



5th Oil and Gas Security Network Forum
Sendai, Japan

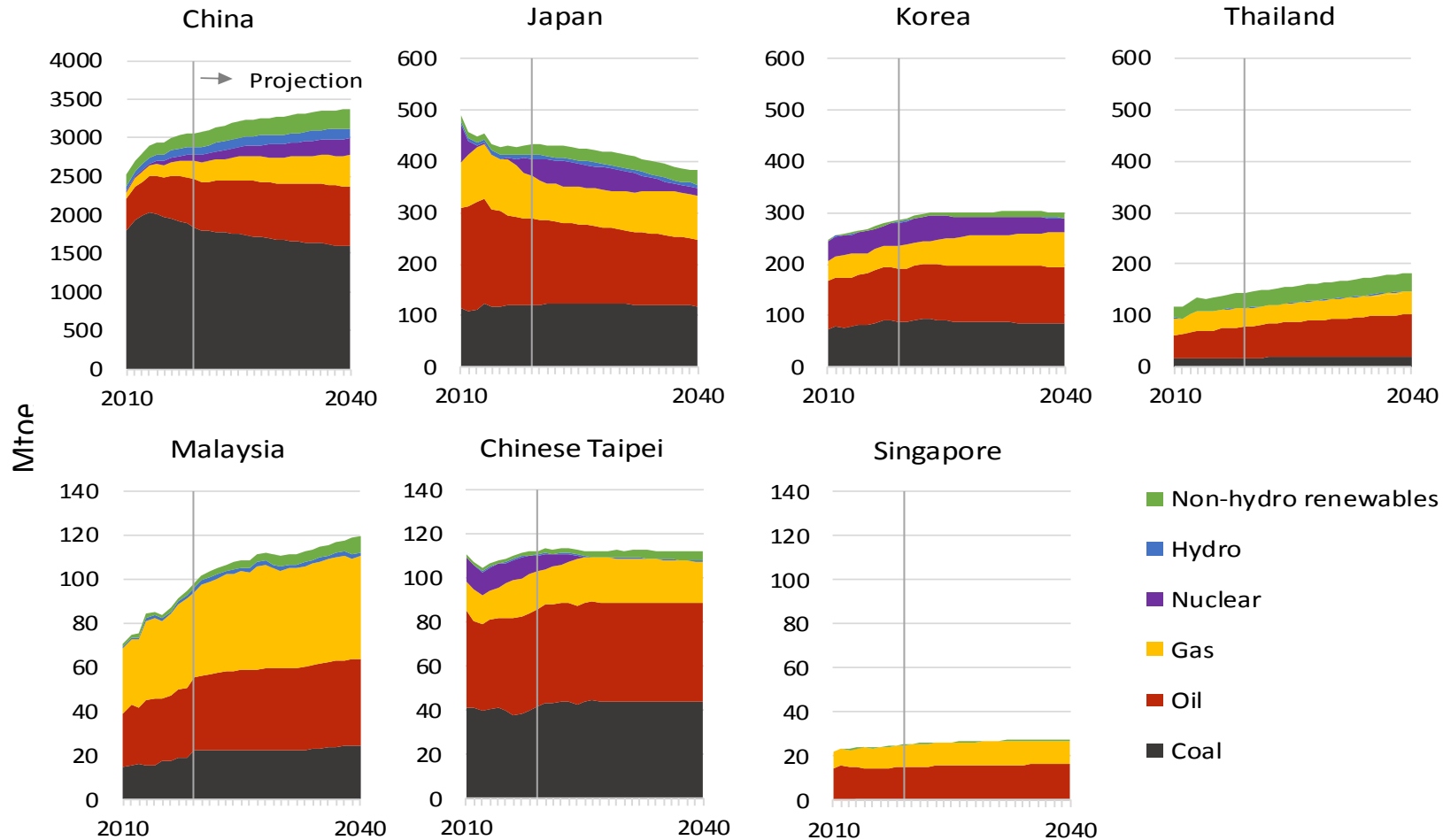
Future LNG trade and gas supply security

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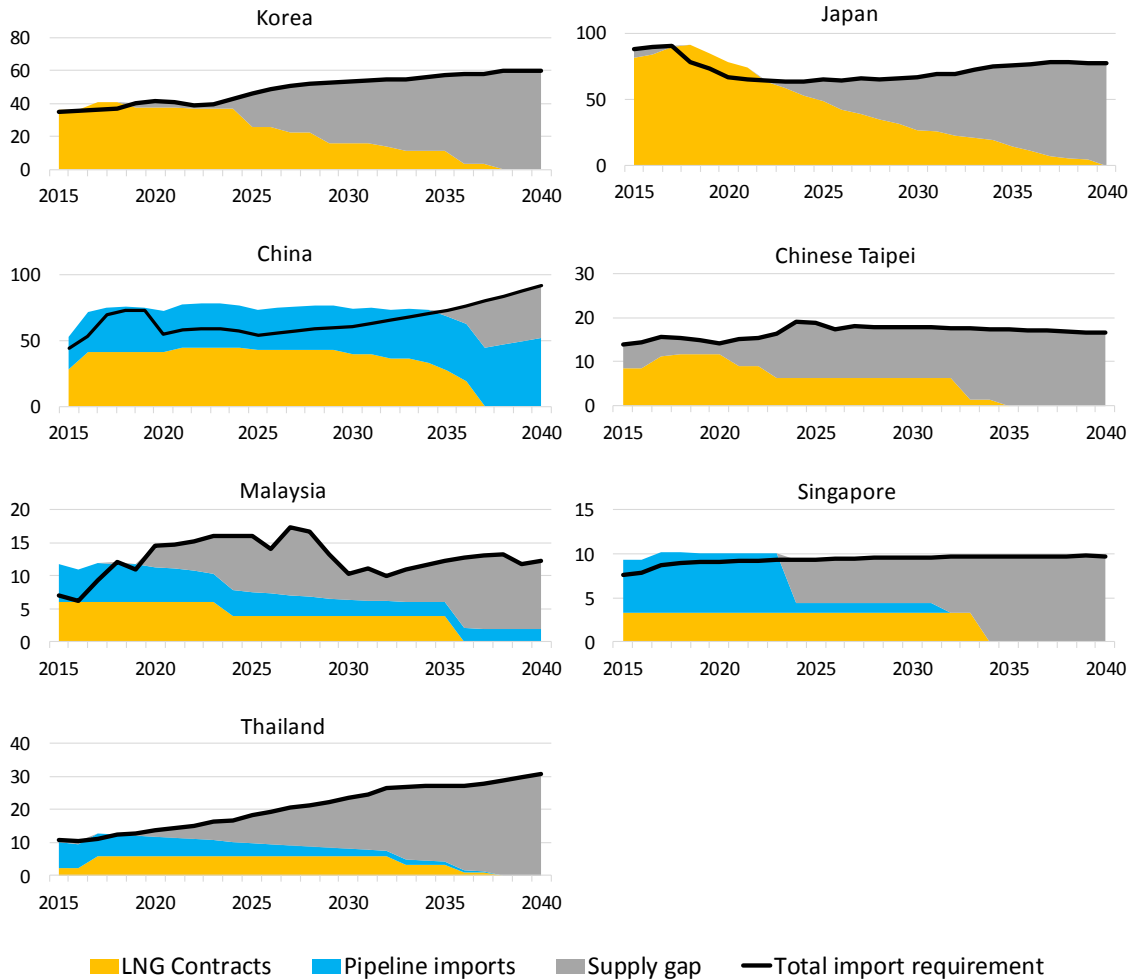


Total primary energy supply by fuel, 2010-2040



Gas is projected to grow the most rapidly in APEC among all the fuels, which implies LNG demand continues to grow.

Projected natural gas supply gap in APEC, 2015-2040 (Mtoe)



Total gas import

$$Im_{i,y} = PS_{i,y} + Ex_{i,y} - P_{i,y}$$

$P_{i,y}$ = Domestic gas production projection for economy i in year y .

$PS_{i,y}$ = Primary gas supply for economy i in year y .

$Ex_{i,y}$ = Total gas export for economy i in year y .

Gas supply gap

$$S_{i,y} = Im_{i,y} - Im_{pipe,y} - Im_{LNG_c,y}$$

$Im_{i,y}$ = Total gas import projection for economy i in year y .

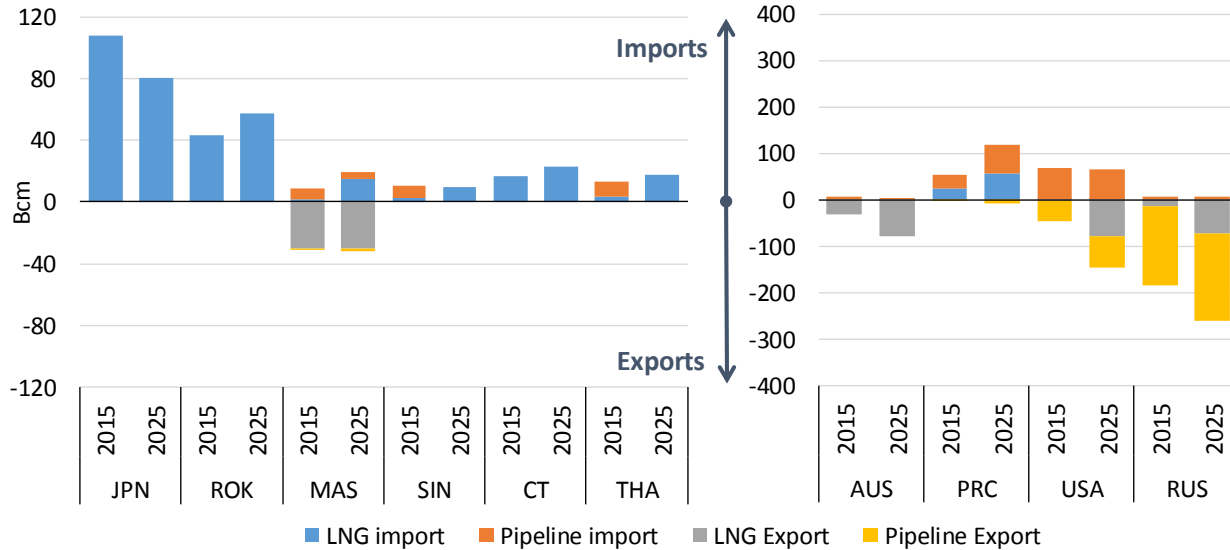
$Im_{pipe,y}$ = Projection of gas pipeline import based on existing pipeline capacity for economy i in year y .

$Im_{LNG_c,y}$ = LNG imports based on existing LNG supply contracts at 100% for economy i in year y .

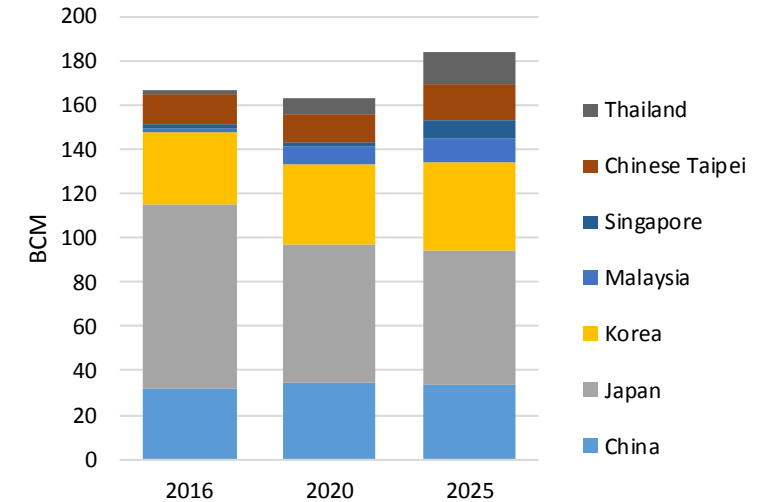
The gas import and export is based on capacity limitation, possible trade flow, domestic demand and gas production.

Gas trade and LNG demand projection in 2025

Gas trade, 2015 and 2025



LNG demand, 2015-2025



- **LNG is projected to become the main source of gas imports in the future.**
- **The US, Russia and Australia are projected to expand LNG export capacity in order to meet demand**

Methodology of gas supply security

The Worldwide Governance Indicators of economies who export gas to APEC members in 2017

Economy	WGI*	Economy	WGI*
Algeria	-0.96	Nigeria	-1.94
Angola	-0.29	Norway	1.15
Australia	0.90	Oman	0.74
Belgium	0.42	Papua New Guinea	-0.58
Brazil	-0.41	Peru	-0.26
Brunei Darussalam	1.19	Qatar	0.55
Egypt	-1.42	Russia	-0.67
Equatorial Guinea	-0.15	Singapore	1.59
France	0.21	Spain	0.27
India	-0.83	Taiwan	0.89
Indonesia	-0.51	Trinidad and Tobago	0.29
Japan	1.12	Turkmenistan	-0.15
Kazakhstan	0.02	UAE	0.63
Korea, Rep.	0.29	United Kingdom	0.26
Malaysia	0.16	United States	0.30
Myanmar	-1.08	Uzbekistan	-0.28
Netherlands	0.92	Yemen	-2.96

* Political Stability and Absence of Violence/Terrorism indicator
Source: (WBG, 2017)

Gas supplier stability index

$$S_{e,y} = \left(\left(\frac{(P_i - 2.5)}{5} \right) \times -1 \right) \times IS_{i,e,y}$$

Where:

$S_{e,y}$ = Stability indicator of gas importing economy e in year y .

i = gas import source economy i

$IS_{i,e,y}$ = share of exporter i from total imports received by economy e in year y

Gas import source diversity index (HHI)

$$H = \sum_{i=1}^{N_t} E_i^2 D_{e,y} = \sum_{i=1}^n IS_{i,e,y}^2$$

Where:

$D_{e,y}$ = gas import source diversity of gas importing economy e in year y

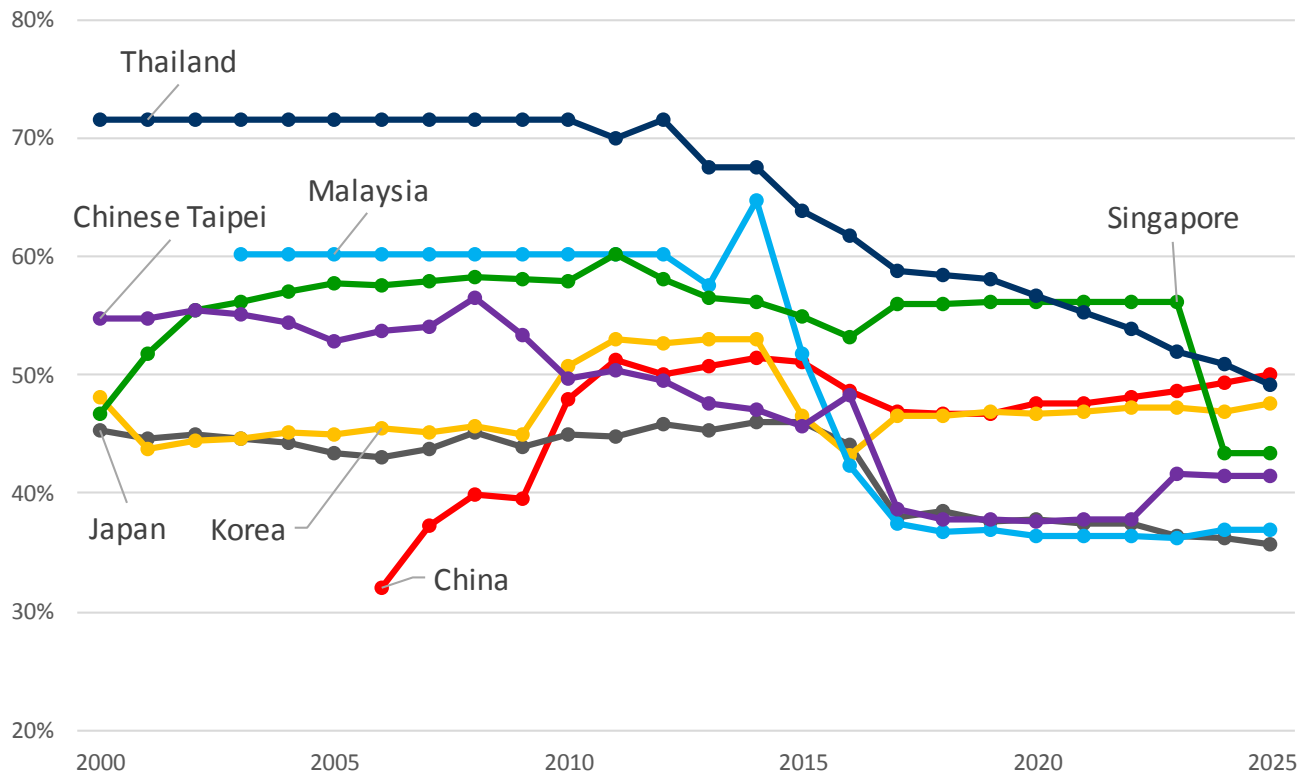
i = gas import source economy i

n = number of gas import source economies

$IS_{i,e,y}$ = share of exporter i from total imports received by economy e in year y

Gas supply stability index

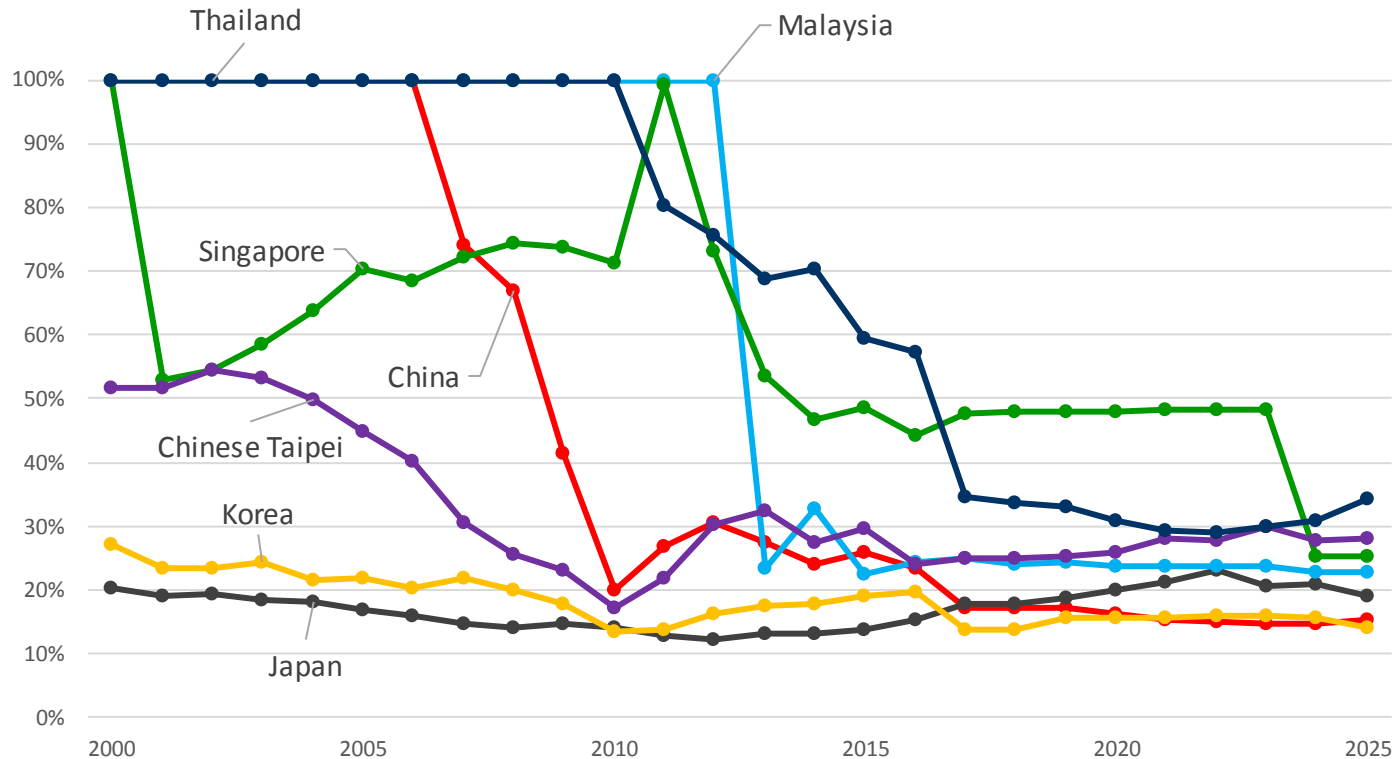
Gas supply stability index, 2000-2025



The overall gas supply stability index has improved since 2010 because of termination of LNG contract with higher risk economies.

Gas export economy	Risk index
Australia	32%
Brunei Darussalam	26%
Equatorial Guinea	53%
Indonesia	60%
Malaysia	47%
Myanmar	72%
Nigeria	89%
Oman	35%
Papua New Guinea	62%
Peru	55%
Qatar	39%
Russia	63%
Turkmenistan	53%
UAE	37%
Yemen	100%

Gas supply diversity index, 2000-2025



Most economies' gas supply sources are becoming more diversified as more new LNG producers are coming in.

Conclusion

1. Gas is projected to grow the most rapidly in APEC among all the fuels, which implies LNG demand continues to grow.
2. The projected gas supply gap in APEC economies presents opportunities for LNG exporters.
3. There are more new LNG suppliers, such as the US and Russia, they are the most promising LNG exporter to fill up the supply gap given the considerable production. This will help the LNG importers to improve their gas supply diversity and also enhance the gas supply security.
4. Stable import source and secure trade route is important for both exporter and importer.
5. This is a preliminary study of LNG security. The new OGSS project will deepen this study in two ways. First, in addition to gas supply stability and diversity indices, we will further explore other LNG security indices, such as concentration of the supply source, infrastructure completeness, dependency on chokepoints etc. Second, we will also look at the potential risks that might impact future supply, such as inability to attract sufficient investment in LNG facilities and labor constraints for infrastructure build-out etc.



Thank you

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