



Gas Pricing in Southeast Asia

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THE LANTAU GROUP
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Overview

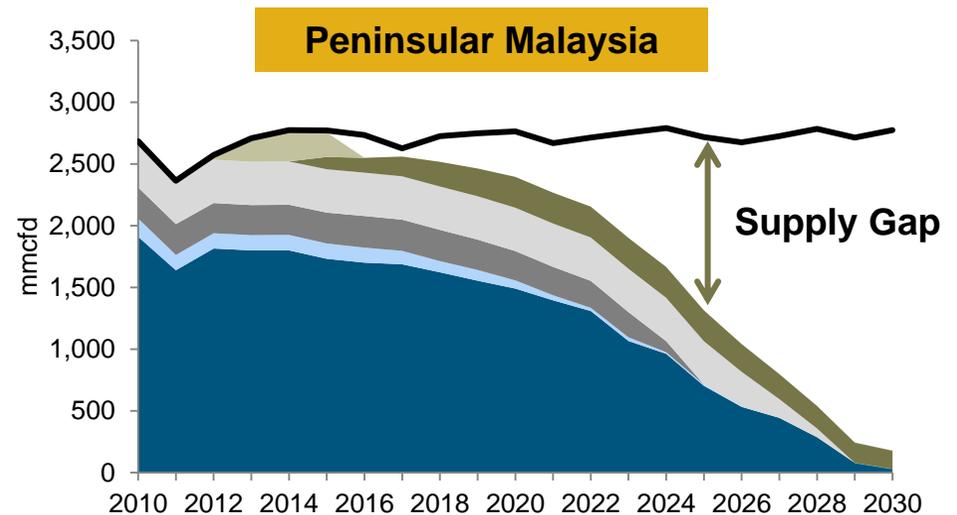
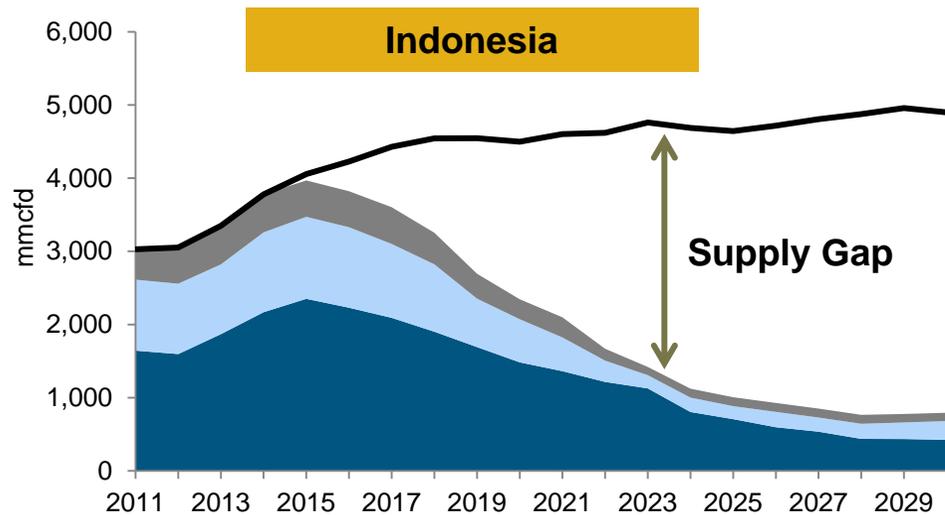
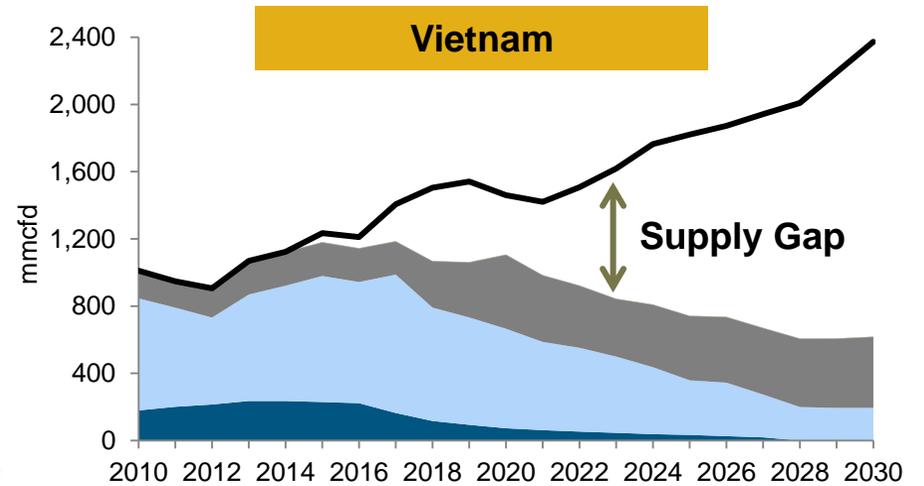
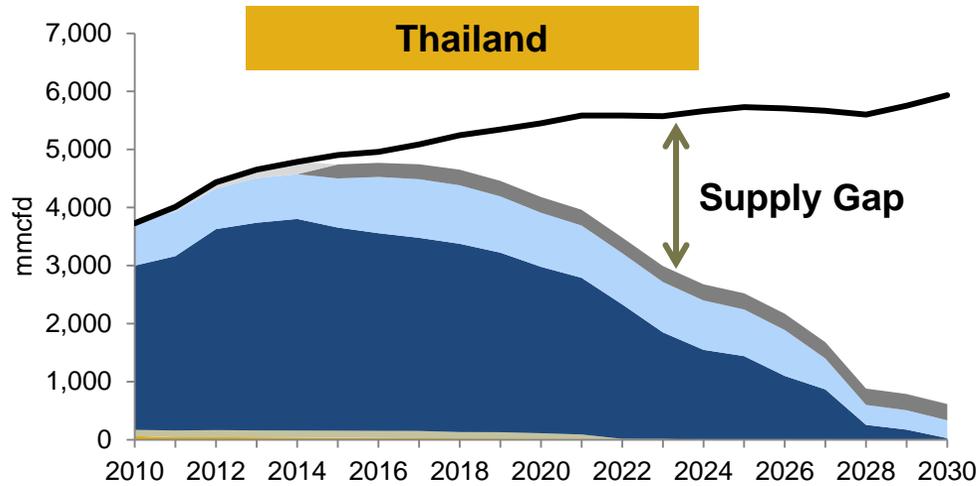
1 The supply/demand gap and gas pricing

2 Country-specific analysis

- Thailand
- Indonesia
- Malaysia
- Vietnam

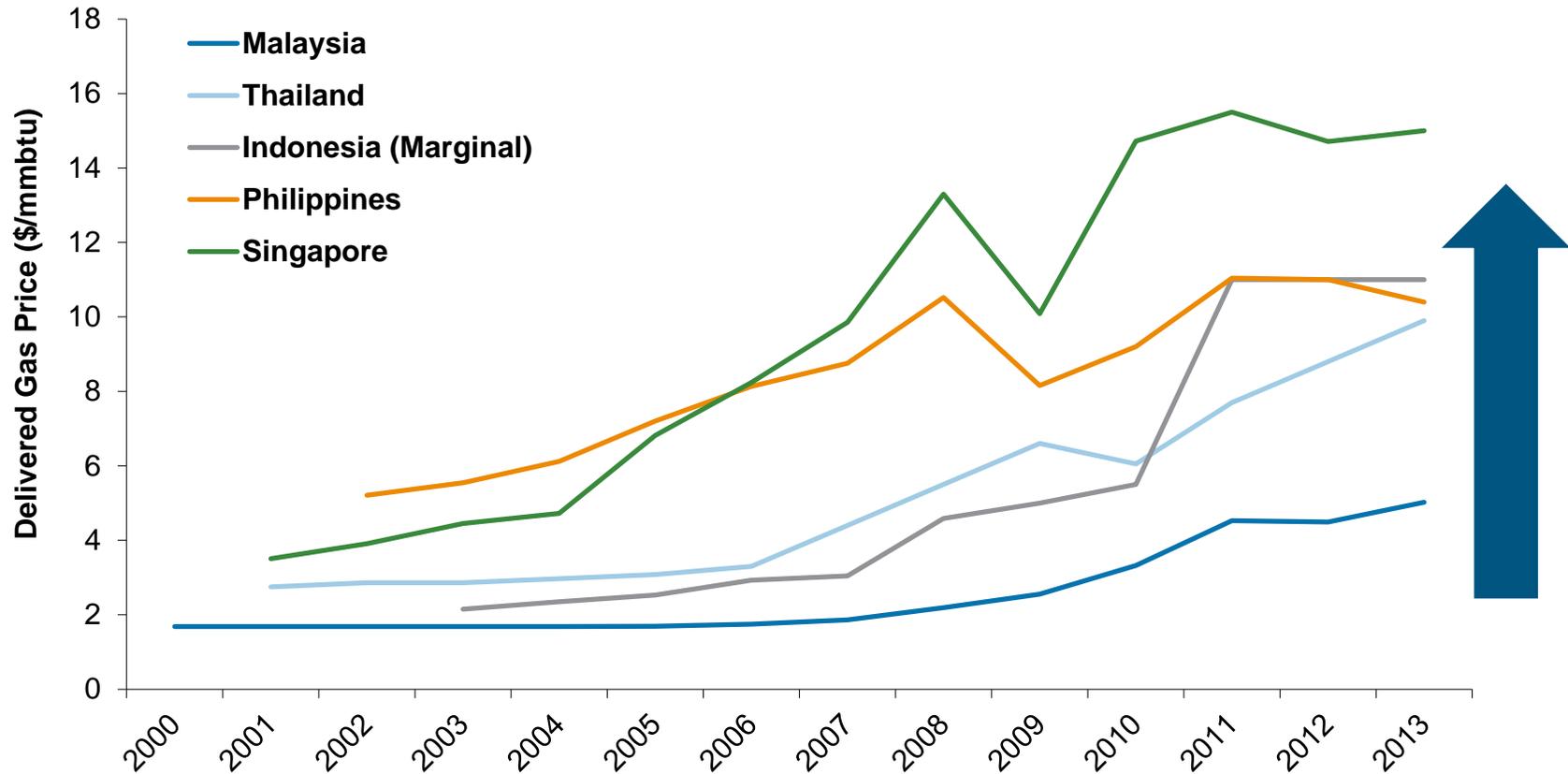
3 Gas pricing and the supply/demand gap

Key Asian producing countries face a natural gas supply/demand gap



Source: Various government statistics and TLG analysis

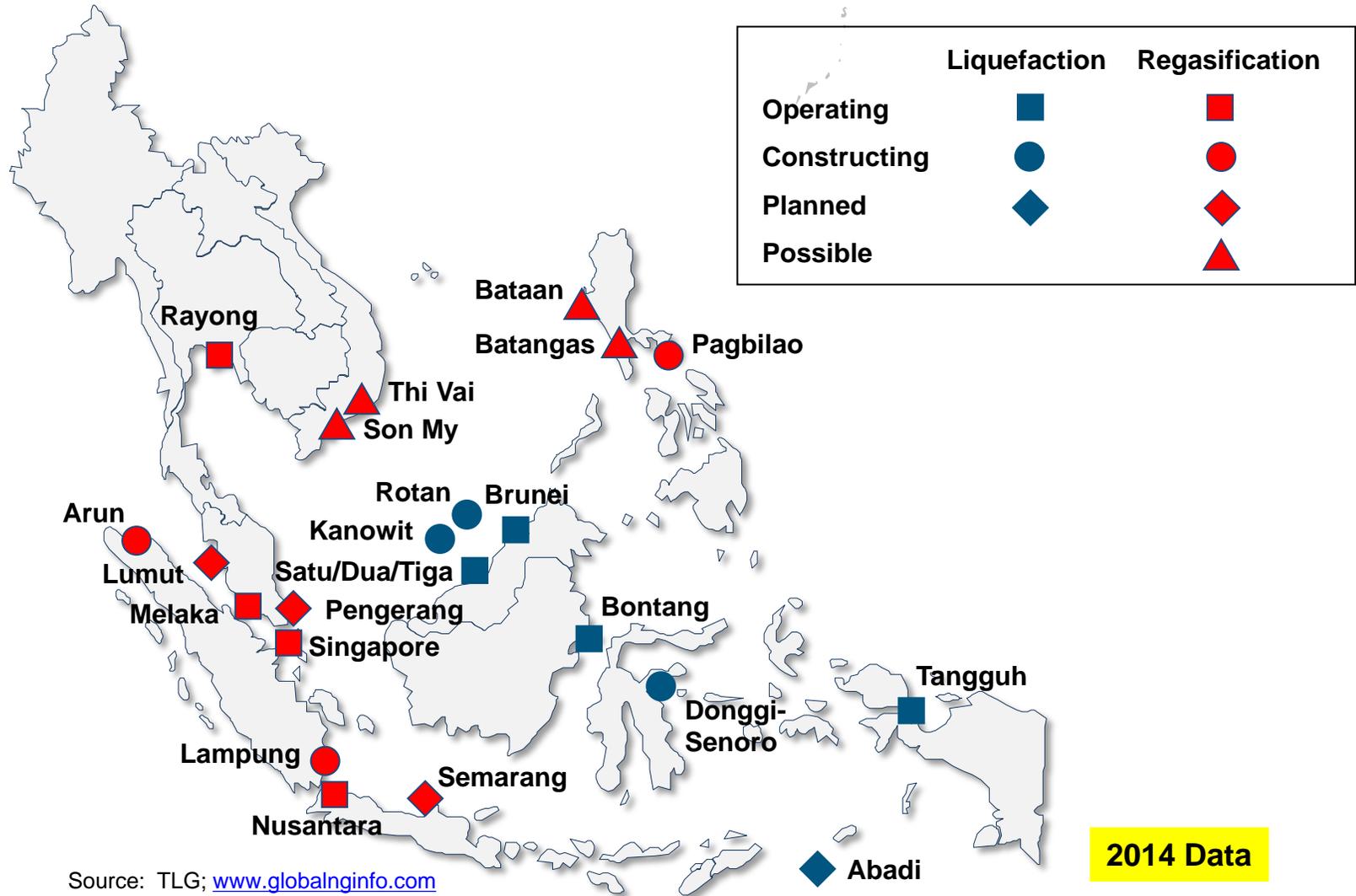
This gap puts upward pressure on the pricing of new domestic resources...



Source: TLG compilation from various online sources and associated analysis, mostly ex platform prices before transmission

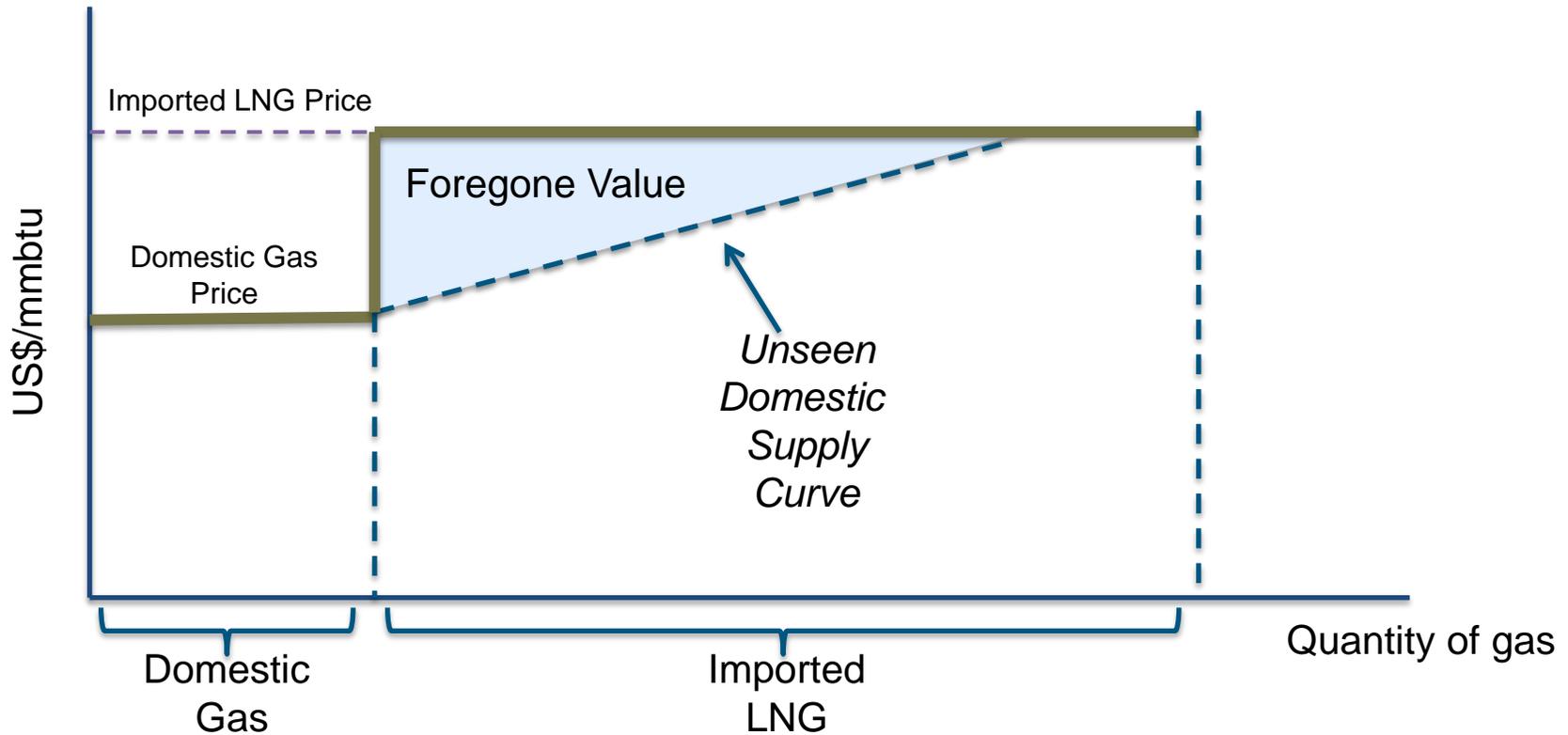
Note: Indonesia marginal price jumps in 2011 due to domestic LNG at Nusantara Regas

And leads to many decisions to import (and export) LNG



Source: TLG; www.globalnginfo.com

Imported LNG usually comes in at the “market price” – but local (domestic) gas is priced differently – leading to a “kinked” gas supply curve



Domestic gas price regulation creates an artificial shortage of domestic gas – and also creates the illusion that domestic gas is cheaper...

Overview

1 The supply/demand gap and gas pricing

2 Country-specific analysis

➤ **Thailand**

➤ Indonesia

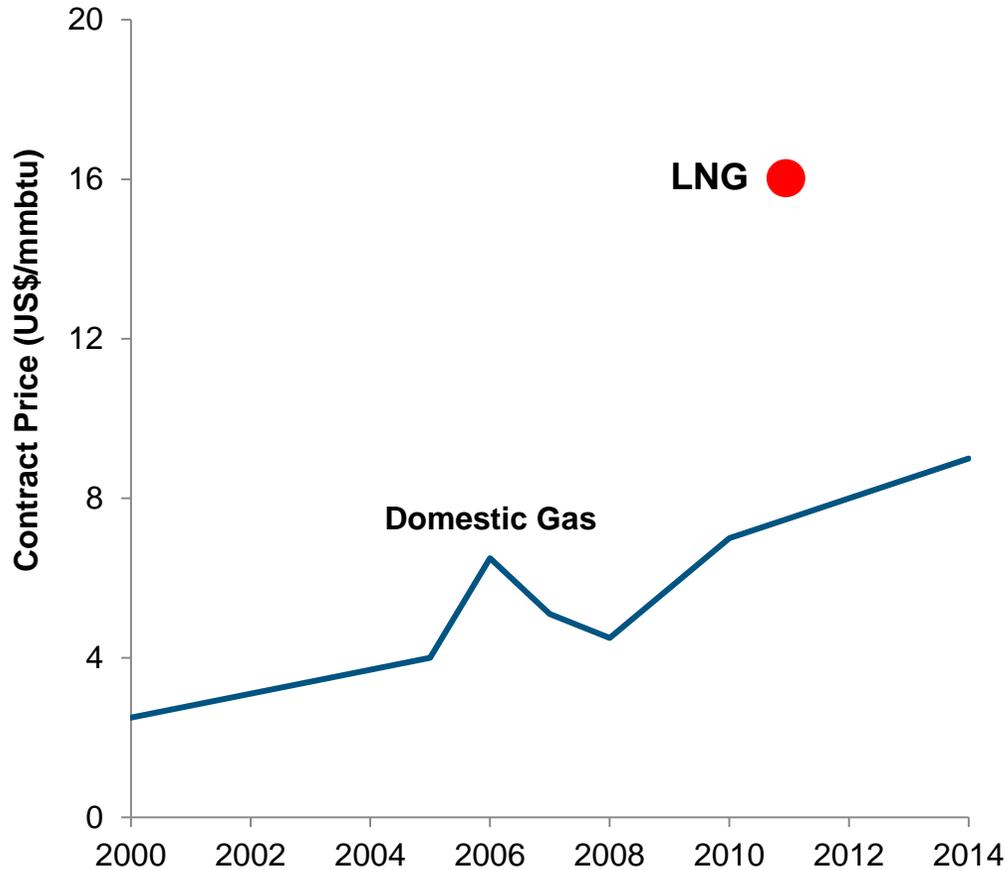
➤ Malaysia

➤ Vietnam

3 Gas pricing and the supply/demand gap

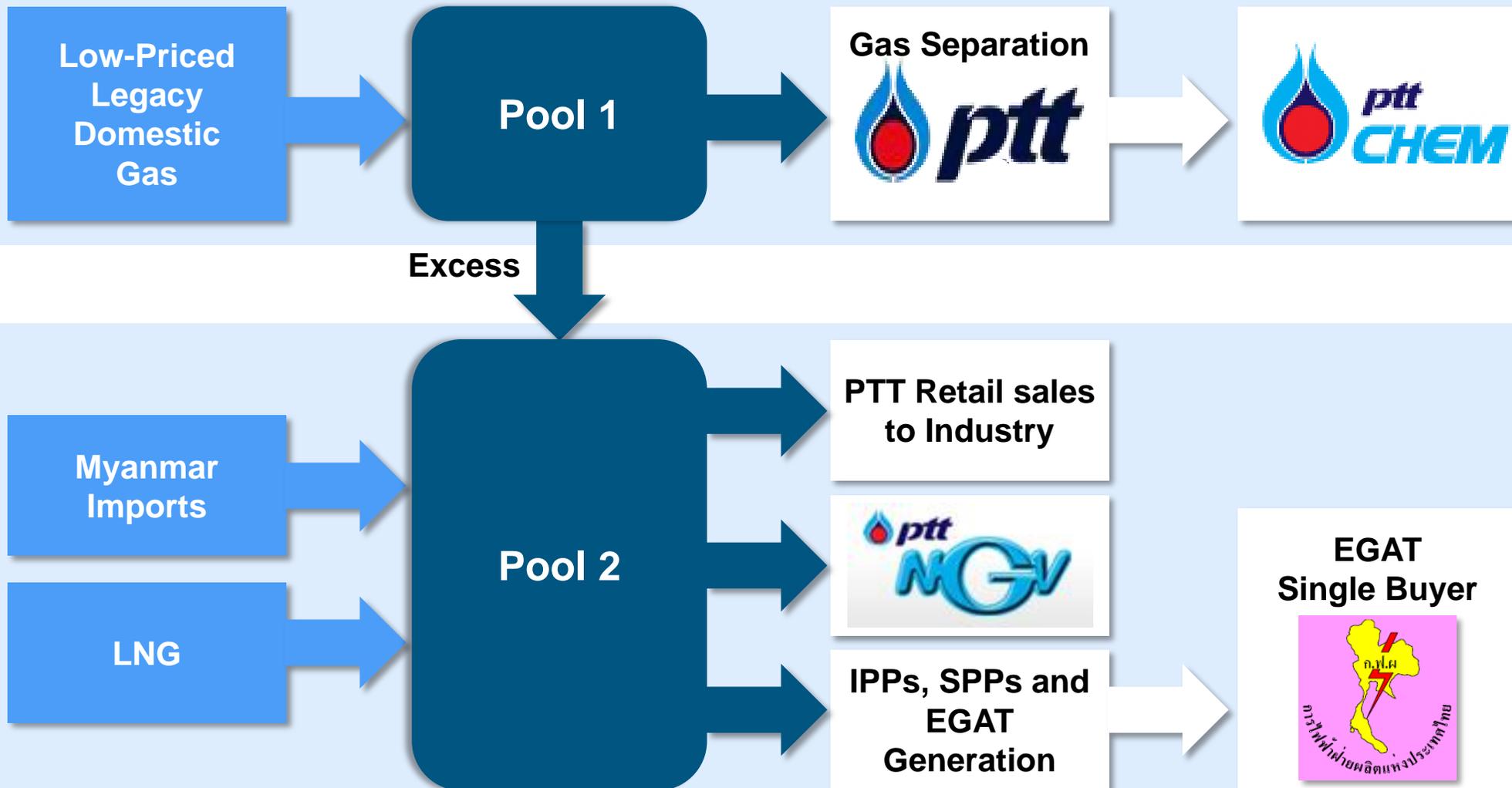
LNG into Map Ta Phut terminal starting in 2011 was priced at double PTT's historic ex-wellhead gas prices

Ex-Platform Gas Pricing

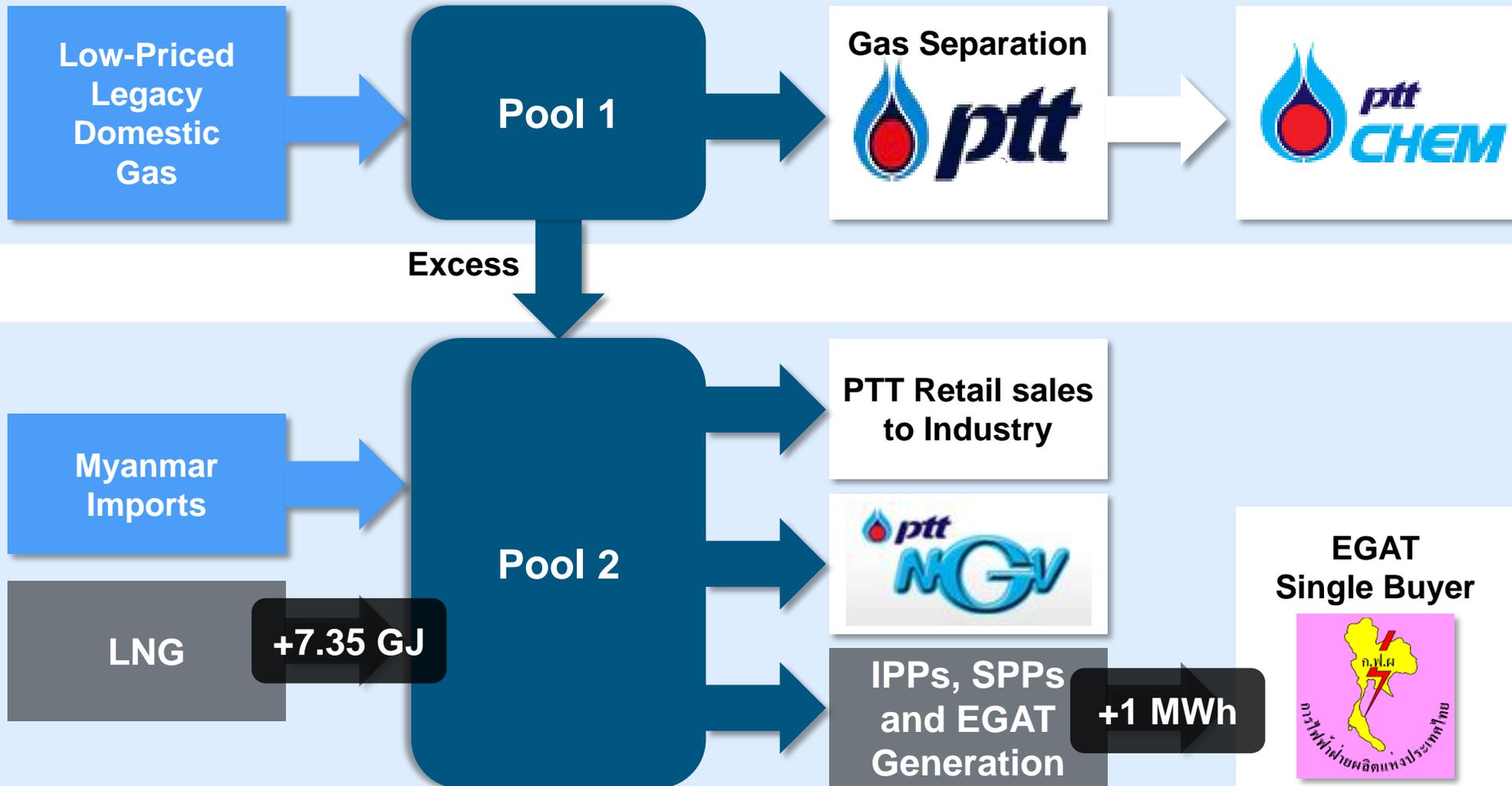


- At the turn of the decade, a time of low oil prices, Unocal delivered new supplies to the PTT.
- The next significant source of new supplies was from the MT Joint Development Area in 2005.
- The onshore field Sinphuhorm started supplying just as crude prices started to rise in 2006.
- Additional supplies from the Unocal blocks in 2007 coincided with PTT's third offshore pipeline.
- Supplies from the Arthit field operated by PTTTP, which reached market in 2008, came in at an attractive price.
- PTT has brought in spot cargoes since 2011, but started a long-term LNG supply contract with Qatar in 2015 at a landed price close to US\$16//mmbtu, assuming Brent at 100 US\$/bbl.
- The Unocal and the Bongkot concession extensions were coupled with new investment to lift output, resulting in higher prices between 2010 to 2012.
- We believe the first gas from block M9 in Myanmar sets the 2014 price for new piped gas.

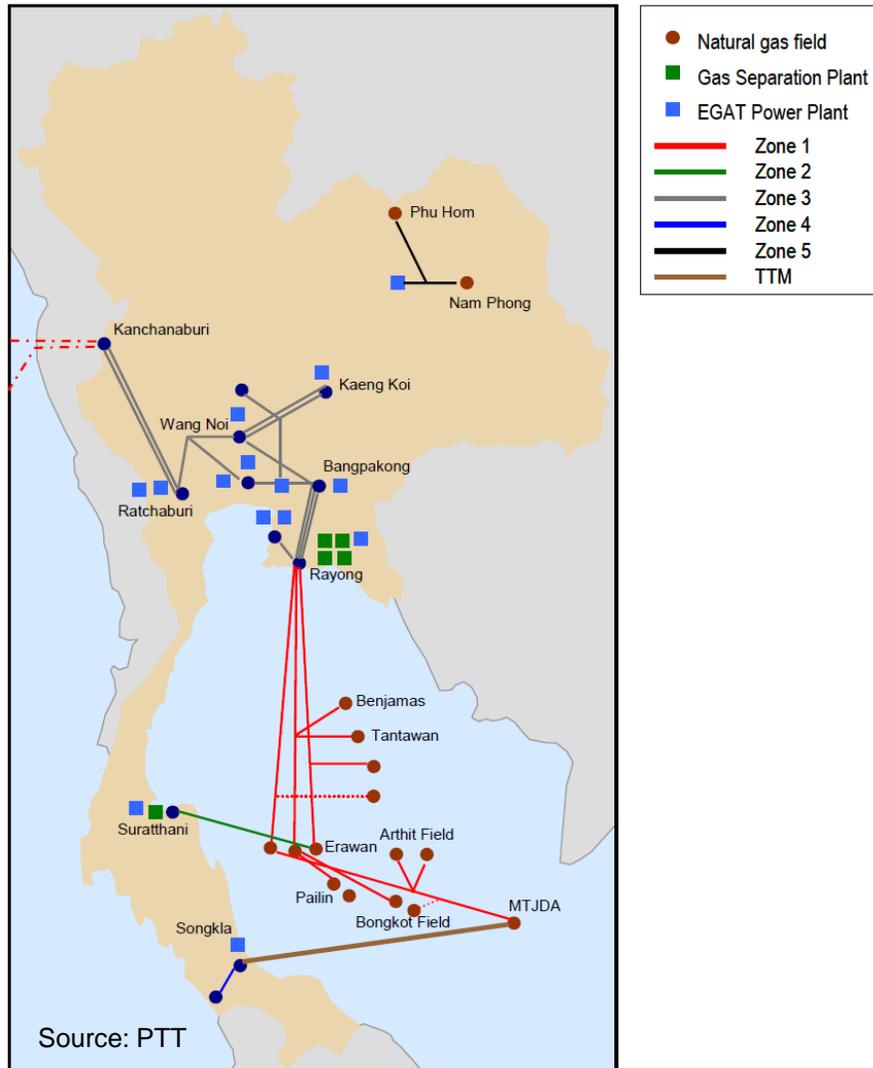
PTT “pools” gas to mitigate the impact of LNG prices



But pooling cannot change the marginal economics



Planned third-party access to gas transmission might lift marginal gas prices



- The new military government intends to introduce third-party access to the gas transmission system and transfer ownership of the gas transmission system to a company partly owned by the PTT.
- PTT has been asked to draft the code within the next six months.
- If fully implemented, third-party access would allow gas suppliers to contract directly with gas users such as power and industry – and create market price signals for new gas-fired power plants.
- These higher marginal prices might stimulate the domestic gas supply industry to bring more gas to market, thereby backing out imported LNG.

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➤ Malaysia

➤ Vietnam

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New FSRUs introduced oil-linked gas pricing to the domestic market

Nusantara Regas FSRU Java Bay



Source: Nusantara Regas

PGN FSRU Lampung



Source: Hoegh LNG

Gas Linkage to Oil

Nusantara Regas

- Nusantara Regas (Pertamina and PGN) lease FSRU and are the counterparty for LNG from Bontang plant.
- 11.75 mmtpa supplied by TOTAL over period of 11 years. Declining from 1.4 mmtpa in 2012 to 0.75 mmtpa in 2022.
- Price formula is 11 percent slope of Indonesian Crude Oil price.
- So at USD 100 per barrel, this is US\$11/mmBtu at the Floating Storage Regas Unit plus transport.

PGN FSRU Lampung

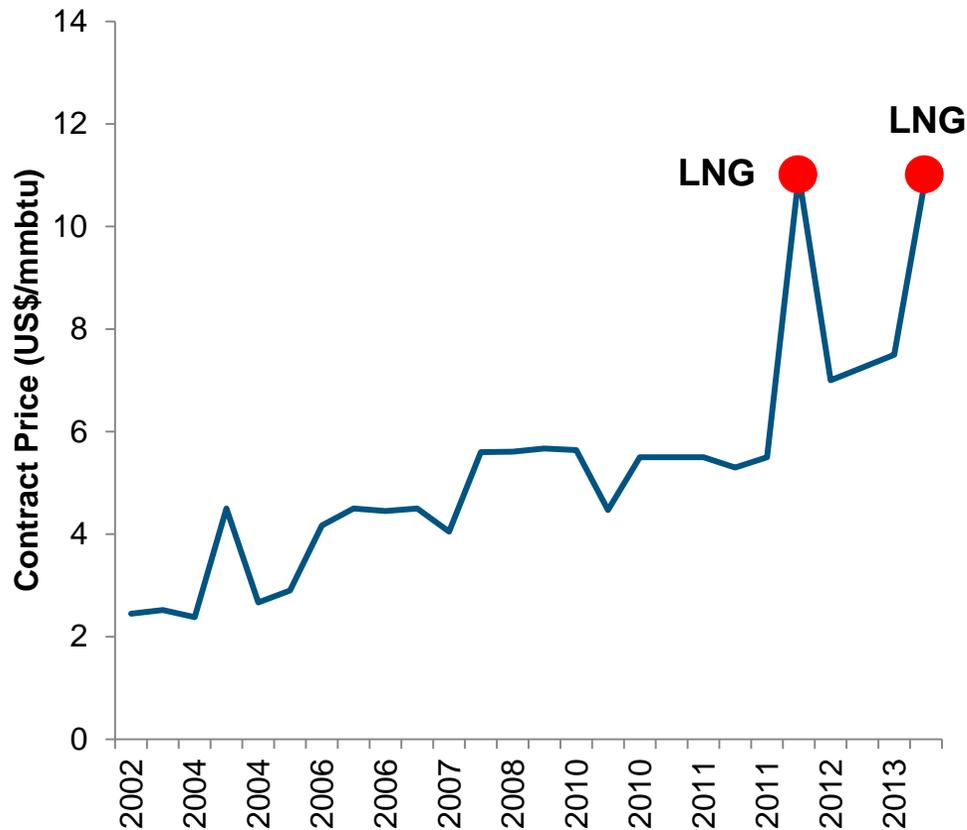
- Leased from Hoegh for 20 years by PGN
- Initial volumes from Tangguh of between 3 to 5 cargoes in 2014 then ramping up using Sempra's diversion volumes.
- By 2019 should be able to access some domestic market obligation volumes from 3.8 mmtpa Train 3 at Tangguh

Domestic LNG

- Close to double the price of any existing gas supply contract for piped gas to power.

Domestic prices are increasing to close the gap with LNG prices – will these recent price increases stimulate further supply?

Java last delivered gas contract prices to power

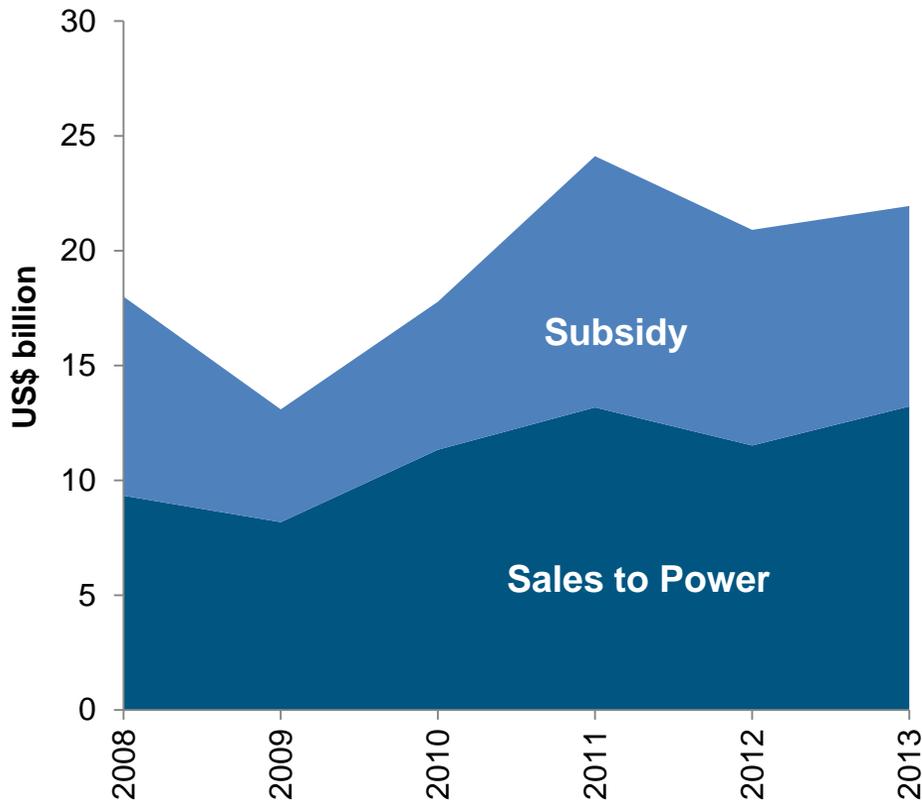


Source: Indonesia Ministry of Energy and Mineral Resources, and TLG estimates

- in May 2012, Energy and Mineral Resources Minister Jero Wacik substantially raised upstream gas prices. Downstream prices broadly followed suit.
- Minister Wacik said that the new higher prices were expected to become a reference – to help the oil and gas upstream firms “review the economics of their oil and gas prospects and their already found reserves”.
- The LNG price in 2011 refers to the delivery at ship (DAT) price of LNG from Bontang.
- The LNG price in 2014 refers to the first cargo from Tangguh to the PGN Lampung terminal in South Sumatra that will partly supply gas to power in Java via the South-Sumatra-West-Java pipeline system.

Maintaining gas use in the power sector requires massive subsidies

PLN Revenues from Sales and Subsidy



Source: PLN

- Only by virtue of the huge fuel subsidy to PLN under the Public Service Obligation can PLN stay in the black.
- A direct formal subsidy mechanism like this would be one option for Ministry of Electric Power – enabling it to pay for higher priced gas.
- PLN would need average retail price of IDR 1,375/kWh or US 12cents/kWh, whereas price is now IDR 820 kWh.
- Large increases in tariffs for commerce and industry were green lighted by Parliament in early 2014, but elimination of subsidies to residential uses still needs to be addressed.
- Another alternative would be to set power at the cost of service and offer handouts direct to disadvantaged sectors.

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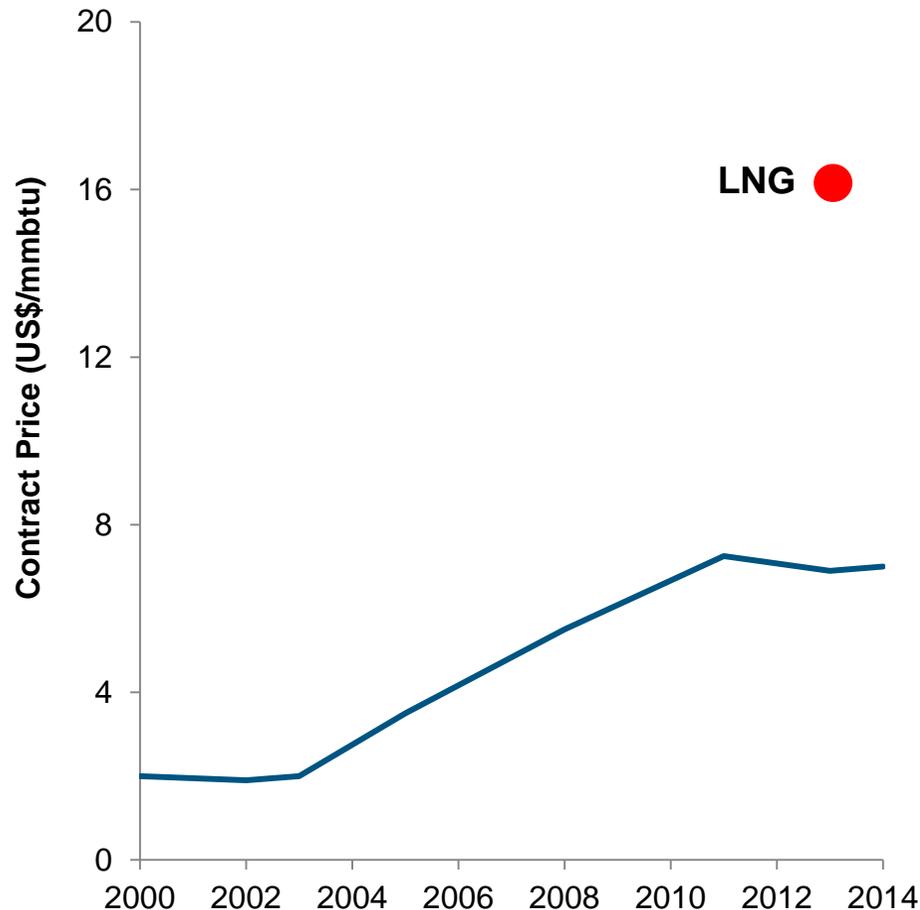
➤ **Malaysia**

➤ Vietnam

3 Gas pricing and the supply/demand gap

Historic ex-platform gas prices (at start of production) are rising, but still significantly lag the LNG price

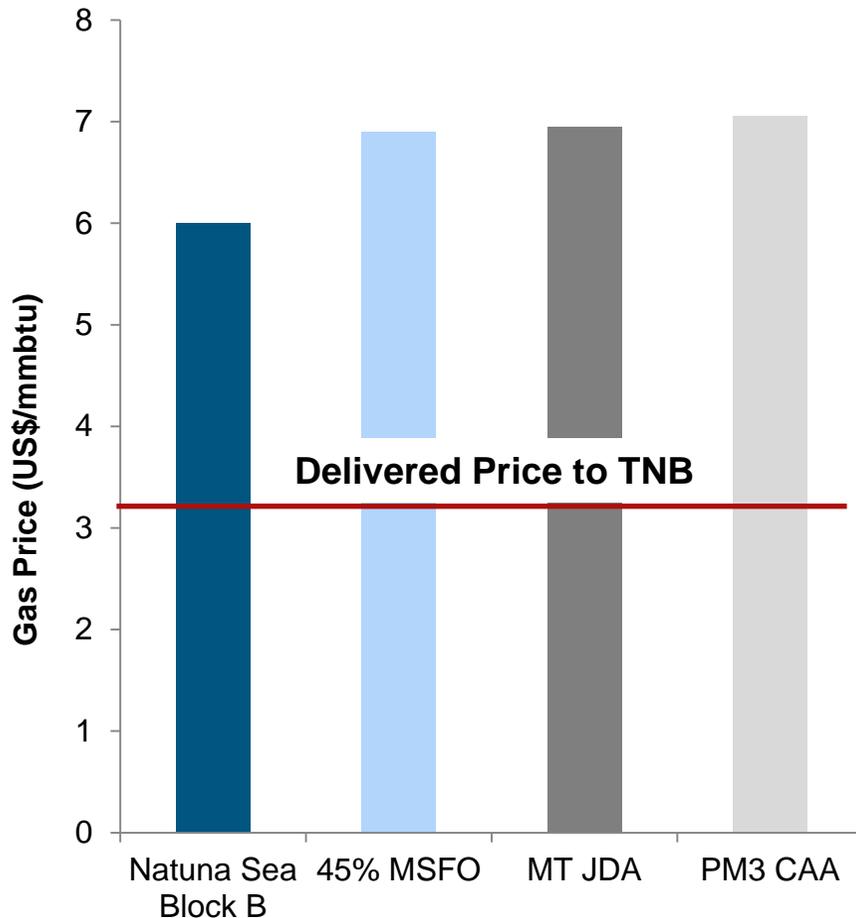
Ex-Platform Contract Prices



- The linkage for most PSCs offshore Peninsular Malaysia to the fuel oil price explains the rise in starting prices for new supplies – this tracked the rise in crude oil and hence fuel oil.
- Price rises have arisen from new gas supplies signed up from the Gas PSCs in 2007/8, PM313 PSC, Beranti RSC, and the North Malay Basin development.
- There are two short term signed LNG agreements for supplies from Woodside and GDFSUEZ, which we understand are priced at close to US\$/16 mmbtu, assuming Brent at US\$ 100/bbl.

Even so, Petronas heavily subsidizes gas sales to the power sector

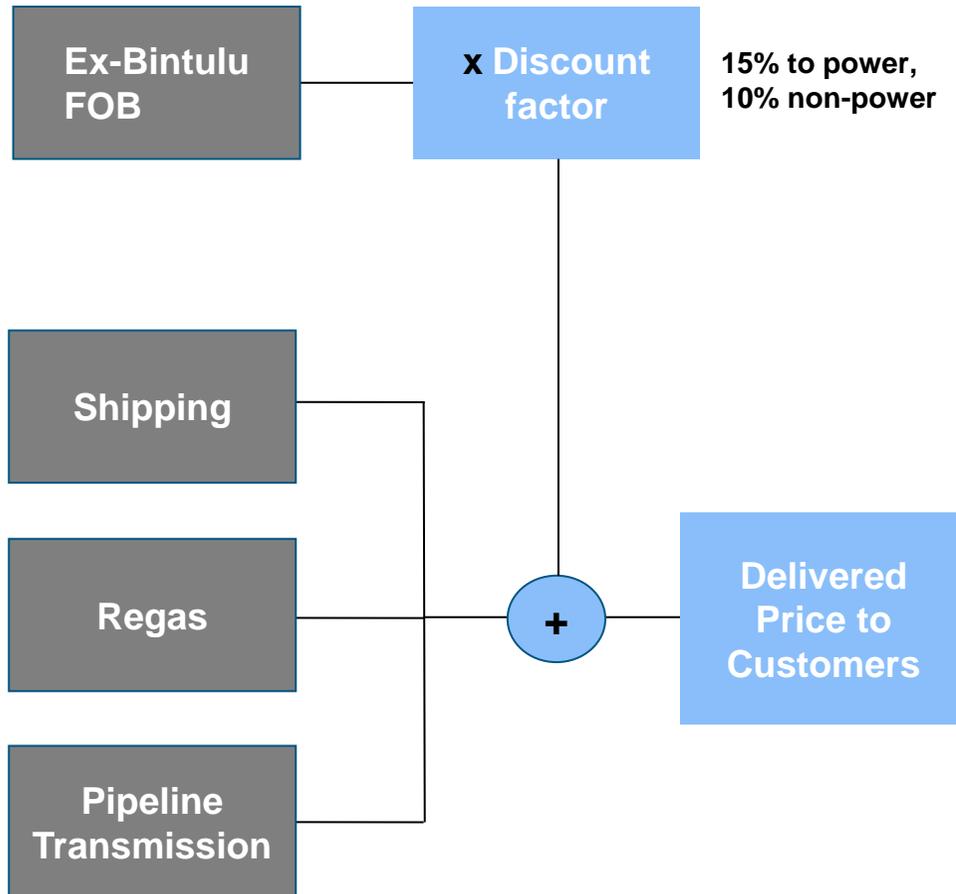
Ex-Platform Gas Pricing



- The four main sources of piped gas into Peninsular Malaysia are:
 - Indonesian gas from Natuna Sea Block B
 - Offshore Peninsular Malaysia with a 45 percent linkage to Singapore free on board medium sulphur fuel oil
 - MT Joint Development Area shared with Thailand
 - Commercial Agreement Area shared with Vietnam
- Note that these ex-platform prices do not include transport charges
- The delivered price (for volumes of 1,000 mmcf/d) to the power sector equals US\$ 3.17/mmbtu at current forex rates.

Malaysian gas pricing reform ties consumer prices to LNG prices – and thereby creates incentives for Petronas to sign new upstream contracts

New Gas Price Mechanism



Application

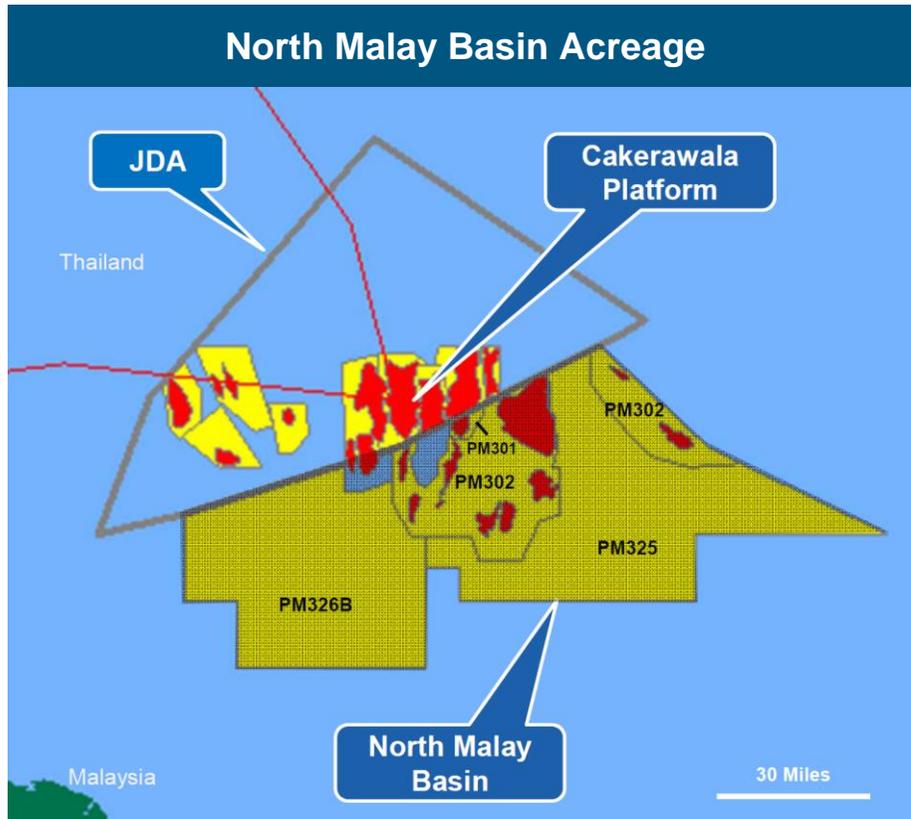
Power Sector

- Supply of up to 1,000 mmcf/d at regulated prices. Threshold will be reviewed every three years by PETRONAS starting in 2016.
- Supply above this threshold will be at the new gas pricing mechanism – this sends the correct economic signal to new build (and renegotiated second life IPPs).

Non-Power Sector

- Current contracted volumes at regulated price.
- All new contracts will be at the new gas price mechanism.

If the North Malay Basin development is indicative, it appears that pricing reform may be successful at inducing development of new gas supply



Source: Hess

- The North Malay basin is a project led by PETRONAS and Hess to commercialize gas from PM301, PM302, PM325 and PM326b.
- These blocks contain gas that is deep, high pressure, and high in CO₂ – and therefore expensive to produce.
- Approximately US\$ 5.2bn will be spent to monetize 1.7 Tcf of gas. Production will ramp up from 100 mmcf/d to 250-300 mmcf/d by 2020.
- We believe that PETRONAS would not have embarked on extracting this expensive gas except for the ongoing gas pricing reform in Malaysia.
- This pricing reform has the general aim of pricing all new supplies of gas (piped or LNG) at prices linked to the ex-plant LNG price at PETRONAS's Bintulu liquefaction plant in Sarawak.

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➤ **Vietnam**

3 Gas pricing and the supply/demand gap

Vietnam is blessed with abundant reserves and resources – but harvesting this potential requires a willingness to pay the cost of development

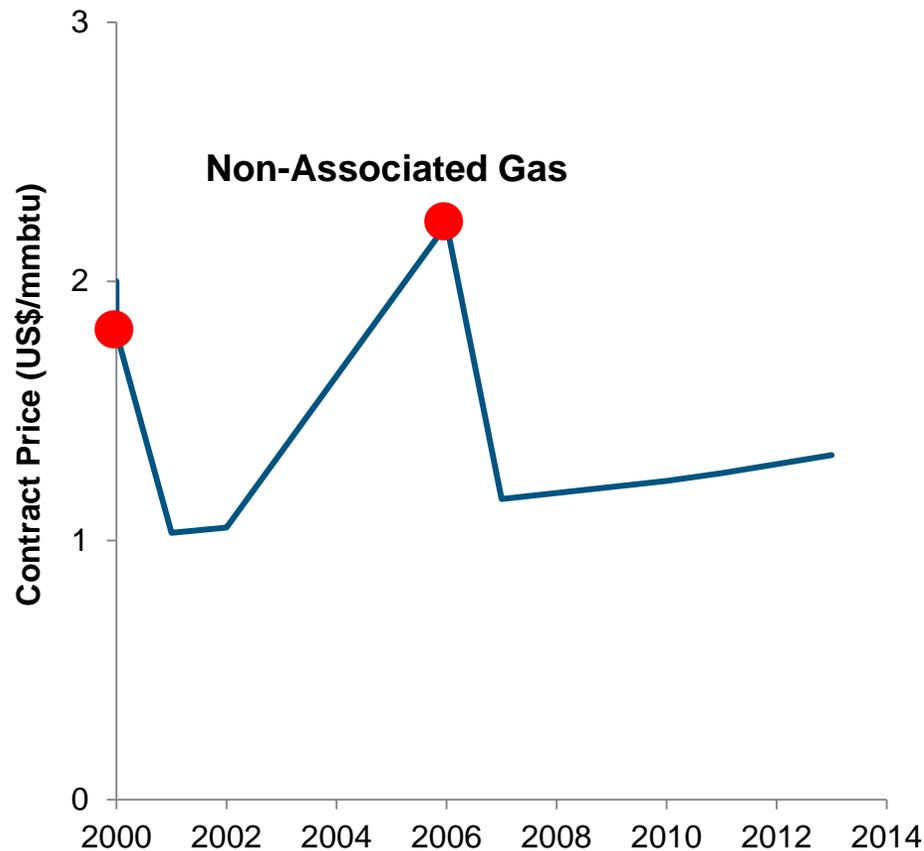


	TCF
Total proved reserves	12.6
Cuu Long Basin	3.5
Nam Con Son Basin	6.6
Malay-Tho Chu Basin	4.8
Song Hong Basin	9.6
Total potential resources	24.4
Total reserves and unrisks resources	37.0

Source: PVN, PVGAS

Vietnam gas pricing has been distorted by the oil economics

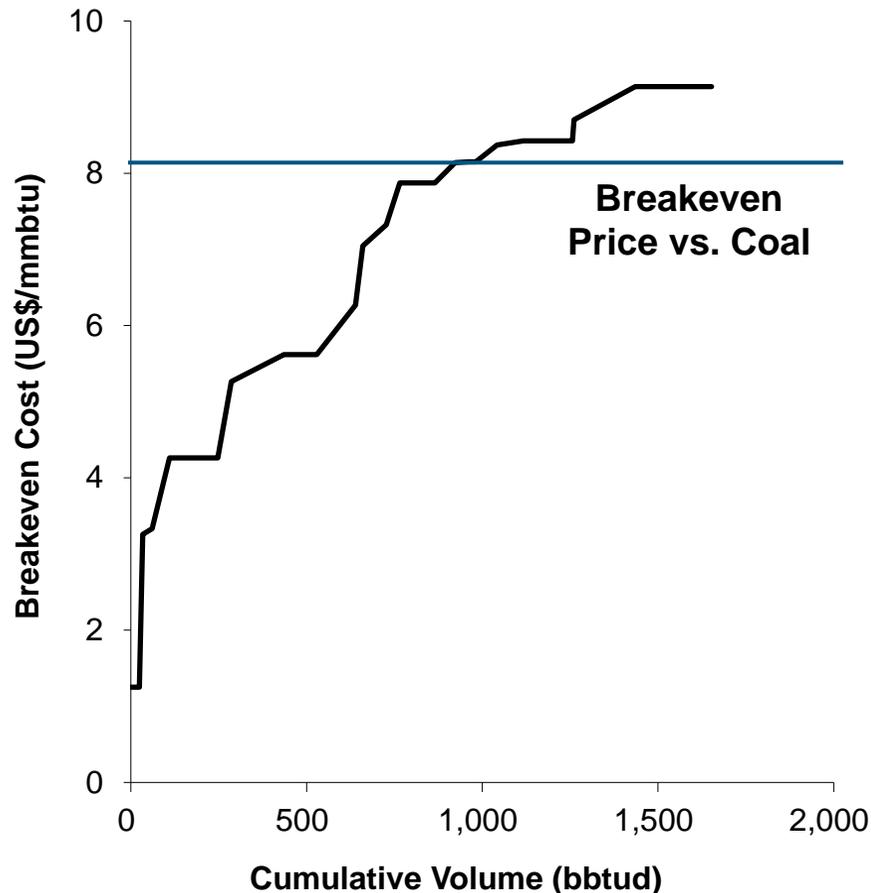
Ex-Platform Gas Pricing



- The only two **non-associated** gas sales agreements signed in Vietnam are for 6-1 (Lan Tay and Lan Do) and from 11-2 (Rong Doi) in 2006.
- Development of **associated** gas from other blocks has ranged in price around the US\$ 1.00-1.25/mmbtu.
- Other blocks with non-associated gas such as 5-2 (Hai Thach) and 5-3 (Moc Tinh) are under development by PVN (after relinquishment by BP) at a breakeven price in the range US\$5/mmbtu.
- Blocks B&52 formerly operated by Chevron would have required between US\$ 8-9/mmbtu at the platform to break even.
- We understand that the block 118 Ca Voi Xanh discovery of XOM and PVEP would also need close to US\$ 7-8/mmbtu to break even – due to deep water and high CO₂.
- Landed LNG would be on the order of US\$ 16/mmbtu.

Vietnam has considerable reserves that could compete with coal for baseload generation

Delivered Gas Supply Curve (2020)



- This diagram stacks up uncontracted and estimates for yet-to-find gas by breakeven cost.
- Any gas above US\$ 8/mmbtu delivered, or in the range of US\$ 6.25-6.50/mmbtu ex-platform would be displaced by less expensive generation from new build imported coal-fired plants.
- There is a fairly large amount of gas that can compete with new imported coal-fired plant. But there is also a substantial volumes of gas that would come in above the tipping delivered price of US\$ 8/mmbtu.
- Real-world siting constraints on new coal build would support development of some of this higher-cost gas.

Chevron's blocks 52/97, 48/95 & B (B&52) represented a major gas find that was intended to support a cluster of power plants at O Mon

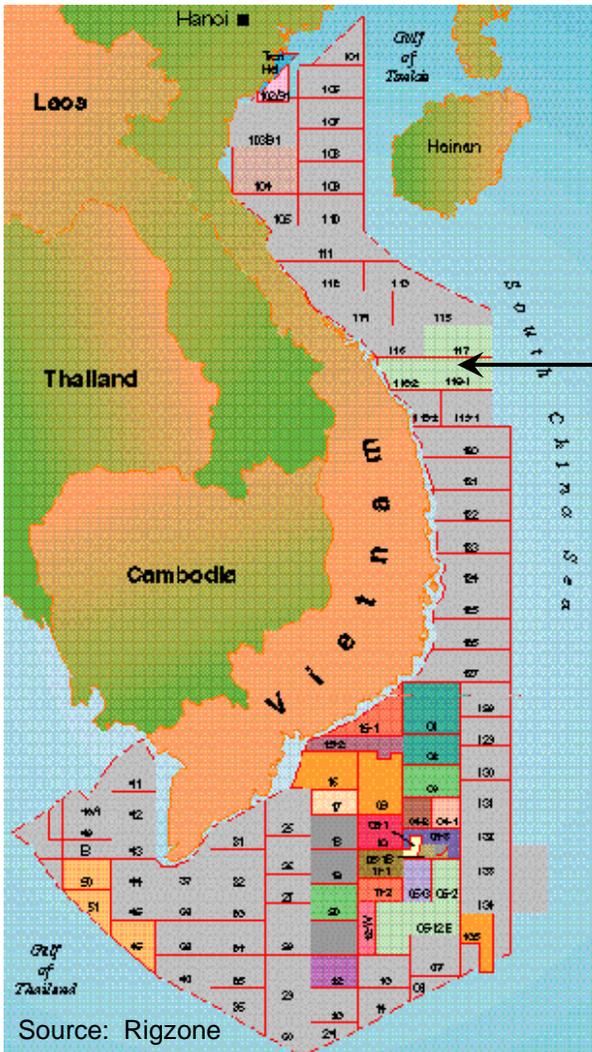


Block B & 52 Gas Project		
Location	Offshore, Vietnam	
Investment	~US\$4.3 billion	
Partners	Chevron Vietnam Mitsui Oil Exploration (MOECO) PetroVietnam PTTEP Kim Long Vietnam Company Ltd	42.38% 25.62% 23.5% 8.5%
Operator	Chevron Vietnam	
Capacity	Gas: 600 mmcf/d Condensate: 6000-7000 barrels per day	
Phase	Exploration	

Despite the presence of proved reserves, Chevron and PVN failed to agree on price after nearly a decade of negotiation

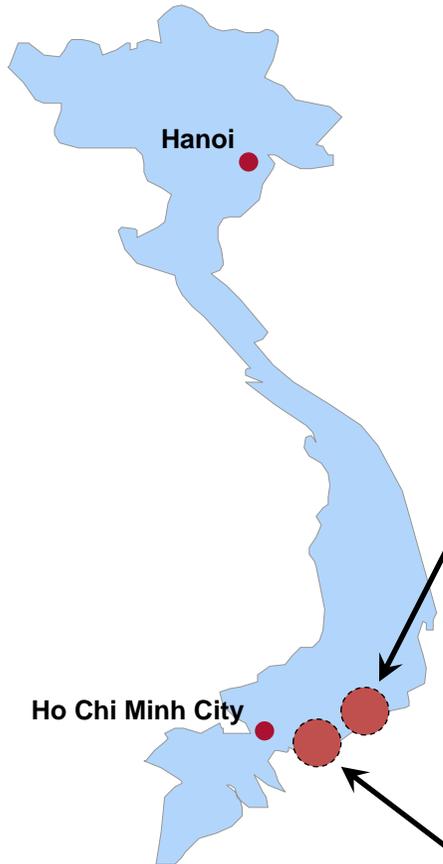
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- In July 2009, Chevron and three partners signed a basic agreement for front end engineering and design (FEED) with Vietnam Oil and Gas Group (PetroVietnam).
 - The EPC for the pipeline from Block B, by subsidiaries of PVN and Vietsovetro, to the shore site at O Mon started in late November 2009 ahead of any gas sales agreement.
 - Chevron has prepared a development plan to produce gas from the block but hasn't started work over a dispute with Vietnam's national oil firm PetroVietnam about the price of gas.
 - However, after many years of negotiations, the parties came close to agreeing on gas sale price in mid-2012 but then stalled again.
 - We believe Chevron wanted a gas price of between \$8 to \$10 per million British thermal units while PVN and the government was unwilling to pay this amount.
 - Chevron has indicated it will exit the project and has invited other partners to buy its stake. Existing partners of the project have the first right to buy stakes from others in the project.
 - This said it was reported that India's ONGC Videsh Ltd (OVL) and Russia's Gazprom expressed an interest in buying a stake in B&52, but to date no details have been revealed by the parties.
 - To add to the competition the Vietnamese government recently gave PetroVietnam the go-ahead to buy Chevron's stake in the B&52 gas project.

ExxonMobil have the next big find – will they succeed where Chevron failed?



- ExxonMobil has drilled three exploration wells in block 118 which proved up the Ca Voi Xanh discovery. It is early days, but some analysts put the breakeven price on the gas in the US\$ 7-8/mmmbtu range.
- XOM has been in discussions with the relevant parts of the government to help clear the way for a large gas-to-power development.
- Skeptics ask how XOM can succeed where Chevron, BP and others have recently struggled. One part of the answer may be in XOM's apparent willingness to invest heavily in the downstream power plants.
- While XOM has many power plants for mostly captive use, it has rarely embraced investing in power plants in order to sell gas.

PV Gas also has big plans to develop two LNG terminals



Son My LNG Receiving and Regasification Terminal	
Location	Binh Thuan province
Investment	>US\$1.3 billion
Capacity	3.6 mmtpa (Phase I) 6-9.6 mmtpa (Phase II)
Operational	2018 (Phase I) – 1.8mmtpa
Expansion	2019 – receiving first LNG 2020 (Phase I) – 3.6mmtpa 2023 (Phase II) – 6mmtpa 2026-2030 (Phase II) – 9.6mmtpa

Thi Vai LNG Receiving and Regasification Terminal	
Location	Ba Ria Vung Tau province
Investment	Est. US\$246 million
Capacity	1-2 mmtpa
Operational	Mid-2016- receiving first LNG

- Vietnam's latest gas development plan contains ambitious plans for LNG import terminals.
- Vietnam's state-run PetroVietnam Gas Corp (PV Gas) will be in charge of constructing the first two LNG terminals in Vietnam.
- Lack of credible off-takers in the power sector or any mechanism to pass through higher gas costs to customers hampers PV Gas in negotiations with sellers.

While these LNG projects have been planned for years, PV Gas cannot seem to get any traction in developing them

- 2007**
 - Preparation of a gas master plan addressed the need for LNG terminals.
 - Outside consultants saw less need for LNG but rather a stronger case for mobilizing domestic resources.
- 2008**
 - Government doubts about the size of gas reserves in the south halts Nam Con Son II pipeline.
 - LNG terminals mentioned in gas master plan as an option for the south.
- 2009**
 - Continued delays with planned coal plant for the south and BP's exit from blocks 05-2 and 05-3 with unexploited gas reserves gives a lift to the back up potential of LNG terminals
- 2010**
 - Listing documents of PV Gas included LNG terminals as part of its route to expand its asset base but without clearly identifying the market for the regasified LNG.
- 2011**
 - Basic engineering for site locations and economic studies under-taken for two terminals at Son My and Thi Vai, coupled with basic LNG procurement strategy. Gas master (2011) plan says LNG in the south by 2014
- 2012**
 - Tokyo Gas enters MOU with PV Gas to assist with terminal design and operation.
 - ConocoPhillips exits Vietnam including block 15-1 with uncontracted gas reserves.
- 2013**
 - Foreigners offered a 49 percent stake in Son My terminal, but no takers yet.
 - International lender study questions need for LNG terminals - uncontracted domestic gas is in the ground.
- 2014**
 - Gazprom LNG Marketing signs master supply agreement with PV Gas for LNG.
 - Still no sign of an EPC contract for either terminal.

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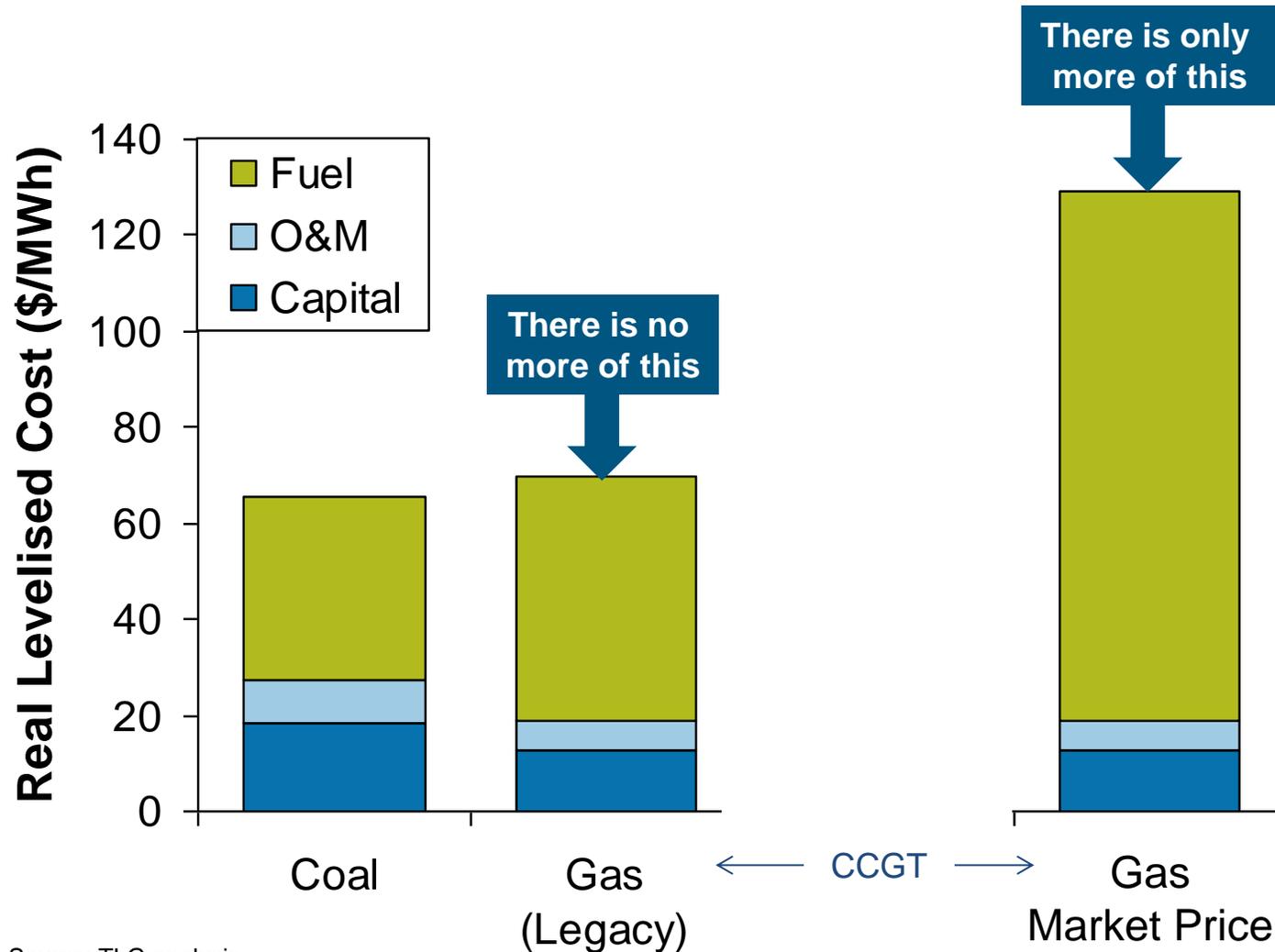
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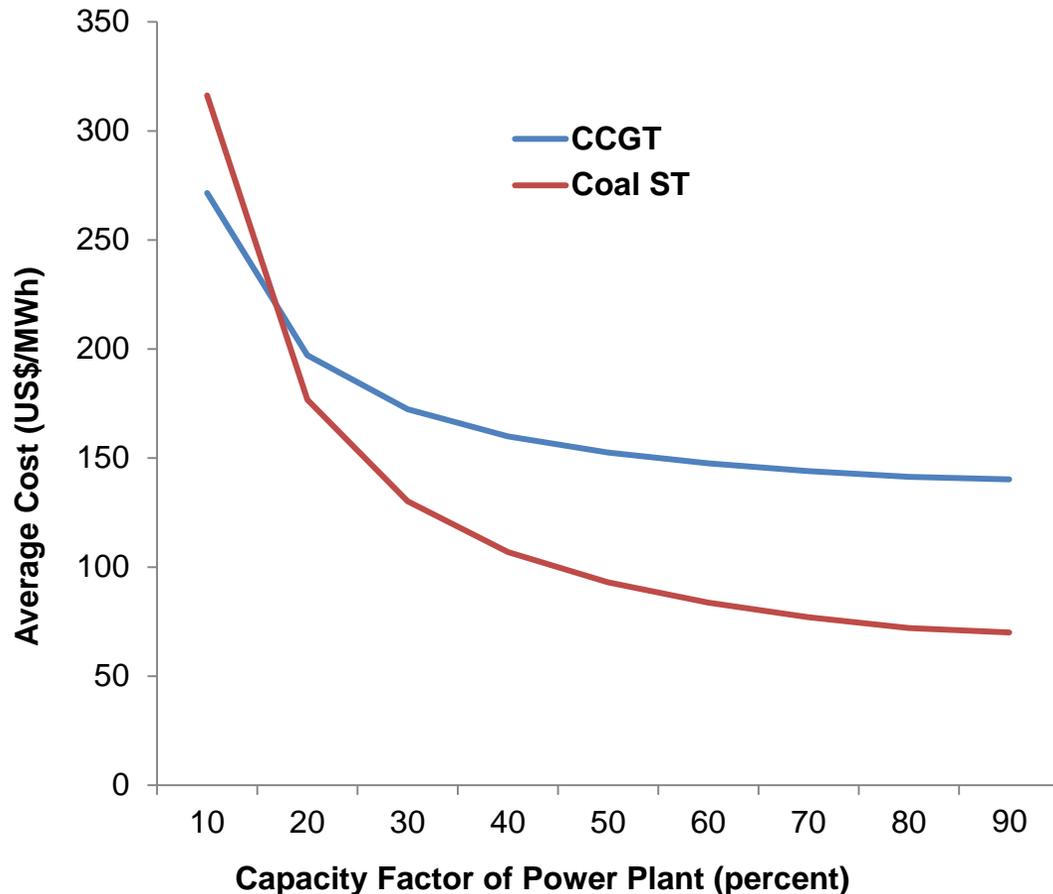
Planning, investment, policy, and operations all need to get the marginal economics right, or risk expensive bad decisions



Source: TLG analysis

New-build economics at marginal gas prices suggest that gas should run in mid-merit mode – even after accounting for a sizable carbon price

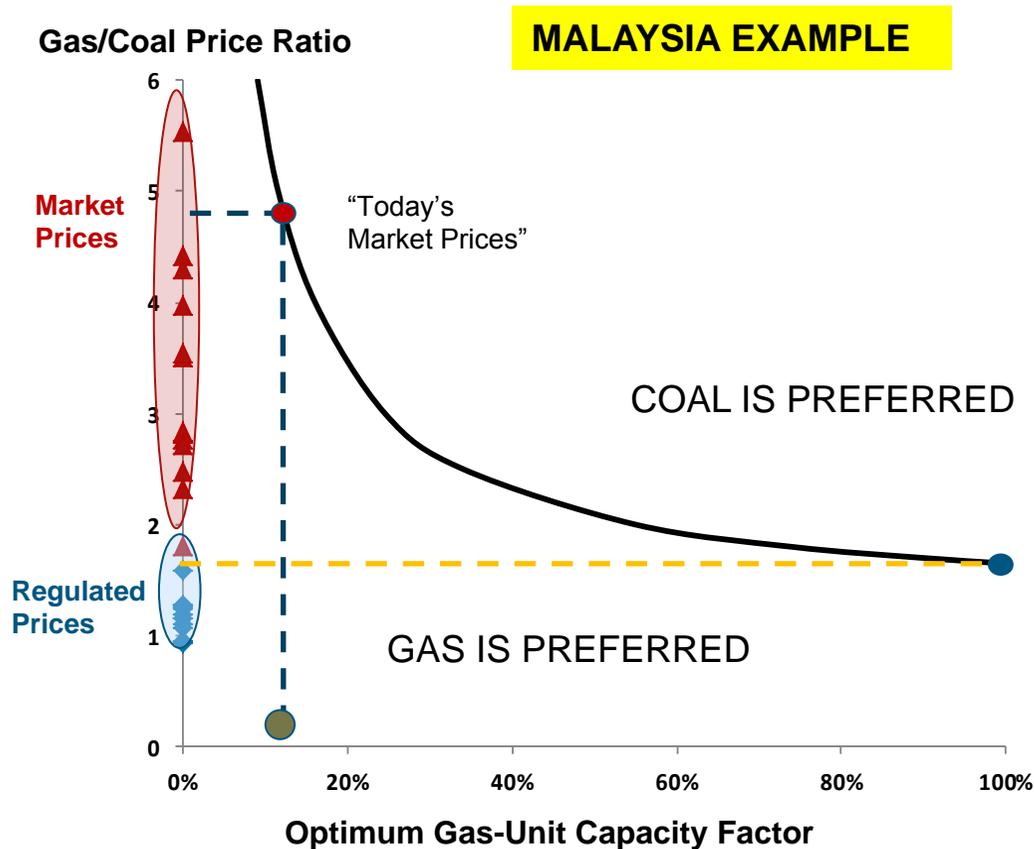
New-Build Economics



Assumptions

- LNG is priced at US\$ 17/mmbtu at the burner tip
- Coal price is US\$ 90/tonne delivered or US\$ 3.6/mmbtu
- CCGT at US\$ 800/kW installed cost; coal at US\$ 1600/kW.
- New build gas-fired plants should run at 20 percent and coal-fired plants should run at base load

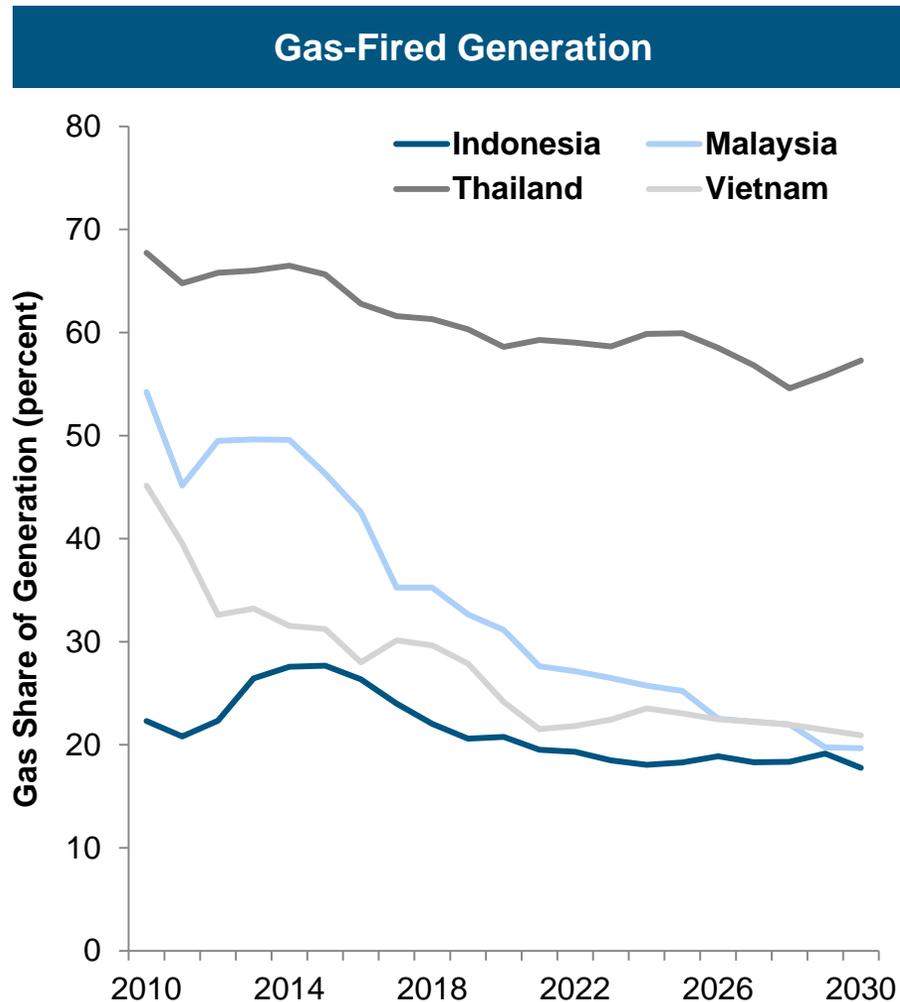
Gas demand, particularly for power, depends on the price and availability of alternative fuel sources



- Peninsular Malaysia sells gas to the power sector at a price approximately equal to coal in terms of RM/GJ
- The market-price of gas (whether measured as the replacement cost, the regional LNG price, or the price paid by the non-power sector) is much higher
- As Peninsular Malaysia moves to market-priced gas, the ratio of gas price to coal price will increase, changing the economics of gas-fired power generation from baseload to peaking duty
- Coal becomes the least-cost source of baseload power supply

Reliance on gas-fired capacity for baseload power is expensive relative to coal

Even after accounting for constraints on new coal build, we foresee the gas-fired share of generation declining across SE Asia



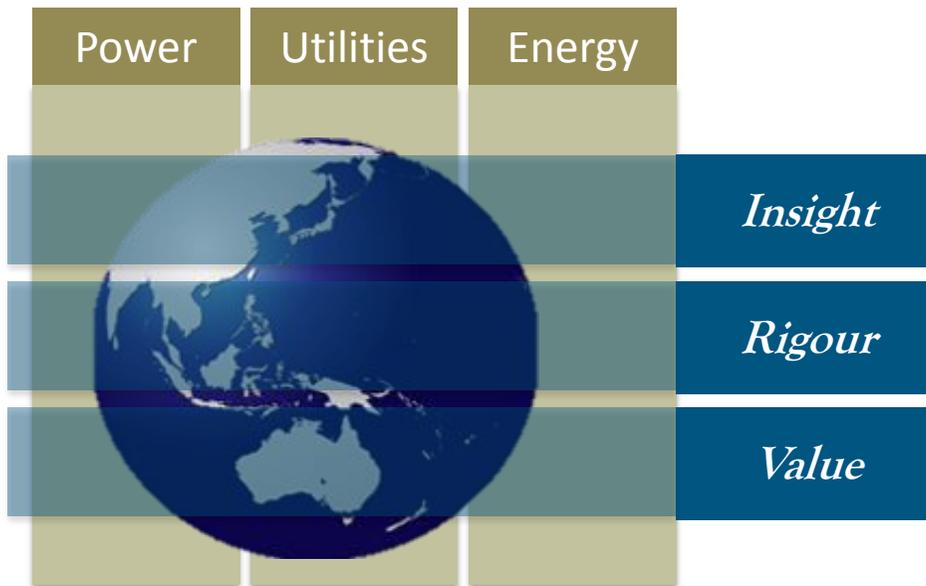
- **Thailand.** Coal build is hampered by strong local resistance to coal build and so gas remains dominant.
- **Indonesia.** The trend rises as large quantities of diesel are displaced by gas/LNG, then the percentage declines due to on-going coal-fired new build.
- **Malaysia.** The trend is down as gas prices rise and more coal is built. The broad trajectory is a gradual move towards marginal gas prices being linked to LNG prices and volumes of relatively inexpensive subsidized legacy gas being cut back.
- **Vietnam.** We constrain the level of coal build down from the heady numbers in the official plans, but even so gas as a percentage of the mix falls over time.

There's a completely different gas "future" awaiting for Asia – and it's time to make it happen

- Coal, nuclear, and renewables will edge out gas as a baseload generation resource
- Mid-merit LNG-fired generation will be subject to daily load variation, seasonal swings, and long-term capacity factor uncertainty
 - Cannot support high load factor for LNG terminals or inflexible take-or-pay commitments
 - May not be able to sign bankable long-term supply contracts
- LNG terminals will be forced to recover their costs primarily via capacity reservation charges, rather than throughput charges
 - Throughput capacity will vary with circumstances – sizing of storage will be a key design variable
 - Break-bulk shipping and LNG trucking – both inherently more flexible – will supplant gas pipelines
- LNG aggregators will act as financial intermediaries between LNG liquefaction projects and downstream customers (e.g., mid-merit CCGTs)
 - Buying shares in liquefaction projects and taking positions in LNG tankers
 - Securing LNG storage capacity



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