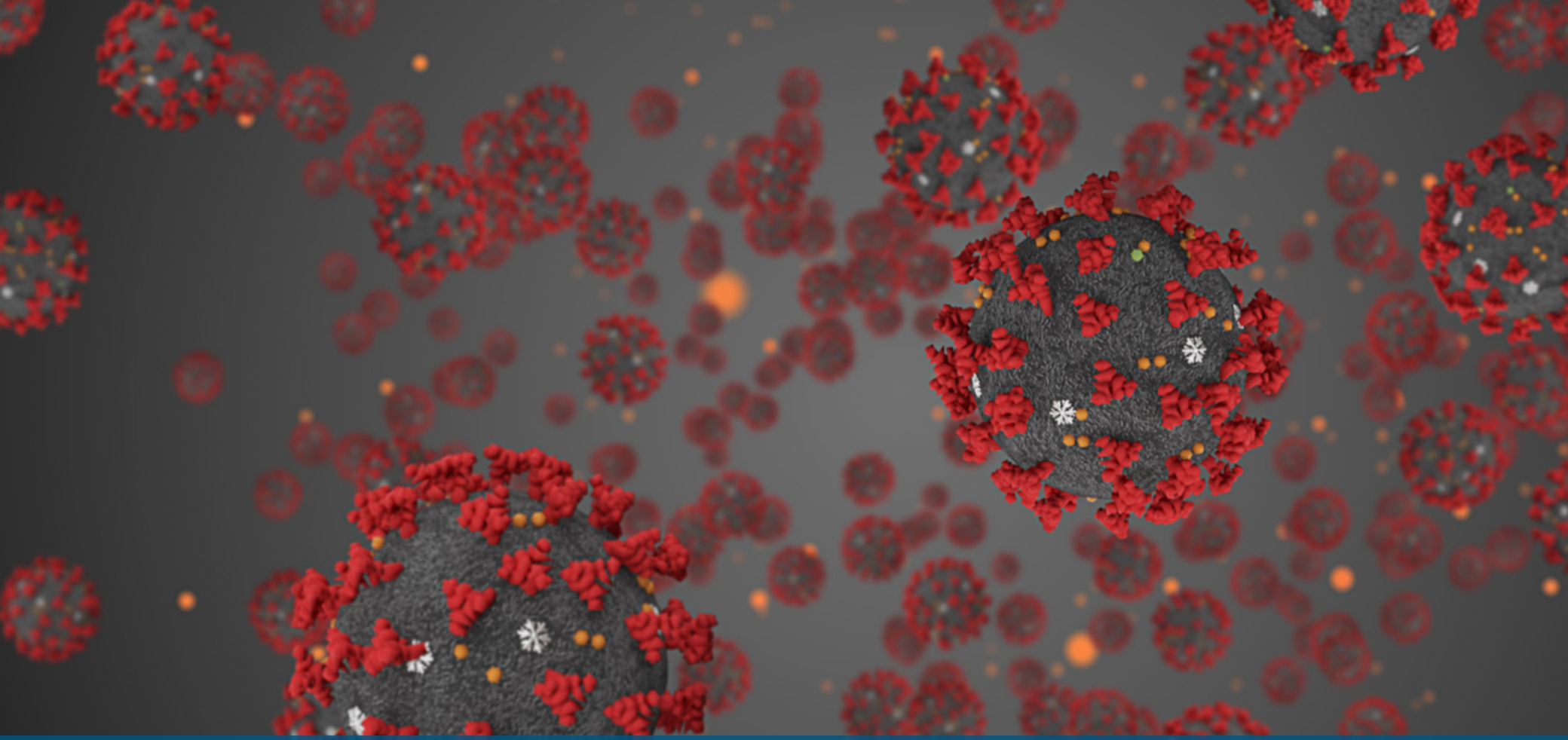


A Webinar for IAEE

COVID-19's Rapidly Changing Impact on Asia Pacific Electricity Markets

Mike Thomas, 5 June 2020
mthomas@lantaugroup.com

THE LANTAU GROUP

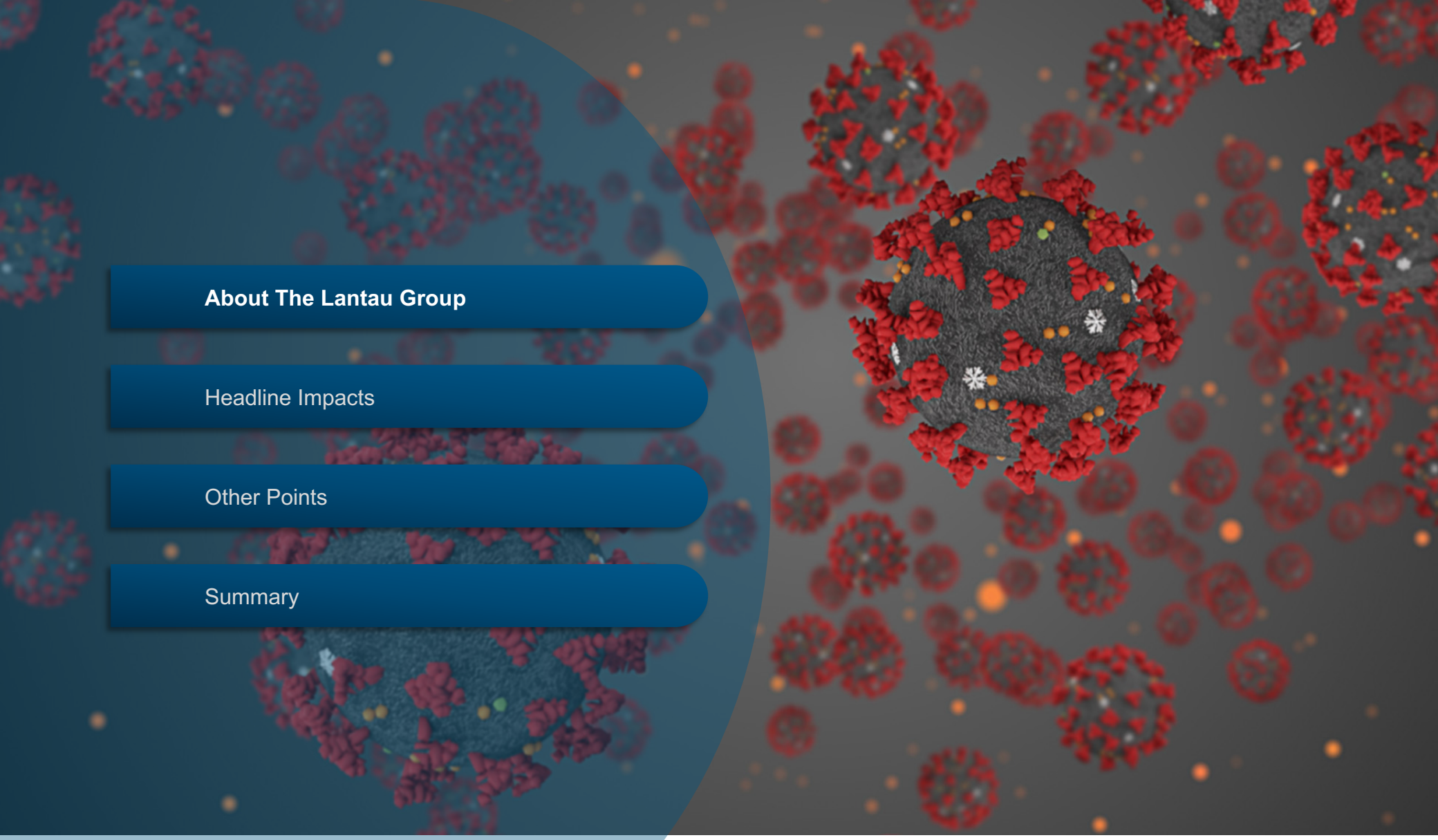
Disclaimer and Credits

This presentation has been prepared to facilitate general discussion and not for support of any commercial or business decision.

Special thanks to the entire team at The Lantau Group, particularly: Stefan Robertsson, Xiaoran Liu, Miaosu Li, and Liyuan Zhao. Additional support was provided by Bobby Ditric, Paul Buckland, Chris Starling, Zander Bischof, David Fishman, Soyeon Park, Jan Stempien, JP Stovall, Ian Yao, Schuyler Kapnick, Sovathana Kem, Anna Leung, and Oscar Ng.

Hong Kong | Singapore | Seoul | Perth

(and Shanghai via Nicobar Group)



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Summary

THE LANTAU GROUP

Decades of experience in commercial and regulatory matters across the globe

Our focus and orientation

Markets & Transactions

We focus on what can be measured and substantiated.

We provide objective, independent, well-grounded advice for decision-makers facing high stakes choices.

Industry Insights

We focus on what matters to energy stakeholders facing changes in markets, technologies, regulations, and policies.

This is what we do.

Impact

We advise on key projects throughout the Asia Pacific region and the rest of the world.

We influence the evolution of the energy sector through our work and expertise.

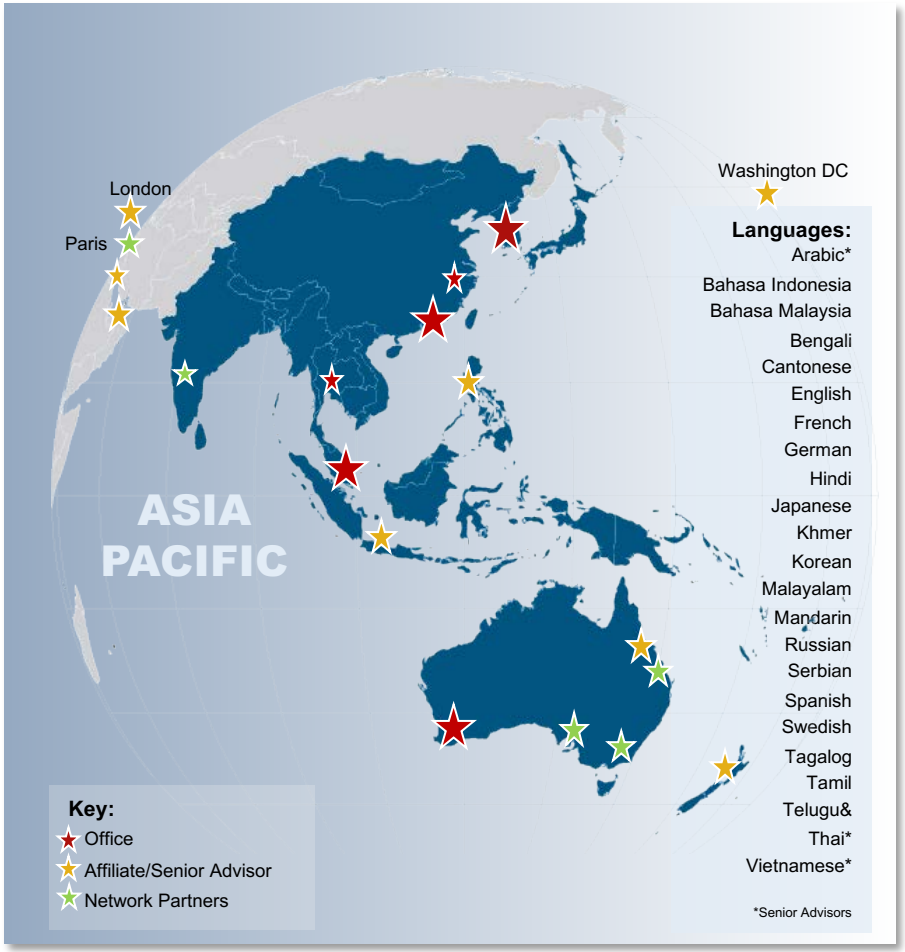
Economic Regulation

We apply economics and analysis to address challenges facing regulators, commercial stakeholders, and policy makers.

Client Service

Our senior team members are actively involved in the execution of mandates and assignments.

We own our company, so when we say we are dedicated to our clients we mean it.



Economic, commercial, and strategy advisory for energy sector stakeholders throughout the region

THE LANTAU GROUP

We draw from a diverse range of experience and expertise

Vietnam
- Extensive due diligence support for new RE and traditional power supply resources across the country
- LNG market entry studies
- Market modelling / development

Thailand
- Demand response pricing
- Grid solar evaluation
- Gas to power economics
- Market development
- Renewable energy

Uzbekistan
- CNG vehicle market evaluation

Mainland China
- Curtailment study in Gansu, Jilin and West Inner Mongolia
- Multiple studies on small-hydro power investment opportunity
- Coal-fired power generation and carbon policy in Zhejiang
- Coal-fired power investment opportunity in Chongqing
- Assessment of gas-fired CHP opportunities in Guangdong
- Strategic assessment of opportunities in multiple provinces
- Green procurement options / end user market support

Singapore
- Market design and regulatory support
- Demand forecasting
- Commercial transactions
- Tariff benchmarking
- Corporate PPA support
- LNG and gas strategy
- Disputes / expert witness
- Capacity market

Malaysia
- MESI 2.0 reforms
- PPA (Green and Other)
- Electricity/gas markets
- Tariff benchmarking
- Third party access
- Demand forecasting
- Commercial transactions
- Disputes / expert witness

Korea
- Renewable energy study for solar and wind
- Due diligence on CCGT and renewable power plants
- Capacity/ancillary market design and evaluation
- SMP/REC modelling and implications to IPP business
- Gas and coal IPP opportunities
- LNG/Coal competitive procurement

Taiwan
- Offshore wind
- Transaction support
- Corporate energy pricing
- Market development

Philippines
- Market design and development
- Due diligence support
- Business strategy
- Natural Gas Masterplan and LNG entry strategy
- Distribution sector structure and regulation
- Power price forecasting

Oman
- Performance regulation
- Direct sales and corporate PPAs
- Market readiness and scarcity pricing
- Retail competition

India
- Wholesale market modelling
- Fuel switching
- End user pricing/invoice tracking

Australia
- Capacity market design
- Contract disputes / expert witness
- Market design and policy / reviews
- Corporate green procurement
- Demand response
- Market modelling / transaction support
- Market design and regulation
- Network regulation and cost recovery
- Storage

Indonesia
- Gas to power (small and large scale)
- Evaluation of market entry opportunities
- Market development

New Zealand
- Market development / regulation / pricing
- Retail sector development
- Gas pipeline access policy
- Market trading and market making
- Disputes / expert witness

Japan
- Customer Solar Entry Strategy
- End user pricing of gas and electricity

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Founders, Partners, Directors

Mike Thomas

Managing Director
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Mike is an expert in energy markets and regulation with experience throughout the Asia Pacific region. He works with stakeholders on matters involving regulation and market design; market evaluation; strategy; and commercial and regulatory disputes. He has advised buyers and sellers on over 50 GW of commercial transactions and associated market and business strategies. And, he has advised governments, regulators, and other stakeholders on numerous major market and regulatory reviews and disputes. Prior to co-founding TLG, he was the Asia Pacific energy and environment practice leader for a global consultancy. Mike has an MPP from Harvard Kennedy School and a BA in economics from Carleton College.

Dave Carlson

Director
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Dave is an experienced energy market operator, designer and change manager with a track record spanning Asia, Africa, Australia and New Zealand. Most recently he was a Senior Business Development Director at SGX, responsible for new initiatives in the gas and power sectors. Prior to that he served for 10 years as the COO and CEO of the Energy Market Company, EMC, the national electricity market operator for Singapore. Dave has served on and chaired many industry and governance panels to further liberalise energy markets including market rules covering such topics as market rules evolution, the implementation of retail contestability, developing gas trading and introducing electricity derivative products.

Stefan Robertsson

Partner
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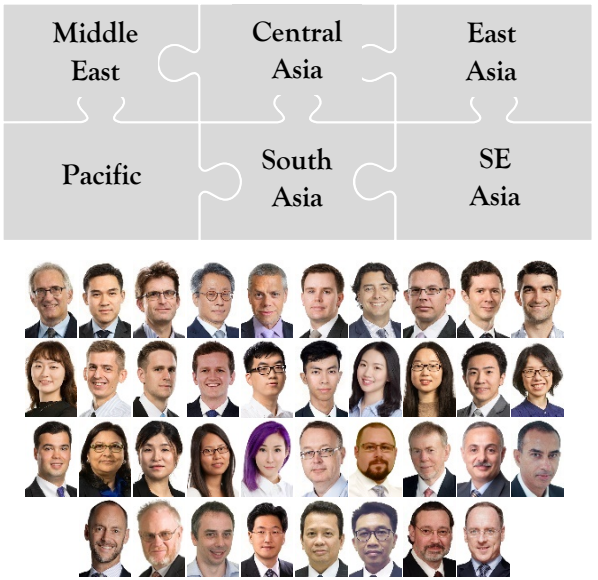
Stefan has over 20 years of experience in business development, M&A, and corporate and project finance across the Asia Pacific region. Prior to joining TLG, he spent nearly 10 years with CLP Group, where he served as head of Corporate Finance and Development for non-Hong Kong activities. He led the CLP Group Investment Committee and Chaired the TruEnergy Risk Committee for CLP's Australian trading and business activities. He also had significant involvement in CLP's investment activities in Mainland China, India, and South East Asia, covering the full spectrum of energy assets and opportunities. Prior to CLP Stefan was with various ABB Financial Services companies in the US, UK, and Asia. He earned his degree in Financial Economics at the Stockholm School of Economics.

James Ooi

Partner
jooi@lantaugroup.com

James Ooi has over 20 years of experience in the energy industry. He is an expert in areas related to energy market design, asset valuation, commercial contracting for gas and power (LNG SPA, GSA and PPAs), corporate strategy, planning and operations, with experience across Asia Pacific, the Middle East and North Africa. Prior to joining TLG, James headed the Gas & Power practice for a global consulting firm in Asia. In addition to consulting, James brings deep operational experience and has held management leadership positions at major generators and power utilities in the region. James is based in Singapore. James holds an MSc and BEng in Electrical Engineering from the UK and is fluent in English, Mandarin, Cantonese and Bahasa (Malaysia and Indonesia).



David Kim

Partner
dkim@lantaugroup.com

David is a partner and director of TLG, based in Seoul, where he works with both inbound and outbound clients interested in investments in the energy sector. He particularly focusses on new energy opportunities throughout the region, helping to connect Korean and global companies into new markets and to help other companies evaluate opportunities in Korea. Prior to joining TLG, Dr Kim was the Managing Director at Hanwha Energy's Energy Solution System Division. Previously, David was a Partner at A.T. Kearney and a Principal at the Boston Consulting Group for over ten years. David holds a PhD in Mechanical Engineering from Massachusetts Institute of Technology. David is fluent in Korean and English.

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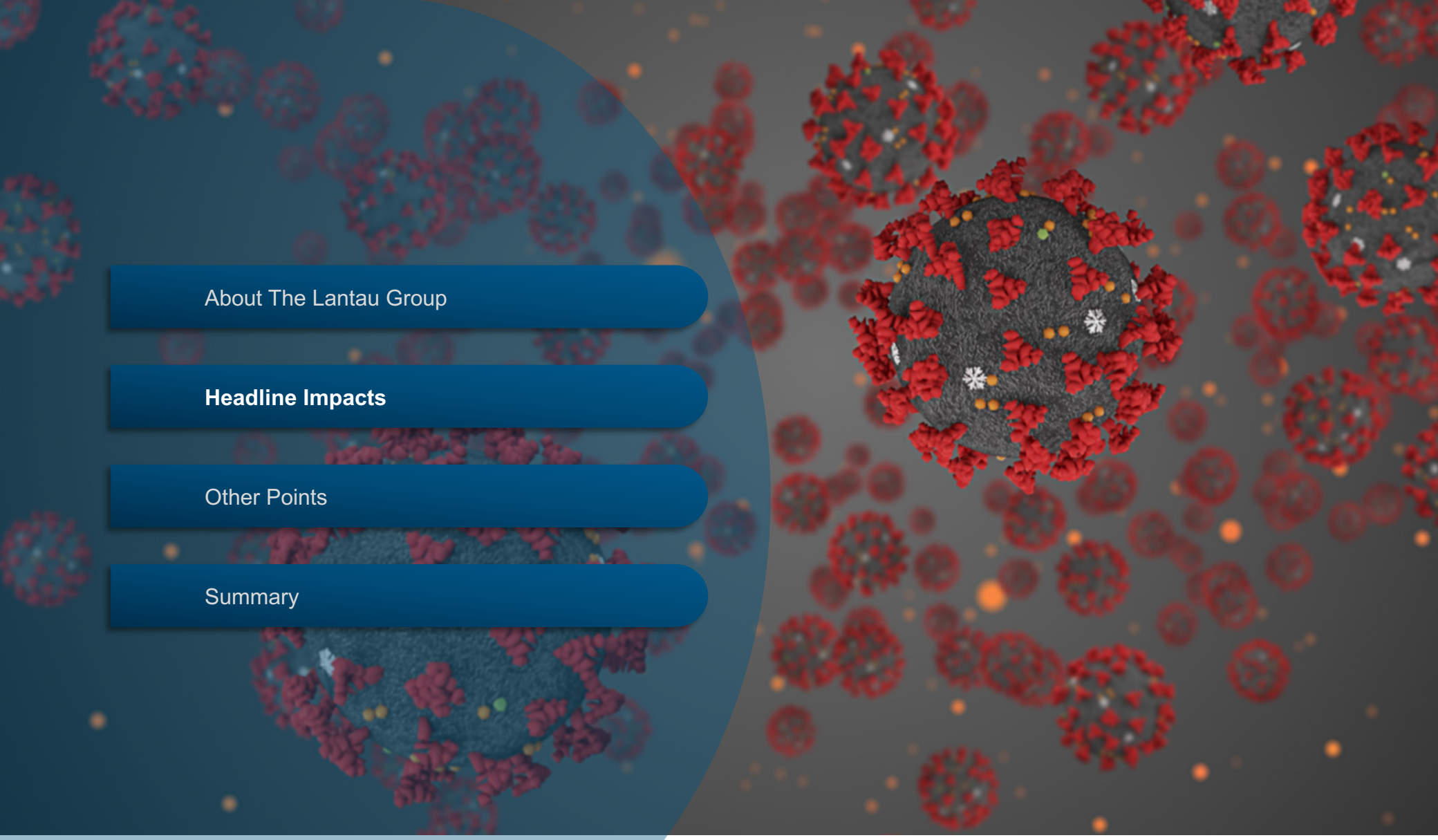

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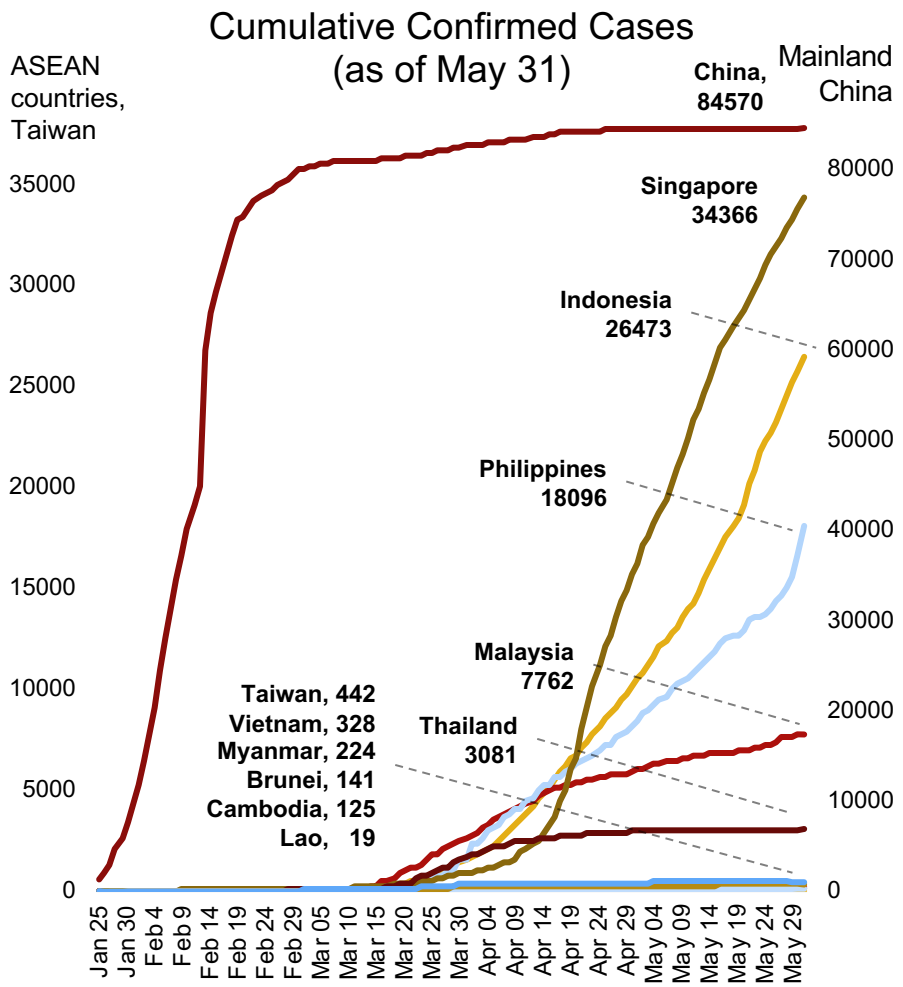
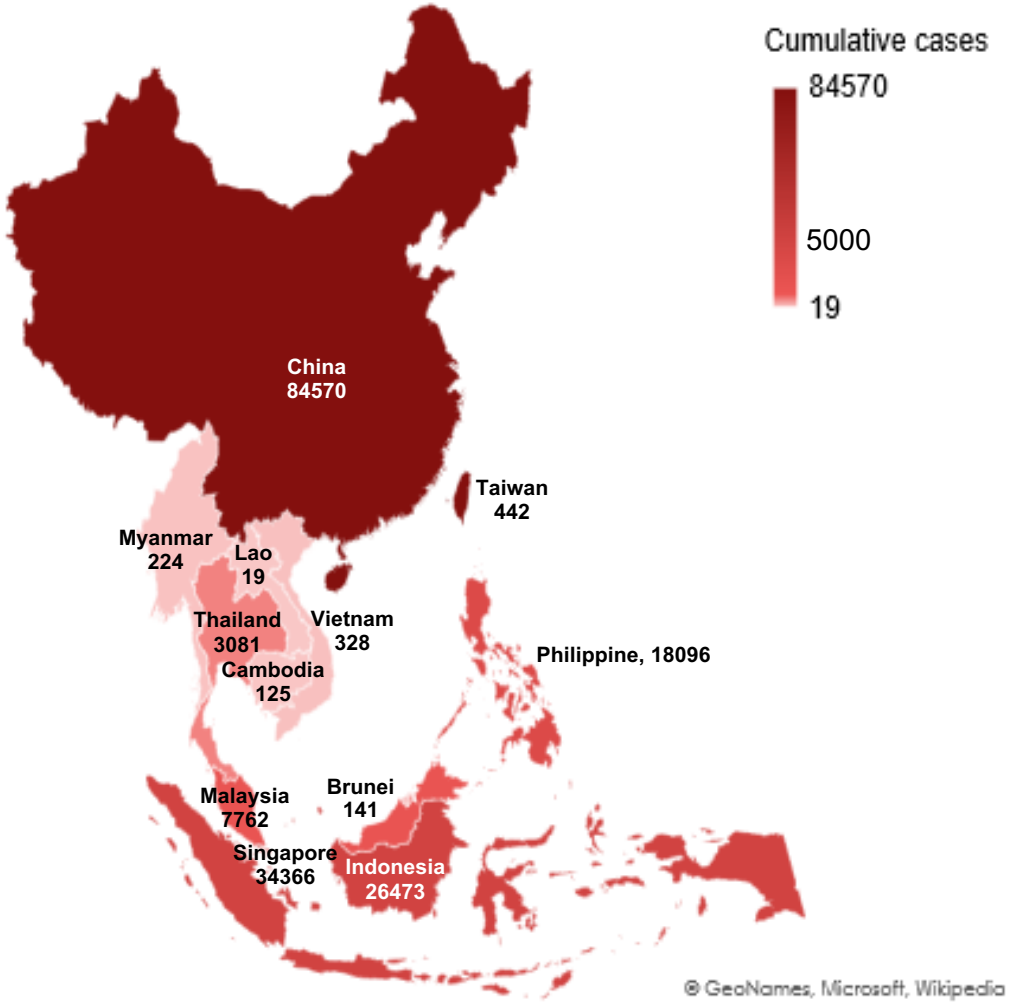
Confirmed Cases in the Asia Pacific Region (as of May 31)





Source: WHO; Taiwan CDC

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Asia Pacific countries continue to be well below global mean for mortality

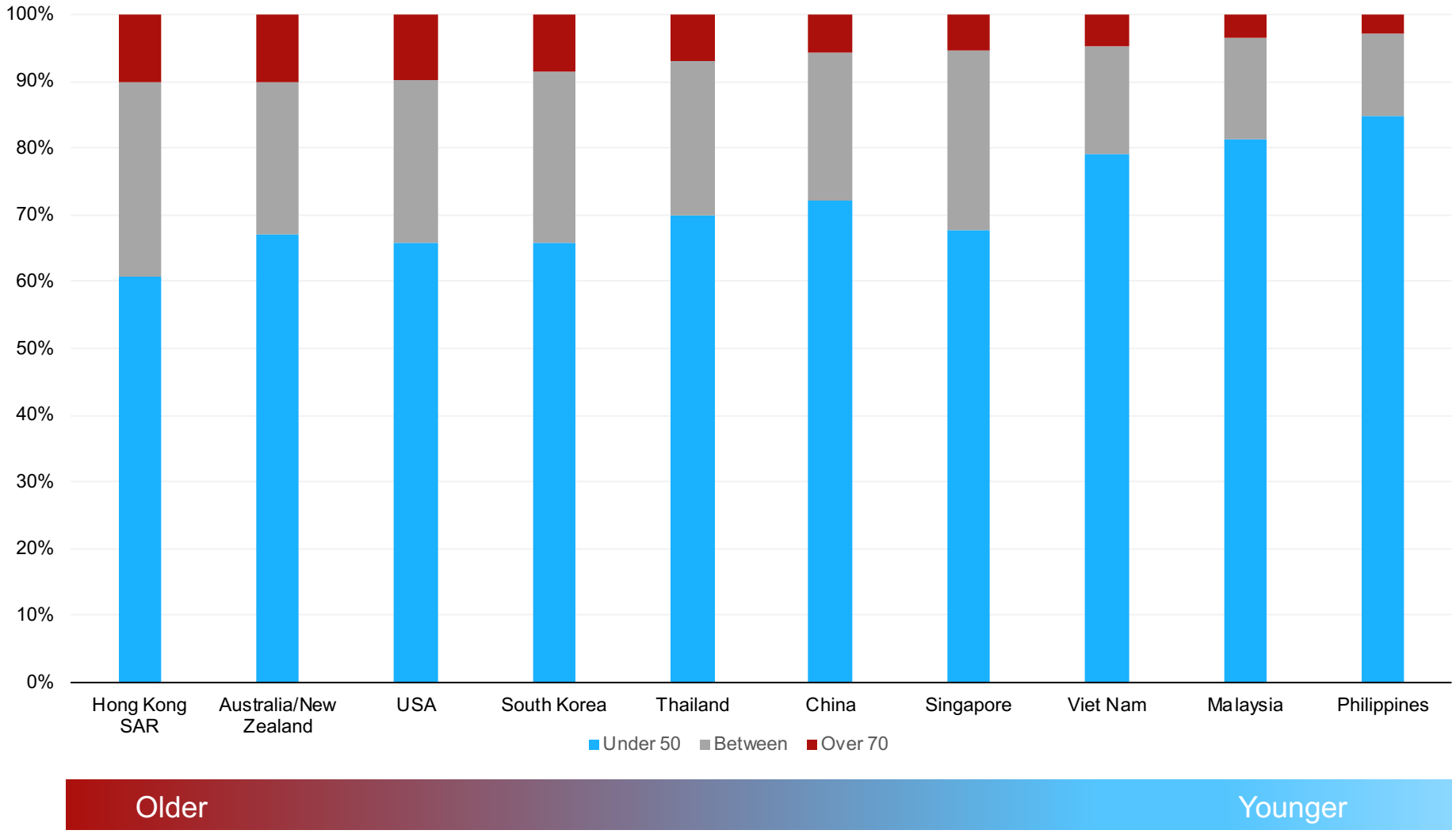
- COVID-19 mortality in Asia Pacific, thankfully, has been extremely low given population size and density

Country/Region	Deaths	Cases	Deaths per 1M population	% Death per Case
Philippines	960	18,638	9	5.15%
Japan	891	16,851	7	5.29%
Indonesia	1,641	26,940	6	6.09%
Korea	271	11,503	5	2.36%
Singapore	23	35,292	4	0.07%
New Zealand	22	1,504	4	1.46%
Australia	103	7,204	4	1.43%
Malaysia	115	7,857	4	1.46%
Mainland China	4,634	83,017	3	5.58%
Hong Kong	4	1,088	0.5	0.37%
Taiwan	7	443	0.3	1.58%
Vietnam	0	328	0	0.00%

- World deaths per 1M = 48

Data circa 1 June 2020 (https://www.worldometers.info/coronavirus/)

Demographic differences



Source: United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, Online Edition. Rev. 1.

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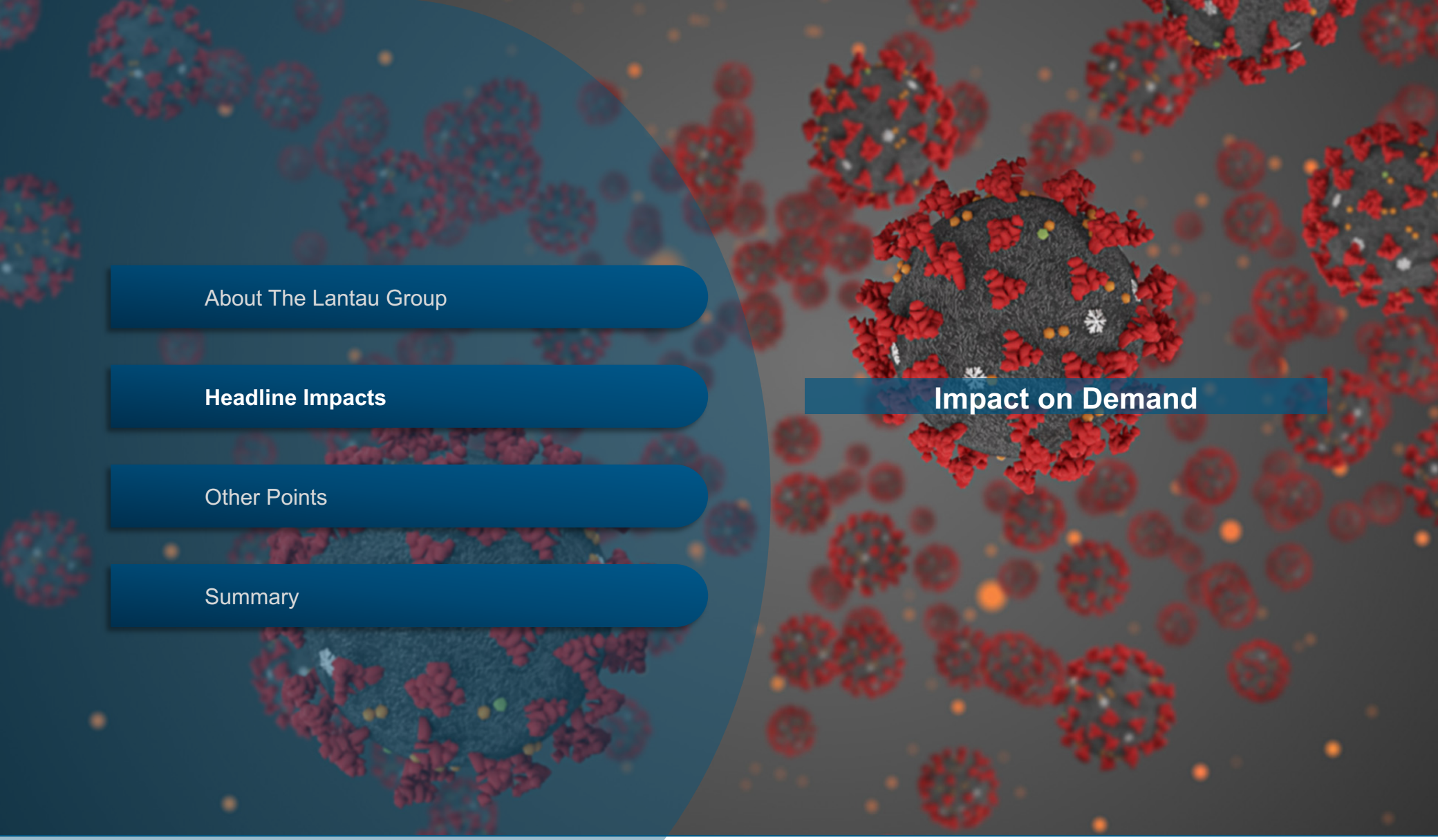

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Impact on Demand

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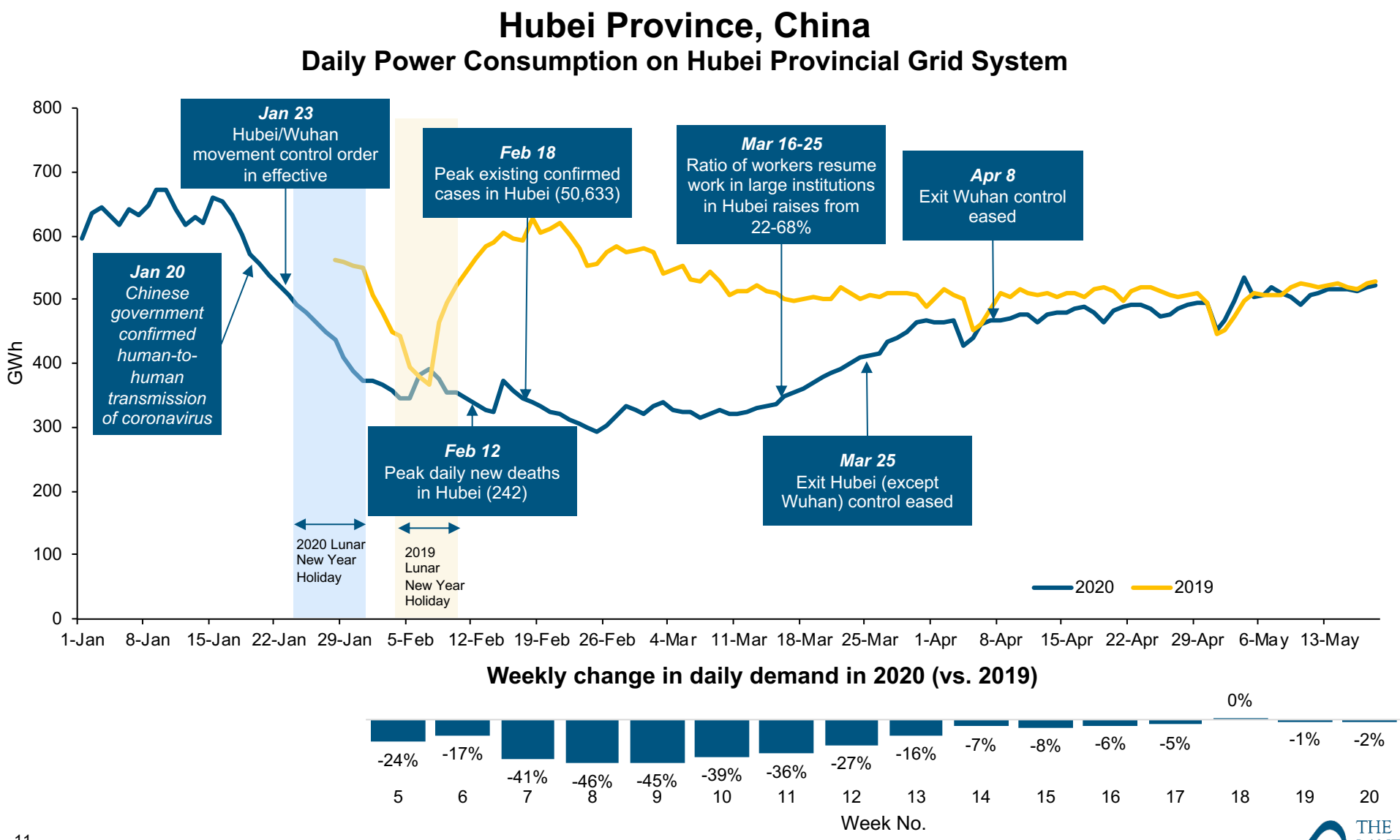
Hubei's power consumption chronicles the evolution of the COVID-19 situation, incorporating both lockdown effects and the beginning of a recovery profile



Source: Hubei Statistics, Hubei DRC, DXY.cn; TLG Analysis
* Note: % difference data only available after the week commencing 27 Jan 2020.

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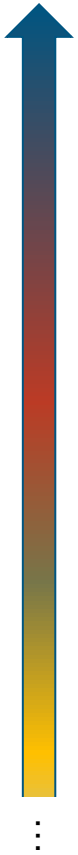
Policies aimed to contain COVID-19 in Asian Pacific countries (1 of 2)

More Strict



Region	Steps Taken
Mainland China	• Home quarantine – exit/entry of neighborhoods regulated and closely monitored; businesses and public services, except for those serving basic living needs, shut down; all gatherings prohibited. Violation could result in fine and/or imprisonment. • City lockdowns – Wuhan city shut down on Jan. 23rd; other cities in Hubei Province and all over the country followed soon; inter/intra-provincial transportation strictly controlled. • Border restrictions – border closed to common foreign passport holders on March 28th • Current Status – all restrictions, except for border restriction, greatly eased/removed as of first week of May.
Singapore	• Quarantine Orders – legal order issued to travelers and citizens suspected of carrying COVID-19 infection in March; • Partial lockdown ("circuit breaker") across the country – 85% of workplaces shutdown, with only most essential services remaining open. • Border restrictions – border closed to foreign visitors on March 15th • Current status– partial lockdown recently eased (1 June); border control still in effect
New Zealand & Australia	New Zealand: • Lockdown – nationwide lockdown in effect on March 26th ; businesses & schools closed, public gathering prohibited • Home quarantine – people are required to stay at home except for absolutely necessary reasons • Border restriction – border closed to foreigners on March 19th • Phased relaxation starting on May 14th Australia: • Lockdown in place for two months, policies vary in different states, in most states social gathering with more than 2/10 people is not allowed; people are required to stay at home and minimize outings, very recent easing • Border closed to all foreigners on March 19th; policy eased on April 7th; Australian nationals not allowed to travel abroad with few exemptions
Philippines, Malaysia & Thailand	Malaysia: • Movement control order (MCO) in place on March 18th -- closure of all government and private premises except those for essential services; prohibition of mass gatherings; Border closed to foreigners; MCO eased on May 4th Philippines: • Partial lockdown – strict lockdown in Luzon, lockdown in certain regions/municipalities in Visayas; border closed to all foreigners; border restriction still in place • Metro Manila lockdown ended on Monday, June 01 Thailand: • Lockdown – Partial lockdown in Bangkok since Mar. 21st; nationwide lockdown since Apr. 20th; State of emergency on Mar. 9th, curfew in place • Border closed on April 4th

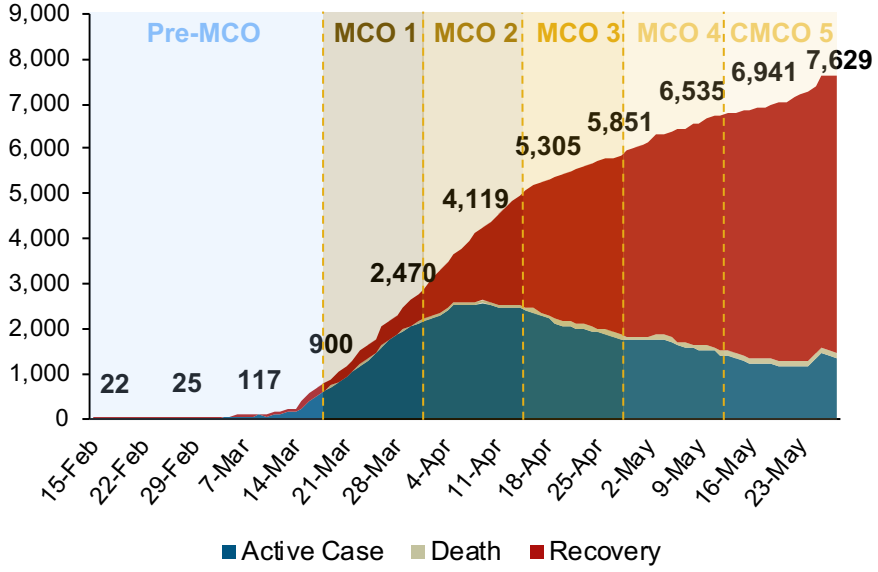
[continued…]

Policies aimed to contain COVID-19 in Asian Pacific countries (2 of 2)

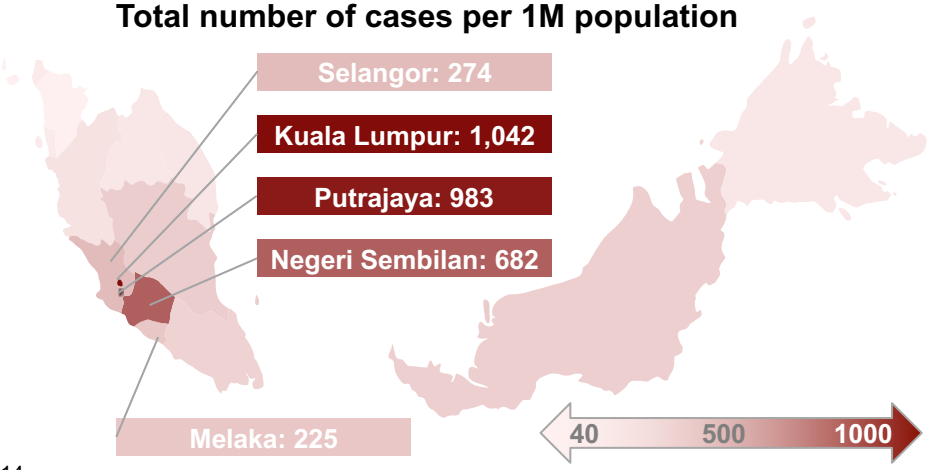
Region	Steps Taken
Korea & Taiwan	Korea: • No lockdown/quarantine ordered – restriction on personal activities is advised but not enforced; the Enhanced Social Distancing campaign from 22 March to 19 April advising limited operation of high-risk facilities, businesses and sectors; relaxed form of social distancing from 20 April to 5 May; transition to 'Distancing in Daily Life' form 6 May • Border restrictions – entry ban to travellers from selective countries/areas with severe outbreaks, i.e. Japan, Hubei Province, China, etc.; all incoming Koreans and foreign nationals are subject to 14-day quarantine Taiwan: • Early and aggressive track, trace • No lockdown – some businesses suspended, public gatherings restricted • Border restriction – border closed to foreigners on March 19th
Oher ASEAN Countries	Vietnam: • Movement control from April 1st – 22nd ; more than 30,000 business shut down • Border restrictions – flights from China suspended on Feb. 1st, international flights on Mar. 25th , visas stopped • Status quo – movement control lifted, businesses reopening Cambodia: • No lockdown – state of emergency declared; New Year (Sangkran, Festival in Mid April, 2020) cancelled; some public/private zones are closed (gyms, nightlife areas, etc) • Border restrictions – suspending foreign visas; entry ban on selective countries with severe outbreaks, i.e. U.S., EU, Thailand, Vietnam

Peninsular Malaysia (example): COVID-19 Impact

Number of active cases, deaths, and recoveries

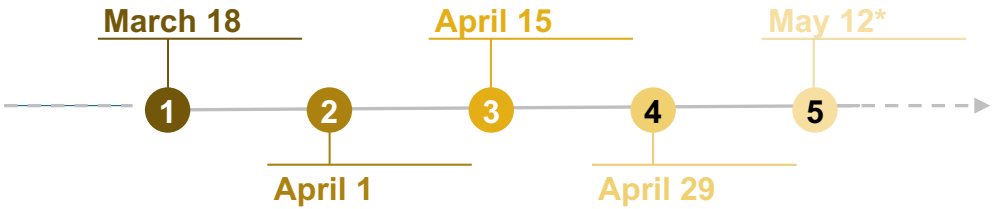


Total number of cases per 1M population



No. of COVID tests: 519,944 (15,391 tests per 1M population)

Movement Control Order (MCO) Phases



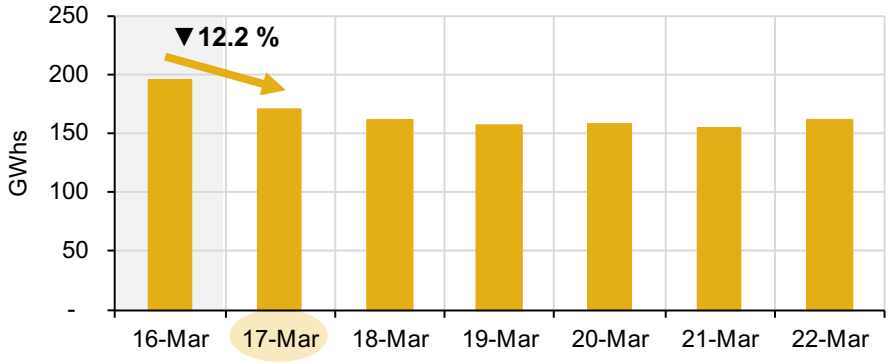
1. Prohibition of mass gatherings including religious, sports, social and cultural activities. All houses of worship and business premises would be closed, except for supermarkets, public markets, grocery stores and convenience stores.
2. Closure of all government and private premises except those involved in essential services (water, electricity, energy, telecommunications, postal, transportation, irrigation, oil, gas, fuel, lubricants, broadcasting, finance, banking, health, pharmacy, fire, prison, port, airport, safety, defence, cleaning, retail and food supply)
3. Closure of all kindergartens, government and private schools, public and private higher education institutions, and skills training institutes nationwide
4. Sanctions covering all Malaysians travelling abroad. Those who have returned from overseas would be required to undergo a health check and a 14-day quarantine.
5. Restrictions on the entry of all tourists and foreign visitors into the country

Note: *Phase 5, a conditional movement control order (CMCO), is a relaxation of MCO regulations, which allows operations of major economic sectors.

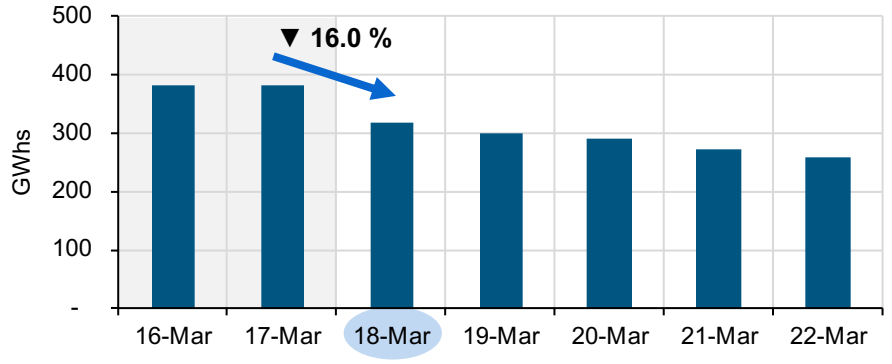
Source: Worldometer (29 May), Department of Statistics Malaysia, Ministry of International Trade and Industry

Lockdown measures were clearly the immediate cause of reduced demand

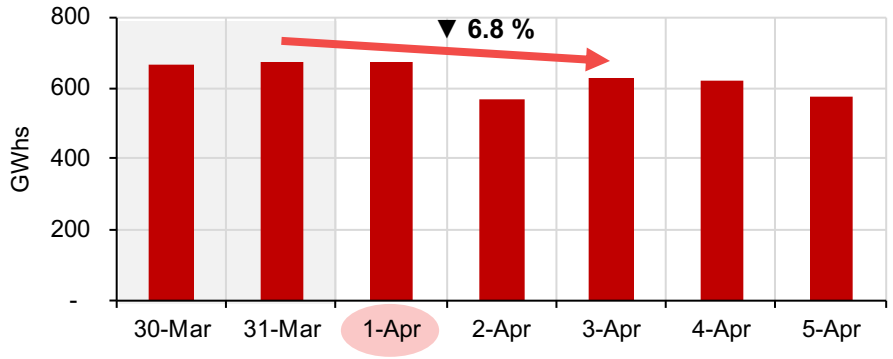
17 March 2020 Philippines
Enhanced Community Quarantine



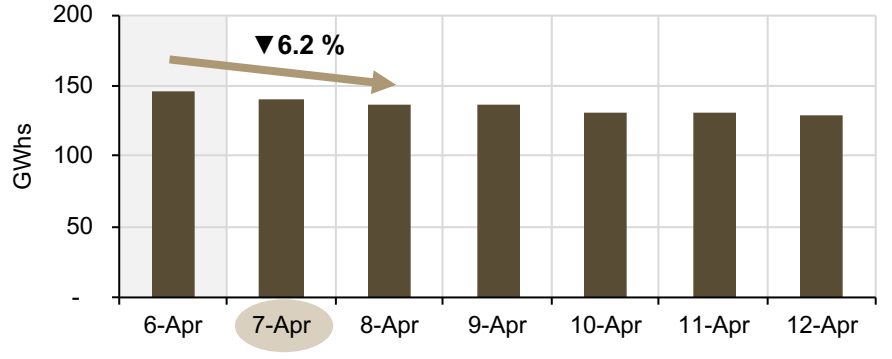
18 March 2020 Malaysia
Movement Control Order



1 April 2020 Vietnam
"Soft Lockdown Measures"



7 April 2020 Singapore
Circuit breaker measures



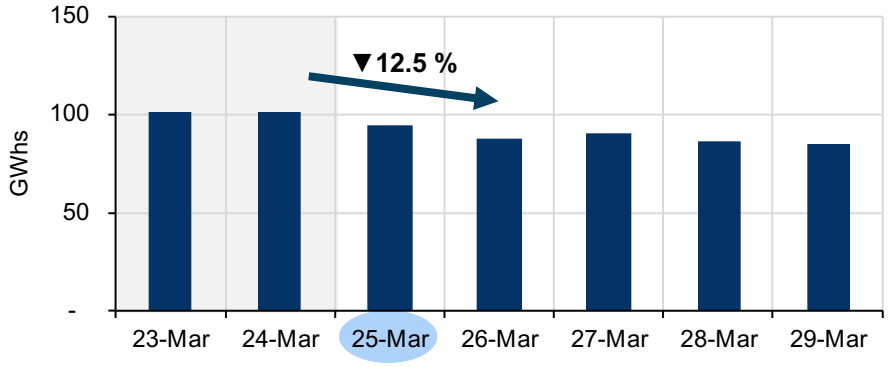
In the charts above we highlight the day to day drop in reported GWhs between the day before lockdown and the day of lockdown. However, for Vietnam and Singapore the impact was slightly delayed.

- For Singapore we measure the day to day drop based on 8 Apr (day after lockdown, and day when schools closed)
- For Vietnam we measure the day to day drop based on 3 Apr (2 days after lockdown as 2 Apr was a public holiday)

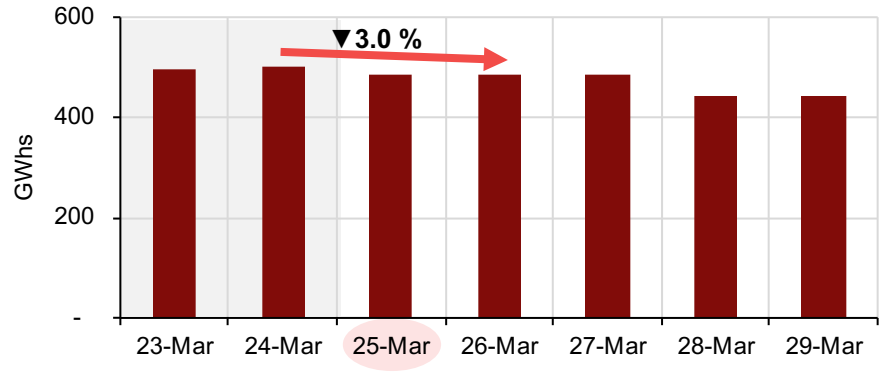
Source: PEMC; GSO; NLDC EVN; EMC; TLG Analysis

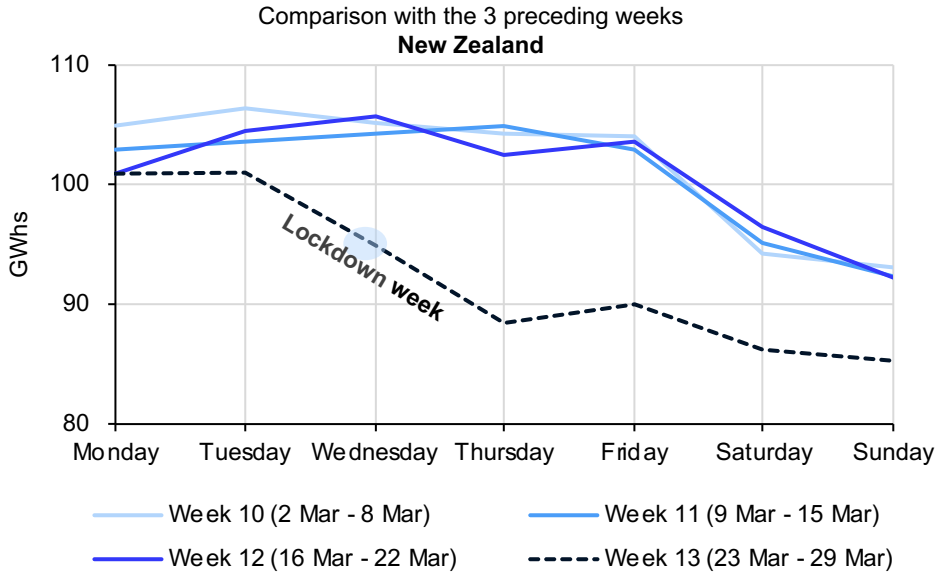
Lockdown measures were clearly the immediate cause of reduced demand (2)

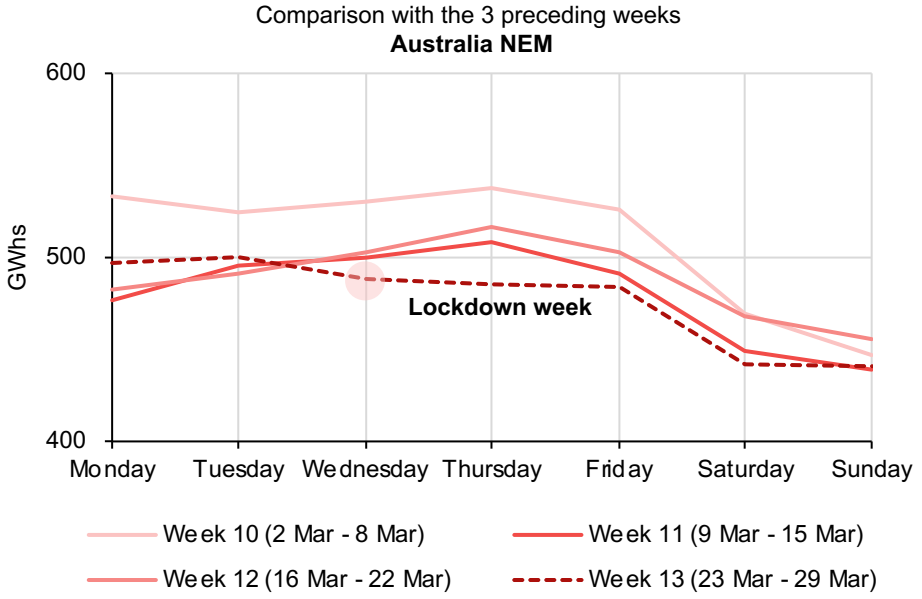
25 March 2020 New Zealand
Lockdown



25 March 2020 Australia
"Stage two restrictions"



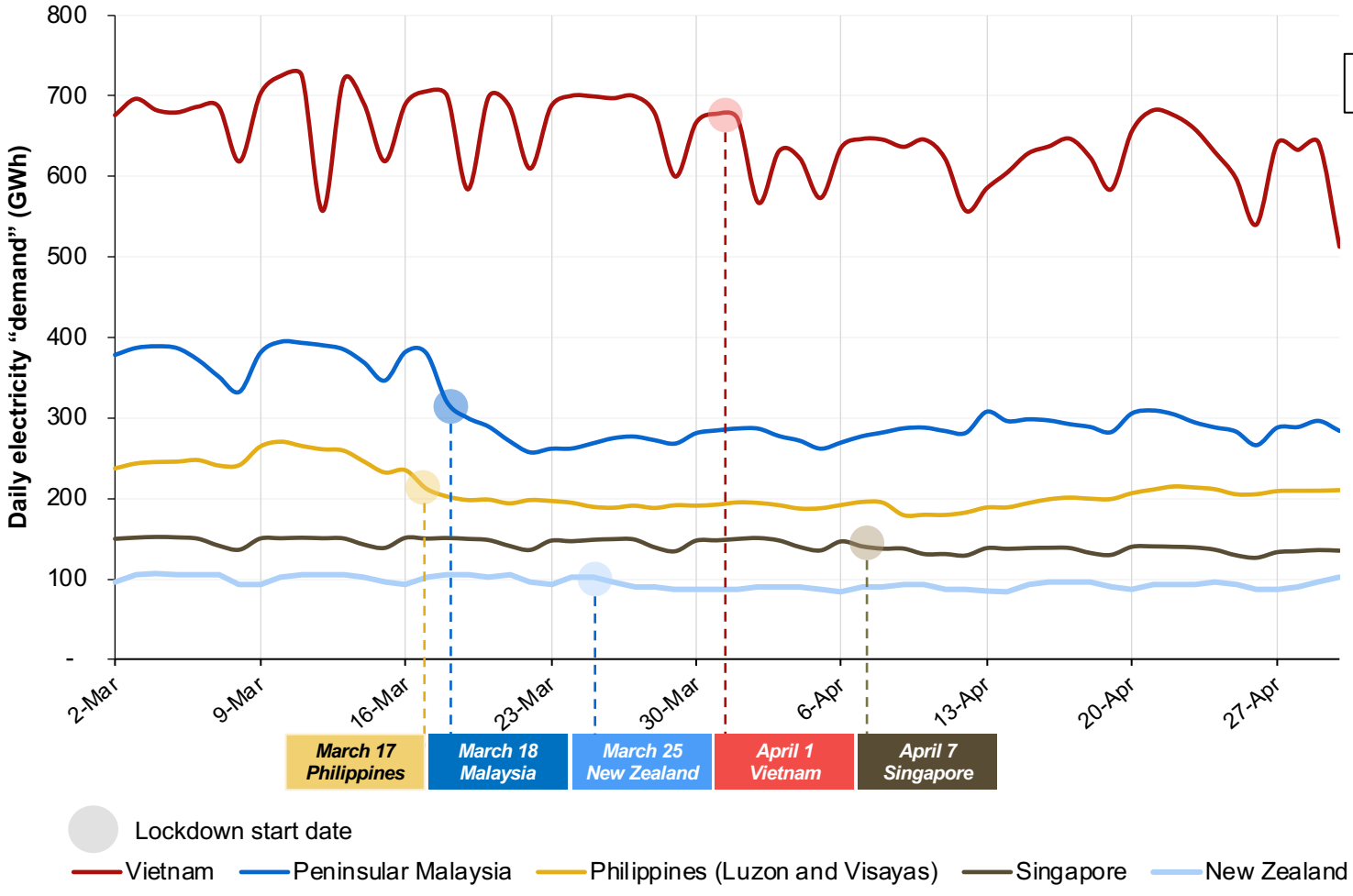




Source: EA; AEMO; TLG Analysis

The initial impact of lockdowns was then typically followed by further consumption declines in weeks to follow

Daily Electricity "Demand" (March and April)



Average Daily "Demand"

	% change	Week before Lockdown	Week after Lockdown
Vietnam	▼ 7.8 %	680 GWh	627 GWh
Peninsular Malaysia	▼ 29.2 %	380 GWh	269 GWh
Philippines (Luzon and Visayas)	▼ 25.5 %	257 GWh	192 GWh
Singapore	▼ 6.5 %	145 GWh	136 GWh
New Zealand	▼ 12.4 %	101 GWh	88 GWh

Source: PEMC; GSO; NLDC EVN; EMC; EA; TLG Analysis

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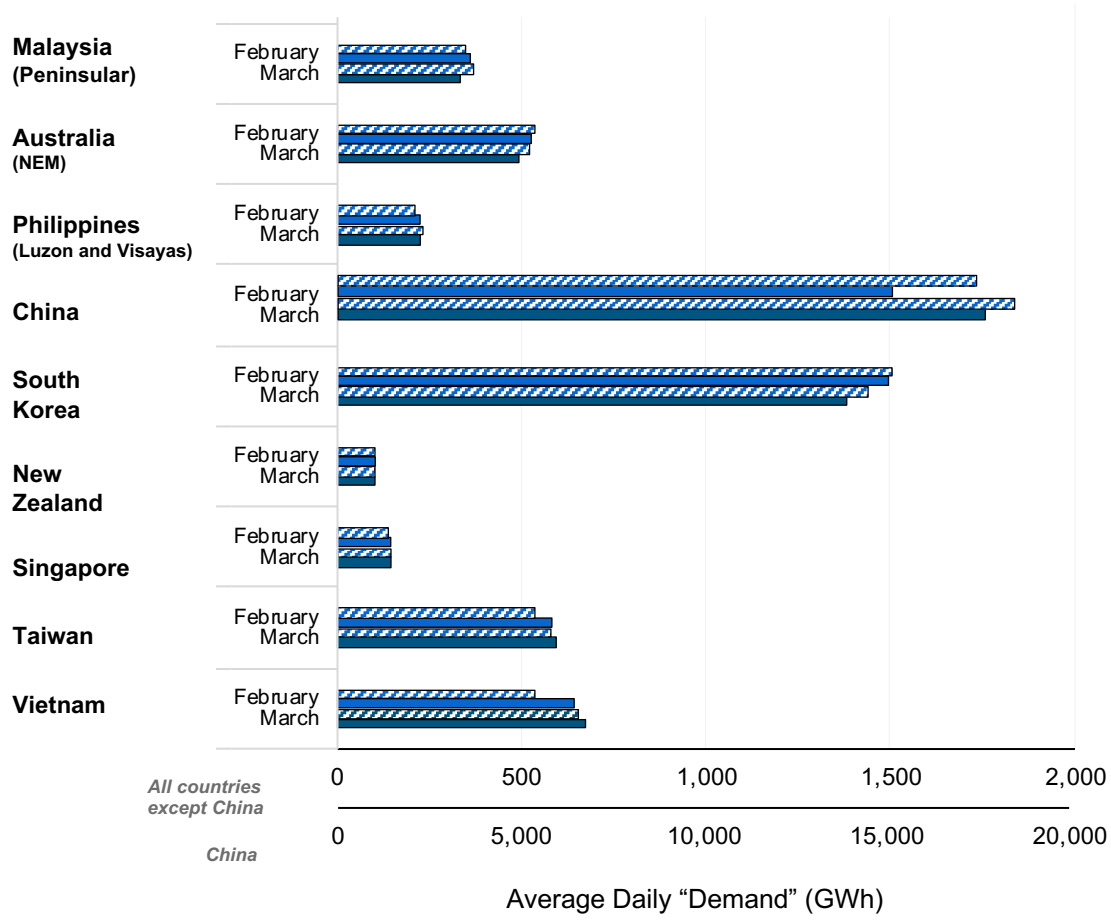
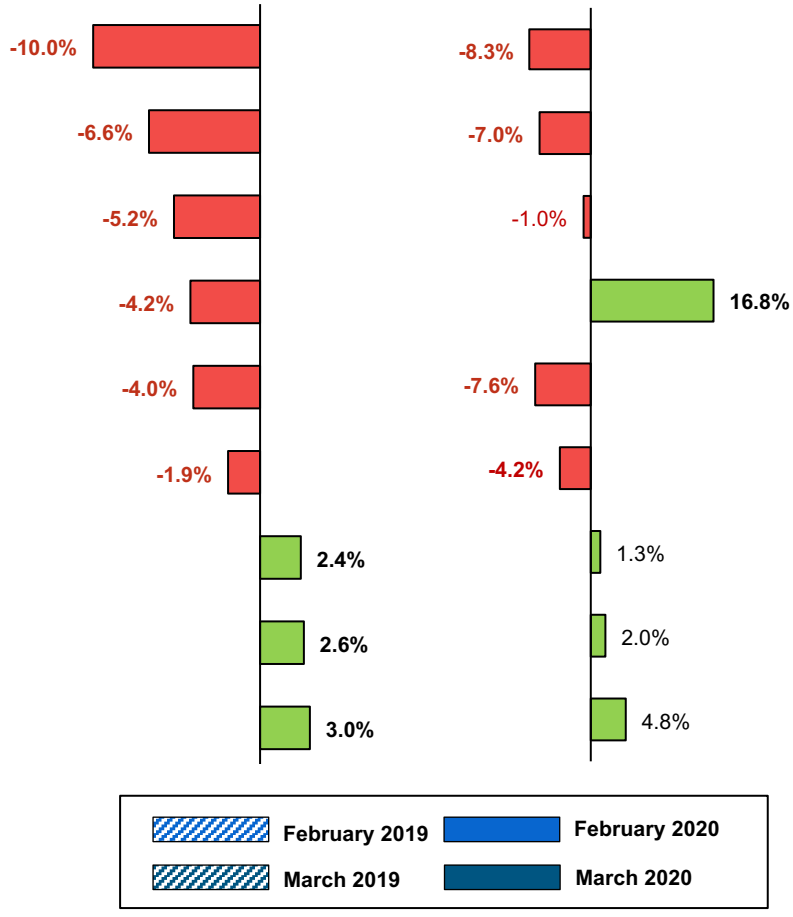
Diversity of impacts and staging across Asia Pacific to end March

Average Daily Electricity "Demand"

February & March - 2019 & 2020



Change in March Electricity "Demand"



Source: GSO; AEMO; PEMC; NEA; KPX; EA; EMC; MOEA BOE; Taipower Statistics; NLDC EVN; TLG Analysis

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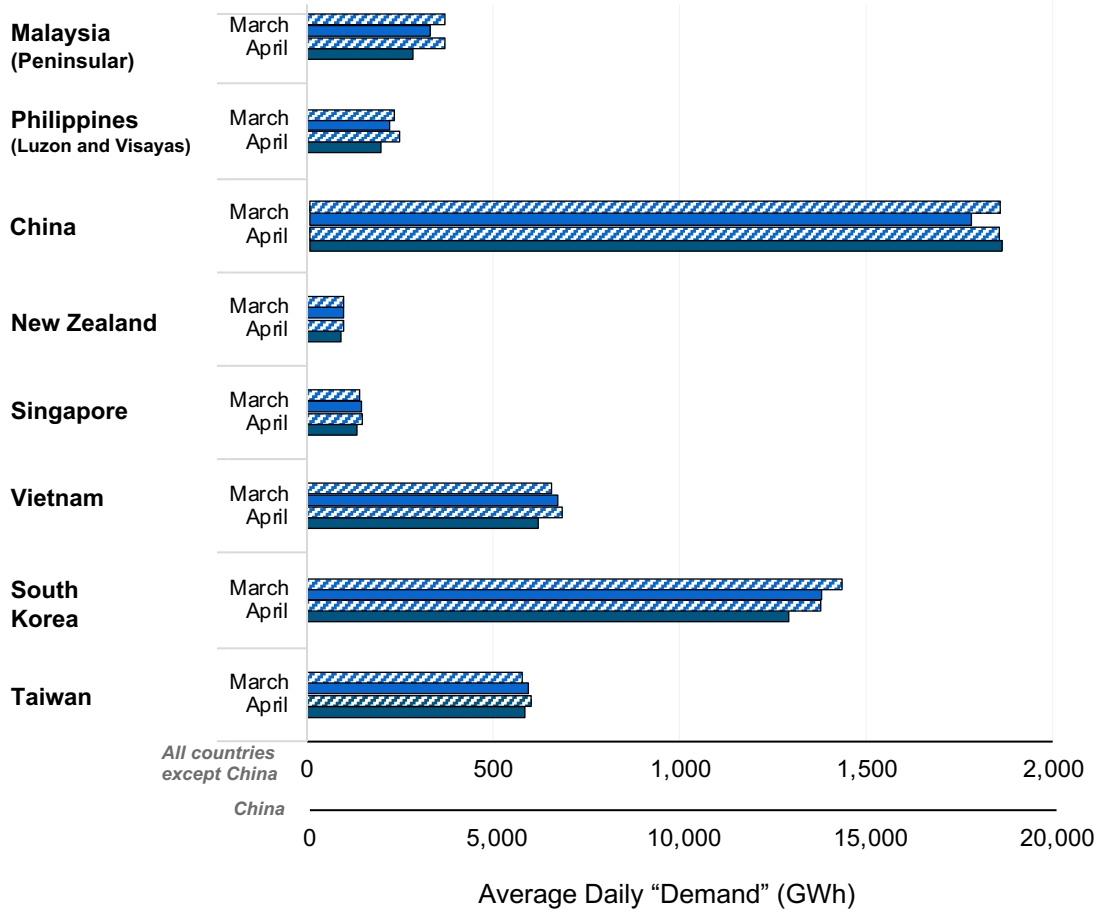
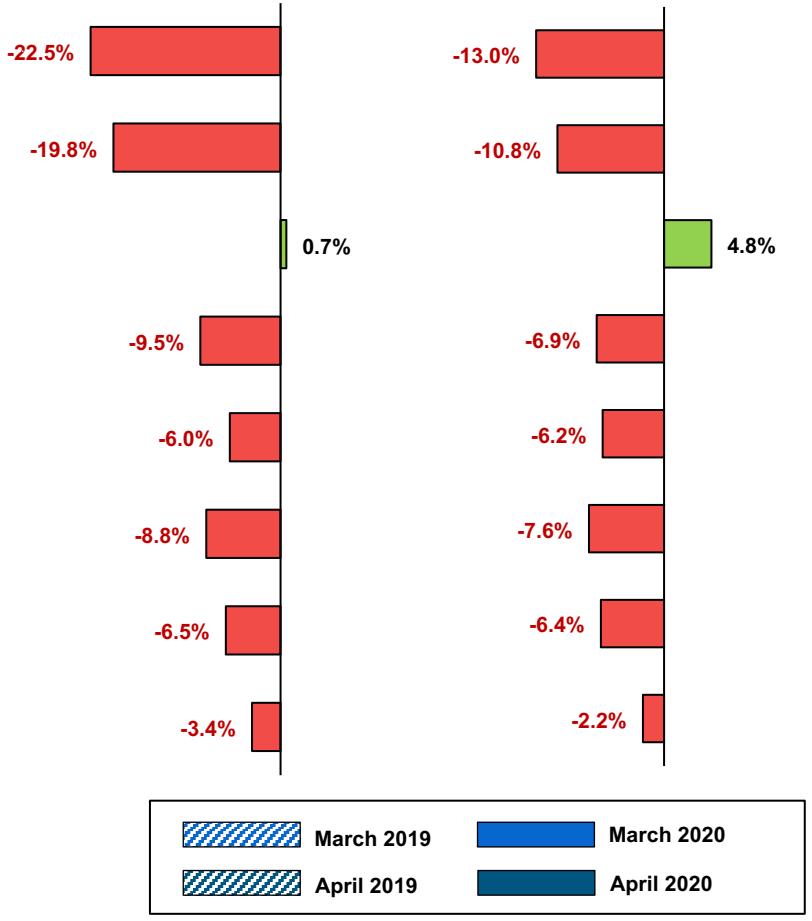
It then just got worse (April)

Average Daily Electricity "Demand"

March & April - 2019 & 2020



Change in April Electricity "Demand"



Source: GSO; PEMC; EA; EMC; NLDC EVN; KPX; MOEA BOE; Taipower Statistics; TLG Analysis

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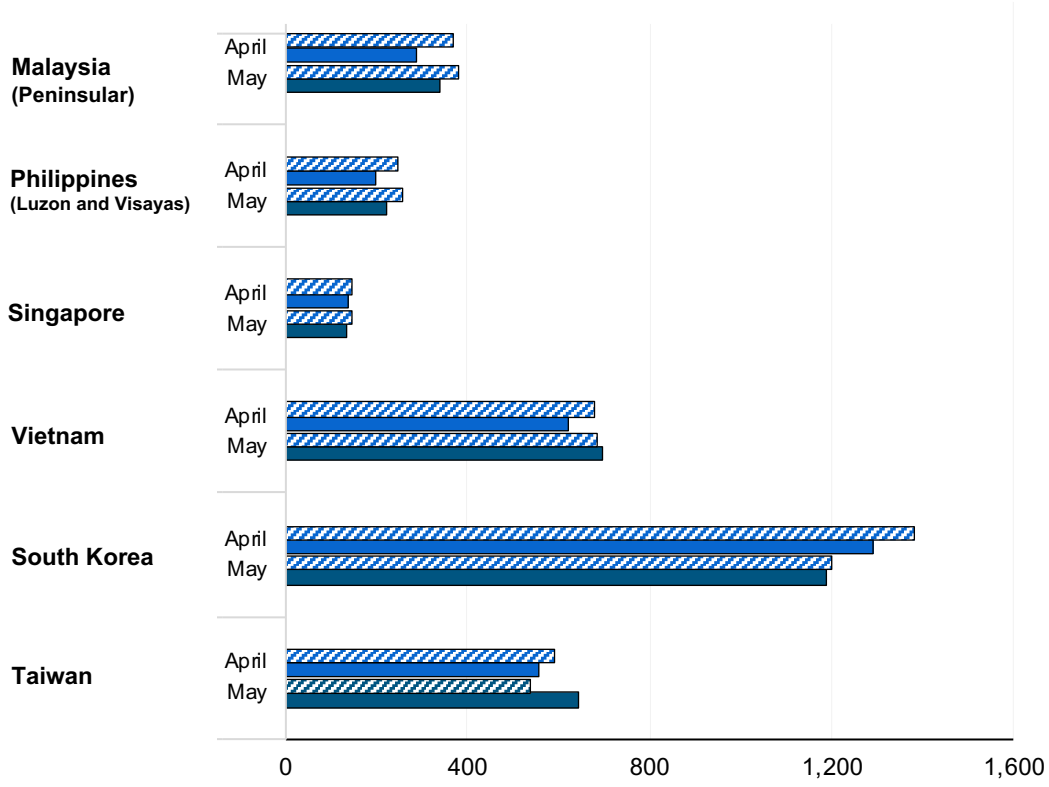
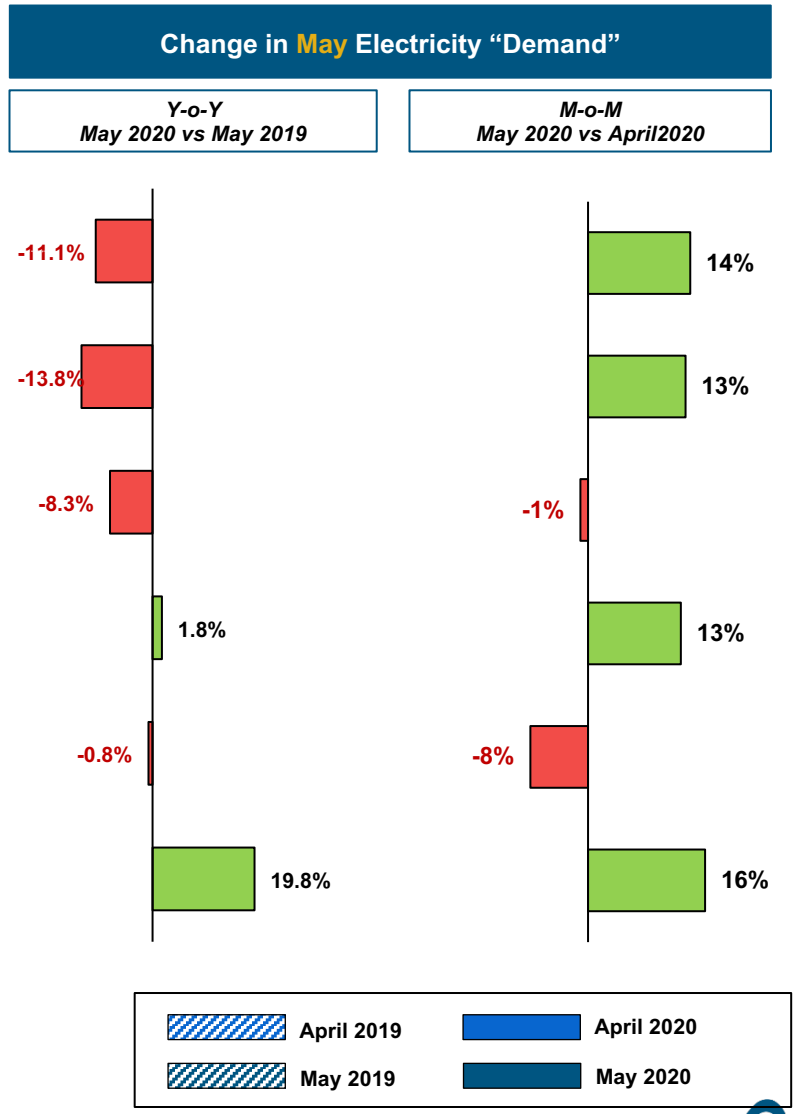
With more movement or adaptation, some reversion/recovery is evident

Average Daily Electricity "Demand"

April & May - 2019 & 2020



Change in May Electricity "Demand"



Note: South Korea data is as of May 10th ,2020

Source: GSO; PEMC; EA; EMC; NLDC EVN; KPX; MOEA BOE; Taipower Statistics; TLG Analysis

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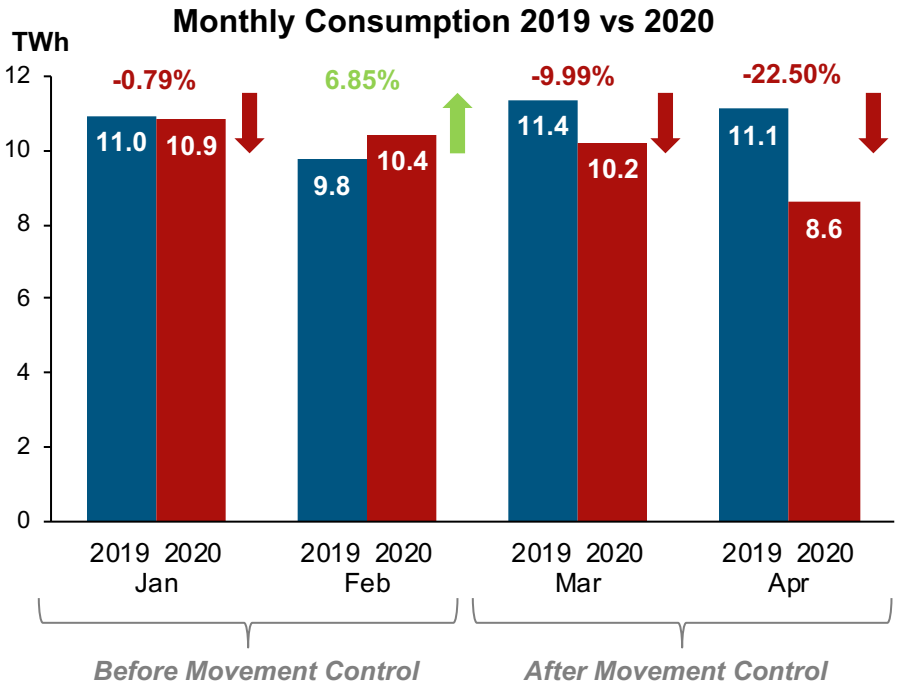
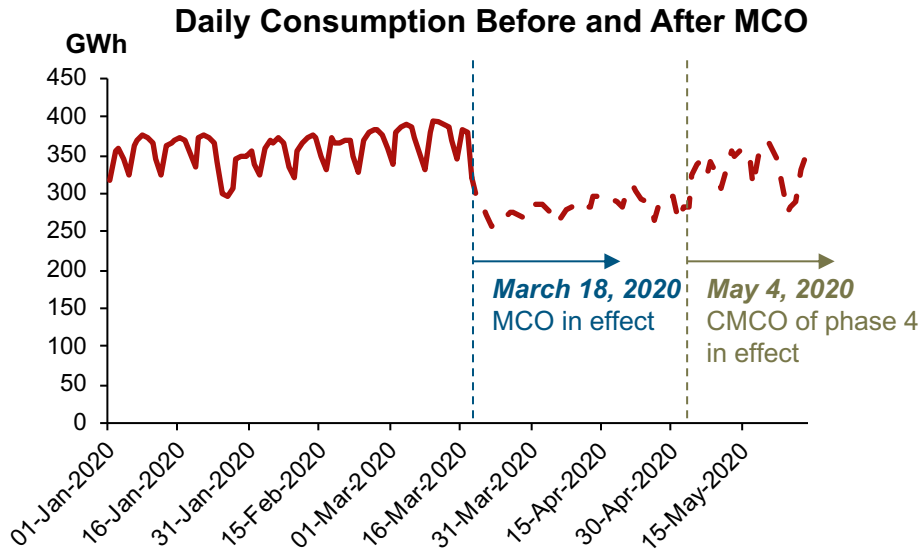
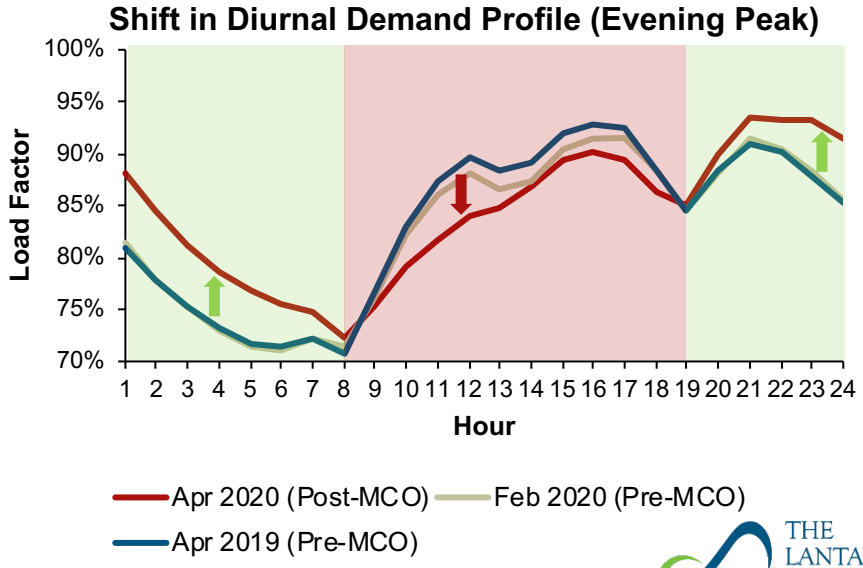
Impact on Electricity Demand Level and Profile – Peninsular Malaysia

- Movement Control Order (MCO) resulted in a 16% drop in daily consumption on March 18, 2020
- The daily consumption has experienced a slight recovery after the conditional movement control order (CMCO) was implemented within MCO phase 4 on May 4, 2020
- Total consumption in April 2020 decreased by 22.5%, compared to that of the same month in the previous year
- Peak demand in April shifted from daytime (8am – 7pm) to night-time (7pm – 1am)







Source: GSO

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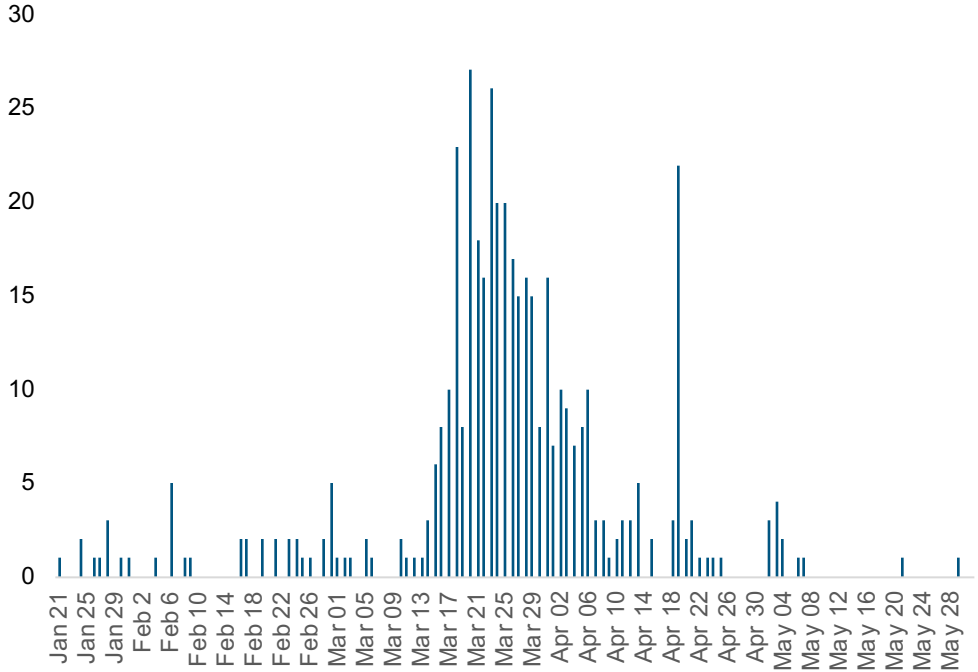
With Covid-19 still under control Taiwan maintains a mostly upbeat outlook

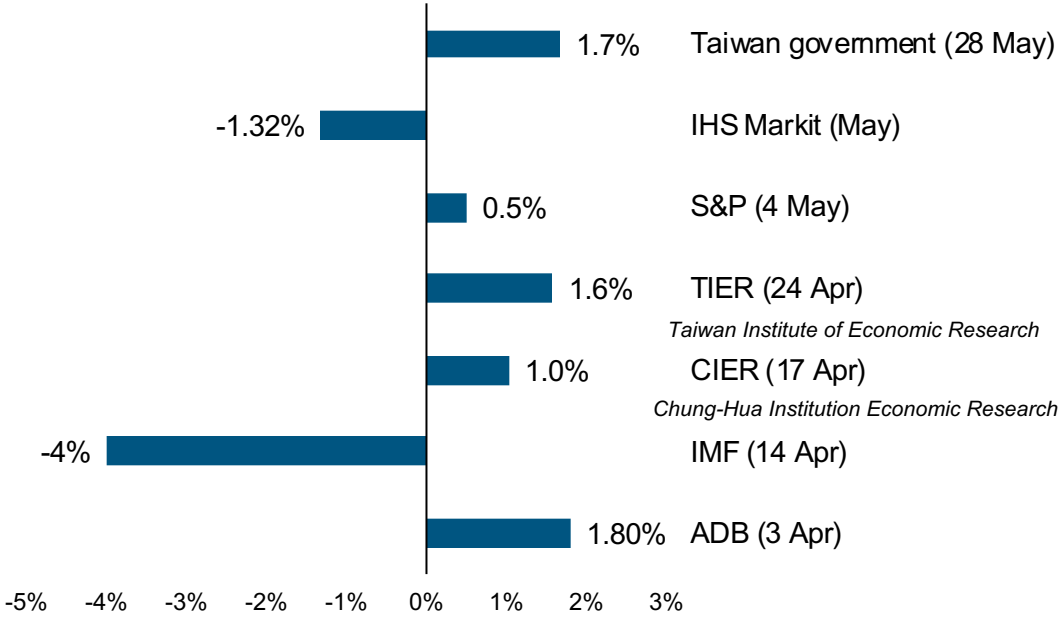
Taiwan has managed to contain the outbreak (442 confirmed cases and 7 deaths as of 31 May) without a lockdown seen elsewhere. Taiwan's economy is heavily reliant on exports (70% of GDP). Major export partners includes Mainland China and HK (40%), ASEAN (18%), USA (12%), Europe (9%) and Japan (7%). In March 2020, exports dropped to Europe, USA, and Japan but increased to Mainland and HK.

Daily New Cases (as of May 31)



Source: Taiwan CDC

Taiwan 2020 GDP forecast



Source: S&P, IMF, IHS Markit, ADB, TIER, CIER, Directorate General of Budget, Accounting and Statistics

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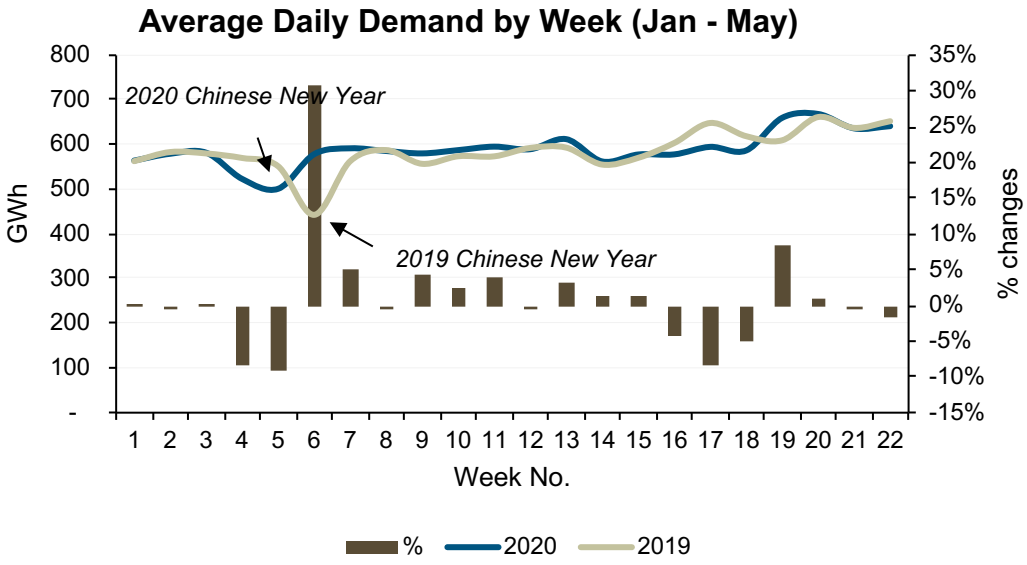
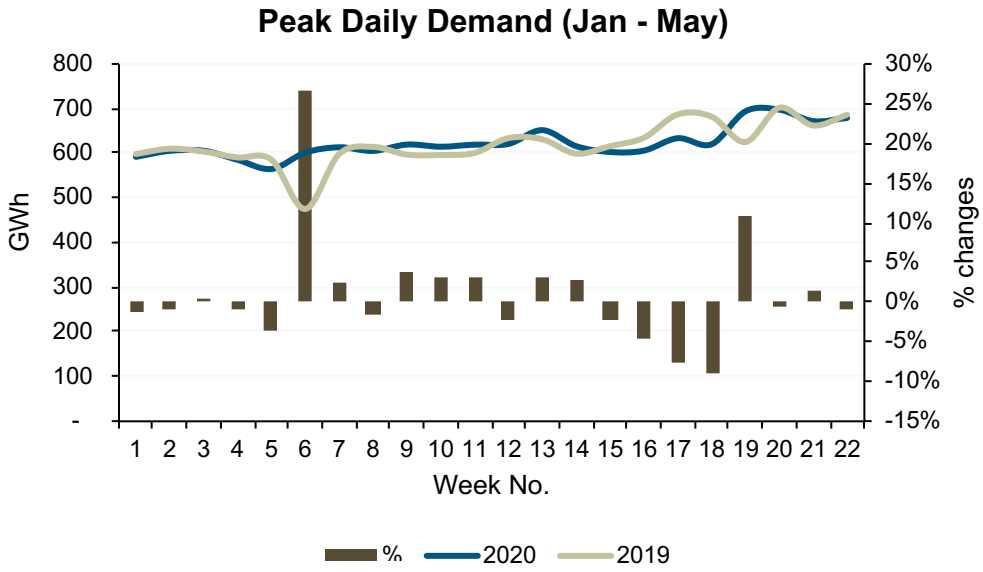
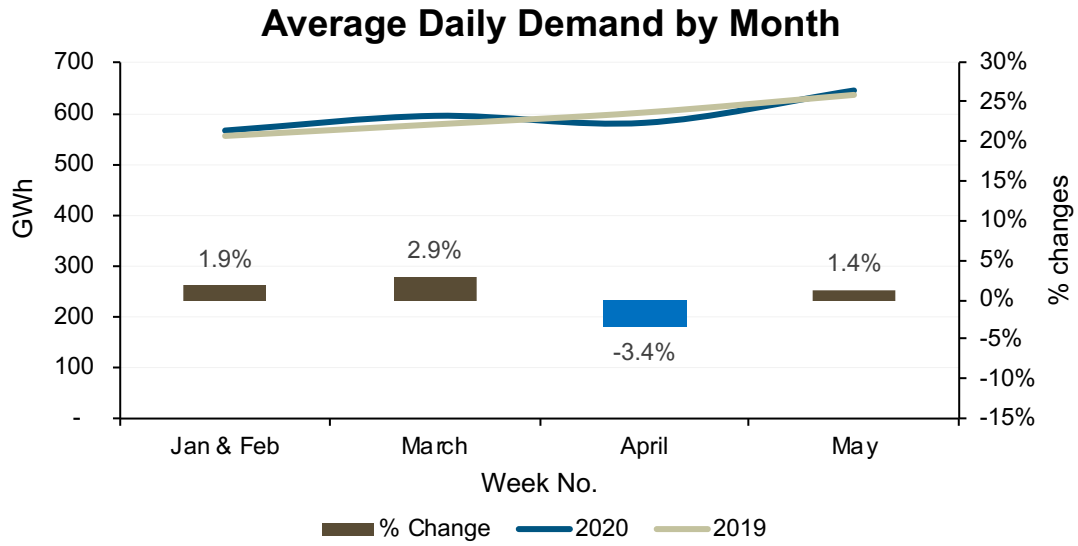
Taiwan's electricity demand in April dropped due mainly due to slowing global growth *and lower temperature*







Source:Taipower

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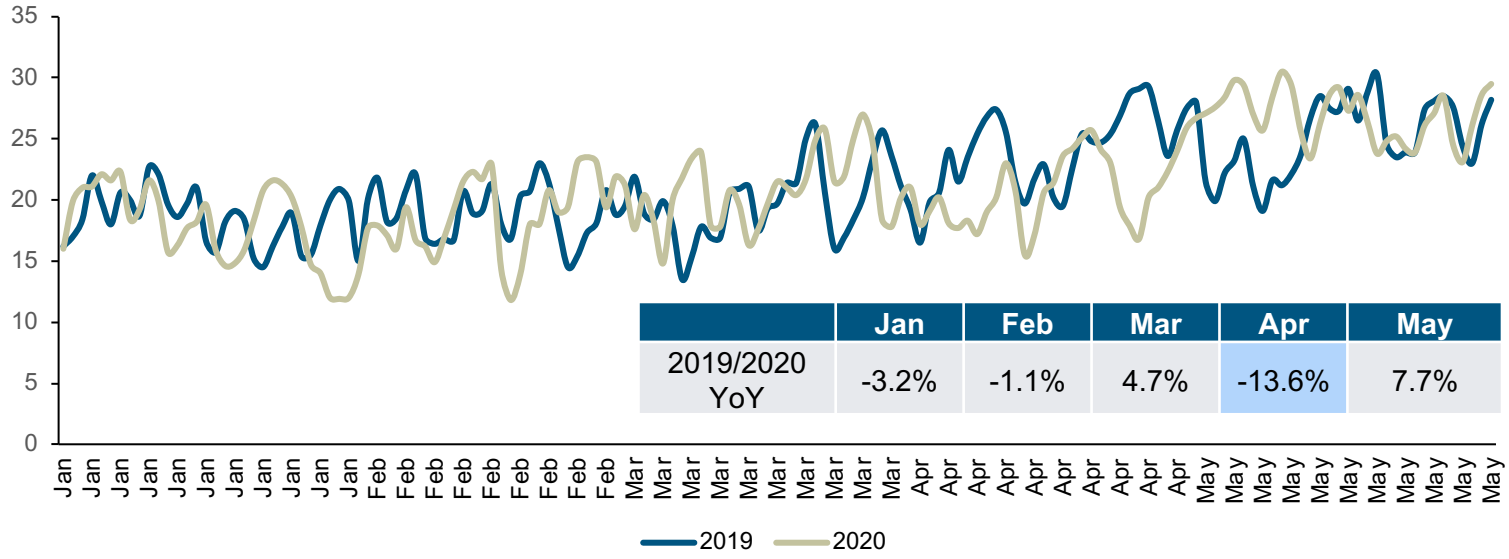
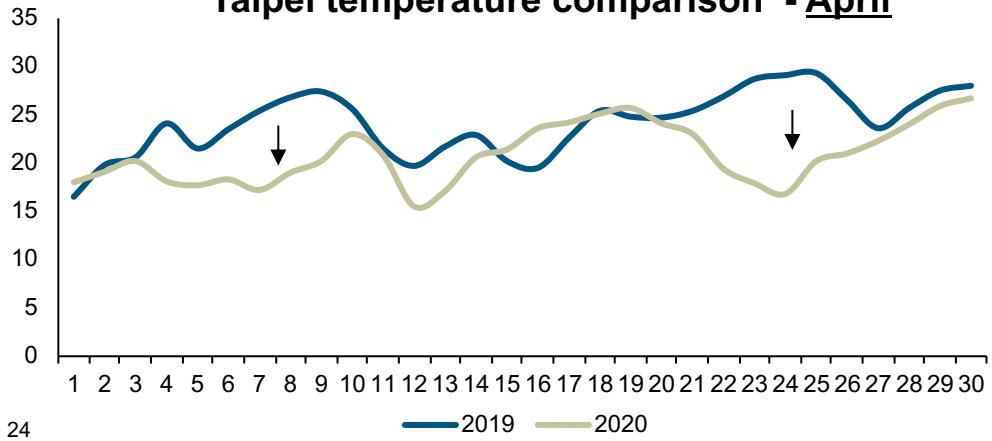
Never forget to check the temperature….

Taipei temperature comparison (Jan - May)

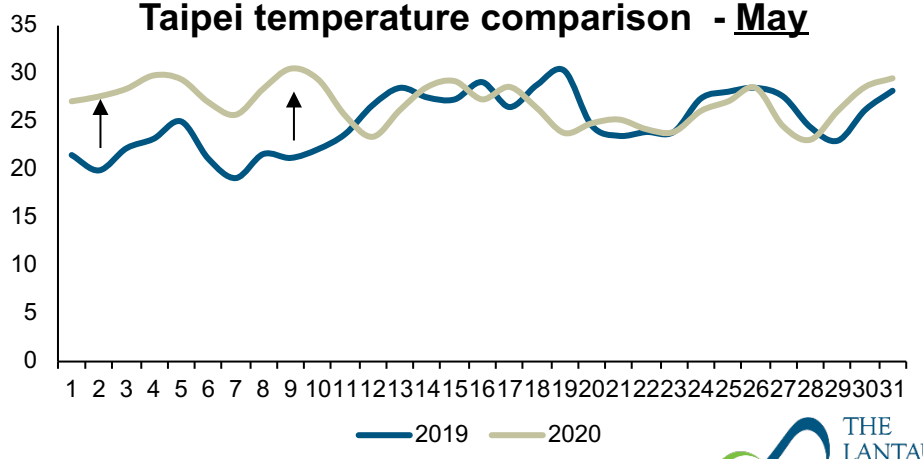


	Jan	Feb	Mar	Apr	May
2019/2020 YoY	-3.2%	-1.1%	4.7%	-13.6%	7.7%

Taipei temperature comparison - April



Taipei temperature comparison - May



Source:Taiwan Central Weather Bureau

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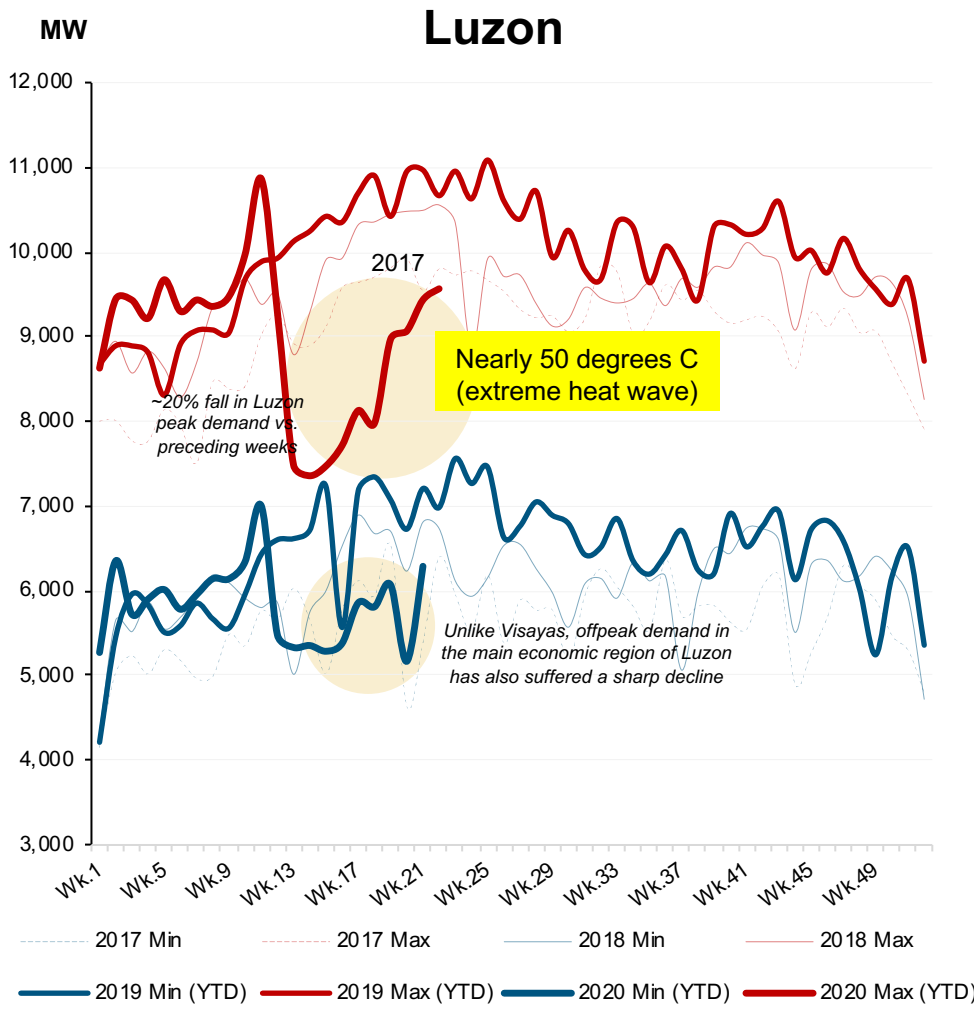
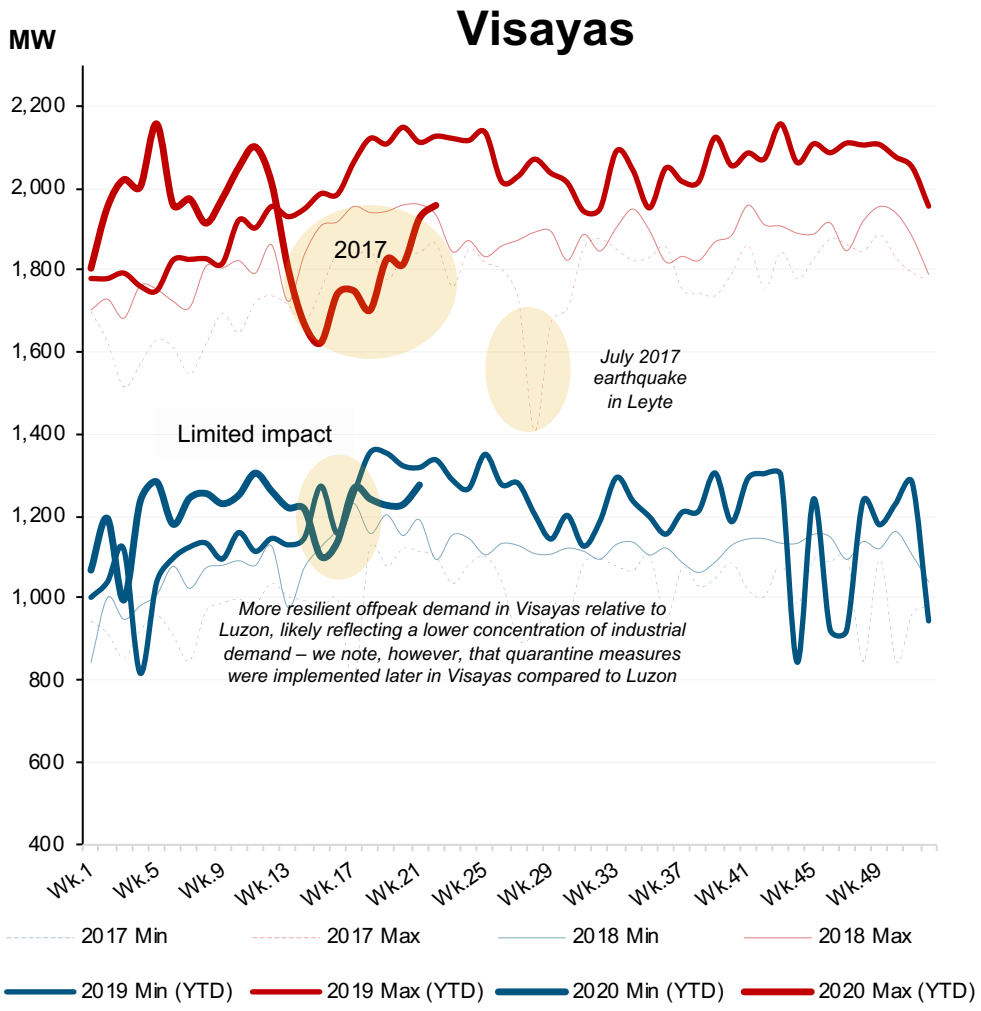
Philippine experience highlights temperature in a different way…lockdown has occurred during an exceptional heat wave recovering some of the lost demand





Note: Years have been rebased to show Week 1 commencing from the first Monday of each year; demand figures are ex-post
Source: PEMC; TLG analysis

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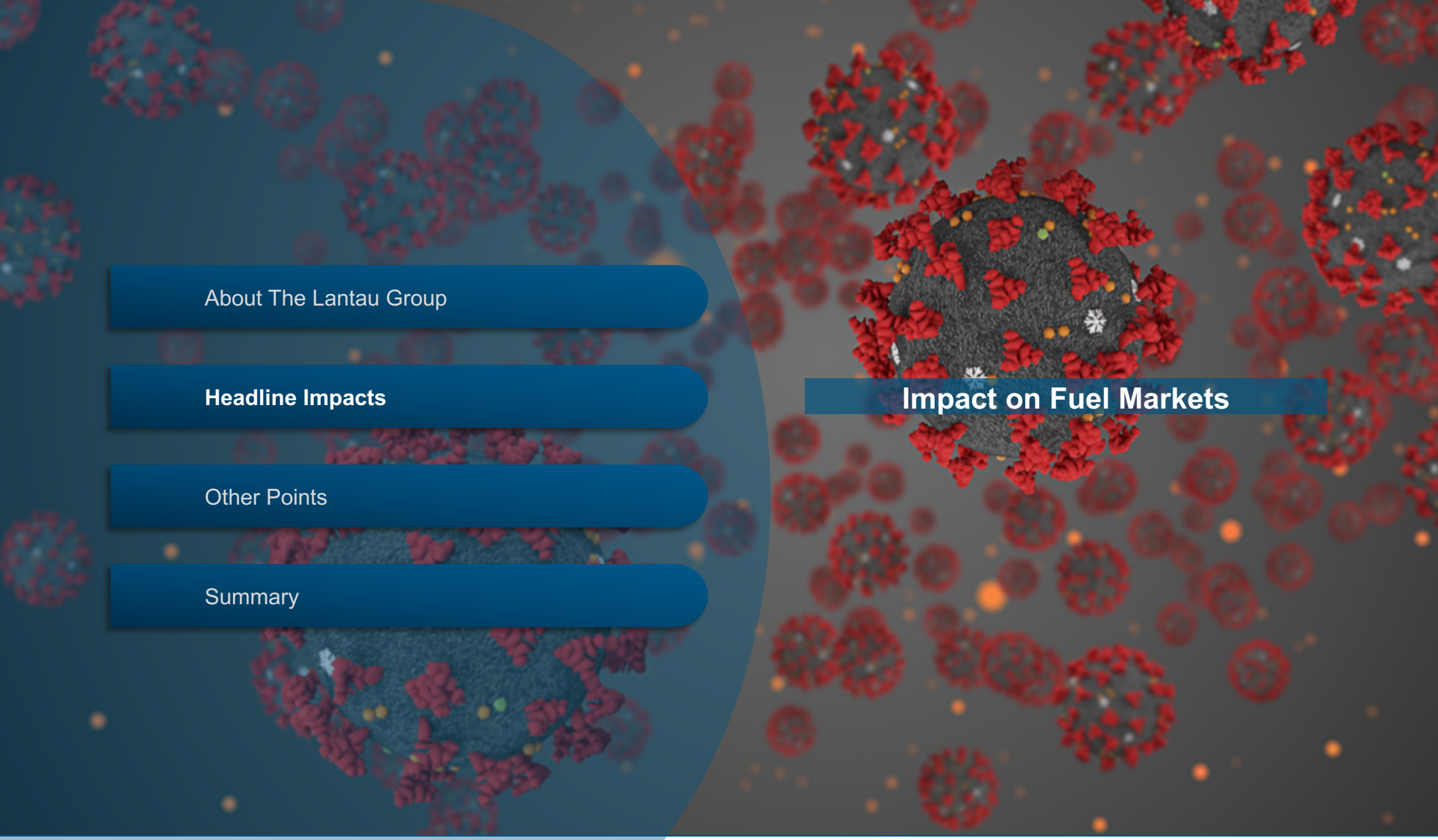
Summary points

- Covid-19 incidence rates are still not under control across all countries, but the mortality story is distinctively encouraging and population age demographics are favourable
- Lockdowns had by far the largest impact on demand (of course)
- Several countries are showing demand recovery, even modest growth, on a year-over-year basis as Covid progresses and movement restrictions ease
  - Mainland China's recovery continues to show strength
  - Many Asian countries are still poised get back onto a growth track, even if the rate is less than it was
  - The impact of the rest-of-world economic demise is not yet clear
- In teasing out key factors, just note that February through May has highly variable weather
  - Normally the peak period for markets like the Philippines
  - Residential bill shock in the Philippines, for example, will be much greater
  - Temperature effects also present in the data
- Because growth is already part of many (not all) Asian' electricity systems, adaptation to a *lower* rate of growth will often lead to new project *deferral*, restoring fundamentals sooner



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Impact on Fuel Markets

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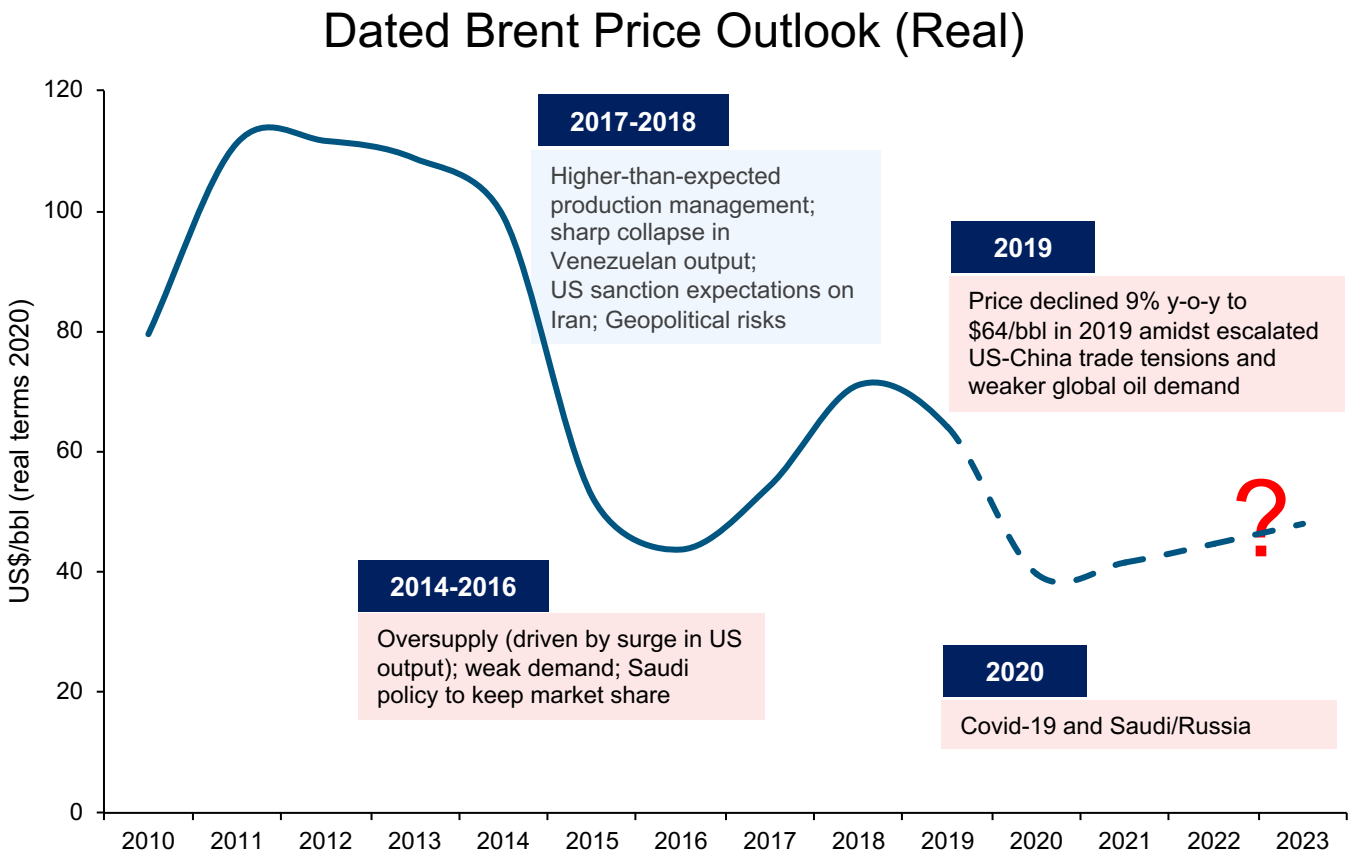
Fuel market “stories” are always easiest in retrospect



In US$/bbl	Dated Brent	Year over Year
2014	99.0	
2015	52.4	-47%
2016	43.7	-17%
2017	54.4	24%
2018	71.0	31%
2019	64.3	-9%
2020	39.7	-38%
2021	41.6	5%
2022	44.7	7%

Recent events have been dramatic, but we’ve seen similar year-over-year changes in the past

Notes: Forecast prices in 2020US$/bbl; 2010-2019 are actuals, forecast thereafter
Source: ICE, Based on latest market forward curves for the front 2 years

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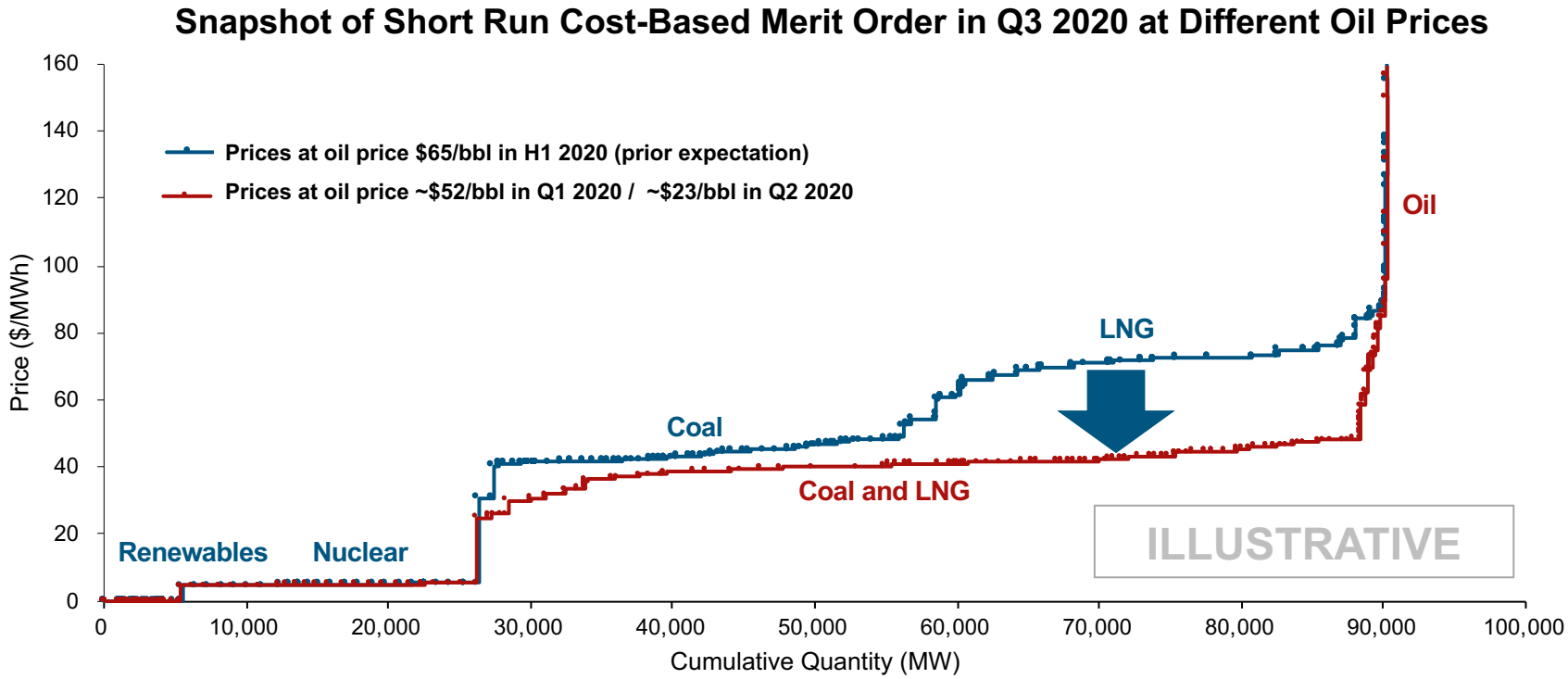
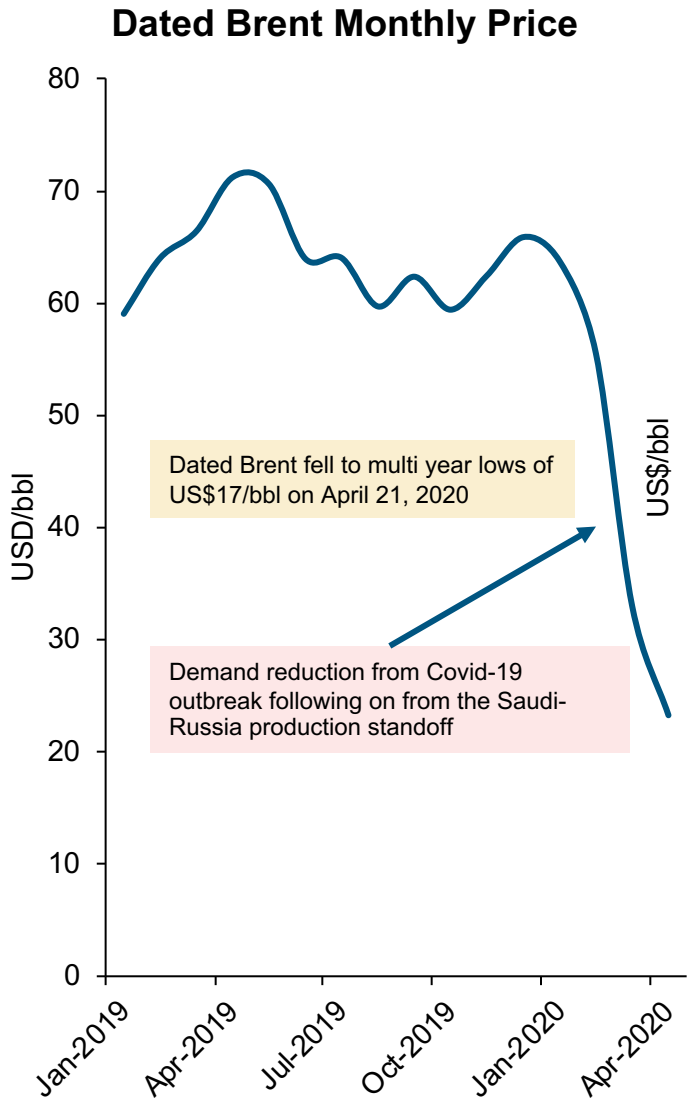
Korea's cost-based electricity pool market is a useful "lens" into the impact of the most recent (short-term) fuel market disruption

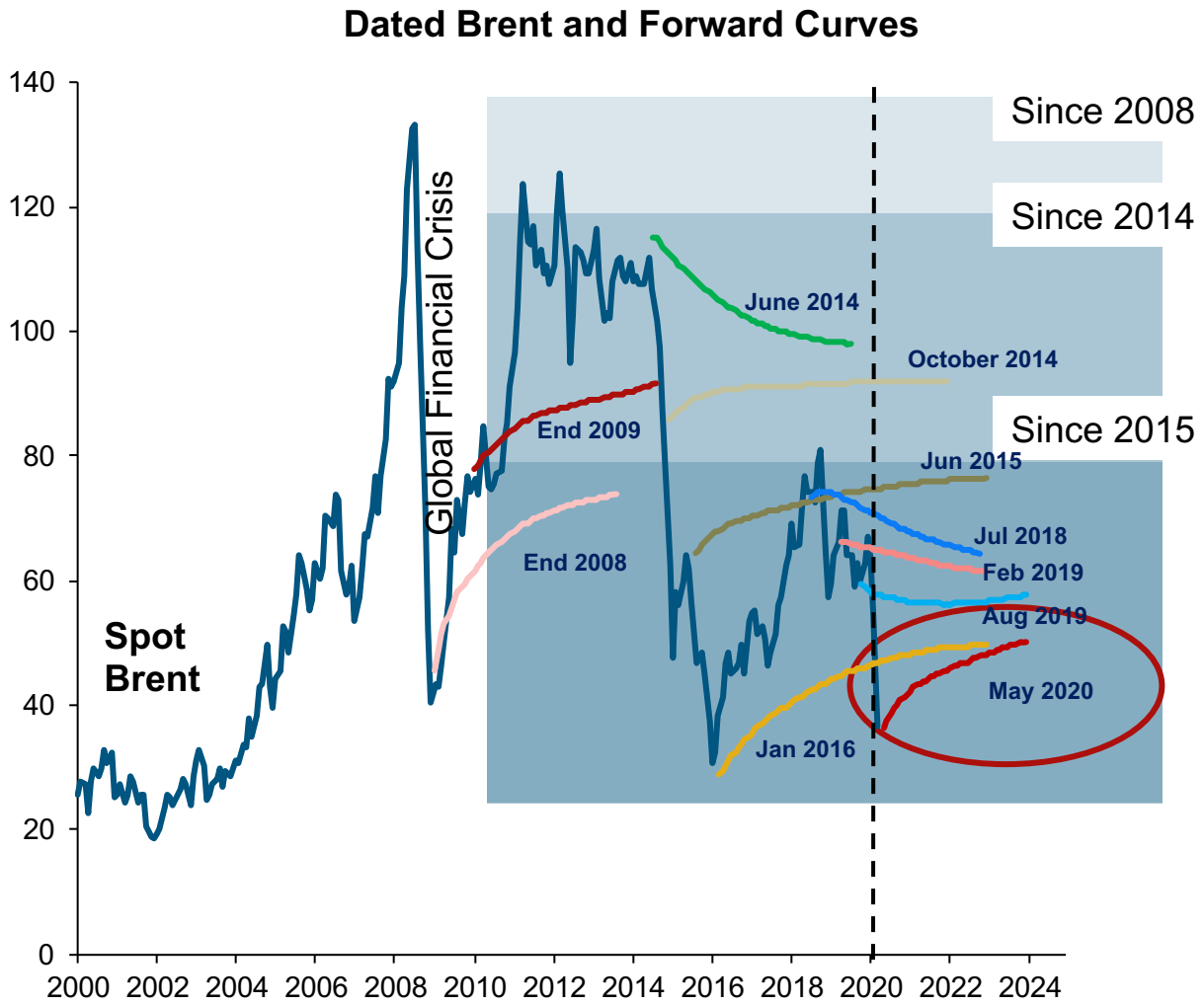


- The chart compares typical merit order of the Korea wholesale power market – stacking renewables, nuclear, coal, LNG and oil in the order – against the expected merit order for Q3 2020 based on outturn oil prices since Q1 2020.
- Typically, there are occasions where SRMC of high coal units coincides with low-priced LNG-based units, SRMC of LNG generation mostly sit after coal. And, LNG often sets SMP (more than 85% of the time).
- In 2020, the impact of oil price drop in Q1 2020 on SMP is expected to be realised in Q3 2020. Associated price drop in oil-linked gas volume would make many of LNG-using power plants competitive against coal unit, resulting in reversal of coal and gas in the merit order. (This would be highly dependent on plant efficiencies of coal and gas power units). Accordingly, SMP currently hovering 75-85 KRW/kWh is forecast to drop to 40-50 KRW/kWh level.

Note: The supply curve is a snapshot of a particular timeslot of Q3 2020, on the basis of TLG assumptions around availability of each power plant.
Source: TLG Analysis

The outlook for oil prices has changed less than immediate disruption suggests





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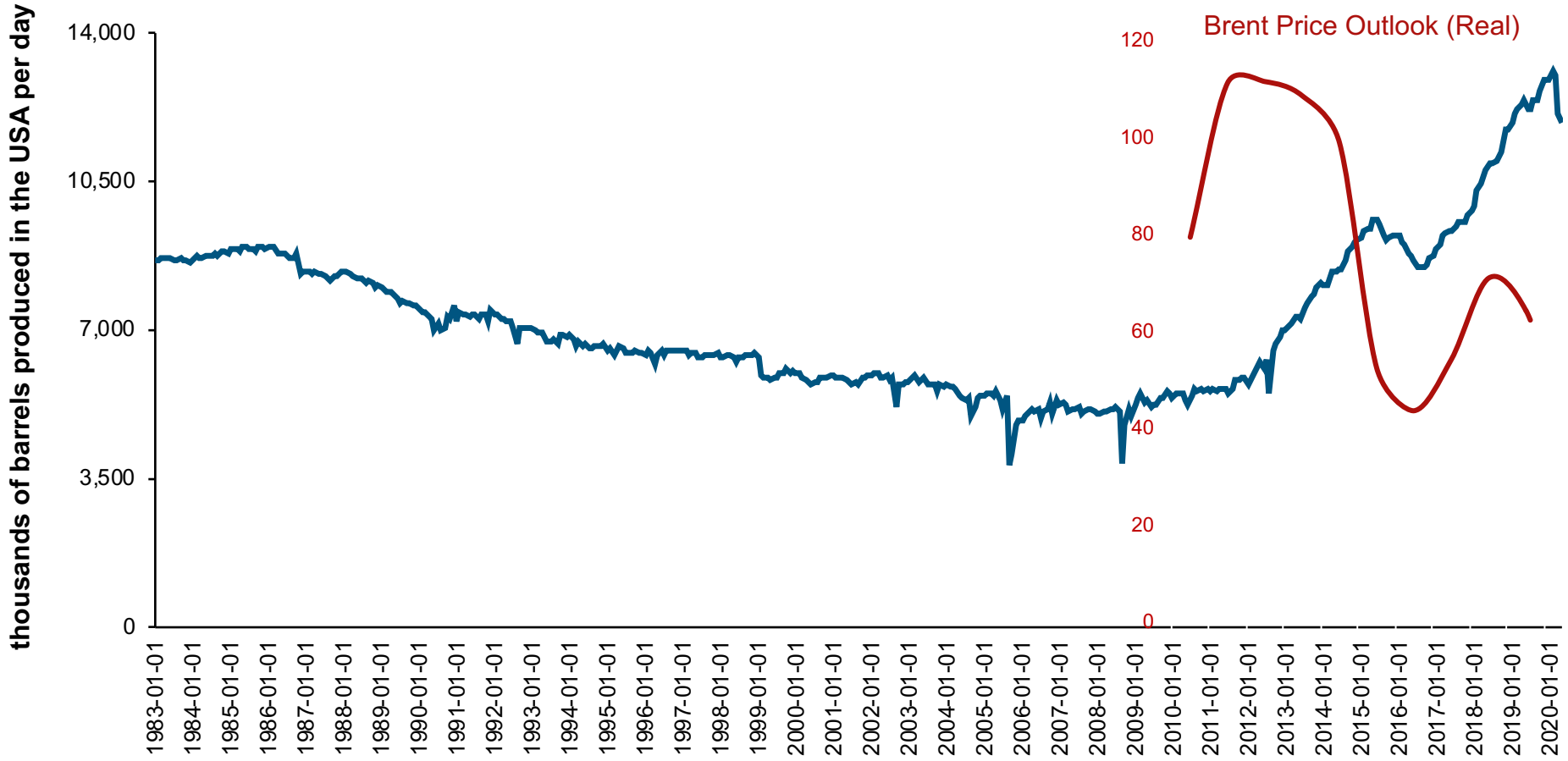
Things to watch: US Oil Production (bbls per day)….



Source: www.macrotrends.net

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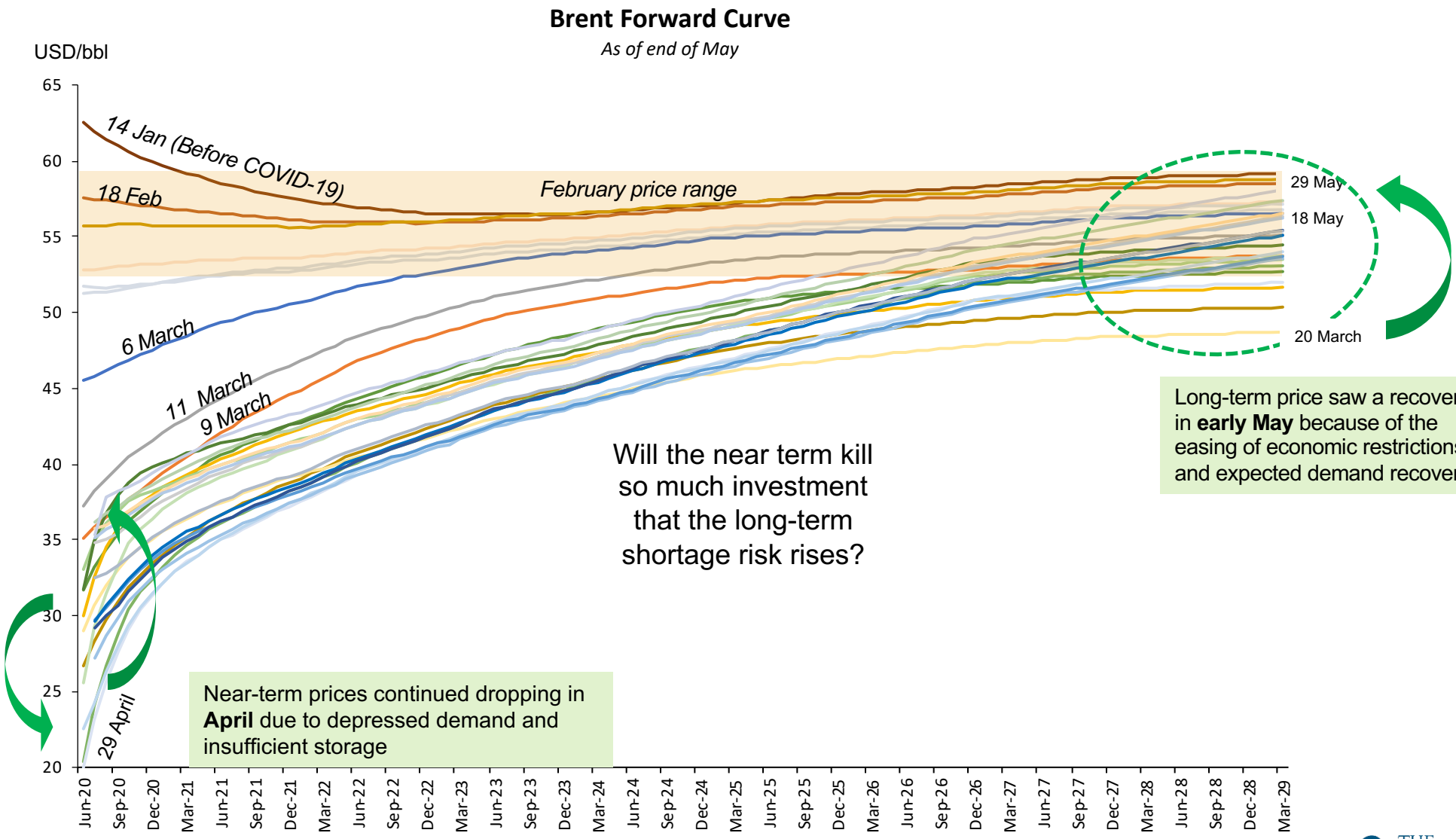
Dated Brent Forward Curve Evolution – a lot of strengthening lately – particularly at the back end



Source: Bloomberg

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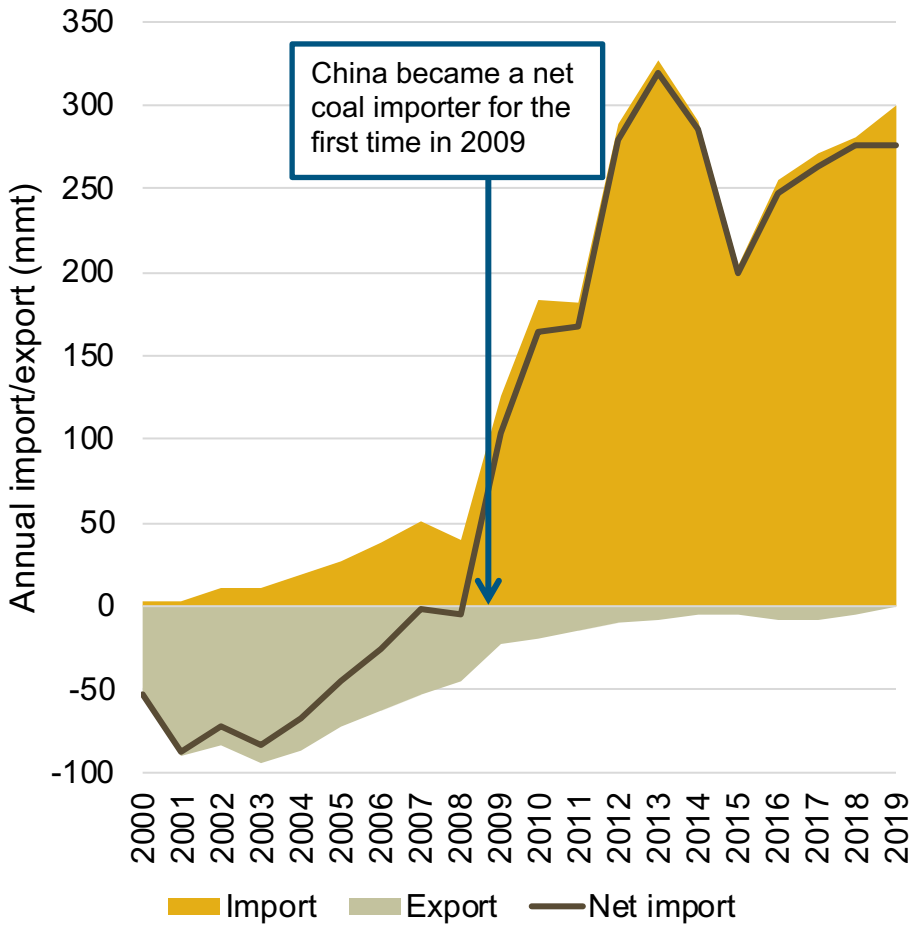
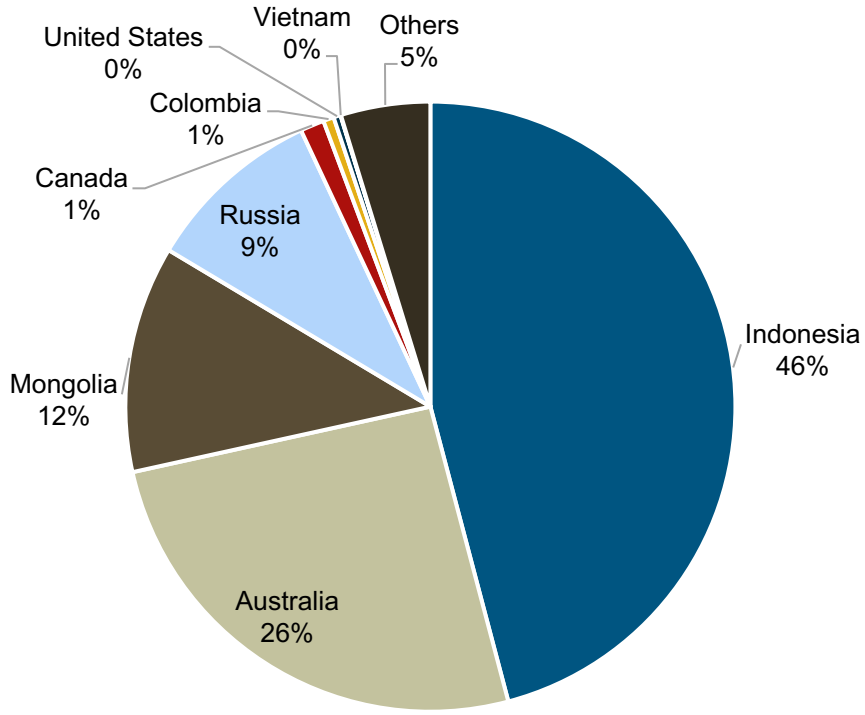
In Asia Pacific, coal market impacts are strongly influenced by China

China's annual coal import and export



Source: NDRC, World Bank

China's Coal import by country in 2019



Source: Bloomberg

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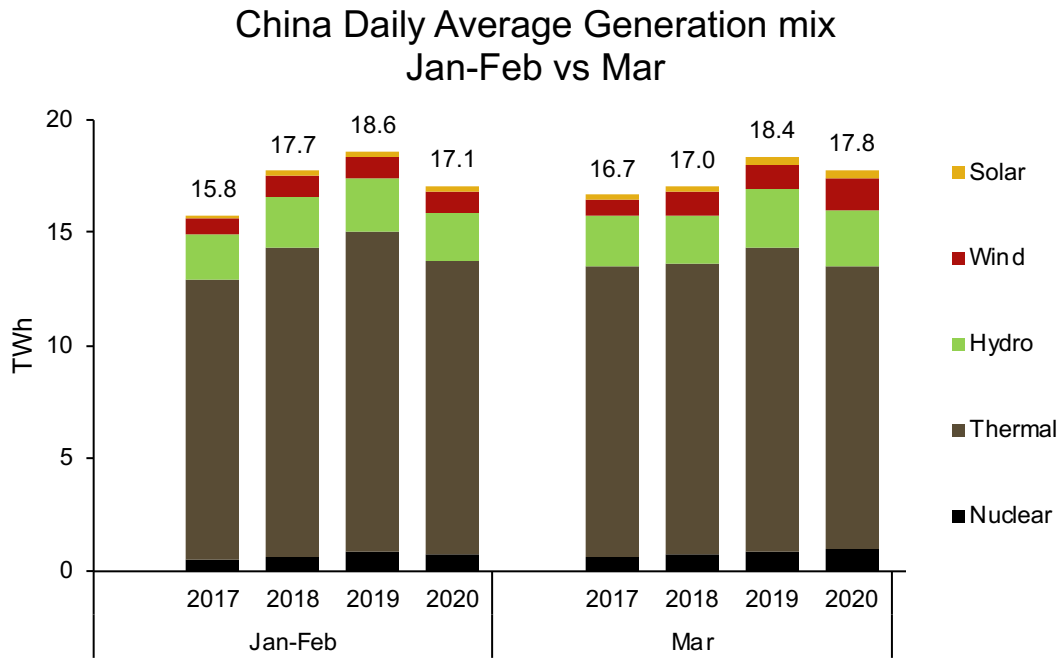
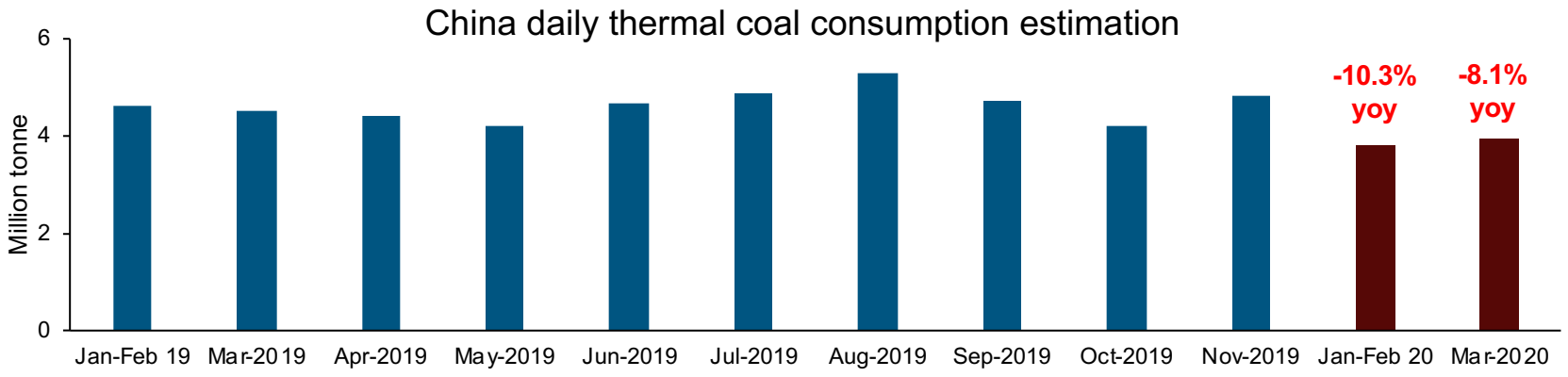
China's thermal generation (coal) down 10% in January-March, but could have been much worse, as there was also sharply reduced hydro availability



	2017-19 CAGR	2019 – 2020 Q1 Changes %
Total	+6.4%	-15.6%
Solar	+37.5%	+40.2%
Wind	+15.0%	+19.7%
Hydro	+3.1%	-13.6%
Thermal	**+5.5%**	**-10.5%**
Nuclear	+18.5%	+1.9%

Note: Weak water flow in Q1 and weak demand both contributed to hydro generation reduction. China also probably increased some storage.



Source: Generation from NBS, Demand from CEC. TLG Analysis

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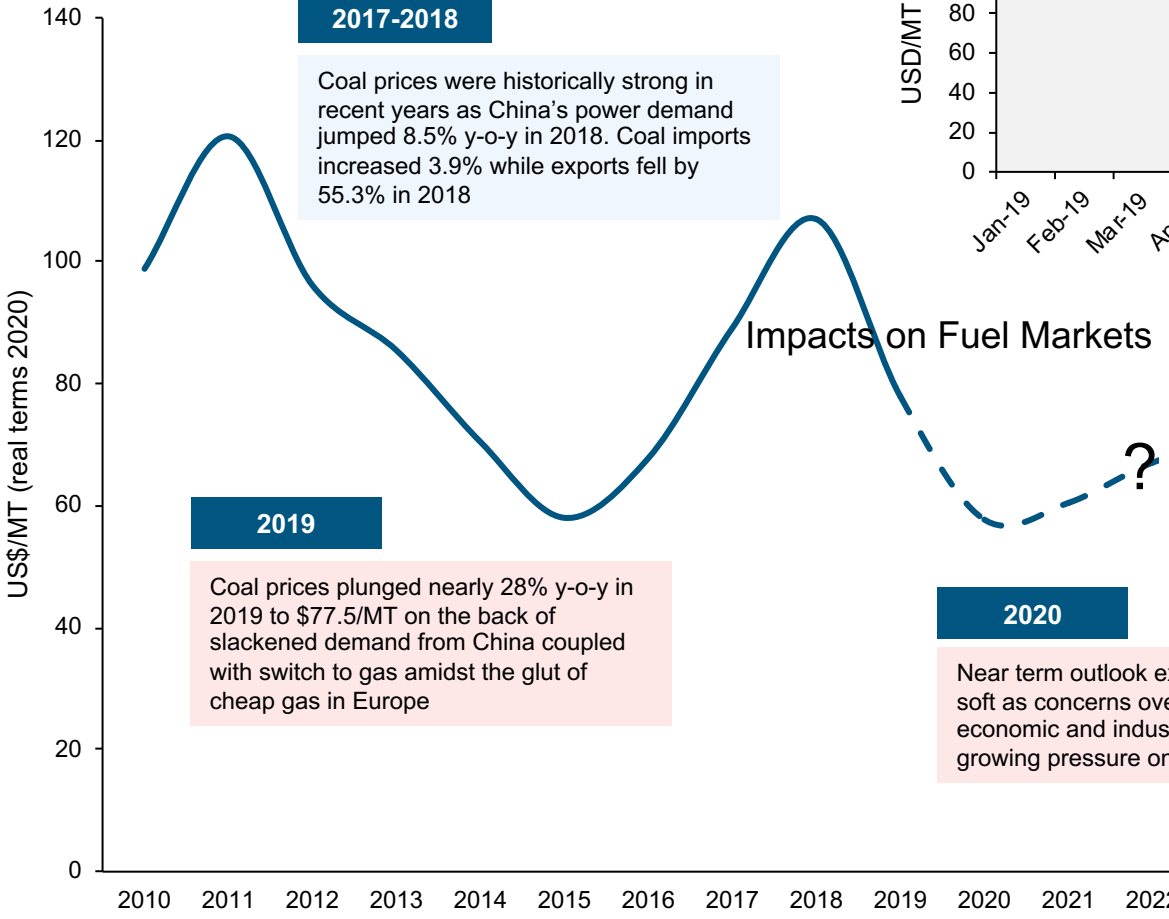
Coal price dynamics were less *immediately* responsive, but subsequently responded to downward demand pressure

In US$/MT

Newcastle Coal Price Outlook (Real)



2017-2018

Coal prices were historically strong in recent years as China's power demand jumped 8.5% y-o-y in 2018. Coal imports increased 3.9% while exports fell by 55.3% in 2018

2019

Coal prices plunged nearly 28% y-o-y in 2019 to $77.5/MT on the back of slackened demand from China coupled with switch to gas amidst the glut of cheap gas in Europe

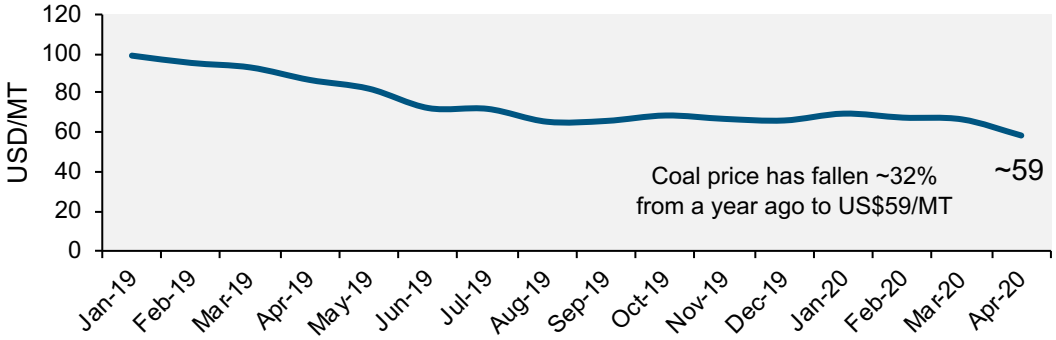
2020

Near term outlook expected to remain soft as concerns over weakened economic and industrial activities place growing pressure on demand.

Impacts on Fuel Markets

Observation: If coal prices recover faster than (or do not decrease as much as) oil/gas, then gas may enjoy a more persistent advantage. This is not a strong theme that we've noticed yet in China, but it would make sense.

Monthly Newcastle Coal Price



Notes: Forecast prices in 2020US$/MT; 2010-2019 are actuals, forecast thereafter
Source: ICE, Based on latest market forward curves for the front 2 years

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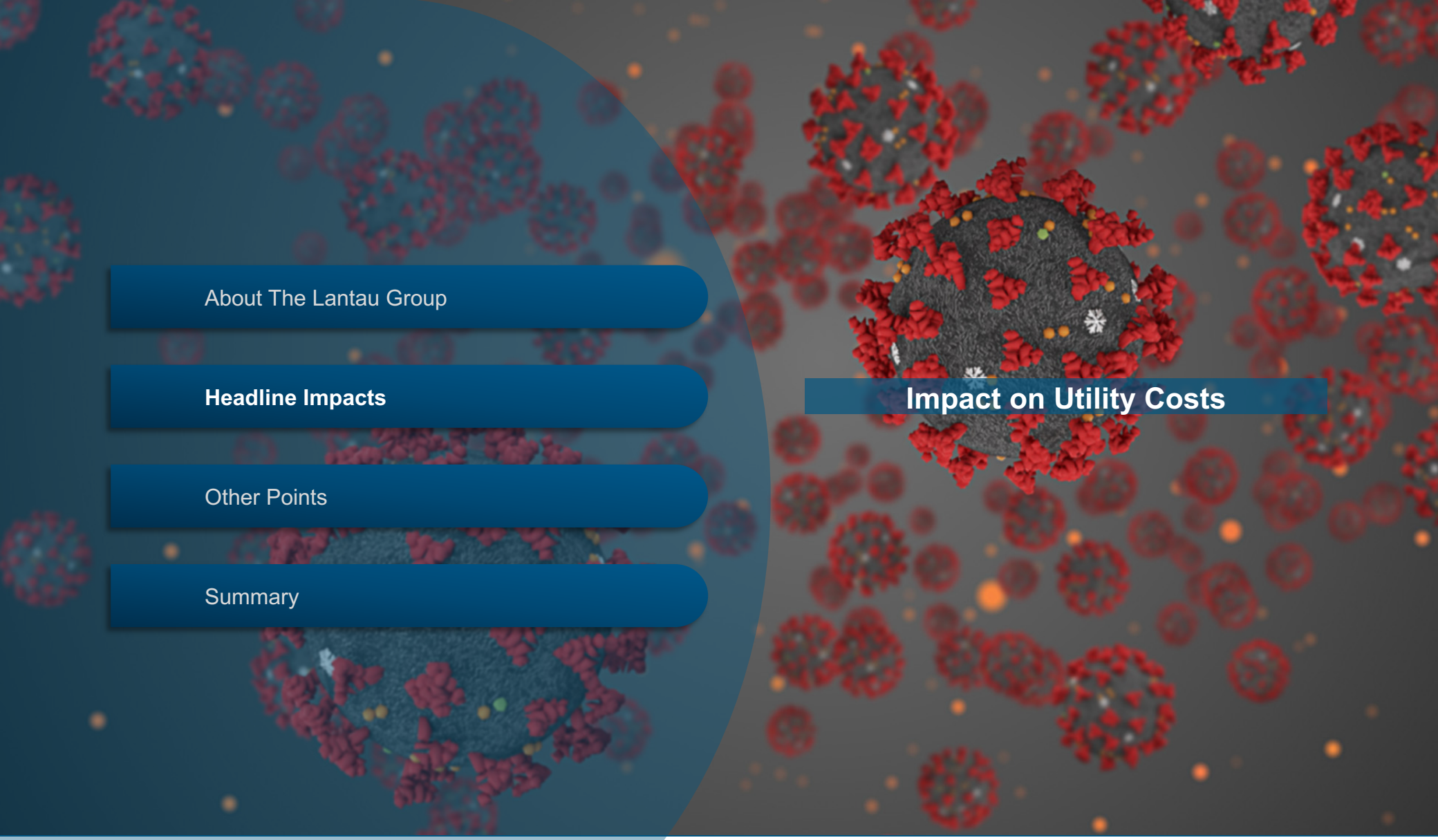

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Impact on Utility Costs

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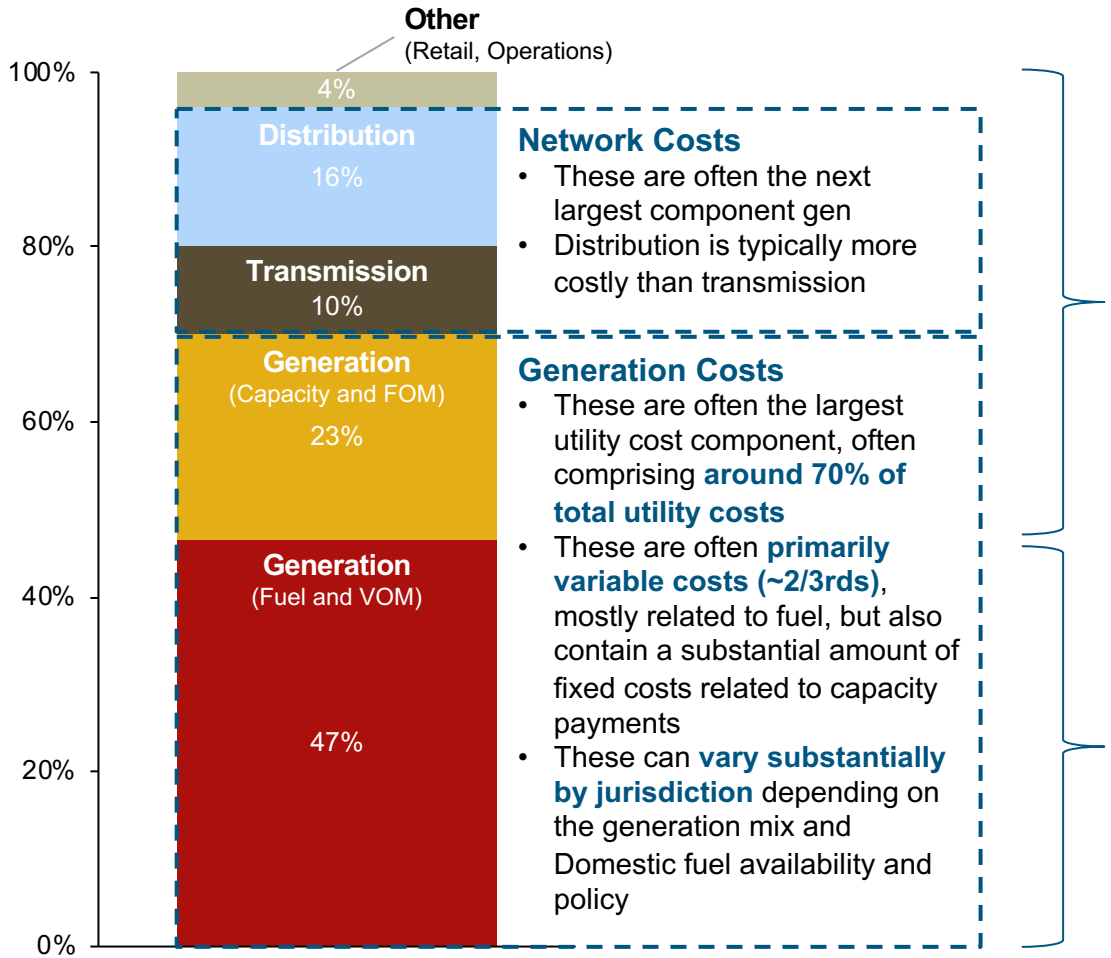
The pandemic will have different effects in each jurisdiction – however, we can look at the impacts for a generic utility cost structure

Generic Utility Cost Structure in SEA Before Pandemic



Network Costs

- These are often the next largest component gen
- Distribution is typically more costly than transmission

Generation Costs

- These are often the largest utility cost component, often comprising **around 70% of total utility costs**
- These are often **primarily variable costs (~2/3rds)**, mostly related to fuel, but also contain a substantial amount of fixed costs related to capacity payments
- These can **vary substantially by jurisdiction** depending on the generation mix and Domestic fuel availability and policy

Over 50% of utility costs are largely fixed in the near-term, and thus, demand destruction related to the pandemic will generally increase the average costs per kWh for customers corresponding to these costs (NB: not an increase in costs, but in average rates)

The details of the **differences between regulatory frameworks from one jurisdiction to the next will determine the mechanics** of the extent to which these costs are passed through (future tariffs and 'clawbacks'), and the period over which they are passed through

Broad energy demand destruction globally has placed immense pressure on energy prices, which have plummeted since the beginning of the year – this will drive **declining variable costs across jurisdictions**

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The short-term loss of sales from reduced demand is likely to be more than offset by the longer-term fall in fuel prices

Indicative Analysis of Cost Impacts of Pandemic

	Lockdown Period (Apr – May 2020)	Easing Period (e.g., Jun – Dec 2020)	Recovery Period (2021)
Fixed Cost Pressures: Assuming Fixed Costs are ~53% of Total	*Demand destruction related to the pandemic will increase the burden of fixed costs for remaining customers*		
Demand Destruction: (Indicative assumptions)	-15%	-5%	-2%
Impact on Average Cost: (Assuming all non-fuel/VOM costs are 'fixed' in the near-term)	+9.4%	+2.8%	+1.1%
Fuel Cost Relief: Assuming Fuel Costs are ~43% of Total	*Softened fuel markets related to the pandemic will decrease sector costs for customers*		
Coal Price Change*: (Newcastle, adjusted for shipping)	+3%	-22%	-16%
Gas Price Change*: (Brent price change – this does not account for new gas/LNG contract slopes or spot purchases of gas/LNG)	-25%	-54%	-41%
Fuel Cost Impact: (Assuming fuel costs are 50/50 coal/gas)	-4.6%	-16.3%	-12.1%
Net Cost Impact:	+4.8%	-13.5%	-11.0%

- The **process by which demand destruction increases end-user tariffs will differ by regulatory regime**, and in some cases, this burden **may be borne in part by the utilities/retailers**
- Generally, this **takes more time under most regulatory mechanisms** to impact end-user rates (lagged)

- **In regulated jurisdictions, fuel cost savings will be passed through to end-users, albeit with some lag** depending on the applicable regulatory mechanisms
- **In unregulated jurisdictions, fuel cost savings may not be immediately realized by retailers**, who often hedge these, **nor by customers**, who sometimes are 'locked-in' to specific rates for a period of time

* Pre-Pandemic price based on Jan forwards; Post-pandemic based on combination of actual spot prices (April – May 2020) and recent forward curves (June 2020 and beyond)

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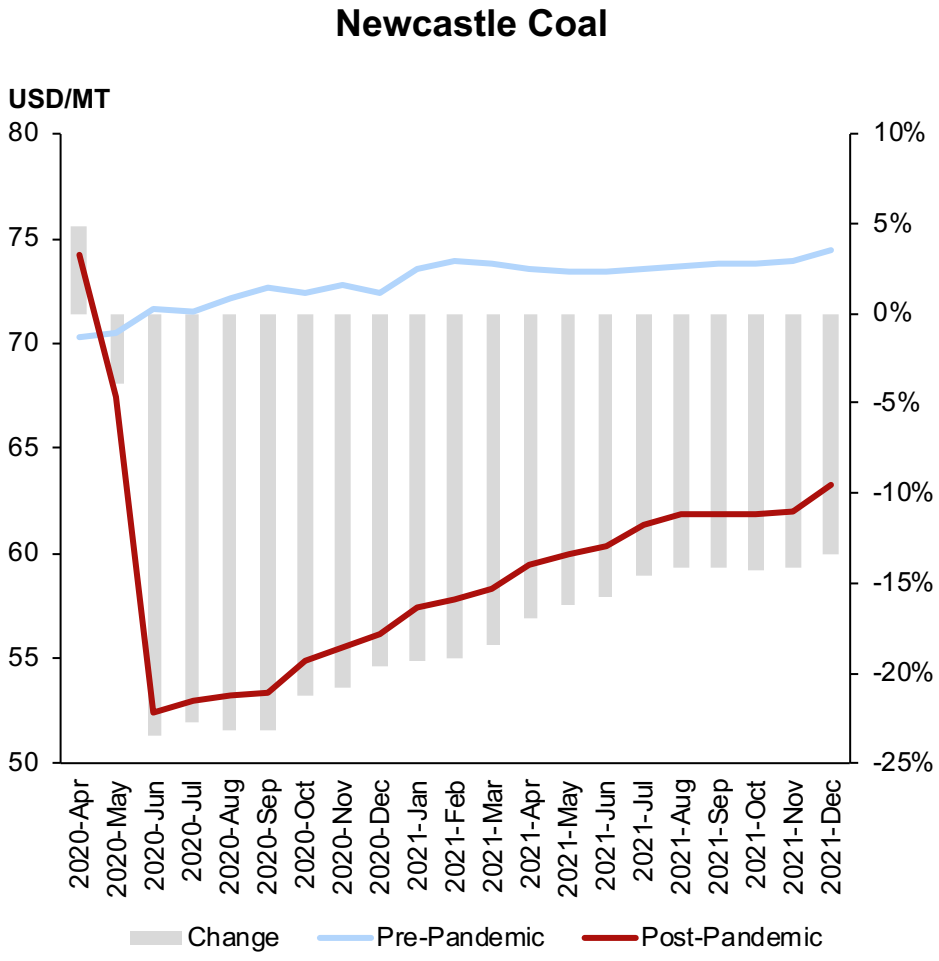
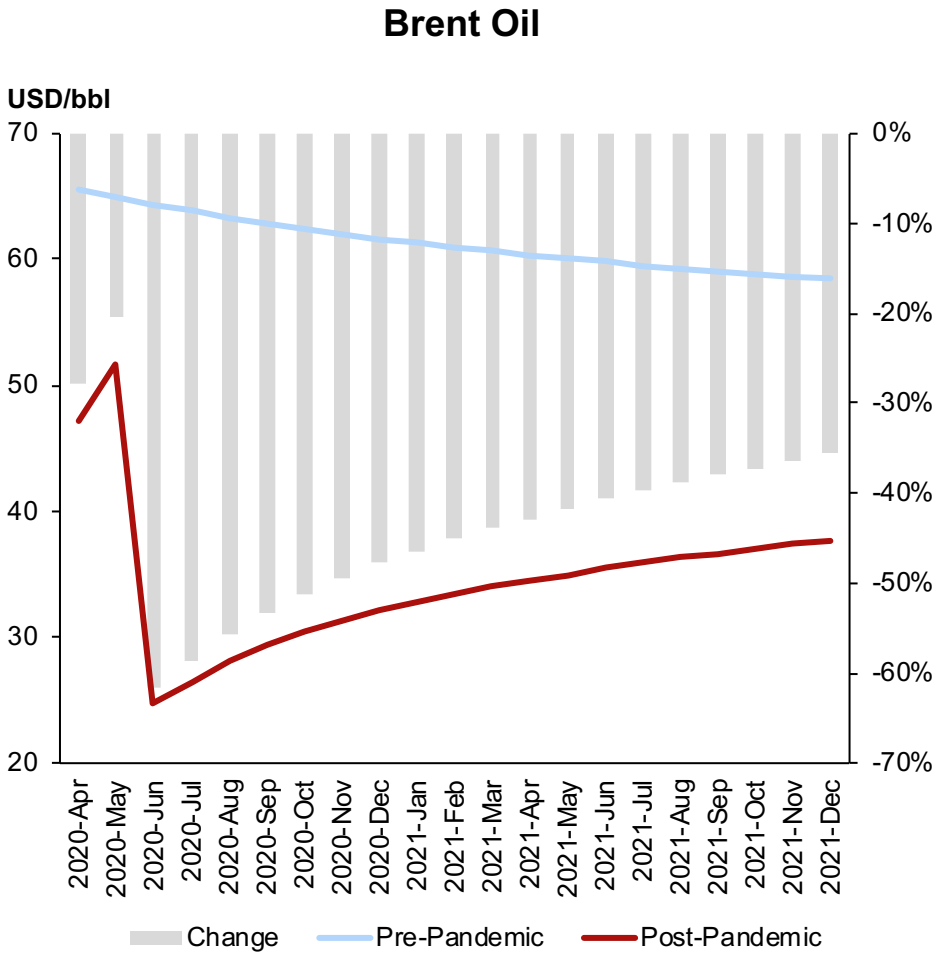
Comparison of fuel price expectations / out-turn before and after the pandemic





'Pre-pandemic' based on forward curve beginning of February 2020
'Post-pandemic' based on actual spot prices through May 2020, and forward curves at beginning of May for June 2020 onwards

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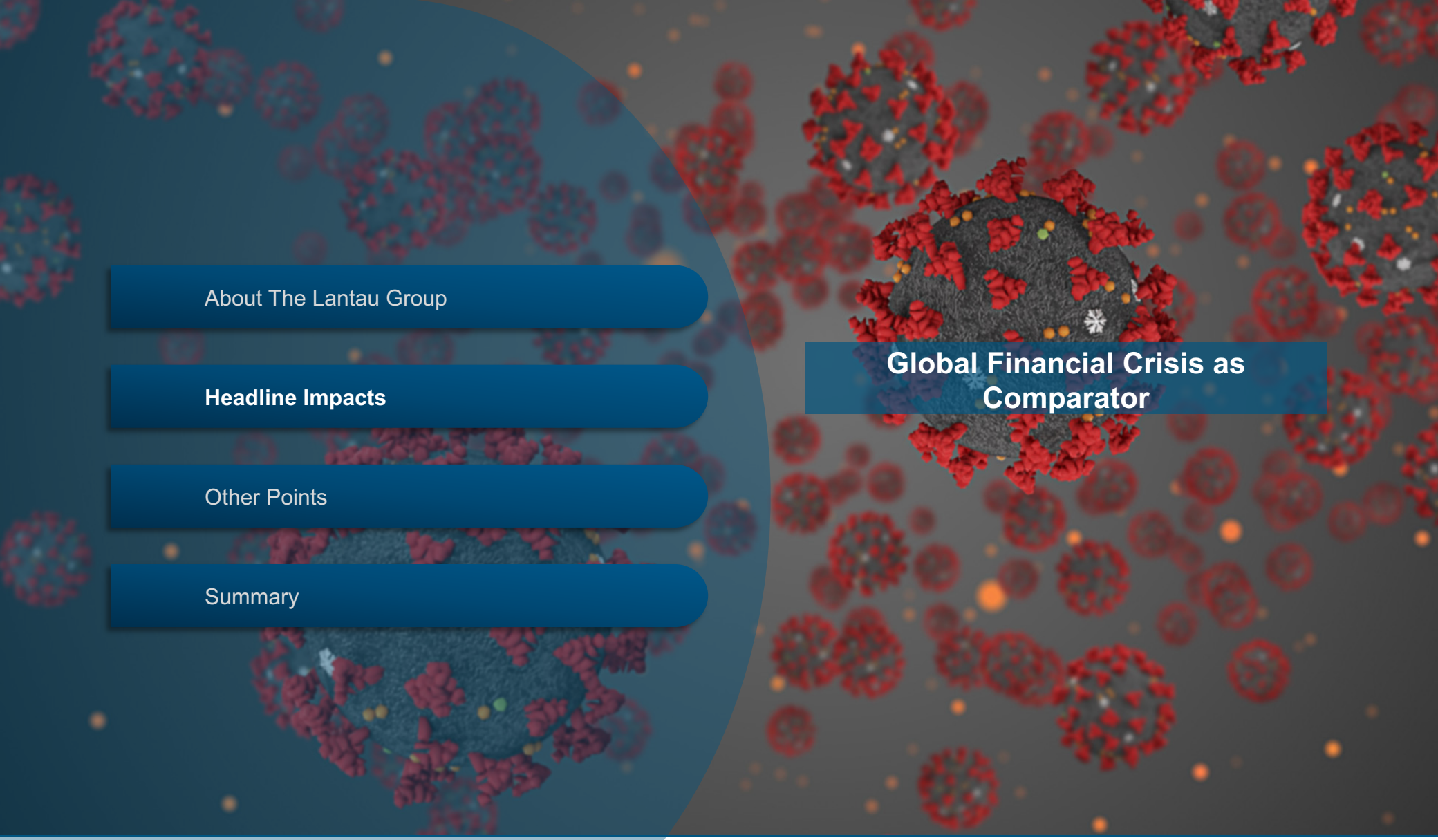

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Global Financial Crisis as Comparator

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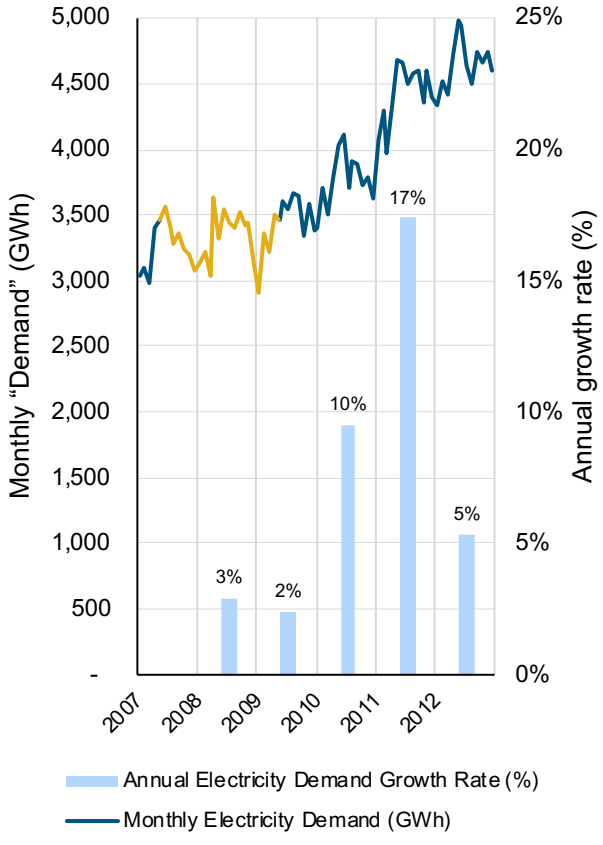
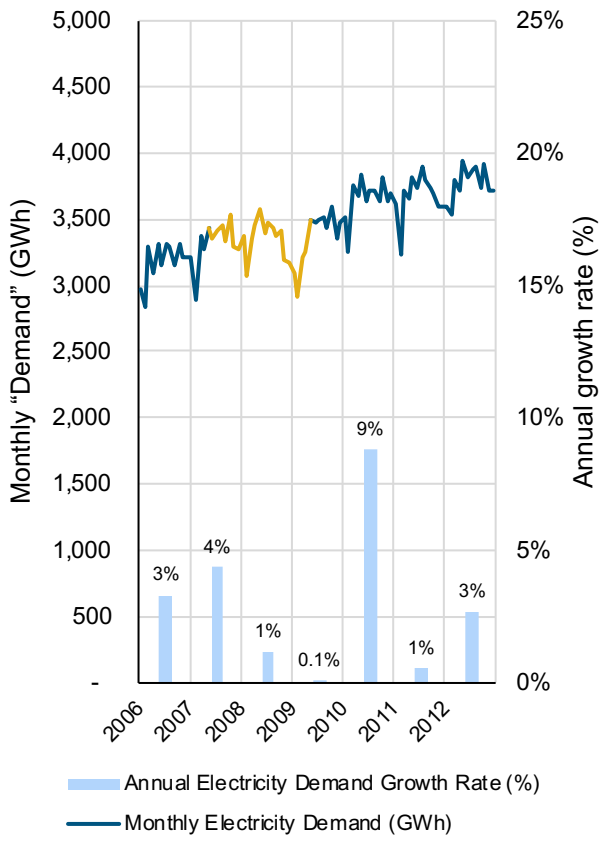
A perspective from the Global Financial Crisis

Monthly Electricity Demand

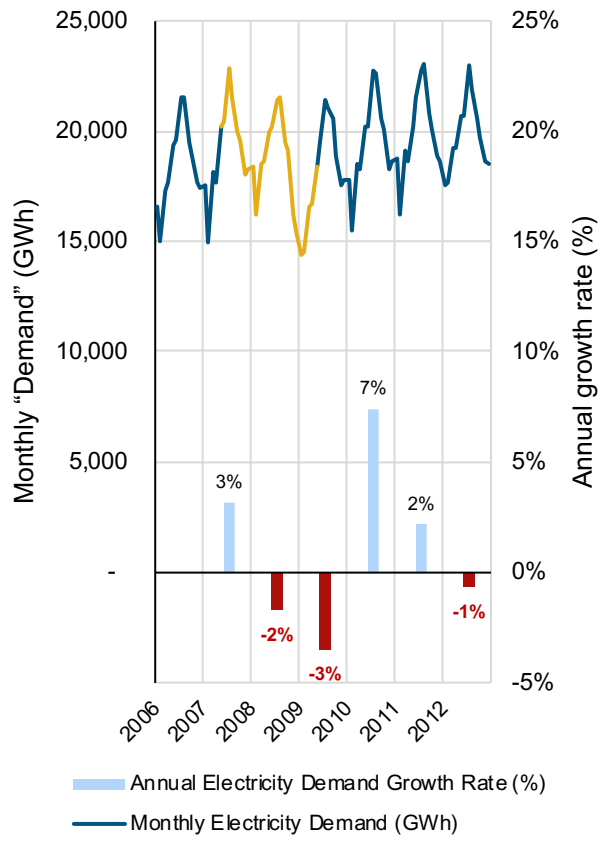
Philippines – Luzon



Singapore



Taiwan



Source: PEMC; EMC; MOEA BOE; Taipower Statistics; TLG Analysis

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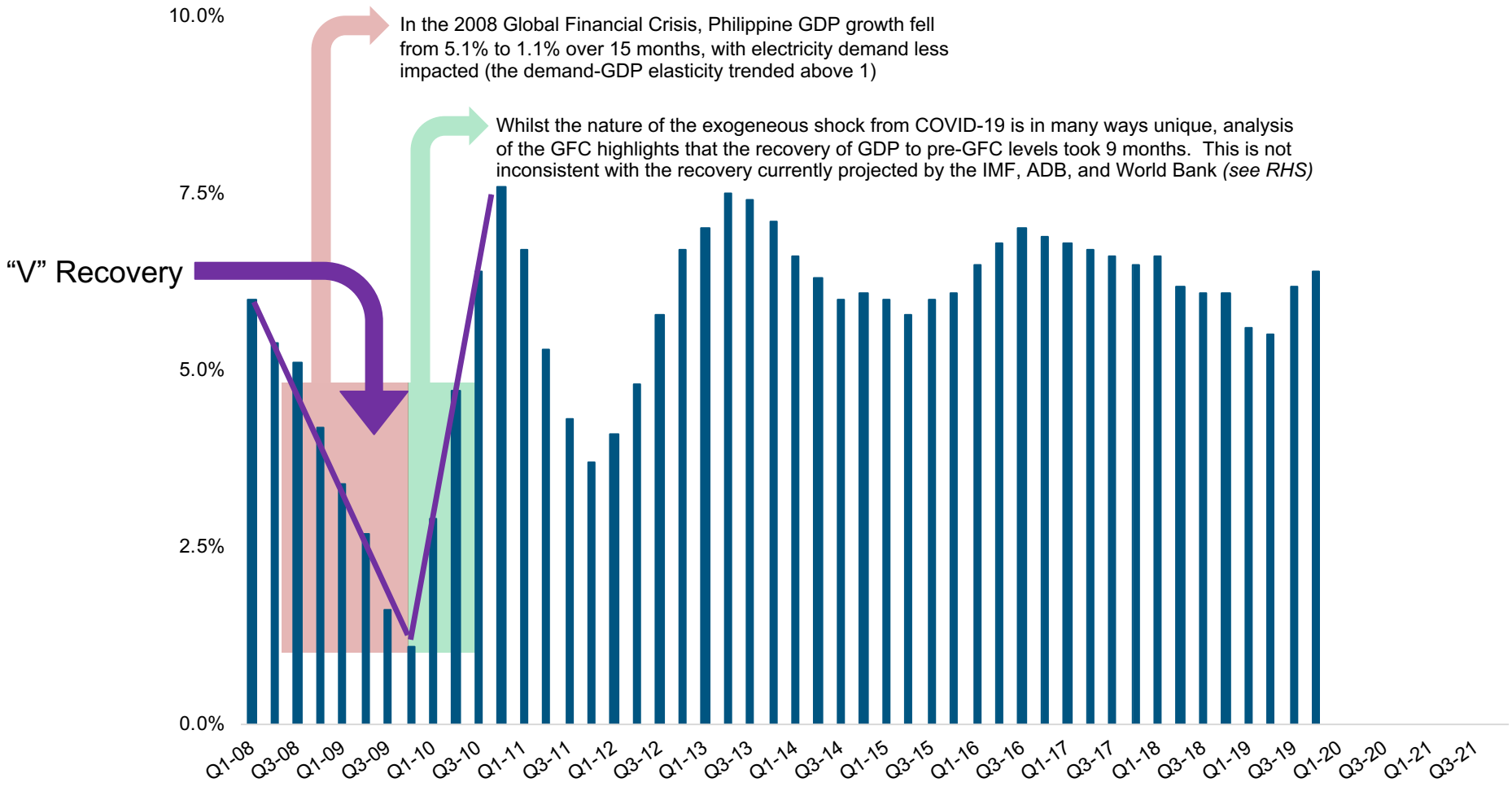
During the GFC, for example, Philippine GDP growth stayed positive through a 15-month decline, taking ~9 months to recover from its bottom

Historical quarterly YoY real GDP growth in the Philippines



Note: Third party forecasts for GDP lack quarterly granularity..
Source: Bangko Sentral ng Pilipinas; ADB; IMF; World Bank

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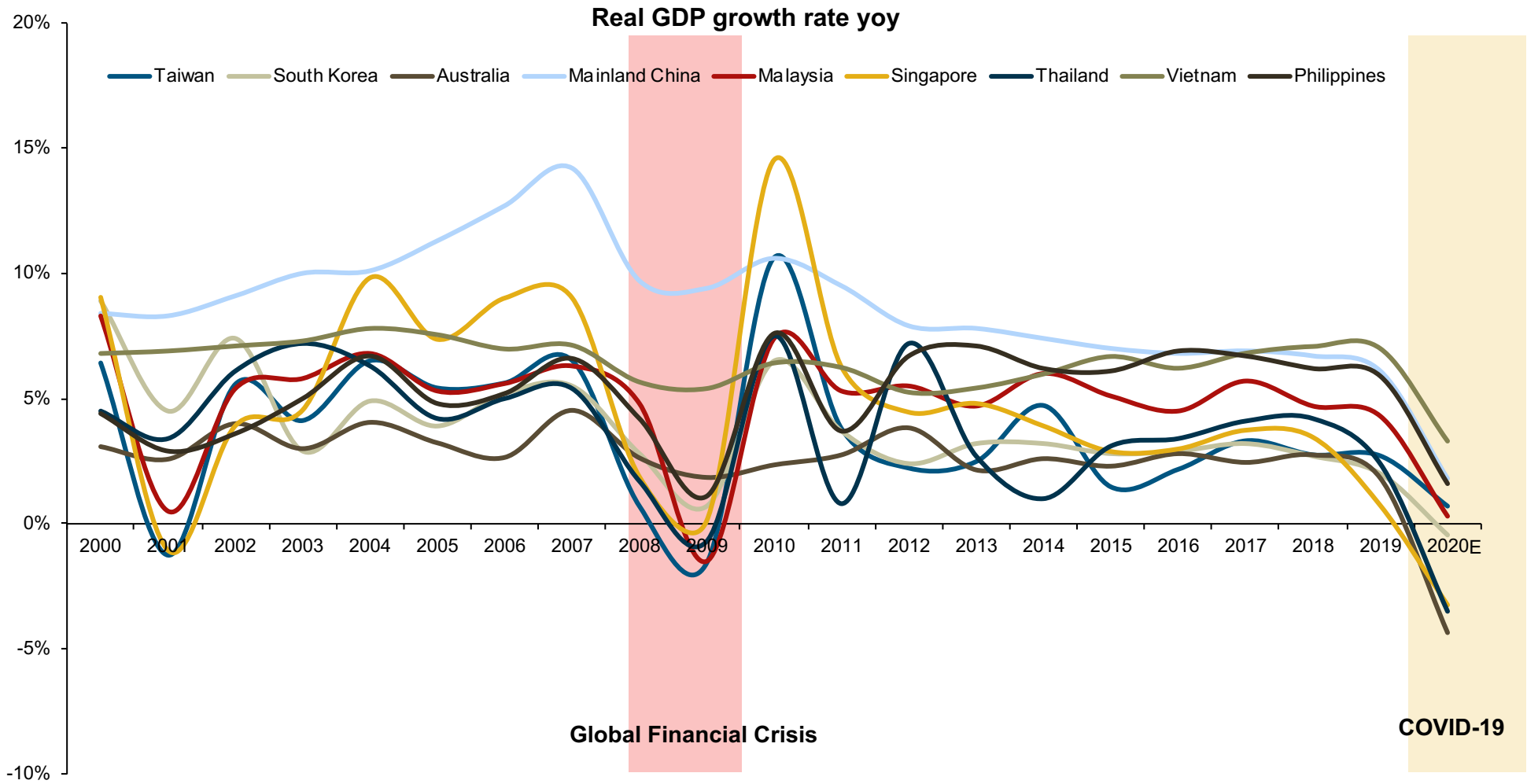
As of now, the recovery profile is not yet clear – and probably depends most on the nature of COVID-19 response (vaccine, treatment, herd immunity, distancing etc.)



Source: WorldBank, and Bloomberg

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Some segments (e.g. tourism) will be hurt more deeply and for longer – due to public fear and because of less discretionary income if a prolonged recession

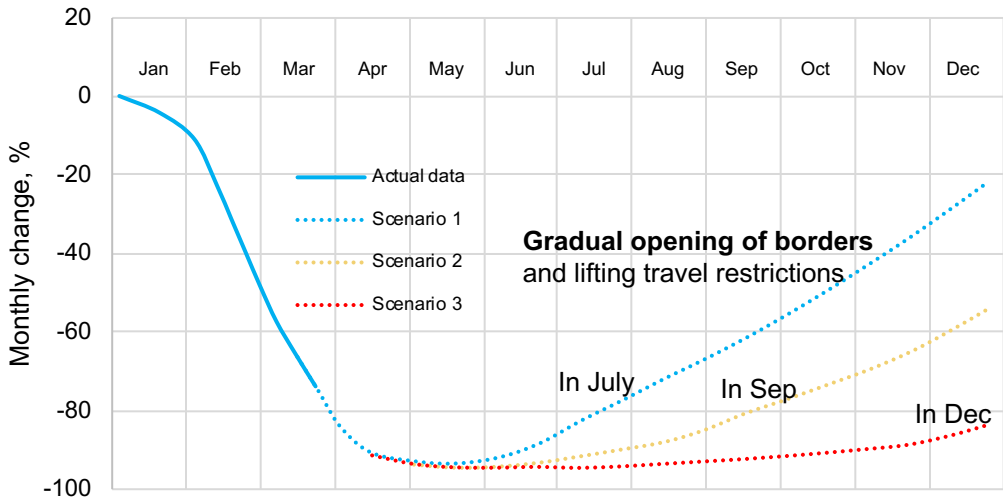
Forecast providers	Indicator	Impact of COVID-19
ICAO	International air passenger traffic	44% 80%
IATA	Airlines' revenue passenger kilometers (intl. and dom.)	56%
UNWTO	International tourism receipts	US$910bn (-62%) US$1,170bn (-79%)
World Trade Organization	Global merchandise trade volume	13% 32%
International Monetary Fund	World GDP	-3% contraction -6% contraction

V-shaped recovery

U-shaped recovery

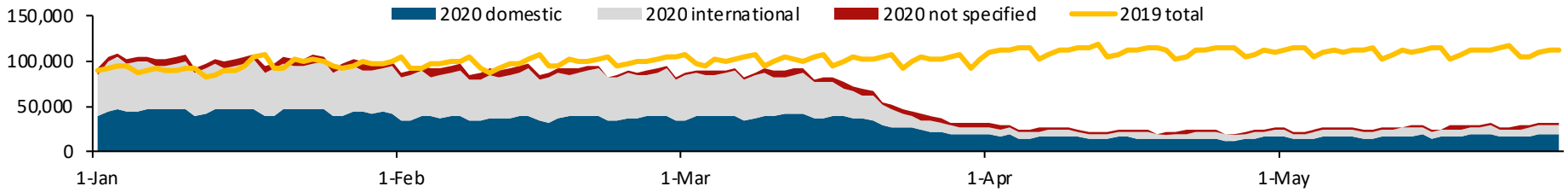
Source: ICAO, IATA, UNWTO, WTO, IMF, Note: All figures are 2020 data compared with 2019 data, except for airport revenue figures which are compared to 2020 business-as-usual.

International tourist arrivals in 2020: three scenarios (YoY monthly change %)



Source: UNWTO

Commercial flights flow statistics



Source: radarbox.com

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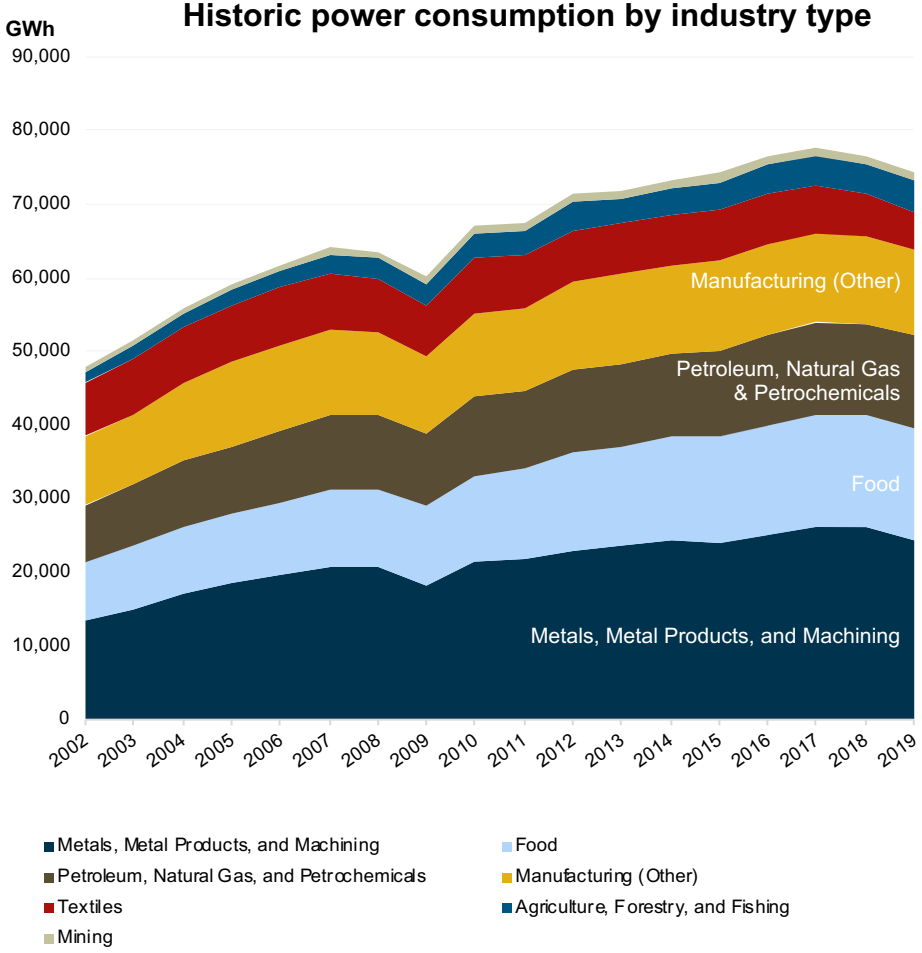
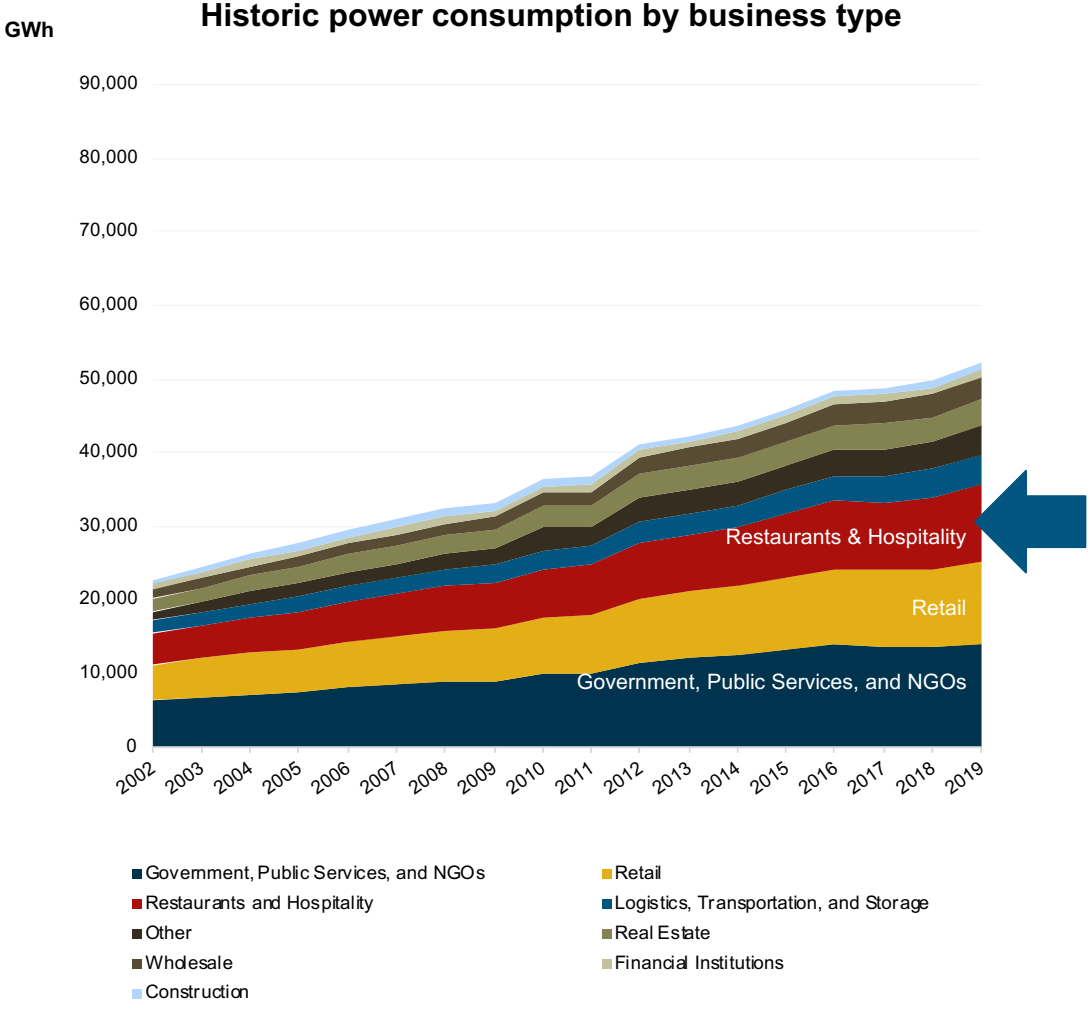
Sorting out economic impacts will take time. For example, Thailand, hospitality is a significant driver of electricity demand (a correlate with GDP)

Thailand

Historic power consumption by industry type



Historic power consumption by business type



Note: Analysis based on TLG interpretation of TSIC codes - all industry types not necessarily represented
Source: EPPO; TLG analysis

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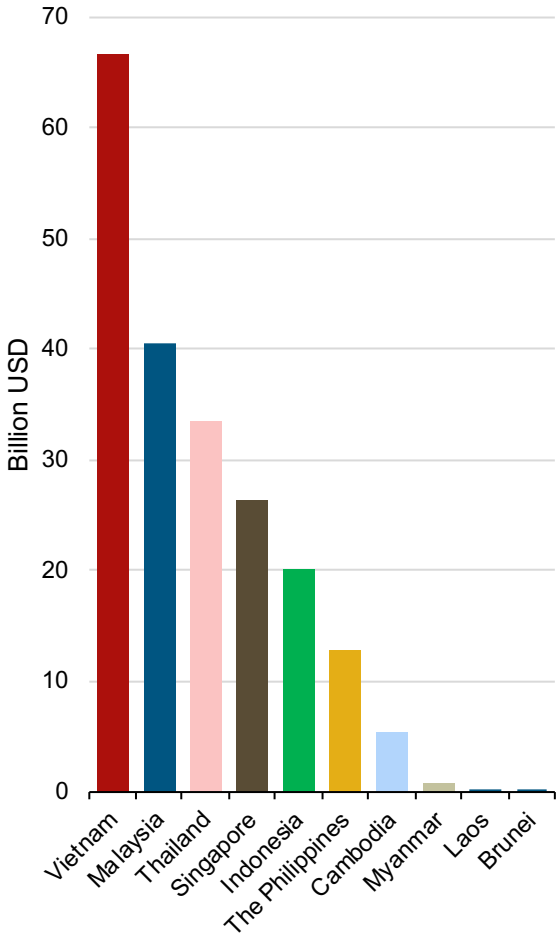
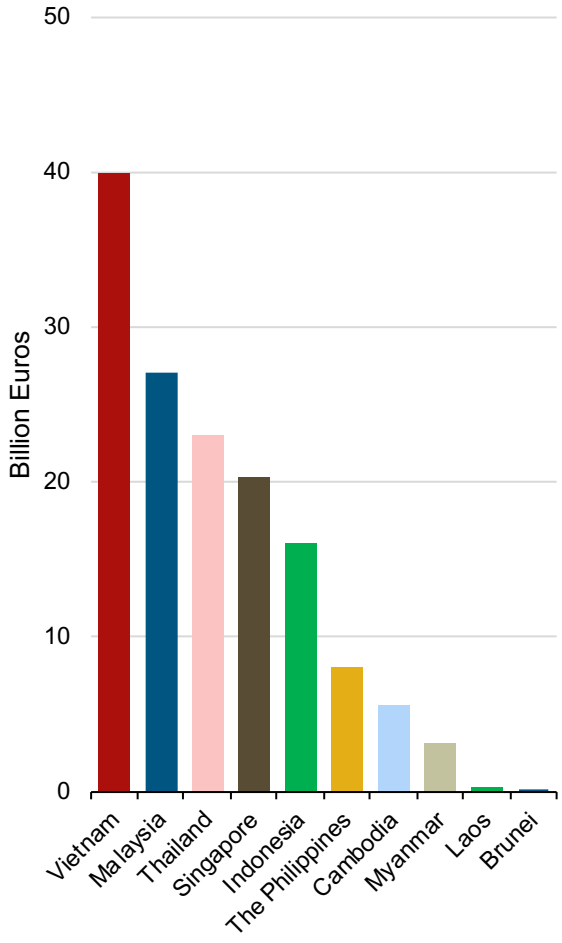
China seems likely to recover faster (at this point) but exports from ASEAN countries depend heavily on USA and EU markets

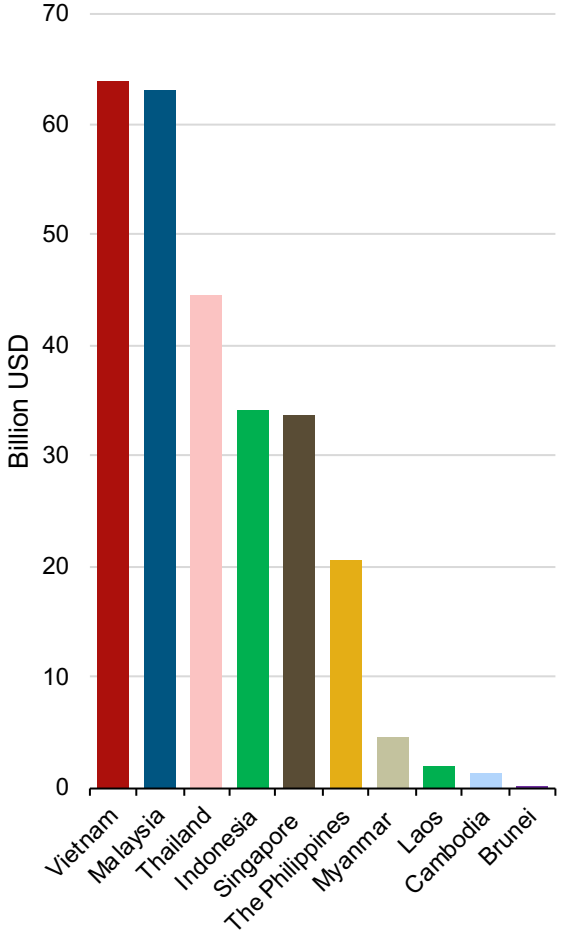
Export from ASEAN to USA (2019)



Export from ASEAN to EU28 (2019)



Export from ASEAN to China (2018)



Source: USA census, European commission, and General Administration of Customs of China

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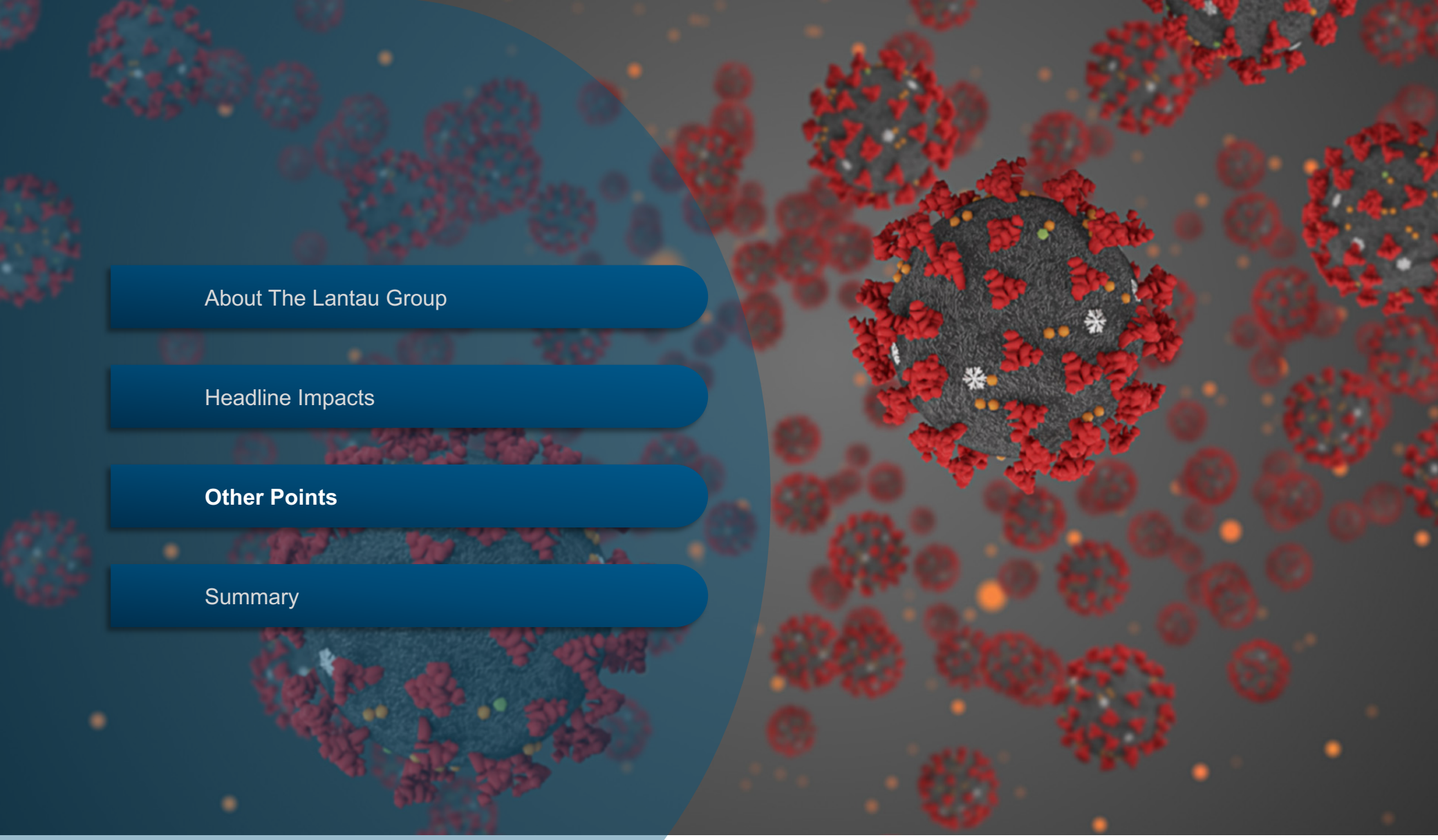

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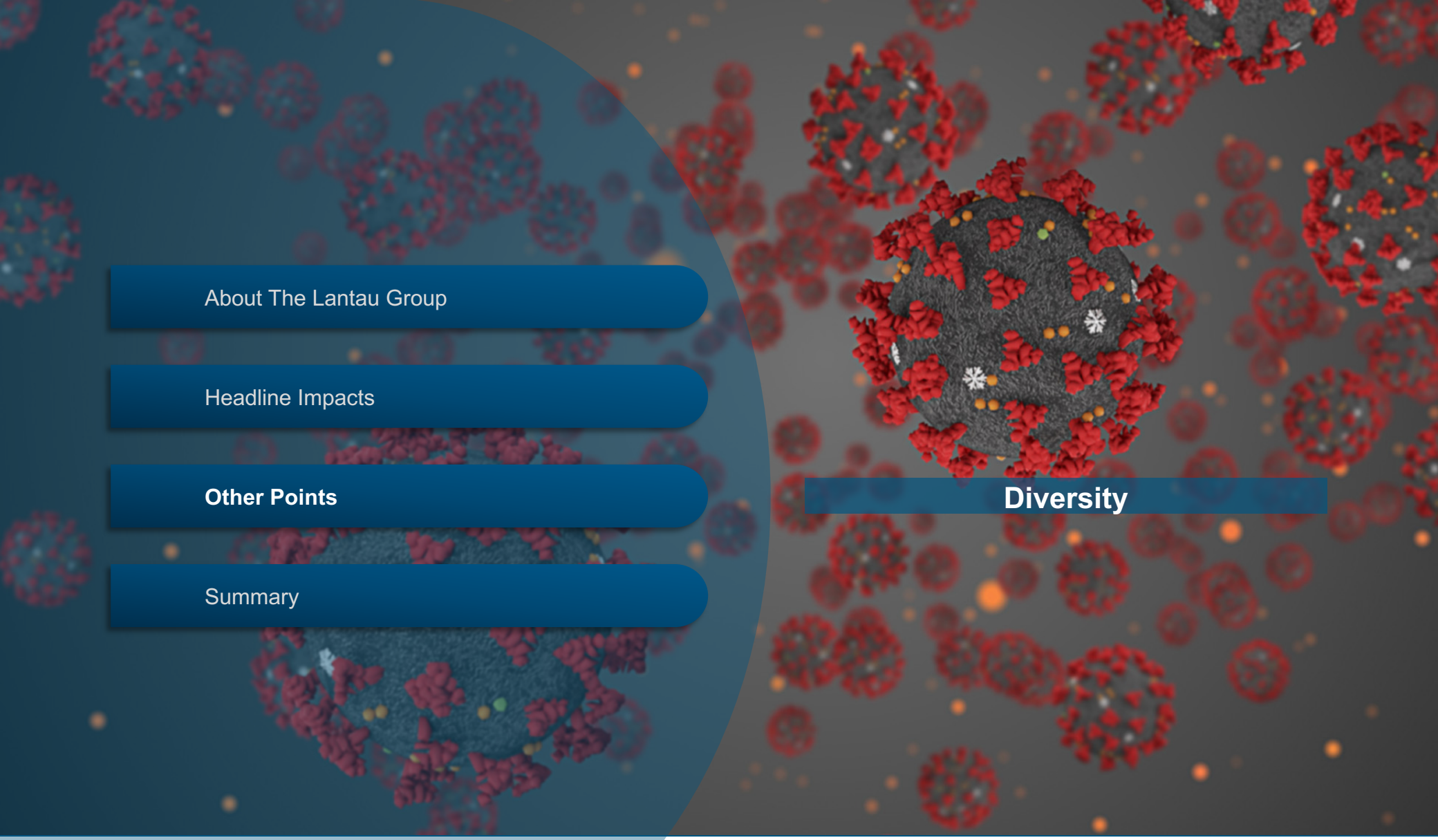

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Diversity

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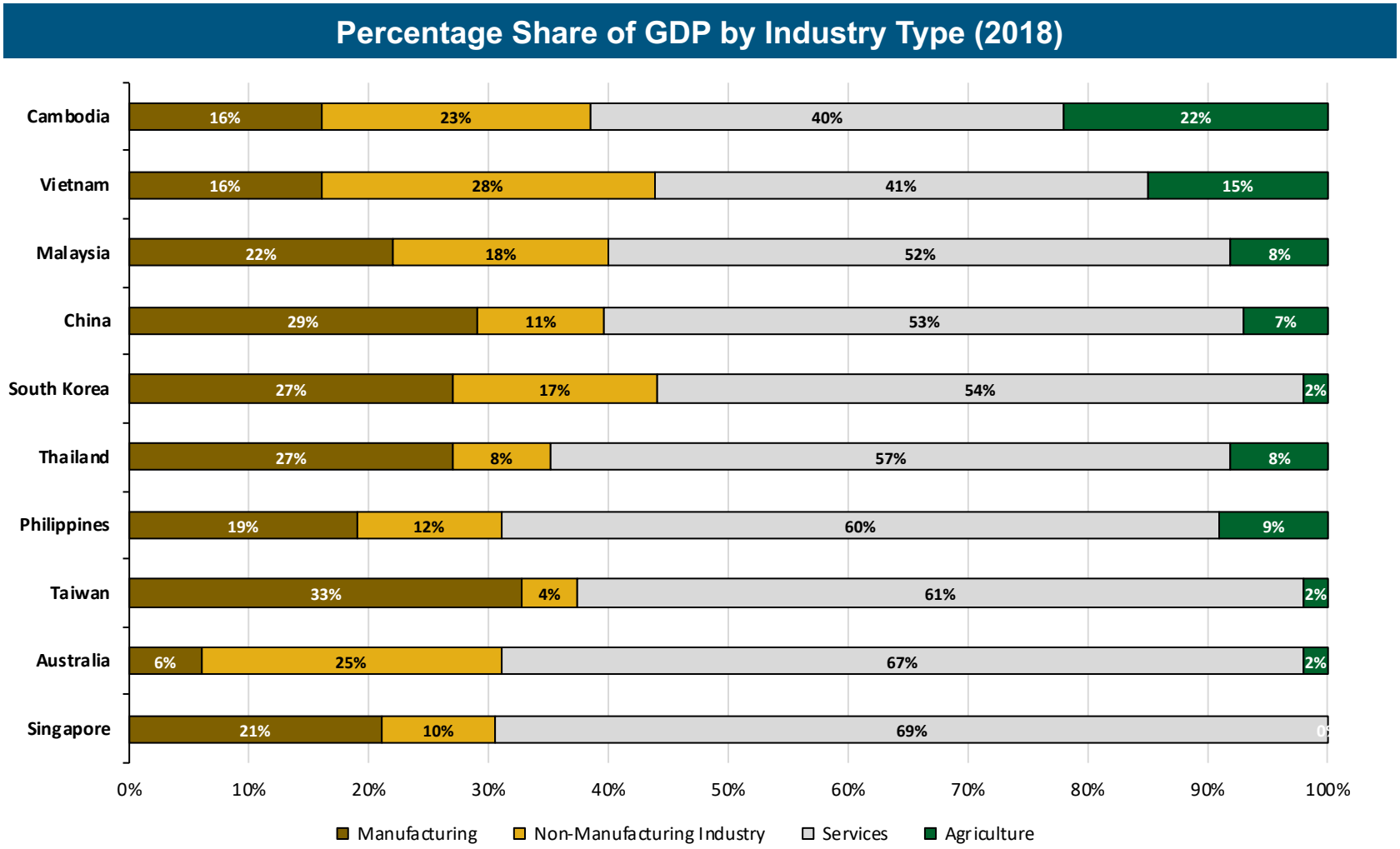
Wide variations in industry mix – suggesting very uneven impacts likely



Source: WB, TW Stats, TLG analysis

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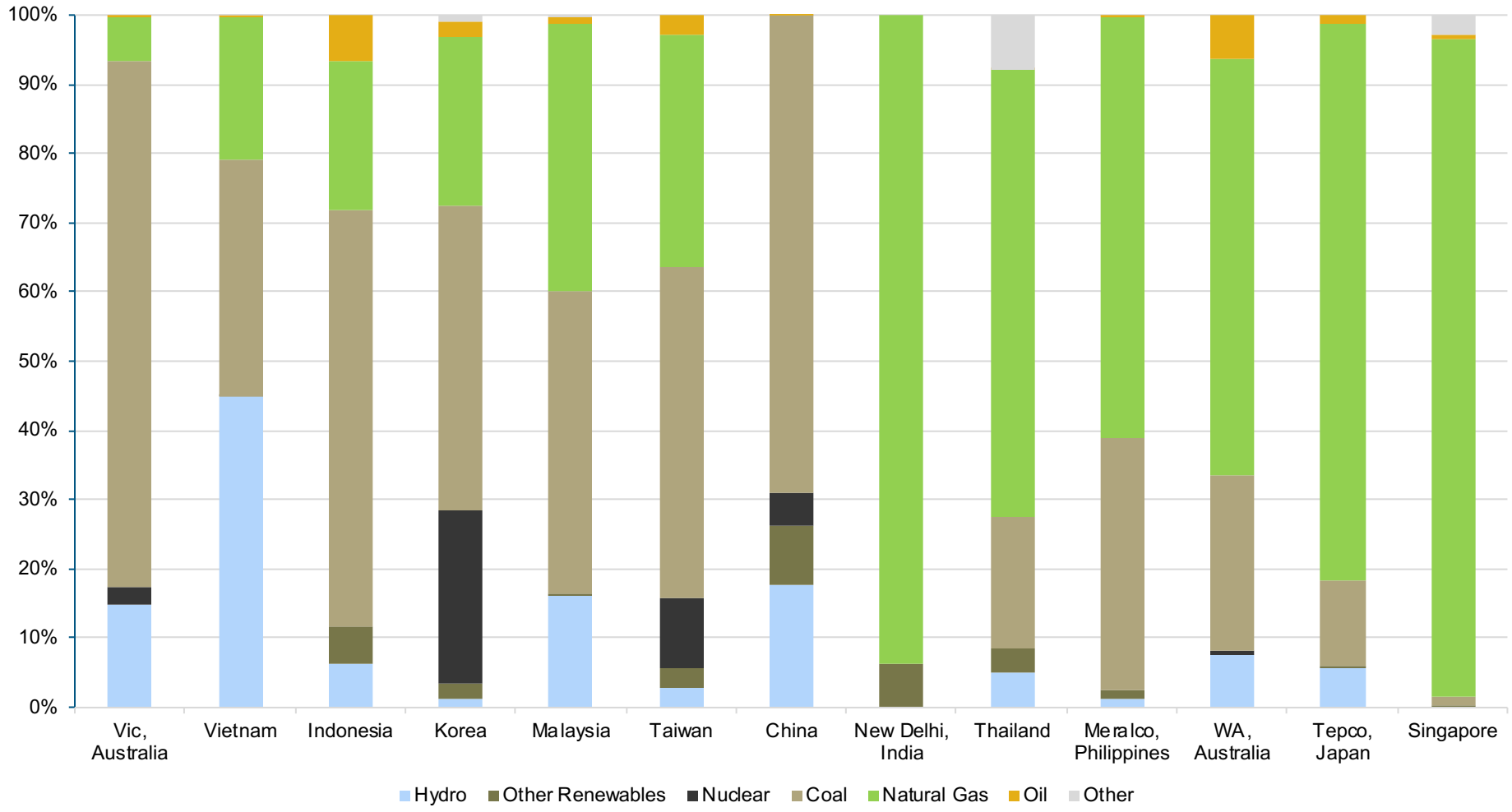
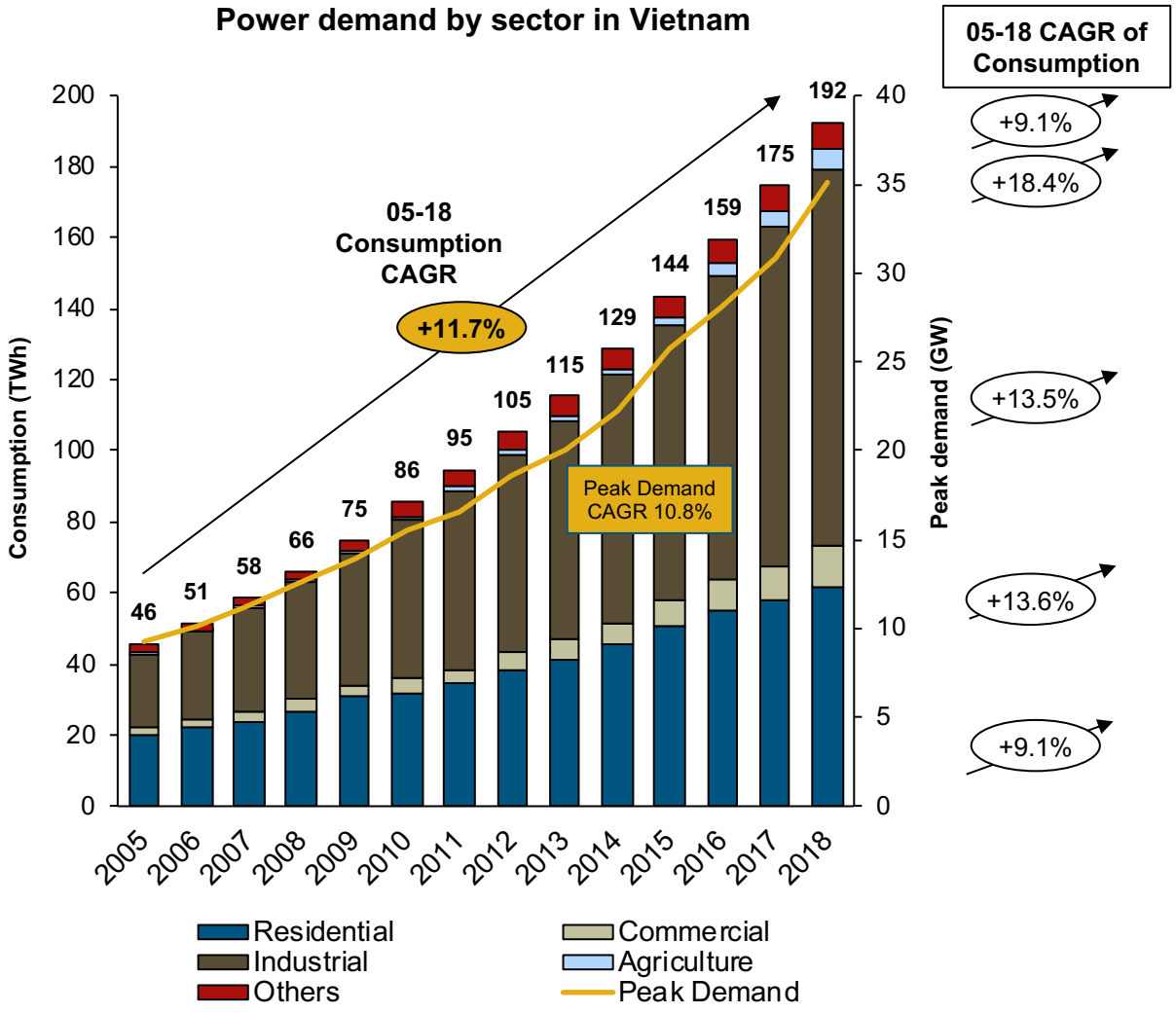
Markets like Singapore, Japan, Thailand, Korea (for example) all import LNG and will benefit (or offset pain) via lower imported fuel costs

(others like Philippines have gas linked to oil prices, and others like Taiwan, Malaysia and Vietnam import a lot of coal)



Source: Department of the Environment and Energy - Australian Energy Statistics, Electricity of Vietnam (EVN), Ministry of Energy and Mineral Resources Republic of Indonesia, Bureau of Energy - Ministry of Economic Affairs - Taiwan, China Electricity Council, Central Electricity Authority – India, Meralco & Department of Energy – The Philippines, TEPCO – Japan, IEA,

Countries like Vietnam with remarkably high growth rates may slow down, but are unlikely to reverse

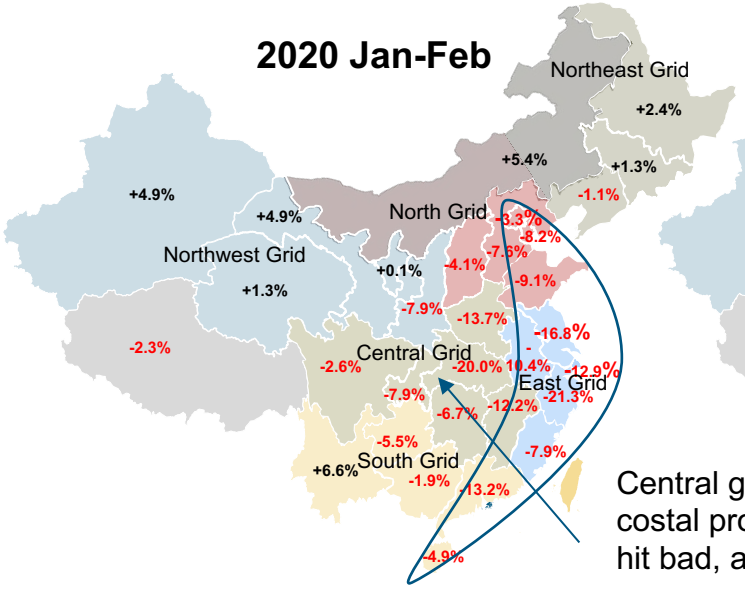


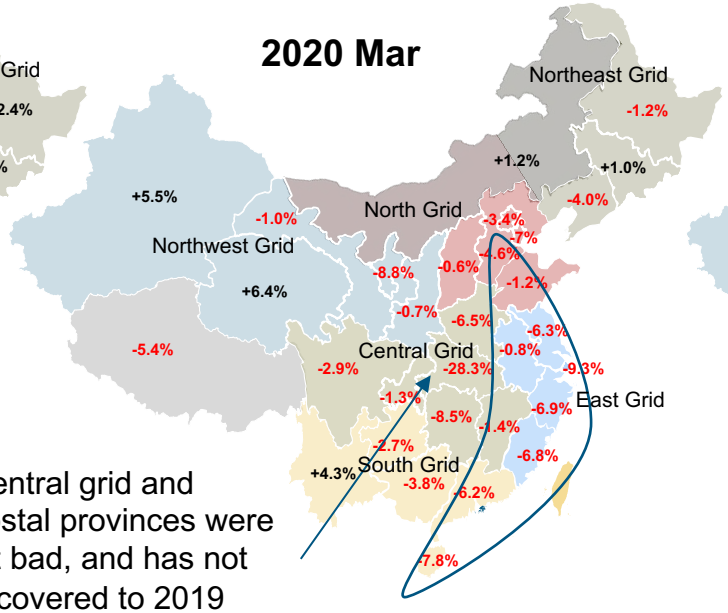
- Against the backdrop of strong economic growth, electricity consumption more than trebled from 46 TWh in 2005 to 192 TWh in 2018 – representing a CAGR of nearly 11.7% over 2005-2018 period. Peak demand is growing at a CAGR of 10.8% during the same period.
- The industrial sector is the main driver of electricity demand, accounting for over half (55%) of electricity consumption in 2018, having grown at 13.5% CAGR since 2005.
- The residential sector accounts for approximately one third of total electricity consumption, with its share having gradually reduced over time. Its CAGR of 9.1% is lower than demand growth in either the industrial or commercial sectors.
- The commercial and agricultural sectors account for a relatively small portion of electricity demand but recorded relatively robust CAGR 13.6% and 18.4% respectively over the 2005-2018 period.

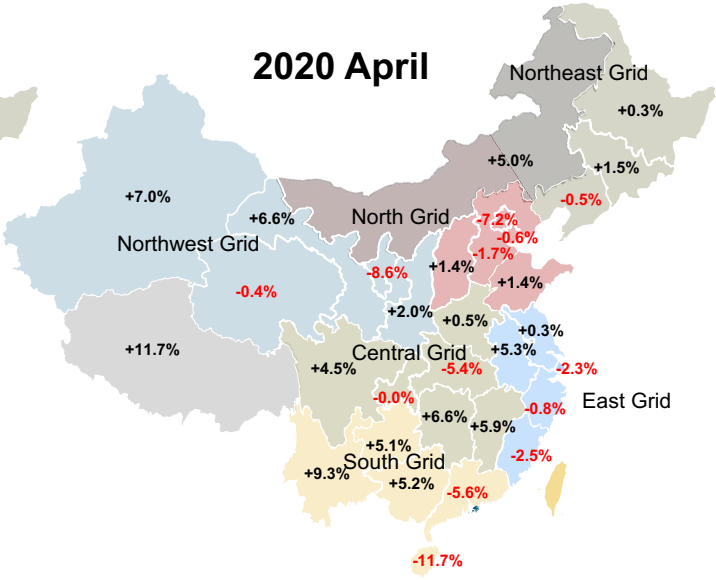
Source: ADB, EVN and EVN NLDC

Implications will vary greatly by region, and not just by country

Power demand growth YoY

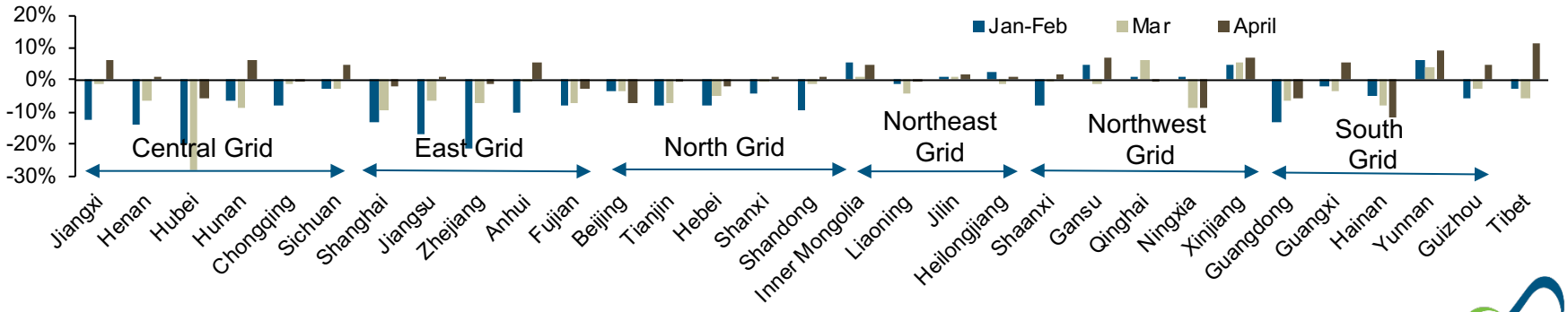






Central grid and costal provinces were hit bad, and has not recovered to 2019 level in March.

Almost all provinces saw improved growth rate in April.



Source: CEC; TLG research and analysis

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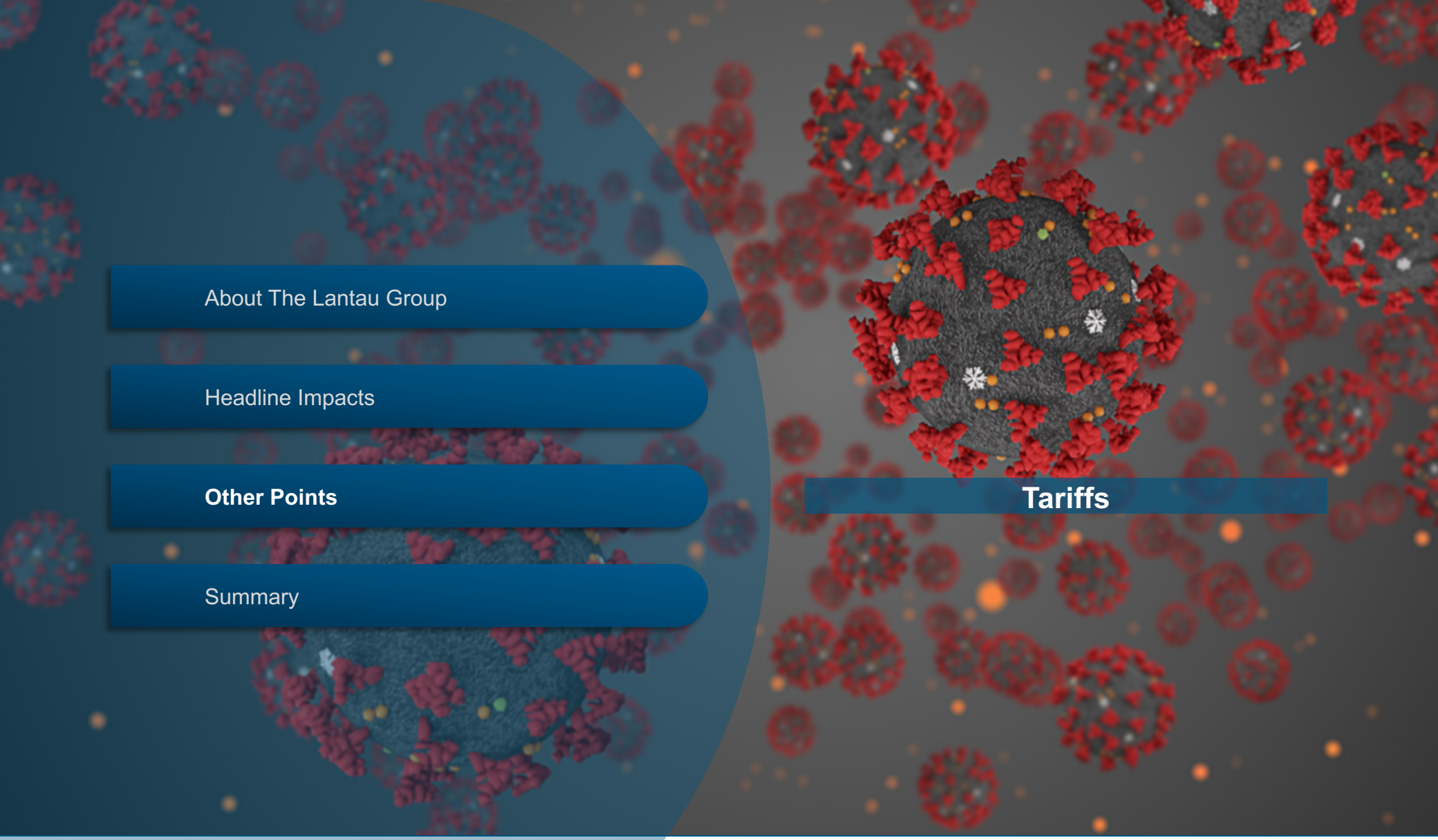
For some, fuel cost decreases already more than offset demand reduction

	Generation output 2020Q1 vs. 2019Q1	Total operating income 2020Q1 vs. 2019Q1	Total operating cost 2020Q1 vs. 2019Q1	Profit margin 2020Q1 vs. 2019Q1
Datang International (601991.SH)	-5.7%	-2.3%	-3.3%	+64.3%
Huadian International (600027.SH)	-10.8%	-6.0%	-9.1%	+54.4%
Huaneng International (600011.SH)	-18.5%	-11.6%	-11.2%	-22.4%
China Resources Power (00836.HK)	-12.5%	-8.2%	N/A	-10.4%
Guangdong Electric Power (000539.SZ)	-16.2%	-15.8%	-13.9%	-93.3%
Zhejiang Zheneng Electric Power (600023.SH)	-36.8%	-34.1%	-32.8%	-47.6%

Note: Generation output - 完成发电量; Total operating income - 营业总收入; Total operating cost - 营业总成本; Profit margin - 归属于上市公司股东的净利润
Source: Company announcements; TLG Analytics, Caixin



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Tariffs

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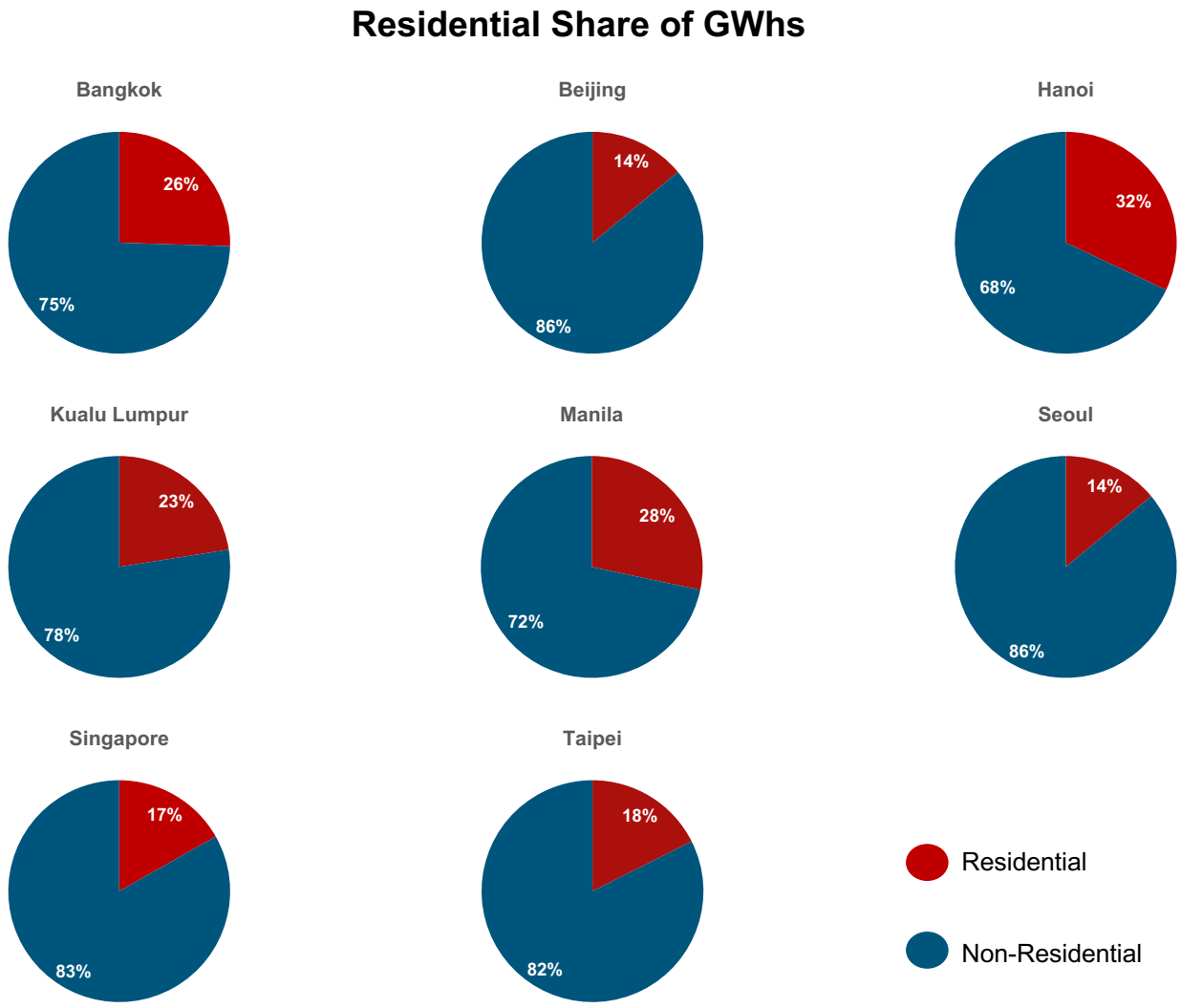
To date in most countries' residential demand has increased due to stay-at-home working, affecting ~15% to 30% of overall load



Source: TLG Research

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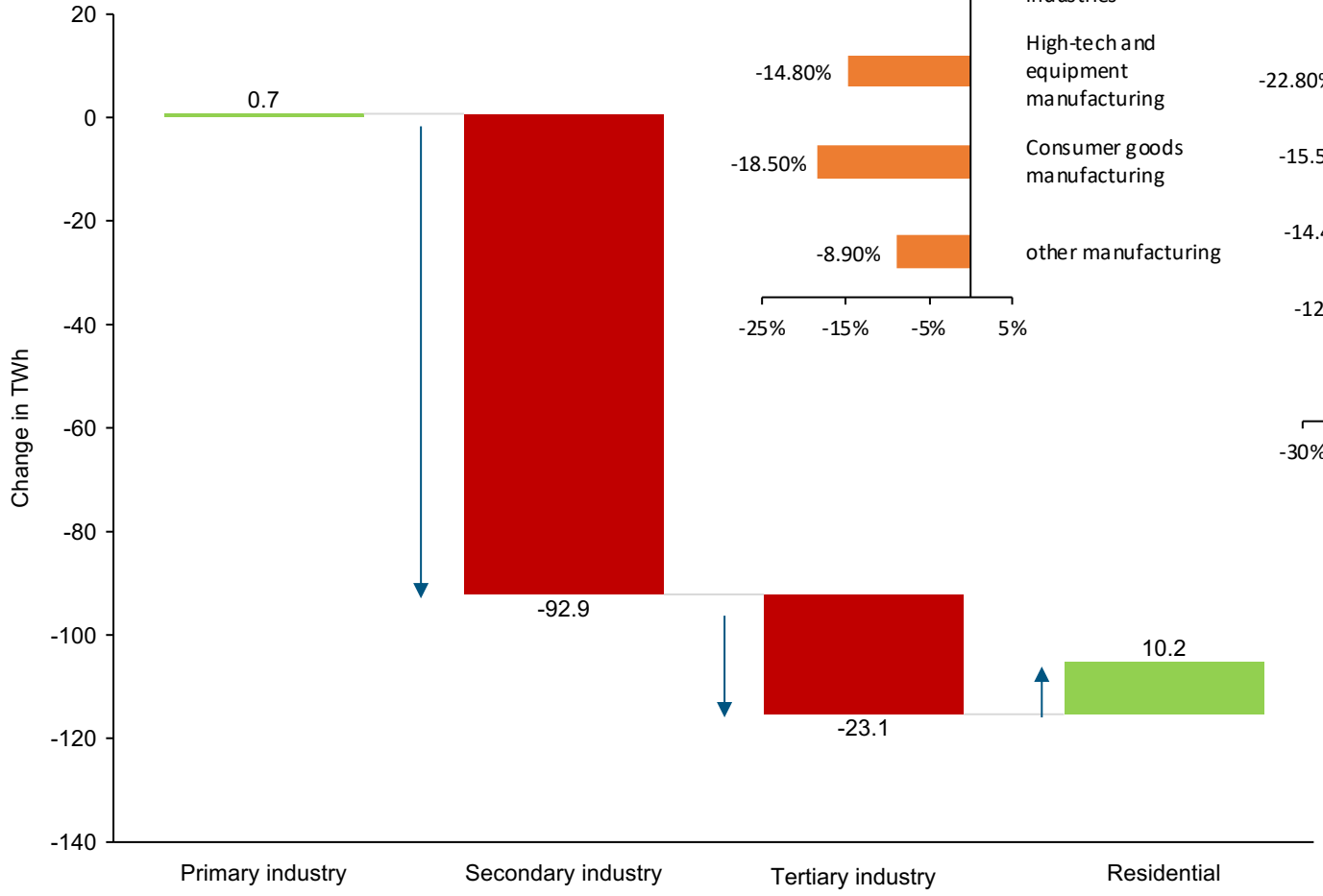
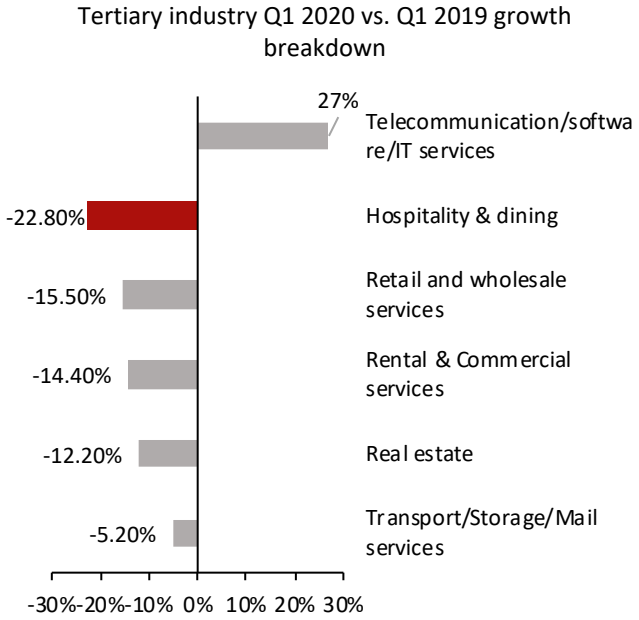
China's electricity consumption trends – like most countries – saw residential use increase, with secondary industry and hospitality sectors hit the hardest





- The 2019 residential growth was 5.7%, with 2019Q1 grew 11% compare to 2018Q1; thus the growth rate in 2020Q1 is not as high as 2019Q1
- For tertiary industry, the Telecommunication/IT growth in 2019Q1 was 9.5%, thus the 27% growth in 2020Q1 more than twice the growth in 2019Q1
- Residential electricity consumption contributes to 17% of the overall consumption in 2019Q1, and 19% in 2020Q1.

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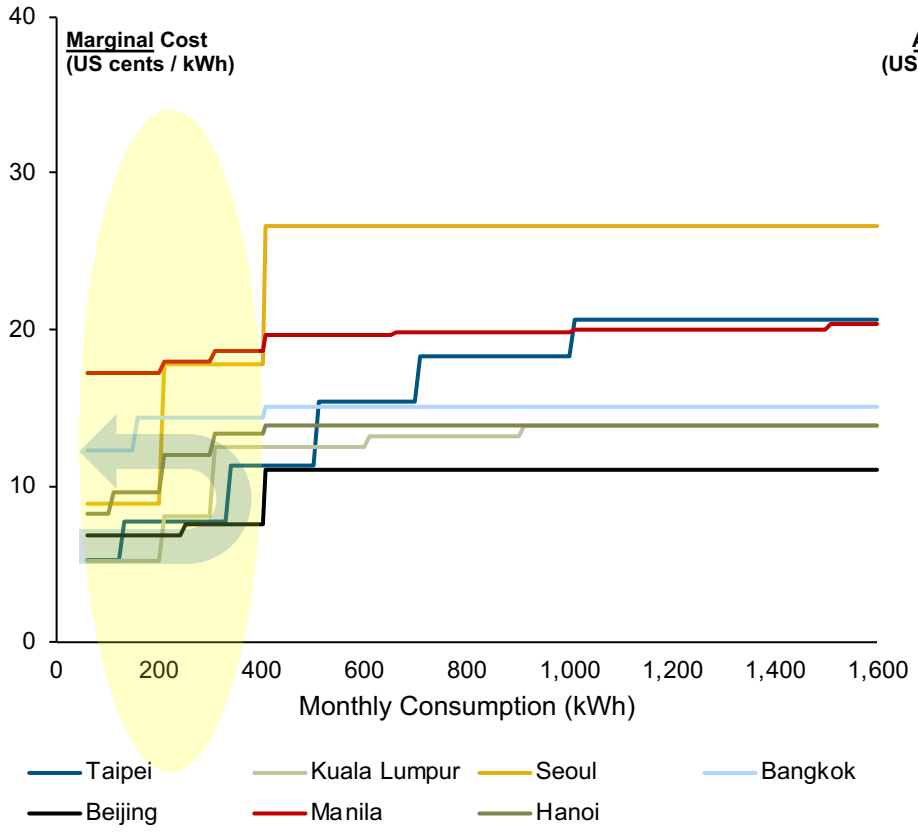
Residential customers pushed to higher usage may see disproportionate bill shock. Could this influence behind-the-meter technologies?

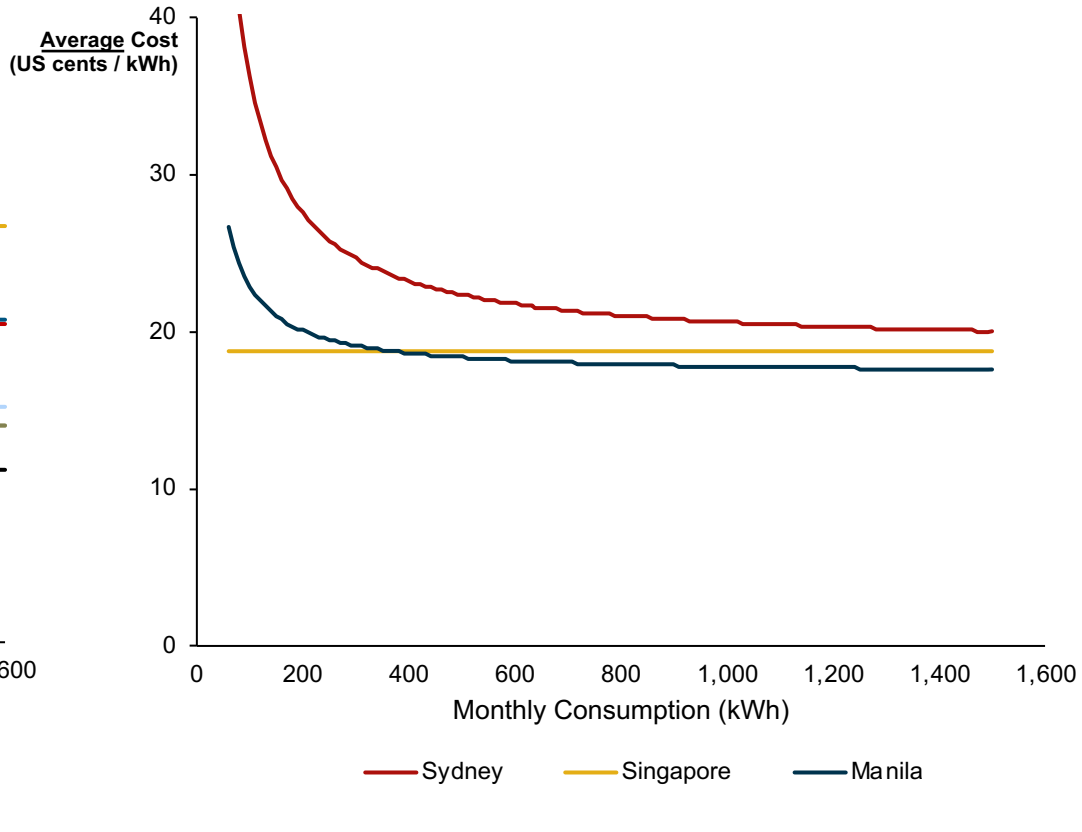
1 Rising Block Tariff Structure

More common in Asian economies to help subsidise costs below cost-reflective levels for low consumption (typically lower income) groups



2 Fixed + Volumetric Tariff Structure

This more cost-reflective structure is more common in Europe, US and Australasia, as well as Singapore and the Philippines



NB. **Manila** is included on both charts, as its residential tariff has both rising block volumetric charges and fixed charge components.

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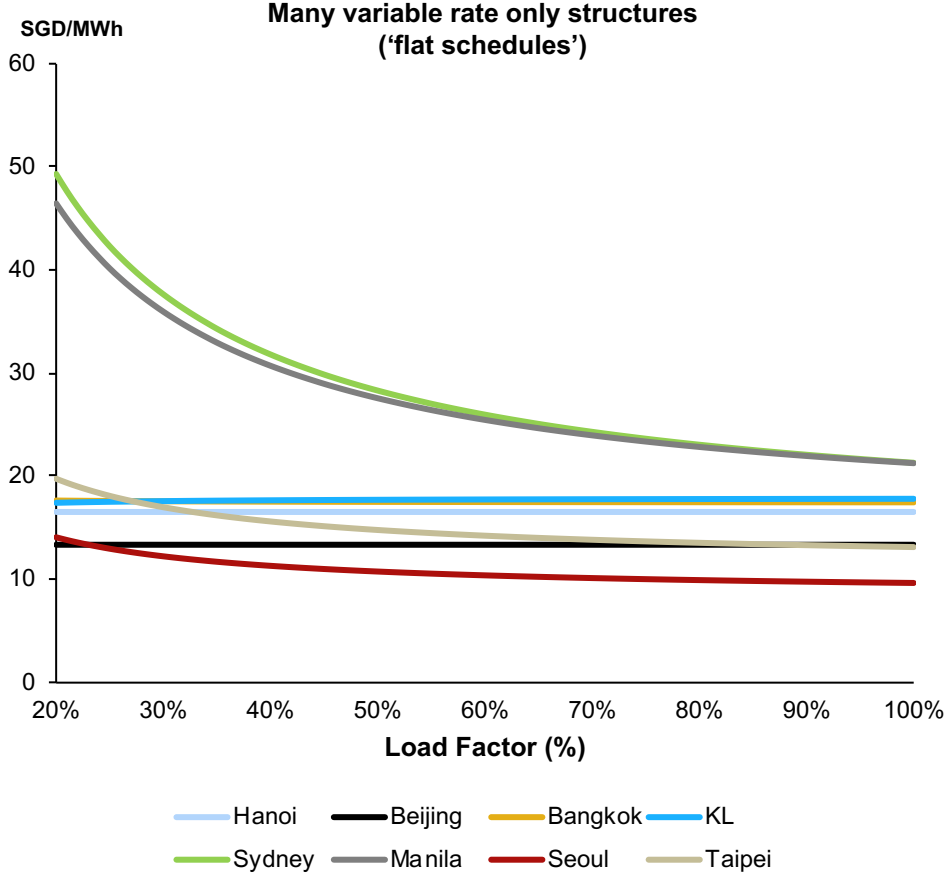
Future tariff reforms/increases may well be needed the more that COVID-19 impacts result in unrecovered costs or accrued losses for utilities

(Many C&I customers pay a premium in Asia to cross-subsidise domestic customers – there could be much less scope for some countries to increase C&I tariffs disproportionately without damaging recovery prospects)

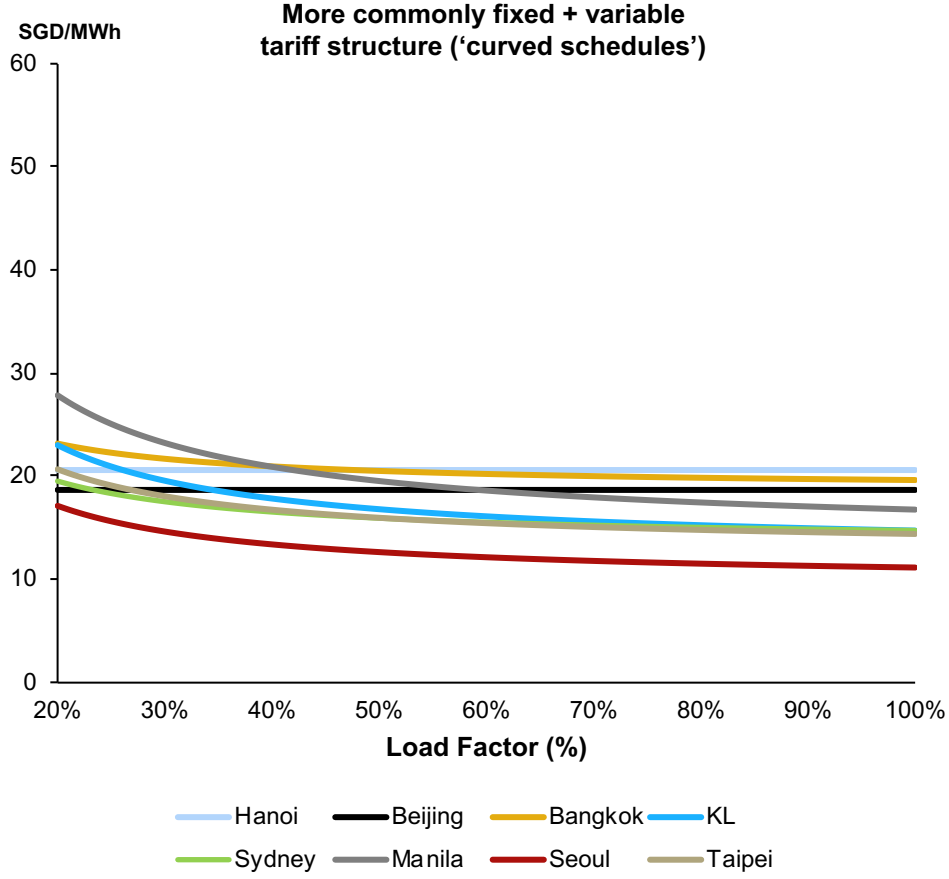
Low Tension Commercial

Many variable rate only structures ('flat schedules')



High Tension Small Commercial

More commonly fixed + variable tariff structure ('curved schedules')



Source: TLG Research (2019 data)

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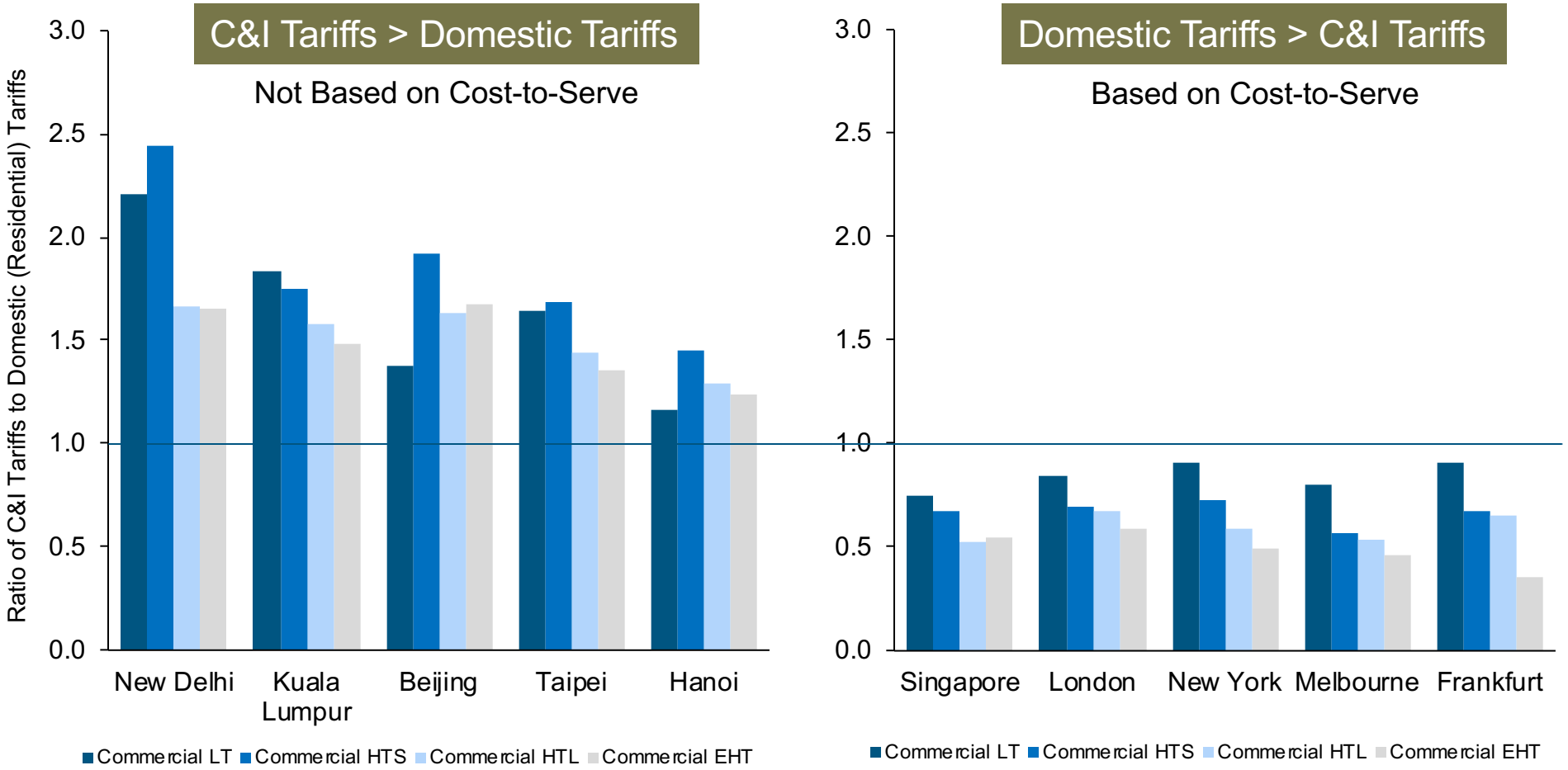
Cross subsidies are common in Asian electricity pricing



Usually domestic customers have a higher cost-to-serve due to more infrastructure per electron

Note: TLG Research, based on 2018 data

Note: Customer types are defined by a load profile and usage level

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Power Tariff Relief Measures in the Region (1 of 3)

Location	Measures	User Group	Duration	Coverage and Funds
Bangkok, Thailand	3% discount on electricity bills	All types	Apr-Jun	3.9 mil users, totalling 1,600 mil baht.
	6-month payment extension	Type 5 (Hotel, rental business)	Apr-May	3,400 users, totalling 1,400 mil baht.
	Refund of electricity meter deposit	Type 1 and 2 (Households and small businesses)	Indefinitely since 31 March	3.8 mil users, totalling 13,000 mil baht.
	Cancellation of minimum electricity charge*	Type 3, 4, 5, 6, 7 (medium-large businesses)	Apr-Jun	29,000 users, totalling 167 mil baht
	Increase of free electricity usage cap from 50 to 90 kWh/month	Home type 1. 1 Consumption ≤ 90 kWh with less than 5A meters)		205,000 users, totalling 74 mil baht
	6-month payment extension	Home type 1.1 (Consumption ≤ 150 kWh)		165,000 users, totalling 300 mil baht
Hanoi Vietnam	10% discount	• Households from rate 1 to rate 4 (0-300kWh) • Businesses and manufacturing companies	Apr-Jun	• VND 2.9 trillion for households • VND6 trillion for businesses and manufacturing companies
	Tariff adjusted to that of manufacturing industry	Service businesses (including hospitality and accommodation)		VND 1.8 trillion
	Power bill exemption	COVID-19 isolation and treatment facilities		VND 100 billion

Source: public information, TLG research

Power Tariff Relief Measures in the Region (3 of 3)

Location	Measures	User Group	Duration	Coverage and Funds
Myanmar	Exemption of electricity cost up to 150 kWh; Exemption of meter charge for customers consuming less than 150 kWh	**Household category:** Home power, Business / religious buildings **Non-household category:** Industries, Businesses, Street light, Government Offices, State-owned industries, State-owned enterprises, Irrigation, Development Office / Works, Non-Governmental Organizations, Foreign embassies, International Organizations	Apr	N/A
Mainland China	5% reduction	Big industrial and C&I customers (excluding high energy consumption customers)	Feb-Dec	RMB 112.6 billion
Taiwan	10% reduction (no more than NT$ 100,000/month); 4-mon payment extension	Low Tension customers with 15%~50% YoY revenue drop	Mar-Sep	All industrial, C&I, public organizations, and agricultural customers (there are separate measures for agriculture & public organizations, excluded in this table)
	Lower contracted capacity applicable (thus reducing capacity fee) or 10% reduction (no more than NT$ 500,000/month)	High Tension customers with 15%~50% YoY revenue drop		
	30% reduction (no more than NT$ 300,000/month); 4-mon payment extension	Low Tension customers with more than 50% YoY revenue drop		
	Lower contracted capacity + 30% reduction (no more than NT$ 3 mil/month)	High Tension customers with more than 50% YoY revenue drop		

Source: public information, TLG research

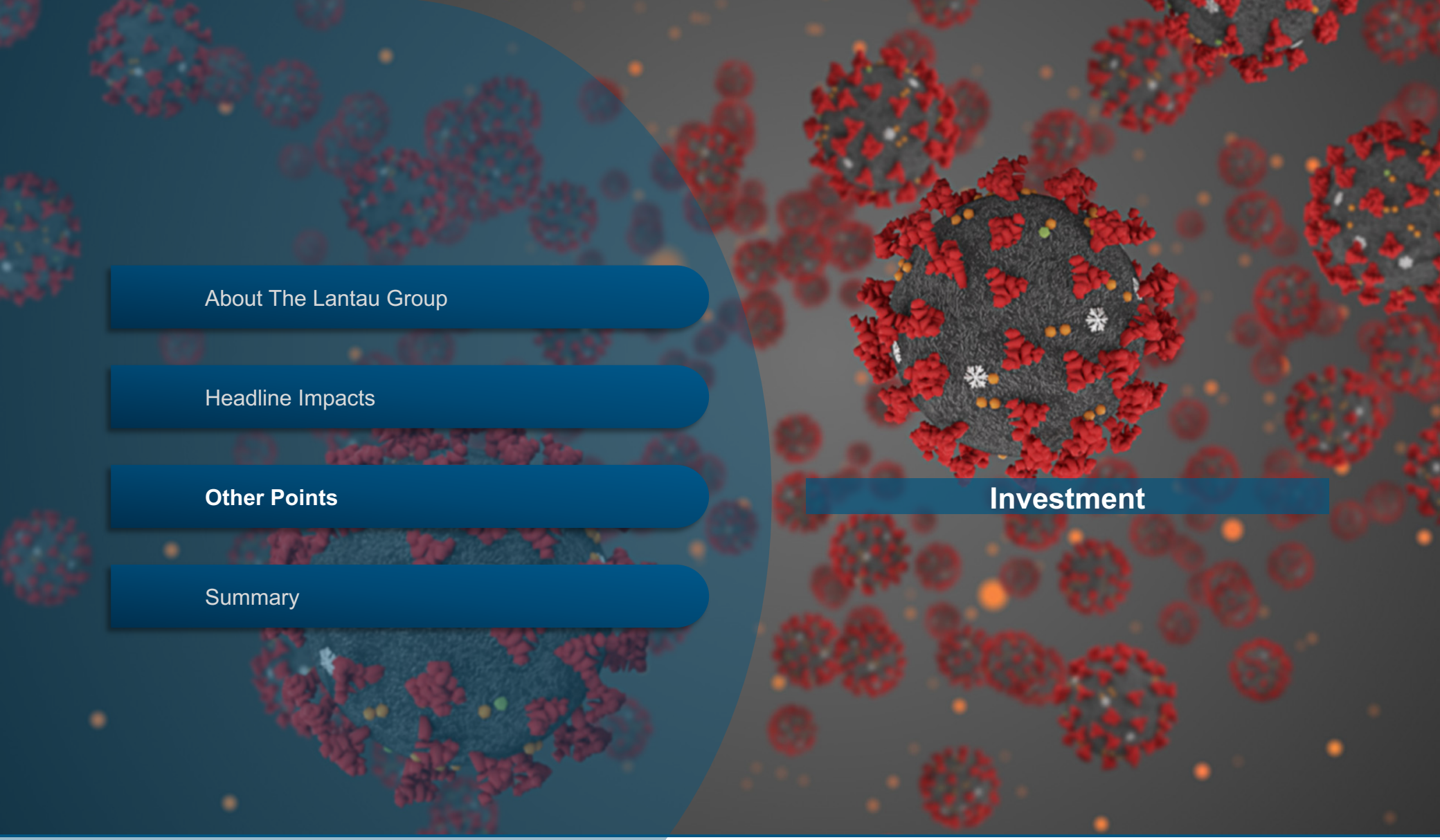
Power Tariff Relief Measures in the Region (2 of 3)

Location	Measures	User Group	Duration	Coverage and Funds
Jakarta, Indonesia	Power bill exemption	Household (450VA, least usage group)	Apr-Jun	• 24 million customers (450 VA) • 7 Million customers (900 VA) • Combined cost of Rp 800 billion ~ 1 trillion/mon, estimated by IESR
	50% discount	Household (900 VA, second lowest group)		
Manila, Philippines	30-day payment extension	All types	1 month (bills due on Mar 1— Apr 14)	N/A
Brunei	15% discount on electricity bills	5 targeted sectors: Tourism, Hospitality, Restaurant and Café, Air Transport, Water Transport	Apr-Sep	N/A

Source: public information, TLG research

Financial performance and tariff implications

- Two factors are occurring
  - Demand reduction → revenue loss from C&I customers who contribute in many Asian countries more than their "cost to serve" relative to domestic customers. Consequently, utilities lose more money relative to costs, when C&I sales drop, and make less money relative to costs when Domestic sales increase.
    - This effect will roll forward potential financial losses to be recovered in the future
  - Fuel cost reduction → potential savings for a given fixed tariff if actual fuel costs are less than embedded fuel costs in the tariffs
    - This effect is likely to more than offset demand reduction effects – but will play out over time
- Which "wins" depends on duration and magnitude of each factor
  - Lockdowns have the greatest depressing impact on demand with material recovery once removed
  - A lingering recession (globally) would likely keep fuel costs lower, longer
  - Smoothing mechanisms could spread tariff "pain" over time, but some regulatory arrangements that exist currently have no formal *longer-term* cost-recovery mechanism for non-capex factors to cater for COVID-19 related demand reduction
- On top of this is the prospect of direct support to customers that may be channeled through utilities either in the form of tariff freezes or reductions when tariffs might otherwise have increased or stayed constant, or other yet to be fully worked out mechanisms



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Investment

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“New infrastructure”（新基建) is and will be a key buzzword of the post-COVID19 stimulus for several countries, notably (but not only for) China

- After the global financial crisis in 2008, China’s stimulus spending focused on housing, highways, bridges and airports, resulting in a big boost for consumption of steel and concrete, along with the power consumption of those industries.
- This time around, the so-called “New Infrastructure” stimulus plan is targeted on seven new areas, namely: 5G networks, data centres, AI, the industrial Internet of Things, UHV transmission lines, high-speed rail, and EV charging infrastructure. Stimulus funding has been allocated for 10 trillion RMB, 2.5 times larger than the stimulus funding allocated after the global financial crisis.
- China Southern Grid estimates growth from data centre power consumption will comprise **3.4%** of all new demand growth in Guangdong and **6.6%** of all new growth in Guizhou out to 2025; Construction of new 5G base stations and EV charging infrastructure are estimated to contribute **2.1%** and **2.5%**, respectively, to all new power demand in the South China Grid over that same period.

Summary of New Infrastructure areas and relevant targets

Area	Targets
5G networks	Build more than 550,000 base stations by the end of 2020 and finish a 5G network that covers the entire country by 2025 (approximately 5-5.5 million base stations)
Data centres	No quantitative targets, just to built “a number” of large and super-large data centers and edge computing data centers to meet China’s data storage needs.
AI	Construct 20 pilot zones for innovation and development of next-gen AI by 2023.
Industrial IoT	Build 3-5 competitive industrial IoT platforms by 2025.
UHV	By the end of 2020, a total of 16 new projects under construction or pending final approval, with 7 more in the finance scoping phase
EV charging infrastructure	12,000 new charging and battery swapping stations by the end of 2020, with 36,000 by 2025; 4.8 million charging piles by the end of 2020 and a national EV to charging pile ration of 1:1 by 2025.
High speed rail	Open 14 new lines by the end of 2020

Source: CCID white paper, Caixin, TLG Analysis

China's situation has changed dramatically…..from a "red light" for coal….

Provincial risks of developing new coal-fired power capacity as part of the 'traffic light system'

Coal projects are allowed to under government's guidance

Provincial government and developers are required to consider cautiously on developing coal projects

Suspend approving and building new coal projects

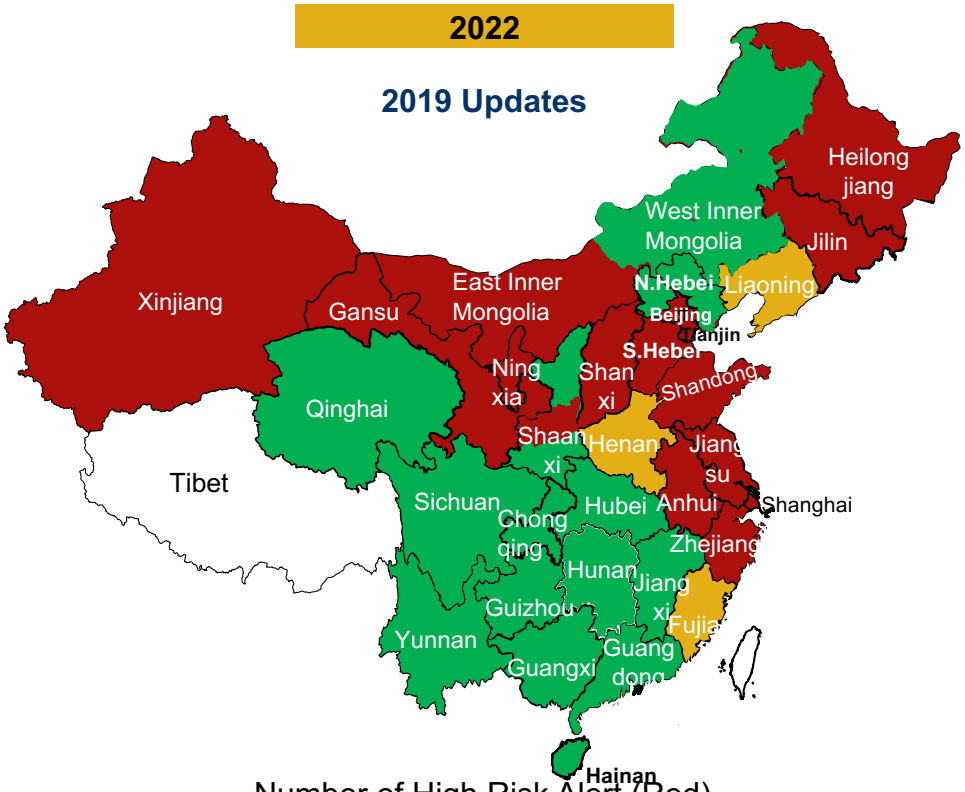
	2019	2020	2021
Green	Anhui, Jiangxi and Hainan	Hunan and Hainan	Shanxi, Hubei, Jiangxi, Anhui and Hunan
Orange	Hubei	Anhui, Henan, Hubei and Jiangxi	Henan and Liaoning

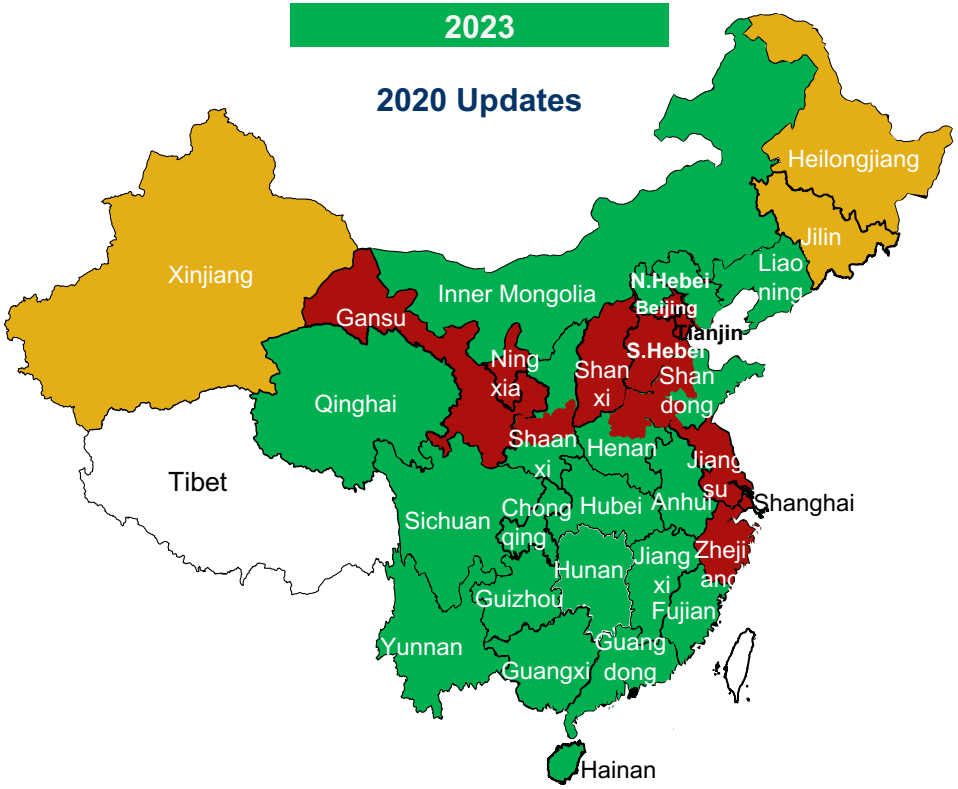
- NEA assess the risks based on the following factors:
  1. Existing coal capacity and reserve margin
  2. Estimated return rate of coal projects
  3. Local water resources, coal demand and emissions

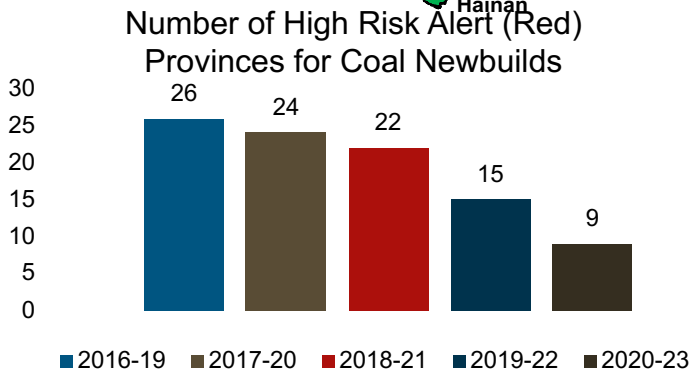
Divergence of interests between the provincial and central governments; and firms with competing interests also played a role in undermining the capacity cut policies

Source: NEA; TLG analysis

Restraints on coal have been relaxed. But should coal still make sense?







Note: 2016-19 means coal power alert for 2019, published in 2016.

- High risk areas for coal newbuilds in 2023 decreased to 9 provinces, a 63% reduction from previous year
- While newbuild alert eased, potential economic risks remain similar to previous year
- General trend shows that governing authorities' restraint has hit a turning point and boosting economy is reprioritized.

Source: NEA; TLG analysis

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The options for **gas** vs coal are theoretically much more balanced and open at present; the coal development "pipeline" is thinner in China than in the past

	Annual Thermal Incremental Capacity (GW)	Annual Approved Coal Project (GW)
2016	50.48	35.9*
2017	44.53	15.05
2018	43.80	8**
2019	40.92	6.31
Q1 2020	7.02	~10

*Among 35.9GW of projects approved in 2016, 14 GW was ordered to pause/delay by NEA in 2017. Construction/grid connection of some of those projects had already been deferred to 2020.
** Estimation

Source: CEC; public information; TLG analysis

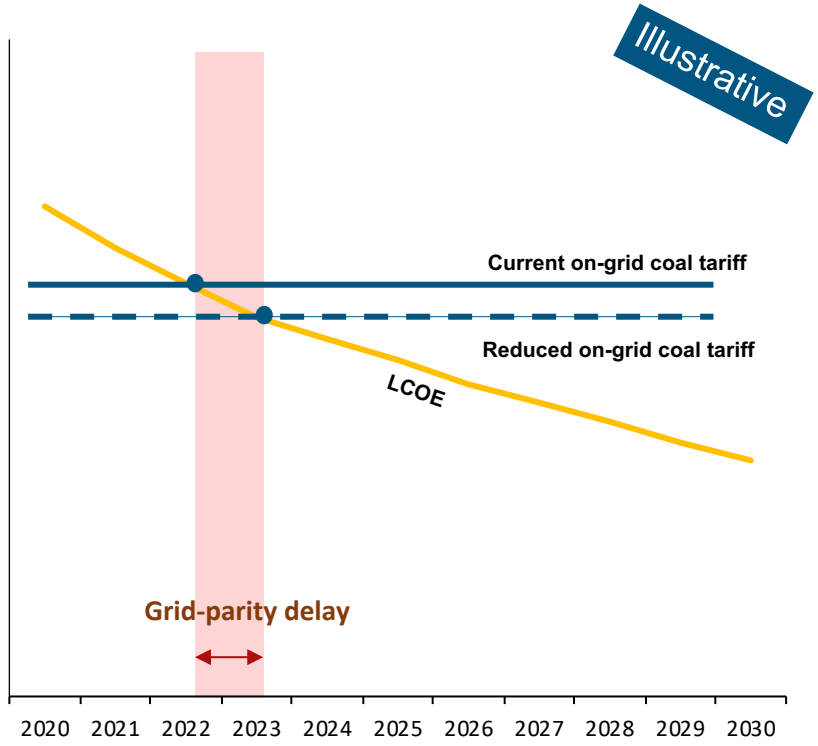
RE investment will be exposed more to falling fuel costs and will depend more on falling technology costs or perhaps more corporate support (CSR driven)

New policy on coal on-grid benchmarked tariff:
NDRC, No. [2019] 1658

- The historical coal-power price linkage mechanism is abolished.
- A new "Base benchmark tariff plus floating" mechanism is introduced from January 2020.
- Base benchmark tariff is existing coal on-grid benchmark tariff for each region, which allows for a cap of 10% and a floor of 15%
- The coal on-grid tariff is not allowed to increase in 2020 to ensure that the C&I retail tariffs do not increase.

Background of the now abolished coal and power price linkage mechanism: the on-grid coal power price is to be adjusted when the average 6 months coal price fluctuates more than 5%. The mechanism was refined in 2015. Adjustments have been made eight times since it went into effect.

Renewable LCOE and on-grid coal tariff

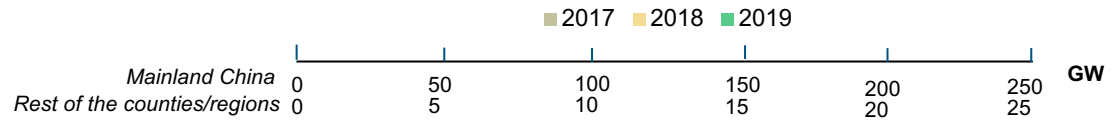


- For grid-parity project, lower on-grid tariff means renewable project developers need to wait for longer time to install new capacity for CAPEX to decrease. This can translate to slow capacity growth in the forthcoming years.

Source: NDRC, World Bank, TLG Research and Analysis

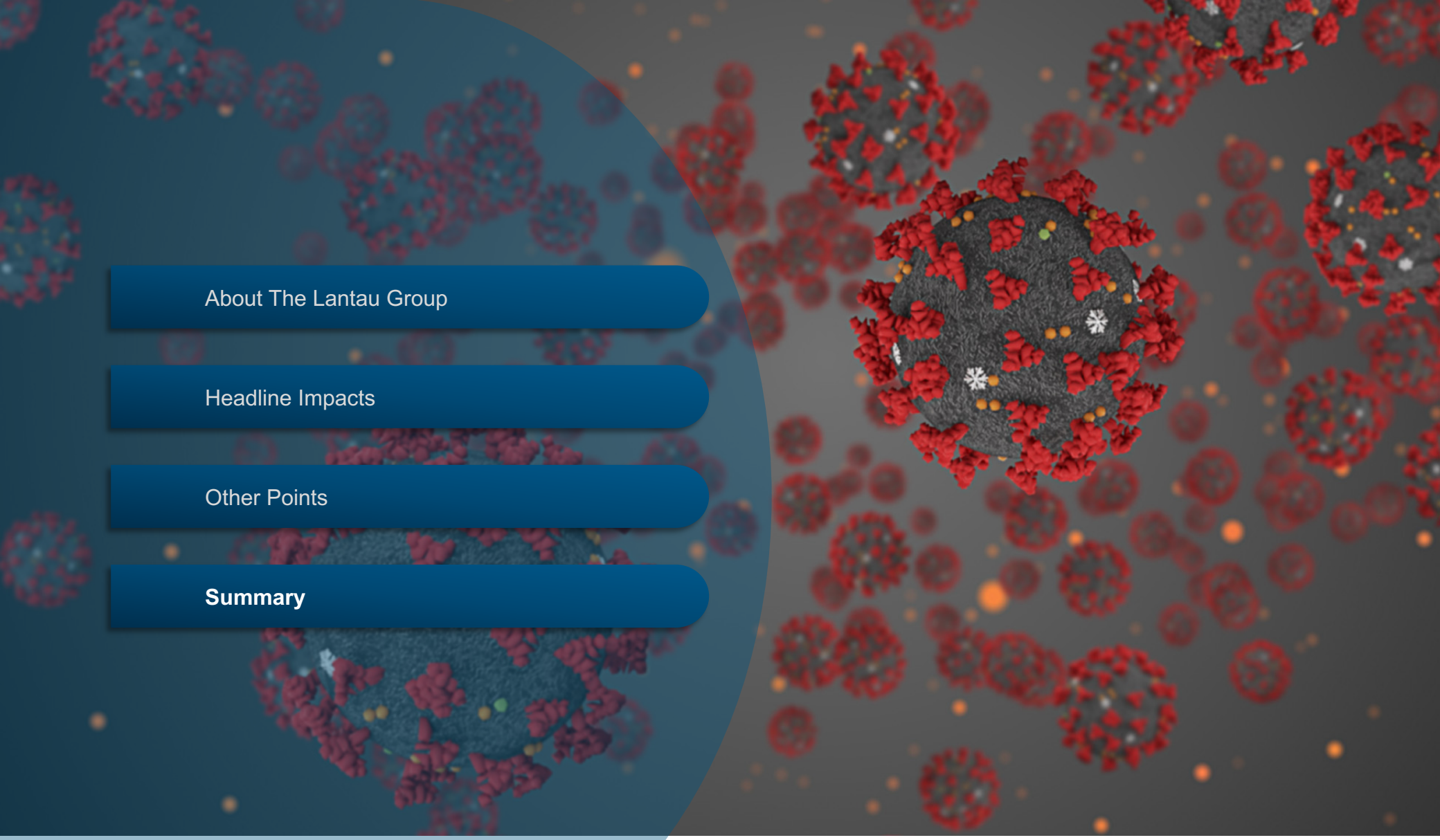
RE development is still early stage in many countries, with many drivers, not just the relative cost of conventional fuels

	Main RE promotion approach	RE development trend *RE capacity additions (2017-2019)*	RE future development trend /Comments
Singapore	Tenders (apply to BTM)	SG	Only solar; limited development; 2GW solar by 2030
Taiwan	FIT (apply to BTM)	TW 1 1.5	~85% addition from rooftop solar; 30GW RE by 2025
Vietnam	FIT/Auction *(soon)* (apply to BTM)	VN *Solar only* 5	14.5 GW solar by 2025
Malaysia	FIT/Auction (apply to grid-connected RE)	MY	3.8 GW RE needed to meet 2025 target of 20% RE
China	FIT/Auction/RPS *(soon)* (apply to BTM)	**CN** 83 78 68	FIT phasing out; Forecast[1] annual addition of wind 53GW, solar 58GW during 14th Five-Year-plan
Japan	FIT/Auction (apply to grid-connected RE)	JP 6 12 7	22%-24% RE generation by 2030
Thailand	Auction (apply to grid-connected RE)	TH 1.1	20% RE generation by 2037, adding 21 GW of new capacity
Philippines	FIT/Merchant (RPS) *(soon)* (apply to grid-connected RE)	PH	FIT is based on a 'first come, first served' quota system with limited quota
Korea	RPS (apply to grid-connected RE) (cost-based pool market and REC market)	KR 1.7 2.3 2.3	30-35% renewable generation by 2040



[1]CERO 2019 by CNREC

Source: TLG analysis and research; REN21; IRENA



About The Lantau Group

Headline Impacts

Other Points

Summary

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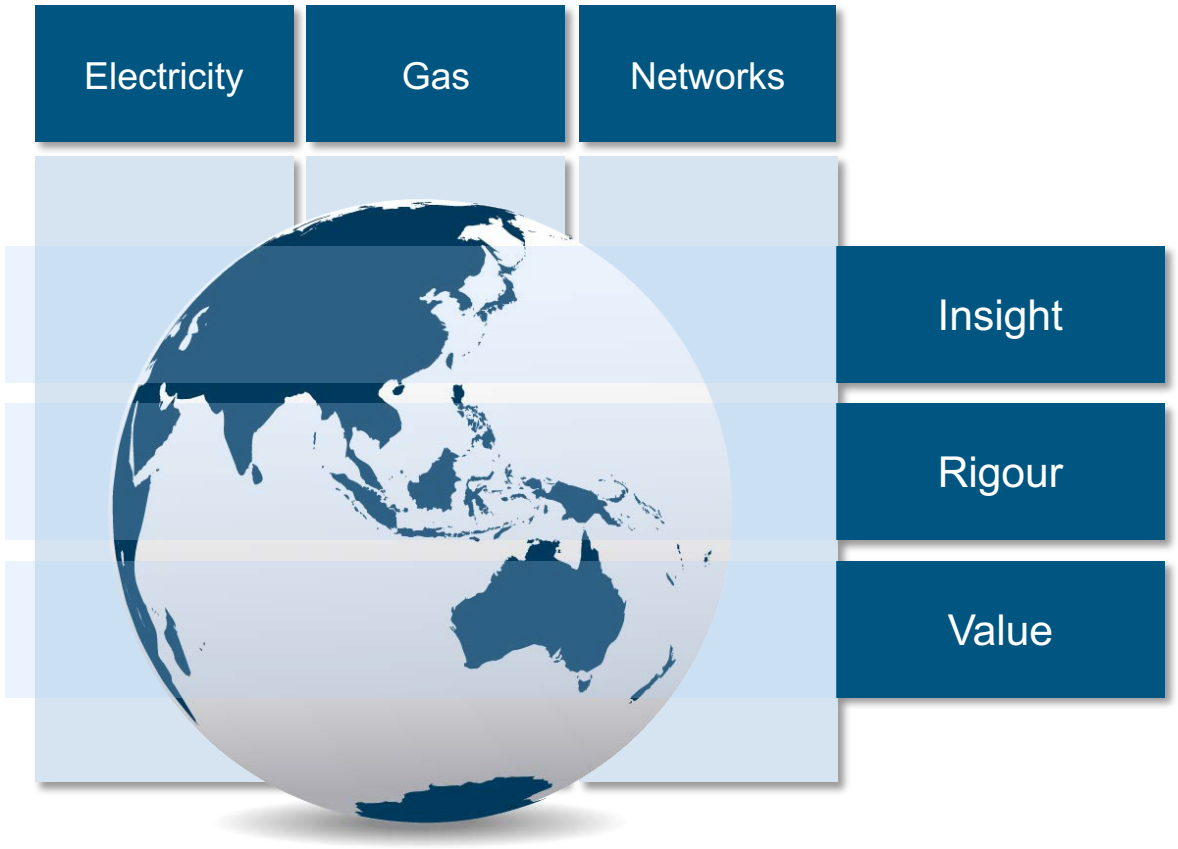
Observations

- Huge disruption – increasingly disproportionate to comparative numbers of cases and deaths – a slow, long-term recovery with a significant amount of government support required
- Manifesting also as materially lower conventional fuel prices
  - Surely there will be a stronger gas and gas infrastructure story emerging
- Some disadvantage to grid-connected renewables, but behind-the-meter (rooftop) story depends much more on tariff structures which are likely to continue to favour development, especially if domestic usage increases or pricing volatility increases
- In some ways, much of Asia's electricity sector is in better position for these developments than in the past
  - Imported gas is suddenly much lower in cost – giving new impetus to gas infrastructure development/discussions that have been going in circles in several markets for some time
  - Not as much "excess" capacity to begin with
  - RE outlook is the most complicated aspect, but should remain a growth area given the relatively low level of RE development in the region overall and the many locational differences in the region
- Key uncertainty is longer-term nature of the recovery if the rest-of-world slips more deeply into a lingering recession

End



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