



Impact of COVID-19 on the Chinese Power Sector

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Summary

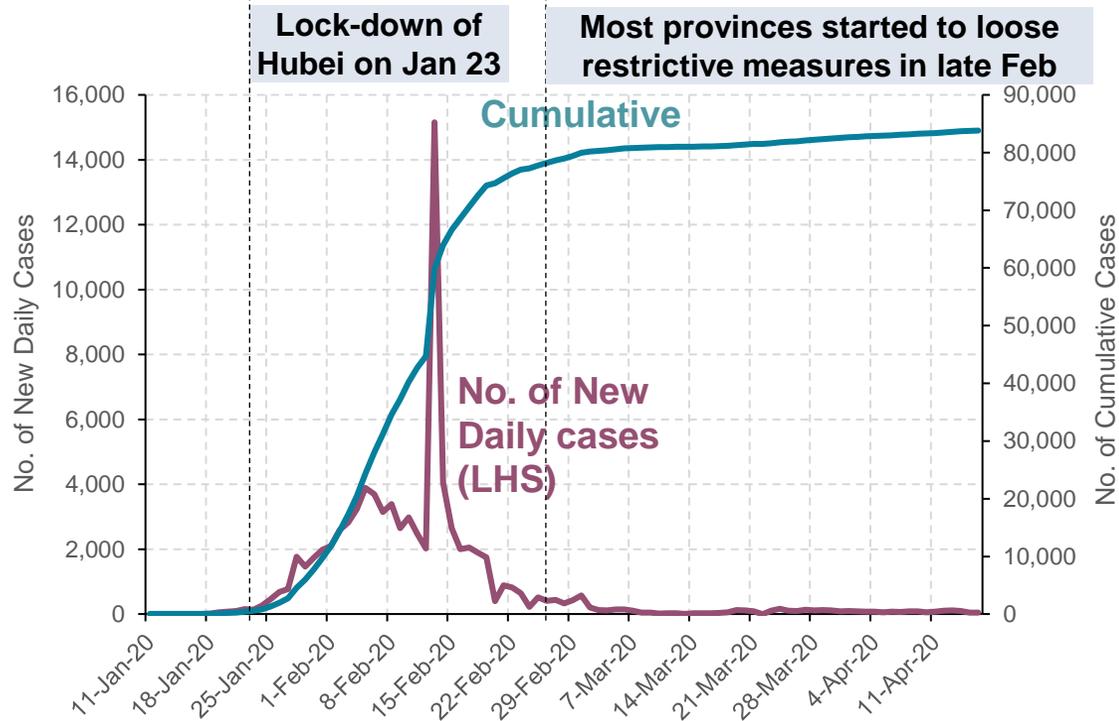
COVID-19 will likely lead to a worsening market fundamental in the near term and increase RE curtailment rate and exacerbate the subsidy delay issue

- **Status of COVID-19 in China [First in First out]:** COVID-19 situation is largely controlled, and people have cautiously returned to work.
- **Impact on GDP [Climbing out of the hole]:** Economic recovery from the lock down is staggered with industry and investment recovering faster than consumption; export sector may become worse due to weak demand from US and Europe in Q2.
- **Impact on demand and generation:**
 - In Q1 2020, power demand in coastal areas were down by 8-16% y-o-y while demand growth in most inland provinces is slightly positive
 - Latest generation data indicate positive demand growth in April
 - Coal generation is reduced the most; but wind and solar generation continues to increase.
- **Impact on Investment:**
 - There are signs that China may embark on a new round of capacity construction (including coal, solar and wind) in the coming months/years
 - Grid firms accelerate building a third round of UHV transmission projects, which can help to mitigate the risk of high RE curtailment in resource regions.
- **Impact on Renewables (RE) Investment Risk**
 - Due to weak demand growth and continued new capacity addition, the risks of higher renewable curtailment have increased in some provinces like Shanxi, Shandong, Anhui etc
 - The subsidy delay issue for the existing renewable projects is getting worse, and delay time may become longer, especially for solar projects commissioned after July 2017.

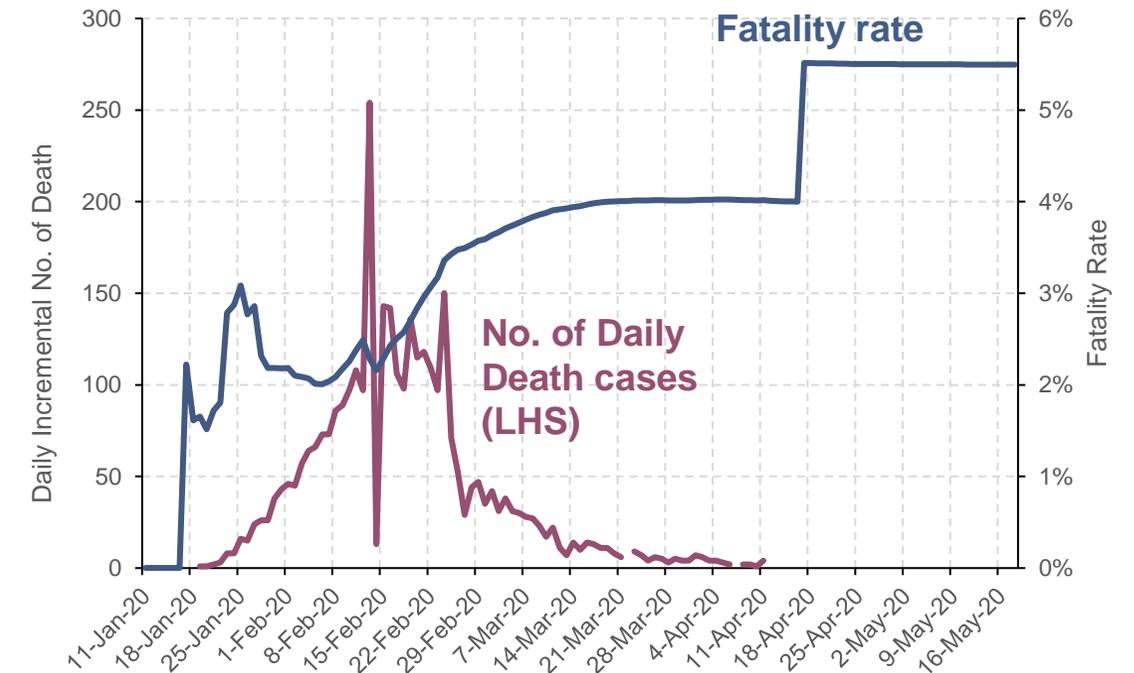
Status of COVID-19 in China

First in First Out: COVID-19 situation is largely controlled, and people have cautiously returned to work

No. of COVID-19 Cases in China



No. of Death Due to COVID-19 in the Philippines



- **First in first out:** Lock down of Hubei was initiated on Jan 23 and most provinces in coastal areas and Central China followed and started to lock down. In late February/early March, lock-down was gradually eased in most provinces; lock-down was officially lifted in Hubei (including Wuhan) on April 8
- **The new normal:** People have cautiously returned to work since late February/early March.

Impact of COVID-19 on the Economy

Climbing out of the hole: economic recovery from the lock down is staggered, with industry and investment recovering faster than consumption

Key Macroeconomic Indicators

Expected GDP Growth Rate: 1-2% in 2020

- Q1 2020 growth rate is **-6.8%**
- Forecast: IMF in April 2020: 1.2% in 2020 and 9.2% in 2021.

Government actions: conservative response so far

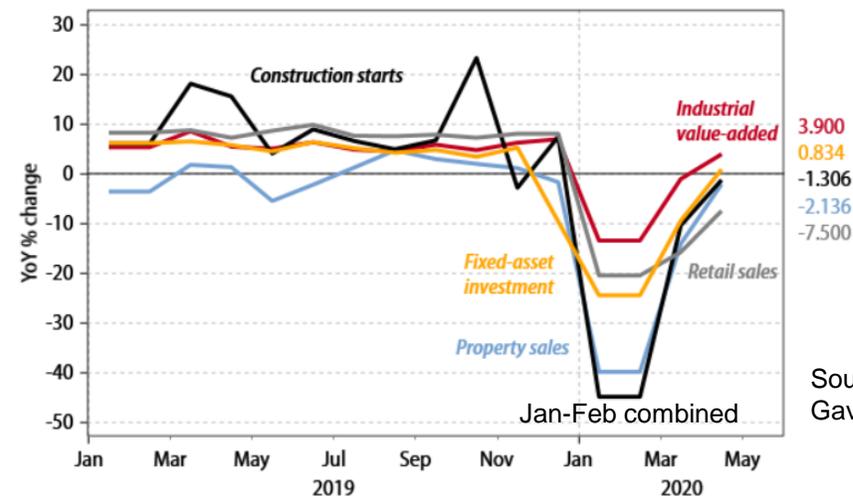
- New infrastructure stimulus plan is announced, but the size is relatively modest
- People Bank of China (PBOC) cut rate by 10 bps in late January
- The government plans to further cut taxes to support local industry; it also ensures a stable USD/CNY exchange rate to support capital inflows and market confidence.

Economic Activities:

- Latest economic data for April shows a continued recovery in industry and investment as well as a surprising recovery in exports* but consumption lagged behind
- Consumer demand for goods and services is likely to continue to improve in the coming months
- But exports are likely to fall as global trade shrinks due to COVID-19 in Europe and US.

Note: *recovery in export in April is likely driven by the delayed shipment of items ordered in Feb – Mar, so the growth in exports is likely to be temporary

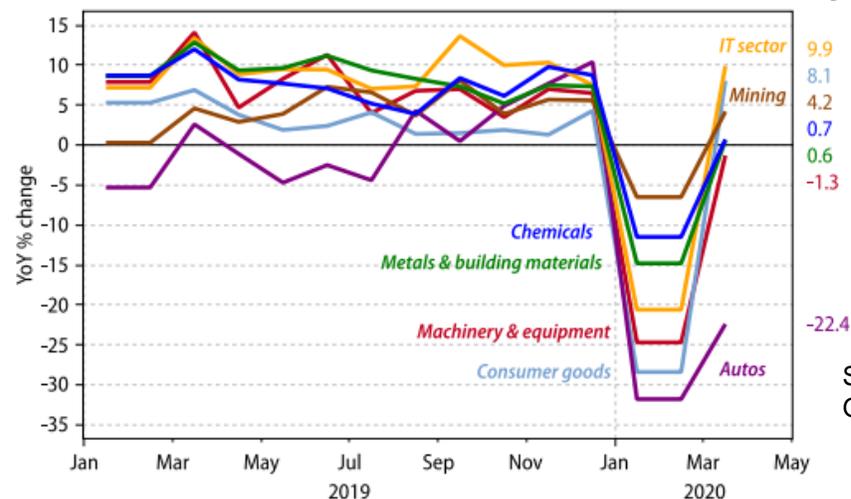
China Monthly Economic Indicators



Industry and investment has started to recover in March

Source: CEIC and Gavekal Research

Real Growth of Industrial value-added by product groups



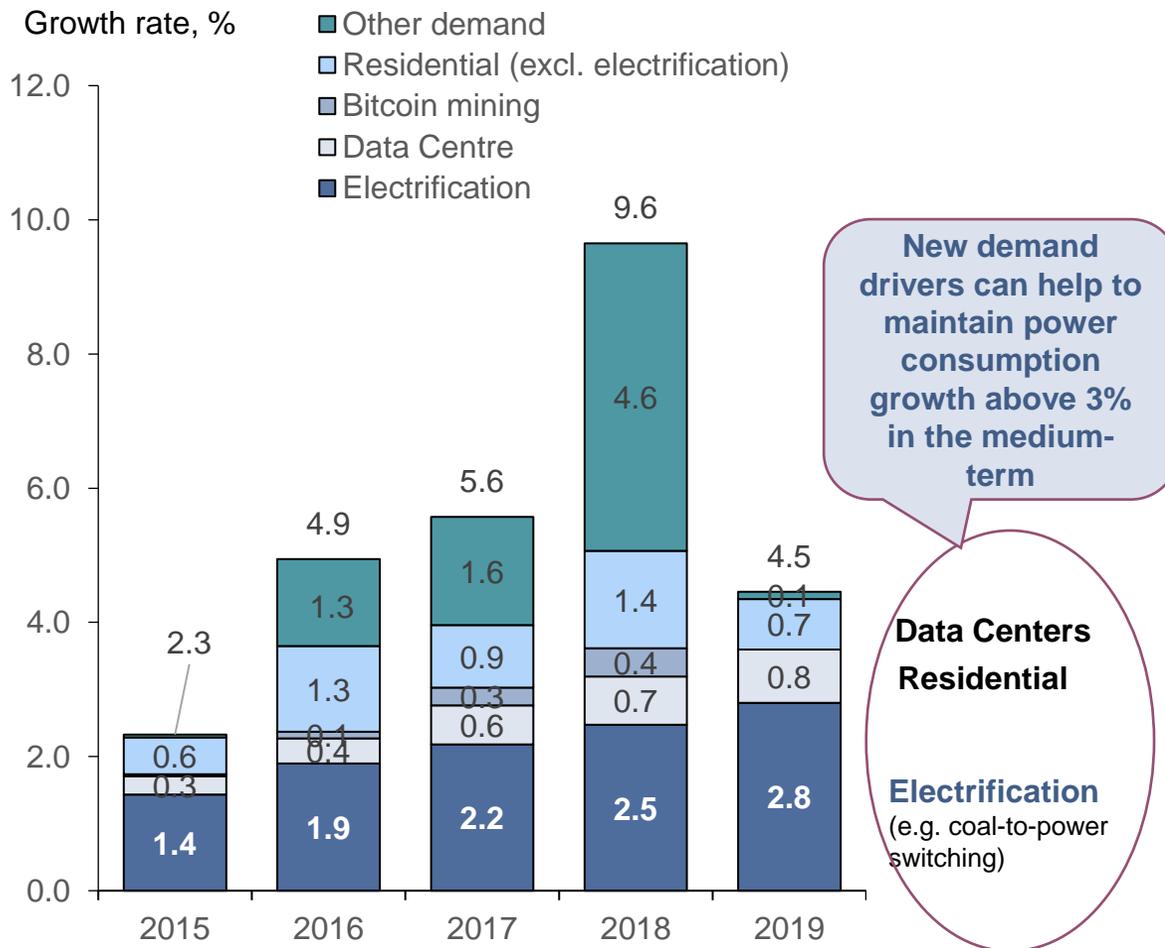
Consumer facing sectors (like autos) lagged recovery

Source: CEIC and Gavekal Research

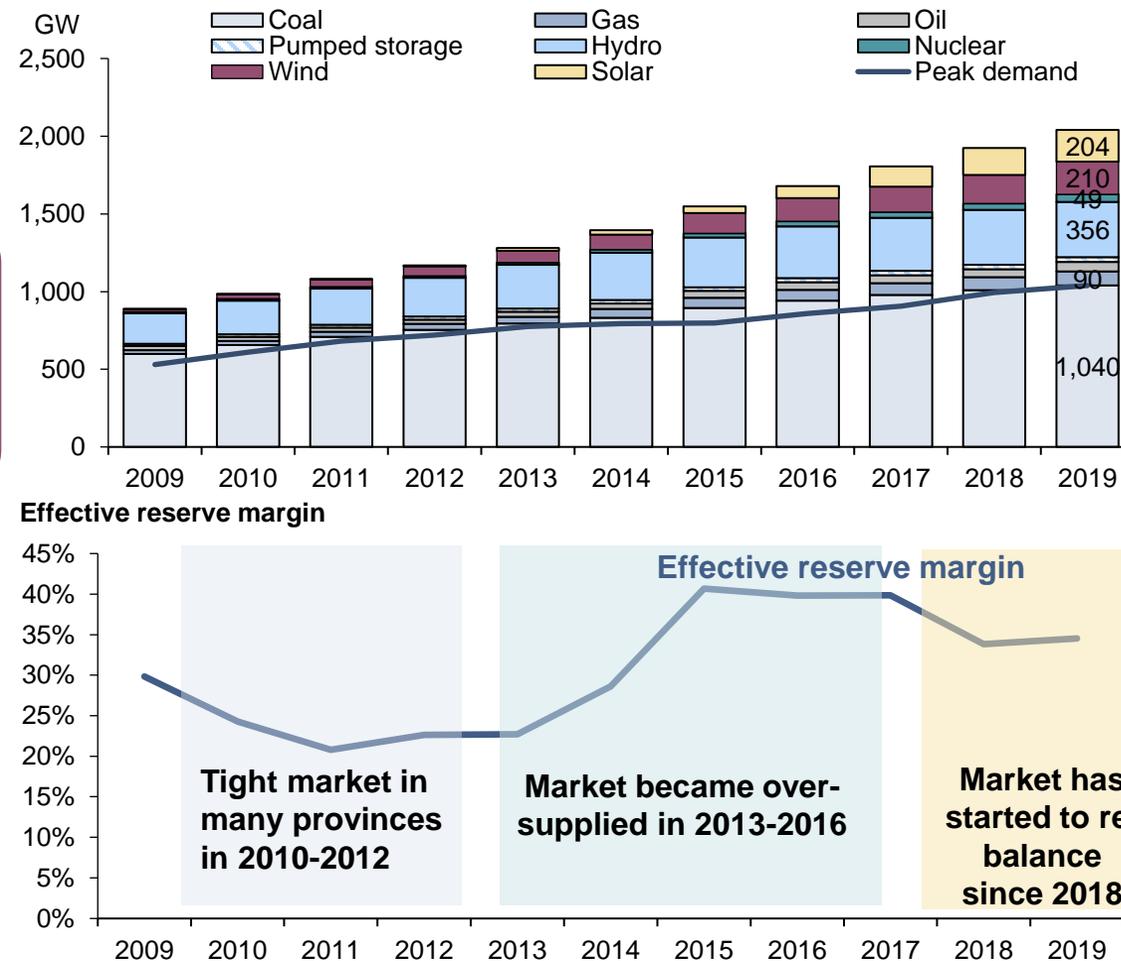
History of Chinese Power Market [1 of 2]

Before COVID-19, new demand drivers from electrification, data centres and residential sector start to re-balance the over-supplied Chinese power market

China Power Demand Growth Rate by Sectors



Power Supply and Demand Balance



History of Chinese Power Market [2 of 2]

High demand growth in 2017-19 is the primary reason for reduction in wind and solar curtailment in the three “North” regions in China

Key Reasons Leading to RE Curtailment

Over-supplied in the local system

Improving (at least up to 2019)

Lack of flexible capacity

Very limited improvement

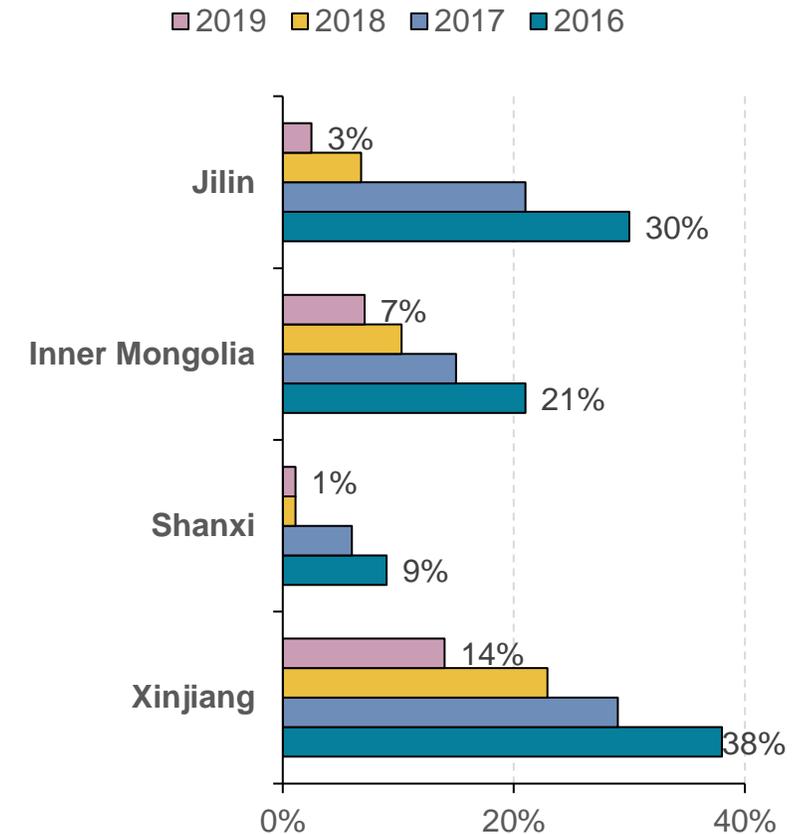
Rigid dispatch protocol

Some improvement in Northeast China

Actions/Market Development

- **National alert system to slow/stop new capacity addition** if curtailment rates increase from previous years
- **High demand growth in 2017-2019**
- Commissioning of UHV lines helps to export more power out of the surplus regions.
- The grid companies have plans to build pumped storage and battery energy storage projects. But progress has been slow because there is no clear mechanism for them to recover cost of their investment.
- In Northeast grid, the government has introduced more co-sharing of resources to provide ancillary services
- There are also plans to have more efficient inter-provincial dispatch in Northwest grid
- Economic dispatch will be eventually adopted for provinces with wholesale competitive spot market.

Historical Curtailment Rate

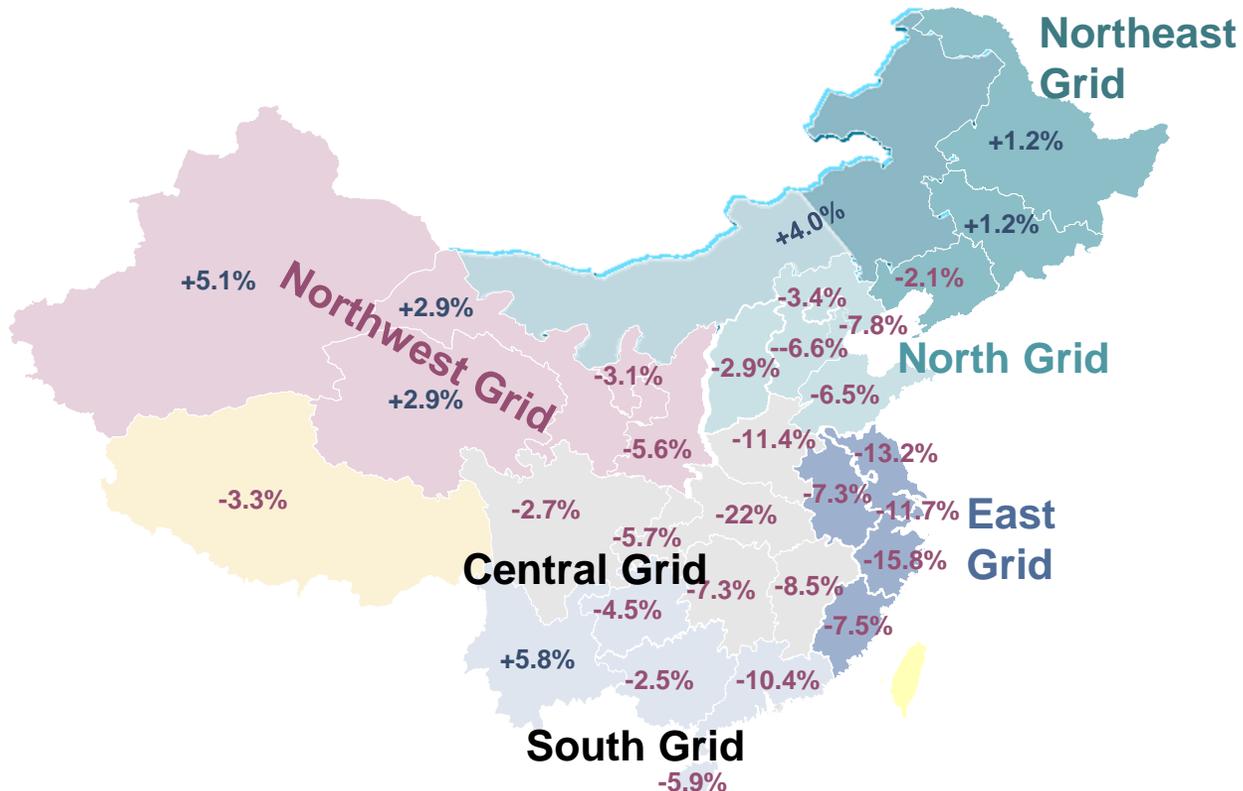


Source: NEA, WaterRock Energy research and analysis

Impact of COVID-19 on Power Consumption

In Q1 2020, power demand in coastal provinces and central China were down by 5-16% y-o-y while demand in most inland provinces grew marginally

% Change of Power Demand in Q1 2020 vs Q1 2019



At national-level, demand in Q1 2020 is **down by -6.5%** from Q1 2019

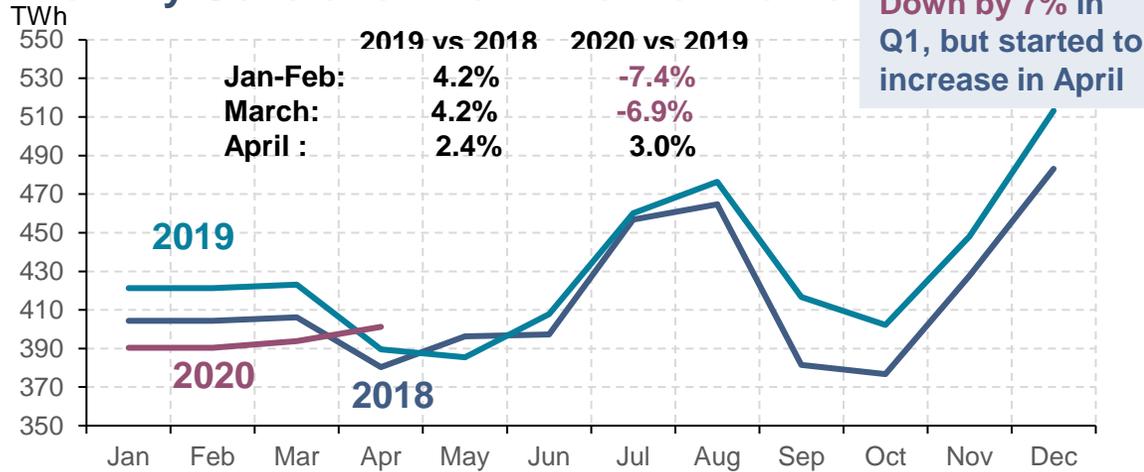
Power consumption growth in Q1 2020 varies across China

- The lock-down in Hubei and other coastal provinces have material impact on power consumption in the load centers
 - Avg power consumption was **down by 22 percent in Hubei** in Q1 2020 y-o-y
 - Demand is **down by 8-16 percent** in Q1 2020 y-o-y in coastal provinces in Pearl River and Yangtze River Delta areas while demand is **down by 5-10 percent** in North China and Central China (excluding Hubei)
 - Demand in most inland provinces in the **three North regions** grew slightly, partly because of the ongoing trend of shifting energy intensive industries from coastal areas to inland provinces within China. **This likely reduces the risk of resurge in wind curtailment in those provinces.**
- It is indicated that total demand in China has positive growth in April; but demand growth is unlikely to rebound to more than 2 percent due to the weakness in the export sector.

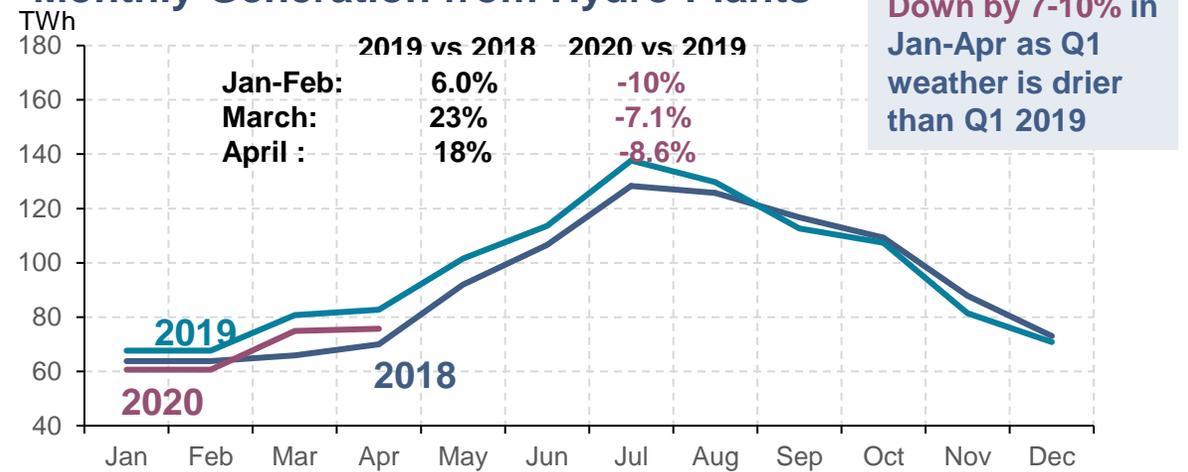
Impact of COVID-19 on Power Generation

Coal generation is hit the most while wind and solar generation continues to increase

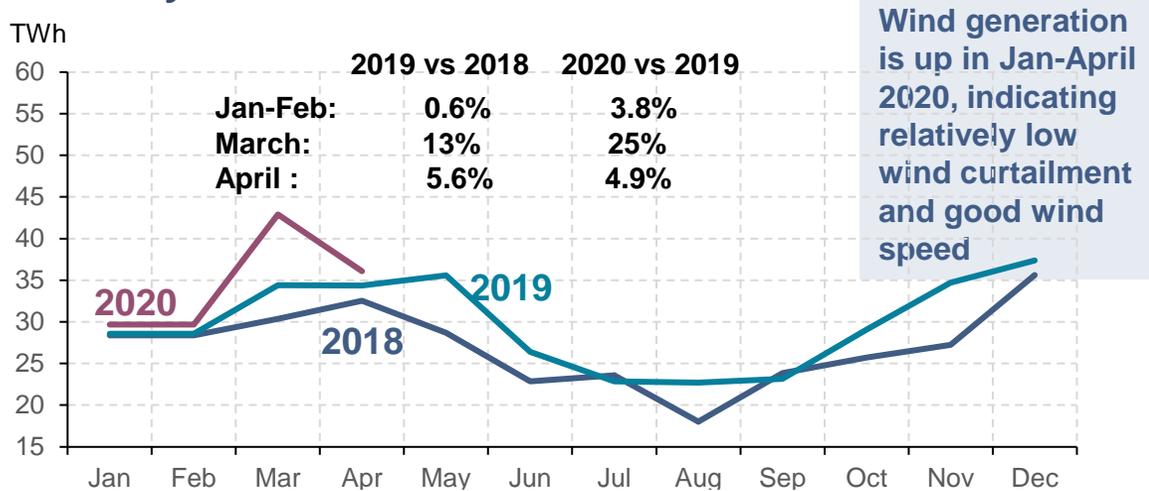
Monthly Generation from Thermal Plants



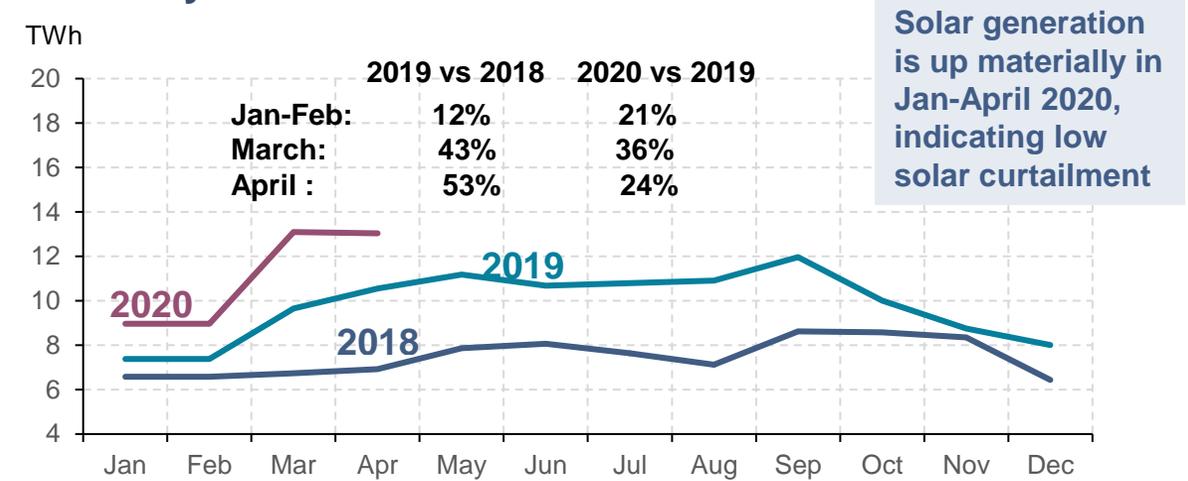
Monthly Generation from Hydro Plants



Monthly Generation from Wind Plants



Monthly Generation from Solar Plants



Impact of COVID-19 on Infrastructure Projects [1 of 2]

There are signs that China may embark on a new round of capacity construction (including coal, solar and wind) in the coming months/years

▪ Coal projects

- There are signs that the central government is easing its restriction on new coal construction. Many provinces have re-started their programs to build new coal capacity
- Given the relatively low return and high risk of investing in new coal capacity, it remains to be seen whether the state-owned power companies will answer to the call from the provincial governments to build new coal capacity.

▪ Solar and wind projects

- **Solar:** as cost of solar panel and inverters continue to drop, solar developers have been actively looking for sites to develop grid parity projects. The ability to connect to existing transmission lines will be the key constraining factors
- **Wind:** COVID-19 has impacted the global supply chain for building wind projects (especially for offshore wind). Wind developers are actively pursuing their existing projects in order to finish on time to get the eligible feed-in tariff in the next 1-2 years.

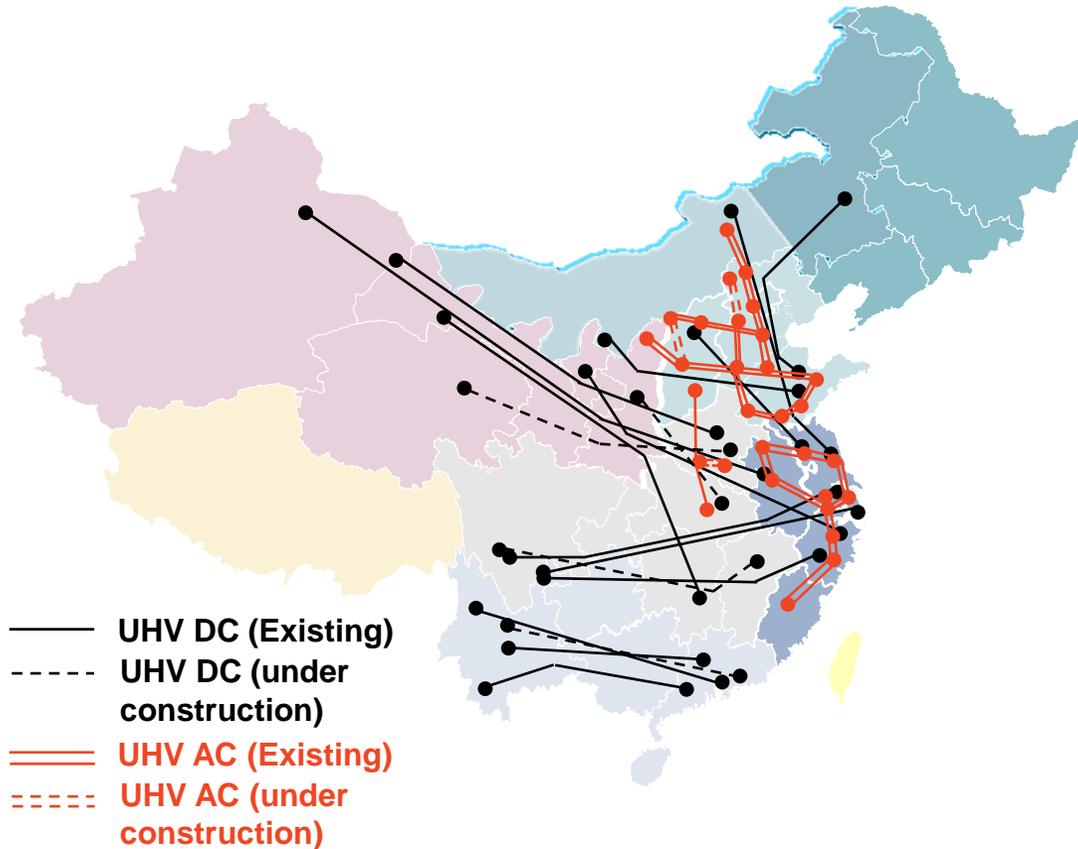
The risk of worsening market fundamental in the power sector has increased as:

- (1) demand growth may continue to be weak due to sluggish export sector in 2021-2022 and
- (2) New coal and renewable capacity addition (as part of infrastructure stimulus programs) could be far higher than expected with encouragement from central and provincial governments.

Impact of COVID-19 on Infrastructure Projects [2 of 2]

State Grid accelerates building a third round of UHV transmission projects, which can help to mitigate the risk of high RE curtailment in resource regions

Ultra-high voltage (UHV) AC and DC lines



UHV DC Lines

State Grid

- 11 UHV DC lines with total transfer capacity of ~96 GW are operating;
- **It announced to start constructing 3 new UHV lines in early 2020; 2 more are likely to be approved and start construction in 2020**

- Total transmission power was 291 TWh in 2018. Avg utilization rate is 40%.

China Southern Grid

- 3 operating UHV lines and one UHV line under construction for exporting hydro-power from Yunnan to Guangdong.

UHV AC Lines

State Grid

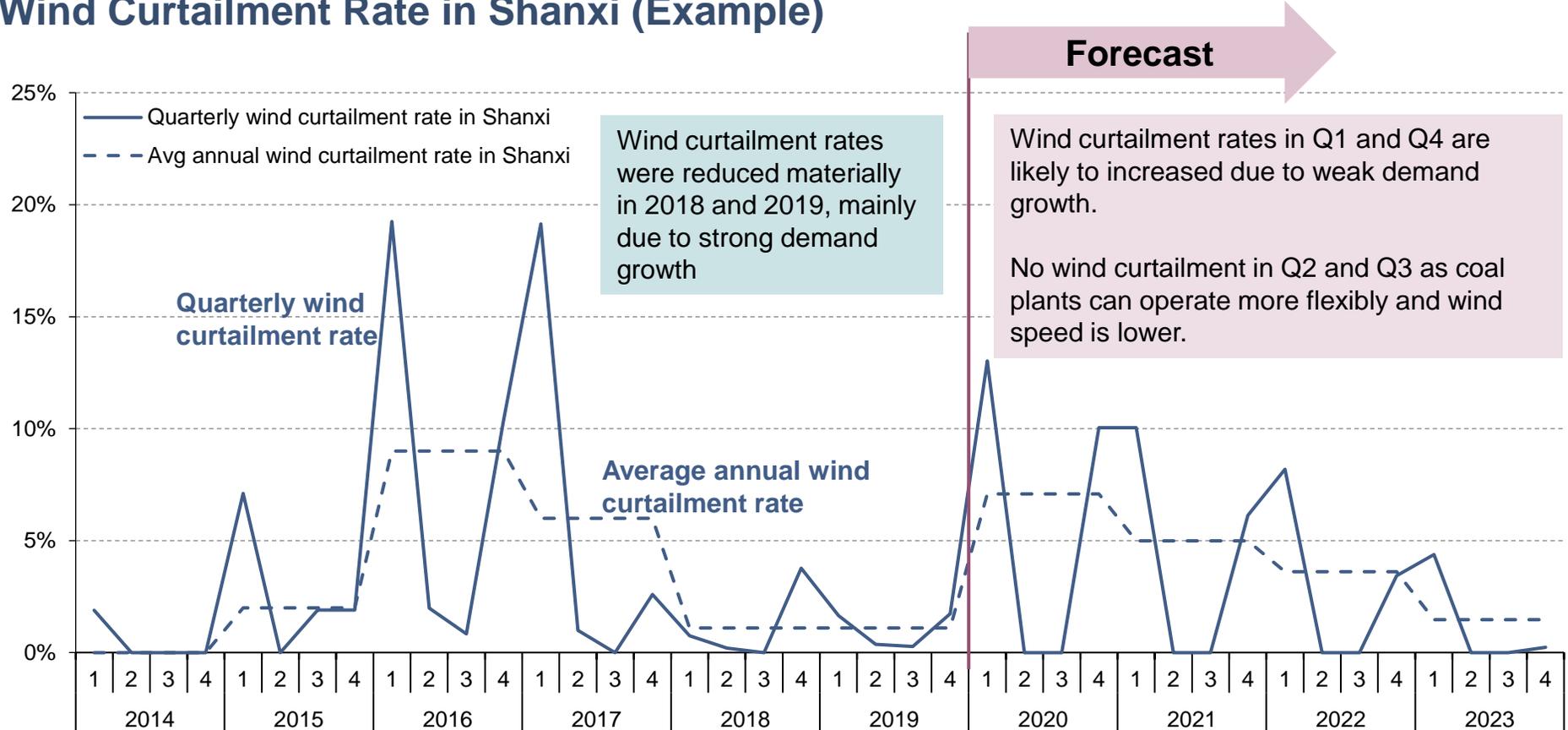
- A UHV AC loop has been built in East China, so power flow within East grid is expected to be more integrated
- Integration of North Grid with construction of UHV AC lines is also in progress
- Only one existing UHV AC line (Jingdongnan-Nanyang-Jingmen) cut across regions, and the central government has just approved the Nanyang-Jinmeng-Changsha UHV AC line. Several other proposed UHV lines cut across regional grids are not approved because of safety concerns.

Note: In Feb 2020, State Grid has announced to start constructing several UHV lines. In mid Sep 2018, NEA announced that it would approve 6 more UHV DC lines and 2 UHV AC line in Q4 2018 and 2019. They are Qinghai to Henan (under construction), Shaanxi North to Hubei (under construction), Zhangbei in Hebei to Xiong'An in Hebei UHV AC (under construction), Yazhong to Jiangxi (under construction), Nanyang-Jinmeng-Changsha UHV AC line (approved). Baihetang to Jiangsu and Baihetang to Zhejiang UHV DC

Impact of COVID-19 on Renewable Investment [1 of 2]

Due to weak demand growth and continued new capacity addition, the risks of higher renewable curtailment have increased in some provinces

Wind Curtailment Rate in Shanxi (Example)



Curtailment rates vary by provinces in China

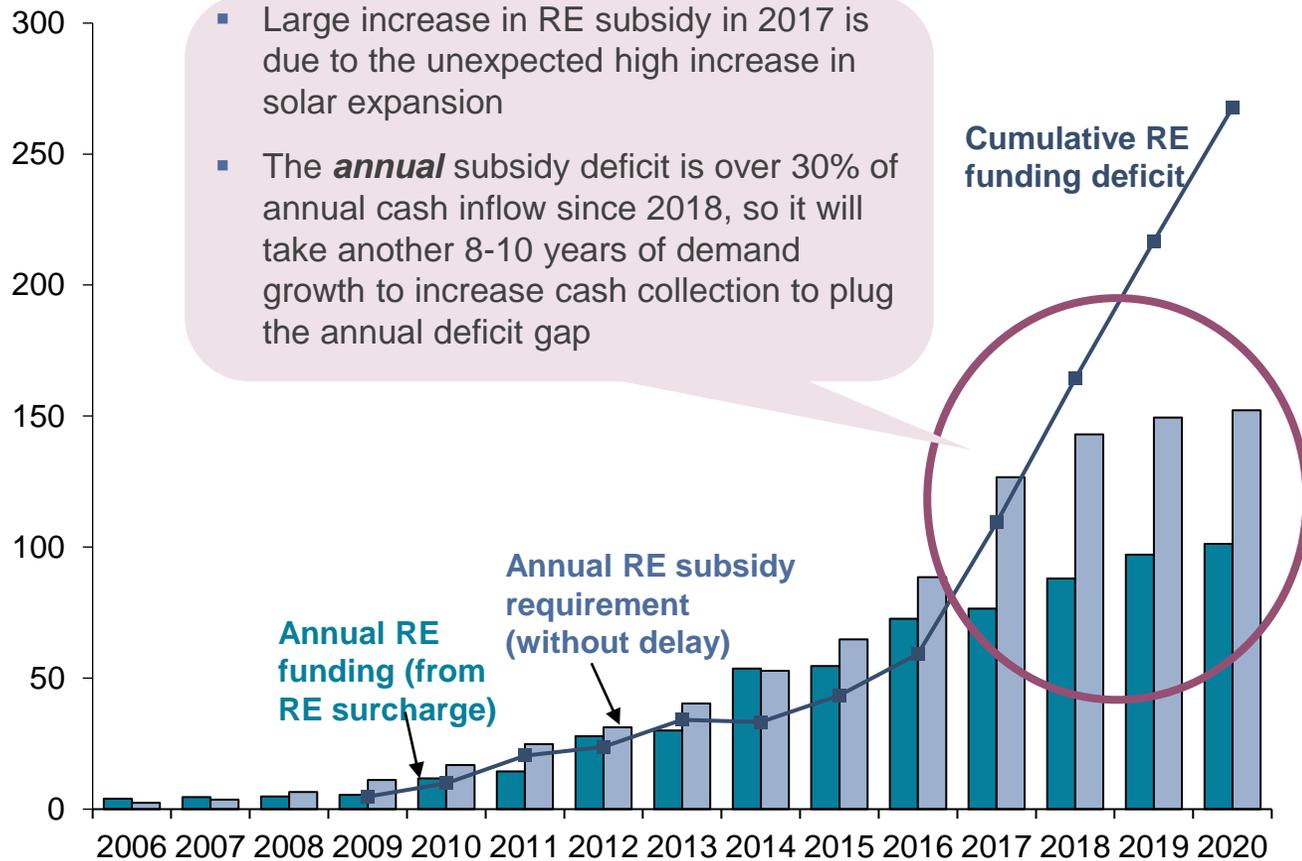
- Provinces in Northwest China (Xinjiang, Gansu, Qinghai, Shaanxi etc) continue to have the highest risk of wind and solar curtailment
- Due to load reduction arising from COVID-19, several provinces, such as Shanxi, Anhui and Shandong, may experience higher wind and solar curtailment rates in the near term.

Impact of COVID-19 on Renewable Investment [2 of 2]

The subsidy delay issue for the existing renewable projects is getting worse, and delay time may become longer, especially for solar projects

Estimation of RE funding and Subsidy Requirement

RMB billion



- The annual gap for renewable funding will likely widen further because
 - Weak demand growth in 2020 and maybe 2021 means that increase in cash inflow to the fund will be very limited as renewable surcharge is based on per kWh.
 - Wind and solar developers are rushing to complete the last tranche of projects that are eligible for subsidies, and this will increase the annual cash requirement for subsidy.
- In March 2020, batch 8 was announced, and it included wind capacity built in April 2016 – Dec 2019 and solar projects built in April 2016 – July 2017*
 - **The delay time could be 5-6 years for wind and more than 8 years for solar projects** built in Aug 2017 – Dec 2018
 - Once the projects start to get subsidy, they will likely only get the “eligible” annual quantity. For the accumulated subsidy “receivables” in the waiting periods, it will likely take very long to get the full payment.

*Note: For front-runner solar projects, the deadline for batch 8 is end December 2019
Source: WaterRock Energy research and analysis

Thanks and Contact

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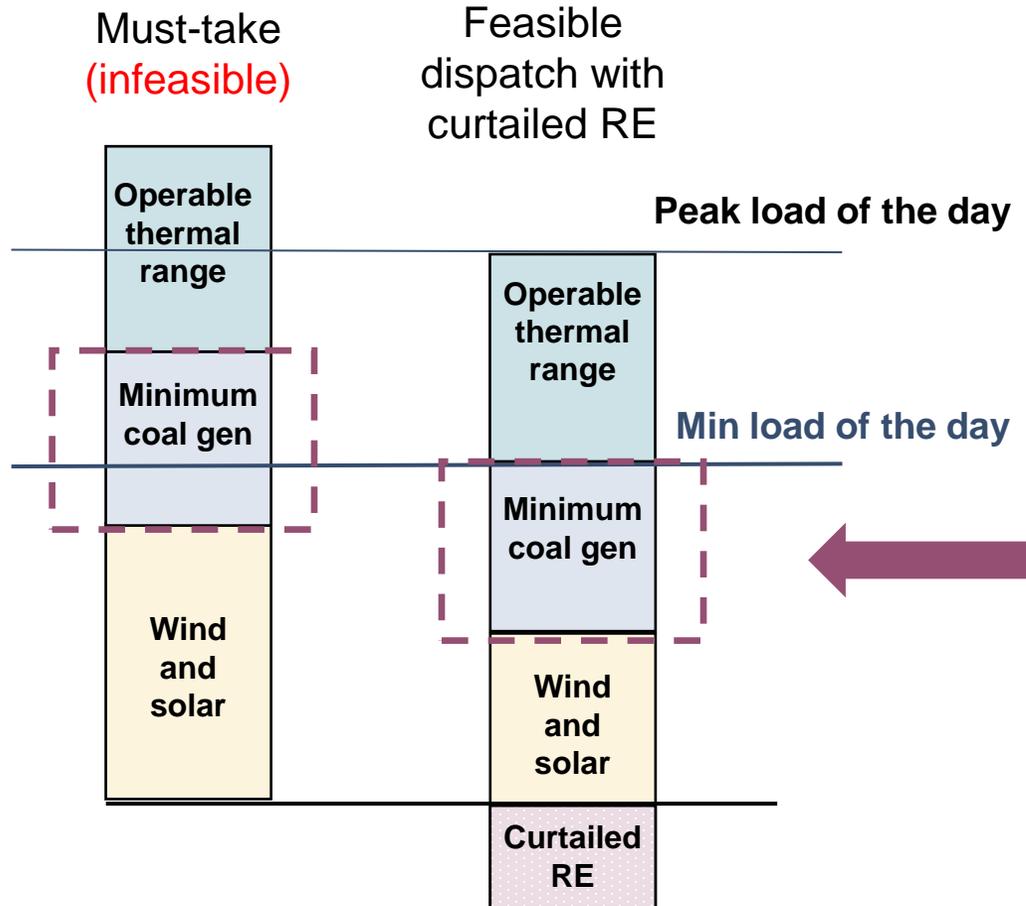
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Background of Renewable Curtailment in China

Fundamental reasons for the RE curtailment is over-supplied in the local system, the lack of flexible capacity and rigid dispatch protocol



The NEA's Rules identify three typical constraints under which a Dispatch Organization (DO) may curtail renewable output:

1. system security constraints;
2. insufficient load following capacity; and
3. system emergencies.

When the DO curtails RE output, it is required to provide the amount of output curtailed, the reason for curtailment, and the situation under which curtailment occurred.

The quantity of **minimum coal gen** has material impact on renewable curtailment, and it is driven by:

- Whether the coal plants need to provide **heating requirement**
- Amount of **flexible resources** to provide ancillary services (such as ramping and regulating reserves) to ensure power system reliability
- Amount of **unpredictable resources** (such as solar and wind) that could increase ancillary service demand
- Capability to **share resources** (such as pumped storage plants) across different provinces.

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 and 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