



Hurdles for Gas Power Generation in the Philippines and South-East Asia

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Some major improvements have occurred in the gas world in the last year....

Stars aligned

- Gas prices have fallen
 - Henry Hub at \$1.70 / MMBtu in March
 - Oil prices dipped below \$30 leading to record low LNG prices.
- In the US gas overtook coal as the main form of electricity generation in 2015
- Just about the whole world signed up to COP21 in Paris in late 2015
- ASEAN tiger economies traditionally have used a large amount of gas generation
- SE Asia to almost double its generation capacity in next 10 years

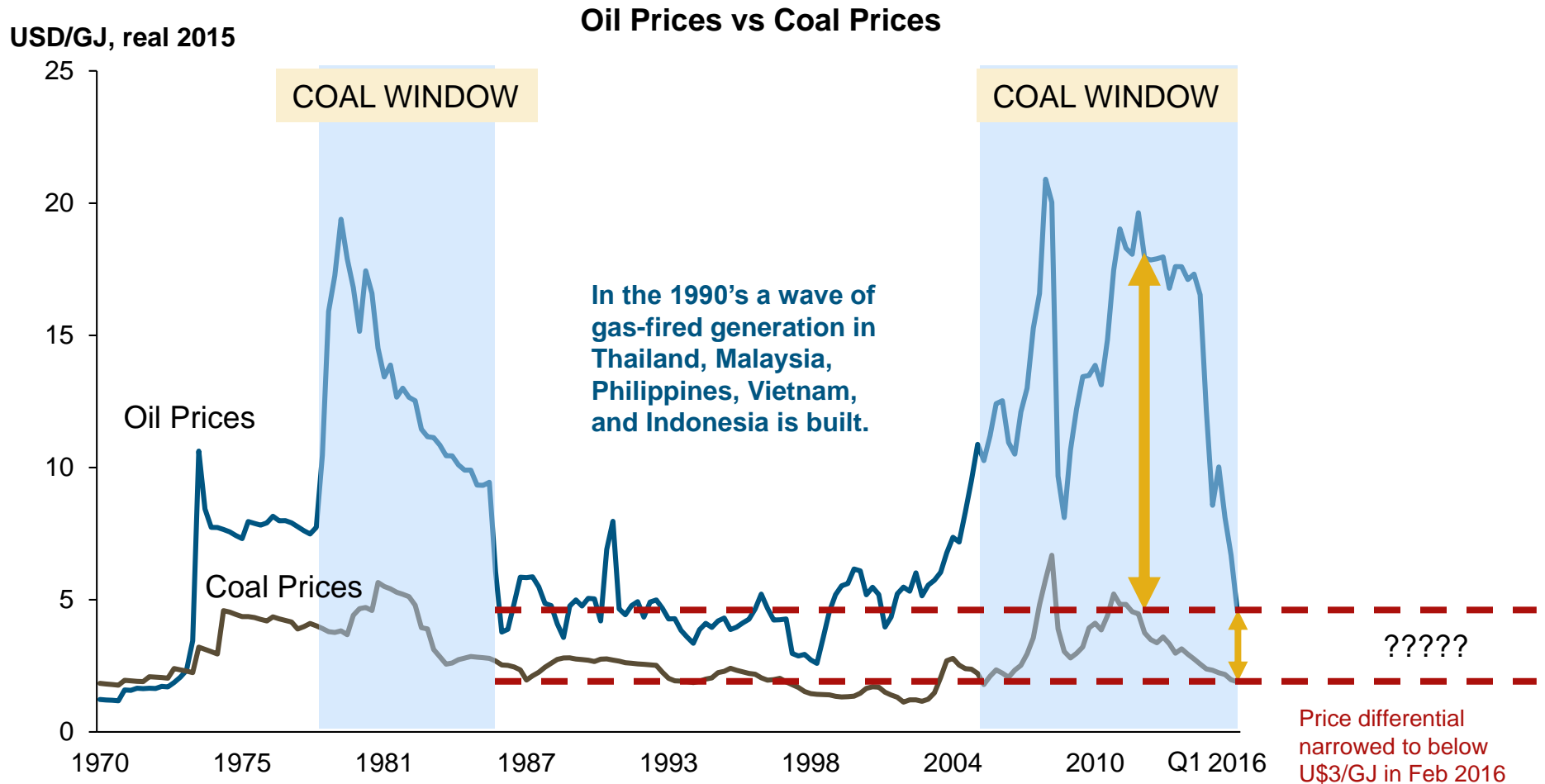
?

Stage set for a new boom in gas fired generation in SE Asia?

And there are a number of reasons Governments like gas for power

Driver	Rationale
Domestic resource	<ul style="list-style-type: none">• Investments / FDI• Government revenues (taxes, license fees, PSC)• Reduction in imports / FX
Generation Cost	<ul style="list-style-type: none">• Competitive generation cost compared to coal fired generation (and other alternatives)
Fuel diversification	<ul style="list-style-type: none">• Improve national fuel supply reliability• Avoid seasonality swings associated with RE
Environmental	<ul style="list-style-type: none">• Reduce CO2 emissions• Improve air quality in polluted cities/load centers
Operating regime	<ul style="list-style-type: none">• Mid-merit and peaking applications• Intermittent RE increase need

The spark spread looks like this "coal window" is closing... what comes next?



Note: Crude price 1970-1979 Saudi Arabian Light, 1979-present Brent; Coal price Newcastle
Source: World Bank; TLG analysis

But there is always a “But”!

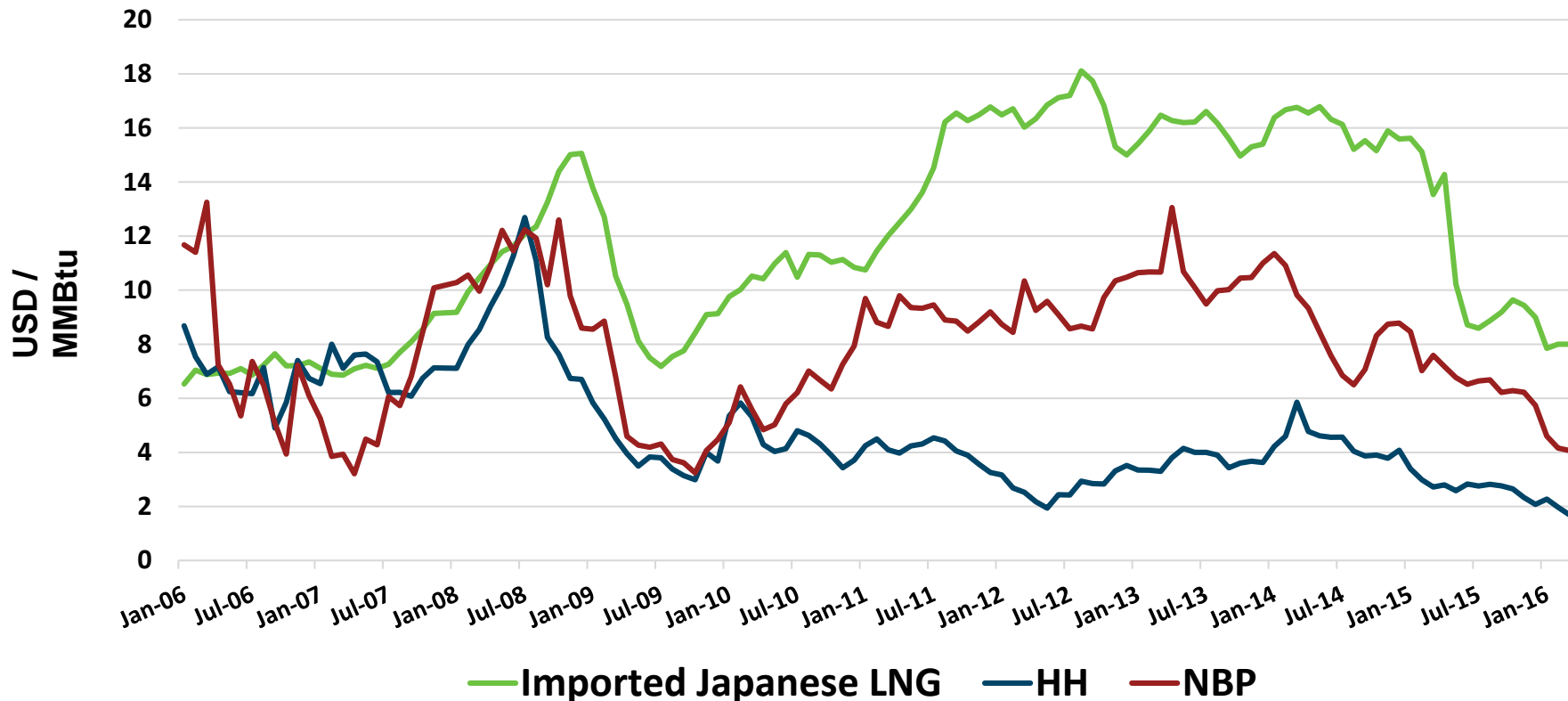
In Asia gas-fired generation is more expensive than coal-fired generation even though gas prices having fallen to record lows.

And in developing Asia cost concerns are paramount.

Global gas prices:

Price *trends* may be the same, but price *levels* are very different

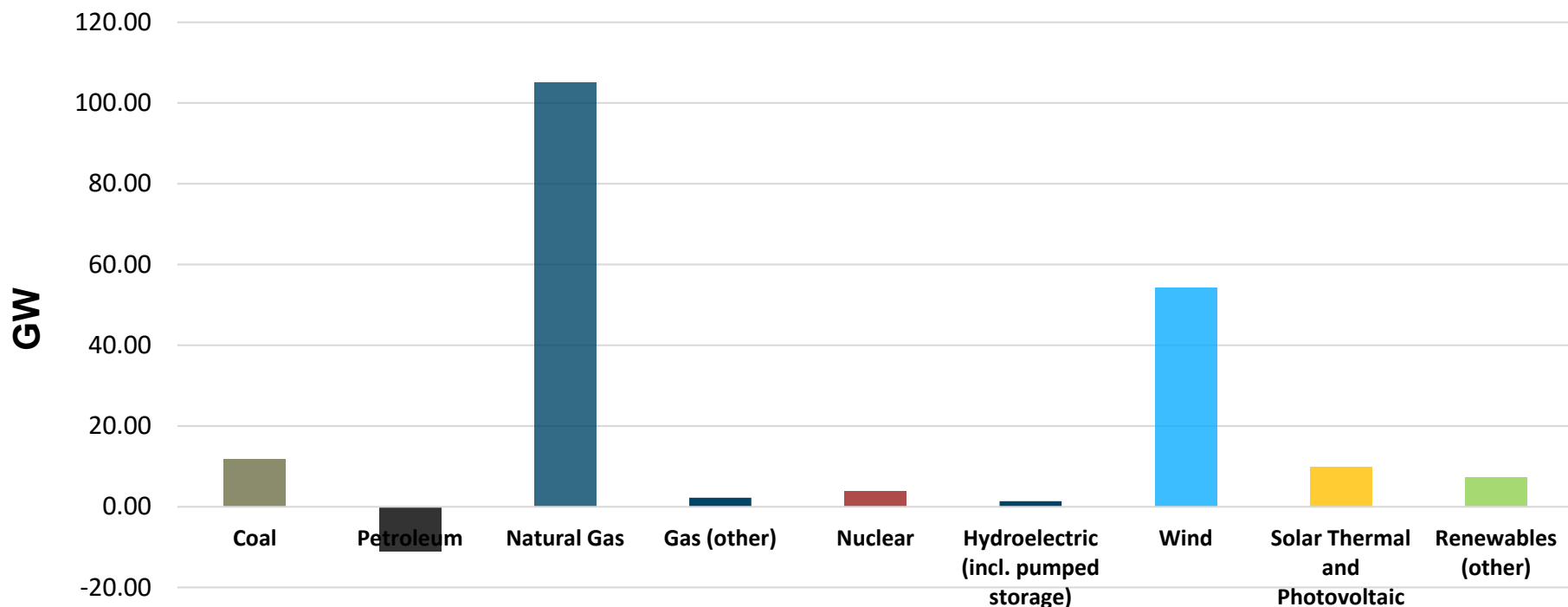
- 2008 peak, US gas prices (HH) have fallen by a 86%
- Europe and Asian prices have also fallen – but not as much
- Were global gas prices more aligned 8-10 years ago?



In the US, power generation is all about natural gas and RE

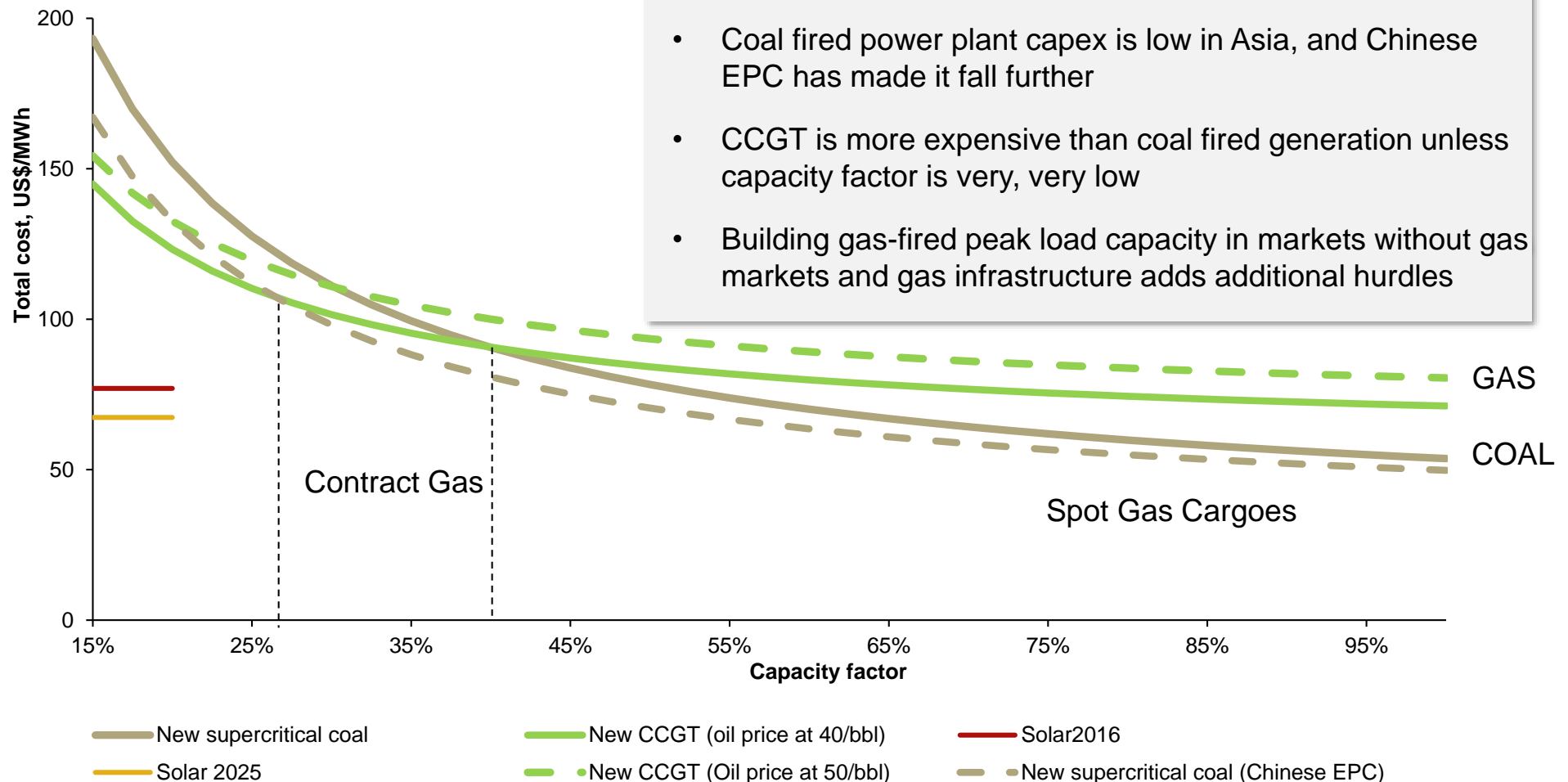
- Since 2006, gas-fired generation has accounted for 60% of increase in generation capacity
- Wind and other RE has made up almost all the remaining capacity
- But the gas in the USA is all domestically produced and massive infrastructure already exists

Net change in US capacity by fuel type (2006-2014)



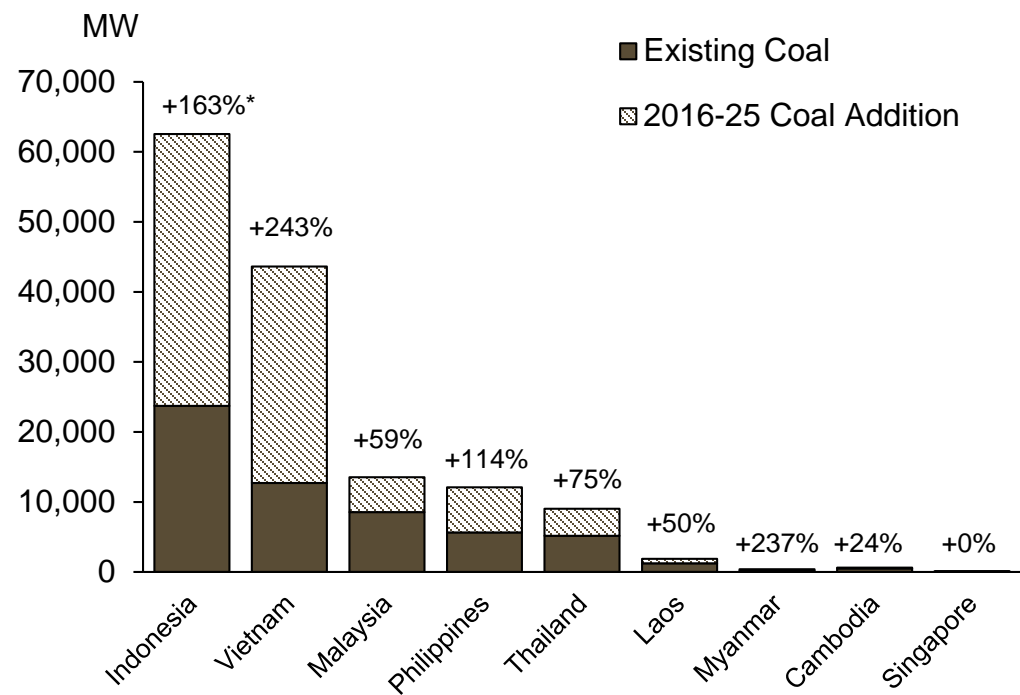
In Asia coal is still king on cost fundamentals, 'despite' low gas prices

Screening curves for new entry in Asia



Next 10 Year coal capacity additions – Putting SE Asia in perspective

ASEAN Coal existing and capacity addition 2016-25

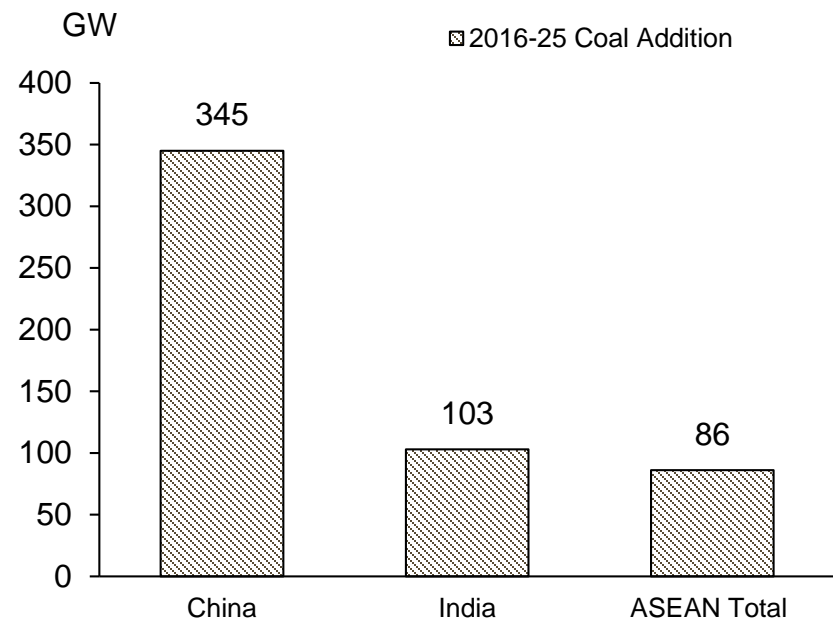


*% represents total percentage increase of coal capacity in the next 10 years

Coal as a % of total capacity addition



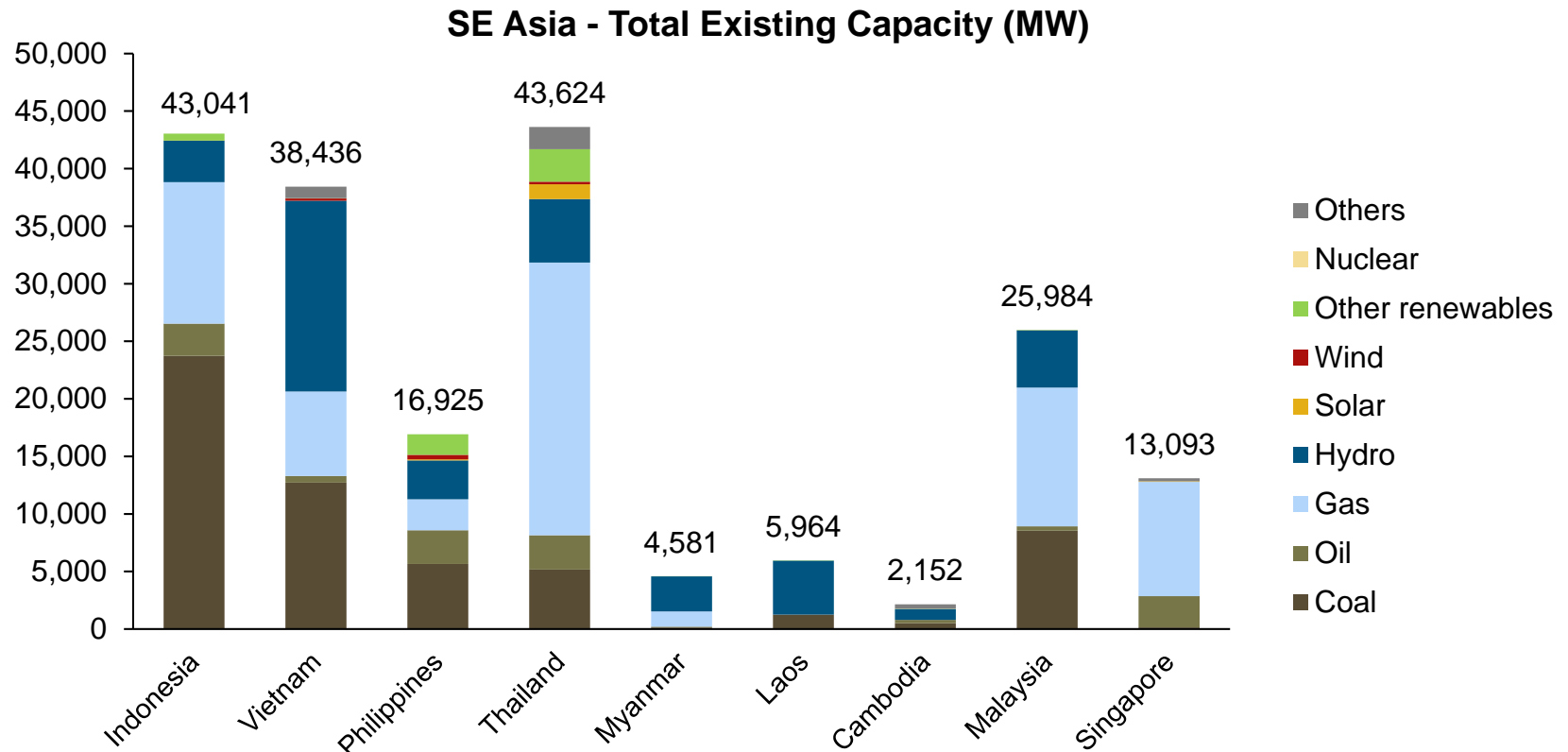
Coal capacity addition 2016-25



Gas is no longer a Domestic Resource in Asia

Gas generation was built-out in Asia to take advantage of an inexpensive domestic resource. Today there is now a shortage of domestic (legacy) gas in almost all of SE Asia.

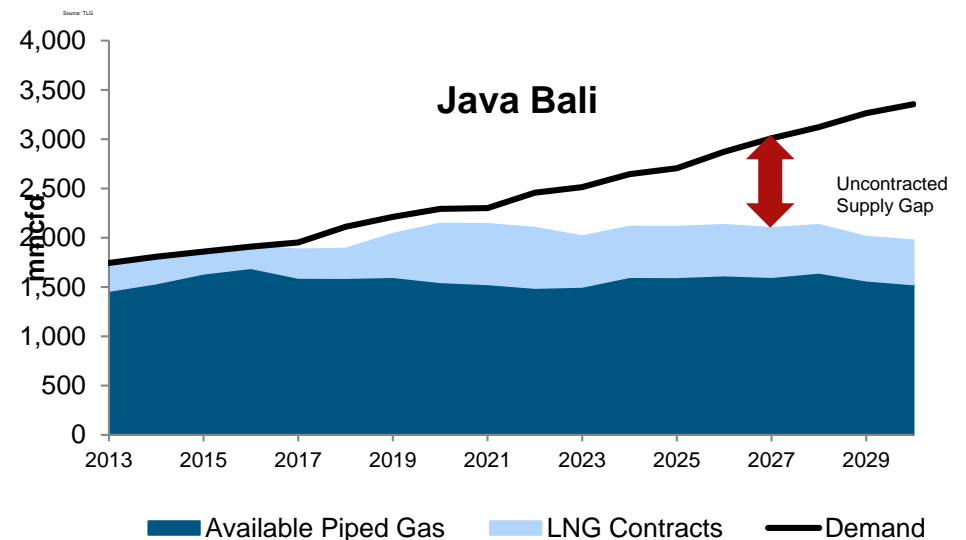
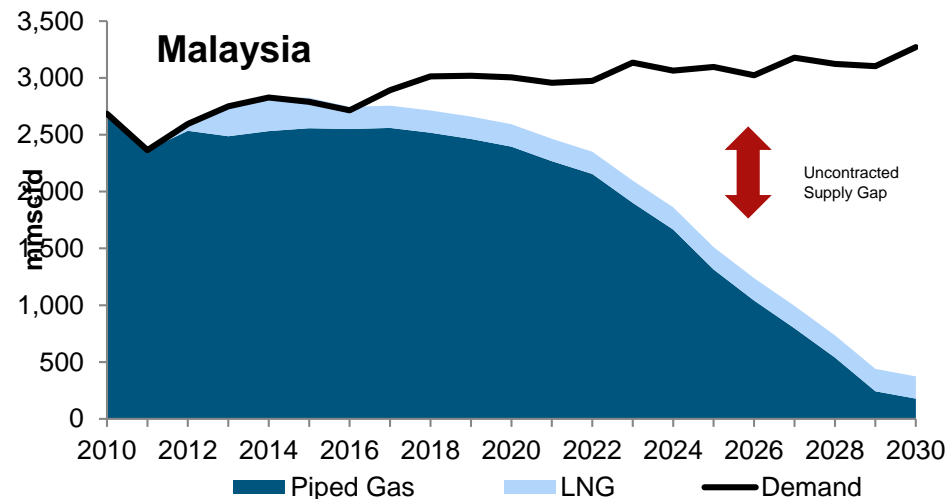
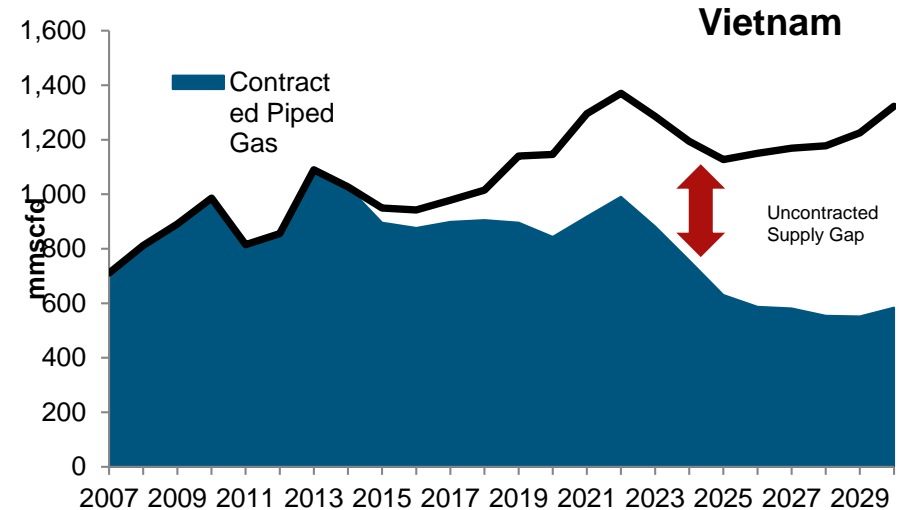
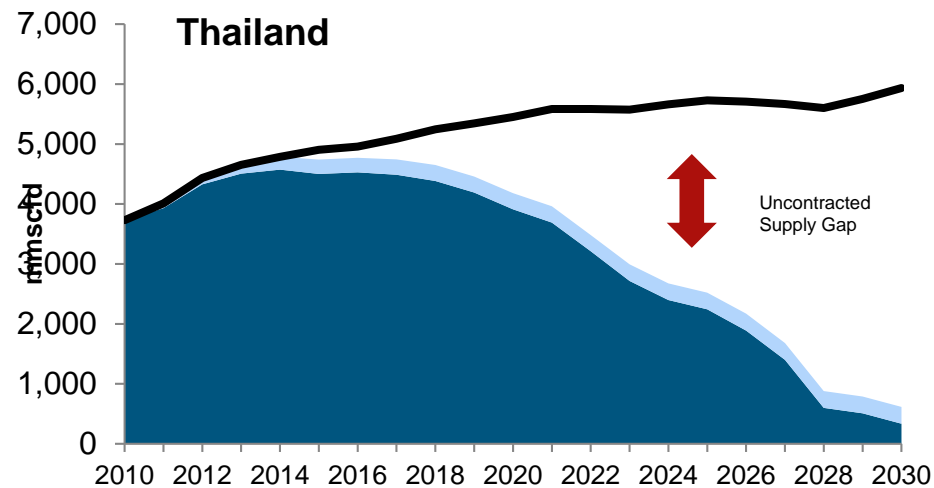
Gas use in Asia reflects domestic (legacy) gas development – but in the future?



Legacy gas was built when gas was cheap, and countries needed to find use for its domestic gas resources and when there was no market-pricing of gas (or an infrastructure to support it)

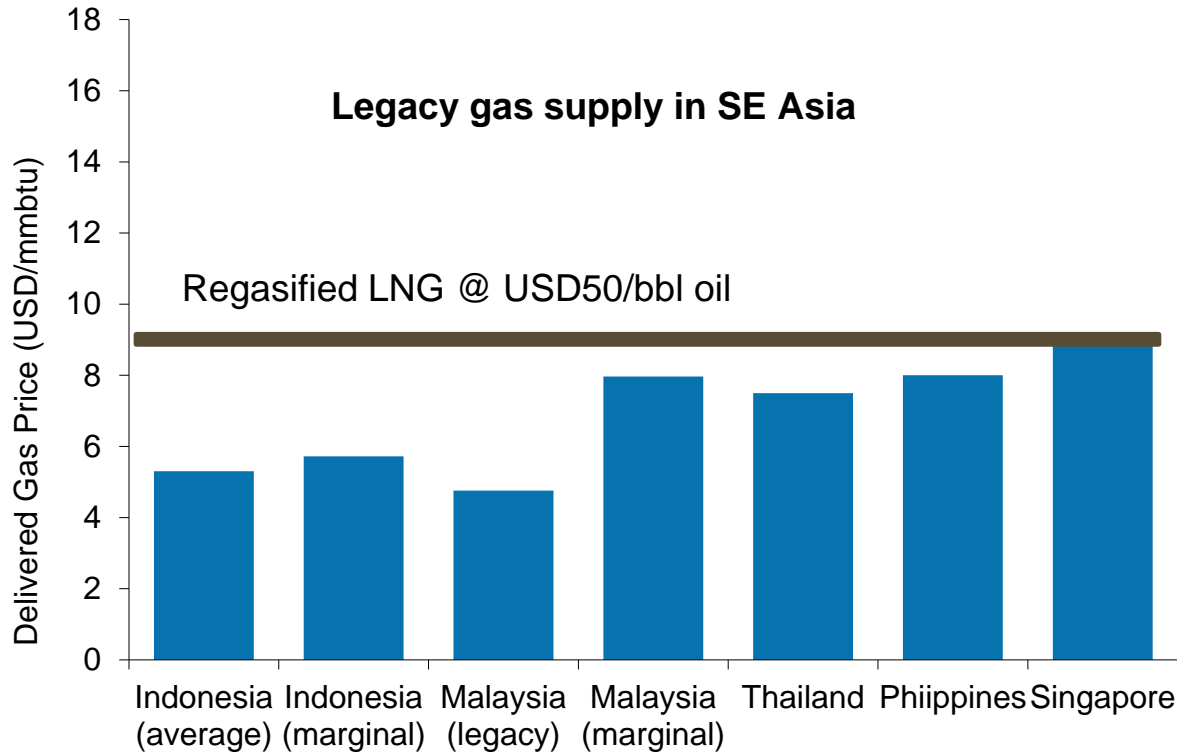
- The rationale for gas generation in SE Asia is different now compared to the past
- Past / existing importance of gas generation will matter less going forward
- In the next 10 years CCGTs installed in 1990s may shut down

Most Asian countries with legacy domestic supplies are running out...and finding imported LNG to be more expensive (even now)



Source: TLG

Long-term LNG prices are both higher AND more volatile than legacy gas pricing



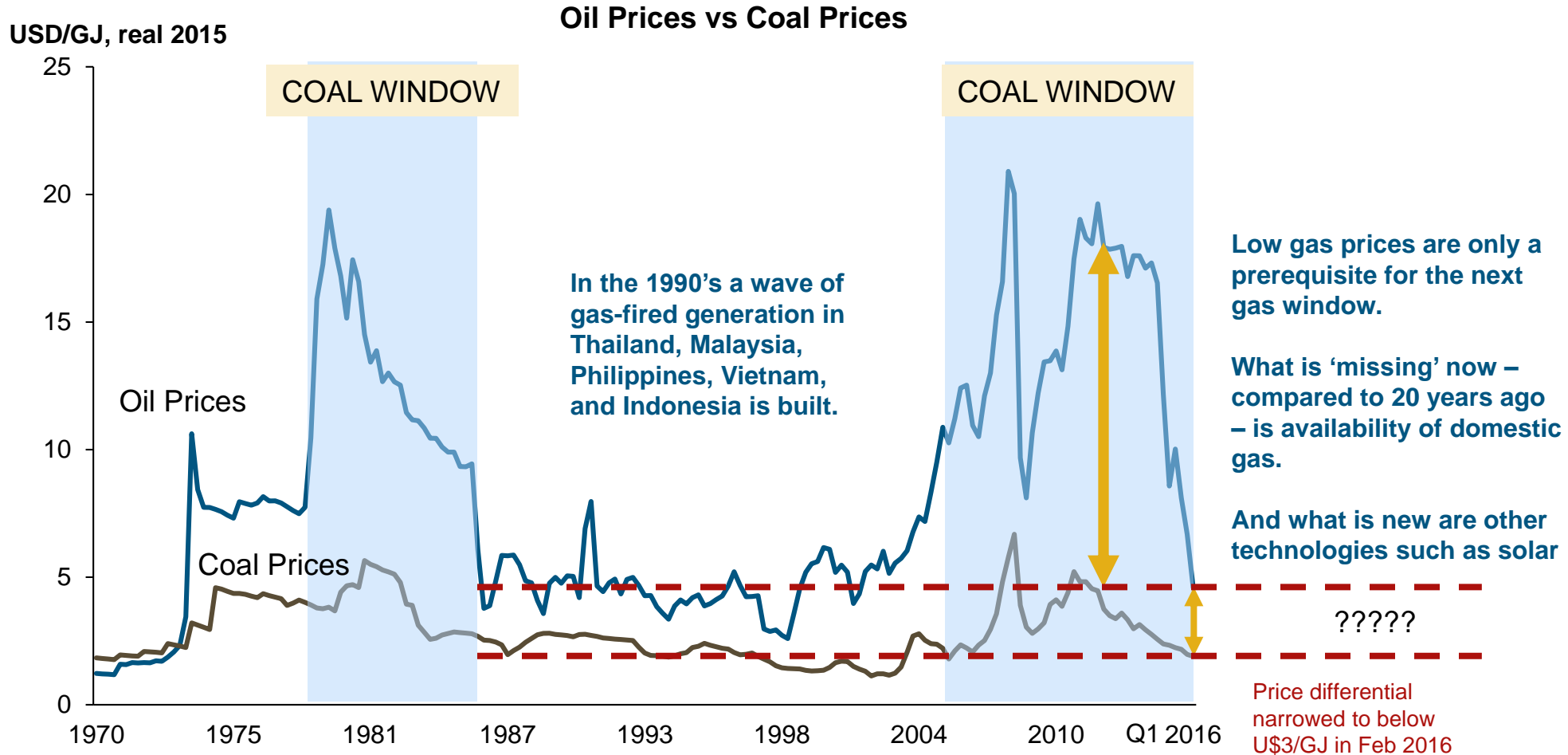
With gas in Asia comes continuing upward pressure on tariffs

Source: TLG

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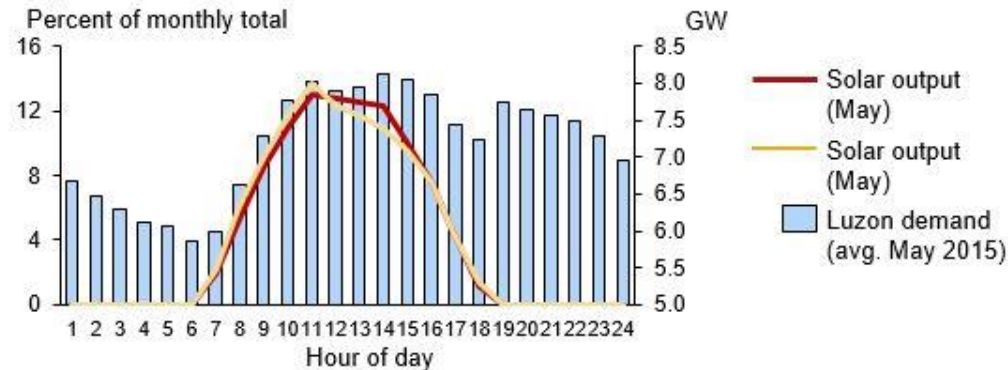
So are we entering a new age of gas? Or what?



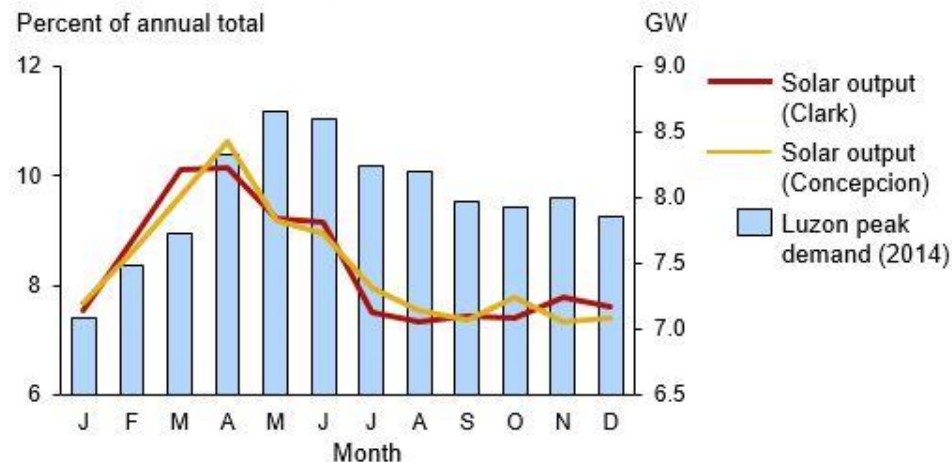
Note: Crude price 1970-1979 Saudi Arabian Light, 1979-present Brent; Coal price Newcastle
Source: World Bank; TLG analysis

For Philippines in particular, “or what” could be solar!

Hourly solar generation profile and alignment with Luzon demand



Monthly solar generation profile and alignment with Luzon peak demand



Source: PEMC; TLG data-base and analysis

Luzon / Philippines

- Profile of solar resource and solar generation match fairly well with peak demand profile
- Market modelling indicate that installation of solar may eliminate the potential for CCGT peaking power roles
- And this is without any assumptions for use of storage / battery

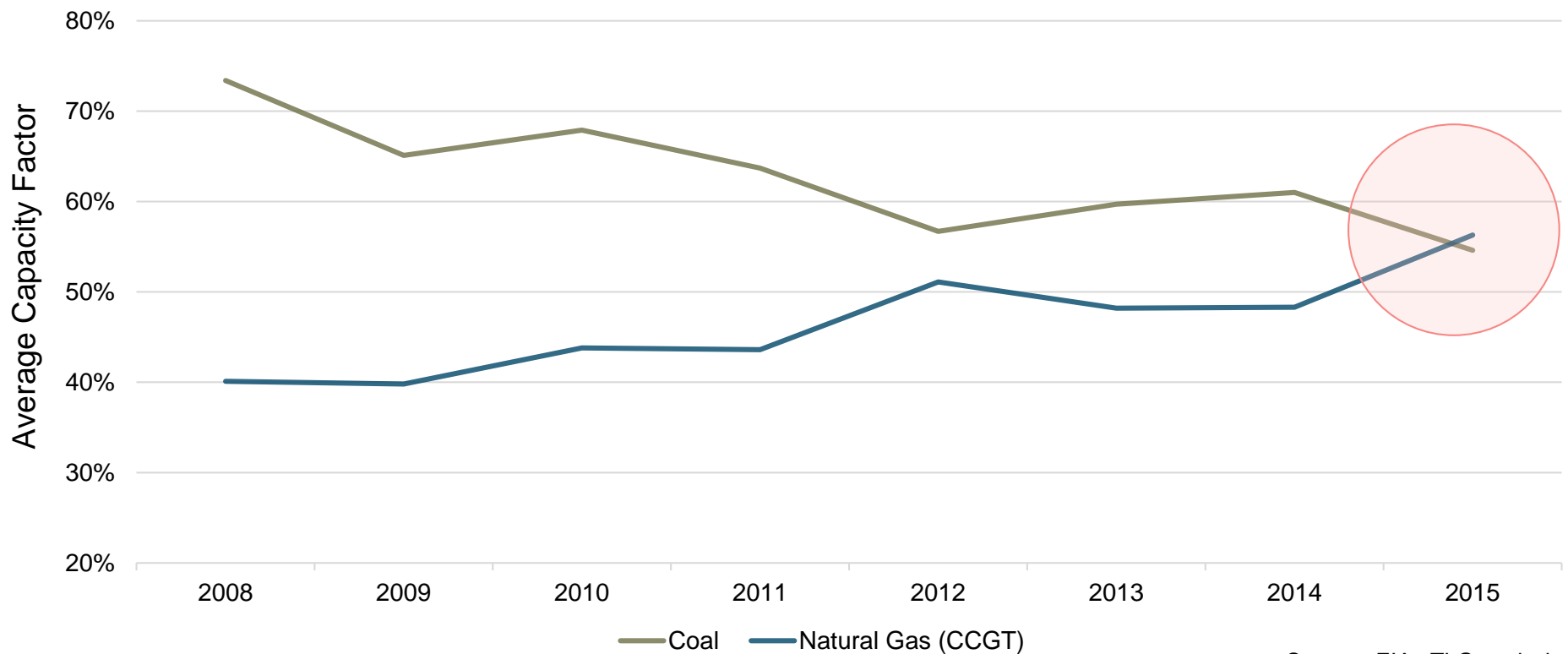
Does gas fit in it's natural merit order role?

Mid-Merit and peaking generation typically requires gas fired generation (especially when building out RE)

But the traditional truism of CCGT for mid merit and coal for base load are not obvious when taking a macro view on markets.

USA - as natural gas prices have declined, capacity factors for coal and gas-fired generation have crossed over

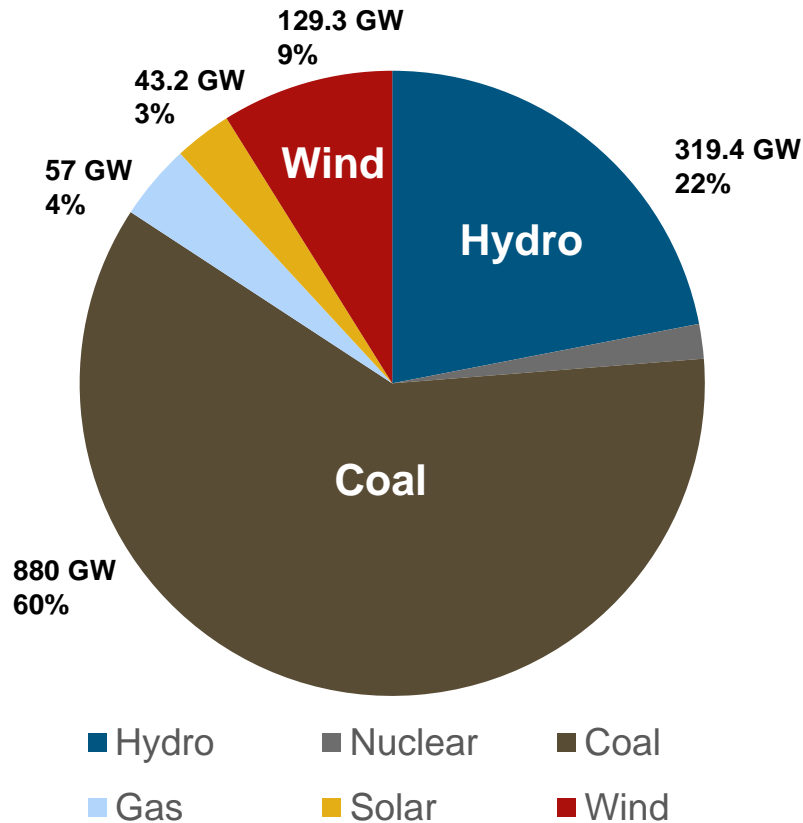
- In 2015 the average load factor of a coal-fired plant was lower than the load factor of the average gas fired plant in the US
- Less distinct baseload and mid-merit roles
- Marginal cost may be more important than technical requirements for load profiling



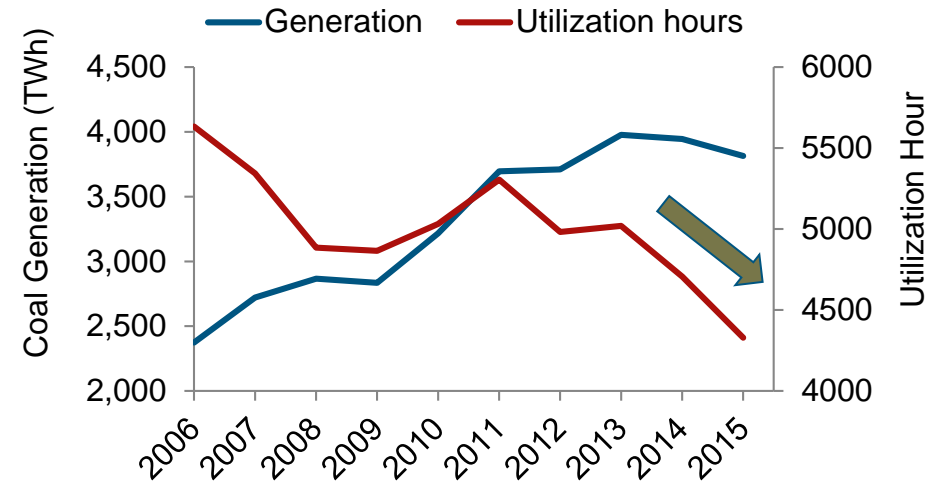
Source: EIA; TLG analysis

CHINA - the generation mix is dominated by coal, and gas is at a minimum

Installed capacity in China



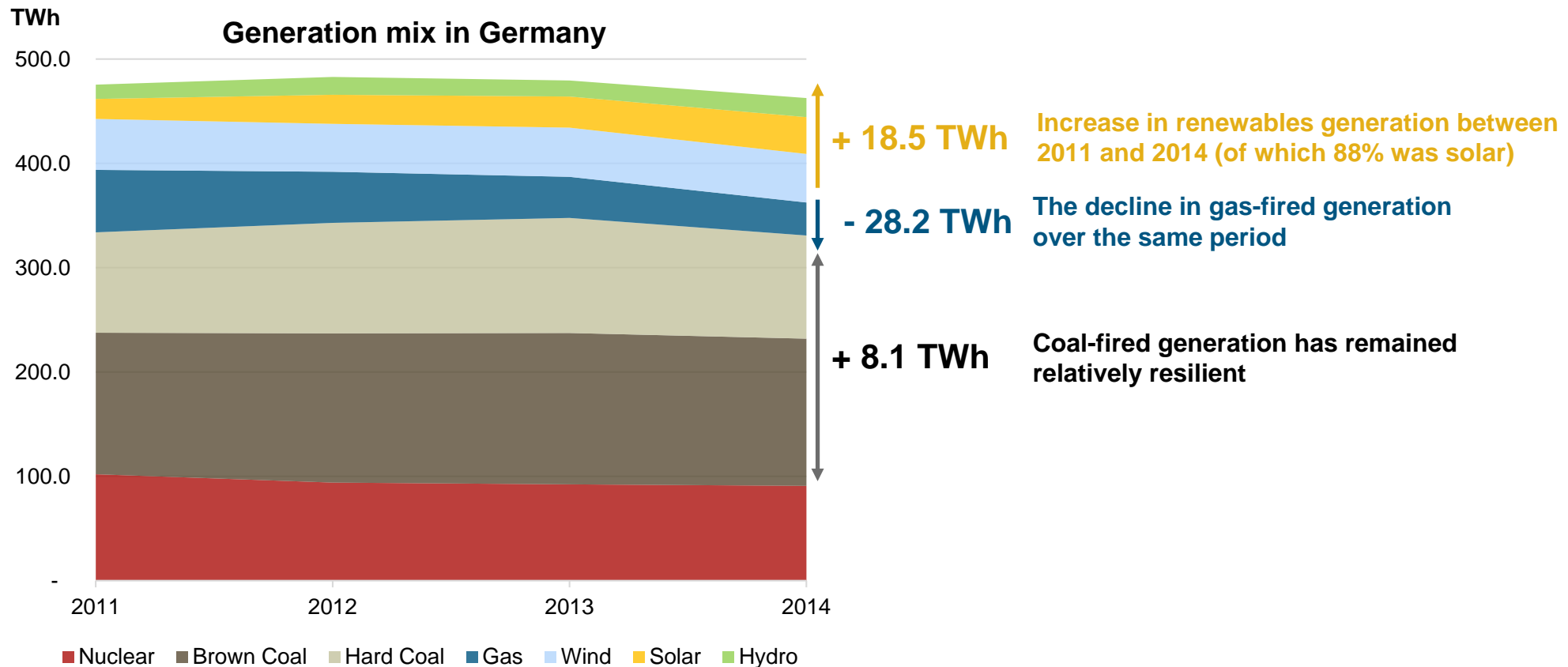
Stable coal generation but falling utilization hours



- In 2015 China approved 2 new large coal-fired projects... every week
- Gas-fired generation will be secondary for China's electricity supply also going forward.

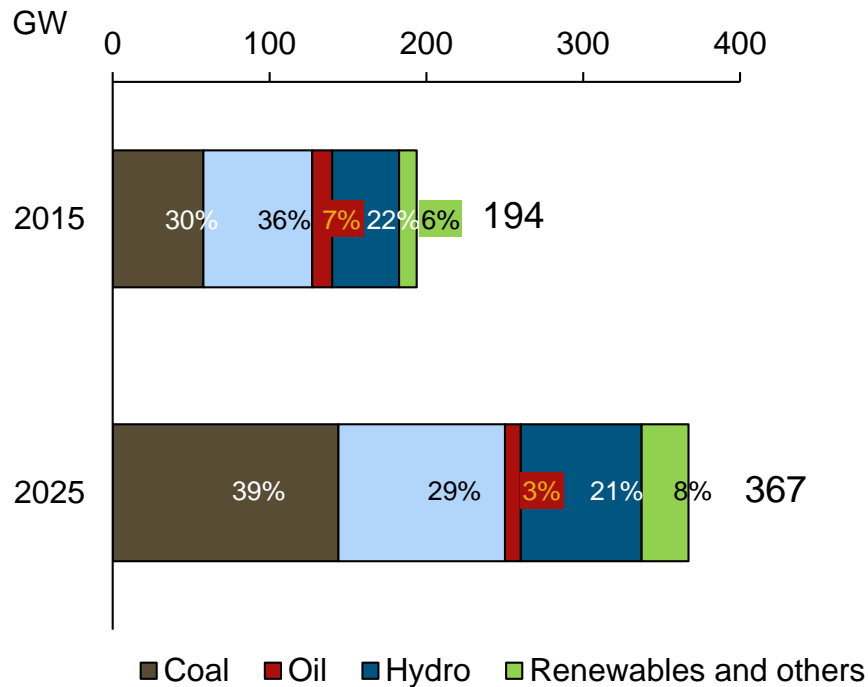
GERMANY – gas generation has now declined to long-term lows

- Record build out of solar and wind power has lead to gas generation being squeezed out.
- Gas generation is now at its lowest level for over a decade
- Chronic over-capacity, and stagnant electricity demand that has decoupled from GDP.



ASEAN: Renewable energy is expected to play a much smaller role in SE Asia compared to much of the rest of the world

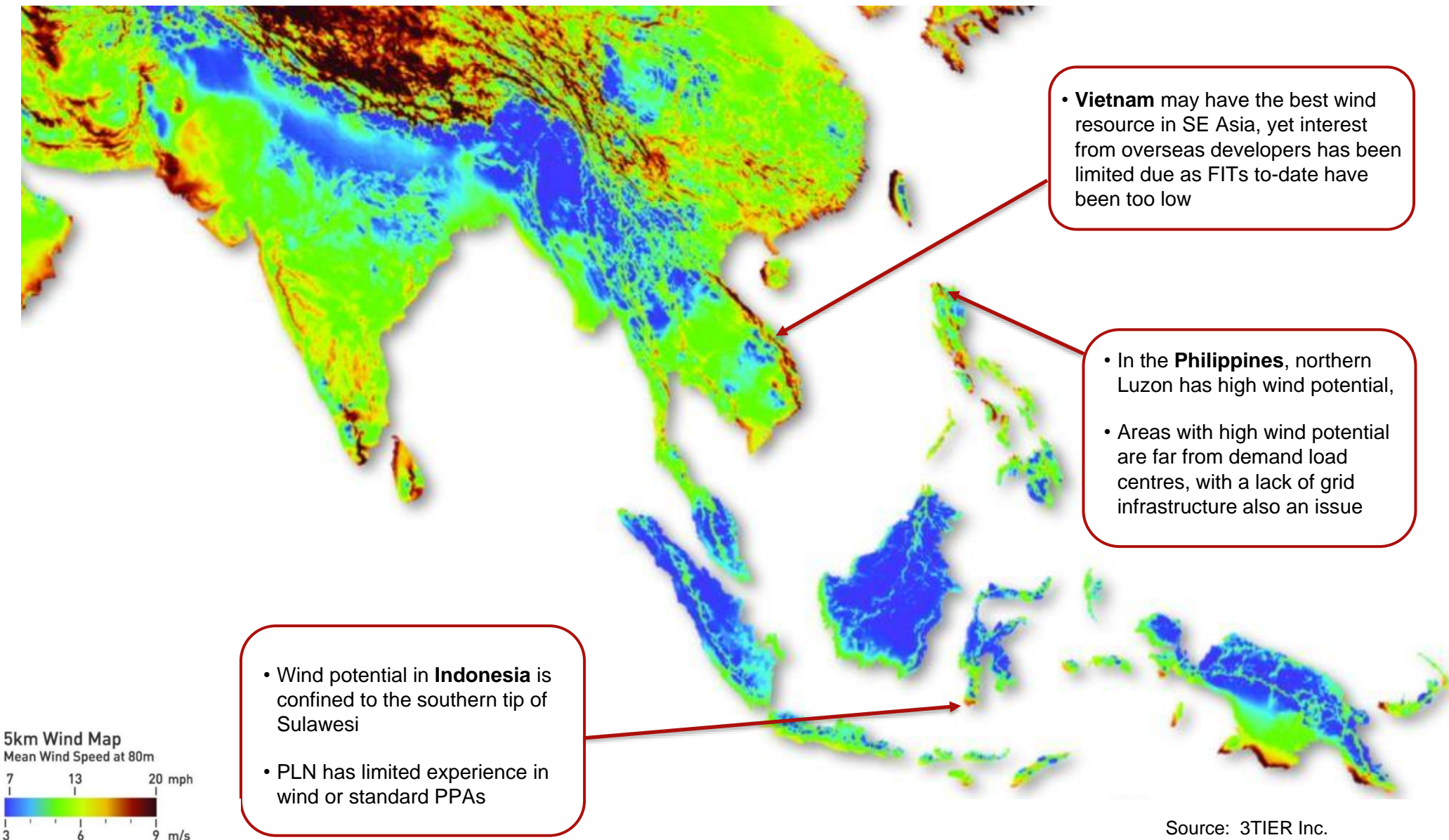
ASEAN Capacity Mix 2015 and 2025



Source: TLG Research and Analysis

- RE is only 3% today (excl. “others” shown in chart)
- In 2025 the share of RE is still in single digits
- Intermittent RE – solar & wind – is less likely to be drive for need for more peaking power in a material way
- Although the Philippines may be a notable exception to this trend

Wind resources in SE Asia do not typically favour the development of utility-scale wind projects

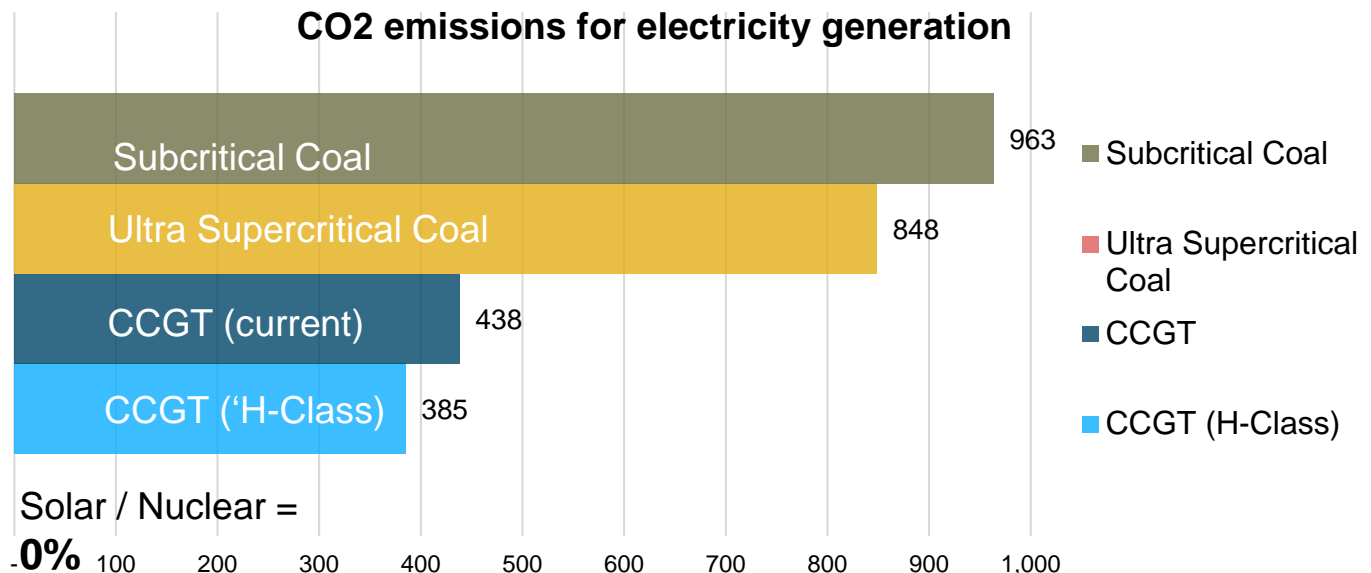


Surely the environmental concerns will drive gas?

Environmental concerns will remain a secondary factor. Priority number one for growing economies is to meet growth in baseload demand, favouring coal.

Gas may not be clean....enough.....after a decade of coal - nuclear & RE / solar may be the main alternative to gas (and coal)

- CO2 will start to matter more
 - Gas generation gets you about half-way in reducing CO2 compared to coal
 - Nuclear and solar gets you all the way – zero CO2 emissions
- No more cheap legacy gas
- Network and generation base big enough to accommodate more RE
- RE cost will continue to reduce, and Chinese nuclear EPC pricing will shift cost of nuclear power



Source: TLG analysis

Gas still has value, but not the way most people often think!

And the Philippines leads the way in some ways

Big picture - Coal vs Gas Generation in next 10 years

Coal wins on economics

- ASEAN generation capacity is doubling.
- Coal is only the realistic option for meeting large increase in base load demand today. There is no other option.
- Vietnam and Indonesia has largest increase in generation capacity. They also plan for the most coal.

Gas generation is falling as domestic supplies deplete

- Share of total generation capacity to decrease from 36% to 29%.
- Gas will reduce in importance more than any other form of generation.

The future of gas remains problematic

- Gas generation is at a cost disadvantage versus coal. For developing economies with rapidly rising electricity demand, the cost of new generation is critical.
- Existing gas generation in SE Asia is based on cheap domestic gas at legacy pricing. That gas is running out.
- The lack of gas market and gas infrastructure represent major obstacles for gas generation in many ASEAN countries
- Intermittent power will not provide a boost for gas generation. Solar generation may even be more downside than upside for gas generation

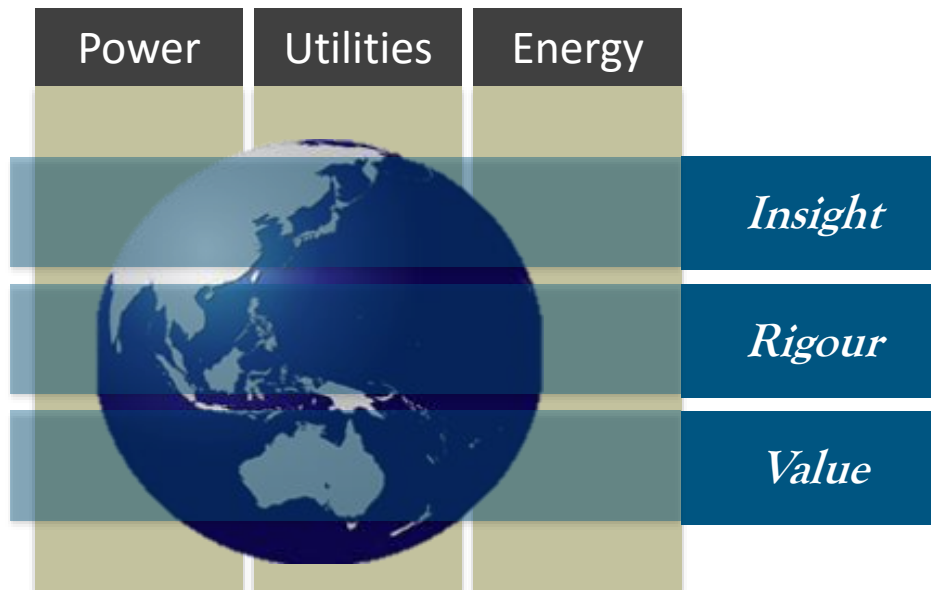
Niches for gas require an overlap of economics and opportunity

- Some customers will pay a *little* more for a clean fuel
 - The contestable market in the Philippines allows customers to make that choice without burdening others who choose the cheaper option
- Where gas power stations exist, the marginal cost of running them on LNG when LNG prices are low can compete with building coal from scratch
 - For example, Philippines has over 3000MW of gas fired capacity that First Gen has a commercial interest in using after Malampaya runs out
 - With a competitive WESM and now a CSP, that plant will only run if the economics work which is good for consumers
- LNG infrastructure can pave the way for the opportunistic use of gas when prices are low
 - The challenge is how to get LNG infrastructure built without a large baseload anchor customer. Watching to see if the Energy World project succeeds in Pagbilao will be a useful indicator of whether this is possible
 - Having infrastructure but no long term contracts allows LNG to be used as gas should be – as a swing fuel for security, flexibility and market opportunity

The Message - Its about Value not Volume

- High volumes of gas generation will become less important in SE Asia going forward
 - Existing gas is built on a legacy of cheap gas
 - Gas generation may not be an ideal fit for SE Asia in next 10 years
- In the next 10 years electricity generation in SE Asia (and rest of developing Asia) will be a story of coal, and more coal
- Long term (>10-15 years) - when coal boom slows - Nuclear and RE/solar may leap frog gas generation as main alternative to coal
- But gas niche markets remain where domestic gas is available
- And LNG remains an excellent fuel to have as an option, and building infrastructure to allow imports as a backup for security of supply still makes sense

Thank you



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