East Asian Gas Markets in Transition:

A Japanes View

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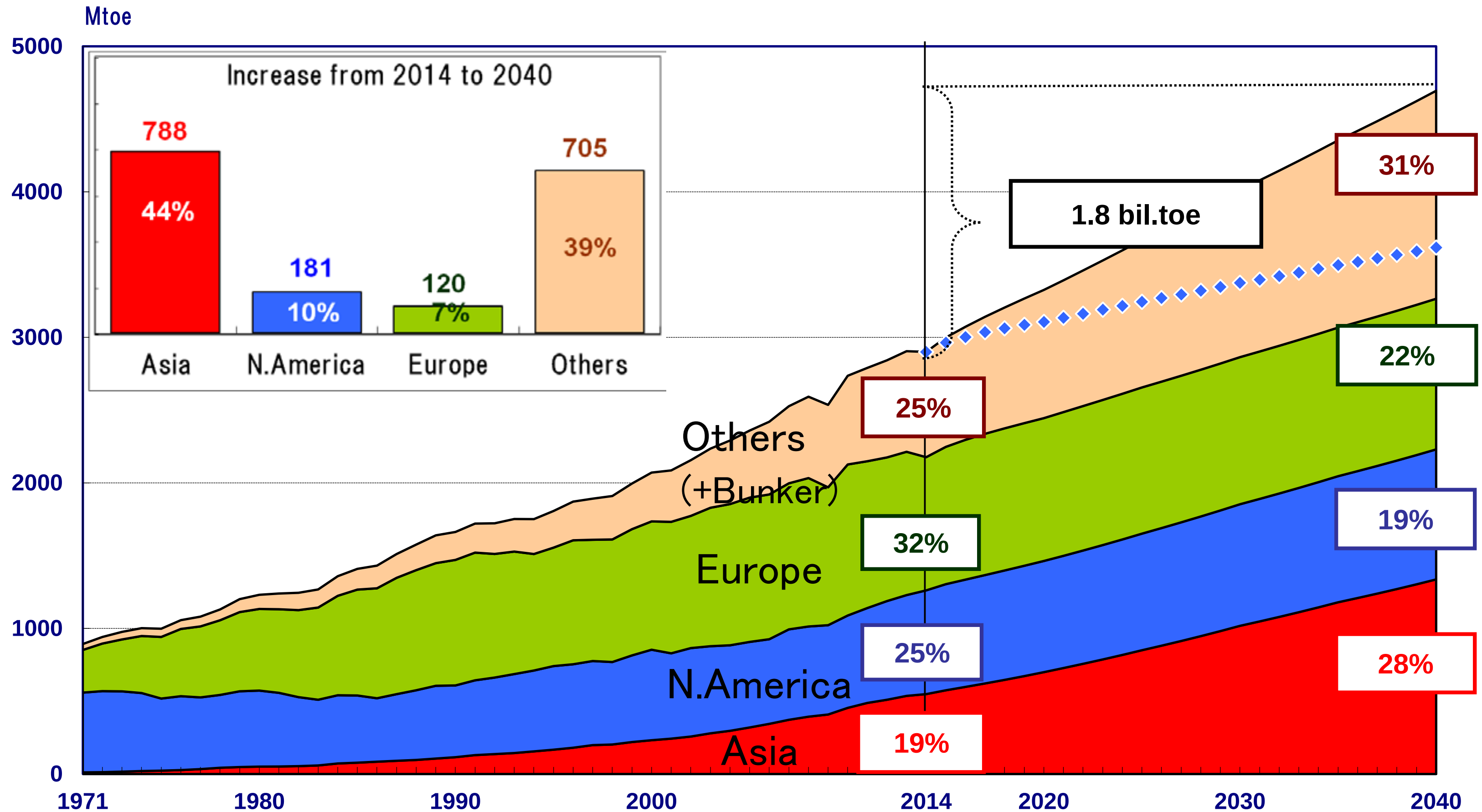
Natural Gas Consumption by Region

Reference
Adv. Tech.

- The world natural gas demand is projected to increase from 3.5 trillion cubic meters (tcm) in 2014 to 5.7 tcm in 2040, a 1.6-fold increase.
- Asia accounts for 44% of projected global increase in natural gas demand between 2014-2040.

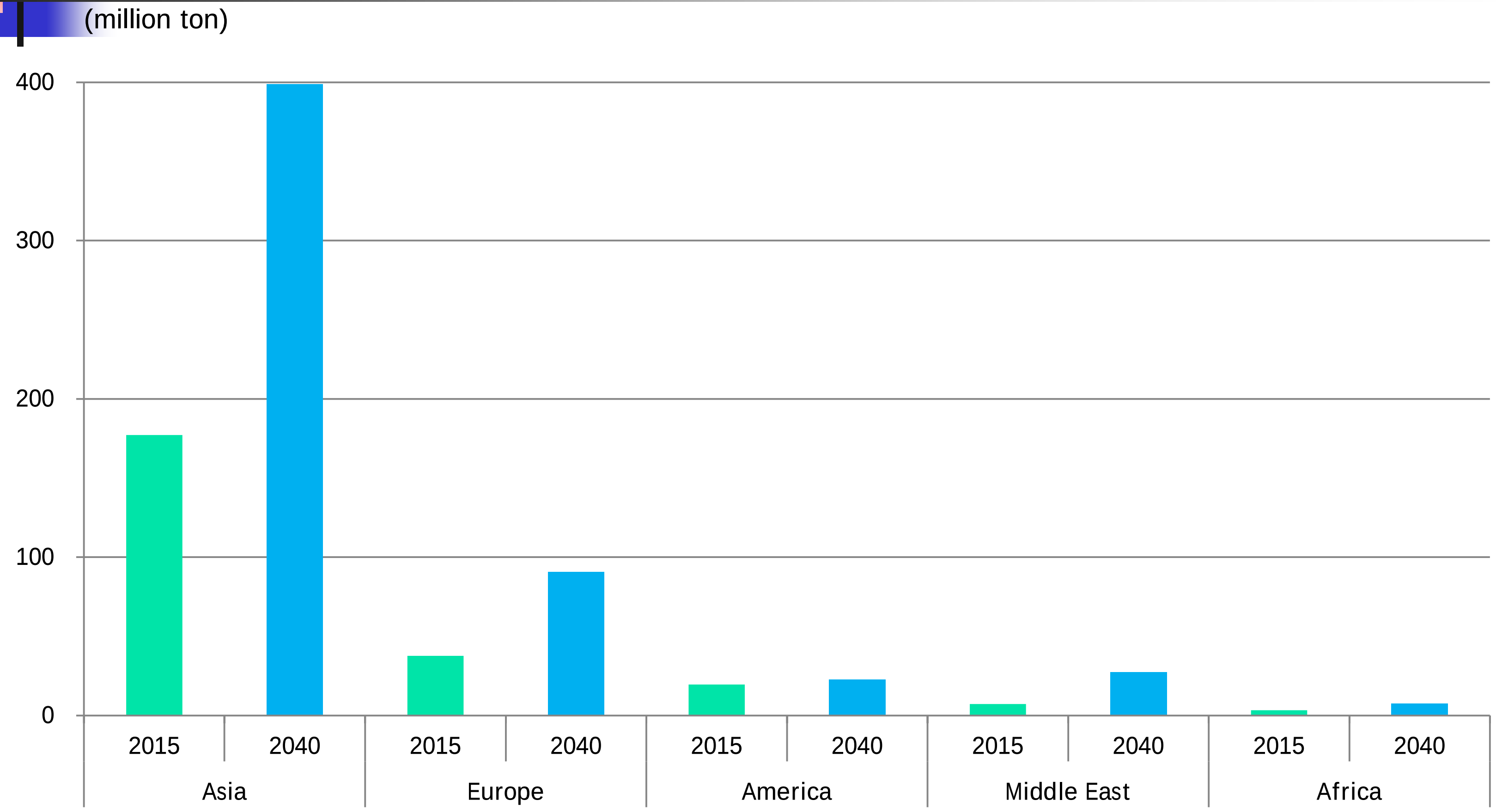


Source: IEEJ, “Asia/World Energy Outlook 2016”

LNG imports Outlook

Reference Scenario

- World LNG demand expands from 245 mtpa in 2015 to 545 mtpa in 2040 (2.2 folds increase).
- Asia's LNG demand increases by 222 mtpa, accounting for about 70% of the world's LNG demand growth.



Source: IEEJ, "Asia/World Energy Outlook 2016"

Factors to affect Gas/LNG Demand in Asia

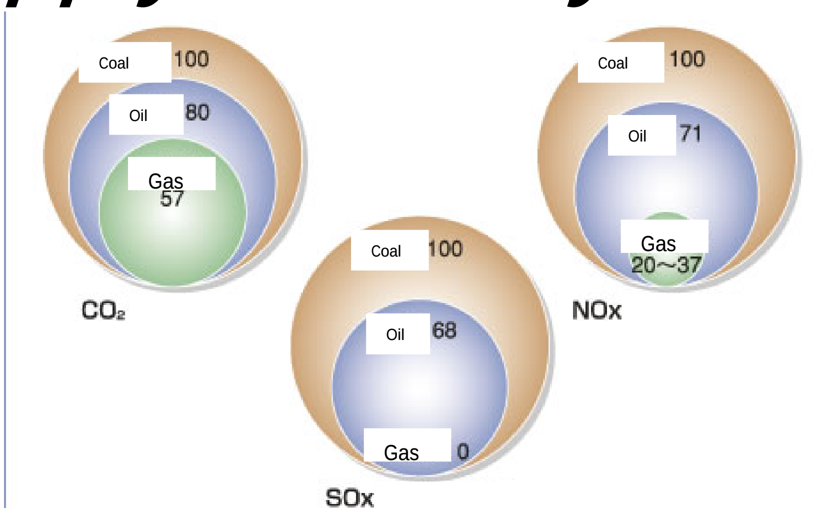
- Economic growth
- Need to protect environment
- Lower price
- Competition against coal
- Future of nuclear power
- Competition against renewable energy
- Competition with LPG
- Impact of power/gas market reform
- Pipeline vs. LNG

"SWOT" of Natural Gas in Asia

- ***S**trength*
- ***W**eakness*
- ***O**pportunity*
- ***T**hreat*

Strength of Natural Gas in Asia

- *Environmental advantages*
- *Supply (potential) abundance*
- *Source of energy diversification*
- *Supply reliability*

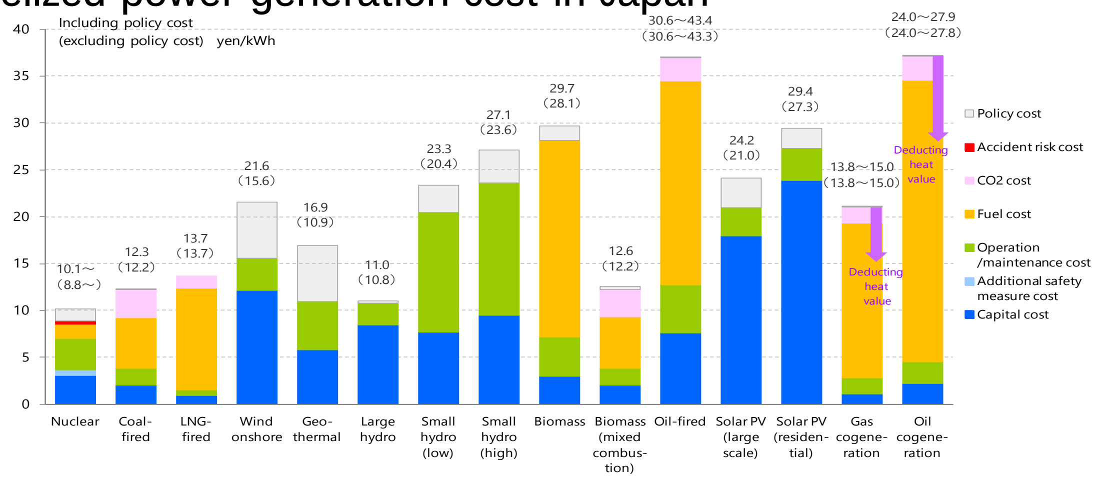


Source: Japan Gas Association

Weakness of Natural Gas in Asia

- ***Weaker economic competitiveness***
- ***Infrastructure requirement***
- ***Large scale initial investment***
- ***Lower flexibility of supply and market***

Levelized power generation cost in Japan



Source: Report from "Power Generation Cost Verification Working Group", METI, Japan (June 2015)

Opportunity for Natural Gas in Asia

- *Growing energy/power demand*
- *Growing energy security concerns*
- *Climate change and air pollution*

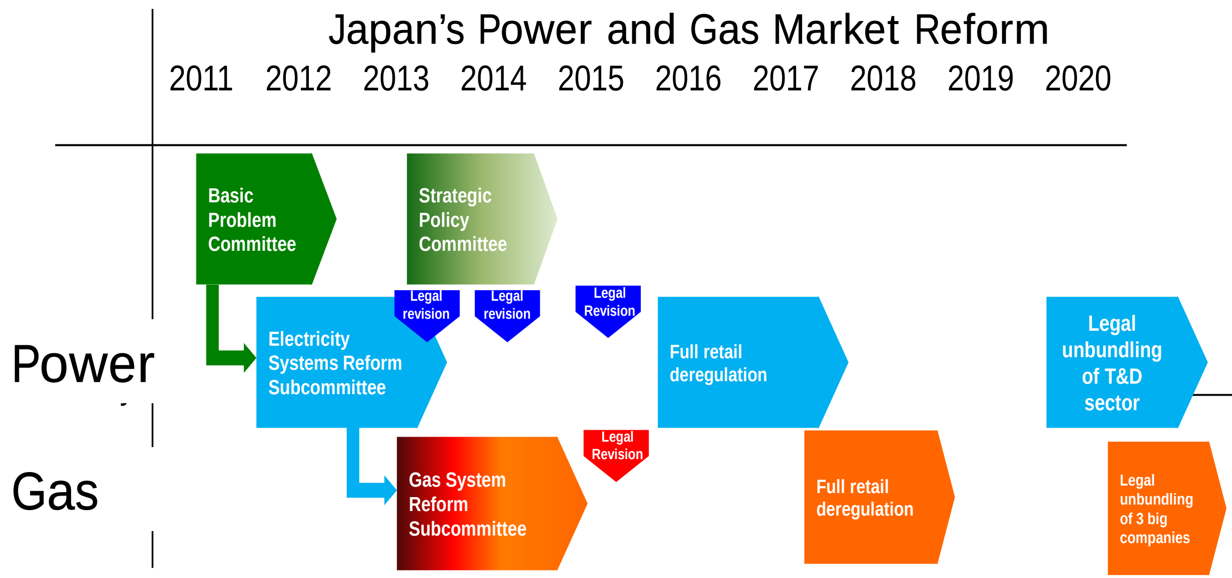
NDC under Paris Agreement

Party	Date of submission	Target type	Reduction target	Base year	Target year	Coverage
EU	Mar 6 2015	Absolute emissions	40%	1990	2030	GHG
United States	Mar 31 2015	Absolute emissions	26～28%	2005	2025	GHG including LULUCF
Russia	Apr 1 2015	Absolute emissions	25～30%	1990	2030	GHG
China	Jun 30 2015	GDP intensity	60～65% Total emission peak out before 2030	2005	2030	CO_2
Japan	Jul 17 2015	Absolute emissions	26%	2013	2030	GHG
Indonesia	Sep 24 2015	Reduction from BAU	29%	BAU	2030	GHG
Brazil	Sep 30 2015	Absolute emissions	37% （43% for 2030）	2005	2025	GHG
India	Oct 1 2015	GDP intensity	33～35%	2005	2030	GHG

Air pollution in China

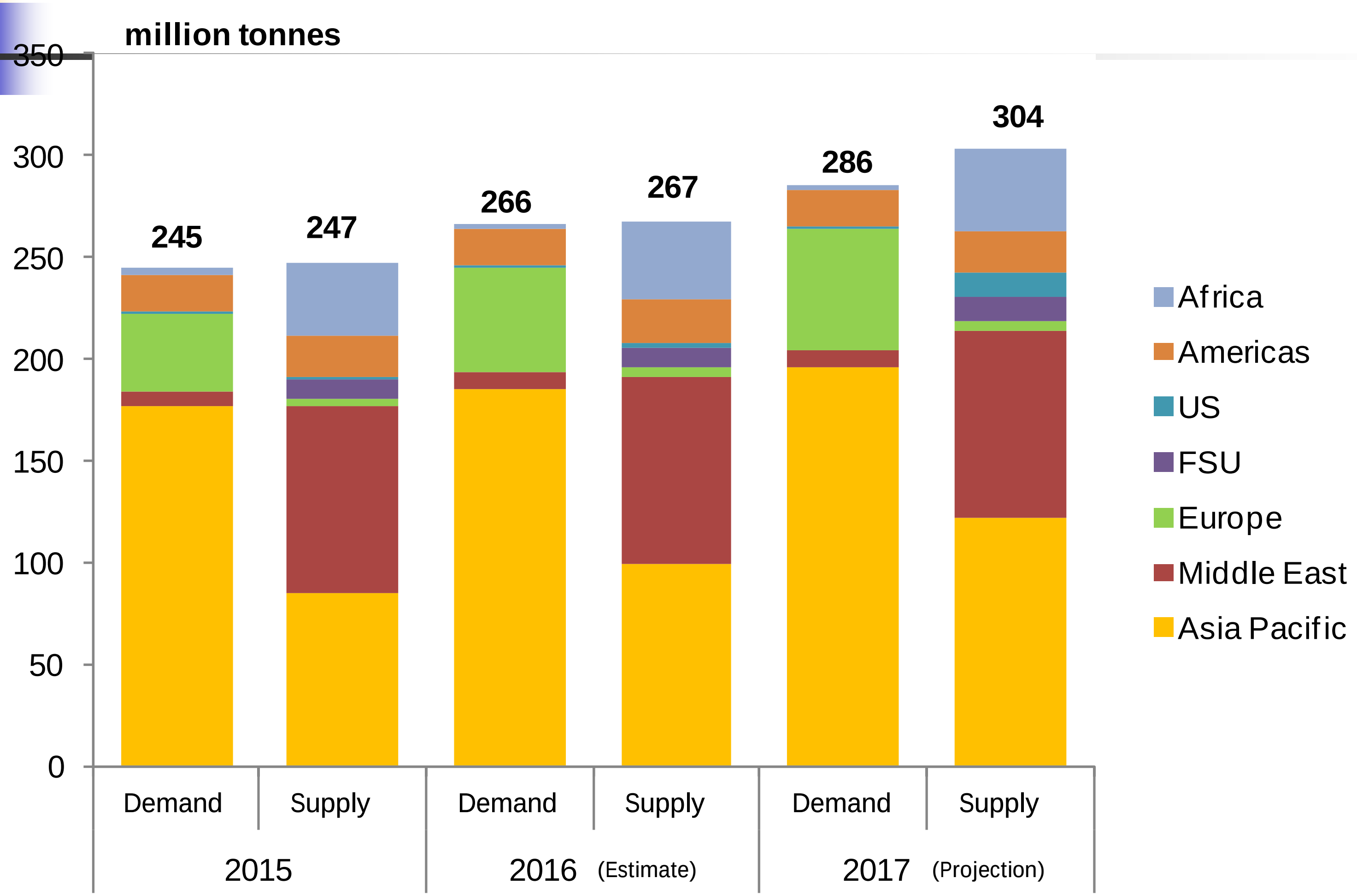
Threat to Natural Gas in Asia

- ***Competition with other energy source***
  - Abundant and lower priced coal, with no effective CO2 pricing
  - Lowering costs of renewable energy with policy back-up
  - Nuclear restart in Japan and new builds in China, India, others
- ***Electricity market reform***



Global LNG Balance up to 2017

Ample supply continues to exist in the short term and LNG supply-demand will be softened further in 2017 and beyond



Source: Yoshikazu Kobayashi(IEEJ) December 2016

Issues for LNG Pricing in Asia

- Given the dominance of the existing contracts, JCC pricing likely to remain dominant mechanism in Asia at least up to early 2020s
- But tide is changing:
  - ✓ Prevailing over-suppled market
  - ✓ Inflow of US LNG with HH pricing will increase in Asia
  - ✓ Spot/short-term trading continue to grow
  - ✓ Initiatives to create hubs and new price discovery in Asia
  - ✓ Power and gas market reforms in Japan and Asia
- Major Asian buyers such as JERA have a strategy to diversify pricing
- Buyers continue to search for possible alternatives to JCC and the share of JCC pricing will be reduced
- So far there is no clear answer as to what is the best alternative
- What will happen if divergence emerges between LT contract and spot price?

Asia's Challenges for "3E+S"

- Rising import dependence and energy security
  - High oil import dependence. Gas import dependence rising
  - High Middle East dependence, Sea-lane dependence
- High coal dependence and environment loads
  - Challenges for both climate change and pollution problems
- Need for energy market reform
  - Japan leads the way. Reform for both energy market and NOCs
- Challenges for nuclear power program
  - Impacts of Fukushima. Ambitious nuclear power program in China, India, etc, with challenges for safety and public acceptance