

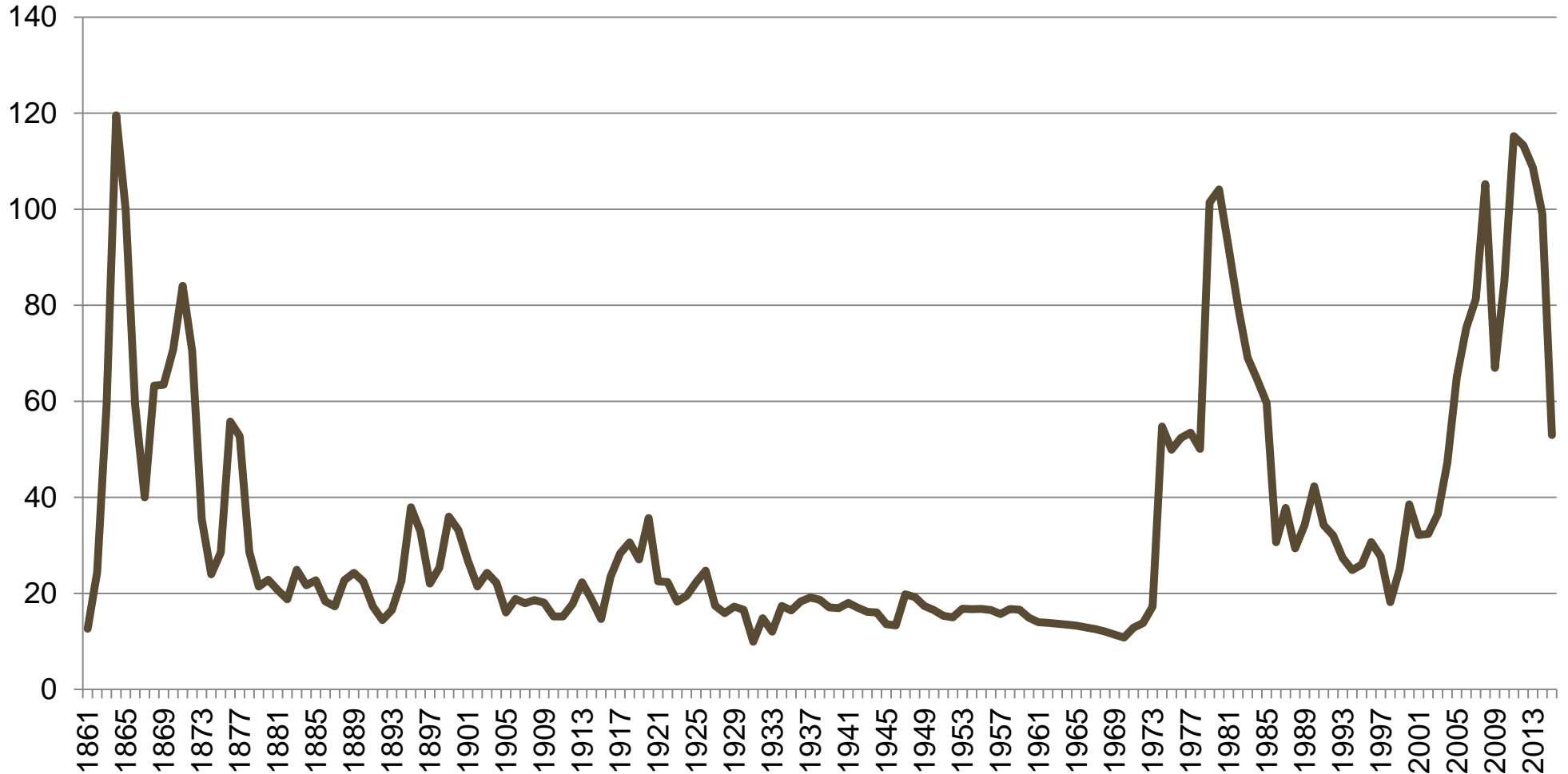


Making Sense of the Current Global Energy Markets & Prices for Crude Oil, Natural Gas & Coal – What does it mean for Myanmar’s Electric Power?

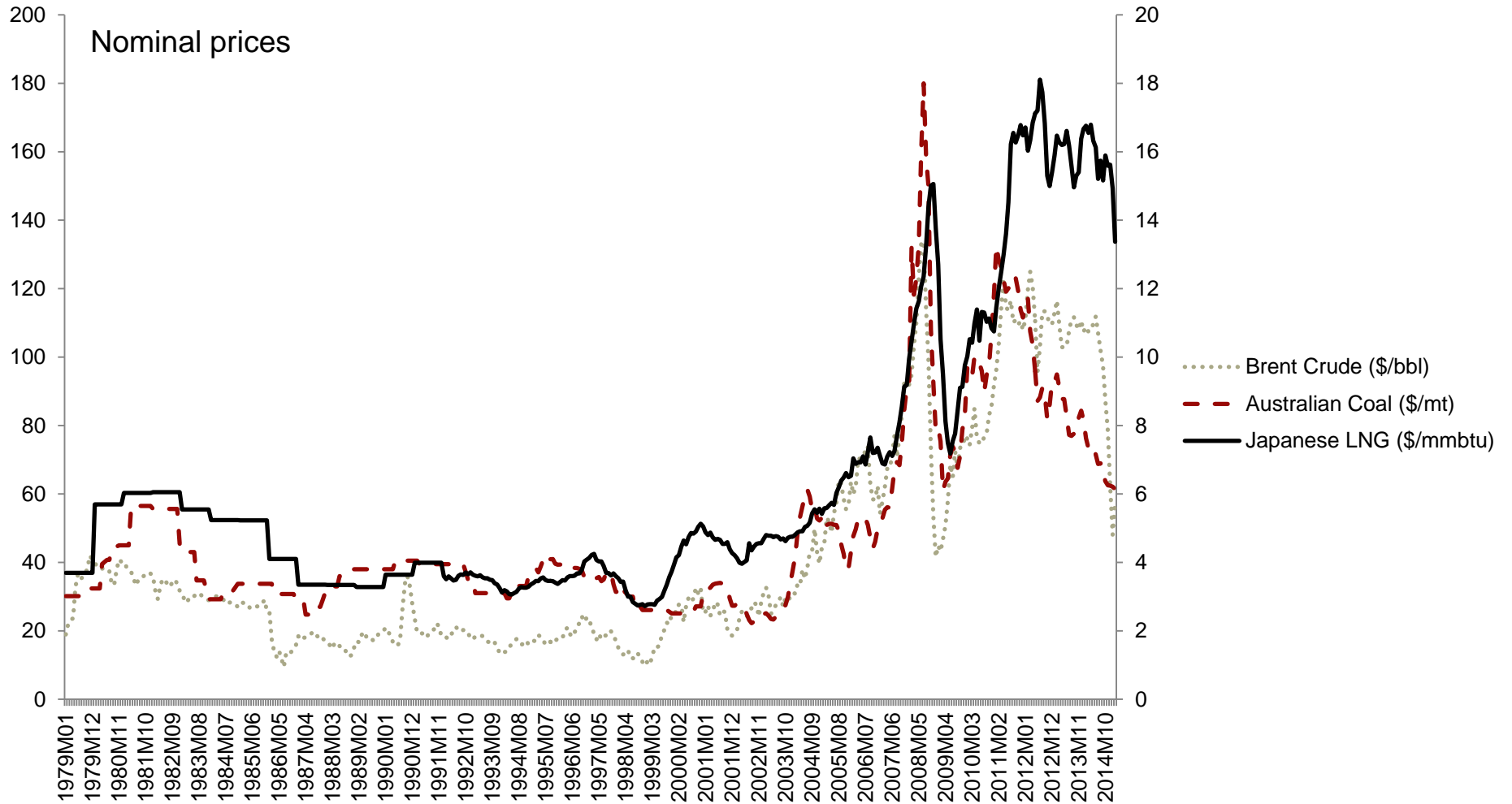
Sarah Fairhurst

Oil prices have always been volatile

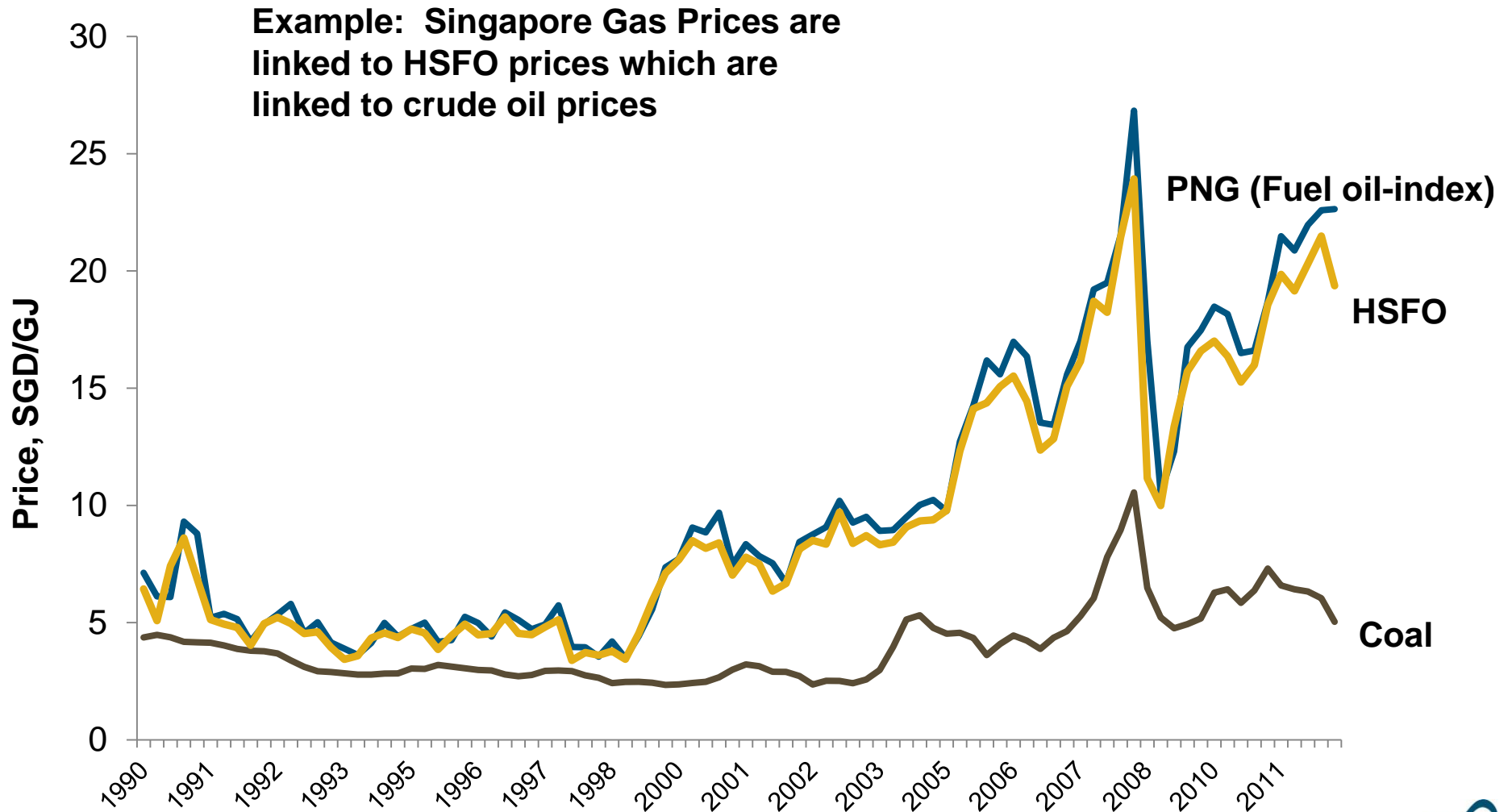
Average Annual Crude Price, USD/bbl in 2013 money



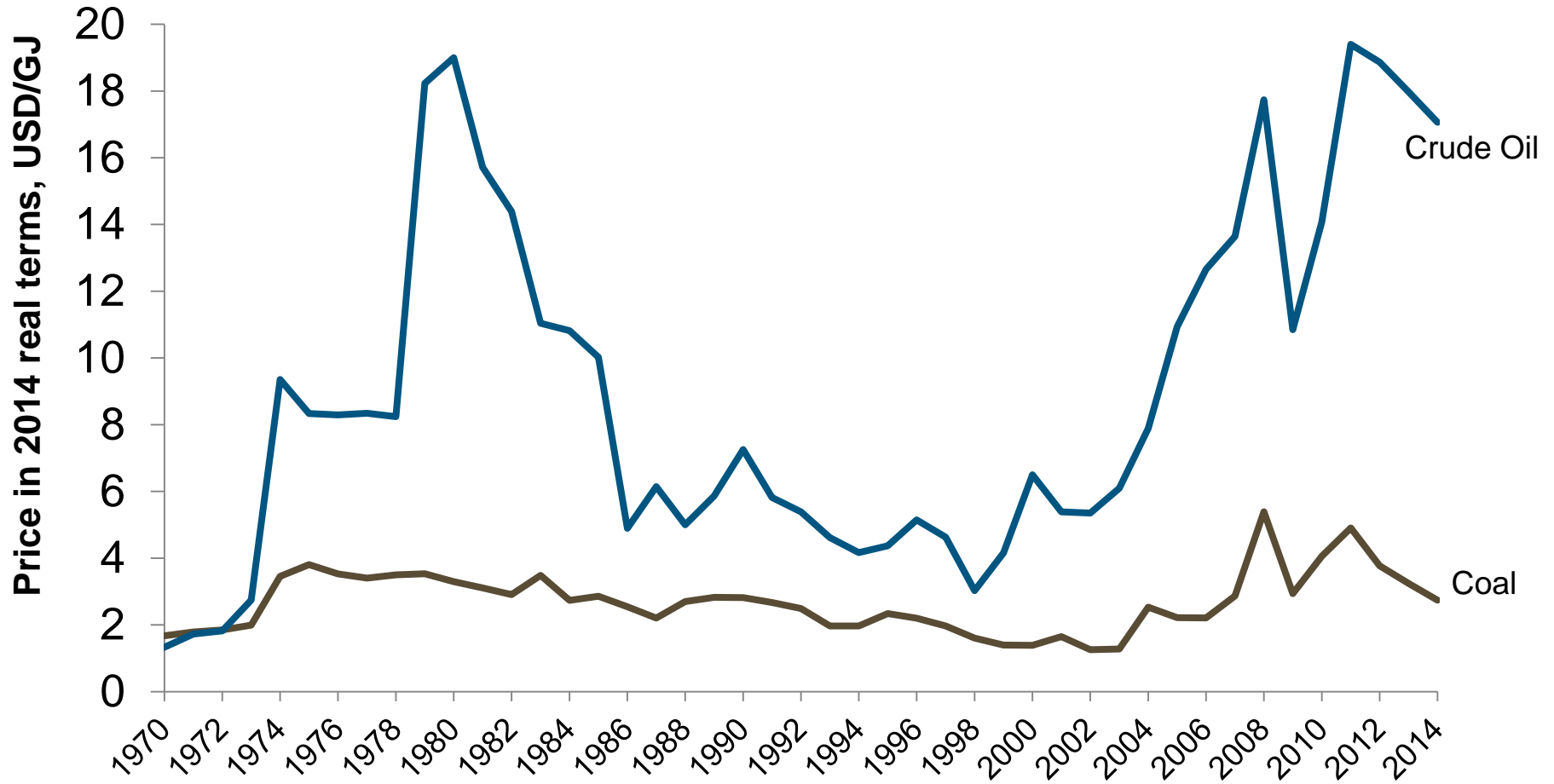
Other fuels may have a shorter history, but the messages are much the same



So understanding what drives prices is important



But not all fuel prices are linked

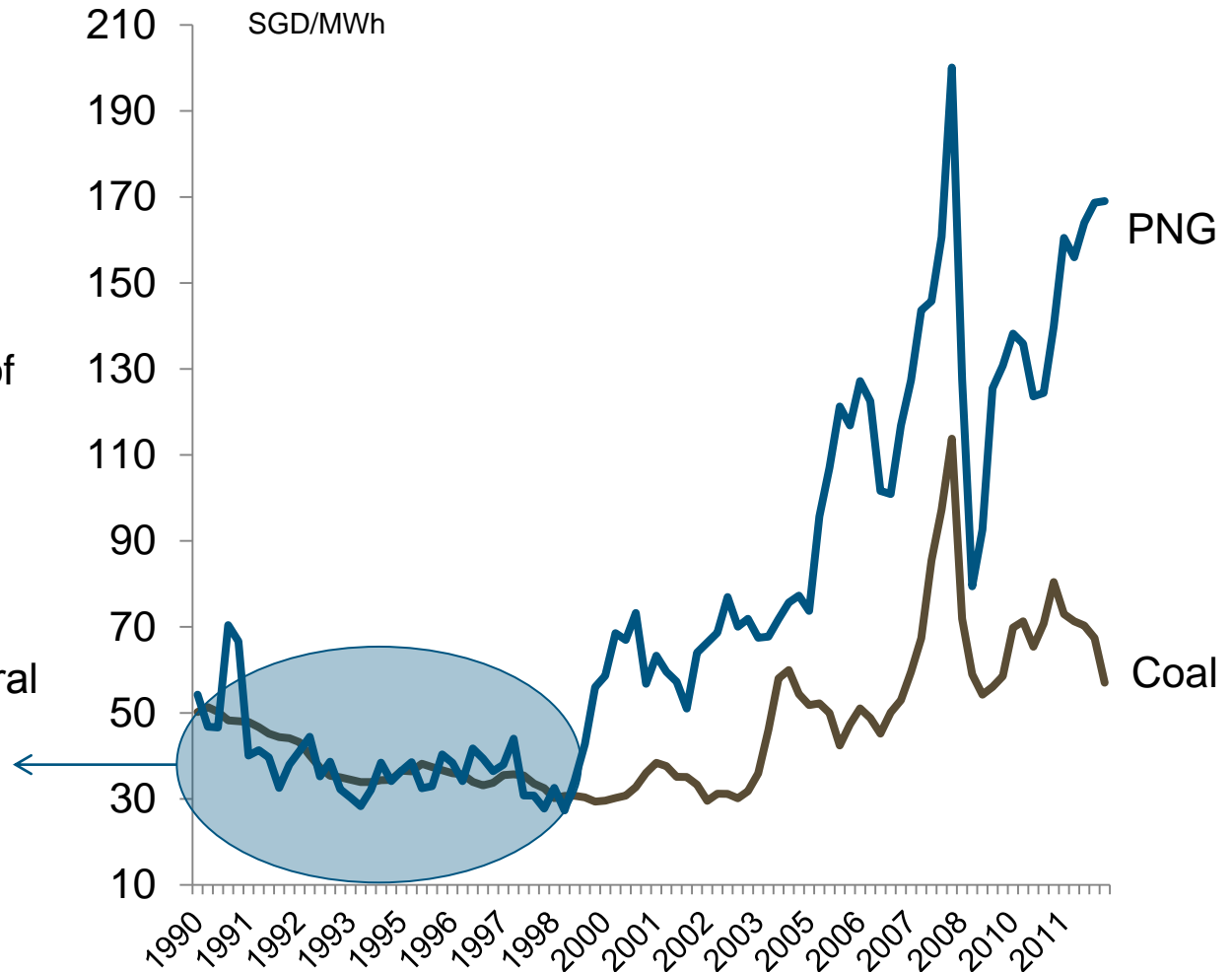


Note: Crude price: 1970 - 1987: Arab Light Crude prices ; 1988 - 2014: Brent price (historical Brent price only starts from May 1987)

And what is important is how decisions are made regarding what fuel to burn; and in the electricity industry, what type of capacity to build

Taking Singapore as an example

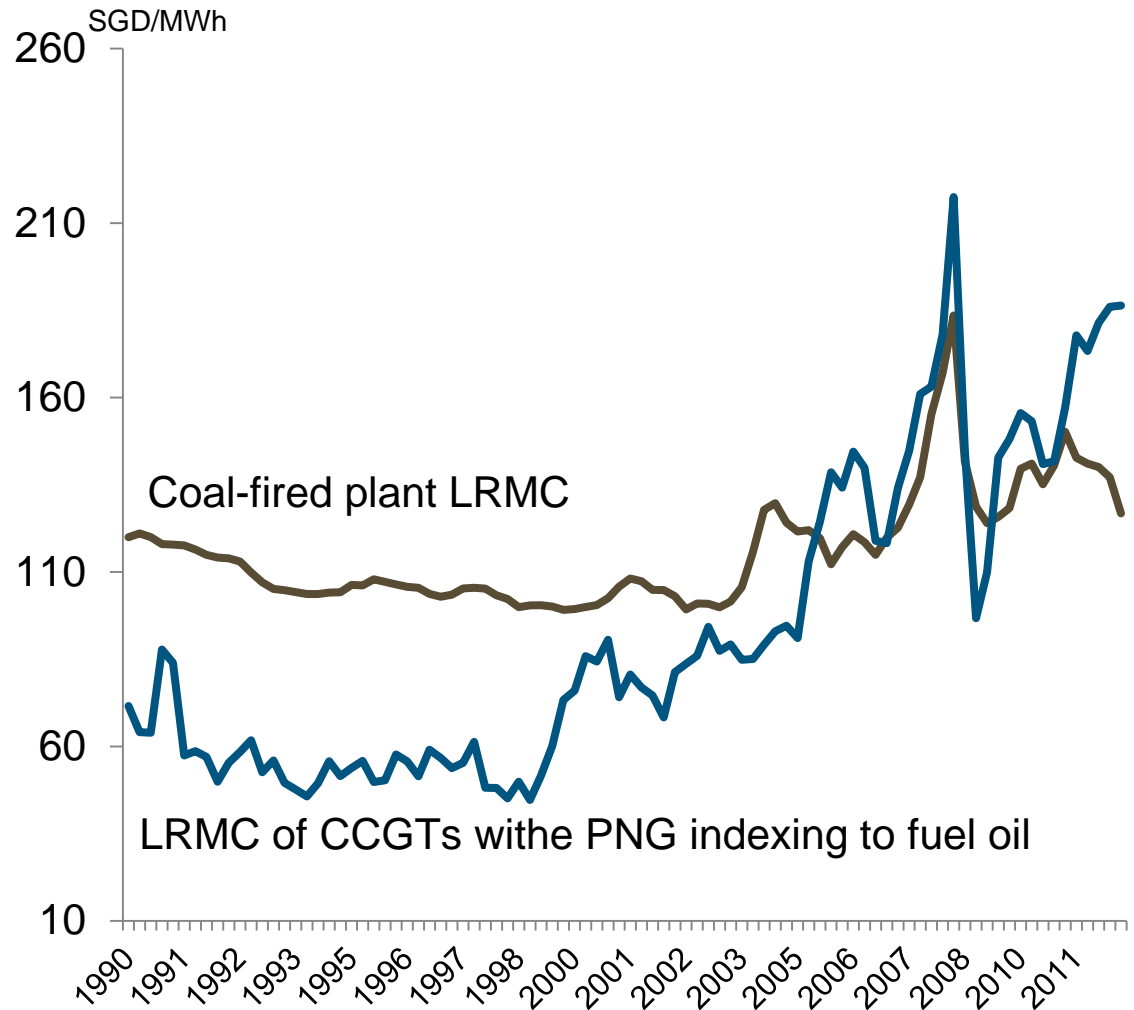
- The SRMC is the Short Run Marginal Cost of a power station
- This is approximately the same as the fuel cost of a power station, taking into account the efficiency of the power station
- In the 1990's, coal and piped natural gas (PNG, coming from Indonesia and Malaysia) had very similar marginal fuel costs



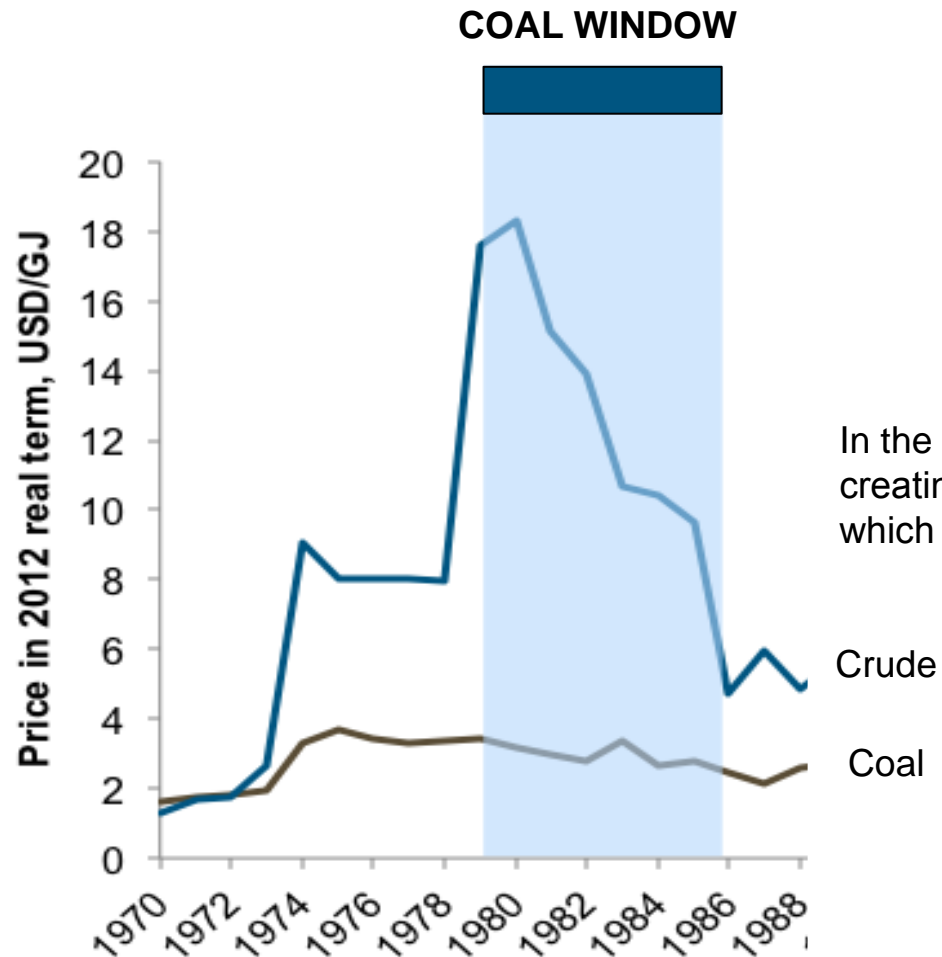
When making decisions about which plan to build, you also need to take into account the capital cost of building the power station

- Continuing the Singapore as an example....
- The SRMC showed before was very similar between coal and gas
- But when you take into account the cost of the plant, and calculate the LRMC (the Long Run Marginal Cost) of the power stations
- Then piped natural gas was a clear winner... at that time....

We will come back to what this meant for Singapore shortly.....



Looking at the history of fuel prices in Asia....



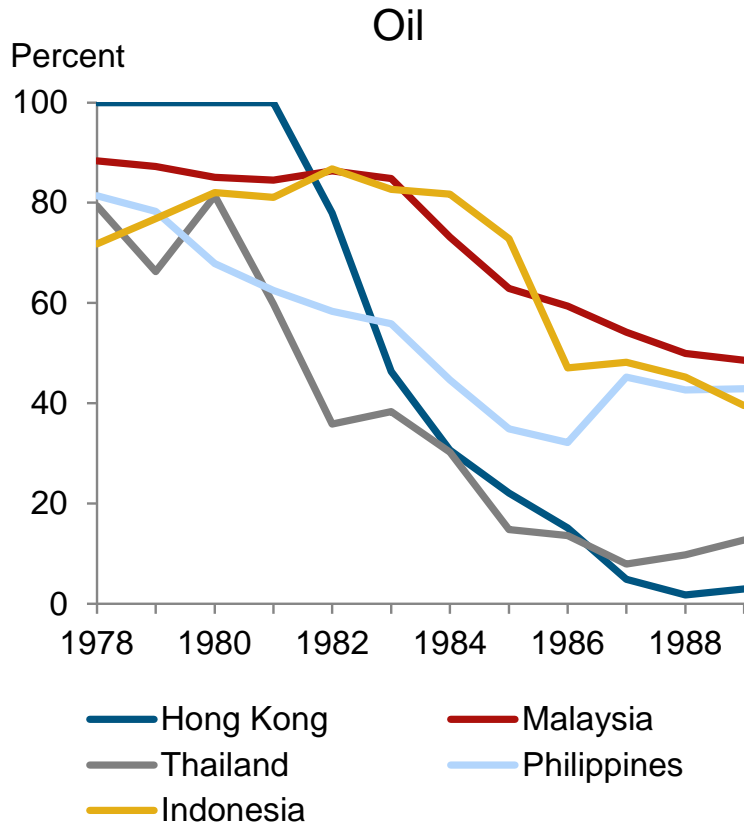
In the late 1970, oil prices shot up during the Iran crisis, creating a “coal window” for Asian countries, most of which had been using oil for power...

Note: Crude price: 1970 - 1987: Arab Light Crude prices ; 1988 - 2012: Brent price (historical Brent price only starts from May 1987)
Coal price: 1970 - 1982: average coal prices in the US from EIA; 1983 - 2012: Newcastle FOB price

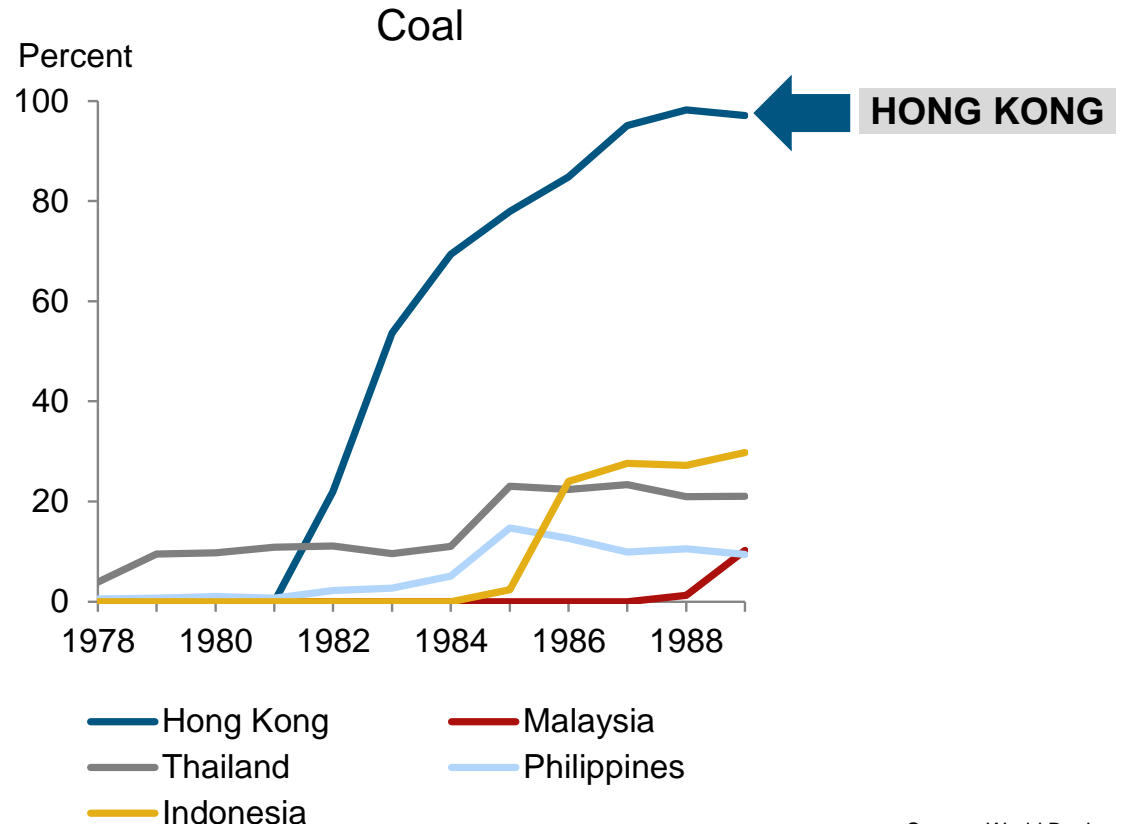
Almost all of Asia shifted away from oil after 1979

(Hong Kong was nearly 100% coal by 1988)

Almost everyone moved away from oil



With no indigenous fuels, Hong Kong moved most aggressively towards coal

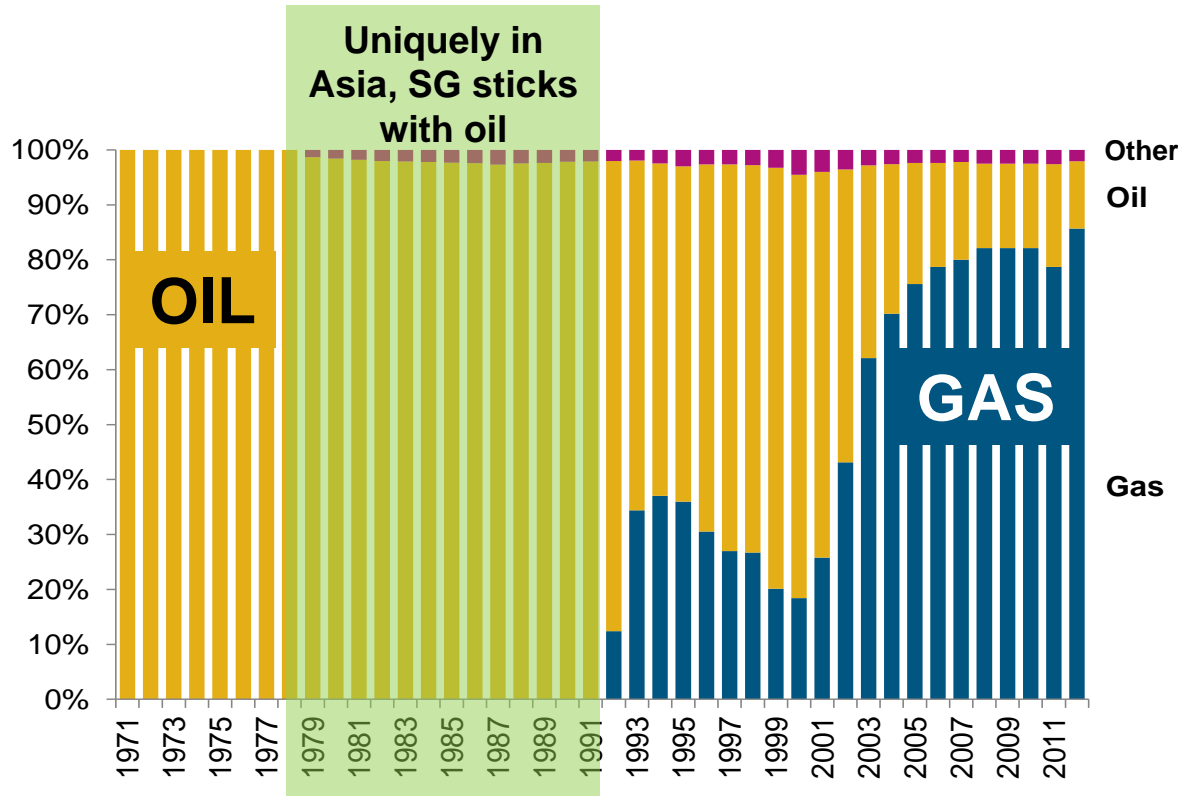


Source: World Bank

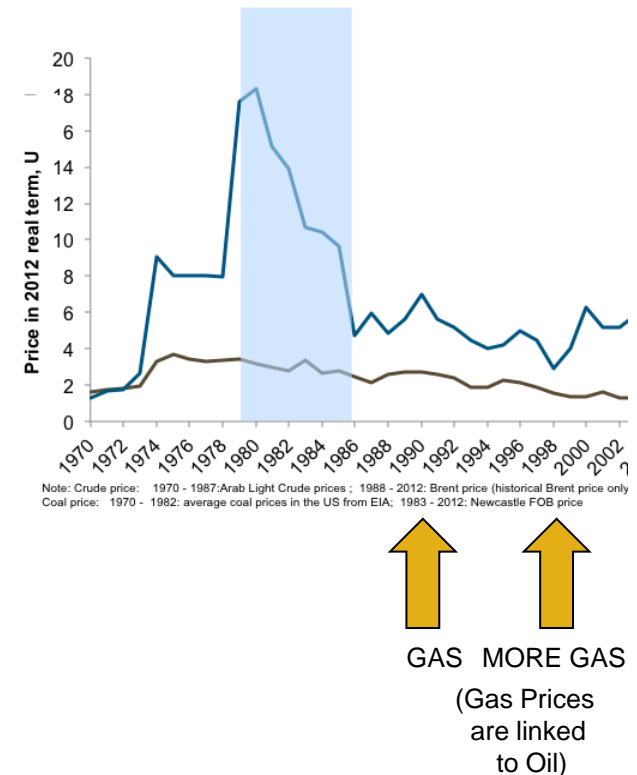
Other countries with indigenous resources started to develop them (hydro, geothermal, etc)

But Singapore stayed with oil through the 1980s, missing the first coal window, later switching to gas-fired CCGT units as oil prices fell again

Singapore's fuel mix of electricity generation (1971- 2012)



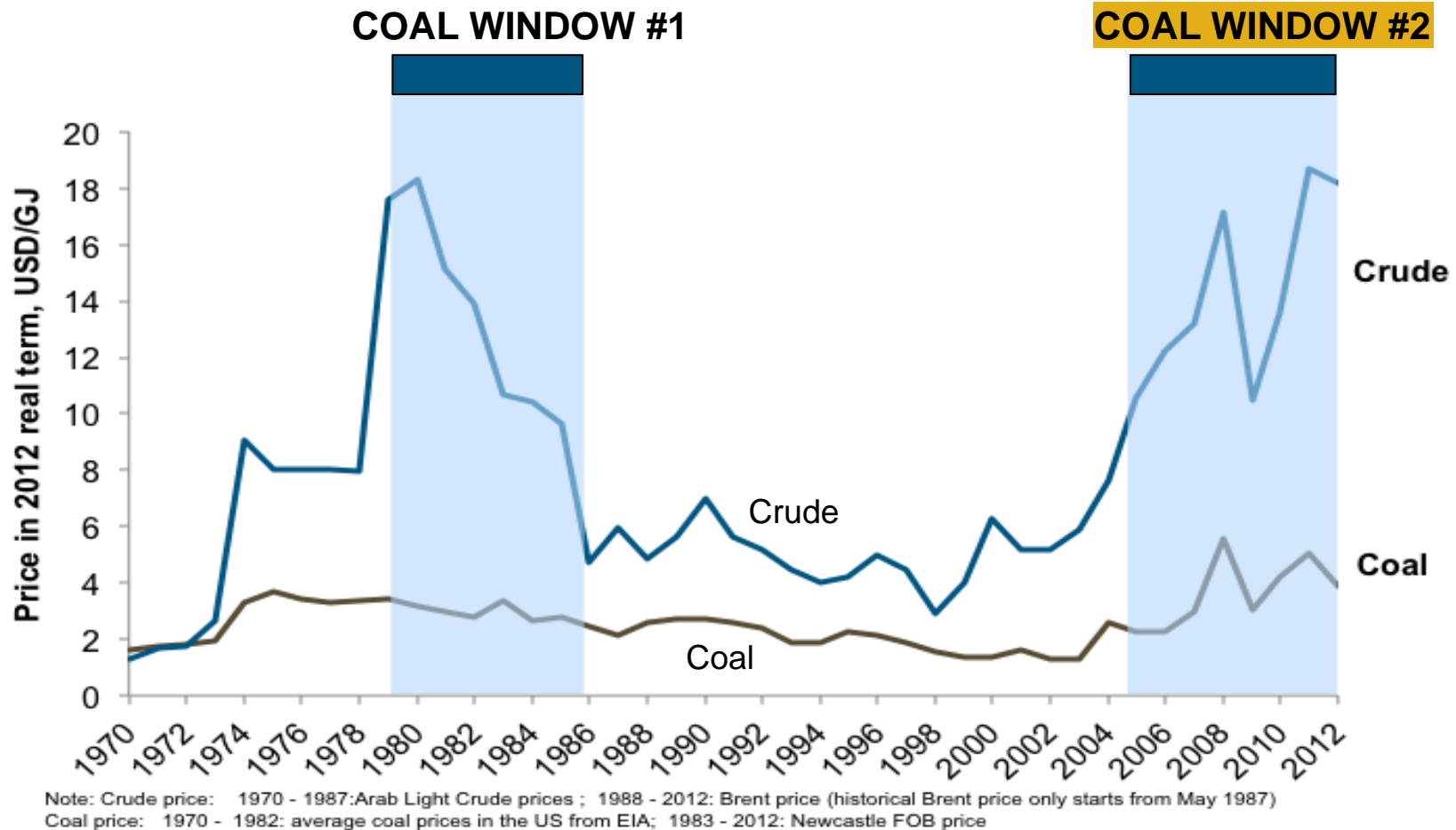
Coal Window 1



Source: IEA (1971-2010), EMA website (2011 - 2012) and TLG analysis

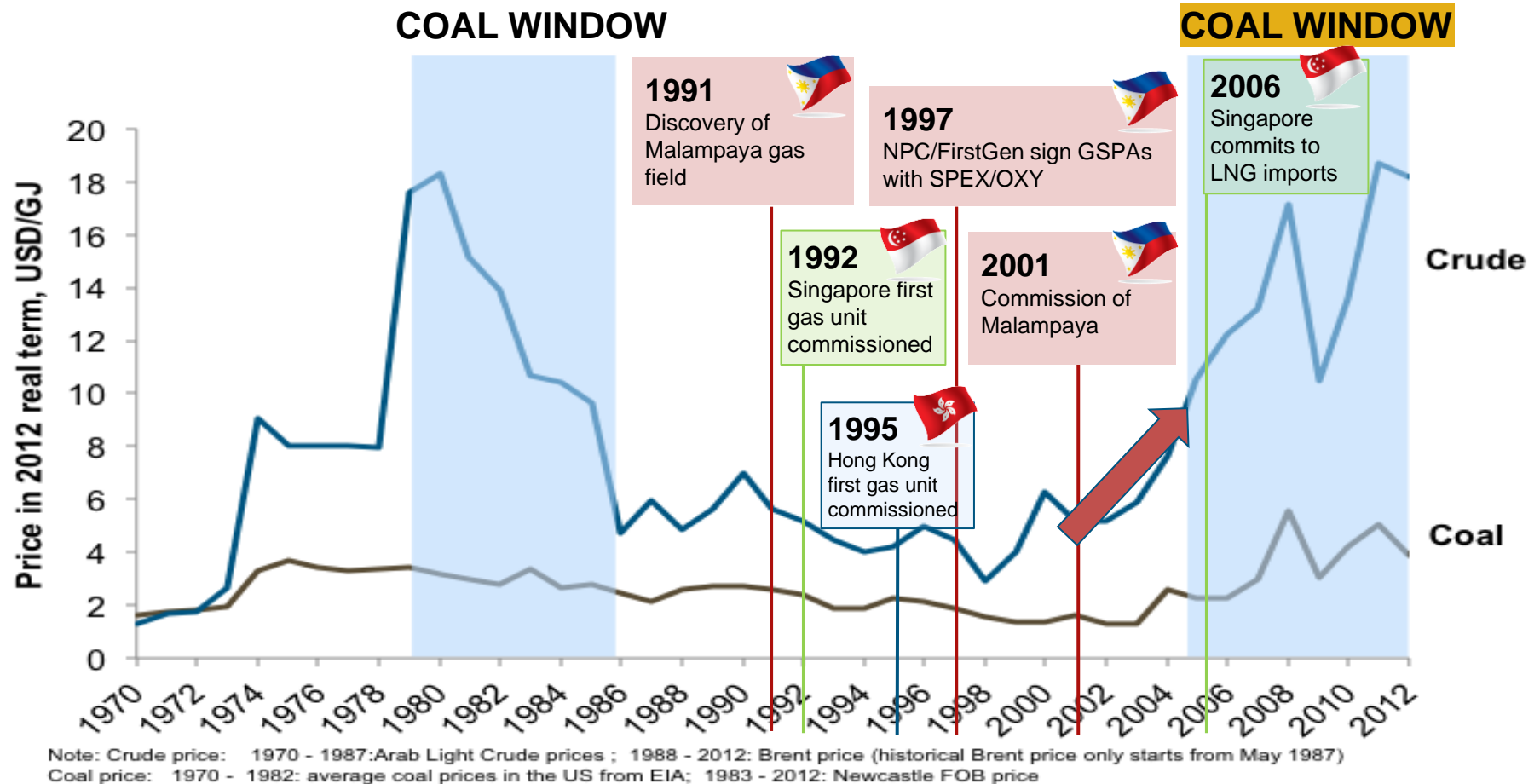
Singapore enjoyed lower oil prices for many years during the between the late 1980's and early 2000's with a fuel mix 100% linked to HSFO prices

But around 2005, a second Asian coal window opened and continues to this day



But by missing the first coal window, Singapore entered the second window without any coal

Many countries committed to gas when gas was expected to be cheaper → but, later, oil-linked gas prices increased materially



As the price of oil increased, gas prices also increased
(due to oil-price linkages in gas pricing formulae)

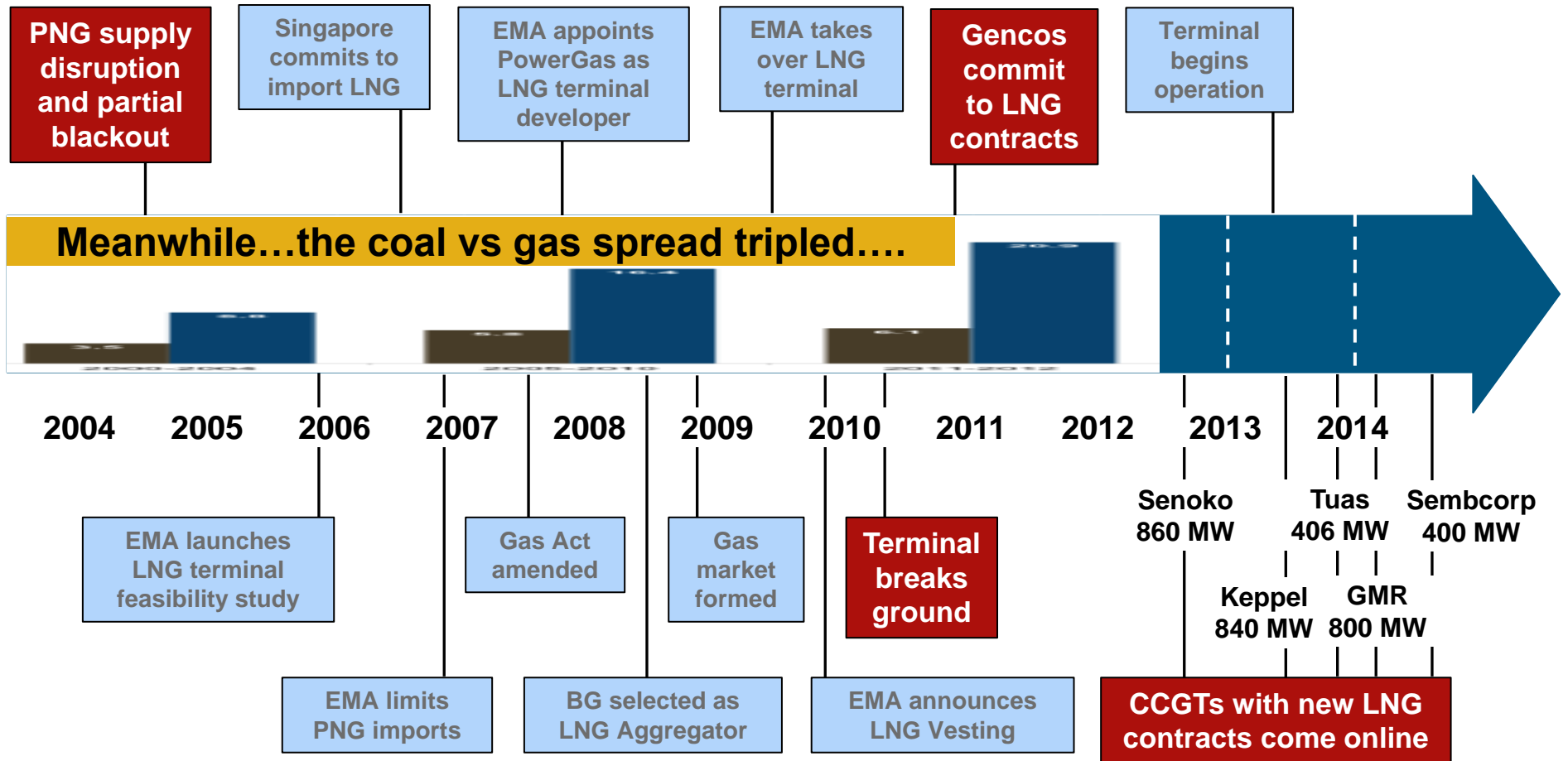
The outcome is that many countries in Asia have a diverse fuel mix

- Coal plants were built during “coal windows”
- Gas thermal or CCGT plants were built during “gas windows”
- Other local resources were developed as and where they were available
 - Hydro in Laos, Cambodia, Philippines
 - Geothermal in the Philippines

“Diverse” fuel mixes are an outcome of making good decisions at various points in time,
not an end in themselves

And not everyone makes Good Decisions

First, Singapore missed the coal window. Then In 2004, Singapore studied LNG and then commissioned a terminal in 2013

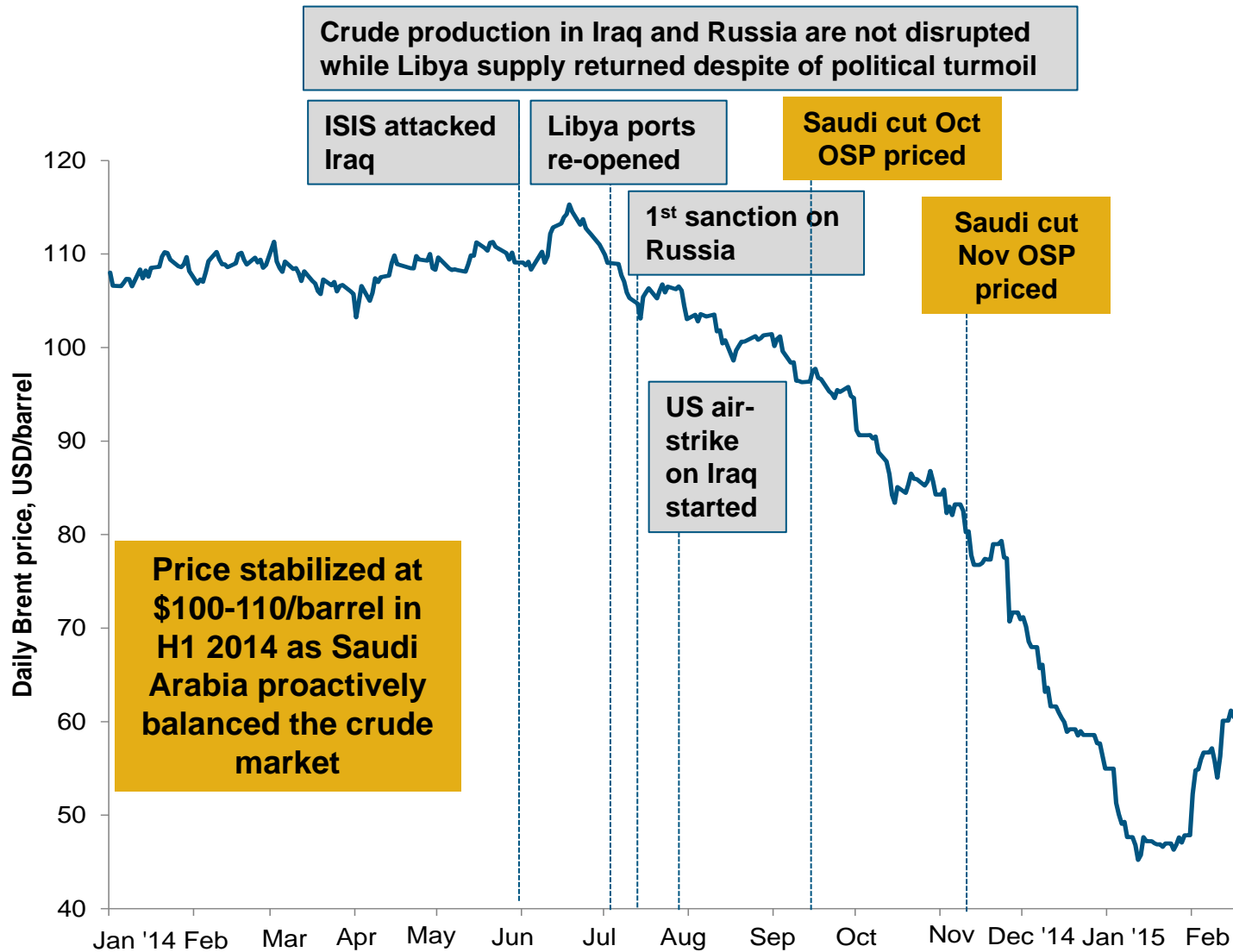


Singapore not only “missed” the second coal window, it actively ignored it!

So where to now?

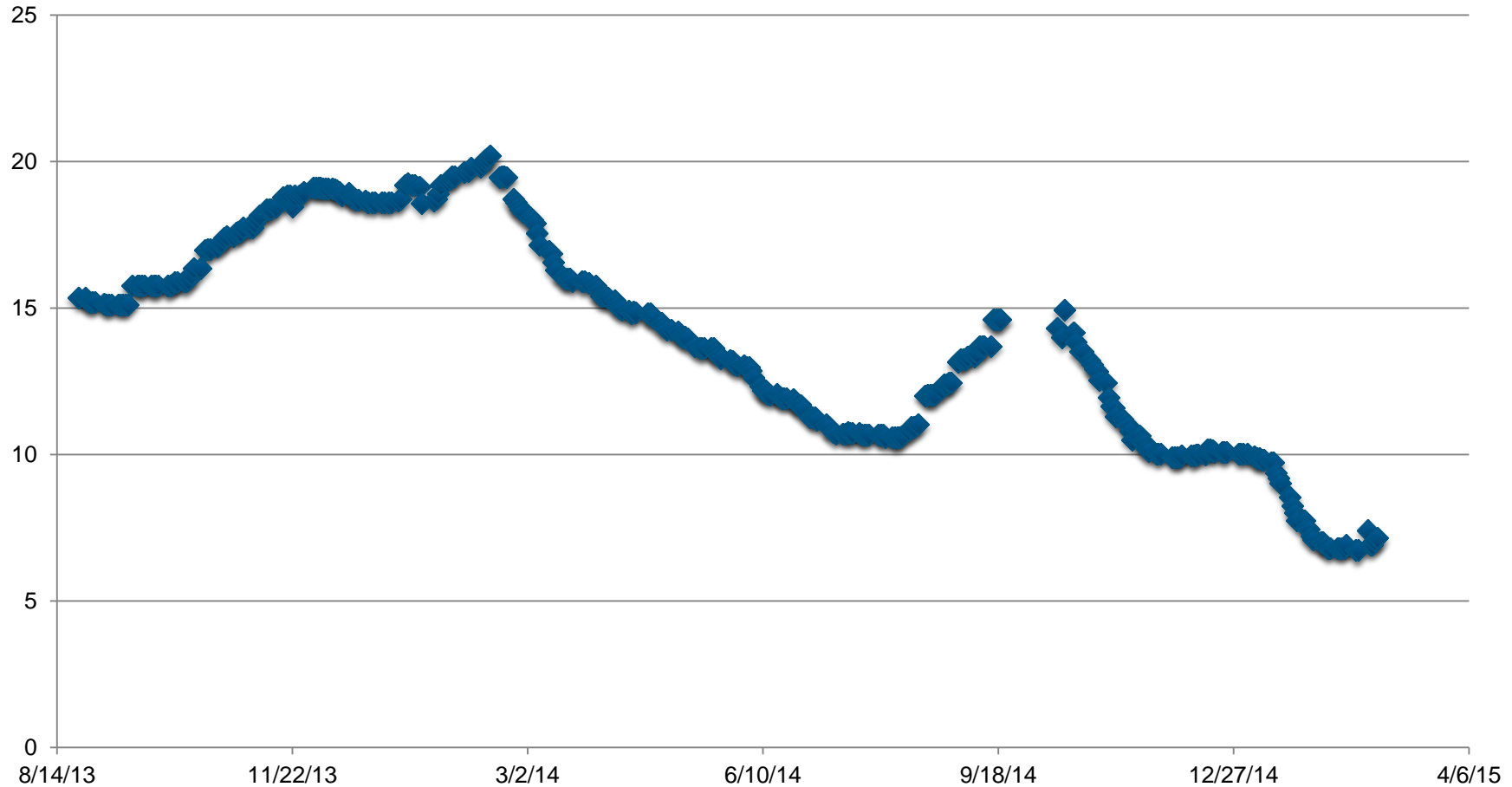
- Oil prices have fallen
- LNG prices have fallen
- ... But Coal prices have also fallen!

Brent has dropped by half from the high level in H1 2014



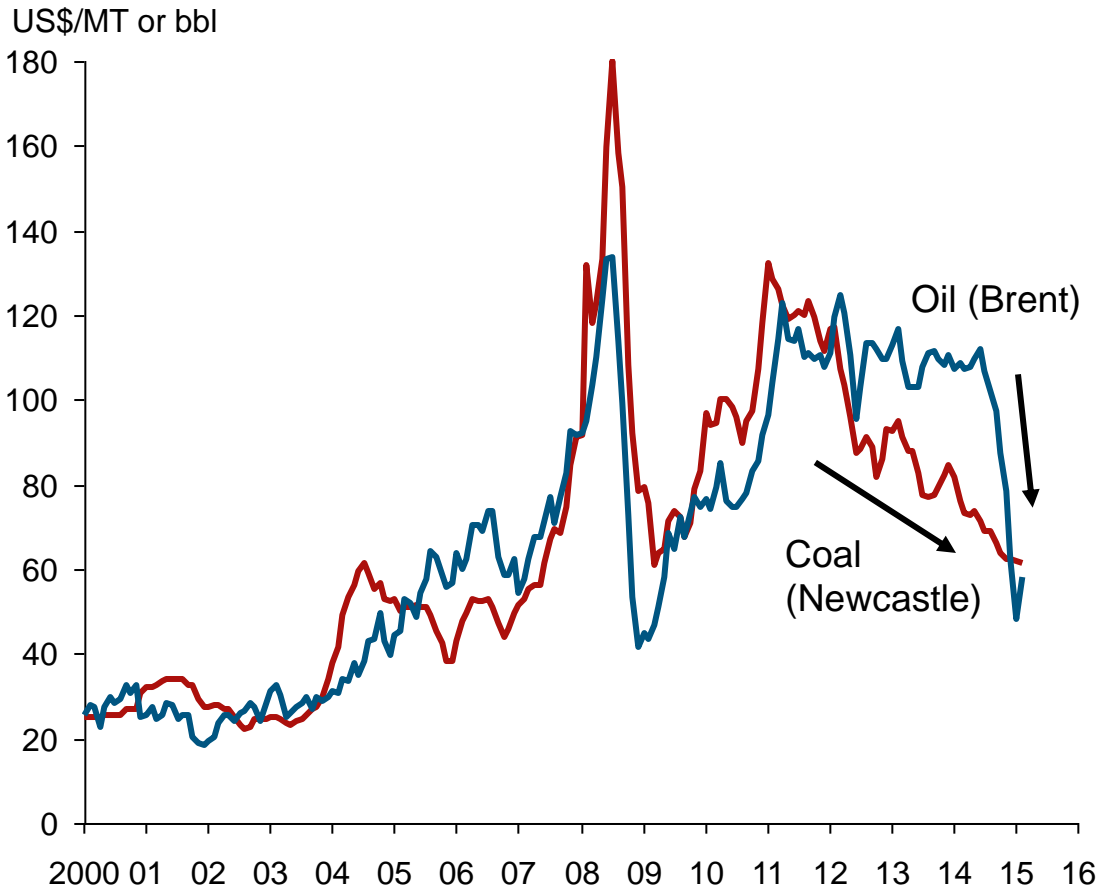
This is reflected in the spot price of LNG over the last 18 months

Daily JKM Spot Prices, \$/MMBtu



But LNG is not the only fuel to have changed price. Coal prices have also softened gradually since early 2011

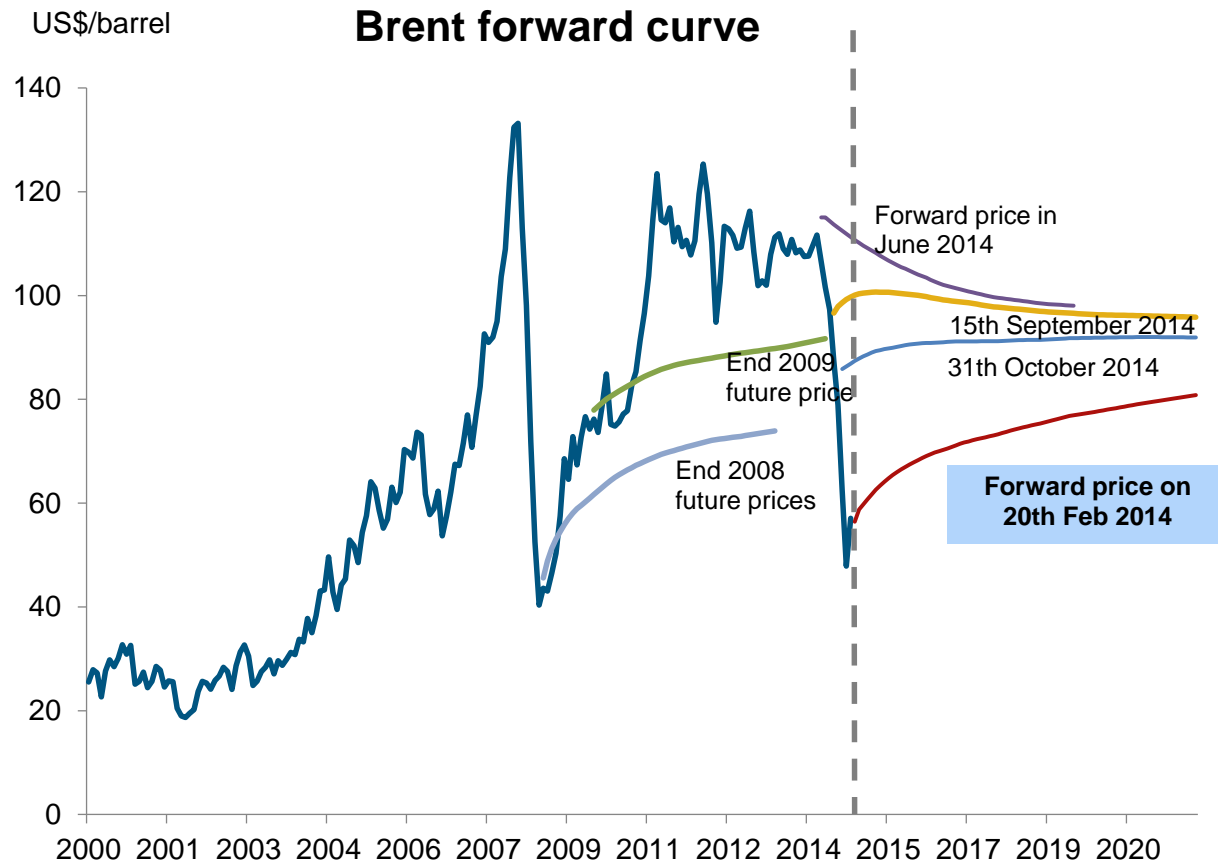
Coal and oil monthly prices (2000-Feb 2015)



Source: World Bank; Macquarie

In addition, we should not forget that the longer term has not changed as much as the short term

- Forward price curves in recent years have been quite consistent



	Dated Brent (\$/barrel)
2013 (historical)	109
2014 (historical)	99
2015 (forecast)	55
2016 (forecast)	65
2017 (forecast)	70
2018 (forecast)	75
2019 (forecast)	80
2020 (forecast)	80

Source: ICE

The market thinks that oil (and thus LNG) prices will rise again in the medium term

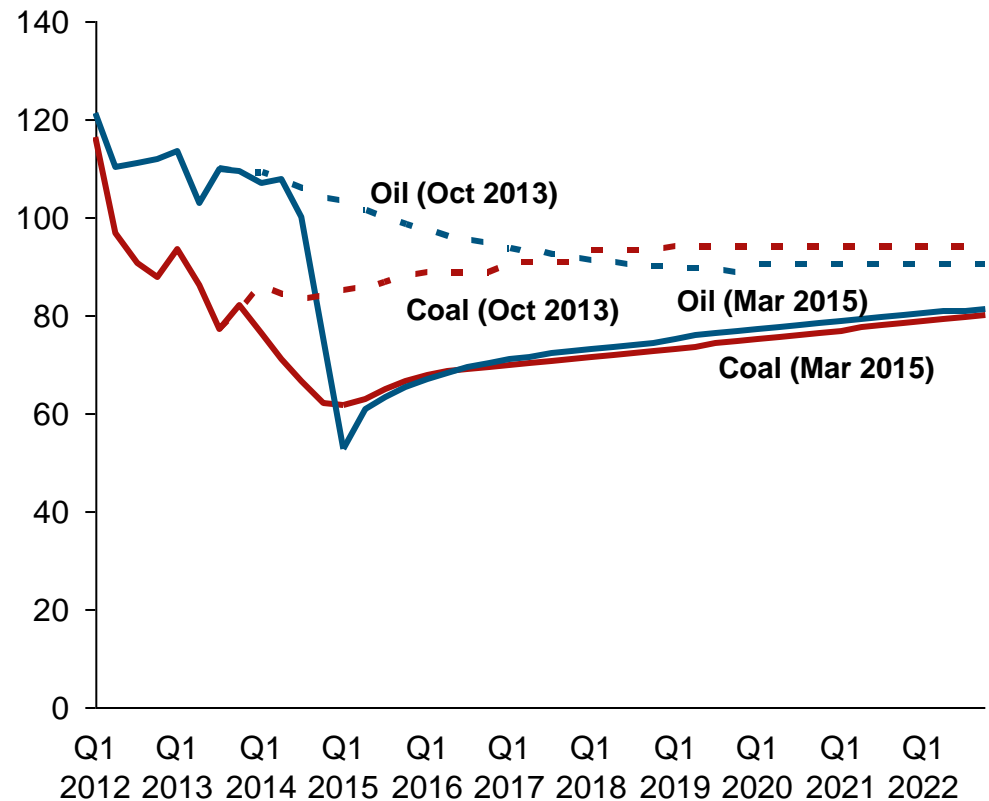
How does the changing fuel price affect the economic use of LNG in Asia?

Philippine Example

- As part of our Gas Master Plan Phase 1 analysis in October 2013, we modelled the economic use of LNG in the WESM and identified how much new plant burning LNG was economic
- At that time, expectations of future fuel prices were quite different to those now, particularly in the near-term
- To see the impact of lower LNG prices, we have re-run that analysis to see if the outcome has changed

Comparison of oil and coal price projections

US\$/bbl or US\$/mt (2013 prices)

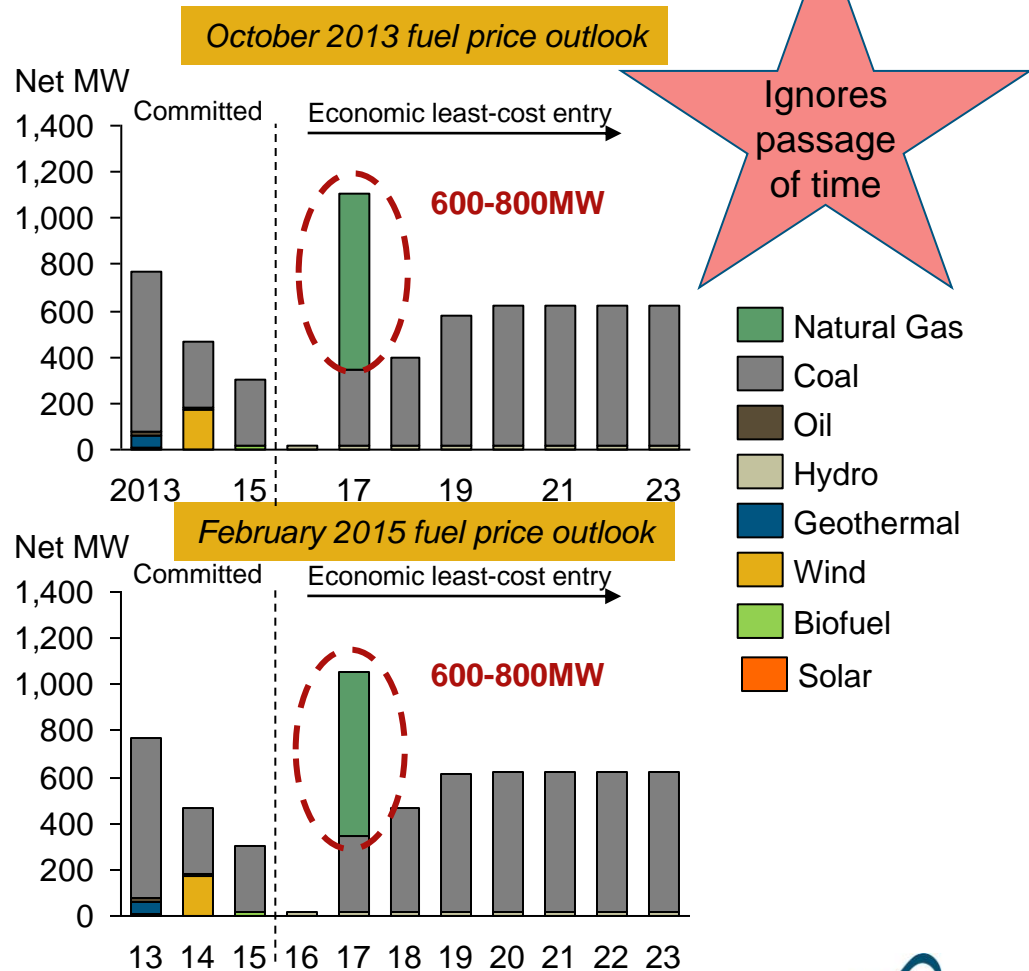


The results were remarkably consistent with the previous analysis – there is still a clear economic role for LNG in the power sector

- The economic new build of CCGT using these updated fuel price assumptions is still about 600-800MW
- If the economic new build were built, these plants would run mid-merit/peaking (varying between 15%-35%) and consume c. 0.1-0.3 mmtpa of LNG
- Existing gas-fired plant would also eventually switch to LNG
- Total demand for LNG in Luzon’s power sector would exceed 0.6 mmtpa

LNG remains a good fuel for mid-merit and peaking operation but it is unlikely to be an economic baseload fuel

Least-cost capacity expansion plan for Luzon under expected assumptions



But other (Philippine specific) developments also affect the need for more gas-fired capacity and ultimately more LNG demand



- More gas fired capacity has been built
 - FirstGen’s San Gabriel phase 2 and Avion have since achieved financing and are under construction
 - They plan to eventually use Malampaya gas and ultimately LNG
 - Changing the way Malampaya gas is used supports the entry of more gas-fired capacity and ultimately more LNG

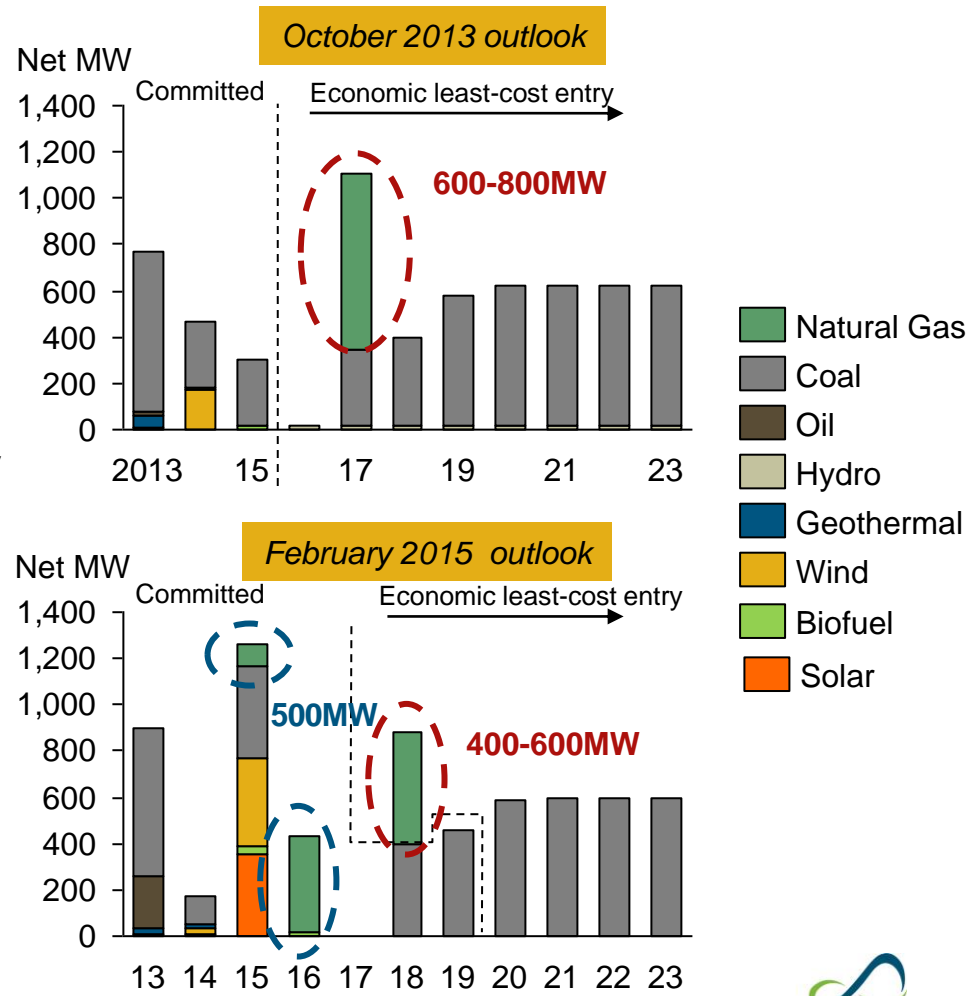


- Government policy is adding renewable to the system
 - Significantly more solar and wind capacity appears likely in response to Government policies increasing total available capacity
 - More intermittent generation may require more flexible plant in the system to respond to times when solar and wind are unavailable



- Market interventions are reducing incentives to build peaking capacity
 - Lower offer price cap and new secondary price cap decrease the incentives to build new gas-fired capacity

Least-cost capacity expansion plan for Luzon under expected assumptions



Source: TLG analysis

In the Philippines, the message remains substantially the same as last year, despite the large global changes in prices

- We are still in a “coal window” – albeit one with a smaller gap between the economic use of coal and gas
- LNG is economic in the Philippines for mid-merit operation
 - This conclusion holds for much of Asia
 - The lower capital costs of building CCGT mean that even high gas or LNG prices support the use of gas/LNG for mid-merit and peaking operations
 - *(In countries where there IS mid-merit or peaking, rather than “everything we possess, all of the time!”)*
- The volume of LNG required is modest
 - Mid-merit and peaking operations do not require that much fuel
- There remain challenges and issues in bringing LNG into the Philippines and incentivising the market to build and burn the economic quantity of LNG
 - This conclusion also holds for much of Asia – there are unique challenges, opportunities or issues in each individual country
 - In Myanmar, the biggest issue may not be coal vs gas, but may be whether to move straight to distributed renewable solutions

So what does all this mean for Myanmar?

- Myanmar has the advantage of having a “blank slate” right now
- It has various fuel options available – indigenous gas, indigenous or imported coal, hydro, other renewable options etc.
- There are advantages and disadvantages to using different fuels..... It just depends which criteria is most important
- Such criteria may include:
 - Overall cost
 - Short term (upfront) costs vs long term (operational) costs
 - Impact on foreign exchanges
 - Speed to build
 - What can be most easily financed
 - Geographical considerations

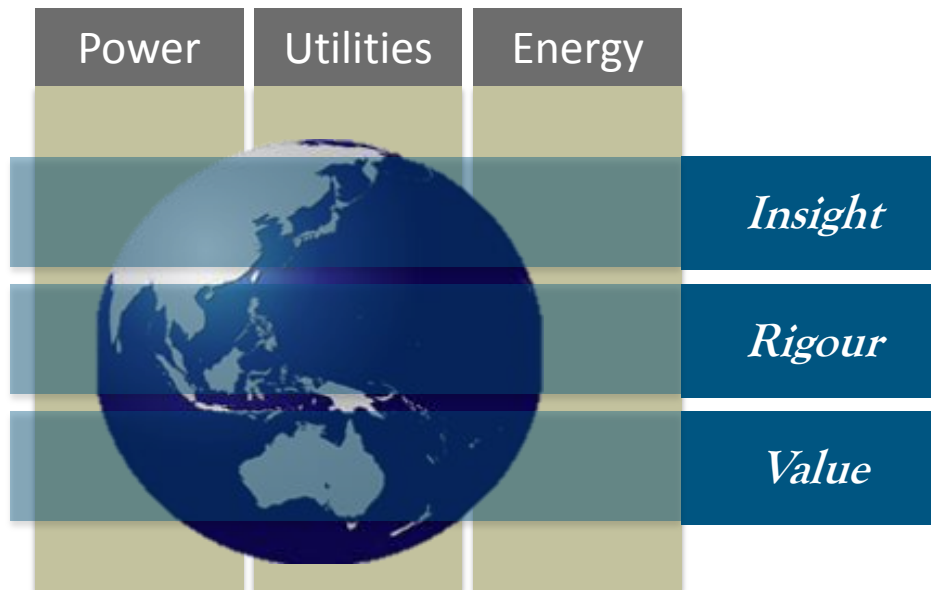
The decisions need to take into account all the criteria

- Across Asia, coal remains the cheaper baseload option while gas makes a very good flexible resource for mid-merit loads
 - This point may be unimportant if there is only “baseload” or “blackout”!
- Indigenous options save hard currency outflows and can be priced to be more stable
 - But using indigenous fuel (eg gas) gives up the option of exporting it for hard currency
- Gas plants may be more expensive, but they are much faster to build
 - Is speed or cost more important?
 - How long are you locked into the higher costs for? (Rental options may help here)
- Different parts of the country may require different solutions
 - For grid-connected generation, traditional larger thermal or hydro plants make more sense than intermittent “renewables”
 - For remote areas, distributed renewable solutions such as solar or micro-hydro plus batteries may be a much faster and cheaper way to electrify the population than building out a distribution network and building large grid-connected power stations

The best outcomes will come from making good decisions

- Identifying clearly the overall goal, including timeframes and cost limitations
- Reviewing ALL the options (including the less conventional ones such as newer technology)
- Analysing the implications of each
 - Needs a clear analytical framework
 - And an understanding of how to do economic analysis
- Making policy that supports the private sector and public sector to invest in the most appropriate options
- Continuing to review and update the assumptions and policy as the situation changes

Thank You



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