintenance during June to September 2023. The Russian government unilaterally took over the control of the operating company in 2022.
- However, there has been larger potential disruption risk since the Russian war in Ukraine.

USA



- [Freeport LNG](#) stopped operation after a fire in June 2022 until February 2023. The restart was delayed a few times from November 2022.
- Venture Global LNG notified federal energy regulators that there was needs to make repairs at [Calcasieu Pass](#) that would delay the start of its commercial operations planned in Q3 2023.

Papua New Guinea



- In the past two years, no major accident has been announced or reported.
- [PNG LNG](#) operated by ExxonMobil has been ramp up production since its start in 2014, which production volume is now over 8 million tonnes per year, which is exceeding its first planned capacity of 6.9 million tonnes.

Australia



- From July to September 2022, [Prelude Floating LNG](#) did not operate due to a strike.
- From December 2022 to January 2023, [Prelude FLNG](#) stopped production due to a fire incident.
- Since July 2023, [the following three LNG related law reforms have been enforced.](#)
 - [Safeguard Mechanism reforms](#) requires the subjected facilities to cut net emissions by 4.9% annually until 2030, while new gas fields supplying to LNG plants are required to have a baseline of net-zero emissions from day one.
 - [PRRT reforms](#) limit the proportion of assessable income on LNG projects that can be offset by deductions to 90%, while most LNG projects were not expected to pay any significant amounts until the 2030s.
 - [ADGSM reforms](#) include protection for long-term LNG contracts, though which remains unclear.
- Japan is concerned that the Safeguard Mechanism reforms will impose burdens on the [Barossa gas project](#) development, which is expected to have high CO2 gas stream and plans to set up a CCS facility in Timor Leste, since the reforms include uncertainty over the actual implementation of the net zero from Day One and sufficient availability of carbon credits.
- In August 2023, Woodside and Chevron had negotiations with unions representing workers at certain LNG projects. Woodside made an agreement. However, Chevron's [Gorgon and Wheatstone projects](#) are subject to protected industrial actions.

Malaysia



- In October 2022, Petronas declared force majeure on [Malaysia LNG Dua](#), due to a pipeline leak caused by soil movement.
- The impact was not apparently so significant.

Factors to be Considered on Future LNG Supply Sources

- There are many planned and potential LNG supply sources around the world
- Each one has its advantages and potential challenges to overcome
- As existing and future LNG suppliers also see advantages and risks in consuming markets, communications between producers and consumers will be more important

Russia

- New LNG production projects look less likely.
- Existing LNG production plants may have difficulty or less availability, due to sanctions and other political causes, as well as technical incapability.

Canada

- The Canadian government promotes huge investment toward electrification of gas field and LNG facilities. Canada is a top runner for smart grid, storage technology and CCS.
- LNG Canada, which claims itself as one of the cleanest LNG facility in the world, is expected to start production in 2025.

Eastern Mediterranean (Israel/Egypt/Turkey)

- In June 2022, Israel, Egypt and EU agreed to increase LNG export from Egypt, partially fed by gas from Israel.
- Israel is accelerating development of gas fields with possible plans of its own LNG export facilities. There has also been an idea of an undersea pipeline between Israel and Turkey.

USA

- Freeport LNG reopened fully in March 2023, making the United States the world largest LNG export nation in the year.
- The increase of LNG term-offtake commitment is expected to facilitate FIDs.
- Though political risks including opposition by the environmentalists remain, the Biden administration has adopted a pragmatic approach, which is expect to continue for a while.

Algeria

- Export of LNG and pipeline gas to Europe (especially to Italy) has been increasing since the Ukraine Crisis.
- Political risks include the conflict with Morocco over Western Sahara.

Iran

- Despite huge gas resources, sanctions tend to hinder development.
- Russia and China pursue deeper cooperation with Iran including LNG development.

Tanzania

- In May 2023, Equinor, Shell, and Exxon agreed with the Tanzanian government to develop an LNG project.
- An FID is expected in 2025.

Papua New Guinea

- The government and PNG LNG agreed on development of the P'Nyang field in February 2022.
- Papua LNG started FEED in March 2023, expecting production by early 2028.

Qatar

- North Field East (NFE) and North Field South (NFS) projects are expected to start production in 2025 and in 2027 respectively.
- Since 2022, Western and Chinese Majors have been accepted to be partners in the projects. Sinopec and PetroChina, as well as Petrobangla, have concluded long-term purchase agreements, for 27 years each for the Chinese and 15 years for the latter.
- Japanese firms have been negotiating term offtake deals.

Mozambique

- In November 2022, Coral Sul FLNG began LNG export. The capacity is 3.4 million tonnes per year, all to be taken by bp under a 20-year agreement.
- While the Mozambique LNG 1 project took an FID in 2019 expecting the first LNG in 2024, TotalEnergies declared force majeure in April 2021 and suspended construction. Now the project targets production in 2026, but there is a cost overrun issue in addition to the security concern.

Australia

- Potential regulatory and labour risks could hinder new investment in LNG projects.

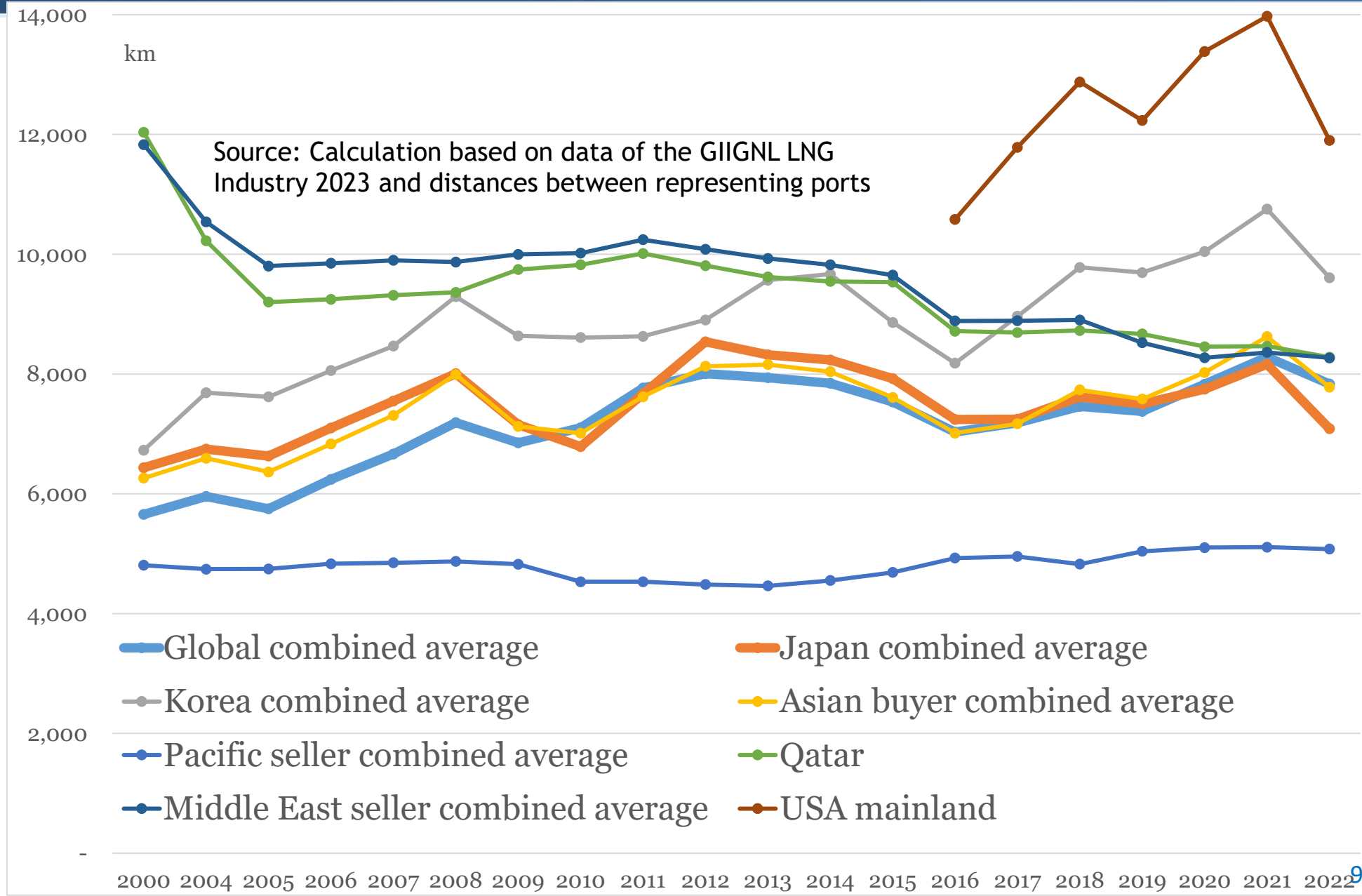
Mexico

- New Fortress Energy is expected to start operation of Altamira FLNG in 2023.

Source: Company information

Some LNG Travels Longer Distances

- ✓ With supply sources and consuming markets, LNG shipping routes and distances have diversified
- ✓ Distances have tended to be longer with sudden increases LNG demand including the 2007-2008 and 2011-2013 Japan's nuclear crises
- ✓ With increasing LNG supply from the United States, shipping optimisation efforts are even more important



Panama Canal Enabling LNG Imports From the U.S. Gulf

- The expanded Panama Canal has contributed significantly to transportation of LNG from the United States to the Asian markets
- Not only more LNG, but also more LPG has been a beneficiary of the Shale revolution, as well as the Panama Canal expansion

million tonnes

35

30

25

20

15

10

5

0

Panama Canal Transit of LNG / LPG

(Source) Based on data of Canal Authority Annual Report

Note: Canal year lasts from October to September

number of transit

700

600

500

400

300

200

100

0

2016

2017

2018

2019

2020

2021

2022

2016

2017

2018

2019

2020

2021

2022

Northbound (Pacific to Atlantic)

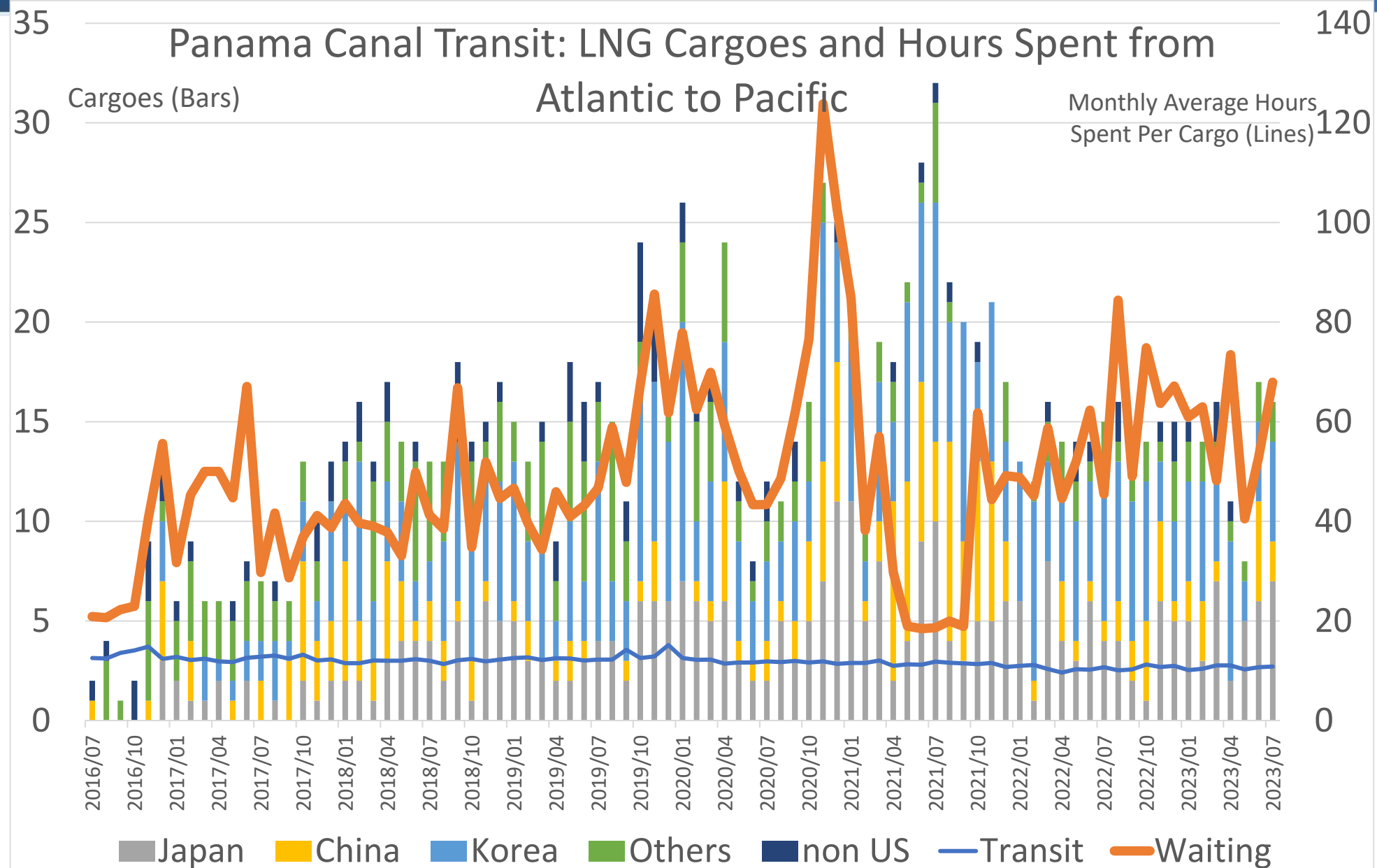
Southbound (Atlantic to Pacific)

	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
■ LNG Tonnes	0.12	0.46	0.06	0.87	0.15	0.02	0.45	0.43	6	11	12	14	19	12
■ LPG Tonnes	0.05	0.08	0.06	0.05	0.06	0.20	0.17	6	15	18	20	24	28	29
— LNG Transit	2	8	4	16	5	2	11	7	88	172	185	212	272	195
— LPG Transit	6	14	11	19	14	40	27	221	440	503	508	646	756	743

(Source)

Sometimes Some LNG Has to Wait

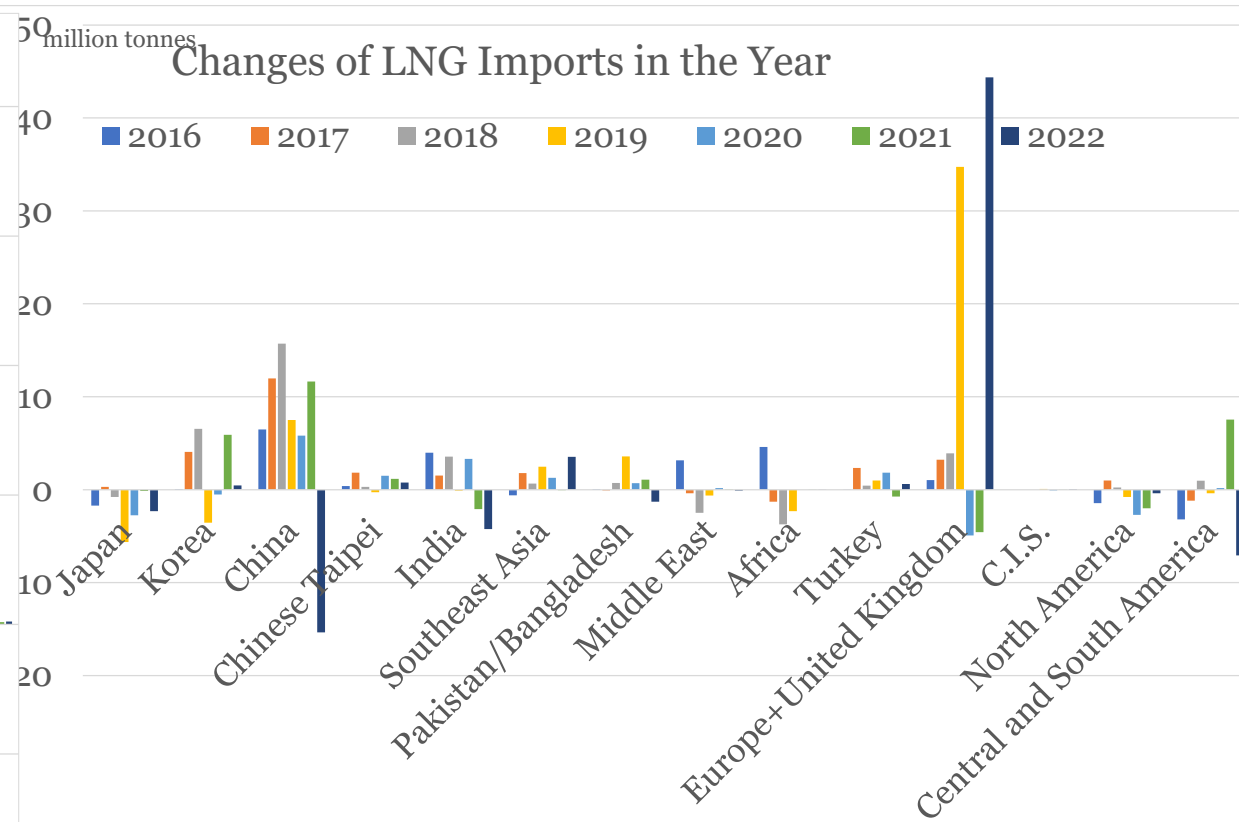
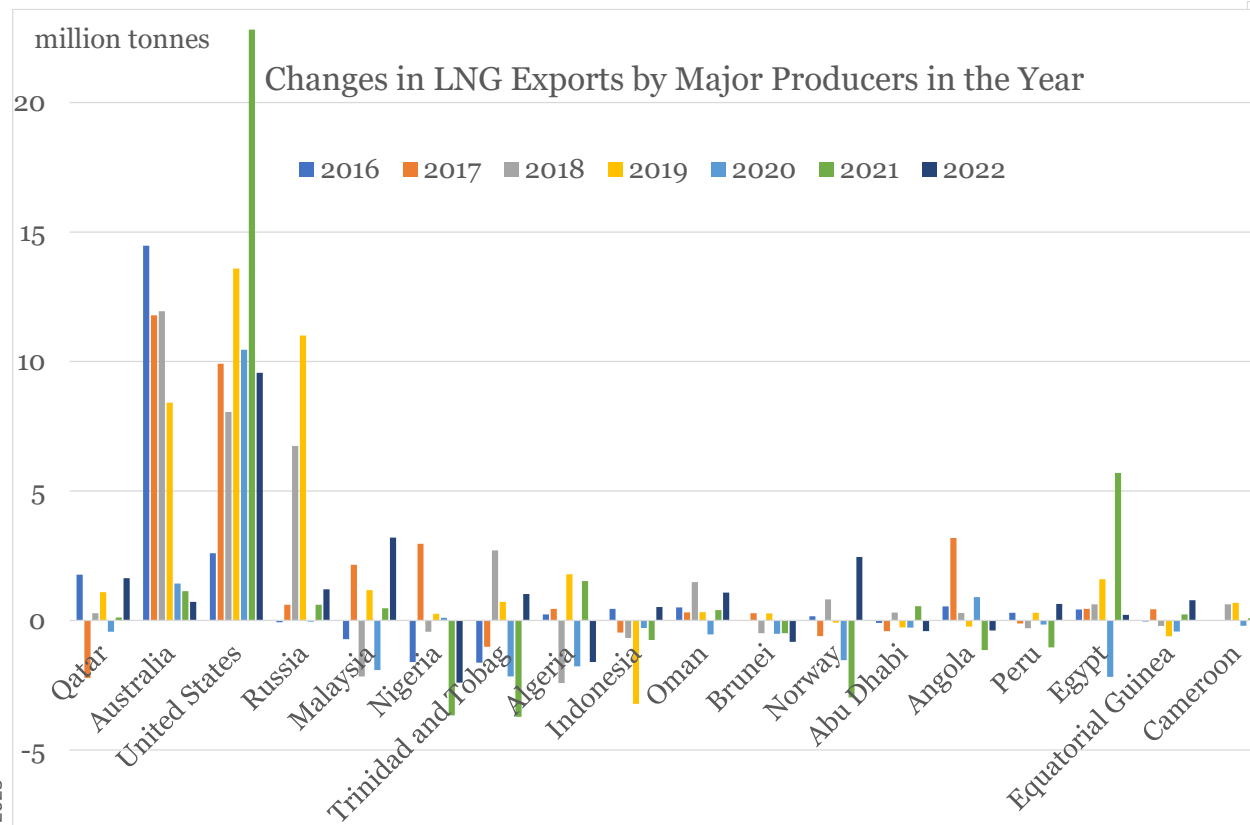
- Japan was again No. 1 importer of LNG in 2022 with 72 million tonnes, while China imported 63 million tonnes
- The United States exported 77 million tonnes compared to Qatar's 79.8 million tonnes and Australia's 79.4 million tonnes
- Russia, Malaysia, Oman, and Cameroon also renewed their record highs, although Nigeria and Trinidad and Tobago did not



(Source) based on ICIS LNG Edge

Europe Increased LNG Imports From USA and “China” in 2022

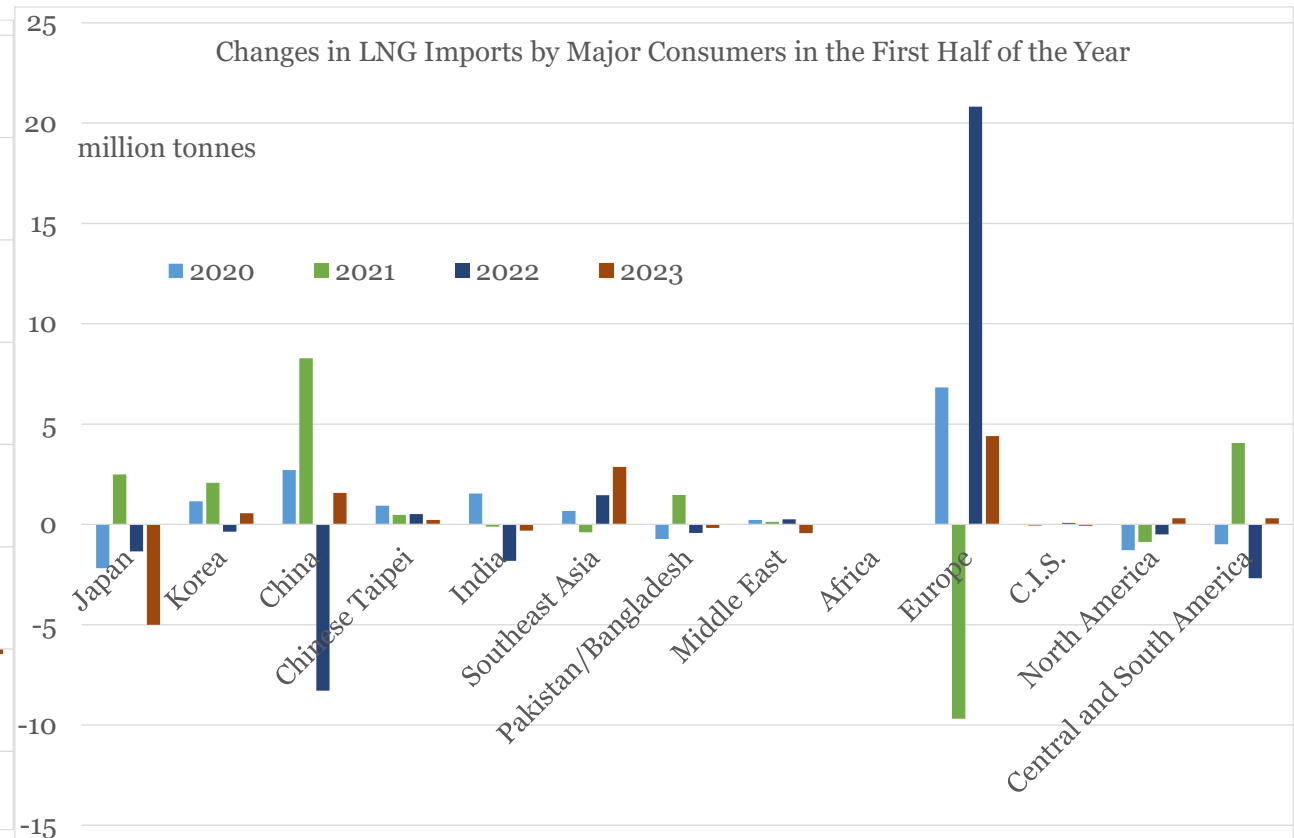
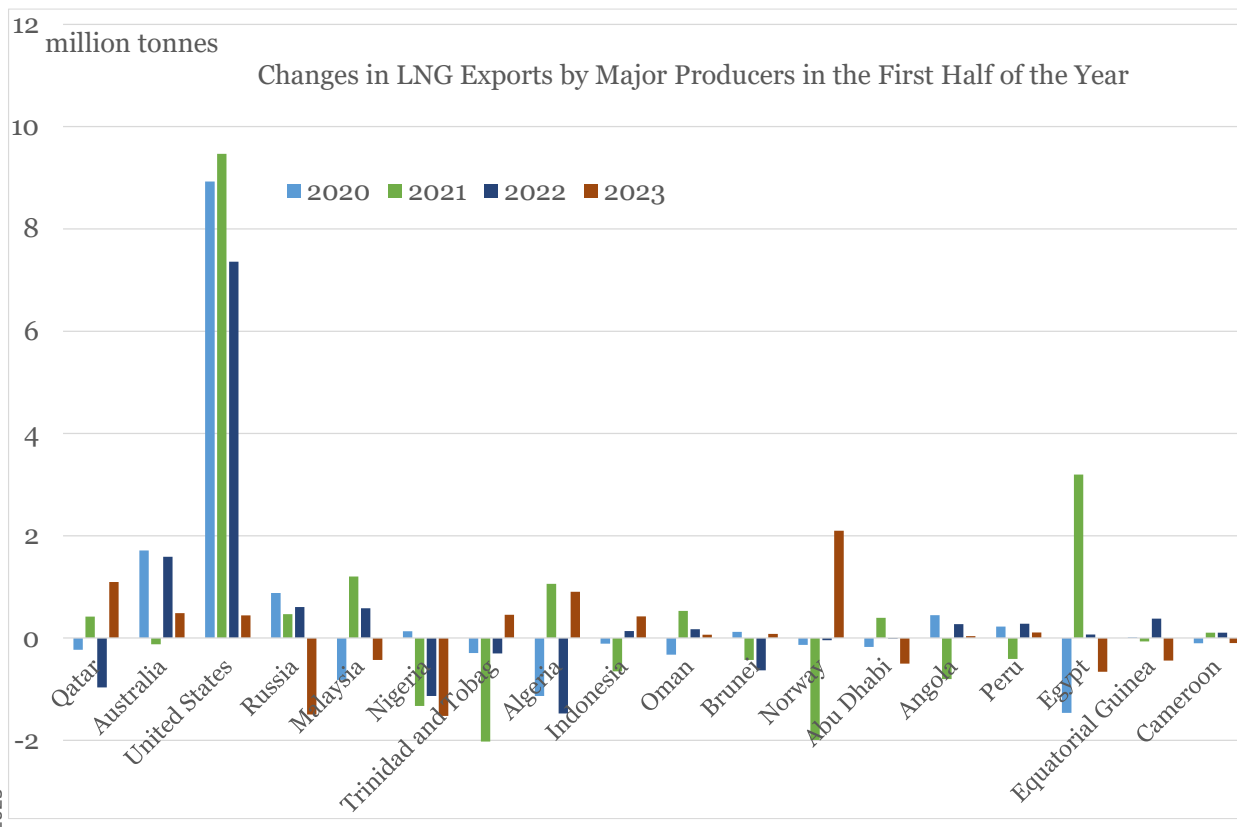
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(Source) based on customs statistics and data of Cedigaz LNG Service

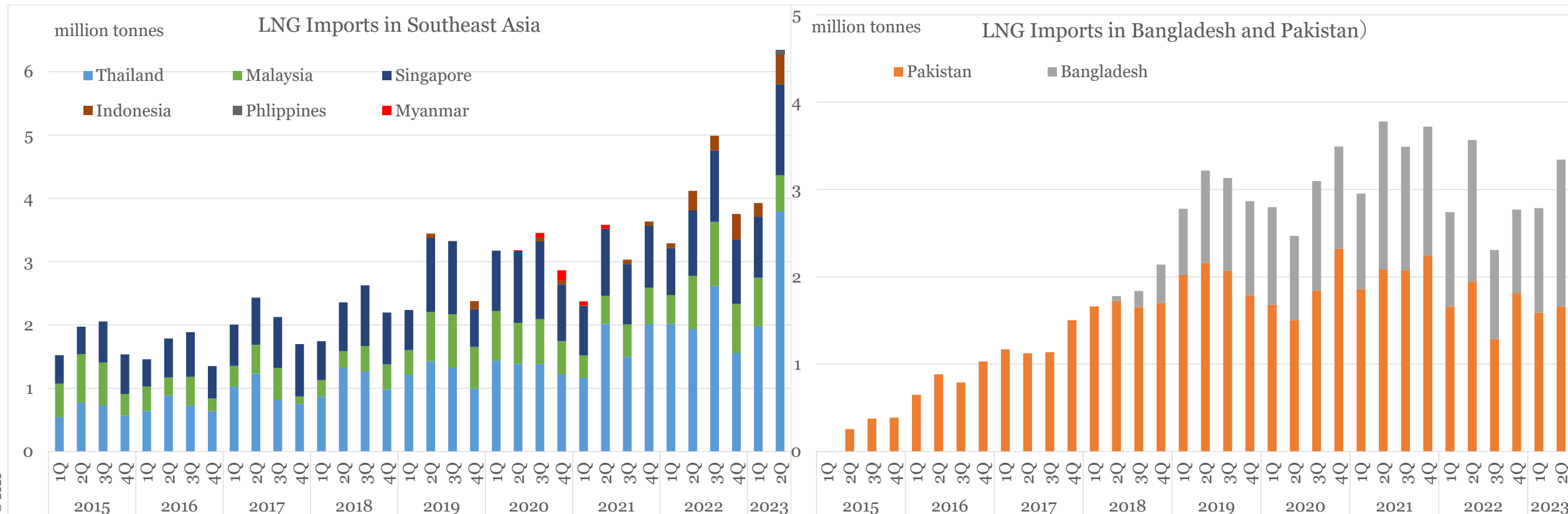
Global LNG Trade Growth Has Been Flatter in 2023

- In 1Q 2023, while Japan and China decreased LNG imports, Europe and the United Kingdom increased theirs
- China turned to positive growth in March, while Europe slowed its pace of increase with higher inventories
- In 1H 2023, China increased LNG import and returned to the top importer position.
- The United States, Australia, and Qatar increased LNG exports, while Russian LNG export decreased by 9%.



Contrasts in LNG Import Patterns in Southeast and South Asia

- Southeast Asia increased LNG imports by 20% or 2.5 million tonnes while Pakistan and Bangladesh combined decreased LNG imports by 18% or 2.5 million tonnes in 2022
- Southeast Asia has LNG exporters and importers, as well as prospective importers
- Bangladesh and Pakistan reduced LNG imports significantly in 2022, before showing some signs to resume more LNG imports in 2023

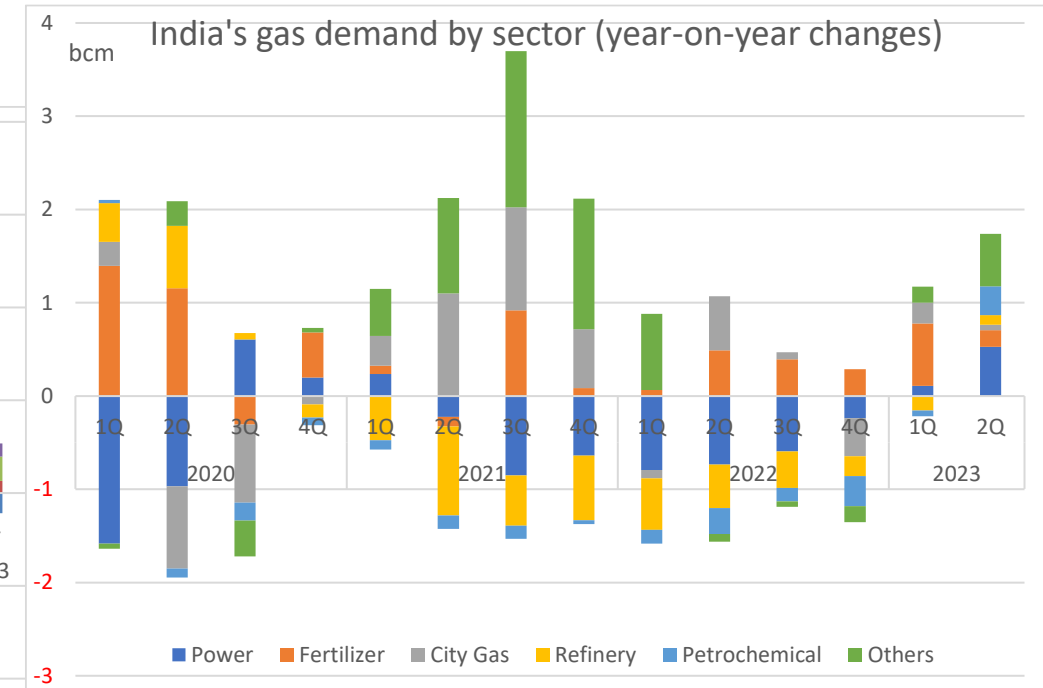
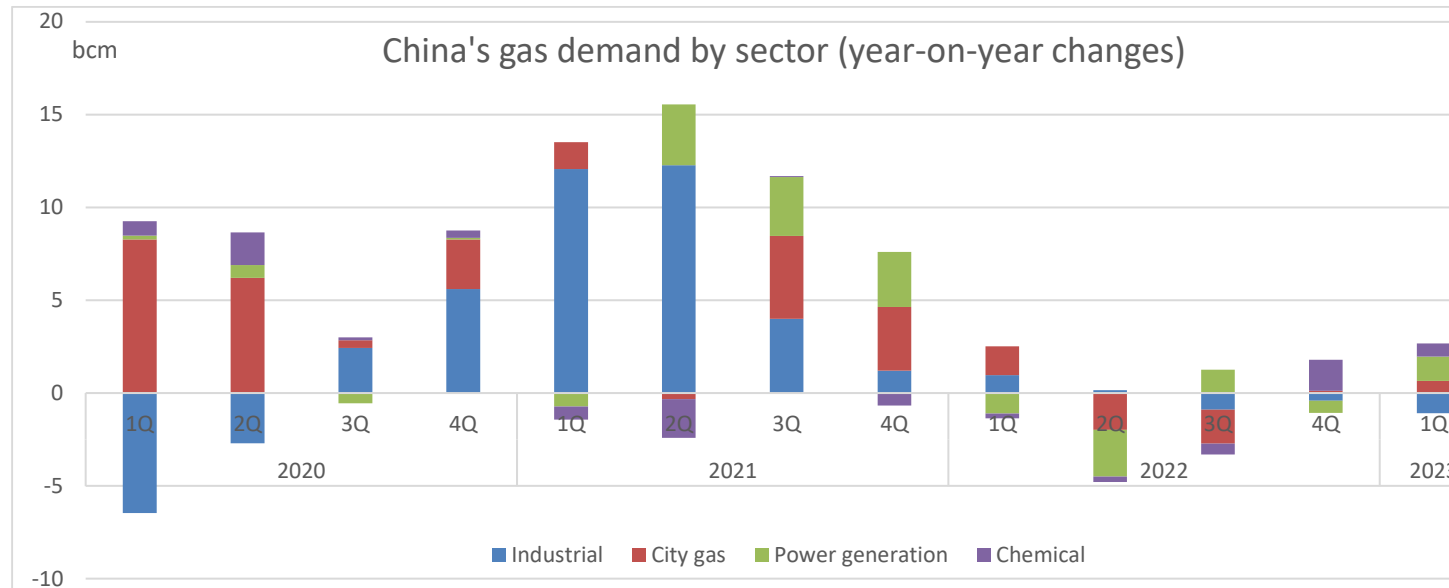


(Source) based on customs statistics and data of Cedigaz LNG Service

Gas Consumption in China and India Declined in 2022

- China's natural gas consumption increased by 6.5% year-on-year during the first seven months of 2023, especially a 10.5% increase in 2Q
- In 2022, half of decrease in gas consumption came from the power generation sector, although the share of power generation in gas consumption relatively low
- In 1Q 2023, natural gas consumption increased in the city-gas and power generation sectors, while the industrial use declined

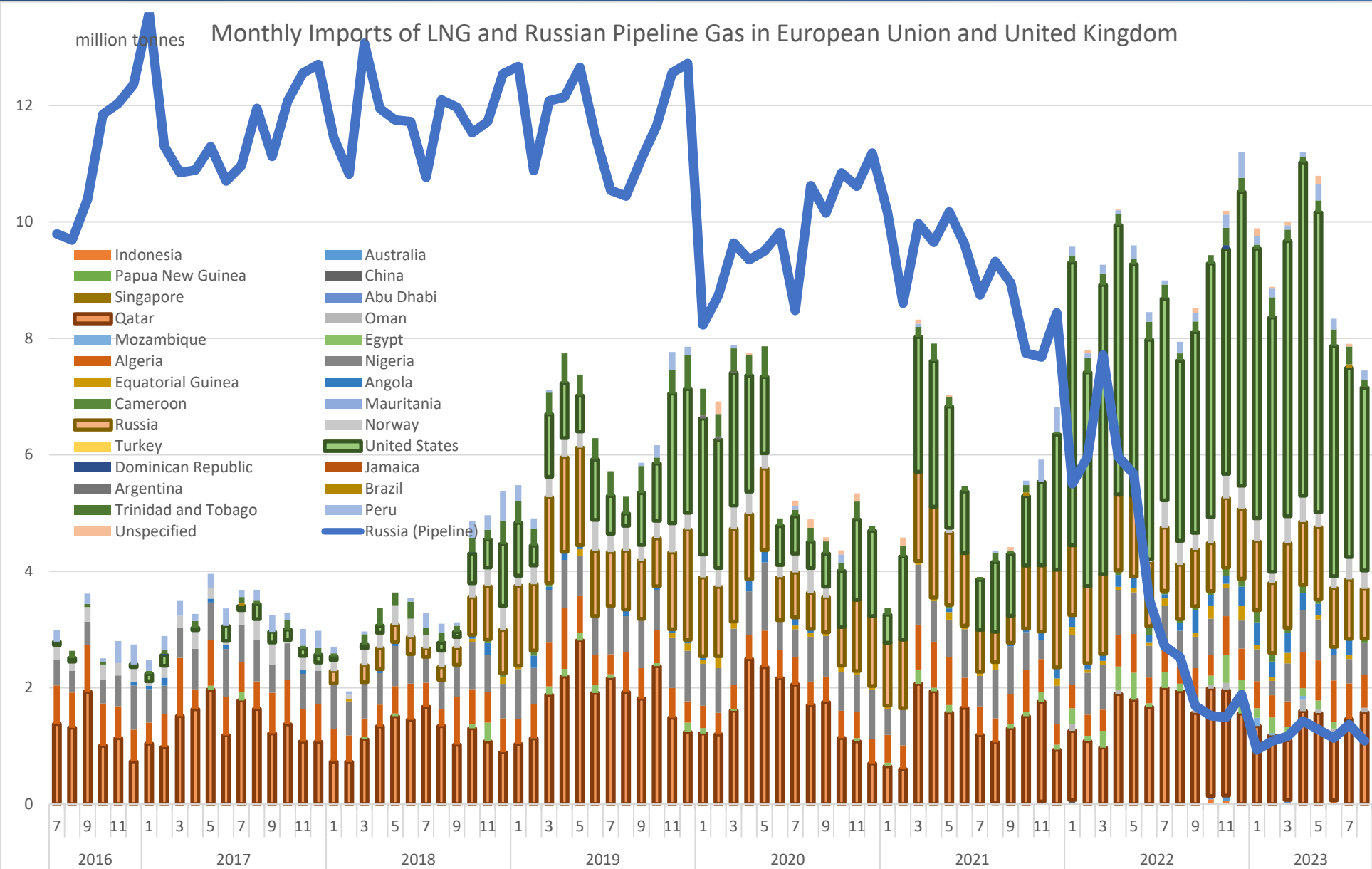
- In 2Q 2023, India's gas consumption was all-time high.
- In 2022, India's overall gas consumption decreased by 5.0% or 3 bcm, in which decline in gas use for power generation was notable at -24% or -2.4 bcm
- In 2022, although LNG imports and domestic gas production by the main producer ONGC declined, private sector gas production increased by 25% or 2.1 bcm



(Source) Based on data of National Statistics Bureau of China, and Ministry of Petroleum & Natural Gas of India

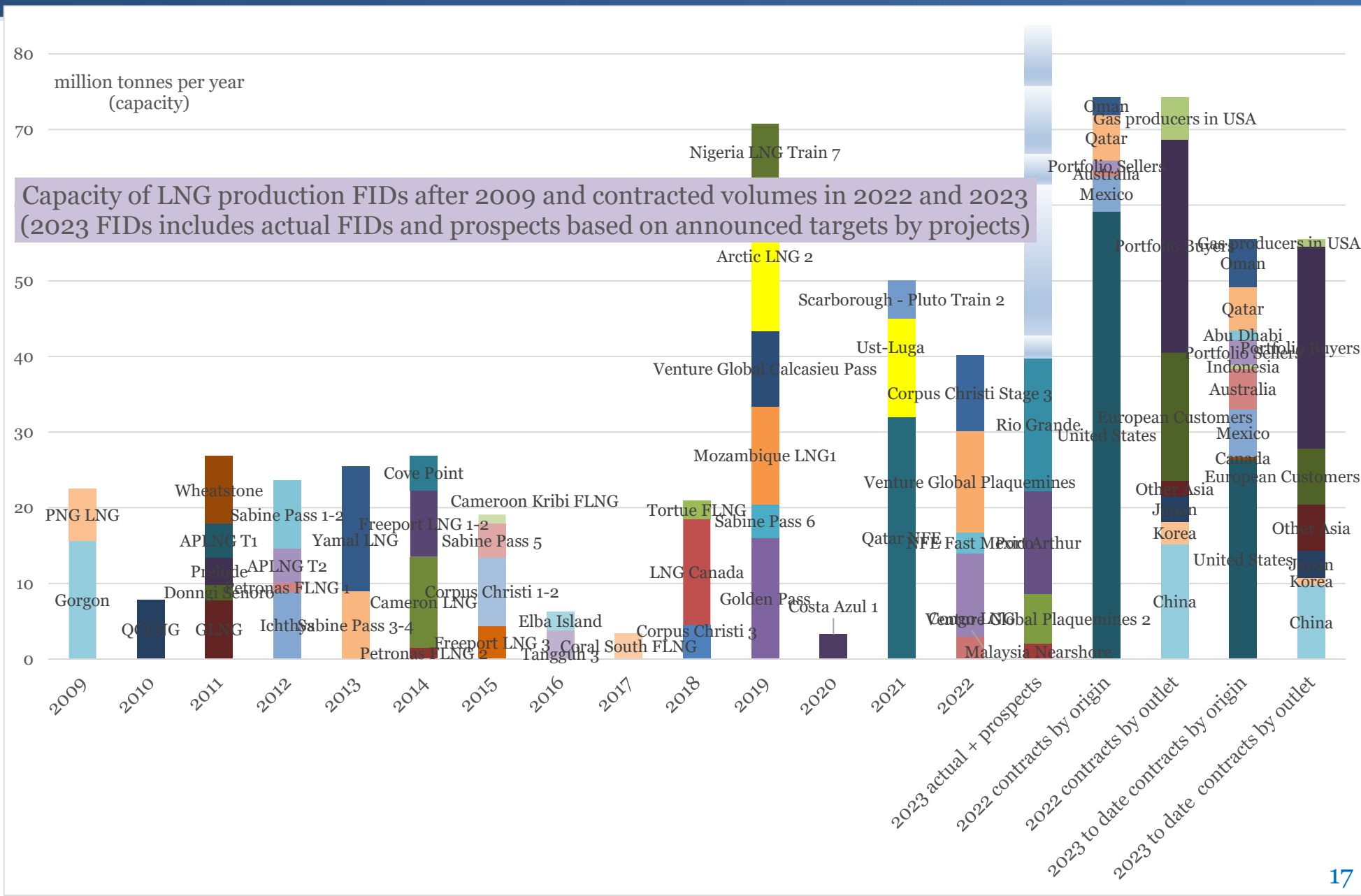
Europe's Shift from Russian Pipeline Gas to LNG Continues

- Russian pipeline gas further decreases in 2023, while Gazprom's income from gas sales will decrease in a faster pace in 2023 with lower prices
- Exports of Russian pipeline gas to the EU declined sharply in 2020, from more than 10 million tonnes per month until 2019
- Russian pipeline gas also lagged in terms of price compared to the increasing LNG from the United States
- European measures to cut dependence on Russia and intentional supply cuts from the Russian side



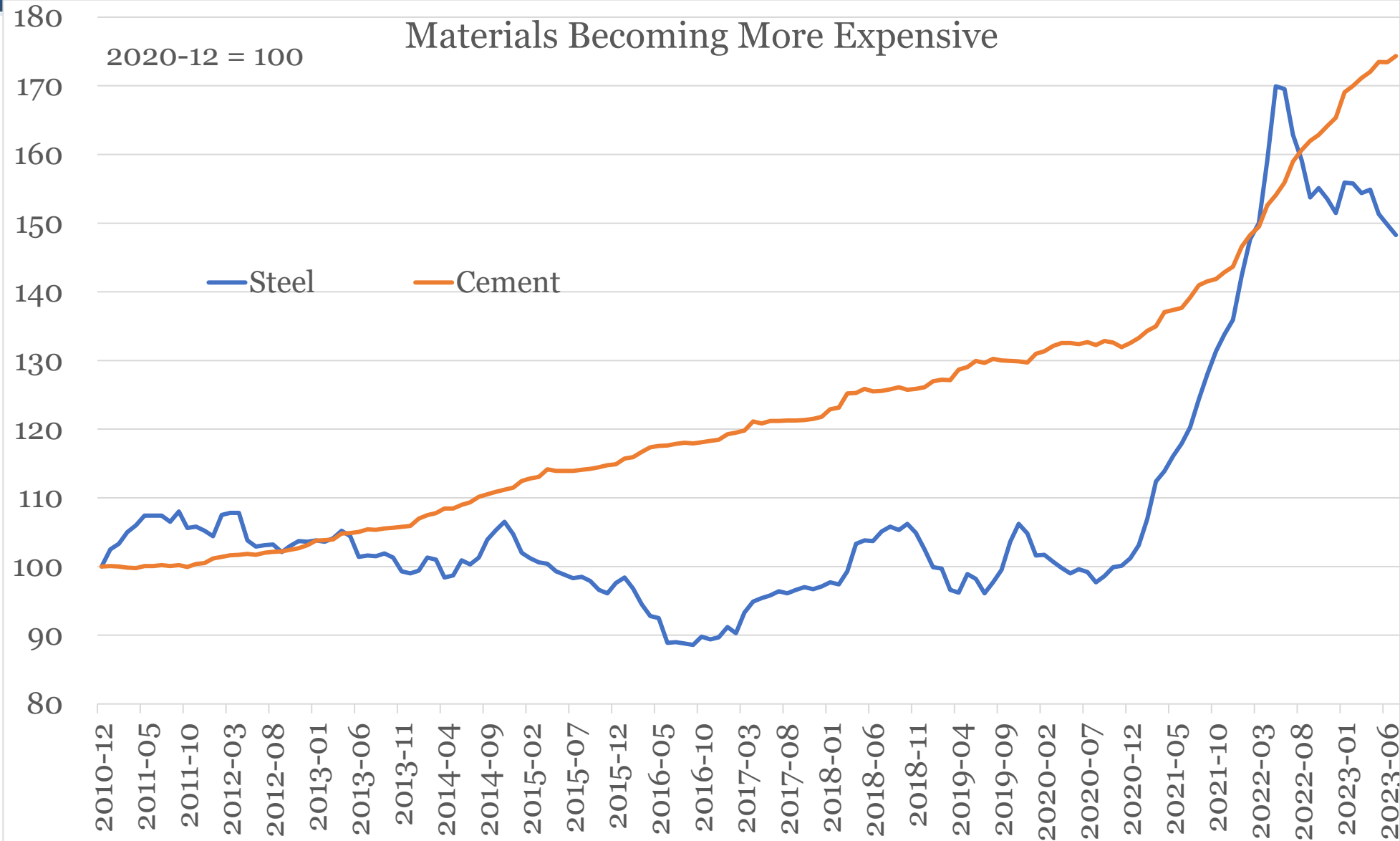
Term Contracts Should Underpin Investment

- LNG FIDs and construction activities are expected to increase (although the project boom may lead to higher EPC prices)
- Among the projects from past investment decisions, the realization of Russian projects is unclear
- Projects in other regions also require attention to the progress toward their realization



Term Contracts Should Underpin Investment

- Basic material costs have been in an increasing trend, especially later half of the 2021
- Those material costs are likely reflected in project construction costs.



Source: Based on data of Federal Reserve Bank

Relevant Items in G7 Energy Ministers' Communiqué

49. Energy security and clean energy transitions:

... commitment. . . to accelerate the phase-out of unabated fossil fuels

61. Methane:

... an internationally aligned approach for measurement, monitoring, reporting, and verification of methane and other GHG emissions to create an international market that minimizes GHG emissions across oil, gas, and coal value chains, including by minimizing flaring and venting, and adopting best available leak detection and repair solutions and standards.

69. Natural gas and LNG

... investment in the gas sector can be appropriate to help address potential market shortfalls provoked by the crisis, subject to clearly defined national circumstances, and if implemented in a manner consistent with our climate objectives and without creating lock-in effects, for example by ensuring that projects are integrated into national strategies for the development of low-carbon and renewable hydrogen.

Emissions: Inconvenient Facts for the LNG and Gas Industry

1. It is not well understood by the general public that majority of methane emissions are from outside of the LNG and gas industry.
 - i. However, the LNG and gas industry now has to prove that it is a contributor to solve the methane emission problem, rather than a cause of the problem.
 - ii. It is important to take good care of public relations in this front - make the industry look more serious.
 2. Every gas system is not made equal. Some gas systems emit more than others.
 - i. The best practices now have to be shared to save the industry as a whole.
 - ii. The best practices may have to be adjusted to local conditions.
 3. It is increasingly important to think about Scope 3.
 - i. Take a close look at how your gas production is eventually consumed.
 - ii. Take a close look at how your gas sources are produced without causing harm (emissions during the process).
 - iii. Take a close look at corporate level, site level, as well as cargo specific, emission profiles.
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LNG and Japan's Energy Mix

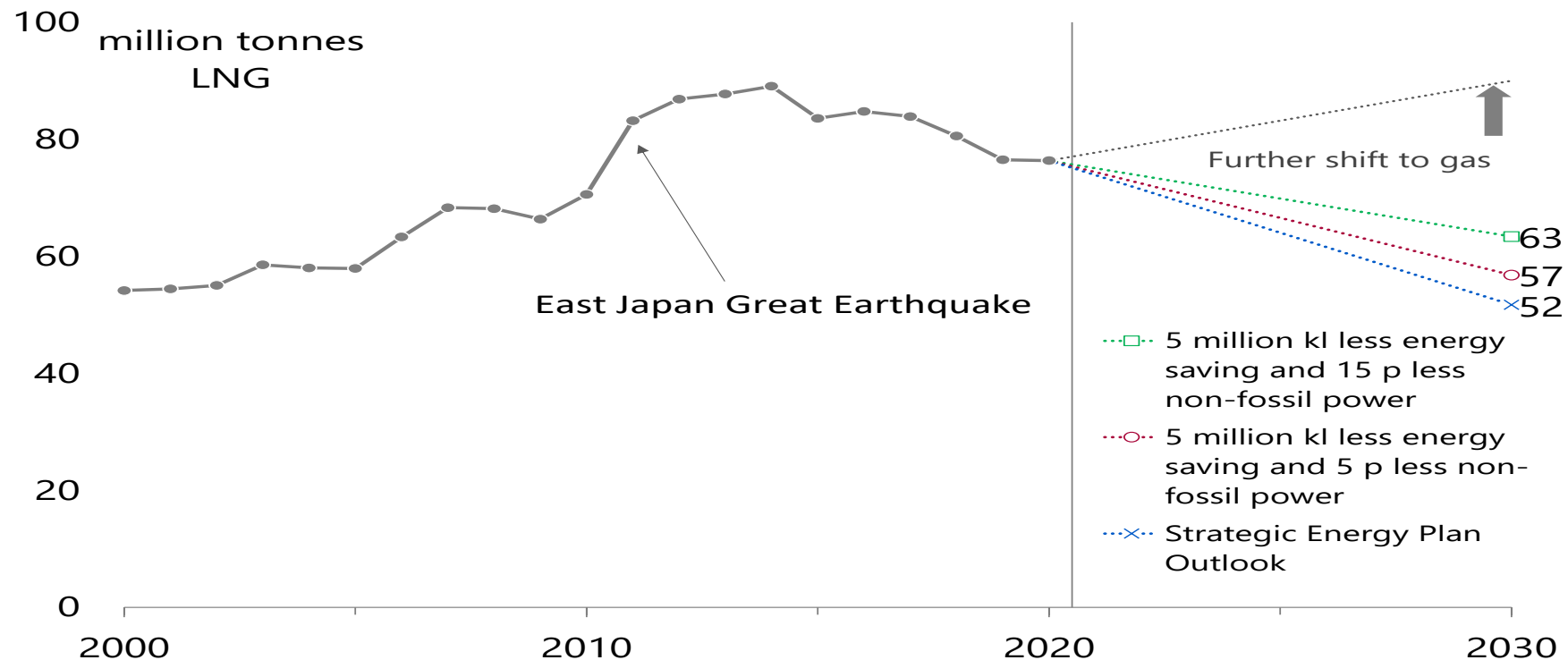
- In October 2021, Japan announced new Strategic Energy Plan, taking into account Japan's 2050 Net Zero goal published in the previous year(2020).
- The plan includes new energy mix goal, in which the share of LNG in 2030 modified from 27% to 20%, while LNG will be the most among thermal.

		(FY2019 ⇒ previous energy mix)	Energy mix in FY2030 (<u>ambitious outlook</u>)	
Energy efficiency improvement		(16.55 million kl ⇒ 50.30 million kl)	62 million kl	
Final energy consumption (without energy conservation)		(350 million kl ⇒ 377 million kl)	350 million kl	
Power generation mix Electricity generated : 1,065 TWh ⇒ Approx. 934 TWh	Renewable energy	(18% ⇒ 22-24%)	36-38%	
	Hydrogen/Ammonia	(0% ⇒ 0%)	1%	
	Nuclear	(6% ⇒ 20-22%)	20-22%	
	LNG	(37% ⇒ 27%)	20%	
	Coal	(32% ⇒ 26%)	19%	
	Oil, etc.	(7% ⇒ 3%)	2%	
(+ non-energy related gases/sinks)			46%	
GHG reduction rate		(14% ⇒ 26%)	Continuing strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50%	

Sources : Outline of Strategic Energy Plan (October, 2021)
https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/6th_outline.pdf

LNG and Japan's Energy Mix

- While the new Energy Plan sets reduction of LNG requirement, if the energy saving performance falls, LNG import demand should go up.
- In order to take care of fluctuation in LNG demand, substantial flexibility in LNG supply will be more important.
- In addition to securing more medium-term deals from flexible LNG supply sources, basic demand with certain prospects should be covered by term contract with relatively longer durations with more competitive conditions.



(Source) IEEJ Outlook 2022, October 2021

Toward Stability of the LNG Markets

- Elements to Survive the Turbulence

	Short-term issues	Long-term issues
Supply issues	<p>Declining Russian piped gas supply, Russian LNG supply maintenance</p> <p>Feed gas shortage issues in LNG production at some projects</p> <p>Unplanned outages at some LNG projects</p> <p>New projects ramping up in the next one, two years</p>	<p>Additional projects in North America</p> <p>Maintain stability and enable expansion of Australian LNG production</p> <p>Realization of LNG projects in Africa</p> <p>LNG related policies in producing countries</p>
Demand issues	<p>LNG and natural gas demand recovery pace in China</p> <p>Nuclear developments in Japan, Korea and France</p> <p>Analysis of European gas demand reduction (structural reduction thanks to efforts or demand destruction by higher prices)</p> <p>Demand fluctuation in emerging price-sensitive markets</p>	<p>Transition scenarios changing demand outlooks significantly</p> <p>Demand centers shifting to developing economies</p> <p>Preference of shorter long-term contracts</p>
Price	<p>Increasingly greater fluctuation of prices due to increasing volatility and increasing gas-on-gas pricing</p>	<p>Changing pricing arrangements in long-term contracts</p>
Climate	<p>Greater needs to enhancing MRV in the LNG value chain</p> <p>Short-term emission reduction measures (recovery of wasted)</p>	<p>Clearer standards of transition-proof LNG projects</p>
Financial	<p>Diversifying channels of funding responding to needs of LNG projects</p> <p>Presenting economic advantage and environmental superiority of LNG projects as investment and lending opportunities</p>	<p>Filling the gap between buyer's preference for flexibility and shorter duration of contracts, increasing buyer profiles including lower credit and needs to secure long-term commitment by higher rated buyers</p>