Executive Summary

1. Assumptions

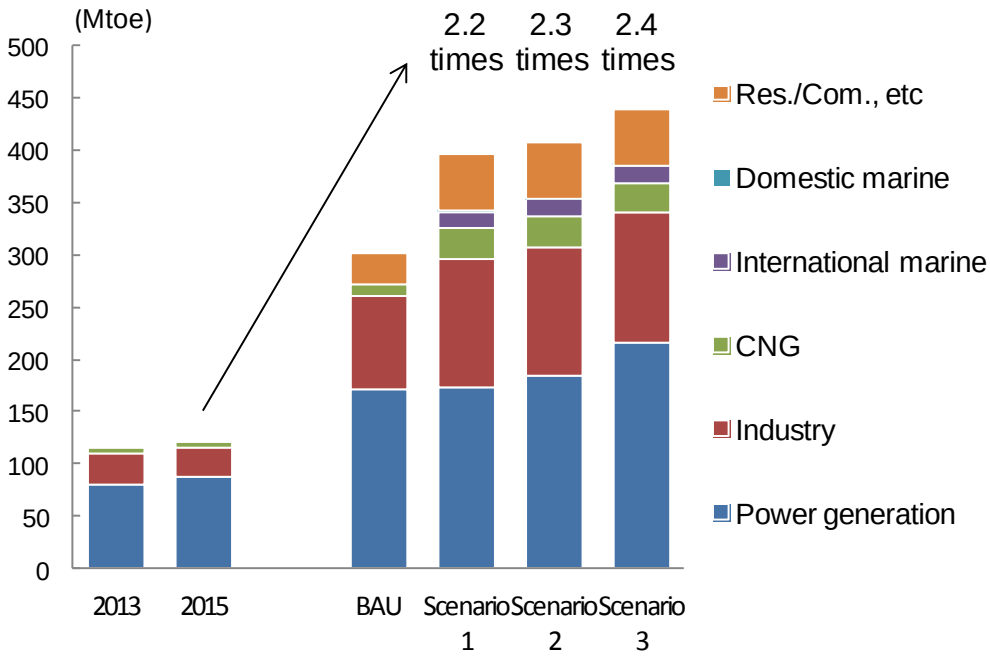
The table below shows the assumptions used in estimating the potential demand for natural gas by sector. For the baseline, the business as usual (BAU) scenario for 2030 in the *ERIA Energy Outlook 2015* was used. For the power generation sector, three scenarios were prepared.

Sector	Assumptions
Baseline of estimation	Based on the ERIA Energy Outlook 2015 Up until 2030 (BAU scenario)
Power generation	Renewable energy (RE) power generation will not be replaced by gas. Existing coal–or oil-fired plants will be replaced by gas after 40 years life. **New/additional thermal power plants – Share of gas: 15%, 30%, and 60% under the three scenarios, respectively**
Industry	Assumes an increase in the share of gas depending on baseline estimates: Share of gas in 2030: more than 33% in BAU >> 5% higher share Share of gas in 2030: between 10% to 33% in BAU >> 1.5 times share Share of gas in 2030: less than 10% in BAU >> 2 times share
Residential & Commercial	Assumes 25% of the consumption of oil by 2030 under BAU scenario will be replaced by gas.
Road transport	Assumes two times higher annual growth rate in gas demand than BAU.
Marine transport	Assumes 32.5% of high sulphur bunker fuel demand in BAU will be replaced by liquefied natural gas.

2. Potential Demand for Natural Gas (Preliminary)

Figure 1 shows the potential demand for natural gas by sectors in ASEAN + India. The potential demand for natural gas is expected to increase by up to 2.4 times from 2015, or by 322 Mtoe/year. The power generation sector shows the highest potential, followed by the industry sector.

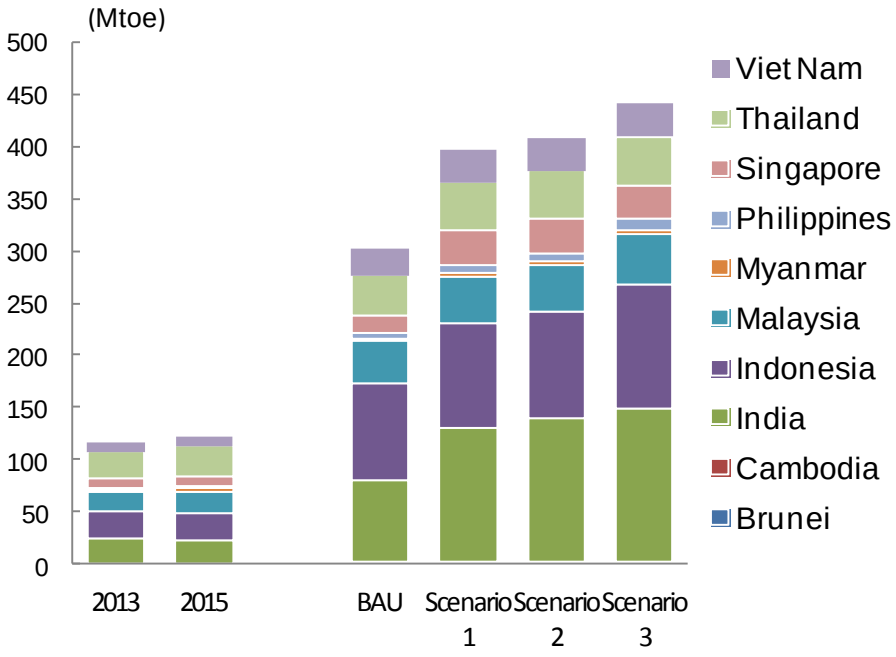
Figure 1. Potential Demand for Natural Gas by Sector, ASEAN + India



BAU = business as usual; CNG = compressed natural gas.

Figure 2, meanwhile, shows the potential demand for natural gas by nation. The highest demand is expected to be from India, followed by Indonesia.

Figure 2. Potential Demand for Natural Gas by Country, ASEAN + India



BAU = business as usual.

3. Expected Economic and Environmental Benefit

The impact of the change in potential demand for natural gas on both the economy and the environment was also estimated and compared with the baseline— i.e. the BAU state. Assumptions on fuel cost and power plant construction cost are shown in Tables 1 and 2.

Table 1. Assumptions on Fuel Costs

Coal	Crude oil	LNG		
77	**111**	**11.9**	**9**	**6**
US$/ton	US$/bbl	US$/MMbtu	US$/MMbtu	US$/MMbtu
(125)	**(820)**	**(472)**	**(357)**	**(238)**
US$/toe	US$/toe	US$/toe	US$/toe	US$/toe

Note: Assumption: LNG prices (US$9 and 6/MMbtu)
Source: International Energy Agency (2016a).

.

Table 2. Assumptions on Power Plant Construction Cost

Fuel	Construction cost	Life time
Coal (SC)	US$1,600/kW	30 years
Natural gas (CCGT)	US$700/kW	25 years

Notes: SC = Supercritical, CCGT = Combined Cycle Gas Turbine
Source: International Energy Agency (2015), *Southeast Asia Energy Outlook 2015*. Paris.

Table 3 shows fuel costs, construction costs, and CO_2 emissions in the power generation sector under a BAU scenario and three other scenarios. Part of the increase in fuel cost is expected to be tempered by a reduction in construction cost. There are scenarios where a reduction in CO_2 emissions can be expected.

Table 3. Cost and CO_2 Emission (Power Generation), ASEAN + India

Scenario	Fuel import cost			Construction cost (US$ billion)	CO_2 emission (Million tons-CO_2)
	LNG: US$11.9/MMbtu (US$ billion)	LNG: US$9/MMbtu (US$ billion)	LNG: US$6/MMbtu (US$ billion)		
1	+0.7	+0.5	+0.4	* +0.1	* +6.4 (+0%)
2	+7.5	+4.9	+2.2	-0.5	-55.8 (-2%)
3	+20.7	+13.3	+5.6	-1.7	-176.5 (-6%)

LNG = liquefied natural gas; CO_2 = carbon dioxide.
Note: * Based on the assumption that Viet Nam's BAU scenario for nuclear power generation after 2028 will be substituted by coal–and natural gas-fired power.
Source: Assumption on specific CO_2 emission data is from the International Energy Agency.

In Scenario 1, the fuel import cost is expected to increase by as much as US$700 million. The construction cost is expected to increase by US$100 million even if the cost of the gas-fired power plant is lower than that of the coal-fired facility. The increase in construction cost is based on the assumption on nuclear power generation in Viet Nam. That is, although the BAU's original plan for Viet Nam is to commence the operation of a nuclear plant in 2028, this plan will be shelved and instead replaced by a thermal plant. In terms of the NPP power generation equivalent, neither the coal-fired power plant (CPP) nor gas-fired power plant (GPP) are an alternative, but both will be constructed on a net basis.

Estimating the NPP construction cost is difficult; thus, only the thermal power plant's (TPP) construction cost is considered in this study. The climb in the CO_2 emission (+6.4 million tons) is due to the same reason for the rise in construction costs.

In Scenario 2, the fuel import cost is expected to increase by as much as US$7.9 billion due to a higher gas power generation compared to Scenario 1. Construction cost is expected to decrease by US$500 million. The CO_2 emission is expected to drop by 55.8 million tons. The increase in gas power generation compared to Scenario 1 reduces the effect of having to replace NPP with TPP, on the construction cost and CO_2 emission.

In Scenario 3, the fuel import cost is expected to climb by as much as US$20.7 billion because of the expected higher gas power generation compared to Scenario 1. Construction cost will drop by US$1.7 billion, while CO_2 emission is expected to decline by 176.5 million tons. The rise in gas power generation when compared to Scenario 2 further lessens the impact of the shift from NPP with TPP on the construction cost and CO_2 emission.

The following table shows fuel costs, construction costs, and CO_2 emissions in sectors (total) other than the power generation sector. In these other sectors, both fuel cost and CO_2 emissions can be reduced by substituting oil products with natural gas.

Table 4. Cost and CO_2 Emission (Other Sectors Combined), ASEAN + India

Fuel import cost			**CO_2 emission** (Million tons-CO_2)
LNG: US$11.9/MMbtu (US$ billion)	LNG: US$9/MMbtu (US$ billion)	LNG: US$6/MMbtu (US$ billion)	
-23.9	-34.6	-45.6	-0.048 (-2%)

LNG = liquefied natural gas; CO_2 = carbon dioxide; MMbtu = one million British thermal units

The fuel import cost in the power generation sector is expected to increase by as much as US$20.7 billion (Table 3), while the combined fuel import cost in other sectors is expected to decrease by at least US$23.9 billion (Table 4). If all the potential demand for natural gas is met, there will be a benefit in the total fuel cost of the power generation sector and other sectors even if the LNG price is at US$11.9/MMbtu (Tables 3 and 4).

4. Policy recommendations

The following policy recommendations aim to help attain the potential demand for natural gas in the region.

Set clear policies that promote natural gas use.

- Have an energy/electricity mix target.
- Set climate and environmental regulations to promote lower carbon energy.

Enhance economic competitiveness of natural gas.

- Eliminate energy subsidies.
- Put in place mechanisms that will maximize the environmental value of natural gas (e.g. through carbon pricing).

Develop the supply infrastructure (liquefied natural gas receiving terminal, pipeline, etc.).

- Help meet residential and commercial demand.
- Dialogue with stakeholders to gain acceptance for natural gas.
- Present a clear regulatory framework.
- Find financial support for projects (e.g. low interest rate loan, tax benefits).

Support human capacity building on how to:

- Develop laws and regulations on gas infrastructure construction and operation.
- Develop safety (technical) standards.
- Control and monitor markets (e.g. change in prices).
- Monitor business operations (commercial and technical operations).
- Review and consider new gas utilization technologies.