



Proposed DME Project in Indonesia (D)oes Not (M)ake (E)conomic Sense

*Annual Losses Will Be US\$377 Million, Costing
More Than LPG Import Savings*

Executive Summary

Indonesia's coal industry is currently facing tough questions with prices below breakeven for all but one of 11 listed companies, as highlighted in our three previous Indonesian coal industry reports.¹

To boost coal demand, the Indonesian government is exploring policies which support downstream coal processing in the hope of finding profitable value addition niches.

One of the most advanced proposals is state-owned Tambang Batubara Bukit Asam's (PTBA's) proposed US\$2 billion project in Sumatra for the construction of a coal gasification plant to produce methanol and subsequently dimethyl ether (DME). DME would then be used as a direct substitute in Indonesia's domestic liquefied petroleum gas (LPG) sector.

In a sign of the government's commitment to a new generation of fossil fuel subsidies, the recently passed Omnibus Law now grants royalty relief for any downstream coal projects.

What top planners have missed, however, is that technical viability is not the same as financial viability. The coal-to-DME process has been tried in other coal-rich countries but it has never been deployed at scale. Although there have been studies on the technical and operating aspects of a DME project for Indonesia, the one report on the economics of DME uses 2018 data when the price of LPG was US\$591/tonne.² This compares to the current price of around US\$365/tonne — a level which robs DME of its competitiveness as an LPG substitute.

**A DME plant cannot
be justified in economic
terms. It would lose
US\$377 million annually.**

¹ IEEFA. [Indonesia Coal: No Bailout, Don't Throw Good Money After Bad](#). September 2020.

[Indonesia Coal at the Mercy of the Dragon and Tiger](#). June 2020. And, [Can the Indonesian Coal Industry Survive COVID-19?](#) May 2020.

² Annisa Muliahati, Eva Fathul Karamah and Ika Kafiah. Study of domestic coal-based dimethyl ether (DME) utilization to reduce LPG import. 2018.

To test the financial viability of the proposed DME project, we used updated market prices and relevant coal sector project costs and compared these to costs from an operating DME plant in China as a proxy.

Our conclusion is that an Indonesian DME plant cannot be justified on economic terms. The proposed DME plant would lose US\$377 million annually after operating and finance costs. **This would exceed any savings from lower LPG imports by US\$19 million.**

On this basis, IEEFA's estimates indicate that the total per tonne cost of the proposed Indonesian DME plant would be US\$470/tonne. This would value the energy in DME at nearly twice what consumers now pay for LPG. In the end, the Indonesian taxpayer will be paying more for less energy.

The total per tonne cost of the DME plant would be US\$470/tonne — nearly twice what consumers now pay for LPG.

IEEFA's view is that the numbers on the proposed DME project do not add up:

1. PTBA is proposing to spend US\$2bn to build a DME plant to produce 1.4m tonnes of DME using 6.5m tonnes of coal annually. This is to replace 980kt of LPG imports.
2. At the current LPG price of roughly US\$365/tonne, the equivalent price of DME is a 30% discount or US\$256/tonne. We used the average 2016-2019 non-coal DME production cost of US\$300/tonne from listed company Lanhua in China, and the average Indonesian coal sector production cost of US\$37/tonne, to derive our baseline costs. IEEFA estimates the total operating cost for the PTBA plant per tonne of DME would be US\$470/tonne.
3. IEEFA expects that the US\$2bn capital costs will be wholly debt funded at around 3.8% per annum for interest expenses of US\$76m. At a price of US\$256/tonne, the DME plant will incur an operating loss of about US\$215/tonne on 1.4m tonnes for a total operating loss of US\$301m. When interest expenses are added in, the DME project will lose US\$377m per year.
4. Thus, not only is the project left with debt of US\$2bn that it cannot service, there will also be an annual operating loss of US\$377m. In theory, this loss could be offset in part by annual cost savings of US\$358m from lower LPG imports. In a best-case scenario, including LPG cost savings, the project would result in a loss to the government of Indonesia (GoI) of US\$19m.

Table 1: Government of Indonesia Financial Position Current vs DME Project (US\$ millions, 000 tonnes, US\$/ tonne)

| | Unit | Current | DME Project |
|------------------------------|------------|---------|-------------|
| Debt | US\$ m | 0.0 | 2,000.0 |
| DME project | | | |
| Operating losses pre finance | US\$ m | | -300.6 |
| Finance expenses | US\$ m | | -76.0 |
| Total losses | US\$ m | 0.0 | -376.6 |
| LPG savings | | | |
| LPG purchased/substituted | 000 tonnes | 980.0 | 980.0 |
| LPG price | US\$/tonne | 365.0 | 365.0 |
| LPG replacement savings | US\$ m | | 357.7 |
| Financial position | | | |
| Net impact to Gol vs current | US\$ m | | -18.9 |

Source: Jakarta Post, IEEFA estimates.

Coal Royalty Exemption Misses the Point

Despite flaws in the business case for DME, provisions in the new Omnibus Law could result in further losses for the GoI. In line with the government’s focus on resource nationalism, the new Omnibus Law offers a coal royalty exemption for any downstream processing of coal. One of the first potential beneficiaries of this new subsidy would be PTBA’s proposed DME project.

Based on IEEFA’s analysis, however, the DME project does not make a strong case for the subsidy or downstream processing “value addition” given the potential for significant losses. Using the average royalty paid by 8 coal companies in 2019 to estimate the royalty subsidy for PTBA’s proposed US\$2bn plant, if the plant uses 6.5m tonnes of coal annually, the royalty cost savings would be a US\$5.0/tonne for a total saving of US\$32m versus a loss of US\$377m.

Provisions in the new Omnibus Law could result in further losses for the GoI.

In IEEFA’s view, the DME project does not make economic sense and should not be considered a viable investment project that simply needs a modest push from a royalty subsidy.

DME: Paying More for Less Energy

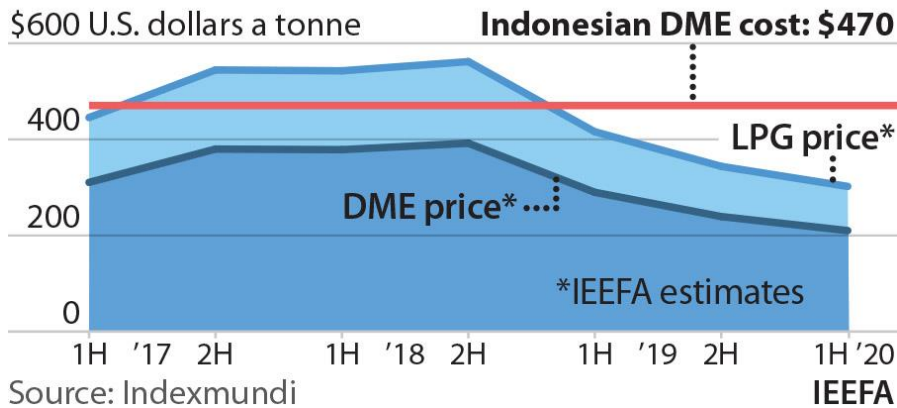
Viewed through a policy lens, the case for subsidizing coal usage suffers in this case because high cost domestic DME is being positioned to compete with LPG — a cost-competitive alternative that already benefits from an established distribution chain.

The policy problem is made worse because the Indonesian taxpayer will be paying more to get less energy.

The energy content of one kilogram of DME is 6,900 kcal compared to 11,100 kcal for LPG. At the current LPG price of US\$365/tonne, the matching DME prices should be a 30% discount (to reflect lower energy content) at US\$256/tonne. This compares to the DME project production cost of US\$470/tonne as indicated in the figure below.

Indonesian Downstream Coal Not Cost-Effective

The government is exploring plans to add coal-derived dimethyl ether (DME) to LPG in an effort to cut imports.



**Please see Appendix 1 for calculation details.*

The key issue is that technical viability is not the same as financial viability. At the technical level such a plant can be built, and we have identified a comparable plant using coal as a feedstock that has been operating in China. However, using the costs for that plant and the current LPG price of US\$365/tonne to calculate the matching DME price, IEEFA estimates that this proposed project will have annual losses of US\$377m after financing and operating costs, in addition to US\$2bn of new debt.

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DME: Making the Problem Worse

In recent years, the Indonesian government has focused on finding ways to add value, through downstream processing, to Indonesia's abundant natural resources. While this strategy can make sense at a conceptual level, commodity market realities can often disrupt ideas promoted by engineers focussed on technical viability.

IEEFA's research indicates there have been a number of academic studies examining the role of dimethyl ether (DME) and its relevance to Indonesia. DME is an organic compound with the formula CH_3OCH_3 and can be produced from fossil gas, coal, and biomass. Although a flammable gas, when pressurised it can be handled and stored as a liquid.

Studies by Prabowo et al (2017) and Muliahati et al (2018)³ note that Indonesia has abundant coal resources and that DME could be substituted for LPG, up to 15% in an LPG:DME mix. In theory, this would not require any changes to existing distribution infrastructure and user equipment.

Using coal as a feedstock to make DME has been explored but rarely scaled in other countries with abundant coal resources, except for China which has existing DME plants that use coal as the feedstock. The technology for converting methanol into DME through dehydration involves coal first being converted into a syngas, with the hydrogen and carbon monoxide removed to form a liquid methanol. The water is then removed to form DME.

Using coal as a feedstock to make DME has been explored but rarely scaled in other countries.

The market value of DME in Indonesia would be determined by the ability of domestically produced DME to displace imported and domestically produced LPG.

According to the 2018 Handbook of Energy, Indonesia imported 5.6m tonnes of LPG and exported 0.4m tonnes in 2018. Indonesia imported 73% for its total LPG supply excluding exports. The remaining 27% of total LPG supply was supplied from its domestic gas refineries (15%) and domestic oil refineries (12%).

³ State of the Art of Global Dimethyl Ether Production and Its Potential Application in Indonesia by Bayu Prabowo et al. 2017. And, Study of domestic coal-based dimethyl ether (DME) utilization to reduce LPG import by Annisa Muliahati, Eva Fathul Karamah and Ika Kafiah. 2018.

Table 2: Indonesia LPG Domestic Production, Imports, Exports and Total Consumption 2015-18 (000 Tonnes, %)

| LPG | Unit | 2015 | 2016 | 2017 | 2018 |
|----------------------------|------------|---------|---------|---------|---------|
| Domestic Production | | | | | |
| Gas refinery | 000 tonnes | 1,631.6 | 1,410.2 | 1,162.6 | 1,144.0 |
| Oil refinery | 000 tonnes | 675.8 | 831.4 | 865.4 | 883.3 |
| Total domestic | 000 tonnes | 2,307.4 | 2,241.6 | 2,027.9 | 2,027.3 |
| Less: Export | 000 tonnes | -392.0 | -580.0 | -360.0 | -434.0 |
| Add: Imports | 000 tonnes | 4,025.6 | 4,475.9 | 5,461.9 | 5,566.6 |
| Total LPG supply | 000 tonnes | 5,941.0 | 6,137.5 | 7,129.9 | 7,159.8 |
| Total LPG sold | 000 tonnes | 6,377.0 | 6,642.6 | 7,190.9 | 7,562.2 |

Source: Directorate General of Oil and Gas.

In 2018, Indonesia consumed 7.6m tonnes of LPG, of which 96% was used mainly for residential cooking and heating. The main consuming sector for LPG in Indonesia for 2015-18 was the household sector.

Table 3: Indonesia LPG Use by Sector (000 Tonnes, %)

| LPG | Unit | 2015 | 2016 | 2017 | 2018 |
|-----------------------------|------------|-------|-------|-------|-------|
| Domestic Consumption | | | | | |
| Household | 000 tonnes | 6,115 | 6,370 | 6,896 | 7,252 |
| Commercial | 000 tonnes | 169 | 176 | 191 | 201 |
| Industrial | 000 tonnes | 92 | 96 | 104 | 110 |
| Total domestic | 000 tonnes | 6,376 | 6,642 | 7,191 | 7,563 |
| Percentage Breakdown | | | | | |
| Household | % | 95.9 | 95.9 | 95.9 | 95.9 |
| Commercial | % | 2.7 | 2.6 | 2.7 | 2.7 |
| Industrial | % | 1.4 | 1.4 | 1.4 | 1.5 |
| Total | % | 100.0 | 100.0 | 100.0 | 100.0 |

Source: Directorate General of Oil and Gas.

DME Limited in Scale and Heat Value

While the focus has been on DME as a substitute for LPG, IEEFA notes that there are limits for this substitution:

- **Total amount of LPG imports substituted:** Based on a 15-20% substitution and the 2018 import volumes, the total LPG tonnage that can be displaced by DME is 0.84 - 1.1m tonnes.
- **Lower heat value:** DME has a lower heat value, meaning cooking time would take 20% longer — a DME performance characteristic that could limit its appeal in the market. One kg of DME only contains 7,749 kcal/kg which is 64% of the heat value for one kg of LPG.

The report by Muliahati et al (2018) suggests a desired mix containing a 15% blend⁴ of DME with LPG, but the head of R&D at the Energy and Mineral Resources Ministry has suggested mixing 80% LPG with 20% DME to maximize retail economics, according to studies carried out between 2017 and 2020.⁵

This means that based on 2018 imports of 5.6m tonnes, Indonesia could substitute a minimum of 15% of 5.6m tonnes of LPG which is 0.84m tonnes or based on a 20% DME/LPG blend a maximum of 1.1m tonnes of imported LPG. In the absence of any other downstream DME uses, the maximum addressable DME market for LPG substitution would be 1.1m tonnes. Thus, the proposed DME plant of 1.4m tonnes per annum would be enough to meet this substitution demand.

Table 4: LPG vs DME Energy and Emissions (kcal/kg, kg, mg/m3, ppm)

| Characteristics | Unit | LPG | DME |
|---------------------|------------------|--------|---------|
| Gross Heating Value | kcal/kg | 12,076 | 7,749 |
| CO2 emission | kg CO2/home/year | 930 | 745 |
| SO2 emission | mg/m3 | 6 | 0 |
| NO2 emission | ppm | 18 | 0 |
| CO emission | ppm | 9 | 0.0 |
| Cooking time | unit | 1 | 1.1-1.2 |

Source: Jakarta Post.

Getting the Cost Estimates Right — DME Is Not Cheap To Produce

The best proxies for representative DME manufacturing costs are in China due to the cost of coal and the age of the technology. Also, China uses coal as the feedstock for its DME plants which is most relevant to Indonesia. Other types of feedstock for DME include natural gas and biomass.⁶

We based our calculation of DME production costs on PTBA’s proposed US\$2bn project in Sumatra that would use 6.5m tonnes of coal to produce 1.4m tonne of DME.⁷ We estimate that one tonne of DME produced in the PTBA project would cost US\$470/tonne.

⁴ Annisa Muliahati, Eva Fathul Karamah and Ika Kafiah. Study of domestic coal-based dimethyl ether (DME) utilization to reduce LPG import. 2018.

⁵ Jakarta Post. [Indonesia to mix coal-based DME, LPG as cooking gas to reduce imports](#). 27 July 2020.

⁶ State of the Art of Global Dimethyl Ether Production and Its Potential Application in Indonesia by Bayu Prabowo et al. 2017. And, Study of domestic coal-based dimethyl ether (DME) utilization to reduce LPG import by Annisa Muliahati, Eva Fathul Karamah and Ika Kafiah. 2018.

⁷ Jakarta Post. [Indonesia to mix coal-based DME, LPG as cooking gas to reduce imports](#). 27 July 2020.

Table 5: Production Cost Per Tonne DME (000 tonnes, US\$/tonne)

| | Unit | DME |
|--|------------|-------|
| Total DME plant capacity | | |
| Coal required | 000 tonnes | 6,500 |
| DME produced | 000 tonnes | 1,400 |
| Coal to DME ratio | tonnes | 4.6 |
| Production cost per tonne DME | | |
| Coal production cost per tonne | US\$/tonne | 37.0 |
| Coal production for one tonne DME | US\$/tonne | 170.2 |
| Non-coal production cost one tonne DME | US\$/tonne | 300 |
| Total production cost for DME | US\$/tonne | 470.2 |
| Coal Royalty per tonne DME | | |
| Included in coal production cost: | | |
| Average royalty paid | US\$/tonne | 5.0 |
| Royalty per tonne DME | US\$/tonne | 23.0 |

Source: Company reports, IEEFA estimates.

We derived our calculation based on the following:

Mining cost of coal: We took the average 2019 production cost for 11 listed coal companies of US\$37/tonne. This is lower than PTBA's 2019 production cost of US\$41/tonne.

Table 6: Indonesian Coal Companies Sales and Production Cost (million tonnes, US\$/tonne)

| Company | Stock Code | Sales (m tonnes) | | Cost (US\$/tonne) | |
|-----------------------------|------------|------------------|-------|-------------------|------|
| | | 2018 | 2019 | 2018 | 2019 |
| Adaro | ADRO.JK | 54.4 | 59.2 | 41.0 | 38.6 |
| Bumi Resources | BUMI.JK | 80.6 | 87.7 | 47.3 | 45.6 |
| Bayan | BYAN.JK | 28.3 | 29.2 | 29.3 | 30.9 |
| Indika | INDY.JK | 34.1 | 34.9 | 31.0 | 31.2 |
| Geo Energy Resources | RE4.SI | 7.1 | 7.4 | 30.8 | 29.5 |
| Golden Energy and Resources | AUE.SI | 22.8 | 30.0 | 27.4 | 24.1 |
| ABM Investama | ABMM.JK | 9.5 | 11.1 | 23.5 | 22.4 |
| ITMG | ITMG.JK | 23.5 | 25.3 | 50.6 | 47.3 |
| PTBA | PTBA.JK | 24.6 | 27.8 | 40.1 | 41.0 |
| Toba | TOBA.JK | 4.9 | 4.2 | 49.6 | 50.9 |
| Harum | HRUM.JK | 4.6 | 4.1 | 49.3 | 45.5 |
| Total | m tonnes | 294.4 | 320.9 | | |
| Average Cost | US\$/tonne | | | 38.2 | 37.0 |

Source: Company reports, IEEFA estimates.

Non-coal production costs: Our estimates are based on the average 2016-2019 production cost for listed DME producer Shanxi Lanhua Sci-Tech Venture (600123.SS) (Lanhua) of US\$300/tonne. Lanhua is a diversified coal chemical-based plant. The plant is located in traditional coal area of Shanxi Province and produces DME, Urea and also Caprolactam (CPL) which is used in producing nylon.

In 2019, Lanhua sold 8.4m tonnes of coal, 830k tonnes of Urea, 252k tonnes of DME, and 120k tonnes of CPL. Although these products have profit cycles, DME has been loss making since 2019 while the CPL segment recorded a loss for the first half of 2020 (1H20).

Table 7: Lanhua Business Segments Sales, Prices and Gross Margins (000 tonnes, US\$/tonne, %)

| Business segments | Unit | 2016 | 2017 | 2018 | 2019 | 1H 20 |
|---------------------|------------|---------|---------|---------|---------|---------|
| Coal segment | | | | | | |
| Coal sales | 000 tonnes | 6,196.5 | 6,780.8 | 7,580.6 | 8,408.5 | 3,905.6 |
| Coal price | US\$/tonne | 59.2 | 86.4 | 97.9 | 78.7 | 66.1 |
| Coal gross margin | % | 47.8 | 63.5 | 63.6 | 58.0 | 57.6 |
| DME segment | | | | | | |
| DME sales | 000 tonnes | 248.8 | 283.5 | 272.9 | 252.2 | 363.0 |
| DME price | US\$/tonne | 356.6 | 483.7 | 544.6 | 410.2 | 330.2 |
| DME gross margin | % | 2.5 | 10.8 | 7.8 | -6.3 | -3.7 |
| Urea segment | | | | | | |
| Urea sales | 000 tonnes | 1,213.9 | 981.2 | 790.2 | 833.7 | 476.2 |
| Urea price | US\$/tonne | 159.4 | 208.9 | 269.7 | 242.5 | 218.9 |
| Urea gross margin | % | -11.2 | -2.9 | 11.4 | 15.1 | 11.0 |
| CPL segment | | | | | | |
| CPL sales | 000 tonnes | 0.0 | 100.2 | 109.0 | 119.9 | 40.2 |
| CPL price | US\$/tonne | 0.0 | 1,847.8 | 2,118.8 | 1,570.7 | 1,298.1 |
| CPL gross margin | % | 0.0 | 12.9 | 24.1 | 11.1 | -1.8 |

Source: Company reports, IEEFA estimates.

We used Lanhua's results to estimate the non-coal production costs for Lanhua's DME output, allocated to DME production. The production cost for each tonne of Lanhua coal ranged from US\$28-36/tonne during 2016 - 1H20.

We accounted for the fact that Shanxi coal tends to have higher energy value, roughly 5,500kcl/kg or more. By comparison, PTBA's 2019 Annual Report and presentation indicated that its major coal brand, BA-50, accounted for 65% of total sales in 2019 with an energy value of 5,000kcl/kg coal.⁸ PTBA has said it requires 4.6 tonnes of coal to make one tonne of DME.

Considering the higher energy value for Lanhua's coal, we assumed it would take 4 tonnes of coal to make one tonne of DME. We deducted the cost of 4 tonnes of

⁸ PTBA 2019 Annual Report page 72, PTBA 2019 Corporate Presentation 2019, page 10.

Lanhua coal from the total cost of DME and found the non-coal DME production cost ranged from US\$224-360/tonne from 2016 to 1H20.

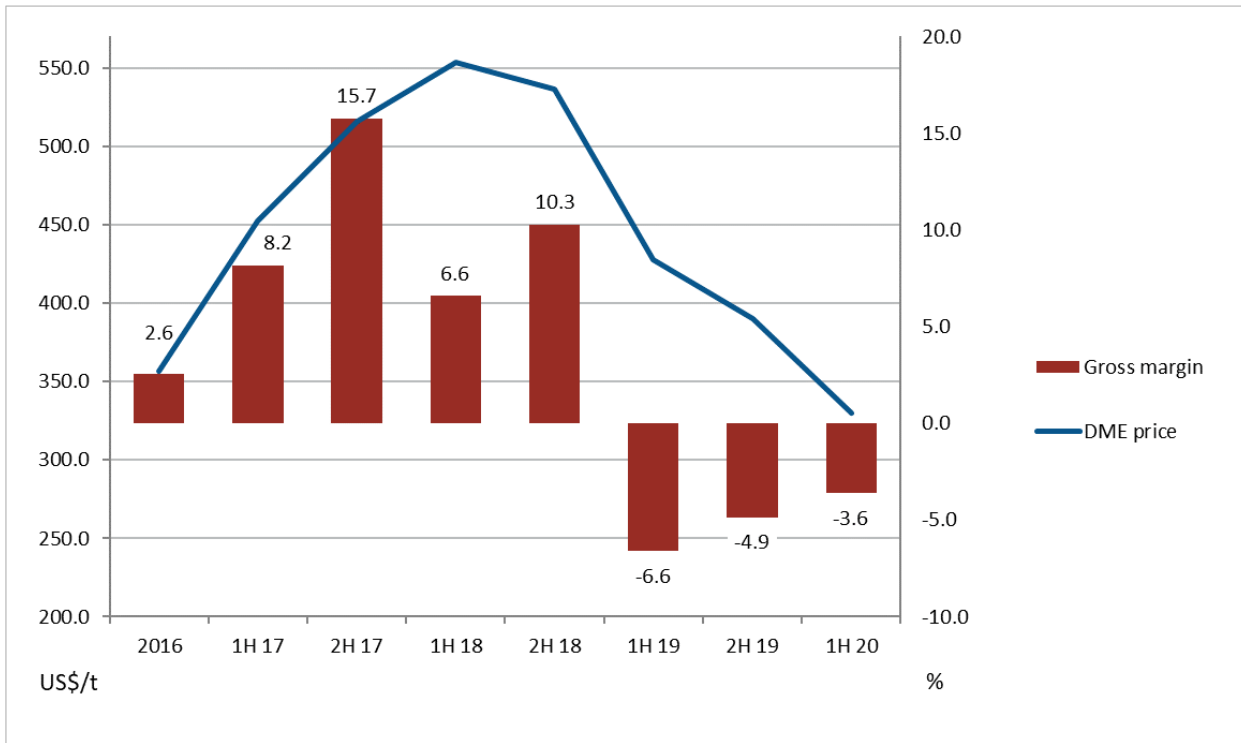
**Table 8: Lanhua Coal and DME Financial Indicators, DME Cost Breakdown
(000 tonnes, US\$/tonne, %)**

| Lanhua Coal and DME | Unit | 2016 | 2017 | 2018 | 2019 | 1H 20 |
|--------------------------------------|------------|-------|-------|-------|-------|-------|
| Coal segment costs and profit | | | | | | |
| Coal price | US\$/tonne | 59.2 | 86.4 | 97.9 | 78.7 | 66.1 |
| Coal production cost | US\$/tonne | 30.9 | 31.5 | 35.7 | 33.1 | 28.0 |
| Coal profit | US\$/tonne | 28.3 | 54.9 | 62.2 | 45.7 | 38.1 |
| DME costs and profit | | | | | | |
| DME sold | 000 tonnes | 248.8 | 283.5 | 272.9 | 252.2 | 363.0 |
| DME price | US\$/tonne | 356.6 | 483.7 | 544.6 | 410.2 | 330.2 |
| DME cost | US\$/tonne | 347.6 | 431.5 | 502.4 | 435.8 | 342.5 |
| DME profit | US\$/tonne | 9.0 | 52.1 | 42.3 | -25.7 | -12.4 |
| DME gross margin | % | 2.5 | 10.8 | 7.8 | -6.3 | -3.7 |
| Breakdown of DME cost | | | | | | |
| Cost of 4 tonnes coal | US\$/tonne | 123.7 | 126.1 | 142.7 | 132.3 | 112.0 |
| Non coal DME cost | US\$/tonne | 224.0 | 305.5 | 359.7 | 303.5 | 230.6 |
| Total DME cost | US\$/tonne | 347.6 | 431.5 | 502.4 | 435.8 | 342.5 |

Source: Company reports, IEEFA estimates.

IEEFA stresses that DME, like any energy commodity, is highly cyclical, reflecting market structure and the degree of diversification of the end user base. It's notable that China has invested in the creation of a downstream DME consuming sector which includes DME vehicles. In Lanhua's case, it should also be noted that Shanxi is a landlocked province and it would be difficult for it to access LPG without pipeline infrastructure. This puts limited competition and price pressure on Lanhua.

**Figure 1: Lanhua DME Prices and Gross Margins 2016-1H 2020
(US\$/tonne, %)**



Source: Company reports, IEEFA estimates.

Despite these market advantages for a DME producer, Lanhua’s DME operations have been loss making since 1H2019. DME prices declined from US\$536/tonne in 2H2018 to US\$428/tonne in 1H19 with a gross margin of minus 6.6%. For 1H20, DME prices in China have further declined to US\$330/tonne with the gross margin negative 3.6%.

Average royalties paid: According to the 8 Indonesian companies which disclosed royalty payments in 2019, average coal royalties were US\$5.0/tonne.

Table 9: Indonesian Coal Companies Sales, Royalties Paid and Royalty per tonne (million tonnes, US\$ million, US\$/tonne)

| Company | Stock Code | Sales (m tonnes) | Royalties paid (US\$m) | Royalty per tonne (US\$/t) |
|----------------------|------------|------------------|------------------------|----------------------------|
| | | 2019 | 2019 | 2019 |
| Bumi Resources | BUMI.JK | 80.6 | 140.4 | 1.7 |
| PTBA | PTBA.JK | 24.6 | 95.3 | 3.9 |
| Toba Bara | TOBA.JK | 4.9 | 13.3 | 2.7 |
| Harum Energy | HRUM.JK | 4.6 | 32.5 | 7.1 |
| Adaro | ADRO.JK | 54.4 | 344.9 | 6.3 |
| ITMG | ITMG.JK | 23.5 | 200.7 | 8.5 |
| Indika | INDY.JK | 34.1 | 232.5 | 6.8 |
| Bayan | BYAN.JK | 28.3 | 88.1 | 3.1 |
| Total sales | m tonnes | 255.0 | | |
| Total royalties paid | US\$ m | | 1,147.7 | |
| Average royalty | US\$/tonne | | | 5.0 |

Source: Company reports, IEEFA estimates.

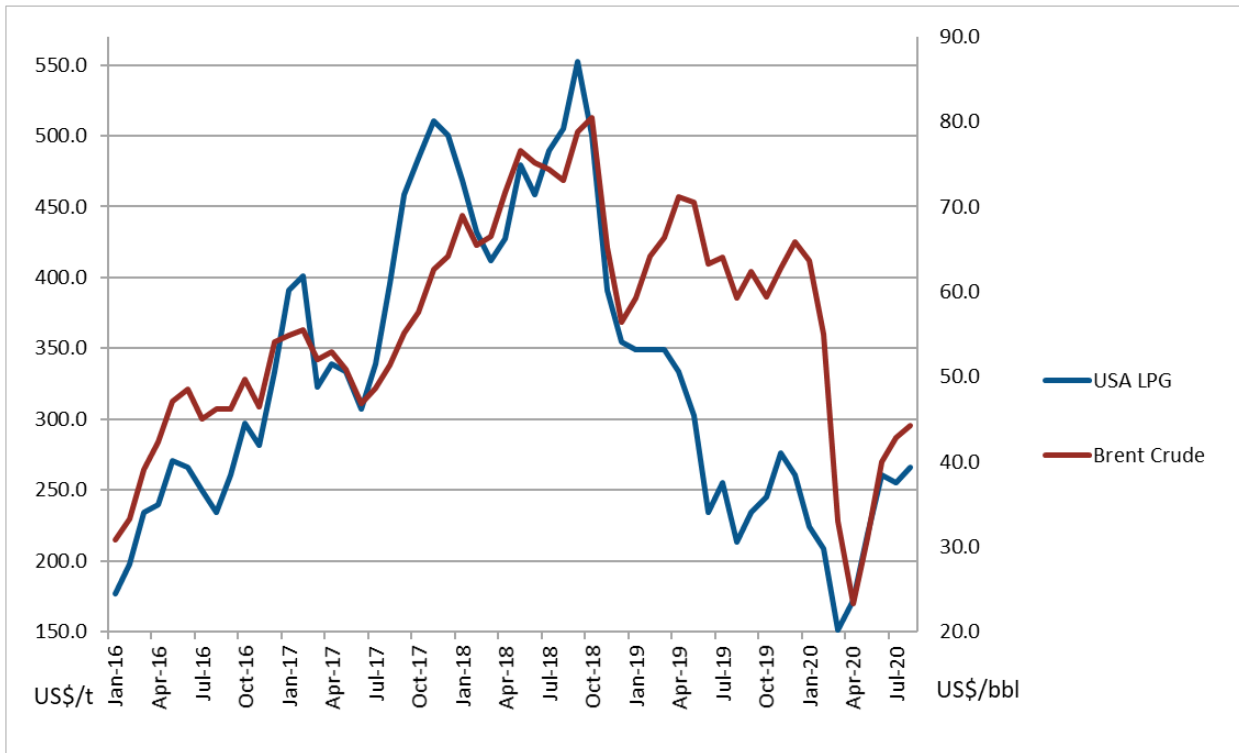
The biggest challenge facing analysts and policy-makers looking at energy substitution is that the prices of energy commodities tend to move together. We compared the following three energy commodity prices and concluded that the positive relationship is high:

- USA Texas propane (LPG) price (US\$/tonne) and Brent Crude Oil (US\$/bbl) monthly price Jan 2016 – Aug 2020,
- Lanhua DME price (US\$/tonne) and USA Texas propane (LPG) six month average price 1H17-1H 20,
- Lanhua DME price (US\$/tonne) and Brent Crude Oil (US\$/bbl) six month average price 1H17-1H 20.

IEEFA's view is that energy prices are dynamic. Policy-makers should realise that committing to a long-term DME plant could result in significant losses over the long-term as production costs are fairly fixed but the market price of DME and related commodities could decline way below production costs.

To examine this scenario, we converted the USA Texas propane price from US\$/gallon to US\$/tonne and noted the positive relationship with the crude oil price. Indonesia buys LPG based on the Saudi export price however this is not publicly available. According to Argus Media, the Saudi price for contract propane for August 2020 was set at US\$365/tonne compared to the August Texas propane price of US\$265/tonne. From January 2016 to August 2020, Brent Crude and Texas Propane prices moved together.

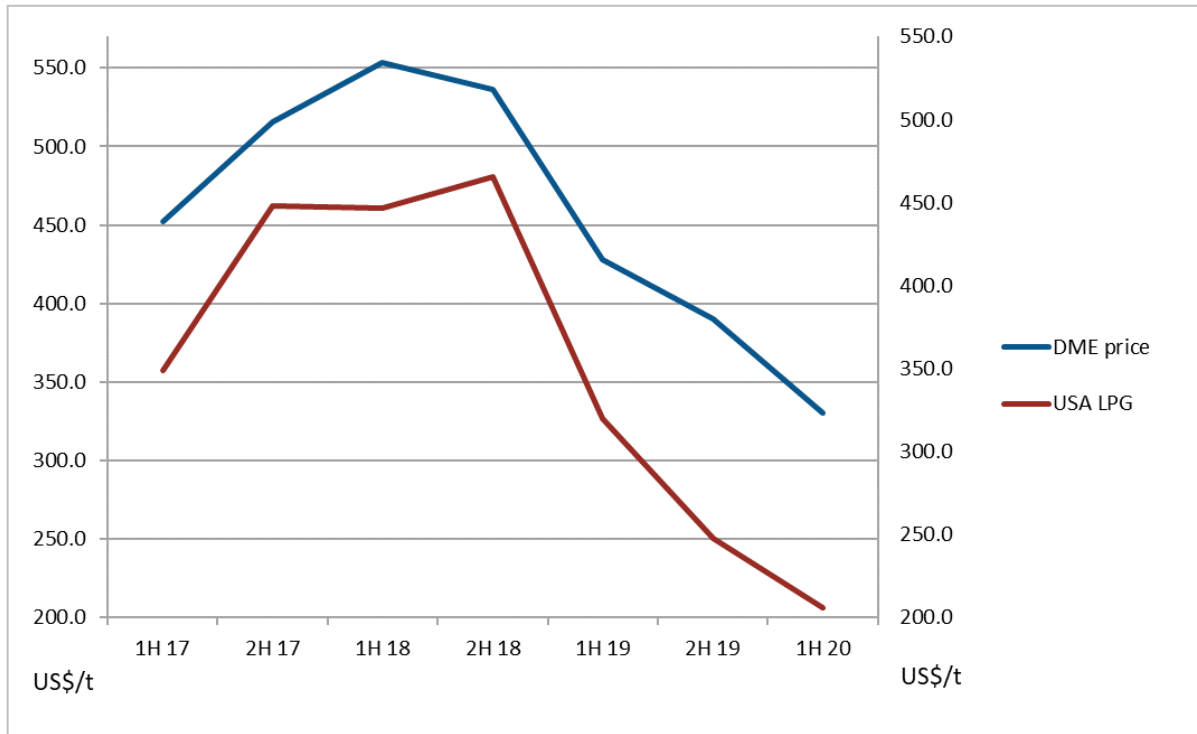
Figure 2: USA Texas LPG Spot Price and Brent Crude Monthly Price Jan 2016-Aug 2020 (US\$ /tonne, US\$ /barrel)



Source: Indexmundi, IEEFA estimates.

We also compared the average six-month DME price for Lanhua to the USA LPG spot price over a six-month basis for 1H17-1H20 and found that the prices tended to move together. For 1H19, the average DME price for Lanhua was US\$428/tonne and the average spot USA LPG price was US\$320/tonne. By 1H20, the DME price was US\$330/tonne and the spot LPG price was US\$206/tonne, a decline of 23% year-on-year and 36% y-o-y respectively.

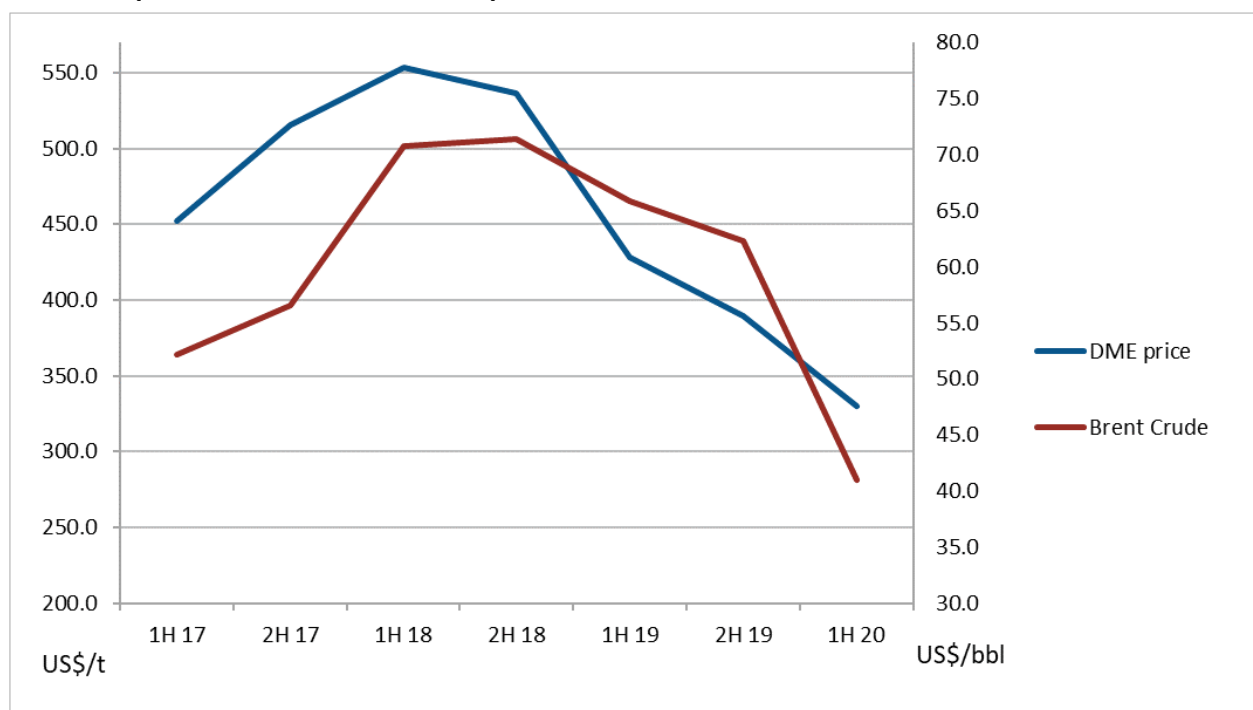
Figure 3: Lanhua DME Price and USA Texas LPG Spot Six Month Price 1H2017-1H 2020 (US\$ /tonne)



Source: Source: Company reports, IEEFA estimates.

Finally, we compared the average six-month DME price for Lanhua to the Brent Crude price on a six-month basis for 1H17-1H20. Like the DME and LPG spot price, the prices tended to move together. For 1H19, the average DME price for Lanhua was US\$428/tonne and the average spot Brent crude oil price was US\$66/bbl. By 1H20, the DME price was US\$330/tonne and the spot LPG price was US\$41/bbl, a decline of 23% y-o-y and 38% y-o-y respectively.

Figure 4: Lanhua DME Price and Brent Crude Oil Six Month Price 1H2017-1H 2020 (US\$ /tonne, US\$ /barrel)



Source: Indexmundi, Company Reports, IEEFA estimates.

Table 10 below summarises all the Lanhua coal, DME, USA LPG and Brent Crude Oil prices. These prices show a strong positive relationship, and that they tend to move in the same direction.

Table 10: Lanhua Coal, DME Price, USA LPG, Brent Crude Price Six Month Basis (US\$/tonne, US\$/barrel)

| Energy Source | Unit | 2016 | 1H17 | 2H17 | 1H18 | 2H18 | 1H19 | 2H19 | 1H 20 |
|-------------------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Coal price Lanhua | US\$/tonne | 59.2 | 83.3 | 89.9 | 99.7 | 95.9 | 72.9 | 78.7 | 66.1 |
| DME price Lanhua | US\$/tonne | 356.6 | 452.1 | 515.6 | 553.8 | 536.6 | 428.0 | 389.9 | 330.2 |
| LPG price USA | US\$/tonne | 253.6 | 349.1 | 448.1 | 446.3 | 465.4 | 319.5 | 247.5 | 205.8 |
| Brent crude | US\$/bbl | 44.0 | 52.2 | 56.6 | 70.7 | 71.4 | 65.8 | 62.3 | 41.0 |

Source: Indexmundi, Company Reports, IEEFA estimates.

DME: A US\$2bn Project That Could Lose US\$377m Annually

Taking the many variables into account, our forecasts suggest the proposed PTBA project could lose US\$377m per year.

But, what about any potential “gains” from domestic value addition that might be realized from import substitution? Based on our example, the savings from buying

less imported LPG is only US\$358m. This creates a situation whereby the GoI would be investing US\$2bn in PTBA's DME project while facing a loss of US\$19m per annum, even when the notional benefit of import substitution is considered.

Table 11: Calculation of DME Project Annual Cost and Savings (000 tonnes, US\$/tonne, US\$ millions)

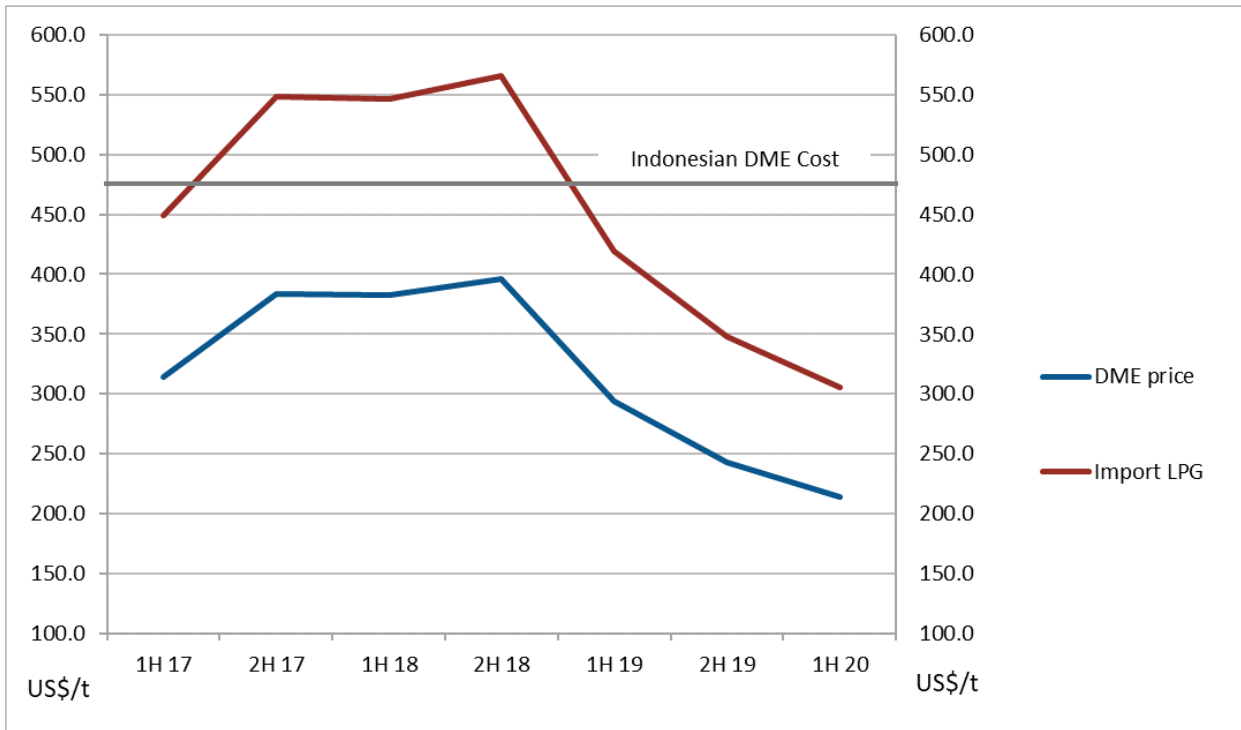
| Savings | Unit | Current |
|---|------------|---------|
| LPG/DME prices | | |
| LPG price Saudi contract propane | US\$/tonne | 365.0 |
| Substitute DME price (30% discount) | US\$/tonne | 255.5 |
| Substitution savings | | |
| DME plant size per year | 000 tonnes | 1,400.0 |
| LPG substituted (70%) | 000 tonnes | 980.0 |
| Cost savings | US\$ m | 357.7 |
| DME production cost | | |
| DME non coal production cost | US\$/tonne | 300.0 |
| Cost of 4.6 tonnes coal at US\$37/t | US\$/tonne | 170.2 |
| Total DME cost at US\$37/t coal | US\$/tonne | 470.2 |
| Offsetting DME losses with LPG savings | | |
| DME losses per tonne at US\$37/t coal | US\$/tonne | -214.7 |
| DME produced | 000 tonnes | 1,400.0 |
| Total DME losses pre finance | US\$ m | -300.6 |
| Finance cost US\$2bn @3.8% | US\$ m | -76.0 |
| Total DME losses post finance | US\$ m | -376.6 |
| Net savings DME sub at US\$30/t | US\$ m | -18.9 |

Source: Argus Media, IEEFA estimates.

Based on IEEFA's analysis, we believe that policymakers face a dilemma in making the case for PTBA's proposed DME plant. Simply stated, DME is not a perfect substitute for LPG because of its higher cost and lower energy content. In addition, with high fixed capital costs of US\$2bn and volatile market pricing, it's difficult to count on stable market conditions, and much less the optimistic estimates of DME pricing.

To demonstrate market challenges related to the DME-LPG substitution, we compared recent LPG price movements to the PTBA project DME production cost of US\$470/tonne. We calculated the matching DME price at a 30% discount to the LPG price to account for the lower energy content.

Figure 5: Indonesian DME Production Cost Vs Adjusted LPG Import Price and Matching DME Price 1H17-1H 2020 (US\$/tonne)



Source: Indexmundi, IEEFA estimates.

*Please see Appendix 1 for calculation details.

The bottom line for policymakers is that the economic case for PTBA's DME project is sitting on weak foundations. It is not that the engineers are wrong; it is technically possible to convert coal into DME.

What is harder to demonstrate is that the project simply does not make economic sense. The GoI will lose money if they support this proposal. This is evidenced by the lack of projects where DME is replacing LPG or other household cooking fuels in countries with abundant low-cost coal. If it worked, and more importantly, was cost effective, the case for DME value addition would have been embraced by other nations long before now.

Appendix: Adjusted LPG Prices and DME Match Price

For Figures 1 and 6, we calculated an adjusted LPG price and a DME match price. The methodology is outlined below.

- **Adjusted LPG price:** Indonesia imports LPG from Saudi Arabia based on the monthly LPG marker. This price is not publicly available except in media announcements. The August announced LPG price was US\$365/tonne.⁹ The monthly Texas spot propane (LPG) price is publicly available as a time series.¹⁰ As at August 2020, the Saudi Arabia price was US\$100/tonne higher. We adjusted the historical Texas LPG price by adding US\$100/tonne to get a time series for the Indonesia import price.
- **DME match price:** DME contains 64% of the energy of LPG. DME is not a widely traded commodity. Other than the half yearly price received by Lanhua, the DME price is not publicly available. Also, due to the inland location and limited energy alternatives, the Lanhua DME price may not be as relevant to Indonesia. In order to estimate a likely time series for Indonesia, we applied a 30% discount to the adjusted LPG price.

⁹ <https://www.argusmedia.com/en/news/2126982-saudi-aramco-raises-august-propane-butane-cp>

¹⁰ <https://www.indexmundi.com/commodities/?commodity=propane&months=12>

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The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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