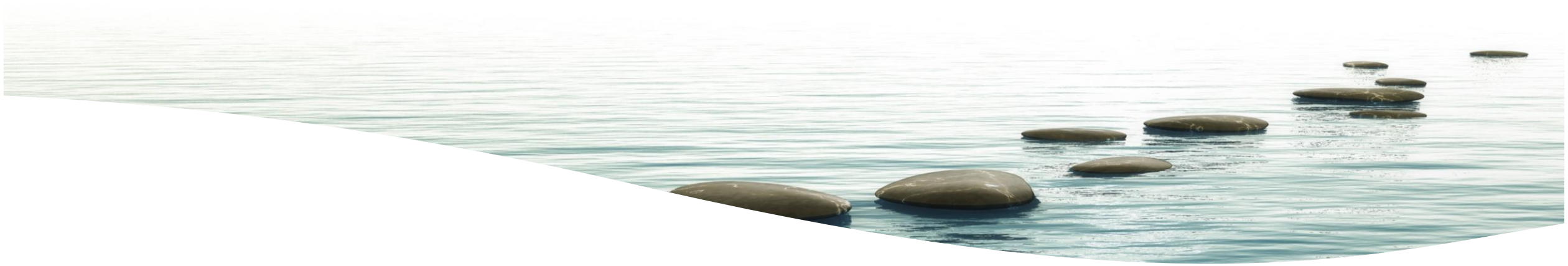

Impact of COVID-19 on the Singapore Power Sector and Future Investment Opportunities and Risk

May 19 2020

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Topics

1 **The Impact of COVID-19 on the Power Sector in the Near Term**

2 **Investment Opportunities and Risks Post COVID-19**

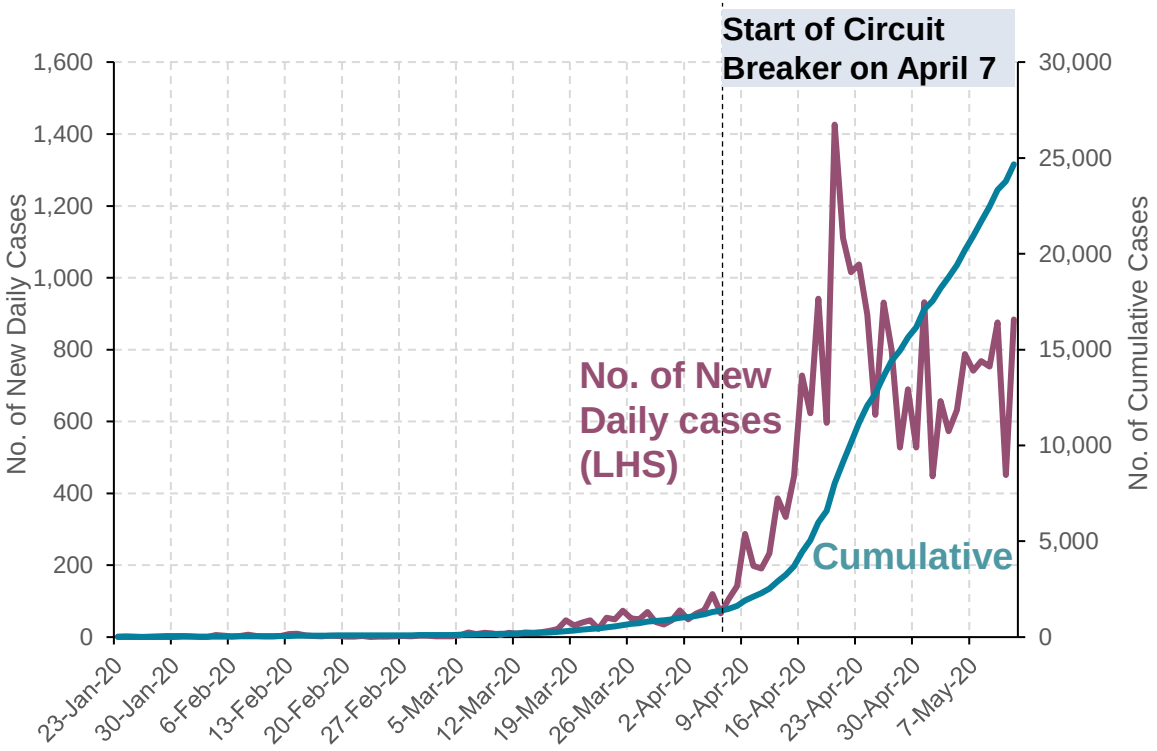
Summary
The Singapore power market will continue to experience challenges in the next few years, but opportunities still exist for long-term investors

- **Status of COVID-19 in Singapore**: With the outbreak of COVID-19 cases in the dormitories for the migrant workers, it remains highly uncertain how the situation will evolve after restriction measures are gradually eased from 1 June onwards.
- **Impact on GDP**: COVID-19 has material negative impact on the near-term economic outlook [GDP could be down by 4 percent in 2020], and increases the uncertainty of economic growth in the medium-term.
- **Impact on demand and spot price**:
  - Power demand shock due to circuit breaker is 8-15% in SWEM, and spark spread remains negative/close to zero
  - The daily load curves are “flattened” due to load reduction in the commercial sector; normal price pattern over the day has also changed
  - Demand will likely rebound gradually in H2 2020 but spark spread will remain low/negative due to rigid constraints on take-or-pay (ToP) gas.
- **Future Market Evolution:**
  - In 2021-2022/23, even if ToP gas is no longer in excess, the marginal fuel is the less expensive gas (i.e. PNG) in most hours, leading to low spark spread
  - After 2022/23, existing gas contracts will expire. Nonetheless, Singapore still has homogeneous technology and likely similar gas cost, resulting in a very flat merit order curve. Thus, Gencos’ profitability will be highly uncertain as it depends on their ability to exercise market power to drive up prices if SWEM remains as energy-only market
  - By 2026, new investment is likely required to replace old capacity and meet demand growth arising from addition of data centres
  - Singapore government has been doing a study to introduce a Forward Capacity Market since early 2019; as the market will become two-parts (capacity payment + energy margin), Gencos may be able to have higher revenue certainty.
- **Investment Opportunities:**
  - Build new capacity [in Singapore or in Malaysia and export to Singapore] to meet demand growth and replace old capacity
  - Merger and acquisition opportunities exist as some players would like to exit the market.

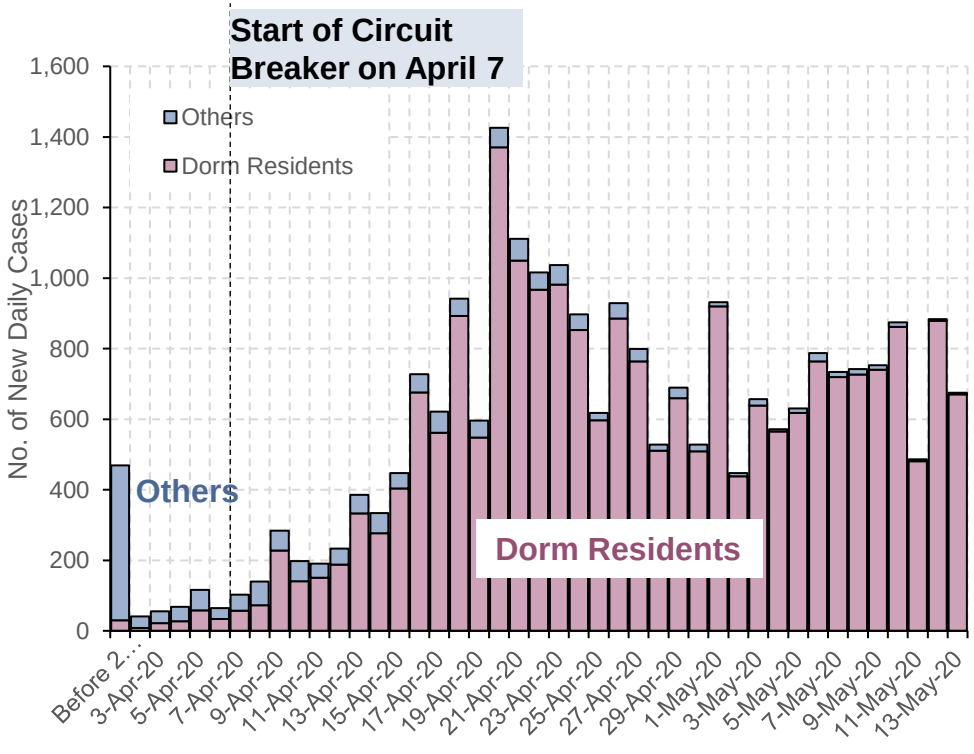
Status of COVID-19 in Singapore

With the outbreak of COVID-19 cases in the dormitories for the migrant workers, it remains highly uncertain how the situation will evolve in Singapore

No. of COVID-19 Cases in Singapore



Break-down on the No. of COVID-19 Cases



- No. of daily new cases have remained very high (>500) since mid April while more than 90% of the cases are from clusters in the dormitories for the migrant workers
- The implementation of circuit breaker measures from 7 Apr – 4 May is essentially a partial shutdown of the economy. On 21 April, the measures were further extended by another four weeks till 1 June, with more tightened measures; the Singapore government has announced that it is going to gradually ease the restrictive measures from 1 June onwards.

Source: Ministry of Health Singapore, WaterRock Energy Research and Analysis

Impact of COVID-19 on the Economy

COVID-19 has material impact on the near-term economic outlook, and increases the uncertainty of economic growth in the medium-term in SG

Key Macroeconomic Indicators

Expected GDP Growth Rate

- Q1 2020 growth rate is **- 2.2%**
- Forecast: **IMF** in April 2020: **-3.5%** in 2020 and 3.0% in 2021; **MAS** on April 28, 2020: **-4% to -1% in 2020** (assuming gradual recovery in H2 2020).

Government actions:

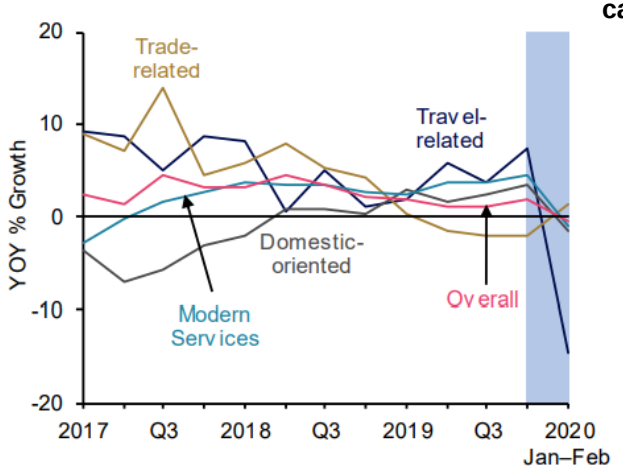
- To provide financial relief to businesses and households, the government has announced three stimulus packages, totaled about **S$ 60 billion**, equivalent to 12% of GDP.

Macro fundamental is relatively healthy:

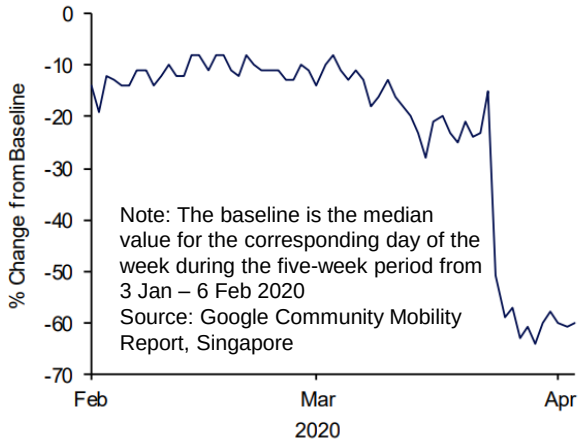
- Government debt to GDP ratio is 126% in 2019, higher than the historical level
- Household debt to GDP is at 64% in 2019, comparable to the level in 2008 and lower than the level in 1997
- Total official foreign reserves is **USD 279 billion** as of March 2020, equivalent to about 80 percent of its GDP
- SGD has depreciated slightly against USD, but exchange rate remains largely stable

Singapore Economic Activities

Economic Activities

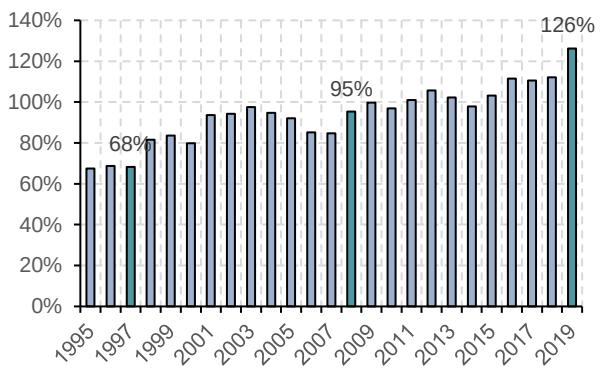


Population Mobility Trends (restaurants, cafes, malls and other recreational places)

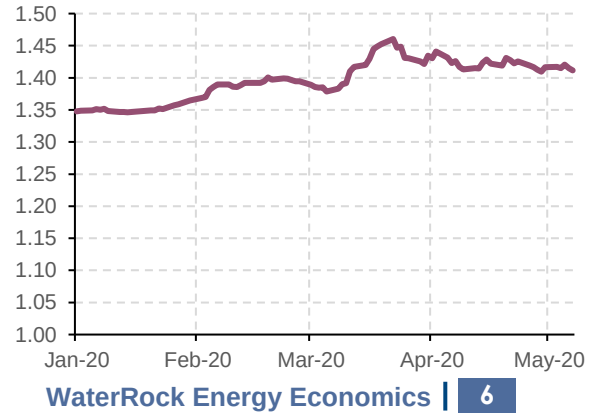


Source: Singapore MAS, Macroeconomic Review Volume XIX Issue 1, Apr 2020, published on April 28, 2020

Government Debt, % GDP



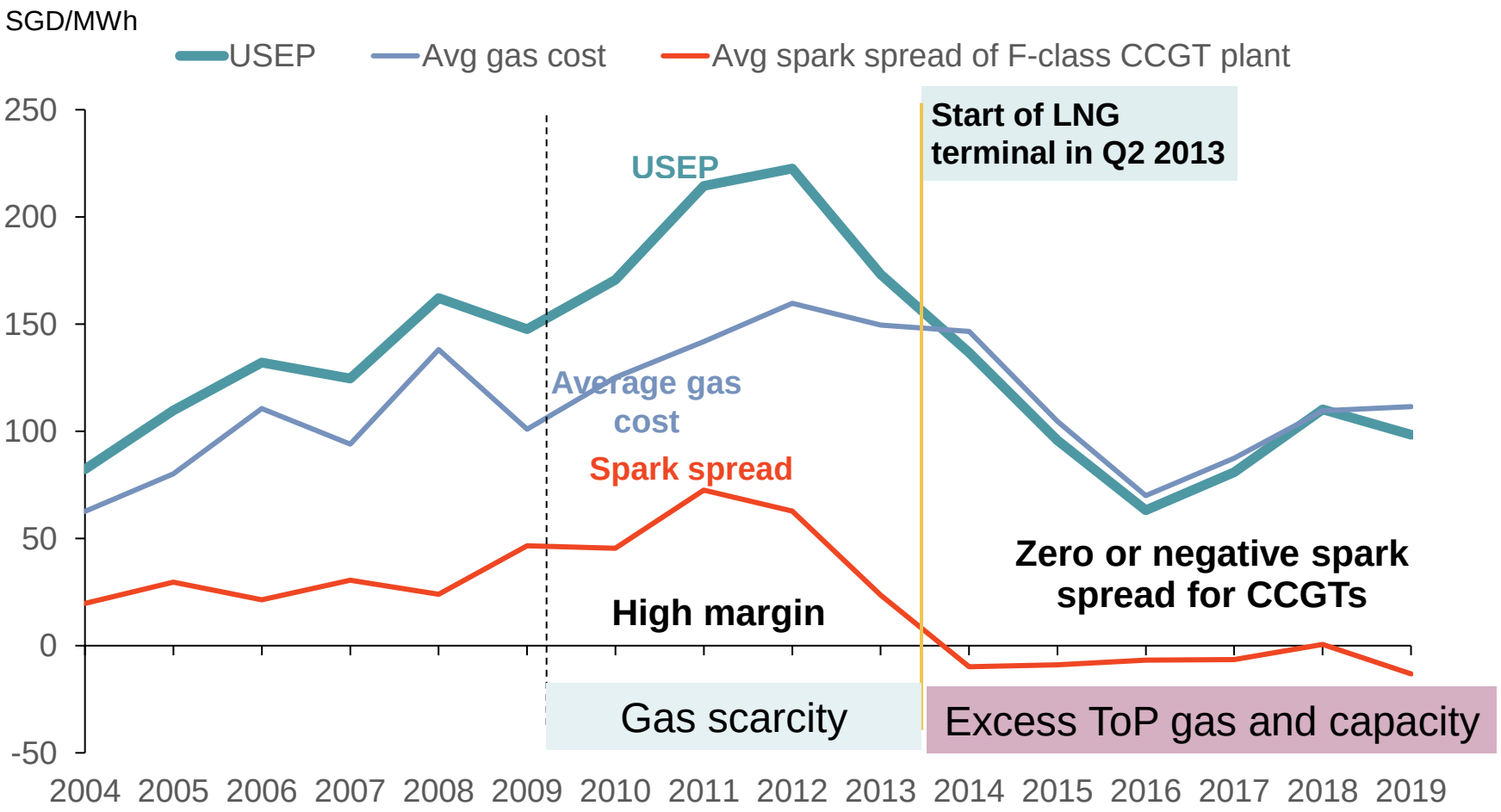
USD/SGD Exchange Rate



History of Singapore Wholesale electricity Market (SWEM) [1 of 2]

Even before COVID-19, the spark spread in SWEM has been zero/negative since 2013 due to excess take-or-pay gas and excess capacity

Market Prices and Spark Spread



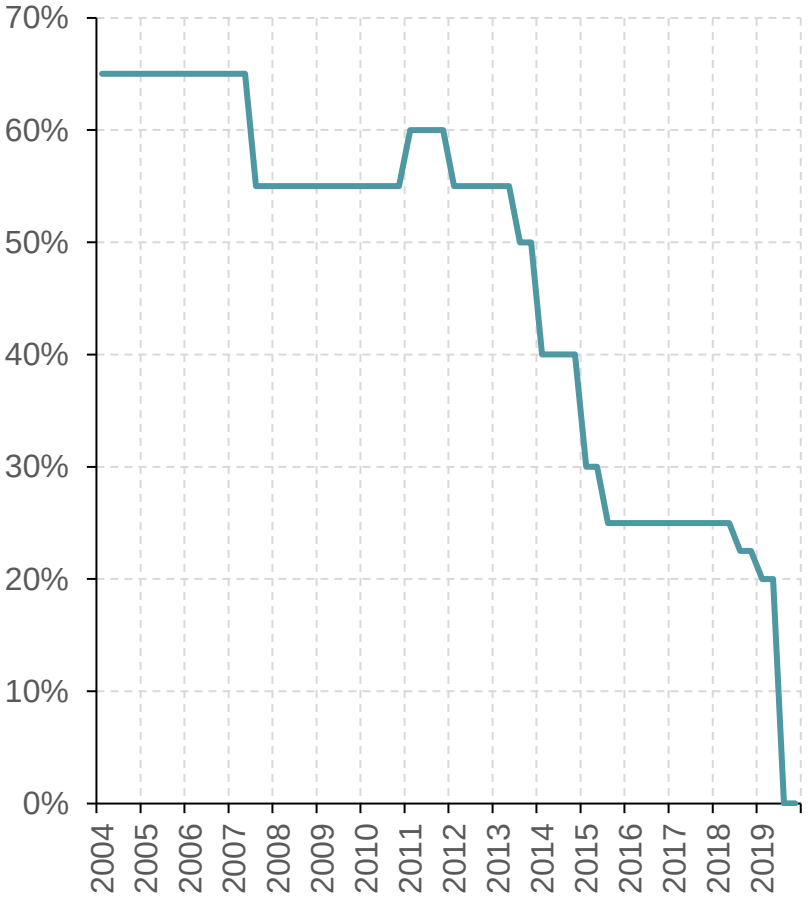
- Policy of PNG moratorium leads to **gas scarcity in 2010-2012**, increasing prices and spark spread
- LNG vesting policy and investors' optimism lead to large amount of CCGT capacity built at the same time, resulting in **excess capacity with more players, same generation technology and similar gas cost**
- Demand growth is lower than expected/forecasted, and both PNG and LNG contracts have high take-or-pay (ToP), leading to **excess ToP gas situation once the LNG terminal is commissioned**

Note: Spark spread is based on the difference between USEP and average fuel cost of a F-class CCGT plant
Source: EMC, WaterRock Energy Analysis

History of Singapore Wholesale electricity Market (SWEM) [2 of 2]

In addition to low spot prices, vesting contract level is reduced quickly, leading to negative cash flow on average for SG Gencos since 2014

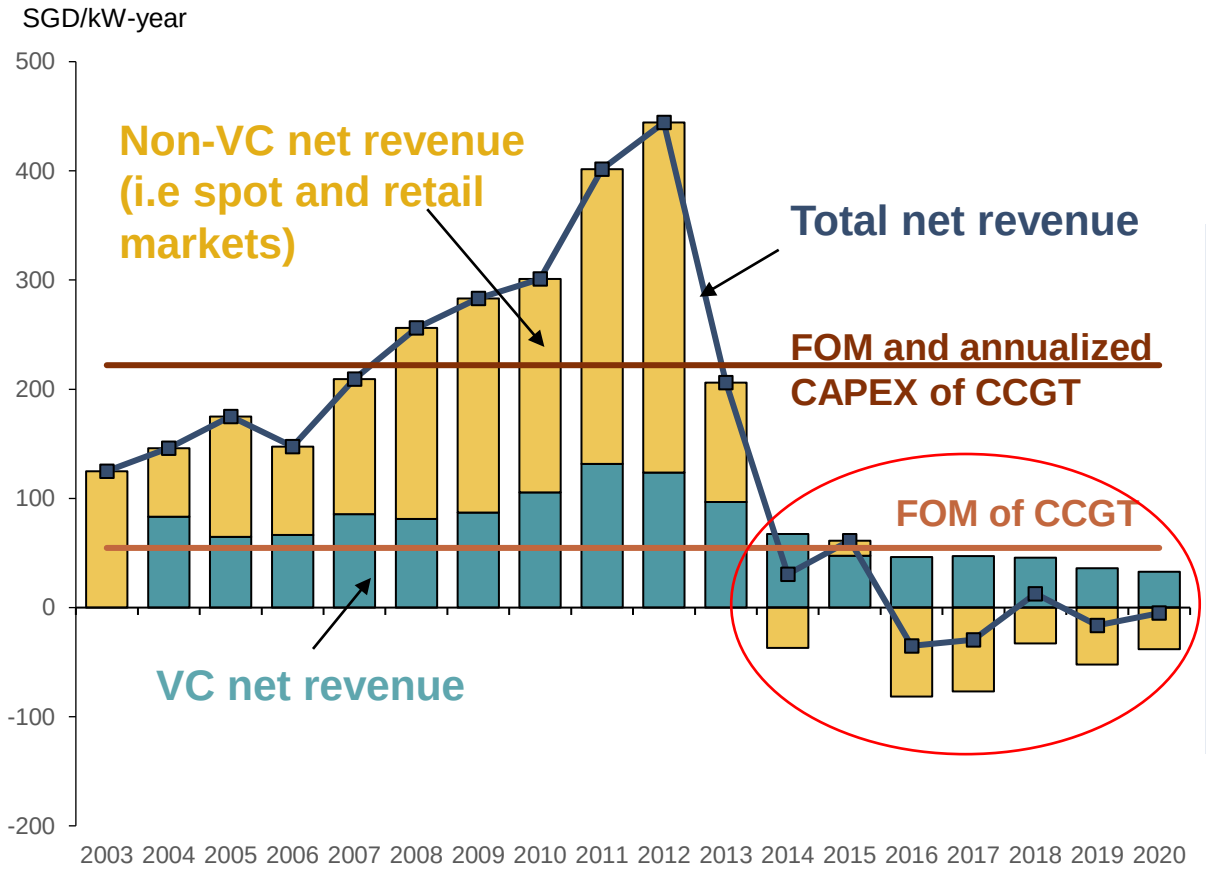
Vesting Contract Level



Note: In Q3 2019 – Q2 2023, there is still LNG vesting contracts for Tuas, PowerSeraya, Senoko, SembCorp, Keppel and PacificLight. Total amount of LNG vesting is equivalent to about 16 percent of total demand.

Source: EMC, EMA, WaterRock Energy Analysis

Estimation of Net Revenue* for a Typical F-class CCGT plant



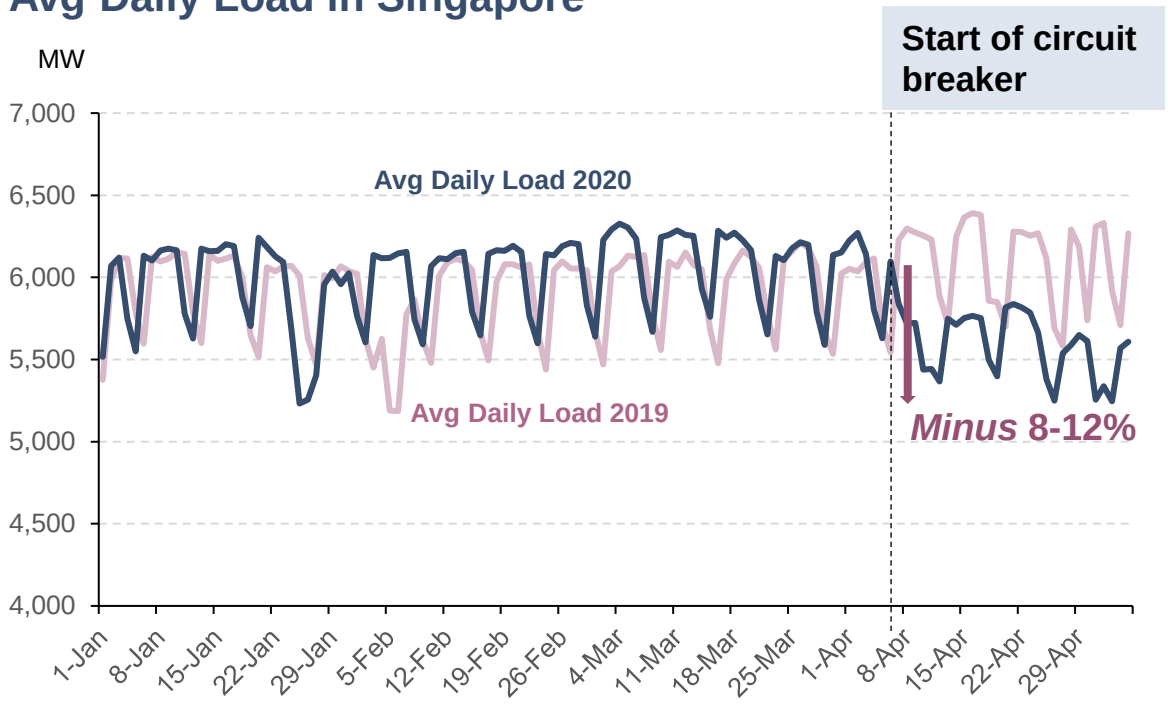
Total net revenue for a typical F-class CCGT has been slightly below fixed operating cost; it needs cash injection to honour its ongoing debt obligations

Note: Net revenue is defined as total revenue minus fuel cost & variable operating cost. 2020 price is estimated.

Impact of COVID-19 on Demand and Price (1 of 3)

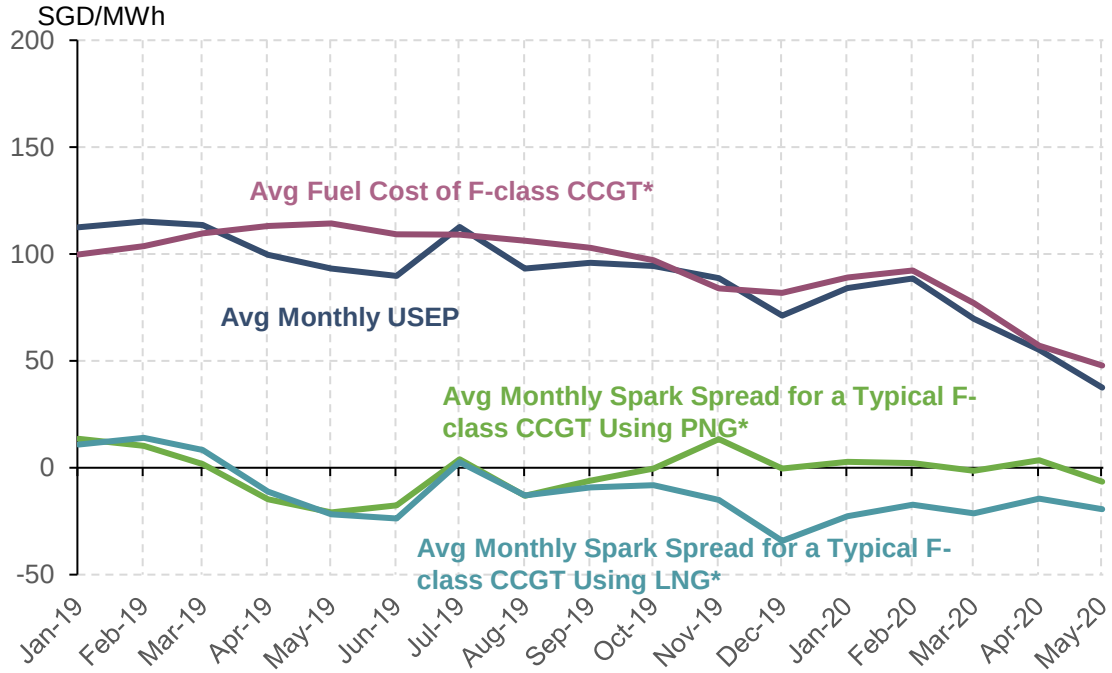
Power demand shock due to circuit breaker is around 10% in SWEM, and spark spread remains negative/close to zero

Avg Daily Load in Singapore



- Average daily load is reduced by about 10 percent year-on-year since the start of circuit break on April 7, 2020
  - Circuit break has mainly impacted demand from commercial sector [accounting for 35-40% of total consumption]; most of the large industrial power users [like semiconductor fabrication, petrochemical and pharmaceutical plants] are treated as “essential” services.

Avg Monthly USEP and Spark Spread in Singapore

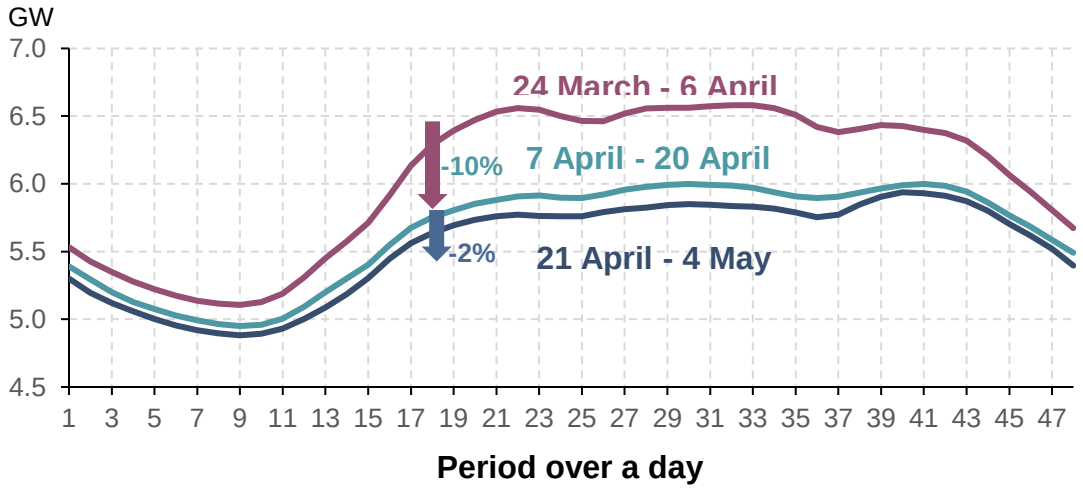


- USEP has fallen along with falling oil prices
- In H1 2020, spark spread for LNG-fired CCGT plants remains negative while spark spread for PNG-fired CCGT plants is close to zero.

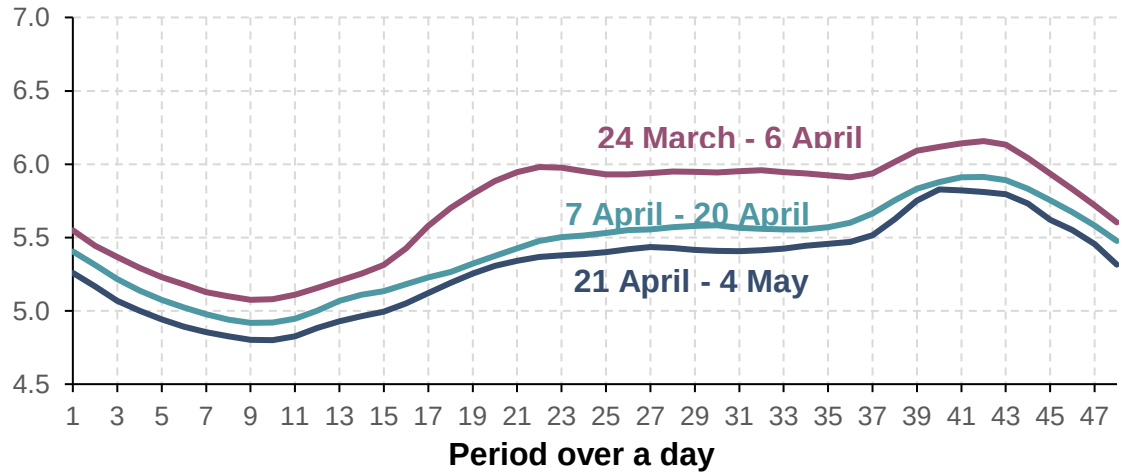
Note: *Average fuel cost is based on the weighted average cost of PNG (pipeline natural gas) and LNG (liquefied natural gas) multiplying the average heat rate of a F-class CCGT plant.
Source: EMC, WaterRock Energy Analysis

Impact of COVID-19 on demand and price (2 of 3)
The daily load curves are "flattened" due to reduction of load in the commercial sector; normal price pattern over the day has also changed

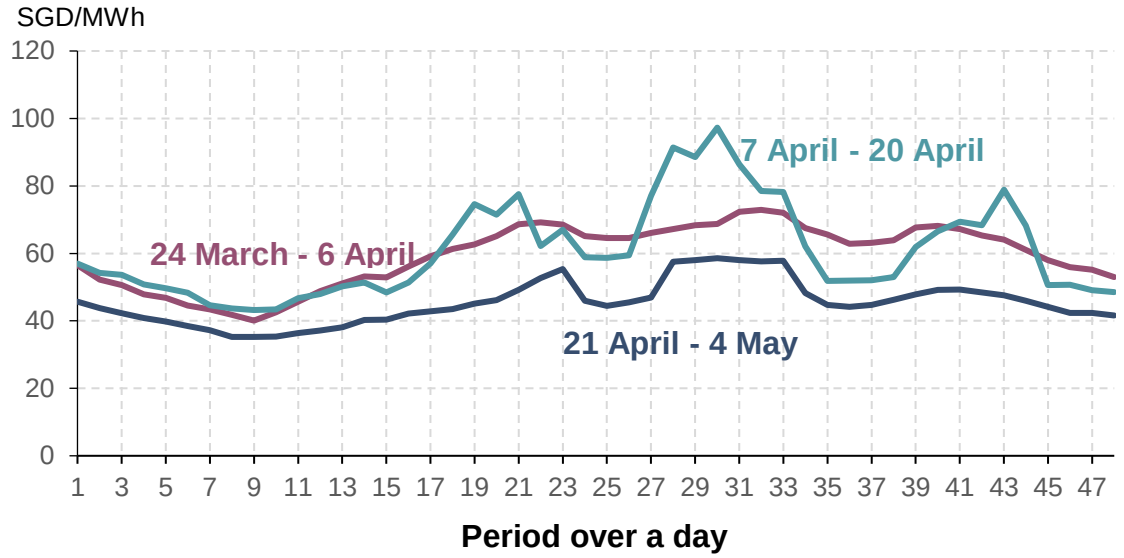
Avg Half-hourly Week-day Load in SWEM



Avg Half-hourly Weekend/Public Holiday Load in SWEM



Avg Hourly Prices in SWEM Every Two Weeks



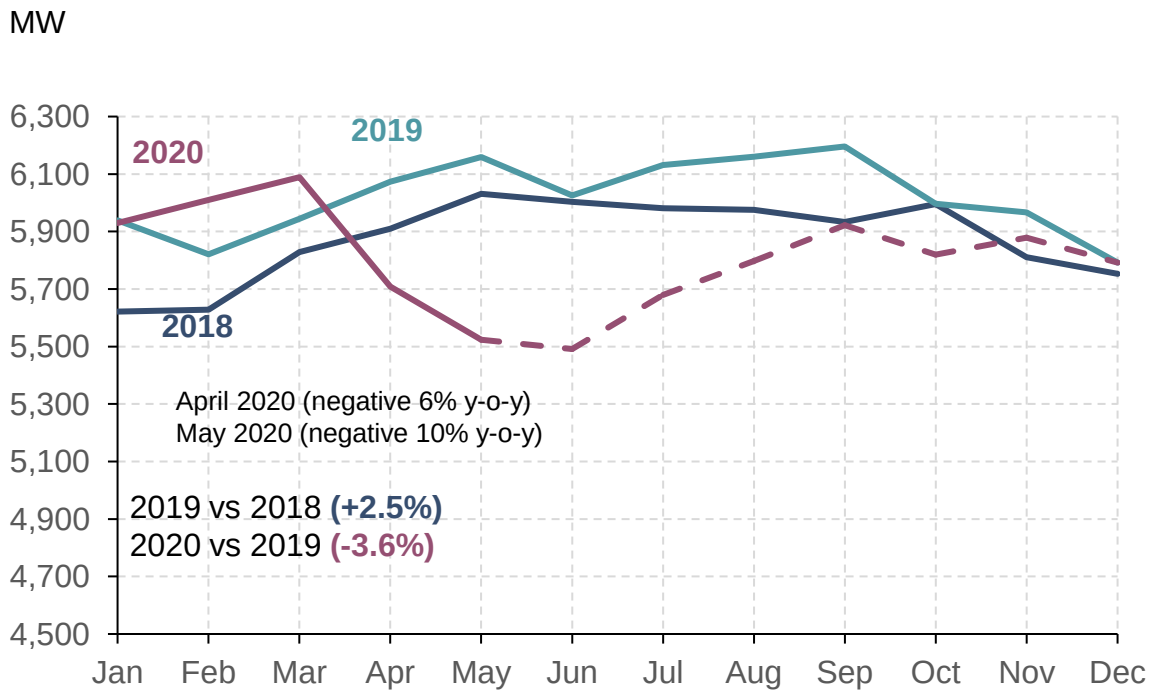
- While the curve of viral spread is flattened, the load profile is also "flattened" as the partial lock-down has largely reduced loads in the commercial sector
- The typical price patten over the day is also changed; average price level continues to remain very low, at/below average fuel cost.

Source: EMC, WaterRock Energy Analysis

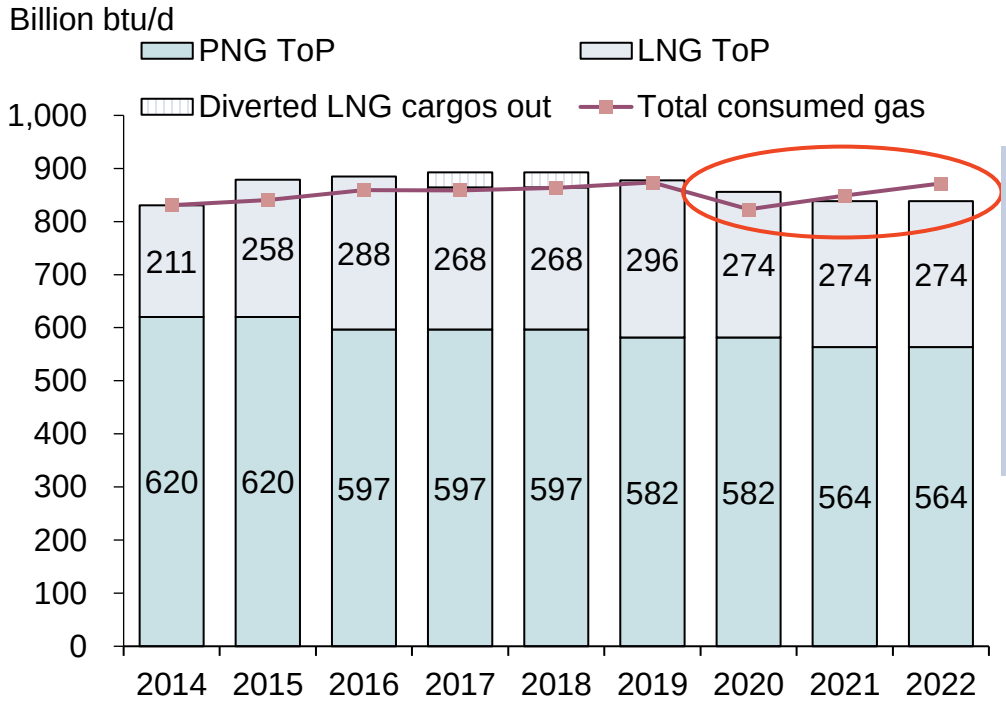
Impact of COVID-19 on demand and price (3 of 3)

Demand will likely rebound gradually in H2 2020 but spark spread will remain low/negative due to rigid constraints on take-or-pay gas

Average Monthly Load, 2018-2020



Contractual ToP Gas Obligation vs Gas Consumption



Low spot LNG prices in Asia exacerbate the situation as small Gencos may choose to import spot LNG

- The Singapore government has announced that it will remove the restriction phase-by-phase after June 1, 2020. Demand may start to rebound from the low level seen in May, but likely only gradually. Demand in 2020 will be around 4% lower than 2019
- There are risks of a third wave of COVID-19 cases in H2 2020.

- The negative demand growth in 2020 means that Gencos may need to compete to burn ToP gas again, leading to negative spark spread in the wholesale market
- The low spot LNG price in Asia also increases the cost of cargo diversion out of Singapore, and smaller Gencos may be incentivized to import spot cargos.

Source: EMC, WaterRock Energy Analysis

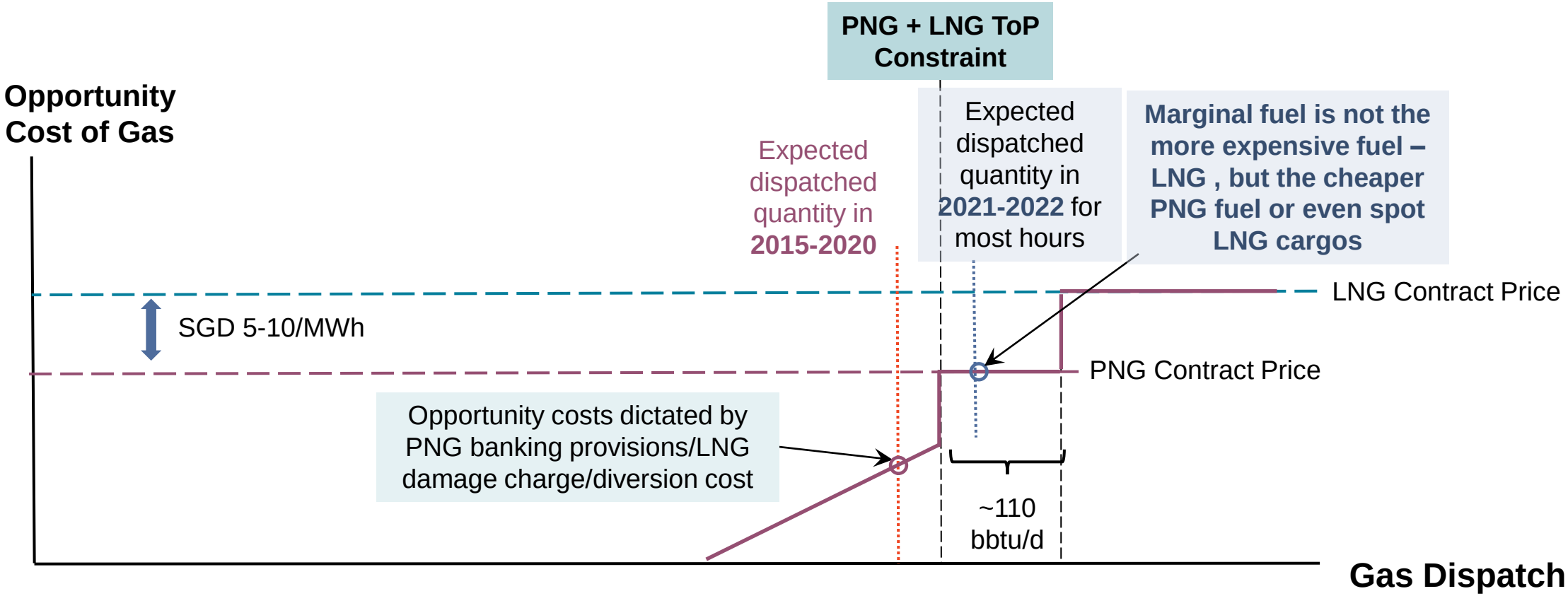
Topics

1 The Impact of COVID-19 on the Power Sector in the Near Term

2 **Investment Opportunities and Risks Post COVID-19**

Price Expectation in 2021-2022/23

2021-2022/23: even if ToP gas is no longer in excess, the marginal fuel is the less expensive gas (i.e. PNG/spot LNG) in most hours, leading to low spark spread



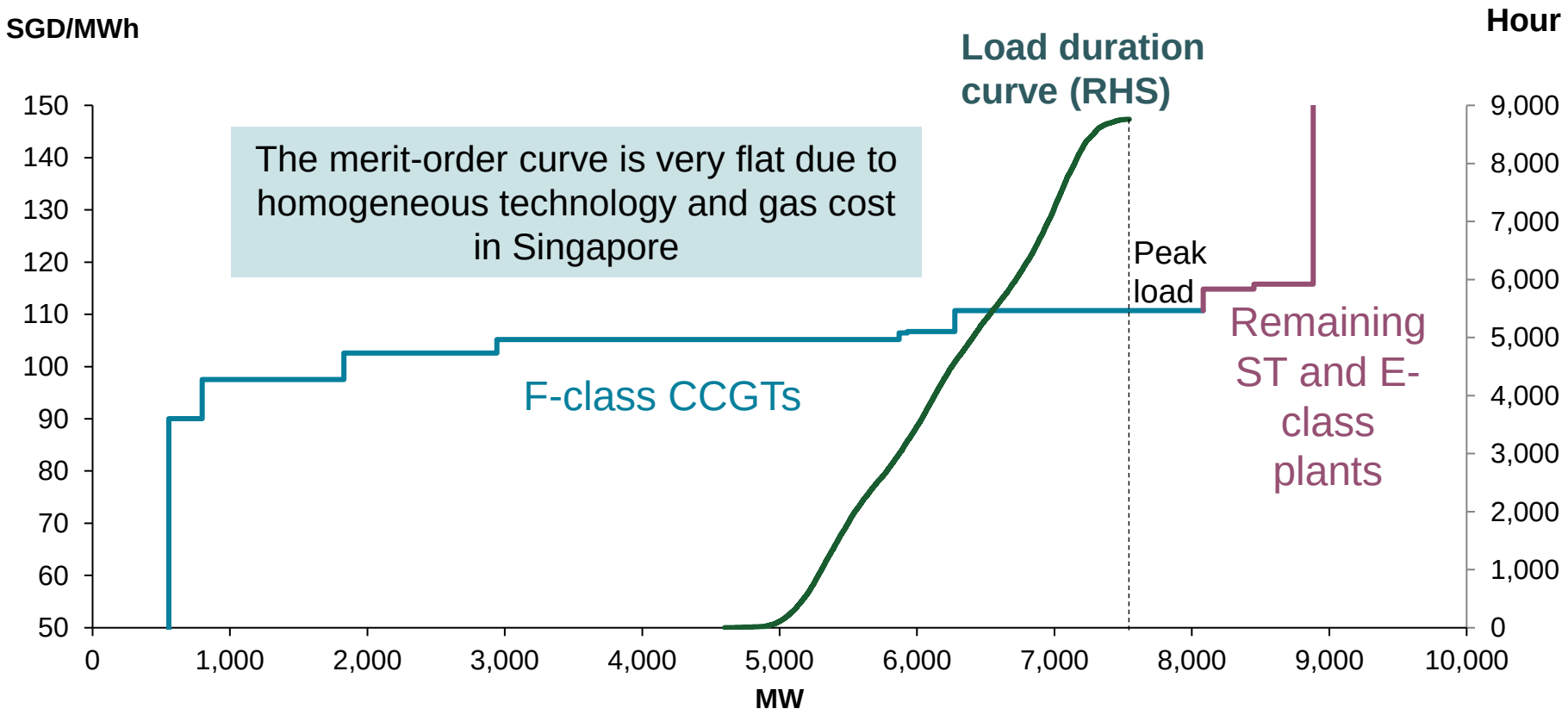
Spark spread will likely remain low in 2021-2022, as high ToP PNG and LNG contractual volume continue to influence bidding behaviour of the Gencos

Source: WaterRock Energy Research and Analysis

Spark Spread Expectation after 2022/23

Post 2022/23: If SWEM remains as energy-only market, Gencos' profitability is uncertain as it depends on their ability to exercise market power to drive up prices

Merit Order Curve and Load Duration Curve



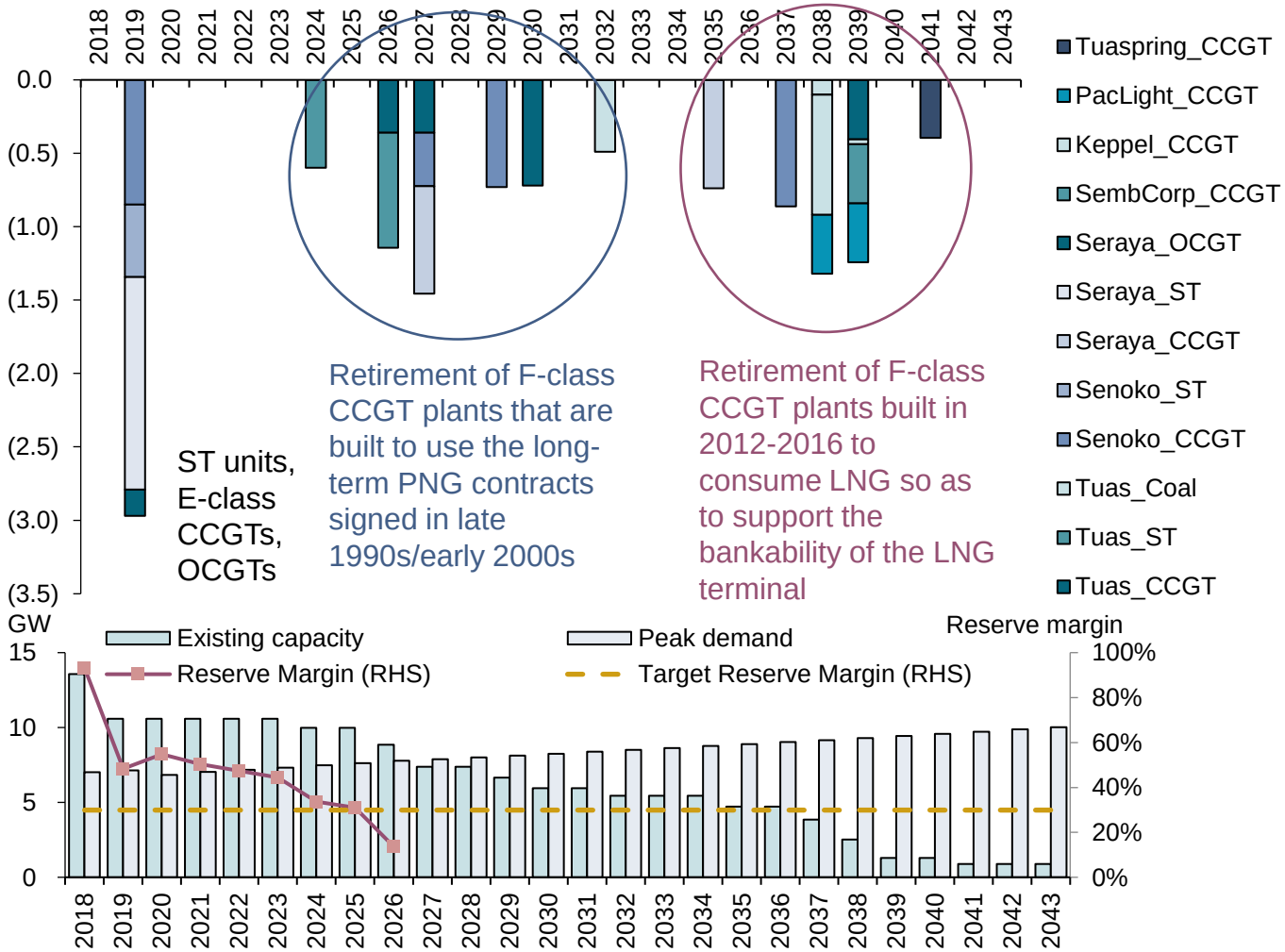
- If SWEM remains as energy-only market, Gencos will need to rely on strategic bidding to increase price to pay interest cost and earn equity return in the medium- and long-term
- Net revenue stream from strategic bidding is likely to be too uncertain to attract new investment.

Source: WaterRock Energy Research and Analysis

Issue of Resource Adequacy in the medium-term

By 2026, new investment is likely required to replace old capacity and meet demand growth arising from addition of data centres

Expected Retirement/Mothball of the Existing Capacity



Source: WaterRock Energy Research and Analysis

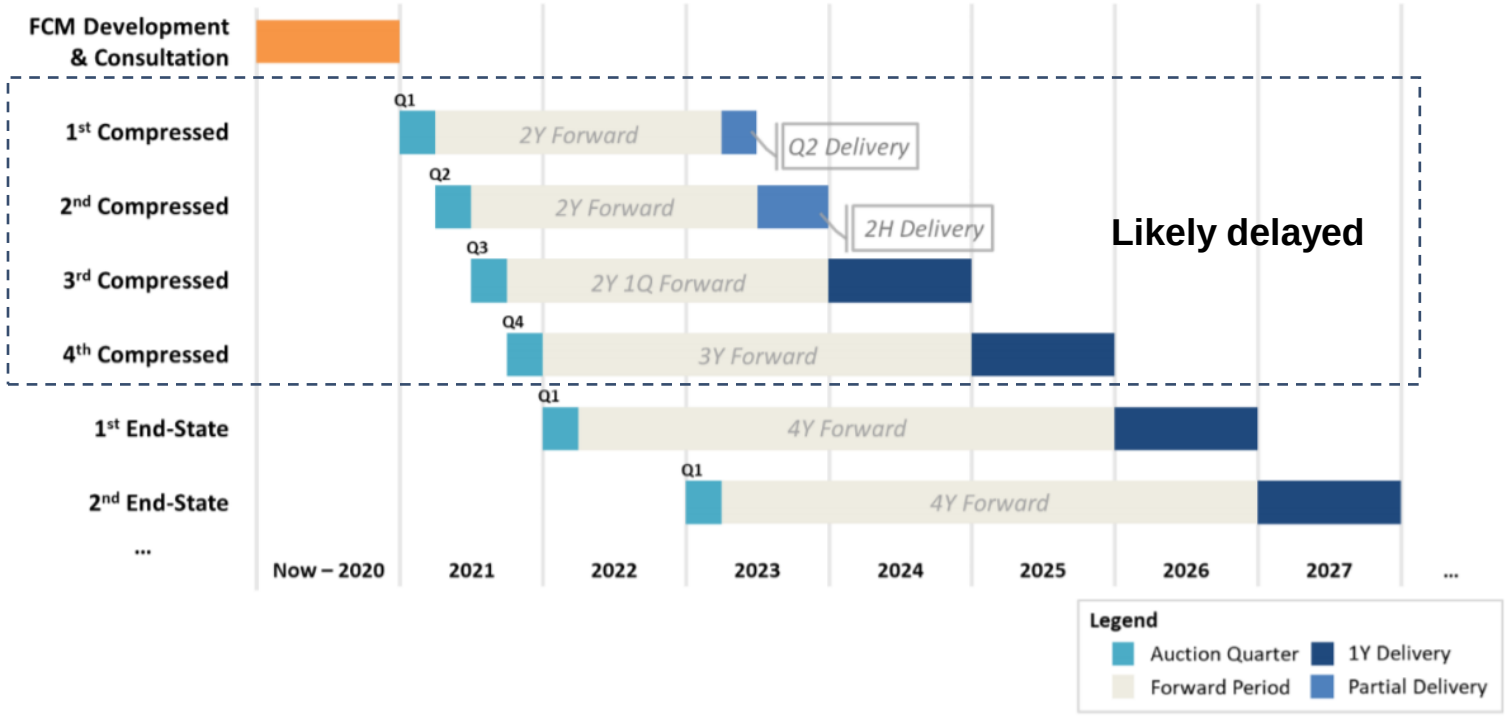
Demand Growth

- Some global technology companies have chosen Singapore as its Southeast Asian regional hub to set up data centers
  - For example, Facebook has announced to set up an 11-story facility data center in Singapore.
- Data centers are energy intensive industry. It is expected that they can add 100-200 MW of incremental load each year in the next 5-10 years. Thus, this can increase demand growth by 1.5-3.0 percent each year.
  - Even though data centers prefer to use renewable generation sources, bulk of the demand will be served by conventional generation units (i.e. CCGTs in Singapore) due to the limitation of land space for building solar in Singapore
    - Even assuming 2 GW of solar capacity is built in the long-term, solar can only serve about 0.32 GW of load [as its avg capacity factor is only 16%].

Key Regulatory Change – Introducing FCM (1 of 2)

Singapore government has been doing a study to introduce a Forward Capacity Market since early 2019

Indicative Timeline for Compressed and End-State FCM Auctions



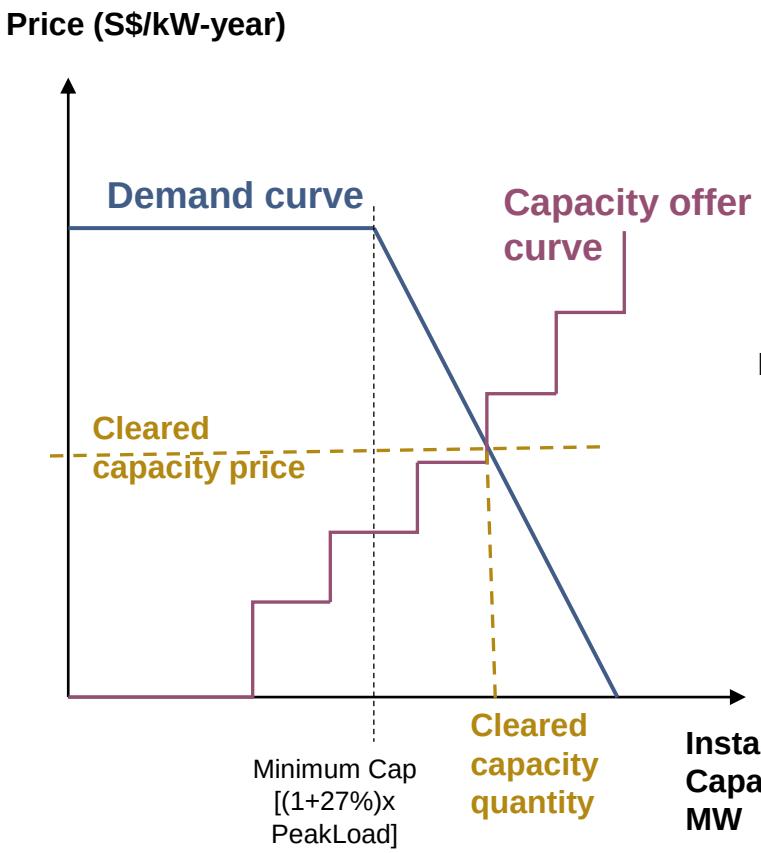
- **Key objective of introducing the Forward Capacity Market (FCM)**
  - Maintain resource adequacy to meet an expected LOLH (Loss of Load Hours) of 3 hours by providing adequate incentives to existing and new resources
  - Use a market process to maximize economic efficiency and minimize long-run costs to consumers.
- **Impact on the Existing Capacity**
  - Provide another venue for net revenue for available capacity but there would be stronger mitigation regulation on exercise of market power in the energy market
  - Potentially reduce the volatility of profitability of Gencos.

Source: EMA website, The Brattle Group, Second Consultation Paper – Developing an FCM to enhance the SWEM, https://www.ema.gov.sg/cmsmedia/Second%20Consultation%20Paper%20-%20Developing%20a%20FCM%20to%20Enhance%20the%20SWEM.pdf

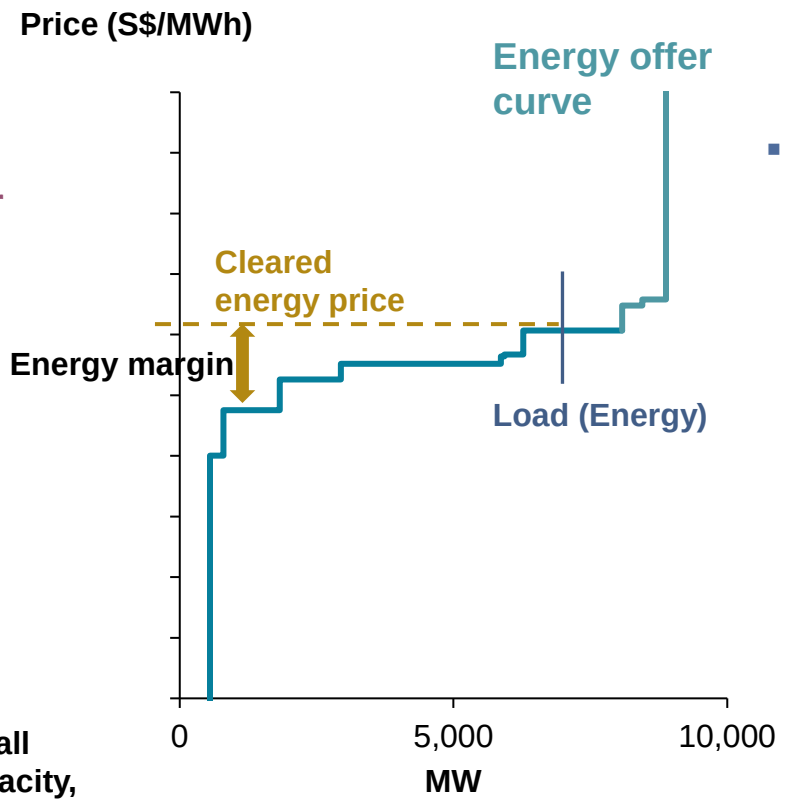
Key Regulatory Change – Introducing FCM (2 of 2)

The market will become two-parts (capacity payment + energy margin), and this could potentially provide more revenue certainty for Gencos

Forward Capacity Market
Annual Capacity Auction



Energy Market
Real-time half-hourly



- **Total Net Revenue for the CCGT units will be:**
  - Capacity price for the cleared capacity *plus*
  - Net revenue from the half-hourly energy market
- **Key features of the Forward Capacity Market**
  - Determination of the reliability standard
  - Determination of the demand curve
    - Price cap and shape of the demand curve
  - Determination of the capacity supply curve
    - Resource qualification and penalty framework
  - Auction framework and format
  - Settlement framework.

With expected tightening market fundamentals and changing regulatory structure, there are opportunities to invest in the Singapore power market

Opportunities	Market Context
To meet growing demand and displace old capacity	▪ With new demand drivers such as the addition of data centers, demand growth will be likely higher than what is seen in the past 10 years; after COVID-19, annual incremental demand can be in the range of 150-250 MW. ▪ Existing gas contracts will expire in 2022/23, which will be the pivotal change to allow existing capacity to bid rationally so that spark spread can increase to the level to at least cover ongoing operating cost ▪ Old gas plants built in the 1990s need to be replaced or refurbished ▪ The introduction of forward capacity market (FCM) can potentially increase the market sustainability in the medium- and long-term ▪ There are opportunities to invest in new capacity in Singapore or in neighboring countries and export to Singapore.
M&A Opportunities	▪ Merger & acquisition opportunities are likely to increase as some players in the market are seeking to exit the market
Special projects	▪ Cost of renewable technologies (such as solar and battery energy storage) continues to fall, and thus they are likely to be economical for more applications in the power sector.

Even with the identified opportunities, there are many hurdles to overcome to commercialize and capture the value

? Many Questions Remain to be Answered

- What are the available **Commercial Mechanisms** that define commercial opportunities?
- Who are the **Competitors** and what are their motivations and commercial objectives?
- What are the **Risks** that need to be evaluated?
- Does the investment **Create Future Options** which may become valuable?
- What are the **Exit Options**?

We can work closely with you to address these questions one-by-one

Source: WaterRock Energy Research and Analysis

Thanks and Contact

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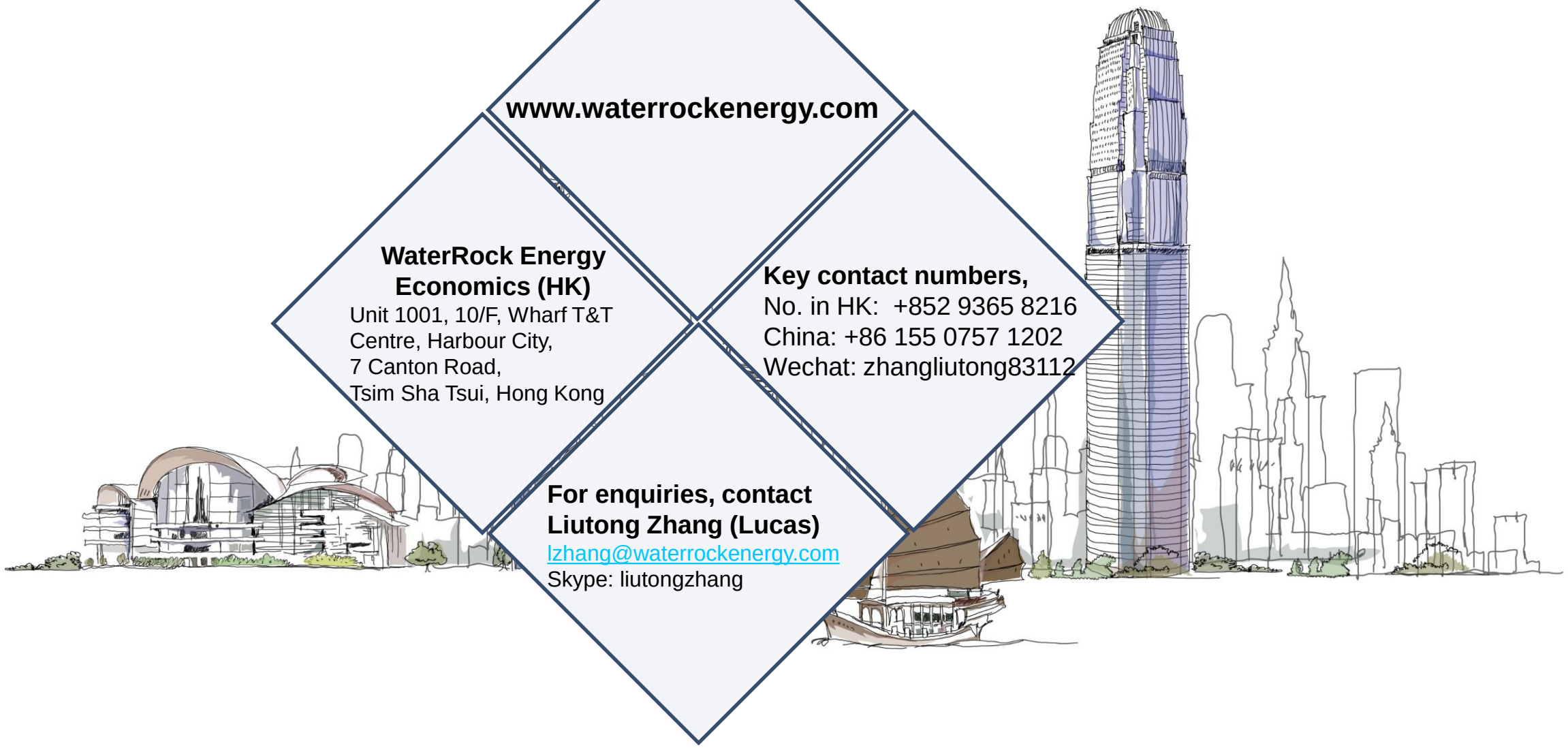


Who is WaterRock Energy Economics

Background:

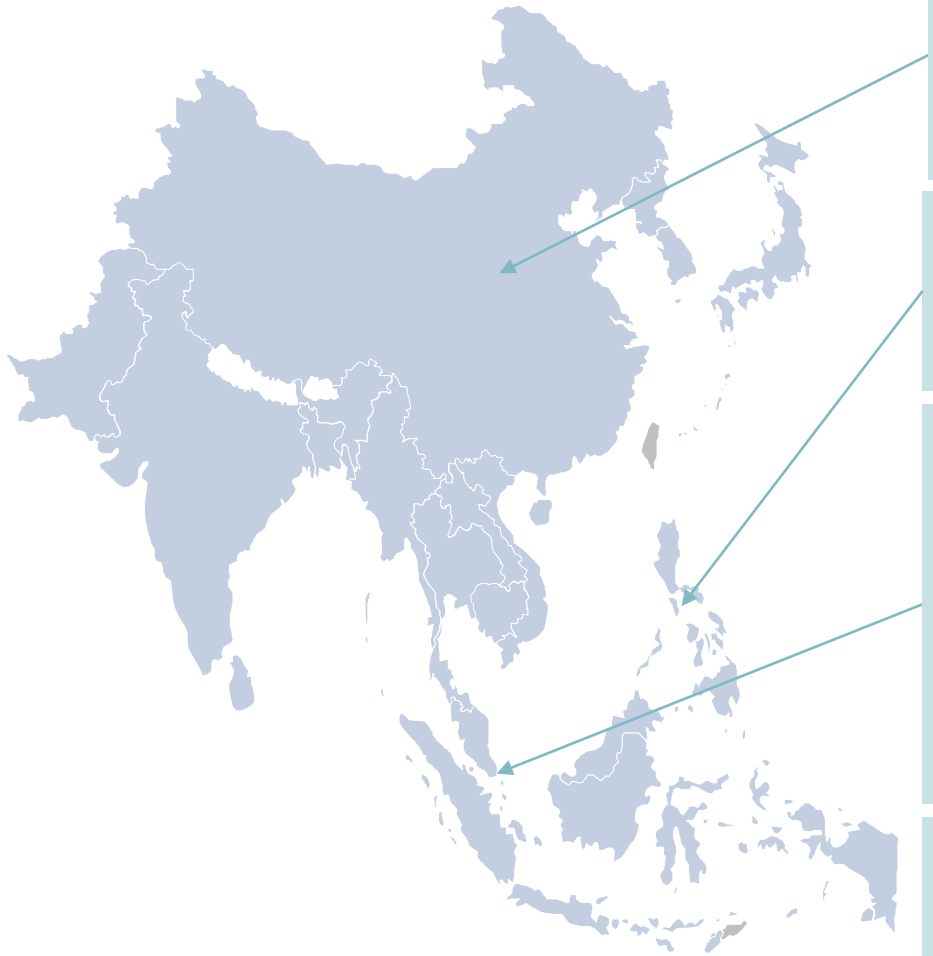
- A boutique market and economic consulting firm for provision of advisory services related to the power and gas markets in ASEAN and East Asia regions
- Small, nimble and client-focused.
- Focus on the power and gas sector in the Philippines, Singapore, Taiwan, Hong Kong and mainland China
- Very analytical team
- Deep local knowledge and connection with local companies
- Flexibility to partner with other consulting firms for projects.

Services:

- **Transaction Support**: Offer due diligence studies on power and gas assets in ASEAN and greater China region. To date, the team have supported the successful completion of >20 GW of renewable and thermal capacity with a transaction value of more than US$30 billion
- **Market Analysis**: Provide independent and detailed fundamental market analysis on the power, gas and oil sector since 1990s. Key focused topics are opportunities and risks of investing in RE sector, economics of power plants and gas infrastructure projects (like LNG terminals) etc
- **Regulatory Support**: Provide analysis and support on regulatory issues related to fuel mix, market design, market power mitigation and long-term resource adequacy in competitive electricity markets such as Singapore and the Philippines
- **Modelling Support**: Create and provide power dispatch and optimization modelling support for power companies and consultancies.

We focus on the power and gas sector in ASEAN and East Asia Regions

Extensive Experience in Power and Gas Markets in Asia



For foreign investors and gas exporters to China:

- More than 10 GW of due-diligent studies on issues such as regulatory risks, fundamental power supply ad demand, renewables curtailment and tariff forecast
- Multiple detailed provincial level natural gas studies on key drivers of gas demand, economics of gas-to-power and opportunities of selling LNG to China

For both domestic and international players in the Philippines:

- More than 5 GW of due-diligent studies on thermal and renewables plants.
- Multiple studies on the opportunities and risks of investing in a LNG terminal

For Singapore regulators:

- Energy market design issues such as creation of forward capacity market, market power mitigation and resource adequacy studies
- Fuel mix and carbon emission related projects

For existing generators, large consumers and potential investors:

- More than 2 GW of due-diligent studies on wholesale electricity price and end-user tariff forecast
- Over-contracted gas and financial sustainability issues

Regional studies:

- Multiple studies on investment opportunities in the electricity sector in Asia
- Multiple studies on regional gas market and opportunities of selling LNG to Asia