Transporting natural gas from East Kalimantan to Java: Why did we choose a pipeline option?*

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Abstract- Java’s huge demand for natural gas, esp. in the power sector has to be met by importing gas from other sources. Sumatra, East Kalimantan, Papua and Sulawesi were considered as sources for supply. Transporting gas from East Kalimantan to Central Java using pipeline is the least cost option to be selected as the first priority, but over the longer term this option must be complemented by LNG chain option.

1. Introduction

Indonesia has proved successful in developing LNG industry in the Asia-Pacific market and becoming the world largest exporter for LNG, but she has not yet succeeded in meeting its large domestic demand for natural gas, particularly experienced by Java, the most populous island where about 2/3 of Indonesian reside and industrial activities take place.

The Indonesia Law No. 22 Year 2001 concerning Oil and Gas states explicitly the priority for using the country’s natural gas for domestic usages. Given the existing poor natural gas infrastructure for domestic market, these will require that a national gas transmission system be put in place from Sumatra, Kalimantan, and possibly other sources.

On June 17, 2006, the Downstream Regulatory Body (BPH MIGAS) announced that Bakrie & Brothers won the “Special Right” bidding for a US$ 1.2 Billion, 1,120 km East Kalimantan - Central Java pipeline. Previously (March 1st), the Body awarded the similar Right to develop the Trans Java gas transmission pipelines: Cirebon-Semarang (230 km) to state-owned EPC company, PT Rekayasa Industri and Semarang-Gresik (250 km) to state-owned oil and gas company, PT Pertamina.

The choice of a pipeline option for transporting natural gas from East Kalimantan to Java has attracted debates, mainly because the Badak LNG Liquefaction Plant -the largest one in the world- has already been there in East Kalimantan. Is a pipeline option still necessary? Why not directly to build LNG receiving terminals in Java?

This paper discusses the issues on —mainly- gas transportation from East Kalimantan to Java. It begins by presenting Java’s demand for natural gas, followed by options for transporting the gas that basically consists of pipeline and LNG chain. The analyses part shows that pipeline is the least cost option to be selected first. It also has some others advantages. However, over the longer period, the pipeline option is not the only choice.

2. Why transporting natural gas to Java?

Java’s huge demand for natural gas, mainly driven by the needs of power generation sector, is the main driver for importing gas from other sources in Indonesia.

There is a significant suppressed demand in Java where would-be consumers are lining up to get gas, particularly for power generation but also for small and medium industry. Shortages of gas have already happened for many applications in Java.

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In the power generation system about 2,700 MW of the current combined cycle plants are “forced” to burn the costly diesel oil due the lack of local gas supply/resources, and this represents a suppressed demand of about 400 MMCFD. Potential gas demand in the power sector is particularly high as natural gas competitive position vis a vis coal is quite favorable even if Indonesian high quality coal is relatively cheap.

A market survey conducted by the state gas company PGN estimated the potential for non power gas markets at 1.28 BCFD, about four times the current level of PGN sales. West Java retains the lion’s share with about two-thirds of the demand, while East Java (25% of total demand) and Central Java (12%) make up for the balance.

On the supply side the limited reserve base in Java area and the current gas pricing policy do not allow producers to boost exploration and develop additional gas supply for the domestic market. In addition, the liberalization of the current subsidized oil prices tends to increase energy supply costs, hence the demand for cheaper fuels, such as natural gas.

Consequently, future supply/demand balance in Java area shows an impressive deficit growing progressively from 2005 to 2025 a range of 1,000 to 2,000 BCFY (2,700 to 5,400 MMCFD). The estimated cumulated gas deficit over the next 20 years is in the range of 9.5 to 19.2 TCF, representing a volume of gas to be imported in 2015 in the range of 1,100 - 2,300 MMCFD.

In a context of better energy mix, natural gas in Indonesia has potential role to substitute the costly petroleum products and to limit the increasing budget for subsidies given to oil based fuels. Based on 2005 estimated energy consumption, economic subsidies to oil based fuels amount to 15 billion US$ while natural gas consumed allows to save 2.4 billion US$ of subsidies.
3. Sources for meeting Java’s gas demand

Over the long term, gas demand in Java is projected to grow at 6 to 8% per annum, reaching 6.5 BCFD by 2025 (high scenario), compared to current figure of about 1.0 BCFD. The main drivers for this rapid growth will still be gas for power generation, and for small and medium industry uses which will capture 57% and 35% of total Java gas demand by the end of 2025, respectively. In the highest scenario, total cumulative gas demand up to 2025 will reach 27.4 TCF and 21.5 TCF in the lowest demand scenario.

Java’s own gas reserves (8-12 TCF) are far from sufficient to meet the long-term demand, but have been adequate to develop the market, leaving however an increasing volume of suppressed demand. In order to meet this growing potential market, the gas has to be imported from other islands, where uncommitted reserves are available, although not considerable.

As indicated, the gas deficit to be imported in Java is particularly high and has to be compared with surplus gas made available in other source regions. The main sources of supply considered within Indonesia are Sumatra, East Kalimantan, Papua, and Central Sulawesi.

It is noted that South and Central Sumatra reserve base has been recently increased, leaving a potential for rising export capacity. The Government (PT PGN) has started recently to invest in a natural gas transmission system from Sumatra, involving two offshore pipelines able to deliver 920 MMCFD to Jakarta area starting in 2007. The Sumatra I and Sumatra II gas pipelines will relief total Java gas demand by up to 6 TCF over the period 2007-2025.

East Kalimantan reserves are quite large with a total of 47 TCF (unrisked), involving 25 TCF of proved reserves. However part of this gas will be committed to LNG exports and current production difficulties in major fields cast a doubt on the possibility of increasing current production level after 2010. East Kalimantan is however the major potential supplier for Java gas market, either by pipeline or LNG.

Papua would be a source to supply gas to Java in LNG form, as far as the two trains LNG project in Tangguh (7.2 million tons) would leave some gas available from the 14.5 TCF of proved reserves. Delivered cost to Java would however be higher than from Kalimantan.

The next sources of domestic gas available for Java is Central Sulawesi, where total gas reserves amount to 4 TCF but have been reviewed.

Natural gas can be transported from these regions in Indonesia either by pipeline (for East Kalimantan gas only), either as LNG through an existing Badak or new LNG chain (Tangguh, Donggi). In any case, the LNG solution will compel the construction of LNG receiving terminals on the island of Java.

4. Pipeline or LNG?

The “Pipeline or LNG” rule of thumb suggest that, for a green field gas transportation project shorter than 2,500 km, using pipeline would be the best option. However, one has to take into account that Badak Liquefaction Plant (22.4 MMTPA capacity) has already been there, by comparing pipeline option to the LNG chain.

Our analysis confirms that even with a marginal liquefaction cost (US$ 0.28/MMBTU) LNG chain cost is higher than pipeline chain cost. Therefore, the option for transporting natural gas from East Kalimantan to Central Java using pipeline was considered as high priority. The East Kalimantan to Java pipeline involves 619 km onshore from Bontang to Banjarmasin/Takisung and only 600 km offshore from Banjarmasin to Semarang/Tambak Lorok. The LNG receiving terminal would receive gas from not only Bontang, but also Tangguh and Donggi.

Unit cost difference is however small with 0.72 US$/MMBTU for the pipeline option and 0.77 US$/MMBTU for the LNG option. Liquefaction and shipping costs (0.53
US$/MMBTU) account for 68% of total LNG option cost, but the LNG option is less
capital intensive than the pipeline option even if LNG tankers are taken as investment.

Main characteristics and key economic parameters of the East Kalimantan –
Central Java gas pipeline and the LNG terminals using in the analysis are summarized
in the following tables.

**Table-1. Main Economic Assumptions on Pipeline and LNG Terminal**

<table>
<thead>
<tr>
<th>Kalimantan Gas Pipeline</th>
<th>LNG Terminals</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>419 bcf/y</td>
<td>4 Mt/y (206 bcf/y) 8 Mt/y (412 bcf/y)</td>
</tr>
<tr>
<td>Investment</td>
<td>1590 million US$</td>
<td>456 million US$ (1st train)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional cost for 2nd train is 65 million US$</td>
</tr>
<tr>
<td>Operating Cost</td>
<td>31.8 million US$/yr</td>
<td>9.4 million US$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.4 million US$ for 8 MT/y terminal</td>
</tr>
<tr>
<td>Liquefaction cost</td>
<td>0.81 to 1.03 US$/MMBtu</td>
<td>0.81 $/MMBtu for Bontang 0.86 $/MMBtu Tangguh 1.03 $/MMBtu for Donggi</td>
</tr>
<tr>
<td>Transportation Cost</td>
<td>0.20 to 0.40 US$/MMBtu</td>
<td>Depending on location of LNG liquefaction terminal and LNG receiving terminal</td>
</tr>
</tbody>
</table>

**Table-2. Comparison between Pipeline and LNG Chain Options**

<table>
<thead>
<tr>
<th>Investment Cost</th>
<th>Pipeline chain</th>
<th>LNG chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Million US$</td>
<td>1,590</td>
<td>521</td>
</tr>
<tr>
<td>Pipeline</td>
<td>1,590</td>
<td></td>
</tr>
<tr>
<td>LNG Terminal</td>
<td>521</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual Costs</th>
<th>Pipeline chain</th>
<th>LNG chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Million US$/y</td>
<td>31.8</td>
<td>233.8</td>
</tr>
<tr>
<td>Pipeline Operation</td>
<td>31.8</td>
<td></td>
</tr>
<tr>
<td>LNG Liquefaction</td>
<td>115.4</td>
<td></td>
</tr>
<tr>
<td>LNG Shipping</td>
<td>103.0</td>
<td></td>
</tr>
<tr>
<td>Regasification and Terminal Operation</td>
<td>15.4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit Costs at 10% discount rate</th>
<th>US$ /MMBTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline CAPEX</td>
<td>0.62</td>
</tr>
<tr>
<td>Pipeline OPEX</td>
<td>0.10</td>
</tr>
<tr>
<td>LNG Terminal CAPEX</td>
<td>0.20</td>
</tr>
<tr>
<td>Liquefaction cost</td>
<td>0.28</td>
</tr>
<tr>
<td>Shipping cost</td>
<td>0.25</td>
</tr>
<tr>
<td>LNG Terminal Operation</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Compared to LNG chain, the pipeline option has addition advantages, i.e.:

- Possible development of gas market outlets along pipeline route (Samarinda, Balikpapan, Banjarmasin, etc.)
- Possible contribution to construction of a regional natural gas pipeline grid (ASEAN Pipeline). The ASEAN Pipeline concept and some other proposals has for a quite along put the East Kalimantan-Java pipeline as a part of the ASEAN grid to be developed.
- Faster to implement in terms of contractual arrangements than the LNG option.
- Creating jobs in Kalimantan regions, esp. during construction period.
- Promoting domestic capacity/capability in pipe manufacturing, etc.

5. The Least Cost option to meet Java gas market

Building a transmission pipeline from East Kalimantan to Central Java, however, is not the only economic solution to meet Java’s fast growing demand for gas.

Under a long term perspective until 2025, it is clear that several transport infrastructure projects will have to be implemented. A question raised is the time sequence of projects able to meet Java gas demand with due consideration of regional imbalances: West Java currently draining the largest share of gas consumption and potential demand, but East Java progressively increasing its market share.

This complex problem has been addressed using a dedicated simulation model able to compare different scenarios of time-staged gas transport options and to evaluate their economic cost over a 20 year period (2005-2025).

In order to formulate an optimum gas transportation plan, the sequencing of three different gas transportation options for bringing gas to Java from neighboring islands have been studied and economically compared based on the net present value of total cost of each option (capital plus operating and running costs).

The three options were:

- Option 1: LNG Terminal in East Java, **East Kalimantan pipeline**, LNG Terminal in West Java.
- Option 2: **East Kalimantan pipeline**, LNG Terminal in West Java, LNG Terminal in East Java.
- Option 3: LNG Terminal in East Java, LNG Terminal in West Java, **East Kalimantan pipeline**.

The following assumptions have been considered:

- The Sumatra to Java pipeline system would start operation in 2007 with a maximum capacity of 920 MMCFD.
- Two inland pipelines will be required in Java to direct gas to West and East Java: a 32" Central Java–West Java branch and a 30" Central Java-East Java branch.
- The East Kalimantan to Java pipeline would involve a 48" onshore branch to Banjarmasin and a 42" offshore branch to Semarang with a maximum capacity of 1,150 MMCFD.

Capital investment is estimated as follows:

- East Kalimantan to Java pipeline: US$ 1,590 Million
- Java inland pipelines: US$ 540 Million
- One LNG Terminal of 8 Million tons: US$ 521 Million
- Total capital investment for a full sequence: **US$ 3,172 Million** *(including two LNG Terminals)*

Based on assumptions for pipeline and compression station investment costs, operating costs, LNG liquefaction and shipping costs and the implementation schedule of the different options as presented above, it is possible to calculate an equivalent supply cost in order to rank the different solutions to supply natural gas to Java.
To conclude, our study has identified that Option 2 is the lowest cost solution to meet Java’s gas supply needs, with gas delivered by pipeline from East Kalimantan to Central Java as the first priority project.

6. Critical issues and conclusion

The option of "East Kalimantan pipeline project first" has been found as the least cost solution, and shows some attractive characteristics in terms of regional coordination within Indonesia and also as an important piece of a future ASEAN gas grid. It has however some challenges:

- A major upfront capital investment is required with the pipeline project, while in the other side, capital investment phasing is technically possible with a progressive installation of LNG Terminals,
- Securing gas supply to the pipeline will be a central issue. Although East Kalimantan gas reserves are sufficient to support 15-20 years of gas delivery to Java, recent gas production performance in this region may affect the renewal of all LNG contracts and lead to operate Badak LNG plant at a lower capacity factor. Expectedly, this question could find an answer in the long term, compensating reduced gas production with the huge potential of coal bed methane (CBM) resources identified in Kalimantan, particularly the Barito basin with reserves of about 100 TCF. Furthermore, using a dynamic approach for the size of the reserve base, considering that the market actually drives the reserve, East Kalimantan production capability after 2010 could be higher than expected.
- In the case of persistent limitation of East Kalimantan gas production (maximum of 3,500 MMCFD), the Pipeline to Java option would lead to leave idle a liquefaction capacity of about 8 million Tons (3 LNG trains). If these LNG trains can be operated with a marginal cost of US$ 0.28 US$/MMBTU to deliver gas to a Terminal in Java, this LNG option and the Pipeline option would provide approximately the same economic cost.

Finally, it needs to reemphasize that the removal of subsidies on oil based fuels is essential as it would make Indonesian gas sector more competitive, encourage gas exploration and development. An improvement in gas pricing policy toward a market based pricing system would automatically lead producers to fulfill both local and export demand.

Reference