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## **CAN NATURAL GAS PLAY AN IMPORTANT ROLE IN THE ENERGY TRANSITION IN ASIA IN THE FUTURE?**

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### **Abstract**

Asia has been the region with the world's fastest growing economies in decades, and it continues to lead global growth in the future. The rapid economic growth has led to a huge demand for energy. However, this problem faces enormous environmental problems, climate change and global warming, in particular. Therefore, the transition energy from traditional energy to clean energy sources, renewable energy is imperative and to be inevitable trend in the future. With cleaner properties than oil and coal, natural gas can be seen as an important bridge in the transition energy process towards a low-carbon economy in Asia. Despite the fact that there are a lot of controversies and uncertainties about the development of natural gas in Asia, there are many reasons for us to believe that natural gas will play an important role in the energy mix in Asia in the future, such as the development of unconventional gas, the development of natural gas and LNG markets, environmental and climate policies, or the decline in energy prices. This paper will show the favorable condition to explain why natural gas can play an important role in the energy transition in Asia.

**Keywords:** Natural Gas, Energy Transition, Energy, Environment

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## 1. Introduction

Entering the 21st century, the world is facing extremely serious problems, in which the most serious issues are climate change and global warming. The causes of these phenomena are due to human activities, especially the excessive use of energy. Climate change is a global challenge that does not respect national borders. The impacts of climate change are enormous, lasting for many generations, and it affects all regions, all countries and all fields. Therefore, all countries have to be responsible and make a positive contribution to combating climate change. At the Paris climate conference (COP21) in December 2015, 195 countries adopted the Paris Agreement. The agreement's main aim is to keep a global temperature rise in this century well below 2°C and to drive efforts to limit the temperature increase even further to 1.5 °C above pre-industrial levels (UNFCCC, n.d.). In order to implement this agreement, countries are responsible for taking action on both mitigation and adaptation to reduce emissions.

How can we prevent global warming and combat climate change? How can we ensure energy security while still protecting the environment and combating climate change? These are urgent issues that are posed not only to every country but to the whole world. There have been many solutions put forward to debate. Undoubtedly, the first choice is to use renewable energy sources instead of traditional sources of energy like coal and oil, or systems with higher energy efficiency. However, these will face technical and economic barriers in the short term. The next option for reducing greenhouse gas emissions is to replace high-carbon fossil fuels by cleaner energy sources. In this case, natural gas is the optimal choice, because compared to other fossil energy sources, gas is known as the cleanest. When burned, natural gas emits less pollutant than other fossil fuels (see Table 1). Natural gas emits only half as much carbon dioxide than coal, three-quarters as much as oil, and almost no sulfur dioxide, particulates, or mercury (EIA, 1998; Nature, 2009). Besides, natural gas is used quite flexibly as an energy, an input material, it can be used in many different fields such as transportation, industry, residential and electricity production. So that natural gas can substitute coal or petroleum in many ways to help reduce the emissions of pollutants (Jenner and Lamadrid, 2013). In fact, natural gas is now considered an important source of energy in the transition of energy to a low-carbon economy of many countries, in particular, it is set to replace coal in electricity generation (Chandra, 2006; Rojey, 2013).

**Table 1. Fossil Fuel Emission Levels (Unit: Pounds per Billion Btu of Energy Input)**

Pollutant	Natural gas	Oil	Coal
Carbon Dioxide	117,000	164,000	208,000
Carbon Monoxide	40	33	208
Nitrogen Oxides	92	448	457
Sulfur Dioxide	1	1,122	2,591
Particulates	7	84	2,744
Mercury	0	0.007	0.016

**Source:** EIA (1998)

In recent decades, most predictions of energy organizations and companies in the world such as the International Energy Agency (IEA), the World Energy Council (WEC), BP, Shell, ExxonMobil have identified about the rapid growth of natural gas in the future, the demand for natural gas will increase very strong, and natural gas can contribute to a cleaner global energy system. These organizations also see strong growth in gas consumption in Asian countries in future, and Asia is the center of growth in natural gas demand in the future. In 2011, the International Energy Agency even predicted that the world would quickly enter a "golden age of gas" (IEA, 2011). There are many reasons to advocate securing an important role for gas in the future, for instance the development of unconventional gas in the last decade, in particular, shale gas in the United States, has tremendously improved the availability of gas resources; the development of natural gas markets towards greater globalization, especially the potential to development of liquefied natural gas (LNG) market.

However, the development of world gas market in general, the Asian market in particular have many doubts and uncertainties. In particular, the oil price socks at the end 2014 led to a decline in natural gas demand in Asia. In recent years, natural gas demand has increased sharply again in Asia. This reignites previous judgments about the growth of natural gas for Asia in future. Therefore, the analysis to show the conditions affecting the development of the Asian gas market is important to understand the role of natural gas in the energy structure in Asia.

## 2. The natural gas demand in Asia

In all energy scenarios, economic activities and demography are the main factors affecting energy demand and changes in energy mix. Projections in the scenarios are very sensitive to assumptions about the growth rate of GDP and population. According to United Nations (2015) and the International Monetary Fund (2015), world population growth is 0.7% / year on average for the period from 2015 to 2050. The world population in 2050 will reach 9.55 billion, an increase of 56% compared to 2000. The global economic growth would be 3.1% / year between 2015 and 2050. The global economic growth rate would tend to decrease after 2020 (Table 2). So that the world energy demand will rise in the future alongside the population growth and economic growth.

In developing countries like the countries of Asia, the average consumption of energy is higher than in developed countries because of the speed of urbanization and industrialization is rapid, an increase in the standard of living. Therefore, energy demand for heating, cooling, electricity, transport and industrial use will inevitably rise in these countries. Among the world's major regions, Asia will have a high rate of economic growth and play an important role in the global economy, with countries such as China, India and Southeast Asian nations expected to become the new leading powers.

**Table 2. Forecast the growth rate of GDP and population in the world and Asia**

<b>World</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>
The GDP growth rate (%)		4.53	5.03	3.80	4.09	3.75	3.43	2.85	2.34
Population (M)	6,128	6,514	6,916	7,325	7,717	8,083	8,425	9,039	9,551
<b>Asia</b>									
The GDP growth rate (%)	0.0	8.64	9.36	6.32	6.50	5.45	4.59	3.53	2.47
Population (M)	3,287	3,483	3,670	3,858	4,026	4,168	4,285	4,441	4,496

Source: Le (2017)

With a high rate of economic growth, particularly in China, India and Southeast Asian countries, Asia has become a major region for growth in global energy demand and will remain so in the future (BP, 2016, ExxonMobil, 2016). The natural gas consumption in Asia has increased dramatically in recent decades. According to BP (2018), natural gas consumption in the Asian zone is growing very rapidly and has become the highest in the world, with an average annual growth rate of 5.5% in the period from 1980 to 2018. In 1970, the consumption of this region represented about 1% of the total consumption, about 10 Bcm. In 2017, the figure reached 21% of the world total, more than 650Bcm (BP, 2018). Figure 1 presents the evolution of gas consumption in Asia.

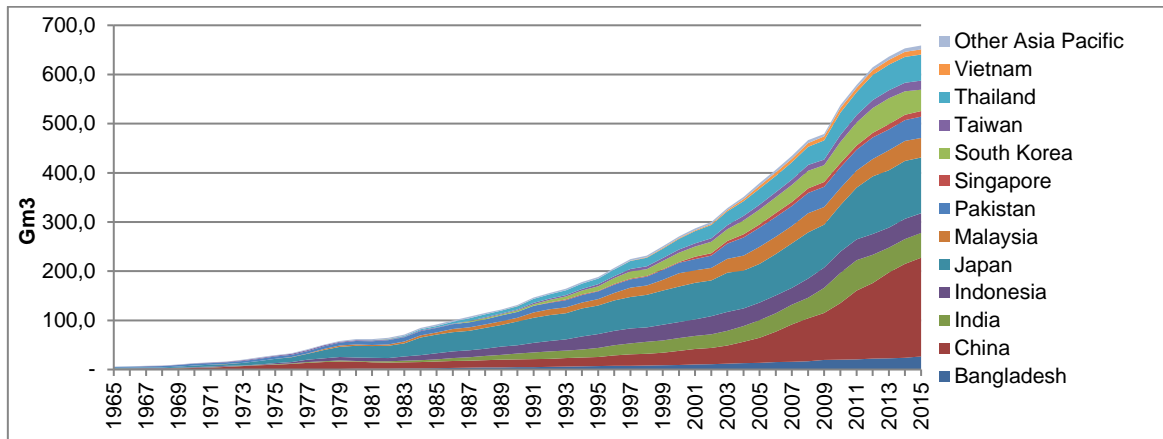


Figure 1. The evolution of gas consumption in Asia

Source: BP (2018)

According to International Energy Agency (2014), until 2040, the energy demand in Asia will always depend heavily on fossil fuels. According to Nakano (2012), between 2012 and 2035, world energy consumption is expected to increase by 50%. This growth will mainly come from Asia in which China and India account for more than half of this growth. This estimation is quite similar to the forecast in scenarios of IEA when it is assumed that Asia's gas demand will account for between 40% and 60% of global gas demand (IEA, 2014, IEA, 2015, IEA, 2016a, IEA, 2017 IEA, 2018). Due to strong economic growth and environmental policies, many countries have used natural gas to replace traditional fossil energy such as oil and coal. No region has a growth potential equivalent to that of Asia, natural gas consumption will grow faster in Asia than in other parts of the world. By 2030, this region will be the world's largest consumer of natural gas (Perelman, 2014; Asian Development Bank, 2013; Aguilera et al. 2014; IEA, 2016b).

According to the New Policies scenarios of IEA (2014, 2015), the demand for natural gas would increase steadily, but with different dynamics across years and regions. Table 3 shows the growth rate of energy demand in general and natural gas in particular in the New Policies scenarios of World Energy Outlook (WEO) from 2010 to 2018.

Table 3. Growth Rates of Natural Gas until 2040 in New Policies Scenarios of IEA

Region	WEO 2010	WEO 2011	WEO 2012	WEO 2013	WEO 2014	WEO 2015	WEO 2016	WEO 2017	WEO 2018
<b>Total world energy</b>	<b>1.20%</b>	<b>1.3%</b>	<b>1.2%</b>	<b>1.2%</b>	<b>1.1%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>1.0%</b>
- Petroleum demand	0.5%	0.6%	0.5%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%
- Coal demand	0.6%	0.8%	0.8%	0.7%	0.5%	0.4%	0.2%	0.2%	0.1%
- Gas demand	1.4%	1.7%	1.6%	1.6%	1.6%	1.4%	1.5%	1.6%	1.6%
<b>North America's gas demand</b>	<b>0.4%</b>	<b>0.6%</b>	<b>0.8%</b>	<b>0.8%</b>	<b>1.0%</b>	<b>0.7%</b>	<b>0.7%</b>	<b>0.7%</b>	<b>0.8%</b>
<b>Euro's gas demand</b>	<b>0.5%</b>	<b>0.9%</b>	<b>0.7%</b>	<b>0.6%</b>	<b>0.7%</b>	<b>0.1%</b>	<b>0.4%</b>	<b>0.3%</b>	<b>-0.1%</b>
<b>Asia's gas demand</b>	<b>3.8%</b>	<b>4.3%</b>	<b>4.2%</b>	<b>4.2%</b>	<b>3.8%</b>	<b>3.6%</b>	<b>3.6%</b>	<b>3.0%</b>	<b>3.1%</b>

Source : IEA & OECD (2010); IEA (2011); IEA (2012a); IEA (2013); IEA (2014); IEA (2015); IEA (2016a); IEA (2017); IEA (2018)

According to the forecast data in the New Policies Scenarios of IEA in the table 3, natural gas is the fastest growing fossil fuel. The natural gas demand will grow by 1.6% per year

and gas consumption is almost 45% higher in 2040 than today. The Asian region will be a driver of growth in demand and in future consumption of natural gas in the world. In all New Policies scenarios, the growth rate of natural gas demand in this region is very high, between 3.0% and 4.3% per year against 1.4-1.6% per year at the global level.

### 3. The prospects of the natural gas in Asia

Although there are many questions and uncertainties about the natural gas market in Asia, this region has strong development potential for its natural gas market. According to our analysis, Asia has many favorable conditions for entering a "golden age of natural gas" for the reasons as follows:

#### 3.1. Profuse of gas supply

Recent figures show that the total proved reserves of natural gas in the world are still trend to increase, and it is capable of meeting world demand in the near future. Until now, there has been some estimation about peak gas. Hubbert (1971) estimated that the peak of natural gas production would probably be reached between 1975 and 1980. Maggio and Cacciola (2012) calculated and set the forecast scenario for peak gas and estimated the peak production of gas at 132Tcf/year in 2035. BP (2018) showed that proven reserves of gas are enough to cover over 50 years of current demand of the world. Even according to the evaluation of IEA total recoverable resources of natural gas are much higher, it could sustain an amount equivalent to 250 years of current production (IEA, 2011). Especially the strong development of unconventional gas, especially the development of shale gas in the United States over the last decade, has created an increase in the prospects of natural gas supply in the world. The natural gas production in the world has increased sharply in recent years, including a great contribution of unconventional gas (MIT, 2011; IEA, 2012b; Serbutoviez, 2012; Rojey, 2013). Table 4 below shows the potential of natural gas in the world as reported by IEA (2018). This will have a positive impact on the security of gas supply in the global market, including in Asia.

**Table 4. Remaining technically recoverable natural gas resources (trillion cubic meters)**

Region	Proven reserves	Resources	Conventional gas	Unconventional gas		
				Shale gas	Tight gas	Coalbed methane
Eurasia	76	171	134	10	10	17
Middle East	81	122	103	11	9	-
Asia Pacific	20	139	44	53	21	21
North America	12	134	50	66	11	7
Central and South America	9	84	28	41	15	-
Africa	18	101	51	40	10	-
Europe	6	47	19	18	5	5
World	221	798	429	239	81	50

Source: IEA (2018)

The Asian region seems very rich in natural gas resources, including conventional gas and unconventional gas. According to Aguilera et al. (2014), the potential of conventional gas resources in Asia is sufficient to meet the current level of consumption for over 140 years. In addition, the shale gas potential in China is considered one of the largest in the world (EIA, 2013; Le, 2018). Therefore, the production of natural gas in Asia can increase rapidly to meet a growing demand. Apart from the growth potential of domestic supply to the region, the growth potential of external supply to the Asian region is very strong. Discoveries of new gas reserves in recent years in many parts of the world such as in North America, Africa, and Australia, will add significantly to global supply.

### **3.2. The development of liquefied natural gas market**

Pipeline import into Asia is limited due to a lack of infrastructure, geographic, and political problems. Abundant LNG supplies could strengthen the use of natural gas as a long-term strategic option. Then, LNG would be considered as a choice of Asia to meet its future demand. In fact, until now, international trade of natural gas via pipelines is quite limited in the Asian region. Gas trade in Asia is predominantly in the form of liquefied natural gas. Asian countries increasingly rely on imports of LNG to satisfy their energy demand (Stern, 2008; Andrews-Speed and Len, 2014). Asia dominates the world LNG market and represents more than 72% of global LNG demand. In the future, the Asian demand of LNG will continue to grow strongly to ensure energy demand and solve the problems of air pollution, environmental and greenhouse gas reduction. Besides traditional LNG importing countries like Japan, South Korea, and Taiwan will remain important players with vested interests in reshaping the LNG markets toward greater liquidity and transparency, this growth will focus mainly on the large emerging economies such as China and India, as well as the countries with high economic growth rates like Southeast Asian nations.

Liquefied natural gas is an important factor in the development of a global gas market because it allows easy exchange between the regional markets. It allows a diversification of the supply and there is no transit problem as pipeline. The production of gas as LNG has grown significantly due to the global gas trade in the form of LNG has grown rapidly in the last decades. The global increase in LNG liquefaction and regasification capacity may lead to more liquidity in the global gas market. This increase is allowing for more competitive and transparent pricing in gas markets. In Asia, many countries have announced plans to import LNG, and there are many projects of regasification terminal to be built in the future. This would increase resiliency in supply and demand for individual countries and could reduce interdependencies.

In addition, the revolution of shale gas in the United States has reshaped the global LNG market. Thanks to the shale gas revolution, the supply of natural gas in the United States seems overabundant. From a country that had to import LNG, America has now become an LNG exporter. Former exporters of LNG to the United States like Qatar had to divert exports to other markets and seek new customers. In this situation, Asia is an attractive destination for LNG exporters because the demand of natural gas is very large and the price is higher than that in other markets like Europe. Hence, countries in Asia could rely on LNG to satisfy their demand.

### **3.3. Environmental policies**

As we mentioned in the previous section, Asia has a dynamic economy and the highest growth rates in the world, so the demand for energy is high, especially in large countries such as China, India and the Southeast Asia nations. At the same time, climate issues in this region are significant and will strongly influence the energy policies of the countries involved. Air pollution as well as the need to reduce greenhouse gases has become a particularly serious problem in China, India, etc. In parallel with economic development, the problems of environmental protection, the improvement of air quality and quality of life, and the fight against climate change are taken more seriously than ever.

As mentioned above, energy and the environment are closely related. In the current context, the environmental policies of Asia will strongly affect energy demand. Environmental policies will focus on reducing air pollution and reducing greenhouse gas emissions, so they will greatly affect the demand for clean energy sources such as nature gas. Like other regions in the world, Asia needs a strong change in energy mix to fight against climate change and environmental pollution. Climate policies are steering the global energy system in the direction of decarbonization.

When environmental and climate policies are increasingly constraints, natural gas is considered a possible transition energy source. Especially in Asia, where economic and technical conditions do not allow these countries to immediately switch to low-carbon economies by using renewable energy sources. With the good qualities in terms of

environmental benefits compared to other fossil fuels, the natural gas is considered as an important bridge in the process of energy transfer in Asia.

As a result, several Asian countries are developing policies to improve air quality and combat climate change (Cornot-Gandolphe, 2014b; Li *et al.* 2015). Under current conditions, the development of renewable energies or nuclear energy meets different restrictions such as high cost, or nuclear security issues. Therefore, in parallel with the development of renewable energies, gas can be used as an alternative energy to other emitting fossil fuels, while we are waiting for a renewable energy system, and in order to meet the energy demand with some flexibility throughout the transition.

### **3.4. The economic competitive of natural gas with coal: special in the electricity generation sector**

Asia is still highly dependent on coal, which emits many greenhouse gases, and is the main cause of environmental pollution, air pollution and climate change problems. For example, in China, coal represents more than 90% of the country's recoverable energy resources (Cornot-Gandolphe, 2014a). The electricity generation sector is the largest user of coal, accounting for half of the total coal consumption in Asia. Due to the abundant supply of coal with very low prices compared to other fuels while the price of gas is higher, the use of natural gas in electricity and heat plants is still quite limited.

According to Kahrl *et al.* (2013), apart from the price factor, the investment cost between gas-fired and coal-fired power stations, the competitiveness of gas-fired electricity generation over coal depends on the price of carbon. The use of coal and gas to produce electricity generates CO<sub>2</sub>. Coal plants emit a lot of CO<sub>2</sub> while gas is a much cleaner fuel; it emits much less CO<sub>2</sub> than coal (about 50% of CO<sub>2</sub> emitted by coal). Although gas is more environmentally friendly, the market does not select fuels for electricity generation based on their environmental merit, but on their profitability (Bros, 2012). Therefore, the price of natural gas and CO<sub>2</sub> are very important factors for the market to select gas. In fact, currently, Asia does not yet have a full carbon market. It plans to reform the coal resources tax, implement a carbon tax and is developing pilot regions for the establishment of a national CO<sub>2</sub> trading system, such as in China (Cornot-Gandolphe, 2014a; Cao, 2015). According to De Boer *et al.* (2015), the price of carbon and the carbon tax will increase steadily in the future. Therefore, these measures are likely to change the competitiveness of coal in the future.

The boom of unconventional gas, and especially the decline in oil prices in recent years, has caused prices to fall sharply from about 16 USD/MBtu in 2013 to about 8 USD/MBtu in 2017 (BP, 2018). These have increased the competitiveness of nature gas compared to other fuels, especially coal. Besides, in order to reduce gas emissions causing the greenhouse effect, the carbon market now starts to grow in Asian countries, which is increasing the competitiveness of gas thermal power plant compared to coal power. Therefore, if Asian countries have gas price reforms, augment electricity prices and carbon prices, the ability to consume natural gas instead of coal in electricity production will be huge.

## **4. Conclusion**

The tremendous growth of the Asian economy has fueled a sharp increase in the demand for energy. This region has become an important center for the growth of global energy demand, and according to experts of the International Energy Agency, will remain at this position for the coming decades. However, to achieve environmental and climate goals, Asia needs to change the structure of energy. In parallel with economic development, the problems of environmental protection, the improvement of air quality and quality of life, and the fight against climate change are taken more and more seriously. As a result, Asia needs an energy transition to follow the direction of reducing greenhouse gas emissions and increasing the use of clean energy resources. Through our analyses, with a lot advantages, natural gas could play an important role in the process of energy transition to a green and low-carbon energy system in Asia in the future.

However, in order to develop the Asian gas market in the future, countries in Asia need to develop more appropriate policy mechanisms to encourage the development of this fuel. First, Asia still lacks a gas trading hub, in particular an LNG hub, so that it is very important that Asia needs to establish a gas trading center that will be used for spot trading, long-term contracts, and hedging. With this hub, the new price indexes will gain acceptance from buyers and sellers fast and reflect the region's gas market fundamentals. Second, the Asian natural gas market has still the characteristics of a monopoly market, lack of competition. The Asian countries need to reform the gas market towards liberalization, and reform the regimes for gas price to encourage the development of gas. Finally, thirdly, Asian nations need to build a CO2 market to enhance the competitiveness of natural gas with other energy fossils like coal and oil.

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