

Shale Gas Energy Alternative towards a Rapid Growth of Coal Energy Demand

An Analysis and Proposed Energy Diversification Model

Winarko. Bambang, Mahadewi. Lufina

Faculty of Management, Sampoerna School of Business at Jakarta, Indonesia

e-mail: bambang.winarko@ssb.ac.id; lufina.mahadewi@ssb.ac.id

Abstract

Indonesia has been enjoying a lucrative market in its coal business history during the past decade. The country is one of the top coal reserves and producers in the world mainly serve to China and India markets. Besides coal reserves, the country also one of the largest shale gas reserve in the world. The industry players and regulators are wondering if the shale gas technology revolution would also make significant impacts on coal industry sustainability or whether they urge to change the corporate strategies and policies. There are few studies focus the research on coal industry insight to understand its challenges from the energy diversification standpoint.

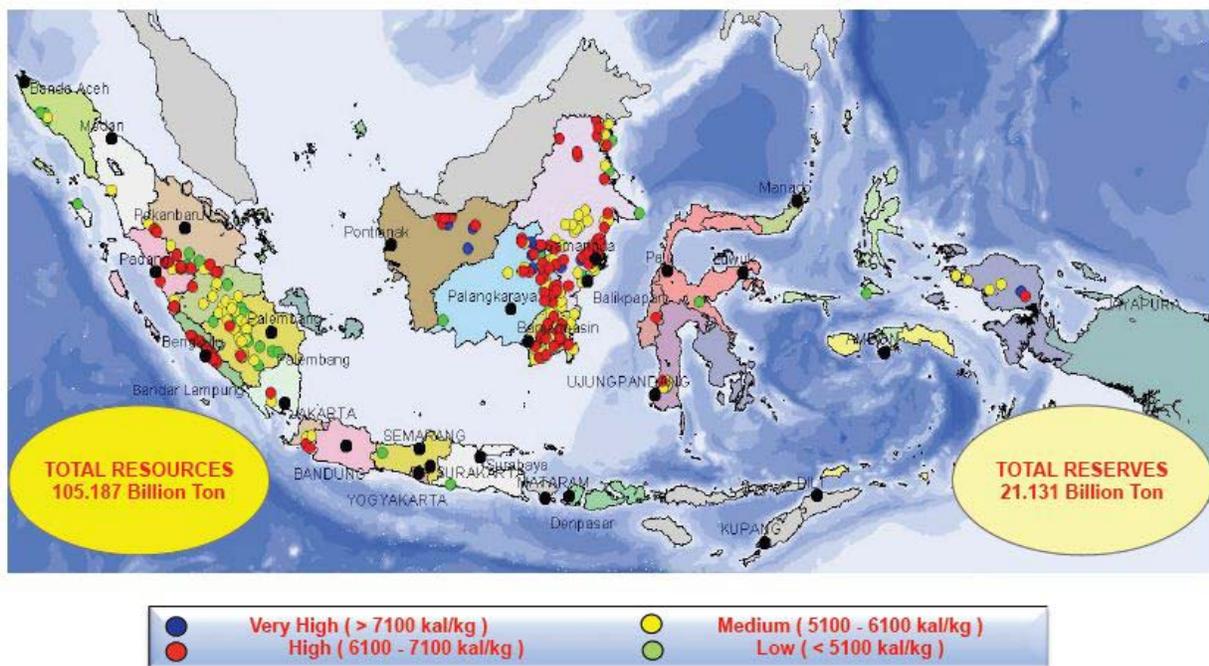
The purpose of this paper is to provide a deeper insight into some key factors that contributing the rapid growth of coal demand in Indonesia recently, how to strategize it and to determine what key factors shall be considered in implementing shale gas as clean and safe energy alternative in the National Energy Mix strategy. Comprehensive analysis from multifaceted point of views through literature reviews and industry research is conducted mainly from the perspective of coal supply-demand both nationally and internationally. Furthermore, SWOT analyzes is conducted to review the development of clean and safe technology of shale gas. It suggests a proposed model of energy diversification and careful approach on infrastructure and technology deployment selections of more experienced operators that proven in this field.

Introduction

Indonesia which is an archipelago country has huge mineral resources and coal reserves that are potentially mined mainly located in Sumatera and Borneo islands, and other areas such as Java and Sulawesi, but its reserves are relatively small. The overview of coal resources and reserves in Indonesia can be seen in the Figure 1. Indonesian Coal Potency Mapping. With the estimated 21 billion tones of coal reserve, the country is becoming one of the world's potential coal energy resources. Currently Indonesia is becoming the top coal exporting country that mainly serve to China and India to support their electricity power demand, following other Asian countries, such as South Korea, Japan and Taiwan. Last year, China imported 64.5 million tones of Indonesian coal which is worth US\$ 845 million. India also needs coal supplies to meet their needs for new power plants of 118 million tones for its Ultra Mega Power Projects (UMPP), that dominantly coming from Indonesia. The Indonesian Coal Mining Association (ICMA) estimates that the exporting coal to China and India by the end of 2012 could reach 80 million tons.

Domestically there is also big demand of electricity power using coal as its energy. Indonesia's electricity consumption per capita, electrification levels and the installed capacity levels are still among the lowest in Asia (0.6 MW per Capita). Besides, in the recent years there is a demand for substantial increase in generating capacity is evident by the increasing number of power outages. Other factors that drive the growing electricity demand are the increasing of income levels, urbanization, improvement on its standard of living, the ongoing transformation from an agricultural to a manufacturing oriented economy. The Government is facilitating the power plant fast track program of 10,000 MW Phase I and II. To support this program, the National Electricity Company PLN will develop small-scale steam-fired coal power plants as alternative to replace the use of fossil fuel and to reduce operational cost of electrical systems on the outer area of Java-Madura-Bali islands.

Figure 1. Indonesian Coal Potency Mapping



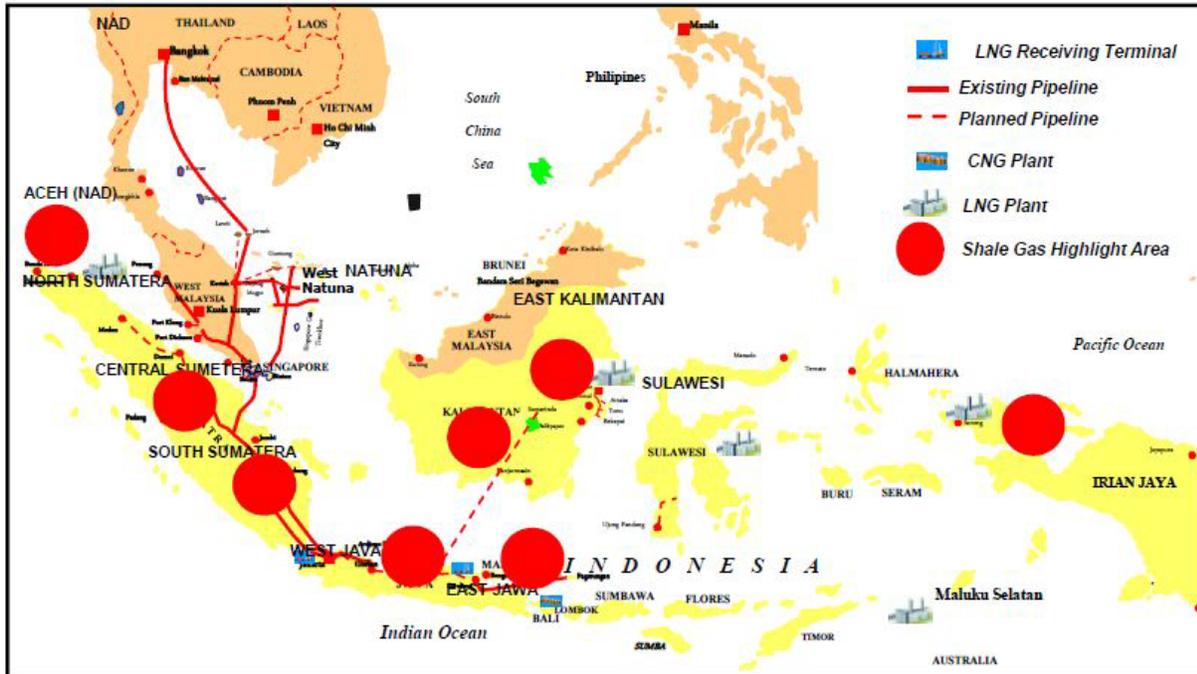
(Source: Indonesian Geological Agency, 2010)

Indonesia is the second world's largest coal exporter after Australia. In 2011, the country supplied 30% of total world's exporting coal of 910 million tones. Its total production was equal to 5% of world's coal production of 6,941 million tones. Dominantly, 77% from the total Indonesia coal production in 2011 was absorbed by export market. But if we look from the coal demand side, in the first semester of 2012 there was reduction on exporting coal demand from Asia Pacific and Europe regions. Total exporting coal in the first semester year 2012 is decreasing by 19% due-to the decreasing of exporting coal demand from these regions.

One of the factors that drives the decreasing of Indonesian coal demand is the increasing coal supply from Atlantic market because of the advent of technology to produce Shale Gas, in which the price is relatively cheaper than coal (US\$ 3-4 per MMBtu). This also may affect in the declining of coal commodity price in the US and makes American coal is relatively competitive against Indonesian coal.

In general, Shale gas technology advent has recently shocked coal producers all over the world, with no exception of Indonesia, due-to its price competitiveness and relatively more environmentally friendly than coal. As the country also one of the largest shale gas reserve in the world with hypothetical resources of 574 trillion cubic feet (see Figure 2. Indonesia Shale Gas Potency and Infrastructure Mapping), the industry players and regulators are wondering if this shale gas technology revolution would also make significant impacts on its industry sustainability or whether they urge to change their corporate strategies and policies.

Figure 2. Indonesia Shale Gas Potency and Infrastructure Mapping



(Source: Indonesian Ministry of Energy and Mineral Resources)

Research Objective

The research purpose is to provide a deeper insight into some key factors that contributing the rapid growth of coal demand in Indonesia recently, how to strategize it in facing the fact that shale gas technology development will affect the coal market and to determine what key factors shall be considered in implementing shale gas as clean and safe energy alternative.

Coal Industry Dynamics

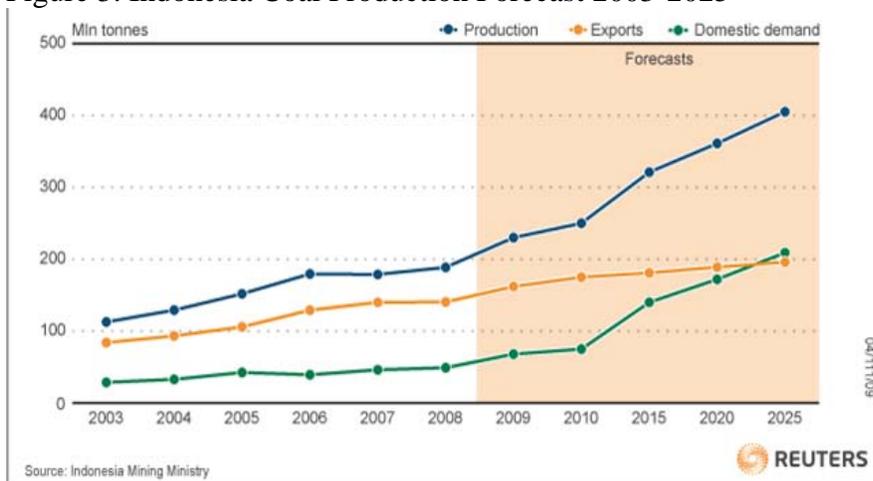
In response to the increasing of coal demand both domestic and export markets, the Indonesian coal industry have been integrating its industry structure vertically to gain competitive advantage. There were 116 mining contracting service companies that work for 60 companies that own coal mining concession. The emergence of these new contractors is because the owners do not have the experience and adequate heavy equipment available for operation.

Most of Indonesian coal deposits due-to its nature can efficiently be mined through open or surface mining system. But as the mineface is expanding horizontally to deeper inland areas the transportation expense is increasing. If the company wants to expand the pit vertically, it

shall consider the allowed stripping ratio level. To achieve operation efficiency, bigger coal companies are trying to expanding its business operation from upstream to downstream sector. Not only doing the coal production, but also business diversification in coal transportation, coal terminal, and make a consortium company to build coal fired power plant.

Indonesia has been enjoying the rapid growth of its demand during the past decade (see Figure 3. Indonesia Coal Production Forecast 2003-2025). The national coal production in 2012 is expected to rise by 7% -10% relatively from the previous year 2011. Realization of coal production in the first semester of 2012 is amounted 184 million tones, equivalent to 54% of this year's production target of 340 million tones. This number is increasing only 5% compared to the first semester of 2011. As mentioned earlier that total exporting coal in the first semester of 2012 is decreasing by 19% due-to the decreasing of exporting coal demand from Asia Pacific and Europe regions.

Figure 3. Indonesia Coal Production Forecast 2003-2025



(Source: Reuters, Indonesia Mining Ministry)

There are several factors that can lead to a declining demand of Indonesian coal. The first factor is the economic pressure that occurred in the Europe and U.S. The coal demand for steel industry in Europe dropped dramatically, resulting in decreasing the coal benchmark price of high calorie nearly 30% during 2011, which directly affects to the thermal coal price benchmark. The global economic crisis is affecting the global demand of coal that influencing on the overall Indonesian coal mining sales performance.

Second, the increasing coal supply at Atlantic markets, especially the U.S. because of the advent of technology to exploit shale gas. There is other threat that coming from alternative energy in the form of shale gas, in which its gas prices is currently very low of US\$ 3 - 4 per MMBtu compared to the coal price (US\$ 0.05789 per KWh). The development of resources and reserves Shale Gas in the U.S. will reduce its dependence on coal as a fuel for generating electricity were also opened opportunities for the exporting the coal to Asian markets. The U.S. Department of Energy projected the market share of coal as electricity generation resource will decline from 44.9% in 2011 to 43.5% in 2012.

Third, Russia plans to increase coal exports of 85 million MT (Metric Tone) within a period of 10-15 years (or until 2030), including 14.9 million MT to China. In comparison, Russia has exported 32 million MT of coal to India, Taiwan, South Korea, Japan, and China in 2011. Russia also has budgeted US\$ 120 billion to develop the coal industry (Bloomberg, 2012).

Fourth, China is expected to continue in importing coal in large quantities to meet its domestic demand with consideration of a lower price level. Generally China's coal demand is met by the Indonesian coal supply, but China's coal demand may be fulfilled by the U.S. coal oversupply. According to the ICMA (Indonesian Coal Mining Association), the North American countries supplied coal to China amounted to 59.6 million tons in 2009. And in 2011, the coal supply was soared to 107 million tons, while the average increase in exports to China about 25% per year.

The above mentioned combining factors of declining demand for Indonesian coal and high coal production level cause the declining of its coal price in general. The coal prices according to Newcastle Coal Index at the end of August 30, 2012 is declining up to 21% and reach up to US\$ 86 per tone. The declining coal price likely to continue until the end of this year (see Figure 4. The Coal (HBA) Indonesia FOB Price US\$/MT).

Figure 4. The Coal (HBA) Indonesia FOB Price US\$/MT



(Source: Thomson Reuters Datastream)

Shale Gas Development

Indonesia has 125 years history in the oil and gas production with various geological basins, however its crude oil production has declined over the last decade due to the natural maturing of producing oil fields, a slower reserve replacement rate and decreased exploration/investment. According to PwC Indonesia survey report the demand for gas is higher than oil due-to a shift towards cleaner energy. The country is ranked eighth in world gas production, with proven reserves of 108 Trillion Cubic Feet (TCF) in year 2010 or the eleventh largest reserves in the world and the largest in the Asia Pacific region. Its gas reserves are equivalent to three times Indonesia's oil reserves and can supply the country for 50 years at current production rates.

In 2010, Indonesia was turned its status from the world's largest exporter of LNG (Liquefied Natural Gas) in 2005 into the second largest exporters for its LNG to Japan, South Korea and Taiwan, after announcing its 2006 policy to re-orient natural gas production to serve domestic needs. The country's LNG facilities are based in Arun in Aceh, Bontang in East Kalimantan and Tangguh in Papua. The Tangguh LNG facilities was commenced its first production in mid 2009 and expands its LNG market to China and the west coast of the U.S.

The advancement technology in horizontal drilling in conjunction to hydraulic fracturing has been significantly adding economic value to natural gas producers in exploiting shale gas. Shale gas is a non conventional type of natural gas, which is trapped within sedimentary rock layer under time, pressure, temperature and compaction. It was formed by fine mud particles that is tightly packed and having vertical joints (cracks) and can be fractured further. Compared to the conventional gas drilling vertically, shale gas exploitation is using this horizontal drilling with hydrofracturing technique in which high pressured water is injected in-order to break the rock and release the gas flow.

The development of the shale gas industry may slower the rapid further development of the renewable energy industry, especially if the shale gas (if applicable estimated) to be one of the cheapest energy option. Renewable energy has long been difficult to compete with coal, and the availability of cheap shale gas, this could exacerbate the development in the renewable energy sector.

The advent of large-scale shale gas productions in the U.S. were initially started by Mitchell Energy and Development Corporation which had experiment during the 1980s and 1990s to exploit deep shale gas commercial production in the Barnett Shale in North-Central Texas that produced half a trillion cubic feet per year of natural gas in 2005. According to the U.S. Energy Information Administration (EIA) at its *Annual Energy Outlook 2011 (AEO2011)*, the U.S. shale gas resources is estimated at 862 TCF. Given a total natural gas resource base of 2,543 trillion cubic feet in the *AEO2011* Reference case, shale gas resources constitute 34 % of the domestic natural gas resource base represented in the *AEO2011* projections and 44 % of lower 48 onshore resources. Shale gas is predicted as the largest contributor to the projected growth in production, and by 2035 shale gas production accounts for 46 % of U.S. natural gas production.

As comparison, Indonesia has more shale gas than conventional natural gas resources potential. According to Indonesian Directorate of Oil and Gas, Indonesian shale gas resources can reach 570 TCF compared to 453 TCF for Coal Bed Methane (CBM). The Indonesian shale gas resources are located in 7 basins: 3 basins in Sumatera island (Baong Shale, Telisa Shale and Gumai Shale) and the other 4 basins are in Java and Kalimantan islands. The Government of Indonesia has already developing four joint studies for shale gas development and preparing for tendering for 23 shale gas blocks investment.

Shale gas although appears as cleaner energy source than coal, it still generates significant carbon emissions. From an environmental standpoint, shale gas becomes less acceptable than other renewable energy sources. It may hazard environment and climate condition in the form of methane leaks from shale gas which may reduce the effects of carbon dioxide due to switching from coal to shale gas.

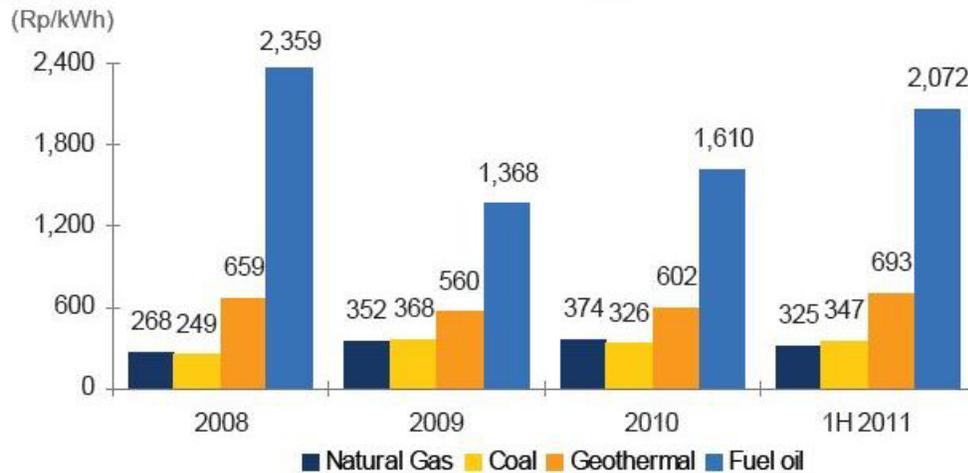
According to studies by PWC (2011), there is a potential for contamination of water sources from chemicals used during fracking. The Government involvement is needed to encourage the industry to disclose the chemicals used in fracking that will help to allay some environmental issues.

Nowadays, the cost and financing associated with shale gas development is considered as relatively high, for instance the transmission infrastructure. One of the challenges is the need to build infrastructure in areas that have not been produced. The Government policy is supposed to support to reduce the high upfront costs, especially in transportation and refueling facilities.

SWOT Analysis

Currently Indonesia electricity power generation consumes the biggest portion of its generating capacity from Coal (31%), followed by Gas (28%), Oil (27%), Hydro (12%) and Geothermal (2%). From the point of view of this generating capacity figures, we understand that coal is becoming the most important commodity in the country's power generation, followed by gas, meanwhile the fuel oil is still the most expensive energy resource.

Figure 5. Fuel Cost Comparison in IDR per kWh



(Source: Indonesian State Electricity Company, PLN)

Further SWOT analyzes can be developed constitutes the Strengths and Weaknesses that characterize the internal aspects, and the Opportunities and Threats that characterize the external aspects. First is *Strengths*. Indonesia has abundance coal and shale gas resources. Refers to the current Government's Energy Mix policy, both commodities are positioned as the top ranks in responding the growing demand of national electricity power domestically and Asian regions. In terms of the price, Indonesian thermal coal may relatively competitive against Australian coal due-to the shorter distance in reaching other Asian markets.

The second internal aspect is *Weaknesses*. The efficiency of overall coal operation and lack of transportation infrastructure, especially in Kalimantan are the biggest issue for Indonesian coal to improve its competitive advantage. Similarly, the infrastructure readiness and safe technology for shale gas development has not already taken in place. The other weakness factor is environmental problem issues caused by the exploitation of coal and shale gas resources.

Opportunities as external aspect can be seen from the point of view the growth demand of Indonesian coal for National Fast Track Electricity program as domestically the electricity demands is expected to grow 9% per year. Total coal consumption in 2012 for Indonesian State Electricity Company (PLN) is estimated at 60 million tones. This growing demand of electricity is required to maintain country's robust economic growth in the East Asia and Pacific region. The shale gas development in Indonesia is still at the early stage and its cheaper price relatively to coal may fulfill the energy diversification for electricity demand domestically and able serve regional electricity gap in China and India. Investments in this sector may create and attract more job opportunities for wide-range of skills and expertise from world class shale gas operators.

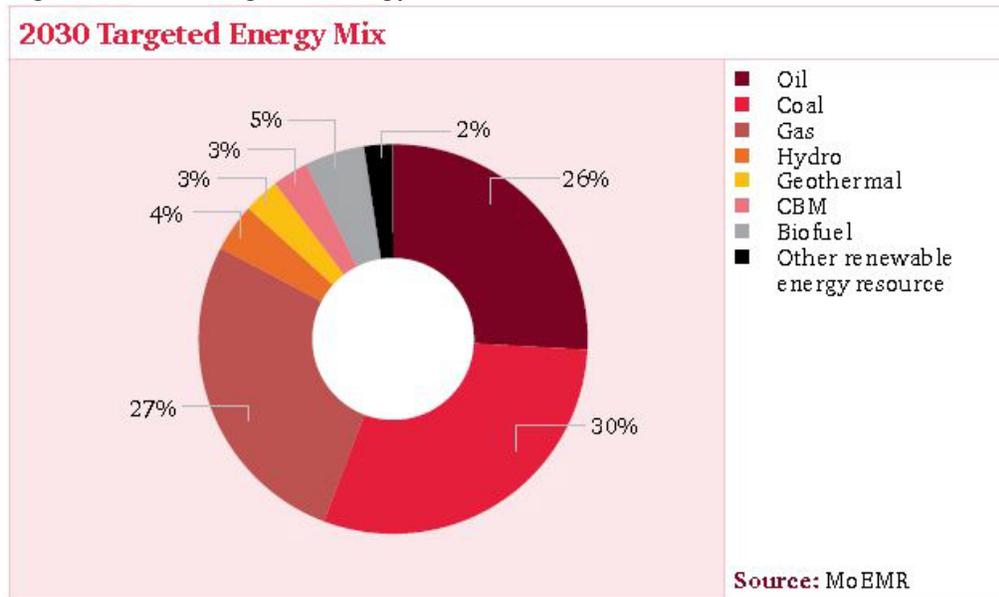
The last external aspect is *Threats*. The advancement of shale gas fracturing technology to produce unconventional gas is threatening Indonesian coal industry sustainability due to its price competitiveness. Furthermore, China is already one of the largest shale gas rich country in the world with total resources of 1,275 TCF. However China has started the drilling in 2010 and by 2020 it targets to supply only 6% of country's energy demand. In responding global economic slow down impact, efficiency in energy consumption spending is perceived as one the most important key successful factors in winning the global competition.

The development of safe and clean technology of shale gas is critical to the successful of its investment and commercialization. There are some factors that need to be considered to support this effort such as:

- The geology of shale gas in the U.S. and Indonesia is quite different. There are topographies constraints whereby the shale gas that exists in national parks and swamps in Kalimantan island and forests in Sumatera island (see Figure 2. Indonesia Shale Gas Potency and Infrastructure Mapping).
- Consideration to apply appropriate technology that requires combined knowledge of coal concessionaires and upstream operators.
- The regulatory bodies need time to understand the needs of operators causing potential delays of the deployment.
- Strong law enforcement is required to ensure there is no overlapping acreage for coal concessionaires and shale gas licensees.
- Service sector is in the developing stage and requires sufficient incentives from local government to do horizontal drilling.
- There is a need to develop pipeline network for shale gas developers to channel its gas supplies to demand centers more efficiently.

Large international oil companies (IOCs) that believe in the shale gas long-term economics have acquired significant stakes and investments in shale gas resources in North America and further in the U.S. over a period of several years. It has also positive implications for the application of best practices of drilling and processing techniques, which will make cleaner its shale gas exploitation. The poor casing practices by inexperienced exploration companies has been the cause of much of the challenging environmental issues. These IOCs will most likely lead exploration activities of shale gas worldwide. Careful approach on infrastructure and technology deployment selections only from experienced IOCs that already proven in this field is critically required.

Figure 6. 2030 Targeted Energy Mix



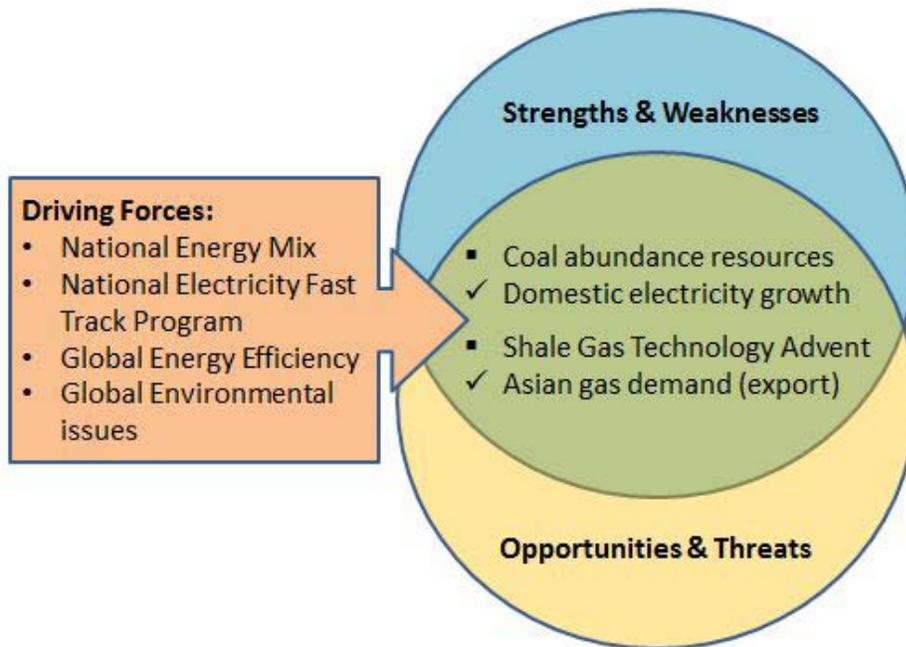
(Source: PwC Indonesia)

Discussion and Conclusion

The Government of Indonesia has already developed and revised its Energy Mix policy in 2012 calling for greater diversification (see Figure 6. 2030 Targeted Energy Mix). However based on the SWOT analyzes above, we can develop further energy diversification model by matching external threats and opportunities against internal strengths and weaknesses. Meaning that energy diversification model should attempt to leverage its strengths so as to capitalize on opportunities and counteract threats; additionally the model should attempt to protect its weaknesses.

Based-on the previous SWOT analyzes, we understand that in-order to leverage the abundance resources of coal and shale gas and capitalize on its demands of electricity growth for domestic and regional markets, the shale gas development shall be focused on grabbing profitable opportunities for export market to China and India, while existing coal production shall be dominantly focused to fulfill the growth demand of national electricity fast track program. By having such kind of market focus, the threat of shale gas development against coal shall be reduced. Furthermore, in-order to protect the weaknesses on coal operation efficiency, big coal contractors are trying to diversify and integrate its business from upstream up to downstream-scale operation. Meanwhile as the shale gas development is only at early stage point, it requires the expertise from the experienced IOCs, especially those who have the knowledge and experience in dealing with regulatory bodies and local government regulations. Preferably those who have long-term economics sight and proactively maintaining proven safe and clean shale gas exploitation, rather than defensive stance.

Figure 7. Proposed Energy Diversification Model



A proposed model on sustainable energy diversification can then be developed further to suggest better strategy formulation by intersecting the SWOT analysis components of coal and shale gas industry. It can be shown at Figure 7. Proposed Energy Diversification Model. Few variables such as national energy mix, national electricity fast track program, global energy efficiency and global environmental issues shall support this strategy formulation. Such model may be utilized and developed for further research to suggest better plausible solutions and able to be applied in other energy diversified countries that may face similar conditions.

Further Research

Further researches can be developed further based-on current proposed model in other countries by using more rigorous research methodologies, to see whether it can be applied, or expanding the present study to other energy diversification model alternatives.

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