The 3rd APEC Oil and Gas Security Network Forum

Irkutsk, Russia, 29 June 2017

Oil and Gas Security Indexation

Izham Shukor

Researcher, APERC

APERC
Asia Pacific Energy Research Centre

Asia-Pacific Economic Cooperation

Background

In EWG 50 (14-18 December 2015), **Energy Security Indexation** was proposed as one of the topics under the Oil & Gas Security Studies (OGSS) research activities for 2016.

APERC presented the proposal on **Energy Security Indexation** in 2nd OGSN Forum (10 March 2016). The study objectives are:

- Identifying the issues of potential risk on energy security
- Historical analysis and synthesis on energy trade, energy use etc
- No specific weightages applied on risk

Not all indicators are relevant to one's economy but APERC hopes that this study may help individual economy to established their own energy supply security index.

Many factors may contribute to supply interruptions

Identifying factors by using PESTLE methodology

POLITICS

Domestic and import source stability; International agreement; Chokepoints risk

ECONOMICS

Fuel diversity; Import source diversity; Energy pricing; Oil and gas intensity; Oil and gas share to primary energy; Doing business; Oil to GDP ratio;

SOCIAL

Oil and gas consumption per capita

TECHNOLOGICAL & TECHNICAL

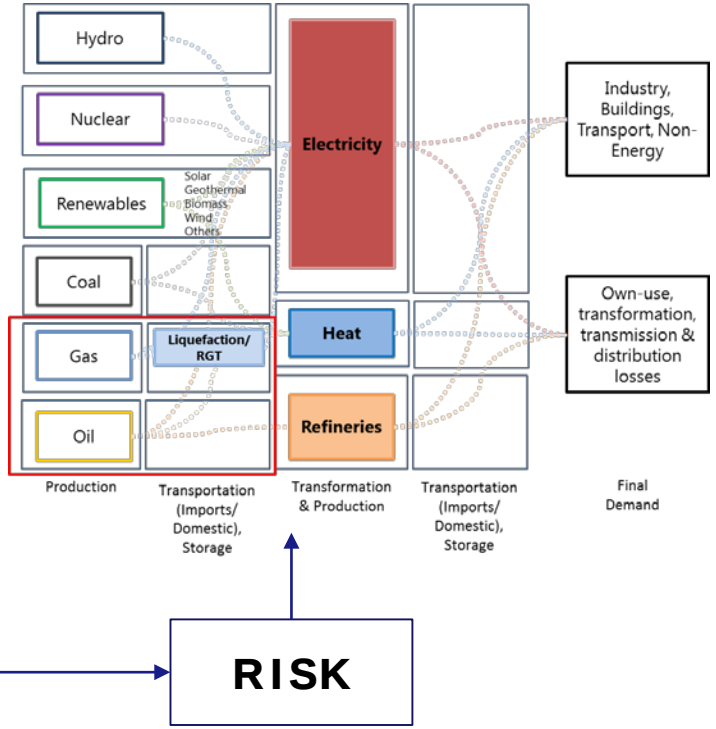
Logistics efficiencies; Pipelines, LNG terminal and refinery utilization rate; R/P ratio for oil and gas; Oil and gas self sufficiency; Underground gas storage

LEGAL

Emergency preparedness; Rule of law; Strategic stockpile; Resource extraction regulation

ENVIRONMENT

Vulnerability and preparedness facing climate change; Natural disaster



This study focuses on production, transportation and to some extent transformation in oil and gas. Each segment poses its own challenges and supply disruption risk.

Source: APERC analysis

Index Building Blocks

Why PESTLE?

- This methodology can give a helicopter view on the risk of energy supply as it covers most of the major concerns lingering around energy security.

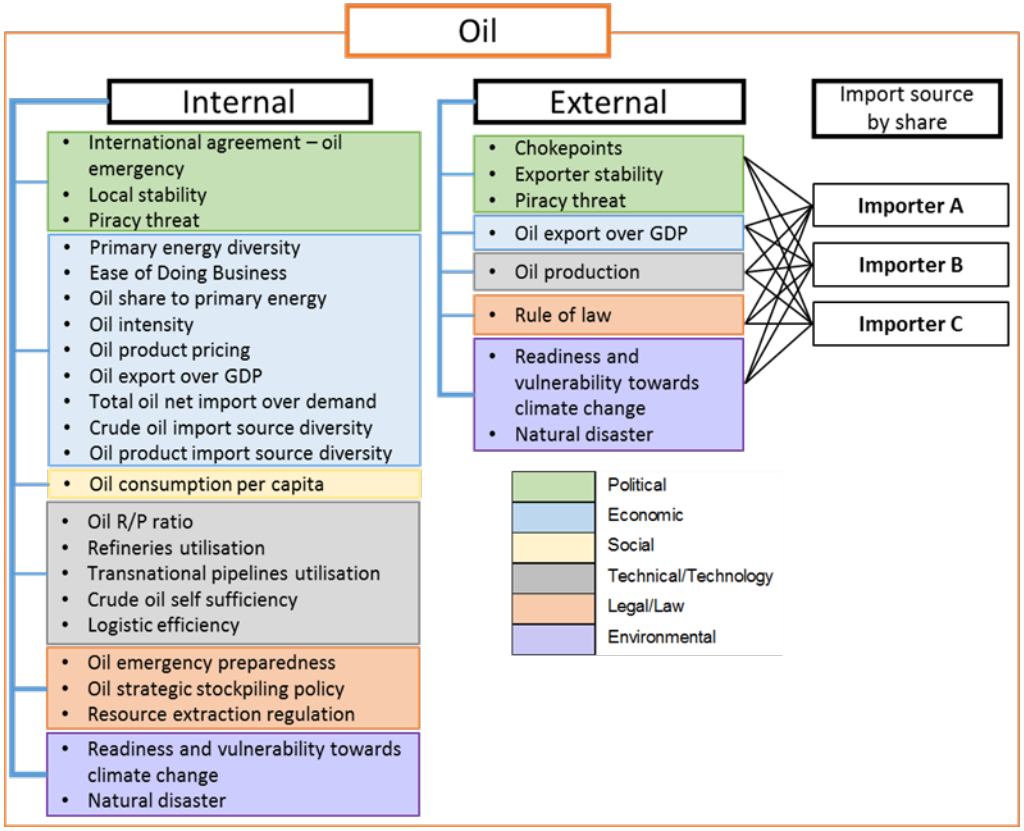
- Economy that wish to established their own index will be able to prioritise one to each other e.g. Environmental has higher priority than social or vice versa etc.

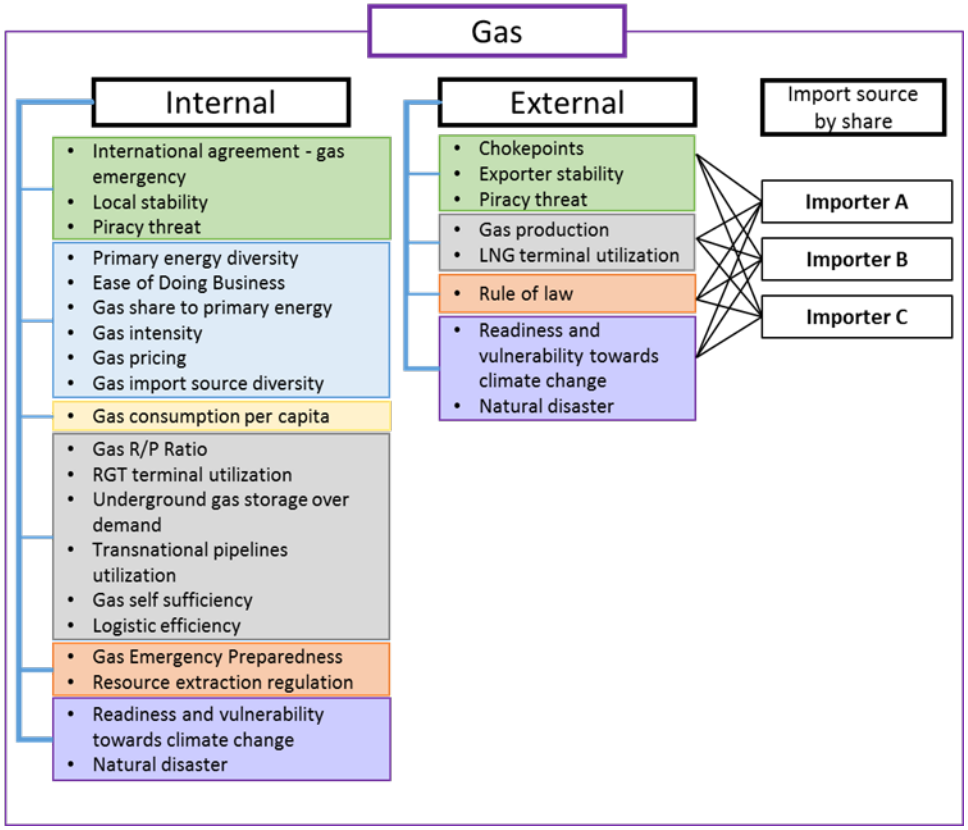
- Able to relate with economy's focus in strengthening security of supply such as infrastructure development as well as time based focus i.e short term, long term.

- To examine relation between APEC trade (which is one of the main objective of APEC establishment) and supply security.

Index Building Blocks

Oil and gas security indexation sub-indicators





Each segment poses its own challenges and supply disruption risk.

Source: APERC analysis

Notes: Oil includes crude and product. However, external risk for crude and product is calculated separately. Each import source was calculated separately

Index Building Blocks

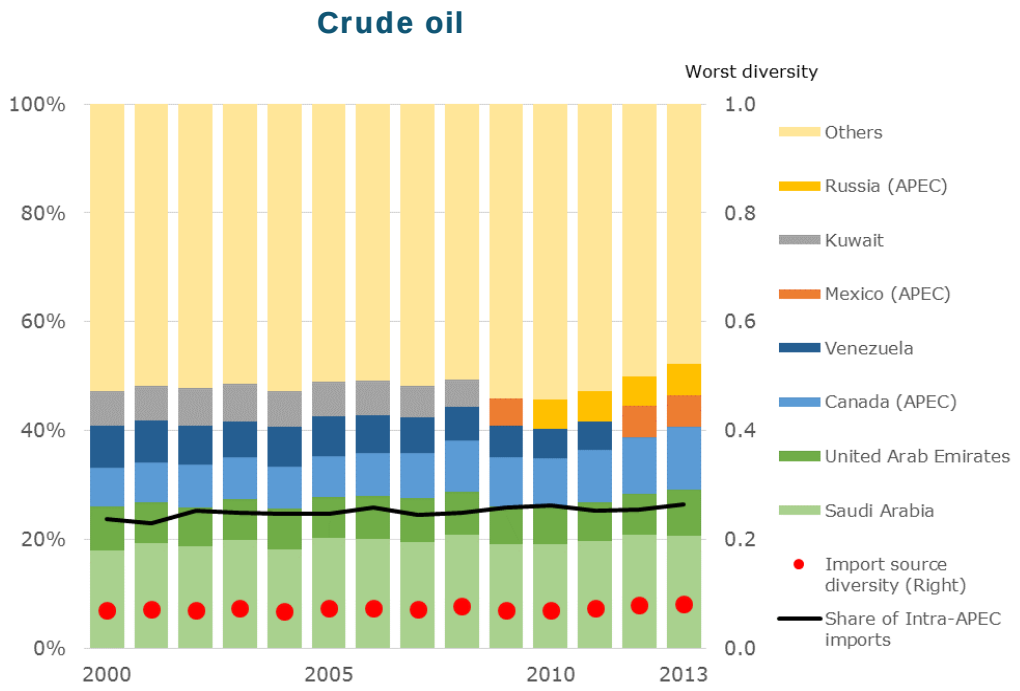
Source of information and data

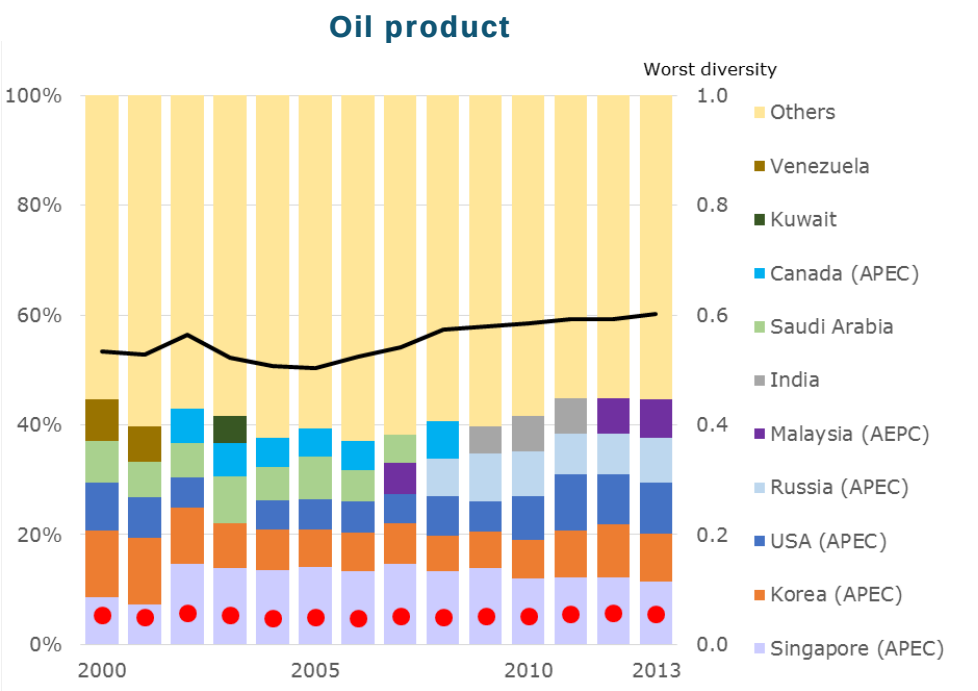
- Trade data (UN Comtrade)
- World Governance Indicator 2014 (World Bank)
- Piracy and Armed Robbery against ship (International Chamber of Commerce - Maritime Bureau)
- Doing Business Report 2004-2015 (World Bank)
- Logistic Performance Index 2006-2013 (World Bank)
- World Economy Outlook 2013 (International Monetary Fund)
- Global Petroleum Survey 2007-2014 (Frasier Institute)
- University of Notre Dame Global Adaptation Index (ND-GAIN) 1995-2015
- Centre for Research on the Epidemiology of Disasters (CRED)
- World Energy Statistics 2015 (IEA)
- International Energy Statistics (EIA)
- Oil and Gas Security Forum (APERC)
- Oil and Gas Journal (subscription)
- Cedigaz (subscription)
- World LNG Report (IGU)

APERC has been trying to use open data as much as possible. Since this study is focusing on supply risk, the lower index reading become means better supply security.

High intra-APEC import for oil products help to mitigate some of supply risk for oil

Crude and oil product import source



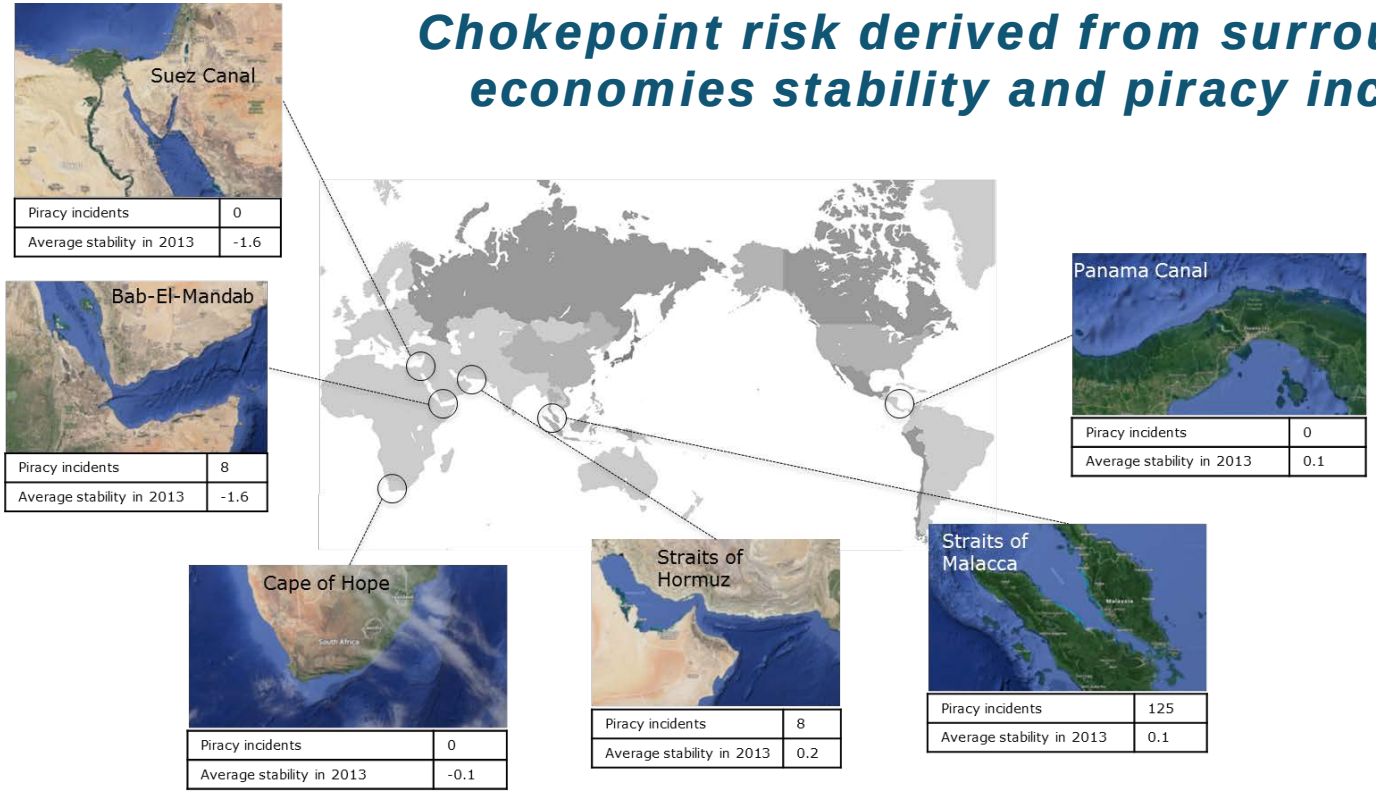


Although crude oil import among APEC members is low (~30%) because of limited resources, oil product import reached more than 50%

Sources: UN Comtrade and APERC analysis.

Chokepoints Risks

Chokepoint risk derived from surrounding economies stability and piracy incidents



In 2013, two-third of crude oil and one-third of LNG imports to APEC passed through at least one of these chokepoints

Sources: World Bank, ICC-IMB and APERC analysis.

Note: WGI consist of six sub-indices. The Study adopted the WGI's "Political Stability and Absence of Violence/Terrorism indicator" published by the World Bank in order to establish the local stability indicator. ICC-IMB recorded incidents that occurred in economy and international waters. The study assume that there is no chokepoint risk for intra-APEC oil and LNG trade.

Oil supply security index

Key Findings:

- On average, Oil Supply Security Index improved by 2 percentage point from 29% in 2000 to 27% in 2013 (*lower score means lower risk and better security*).

- In 2013, half of the crude oil imports came from five main suppliers - Saudi Arabia (~ 20%), Canada (~10% mainly to US), UAE (8%), Russia (6%) and Mexico (6% mainly to US). Russia saw a steady increase in its oil exports to other APEC economies over the study period, and became one of the top five exporters to the APEC region in 2011.

- Technical/technology related risk for oil showed the best improvement for 2000-2013 period – partly due to higher oil production (shale and oil sand), new reserves discoveries and improved production/trade infrastructure.

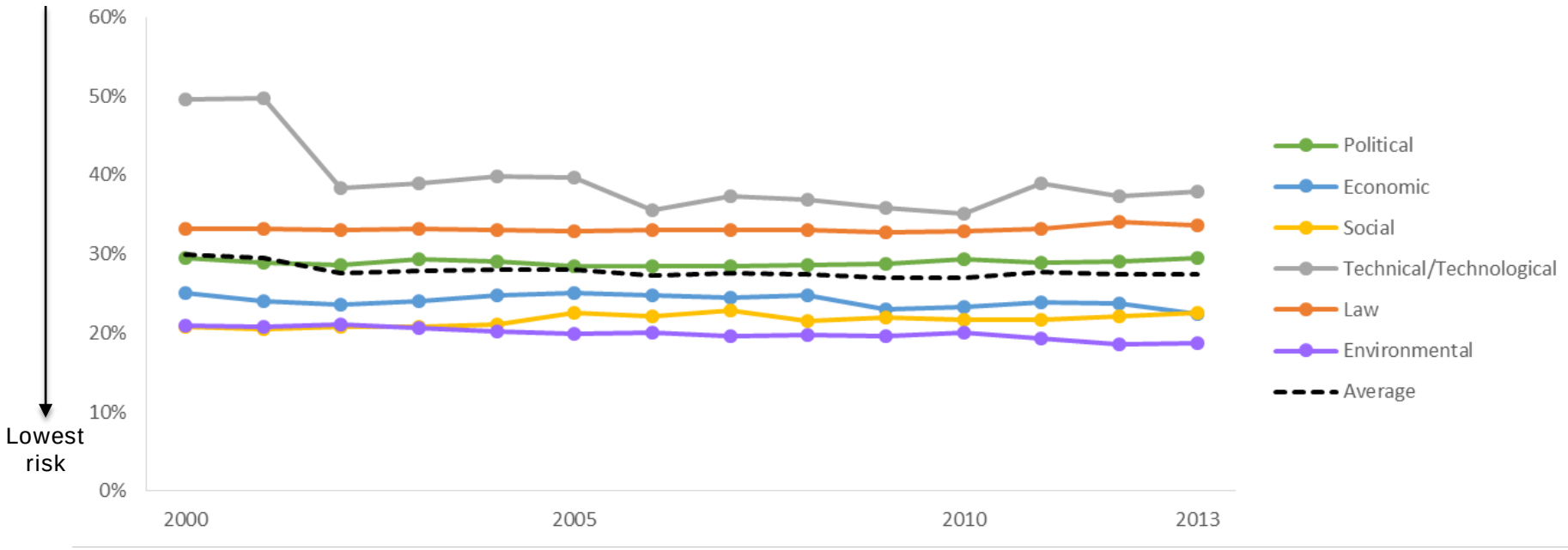
- Political risk, especially in external group, remain as big challenge for APEC members. The absence of an oil emergency supply agreement in eight APEC members prevented the Oil Supply Security Index to improve further.

- Piracy incidents in the APEC region recorded a sharp increase from 69 incidents in 2008 to 148 incidents in 2014. The increase of piracy in the APEC region added another 6.0% of risk to the political indicator.

- APEC's overall oil intensity reduction helps to improve Economic risk by 2 percentage points

Oil supply security index

PESTLE analysis on oil supply security



The average of APEC's oil security index improved because of new oil reserves in Canada. However, social indicator is expected to increase as oil consumption in developing APEC members will continue to grow.

Source: APERC analysis

Note:

- *In the oil security index (1.0% to 100.0%), a lower index means less vulnerability to any gas supply disruption/crisis. A security index of 20% and below is considered low exposure to supply disruption, 21%-40% is moderate-low exposure, 41%-60% mid-exposure, 61%-80% moderate-high exposure, and 81% and above is high exposure.*
- *Oil includes crude and product*

Oil supply security index

Majority of the sub-indicators improved

Political sub-indicators	2000	2013	Changes
Local Stability	46	46	0
Piracy	5	6	1
International agreement	50	48	-2
Piracy	2	2	0
Chokepoints	11	10	-1
Exporter Stability	39	44	5

Economic sub-indicators	2000	2013	Changes
TPES Diversity (HHI)	25	27	2
Ease of Doing Business	34	27	-8
Oil Shares to primary energy	28	25	-3
Oil intensity	75	55	-20
Oil product pricing	38	33	-5
Oil export over GDP	7	8	1
Total oil net import over demand	41	32	-9
Crude oil import source diversity	7	8	1
Oil product import source diversity	5	6	1
Oil export over GDP	17	19	2

Internal factors

External factors

(0 means no risk)

Social sub-indicators	2000	2013	Changes
Oil consumption per capita	21	23	2

Technical/technology indicators	2000	2013	Changes
Logistic efficiency	32	31	-1
Oil reserves/production ratio	10	10	0
Refinery utilization	89	85	-4
Transnational pipelines utilization	100	90	-10
Crude oil self-sufficiency	36	31	-5
Oil production rate	15	5	-10

Law sub-indicators	2000	2013	Changes
Resource extraction policy	37	40	3
Oil emergency preparedness*	0	0	0
Oil strategic stockpiling policy	58	58	0
Rule of law	38	37	-1

Environmental sub-indicators	2000	2013	Changes
Readiness & vulnerability (climate change)	42	37	-5
Natural disaster	1	2	1
Readiness & vulnerability (climate change)	39	33	-6
Natural disaster	0	0	0

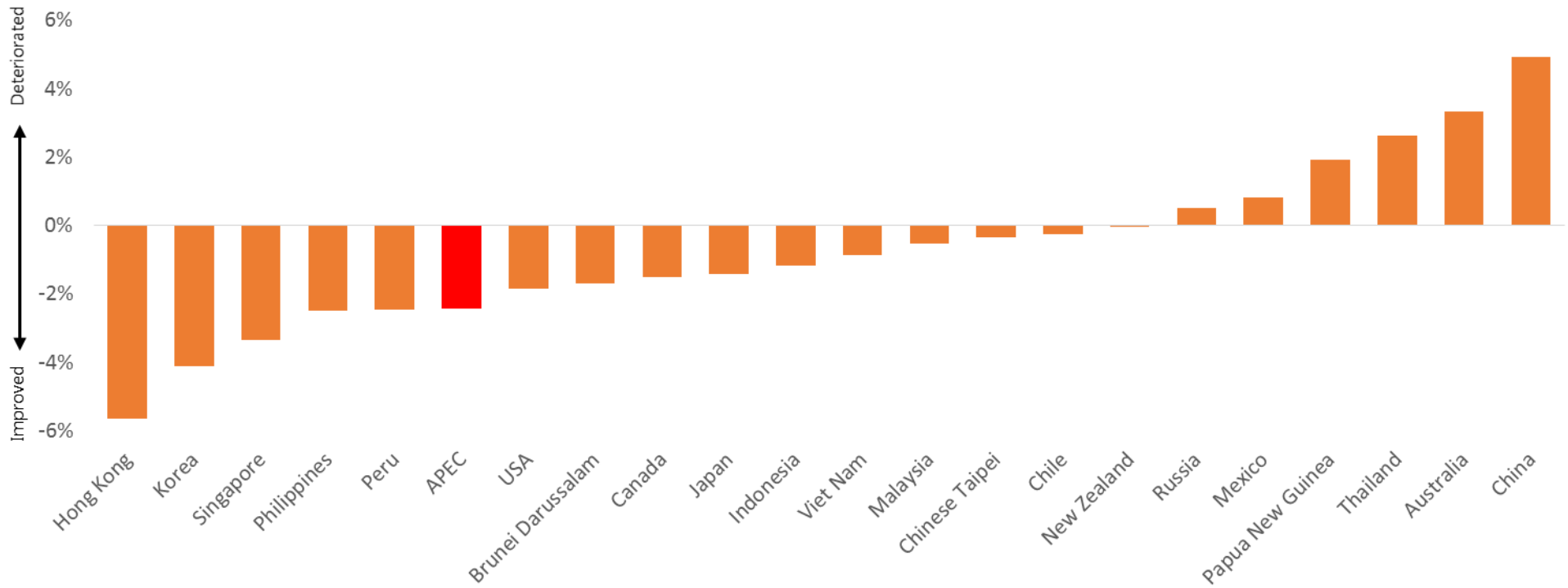
Oil intensity provided the biggest changes - improving by 20%. Risk of exporter stability deteriorate by 5%. All technical/technology sub-indicators improved.

Source: APERC analysis

** APERC assumed all members has some sort of emergency preparedness for oil. However, a detail study on the readiness and resiliency of the system can help to determine the score index.*

Depleting reserves and increase in oil consumption pushed the index higher for some economies..

Changes in average of oil security index, 2000-13

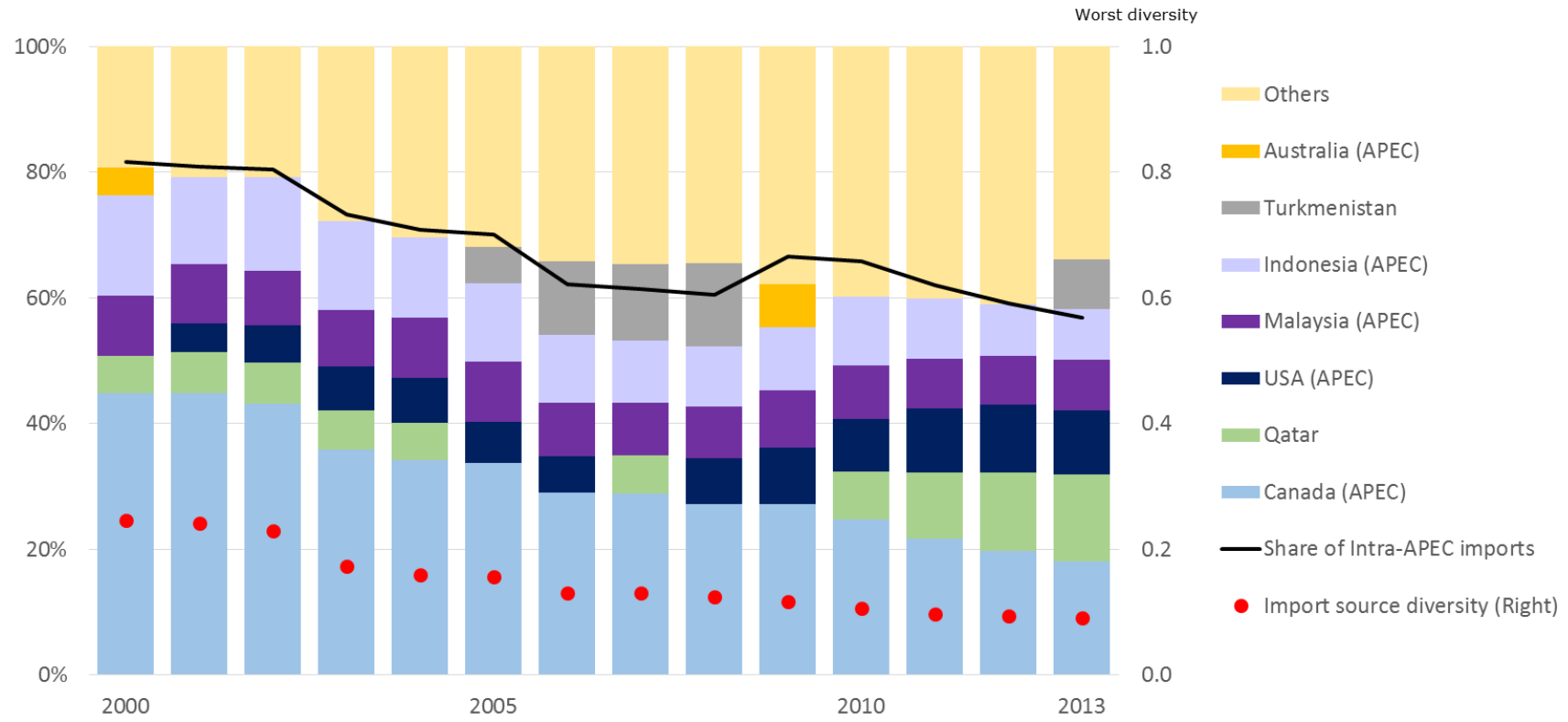


Most APEC members showed improvements because of lower oil consumption, improvement in oil reserves, lower risk from import sources and highly stable domestic situation

Source: APERC analysis
Note: Oil includes crude and product

Most of gas import came from APEC members

Gas import source of APEC



Share of intra-APEC imports reduced as importers trying to diversify their source (and subsequently the risk)

Source: Cedigaz and APERC analysis
Note: Gas import source covers pipelines and LNG

Gas supply security index

Key Findings:

- APEC registered a relatively stable Gas Supply Security Index at around 28%. The index recorded the lowest risk in 2009, partly because of weaker gas demand due to the global economic crisis that occurred in 2008-2009. Of the six indicators, only two of them – social and technical/technology indicators, displayed an increasing risk.

- Australia, Canada; Indonesia; Malaysia; the United States; and Qatar are major gas import source for APEC (pipelines and LNG), supplying 65% of the region's gas import demand in 2013. An improved diversity of import sources can be seen from 0.25 in 2000 of HHI to 0.09 in 2013.

- There are only seven APEC members that have a regional agreement on gas supply for emergencies. A regional wide agreement can help to lower supply risk.

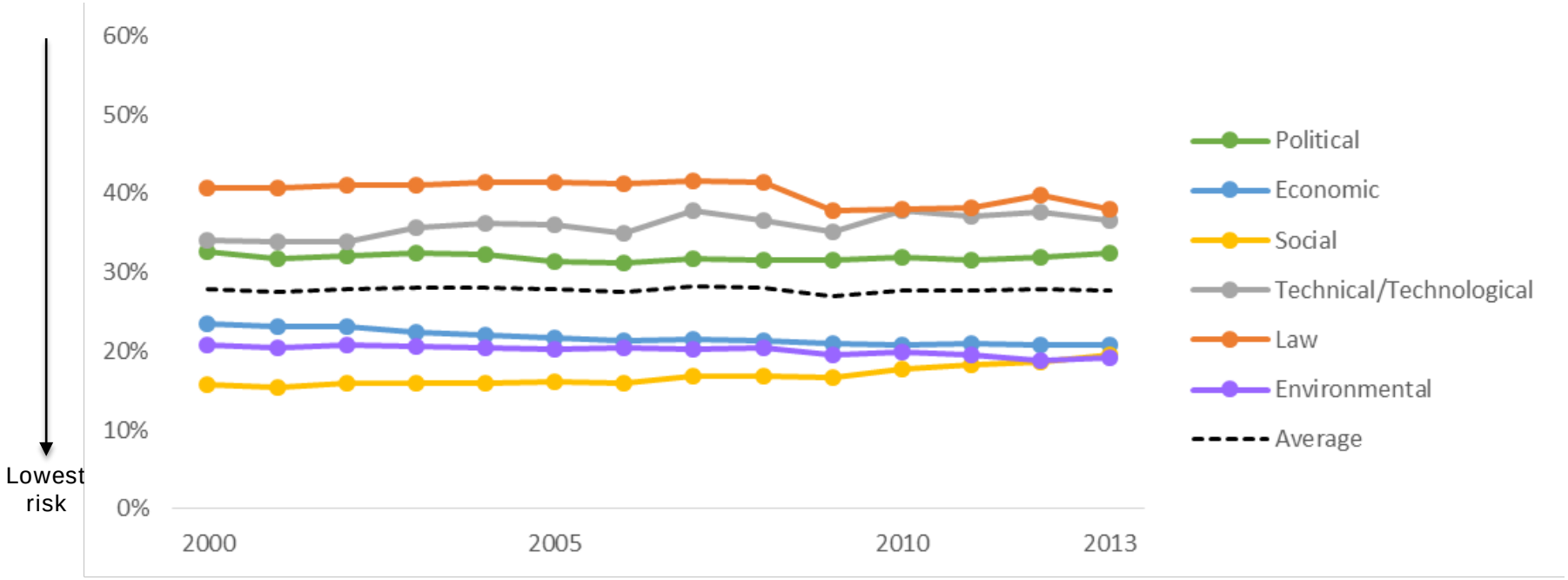
- Technical/technology risk (which includes gas reserves as well as infrastructures) for both importers and exporters has been increasing as more gas is being used in APEC.

- Law risk decrease as more APEC members established policies, such as allowing gas to be imported in LNG form or having gas storage in place, and built new infrastructure.

- APEC can make use full advantage of its geographic location and stability i.e less chokepoints, shorter distance, stable region and active trade.

Gas supply security index

PESTLE analysis on gas supply security



Law indicator provides the highest risk followed by technical /technology indicator. There are 14 APEC members does not have regional gas emergency agreement. Gas consumption per capita continue to increase in developing and gas producing economies.

Source: APERC analysis

Note: In the gas security index (1.0% to 100.0%), a lower index means less vulnerability to any gas supply disruption/crisis. A security index of 20% and below is considered low exposure to supply disruption, 21%-40% is moderate-low exposure, 41%-60% mid-exposure, 61%-80% moderate-high exposure, and 81% and above is high exposure.

Gas supply security index

APEC continue to be a gas self-sufficient region…

Political sub-indicators	2000	2013	Changes
Local Stability	46	46	0
Piracy	5	6	1
International agreement	60	60	0
Piracy	6	5	-1
Chokepoints	3	6	3
Exporter Stability	56	51	-5

Economic sub-indicators	2000	2013	Changes
TPES Diversity (HHI)	25	27	2
Ease of Doing Business	34	27	-7
Gas Shares to primary energy	20	20	0
Gas intensity	57	55	-2
Gas pricing	36	36	0
Gas import source diversity	25	9	-16

Social sub-indicators	2000	2013	Changes
Gas consumption per capita	16	20	4

Internal factors

External factors

(0 means no risk)

Technical/technology indicators	2000	2013	Changes
Logistic efficiency	32	31	-1
Reserves/production for gas	2	6	4
RGT terminal utilization	49	39	-10
Nat gas underground storage over demand	90	87	-3
Transnational pipelines utilization gas	29	58	29
Gas self-sufficiency	0	0	0
LNG utilization	49	65	16
Gas production	21	6	-15

Law sub-indicators	2000	2013	Changes
Resource extraction policy	37	40	3
Gas emergency preparedness*	50	37	-13
Rule of law	34	37	3

Environmental sub-indicators	2000	2013	Changes
Readiness & vulnerability (climate change)	42	37	-5
Natural disaster	1	2	1
Readiness & vulnerability (climate change)	38	37	-1
Natural disaster	0	0	0

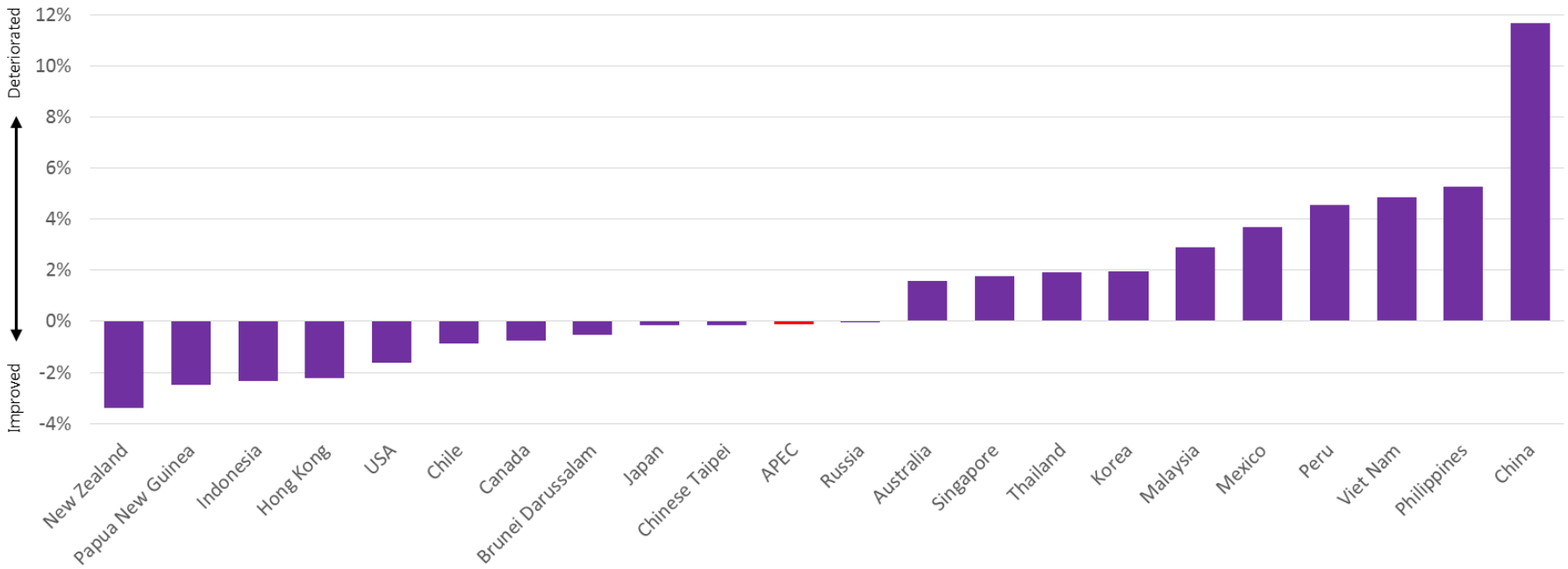
…although different level of sufficiency can be seen among members. Risk on infrastructure utilization posed the highest changes as economies started to build pipelines and LNG terminals.

Source: APERC analysis

** APERC assumed all members has some sort of emergency preparedness for oil. However, a detail study on the readiness and resiliency of the system can help to determine the score index.*

Unconventional gas managed to improve gas security in North America…

Changes in average gas security index, 2000-13

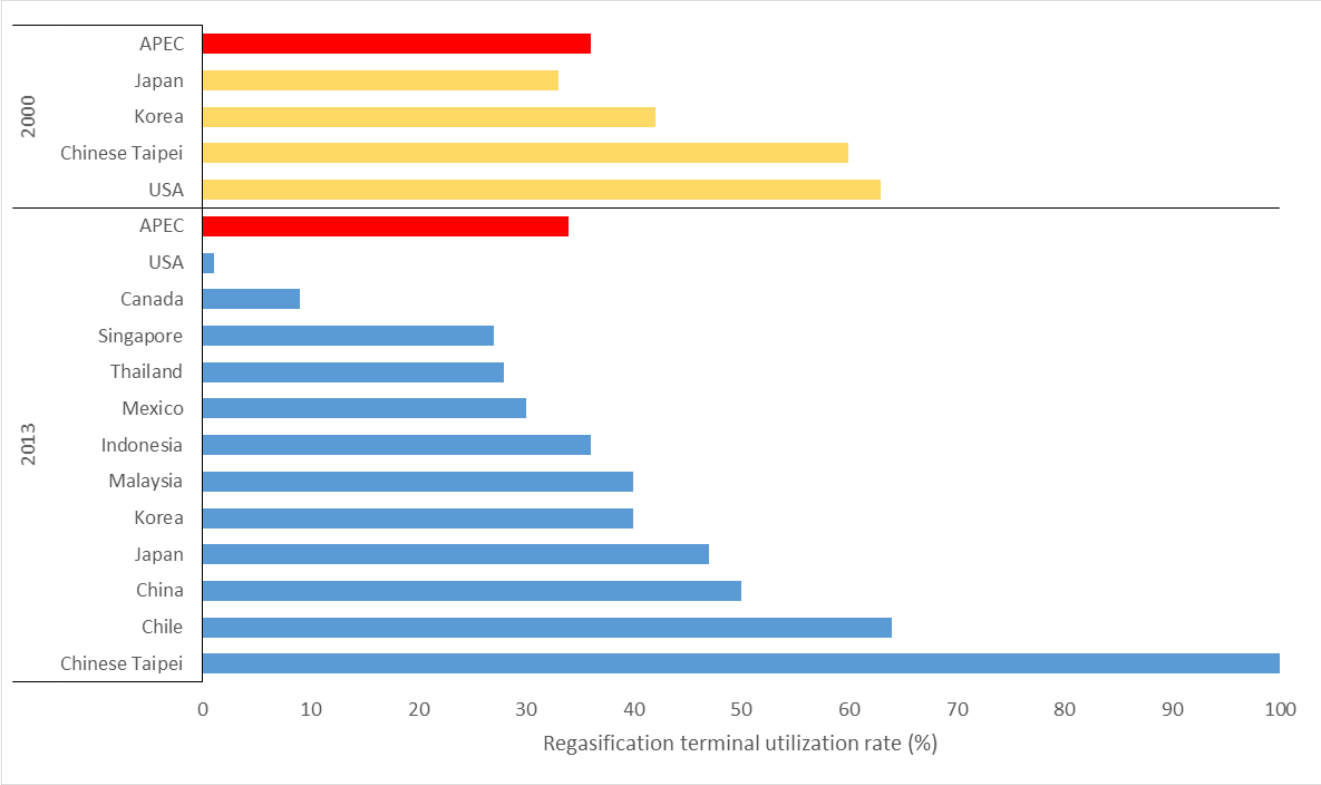


…But nearly half of APEC members gas security index deteriorated because of the increase in gas consumption, higher dependency on imports and lack of infrastructure to meet demand

Source: APERC analysis

APEC LNG import increased by more than double

Annual regasification terminal utilization rate, 2000 and 2013



More than half of APEC members owned RGT in 2013, up from only 4 economies in 2000. This trend will continue in the future with new RGT expected in the Philippines and Viet Nam soon

Source: Cedigaz and APERC analysis

A regional agreement for emergency supply will help to improve supply security

International/regional emergency supply agreement

International Energy Agency-International Energy Program (for oil emergency)

Australia
Canada
Japan
Korea
New Zealand
USA

ASEAN Petroleum Security Agreement (APSA) (for oil and gas emergency)

Brunei Darussalam
Indonesia
Malaysia
Philippines
Singapore
Thailand
Viet Nam

APEC members without regional agreement

Chile*
China
Hong Kong, China
Mexico*
Papua New Guinea
Peru
Russia
Chinese Taipei

A region-wide agreement will be able to lower risk of supply of disruption by 2 percentage point for oil and 3.5 percentage for gas

Source: IEA, ASCEAN and APERC analysis
Note: Chile and Mexico are currently candidate economies for IEA membership

Conclusions and policy implications

- APEC economies should try to expand intra-APEC energy trade as APEC members are politically stable

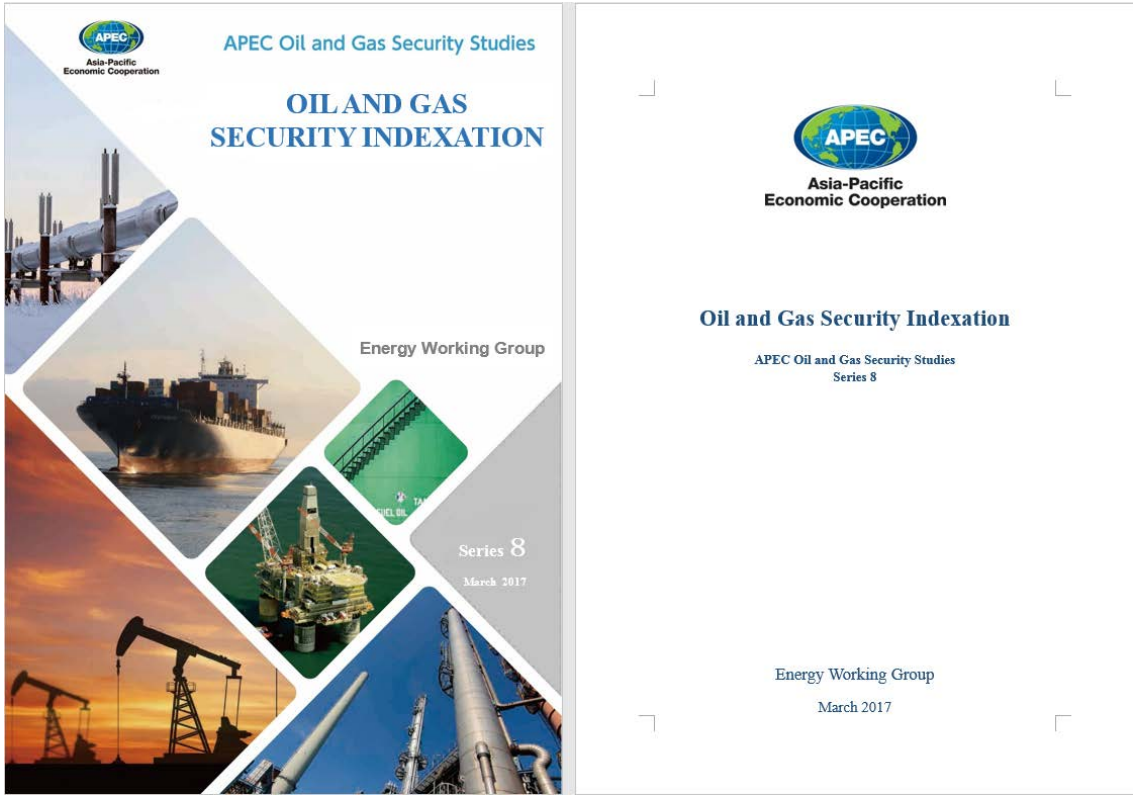
- Oil had a higher supply disruption risk than gas in 2013 because of lack of oil reserves in some APEC members with high oil share in their primary energy supply mix

- APEC could consider formulating a strategy for possible joint stockpiling among and between member economies, which could improve the region's overall risk on supply disruptions

- Reducing oil demand or oil intensity will help improve supply security, as demonstrated by some of the APEC economies (such as New Zealand)

- APEC may consider developing its own oil and gas security framework agreement covering supply sharing in the event of domestic or regional supply emergencies.

Download links



- http://aperc.ieej.or.jp/file/2017/5/16/Oil_and_Gas_Security_Indexation.pdf
- http://publications.apec.org/publication-detail.php?pub_id=1838

Thank you for your kind attention

http://aperc.ieej.or.jp/

APERC
Asia Pacific Energy Research Centre