

APEC investments in the natural gas supply chain in a low price environment

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Key take-aways

- **Investment in natural gas sector is critically important for energy security for the Asia Pacific.**
 - Natural gas demand of the Asia Pacific will grow by 1.7 times from 2015 to 2040.
 - The region will require USD 2,234 billion investments to sustain the demand growth.
- **The role of government is very important.**
 - Private companies are the primary entity in natural gas projects; but natural gas projects also require public support in various situations.
- **Identify, reduce, and allocate risks to promote investments**
 - Effective management of risks is a critical condition for sustained investments to natural gas infrastructures.

Background

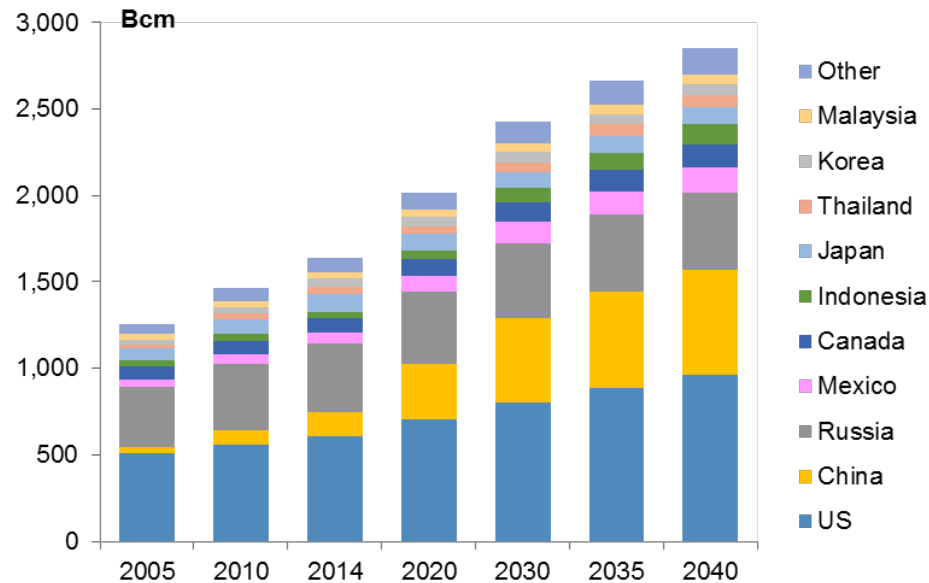
- Significant growth of natural gas demand in Asia Pacific
 - Demand will grow by 1.7 times from 2014 to 2040
 - Necessity for sufficient and timely investments in the natural gas supply chain to ensure the region's natural gas security.
- Fluctuation of investments
 - Investments in the global upstream (oil and gas) sector dropped from 2014 to 2016 by 42% because of lower oil price.
 - Potential supply crunch when the global demand picks up in the future.
- How can we control the inherent risk of such a supply crunch caused by the investment cycle?
 - Estimate of the amount of the required investment amount
 - Case studies of four countries: Australia, Canada, Indonesia, and Singapore.
 - Measures to ensure sufficient investments for the natural gas supply chain (three steps of risk management).

Natural gas demand in the Asia Pacific

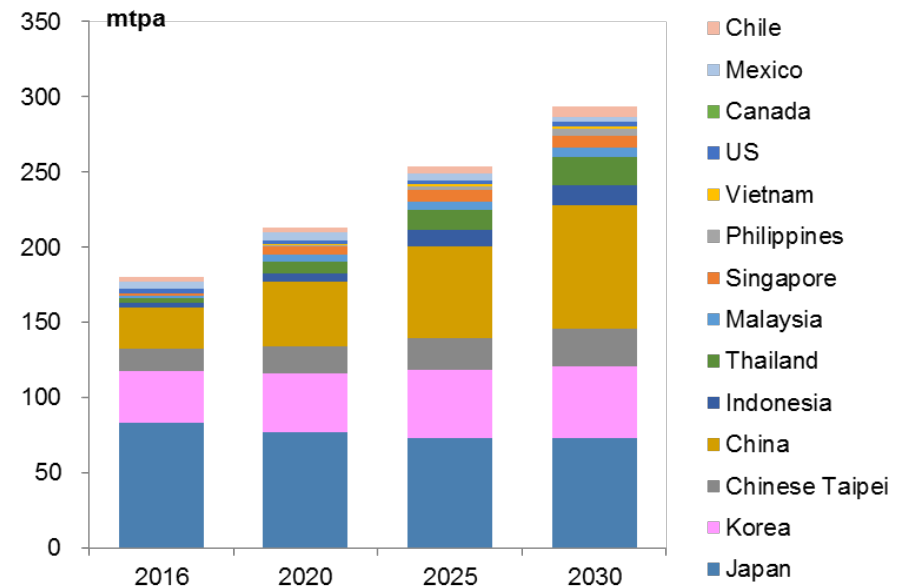


- APERC forecasts that the natural gas demand in the Asia Pacific will grow by 1.7 times from 2014 to 2040.
 - The scale of the demand growth is larger in emerging economies.
- LNG Demand in the Asia Pacific will also grow steadily.
 - LNG requires large upfront capital investment. Steady and sustained investment is particularly critical to meet the increasing demand.

Natural gas demand in Asia



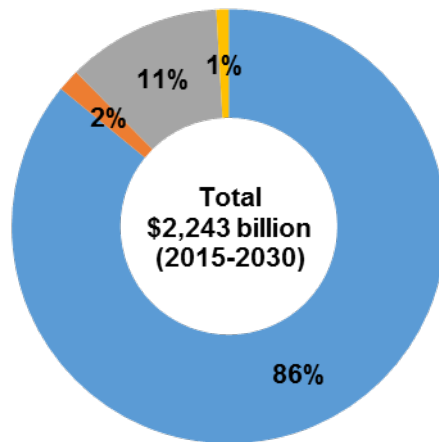
LNG demand in Asia



Overview of required investments

- USD 2,243 billion investment is needed for natural gas supply infrastructures in the Asia Pacific until 2030.
 - 86% of the required investment is in upstream sector.
 - US, Russia, Australia, and China are the major directions of investments.

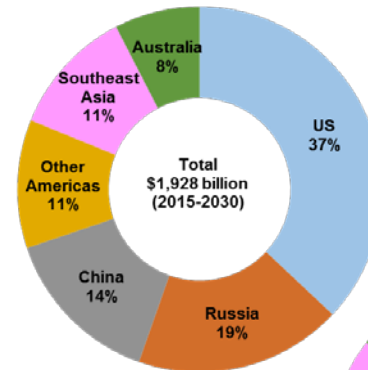
Required investments from 2015 to 2030



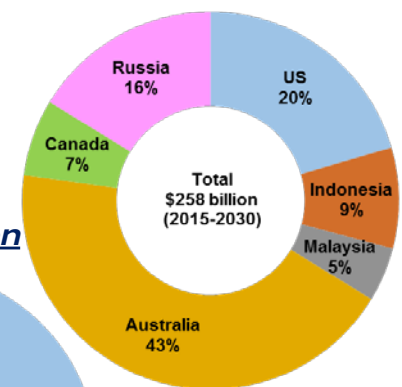
- Exploration and Development
- International Pipeline
- LNG Liquefaction
- LNG Regasification

Required investments by segment

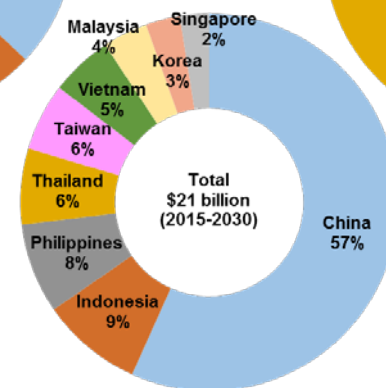
Exploration and Development



Liquefaction



Regasification



Case study: Australia

- NWS LNG as a successful case
 - Formation of an extensive alliance among relevant parties worked very well to reduce uncertainties of the large-scale green-field project.

- Issues / implications
 - Importance of long-term commitments from buyers to realize the project
 - Risk management by cross investments particularly from buyers
 - Avoiding excessive competition that may lead to higher cost, delay of construction, and gas supply shortage

Buyers' commitment for Australian LNG projects*

	Tohoku	Tepco	Chubu	Kansai	Chugoku	Kyushu	Tokyo Gas	Osaka Gas
NWS	LT	LT	LT	LT	LT	LT	LT	LT
Darwin		EQ					EQ	
Pluto				EQ			EQ	
Gorgon			EQ			LT	EQ	EQ
Wheatstone	LT	EQ	LT			EQ		
Prelude								(LT)
Ichthys		LT	EQ	LT		LT	EQ	EQ
QCLNG			(LT)				EQ	
GLNG								
APLNG				LT				

	Toho Gas	Kogas	CNOOC	Petro China	Sinopec	CPC	Petronet	Petronas
NWS	LT	LT	EQ					
Darwin								
Pluto								
Gorgon				LT			LT	
Wheatstone								
Prelude		EQ				(LT)		
Ichthys	EQ	(LT)				LT		
QCLNG			EQ					
GLNG		EQ						EQ
APLNG					EQ			

* LT: Long-term contract, (LT): Part of long-term portfolio contract, EQ: Equity investments Source: IEEJ

Case study: Canada

- LNG as a potential solution to the Canadian natural gas dilemma
 - Growing reserves while diminishing export to the US and production
- Many factors hinder investments
 - Delays and/of lack of infrastructure development,
 - Lower oil prices,
 - International LNG market condition,
 - Acceptance from local communities,
 - Labor and engineering shortage.
- Issues / implications
 - Policy efforts, such as speeding up environmental reviews, infrastructure development, training human resources
 - Importance of long-term commitment from buyers

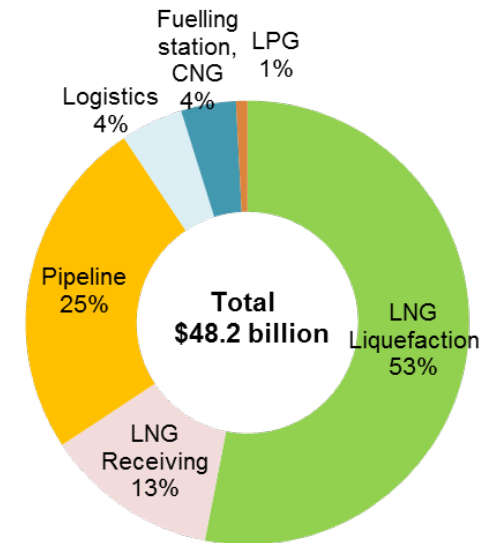
Status of Canadian LNG Projects

Project	Company	Capacity (mtpa)	NEB approval	EIA approval
Steelhead LNG: Malahat LNG	Steelhead LNG Inc.	6	Approved	-
Steelhead LNG: Sarita LNG	Steelhead LNG Inc.	24	Approved	-
Triton LNG	AltaGas, Idemitsu Canada Corporation	2.3	Approved	-
Canada Stewart Energy Project	Stewart Energy	30	Approved	-
Woodfibre LNG Project	Woodfibre LNG Ltd.	2.1	Approved	Approved
WCC LNG Ltd	Imperial Oil Resources Limited, ExxonMobil Canada Ltd	30	Approved	Submitted
Watson Island LNG	Watson Island LNG Corporation	1	-	-
Orca LNG	Orca LNG Ltd.	24	Approved	-
NewTimes Energy Ltd.	NewTimes Energy Ltd.	12	Approved	-
Grassy Point LNG	Woodside Energy Ltd.	20	Approved	Submitted
Nisga'a LNG	Nisga'a Nation	N.A.	-	-
Kitsault Energy Project	Kitsault Energy	20	Approved	-
LNG Canada	Shell Canada, PetroChina Company Limited, Korea Gas Corporation (KOGAS), Mitsubishi Corporation	24	Approved	Approved
Kitimat LNG	Chevron Canada Limited and Woodside Energy International (Canada) Limited	10	Approved	Approved
Cedar LNG	Cedar LNG Export Development Ltd.	6.4	Approved	-
WesPac LNG Marine Jetty	WesPac Midstream-Vancouver LLC	3	Approved	Submitted
Discovery LNG	Rockyview Resources Inc.	20	Approved	-
Aurora LNG	Nexen, IGBC	N.A.	Approved	-
Pacific Northwest LNG	Petronas, Sinopec, JAPEX Montney, Indian Montney LTD., Petroleum BRUNE I Montney Holdings Limited	12	Approved	-
Douglas Channel LNG	AltaGas, Idemitsu	1.8	Approved	-
Canaport LNG	Repsol	5	Approved	-

Case study: Indonesia

- Investments in both in upstream (liquefaction) and downstream (LNG receiving facilities) are under way.
 - Utilization of external expertise (project development of IOC, funding from external financial institutions) and adoption of new technology (FSRU) are the key success factors in upstream and downstream, respectively.
- Issues / implications
 - Small scale LNG: aggregation of demand and optimization of logistics to minimize supply cost
 - Importance of PLN's capacity in development of gas to power project
 - Utilization of external funding sources such as ADB and AIIB

Planned investments in natural gas sector in Indonesia



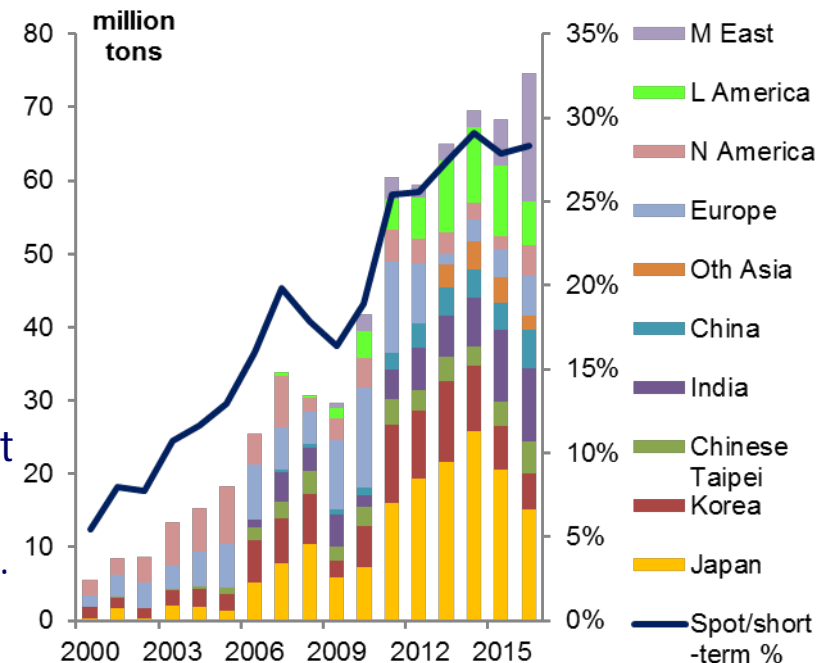
Sector	Investors
LNG Liquefaction	BP, INPEX, Mitsubishi, Shel, EWC, etc.
LNG Receiving	Pertamina, PLN, Marubeni, ENMP, etc.
Pipeline	PGN
Logistics	Local companies
Fuelling station, CNG	Local companies
LPG	Local companies

Source: Ministry of Energy and Mineral Resources

Case study: Singapore

- Strong initiative by the government to develop LNG infrastructure
 - Clear vision to become an “LNG hub”
 - Roles capacities of state-owned companies
- Remarkable progress for infrastructure developments so far
 - Construction of LNG receiving terminal
 - LNG bunkering and reloading facilities
 - Nitrogen blending facility is under construction
- Issues / implications
 - Structural reform of the international LNG market to enhance liquidity of spot trading.
 - Limited domestic demand in Singapore.
 - Lack of standardized LNG pricing benchmarks

Short term / Spot trading of international LNG market



Identifying risks

- Major risks associated with natural gas investments are as follows:

- ✓ **Market risk:** whether a sufficient return on investment can be obtained
- ✓ **Political risk:** from government changes to policy and regulation
- ✓ **Financial risk:** whether sufficient capital can be procured,
- ✓ **Environmental risk:** effects of the construction and operation on the environment,
- ✓ **Engineering, procurement and construction (EPC) risk:** cost increases during construction.

- Although it is difficult to foresee all potential risks prior to making an investment decision, it is necessary to identify potential risks to the extent possible in preparation for smooth execution of a project.

Reducing risks

- **Liquid natural gas/LNG market**

- Under the current increased demand for more flexible natural gas / LNG supply, it becomes increasingly necessary to build a system that can sell cargoes in a highly liquid spot market.

- **Policies to reduce the uncertainty of future demand**

- Energy (power) mix target, master plan on gas utilization, etc.
- Policy package (regulations, taxation, subsidies, etc.) is also needed to realize this after creating clear numerical targets and road maps.

- **Capacity building**

- Fostering human resources who are familiar with natural gas and LNG projects, market frameworks and policy systems

- **Information exchange between sellers and buyers**

- Utilization of existing occasions such as World Gas Conference (WGC), Gastech, and the LNG Producer-Consumer Conference to lower uncertainty about the future market environment through information exchange.

Allocating risks

● Proactive utilization of public financial sources

- Assistance from the Export Credit Agency of the home economy of the foreign enterprise making the investment
- Obtaining a loan from multilateral development banks such as the World Bank, Asian Development Bank, or Asian Infrastructure Investment Bank
 - + By these public institutions partially incurring the risks that private companies cannot bear alone, promotion of investments can be expected.

● Integrated projects

- Packaged projects of procuring LNG, building LNG receiving terminals, marketing city gas, and operating gas-fired power plants.
- Cross investments between upstream companies and downstream companies
 - + Taking on the burden of new risks, they have secured stable demand and supply, which is expected to promote investment in new projects.

● Collaboration / alliance among companies

- Pooling and optimizing assets to absorb investment risks
 - + Shell and BG merger, the formation of JERA, etc.